

SimCLIM 4.x Essentials

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The team at CLIMsystems strives to demystify the complex world of climate modelling and to make available practical and scientifically robust tools for application in the real world of planning, policy making and infrastructure design across numerous sectors. We continue to evolve our practices and expand our products and services and to do this most effectively we require feedback from you. Please do not hesitate to contact us with praise or criticism or ideas for new functionality.

In some versions used in the USA the PRECIS data set has been incorporated. For Australia BOM historical time series data is included.

Limitations, Uncertainty and Data

Limitations, Uncertainty and Data

The methods employed in developing SimCLIM involve the following limitations and uncertainties:

- *CLIMsystems ascribes to the ethical principles in the use of climate data as explained in: [Toward an Ethical Framework for Climate Services - A White Paper of the Climate Services Partnership Working Group on Climate Services Ethics](#)*
- *Historical observation data limitations:* Values presented in SimCLIM must be viewed as best estimates. The most important limitation in relation to historical meteorological observation data are not compiled appropriately for use in climate modelling.
- *Uncertainty in projections:* The RCPs one selects in using SimCLIM represent a range of scenarios for future global change. However, the uncertainty range presented cannot cover the full range of uncertainties of future climate change.
- *Uncertainty in translating GCM (global)-scale results to the local scale:* The future projections of precipitation were generated from AR5 GCMs using pattern scaling and/or spatial interpolation methods. There are a range of downscaling approaches applied depending on the area of study. In all cases the approach is based on the best available knowledge for this location and readily available data.

Other Climate Data Sources

There are numerous data and information providers around world, such as WorldCLIM and World Bank portal, which only provide limited variables. However we cannot find comparable publicly available data sources in relation to the following important features of CLIMsystems datasets:

(1) Legitimate: We follow the conventions, guidance and standards of IPCC and country specific, scientific and engineering communities and articulate these transparently in documentation. The CLIMsystems devised SimCLIM sea level rise methodology and dataset was applied in the most recent IPCC sea level rise guidance document.

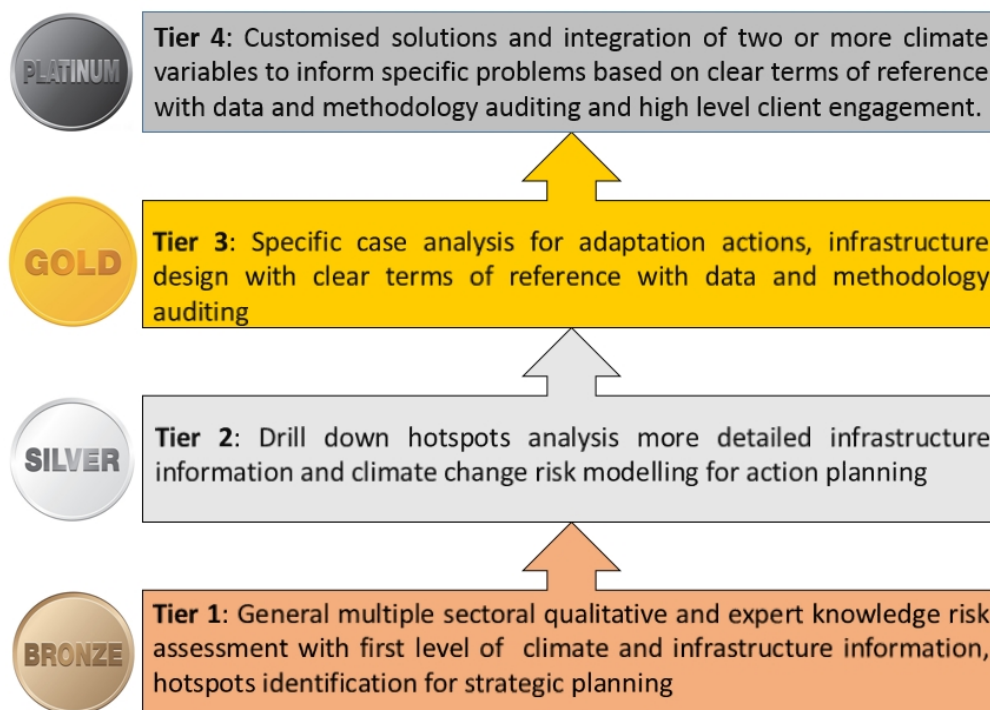
(see Nicholls, R. J., *et al.* (2011). Constructing sea-level scenarios for impact and adaptation assessment of coastal areas: A guidance document. *Supporting material, Intergovernmental Panel on Climate Change task group on data and scenario support for impact and climate analysis (TGICA)*(47).

The CLIMsystems devised and SimCLIM deployed extreme precipitation dataset was applied by a client in generating the EPA CREAT tool. (See https://www.epa.gov/sites/production/files/2016-05/documents/creat_3_0_methodology_guide_may_2016.pdf).

(2) Wide ranging: We can provide high resolution and a wide range of climate-related data obtained through partners and provision of secondary data from respected and fully documented sources, including a wide range of climate change-related parameters or variables within the realms of land, ocean, coast and extremes and means for derived variables and parameters for impact models.

(3) Defensible: Is scientifically robust and is assured through scientific review and advisory groups internally and externally. We have a dedicated team of climate data scientists to explore, manage and update proprietary database, and cross validate data using multiple sources as required. All the datasets provided to clients are clearly referenced and documented.

(4) Actionable: We deliver climate and derived analysis results fit for purpose for adaptation planning and engineering projects, through a tiered approach for different applications.



Climate change impact/risk assessment needs highly specialised experience and knowledge of climate change science, and a thorough understanding of climate change data and its limitations and applicability to specific climate-related problems.

The development of our in-house city and asset risk tool and datasets is a result of twenty years of dedicated practice in different sectors.

Close and seamless cooperation of a team with experts and specialists in climate data and with sectoral experience can offer a range of integrated and useful information for different sectors. Common understanding of data applications, limitations and caveats, and transparent communication and interpretation of the data is very important in achieving credible outputs.

All the data created by CLIMsystems could be replicated by other teams if they have enough expertise as all the methodologies used in generating the datasets are well documented and the raw data used is publicly available. That said a cold start for replication would require considerable time (years) and resources as terabytes of raw GCM data and processed RCM data from CORDEX and other very extensive and large datasets would need to be acquired, critically assessed and processed.

CLIMsystems Range of Services

- ✓ SimCLIM training – beginners, intermediate and advanced
- ✓ Data manipulation and compatibility testing
- ✓ Data acquisition
- ✓ Customised corporate training
- ✓ Project development
- ✓ Project implementation – independent and collaborative
- ✓ On-line support and technical assistance (terms and conditions apply)
- ✓ Software development
- ✓ Impact model partnerships
- ✓ Green Climate Fund Support

CLIMsystems mailing list

Join the SimCLIM on-line forum to get the latest news of SimCLIM and other CLIMsystems products and services.

How to subscribe:

1] Contact CLIMsystems at info@climsystems.com and request to be added to the CLIMsystems Mailing List.

If you experience any difficulties contact CLIMsystems at info@climsystems.com.

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<https://www.facebook.com/Extendweather/>

Getting Started - Description and Aim

This manual is designed for new users of SimCLIM 4.x for Desktop who are already familiar with a personal computer, Microsoft Windows and a mouse.

Our aim is to provide you with the necessary skills to produce scenarios of climate change and to conduct analysis of historic time series data and to examine such data in the context of potential climate-induced change. We will introduce many time saving features using quick keys and short cuts.

SimCLIM 4.x for Desktop is a computer-based modelling system for examining the effects of climate variability and change over time and space. It is a customised GIS which includes tools for the spatial analysis of climate variability and change and associated impacts on various social-economic sectors. Its "open-framework" feature allows the user to customise the model for their own geographical area and spatial resolution and to attach impact models.

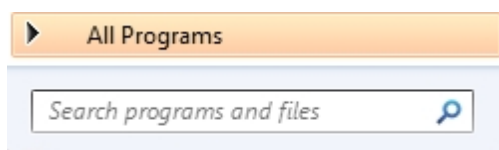
SimCLIM Applications

- ✓ Describe baseline climates;
- ✓ Examine current climate variability and extremes;
- ✓ Assess risks - present and future;
- ✓ Investigate adaptation - present and future;
- ✓ Create scenarios of climate and sea-level change;
- ✓ Conduct sensitivity analyses;
- ✓ Project sectoral impacts of climate and sea level change;
- ✓ Examine risks and uncertainties; and
- ✓ Facilitate integrated impact analyses.

It is essential that SimCLIM 4.0 for Desktop Users have a good working knowledge of the fundamental concepts of the Windows environment and are familiar with drop down menus and file management. Understanding of other Windows programs such as Word, Powerpoint and Paint would be helpful but not mandatory.

Starting SimCLIM

At the bottom left of the computer screen click on .



Click on  All Programs.

Type SimCLIM in the search programs and files box and click on  SimCLIM program .

Critical to any program such as SimCLIM are updates. From time to time the team at CLIMsystems will upgrade the system either with new tools or functionality. We wish to hear from you -- our end users -- about what you would like to see in SimCLIM so please contact us at info@climsystems.com and pass on your ideas.

To check for updates we suggest that from time to time will appear in the start-up menu (see below) or you can click on the welcome to SimCLIM menu in SimCLIM and toggle through to check for updates. Of course, you must be on-line for this functionality to work. If an update is available you can download and install it. Easy!

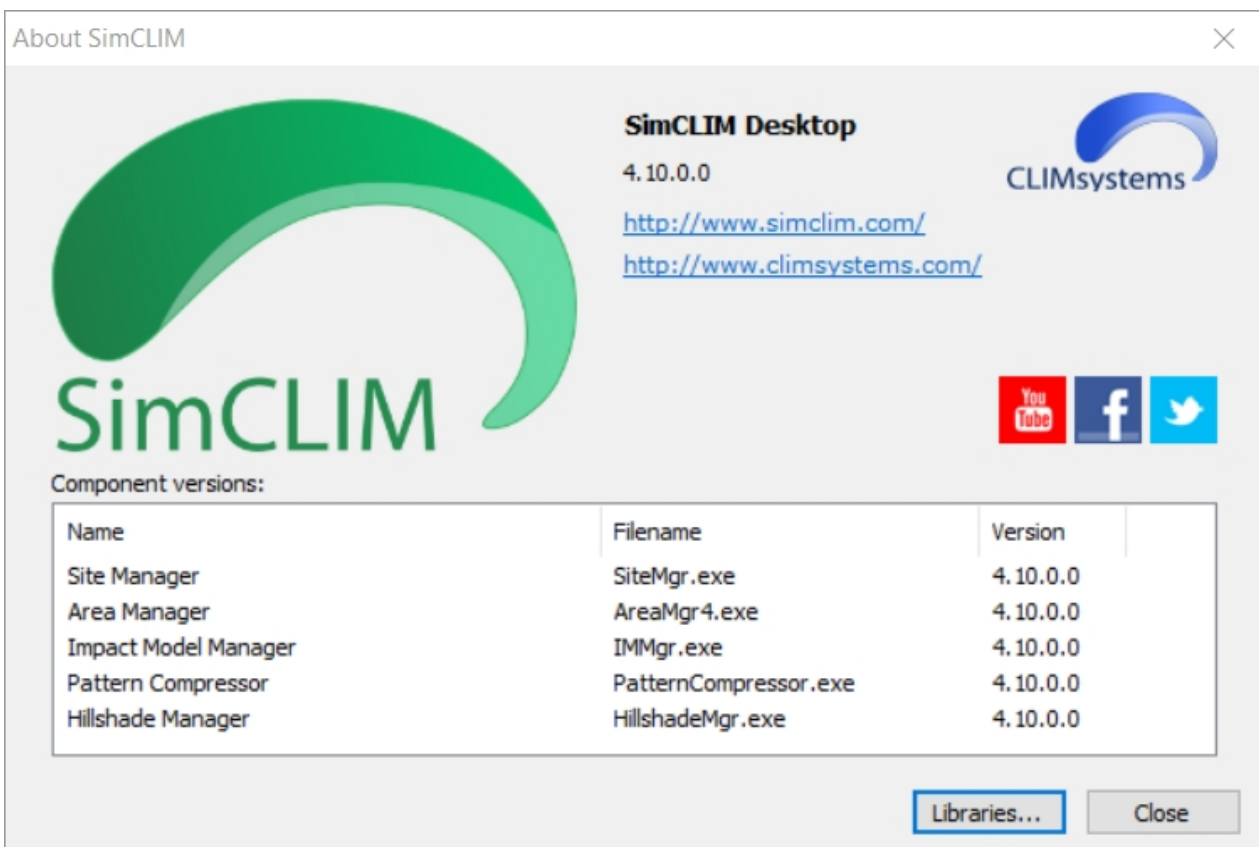
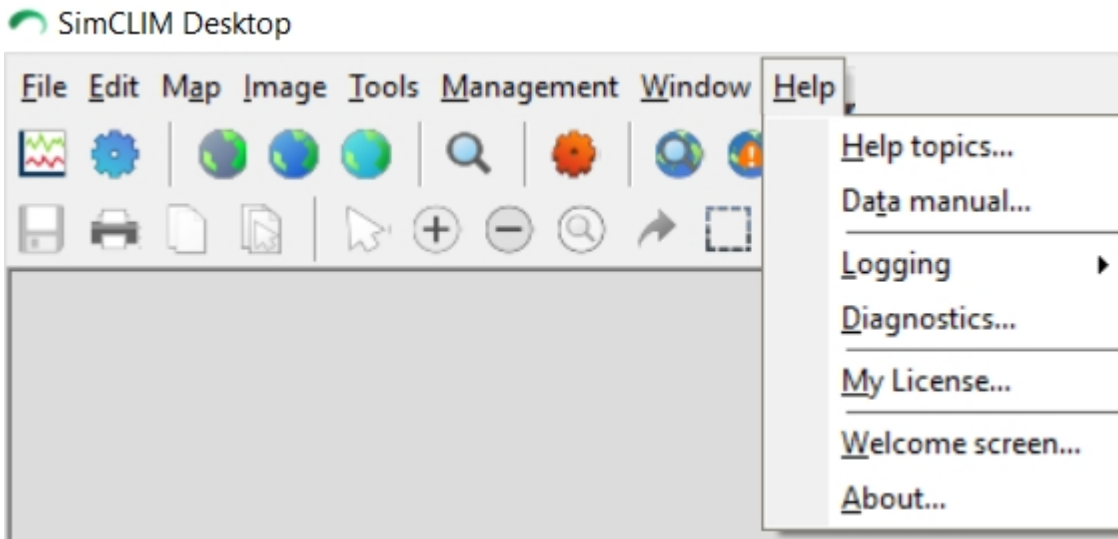
Updating SimCLIM

To check for updates we suggest that from time to time you check for updated from the Welcome to SimCLIM window that appears in the start-up menu (see below) or you can click on the welcome to SimCLIM menu in SimCLIM and toggle through to check for updates. Of course, you must be on-line for this functionality to work. If an update is available you will download and install it. Easy!



After downloading the update to your computer close SimCLIM and then initiate the installation of the update. After the update is completed open SimCLIM.

You can check on your version number by clicking on the help menu again but this time click on the about option:



Restoring legacy functionality

As SimCLIM is developed, certain functions and features may be updated or replaced. For a period of time, the old (legacy) functionality is retained and can be re-enabled should the need arise (for example, is a problem or incomparability issue is found, or if a new feature is missing a function available in the legacy version).

Current legacy functions available

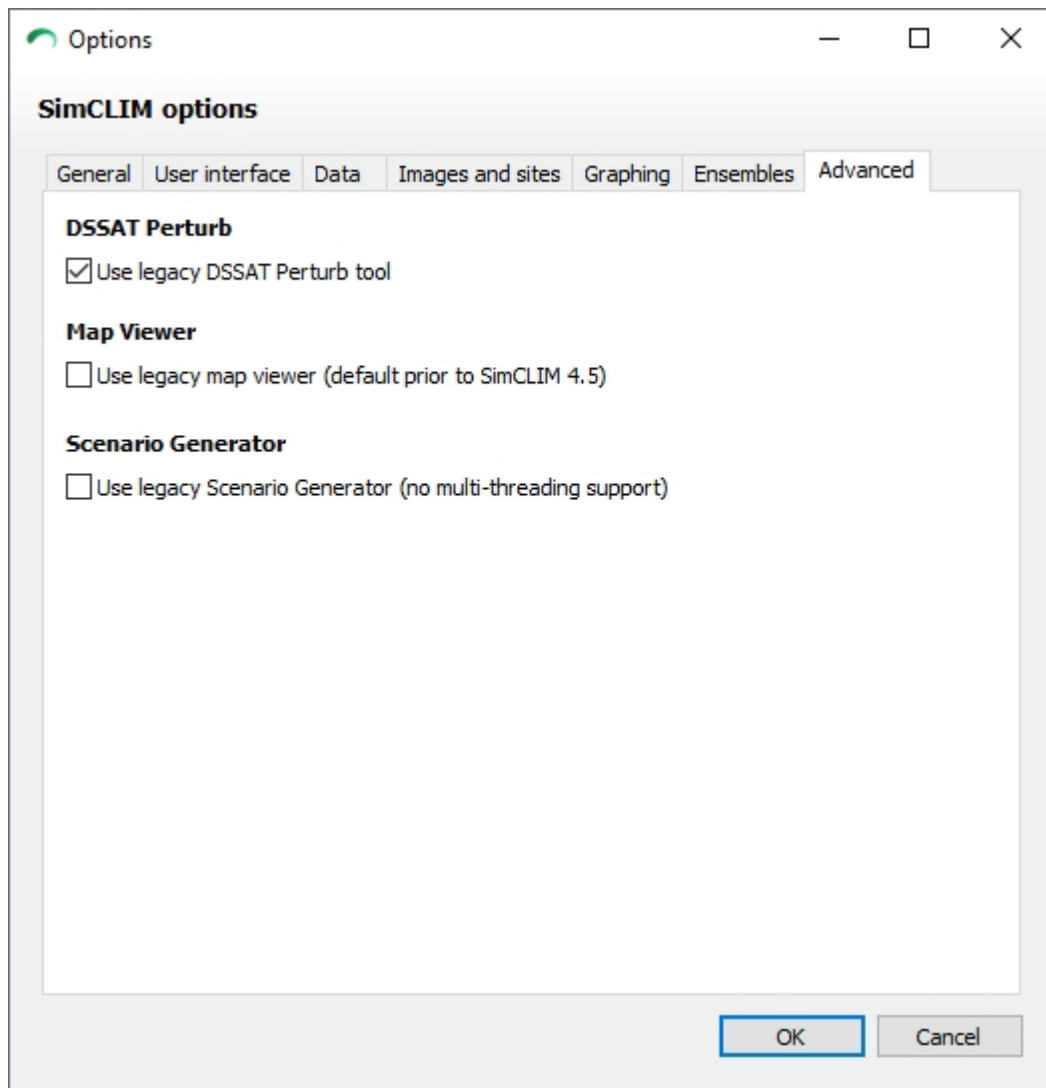
The current functionality can be re-enabled:

- **DSSAT Perturb** - The DSSAT Perturbation functionality has been replaced with our separate [DSSAT Perturb](#) product. Selecting this option will restore the previous DSSAT Perturbation tool.
- **Map Viewer** - The [Map Viewer](#) is a complete re-write of the map viewing functionality of SimCLIM. Certain image manipulation tools (such as the Map Calculator) are not currently available for use with the Map Viewer. Selecting this option will use the previous SimCLIM Image Viewer when generating scenarios.
- **Scenario Generator** - The scenario generator has been re-written to make use of multiple threads, providing a significant improvement in performance on modern systems with multiple CPU cores and SSD hard-drives. Selecting this option will restore the previous scenario generator.

Re-enabling previous functions

To re-enable old or replaced functionality follow the following instructions:

1. Open the Options dialog box by selecting the Tools -> Options menu item in the SimCLIM main window.
2. Open the Advanced tab.
3. Place a check-mark next to the legacy function(s) you'd like to restore.



The SimCLIM User Interface

Objective:

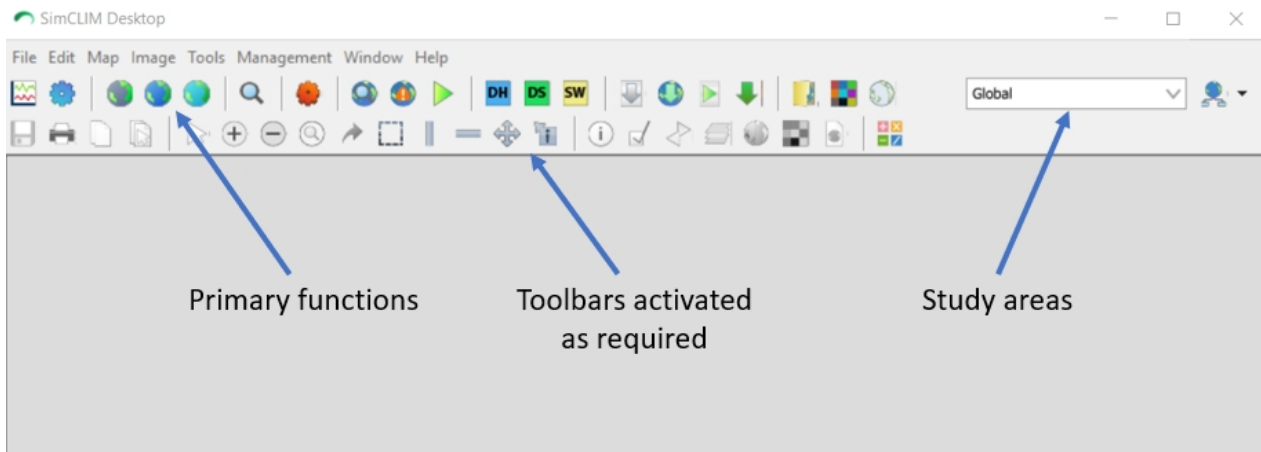
On completion of this topic you will be:

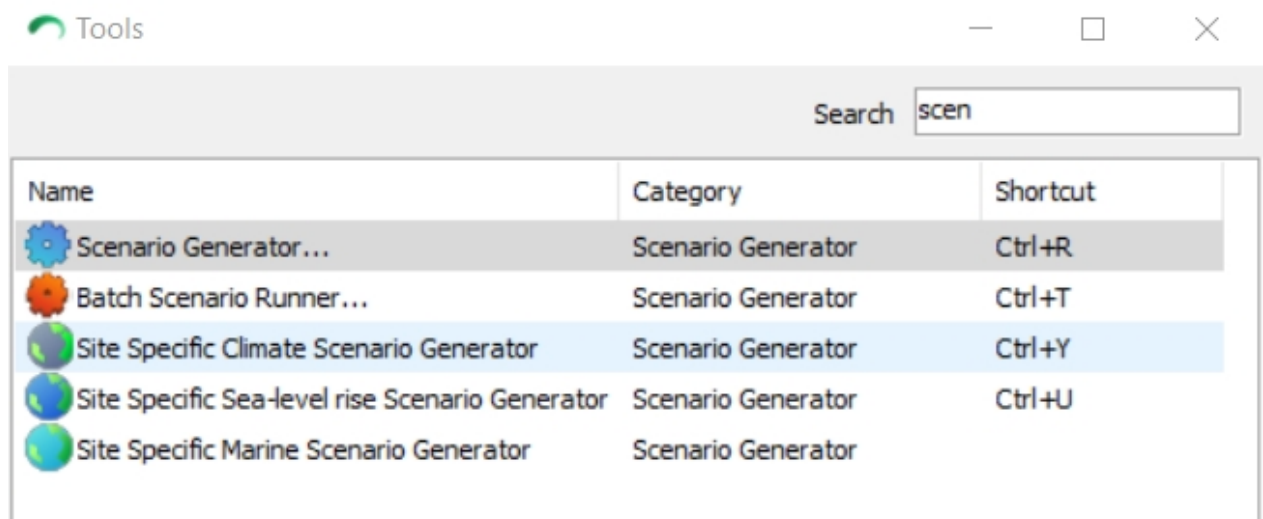
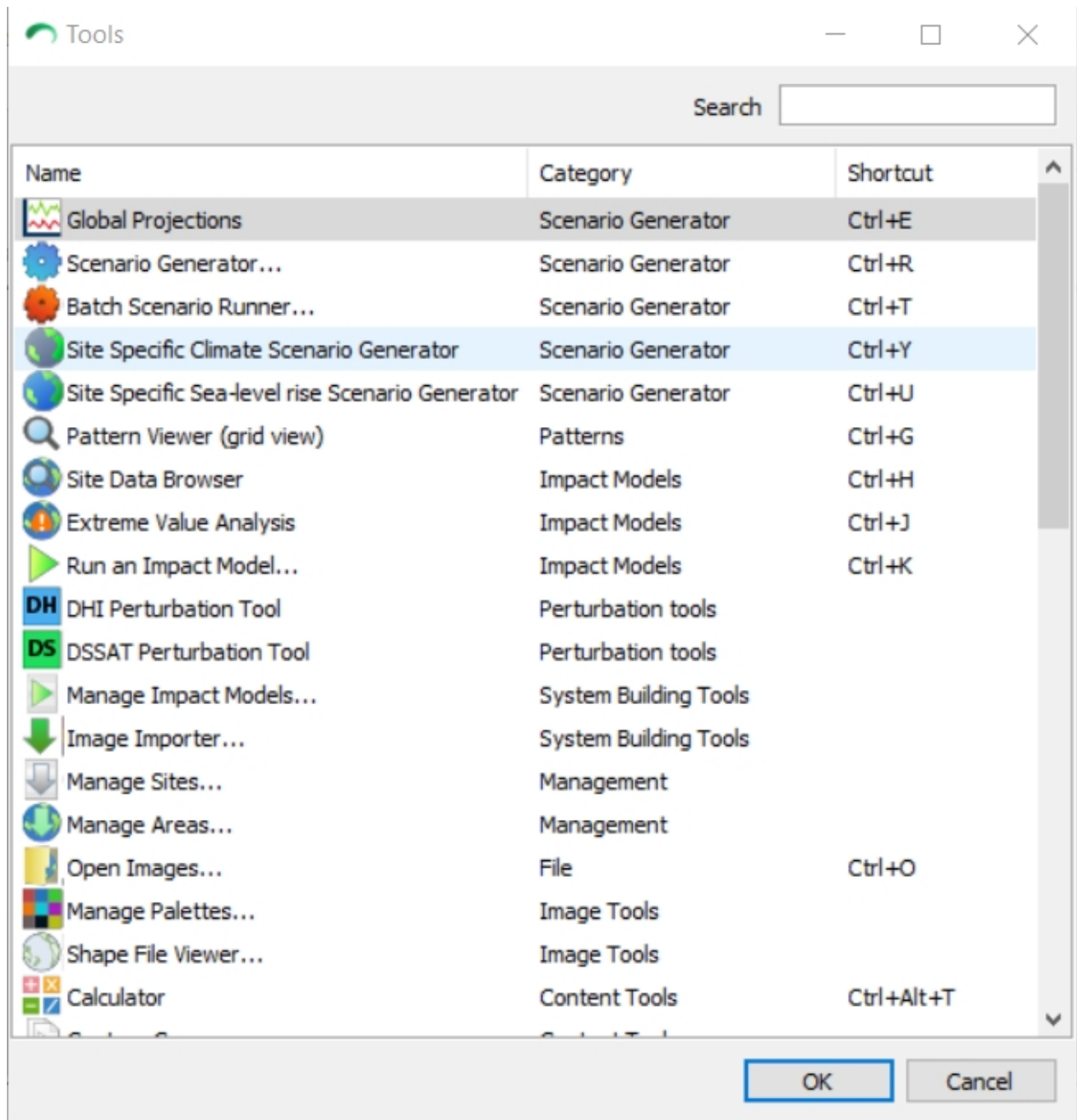
- ✓ Familiar with SimCLIM screen layout
- ✓ Able to recognise some of the terminology used to describe the different elements of the SimCLIM 4.x for Desktop window

Overview:

When you start SimCLIM 4.x for Desktop, the cursor (the white arrow) will be floating in the screen. It can be easily manoeuvred through the movement of the mouse. Parts of the SimCLIM 4.x for Desktop program are activated by left clicking, right clicking and double clicking with the mouse buttons.

Some parts of the SimCLIM 4.x for Desktop window only become active when they are required by the function being undertaken within the program, for example, when a climate change scenario is produced the image display and analysis functions become active.





The Use of Ensembles

The Use of Ensembles

Climate model results provide the basis for projections of future climate change. Historically the international scientific community released assessment reports that included model evaluations but avoided weighting or ranking models. Projections and uncertainties are based mostly on a 'one model, one vote' approach, despite the fact that models differ in terms of resolution, processes included, forcings and agreement with observations.

Projections in the IPCC's Fifth Assessment Report (AR5) are based largely on CMIP5 of the World Climate Research Programme (WCRP), a collaborative process in which the research and modelling community has agreed on the type of simulations to be performed. While many different types of climate models exist, the following discussion focuses on the global dynamical models included in the CMIP project.

Uncertainties in climate modelling arise from uncertainties in initial conditions, boundary conditions (e.g., a radiative forcing scenario), observational uncertainties, uncertainties in model parameters and structural uncertainties resulting from the fact that some processes in the climate system are not fully understood or are impossible to resolve due to computational constraints. The widespread participation in CMIP provides some perspective on model uncertainty. Nevertheless, intercomparisons that facilitate systematic multi-model evaluation are not designed to yield formal error estimates, and are in essence 'ensembles of opportunity'. The spread of a multiple model ensemble is therefore rarely a direct measure of uncertainty, particularly given that models are unlikely to be independent, but the spread can help to characterise uncertainty. This involves understanding how the variation across an ensemble was generated, making assumptions about the appropriate statistical framework, and choosing appropriate model quality metrics. Such topics are only beginning to be addressed by the research community (e.g., Randall et al., 2007; Tebaldi and Knutti, 2007; Gleckler et al., 2008; Knutti, 2008; Reichler and Kim, 2008; Waugh and Eyring, 2008; Pierce et al., 2009; Santer et al., 2009; Annan and Hargreaves, 2010; Knutti, 2010; Knutti et al., 2010).

When analysing results from multi-model ensembles, the following points should be taken into account:

(1) Forming and interpreting ensembles for a particular purpose requires an understanding of the variations between model simulations and model set-up, and clarity about the assumptions.

(2) The distinction between 'best effort' simulations (i.e., the results from the default version of a model submitted to a multi-model database) and 'perturbed physics' ensembles is important and must be recognized. Perturbed physics ensembles can provide useful information about the spread of possible future climate change and can address model diversity in ways that best effort runs are unable to do.

(3) In many cases it may be appropriate to consider simulations from CMIP3 and combine CMIP3 and CMIP5 recognizing differences in specifications (e.g., differences in forcing

scenarios). IPCC assessments should consider the large amount of scientific work on CMIP3, in particular in cases where lack of time prevents an in depth analysis of CMIP5. It is also useful to track model improvement through different generations of models.

(4) Consideration needs to be given to cases where the number of ensemble members or simulations differs between contributing models. The single model's ensemble size should not inappropriately determine the weight given to any individual model in the multi-model ensemble. In some cases ensemble members may need to be averaged first before combining different models, while in other cases only one member may be used for each model.

(5) Ensemble members may not represent estimates of the climate system behaviour (trajectory) entirely independent of one another. This is likely true of members that simply represent different versions of the same model or use the same initial conditions. But even different models may share components and choices of parameterisations of processes and may have been calibrated using the same data sets.

Ensembles - Terrestrial

Objectives

On completion of this topic you will be:

- ✓ Familiar with constructing ensembles and applying them to your analysis
- ✓ Be able to explain the ensembles

Overview

Ensembles are being recognised increasingly in the climate change adaptation and risk assessment literature as an appropriate method for managing uncertainty in GCM impacts on climate change risk analysis i.e. the range of possible outcomes based on the choice of GCM pattern in one's analysis. The convergence of future climate simulations by different models for a given emissions scenario has to be assessed; the closer the results are together the more reliable the projection.

The ensemble calculation in SimCLIM 4.0 for Desktop:

The ensemble option in SimCLIM 4.0 for Desktop enables a user to select a group of GCM patterns to carry out climate change scenario generations and impact studies. By default, the output shows the median value of the group GCMs selected. For example, if a total of 21 GCM patterns are selected, the one that has the value in the 11th place in terms of the magnitude is chosen as the median value.

The value is defined by the GCM that has value position decided by: $(21-1)*50\%+1 = 11$.

If a total of 22 GCM patterns are selected, the median value is calculated as the average of the GCM values in the 11th and 12th places in terms of the magnitude.

The position is decided by: $(22-1)*50\%+1=11.5$.

For the purpose of sensitivity analysis, a user can also select low and high percentiles in the ensemble option. If low percentile is selected and a percentage value is given, SimCLIM 2013 will generate a climate change value corresponding to the percentile value. Similar as the median value, the determination of the change value is based on the number of GCM selected for ensemble, as well as the percentile value. For example, if a total number of 21 GCMs are selected and 10% as the low percentile value, the 3rd place GCM value in term of its magnitude is defined as the low percentile climate change value.

The position is defined by: $(21-1)*10\%+1=3$.


If a total of 22 GCM is selected, the change value is calculated as the combination of the 3rd and 4th place GCM value in terms of their magnitude in the total GCMs, i.e., $0.9*3^{\text{rd}}$ GCM value + $0.1*4^{\text{th}}$ GCM value.

The position is defined by: $(22-1)*10\%+1=3.1$

In the scenario generating dialogue box simply click on the GCM/RCM patterns you wish to include in your ensemble:

Scenario Generator

Generate a scenario

Work area: 


Variable:

Linked **Synthetic**

Year: Baseline Future years: ?

Patterns

- ACCESS 1-0
- ACCESS 1-3
- BCC-CSM1-1
- BCC-CSM1-1-M
- BNU-ESM
- CANESM2
- CCSM4
- CESM1-BGC
- CESM1-CAM5
- CMCC-CM
- CMCC-CMS
- CNRM-CM5

Select all Select none 

Showing 40 of 40 patterns. 0 selected.

GHG concentration pathway:

Climate sensitivity: Low Mid High

Output change from baseline

Months: Jan Feb Mar Apr May Jun
 Jul Aug Sep Oct Nov Dec

Keep window open

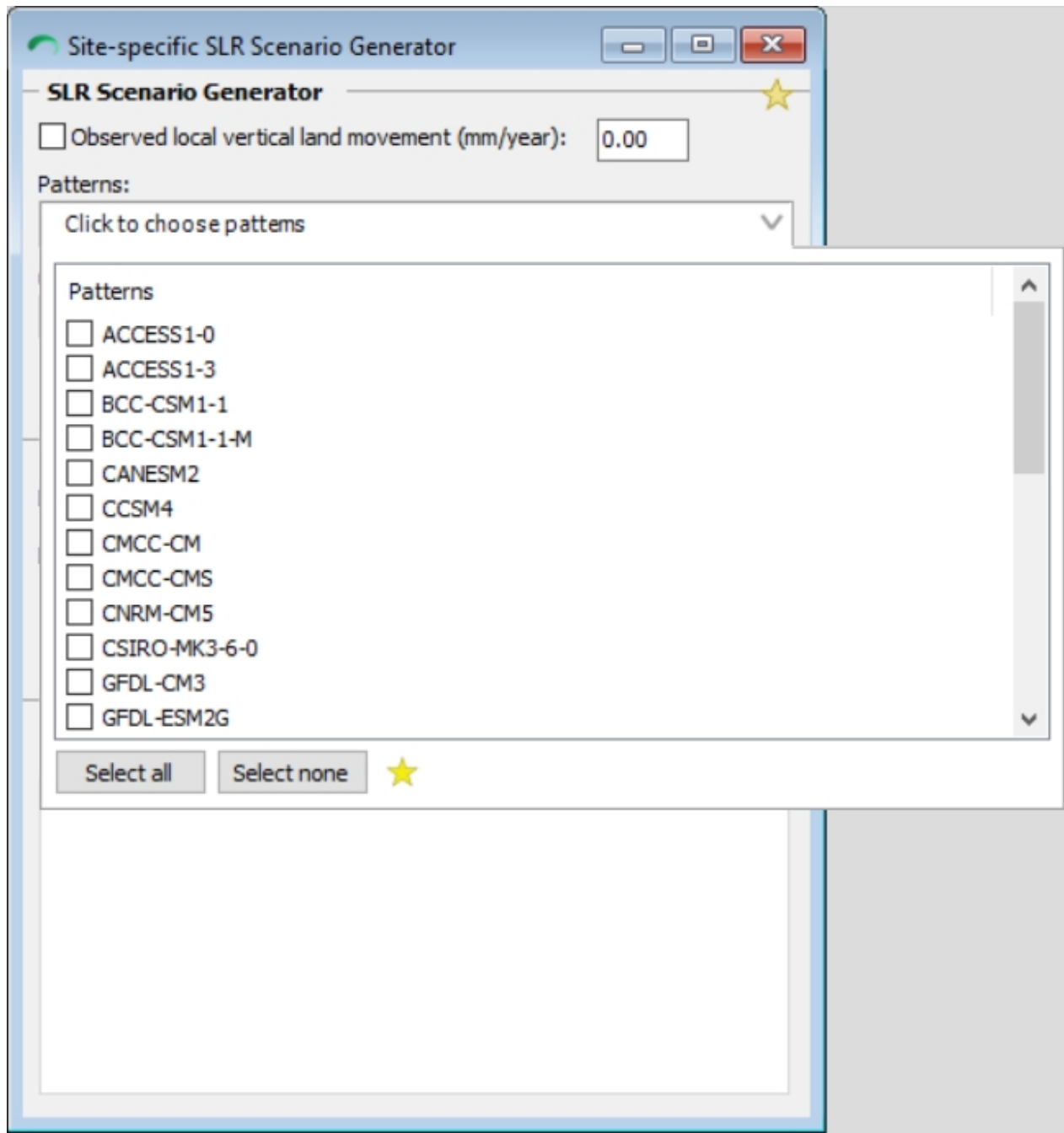
Then choose the remainder of the options such as RCP, year, months and if you wish low and high percentile values.

NOTE: It is recommended that you maintain the default setting for the cache. It can take considerable time to generate your first output using an ensemble and by caching this initial process it can save considerable time with future applications. You can also designate where the cache is stored and clear your cache by clicking on that option.

Ensembles - Sea Level Rise

Sea Level Rise Ensemble

Choose site specific sea level scenario generator and like the terrestrial scenario generator click on the GCMs you wish to include in your ensemble and proceed to create an output.



Explanation of the perceived inconsistency in global SLR values for 2050 between RCP4.5 and RCP6.0

The numbers are directly taken from the AR5 WG1 report

tabel AII.7.7		RCP2.6			RCP4.5			RCP6.0			RCP8.5			A1B		
year	5%	50%	95%	5%	50%	95%	5%	50%	95%	5%	50%	95%	5%	50%	95%	
1995	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2007	2	3	4	2	3	4	2	3	4	2	3	4	2	3	4	
2010	3	4	5	3	4	5	3	4	5	3	4	5	3	4	5	
2020	6	8	10	6	8	10	6	8	10	6	8	11	6	8	10	
2030	9	13	16	9	13	16	9	12	16	10	13	17	9	12	16	
2040	13	17	22	13	17	22	12	17	21	14	19	24	13	17	22	
2050	16	22	28	17	23	29	16	22	28	19	25	32	17	23	30	
2060	18	26	35	21	28	35	19	27	35	24	33	42	21	30	38	
2070	21	31	41	25	35	45	24	33	43	31	42	54	26	37	48	
2080	24	35	48	28	41	54	28	40	53	37	51	67	31	44	58	
2090	26	40	54	32	47	62	33	47	63	45	62	81	36	52	69	
2100	28	44	61	36	53	71	38	55	73	53	74	98	41	60	80	

Indeed 2050 shows 17-23-29 for RCP4.5 vs. 16-22-28 for RCP6.0.

The two RCP’s are fairly similar, with differences in timing of the usage of various energy-sources and implementation of policies. This results in short periods where the RCP4.5 CO2 emissions and concentrations are slightly higher than the RCP6.0 values, resulting in slightly higher temperatures and sea levels between 2035 and 2055. It is only after 2060 that RCP6.0 is rising quicker than RCP4.5.

This is the result of choices made by IPCC regarding the definition and implementation of RCP4.x and RCP6.0 not choices made by CLIMsystems for application in SimCLIM 4.x for Desktop.

Defining a Representative Concentration Pathway for Application

Defining a Representative Concentration Pathway for Application

Choosing a Representative Concentration Pathway (RCP) for examination in this project should be based on a consultative process. This part of the manual outlines some of the current thinking we have had on defining RCPs for various clients in project work and given the latest Conference of Party (COP) discussions we have tried to make it as up-to-date as possible and bring to the discussion consideration of Intended Nationally Determined Contributions (INDCs) and potential limitations in societal capacity for achieving not only a reduction in greenhouse gas emissions but a decarbonisation of the world economy. We have taken a pragmatic approach that explores the big picture issues rather than diving deeply into individual and nuanced aspects of each and every possibility that could impact change.

The Representative Concentration Pathways (RCPs) are four greenhouse gas concentration (not emissions) trajectories adopted by the IPCC for its Fifth Assessment Report (AR5). The four RCPs, RCP2.6, RCP4.x, RCP6.0, and RCP8.5, are named after a possible range of radiative forcing values in the year 2100 (of 2.6, 4.x, 6.0, and 8.5 W/m², respectively) (Table 1).

Table 1. Overview of representative concentration pathways (RCPs) (van Vuuren *et al.* 2011; Moss *et al.* 2010; Rojeli *et al.* 2012)

Description ^a		CO ₂ Equivalent	SRES Equivalent	Publication – IA Model
RCP8.5	Rising radiative forcing pathway leading to 8.5	1370	A1FI	Raihi <i>et al.</i> 2007 – MESSAGE

	W/m ² in 2100.			
RCP6.0	Stabilization without overshoot pathway to 6 W/m ² at 2100	850	B2	Fujino <i>et al.</i>; Hijioka <i>et al.</i> 2008 – AIM
RCP4.x	Stabilization without overshoot pathway to 4.x W/m ² 2100	650	B1	Clark <i>et al.</i> 2006; Smith and Wigley 2006; Wise <i>et al.</i> 2009 – GCAM
RCP2.6	Peak in radiative forcing at ~ 3 W/m ² before 2100 and decline	490	None	van Vuuren <i>et al.</i>, 2007; van Vuuren <i>et al.</i> 2006 - IMAGE

^a Approximate radiative forcing levels were defined as $\pm 5\%$ of the stated level in W/m² relative to pre-industrial levels. Radiative forcing values include the net effect of all anthropogenic GHGs and other forcing agents.

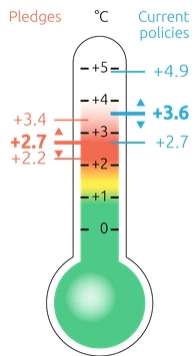
Is 2 °C the Bottomline?

There is plenty of talk of limiting climate change and global warming to 2 degrees C or less from pre-industrial levels. One of the most influential global groups in the G7 +1 that when they met in June of 2015 made strong statements with regard to the Conference of Parties (hereafter COP) negotiations that were to take place at the end of 2015.

The agreement should enhance transparency and accountability including through binding rules at its core to track progress towards achieving targets, which should promote increased ambition over time. This should enable all countries to *follow a low-carbon and resilient development pathway in line with the global goal to hold the increase in global average temperature below 2 °C.* (G7 +1 Leaders Summit, emphasis added)

The latest COP 21 negotiations have concluded in Paris. They do relate and are linked by previous COP meetings and one of the strongest linkages is with the Copenhagen meeting (COP 15), where Member States agreed to a goal of limiting climate change to no more than 2° C. At the current COP (21) there was considerable – but not universal – support for supplementing this goal with a long-term decarbonization goal, like that included in the G7+1 Leaders Statement in June 2015 and noted above, to provide a signal to business and investors. Many countries wanted to include a decarbonization goal in the Paris agreement, but as a consensus could not be reached to do so, a possible fall-back would be to include the goal in the Conference of the Parties (COP) decision that adopts the Paris agreement, which would give the goal a slightly lesser political status (Bodansky 2015).

Limiting to 2.0 (or better) Degrees Celsius



One of the more critical pieces of country engagement in the COP process has been the development of Intended Nationally Determined Contributions referring to greenhouse gas trajectories (i.e. reductions but not in all country cases) that include: current policy projections; short-term pledges (up to 2030) and long-term pledges (up to 2050) with no explanation of post-2050 targets or implementation guidelines or clear statements on binding commitments.

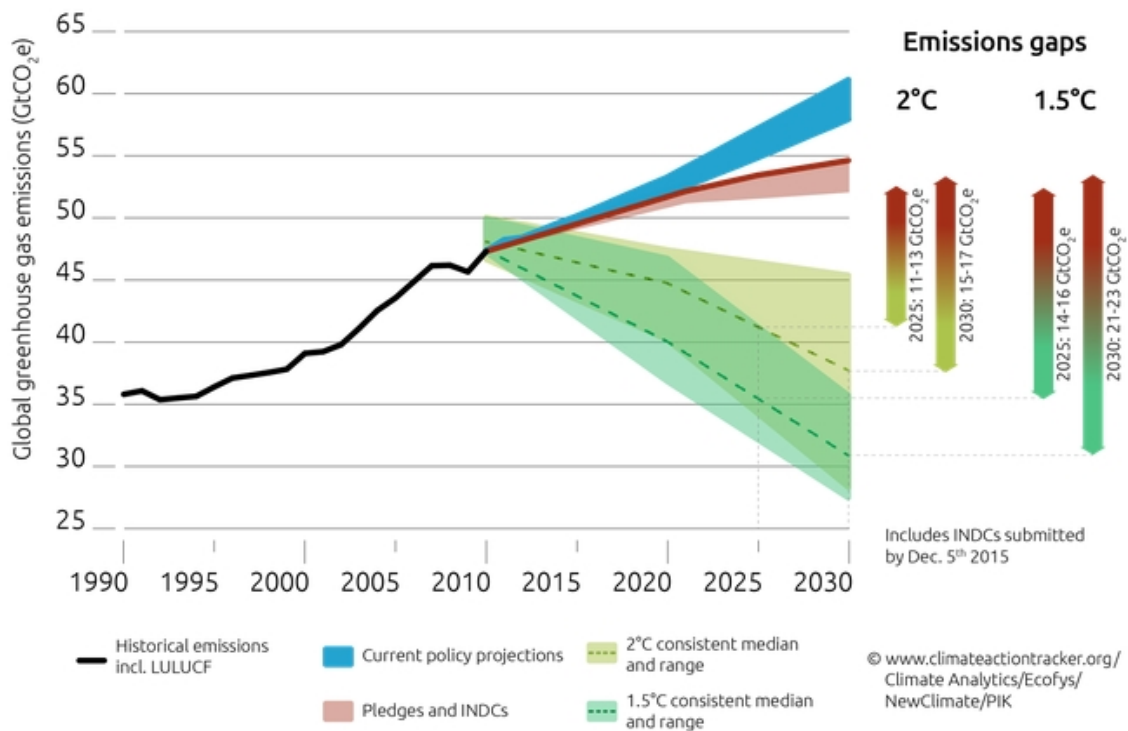
As of 7 December 2015, 158 submissions to the UNFCCC, reflecting 185 countries (including the European Union member states), and covering around 94% of global emissions in 2010 (excluding LULUCF) and 97% of global population had been made. A further 3% of global emissions are coming from international aviation and maritime transport. Almost 1% of global emissions are covered by countries that are not Parties to the UNFCCC.

Various groups have been analysing the INDCs and what they could mean in relation to the achievement of the target global temperature. Given current commitments and on-going negotiations for decarbonising the global economy pledges look likely to fall short of the 2.0 °C target. Even if the global community were to reach the goal of limiting warming to 2.0 °C there would still be up to 30 cms of sea level rise and important shifts in climate and extreme events that must still be considered in adaptation planning (Wigley 2015).

Importantly there are sizeable gaps between what is stated in the recently submitted INDCs and what history tells us. This is called the emissions gap and there are some very good reasons why this gap may persist for the foreseeable future and even if current pledges are fully realised will leave global temperatures at around 2.7 °C and perhaps higher depending on compliance and rates of reduction achieved.

CAT Emissions Gaps

7th December 2015



(Source: Climate Action Tracker Partners 2015)

However, the inertia in the energy system and emissions – e.g. the long lifetime of power plants and other fossil fuel powered technology – sets limits for how quickly nations can realistically slow their emission pathways. Highest emission reduction rates found in the mitigation scenario literature are in the order of 4% to 6% per year, importantly such rates have only been achieved over relatively short periods of time (van Vuuren and Stehfast, 2013). On a longer time frame of 50 years, the maximal rates of reduction observed in scenarios has been only 3% to 4%. Therefore it seems unlikely that most countries could sustain multiyear reduction rates exceeding 4% in the future (Elkholm and Lindroos, 2015).

The 2030 level can affect the achievable future emission levels: being on a higher level initially makes it more difficult to reach a low emission level in the future, as the rate at which emissions can be realistically reduced is limited. The 2030 level can exclude from reaching the target if the further cuts necessary to meet the 2°C target let along 1.5 °C have to be scaled up so fast. This seems highly unlikely given inertia in the energy system and other emission sources (Elkholm and Lindroos, 2015). Underlying such rates of possible emissions reductions beyond international and binding political agreements are national and local issues of politics, institutional capacity and mandates, regulations and standards not only of the UNFCCC but also International Organisation for Standardisation (ISO) and industry requirements. There are also issues of technological capacity and transfer, financial and development stages and goals and equity gaps and financing limitations.

For example, India alone through its submission of its INDC requires significant external financial support for capacity building, technology development and transfer. They noted a need

for USD 834 billion to achieve moderate low carbon development up to 2030. The Green Climate Fund update at the COP20 noted a mobilisation of only USD 10.2 billion to date by contributing parties. The target is for USD 100 billion a year by 2020. Even if it were to achieve this level of donor country support India alone could consume eight of the next ten years of funding to meet its needs.

The Green Climate Fund is one of the most divisive issues at COP 21 and there are long standing disagreements on what has and will constitute donations to the fund. There remains a large gap between the expectations of developing countries for significant levels of climate finance, and donor countries, who already feel donor fatigue. A recent report found that \$62 billion in climate finance was mobilized in 2014, up from \$52 billion in 2013, although these figures are disputed because of the major methodological questions about what should be counted as climate finance (OECD 2015).

What is Best Practice?

Given the confluence of needs for a rapid reduction in greenhouse gas emissions, the slow onset of negotiations to effectuate such change, the move toward non-binding agreements on such reductions is the continued adaptation of a worst case scenario – RCP 8.5 ensemble of models and medium to high sensitivity approach justifiable? And is it even possible when countries or individual clients are not bound by any international standards or national regulations but are free to choose the level of risk they may wish to carry forward through the applications of one of many possible emission pathways. Is this ethical/defensible given the new Intended Nationally Determined Contributions (INDCs)?

What if we try to estimate future scenarios from INDC commitments . . . theory and practice?

The 158 submissions to date representing 185 countries currently reporting representing about 90 percent of emissions. Clearly there is a greater than 50 percent chance that the global community is not going to make target temperatures and driving emission profiles. Do we therefore advise to plan for a worst case 3.4 °C or 2.7 °C (or 2.2 °C) world for durable 50+ year infrastructure (rather than 4.9 °C +)?

Settlement	Baseline (1995)	RCP 8.5 (change) to 2030	RCP 8.5 (change) to 2050
Mumbai	26.9	27.7 (0.8)	28.4 (1.5)
Goa	27.1	27.9 (0.8)	28.6 (1.5)
Bengaluru	23.6	24.x (0.9)	25.2 (1.6)
New Delhi	24.6	25.8 (1.2)	26.7 (2.1)

Table 1: Mean annual temperatures and changes in °C to 2030 and 2050 from a baseline of 1995 for RCPs 8.5 medium sensitivity. Global mean temperature change to 2030 for RCP 8.5 is 0.94 °C and for 2050 is 1.70°C, both with medium sensitivity (Warrick et al. 2013).

Coastal and more southern cities at elevation -- as expected -- show less of an increase in temperature than inland and more northern settlements over time owing to the moderating effect of the sea. Overall when away from the sea India is warming more quickly than the global mean.

In relation to the INDCs that have been submitted there is as shown a general consensus that current pledges will fall short of achieving the 2.0 °C target (and almost certainly the 1.5 °C target suggested by SIDS). Ultimately, can the INDCs and the process be trusted? Monitoring and evaluation is critical and current negotiations are trending toward making it binding to reduce emissions, but actual targets be unbinding (Bodansky 2015; factorCO2 2015).

Given this review the Representative Concentration Pathway RCP8.5 medium sensitivity from IPCC Fifth Assessment Report (IPCC AR5, 2010) it is suggested for application in the Phase One assessments with inclusion of RCP 4.x medium sensitivity as a best case scenario. The natural systems under consideration can be considered lifelines with lifetimes of 100 or more years and thus their resilience to climate risks needs to higher than other variables. Life and property losses could be catastrophic with loss or damage of these natural systems. Furthermore the temperature profile for RCP 8.5 and the time frame for analysis (2030 and 2050) means that even the current goal of limiting temperatures to 2 °C Celsius will be achieved by 2055 (or sooner) under the RCP 8.5 concentration pathway thus planning for the current target temperature is still achieved.

In summary, the RCP8.5 is a greenhouse gas concentration (not emissions) trajectories adopted by the IPCC for its Fifth Assessment Report (AR5) with rising radiative forcing pathway leading to 8.5 W/m² in 2100.

Figure 1 shows the global mean temperature change projected for RCP8.5, between 1995 and 2100. Global mean temperature change projected ranges from 0.96 °C by 2030 and 4.09 °C by 2100.

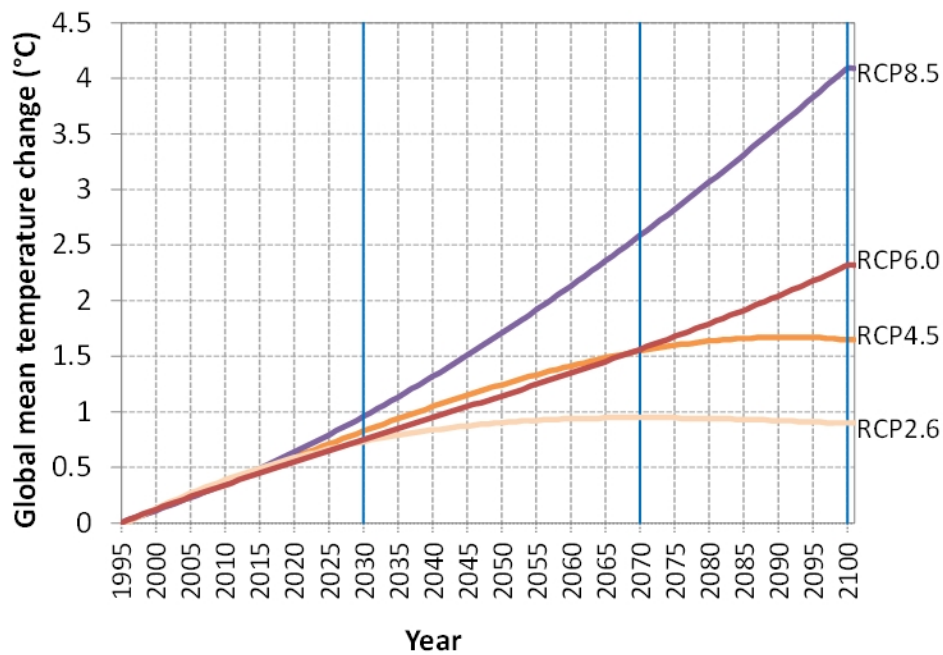


Figure 1 The global mean temperature change of the three selected RCP scenarios. The graph shows that up to 2030, global mean temperature is projected to increase by about 1.0°C (from 1995), irrespective of the RCP scenario and subsequently the future temperature change projections diverge by 2050 and even more by 2100, depending on the RCP scenario.

References:

Bodansky, D. (2015). Crunch Issues in Paris. *Opinio Juris*.

<http://opiniojuris.org/2015/12/06/crunch-issues-in-paris/> Accessed 8 December 2015.

Climate Action Tracker Partners (2015). Climate Action Tracker. <http://climateactiontracker.org/>. Accessed 8 December 2015.

Ekholm, T.; Lindroos, T.J. (2015). An analysis of countries' climate change mitigation contributions towards the Paris agreement. VTT Technical Research Centre of Finland Ltd.

factor CO2 (2015). INDC Update No.6. 5 November. 2pgs

OECD (2015). Climate finance in 2013-14 and the USD 100 billion goal, a report by the Organisation for Economic Co-operation and Development (OECD) in collaboration with Climate Policy Initiative (CPI).

van Vuuren, D. P.; and Stehfest, E. (2013). If climate action becomes urgent: The importance of response times for various climate strategies. *Climatic Change* 121, pp. 473–486.

Warrick, R.; Ye, W.; Li, Y.; Dooley, M.; Kouwenhoven, P.; Urich, P, 2013: SimCLIM 2013: A Software System for Modelling the Impacts of Climate Variability and Change. CLIMsystems Ltd. Hamilton, New Zealand.

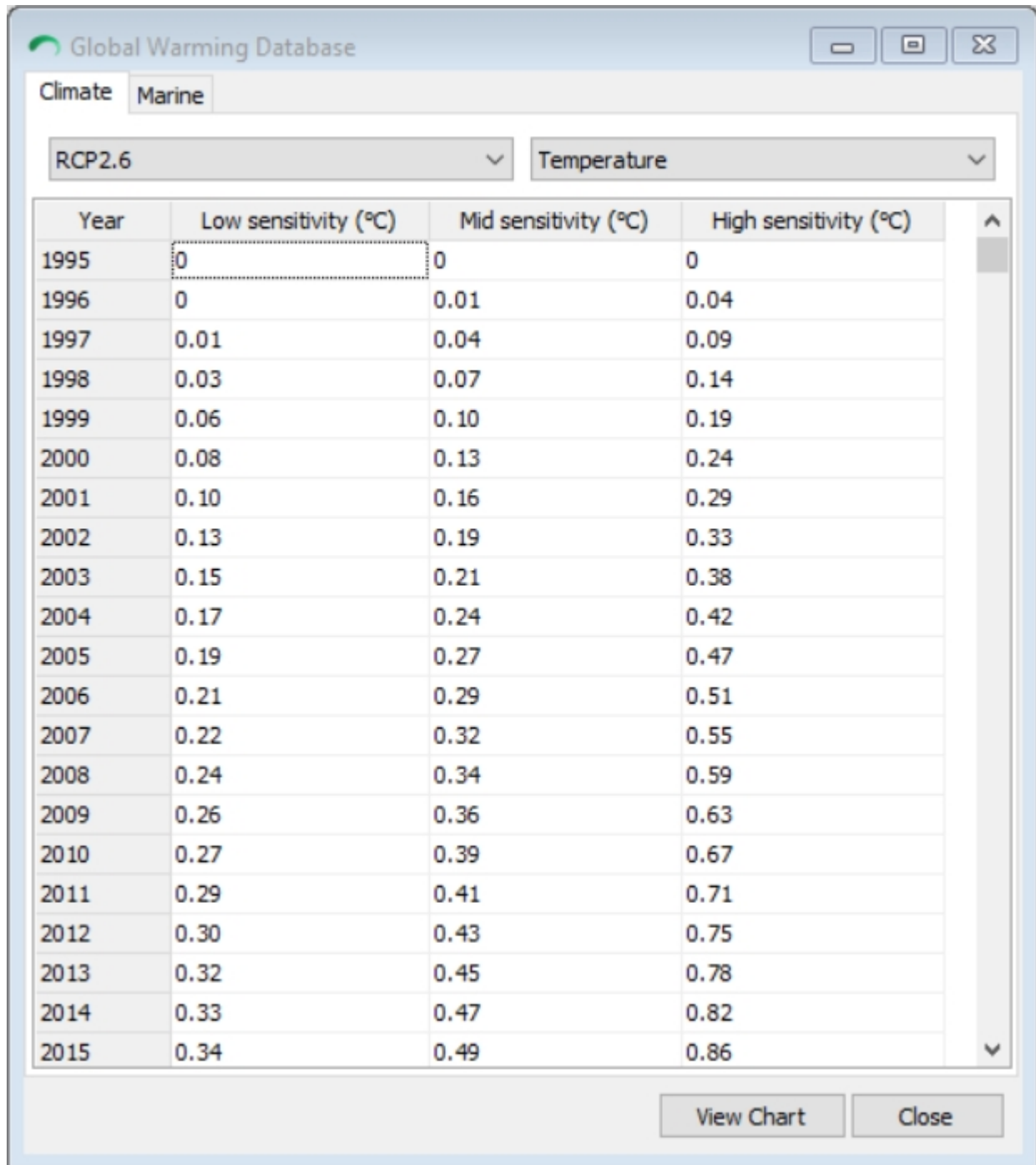
Wigley, T.M.L. (in press). Intermediate radiative forcing targets and sea level stabilization. *Proceedings of the National Academy of Sciences of the United States of America*.

Exploring the Global Database

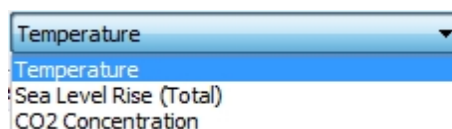
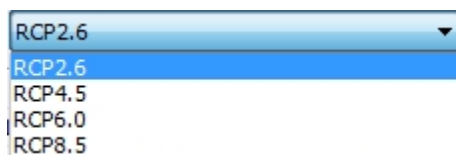
SimCLIM 4.x for Desktop is designed to assist the end user to analyse climates from the global to the local. This can help people with situating their place in context, hence the inclusion of a global database based on IPCC AR5 results. AR5 refers to the 5th Assessment Report of the IPCC (Intergovernment Panel on Climate Change).

Activity: assessing the global database

Click on the Global projection icon in the main toolbar. Look over the dialogue box and assess what can be achieved.



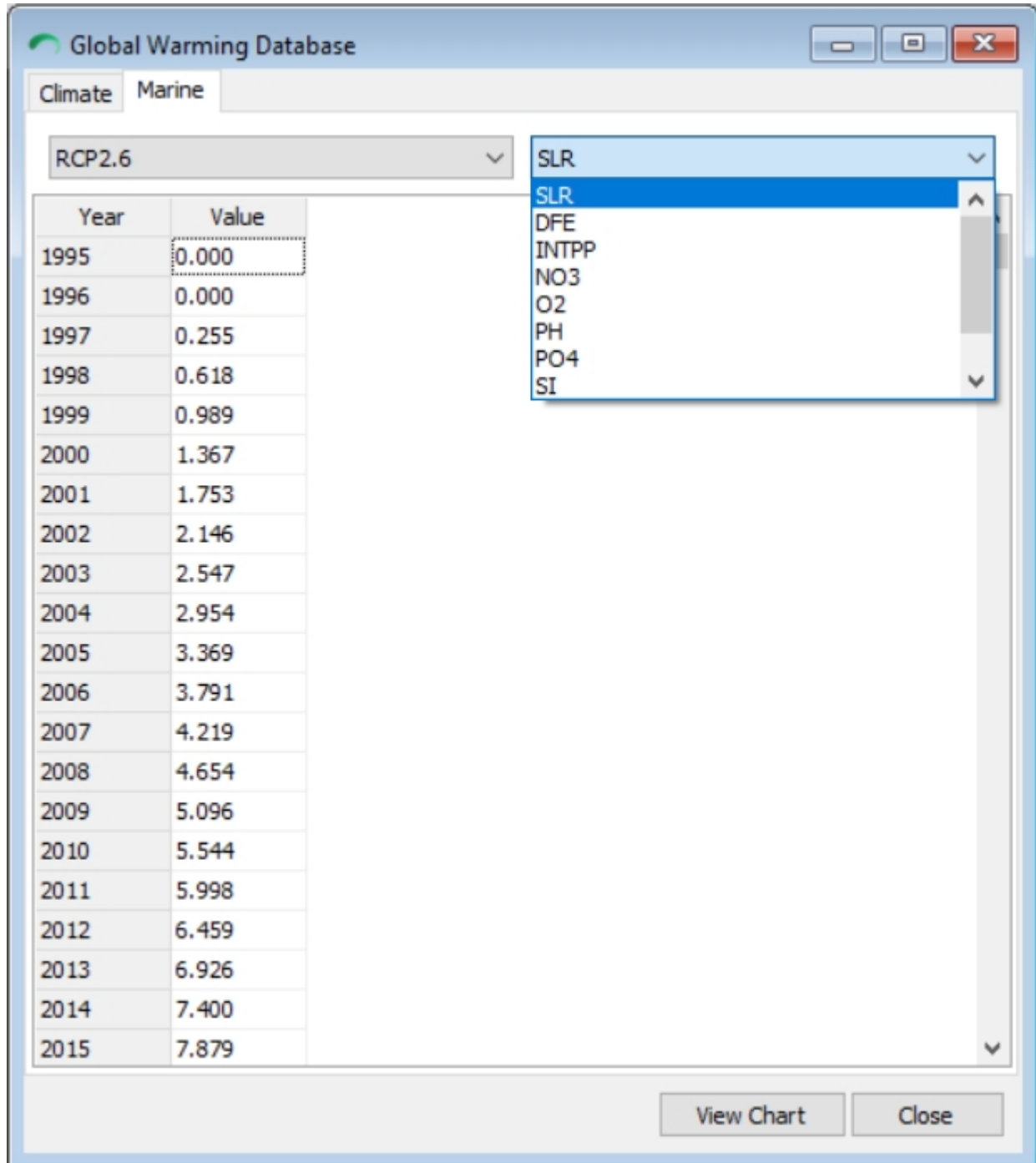
Click on the down arrows on the left and right side to display the various RCP and variables as displayed below:



Analysis within this toolbox is all at the global scale. With the focus on a global scale a study area is not required to be nominated from the dialogue box at the top right.

However, analysis the global atmospheric scale is limited to temperature, CO2 concentration and sea level rise (total – including ice melting, and thermal expansion only).

Click on the Marine table to see the eight variables for ocean climate models as shown below:



Activity: temperature

RCPs

Click on the variable 'temperature' before selecting a warming scenario.

We will review the underlying assumptions of the scenarios at this point as they are often referred to in this manual.

The GCM data in SimCLIM 4.x for Desktop is from CIMP5 which is also the data source for IPCC AR5 climate change projections. For more information on CMIP5 please visit: http://cmip-pcmdi.llnl.gov/cmip5/guide_to_cmip5.html.

The Representative Concentration Pathways (RCPs) are four greenhouse gas concentration (not emissions) trajectories adopted by the IPCC for its Fifth Assessment Report (AR5). The four RCPs: RCP2.6, RCP4.x, RCP6.0, and RCP8.5, are named after a possible range of radiative forcing values in the year 2100 (of 2.6, 4.x, 6.0, and 8.5 W/m², respectively) (Table 1).

Table 1. Overview of representative concentration pathways (RCPs) (van Vuuren *et al.* 2011; Moss *et al.* 2010; Rojeli *et al.* 2012)

Description ^a		CO ₂ Equivalent	SRES Equivalent	Publication – IA Model
RCP8.5	Rising radiative forcing pathway leading to 8.5 W/m ² in 2100.	1370	A1FI	Raihi <i>et al.</i> 2007 – MESSAGE
RCP6.0	Stabilization without overshoot pathway to 6 W/m ² at 2100	850	B2	Fujino <i>et al.</i>; Hijioka <i>et al.</i> 2008 – AIM
RCP4.5	Stabilization without overshoot pathway to 4.x W/m ² 2100	650	B1	Clark <i>et al.</i> 2006; Smith and Wigley 2006; Wise <i>et al.</i> 2009 – GCAM
RCP2.6	Peak in radiative forcing at ~ 3 W/m ² before 2100 and decline	490	None	van Vuuren <i>et al.</i>, 2007; van Vuuren <i>et al.</i> 2006 – IMAGE

^a Approximate radiative forcing levels were defined as $\pm 5\%$ of the stated level in W/m² relative to pre-industrial levels. Radiative forcing values include the net effect of all anthropogenic GHGs and other forcing agents.

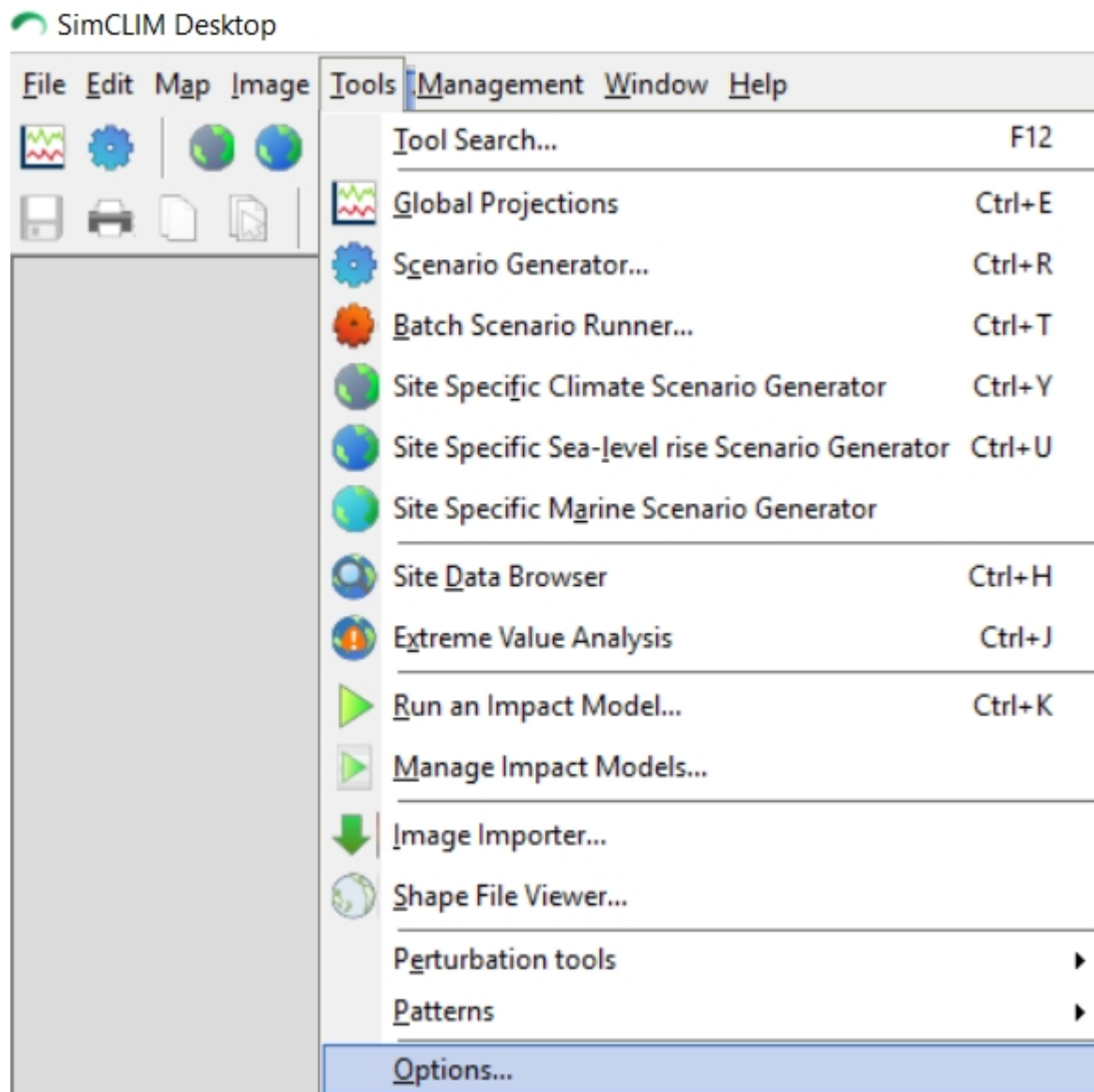
Activity - sub-menus

Take several minutes and right click on the main display window and then click on each of the submenus: global projection, spatial scenario generation, site specific scenario generator, view pattern etc. Go through the entire list and see what is displayed. DO NOT continue beyond the first window displayed for each submenu. You can return to some of these submenus later and explore them further.

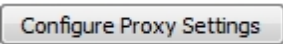
Note: Global is the default study area. You will need to click on the study area window and select a different study area if you wish.

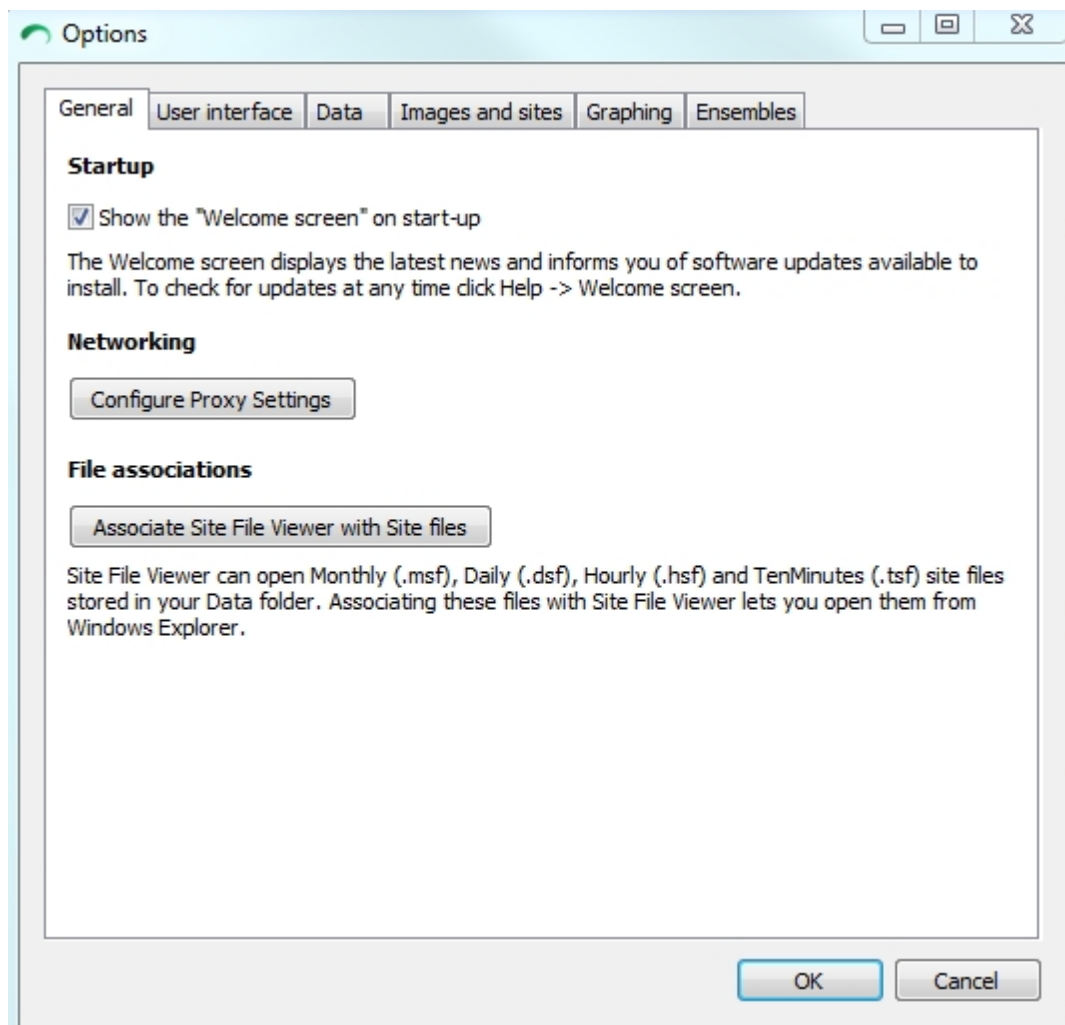
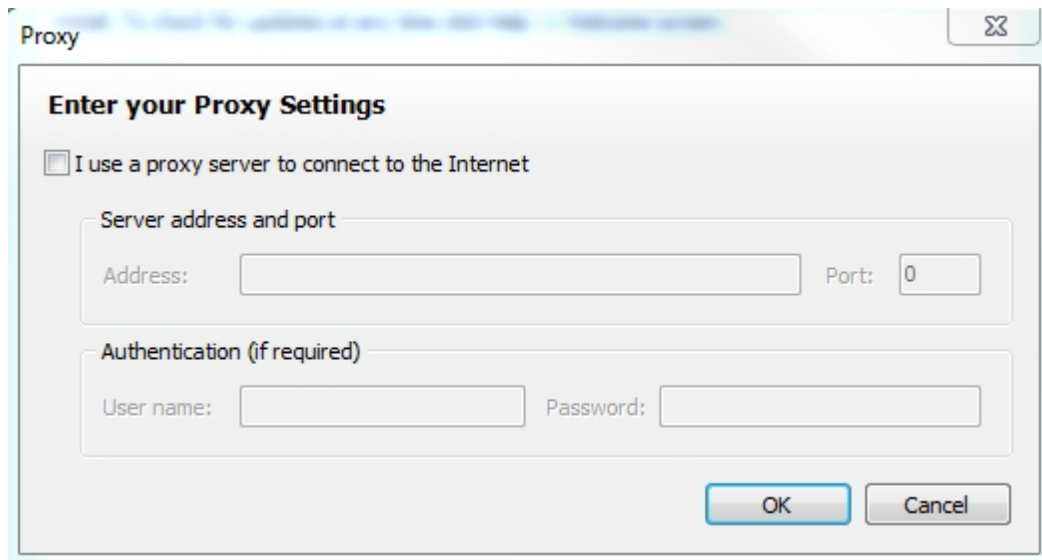
Options:

There are a number of options for customising your version of SimCLIM 4.x for Desktop that can be accessed via the Tools drop down menu, under Options.

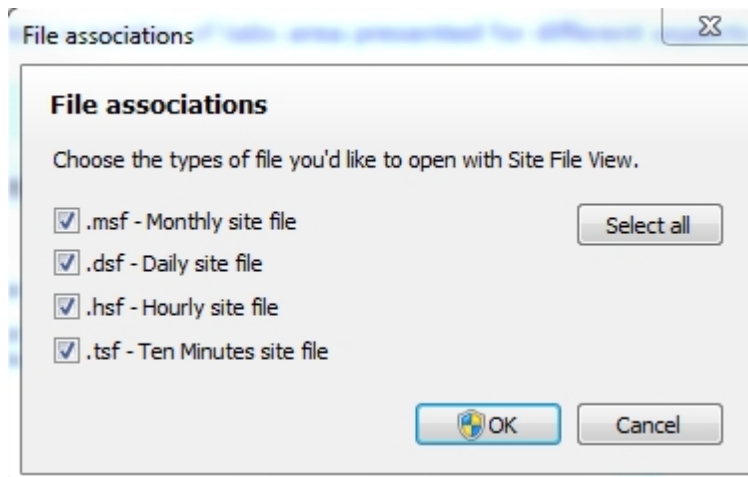



When you click on the Options item a number of tabs area presented for different aspects of the SimCLIM 4.x for Desktop system.

When you click on  a new dialogue box will be displayed. Depending on your network you may require proxy information from your IT Support Centre to enter here so that you will be able to easily access updates for SimCLIM 4.x for Desktop via the internet and the automatic updating facility. If you face issues with firewalls there are other ways of updating your software. Contact info@climsystems.com for information.



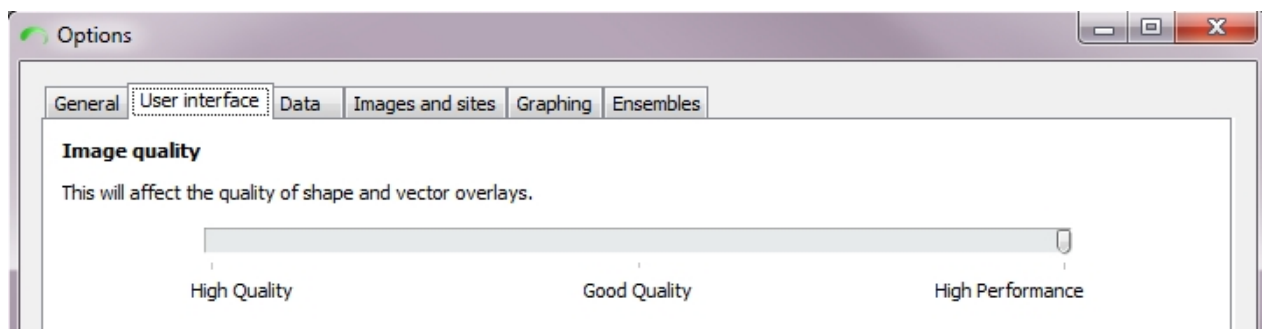
File associations is an import option to consider by clicking on that option another dialogue box will open:



Select one or more or all and click on . Now you will be able to open the files directly from your file explorer when working with SimCLIM 4.x for Desktop.

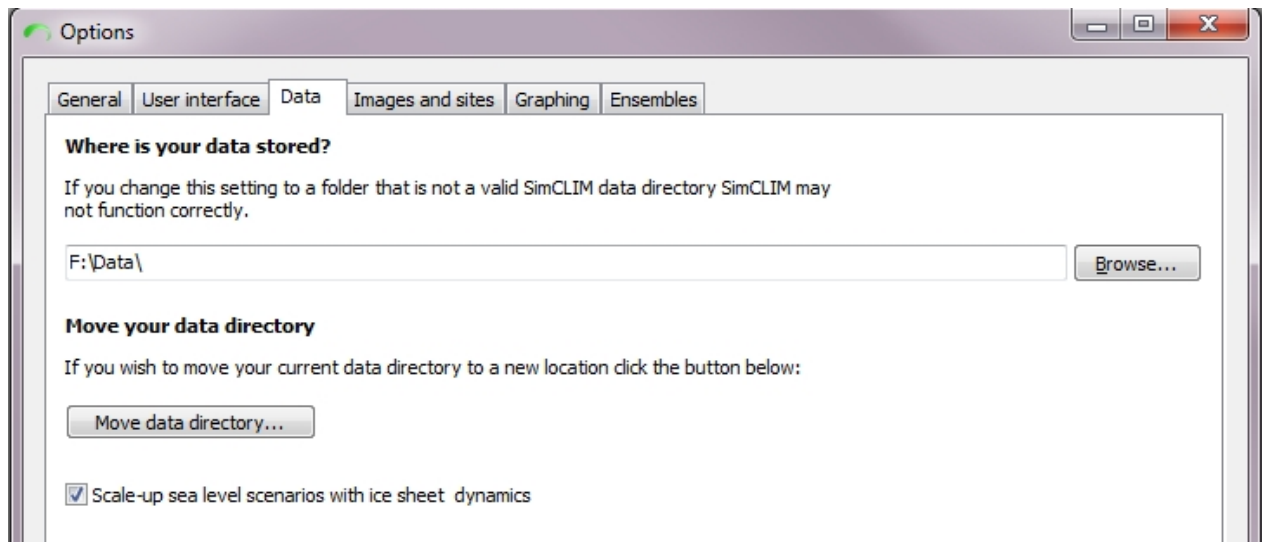
Go through each tab and its features.

User interface: High quality is the default. If you wish to have quicker performance on more complex image builds then you can select Good Quality or High Performance for the fastest redraw.



You can also toggle for the option of hiding unused toolbars on the main SimCLIM 4.x for Desktop page. With this option toggled the toolbar for managing images will not be shown until an image is opened in the main screen.

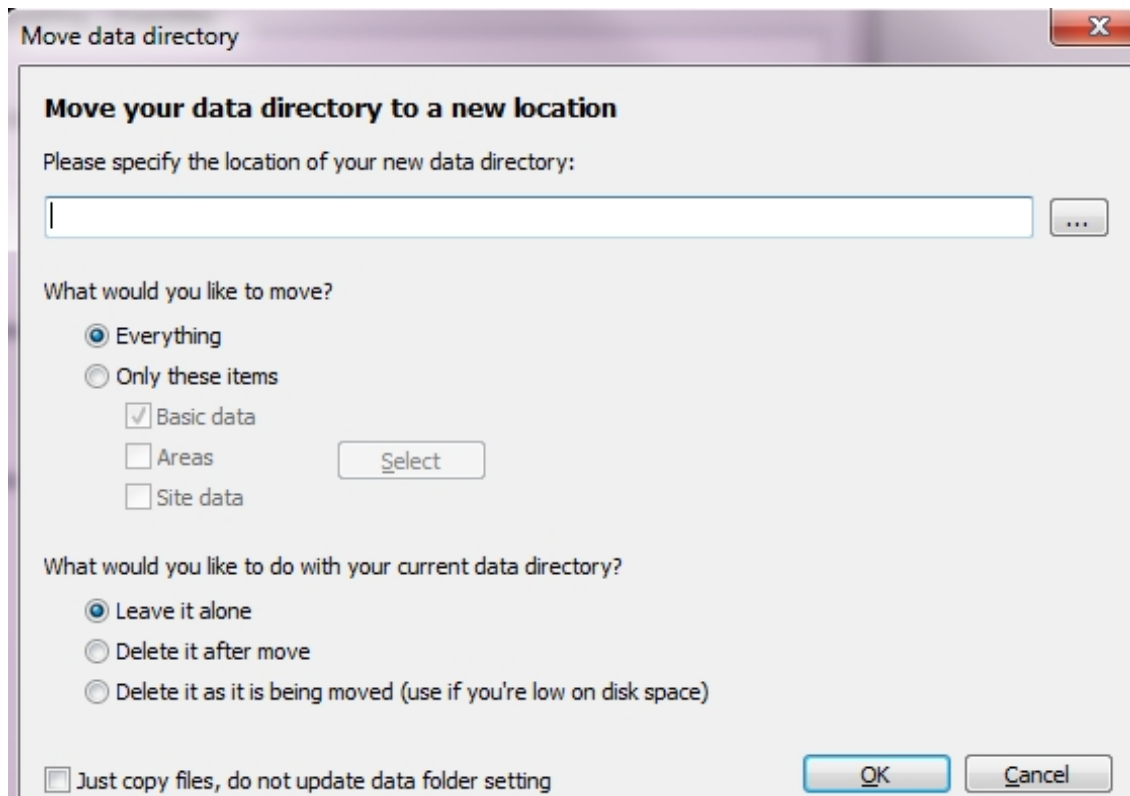
Data: This interface allows you to direct SimCLIM 4.x for Desktop to a remote data directory (not the default). It is important that you keep the data in the correct data structure with a DATA directory named DATA (and all files within it being SimCLIM 4.x for Desktop compatible). If you do not follow this protocol SimCLIM 4.x for Desktop may not function properly.



You may use this function if you wish to store your SimCLIM 4.x for Desktop areas data on an external drive. This may be necessary if you have many areas and vector files that can take up considerable hard drive space.

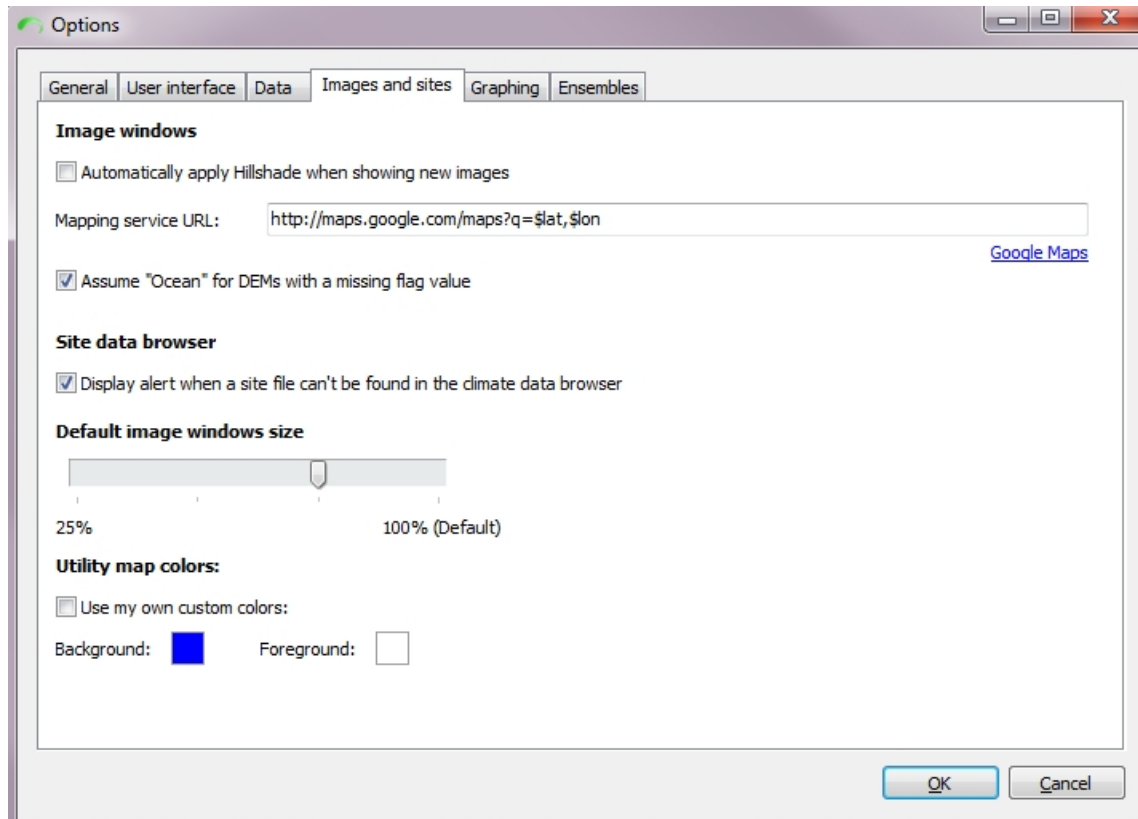
It is recommended that you follow the instructions in this dialogue box if you wish to move your data directory from its default location to a new location.

Click on  .



You must specify the new location. Select the data that you wish to move and what you would like to do with the data at the original location. If you click on Just copy files . . . the options for deletion will no longer be available.

Images and sites: This tab provides options for the visual display of maps. You can choose to have Hillshade on or off. If you choose off you can always toggle when an image is open to apply Hillshade without returning to this option tab. Default is off.



The default mapping service is Google maps.

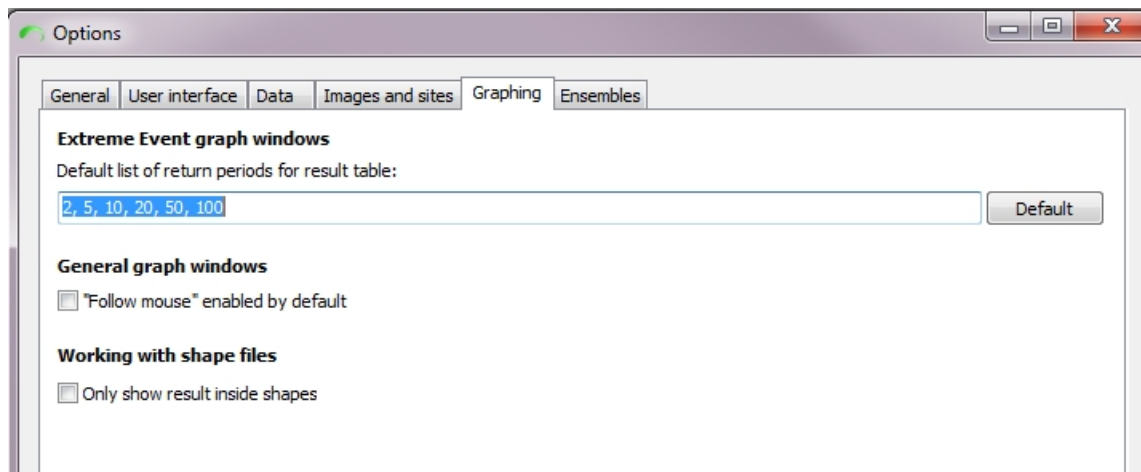
The default is to assume Ocean for DEMs with a missing flag value. A missing flag value sometimes occurs when patterns are developed. This option being toggled assists in avoiding display difficulties.

If a site being queried cannot be found in the Site data browser an alert box is displayed. This is the default setting.

You can set the image size window that will be displayed in SimCLIM 4.x for Desktop. 100% is the default. Slide the bar to customise and be sure to click on OK if changes have been made.

You can also alter the colour scheme for utility maps. These are the maps that are displayed in the site data browser and extreme event analysis tool. Click on the Background and Foreground boxes and choose your colour.

Graphing: More default selections can be customised such as the return periods for the results table in the extreme event tool. You can also have follow mouse on rather than off, which is the default setting. You can turn this feature on within the graph itself if you discover you need it (without having to return to this option tab).



The default for shape files is to only display results that are inside a shape file boundary.

Generating Scenarios and Showing Changes from Baseline Conditions

Method

The beginning of this method is the same as any other scenario generation procedure.

Choose a study area.

As with future scenario generation you will need to specify a date and the GCM pattern and RCP and climate sensitivity.

Generate a scenario

Work area: CA Nunavut

Climate variable: Precipitation

Linked Synthetic

Year: Baseline Future: 2050

Patterns

- BNU-ESM
- CANESM2
- CCSM4
- CESM1-BGC
- CESM1-CAM5
- CMCC-CM
- CMCC-CMS
- CNRM-CM5
- CSIRO-MK3-6-0
- EC-EARTH
- FGOALS-G2
- FGOALS-S2
- GFDL-CM3
- GFDL-ESM2G
- GISS-ESM2G

Select all Select none Percentile: Low: High:

GHG concentration pathway: RCP2.6

Climate sensitivity: Low Mid High

Output change from baseline

Months: Jan Feb Mar Apr May Jun
 Jul Aug Sep Oct Nov Dec All None

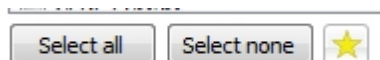
Keep open after generation OK Batch... Cancel

As this is a scenario based on change from baseline you cannot use 1995 (the baseline year) in your analysis.

Click on Future and choose and future data for analysis.

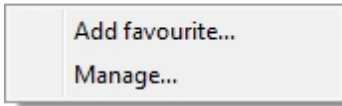
The next choice is for the GCMs to apply. We suggest a complete ensemble but you may have specific reasons for choosing one or more GCMs for your particular analysis.

By clicking on the yellow star



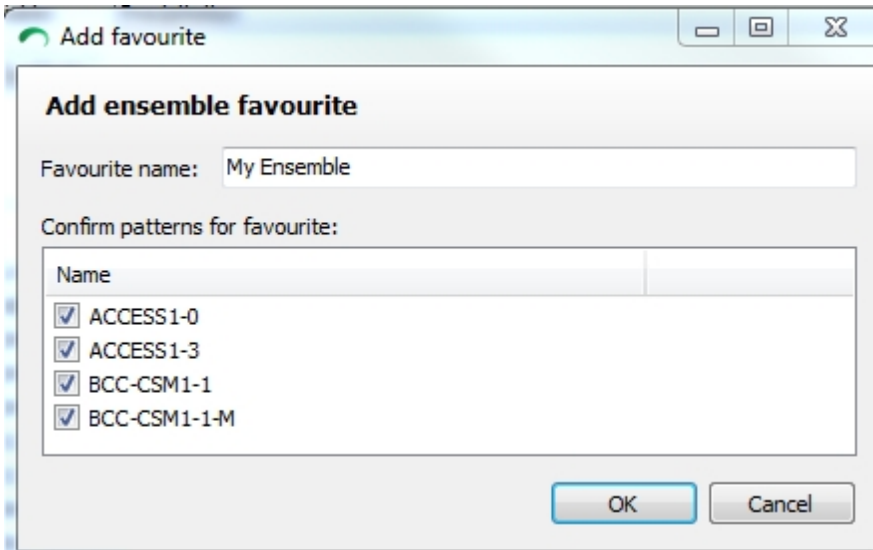
to the right of the selection boxes

you can save the ensemble of choice for future use:

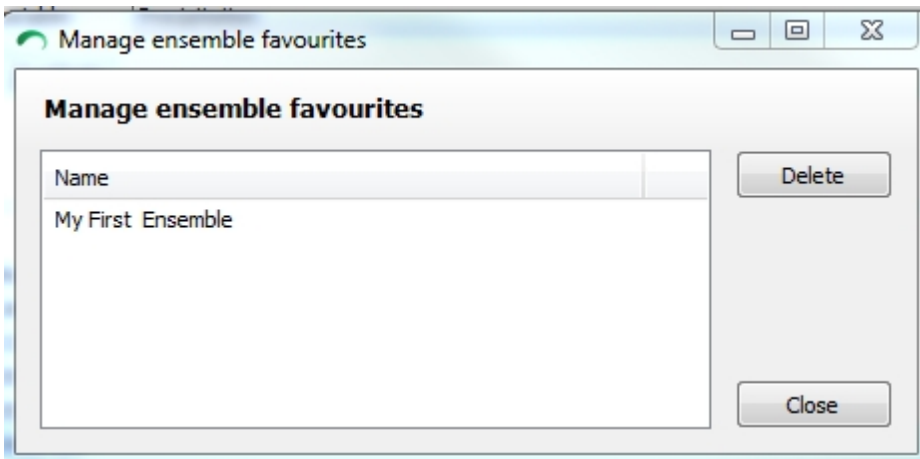


You can add a favourite or manage the ensembles you had saved previously.

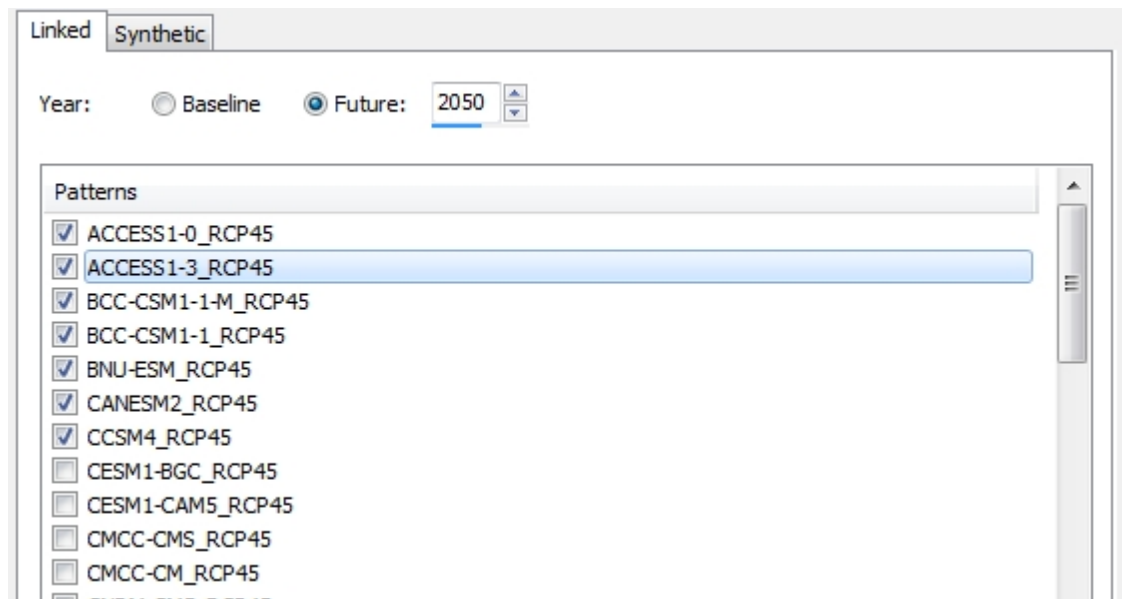
By clicking Add favourite a dialogue box will appear where you can name the ensemble and it will display the GCM/RCMs you have previously selected to form your ensemble. Click OK to save.



By clicking on Manage you will open a dialogue box displaying previously saved ensembles and you can open them for application or delete them if they are no longer required:



Back to making an ensemble for your analysis . . .



When you click on more than two or more GCMS the following dialogue box appears:

Percentile: Low: High:

This functionality represents the option of choosing the percentile of a certain result from the ensemble chosen and can be used to reflect the level of risk that you may wish to test for.

You can leave this dialogue box blank and the resulting scenario will portray the ensemble mean.

Or you can chose , for example, the 5th (low) and 95th (high) scenario. This will result in the generation of three maps. One will still be the ensemble mean. A **percentile** (or a centile) is a measure used in **statistics** indicating the value below which a given percentage of observations in a group of observations fall. There is a point known as the **5th percentile**, because 5% of the GCM values (or 1 value in 20) is less than all values (best case in terms of change from baseline assuming that a change from baseline is not desirable)). The same high point is known as the **95th percentile**, where only 1 value in 20 is higher than all values (worse case from baseline assuming that a change from baseline is not desirable).

Chose the months/season for analysis and climate sensitivity as seen below.

Sensitivity (from SimCLIM FAQ document) : In 2007, the IPCC considered the projections from models, paleo-climate information, and expert judgement and stated that the best estimate of how much the average temperature of the Earth's atmosphere would increase with a CO₂ doubling is 3°C (about 5.4°F). Because climate models yield different results and historical and paleo-climate analyses yield different estimates of temperature associated with CO₂ doubling, scientists have defined a range of climate **sensitivities**.

The IPCC said that there is a two-thirds chance that the true **sensitivity** is between 2°C (3.6°F) and 4.x°C (8.1°F). If there is a two-thirds chance that climate **sensitivity** is between 2°C and 4.x°C, then there is a one-third chance it is outside this range. The IPCC concluded that there is only approximately a one in 20 chance that climate **sensitivity** is below 1.5°C (2.7°F).

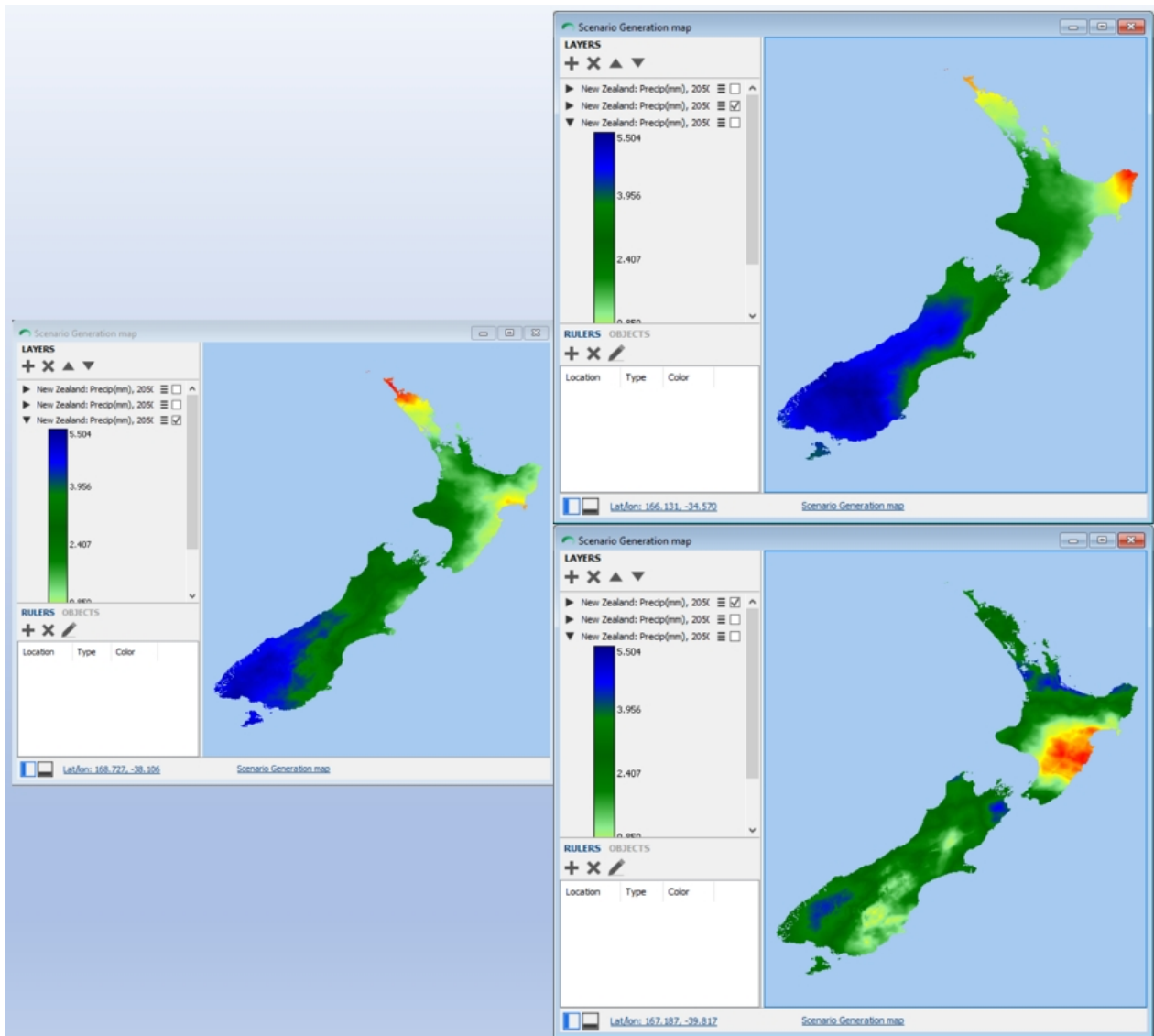
Wigley et al. (2009) found that there is only a one in 20 chance that climate sensitivity is greater than 6°C (10.8°F). Thus, scientists have concluded that there is a nine in 10 chance that the true sensitivity is between 1.5°C and 6.0°C. This range represents a factor of 4. Therefore the medium sensitivity is centered on 3 C and low on 2 C and high on 4.5 C.

The screenshot shows a dialog box with the following settings:

- GHG concentration pathway:** RCP8.5 (selected in a dropdown menu)
- Climate sensitivity:** Low (radio button), Mid (radio button, selected), High (radio button)
- Output change from baseline
- Months:** All months (Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec) are checked.
- Keep open after generation
- Buttons: All, None, OK, Batch..., Cancel

After making your selections click on Generate.

Three images will be displayed.



Activity: changes from baseline using tools

The usual tools are available for working with such images.

By scrolling over the figure the result for that site is displayed with the latitude and longitude on the top left of the screen.

You can use the image display function on your images.

Generate a series of 'change from baseline' images and creatively (think about what you wish to display to your audience) apply the image display function on them.

The image that follows was reclassified for all the values that represented a decrease in rainfall from baseline of between 30 and 10 percent by 2100. It was also reclassified to only five categories.

NOTE: YOU DO NOT NEED TO ACCEPT THE DEFAULT NUMERIC VALUES WHEN RECLASSIFYING. YOU CAN CHOOSE YOUR OWN. TRY IT!

Map Viewer

Introduction

Introducing the new Map Viewer

SimCLIM 4.x contains a new Map Viewer (which includes major improvements to the way maps are presented and can be interacted with). The new Map Viewer will be basis for regular updates that add new features and improvements to existing features.

Legacy Map Viewer

Some functions have not yet been ported from the legacy Map Viewer to the new Map Viewer. The previous Map Viewer will remain available, and can be toggled on/off in the SimCLIM Options dialogue. Once all functionality has been ported to the new Map Viewer, the old map viewer will be retired. [Learn more.](#)

Sending feedback

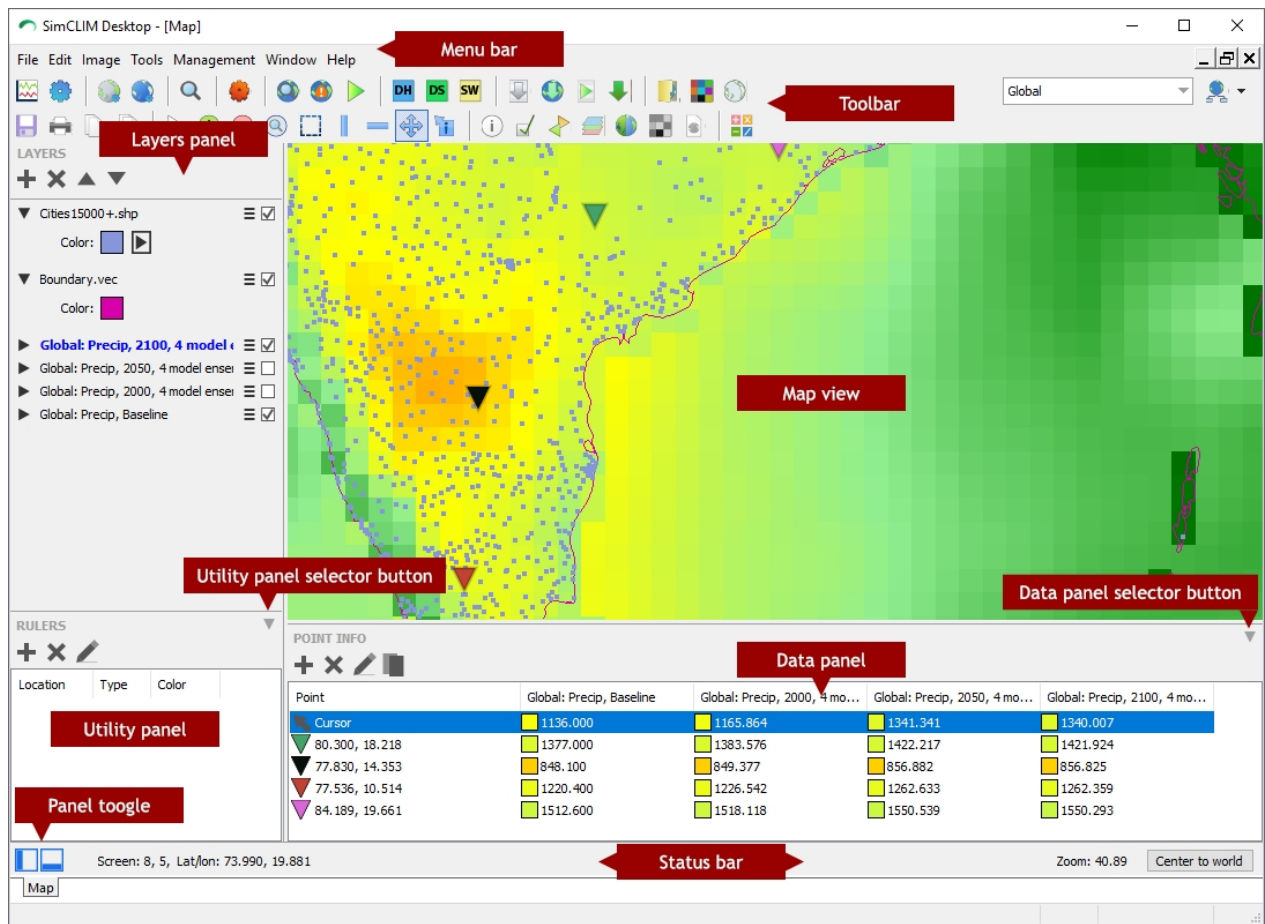
We greatly appreciate all feedback.

If you encounter issues or have comments or suggestions, please e-mail them to matt@climsystems.com.

Map Window overview

Mapping Window overview

Below is an image of SimCLIM 4.x for Desktop showing a typical map window, with labels showing its different parts.



Creating a map

Using the Scenario Generator

Creating a new map using the Scenario Generator

1. Locate the “Scenario Generator” icon on the toolbar and click it.



2. Specify the desired scenario options and click the OK button OR click the Batch button to create a new map for multiple years (each year will be created as a separate layer).
3. A new map will be displayed showing the generated scenario raster image.

From existing file(s)

Creating a new map from an existing file

1. Locate the “Open Images” icon on the toolbar and click it.



2. Browse to one or more images file(s) (Idrisi Image or ESRI Ascii GRID) you'd like to create a map from, select them and click OK.
3. A new Map Window will be displayed, showing the specified image file(s) as layers.

Navigating the map

Navigating the map

Navigating the map can be done with by using tools on the main SimCLIM toolbar. You can perform different actions depending on which tool is selected.



Pan tool

Pan tool

Panning allows you to move around the map with ease.

1. Locate and click the Pan tool on the toolbar.



2. You can now pan around the map by either:
 - Placing the mouse cursor inside the map, clicking and holding the left mouse button and moving the mouse.
 - Dragging the map around with a touchscreen enabled PC.

Zoom tools

Zoom tools

Zooming with the scroll wheel

You can use the scroll wheel to zoom the map in and out.

Zoom in and out



Use the zoom in and out buttons on the toolbar to quickly zoom in or out, relative to the on-screen center point of the map.

Zoom to

The "Zoom to" tool can be used to zoom to a specific location on the map specified by drawing a selection.

1. Locate and click the Zoom tool on the toolbar.



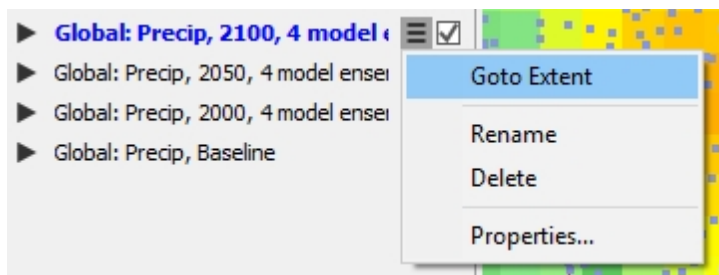
2. Using the left mouse button, draw a selection box on the map.
3. When you release the left mouse button the location and zoom scale will be set to the selection location.

Moving (and zooming) to a layer

Moving (and zooming) to a layer

You can use the "Goto Extent" function to move and zoom the visible area of the map window to the bounds of a layer.

1. In the Layers Panel, choose which layer you'd like to view and click its "Layer menu" button.



2. Click the "Goto Extent" menu item.

Layers

Layers

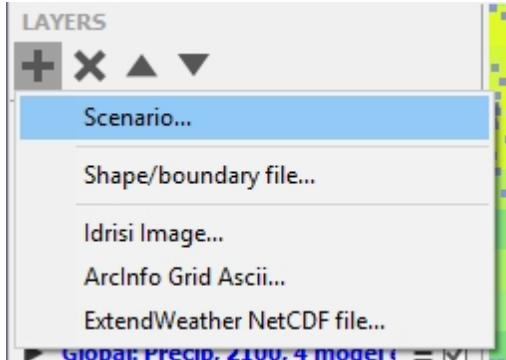
A layer is a piece of geographic data (such as an image, scenario output, shape file, etc), presented in a graphical form and rendered on a map, positioned to its extent (bounds).

A map can have many layers, which are listed and managed in the Layers Panel. On the map, layers are rendered from the top layer in the Layers Panel to the bottom layer in the Layers Panel. Layers that are rendered further down in the list can cover the contents of the layers that were rendered before it. Normally you would order layers, so country raster layers are rendered first, then state/regional raster layers are rendered next and finally shape/vector files are rendered last.

Scenario layers

Scenario layers

The Scenario layer is a raster layer that is created by generating a scenario for an area that can be generated by clicking the Scenario Generator button on the main SimCLIM toolbar (which will create a new Map window) or by adding a Scenario layer to an existing Map window.



See “Editing the display of raster layers” for information on changing how these layers are displayed.

Shape and vector layers

Shape and vector layers

Shape files (.shp) and vector files (.vec) can contain shapes, and consist of a series of lines (that can represent the bounds of a country or city, or roads, rivers, rail, etc) or points (that represent things such as cities, buildings or points of interest). A database file is often included with a shape file that can contain more information about its contents (e.g. road or city names). Currently, SimCLIM 4.x for Desktop has only basic functionality for viewing data contained within this database.

Other image formats as layers

Other image formats as layers

Map images that have already been created can be added to the map as additional layers. SimCLIM 4.0 for Desktop currently supports files in Idrisi Image format (the default for SimCLIM), ArcGRID ASCII format, and ExtendWeather NetCDF, all of which are raster images.

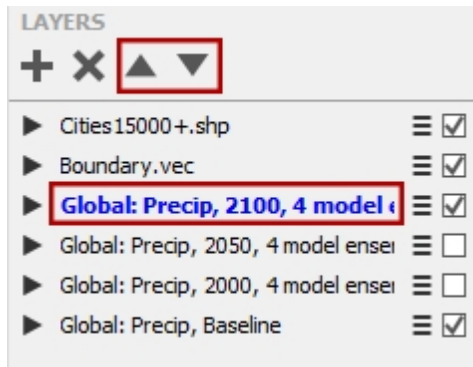
See “Editing the display of raster layers” for information on changing how these layers are displayed.

Moving layers

Moving layers

You can change the order in which layers are rendered on the map by changing their placement in the Layers Panel. Layers are rendered in the order they appear in the Layers Panel, starting with the top layer.

1. In the Layers Panel, select the layer you want to move by clicking its name (its name should turn blue, indicating it is selected).
2. Click the “Move up” or “Move down” buttons to move the layer up or down.

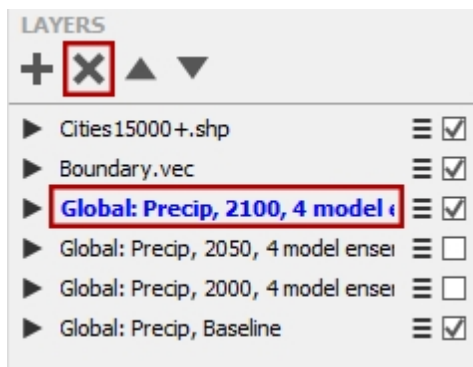


Deleting layers

Deleting layers

Layers can be deleted from the map.

1. In the Layers Panel, select the layer you want to delete by clicking its name (its name should turn blue, indicating it is selected).
2. Click the “Delete layer” button.

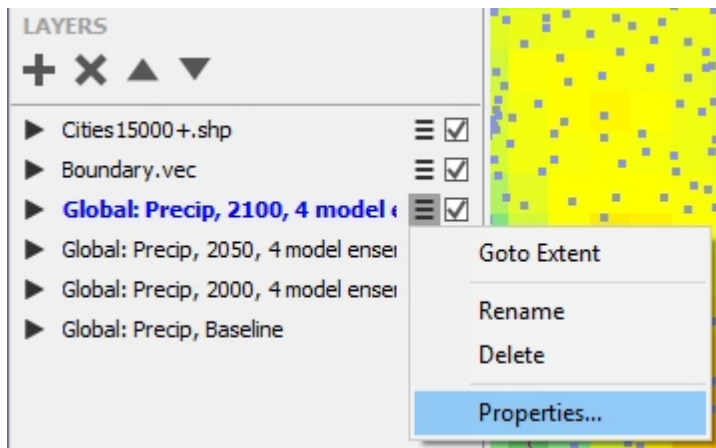


Layer properties

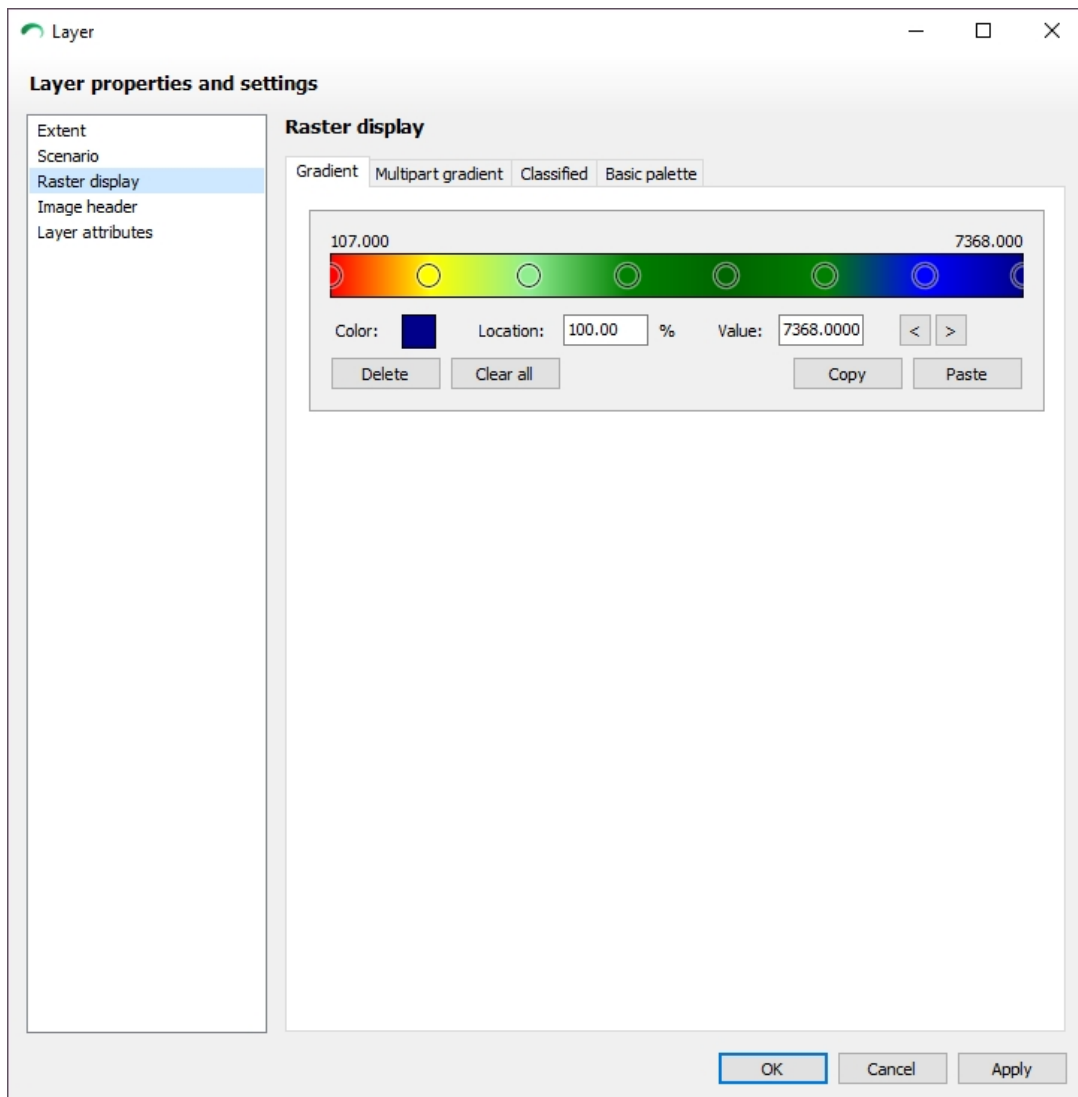
Layer properties

Many layer types have properties that can be viewed or changed.

1. In the Layers Panel, locate the layer you want to view or change the properties for and click its “Layer menu” button.



2. Click the “Properties” in the drop-down menu. The Layer properties dialogue box will be displayed.
3. The different property categories are listed in the box on the left and the details for the selected property page takes up the remainder of the dialogue box. Any changes made can be saved by clicking OK or Apply.

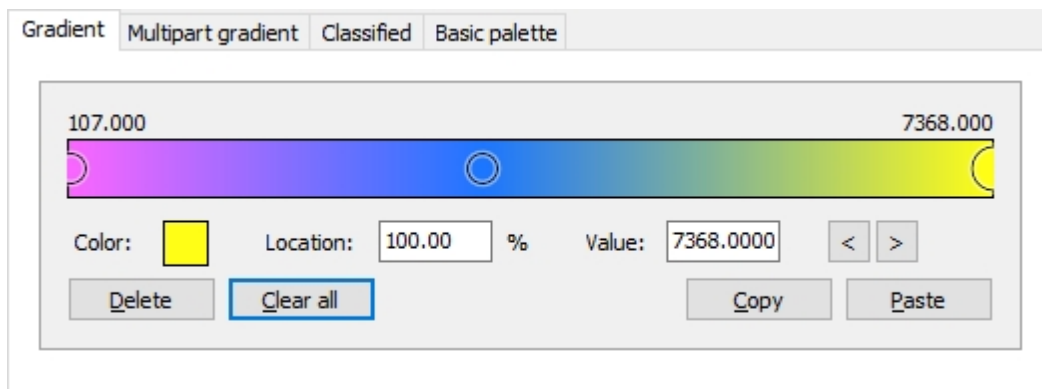


Editing the display of raster layers

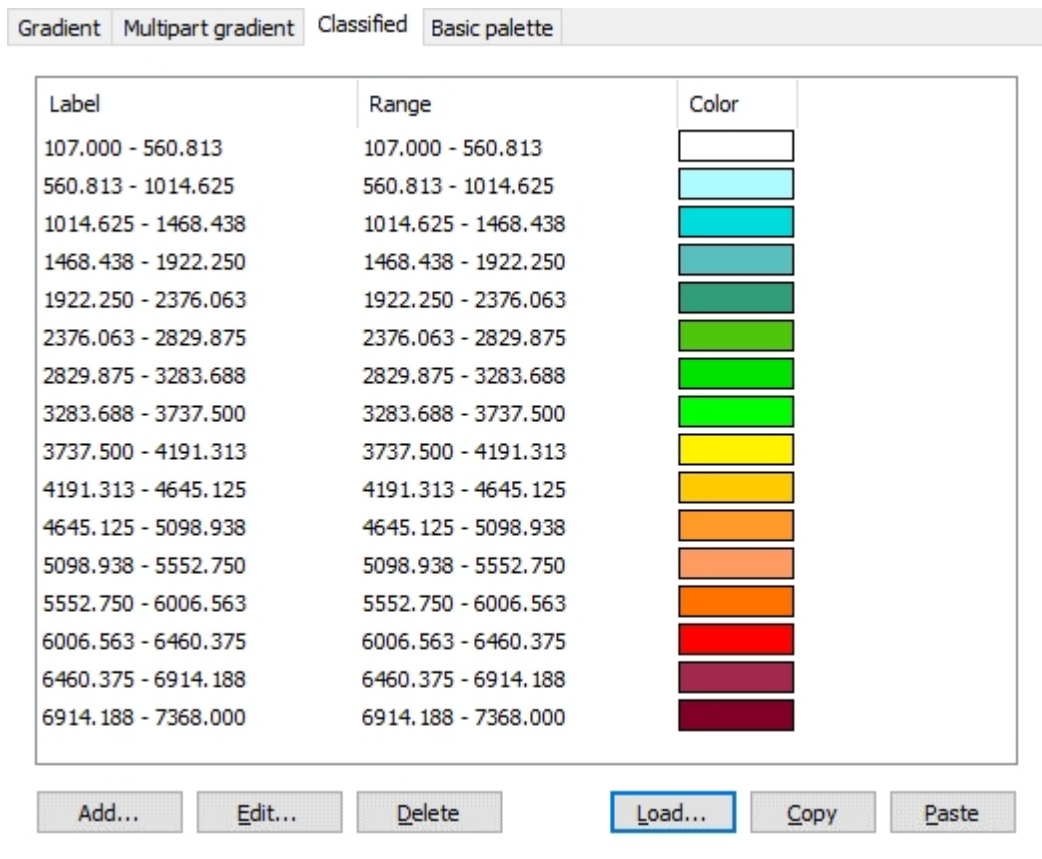
Editing the display of raster layers

The display options for a raster layer (Scenario layer, Idrisi Image or ArcGRID ASCII) can be modified in many ways to change how it is rendered.

1. Locate the layer you'd like to change in the Layers panel and open its Layer Properties dialog.
2. Select the "Raster display" option from the list of property pages.
3. There are four tabs (Gradient, Multipart Gradient, Classified, Basic palette) which let you choose which type of rendering method you would like to use.
 - Gradient: This is the default render type. Select two or more colours to specify a gradient colour scheme for the min to max values from the image data. Use the gradient editor control to add, delete, move and change colours. This method can produce great looking images that also convey detailed information about the data.



- Multipart Gradient: Specify multiple gradients for multiple different ranges.
- Classified: Lets you pick a set of colours. Each colour represents a range of values on the map (e.g. -10 to 5 should be blue, 5 to 10 should be red, 10 to 50 should be green, etc).



- Basic palette: Lets you pick a set of colours that are evenly distributed through the min to max value range of the image data. This is how images are displayed by the image viewer in SimCLIM prior to version 4.x.

Info Query

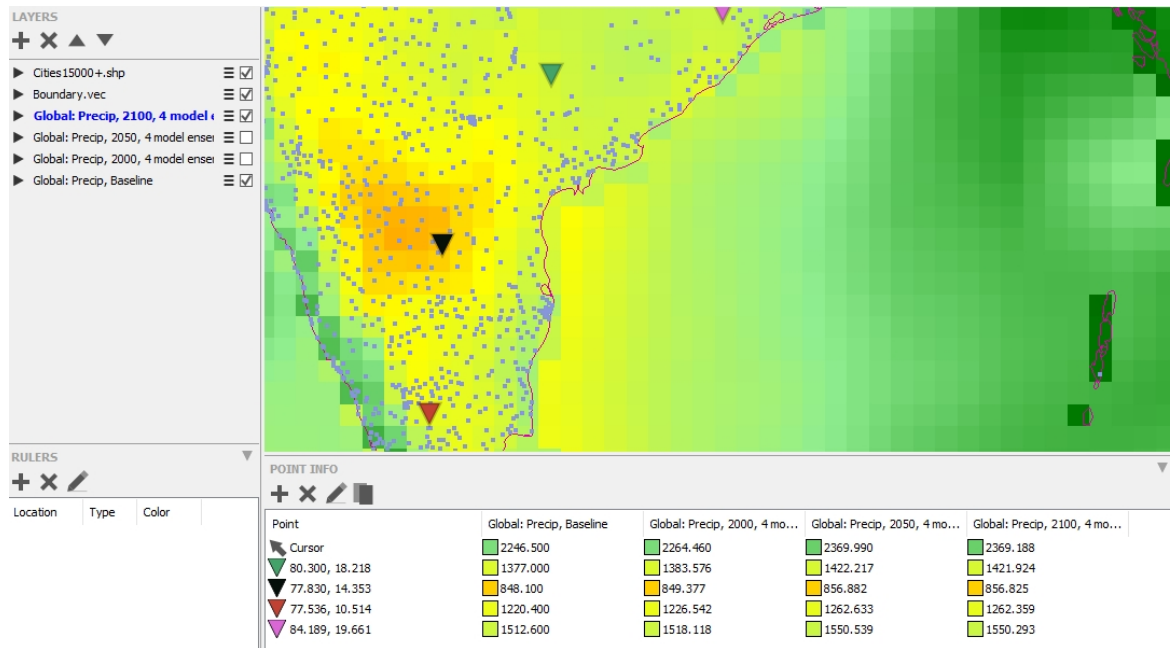
Info Query

The Info Query tool allows you to retrieve and compare data values for a set of points in tabular format across multiple raster layers (Scenario, Idrisi Image, ArcGIS ASCII).

1. Create a map with one or more raster layers.
2. Select the “Info query tool”.



3. Click on locations on the map you would like to get/compare data values for OR click the Add button in the “Point information” panel and enter the location manually. Added points will be displayed on the map as upside-down triangles and will be assigned a random colour for easier identification.



4. Use the table in the “Point information” panel to read and compare values.
5. Click the Copy button in the “Point information” panel if you want to use the data in other programs. Data is copied in CSV format.

Objects

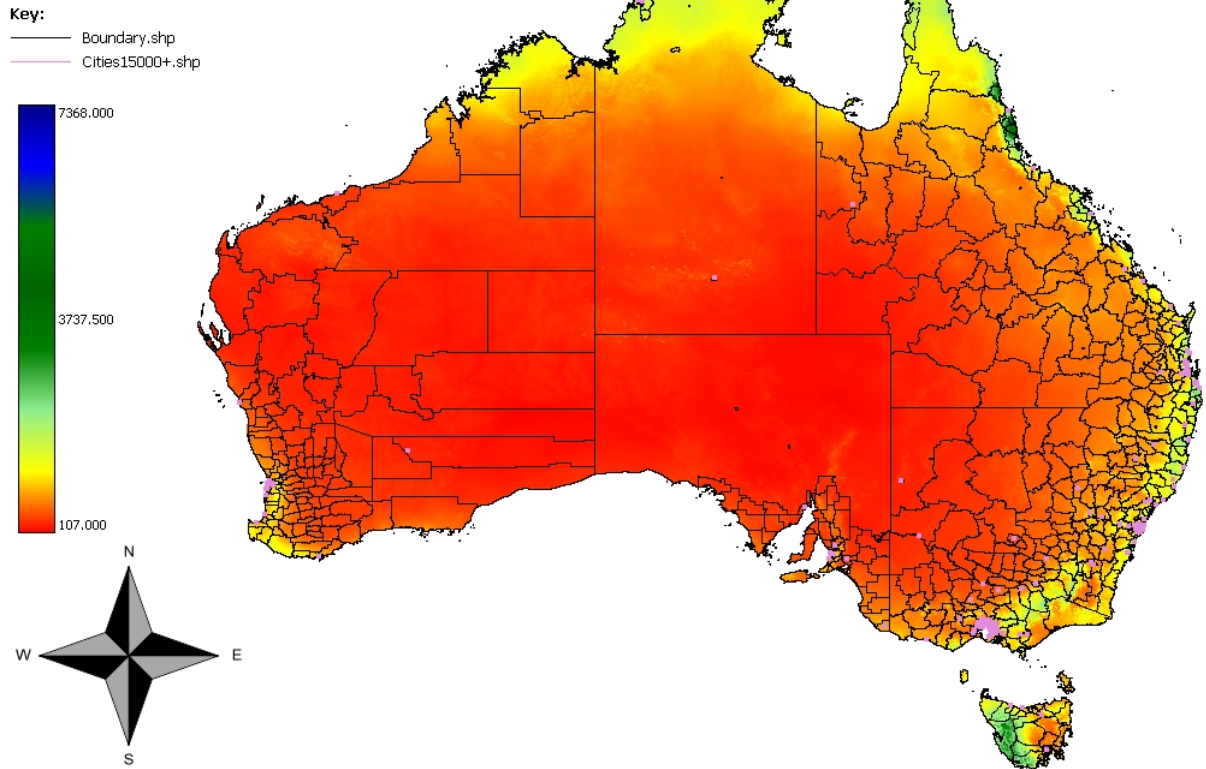
Objects

An object layer can be used to help build up a map with visual meta-objects that convey information about the map to viewers (e.g. someone viewing a map in a report).

Objects in an object layer do not move relative to the map, but to the viewing area of the map window, so, when an object is added, actions such as panning or zooming do not cause the objects to move, they will stay in place. Objects can be moved and certain objects can be resized as required.

Below is a sample map with some added objects to illustrate its purpose:

Australia Precip (Baseline 1995)



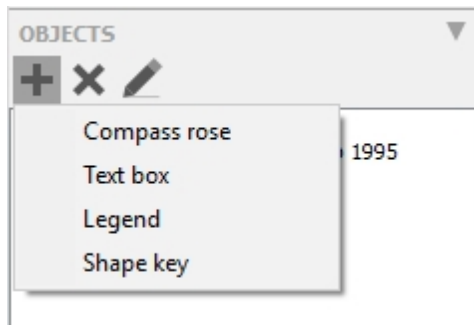
Adding objects to a map

Adding objects to a map

1. Open the Objects panel (by clicking the arrow on the Utility panel).



2. Click the Add button. A drop-down list will appear. Click the type of object you would like to add.



3. A dialog box with Object options may be displayed. If it does, specify the settings for the object and click OK.
4. The Object will be displayed on the map.

Object types

Object types

Compass rose graphic

Use the Compass rose graphic to show relative direction (North, South, East, West) on the map. When this object is selected it can be moved and resized. You can customize the colors of the compass rose.

Text box

Use a Text box object to display some text information on the map. You can change its appearance by changing the font, font size, font style and colour.

Legend

Use a Legend object to display a layer legend graphic within the map. This can be useful when copying the map to paste into reports and you would like to include the legend.

Shape key

Use a Shape key object to display the names and colours of shape files that have been added to the map. This can be useful when copying an image from the map to paste into reports and you would like to include the information to help identify what certain lines represent.

Selecting objects to move or resize them

Selecting objects to move or resize them

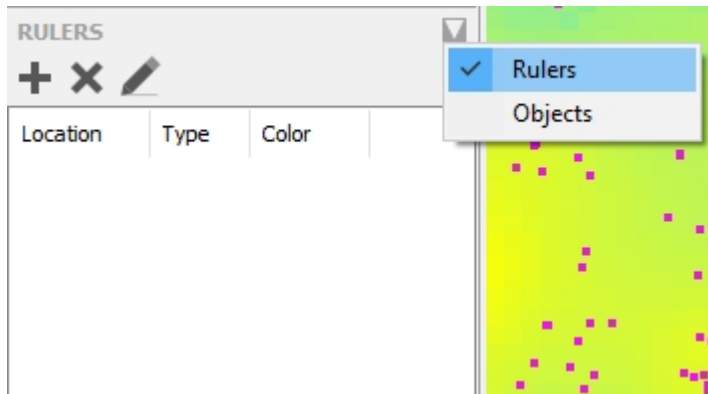
To select an object on the map, click the Select tool then click an object on the map.



Editing and managing rulers

Editing and managing rulers

1. Open the Rulers panel in the Utility panel.



2. Select the Ruler you wish to edit or delete.
3. Click the Edit or Delete button on the toolbar.
4. If editing, make desired changes to the Ruler and click OK.

Changing the background colour

Changing the background colour

The default background colour of a map is white. To change the colour follow the instructions below:

1. Place the mouse cursor inside the map
2. Right click
3. Click "Change background colour". The Colour selection dialog will be displayed.
4. Select a colour from the Colour selection dialog and click OK.

Selections and copying

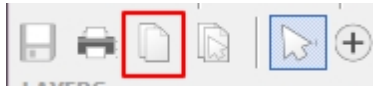
Selections and copying

The selection tool allows you to mark an area you would like to copy to the clipboard which can be pasted into reports and other documents.

1. Select the Selection tool.



- Using the left-mouse button, click and drag to draw a selection on the map.
- On the main SimCLIM toolbar, click the Copy button.



- Paste the result into another program, such as a Word processor or Graphics editing application.

Note: If you click Copy without first making a selection, the entire visible area of the map will be copied.

Reclass Layer

Reclass layer

Often the legend produced is not appropriate for certain kinds of analysis. The Reclass Layer function allows the user to specify a series of value classes (made up of a value ranges, along with a label and a color) and save the output as a new layer. Unlike the [Classified](#) layer type, this function modifies the underlying data of the layer.

To reclass a layer, follow the instructions below:

- Create or load a map with at least one raster layer (e.g. by using the [Scenario Generator](#) or [loading a raster image file](#)).
- Using the Layers panel, select the raster layer you want to reclass by clicking its name (it should be highlighted blue).
- Locate and click the Reclass Layer button on the SimCLIM toolbar:



- The Reclass Layer dialog will appear. Click the Add button to add one or more classes. When a new class is added, the min and max values for each class are recalculated, giving each class an equal distribution of the value range of the layer. As such, it is a good idea to first add all the classes that will be needed before adjusting the min and max values for classes.

Reclass Layer

Label	Min value	Max value	Result value	Color
1.90 - 2395.47	1.9000	2395.4667	1	<input type="checkbox"/>
2395.47 - 4789.03	2395.4667	4789.0333	2	<input type="checkbox"/>
4789.03 - 7182.60	4789.0333	7182.6000	3	<input type="checkbox"/>




Display result in: New layer New map window

Unclassified cells: Create a separate class for unclassified cells

Label:
 Value:
 Color:

- Once classes have been added, the label, min value, max value, result (output value) and colour can be modified. Clicking Load Palette will display a dialog that lets you quickly set class colours based on a pre-created colour palette.

Reclass Layer

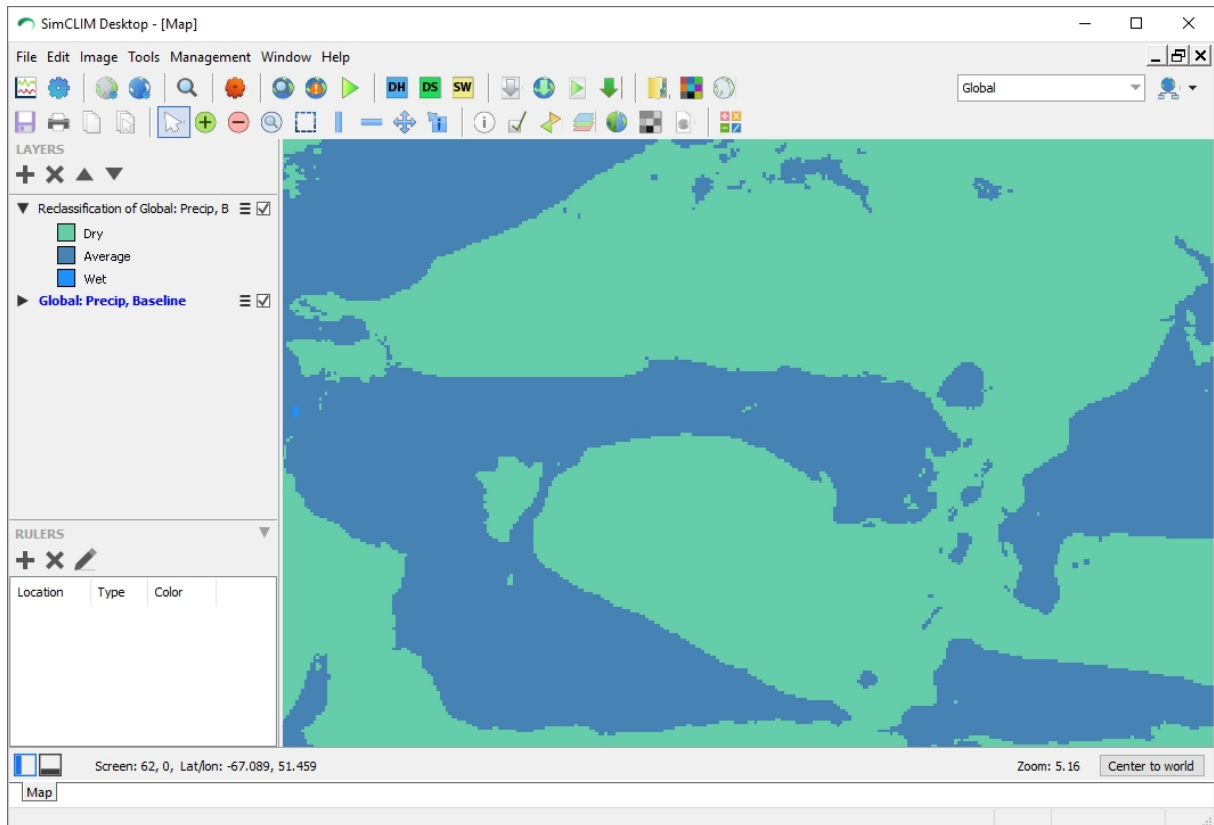
Label	Min value	Max value	Result value	Color
Dry	1.9000	1000	1	
Average	1000	6000	2	
Wet	6000	7182.6000	3	

Display result in: New layer New map window

Unclassified cells: Create a separate class for unclassified cells

Label: Value: Color:

6. Specify whether you'd like to resulting layer to be added to the current map, or to a new map window.
7. It is also possible to specify a special class for cells that do not fall within the ranges of any of the specified classes.
8. Click the OK button to create the re-classed layer.



Sync images

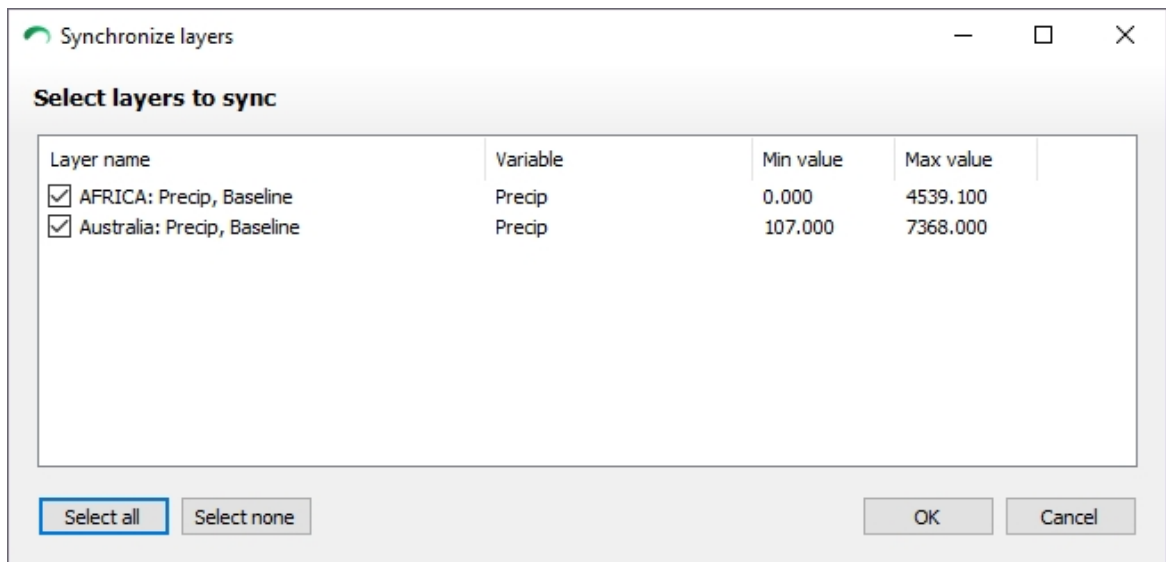
Sync images

The Sync Images function synchronizes the Min and Max values for a given set of raster layers. This makes it much easier to directly compare layers by looking at their rendered output.

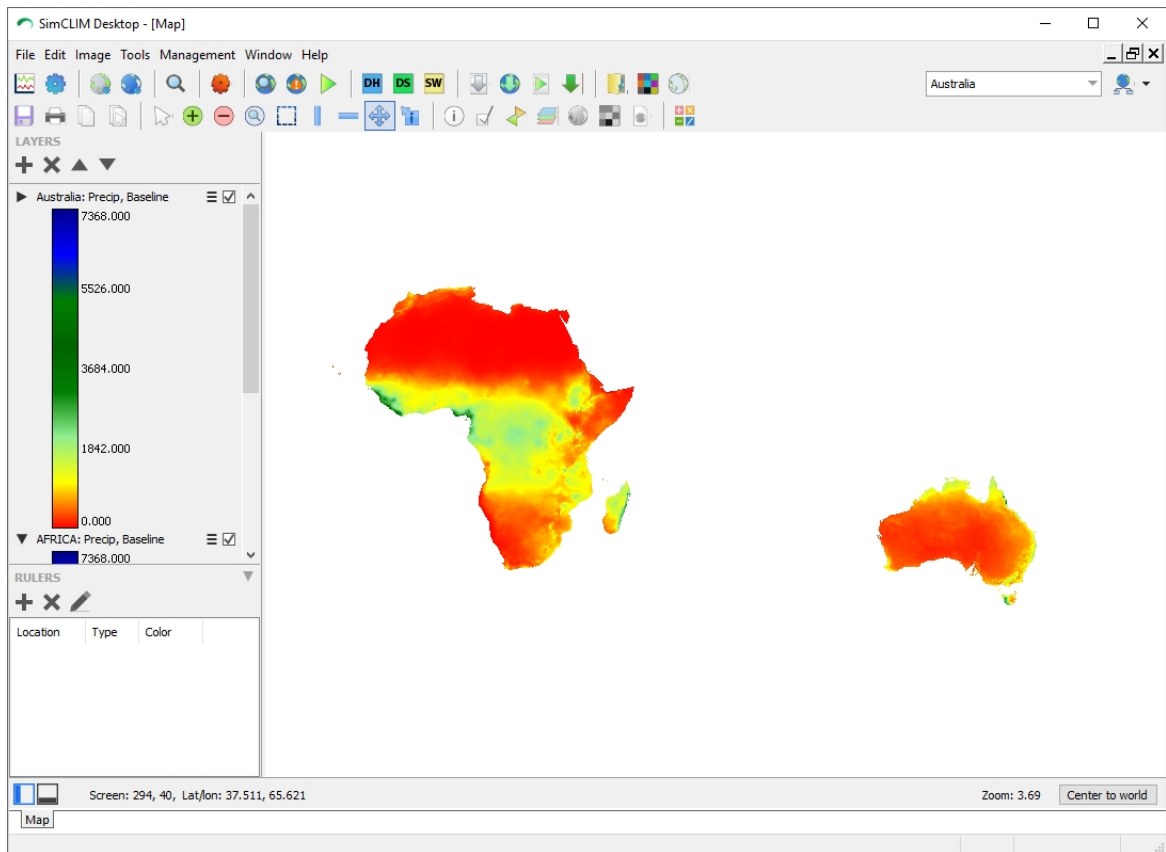
1. Create a map with two or more raster layers (Scenario, Idrisi Image, ArcGRID ASCII).
2. On the main SimCLIM toolbar, click "Sync Images". The "Synchronize images" dialog box will be displayed.



3. Place a check-mark next to two or more layers you want to sync.



4. Click OK.



Adding Rulers

Adding Rulers

Rulers can be useful to line up locations or objects or providing a visual aid for you to quickly find locations.

To add a ruler to the map using the Ruler tool:

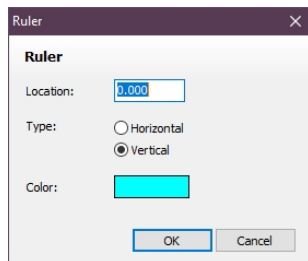
1. Select the Horizontal or Vertical Ruler tool



2. Click the map and drag the cursor to place a ruler at the desired location.

To add a ruler to the map using the New ruler dialog:

1. Locate the Rulers panel in the Map window and click the “Add” button. Enter the Location, Orientation and desired Colour and click OK.



Arranging Images on the Screen

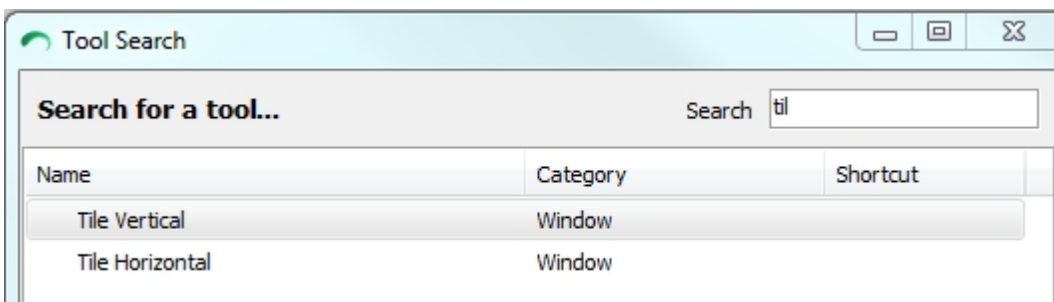
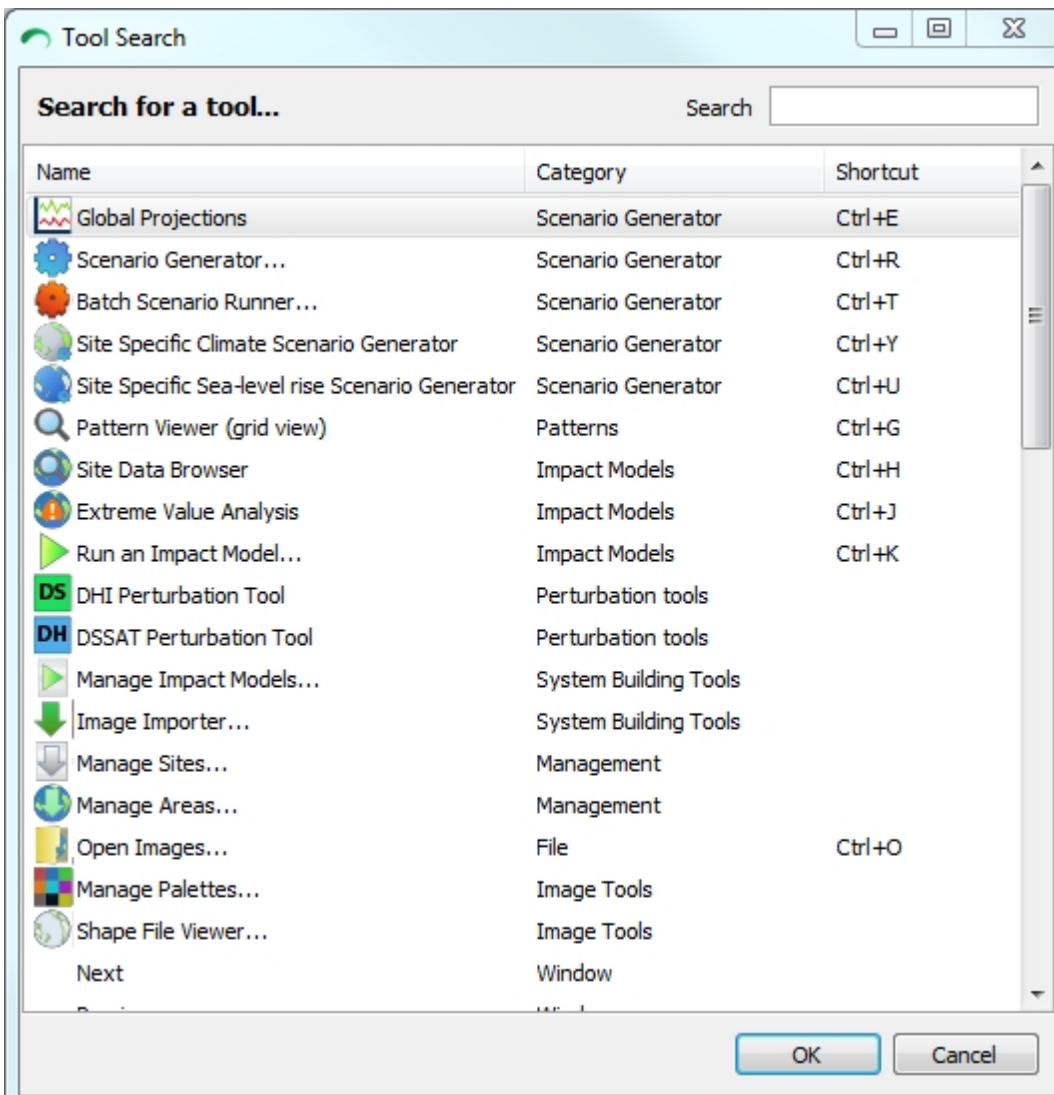
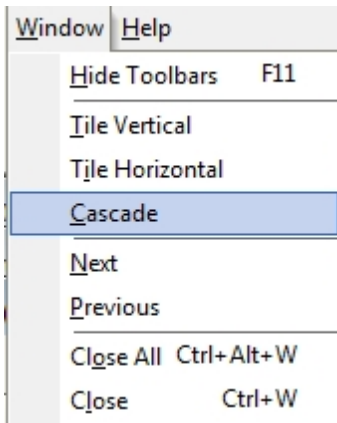
Arranging Images on the Screen

Often you will have more than one image open in SimCLIM 4.x for Desktop at any one time. They need to be managed.

Activity: Arrange images on your screen using the tiling and show all images function.

1] Tiling

Right click in the image display screen and search for tiling. Two options are available: horizontal and vertical. Click on your choice and your images will be rearranged. From the dropdown menu in Management you can also chose Cascade.



The second method for working with multiple images for viewing is to click on the tab at the bottom of the main dialogue box:

Image 1: Global Precip (mm) 1990 (Baseline climate) | Image 2: Global Precip: (mm) 2050 | Image 3: Global Precip: (mm) 2070 | Image 4: Global Precip: (mm) 2100

Ideas for Displaying Spatial Outputs

Ideas for displaying spatial outputs to reduce the need for multiple maps of a single variable

Display methods

Trainee: Would you agree that a concise and meaningful way of displaying change in mean temp and annual precipitation would be to provide:

- a) A baseline map (scenario generator) showing the climate variable across the area of interest.
- b) A map of percentage change/degree change per degree of global warming (climate scenario).
- c) On the map in b. above – display in the legend the percentage change/degree change for both 2030, 2050 and 2070 (as a percentage/degrees and as an absolute value), as the colours show the spatial variation and the numbers give the actual change.

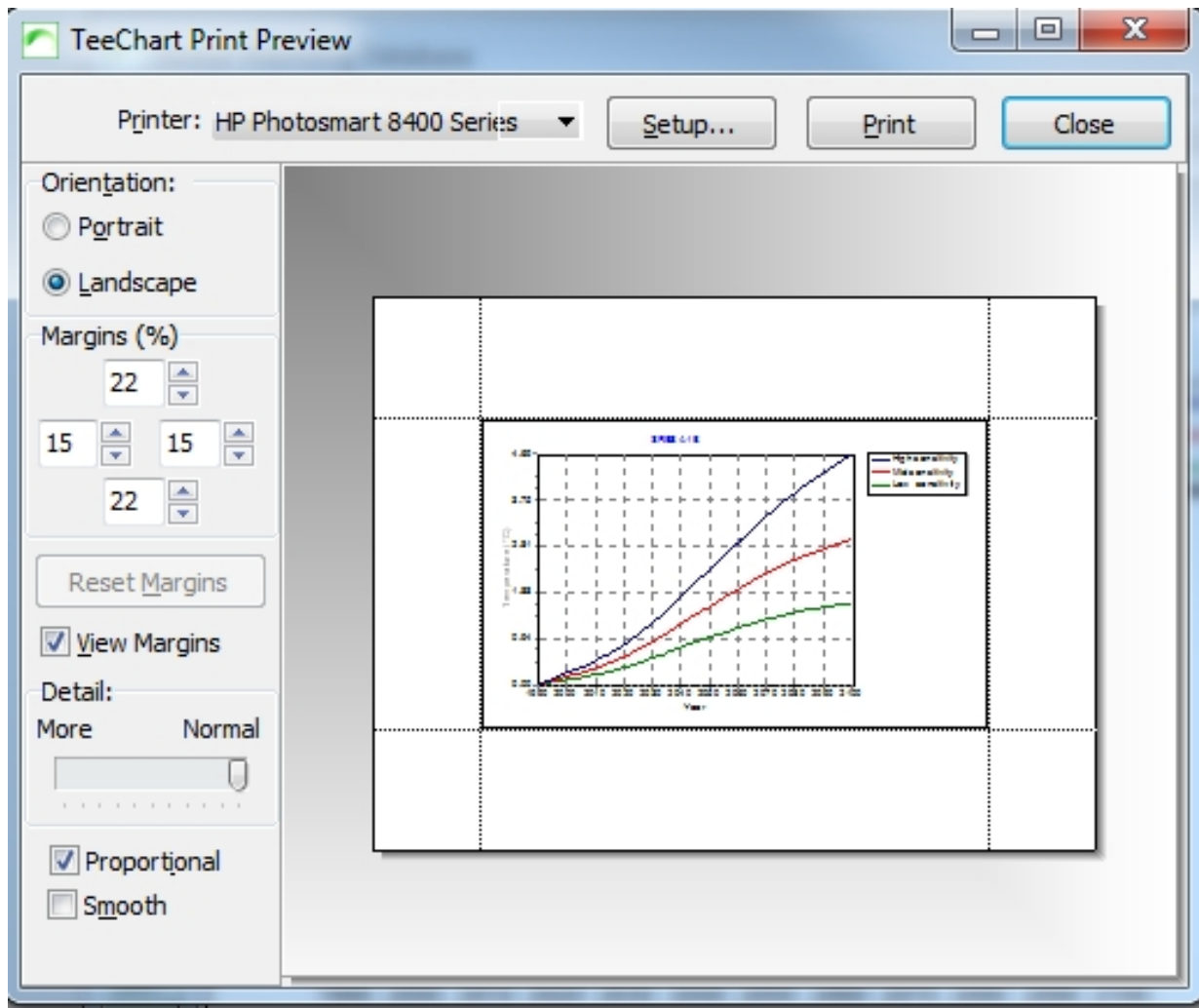
CLIMsystems Answer:

- a) A baseline map is very useful: mention the period over which the baseline was established (1981-2010) and the baseline year (1995, the "midpoint").
- b) This is a way to focus on the spatial variability, regardless of the projection year, RCP or climate sensitivity; this would need a clear explanation to the client (we rarely do this in a report, just show spatial images (with synced legends) for selected years and RCP/climate sensitivity - but you can definitely do this).
- c) This is a great way to show the differences between the scenarios/years.

(b) + (c) are a novel way to present this information, and we think it is a good one!

Printing Options

Select print  from the toolbar at the top. The following dialogue box will be displayed.



Take this opportunity to familiarise yourself with the printing options dialogue box.

- 1] Click on Setup and define the target printer.
- 2] Choose your paper size and whether it is portrait or landscape.
- 3] Click OK to return to the main dialogue box.
- 4] Toggle between Portrait and Landscape to explore how the display is changed.
- 5] Click on the various margins and to see how the image is manipulated.
- 6] Click on reset margins after you have altered them and see how the image is resized.
- 7] Toggle between having the margins viewable and not by clicking and unclicking the view margins box.

8] Click and unclick the smooth and proportional boxes and slide the Detail bar between Normal and More.

At some point in your work you may wish to alter the outputs using these tools. Please take time now to familiarise yourself with the range of options.

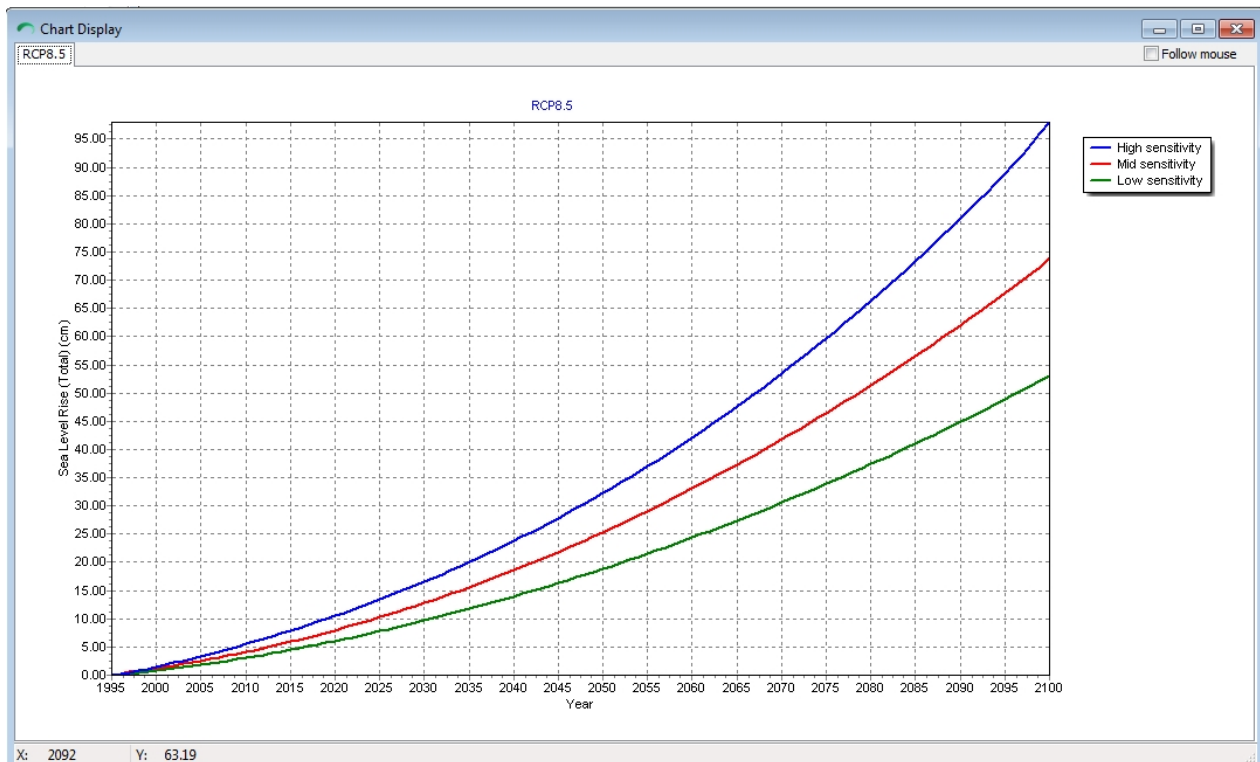
When you have printed or finished exploring click close.

Zooming In

Activity: zooming in on graphs

Return to the graph. We will now explore how to zoom in on particular parts of the graph.

Click on the top right corner of the graph so that the graph will fill the entire display window.



Click on the zoom in/out icon on the toolbar



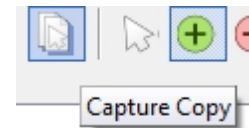
After clicking on the zoom in icon left click in the graph and drag and release the mouse button over the area you wish to zoom in on.

Note: This can be a tedious and frustrating endeavour (it is the nature of the application used to graph these outputs). Be patient!

If you do not achieve the desired result simply click on the zoom out button and you will return to the default full view where you can try again.

The zooming function can be handy if you choose to highlight only one component of the graph for a report or presentation.

How to save a zoomed in view . . .



You cannot 'save to file' a zoomed in view but you may wish to export use in a report or PowerPoint presentation.

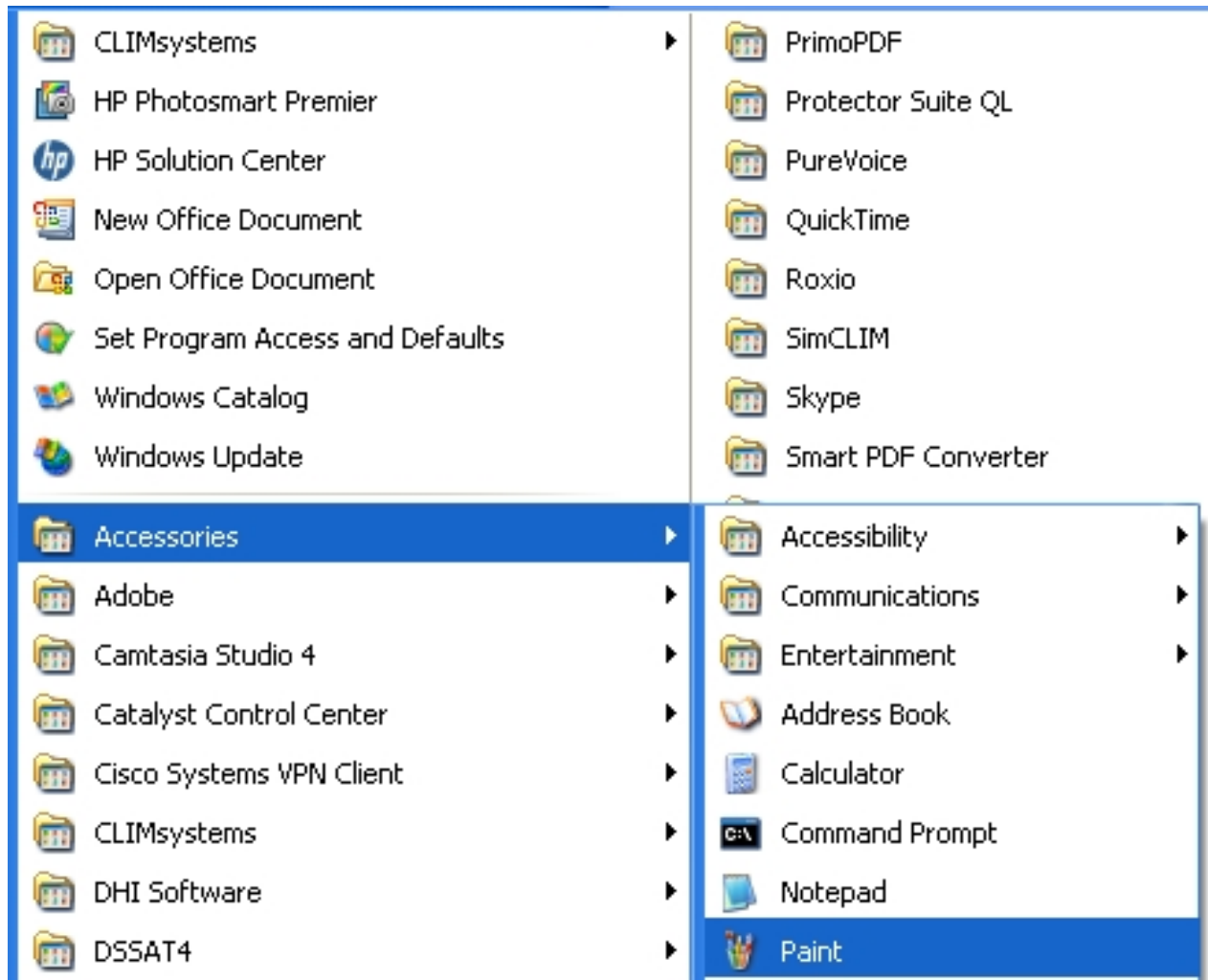
if for

Saving Your Outputs


Saving Your Outputs

To do this, follow these directions . . .

- 1] When you have the desired output on your screen simply press the PrtSc (print screen button) on your keyboard.
- 2] Go to Start menu of windows and toggle to the open program icons and choose paint (usually under accessories).



3] Either do a Ctrl C (for paste – the PrtSc image will be displayed) or use the pull down menu and under edit choose paste.

4] With the printed screen in the dialogue box use the  select tool to drag a rectangle around the part of the Prt Scr you wish to capture for a report or PowerPoint presentation.

5] After highlighting the part you desire click on Ctrl C or use the drop down menu and under edit and select Copy.

6] Open your target document. For our purposes open a blank document in Word and either use Ctrl V or choose Paste from the drop down edit menu. Your selected image should be displayed.

Experiment by capturing several images from SimCLIM and placing them in a work document or PowerPoint presentation.

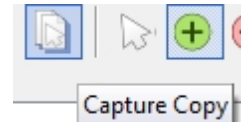
This process can be used at any point to ‘capture’ images in SimCLIM for use in reports or PowerPoint presentations.

You may have an alternative image capture program installed on your computer – such as SnagIt or SnipIt. You may use it as an alternative to PrtSc.

Using the Clipboard Function

Activity: capturing images in the clipboard for use in other programs.

1] Click on a table for any scenario produced for temperature, CO2 or sea level.



2] Click on the save to capture copy icon in the left margin toolbar

3] Move the mouse around the screen and look for various dialogue boxes to be highlighted. Note: move slowly as the highlighting can be very fast and you could miss what you wish to capture. You can capture the whole screen of SimCLIM 4.0 for Desktop to individual parts.

4] Click on a segment of the screen that interests you.

5] Open a blank word document and press Ctrl V or choose the Edit menu and click paste. What you had captured from the clipboard should appear.

6] Repeat this process several times to become familiar with the capacity. **Remember each time you click on save to clipboard your previous save is discarded and replaced with your most recent.**

CLOSE THE GLOBAL WARMING DATABASE AND RETURN TO THE MAIN SCREEN

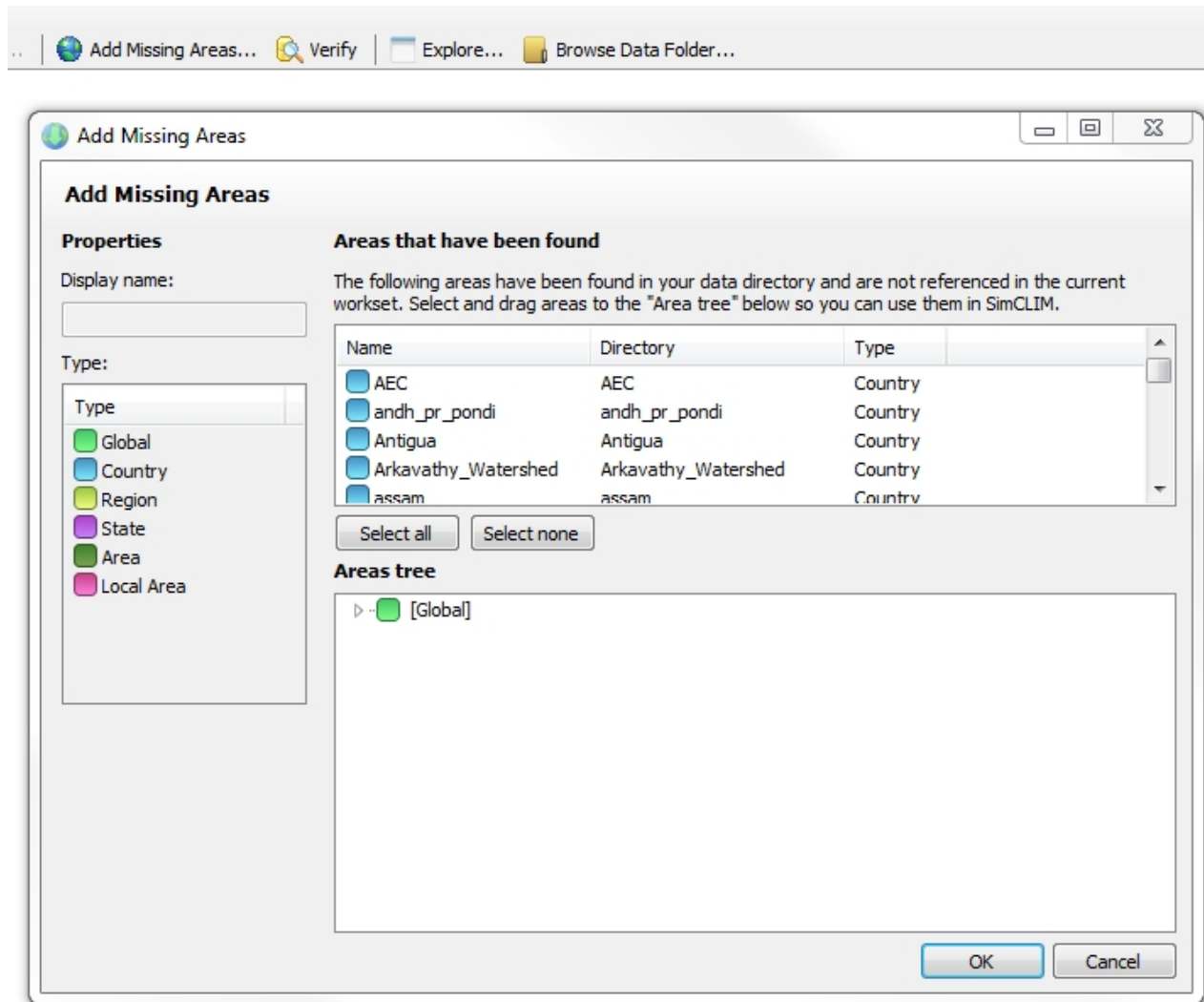
Adding a New Area

If you are missing State and Territory Areas

If not, you cannot see the state and territory areas you can add them using the **Manage areas**

button .

- (1) Select "add missing areas"
- (2) and drop the "newly found areas" (the ones that were missing) to the appropriate place in the area-tree in the bottom window e.g. state and territory data sets will go under Australia, for example, or Global.

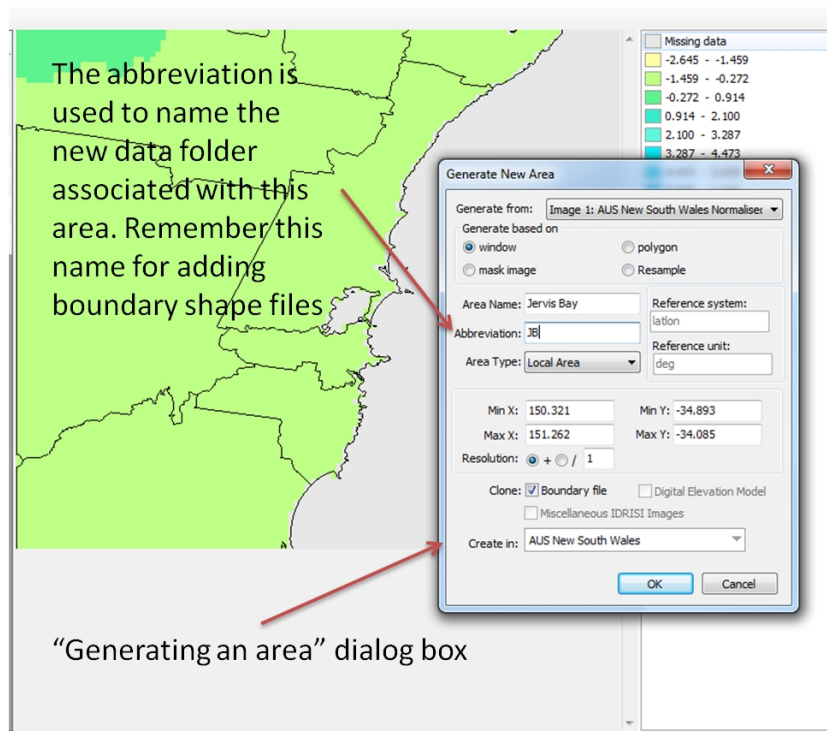


Creating a new area

Creating a New Area

The first thing you need to do when starting a piece of work is to create a new area in area selection dropdown that covers the area of interest. This save a lot of time, as you don't have to continually zoom in from larger areas each time you open a new window.

- 1) Click on the "climate scenario" button (Figure 1 above)
- 2) Zoom into the area you want to have as your new area, from the existing area using the normal zoom function.
- 3) Use the "Generate Area" button (on the images toolbar) to create a new area, specifying name, abbreviation, resolution and copying all info. This area will then become available at the dropdown box in the area selection.



Boundary Shape Area Missing From New Area

The boundary shape file defines visually the coastline, state and local government boundaries – essential for visual context when using the mapping outputs.

When you generate a new area of interest, it does not load the boundary shape file automatically.

This is confusing as you can not see the jurisdictional boundaries or the coast line.

To fix this you need to copy the shapefile and associated files to the generate area. Figure 1

1) Click ‘Manage Areas’ button

2) Click open data folder (top right)

3) Go to the larger area from which you created the sub area of interest (in this case NSW). The folder name will be the labelled with the name you entered in the Abbreviation field in the “Generate New Area” dialogue box (see section directly above)

4) Copy the boundary files and paste them in the area of interest data file.

5) Your area will now always load with boundary files.

Figure 1– adding missing boundary file to newly created study area

Manage Areas (SimCLIM) - Working areas file

Manage Area settings and data

Save Open Add Delete... Move... Add Missing Areas... Add Missing Patterns... Verify Explore Open Data Folder

Name: Global
 Directory: Global
 Type: N/A
 Parent: N/A

Global

folder

Name	Date modified	Type	Size
AUS New South Wales	29/04/2014 9:42 AM	File folder	
AUS Northern Territory	29/04/2014 9:44 AM	File folder	
AUS Queensland	29/04/2014 9:46 AM	File folder	
AUS South Australia	29/04/2014 9:49 AM	File folder	
AUS Tasmania	29/04/2014 9:51 AM	File folder	
AUS Victoria	29/04/2014 9:53 AM	File folder	
AUS Western Australia	29/04/2014 9:54 AM	File folder	
Australia	29/04/2014 10:31 ...	File folder	
Global	29/04/2014 9:40 AM	File folder	
Gr.Syd	29/04/2014 11:34 ...	File folder	
JB	29/04/2014 12:22 ...	File folder	
Site data	29/04/2014 10:02 ...	File folder	
areas.dat.bak	8/11/2013 2:07 PM	BAK File	10 KB

fsystems > SimCLIM 2013 > Data > JB

Search JB

folder

Name	Date modified	Type	Size
BaseCIm	29/04/2014 12:22 ...	File folder	
Patterns	29/04/2014 12:23 ...	File folder	
cookie	29/04/2014 12:22 ...	Microsoft Office ...	1 KB
cookie	29/04/2014 12:22 ...	Disc Image File	11 KB

fsystems > SimCLIM 2013 > Data > AUS New South Wales

Search AUS New South Wales

Name	Date modified	Type	Size
BaseCIm	29/04/2014 9:42 AM	File folder	
Patterns	29/04/2014 9:44 AM	File folder	
Boundary.dbf	27/01/2010 11:17 ...	DBF File	15 KB
Boundary.shp	27/01/2010 11:17 ...	SHP File	10,339 KB
Boundary.shx	27/01/2010 11:17 ...	SHX File	2 KB
cookie	5/11/2013 10:48 AM	Microsoft Office ...	1 KB
cookie	5/11/2013 10:48 AM	Disc Image File	1,994 KB
readme_Australia_NSW	6/11/2013 9:54 AM	Text Document	2 KB

Adding Area With a Higher Resolution

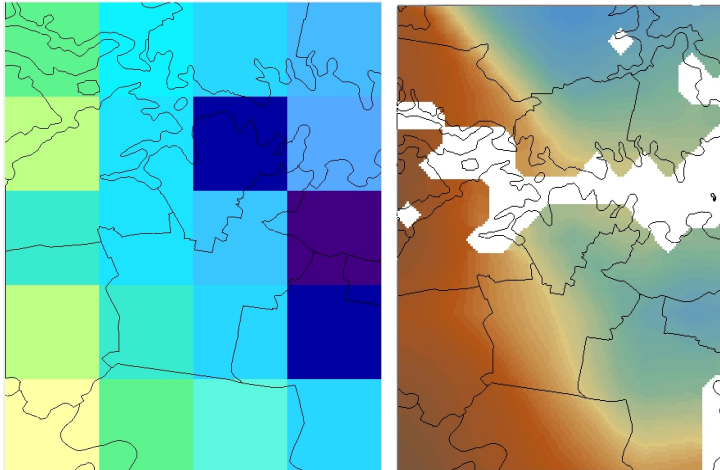
This function interpolates the pattern resolution and creates up to a 10 times higher resolution. This gives a smoother feel to the look of maps that are zoomed in to around 10km x 10km which would be otherwise pixelated.

NB. This is not recommended practice from CLIMsystems if you are going to query the map for data as it is not higher resolution data (does not lead to any downscaling) , however it is acceptable to use for clients that require the maps to be more visually appealing.

For state wide or regional maps the original resolution will be acceptable but for maps spanning only a few kilometres (see Figure 3 below) interpolation may be required.

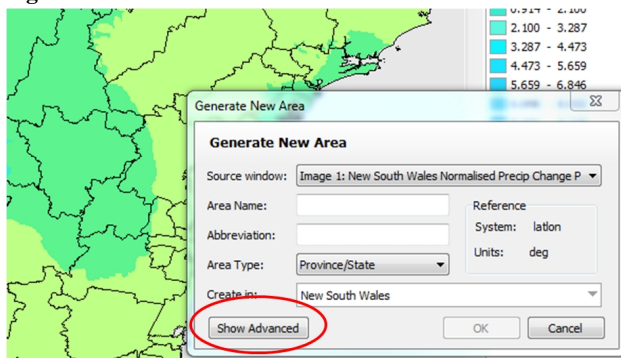
NB. This interpolation is computationally intensive and could take minutes to several hours depending on how large an area you have selected and the computational power of your computer.

Figure 1– standard vs interpolated mapping outputs



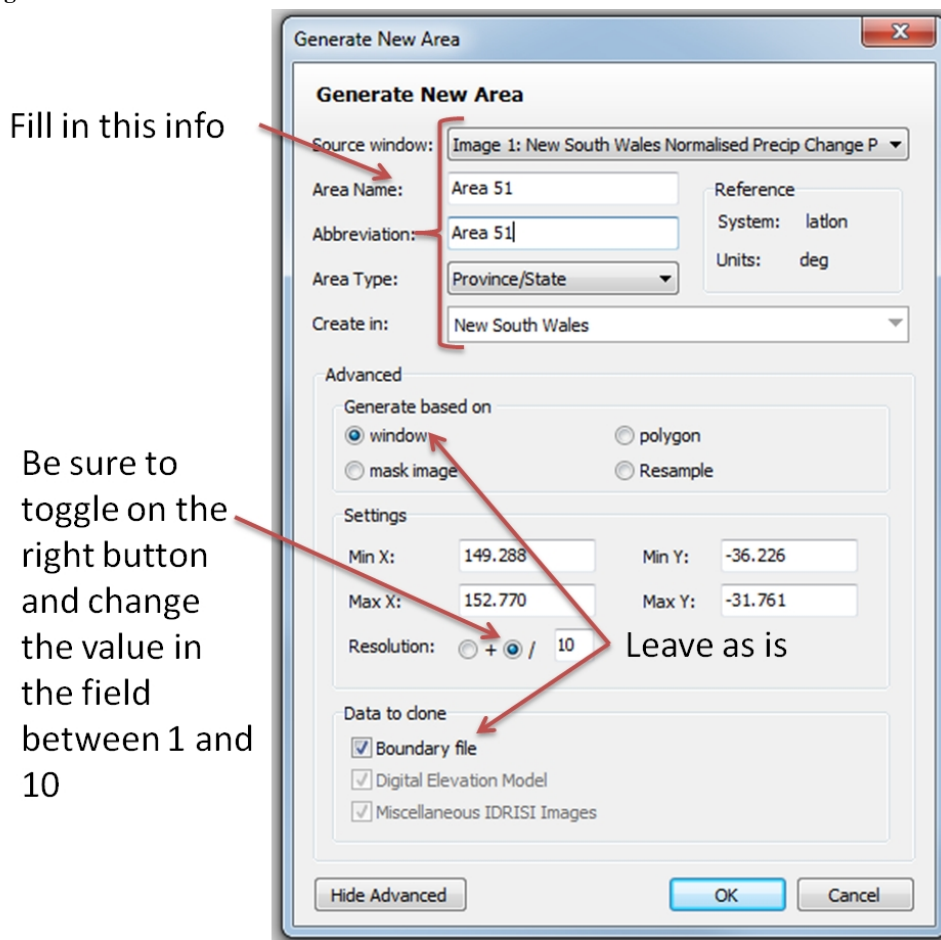
- 1) Click the climate scenario button (see Figure 1)
- 2) Zoom to the area of interest where you want to interpolate the grid for aesthetic purposes
- 3) Click the generate area button, you will see the dialogue box Figure 4 → click “show advanced”

Figure 2



- 4) Fill in the new area information as described in the sub - section above labelled “creating a new area”
- 5) In the advanced portion of the dialogue box do the following (Figure 5)
 - a) Toggle on the right hand button for “resolution”
 - b) Change the resolution field by to an integer between 2 and 10 inclusive. An input of 10 will interpolate the resolution to 10x greater.
 - c) Leave the “generate based on” setting as “window”
 - d) Ensure that “boundary file” is ticked in the “data to clone field at the bottom of the dialogue box
 - e) Click OK and the interpolation will begin.

Figure 3



Using the Pattern Viewer

Introduced in SimCLIM 2.2.0.0, replacing the [View Pattern](#) tool.





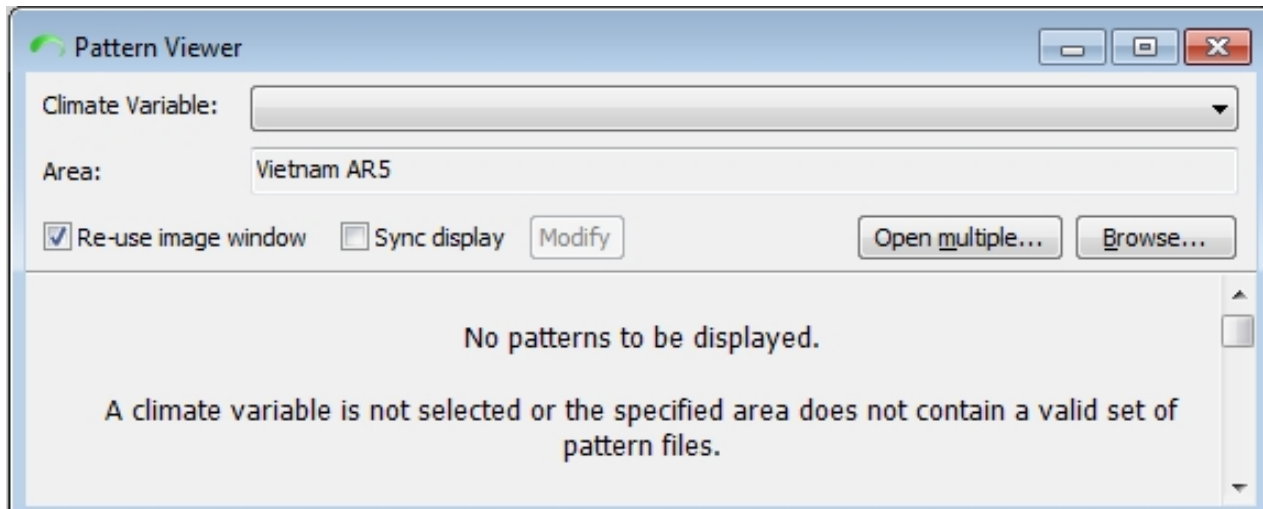
The Pattern Viewer allows you to view monthly pattern files in image format. Apart from simply viewing the pattern files, it also contains features that allow you to compare patterns files between patterns and months.

Please note: the Pattern Viewer is available in Grid format.

From the main SimCLIM 4.x for Desktop window select the work-area that contains the pattern



files you would like to view. Click on the Pattern Viewer icon in the Scenario Generator toolbar and the Pattern Viewer Grid window will be displayed:



Select the Climate Variable (e.g., Temperature, Precipitation, Wind) from the Climate Variable drop down list. The grid will fill with all months that are available.

Pattern Viewer

Climate Variable:

Area:

Re-use image window Sync display

Baseline	J	F	M	A	M	J	J	A	S	O	N	D
ACCESS1-0_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
ACCESS1-3_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
BCC-CSM1-1-M_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
BCC-CSM1-1_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
BNU-ESM_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
CANESM2_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
CCSM4_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
CESM1-BGC_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
CESM1-CAM5_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
CMCC-CM5_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
CMCC-CM_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
CNRM-CM5_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
CSIRO-MK3-6-0_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
EC-EARTH_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
FGOALS-G2_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
FGOALS-S2_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
GFDL-CM3_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
GFDL-ESM2G_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
GFDL-ESM2M_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
GISS-E2-H-CC_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
GISS-E2-H_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
GISS-E2-R-CC_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
GISS-E2-R_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
HADCM3_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
HADGEM2-AO_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
HADGEM2-CC_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
HADGEM2-ES_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
INMCM4_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
IPSL-CM5A-LR_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
IPSL-CM5A-MR_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
IPSL-CM5B-LR_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
MIROC-ESM-CHEM_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
MIROC-ESM_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
MIROC4H_RCP45	J	F	M	A	M	J	J	A	S	O	N	D
MIROC5_RCP45	J	F	M	A	M	J	J	A	S	O	N	D

You can now click any one of the month links (J, F, M, A, M, J, J, A, S, O, N, D) and clicked pattern

will be displayed in a new Image Window.

If the "Re-use image window" check box is checked it will make all pattern images open in the same Image Window.

Sync display

When the "Sync display" check box is checked you will find it easier to visually compare different patterns.


When this is checked the MIN and MAX values of each opened pattern are remembered and applied when a new pattern image is opened. If a new pattern being opened has a higher MIN value than the previous opened pattern the lower pattern value will be used when generating the image output. The same applies to pattern MAX values, where the higher value is always used.

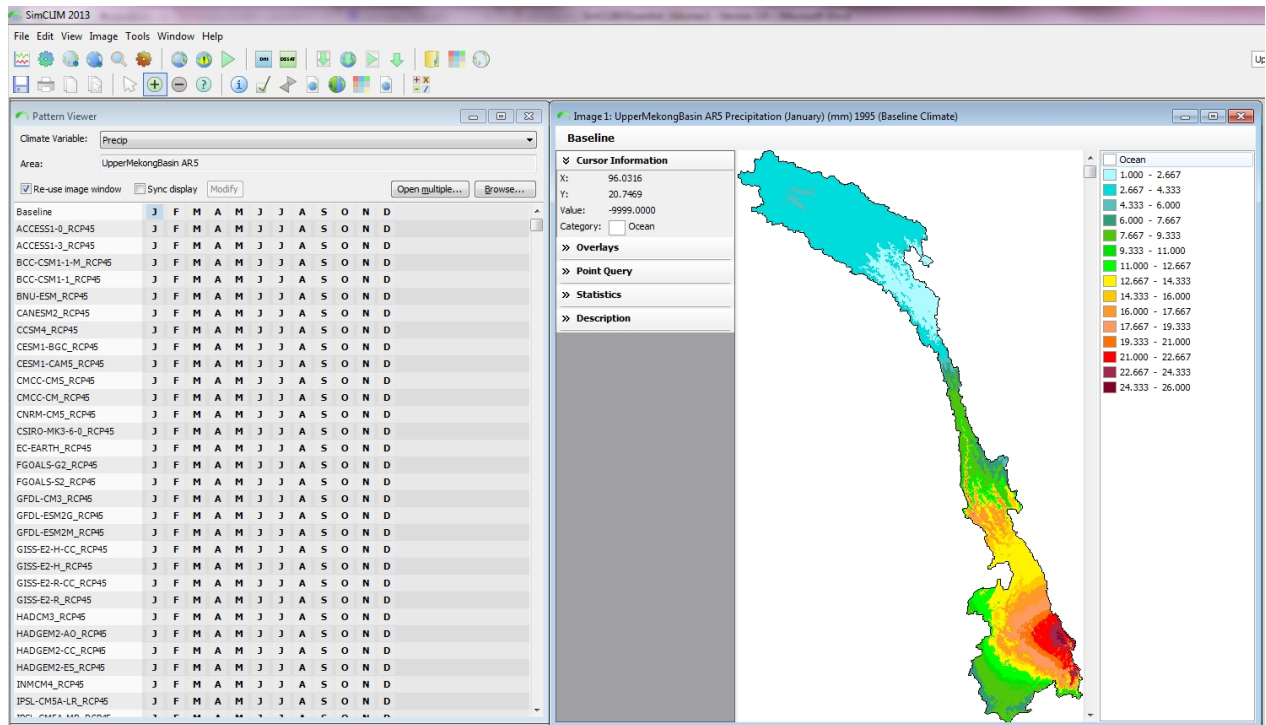
This allows a more comparable palette to be used when a number of patterns files have been opened. Click on the Modify button and manually enter the MIN and MAX values to be used.

If this is not checked each open window uses its own MIN and MAX value, meaning direct visual comparison of the images is not as effective.

Controlling with the Keyboard

Controlling with the Keyboard

Open the pattern viewer . When you click on a pattern month it will remain selected with a light blue color. You can now use the arrow keys to select other months. Press the Space-bar key to open the selected pattern month. Controlling with the keyboard is best when the "Re-use image windows" check box is checked. Note: the first image window that opens will steal focus away from the Pattern Viewer so you will need to click the Pattern Viewer window again to use the keyboard.



Creating Synthetic Scenarios

The **synthetic scenario generator** enables users to make incremental adjustments to temperature and precipitation (in %). These adjustments are applied uniformly to the baseline climate data. This is a valuable tool for rapid sensitivity analysis, and can be used to examine effects of historical anomalies (e.g. past drought events).

For example, on some occasions you may wish to simply create an image based on a known value such as a reduction in rainfall of 10 percent or an increase in maximum temperature of 2 degrees C. With SimCLIM 4.x for Desktop this can easily be achieved by choosing the synthetic option in the Select scenario generation parameters dialogue box as displayed below.

Generate Scenario

Work area: Thailand

Climate variable: Precipitation

Linked Synthetic

Temperature change: 0 °C

Precipitation change: 0 %

Months: Jan Feb Mar Apr May Jun
 Jul Aug Sep Oct Nov Dec

Keep open after generation

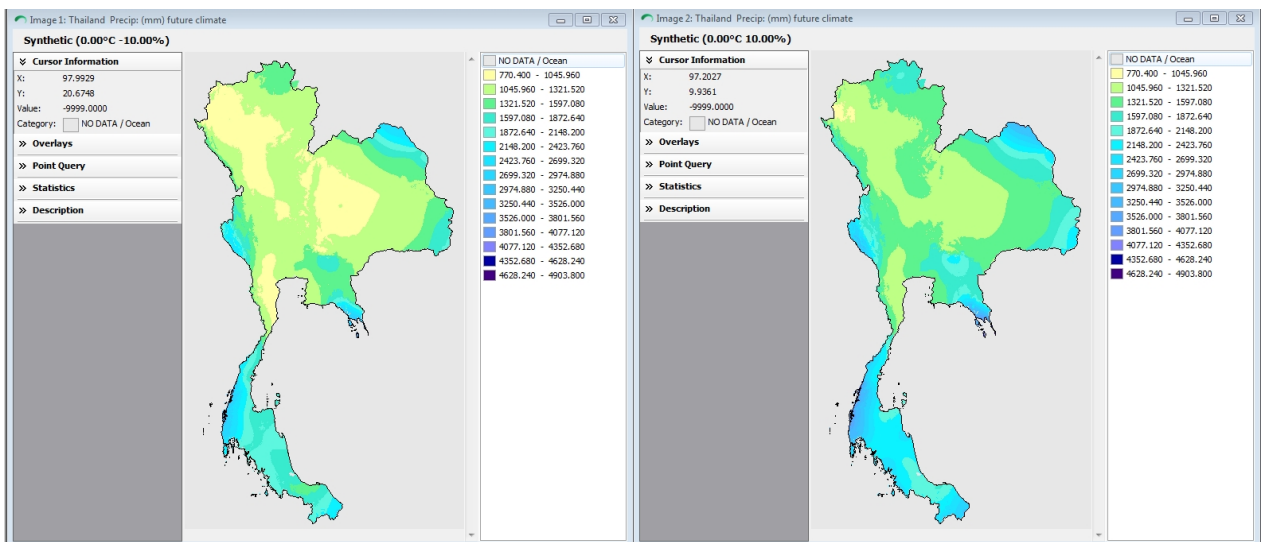
OK Batch... Cancel

To do this define the study area in the top right hand corner and then on the scenario icon .

Choose the Synthetic tab. The difference with a synthetic analysis is that you do not choose a Year, GCM or RCP pattern. Depending on your type of analysis enter the degree C change or percent change in precipitation. These numbers can be either minus (-3.00) or can positive (3.00), for example.

Activity: precipitation and temperature for baseline conditions (the year is irrelevant in this type of analysis) and compare the images using the link images function.

- 1] Choose a study area (perhaps one you have not used before).
- 2] Conduct an analysis for precipitation (say one -10% and a second -20 %).
- 3] Tile the images.
- 4] Link the images and compare (do the same with temperature with different choices 2 and perhaps 3 degrees C.)



Sample synthetic scenarios for Thailand (-10% (left window) and 10% right window)

Other Features of the Spatial Scenario Output Window

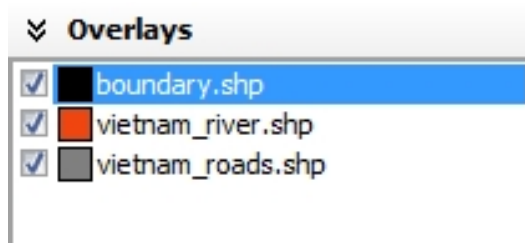
Other Features of the Spatial Scenario Output Window

- 1] Site outputs in a spatial window: as you move the cursor across the output image the site data based on the latitude and longitude is displayed in the top right hand corner of the image.

Cursor Information	
X:	123.9152
Y:	88.2353
Value:	260.2000
Category:	 1.900 - 480.613

With the spatial output image open, move the cursor around and look for the change in the value.

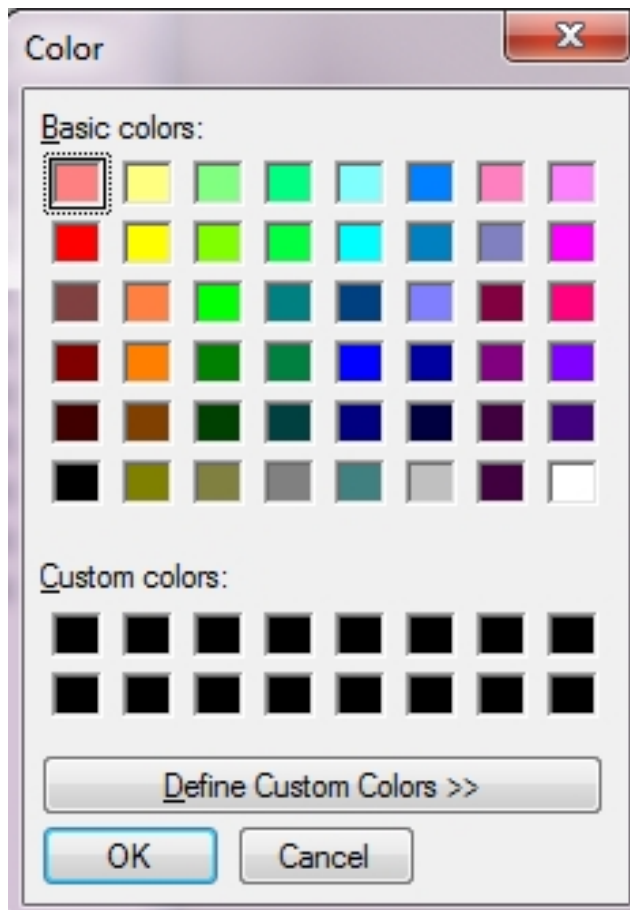
2] Below the legend various types of information are found and options presented. Typically a box will be available for any vector files that are open and the hillside option (as shown below).



When the box is ticked the option is on. **Click and unclick the options to see how the image is altered.**

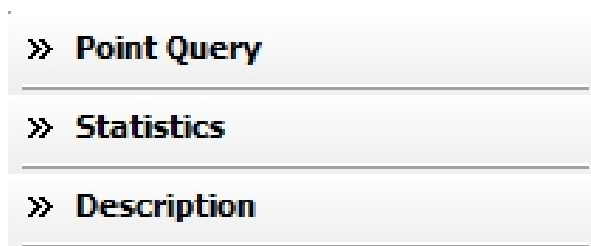
3] With the boundary.vec file black is usually the default colour but this may not always be appropriate if you have several vector files open for things like cadastral and protected area boundaries.

Change the colour of the vector file by clicking on the black box just to the right of the boundary.vec designation.



Select a colour or click on Define Custom Colours and choose a colour and click OK to apply it and return to the main display screen.

Further below the legend there are several more options to explore:



Click on the description option and see the information that is displayed. Note the range of information as it related to how you set up the analysis.

With the cursor in the Description window right click:

Area: Vietnam AR5
Model for Precip (mm)
Selected Month: 1 2 3 4 5 6 7 8 9 10
11 12
Baseline climate



You can Select All and copy and paste among other tasks.

Click on None and the display will disappear.

Click on Statistics. A separate window is displayed that provides summary statistics for the variable and area depicted.

Toggling Through Multiple Images

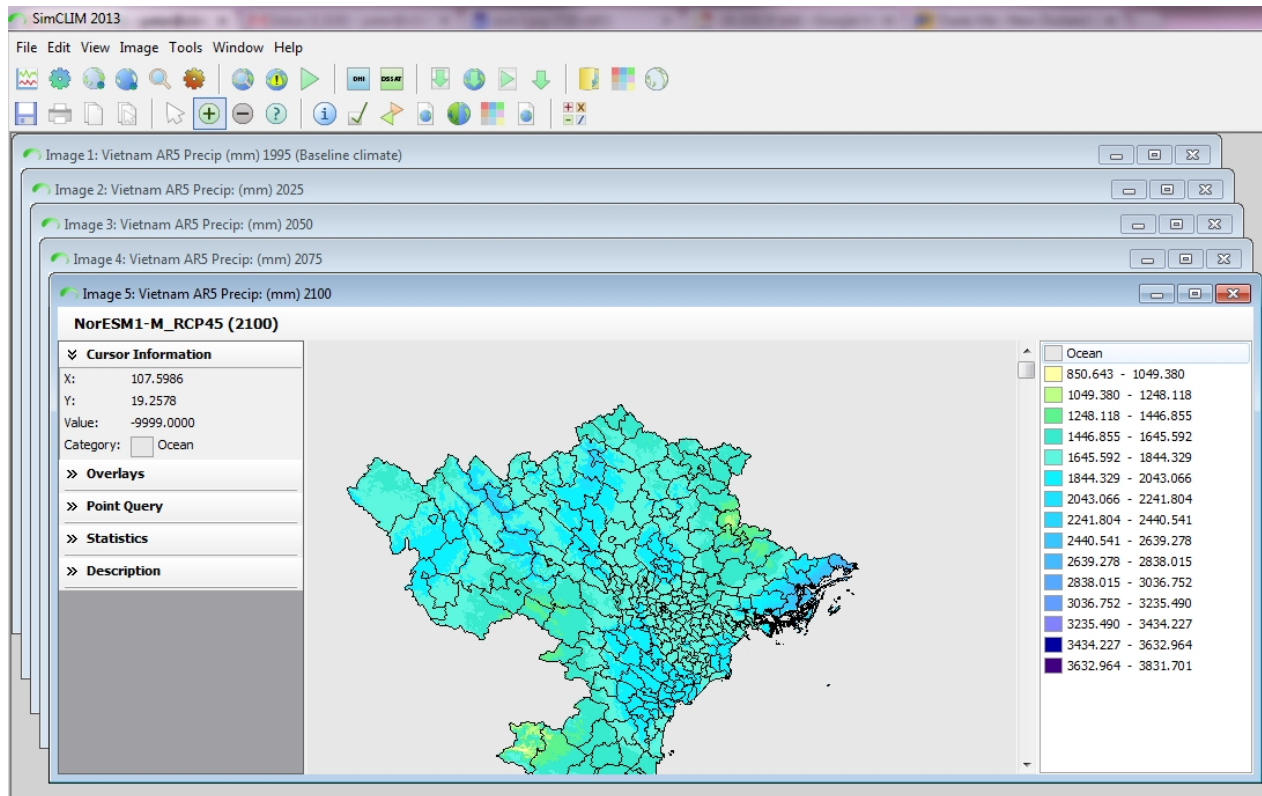
Sometimes it can be visually very powerful to show change over time using spatial images. Much like flicking through pictures where each page represents a slightly different perspective of the same image.

This can easily be done in SimCLIM 4.x for Desktop by creating a series of spatial images, linking them so they have the same legend, then turning the legend off and expanding the window for each image to be approximately the same size.

Then you can toggle between the images by holding down the ctrl key and pressing the tab key repeatedly. You have to be sure that the images are layered by date, for example, baseline, 2030, 2050, 2070 and 2100 so as to maximize the visual effect.

You can reverse the order of running through the images by holding down the ctrl and shift key then clicking repeatedly on the tab key.

Give it a try.



Site Specific Scenario Generators

Site specific scenario generators for atmospheric and oceanic data are available in SimCLIM 4.x. Owing to the nature of the underlying GCM and in some cases RCM data applied the methodologies for the two types of environments are slightly different. The following help topics elaborate on how to display GCM and in some cases RCM data for specific variables at specific locations. This sort of information is important when considering the underlying uncertainty in the climate models and the 'signal' across a wide range of GCM and in some cases RCM data.

Creating Site Specific Climate Change Scenarios

Objectives:

On completion of this topic you will be able to:

- ✓ Compare different General Circulation Models for percent change in precipitation and changes in degrees C of temperature.
- ✓ Find values for places.

Overview:

Site specific climate change scenarios are important when assessing local change. The numeric outputs for specific places are defined by clicking on a location or through entry of latitude and longitude information provides specific outputs for specific places on a per degree C change

value. Like spatial scenario and with other SimCLIM 4.x for Desktop tools the user defines the General Circulation Model and RCP parameters.

Method:

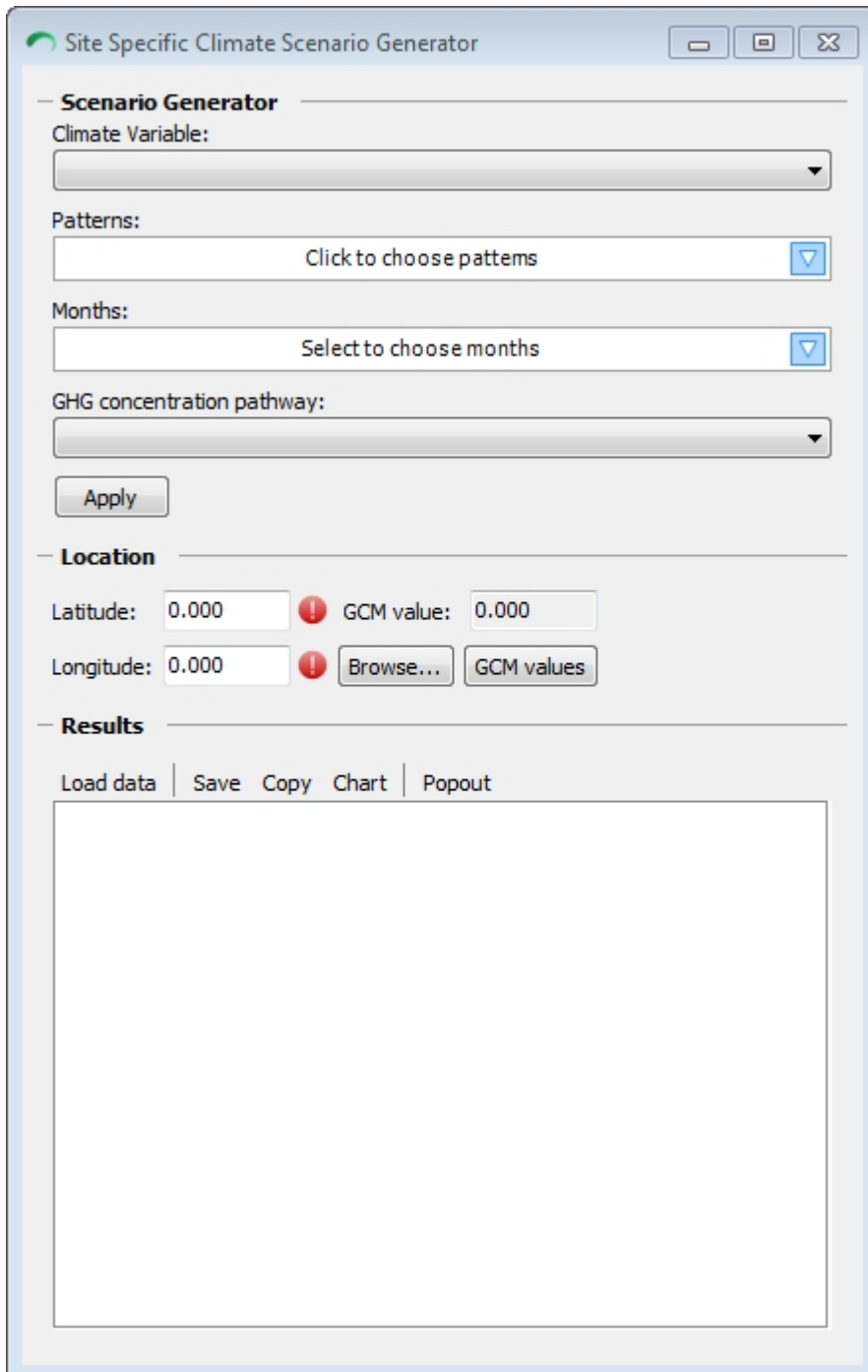
Be sure to have a study area selected.

To open the site specific scenario generator click on the Site Specific Scenario Generator icon

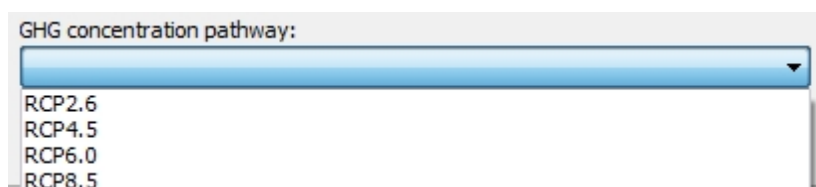
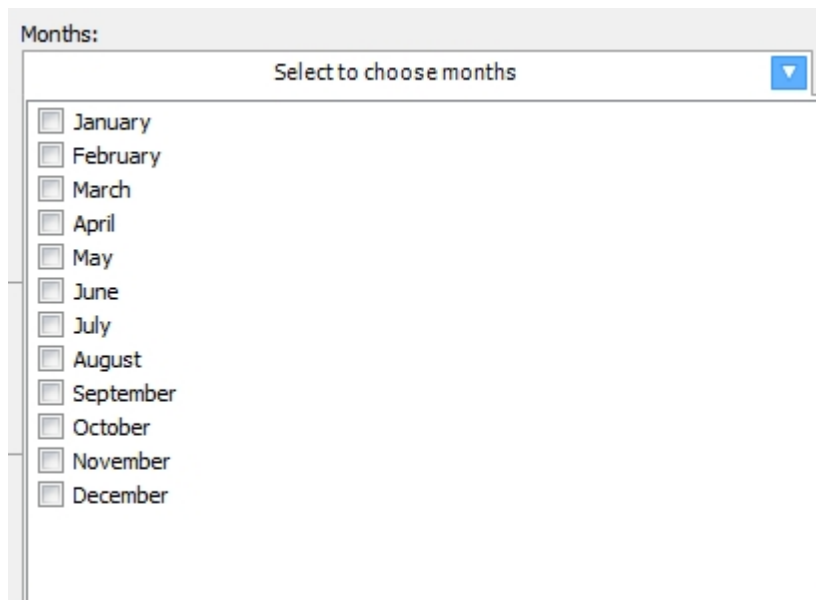
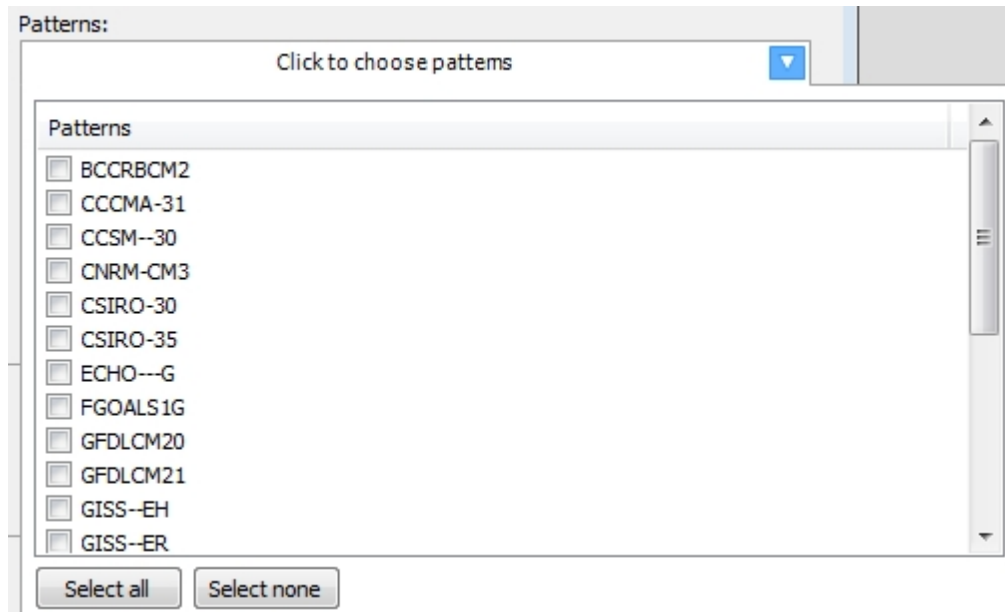
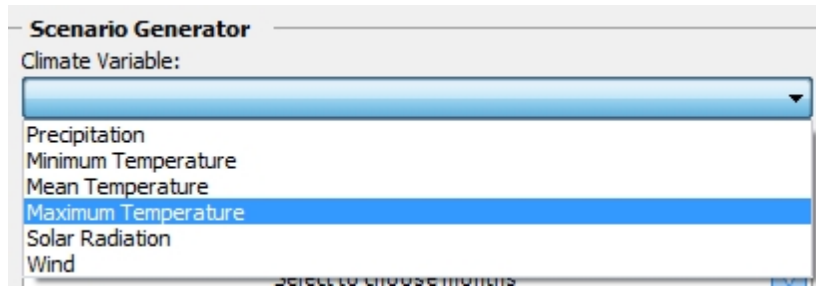


from the main toolbar on the top of the screen or right click in the main screen and select the icon from all those presented.

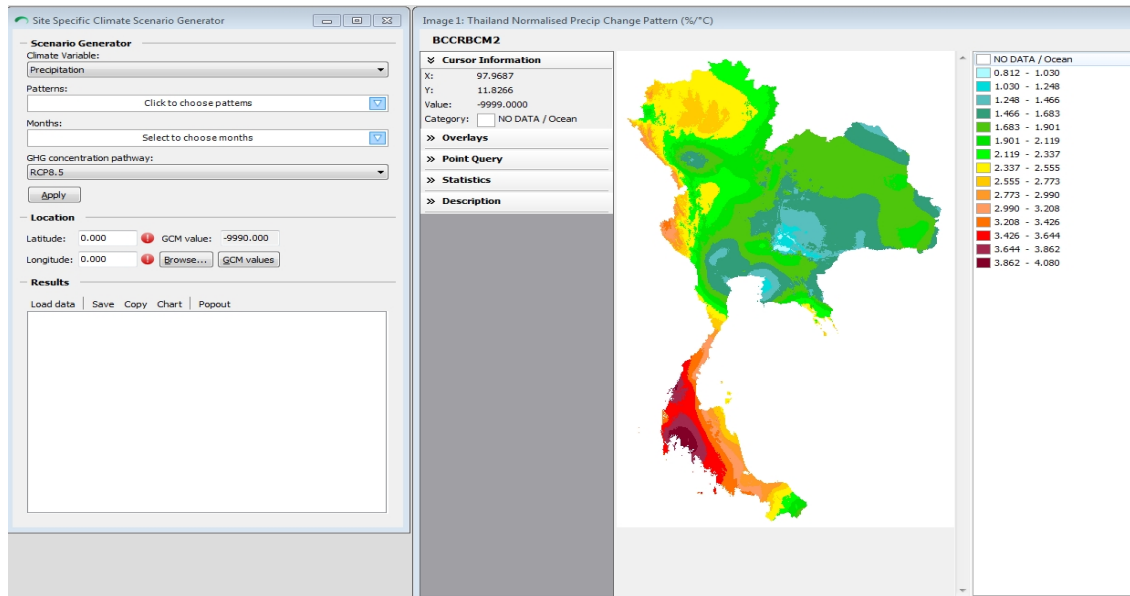
Choose Climate Change (we will look at sea level later).



Move from the top of the dialogue box to the bottom selecting the variables as you go.



Depending of the study area chosen an image similar to one below will be displayed:



Click on Apply and a map of the study area selected will be displayed.

Some tips before proceeding . . .

- 1] Site specific results can also be displayed by left clicking on any site in the map.
- 2] You can also enter the latitude and longitude for a site if it is within the boundaries of the map.
- 3] You can leave a graph open, return to the dialogue box, change a climate change parameter, load the data and open another graph for comparison.
- 4] Graphs can be copied to the clipboard using the clipboard tool.
- 5] You can choose to replace the map when you choose a new GCM pattern or you can choose to open a new window with the new GCM pattern for comparative purposes.
- 6] The tabular information can be saved and exported by right clicking on the data and choosing from the options, including exporting to Excel.

Location

Latitude: GCM value:

Longitude:

Results

Load data | Save | Copy | Chart | Popout

Year	Low	Mid	High
1995	1207.00	1207.00	1207.00
1996	1207.31	1207.42	1207.83
1997	1207.61	1207.85	1208.66
1998	1207.91	1208.29	1209.48
1999	1208.21	1208.74	1210.30
2000	1208.51	1209.19	1211.11
2001	1208.81	1209.64	1211.91
2002	1209.10	1210.11	1212.70
2003	1209.40	1210.58	1213.49

Results

Activity: Conduct analysis for precipitation, Tmin, Tmean and Tmax for your chosen study area. Run different scenarios and compare the graphic outputs. Save the tabular data in different formats

Normalized GCM Patterns

By clicking on the in the site specific scenario generator a number of very useful values is displayed for that site.

GCM values

Pattern values

Area:

Location: Latitude: 14.729 Longitude: 100.965 Chart

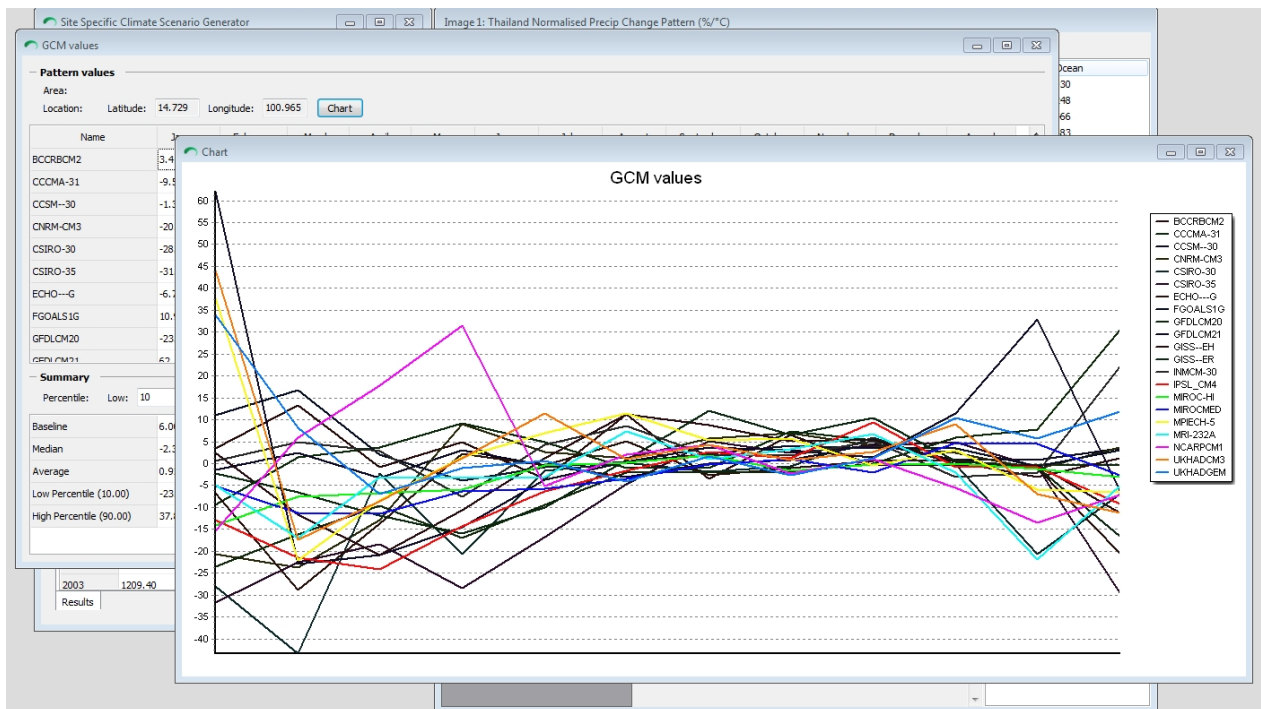
Name	January	February	March	April	May	June	July	August	September	October	November	December	Annual
BCCRBCM2	3.410	13.360	-0.880	4.840	-3.470	11.270	-3.540	6.590	-0.420	-0.380	-0.200	-11.140	1.580
CCMA-31	-9.500	1.460	3.750	9.140	4.810	-1.070	-0.980	7.340	5.340	0.450	-0.420	-0.420	3.368
CCSM-30	-1.380	2.520	-3.180	3.130	-0.430	-3.110	0.000	0.780	4.470	0.740	0.850	3.490	0.904
CNRM-CM3	-20.660	-23.680	-12.780	8.940	2.740	1.330	5.660	6.870	4.180	2.440	-1.310	3.720	2.747
CSIRO-30	-28.070	-43.340	-2.170	-20.580	-1.530	0.260	-1.820	-0.630	5.960	-0.270	-20.650	-7.030	-2.438
CSIRO-35	-31.730	-22.440	-18.340	-28.410	-16.690	-4.760	5.080	2.440	4.000	4.860	-0.890	-29.400	-4.002
ECHO-G	-6.710	-28.750	-13.690	2.210	-0.500	5.090	-2.580	-1.100	0.630	0.740	-0.980	-20.430	-1.007
FGOALS1G	10.960	16.700	2.090	-3.890	-0.720	0.470	2.320	4.060	3.570	3.540	-0.660	3.100	2.133
GFDL20	-23.530	-16.070	-9.600	-16.910	-9.360	-1.950	-2.040	-1.830	0.040	5.960	7.710	30.530	-2.986
INMCM3	6.160	-22.890	-20.750	-14.450	-3.640	0.440	3.630	3.100	1.440	11.490	22.860	-6.150	0.738

Summary

Percentile: Low: 10 High: 90

	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Baseline	6.000	22.000	62.000	90.000	150.000	128.000	154.000	162.000	256.000	137.000	34.000	6.000	1207.000
Median	-2.340	-11.290	-7.010	-3.200	-0.500	0.740	2.320	2.440	4.000	0.740	-0.890	-3.140	0.715
Average	0.925	-10.430	-7.483	-4.128	-1.662	1.974	2.334	2.233	3.273	2.224	-1.427	-2.862	0.615
Low Percentile (10.00)	-23.530	-23.680	-20.750	-16.910	-9.360	-3.510	-2.040	-1.830	-0.420	-2.070	-13.560	-16.490	-5.705
High Percentile (90.00)	37.840	8.160	2.940	8.940	4.810	11.160	5.660	6.590	6.810	9.080	5.740	11.900	7.238

Review the table with the group and your instructor and consider how the outputs from this table can inform your investigation.




Creating Global Sea-level Scenarios

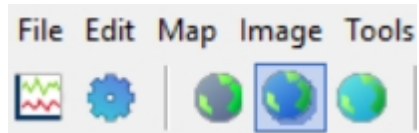
Overview:

The SimCLIM 4.x for Desktop Sea-level Scenario Generator contains tabled year-by-year output, a simple global climate model, as forced by RCP greenhouse gas emission scenarios used by the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report. For each scenario, low, mid and high projections are provided for global-mean changes in temperature,

sea level (thermal expansion only) and sea level (total, including ice melt). The corresponding values for atmospheric concentrations of carbon dioxide are also provided. To view these data, proceed as follows:



1] Click on the  Site Sea Level Rise Scenario Generator in the main tool bar or right click in the main display and select the icon from the list displayed.



2] The following dialogue box will appear.

Proceed from the top of the dialogue box to complete the various attributes for your analysis:

1] Toggle to the local observed sea-level trend you are interested in:

Vertical land movement component only: Trend of relative sea-level that excludes climate-change-related components (eg. land subsidence or uplift). This trend will be added directly to your scenario.

Total trend: The total observed, undifferentiated trend of observed relative sea-level change which includes Greenhouse Gas-related effects. SimCLIM 4.x for Desktop will estimate the non-climate change component of the trend for you, and factor it into your scenario.

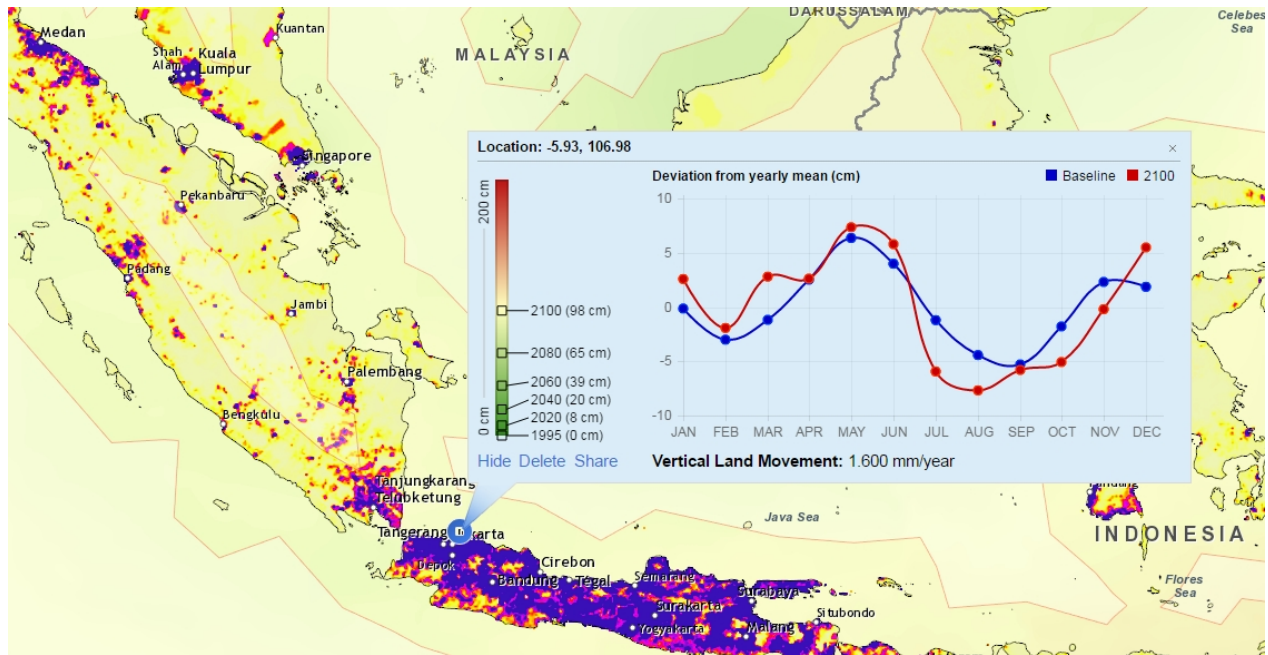
SLR Scenario Generator

Observed local vertical land movement (mm/year):

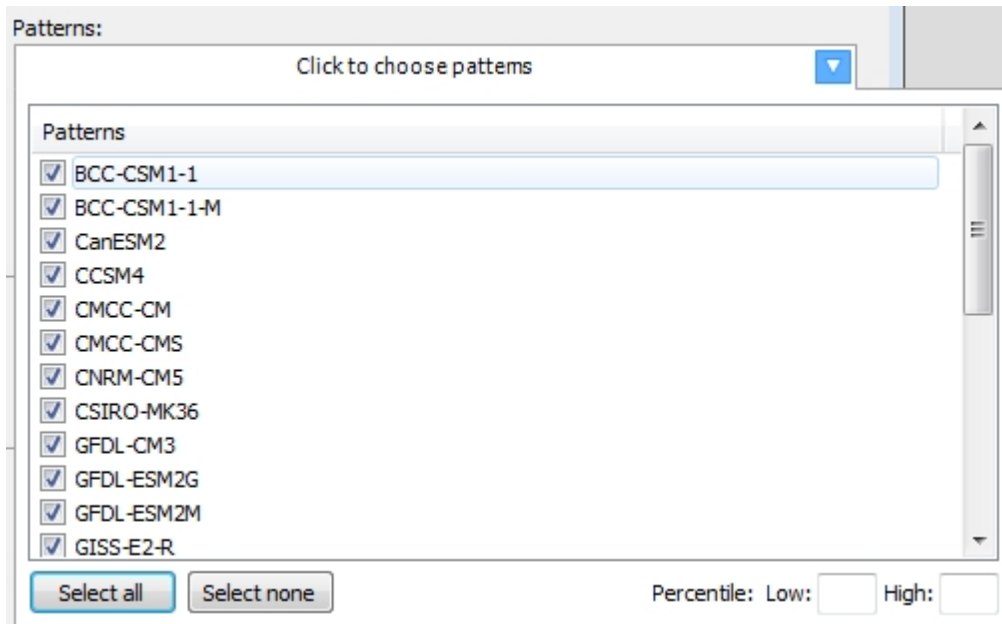
2] Enter a local trend value in mm/yr (this value has to be provided by the user based on off-line work) reflecting the output from Step 1.

Vertical land movement information can be quickly obtained from:

<http://slr-cities.climsystems.com/>



3] Select the normalized Global Circulation Model (GCM) pattern from the drop-down menu in the dialogue box. Select all for an ensemble or you can query individual GCMs.




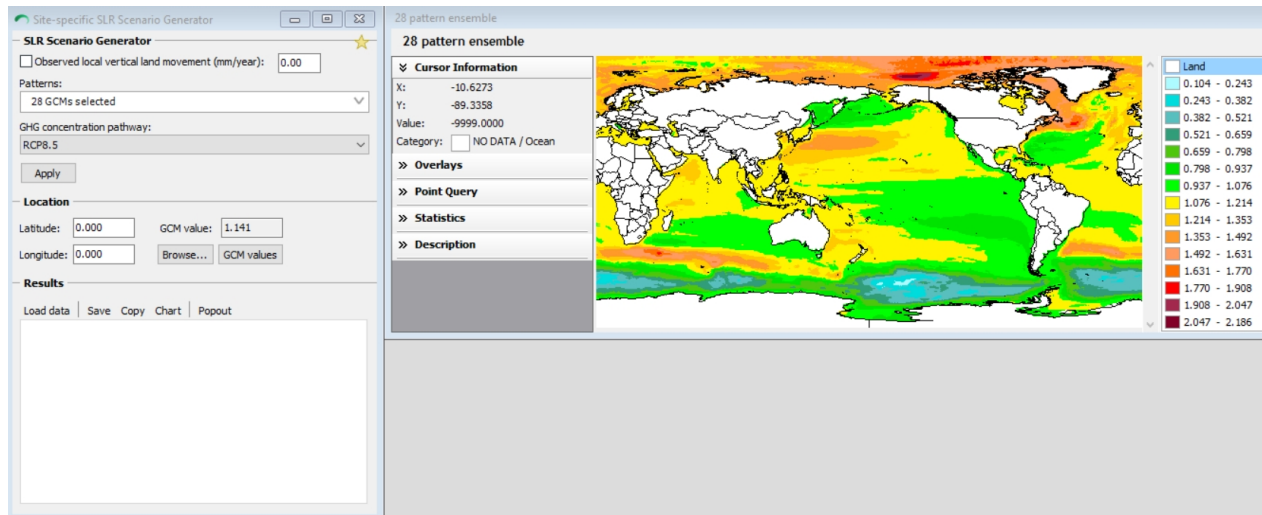
4] Select an emission scenario (RCP), with which global-mean sea-level projections are associated.



Click  and a map will appear.

5] Click on the map to identify the cell of interest (or enter longitude and latitude directly).

IMPORTANT you need to click on the select arrow  in the toolbar before clicking on a site in the dialogue box map that you wish to analyse.

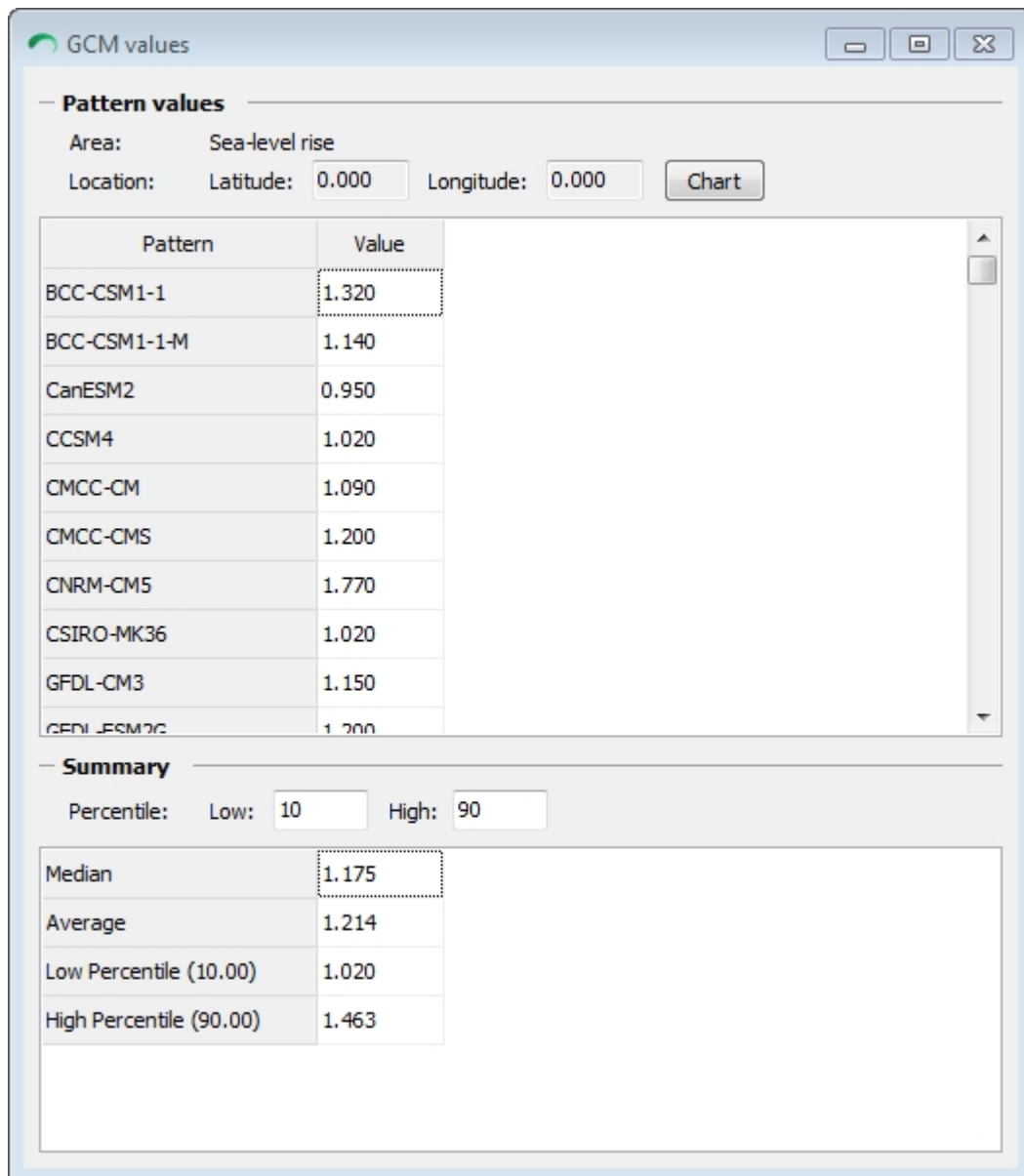


6] Click Load Data.

For each emission scenario, three projections of estimated *eustatic* sea-level changes from 1990 to 2100 are provided, for three sets of sensitivity values. If one wishes to adjust these values in order to obtain *relative* sea-level changes that take into account long-term, non-greenhouse-gas-induced trends, take the additional steps:

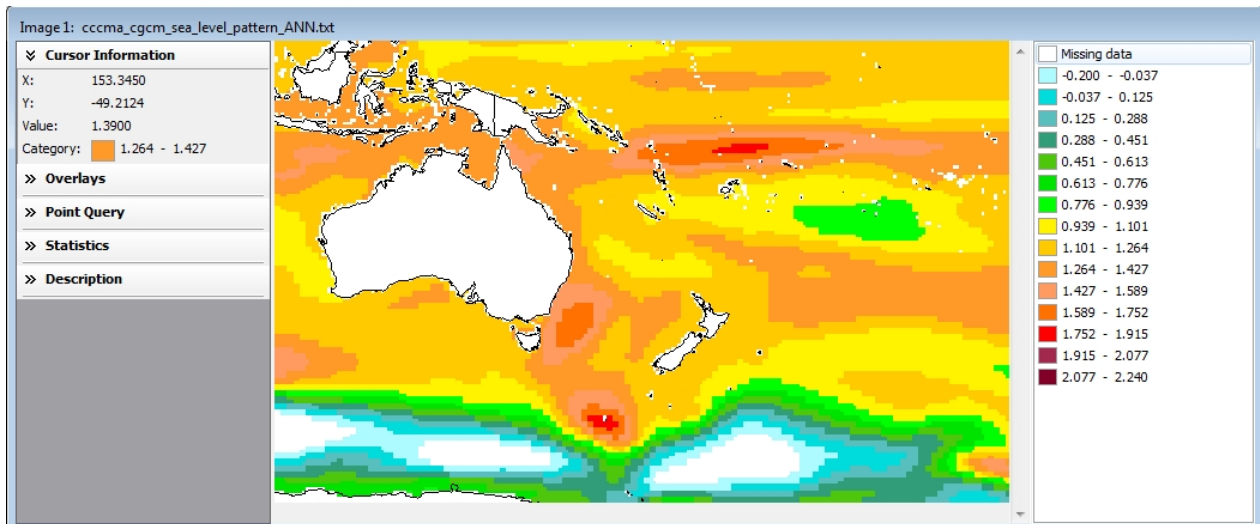
7] Click [Load data](#). The program will now make three estimates of the recent greenhouse-gas-related trend component that are consistent with each of the low, mid and high model parameter sets. These estimates are then subtracted from the overall trend that you provided. The residual, non-climate-related trends which result are typically related to changes in land elevation from, for example, tectonic activity, land subsistence or isostatic readjustment. These local trends will be added to the three future projections following the methods outlined in the “Methods Guide” of the main SimCLIM manual.

There are many options for viewing the various outputs from the analysis. Click on [GCM values](#) for a tabular display of the variability across GCMs.



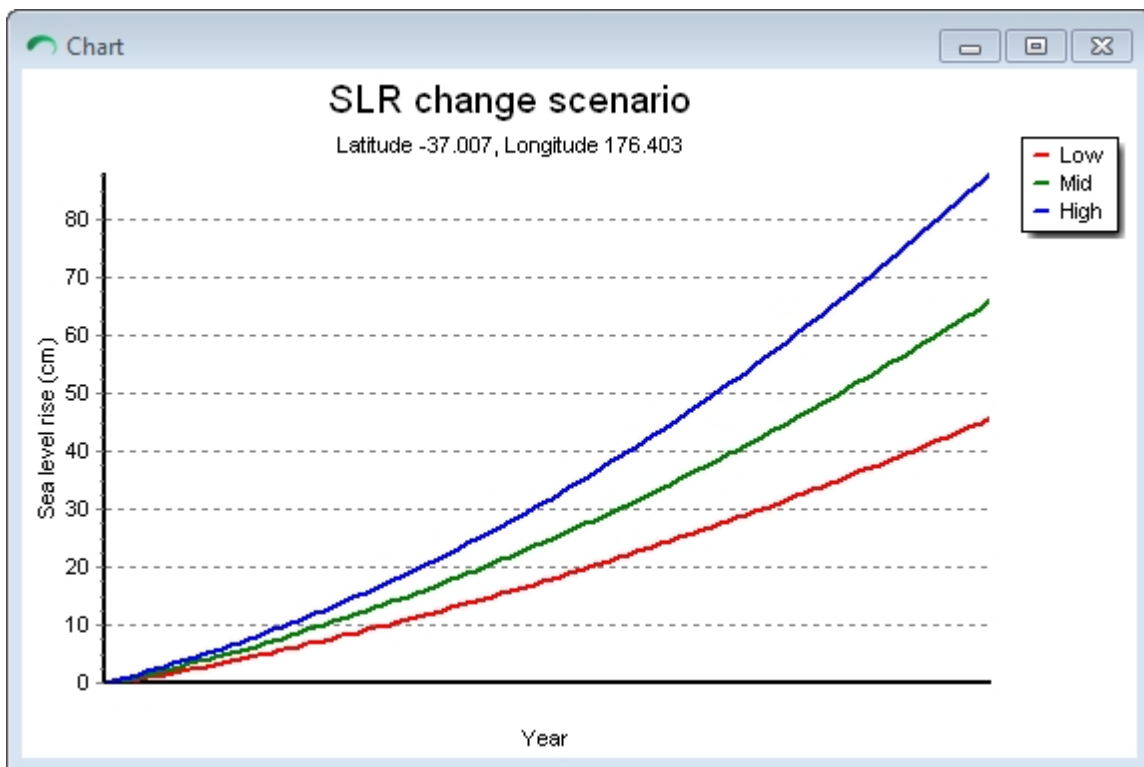
Interpretation of Results

When viewing the spatial patterns it is important to understand the legend. The values in the legend reflect the **scaling** factor in relation to the global-mean sea-level change (pertaining to the thermal expansion component only). For example, if a cell value is 1.0, then the interpretation is that as the sea-level change in that location would be equal to the global-mean value. However, if the cell value is 0.5, then the sea-level change at that location would be half the global-mean value. **Do not** interpret these numbers as the actual change in sea level in meters.



The values highlighted in red above represent from left to right, the **longitude** (0 to 360 degrees) and the **latitude** (0 to 90 degrees for the northern hemisphere and 0 to -90 degrees for the southern hemisphere). The final number represents the actual **scaling factor** for that particular cell at the longitude and latitude depicted.

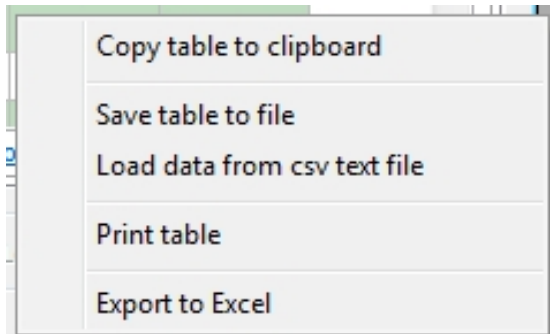
Results for a chosen cell can be depicted graphically as shown below by clicking on the tabular data.



The graphic display includes the longitude and latitude of the site, in blue across the top and by clicking on the 'follow mouse' box in the top right you can scroll around the graphic and get exact data for different years.

It is possible to run any number of scenarios using different GCM patterns and to compare them. Notice that the Y axis of the graphs is not standardised between different graphical depictions. Interpretation must therefore be carried out carefully when comparing different sea-level scenarios.

By right clicking on the tabular data a dialogue box, as shown below, is displayed.



These useful data transfer capabilities can facilitate comparisons of the effects of different CGM patterns and global emissions scenarios on changes in sea level.

Activity: Open the Sea Level Rise Scenario Generator and zoom into an area of your choice. Create some sea level rise scenarios and complete the following table. Use a High sensitivity in all your scenarios.

Year	CSIROMK-36 and RCP 4.5	CSIROMK-36 and RCP 8.5	HADGEM2-ES and RCP 4.5	HADGEM2-ES and RCP 8.5
Baseline				
2050				
2100				

Do the same analysis but add some data to the following (for example -2.00 for local observed trend and then try 2.00):

SLR Scenario Generator

Observed local vertical land movement (mm/year):

Compare your results with those above.

Year	CSIROMK-36 and RCP 4.5	CSIROMK-36 and RCP 8.5	HADGEM2-ES and RCP 4.5	HADGEM2-ES and RCP 8.5
Baseline				
2050				
2100				

Site Specific Marine Scenario Generator

Marine Data Set

Marine Data Set

The Site Specific Marine Scenario Generator tool requires a specific Global marine data set

(called Global_OCNBGC). If you have purchased SimCLIM for ArcGIS Marine you should already have this data set. If you wish to obtain this data set please [contact our sales team](#) for purchasing options.

The Global_OCNBGC must have been added to SimCLIM 4.x like any other spatial area. For information on adding data sets to SimCLIM 4.x please see the [Adding a New Area](#) help topic.

Overview of the Site Specific Marine Scenario Generator window

Scenario options

Marine variable:
 Dissolved Iron Concentration at Surface

Apply Vertical Land Movement

Patterns:
 12 GCMs selected

Months:
 All months selected

Curve:
 RCP8.5

Data points

Name	Lat	Lon	GCM value
Site 1	-24.773	83.112	0.3935
Site 2	-45.346	115.595	0.3113
Site 3	-51.842	-120.448	0.2475
Site 4	18.537	-137.772	0.2734

Buttons: Add..., Remove, Edit..., Load set..., Save set...

Map: GCM Values, Load (monthly), Load (yearly)

Scenario options

Use this section to define the marine variable of interest, which patterns to include in the scenario, which months to include in the scenario and which RCP to use. A map will be generated and the GCM value of any added data points will be updated with any changes to these options.

Data points

This section contains a list of data points and a map. The map displays the current result of a scenario generation (based on the specific scenario options) for the year 2100 and also displays a white dot for each added data point. The map can be clicked to add a data point.

The map can be zoomed or panned like the any Map Viewer window. See the [Navigating the map](#) topic for more information.

Action buttons

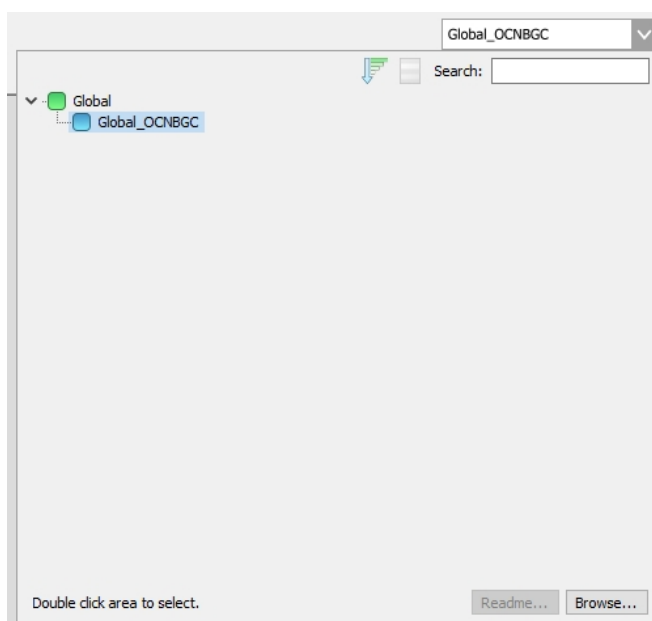
Use the three buttons at the bottom of the window (GCM Values, Load (monthly), Load (yearly)) to generate results. The results for the locations signified by the white dots will be generated.

Using the Site Specific Marine Scenario Generator

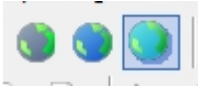
Using the Site Specific Marine Scenario Generator

The steps below will guide you through the use of the Site Specific Marine Scenario Generator.

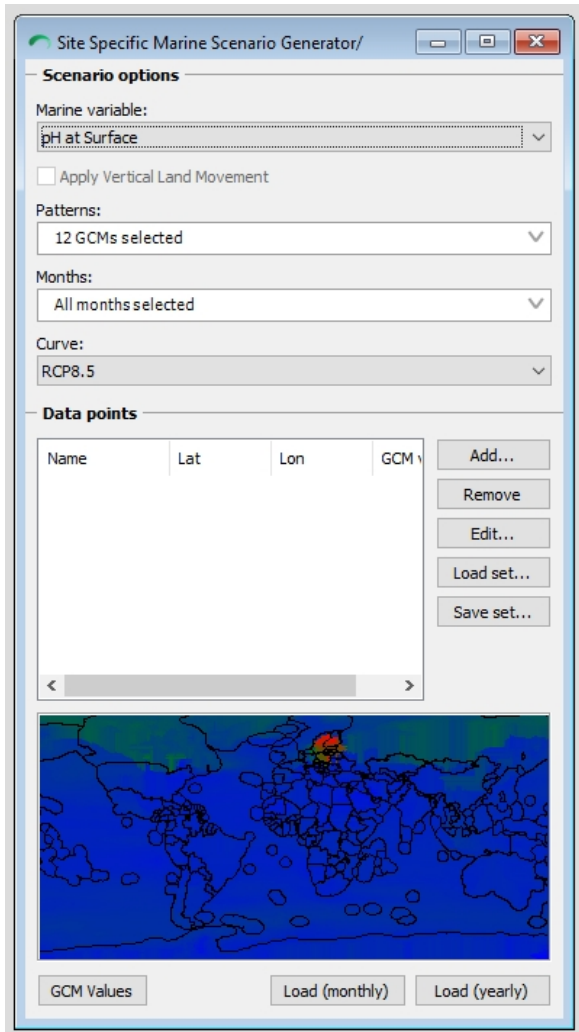
1. Make sure the Marine Data Set (Global_OCNBGC) has been selected from the Area Drop Down in the main SimCLIM 4.x window.



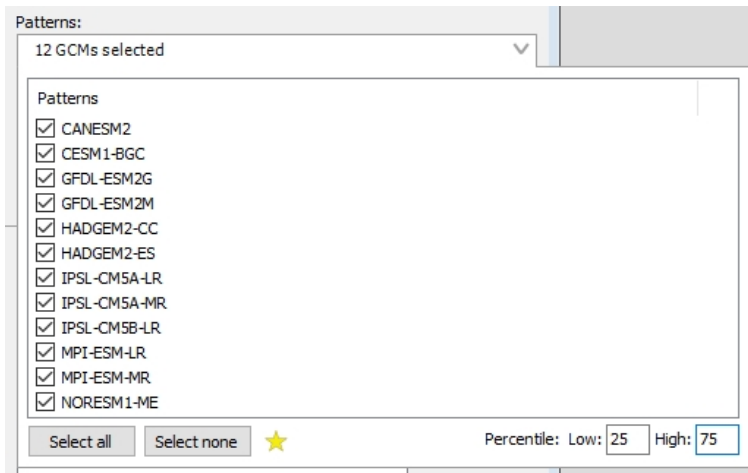
- Click the Site Specific Marine Scenario Generator icon on the toolbar.



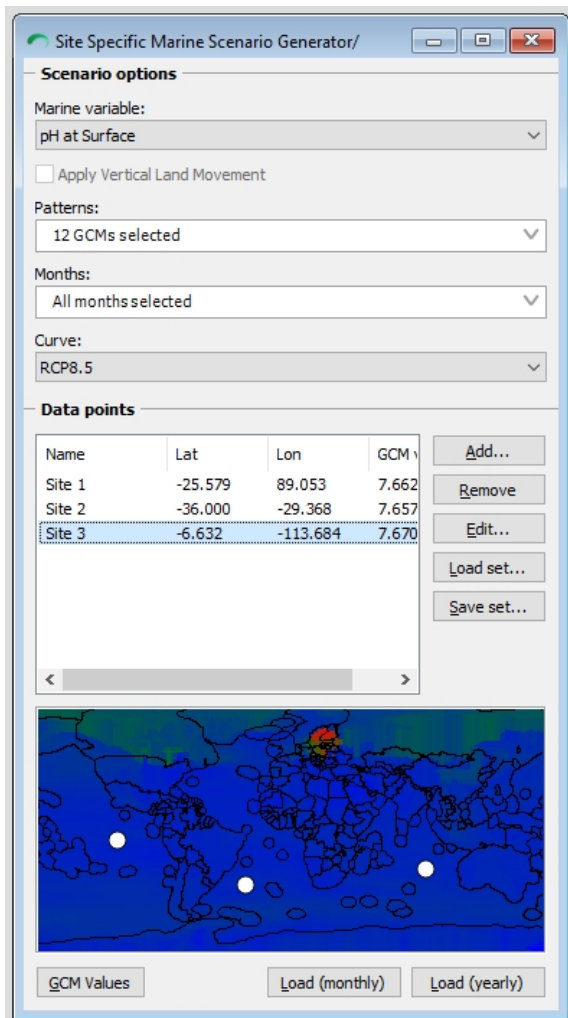
- Specify the Marine variable of interest. By default, all patterns and months will be automatically selected. A scenario map will be generated (be patient as the global ocean model data is accessed - three animating dots in the map area indicate the map is still being generated) and will be displayed in the map area when complete.



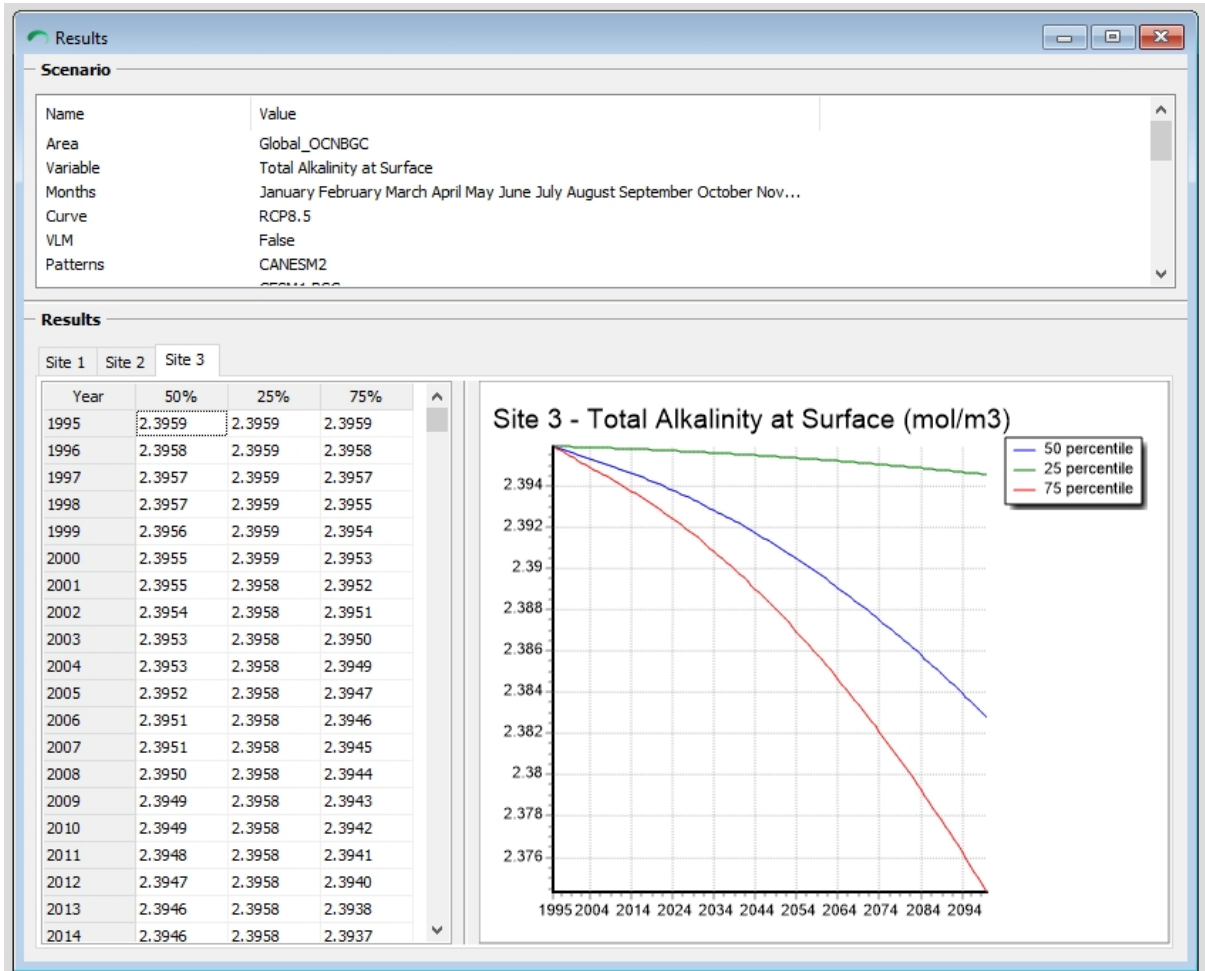
- Update other scenario options (Patterns, Months, Curve i.e. RCP) as required. Use the Patterns drop-down to specify Low and High percentile values if you would like those to be included in the results.



- Use the Data points section to define one or more data points of interest. Click the Add button to specify a location by latitude/longitude or click a location on the map to quickly add a point to the data point list. Data points can be named for easy identification. To modify a data point, select it in the list and click the Edit button. Use the [Load set and Save set buttons](#) to re-use a set of data points.



- Click "Load (monthly)" or "Load (yearly)" to produce results for each added data point. The below screen capture shows a results window for the "Load (yearly)" action for three data points with 25th and 75th percentile values specified.



GCM values table

GCM values table

The GCM values table provides an overview of all GCM values for each pattern/month and provides basic scenario analysis tools.

To use, first set up the Site Specific Marine Scenario Generator with scenario options and data points (as instructed in [this topic](#)). Now, instead of clicking one of the "Load (Monthly/Yearly)" buttons, click the "GCM values" button. A result window (similar to the one below) will be processed and displayed.

Marine GCM Values

Site 1 Site 2 Site 3 Site 4 Site 5

GCM values

Latitude: Longitude: Total Alkalinity at Surface - %/% global change

Pattern	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
CANESM2	-0.058	0.174	0.340	0.181	0.042	-0.294	-0.552	-0.718	-0.757	-0.649	-0.306	-0.140	-0.228
CESM1-BGC	0.361	0.440	0.267	0.216	0.030	-0.054	-0.104	-0.043	0.043	0.103	0.227	0.295	0.148
CNRM-CM5	3.000	3.000	3.000	3.000	3.000	3.000	3.000	2.503	2.106	2.312	3.000	3.000	2.827
GFDL-ESM2G	0.219	-0.324	-0.418	-0.219	0.470	1.327	1.617	1.582	1.074	0.597	0.252	0.056	0.519
GFDL-ESM2M	2.702	2.588	2.447	2.415	2.623	2.928	3.000	3.000	2.831	2.603	2.436	2.365	2.662
HADGEM2-CC	-3.000	-3.000	-3.000	-1.609	-1.036	-0.712	-0.496	0.170	0.169	0.511	0.297	-1.715	-1.119
HADGEM2-ES	-3.000	-3.000	-3.000	-0.184	1.256	1.488	1.884	3.000	3.000	3.000	1.309	-3.000	0.229
IPSL-CM5A-LR	2.809	2.936	3.000	3.000	2.733	1.978	1.361	0.921	0.851	1.143	1.765	2.581	2.090
IPSL-CM5A-MR	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000	3.000
IPSL-CM5B-LR	-1.586	-1.449	-1.605	-1.490	-1.445	-1.589	-1.622	-1.569	-1.568	-1.503	-1.566	-1.704	-1.558
MPI-ESM-LR	-0.878	-0.673	-0.638	-0.892	-0.981	-0.994	-1.290	-1.547	-1.539	-1.566	-1.562	-1.387	-1.162
MPI-ESM-MR	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000	-3.000

Summary

Percentile: Low: % High: % Projection: Year: Curve:

Pattern	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Baseline	2.452	2.448	2.442	2.442	2.441	2.442	2.443	2.446	2.451	2.453	2.455	2.455	2.447
Median	0.080	-0.075	-0.075	-0.002	0.256	0.636	0.628	0.545	0.510	0.554	0.274	-0.042	0.274
Average	0.047	0.058	0.033	0.368	0.558	0.590	0.566	0.608	0.517	0.546	0.488	0.029	0.367
Low percentile (10)	-3.000	-3.000	-3.000	-1.597	-1.404	-1.529	-1.589	-1.567	-1.565	-1.559	-1.565	-2.871	-2.021
High percentile (90)	2.981	2.994	3.000	3.000	2.973	2.993	3.000	3.000	2.983	2.960	2.944	2.958	2.982
Projection	2.452	2.449	2.443	2.442	2.438	2.435	2.436	2.440	2.445	2.447	2.452	2.456	2.445
Projection (low)	2.485	2.480	2.474	2.459	2.456	2.458	2.460	2.463	2.468	2.470	2.472	2.486	2.469
Projection (high)	2.420	2.416	2.410	2.409	2.409	2.410	2.411	2.414	2.419	2.421	2.423	2.423	2.415

Use the Percentile (low, high) and Projection (year, curve i.e RCP) options in the Summary section to perform quick scenario analysis.

Re-using site sets

Re-using site sets

Use the Load set (and Save set) buttons to re-use a set of data point locations. A data point set is a simple CSV file which can be edited or added (ingested) by using a text editor or Excel.

Saving a set

Add one or more data points to the Data points list. Click the "Save set" button and specify a file name.

Name	Lat	Lon	GCM value
Site 1	-25.579	89.053	2.4451
Site 2	-36.000	-29.368	2.4077
Site 3	-6.632	-113.684	2.3828
Site 4	52.500	-32.143	2.3692
Site 5	-47.143	114.643	2.3615

Buttons: Add..., Remove, Edit..., Load set..., Save set...

Loading a set

Click the "Load set" button and browse to a CSV file containing data points. It can either be a file created by using the Save set function, or it can be a file manually created.

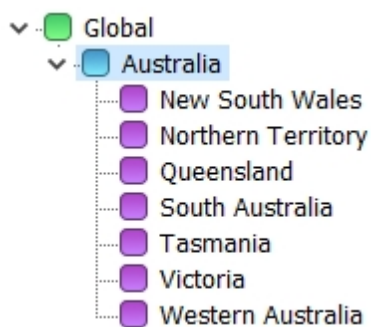
To define a set of data points manually, create a CSV file with the columns: NAME, LON and LAT, and a row for each data point. See below for an example of a properly formatted file:

```
"NAME" , "LON" , "LAT"
"Site 1" , "114.3750" , "33.7500"
"Site 2" , "16.8750" , "7.5000"
"Site 3" , "-63.7500" , "-33.7500"
```

Area Manager

The Area Manager allows you to add, import, delete and manage the Area Tree Index and the data folders and files stored in the SimCLIM 4.x for Desktop data folder.

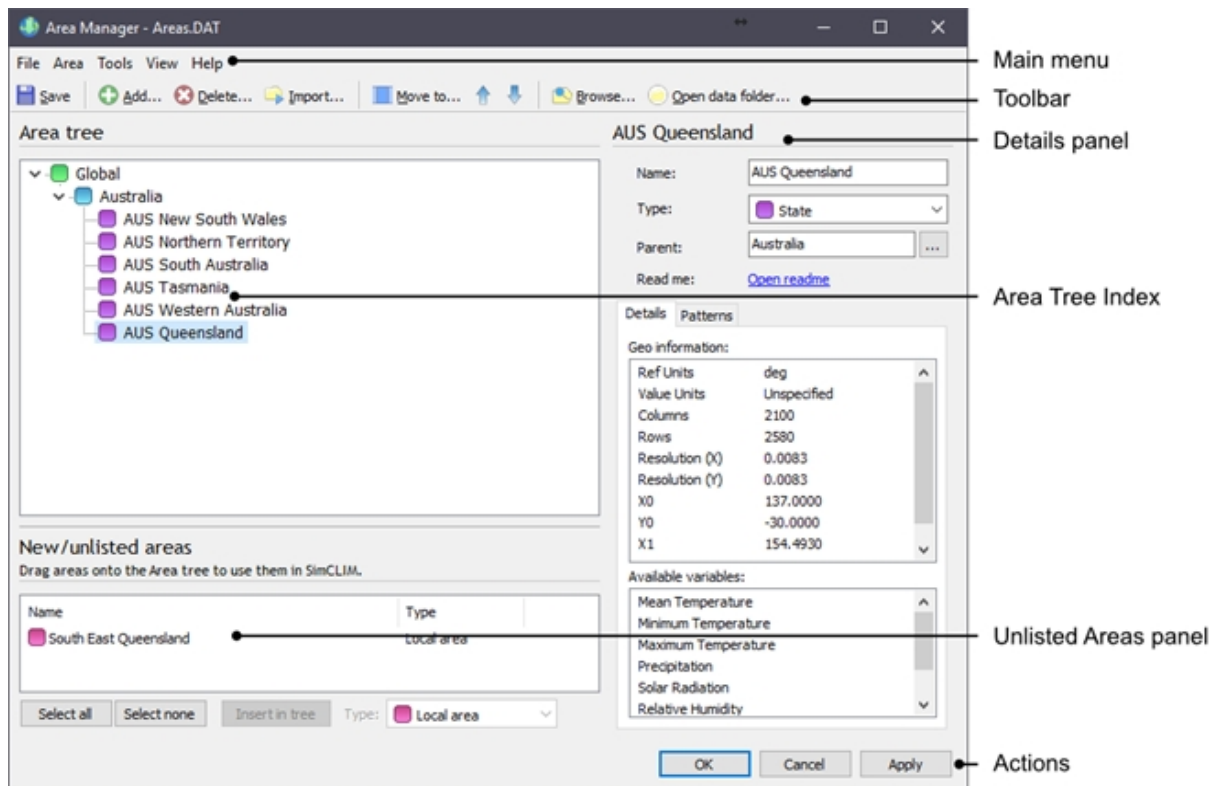
The Area Tree Index represented in SimCLIM 4.x for Desktop as the Areas Drop Down list, and is important not just to make finding and selecting work areas easier, but also because certain functions within SimCLIM 4.x for Desktop can "climb" the tree to find data. It is recommended that sub-areas (e.g. regions, states, cities) be properly placed within their geographic parent area (e.g. a country). For example:



The Area Manager can be started from within SimCLIM 4.x for Desktop, either by clicking the "Manage Areas" icon on the toolbar or by clicking Management -> Manage Areas in the

SimCLIM 4.x for Desktop main menu.

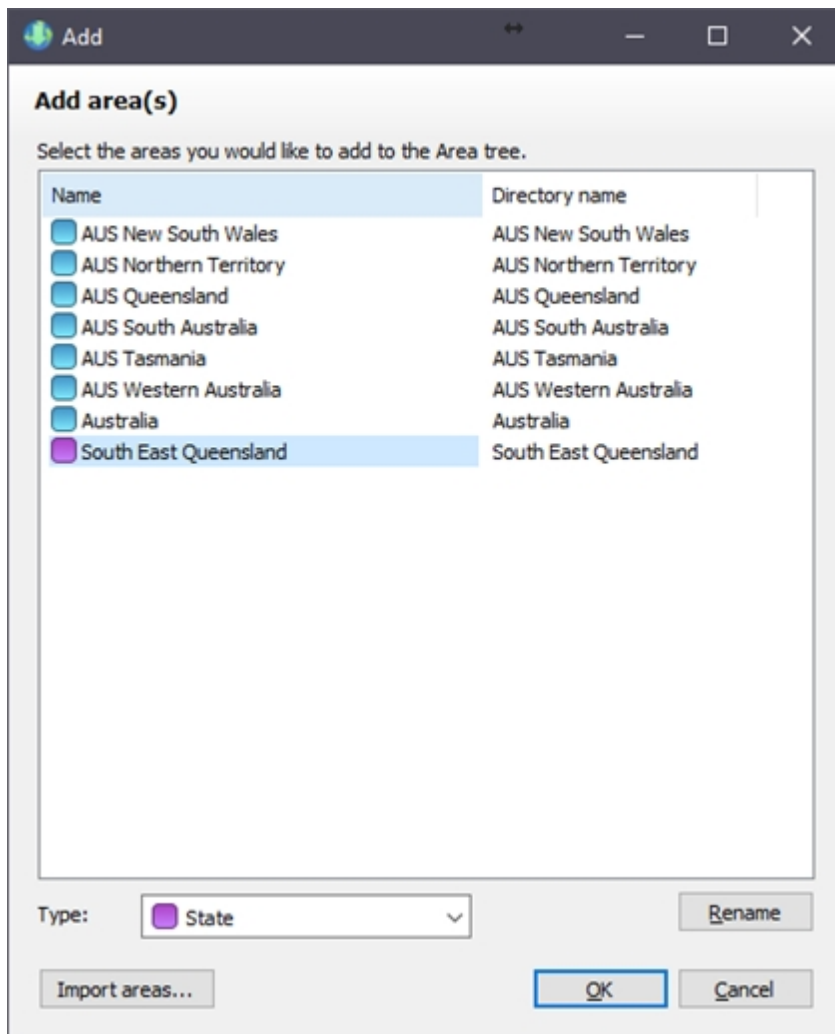
The following image indicates the various user interface elements of the Area Manager window:



Adding an area to the tree

To add an area onto your Area Tree Index follow the instructions below. These instructions apply only if the Area data folder is already in your SimCLIM 4.0 for Desktop data folder. If it is not please see one of the topics for Importing areas.

1. Select the parent area you would like to insert the area into (e.g. if you're adding "New York State", you should select the "USA" area).
2. Click the Add button on the toolbar or click Area -> Add on the main menu.
3. A dialog box containing a list of areas you can add will be displayed. Select one or more areas you would like to add.



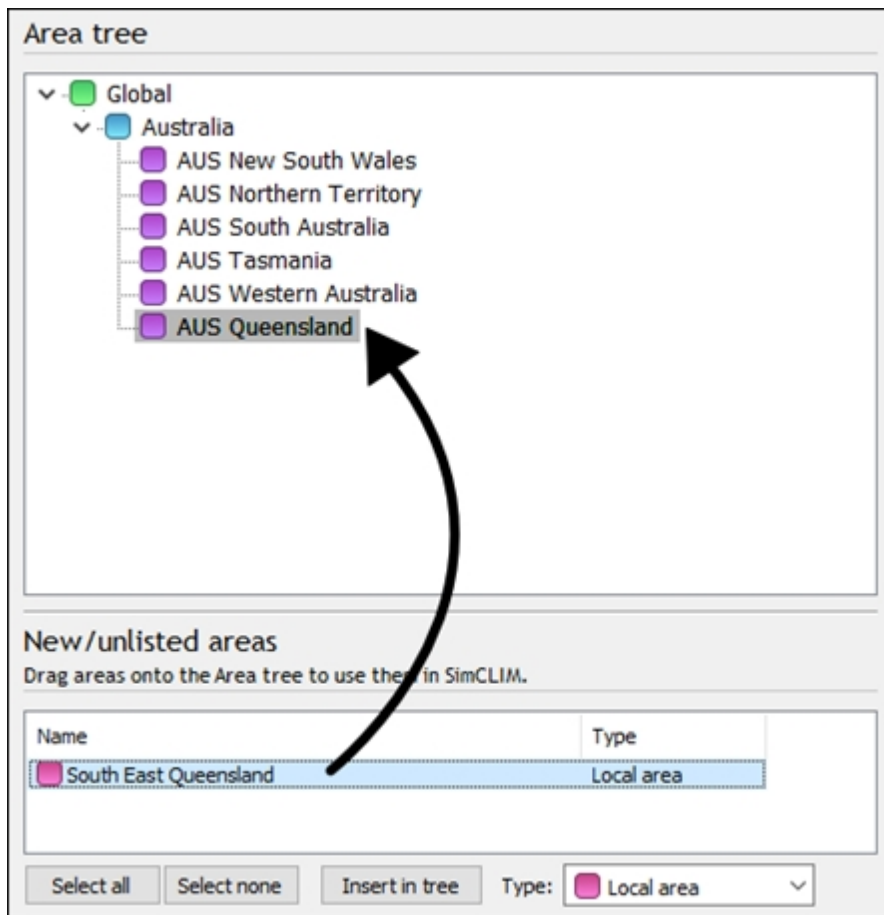
4. Click the OK button.

Adding unlisted areas to the tree

When the Area Manager is opened it will check your data folder for areas that are not present on the Area Tree Index. If one or more areas is found, an "Unlisted areas" panel will be displayed underneath the Area Tree Index in the main window, which you can drag areas from onto the Area Tree Index. This is a convenient way of adding areas to the tree if you have manually placed new areas data folders into your SimCLIM 4.0 for Desktop data folder.

To add these areas to your Area Tree Index, follow the instructions below:

1. Start the Area Manager and wait for the Unlisted Areas panel to be displayed.
2. Select one or more areas from the Unlisted Areas panel you wish to add to the Area Tree Index.
3. Drag the selected areas from the Unlisted Areas panel to the desired destination area in the Area Tree Index OR select the desired destination area in the Area Tree Index and click the "Insert in tree" button.

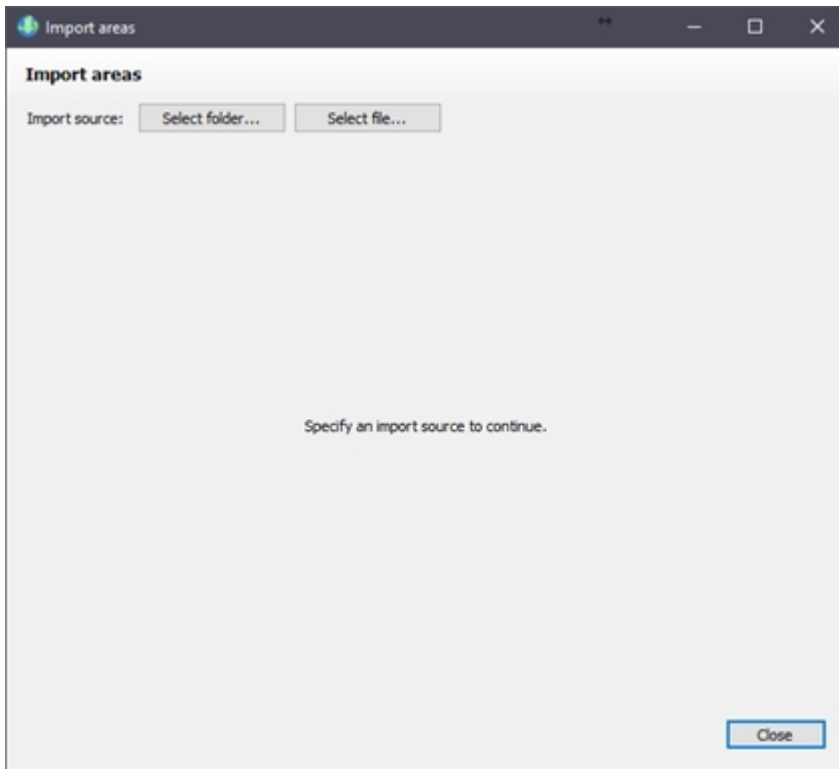


- The selected areas will become members of the destination area. You can use the Move up/Move down buttons to rearrange these areas if you wish.

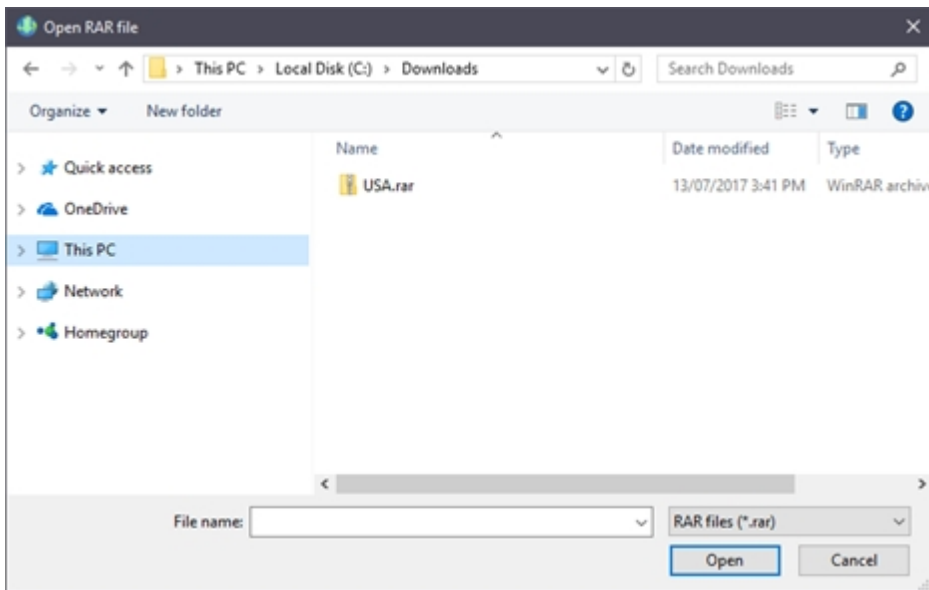
Importing from RAR file

If you have received or downloaded a RAR file containing one or more areas, you can easily import areas directly from this file by following the instructions below:

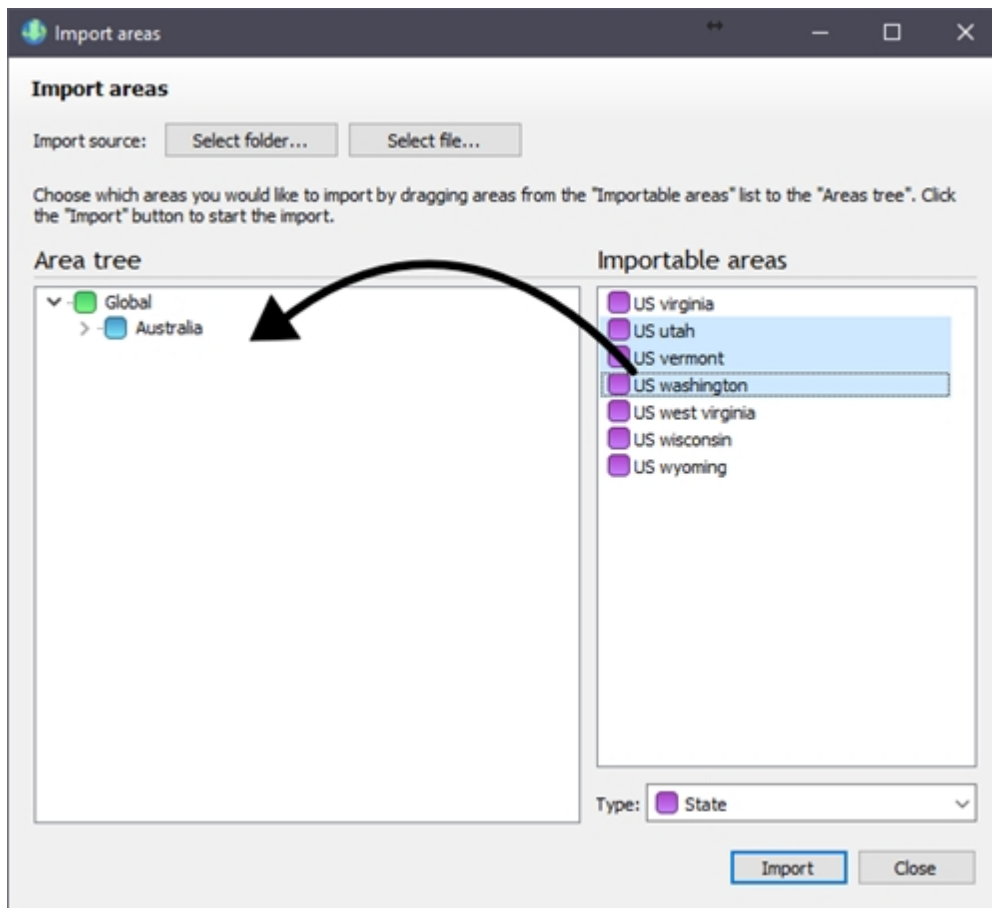
- If you have not done so, download and save the RAR file to your computer.
- Start the Area Manager.
- Click the Import button on the toolbar or click Area -> Import on the main menu.
- The Import dialog will be displayed. Click the "Select file" button.



5. Browse to the RAR file and click Open.



6. Two panels will be displayed, the “Area tree” (which matches your Area Tree Index from the main window) and a list of “Importable areas”.

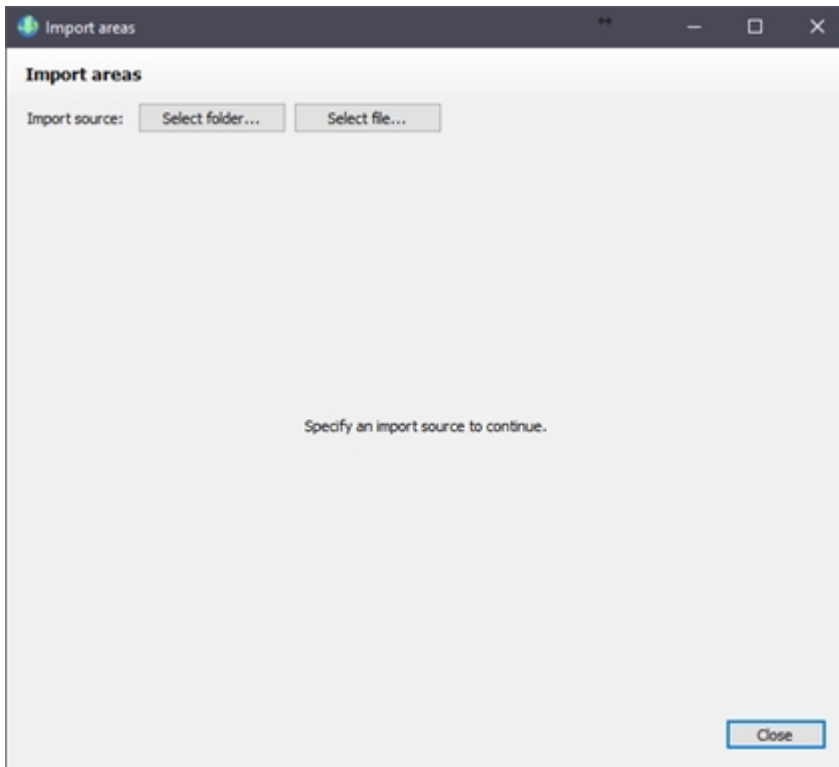


7. Drag areas from the “Importable areas” list to the “Area Tree Index”.
8. Click the Import button. The files will now be copied to your data folder. Depending on the size of the files and speed of your system, this may take several minutes.
9. Once complete, the Import dialog box will close and the changes should be displayed in the main window.
10. Save your changes.

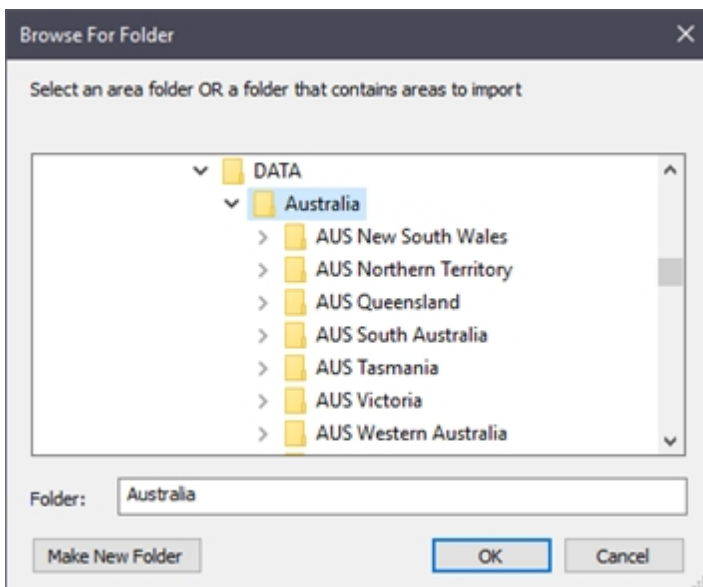
Importing folders

If you wish to import one or more area data folders stored in another location (e.g. a folder, USB memory stick or external drive, CD/DVD) follow the instructions below:

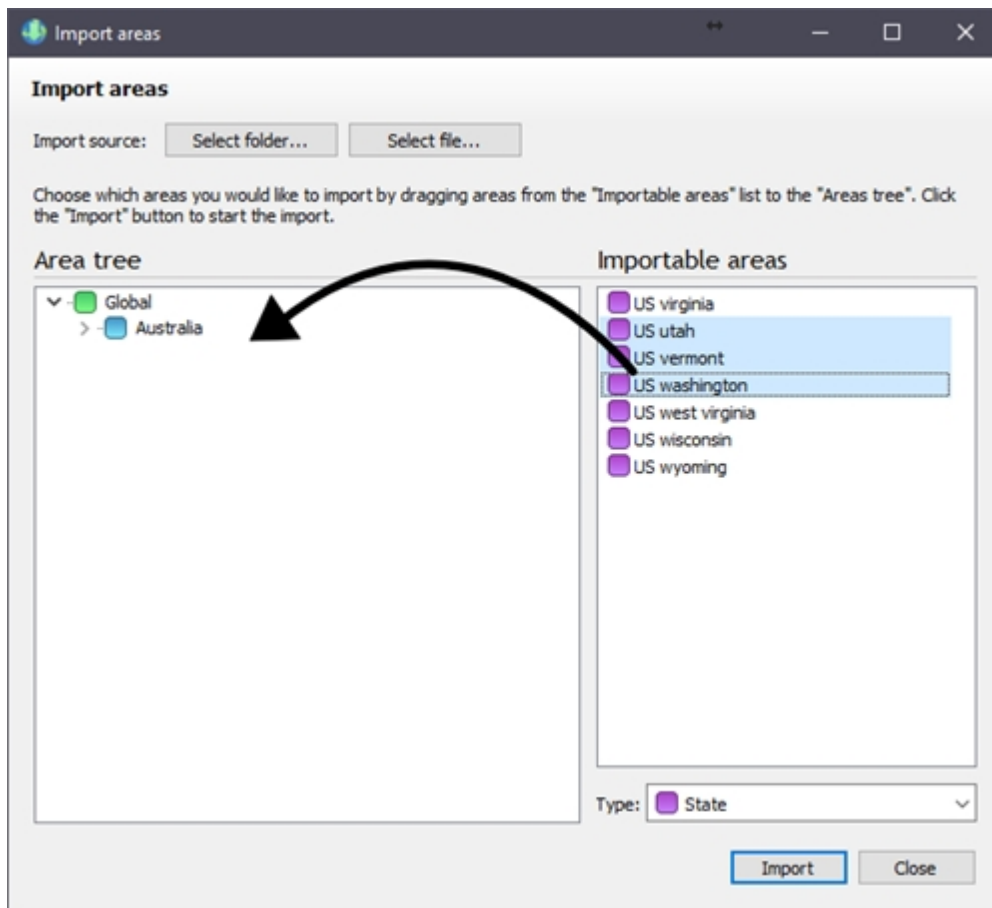
1. Start the Area Manager.
2. Click the Import button on the toolbar or click Area -> Import on the main menu.
3. The Import dialog will be displayed. Click the “Select folder” button.



4. Browse to the folder you wish to import from. This can be a SimCLIM 4.0 for Desktop area folder OR a folder that contains multiple SimCLIM 4.0 for Desktop folders (if you wish to import multiple folders).



5. Two panels will be displayed, the “Area tree” (which matches your Area Tree Index from the main window) and a list of “Importable areas”.



6. Drag areas from the “Importable areas” list to the “Area Tree Index”.
7. Click the Import button. The files will now be copied to your data folder. Depending on the size of the files and speed of your system, this may take several minutes.
8. Once complete, the Import dialog box will close and the changes should be displayed in the main window.
9. Save your changes.

Importing using Windows Explorer

One quick way of importing areas is to simply place SimCLIM 4.0 for Desktop area folders into your data folder and add them to the Area Tree Index using the Area Manager, either by using the Add function or by using the Unlisted Areas function.

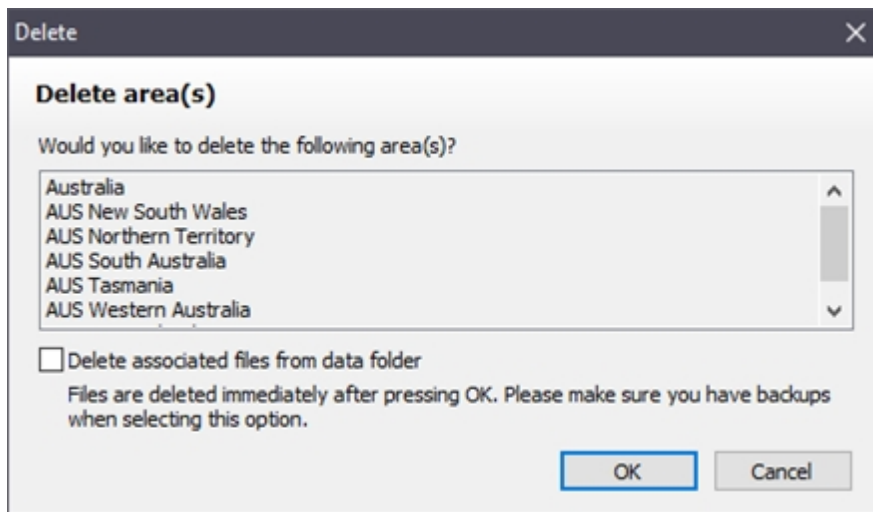
1. Browse to your SimCLIM data folder in Windows Explorer. You can get to this folder quickly in SimCLIM by clicking Management -> Browse data folder in the main menu or in the Area Manager by clicking the “Open data folder” button on the toolbar.
2. Copy or move SimCLIM 4.0 for Desktop area data folders to this folder.
3. Open the Area Manager and follow the directions in [Adding areas](#) or [Adding Unlisted Areas](#).

Deleting areas

Areas can be deleted from the tree, and optionally, their associated area folders and files can be deleted from the data folder if they will no longer be needed in the future. To delete areas, follow these instructions:

1. In the Area Index Tree, select the areas you would like to delete (hold CTRL and click an area

- to select multiple).
- Click the Delete icon on the toolbar or click Area -> Delete on the main menu.
- A confirmation dialog will be displayed. Review the list of areas that will be deleted. If any of the selected areas contains sub-areas, those sub-areas will also be listed here.



- If you wish to delete the area folders and files stored in the data folder, select the “Delete associated files from data folder” check box.
- Click the OK button. The areas will be deleted from the Area Index and (if selected) files will be deleted from your data folder. The process may take a few moments to complete if you have chosen to delete area folders/files.

Note: If you have chosen to delete area folders/files, they will be removed immediately upon clicking OK. If you choose not to save changes when closing the Area Manager, the files will still be deleted.

Editing and viewing area details

When an area is selected on the Area Index Tree, its details are displayed on the Details sidebar.

Australia

Name:

Type: Country

Parent: ...

Read me: [Open readme](#)

Details Patterns

Geo information:

Ref Units	deg
Value Units	Unspecified
Columns	1681
Rows	1361
Resolution (X)	0.0250
Resolution (Y)	0.0250
X0	112.0000
Y0	-44.0000
X1	154.0250
Y1	-9.9750

Available variables:

- Mean Temperature
- Minimum Temperature
- Maximum Temperature
- Precipitation
- Solar Radiation
- Relative Humidity

The following fields can be edited:

- Name – the name of the area as displayed in the tree. Renaming this does not rename the data folder the item is associated with.
- Type – the type of area. A list of possible values is provided (e.g. Country, State, Region). The Type specifies the colour of the icon in the tree. The type is cosmetic only and does not affect how areas are used within SimCLIM 4.0 for Desktop.
- Parent – shows the name of the area that selected area is a member of. Click the ellipse (...) button to move the area to a new parent area.

If multiple areas are selected, only the Type field can be changed (and will apply to all selected areas).

The Details sidebar also displays information about the area (obtained by examining the area folder), such as:

- Geo information – obtained by reading the “cookie” file associated with the area.
- Available variables – contains a list of baseline variables provided with the area.
- Patterns – contains a list of patterns provided with the area.
- Read me – if a readme file is provided with the area, an “Open readme” link is provided (click it to view the readme in a text editor).

Rearranging areas

There are several methods of arranging areas in the Area Tree Index.

Moving areas up or down

Use the Move up or Move down icons on the toolbar (or under the Area menu) to easily arrange an area within its current group.

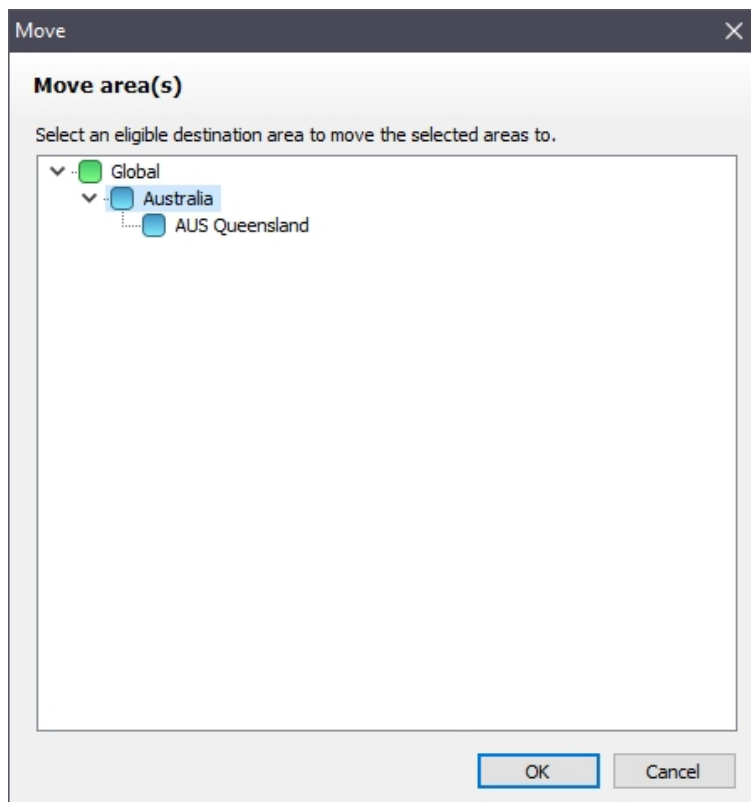


Dragging

You can quickly move one or more areas using the mouse. Select the areas you would like to move (hold CTRL and click an area to select multiple) then drag one of the selected areas (all selected areas will move as a group) to the area you would like to move them to.

Move to dialog box

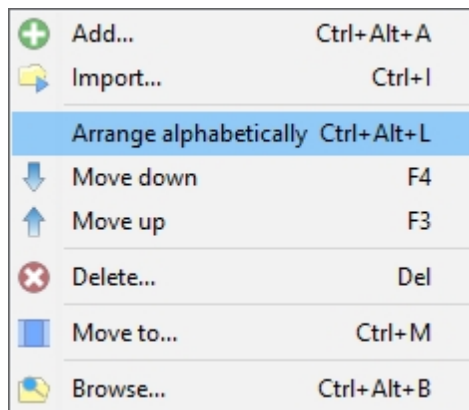
Select the areas you would like to move (hold CTRL and click an area to select multiple) and click the "Move to" icon on the toolbar (or click Area -> Move to in the main menu). A dialog box will be displayed with a list of areas the selected areas can be moved to. Select the desired destination area and click OK.



Arranging alphabetically

You can quickly arrange the entire tree alphabetically. To do list, click Area -> Arrange

alphabetically on the main menu.



Saving changes

You can save changes to the Area Tree Index using one of the following methods:

- On the main menu, click File -> Save.
- Click the OK button on the main window. This will also close the Area Manger.
- Click the Apply button on the main window.
- Click the Close button on the main window caption (the red X) and click Yes when prompted to save changes.

After changes are successfully saved, SimCLIM 4.0 for Desktop will automatically update the Area Tree Dropdown to reflect these changes. If you are not seeing these changes in SimCLIM 4.0 for Desktop please close and re-open it.

Opening alternative area index

Note: these instructions are provided for advanced use only, and are relevant only to users making use of multiple data folders.

The Area Manager lets you open “Area Tree Index files” (usually named Areas.dat) stored in locations other than the default location. It is also possible open these files referencing an alternative data folder, other than folder configured for use in SimCLIM 4.0 for Desktop.

To open an Area Tree Index file, follow the instructions below:

1. In the Area Manager window click File -> Open.
2. An Open File browser dialog will be displayed. Locate the Areas.dat file you wish to open and click Open.
3. Another dialog will be displayed. Specify the data folder you wish to use and click OK. If you select the “Use another data folder” checkbox, click Browse to specify the data folder you wish to use.
4. Click OK. The opened Area Tree Index will be displayed.

Note: Any saved changes will apply to the specified Area Tree Index file and will not be reflected in SimCLIM 4.0 for Desktop.

Restoring defaults

New SimCLIM 4.0 for Desktop installations provide a default Area Tree Index that matches the included data sets. If you wish to restore this default Area Tree Index, follow the instructions below:

1. In the Area Manager window click File -> Restore defaults.
2. If restoration was successful, the tree view in the main window will be updated.
3. Click the OK button or File -> Save to save changes.

Note: You may receive an error message if SimCLIM 4.0 for Desktop is no longer configured to the default data folder OR if the default area index file is missing.

Site Data Manager

Overview:

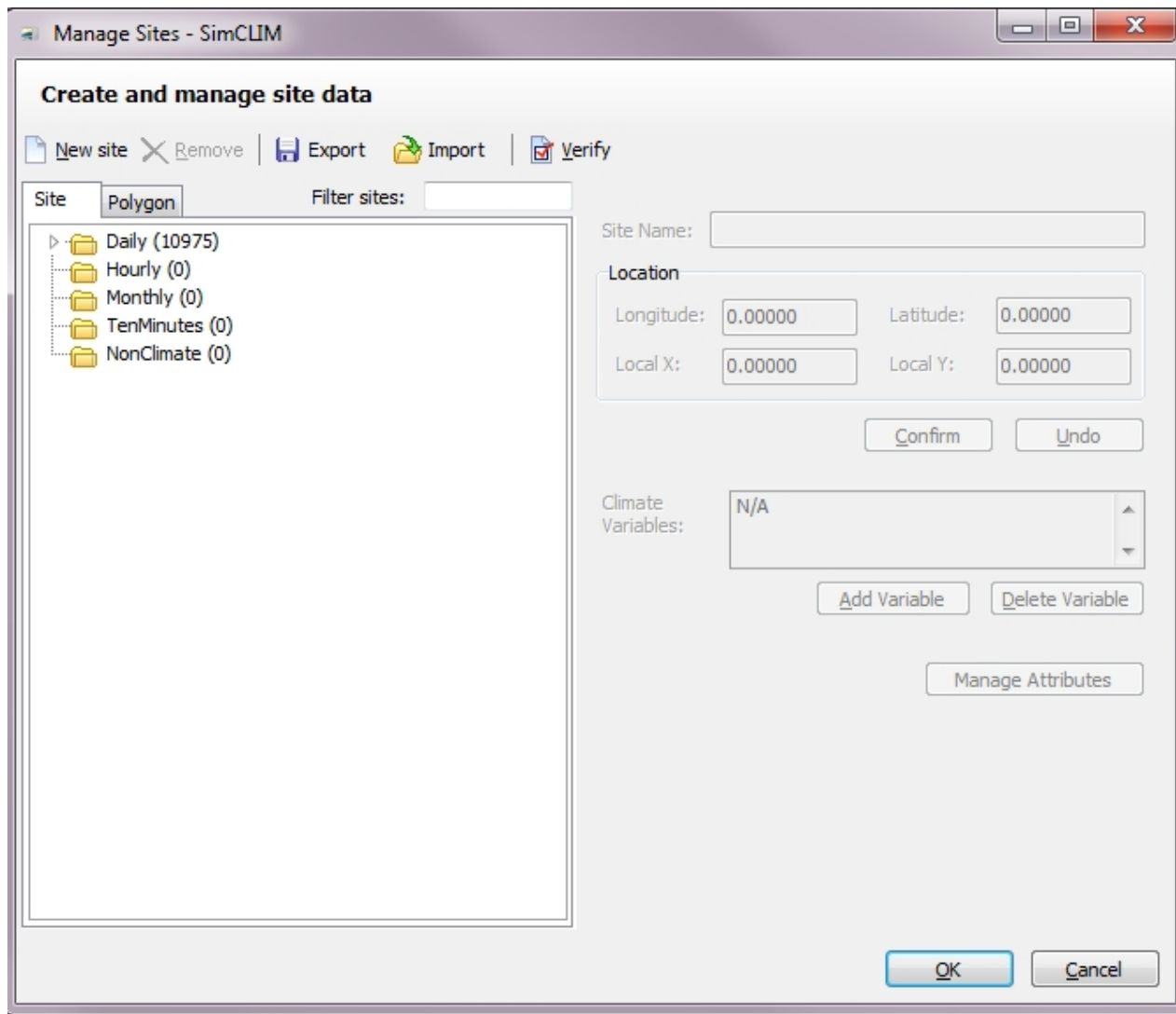
Site data is very important when conducting analysis on extreme events and for some impact models such as rainwater harvesting. We will begin by looking at how you manage already loaded site data. CLIMsystems is striving to provide as much site data as possible from reputable sources. Having such data preloaded in the system allows you to quickly and efficiently conduct analysis and produce outputs.

Activity: Open the site data manager and search for different sites.

Open the site data manager by selecting it in the main toolbar at the top of the screen or click in the main screen and select it from the comprehensive list.



The following screen will be displayed.



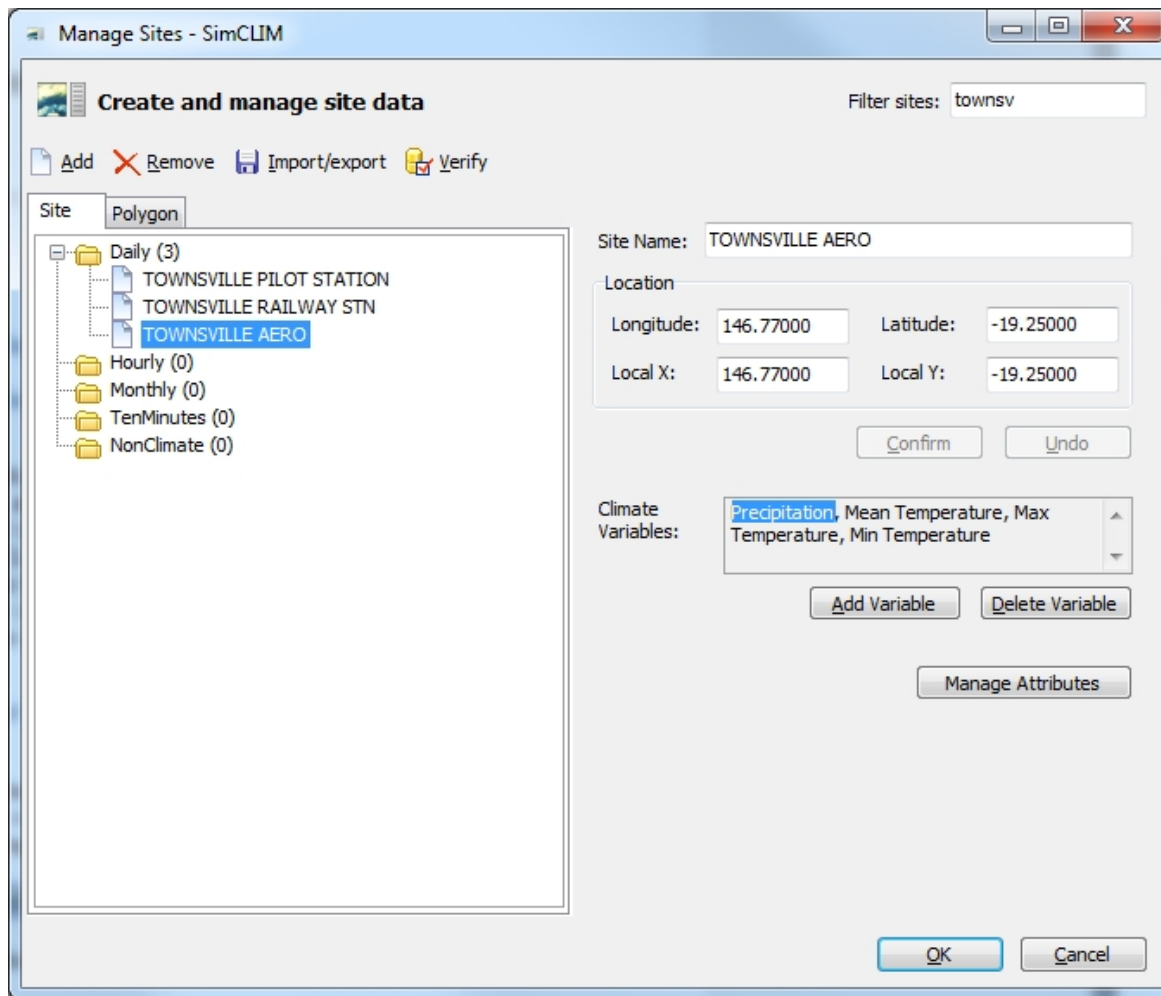
Find a site: To do this click on the daily folder and then begin typing the name of the place that

Filter sites:

you believe has a site you are interested in in the dialogue box. For example, begin to type Brisbane. Watch the number of files (8601) in the brackets to the right of the folder decrease with each additional letter you type. When the number drops to a reasonable figure open the folder and choose the site you are interested in.

Try this for several sites. Clear the filter sites bar and look again. Try Adelaide or Townsville or something else.

When you find a site you are interested in click on it and note the change in the display.



It is important to note what data is contained in the file and its location. Some files will contain only one climate variable. Others may have several.

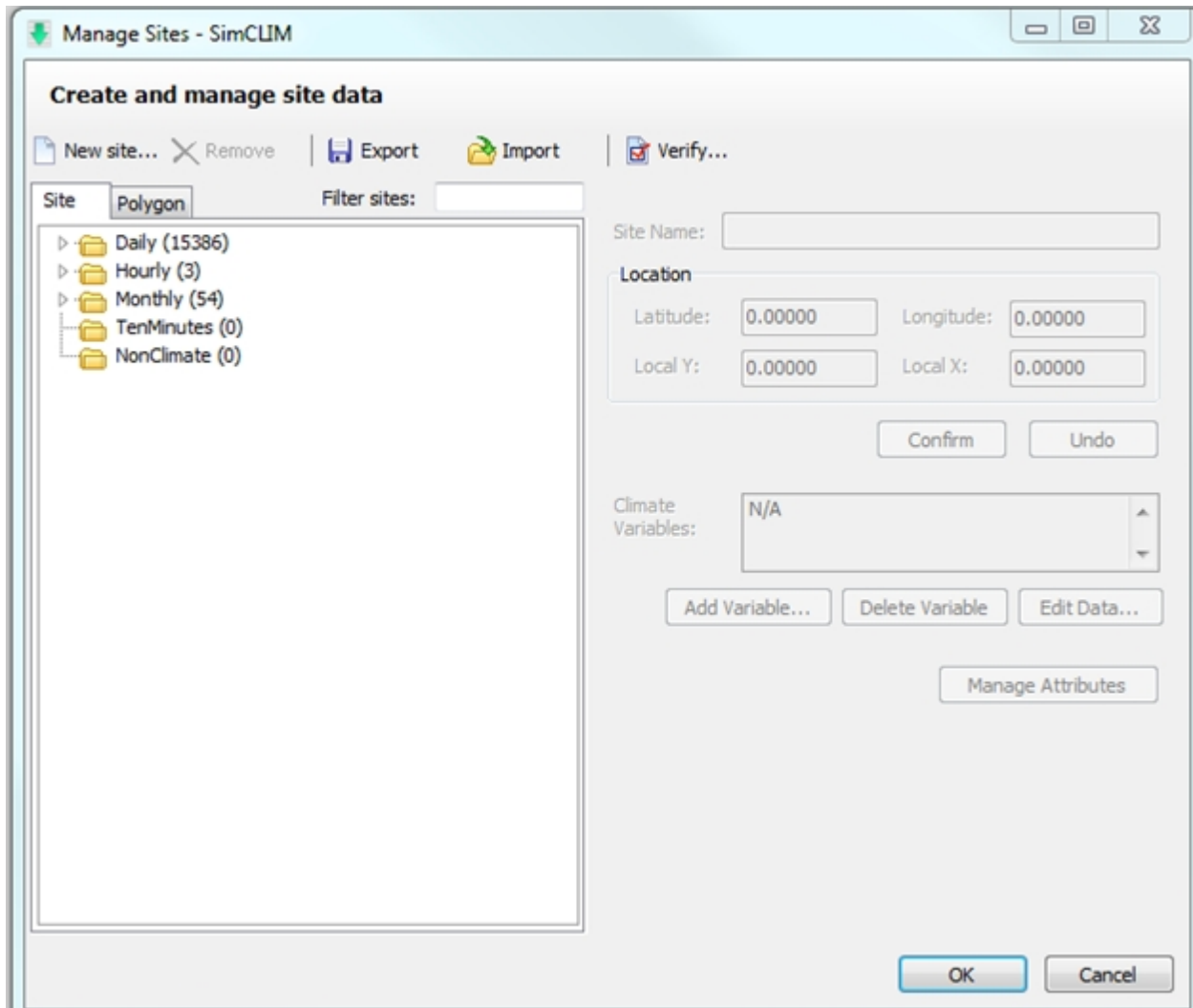
See the next item in the manual for adding new data to the system.

Adding New Site Data

Open the site data manager by selecting it in the main toolbar at the top of the screen or click in the main screen and select it from the comprehensive list.



The following screen will be displayed.



To begin you need to define whether the data you wish to add is Daily, Hourly or Monthly etc. Click once on the data folder you wish to add your data to. After highlighting the folder click on Add.

A new dialogue box will open that will ask you to name the site and provide its location:

To complete this function you will need your data to be in the proper format.

These are:

1. Daily data option 1: the first column is date in 8 digits and the second column is climate data :

```
19790101 33.3
19790102 29.2
19790103 30.6
19790104 30.5
19790105 30.2
19790106 30.9
```

- Daily data option 2: the first column and second column are year and month and the rest 31 columns (column 3 to column 34) are climate data

```
1972 1 50 50 22 11 33 17 22 11 61 72 44 56 122 22 100 89 11 83 94 11 17 94 67 117 100 100 56
61 72 61 56
1972 2 6 22 39 0 89 44 83 83 56 56 44 56 17 22 56 11 6 28 11 100 50 33 56 0 -17 -22 22 28 33 -
999 -999
1972 3 94 22 -67 11 11 -56 100 39 -39 -50 50 22 -6 17 22 22 39 11 -33 44 72 56 11 -28 -22 17 0
11 83 56 111
1972 4 56 56 61 39 22 11 39 39 50 83 128 100 144 83 78 67 128 211 161 111 106 89 89 83 78
128 106 156 156 156 -999
```

- Monthly data option 1: the first column is date in 6 digits and the second column is climate data :

```
197901 33.3
```

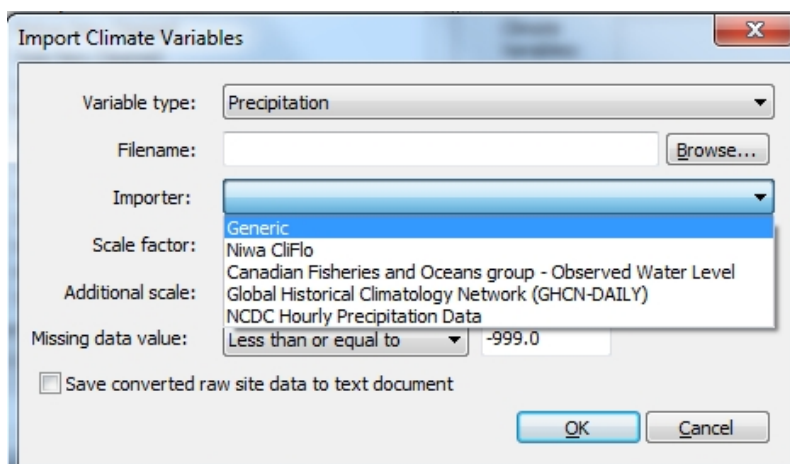
197902 33.2
 197903 29.6
 197904 25.5
 197905 21.2
 197906 18.9

- Monthly data option 2: the first column is recording year and the rest 12 columns are climate data:

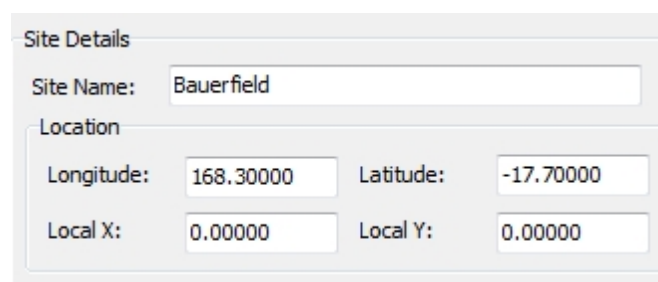
1972 30 32 29 26 23 17 12 11 16 17 24 29 1973 31 32 29 24 19 14 13 13 16 16 24 26 1974 29 28
 26 21 19 16 10 9 15 20 21 22 1975 32 30 28 25 22 11 11 9 15 23 22 30 1976 32 31 28 24 26 13
 14 9 19 18 21 30

If your data is not in one of the above formats contact CLIMsystems and we will assist in reformatting the data.

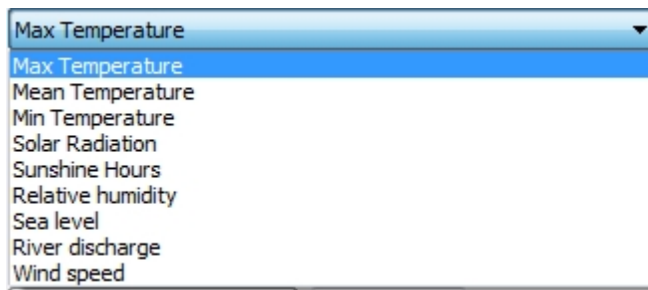
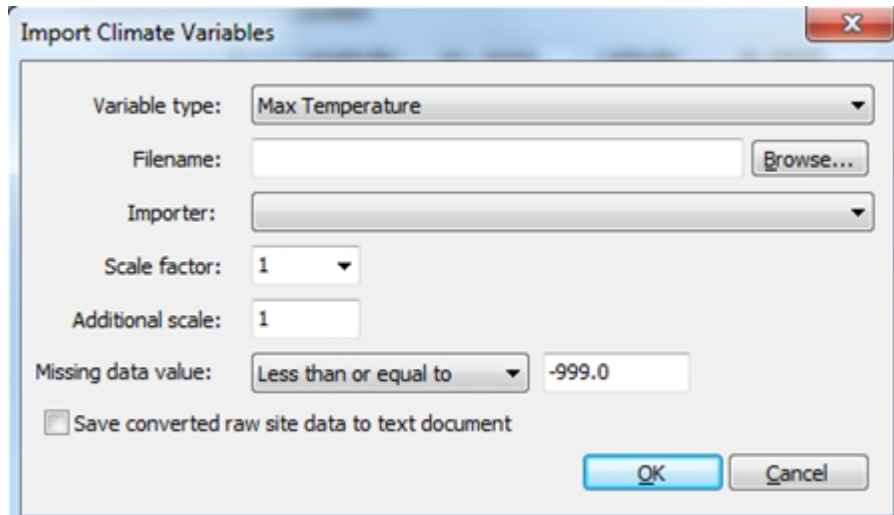
There are also preformatted data that from time to time you may have access and wish to import using the data manager. See the list below of importers that accept data from a range of global, often web-accessed databases.



After naming the site you need to enter the data on the latitude and longitude. This is critical so that the impact models know where to search in the database for running models. This sort of information is often in the header files for the data.



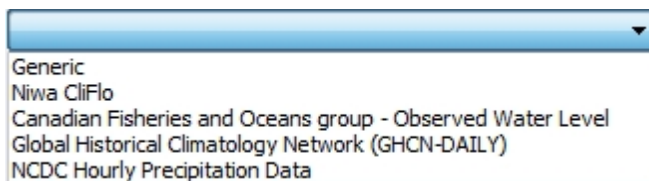
After defining the name and location you have a number of choices to make with reference to the data type, its location and format.



Variable type:

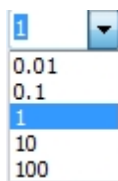
Choose from the list.

Filename: Click on the  button and find the directory and file you wish to import.



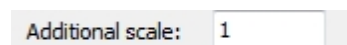
Importer:

Click on the format required.

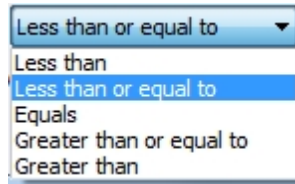


Scale factor:

This moves the decimal point in your data. Commonly 1 is used and is the default. You will need to check your data to determine if this is the correct scaling factor.



This tool can be used in certain cases where known scaling factors are required to standardise data. Often this is left as 1.



Missing data value:

Commonly the default is chosen.

Click on Save converted raw site data to text document if your data is in a SimCLIM 4.0 for Desktop-compatible format such as NIWA CliFlo but you wish it to be saved as a two column text file at the same time as it is being imported into SimCLIM 4.0 for Desktop. Sometimes you may have use for this very versatile format, such as for file sharing or importation into other data management tools such as Excel. In most cases you will not need to check this box.

After you have defined all the parameters click on .

When you are returned to the main dialogue box click  again in the bottom right to force the importation.

If there is a problem with the data format or a dialogue box has been overlooked you will get an error message.

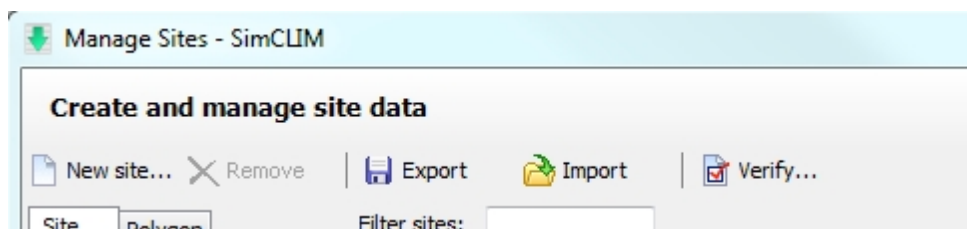
Return to the variable option and choose the next variable type to import, if you have additional variables to import for that particular site.

Browse the new site data in the data browser to see if it makes sense in terms of the values displayed. It is always wise to check your data for anomalies (outliers).

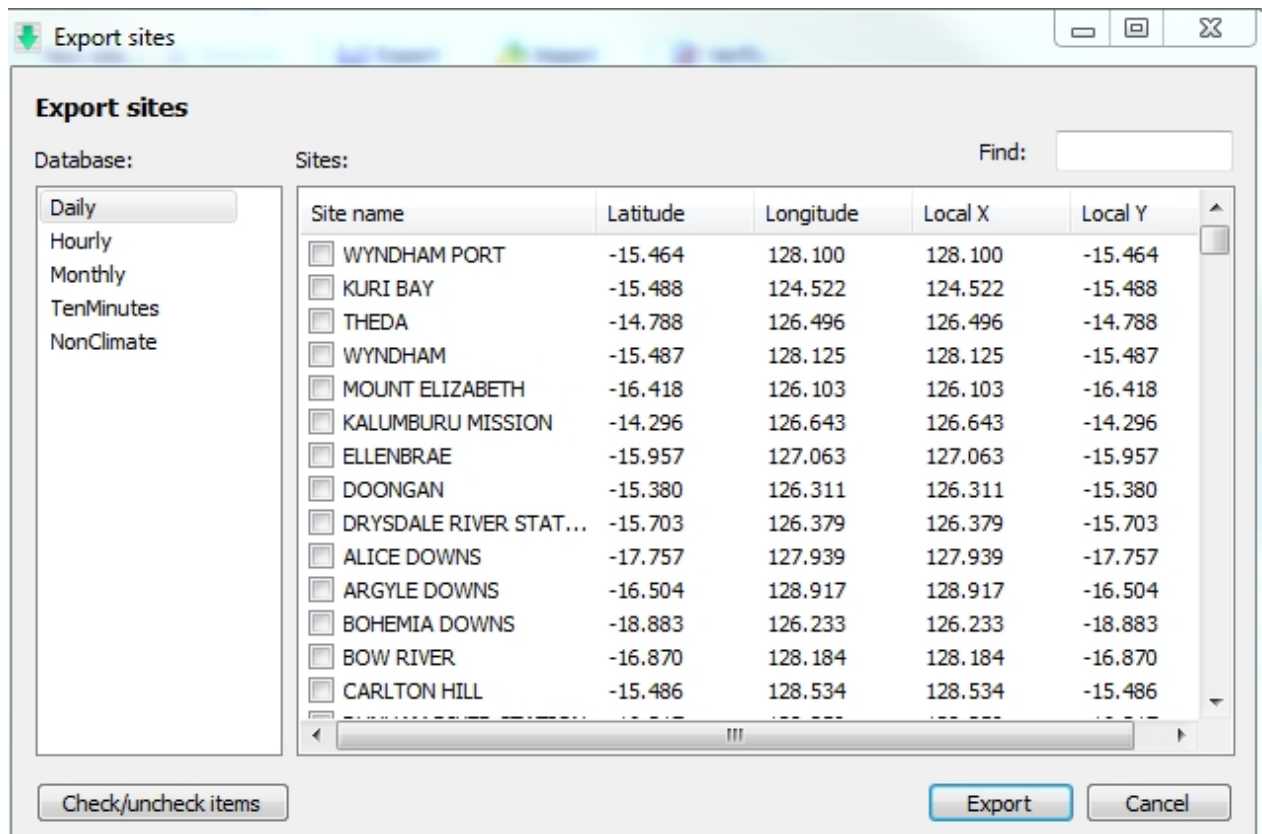
Adding Site Data From a Site Data Package

A .sdpkg file is a bundled site data package that has been created in SimCLIM 4.0 for Desktop to ease the sharing of such data with other users.

To create one simply go to Manage Sites in SimCLIM and click on Export:



Click on the temporal resolution of the sites you wish to consider exporting - in this case daily was chosen:



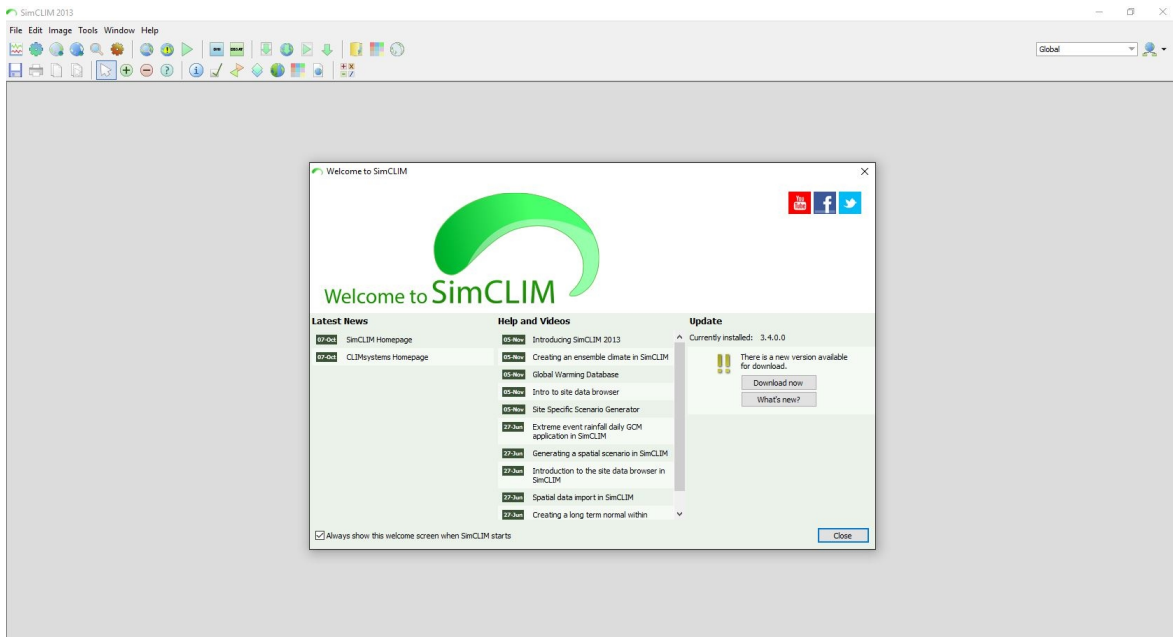
Click on the sites you wish to export or use the check/uncheck items as this may save you some time if you have many sites to consider. Then click on Export.

Your file explorer will open and you create a folder or navigate to a folder where you wish to save the site data package.

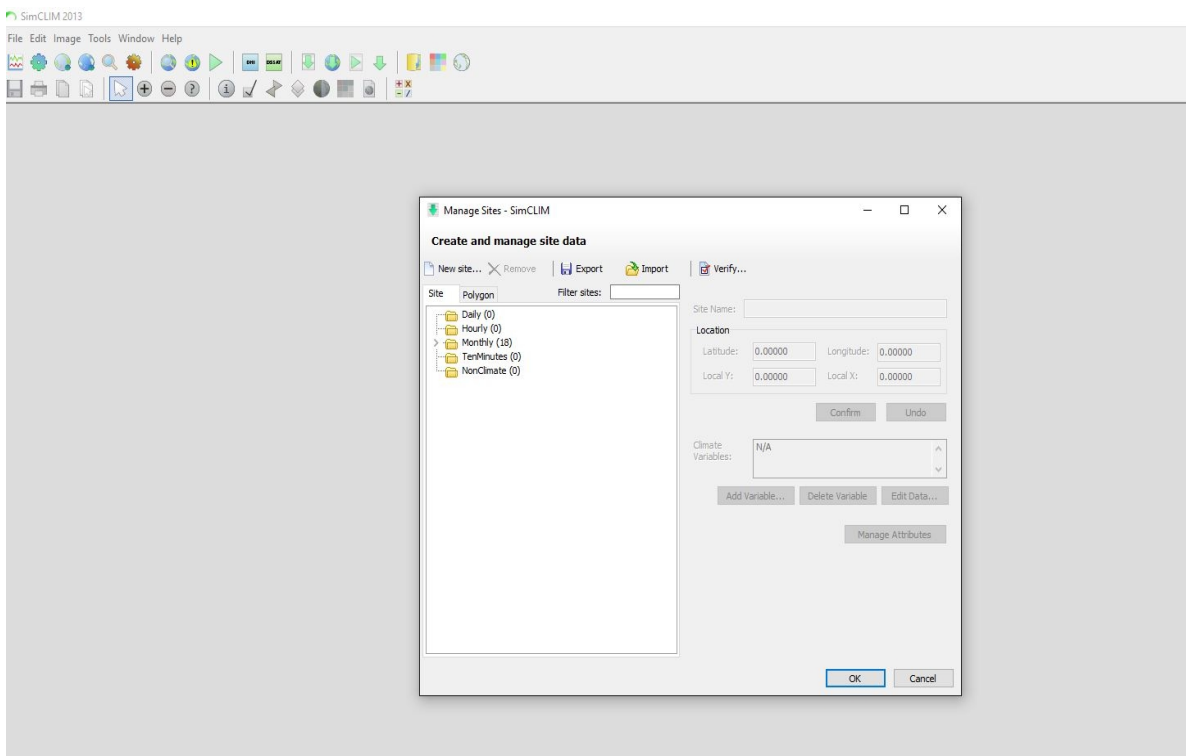
Name the file and save it. It can now be shared with others and imported as described below.

Importing a Site Data Package

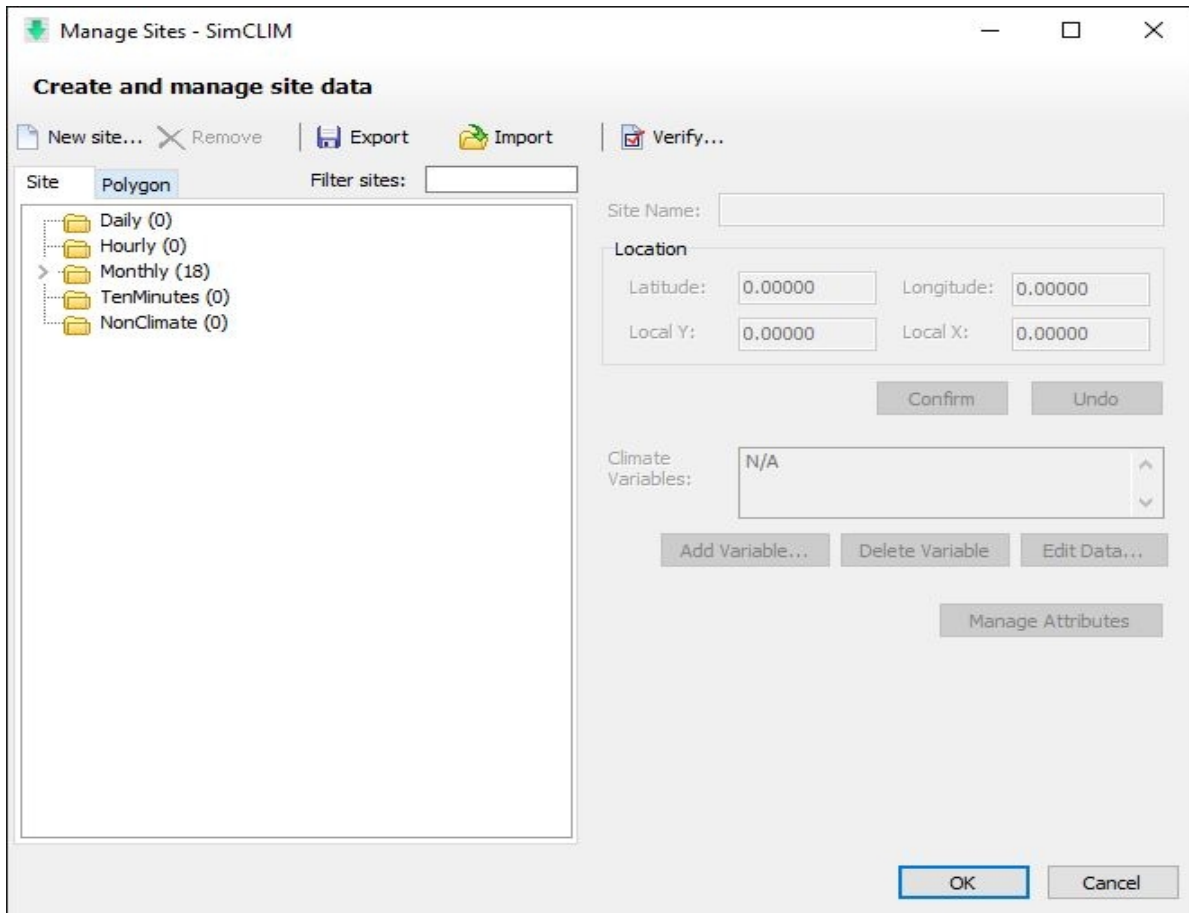
1. Save the "sites.sdpkg" attachment to your computer (e.g. on your Desktop).
2. Open the SimCLIM 4.0 for Desktop application.



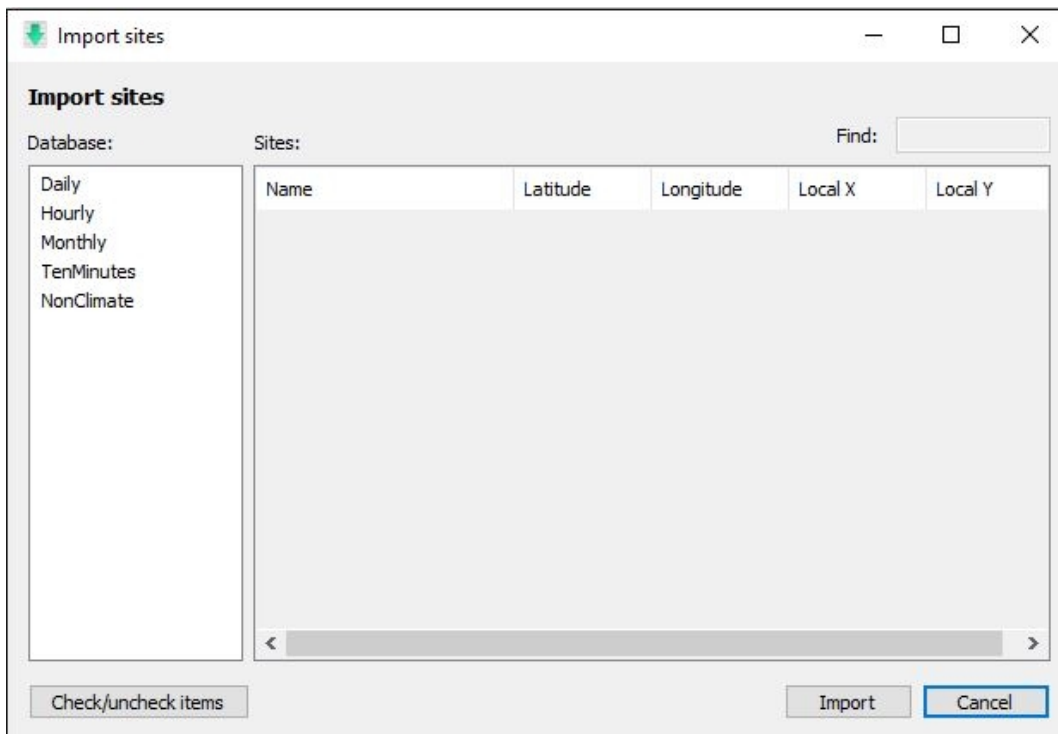
3. On the toolbar, click the "Manage sites" icon



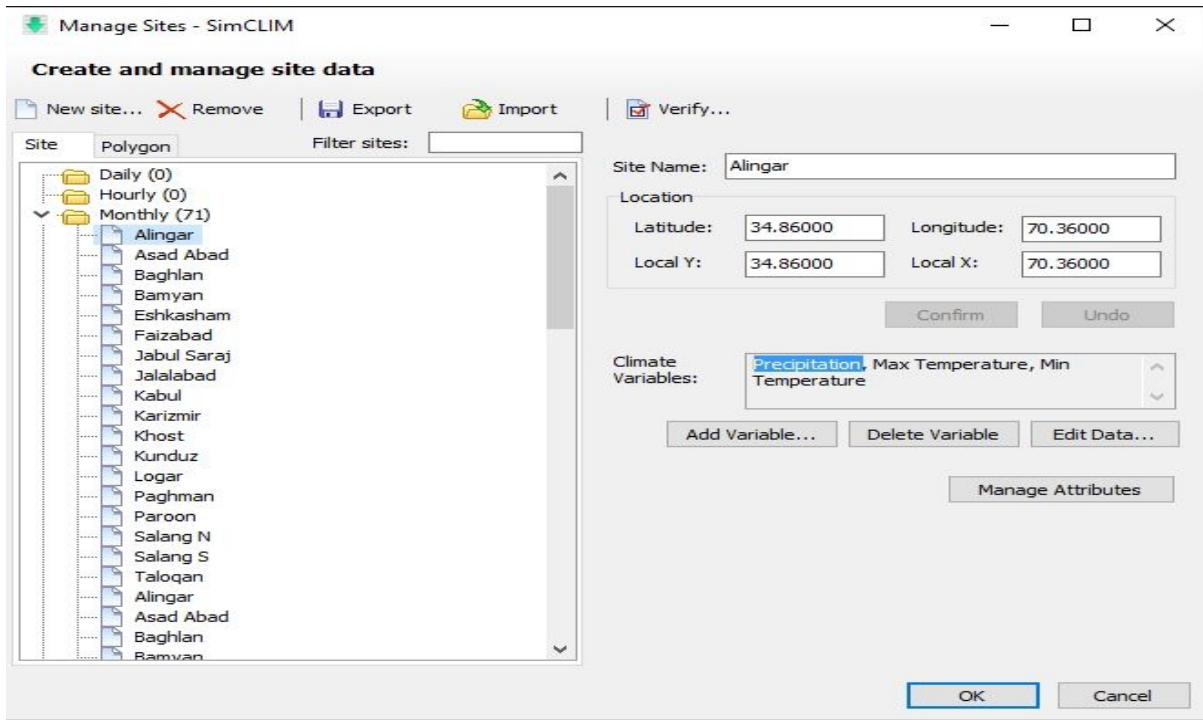
4. In the "Manage Sites" window, click the "Import" button and select the "Sites.sdpkg" file. The Import window will appear.



5. Click either the daily, hourly, monthly etc to see what data is in the package. When data names appear in the right panel click the "Check/uncheck items" button and select "Check all".

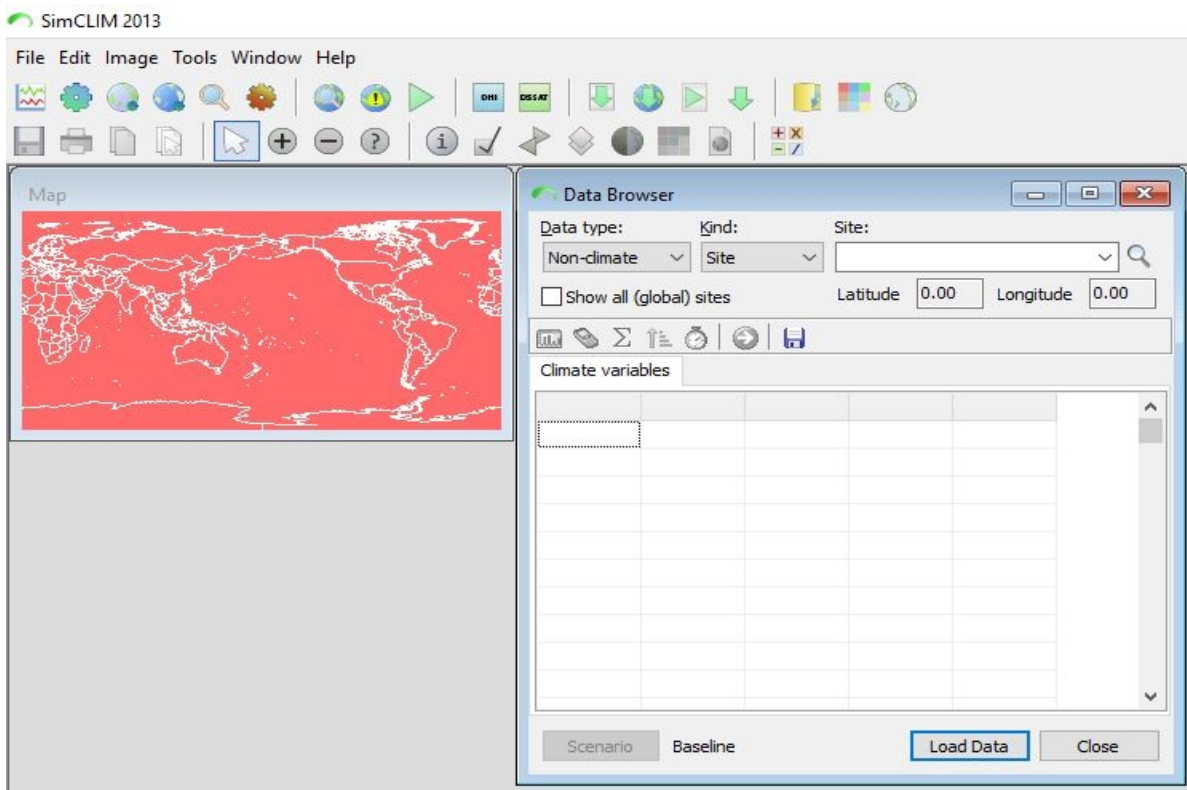


6. Click "Import". You can see all the site data import in the tab. Click on any site to see relevant information. For example: Lat- Long and climate variables provided. You can also add, edit or delete a variable.

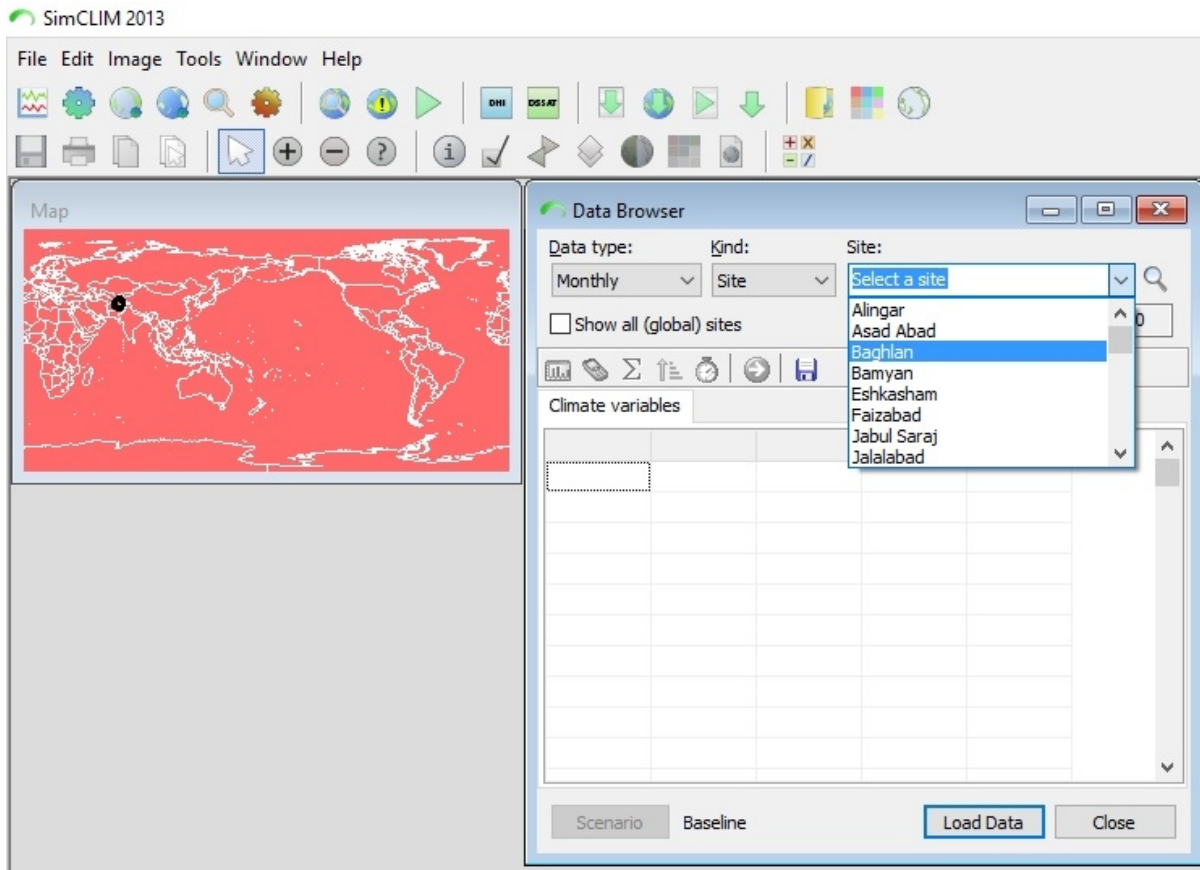


7. Click OK to close the Manage Sites window and save changes. The data should now be available in the Data Browser and Extreme Event functions in SimCLIM.

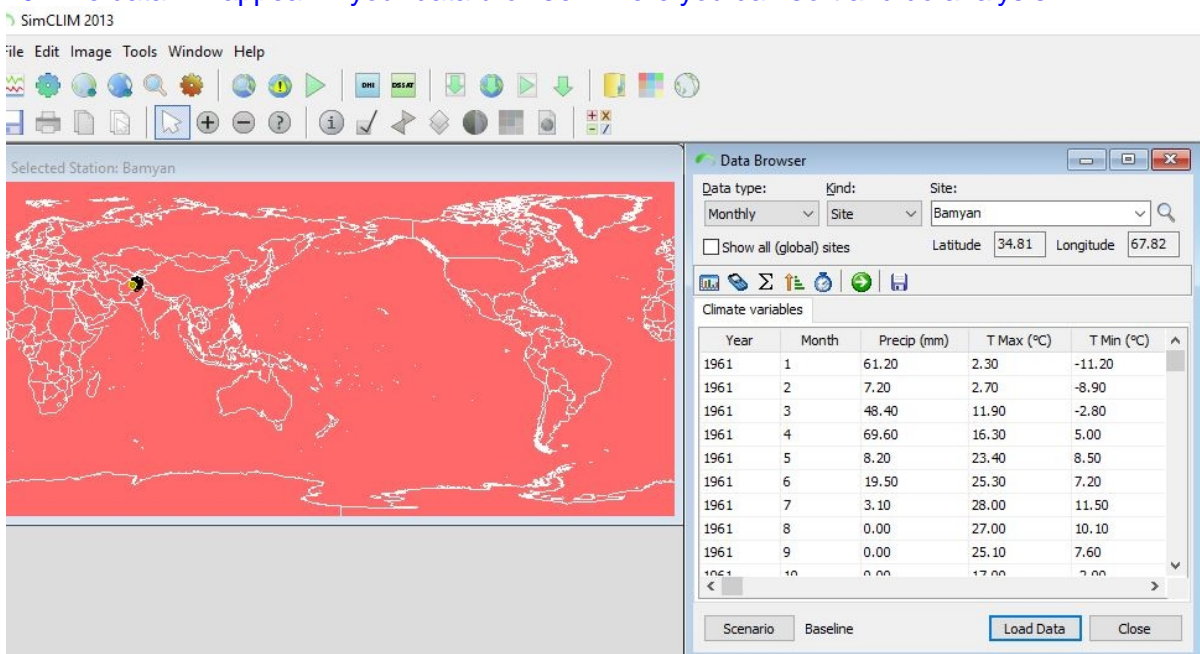
8. Click on the site data browser. The Data browser dialog box will open.



9. Change the data type to monthly or daily depending on the type of data you are interested in and select your site from the list. Then click load data.



10. The data will appear in your data browser where you can sort and do analysis.



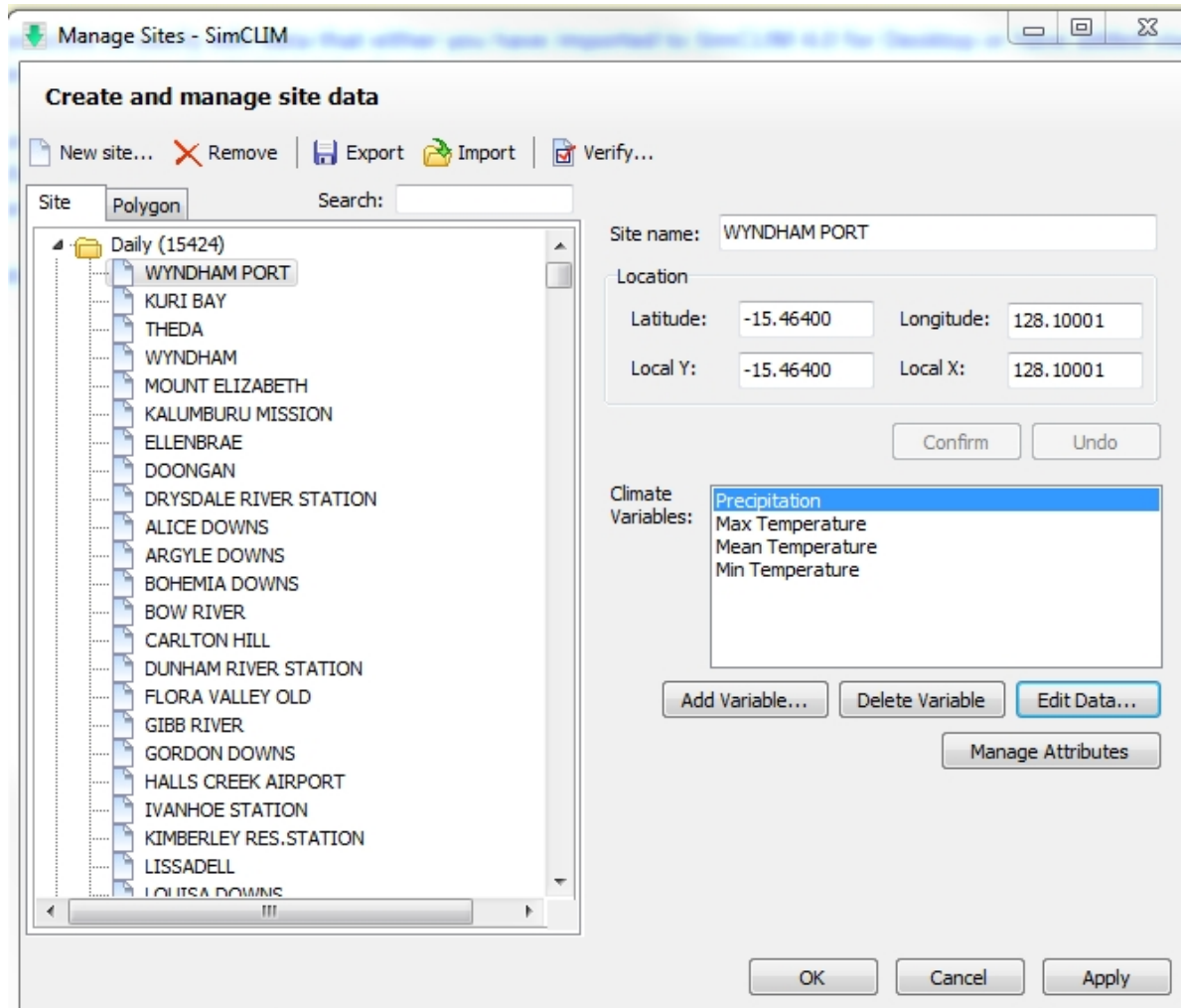
Editing site data

It is now possible to easily edit data that either you have imported to SimCLIM 4.0 for Desktop or have added via a site data package obtained from CLIMsystems or another SimCLIM 4.0 for Desktop user.

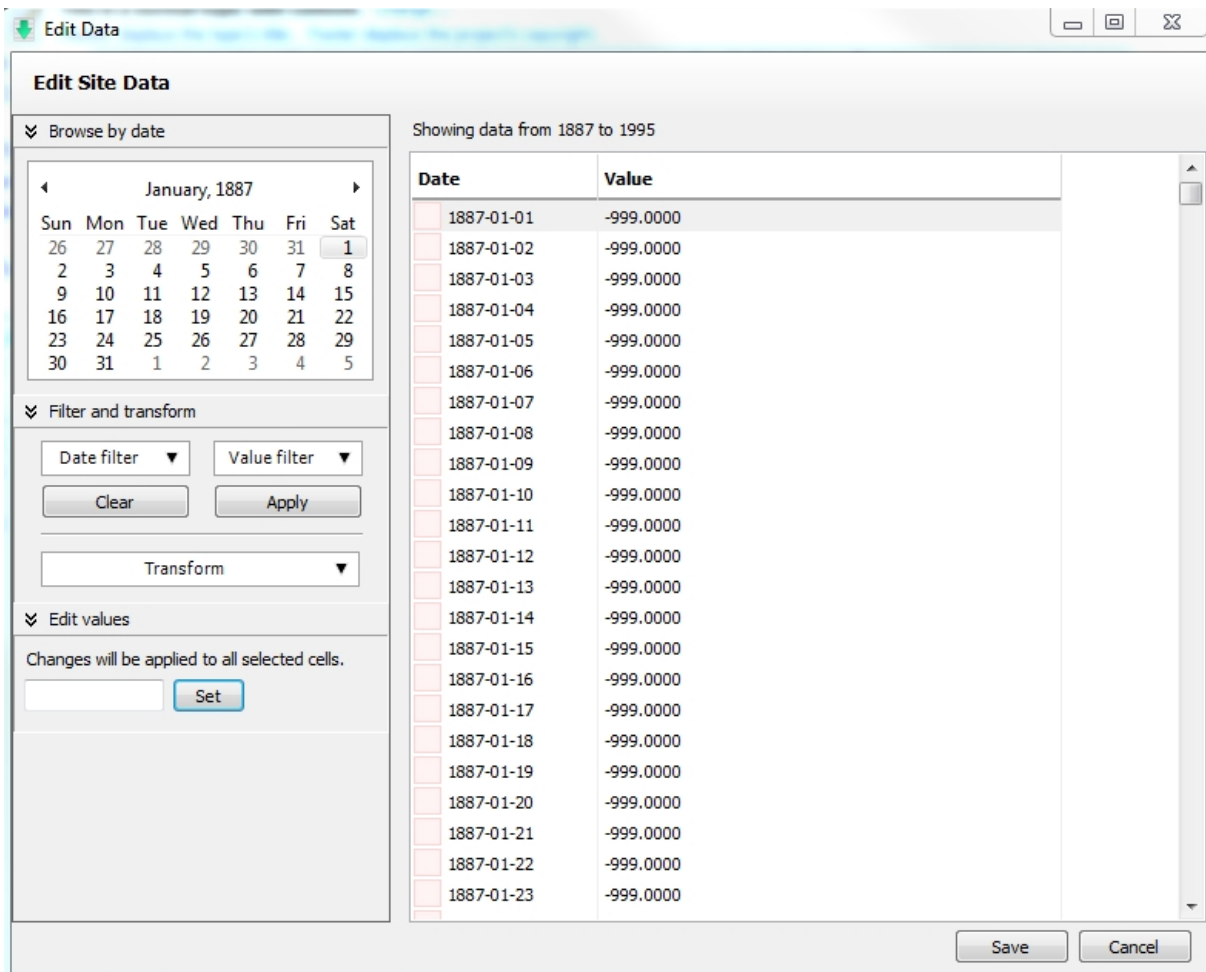
This feature can be very important as often site data that is obtained from various sources can

include errors. This is more common than you might think and therefore we advise you check all site data you apply in your project carefully for what may appear to be anomalous data. You can query data for errors by using display tools in the site data browser. You can identify outliers and the date that they refer to and then note them and edit them to correct values.

To edit data open the Site Data Manager and select a viewing file be it hourly, daily or monthly etc.

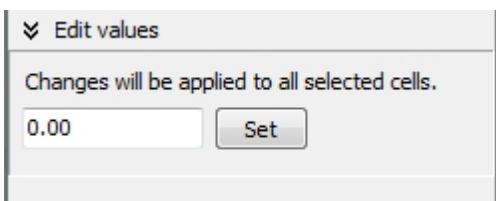


Click on a data variable, for example, precipitation. Then click on .

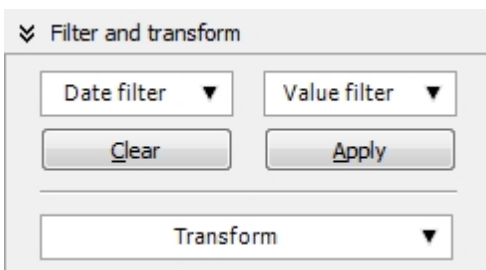


You can then choose the date of the data cell you wish to change/edit.

Then change it in the value window and by entering the number you wish and clicking on set. Be sure to click on save before exiting the dialogic box to be sure the change is registered in the file.



You can also filter your data and transform a number of values collectively.



Click on the date filter to choose a month:

Date filter ▼ Value filter ▼

Months:

<input checked="" type="checkbox"/> Jan	<input checked="" type="checkbox"/> Jul
<input checked="" type="checkbox"/> Feb	<input checked="" type="checkbox"/> Aug
<input checked="" type="checkbox"/> Mar	<input checked="" type="checkbox"/> Sep
<input checked="" type="checkbox"/> Apr	<input checked="" type="checkbox"/> Oct
<input checked="" type="checkbox"/> May	<input checked="" type="checkbox"/> Nov
<input checked="" type="checkbox"/> Jun	<input checked="" type="checkbox"/> Dec

Select all Deselect all

And then select the Value filter:

Value filter ▼ 1936-10-02 0.0000

Values greater than or equal to: 100

Values less than or equal to: 0

Missing data values

Finally select the manner you wish to transform the data either by a set value or by multiplying, dividing, adding or subtracting from the data:

Transform ▼

Transformations will be applied to currently displayed records.

Set value to: 110

Transform value: Multiply 0

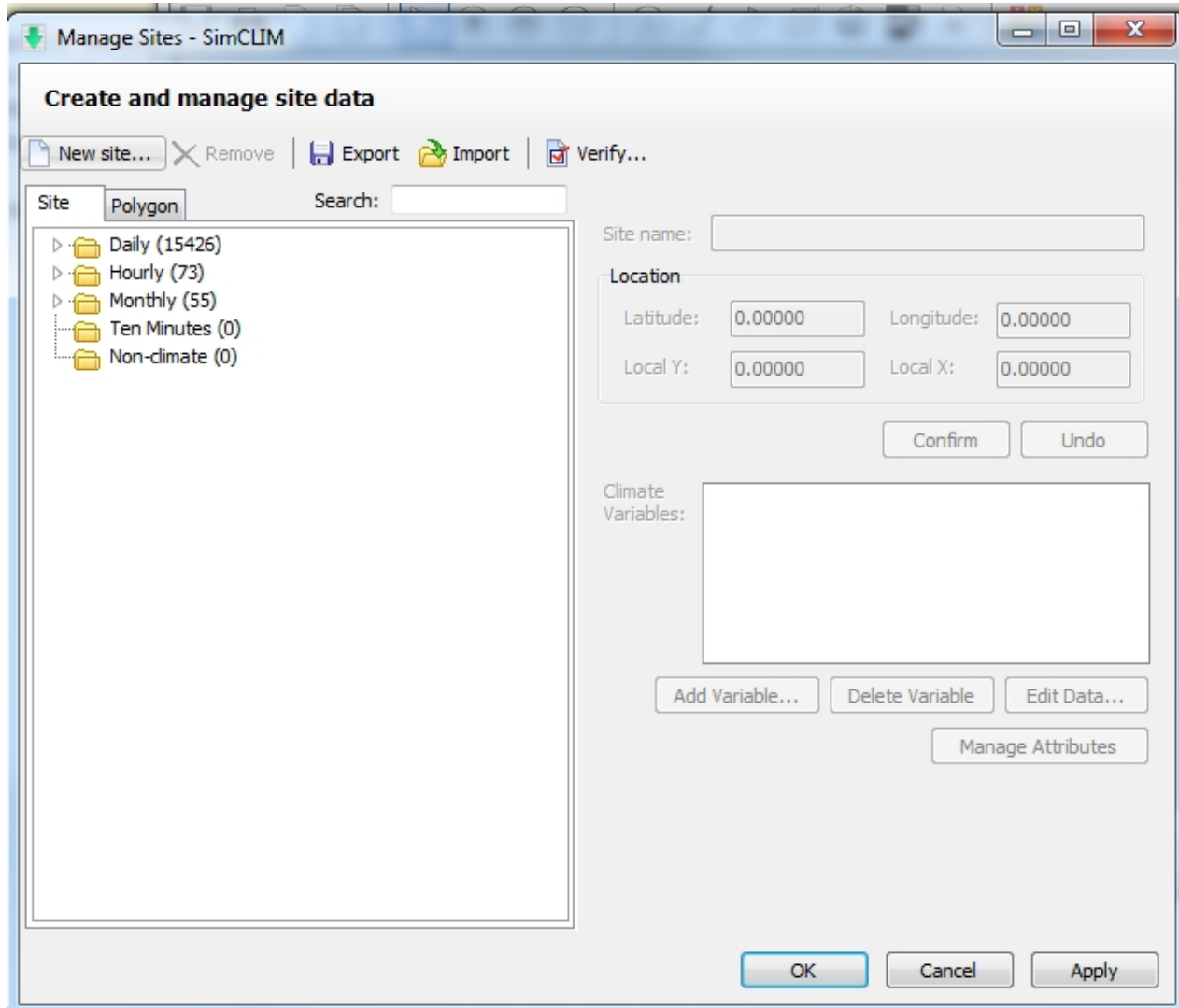
Transform

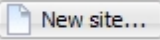
Again be sure to save the data after transforming it.

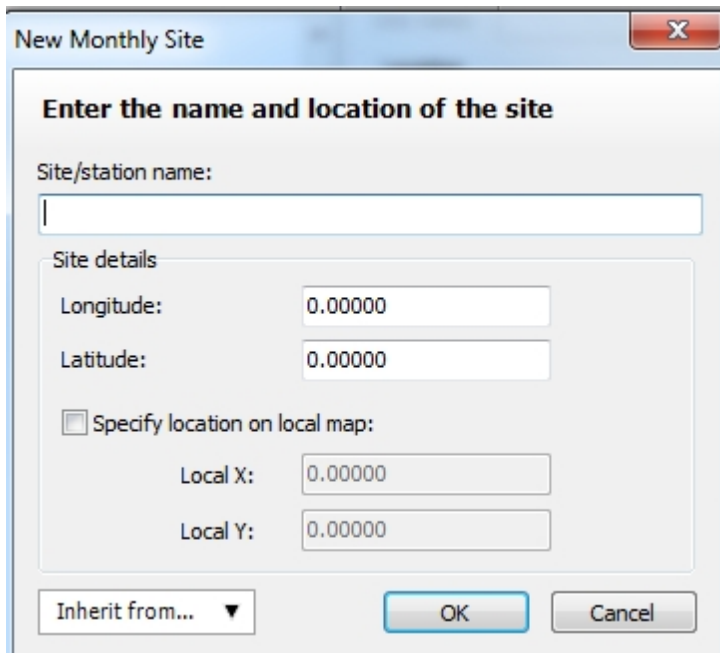
Inheriting Site Data Attributes and Populating with Aggregated Data

Sometimes it is necessary to create site data for an already present data site that has a different data temporal resolution. For example you may have daily data in a site data file but you need monthly data for the same site. This can be easily achieved by following a two step process: creating a new site by inheriting the location information from the already present file; and secondly, by then using the aggregate tool to add the data at the resolution required to the new file.

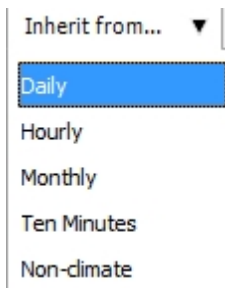
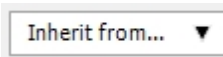
To begin open the site data manager:



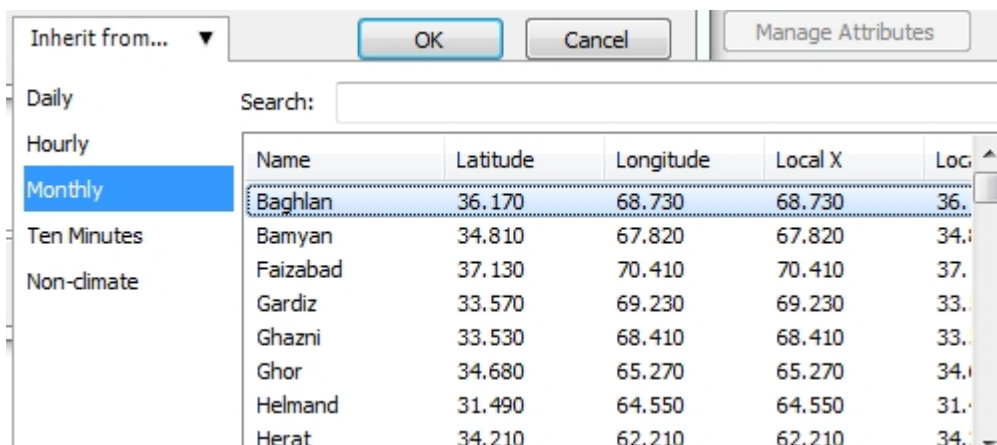
Choose what type of aggregation resolution you are going to create: daily (from hourly) or monthly (from daily). Click on the folder you wish in this case. DO NOT TYPE IN A SITE NAME if you wish to inherit the location information from another site. Click on  and then



Then click on



You can click on any one of the dropdown choices.



Double click on the site of choice.

The name and latitude and longitude of the clicked on site will be displayed. Now you can replace the name with the name of your new site that will be in the monthly folder. Be sure to check the specify location on local map if you wish the site to be available on the map in the

data browser etc. Click on

OK

New Monthly Site

Enter the name and location of the site

Site/station name: Rangeville

Site details

Longitude: 68.73000

Latitude: 36.17000

Specify location on local map:

Local X: 68.73000

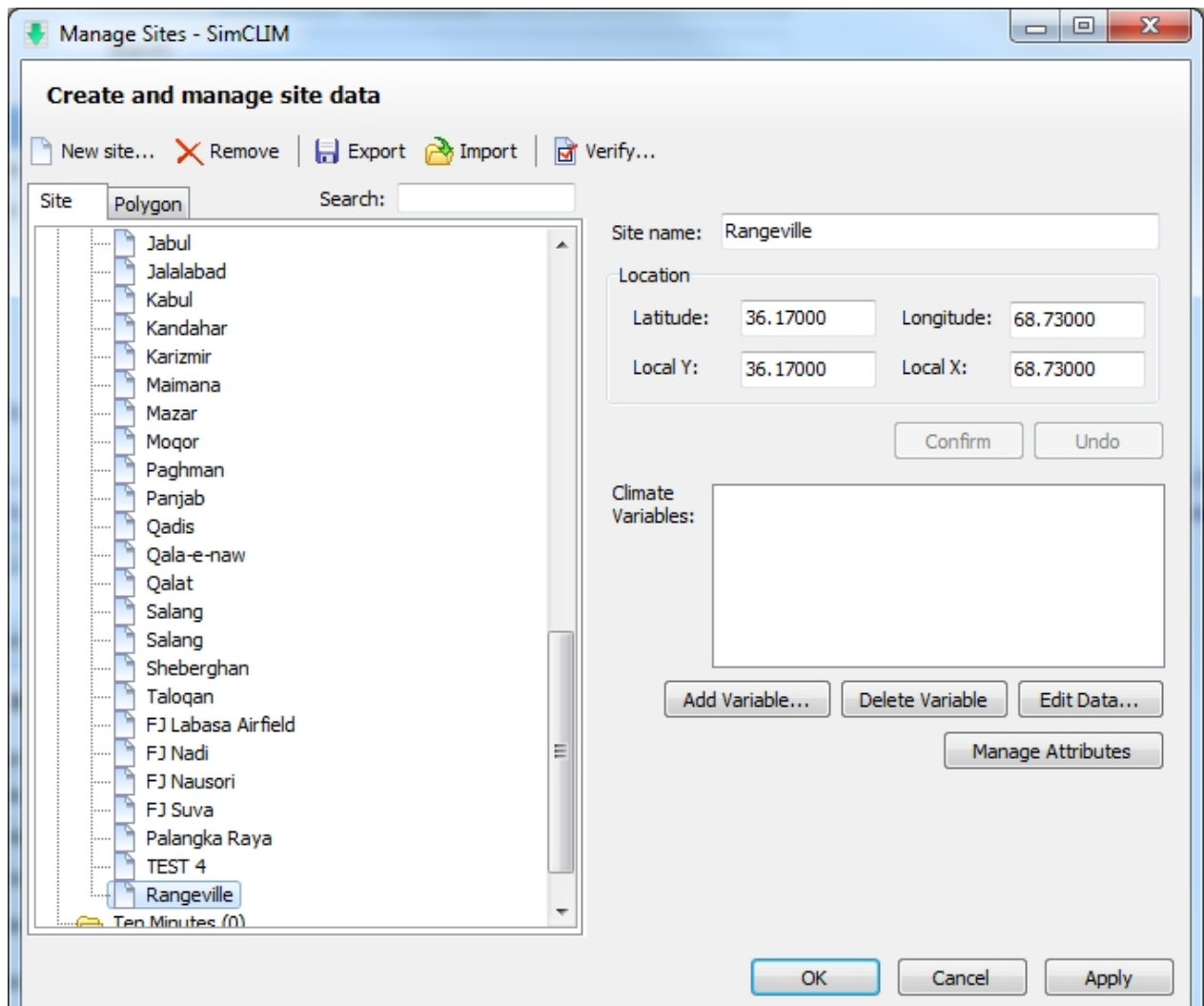
Local Y: 36.17000

Inherit from... ▼

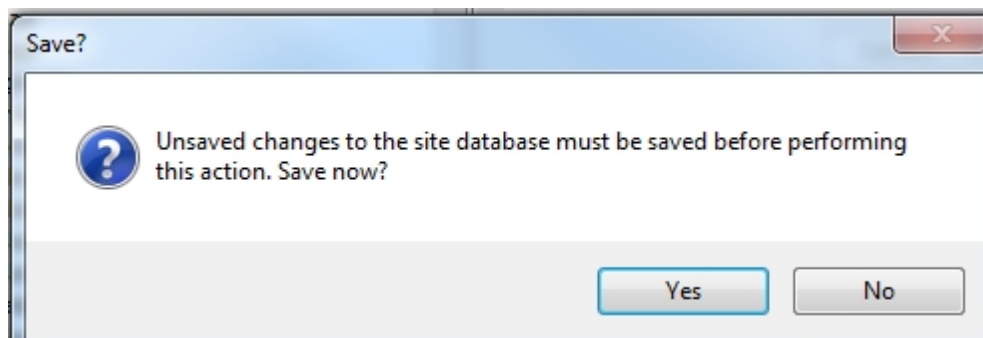
OK Cancel

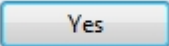
Then close the New Monthly Site window.

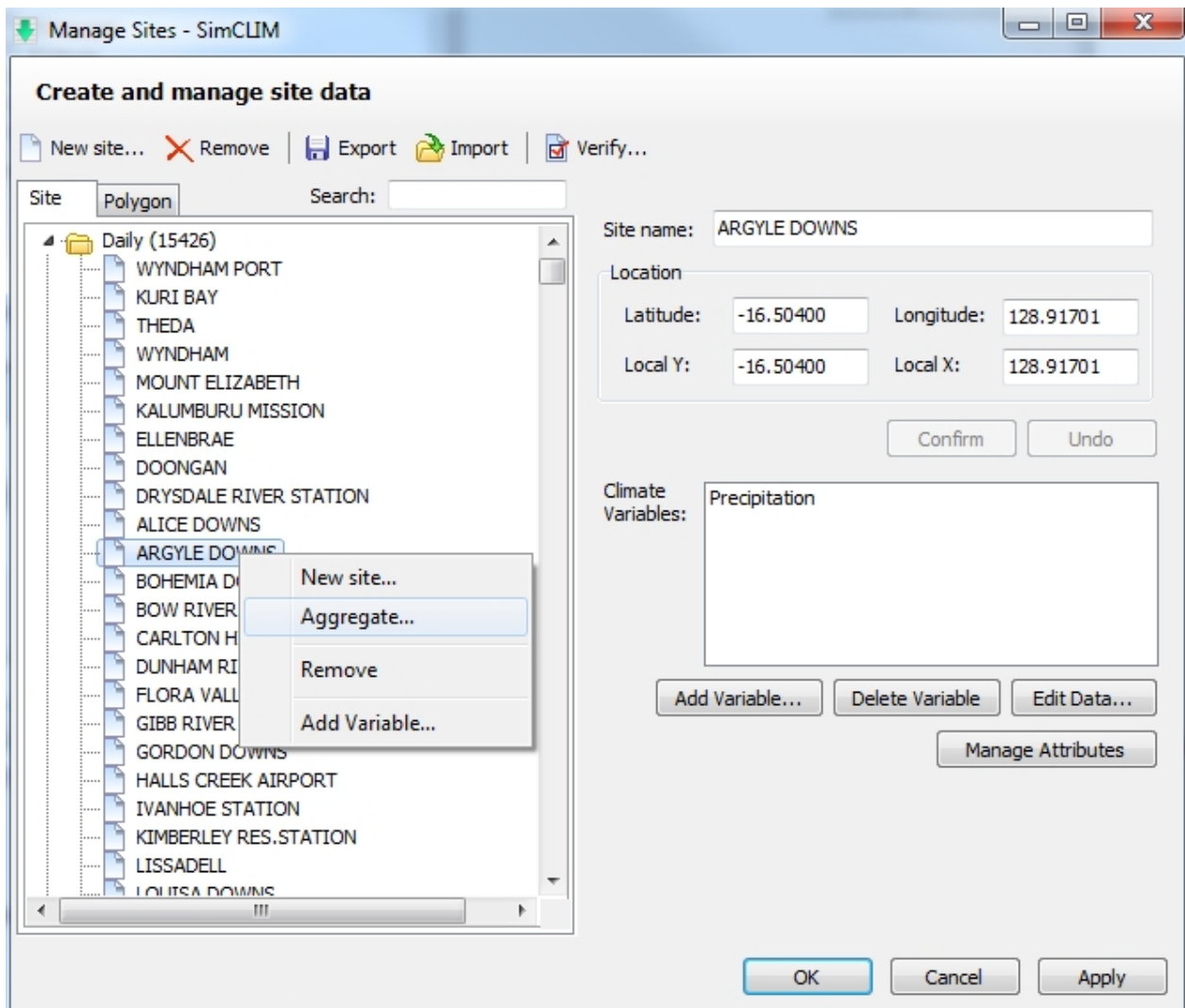
When back in the Manage Site window find the new site in the monthly folder. Right click on it and choose aggregate.



The following window will pop up:



Choose . The aggregate dialogue box will appear. Now you can add data to the new monthly data site. Choose the site you are going to AGGREGATE FROM.



Right click on the site you wish to aggregate from and the aggregate choice appears and you should click on it.

Aggregate

Aggregate to new site

Selected site: ARGYLE DOWNS

Aggregate to: Monthly

Destination:

Create new site (inherited from selected)

Override site ID:

Existing site

Select:

Value option:

Default

Min

Max

OK Cancel

You wish to aggregate to Rangeville so choose existing site (created above) to aggregate to.

Aggregate

Aggregate to new site

Selected site: ARGYLE DOWNS

Aggregate to: Monthly

Destination:

Create new site (inherited from selected)

Override site ID:

Existing site

Select: Rangeville F:\Data\Site data\Sites\M

Value option:

Default

Min

Max

OK Cancel

Use the default data type and click

OK

Click on Apply and Okay and your new data site will have been created. Go to the site data browser to view the new data.

Selected Station: Rangeville

Data Browser

Data type: Monthly Kind: Site Site: rangeville

Show all (global) sites Latitude: 36.17 Longitude: 68.73

Climate variables

Year	Month	Precip (mm)
1947	4	0.00
1947	5	0.00
1947	6	0.00
1947	7	0.00
1947	8	356.00
1947	9	110.00

Scenario... Baseline Load Data Close

In this case you are going to aggregate to an existing site: Rangeville.

Monthly and type in the name of your new site. It can be the name of an already present site but you might wish to add a signifier like Rangville_daily if there is already a Rangville monthly file.

Now that you ha

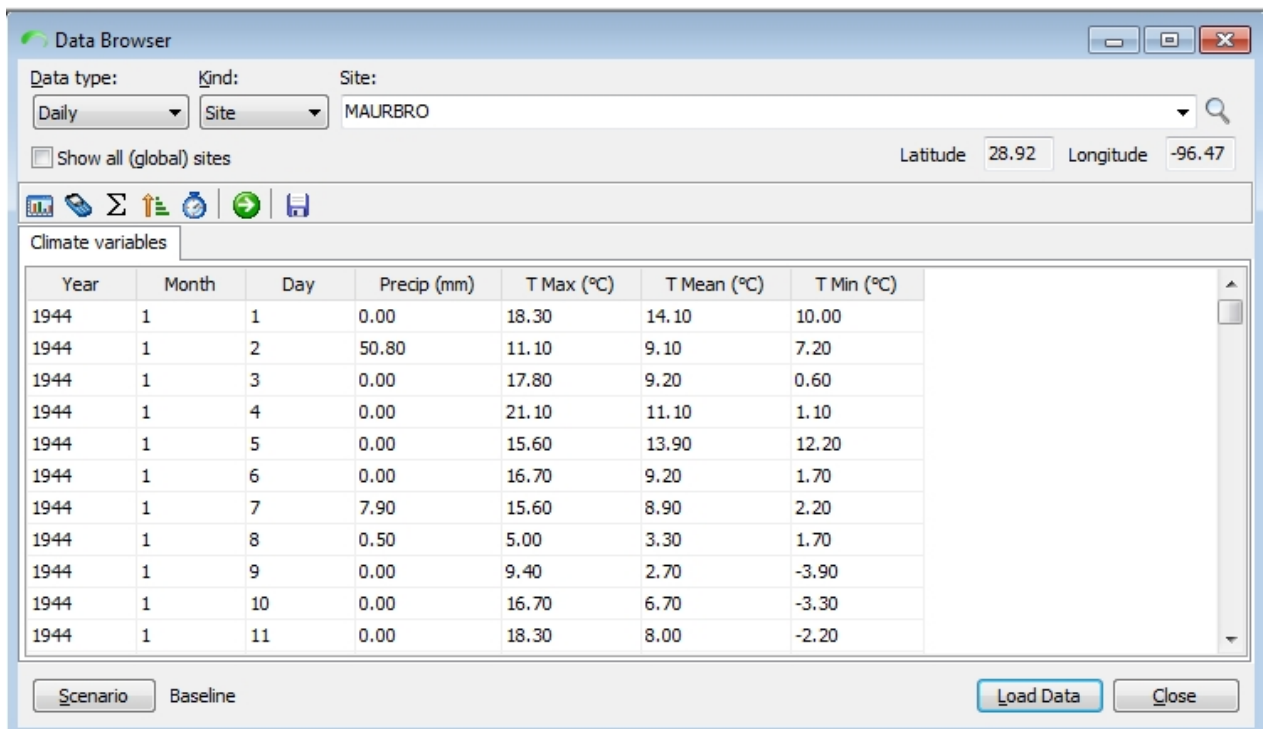
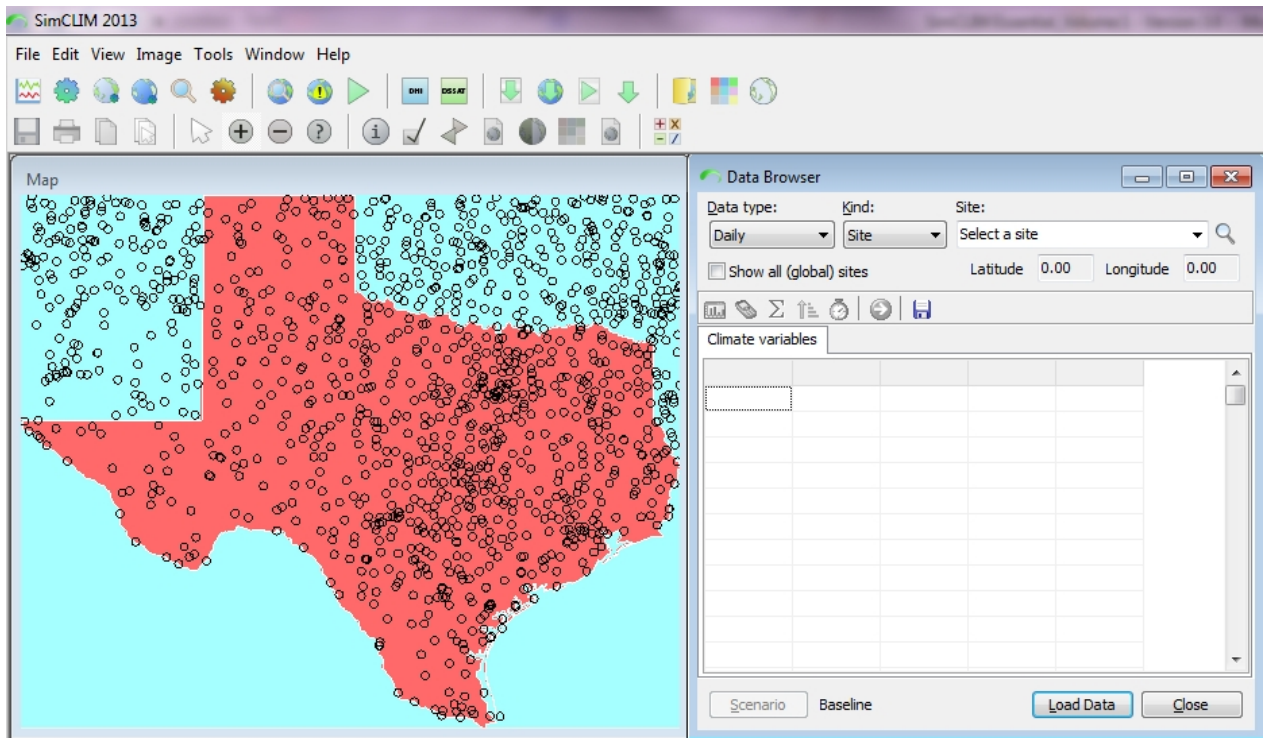
Climate Data Browser

The Data Browser allows the user to visualize the historical climate stored in the system and carry out some basic data analysis.

Click on the Climate Data Browser icon in the Impact Models Tab to view the stored historical data in the system.



The main Climate Data Browser window with an accompanying map as depicted below will be displayed.

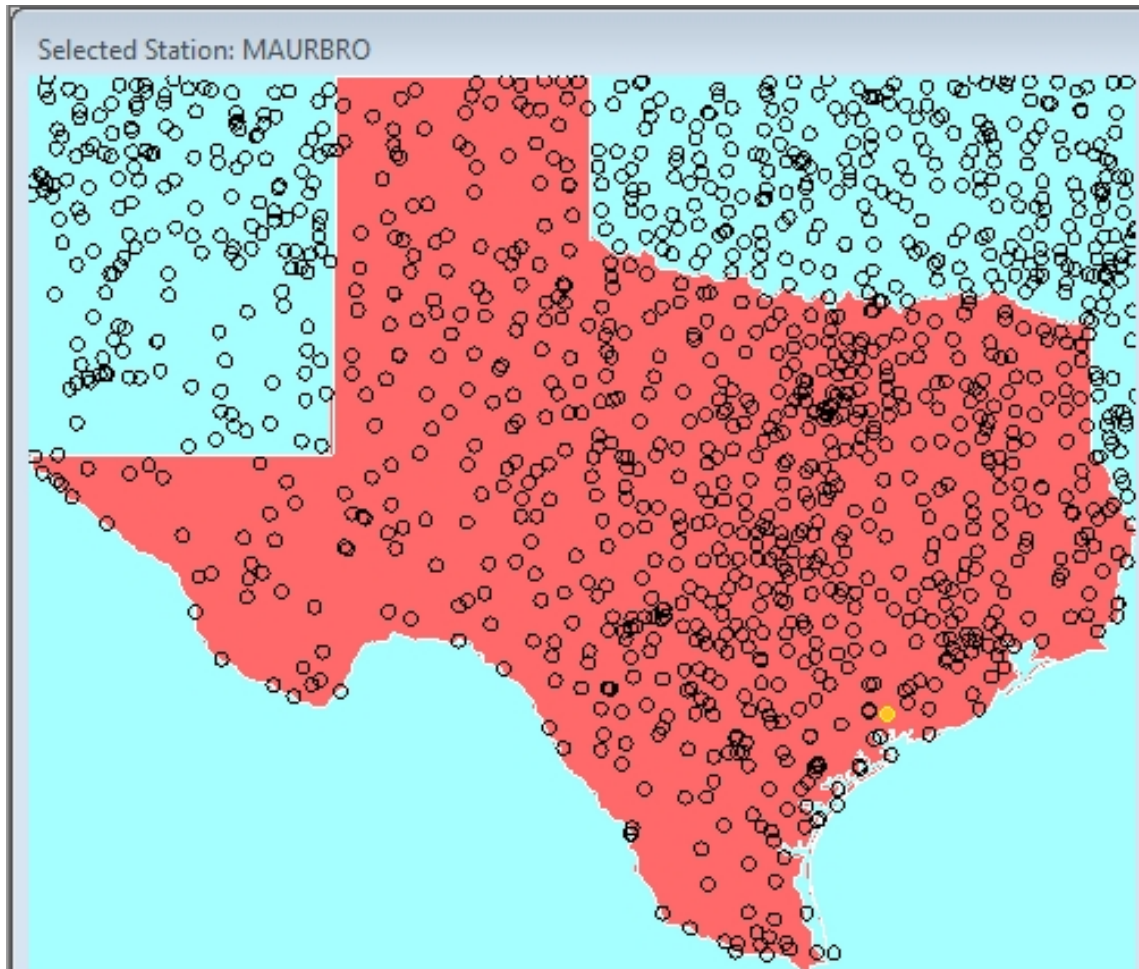


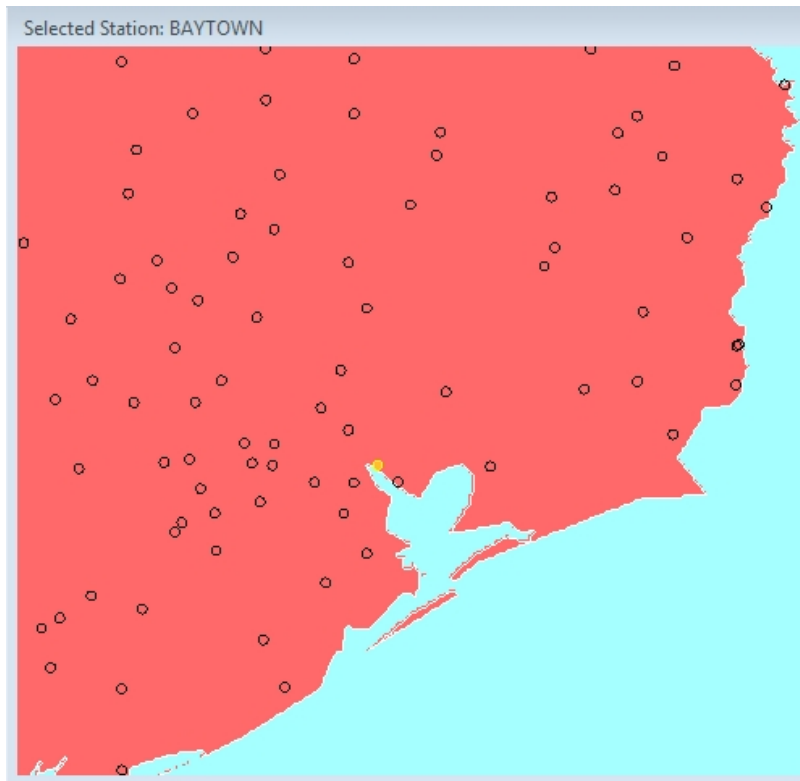
Open the data browser main window and choose a temporal scale, and then select a site by clicking on the associated map or from the site drop down box.

Click Load data.

This tool can be used for monthly, daily and hourly data. The table on the previous page shows

the stored Chico Uni Farm, USA climate data from 1906 to 1997. After the data is loaded, four types of data analysis can be carried out by clicking the buttons in the toolbar menu.





Associated map. You can zoom in on an area on the map and click on the site to select a station. When you click on a station the name and its latitude and longitude are displayed in the accompanying data browser window. You will not know what data is present for that site until you click on 'load data' in the data browser.

When you do load the data look at the table to see what kind of information the file contains.

The screenshot shows the 'Data Browser' window with the following details:

- Data type:** Daily
- Kind:** Site
- Site:** BAYTOWN
- Latitude:** 29.79
- Longitude:** -95.04
- Scenario:** Baseline

Year	Month	Day	Precip (mm)	T Max (°C)	T Mean (°C)	T Min (°C)
1982	5	25	0.00	27.80	25.50	23.30
1982	5	26	0.00	29.40	26.30	23.30
1982	5	27	0.00	31.10	27.50	23.90
1982	5	28	0.00	31.70	28.30	25.00
1982	5	29	0.00	30.00	27.80	25.60
1982	5	30	0.00	31.10	27.70	24.40
1982	5	31	0.00	31.10	27.70	24.40
1982	6	1	0.00	33.30	27.20	21.10
1982	6	2	0.00	31.70	26.40	21.10
1982	6	3	0.00	30.00	26.60	23.30
1982	6	4	0.00	31.70	28.00	24.40

This file for Baytown, Texas includes precipitation and temperature data.

Note: the associated map shows the sites either inside the selected area or all the sites globally, depending on the selection of 'Show sites in selected area' or 'Show all (global) sites'

Show all (global) sites

Activity: Select various sites and search for sites of your choice by typing the name of a place in the site window.

If the location is present in the database a yellow (depending on the default colours you have selected under options drop down menu) symbol will be displayed at its location on the accompanying map.

Activity: With a site of your choice open work with the data using the tools displayed below.

Be creative and think of how working with the data could enhance your understanding of it. For example, perhaps you wish to find the 100 greatest rainfall events for your site over the length of record. How would you do that? With some creative thinking you can access some very interesting information on your site and then export the data for graphing in other programs such as Excel.

Select Viewing Period

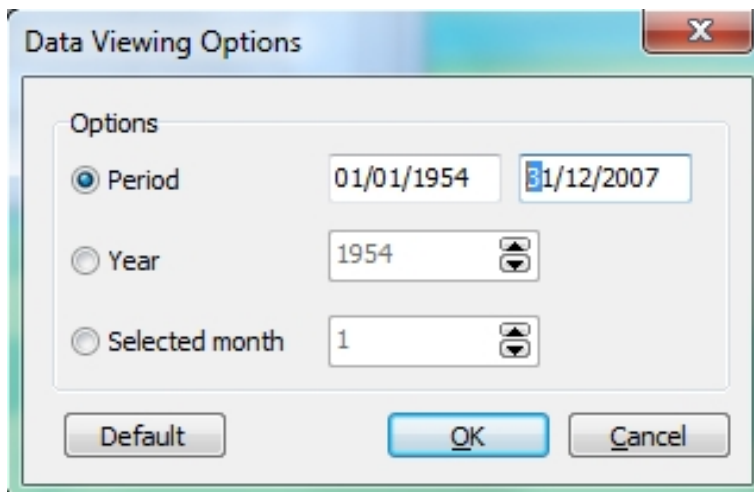
Select viewing period

This option lets the user select their particular period of interest to be depicted in the table. This can be a period inside the observed data, or a particular year, or a particular month.

Often data has beginning and end points that do not contain real data. They are assigned a -999.00. Trim the data in your file. Often we try to get a 1 January start date and a 31 December end date. We also try to have data with at least a 30 year record. Using the

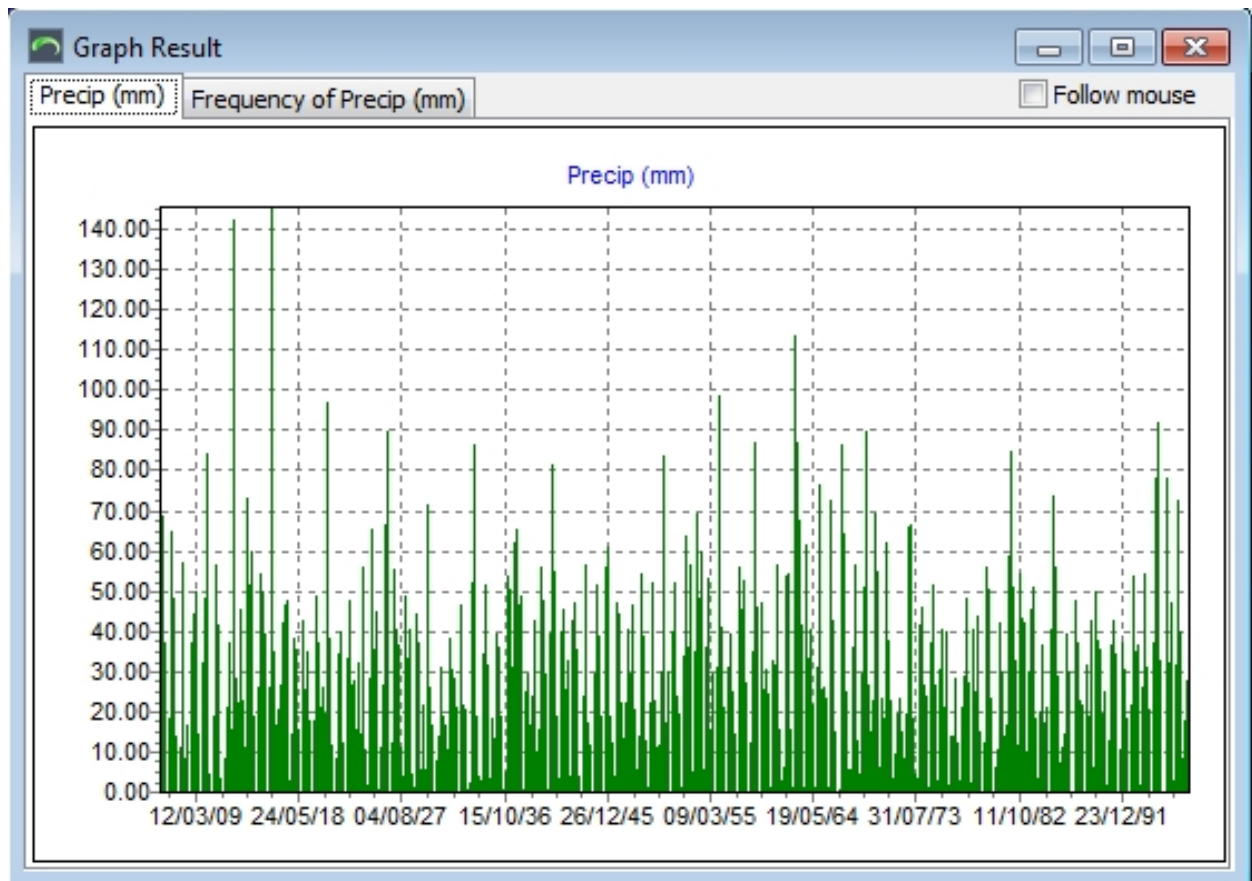


select viewing period tool trim your data for a specified period of time by using the associated dialogue box.

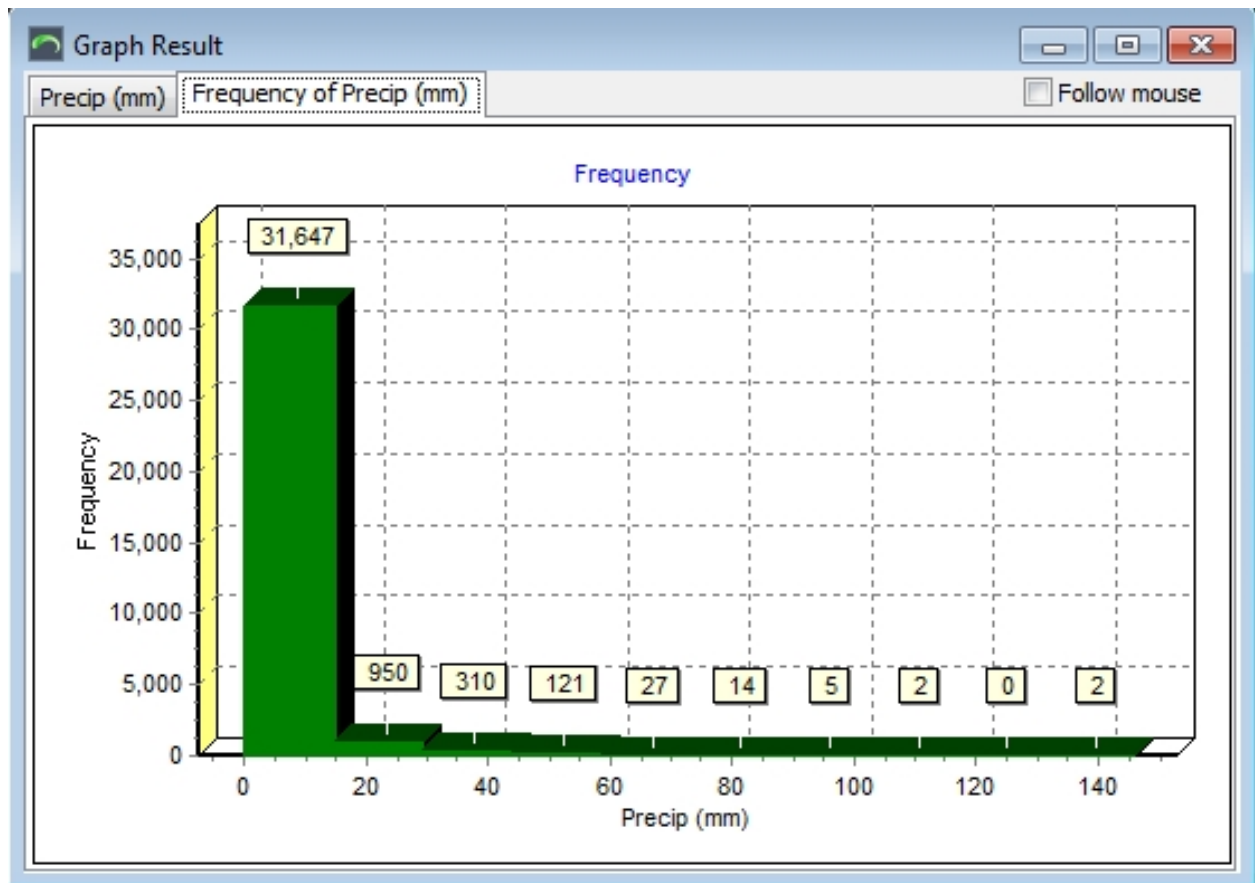


Also select a year to be displayed and a month.

Explore the data by click in the data column to produce a graph. You can quickly and easily 'grab' the graph by clicking on the clipboard tool and then clicking on the part of the window you wish to save. Do this and open Word or PowerPoint and drop the image there. After loading, the data can be visualized by clicking on the data column. Below is the visualized precipitation data for Patiala, India.



The frequency distribution can also be visualized by clicking the second tab in the above figure, as shown below:



NOTE: YOU CAN ALWAYS RETURN TO THE ORIGINAL DATA BY CLICKING ON LOAD DATA. DO THIS.

Calculate Long Term Normal

Calculate long term normal

This option lets a user calculate long term averages of the data and depicts it in tabular form. For example, if a daily time series data is loaded, a user can then calculate the monthly or yearly long term average from the daily data.

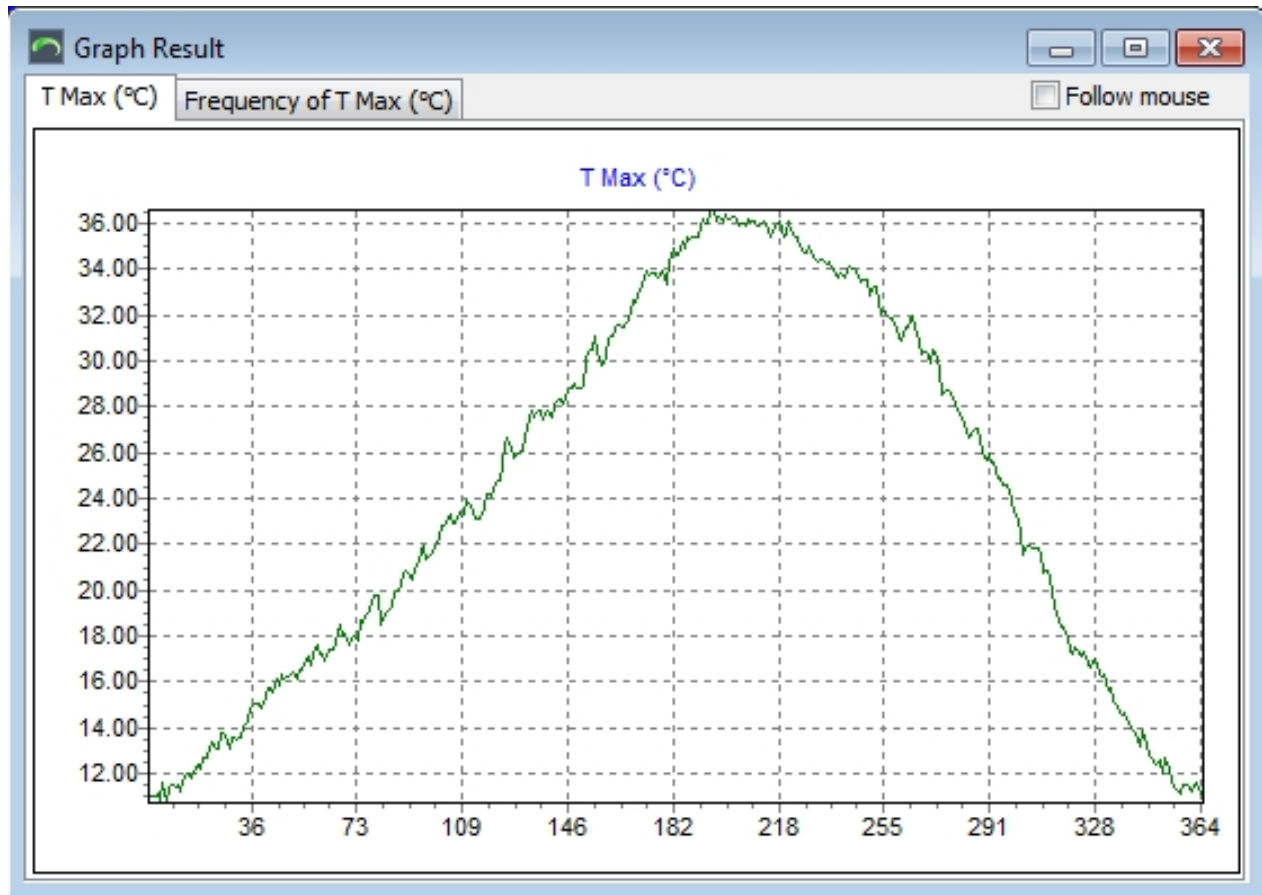
Activity: long term normal

This is a quick and easy function which can be used on a range of data. Cut your data in various ways and run the long term normal tool. This can be particularly useful when exploring temperatures (min, max and mean).

An interesting exercise can be done to explore the long term normal of places with climate change. Select a site that has all the data variables (prec, tmin, tmax and tmean such as CAMOOWEAL TOWNSHIP). You can find others.

Load the data. You do not need to clean the data by clipping the -999.00 from the front and back end as SimCLIM disregards this data when doing calculations.

Apply a long term normal to the data. Click on each column to display a graph.



Keeping one or more of the graphs on reload the data and apply a climate change scenario to the data. The climate scenario toggle is located at the bottom left of the data browser dialogue box.

You will by now be familiar with this function. Choose the parameters you wish for this analysis and press OK. Your data set has now been perturbed (Simulated what those daily events would have been like under climate change conditions as you defined them).

Conduct a long term normal function on the perturbed data. Click on a column and produce graph and compare it with the graph you left open from the baseline conditions.



You can run multiple analyses with different scenarios. Think about how this sort of analysis could be used?

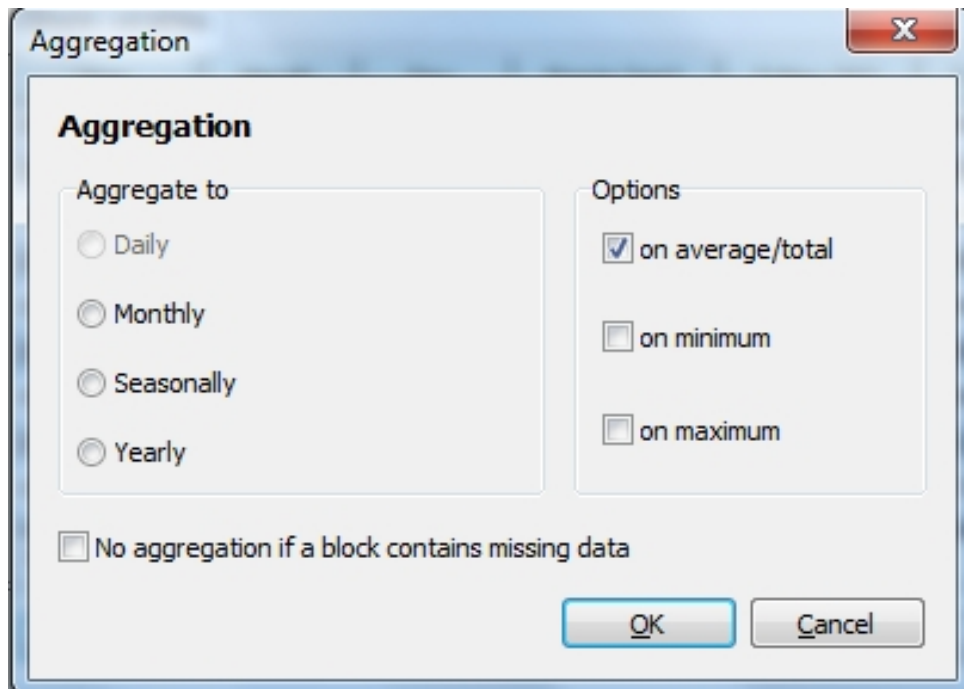
Aggregate Data

Aggregate data

This option lets the user aggregate the time series data to another coarse time series resolution. For example, daily to monthly.

Activity: aggregate data

Open another daily time series data file. Click on the Aggregate data function and the following dialogue box will open.



Depending on the current aggregation of the data different functions will be available to you. In the case above daily data is open therefore monthly, seasonal and yearly aggregation can be done. If you opened monthly, only seasonal and yearly aggregation could be conducted i.e. you cannot disaggregate data.

Find some daily time series data by clicking on the map and go through the process of aggregation and graphing to familiarise yourself with the function and associated outputs in tabular form.

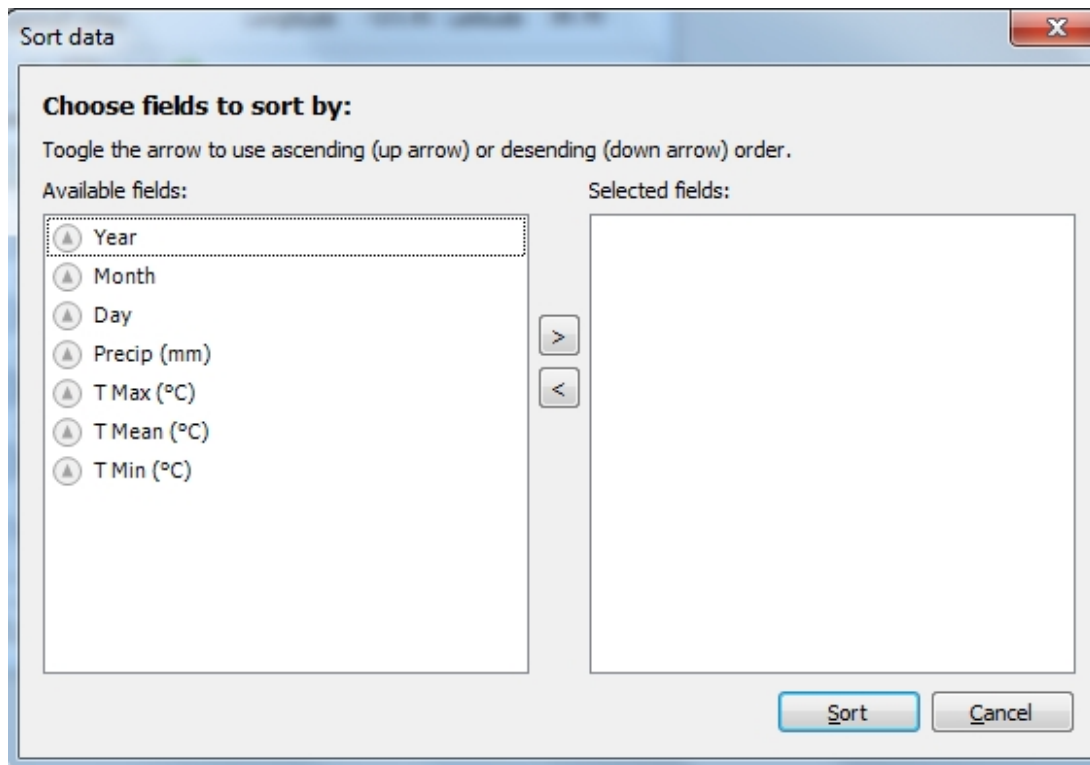
Sorting Data

Sort data

This option will sort the time series data based on a user's choice.

Activity: sorting data

This powerful little tool permits the user to manipulate data in a number of ways.



It is best to start with a simple function such as sorting precipitation from descending value (this will put the greatest event at the top and all the -999.00 at the bottom). Choose Precip (mm) from the left hand side and using the arrow in the middle direct it to the right hand side. Then click on the arrow just in front of the Precip (mm) label



to define how you wish the data to be sorted. With the wide portion of the arrow at the top and the arrow pointing down the greatest values will be displayed at the top of the table. Click on sort and then you can view, graph and export your sorted data.

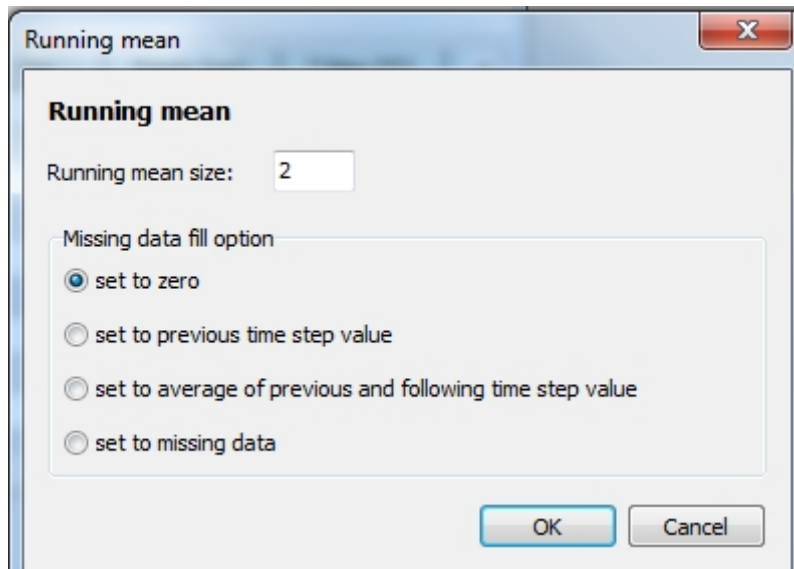
The functionality of this tool is extensive. Please take time now to work with your data in a creative way. Think about how sorted data may be used to explain certain phenomena?

You can also sort perturbed data for comparison purposes.

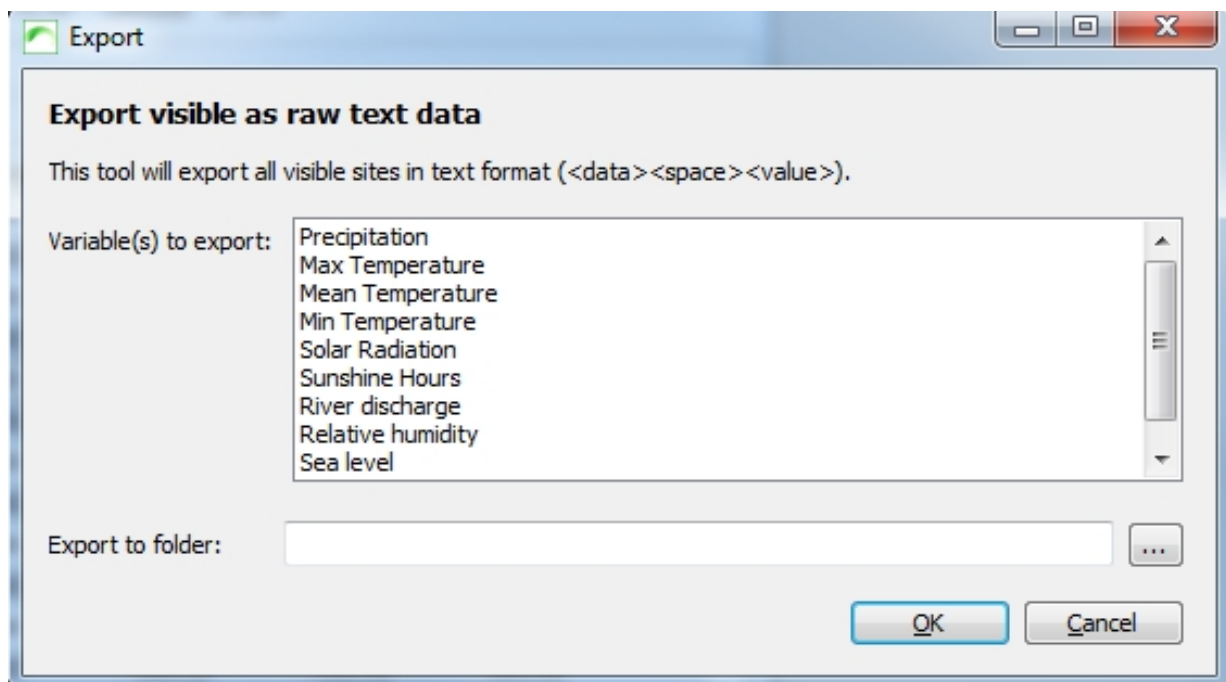
Running Mean

Running Mean Computation

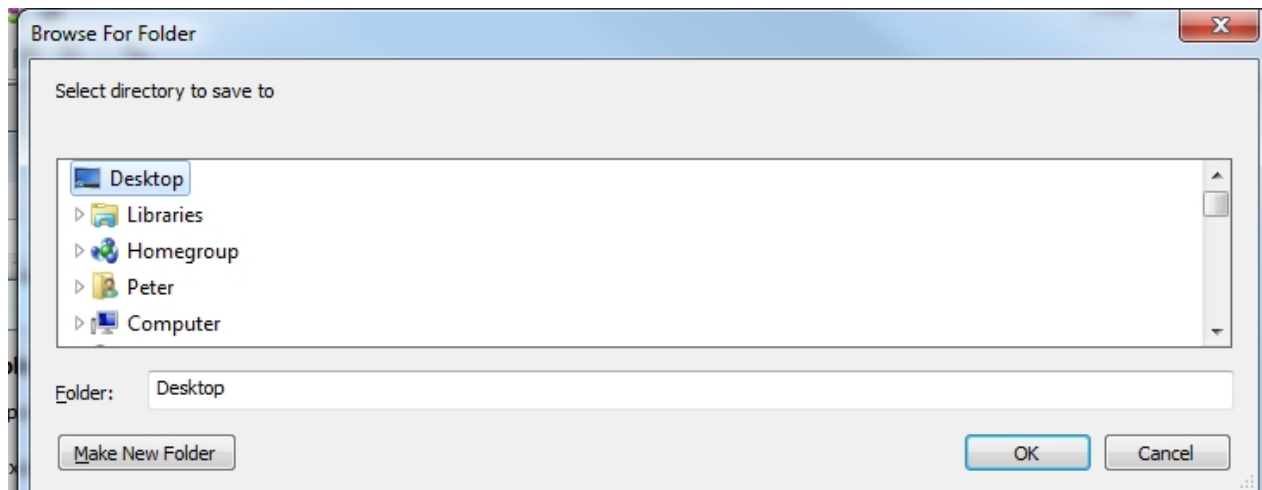
A moving average is commonly used with time series data to smooth out short-term fluctuations and highlight longer-term trends or cycles. The threshold between short-term and long-term depends on the application, and the parameters of the moving average will be set accordingly.



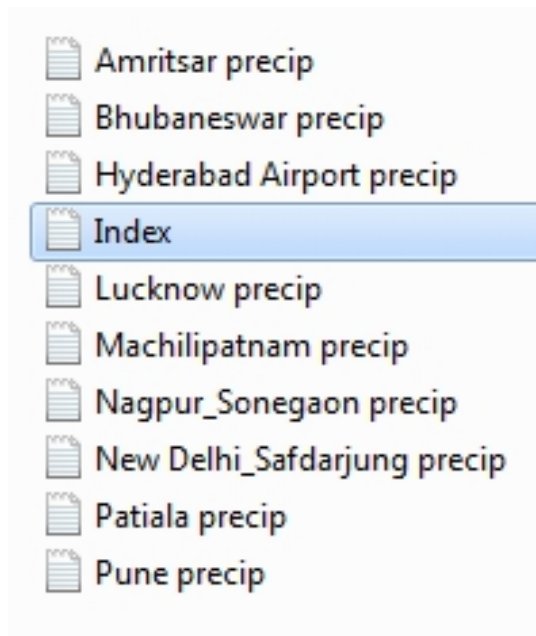
Save function. This tool will export all 'visible' data as a raw text file to a location of your choosing.



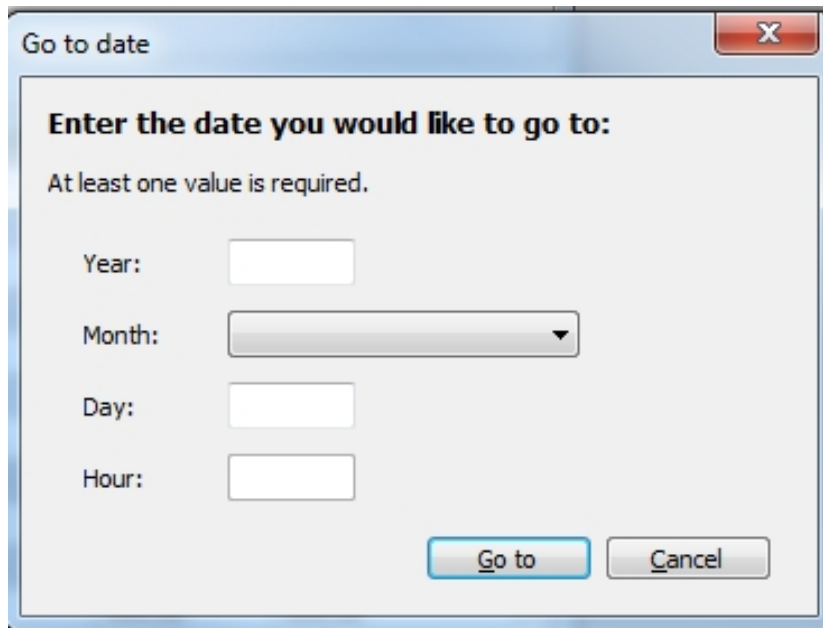
Click on the Export to folder tab and either click on an already prepared folder or define a new one.



We had chosen precipitation and the following data was exported in text format, including the index which is handy to know the location of each station.



Go to date function. In large datasets it can be handy to be able to find a specific date in the database. This function makes this possible and thus avoids endless scrolling.



Go to date

Enter the date you would like to go to:

At least one value is required.

Year:

Month:

Day:

Hour:

Choose the year, month (drop down menu), day and or hour and click Go to.

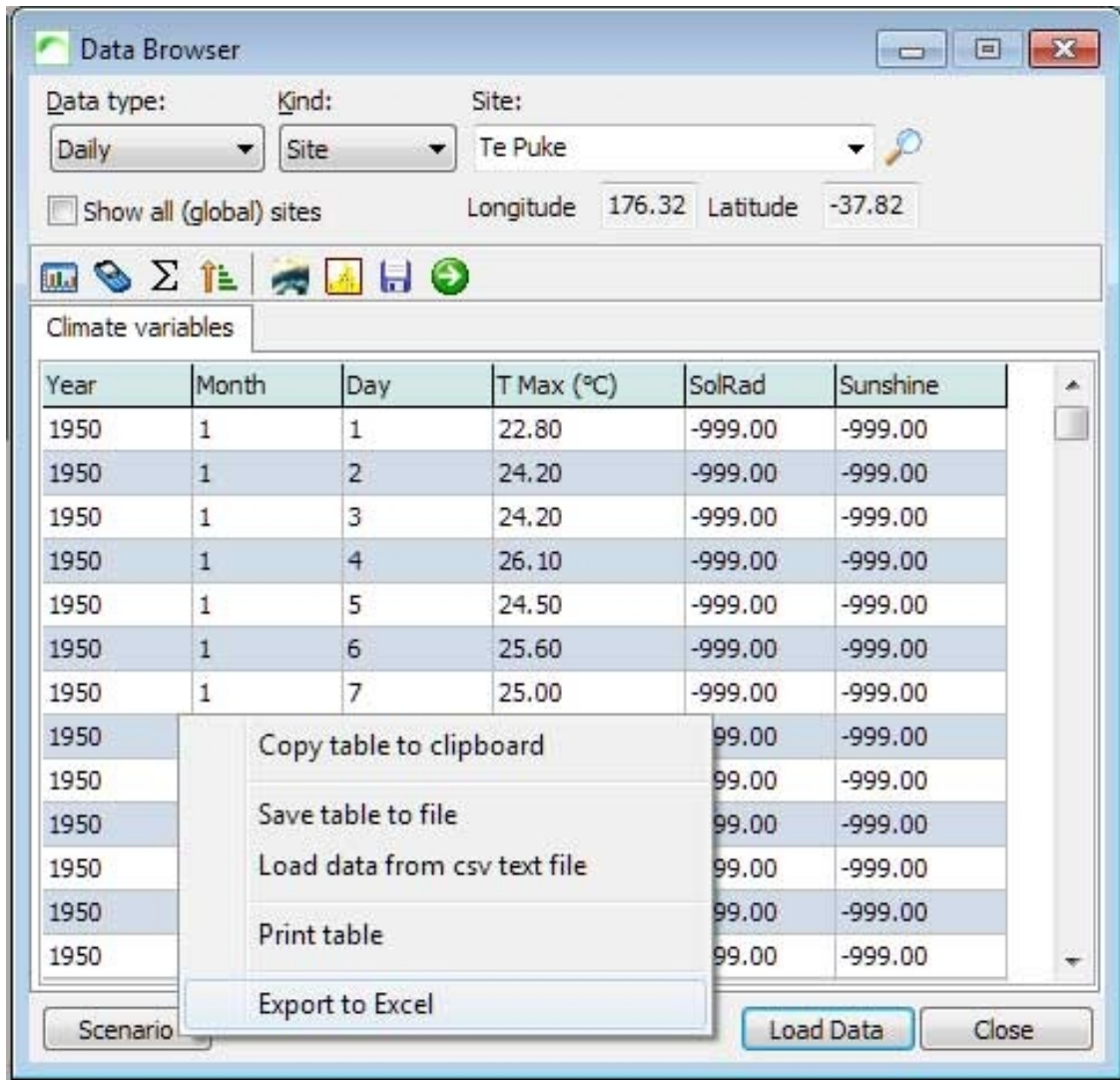
Exporting Table Data to Excel

Exporting Table Data to Excel

Microsoft Excel must be installed to use this feature.

Most table data in SimCLIM 4.0 for Desktop can be directly exported to Excel.

The following example shows how to export data to Excel using the **Climate Data Browser**. Open the **Climate Data Browser**, select a climate variable and site and click the Load Data Button. Now right click the Table displaying the data and click "**Export to Excel**".



Excel with automatically open and the data will be exported to a new worksheet.

	A	B	C	D	E	F	G
1	Year	Month	Day	T Max (°C)	SolRad	Sunshine	
2	1950	1	1	22.8	-999	-999	
3	1950	1	2	24.2	-999	-999	
4	1950	1	3	24.2	-999	-999	
5	1950	1	4	26.1	-999	-999	
6	1950	1	5	24.5	-999	-999	
7	1950	1	6	25.6	-999	-999	
8	1950	1	7	25	-999	-999	
9	1950	1	8	28.9	-999	-999	
10	1950	1	9	29.6	-999	-999	
11	1950	1	10	25	-999	-999	
12	1950	1	11	26	-999	-999	
13	1950	1	12	26.2	-999	-999	
14	1950	1	13	26.2	-999	-999	
15	1950	1	14	24.8	-999	-999	
16	1950	1	15	22.1	-999	-999	
17	1950	1	16	22.9	-999	-999	
18	1950	1	17	23.7	-999	-999	
19	1950	1	18	23.9	-999	-999	
20	1950	1	19	24	-999	-999	

Please note:

Exporting a large amount of data, such as hourly data that takes place over a long time period of time, may take some time to export (and could exceed the capacity of Excel).

Observed Record Length - Implications

Observed record length - implications for analysis using longer time series.

SimCLIM 4.0 for Desktop – outputs/results from SimCLIM 4.0 for Desktop that are generated manipulating the observed data (data browser and extreme value analysis tools) differ if you use a full length of observed records for extreme events analysis rather than the 30 year baseline that is recommended in the training. (e.g. Observatory hill has 155 years of observed data available).

This section outlines an issue I came across doing investor due diligence work and is included below as it is informative on the difficulties of projecting climate using observed daily datasets.

1.1.1 Example for regional BoM sites

Trainee: I am working with these rural sites that often have almost completely continuous precipitation records going back 150+ years.

Some of these records cease in the 70s and 80s.

1. In your opinion is it better to use a longer run of historical data i.e. 100+ years if it is available
2. Does it matter if this data ends in the 1990s? i.e. is it preferable to have a data set 1962-2013 or 1860-1996?
3. When I run the extreme temperature analysis for these sites, once past 2030 (RCP 8.5 high sensitivity) the return period for the baseline returns "errors". I assume that this is because this projected extreme maximum never occurs in the historical record. Is it ok to explain it in this way to a client?

CLIMsystems response: 1/2. Selection of periods/datasets: There is no simple answer here. The assumption is that no (significant) climate change took place in your historic dataset (no significant trend) and that the fitted distribution function thus properly captures the characteristics of the climate variable at that location. This would argue for a series of about 30 years. However, a 30 year period only has 30 extremes, which is not good for estimating much rarer events (ie. 1 in 100 years). This argues for the longest possible time-series. You have to remember though that the "representative" year of a time-series lies in the middle: for 1860-1996 that would be 1928..., which impacts the application of the proper climate change on that set (you would need to "trick" SimCLIM, by finding the global mean warming between 1928 and 1995, say 0.5 degrees, and then first identify your year/scenario/sensitivity combination in the global table, say 2050:+2.3 degrees, and then find the year that shows $2.3+0.5=2.8$ as the year that actually shows the impact from climate change on this dataset by 2050...).

To choose between 1962-2013 and 1860-1996 I would probably a) compare, and b) have a preference for the 1962-2013 set, as the mid year 1986 is relatively close to 1995, the baseline year).

3. Yes. As that temperature is not described by the distribution under the baseline (never occurs), SimCLIM cannot compute how often it happens under the baseline ("never").

Selection of the time period is always a compromise between short enough not to pick up temperature trends that are modelled separately (climate change) and long enough to properly model very rare events. We had many internal discussions as well as discussions with our scientific advisory panel, but have not solved the issue.

Climate Projections Using the Site Data Browser

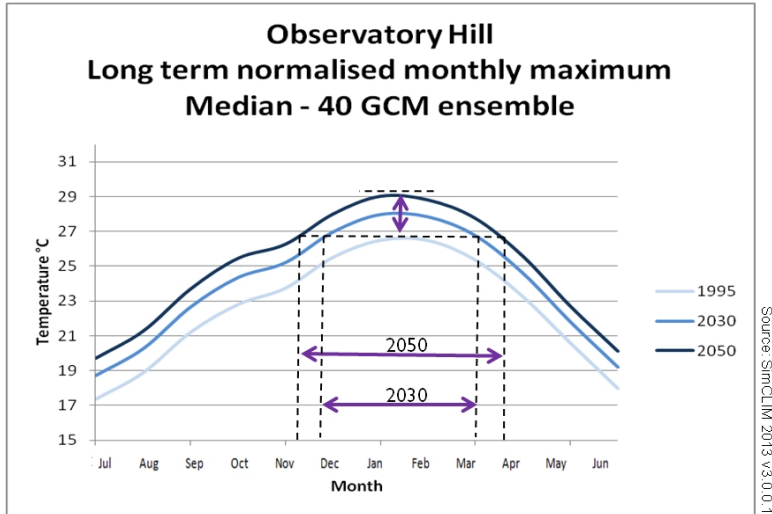
This function can be performed on any data in the browser but we have only used it for temperature so far. The example below is for temperature.

NOTE: EVERY TIME YOU "LOAD DATA" YOU WILL NEED TO RESET THE DESIRED VIEWING PERIOD!!!!

Graphing the long term normalised temperature in the baseline against projections for future years is a good way to visualise how the average temperature will change over time.

Figure 12 shows how not only the hottest month is getting hotter, but also how the current average maximum extends to months earlier and later in the year.

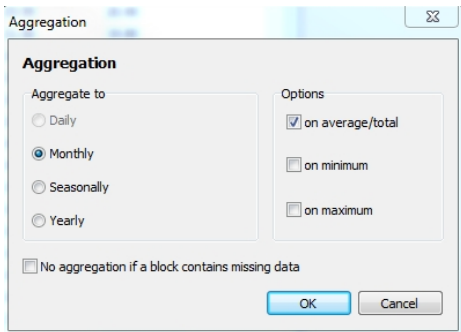
Figure 1 Example projected normalised monthly mean temperature



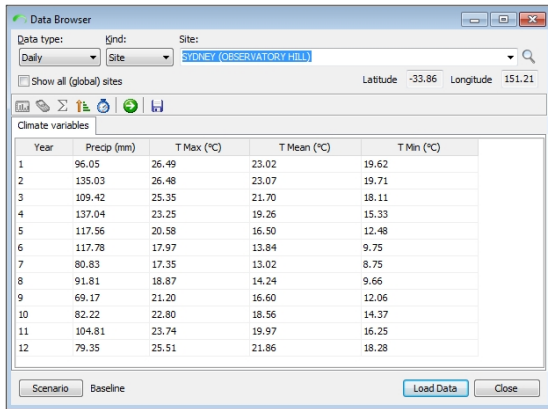
This graph is created by creating a different set of normalised monthly mean data. The baseline and one for every future year of interest.

Create the baseline using the following steps below (instructions on how to use each function are explained in the sub sections earlier in this chapter).

- 1) Open the data browser and select your BoM site of interest
- 2) Limit the baseline period
- 3) Click aggregate data and select “monthly” and “on average/total”. Do not select “no aggregation if a block contains missing data”, Click OK.



- 1)Click “calculate long term normal”



There should be 12 values corresponding to the 12 months 1 = Jan, 2 = Feb and so on.

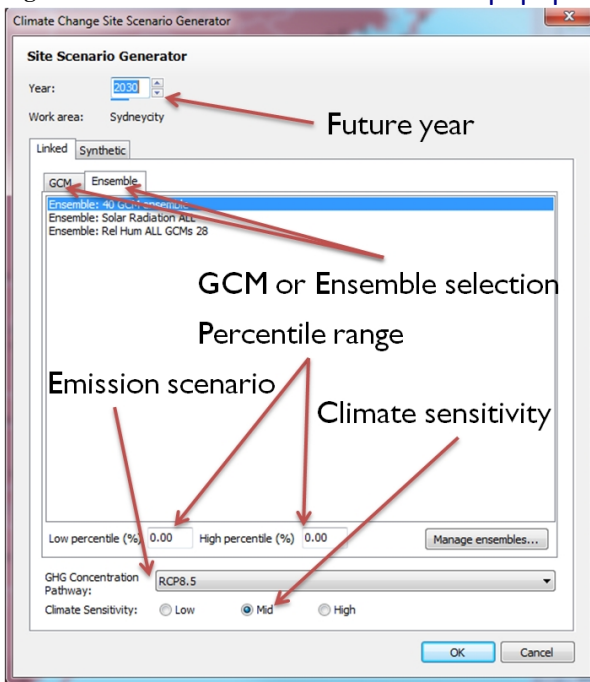
2) Copy to clipboard (right click on heading rows of table) and paste in excel – label with location and timestep (in this case, baseline). It is useful to create an extra column and label the months as Jan, Feb etc.

Generate your projected timeseries using the following steps

3) Load data again and **DON'T FORGET TO RESET THE VIEWING PERIOD TO** that of the original baseline

4) Click scenario (you will see the pop-up window in Figure 13)

Figure 2 Site browser climate scenario popup



1) Select future year

2) Select GCM or ensemble (if using an ensemble you will be returned the ensemble median (50th percentile) as an output. Select and define upper and lower percentiles e.g. 10th and 90th if a range of the result is also required. ****if you haven't defined any ensembles you will have to do this – see SimCLIM essentials manual vol.1

- 3) Select emissions scenario (GHG concentration pathway)
 - 4) Click OK – the dataset with perturb i.e. generate a time-series for the future year selected.
 - 5) Reset your viewing period to be the same as the baseline and repeat steps 3 to 5.
 - 6) Repeat steps 6 to 12 for each future year
 - 7) Rearrange the data in the excel sheet first so the first month is July, this will make the graph smooth with the summer hump in the middle
- You should end up with a table in the same format as shown in Figure 3

Figure 3 longterm average monthly temperature data in excel

Month		1995	2030	2050	2070
name	number	temperature °C			
Jul	1	17.4	18.2	18.9	19.7
Aug	2	18.9	19.8	20.4	21.3
Sep	3	21.2	22.2	22.8	23.7
Oct	4	22.8	23.6	24.1	24.8
Nov	5	23.7	24.9	25.7	26.7
Dec	6	25.5	26.7	27.5	28.6
Jan	7	26.5	27.4	28.1	28.9
Feb	8	26.5	27.5	28.2	29.0
Mar	9	25.4	26.1	26.6	27.2
Apr	10	23.3	23.8	24.2	24.6
May	11	20.6	21.4	22.0	22.8
Jun	12	18.0	19.1	19.8	20.8

- 1) Plot these data in excel using scatter plot – smooth line chart
 - a) X axis is month
 - b) Y axis is temperature
- 2) Format the chart as required and add additional graphics in PowerPoint.

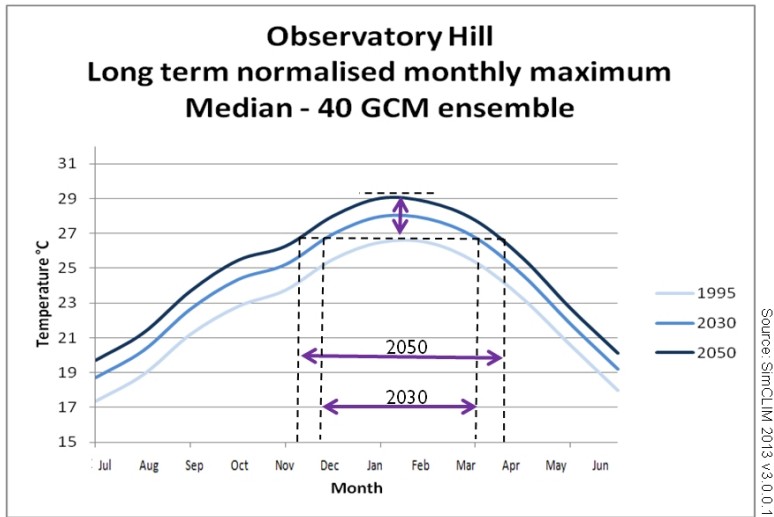
Change in Long Term Monthly Mean

This function can be performed on any data in the browser but we have only used it for temperature so far. The example below is for temperature.

NOTE: EVERY TIME YOU “LOAD DATA” YOU WILL NEED TO RESET THE DESIRED VIEWING PERIOD!!!!

Graphing the long term normalised temperature in the baseline against projections for future years is a good way to visualise how the average temperature will change over time. Figure 1 shows how not only the hottest month is getting hotter, but also how the current average maximum extends to months earlier and later in the year.

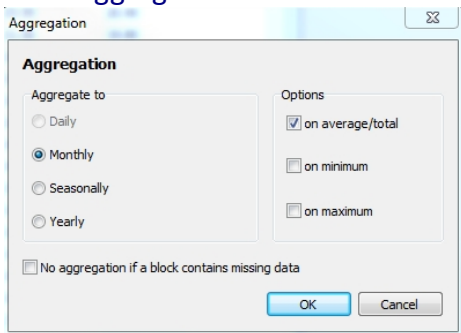
Figure 1 Example projected normalised monthly mean temperature



This graph is created by creating a different set of normalised monthly mean data. The baseline and one for every future year of interest.

Create the baseline using the following steps below (instructions on how to use each function are explained in the sub sections earlier in this chapter).

- (1) Open the data browser and select your BoM site of interest
- (2) Limit the baseline period
- (3) Click aggregate data and select “monthly” and “on average/total”. Don’t select “no aggregation if a block contains missing data”, Click OK.



- (4) Click “calculate long term normal”

Year	Precip (mm)	T Max (°C)	T Mean (°C)	T Min (°C)
1	96.05	26.49	23.02	19.62
2	135.03	26.48	23.07	19.71
3	109.42	25.35	21.70	18.11
4	137.04	23.25	19.26	15.33
5	117.56	20.58	16.50	12.48
6	117.78	17.97	13.84	9.75
7	80.83	17.35	13.02	8.75
8	91.81	18.87	14.24	9.66
9	69.17	21.20	16.60	12.06
10	82.22	22.80	18.56	14.37
11	104.81	23.74	19.97	16.25
12	79.35	25.51	21.86	18.28

There should be 12 values corresponding to the 12 months 1 = Jan, 2 = Feb and so on.

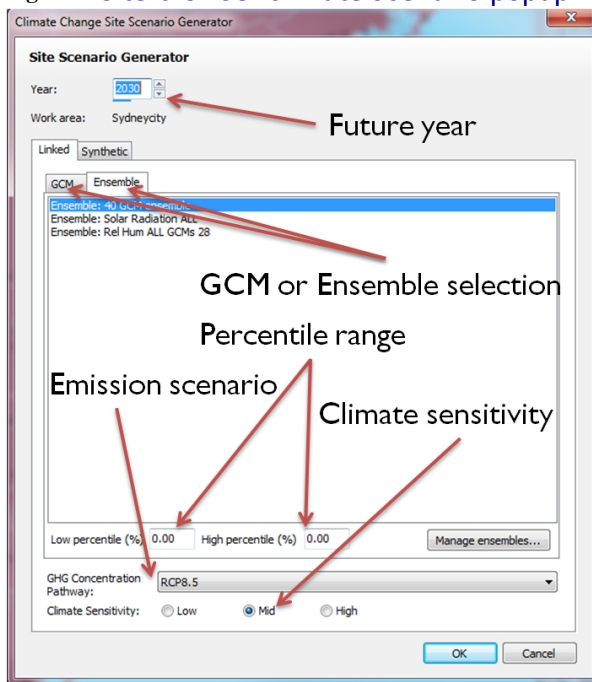
- (5) Copy to clipboard (right click on heading rows of table) and paste in excel – label with location and timestep (in this case, baseline). It is useful to create an extra column and label the months as Jan, Feb etc.

Generate your projected timeseries using the following steps

- (6) Load data again and DON'T FORGET TO RESET THE VIEWING PERIOD TO that of the original baseline

(7) Click scenario (you will see the pop-up window in Figure 13)

Figure 2 Site browser climate scenario popup



- (8) Select future year
- (9) Select GCM or ensemble (if using an ensemble you will be returned the ensemble median (50th percentile) as an output. Select and define upper and lower percentiles e.g. 10th and 90th if a range of the result is also required. ****if you haven't defined any ensembles you will have to do this – see SimCLIM essentials manual vol.1
- (10) Select emissions scenario (GHG concentration pathway)
- (11) Click OK – the dataset with perturb i.e. generate a time-series for the future year selected.
- (12) Reset your viewing period to be the same as the baseline and repeat steps 3 to 5.
- (13) Repeat steps 6 to 12 for each future year
- (14) rearrange the data in the excel sheet first so the first month is July, this will make the graph smooth with the summer hump in the middle

You should end up with a table in the same format as shown in Figure 3

Figure 3 longterm average monthly temperature data in excel

Month	1995	2030	2050	2070	
name	number	temperature °C			
Jul	1	17.4	18.2	18.9	19.7
Aug	2	18.9	19.8	20.4	21.3
Sep	3	21.2	22.2	22.8	23.7
Oct	4	22.8	23.6	24.1	24.8
Nov	5	23.7	24.9	25.7	26.7
Dec	6	25.5	26.7	27.5	28.6
Jan	7	26.5	27.4	28.1	28.9
Feb	8	26.5	27.5	28.2	29.0
Mar	9	25.4	26.1	26.6	27.2
Apr	10	23.3	23.8	24.2	24.6
May	11	20.6	21.4	22.0	22.8
Jun	12	18.0	19.1	19.8	20.8

- (15) Plot these data in excel using scatter plot – smooth line chart
- (a) X axis is month
 - (b) Y axis is temperature
- (16) Format the chart as required and add additional graphics in PowerPoint.

Calculating Number of Days Over a Threshold - Perturbation Method (site browser)

This technique outlined below explains how to generate a timeseries of temperature projections to query for number of days on average over a temperature threshold per year.

1.1.1.1 **Question on the method and reply from CLIMsystems**

The purpose of including this is to give context to how the tool projects future climate using timeseries of observed data.

OK: Each time I perturb the historical data, using the same parameters (ensemble, emissions, year etc), will the results be the same? i.e. hypothetically: 1/4/1980 has max of 25.2 degrees, the ensemble median gives 2 degrees of warming for 2030 so the perturbed value of that date becomes 27.2 degrees? Or does each perturbation (holding the parameters the same) generate slightly different results?

CLIMsystems: A perturbation always generates the SAME result for the same selected parameters. Note that the perturbation uses the monthly normalized values (also with the ensemble) thus the perturbation value is different for different months (this can cause shifts as to which month has the highest temperature)

An idea was to perturb the historical max temp data in the data browser for the site "Observatory Hill" (the only site in the council area with historical max temp data) for the four time steps using the 40 GCM ensemble (10%, median, 90% intervals)

Then

- Set the viewing period 1980 to 2010 (30 year baseline) to keep consistent with the 1995 baseline as used in other analyses.
- Export the data to excel.
- Then count the number of occurrences of temperatures over those thresholds and divide by 30 (number of years in the baseline) to get the average number of days per year.
- Is this a sound approach?
- If not, is there another way to do this?

This is the correct approach. Additionally you can sort the data from small to large (either in SimCLIM or in Excel), get the data in Excel and use the Percentile (returns the temperature for a given percentile) and PercentRank(gives the percentile for the given temperature), to get the values you are after (instead of doing the count). Percent to days is done by multiplying by 365 (not 30 or 30x365) as the percent applies to the chosen timeframe, in your case number of days per year.

Generating the data

Site browser

Calculating the number of days over a threshold

Proposed method reviewed by CLIMsystems (Using percentile or percentrank in excel)

The following method of analysis has been provided by CLIMsystems.

Extreme weather events can be expressed in multiple ways, i.e. through a chosen return period (i.e. 20 year) and then listing the extreme event (i.e 37.3°C), or vice versa, selecting an extreme

event (i.e. 37°C) and then listing the return period (16.6 years). SimCLIM directly supports these types of calculations through its extreme event analyser. It can also show the effect of climate change on the values.

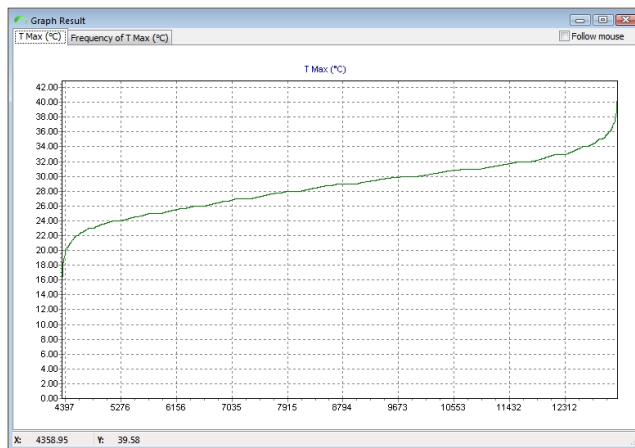
A different way is to select an extreme event (i.e. 37°C) and then list the average number of days this value is exceeded (i.e. 10 days). A statement like this takes results from the PDF (probability density function) of the climate variable (temperature). SimCLIM can produce this information as well. This Technical Note describes how this is done.

The desired output (exceedance days) can be created through the Data Browser ():

Select the station (i.e. Proserpine Airport in Australia).

Sort the climate variable of interest ( i.e. temperature), accepting the default order (small to big).

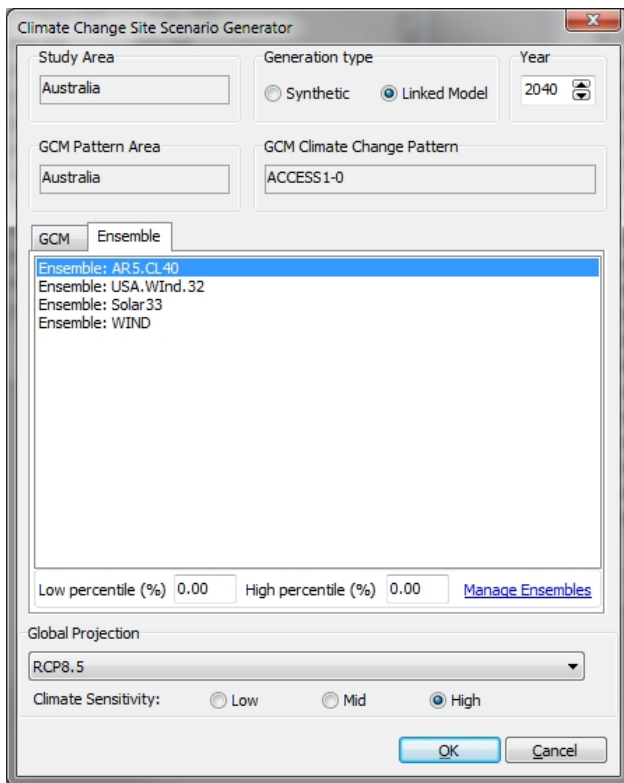
Plot the variable:



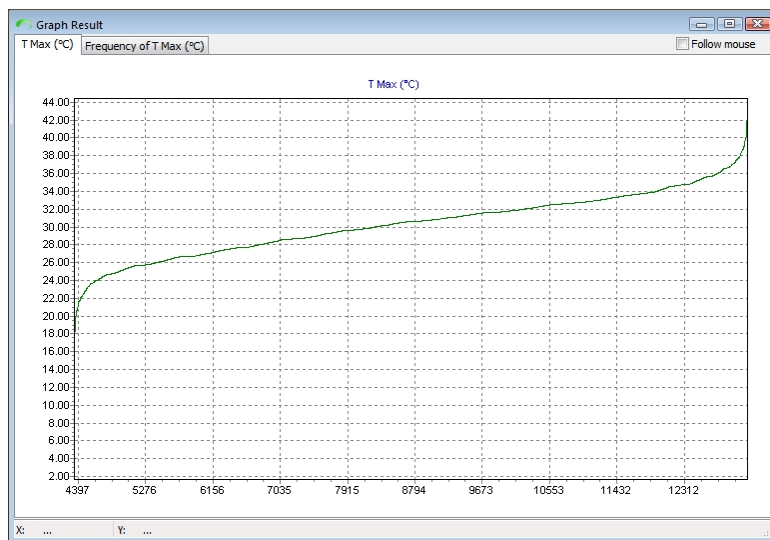
This is the probability distribution function of the variable (TMax), with the values on the y-axis and the sequence number on the x-axis (this does not start at 0, as it counts the missing values). Because the grid-division (vertical lines) shows for every 1/10, these correspond to the 10% intervals. Thus the high 10% value (corresponding to 36.5 days) is about 33°C. The 10-day value is about 35°C.

To generate the climate changed results, the scenario option of the databrowser is used (

Scenario Baseline):



Clicking OK will perturb the climate variable values with the specified climate change scenario. This can take some time. The table needs to be sorted again and then the variable can be plotted:



The 10% value has shifted to about 35°C. As this was the former 10-day value, this shows that this now has become 36.5 days.

More precise information can be generated and displayed by using Excel (using the export to Excel function in the data browser by right clicking the table) and the percentile function:

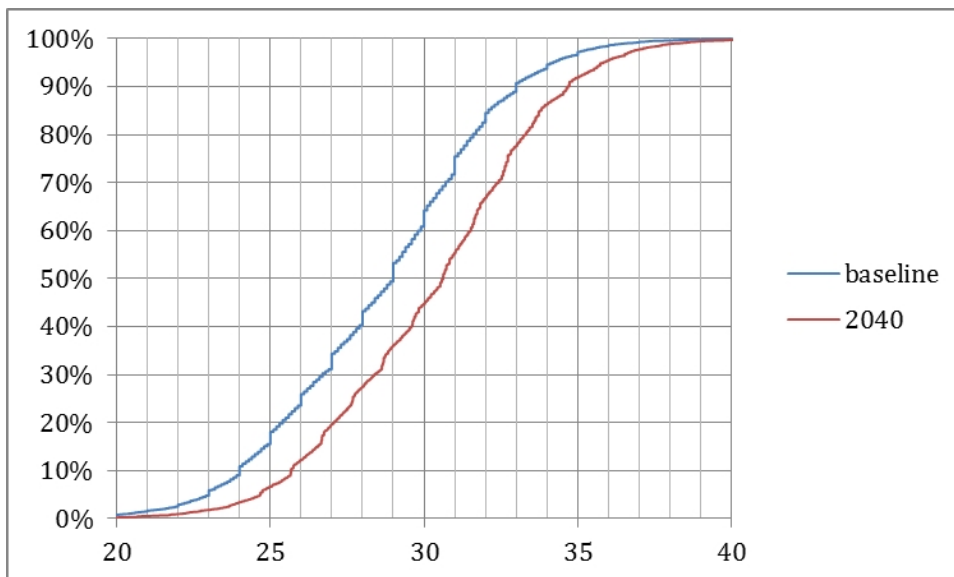
percentile	baseline	2040
1	36.5	38.1
2	35.6	37.1

3	35.0	36.6
4	34.6	36.2
5	34.2	35.8
6	34.0	35.6
7	33.7	35.3
8	33.4	35.0
9	33.1	34.8
10	33.0	34.7

(thus on average, 5% of the year the daily maximum temperatures are currently at or above 34.2°C, which will have changed to 35.8°C by 2040 - RCP8.5-high, 40-GCM ensemble)

days	baseline	2040
5	36.0	37.7
10	35.1	36.7
15	34.x	36.1
20	34.0	35.7
25	33.7	35.4
30	33.3	34.9
35	33.0	34.7

(thus on average, 10 days per year have daily maximum temperatures at or above 35.1°C, which will have changed to 36.7°C by 2040 - RCP8.5-high, 40-GCM ensemble)



Note that the axes have been reversed from the SimCLIM 4.0 for Desktop output.

Probability of magnitude of exceedance over threshold

This is an output that was never fully developed. The text below outlines the thinking behind this type of analysis.

OK: So the other request in the brief was how for the days every year that exceed 35 degrees,

how much higher than 35 degrees will the temperature reach.

My idea here was to somehow plot a frequency distribution for the baseline and 2020, 2030 and 2040 for temperatures 35 degrees and above to give a graphical indication of the likelihood of the how far past 35 degrees the max temp would be on average. As temperatures vary every year, this should be enough for the client to make a decision about which HVAC system etc to install on the trams.

Unfortunately I don't know how to do this in excel. Do you? (even if you just give me the name of the chart type or function I can look up how to use it in office help)

CLIMsystems: If you want to use the perturbed datasets (the same ones as you used for calculating the days over 35 and 42), graphing the sorted (low to high) data (temperature on Y-axis), gives a cumulative distribution function. You could scale the x-axis from 0-100 (as percentage) (or 0-365 as number of days), possibly through creating "dummy" x-values (row/count(x), maybe times 365) (use scatter-plot).

If you want to do this through the extreme event analysis, you would export the tables (right click) to Excel, possibly after first defining a larger default return-period set (under tools, options, graphing) and then create a chart. You could put the return period on the x-axis (possibly as a log-scale), the max temp values on the y-axis (use scatter-plot).

Modelling Assumptions and Limitations

Limitations of temperature modelling for HVAC systems

OK: It occurred to me that the cooling load on in the carriages could vary significantly depending on whether it is sitting in the shade at 35 degrees or in the sun at 35 degrees. Have you ever factored this in to any analyses you have done before?

CLIMsystems: This requires much more complicated modelling (thermo-physics), and would include all kinds of things like albedo, angle of attack, wind, properties of the surrounding (reflections, absorption, local heating). We would not want to go there!

Extreme Event Analysis

Extreme Event Analysis

The GEV analysis tool requires site specific historical daily or hourly time series data. Click the Generalized Extreme Value Analyser in SimCLIM 4.x for Desktop main window to activate the following window.

Query on How to Select Precipitation Method

Query on how to select an Extreme Event Analysis method

CLIMsystems: With extreme high precipitation (only variable combination you are getting this choice) we apply Daily GCM GEV value changes.

This method is based on GCM outputs to find the change in (modelled) extreme values. It is capable of producing higher extremes even while the annual precipitation is going down. We know that in many of these places it "rains less, but when it rains, it rains harder".

For some types of analysis sub-daily analysis is appropriate as exemplified by the graphic below for Washington D.C. In general but not applicable to all locations is that sub daily rainfall intensities are more intense than daily and this can have implications for certain infrastructural and building designs. Contact CLIMsystems at info@climsystems.com for more information.

An Example for Washington DC

GCM data 22 GCM 3 hourly precipitation output for 1986-2005(baseline), 2081-2100 period, RCP45 and RCP85.

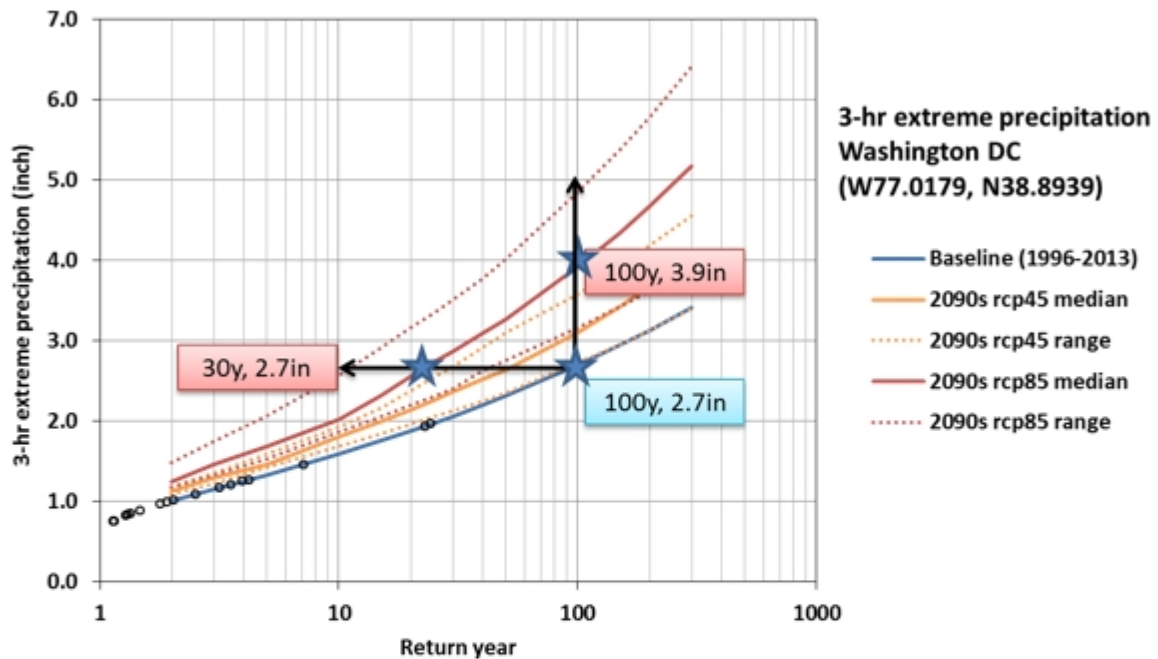


Figure 1: 3 hour extreme precipitation analysis. 100 year return 3 hour precipitation is 2.6 inch during historical period. However in RCP8.5 scenario 2090, it will become 3.9 inch. Or this change can be expressed as: 2.7 inch rainfall becomes the 30 year return event.

Importance:

- (1) Short duration precipitation depth changes larger than longer duration. For example, 2 year return 3hr precipitation increase 25% in 2090, RCP85, while 168hr precipitation changes about 16%.
- (2) The longer return period event changes larger than shorter return period event. For example, 100 year 3 hr precipitation changes about 32%, while 3hr 2 year return event changes 25%.

Extreme Precipitation Analysis

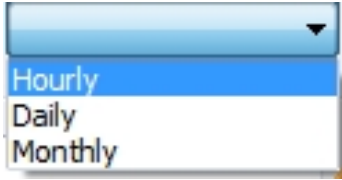
Running a Baseline Scenario

The following is an explanation of the processes involved in conducting an extreme event analysis. Read through the process and look at the sample results and then proceed to conducting your own extreme event analysis.

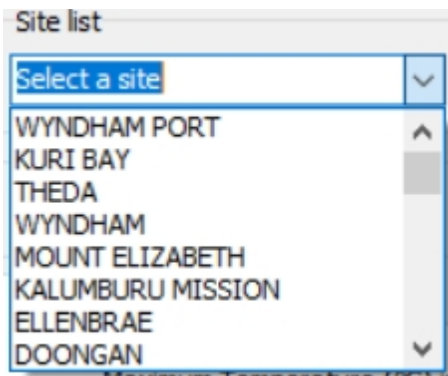
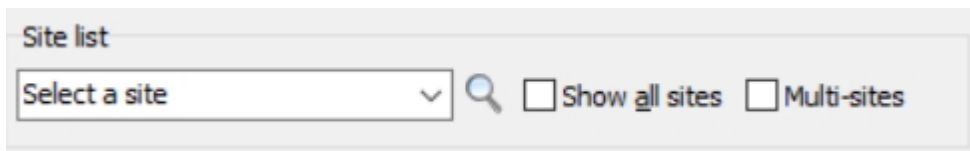


Click on the icon within the Impact Models tab to start extreme event analysis.

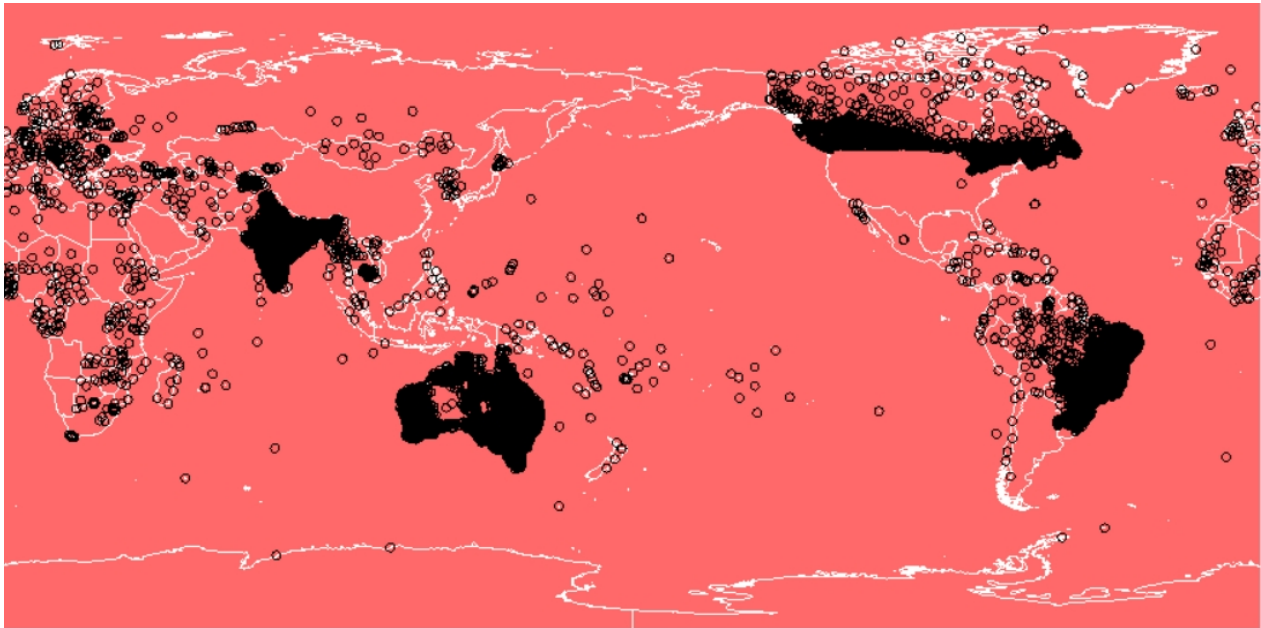
Select a data type to begin:



Then select a site by either toggling in the box or by clicking the site on the associated area map. The selected site will be highlighted in the map.



Associated map. Click on a site to select a station to work with. Note: that the map of associate sites that you will see will be dependent on the site data packages you have loaded in your SimCLIM for Desktop package.

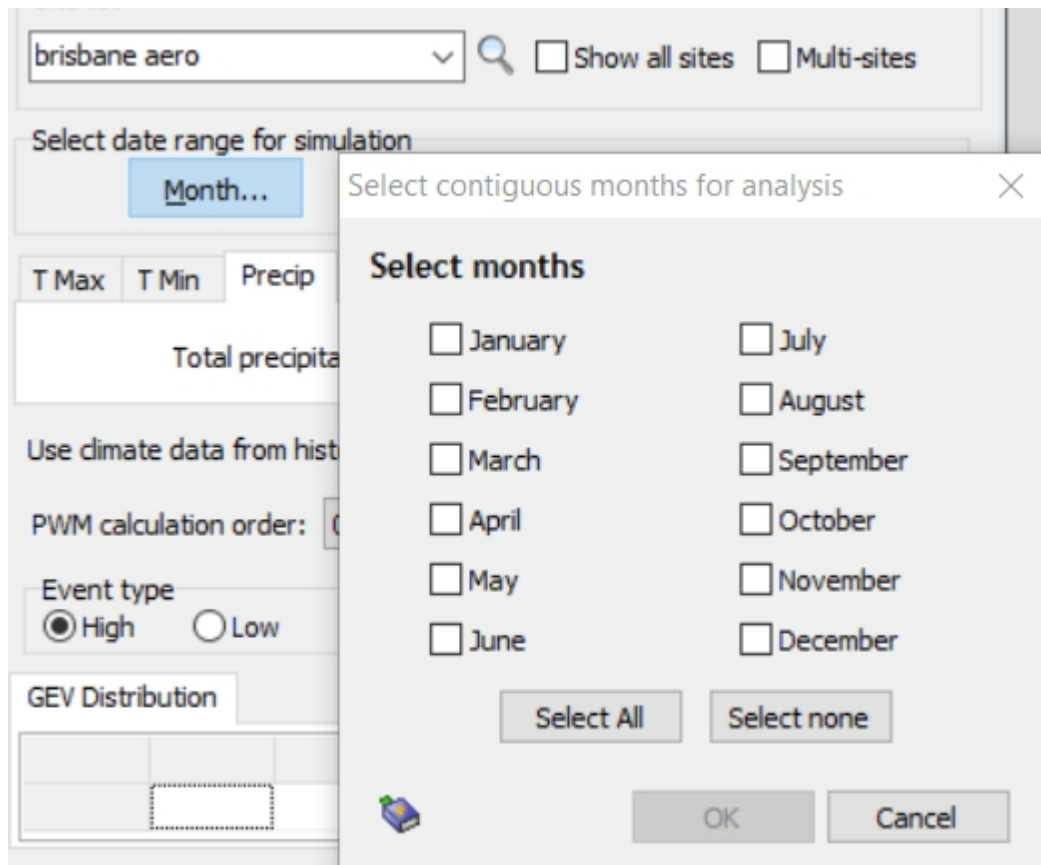


Select a scenario by clicking on the **Scenario** button.

The **Type option** provides the flexibility of defining the period when the extreme value is of concern.

The period of interest can be defined by selecting **month, season**, or by defining a start date and end date as a period, or by fixing a date and with a days range.

Select the months for analysis by clicking on the Month box and making your choice. Select all is a good place to start. Later you can explore seasonal and other results.



By default, the **Run for historical period date boxes** shows the complete period available. The user can define their period by changing the dates.

Select the extreme event variable by clicking the corresponding tab. If the data is not available, the box in its tab page will be disabled.

The box in the tab page determines how many consecutive days you want to carry out the analysis. The Extreme event definition option will become active if you selected more than one day for your analysis.

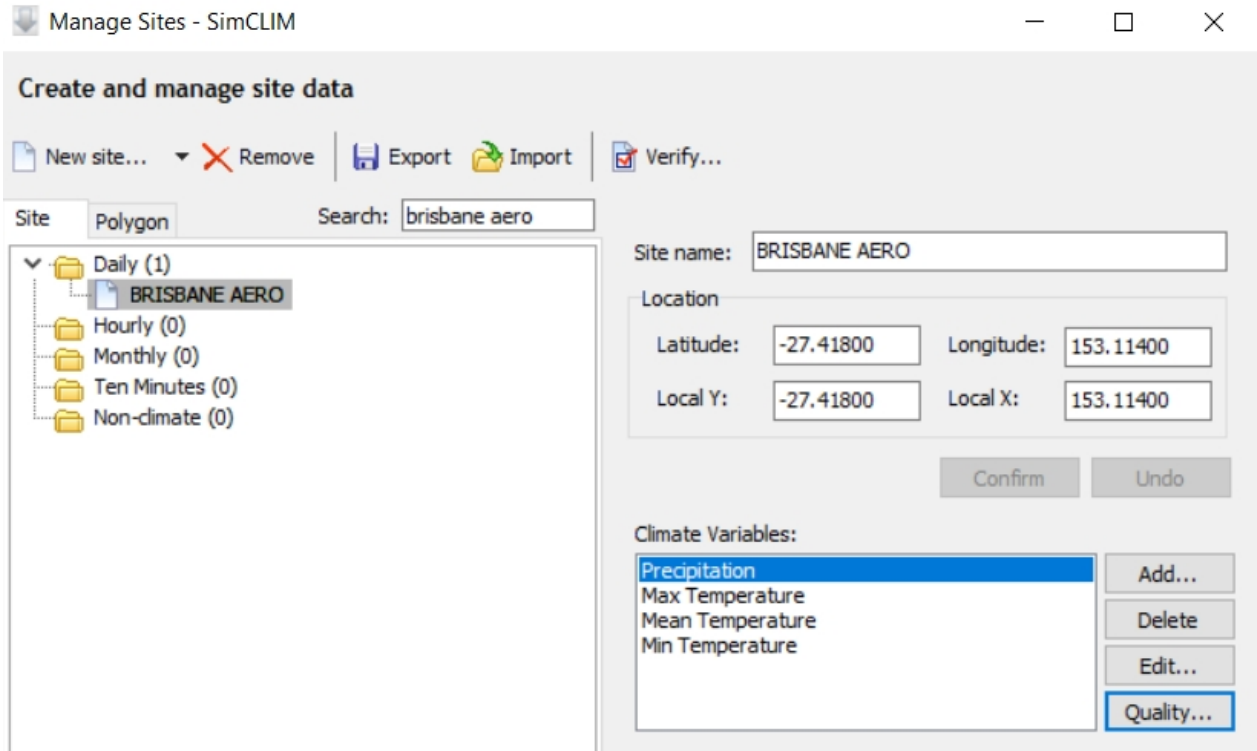
Then you will have the choice to select **total** values (sum of the consecutive day's data), **on the highest** value of the consecutive days or **on the lowest** value of the consecutive days.

You can also select based on the quality of the data you wish to accept in your analysis. It is not uncommon for large data sets to have missing days, months and even years. The amount of missing data can have an impact on GEV analysis.

A simple way to view the data's completeness is to open the Manage Sites tool outside of the extreme event analysis tool as shown below:



Then select the data site you wish to explore for completeness by typing it into the search window. Select the variable you wish to check, in this case precipitation and then click on Quality.



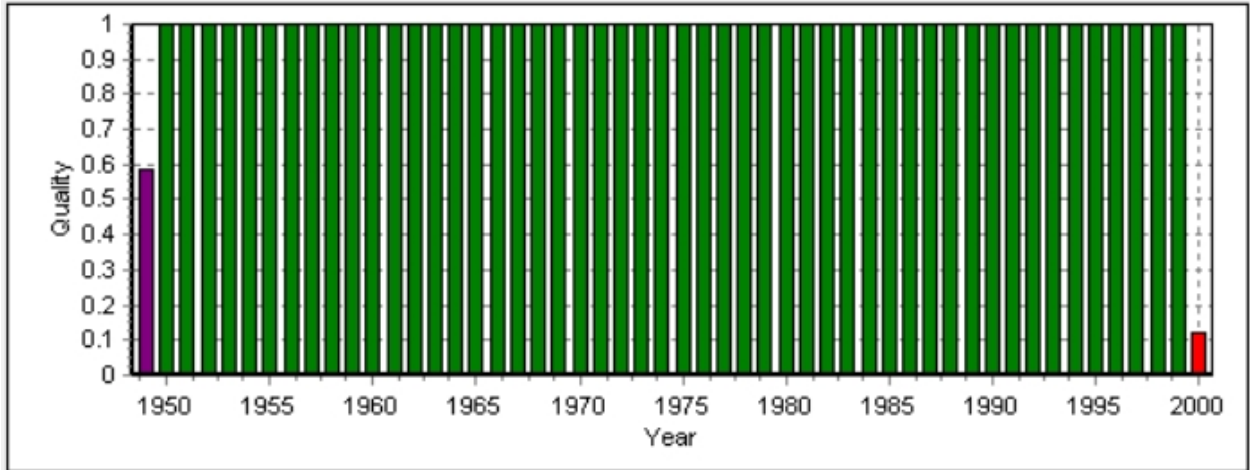
A graph and table will then be displayed showing the completeness of the data file for that particular variable:

Site Quality



Site Quality

Chart



Data quality

	194x	195x	196x	197x	198x	199x	200x
0	-	1.000	1.000	1.000	1.000	1.000	0.123
1	-	1.000	1.000	1.000	1.000	1.000	-
2	-	1.000	1.000	1.000	1.000	1.000	-
3	-	1.000	1.000	1.000	1.000	1.000	-
4	-	1.000	1.000	1.000	1.000	1.000	-
5	-	1.000	1.000	1.000	1.000	1.000	-

The Brisbane Aero site is relatively complete. As can often be the case the first and last year of the data record can be incomplete. With this information you can select the specific dates with full data records when completing your extreme event analysis.

The final option is the **PWM calculation order**. Theoretically, a high order gives a better model fits towards the extreme end, but at the possible expense of under-performance of the model at the not as extreme part. By clicking run, the model result will show in the table.

T Max T Min **Precip**

Total precipitation (mm) in Day(s)

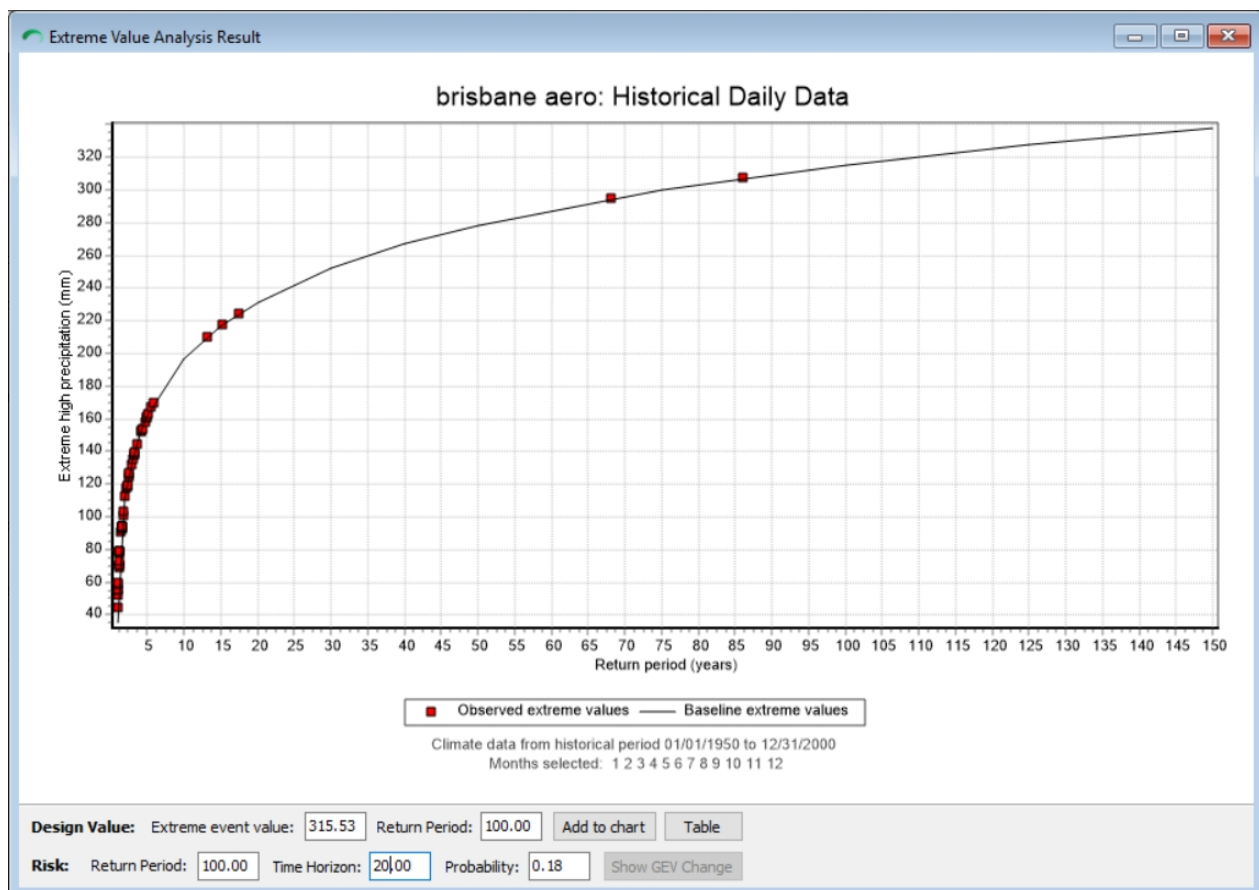
Use climate data from historical period to

PWM calculation order: Record completeness:

Event type High Low

Multiple sample event definition on total on lowest

The figure shows the extreme daily rainfall event result for Brisbane Airport based on 1959 to 2000 historical observed data. For the selected month (the whole year in this example) with one day rainfall total, the estimated GEV model output is listed in a results table. By clicking on the results table, a graph will be displayed:



Further analysis can be carried out using the **design value and risk** calculator at the bottom of the graph. In the above example, the result demonstrates that the 100 year-return-period extreme event for 1 day total precipitation is about 315.53 mm. There is a 18% chance during any continuous 20 year period of such an extreme event occurring.

Table

Click on to display more information on return periods and values:

Return periods Annual Maxima

GCM Baseline

2, 5, 10, 20, 50, 100

Return period	Value	Base RP
2.0	111.856	2
5.0	161.699	5
10.0	196.500	10
20.0	231.299	20
50.0	278.499	50
100.0	315.534	100

Simply type into the year dialogue box if you wish to see, for example the baseline 200 year and 500 year return period values.

Return periods Annual Maxima

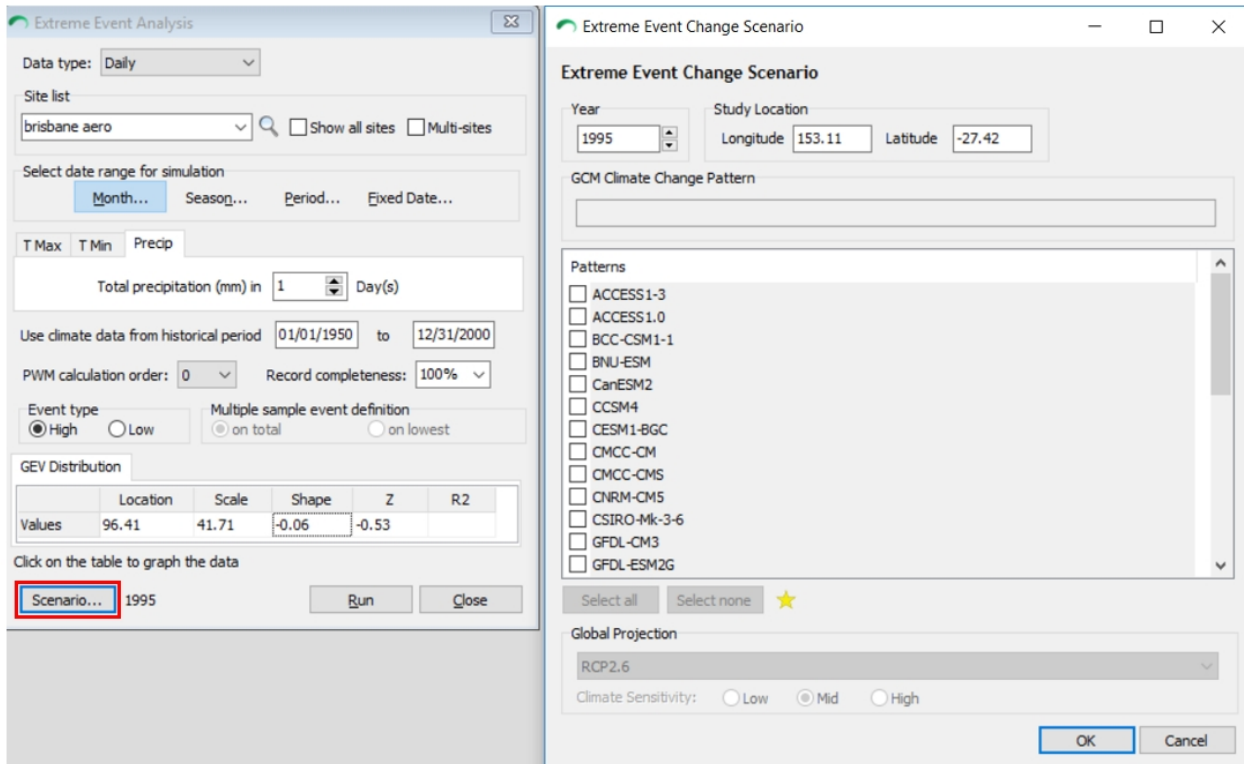
GCM Baseline

2, 5, 10, 20, 50, 100, 200, 500

Return period	Value	Base RP
2.0	111.856	2
5.0	161.699	5
10.0	196.500	10
20.0	231.299	20
50.0	278.499	50
100.0	315.534	100
200.0	353.917	200
500.0	406.922	500

Running a Climate Change Scenario

Return to your dialogue box you prepared for your baseline scenario analysis of extreme precipitation and click on Scenario and the Extreme Event Change Scenario dialogue box will appear:



Select the year and you need not touch the latitude and longitude boxes as they derive this information from the weather file site you have chosen. In this case Brisbane Aero.

You can also select one or more climate model patterns and the RCP of your choice for analysis.

Extreme Event Change Scenario

Year: 2100

Study Location: Longitude 153.11 Latitude -27.42

GCM Climate Change Pattern: 30 pattern ensemble

Patterns:

- ACCESS 1-3
- ACCESS 1.0
- BCC-CSM1-1
- BNU-ESM
- CanESM2
- CCSM4
- CESM1-BGC
- CMCC-CM
- CMCC-CMS
- CNRM-CM5
- CSIRO-Mk-3-6
- GFDL-CM3
- GFDL-ESM2G

Select all Select none ★ Percentile: Low: High:

Global Projection: RCP8.5

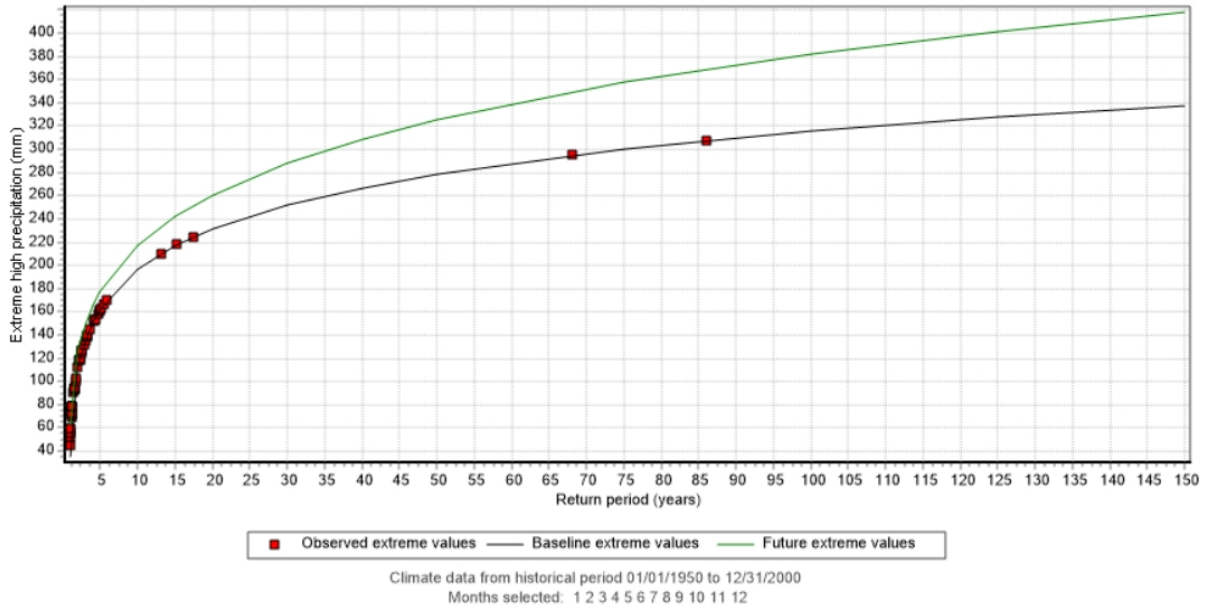
Climate Sensitivity: Low Mid High

OK Cancel

Click **OK** and **Run** back in the main dialogue box.

Then click on the results table above and a new graph will be displayed that includes the baseline and future scenario outputs:

Based on daily GCM GEV value method
 brisbane aero: Daily Data, Scenario Year: 2100
 RCP8.5, Mid_Sensitivity, Ensemble: median







Click on the Table button to see the numerical display like you did with analysis of the baseline and you can now toggle between baseline and climate change conditions based on the models and scenario you have chosen.

Return periods **Annual Maxima**

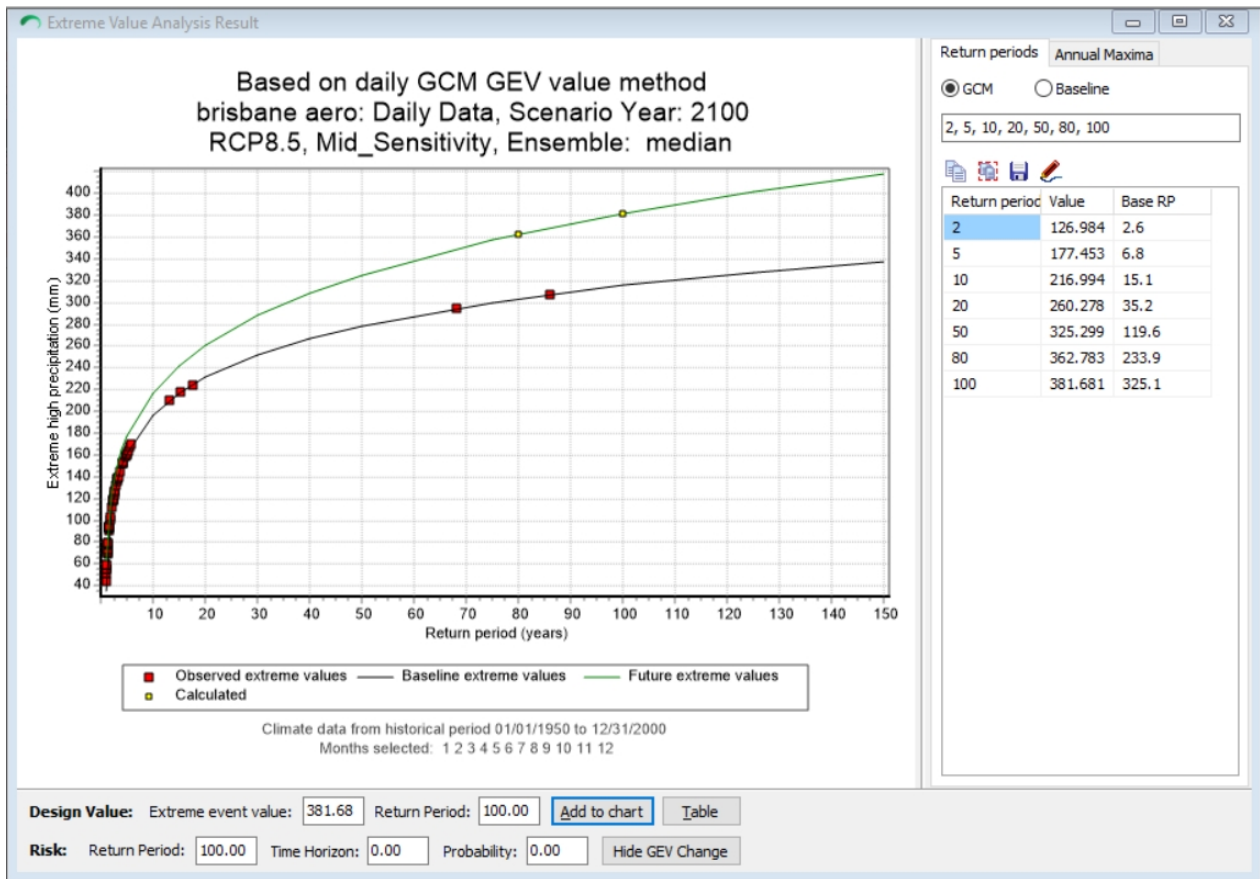
GCM Baseline

2, 5, 10, 20, 50, 100

Return period	Value	Base RP
2	126.984	2.6
5	177.453	6.8
10	216.994	15.1
20	260.278	35.2
50	325.299	119.6
100	381.681	325.1

You will see that the 1 in 100 year event for this site under a RCP 8.5 medium sensitivity scenario increased from 315.5 to 381.7 mm.

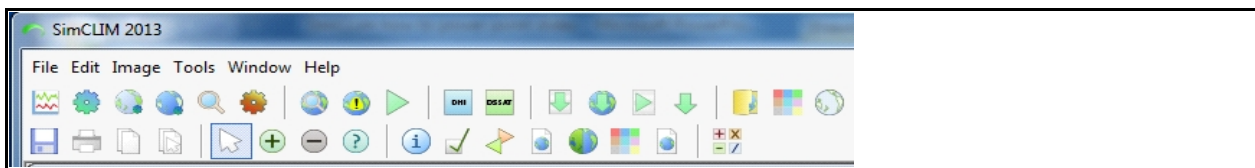


Extreme Temperature Analysis

Using the extreme value analysis tool

This section covers using the Extreme value analysis for Australia where observed data is recorded daily only.

1) Select extreme value analysis



2) Select the following in order (refer Figure 1)

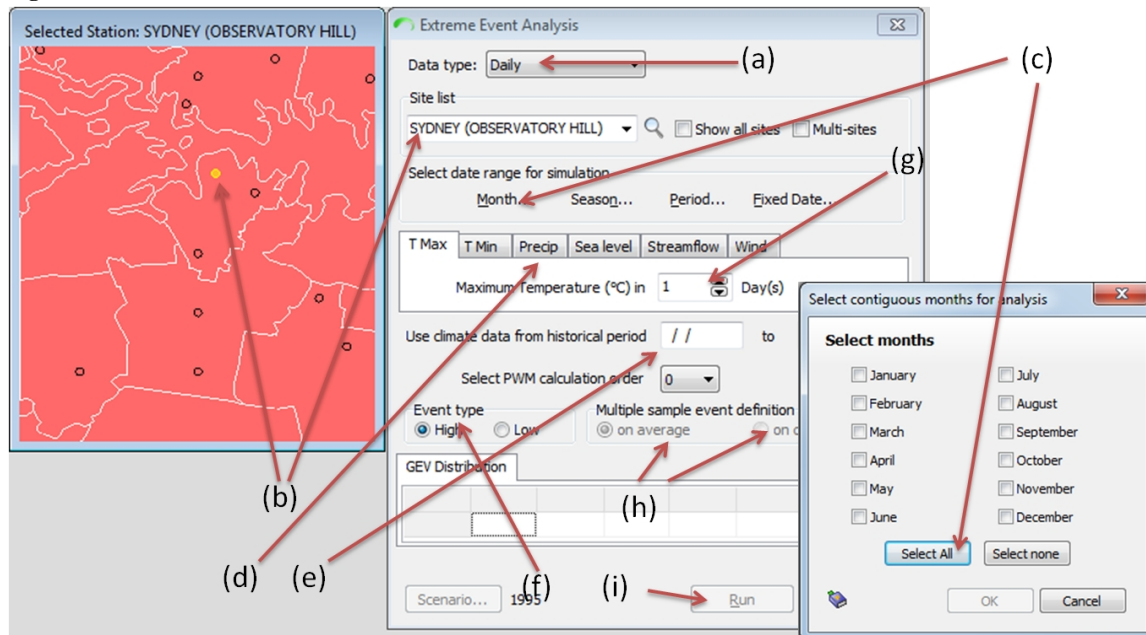
- a) Data type → Daily
- b) Select BoM site
- c) Select date range (month) → select all
- d) Select climate variable
- e) Historical period (keep this consistent with the baseline you are using in the analysis)
- f) Leave event type as high (high gives maximum highs (hottest day maximum), low gives minimum highs (coldest day maximum))
- g) Select number of consecutive days
 - i) A value of 1 gives the data for a single day event.

ii) If you select more than one day in step (g) you can choose between event definition “consecutive” or “average”. Consecutive looks for a temperature that exceeds a threshold each day. Average looks for the threshold temperature averaged across three days.

Anecdotal – for Sydney the return period using the average above was half (twice as frequent) of that given by using the “on consecutive” (absolute) button

h) Click Run

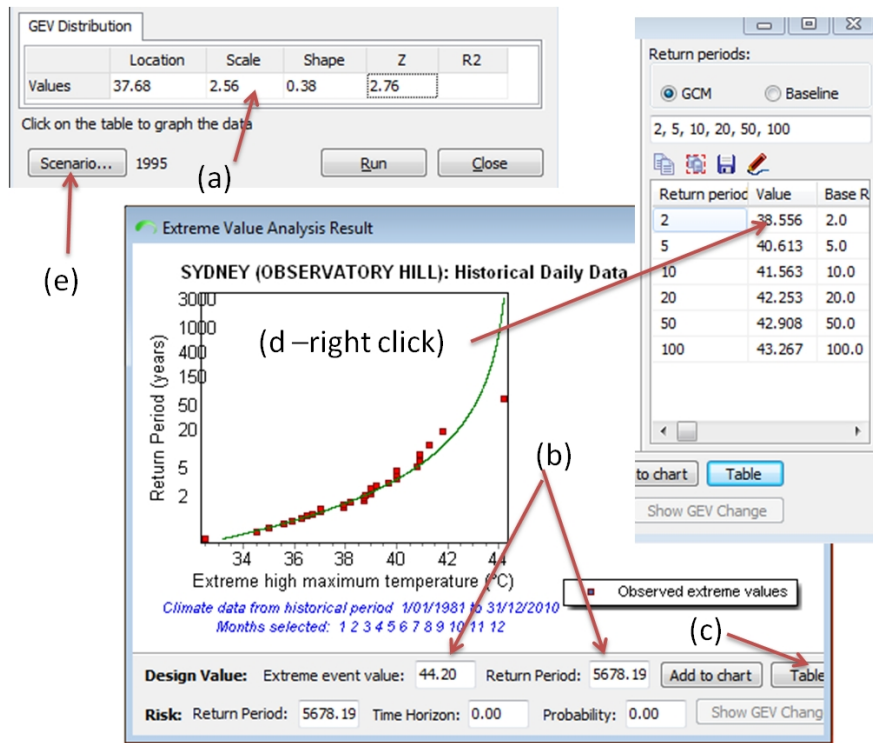
Figure 1



3) The table at the bottom of the form will populate with data (refer Figure 2)

- a) Click the data to generate a chart
- b) Change the extreme event value or the return period to see how they are related
- c) Click on table to generate the table of the set return periods
- d) Export the table to excel for comparison
- e) Repeat using the different projected years by clicking the scenario button

Figure 2



How to read a table of return periods

This section sets describes the how to interpret the values in a table generated using the extreme event analysis tool in SimCLIM.

Table 2 Extreme event return periods

Collinsville Post Off baseline			2030						2050						2100					
RP	Chance	25%		50%		75%		25%		50%		75%		25%		50%		75%		
		°C	RP BL	°C	RP BL	°C	RP BL	°C	RP BL	°C	RP BL	°C	RP BL	°C	RP BL	°C	RP BL	°C	RP BL	
2	0.500	39.5	40.5	3.9	40.7	4.8	41.1	6.4	41.2	7.1	41.6	10.7	42.2	19.1	43.4	78.1	44.4	319.6	45.7	3127.8
5	0.200	40.8	41.8	12.6	42.0	16.4	42.4	23.9	42.5	26.6	42.9	44.7	43.5	95.8	44.7	515.2	45.8	3393.4	47.2	111832.5
10	0.100	41.5	42.6	28.7	42.8	39.2	43.2	60.5	43.3	67.4	43.7	123.1	44.4	300.9	45.5	2039.0	46.6	20792.2	48.1	2552374.0
20	0.050	42.2	43.2	65.2	43.5	93.3	43.9	152.9	44.0	169.6	44.4	342.0	45.1	961.6	46.2	8623.0	47.3	155680.1	48.8	167928272.0
50	0.020	43.0	44.1	194.1	44.4	299.1	44.7	532.7	44.8	587.6	45.3	1391.6	45.9	4844.6	47.0	70810.6	48.2	3967215.8	49.7	-1.0
100	0.010	43.6	44.6	448.4	44.9	739.7	45.3	1412.7	45.3	1550.1	45.9	4277.4	46.5	18077.9	47.6	439231.6	48.8	102913928.0	50.3	-1.0
200	0.005	44.1	45.1	1052.2	45.5	1880.5	45.8	3883.7	45.9	4235.3	46.4	14107.3	47.1	75338.3	48.1	3694515.3	49.3	-1.0	50.9	-1.0

These tables set out temp and precip values against a return period

Moving left to right

RP = return period in years

Chance = chance of that event occurring in any given year

Bold value = baseline value (the temperature that corresponds to the return period in column 1 in the baseline (observed) climate.

25%, 50%, 75% - from the 25th, 50th (median) and 75th percentile of the GCM ensemble respectively

Paired columns - temperature value (°C) and RP BL

- Temperature value is the projected temperature value for that future year and that percentile (from the ensemble result) for the return period in column 1
- RP BL return period of the projected temperature value in the baseline climate.

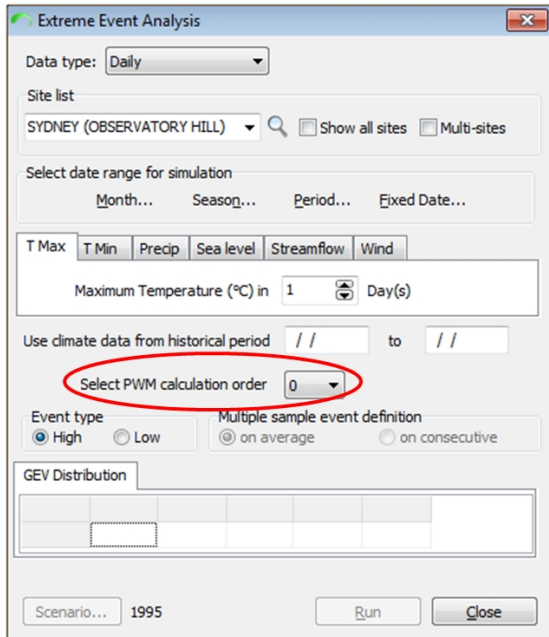
e.g. Collinsville, 2050, 75% 5 year RP (column 1) – value is 43.5 degrees. In 2050 it will occur every 5 years on average. In the baseline it would have occurred every 95.8 years. This is almost a 20% increase in frequency.

Very Large RPBLs and -1.0s mean that that value is outside the historical values observed in that location.

Using the Power Weighted mean function

The power weighted mean field can be used to get a better model fit towards the extreme end, with underperformance away from this extreme end.

Figure 3



We did an experiment for BoM site Observatory Hill. RCP8.5, high sensitivity, 2030 ACCESS 1-0. Single day. 46 degrees.

There is a huge range in the results as shown in the table below.

Power weighted mean	Return period for 46 degree day
0	696652
1	886
2	253
3	156
4	127

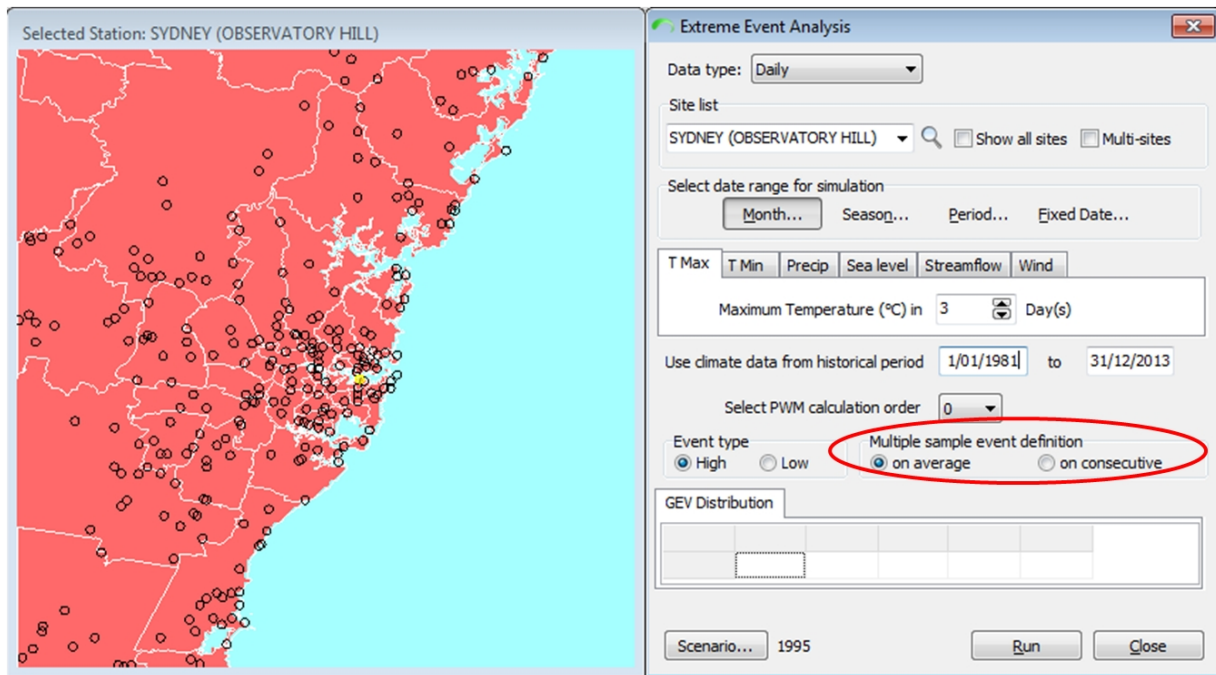
This changes the RP tables that are generated within the Extreme Value analysis as well.

Multiple Day Extreme Events

Clarification on using average vs consecutive when projecting multiple day thresholds

This note is included for the record only as it is useful for understanding the workings of the extreme event tool.

Figure 1



In the extreme value analysis box for Tmax, you have a choice of two buttons under the “multiple sample event definition” option.

Query from a user - the left button gives the return period “x” days where the average between the two days is over threshold temperature. The right gives the return period where the individual temperature for where each of the “x” consecutive days is over the threshold temperature.

In this way, with 35 degree days if there were 2 consecutive days 32 and 39 degrees ((32+39)/2=35.5), they would be picked up by the left button but not the right. Because we are interested in only days over 35 degrees in this case I should use the right button?

CLIMsystems: *You are right on all accounts. I would probably do both, as heatwaves are often defined as the average high temperature over a period of time. In the “consecutive days” approach you could have 5 days with the first and last 2 (way) over 35, and the middle just below, which would not be picked up as an extreme event.*

Anecdotally – for Sydney the return period using the average above was half (twice as frequent) of that given by using the “on consecutive” (absolute) button.

Fitting Rainfall Analysis to Your Problem

Fitting Rainfall Analysis to Your Problem Statement

Precipitation Related Climate Change Analysis

Applications	A] Baseline and total seasonal and monthly changes in slow onset for water resources	B] Extreme changes, changes in return period, IDF, or DDF for water infrastructure	C] Extreme changes in short duration (hourly), changes in return period, IDF, or	D] Water resources, flood inundation modelling
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	planning	design	DDF for urban water infrastructure design	
Precipitation related climate change analysis type	Annual or monthly mean	Daily precipitation extremes	Subdaily to multiple Intensity Duration Function(IDF), or Density Duration Function (DDF)	Hydrological model input data
Recommended methodology	Change factor approach (Percentage change per degree, or percentage in different scenarios)	Generalized Extreme Value analysis, multiple distributions fitting testing.	Generalized Extreme Value analysis and IDF curve fitting, multiple distributions fitting and testing. Multiple fitting methods and high temporal resolution for critical urban infrastructure design	Bias correction statistical downscaled with climate change projections conducted by CLIMsystems with data and held by CLIMsystems
Historical data required	Observation based Monthly historical data	Daily observation time series	Subdaily observation data	Subdaily or daily observations
GCM/RCM data required	Multiple GCM and RCM monthly mean ensemble results	Multiple GCM daily precipitation based extreme value change patterns	Multiple GCM 3 hourly precipitation output extreme value change patterns	Multiple source subdaily or daily GCM or RCM
CLIMsystems tool	SimCLIM 4.0 for Desktop monthly pattern scenario generator, rapid assessment, easy training	SimCLIM 4.0 for Desktop GEV tool and in-house tools, moderate intensity, time consuming if many assets need to be assessed. Can be run in a customised form by CLIMsystems for larger areas with a data set generated for later extraction and application.	Subdaily extreme event analysis in-house methods with shape files as outputs for specific time slices and RCPs. Cost increases with number of RCPs and time slices required.	Multiple GCM daily/sub-daily BCS dataset, moderate labour intensity, can be run for multiple RCPs and time slices but costs increase slightly with additional runs.
Potential linkage to other models	WEAP, DSSAT	Related infrastructure design models	Related infrastructure design models	SWAT, DHI, EWA, HECS, SWMM, Flood Modeller, other flood datasets
Pro/Cons	Quick and easy to generate, but seasonal/monthly average change cannot reflect the extremes which are crucial for certain approaches to	Widely used for engineering design, applying daily GCM/RCM output but may underestimate sub-daily changes in extremes, which is	Widely used for engineering design. GCM/RCM sub-daily data reflects changes in higher temporal resolution (Prein et al., 2016).	Can be directly linked to hydrological flow modelling and cost-effectively multiple scenarios and multiple time

	water resource management.	important for flooding Field, 2012; Wuebbles et al., 2014). See methods D] and E].	Not directly applicable for detailed flood modelling.	slices (Rudd & 2015; Peck et al 2012; Wang et al 2013).
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Guidelines for Return Periods

Guidelines for Return Periods

Ideally, the choice of a design return period should be based on an economic evaluation in which the costs of providing the drainage works are compared with the benefits derived. However, comprehensive local flood damage data are normally not available to the degree of precision required for cost-benefit analysis. For this reason, a general policy decision based on such considerations as land use, hazard to public safety and community expectations is more appropriate. Admittedly, for new drainage systems or drainage upgrading in some existing areas, particularly low lying ones or those in congested urban locations, the recommended standards may not be suitable or achievable. A pragmatic approach should be considered. In a case in Hong Kong the return periods recommended in urban drainage situations ranged from 50 to 200 years (Drainage Services Division, 2014). For the City of Dublin, Ireland a 100 year return period is applied for protection of flooding within properties (Greater Dublin Strategic Drainage Study, 2005). These values may not be appropriate when climate change is considered.

Guidelines for the selection of return period

No.	Type of project or feature	Return period (yr)
1	Urban drainage [low risk] (up to 100 ha)	5 to 10
2	Urban drainage [medium risk] (more than 100 ha)	25 to 50
3	Road drainage	25 to 50
4	Principal spillways (dams)	25 to 100
5	Highway drainage	50 to 100
6	Levees [medium risk]	50 to 100
7	Urban drainage [high risk] (more than 1,000 ha)	50 to 100
8	Flood plain development	100

9	Bridge design (piers)	100 to 500
10	Levees [high risk]	200 to 1000
11	Emergency spillways (dams)	100 to 10,000 (PMP)
12	Freeboard hydrograph [for a class (c) dam]	10,000 (PMP)

Source: Ponce, V.M. Q & A on the return period to be used for design. Sourced 20 May 2016.
<http://returnperiod.sdsu.edu/>


Probability

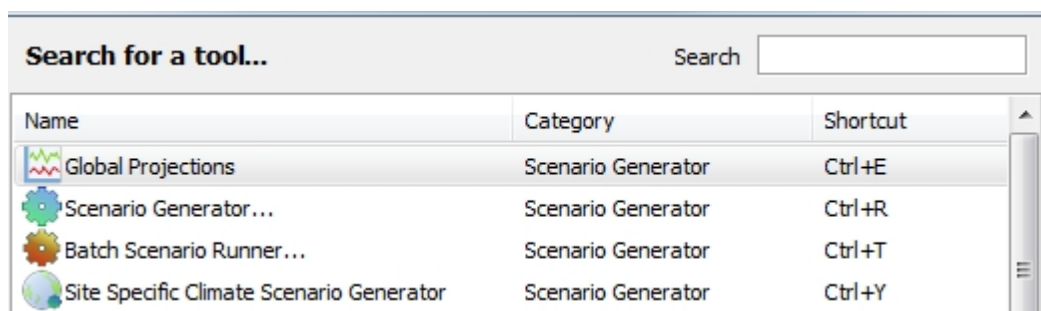
Probability

- In everyday conversations about different possibilities, these are often compared as being equally, or more, or less likely —or probable —than others.
- Risk researchers and practitioners often treat the probability of some event as a number between 0 and 100. They then apply the rules for mathematical probabilities to these numbers. If a possibility appears again and again, the probability that it will be realized is often seen as the limiting value that one would get by counting the cases where it has been realized and dividing it by the number of occasions where the possibility did arise.
- Economists and decision analysts often use the word “probability” to characterize the willingness of an agent to engage in a bet with well defined stakes. Leaving one’s home without an umbrella is then seen as equivalent to betting that it will not rain, where the stakes depend on one’s clothes and further circumstances.
- Mathematicians use the word “probability” for functions that associate real numbers to certain subsets of a set while satisfying the rules known as the Kolmogorov axioms. An example is a function that associates to any number of fields on a chessboard that number divided by 64: the whole chessboard has a probability of 1, a single row or column a probability of 1/8, a single field has probability 1/64, etc.

Scenario Set Generator

Scenario Set Generator


When you start SimCLIM 4.x for Desktop, you can choose scenario set from the toolbar at the top of the screen  or by right clicking within the main window and clicking on the scenario set icon.

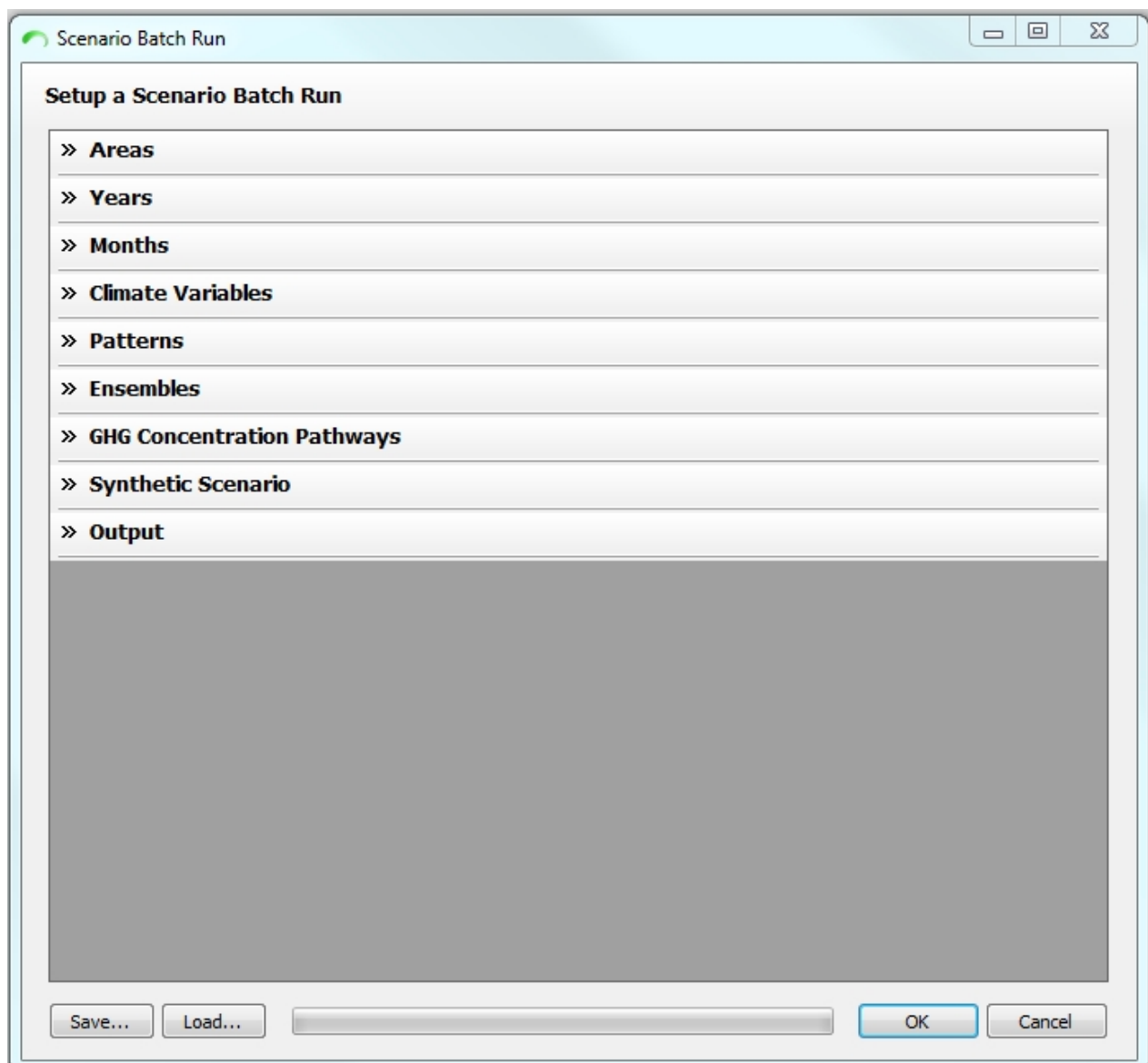


With the new scenario set window open you can consider your many options for rapidly generating multiple scenarios of climate change. The variables include: areas, climate variables, year range, month range, GCM patterns, greenhouse gas projections, synthetic outputs options and file saving, either Idrisi image or ArcView ASCII.

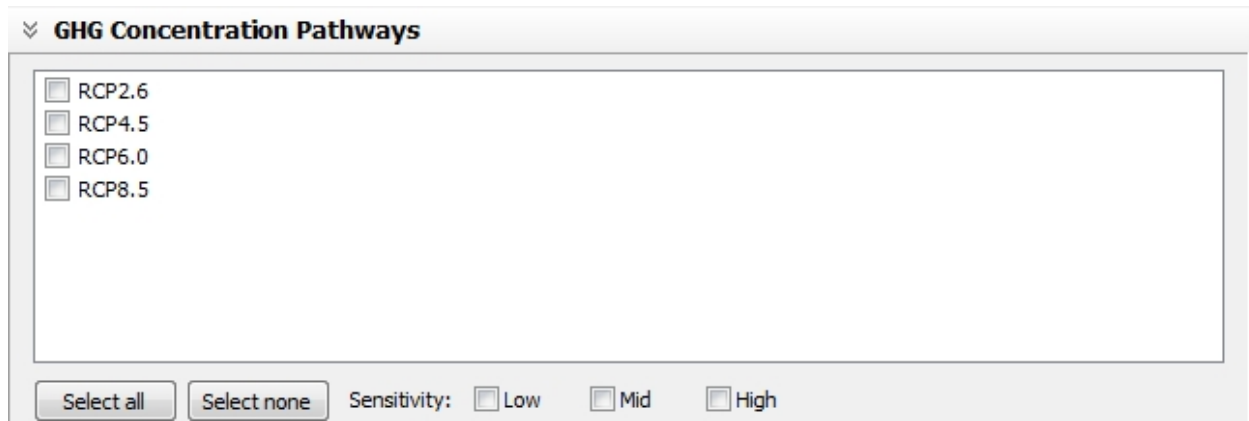
Activity:

In this activity you will generate a set of scenario options and view some of them within the SimCLIM 4.x for Desktop software system.

You will do this for a range of variables and outputs, including synthetic model results. Click on the scenario set icon and explore the window. We will now explore each of the nine areas within the scenario select window prior to running a set. You can open most boxes by clicking on the arrow  at the left side of the variable box.

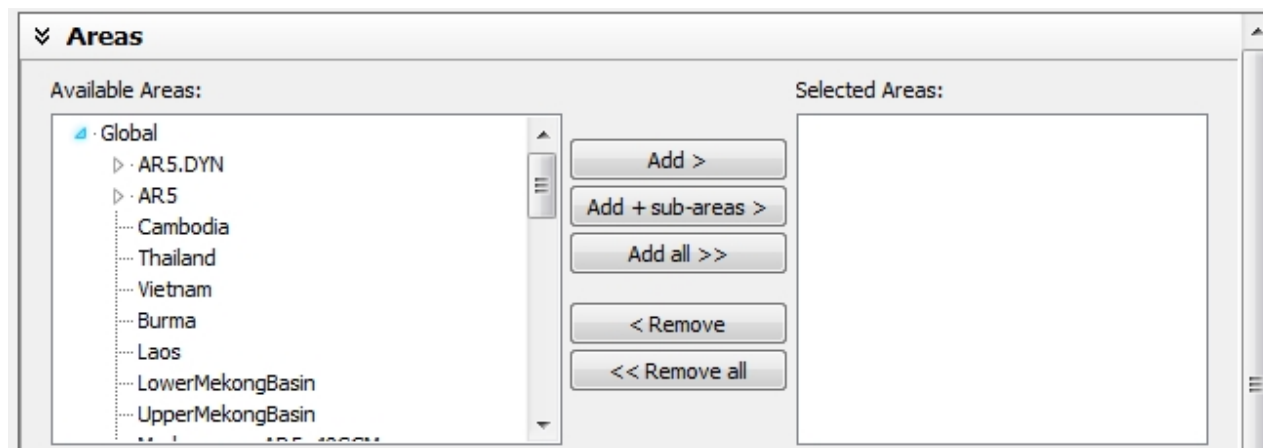


For example the GHG Concentration Pathways when the arrow is clicked for it expands to the following:



Now you can systematically go through each of the nine parameters before running a scenario set for your study area.

By clicking on the areas arrow and then the Global icon in the left window your available study areas will be displayed:



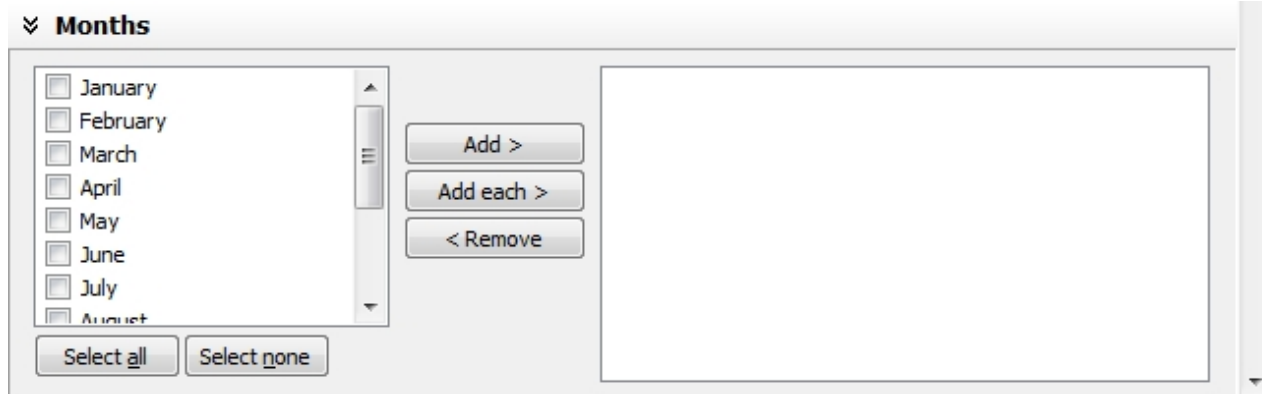
Highlight the area and click add if you wish to include it in your analysis. Do this for each area you wish to include. Experiment with this process of adding and removing areas so you can become comfortable with the process.

Click on the arrow beside Years :



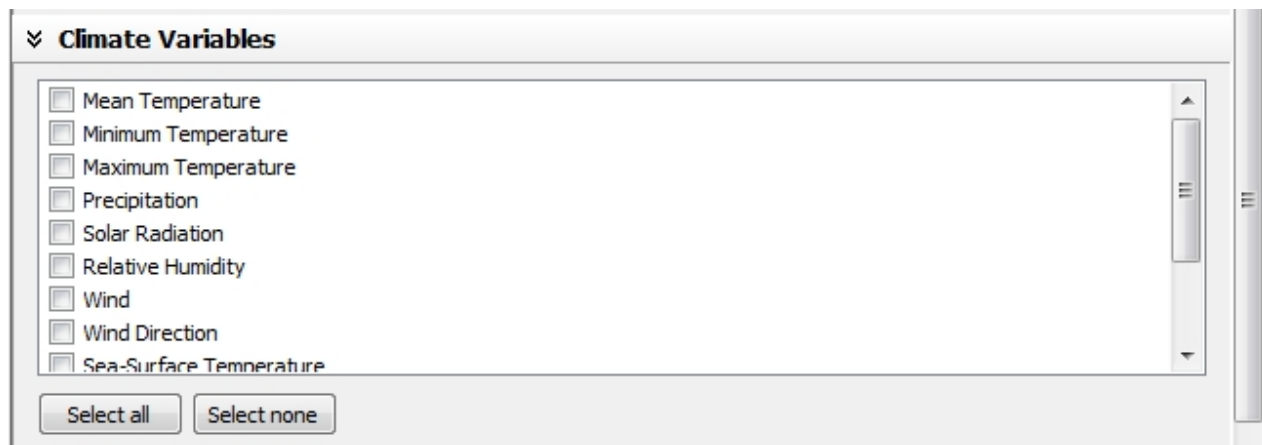
Type in the years your interested in. For example 2050, 2070, 2100 with a comma between each year. Be careful not to choose too many years as depending on the other options chosen you could generate thousands of map outputs.

Click on the arrow beside Months :



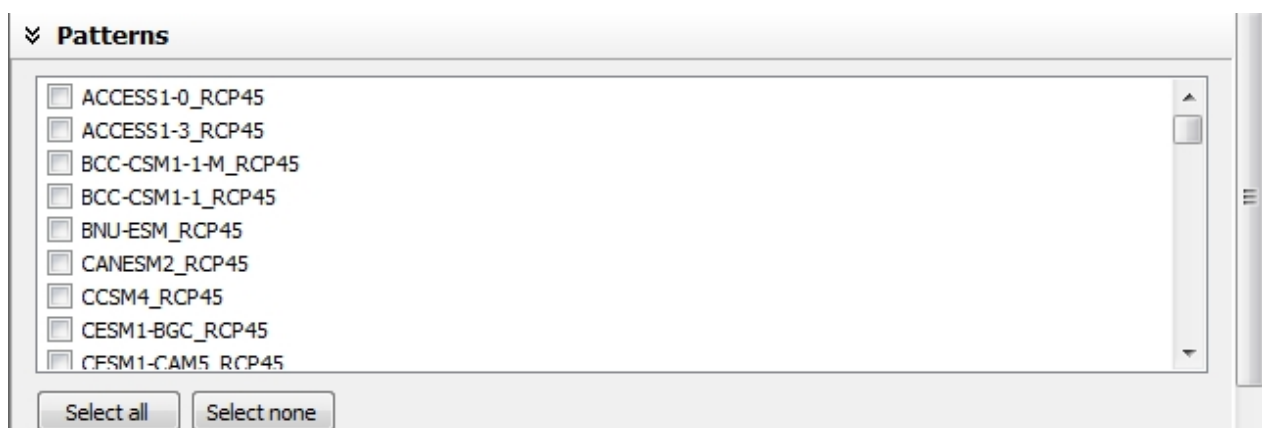
Click on the individual month(s) of interest or select all for annual and Add to move them to the active box on the right.

Click on the arrow beside Climate Variables:



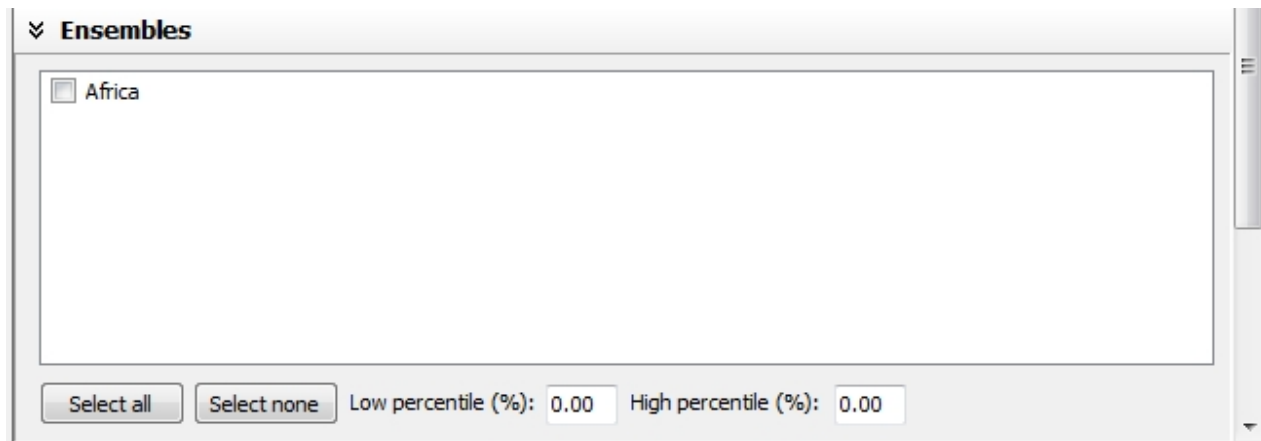
Click the boxes of the variables you are interested in including in your scenario set run.

Click on the arrow beside Patterns:



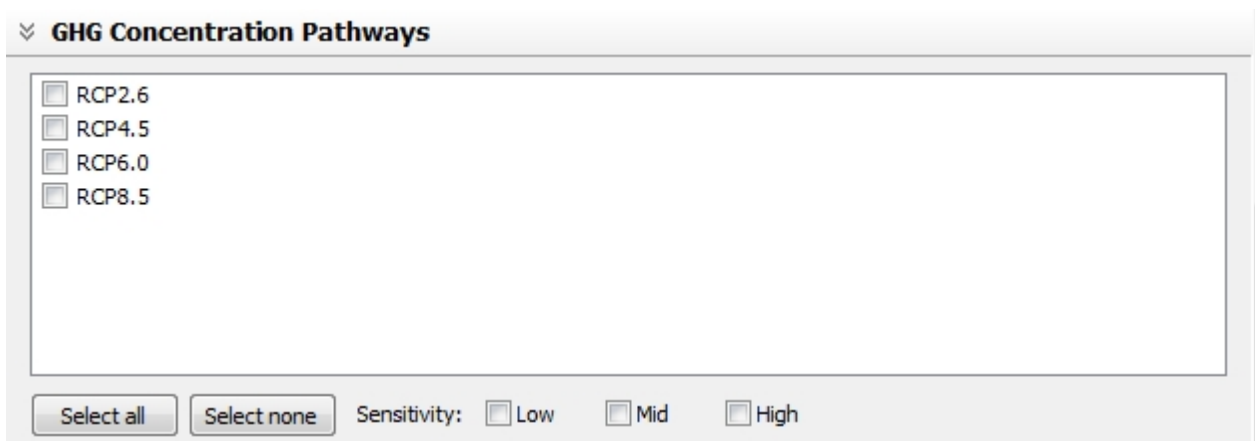
Select the individual patterns you are interested in running. Leave this dialogue box if you are going to apply an ensemble(s).

Click on the arrow beside Ensembles:



Click on the Ensemble(s) of interest for your scenario set run and choose a number for your low and high percentile if you are interested in probability of high or low outcomes.

Click on the arrow beside the Greenhouse Concentration Pathways (RCPs):

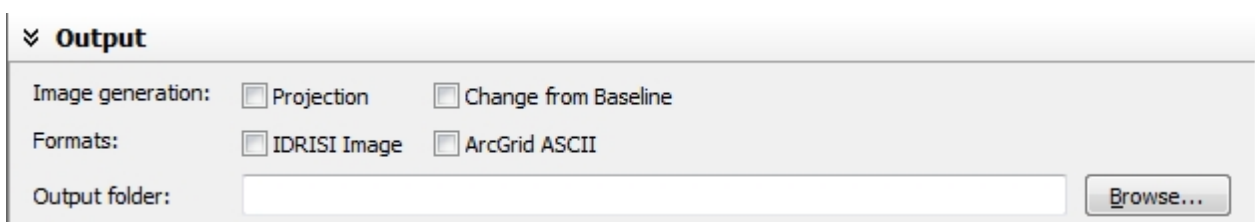


Select the RCP(s) of interest and the sensitivity you wish to apply.

Click on the arrow to beside the Synthetic Scenario if you are running one:

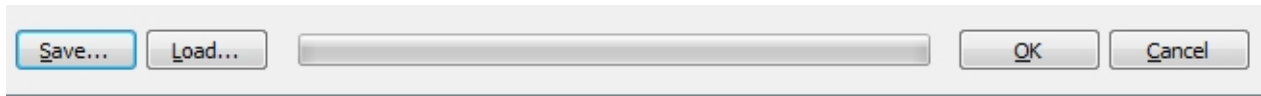


Click on the arrow beside Output:



Choose the type of output you are interested in and the folder where they should be generated.

You are now ready to run your scenario set. If you wish to use the set up again or wish to only change one or two variables but leave most of the parameters again it is suggested that you save the set up by clicking on save on the bottom toolbar:

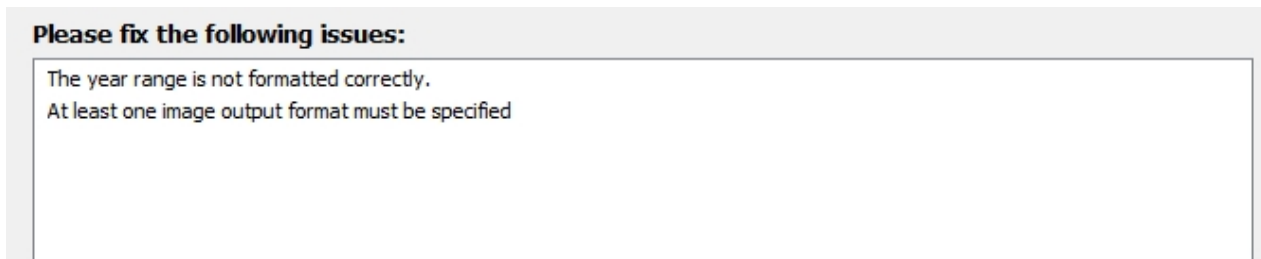


An option for naming the set up will be provided.

You will click on the load button to load a saved set in the future.

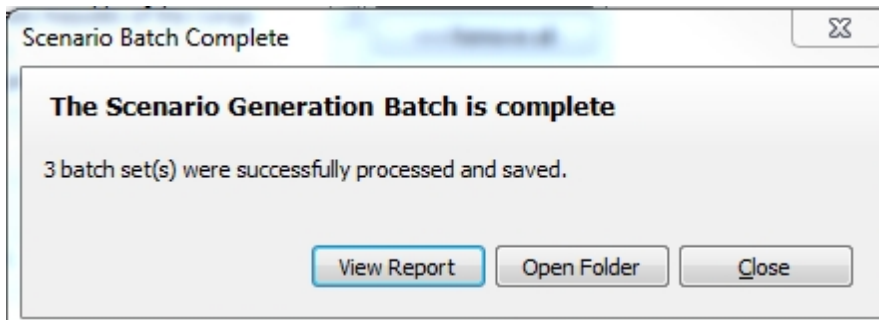
Click OK to run your analysis.

Setting up the scenarios set options can be complicated. The tool will provide you with a list of errors if when you click on OK there are any problems with the set up. An example is found below:

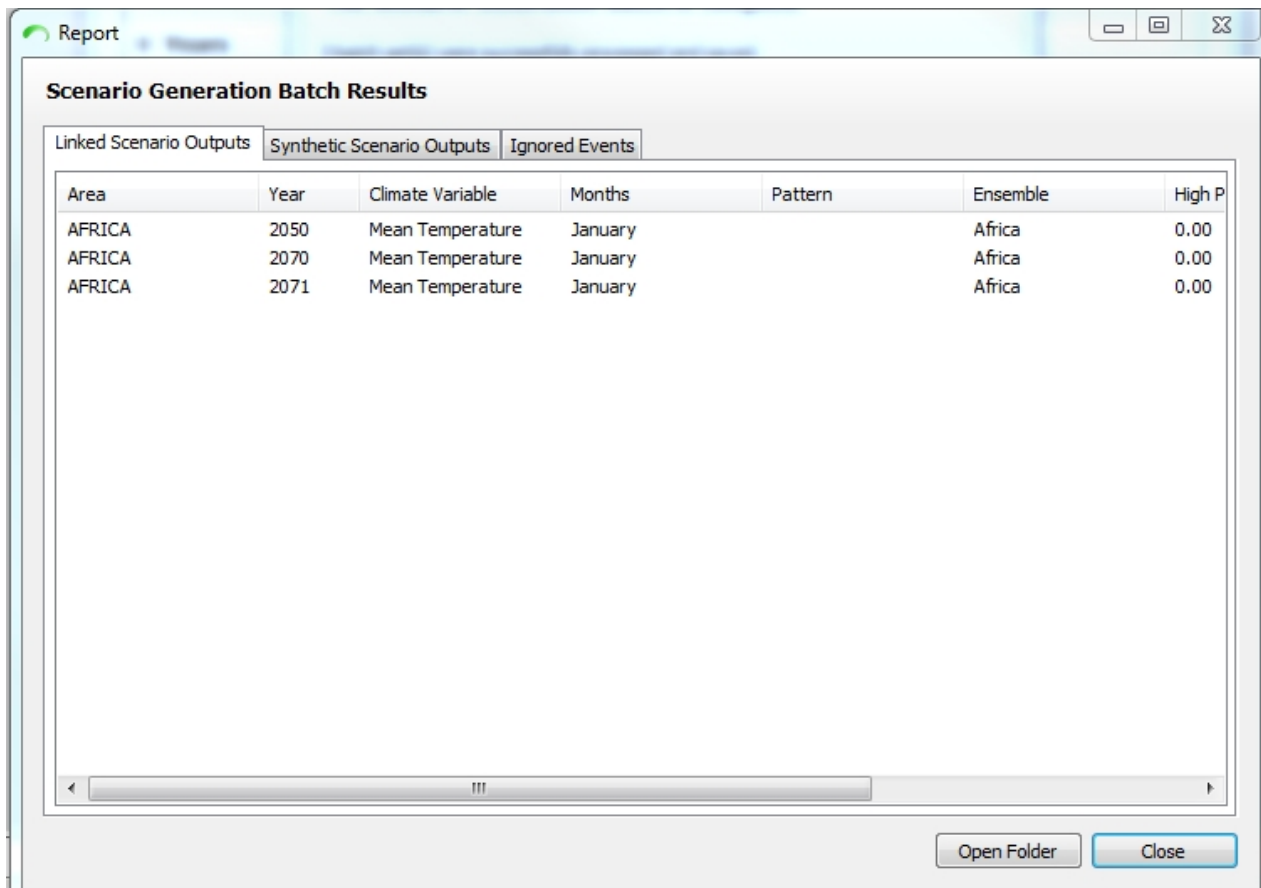



Go back and fix these oversights and click on OK again and hopefully you are successful.

If you are successful the following dialogue box will be displayed:

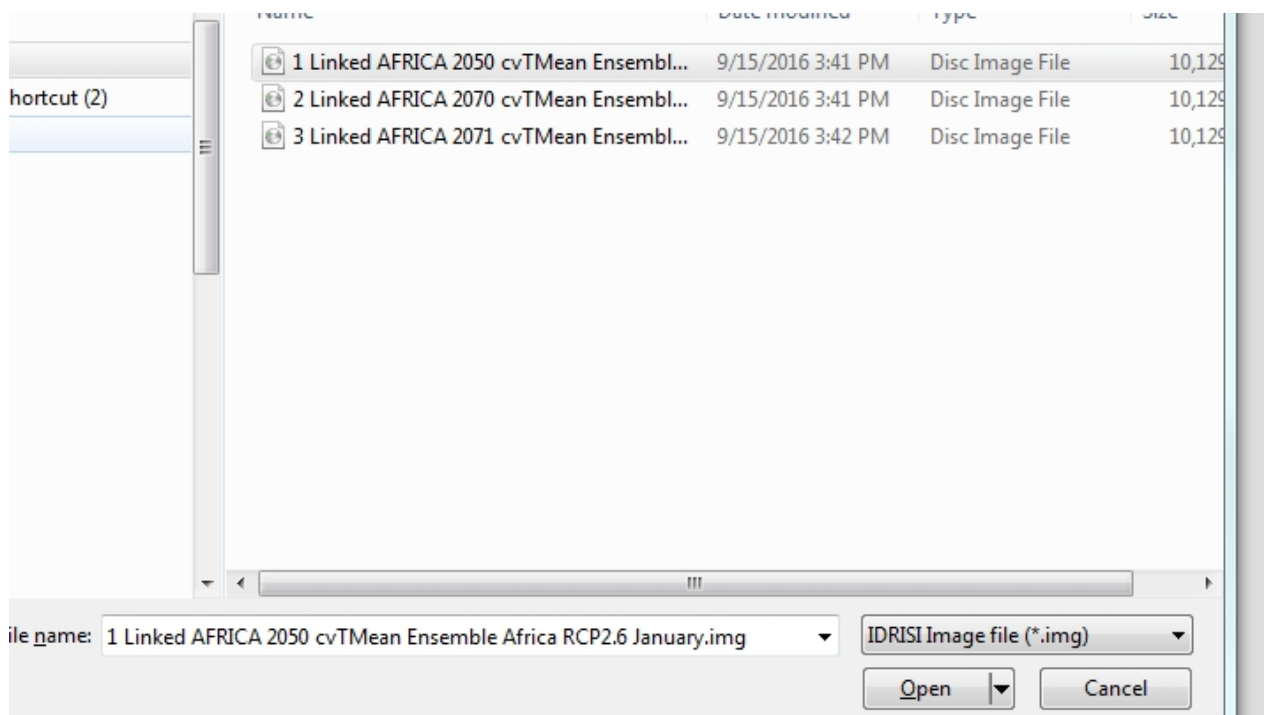


Click on View Report for more information:

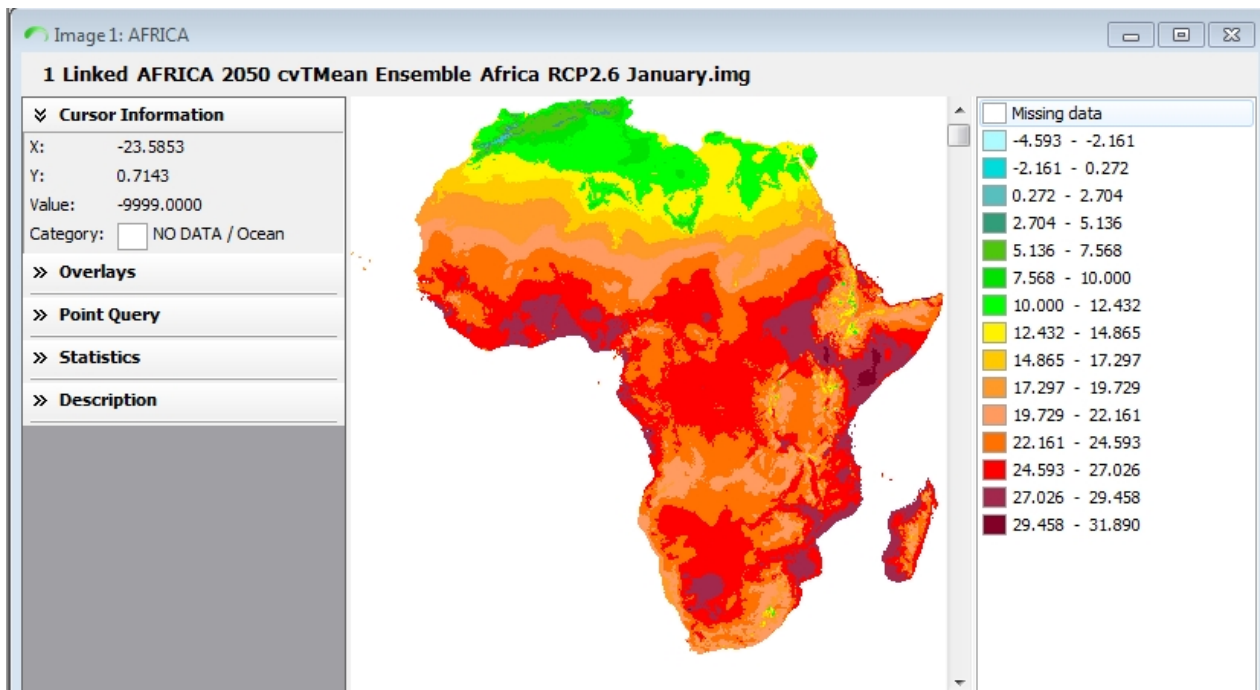
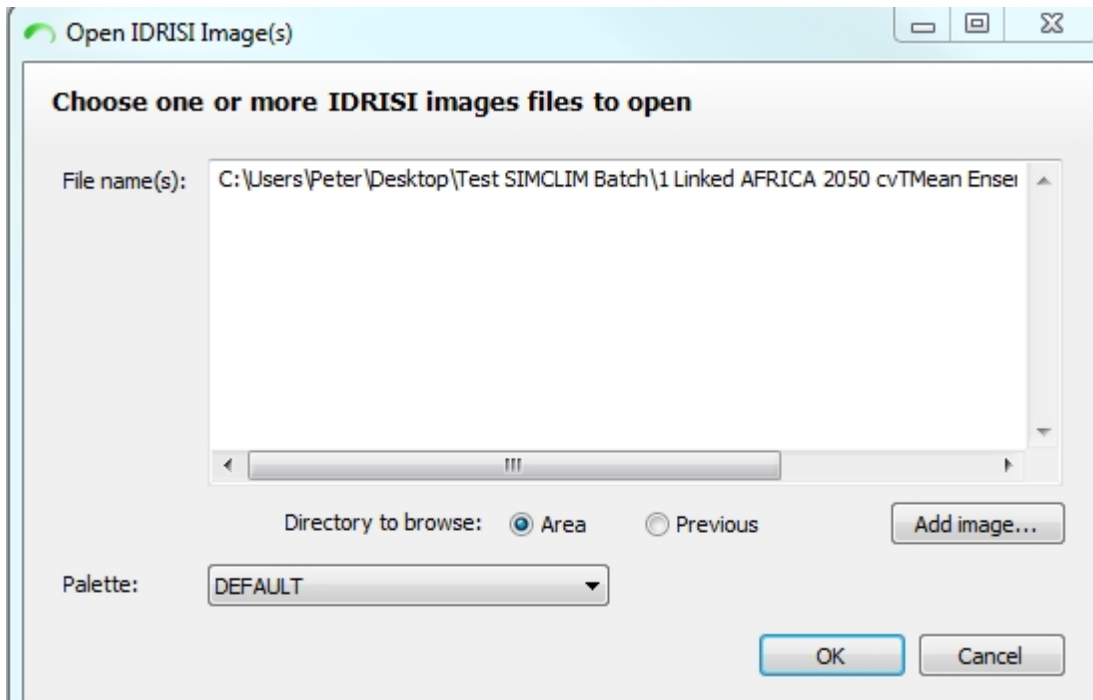


If you wish to view the actual images produced then you can right click in the main SimCLIM window and choose open image  to display the files. You will be asked to browse the the folder where you asked to have the files saved.

Click on a file and click on Open.



You can then click on OK and open the file:



Working With Vector and Shape Files

Some Definitions

Vector Files :

A vector image is one of the two major graphic types (the other being bitmap). Vector graphics are made up of many individual objects. Each of these objects can be defined by mathematical statements and has individual properties assigned to it such as colour, fill, and outline. Vector graphics are resolution independent because they can be output to the highest quality at any scale. Software used to create vector graphics is sometimes referred to as object-based editing software. When you zoom in on the image, notice that the edges of the text are always crisp and sharp at any scale. This is why vector images are called resolution independent.

Shape Files :

There are two different forms of GIS data: raster and vector. Vector data is represented by points, lines, and polygons. A point may represent a certain elevation, a line may represent a contour, and a polygon may represent a region with the same elevation. Each vector object may have one or more attributes associated with it. For example, a single point may be linked to a table that contains a weekly water quality index. For this reason, a vector-based GIS like ArcView is useful when dealing with large databases. Raster data is organized into grids in which each cell in the grid is assigned one attribute (i.e. elevation). The size of each cell relative to the real world is indicated by the resolution of the data layer.

Adding Files

To add files you will need to create a folder within your system hierarchy. While a folder can be placed anywhere it is advisable to place it alongside your BaseClim and Patterns folders. Typically the path to these folders is :

C:\Program Files\ClimSystems\SimCLIM\Data\

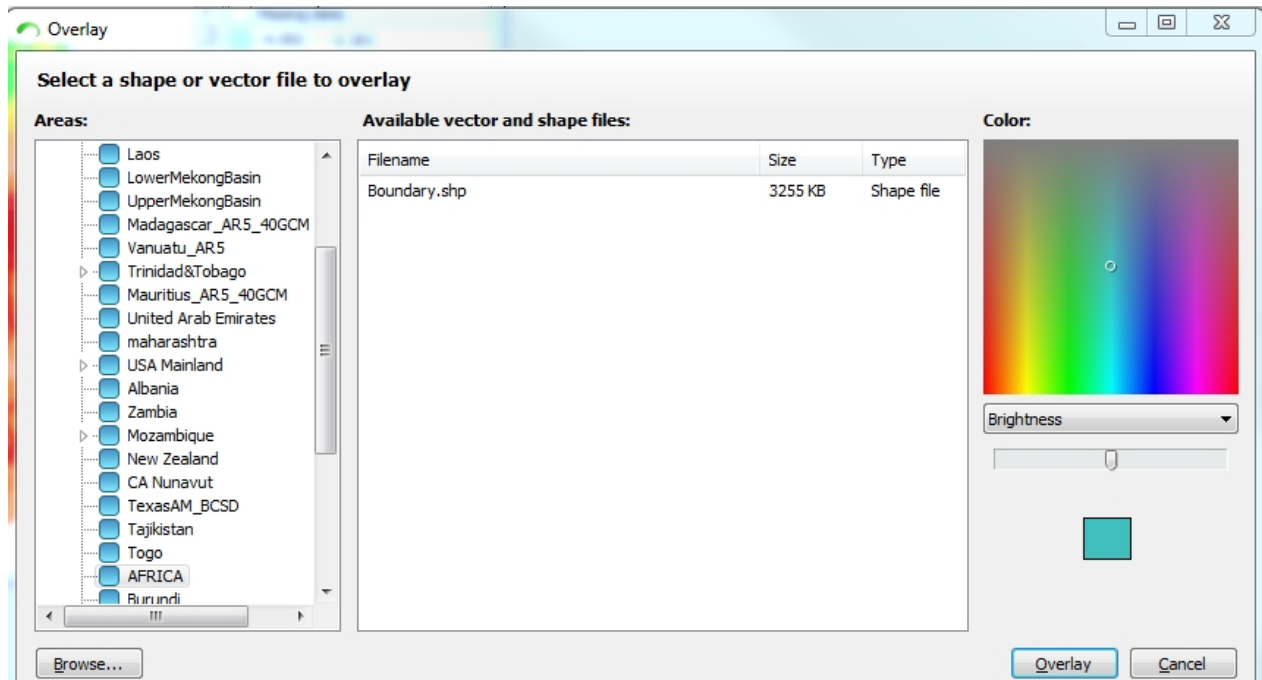
After creating the folder you can add your shape and vector files to it. You must shape and vector files that correspond in terms of their latitude and longitude for the areas within your. In this activity you will generate a set of scenario options and view some of them within the SimCLIM 4.x for Desktop software system otherwise they will not work. Contact ClimSystems for assistance if you encounter difficulties using these sorts of files.

Displaying Files

When you have a spatial output open for which you wish to add additional information (derived from shape and vector files) click on the overlap vector and shape file tool from the toolbar at the

top .

A new dialogue box will be displayed. If no shape or vector files are displayed you will need to browse to them by clicking on the browse button in the lower right of the dialogue box.



Once you have browsed to the files when you return to the overlay tool the files should be displayed (i.e. you should not have to browse to them each time you use the tool). Click on the overlay you desire and choose a colour for display and click on Overlay. Your shape or vector file should be displayed on your image. Try this with several files so that you become familiar with the options.

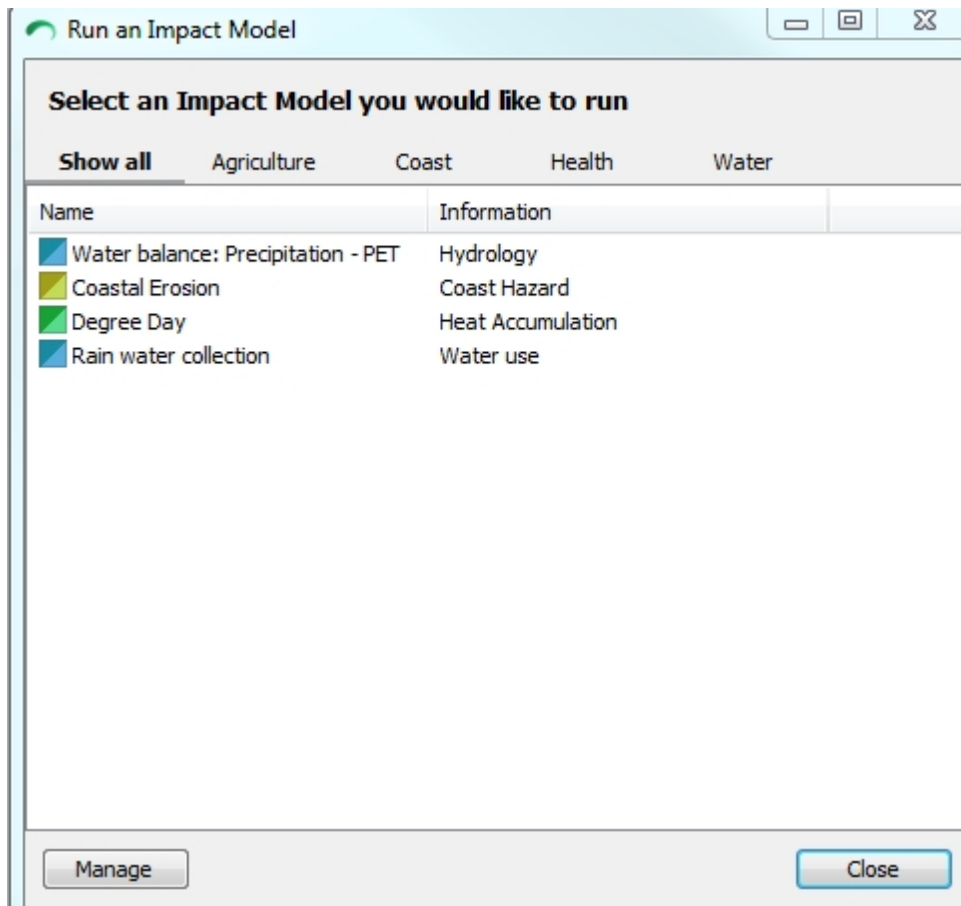
Impact Models

The Model Explorer provides a friendly interface to manage all the SimCLIM 4.x for Desktop compatible impact models in your computer. The impact models can be developed as a plug-in file (*.bpl) or a dynamic link library file (*.dll). You can remove impact models already installed for SimCLIM or to licence a new impact model when it becomes available from your computer (see registering SimCLIM 4.x for Desktop section).

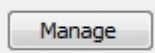
To open the Impact Model Explorer right click in the main SimCLIM 4.x for Desktop window and choose the Impact Model Explorer from the Impact Model submenu.

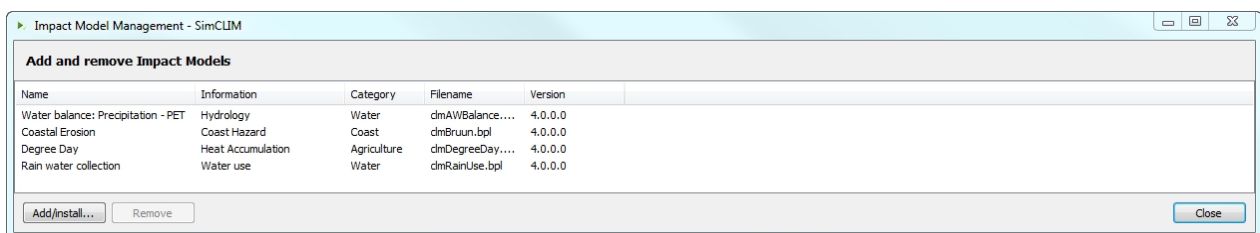


When you click on the link the following dialogue box will be displayed. What is included in your display will vary depending on what version of SimCLIM 4.x for Desktop you are running and which of the optional impact models you have loaded on your system.



From this dialogue box you can launch the impact model. Be careful to have chosen a study area from the top right portion of the window before starting your impact model. It is critical that the area chosen has the required data in the system to run. Not all areas will support all the models.

Another function of the Model Explorer window is to provide access to the  tools. Click on the links in the lower left-hand corner of the Impact Model Management window.



This is where you check on the status of your impact models and register new ones (covered elsewhere). Again, your display could look different than that shown depending on what impact models you requested and have loaded.

Degree Day

Degree Day

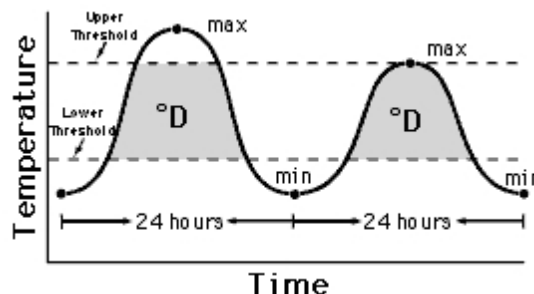
Temperature controls the developmental rate of many organisms. Plants and invertebrate animals, including insects and nematodes, require a certain amount of heat to develop from one point in their life cycles to another. This measure of accumulated heat is known as physiological time or thermal time. Theoretically, physiological time or thermal time can provide a common reference for the development of organisms. The amount of heat required to complete a given organism's development does not vary—the combination of temperature (between thresholds) and time will always be the same. Physiological time or thermal time are often expressed and approximated in units called degree-days ($^{\circ}\text{D}$).

Developmental Thresholds

Upper and lower developmental thresholds have been determined for some organisms through carefully controlled laboratory and field experiments. The lower developmental threshold for an organism is the temperature below which development stops. The lower threshold is determined by the organism's physiology. It is independent of the method used to calculate degree-days. For example, the lower developmental threshold is 15°C and the upper developmental threshold is 35°C for potential dengue carrier mosquito *Aedes aegypti*. Thresholds vary with different organisms. The upper developmental threshold is the temperature above which the rate of growth or development begins to decrease or stop as determined by the cutoff method. The physiological interpretation of the upper threshold is dependent on the cutoff method.

Degree-day calculations and accumulations

Degree-day calculations are based on the area under the diurnal temperature curve and between the thresholds. For a site with maximum and minimum temperatures data available, the different methods for calculating degree-days are single sine, double sine, single triangle, and double triangle. From the simplest to the most mathematically complex, these are: single triangle, double triangle, single sine, and double sine. All of these are linear methods because the rate of development is presumed to be a straight line directly related to temperature.



Degree day thresholds and accumulated degree-days

SimCLIM 4.0 for Desktop provides two degree day models. The first is a spatial model which calculates degree day from monthly mean temperature data using a method described in Carter

et al. (1991). The second is a site specific model which calculates degree day from daily time series of maximum and minimum temperatures. The method has been described in detail by Baskerville & Emin (1969), (Andrewartha & Birch (1973), (Allen (1976), and (Wilson & Barnett (1983).

Degree Days - Cutoff Methods

The cutoff method refers to the manner in which the degree-day calculation area will be modified in relation to the upper threshold.

There are three cutoff methods - horizontal, vertical, and intermediate—to be used in conjunction with the sine and triangle calculation methods:

- Horizontal cutoff method assumes that development continues at a constant rate at temperatures in excess of the upper threshold. Mathematically, the area above the upper threshold is subtracted from the area above the lower threshold.
- Intermediate cutoff method assumes that development slows, but does not stop, at temperatures above the upper threshold. Mathematically, the area above the upper threshold is subtracted twice from the area above the lower threshold.
- Vertical cutoff method assumes that no development occurs when a temperature is above the upper threshold

Degree Days - Calculation Methods

The **single triangle method** draws a straight line between a day's minimum temperature and maximum temperature, assumes the next day's minimum temperature is the same, and draws another line to that point, forming two sides of a triangle. This method assumes the temperature curve is symmetrical around the maximum temperature. Degree-days are estimated by calculating the area within the triangle and between the thresholds.

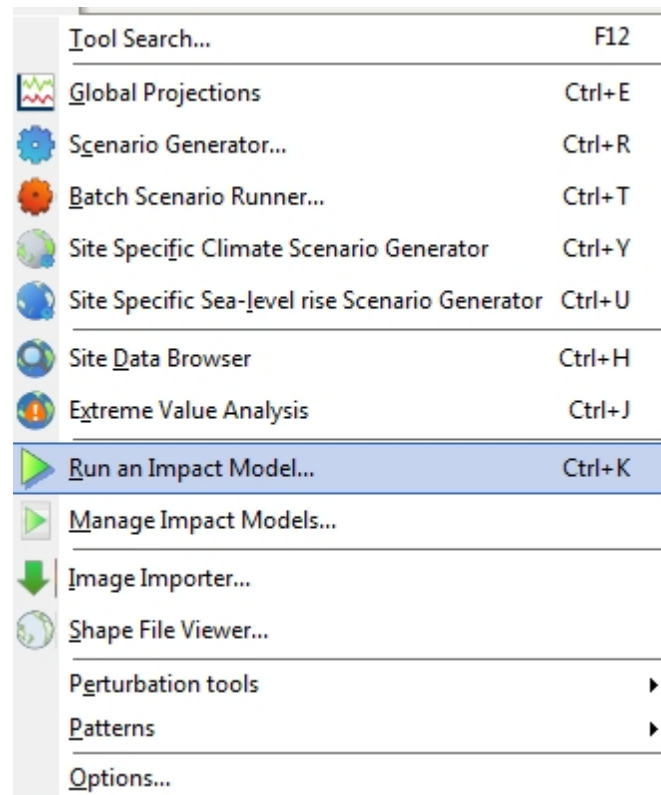
The **double triangle method** draws a straight line between a daily minimum and maximum temperature, and another line vertically through the maximum temperature, forming two sides of a triangle. Degree-days are estimated by calculating the area within the triangle and between the thresholds. The second 12-hour period uses the same configuration with the minimum temperature of the following day. Degree-days for the day are the sum of the degree-days for the two half-days.

The **single sine method** uses a day's minimum and maximum temperatures to produce a sine curve over a 24-hour period, and then estimates degree-days for that day by calculating the area above the threshold and below the curve. This method assumes the temperature curve is symmetrical around the maximum temperature.

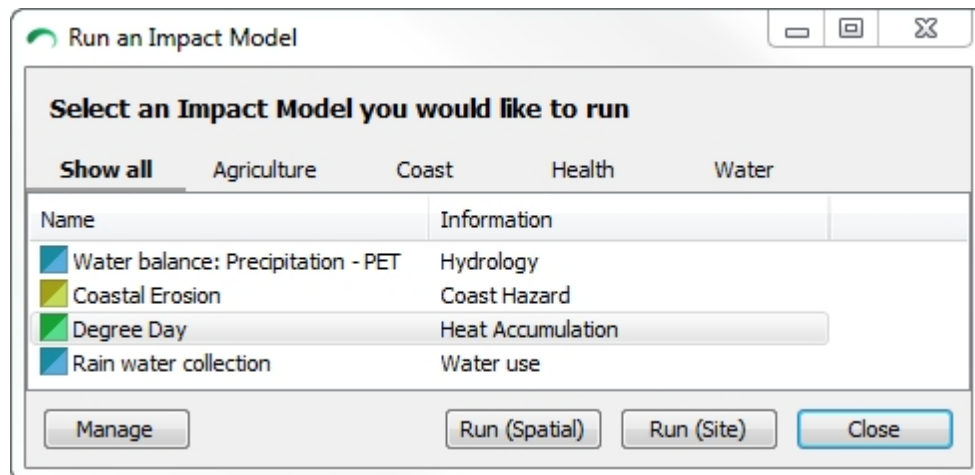
The **double sine method** fits a sine curve from the minimum temperature of the day to the maximum temperature of the day and then fits a separate sine curve from the maximum temperature of the day to the minimum temperature of the next day. Degree-days for the day are the sum of the degree-days for the two half-days.

Using the Degree Day Model - Spatial

Select Run an Impact Model from the Tools dropdown menu.

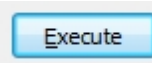
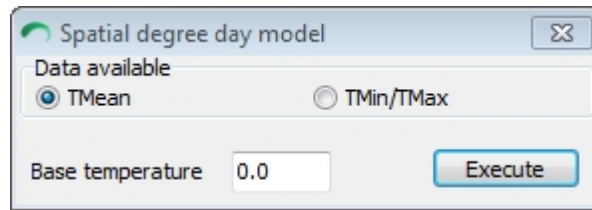


Select Heat Accumulation.



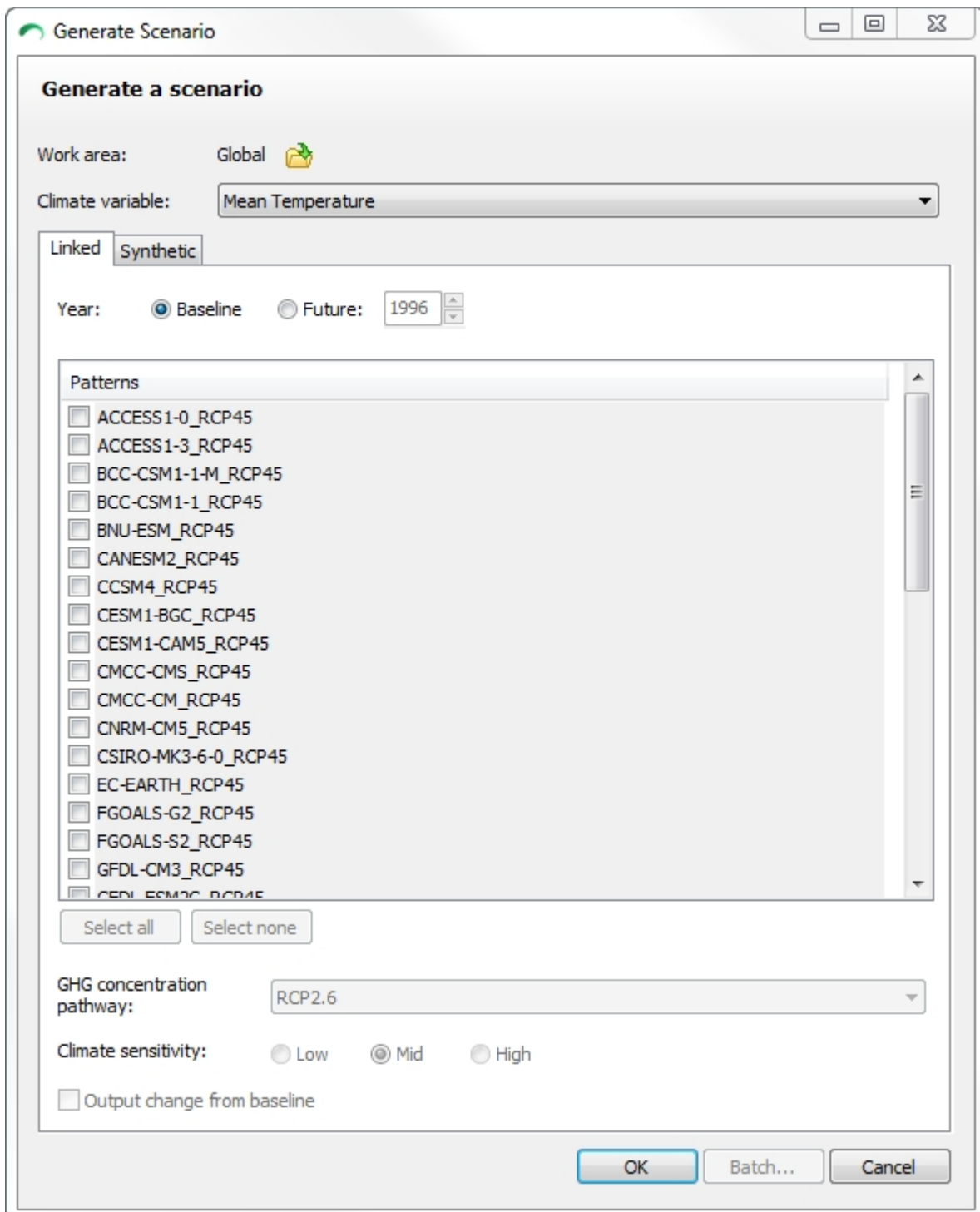
You can then choose between Area wide and Site specific scale.

Select your study area from the top right. If it is spatial like a state or province choose Area wide for your analysis.

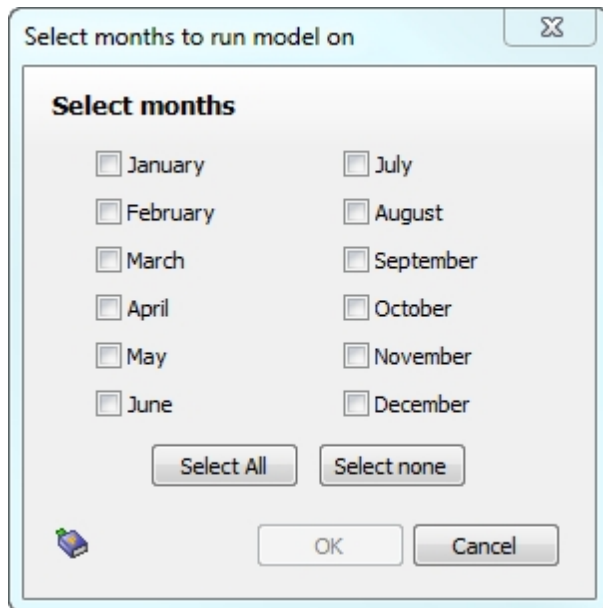


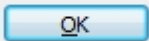

Enter the base temperature and click on

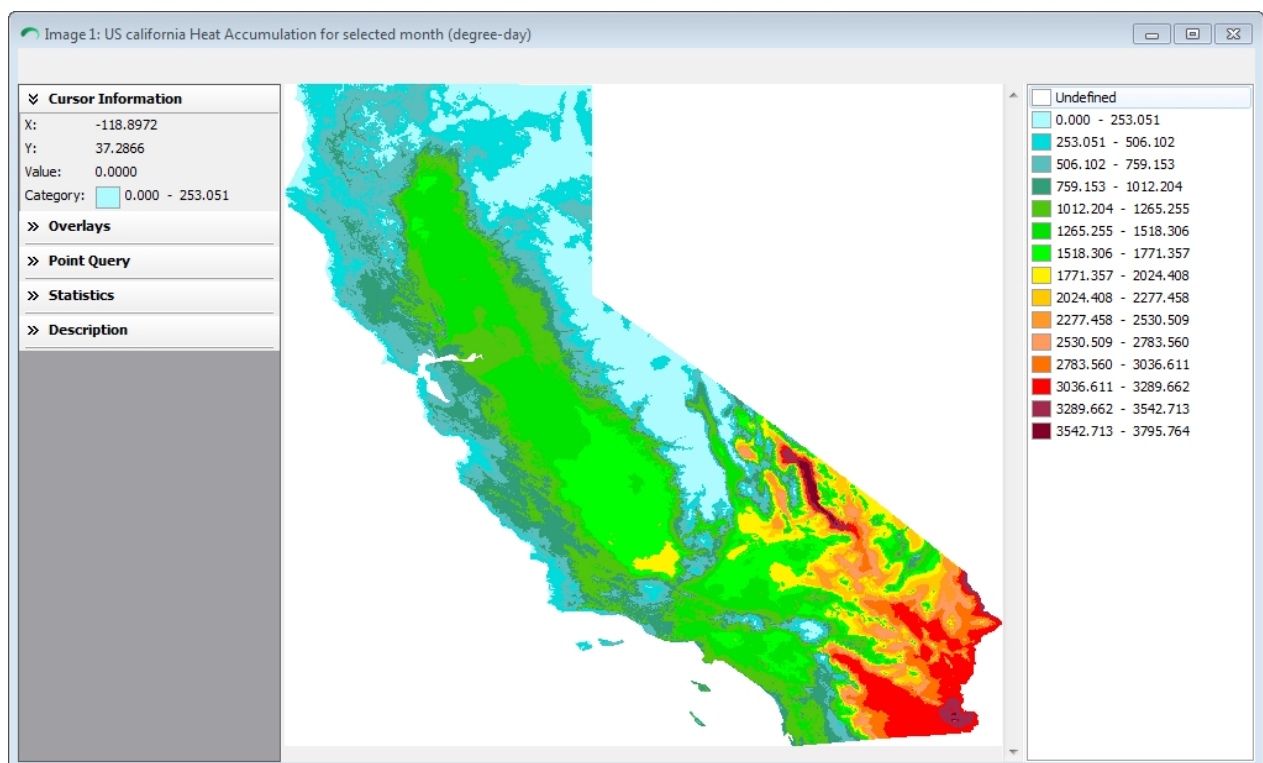
The SimCLIM 4.0 for Desktop scenario generator dialogue box will be displayed. Leave it in its default form to conduct and analysis of baseline conditions or add a year and scenarios to explore the impact of climate change.




Select the months or months of interest.

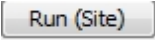


Click . A image will be produced with the criteria in the header. You can click on  at the bottom right of the image to get complete information on the output.

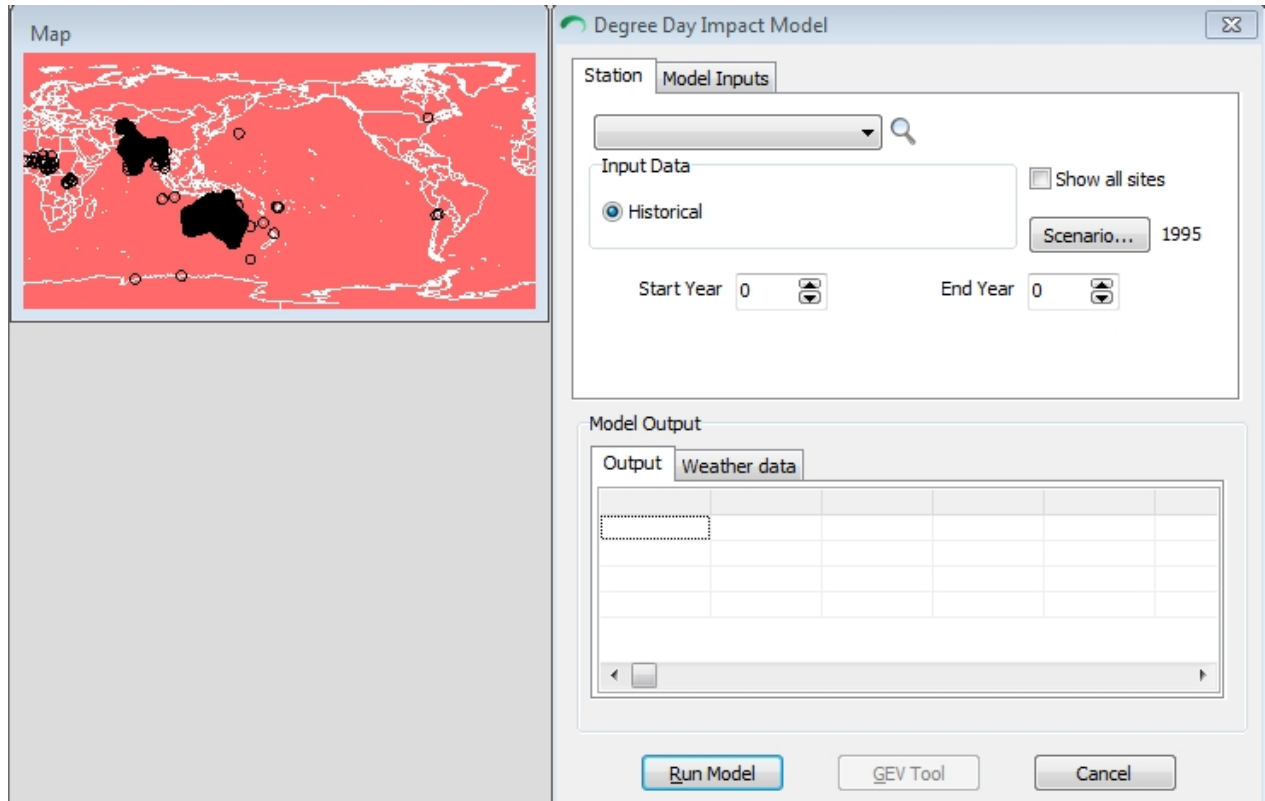


You can run a different scenario for the same area and then choose the  synch images tool from the toolbar to ease your analysis of change.

Using the Degree Day Model – Site Specific

The site specific version of the degree day model is slightly different. Select site specific and click  .

Depending on the study area you have chosen in the upper right of the main dialogue box a map will be generated with site data indicted.



Click on the site of interest in the map or click on the site drop down dialogue box.

Model Output

Output **Weather data**

Day	Daily Degree Day	Degree Day Accumulation
10	13.80	3385.84
11	15.85	3401.69
12	9.20	3410.89
13	9.30	3420.19
14	11.80	3431.99
15	15.35	3447.34

Click on the table for graphing.

Degree Day Tip

Trainee: Have you ever done similar analyses on performance of cooling systems before? Any “cool” tips or tricks you came up with that SimCLIM 4.0 for Desktop can do?

CLIMsystems: *I would definitely use the degree day modelling (site-specific). Energy requirements scale linearly with the degree day sums (i.e. factor of 2 increase in degree day sum under climate change will cause a doubling of the energy required to cool to the same target temperature). The tricky part will be to select the "Base temperature" (the value above which the degrees are summed). I would start with 25 (as a target temperature for train carriages (the case being considered)) and maybe do some sensitivity analysis (26 and 27) (also as an adaptation option for the council: have a slightly higher temperature in the carriages as people respond mostly to temperature differences, so with an increase in ambient temperatures a slightly higher indoor temperature is acceptable).*

Coastal Model

INTRODUCTION

A number of complex, dynamic models are available for examining processes related to sediment transport, wave energy effects, beach profile changes, and so on. While the rigour of such models is clearly an advantage for predicting physical changes and examining coastal processes, their application is severely limited for assessments in many countries, for two reasons. First, such models often demand good quality, high resolution data for a range of variables and model parameters. Good quality data is often very limited and therefore the range of methods for assessing the impacts of climate and sea-level changes is also restricted. Second, the more complex coastal models are not well suited to addressing the issues of sea-level rise because very different time and space scales are involved. In such circumstances, the detailed processes and predictive accuracy of the model may be less important than the capability to conduct *simulations* for the purpose of examining model sensitivities and uncertainties under sets of “what if” scenarios on coarse temporal and spatial scales.

Consequently, following the guidance given in the USCSP Handbook (Benioff *et al.*, 1996, Chapter 5.5) and the UNEP Handbook (Feenstra *et al.*, 1998), a variant of the ‘Bruun Rule’ (Bruun, 1962) was developed at the International Global Change Institute (IGCI) at the University of Waikato, New Zealand. This method appears suitable for simulating shoreline changes on beach and dune systems.

THE BASIC BRUUN RULE

The concept behind the 2-dimensional “Bruun Rule” model is explained in the USCSP Handbook (Benioff *et al.*, 1996). In effect, in the Bruun Rule the equilibrium profile of a beach-and-dune system is re-adjusted for a change in sea level (see Figure 1). A rise in sea level will cause erosion and re-establishment of the equilibrium position of the shoreline further inland, as follows:

$C_{eq} = z l / (h + d)$ where:

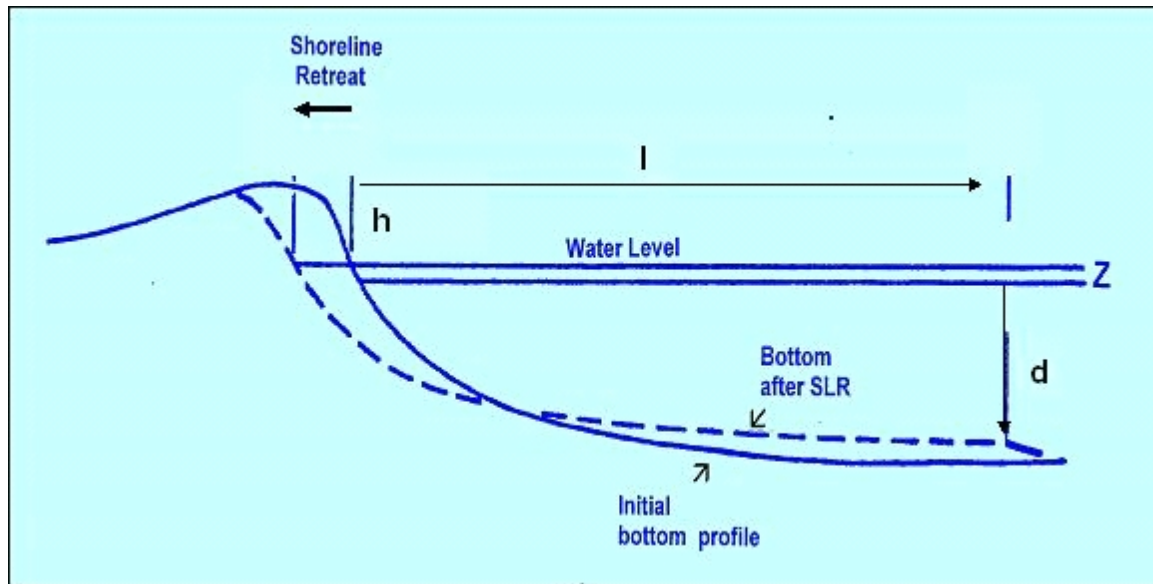
C_{eq} is the equilibrium change in shoreline position (in metres)

z is the rise in sea level (in metres)

l is the closure distance (the distance offshore to which materials are transported and “lost”, in metres)

h is the height in metres of the dune at the site

d is the water depth in metres at closure distance ($l/(d+h)$ thus gives slope)



Principles of the Bruun Rule as the basis for the coastal impact model

There are two important drawbacks to using this simple model to examine shoreline change under a trend of rising sea level. First, it gives only the “equilibrium” (or steady-state) change. In reality, coastal systems do not adjust instantaneously; rather, there is apt to be some time lag in the response. Second, in reality shoreline retreat, as evidenced by historical data on beach profiles, is apt to occur in “fits and starts” over time, not as a steady, year-by-year incremental change. This uneven response of the shoreline is partly a function of the chance occurrence of severe stormy seasons, which often cause erosion (in contrast, a season of very few, or mild, storms may allow the natural system to replenish the sediment supply and the shoreline to advance).

For these reasons, the Bruun Rule was modified slightly to add a response time and a stochastic “storminess” factor as follows:

$$dC/dt = (C_{eq} - C)/\diamond + S \text{ where:}$$

t is time (years)

C is the shoreline position (metres) relative to that of t=0

C_{eq} is the equilibrium value of C

♦ is the shoreline response time (years)

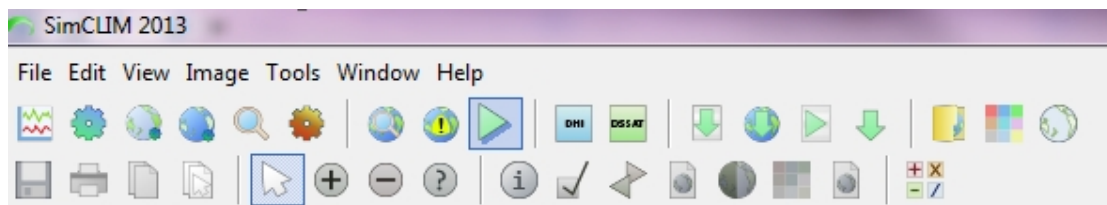
S is a stochastically-generated storm erosion factor

In other words, the yearly change in shoreline is a function of the difference between where the shoreline *should be* (according to the Bruun Rule) in that year and where it actually is (as a consequence of what has occurred in previous years), as well as the effect of storms. The greater the difference, the greater the potential erosion in that year, subject to the rapidity at which the system can respond.

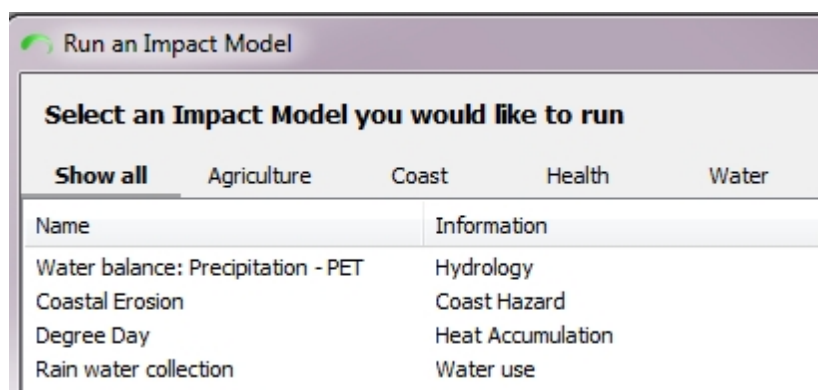
The concept was incorporated into a coastal impact model. The model is forced by changes in sea level (projections selected by the user from library files) and by the randomly selected “stormy seasons”, as defined by the user. The model runs on yearly time-steps and the results are displayed graphically.

USING THE COASTAL MODEL

To launch the Coastal Impact Model you need to navigate to the Impact Model toolbar as depicted below and click first on 1] a study area from the far right part of the toolbar and then (global) and, 2] click on the coastal impact model icon on the left:

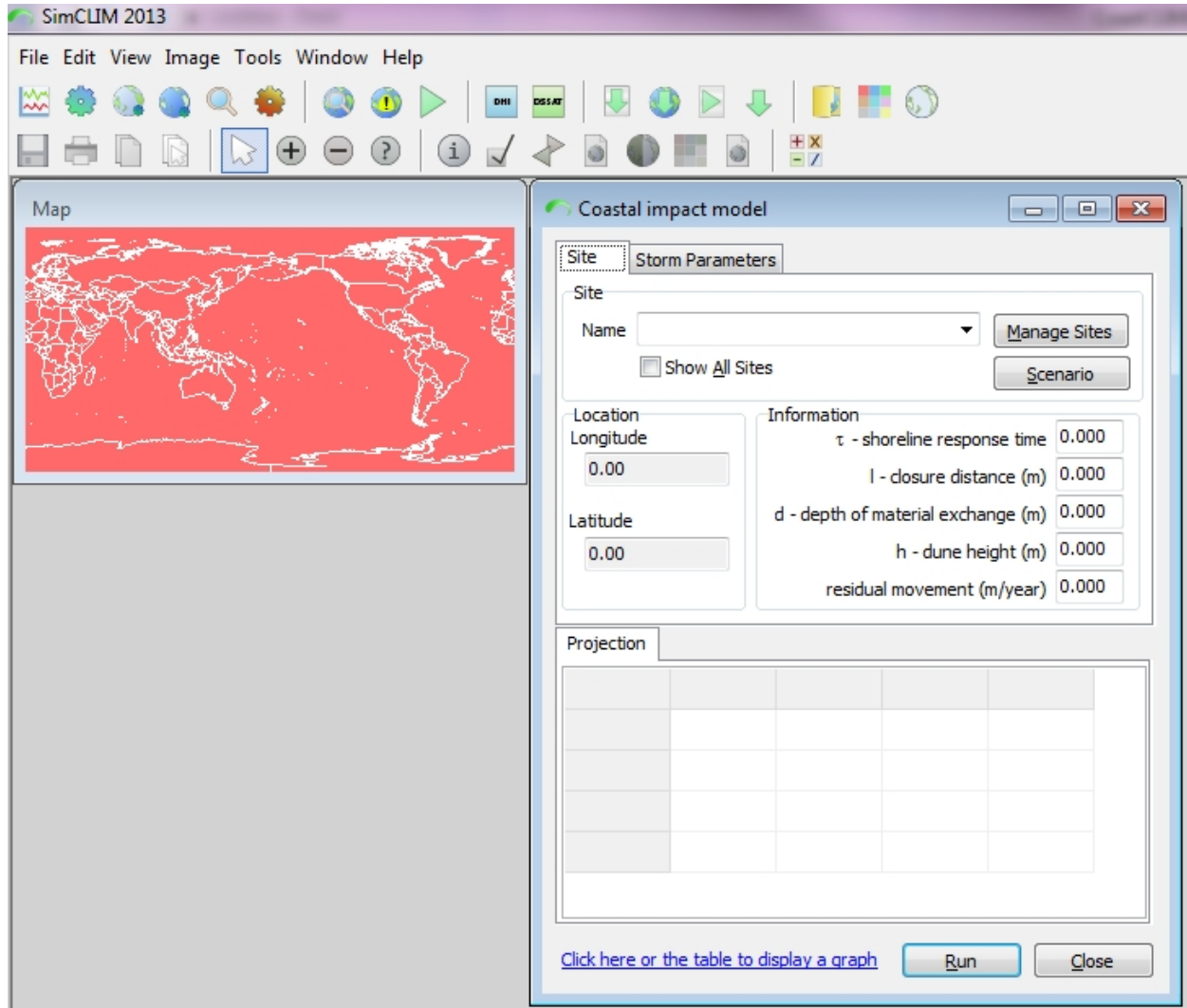


After clicking on the impact model icon the interface for the model will be displayed. As this is the only impact model loaded in your current purchased version of SimCLIM only the option of choosing the coastal impact model will be available to you as shown below.



Click on coastal erosion.

The primary interface for the coast erosion impact model as depicted below will be displayed.



In order to use the modified version of this Bruun, the user must select values for each of the following: site-related model parameters; sea-level rise scenario; and storm characteristics.

Site-related parameter values:

For application at a given site, it is necessary to select the values for the model parameters:

Information	
τ - shoreline response time	5.000
l - closure distance (m)	1500.00
h - depth of material exchange (m)	15.000
d - dune height (m)	2.000
Residual movement (m/year)	0.000

Save/Update Cancel

To create a new site you click on Manage Sites from the main coastal model dialogue box. Enter the name of the site and its location and other data derived from the literature.

Site Editor

To modify a site select it from the list, make the changes and click "Save/Update". No changes are final until you press OK.

Site List:

Change Site Add Site Delete Site

Site Details

Name:

Location

Longitude: Latitude:

Information

τ - shoreline response time	5.000
l - closure distance (m)	1500.00
h - depth of material exchange (m)	15.000
d - dune height (m)	2.000
Residual movement (m/year)	0.000

Save/Update Cancel

OK Cancel

- The **shoreline response time** (τ) governs the responsiveness of the system to sea level rise in a given year. For example, if τ is set to 6, the annual change in shoreline will be one-sixth of the "potential" change indicated by the equilibrium situation (if sea level is constantly rising, the system is continually in dis-equilibrium).
- The **closure distance** (l) is the distance offshore at which sediments are effectively "lost". This value is not very easy to ascertain and expert advice should be sought.
- The **depth of material exchange** (d) is the water depth at closure distance at which the

sediments are lost. It is assumed that the depth is greater at high wave energy sites.

- The **dune height (h)** is the frontal dune height from mean sea level.
- The model parameter called **residual movement** is the very long term change (on the order of centuries) in shoreline position. This factor largely relates to long-term trends in sediment supply and transport as they affect erosion and accretion.

SLR Scenario: The input to the model is sea level rise, selected through the user choice of sea-level scenarios. First, the user can set the value for the **residual sea-level rise** (which is the historical trend, in metres per year), assumed to be due to a combination of vertical land movement, global sea-level trends and regional trends. The value chosen will be applied up to the year 1990 and added to the scenario of future sea level rise for 1990-2100.

Sea-Level Change Scenario Generator

Study Site
Longitude: 174.92 Latitude: -40.92

Regional variation

Patterns	Local change/global change
<input checked="" type="checkbox"/> BCC-CSM1-1 (adjusted)	1.24
<input checked="" type="checkbox"/> BCC-CSM1-1-M (adjusted)	0.73
<input checked="" type="checkbox"/> CanESM2 (adjusted)	1.3
<input checked="" type="checkbox"/> CCSM4 (adjusted)	1.11
<input checked="" type="checkbox"/> CMCC-CM (adjusted)	1.13
<input checked="" type="checkbox"/> CMCC-CMS (adjusted)	1.37
<input checked="" type="checkbox"/> CNRM-CM5 (adjusted)	2
<input checked="" type="checkbox"/> CSIRO-MK36 (adjusted)	0.85
<input checked="" type="checkbox"/> GFDL-CM3 (adjusted)	0.97
<input checked="" type="checkbox"/> GFDL-ESM2G (adjusted)	1.07
<input checked="" type="checkbox"/> GISS-ESM2M (adjusted)	1.19

Select all Select none Percentile: Low: High:

Representative Concentration Pathway (RCP)
RCP8.5

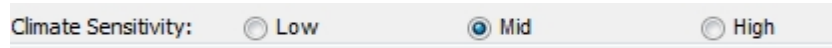
Climate Sensitivity: Low Mid High

Local observed sea-level trend (mm/year) 0.00
 Total trend Vertical land movement component only

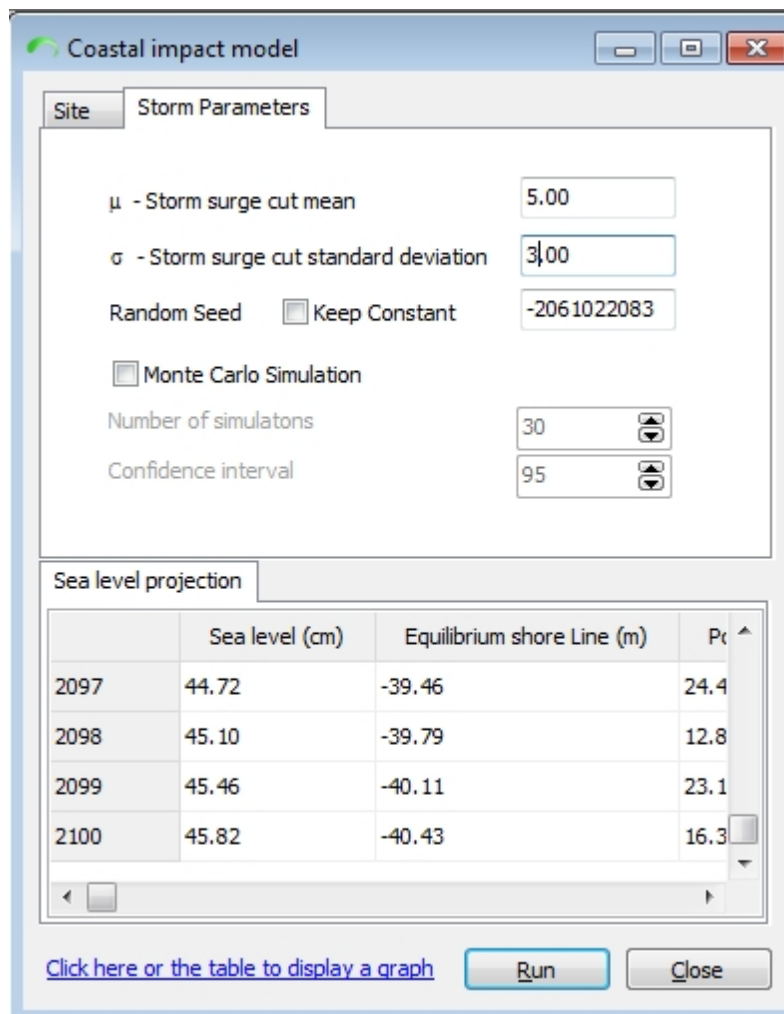
OK Cancel

Second, there is a large library of **future scenarios** (for 1995-2100) from which the user can choose. The latest IPCC scenarios are the four labelled RCP (the Representative Concentration Pathways values here are the projections from the Fifth Assessment Report). The choice of “baseline” scenario (the last selection in the library) sets the future component of sea-level rise to zero and instead provides a simple extrapolation of the past rate of sea level rise into the future.

Third, there is a choice of **climate sensitivity**. The choice reflects the range of scientific uncertainty in climate and sea level modelling. Here, the user selects a low, medium or high projection to be associated with the choice of scenario.



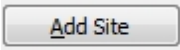
Storm Parameters: Choose the Storm Parameters tab circled in the dialogue box depicted below. The model assumes that particularly stormy seasons provide the energy required to potentially erode the shoreline. The “storminess”, and thus the *erosion potential*, in any given year is selected randomly from a normal distribution with a user-defined mean and standard deviation. These values can be selected by the user on an ad hoc basis to give a reasonable interannual variability in shoreline change, as compared to observational data on shoreline variation. During simulation, values are selected randomly from the distribution. For randomly-selected values that are zero or negative, the erosive potential is set to zero, which usually allows accretion to occur and the shoreline to advance toward its equilibrium position. Positive values are scaled according to the state of dis-equilibrium and applied to the shoreline erosion. The user is encouraged to change the mean and standard deviation in order to examine the effects on shoreline change on yearly, decadal and longer time-scales.

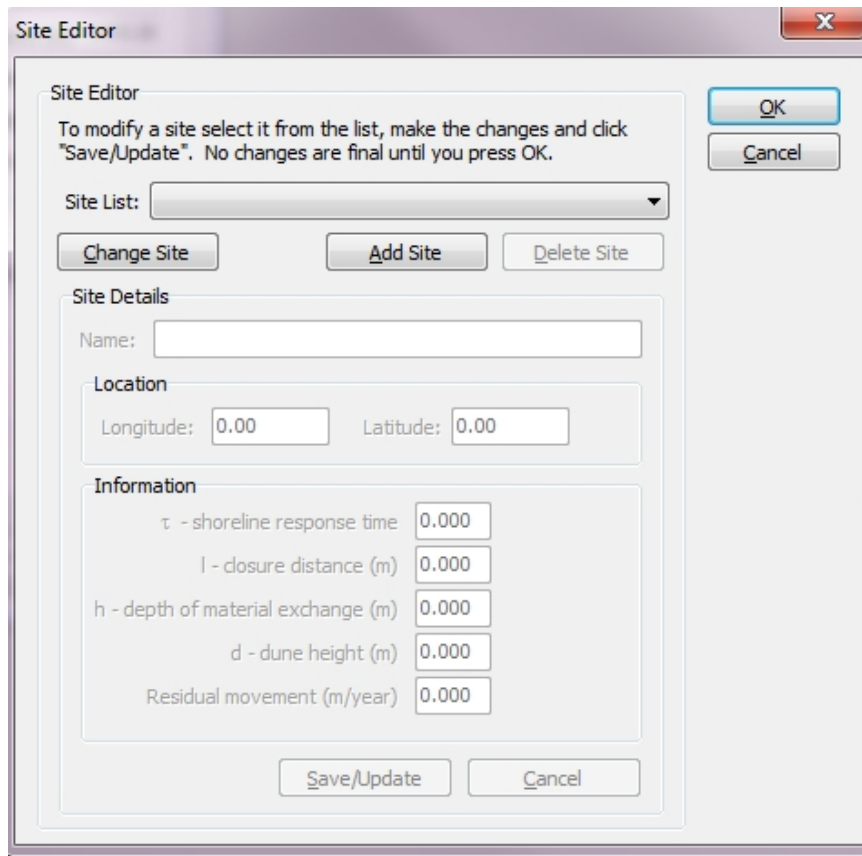


Each simulation of the model can provide a unique sequence of past and future storm seasons. This is useful for looking at short-term variability and extremes in relation to long-term trends in average sea level change as they can potentially affect the coastline.

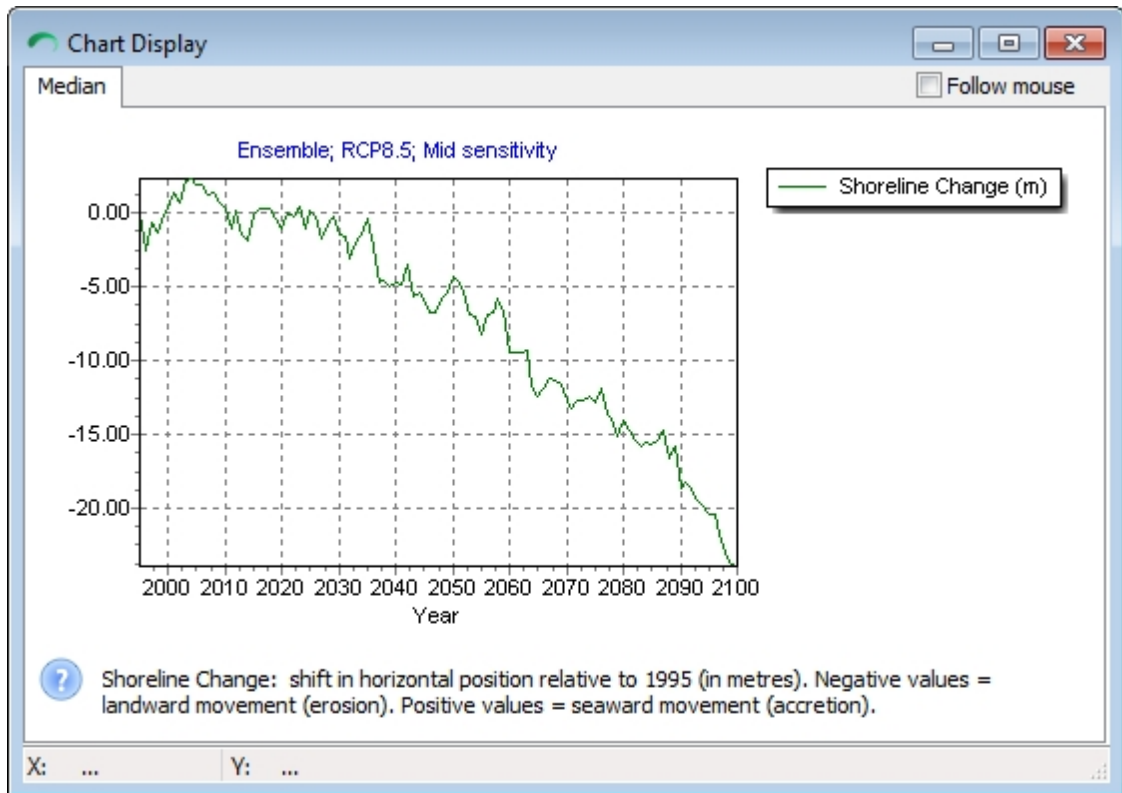
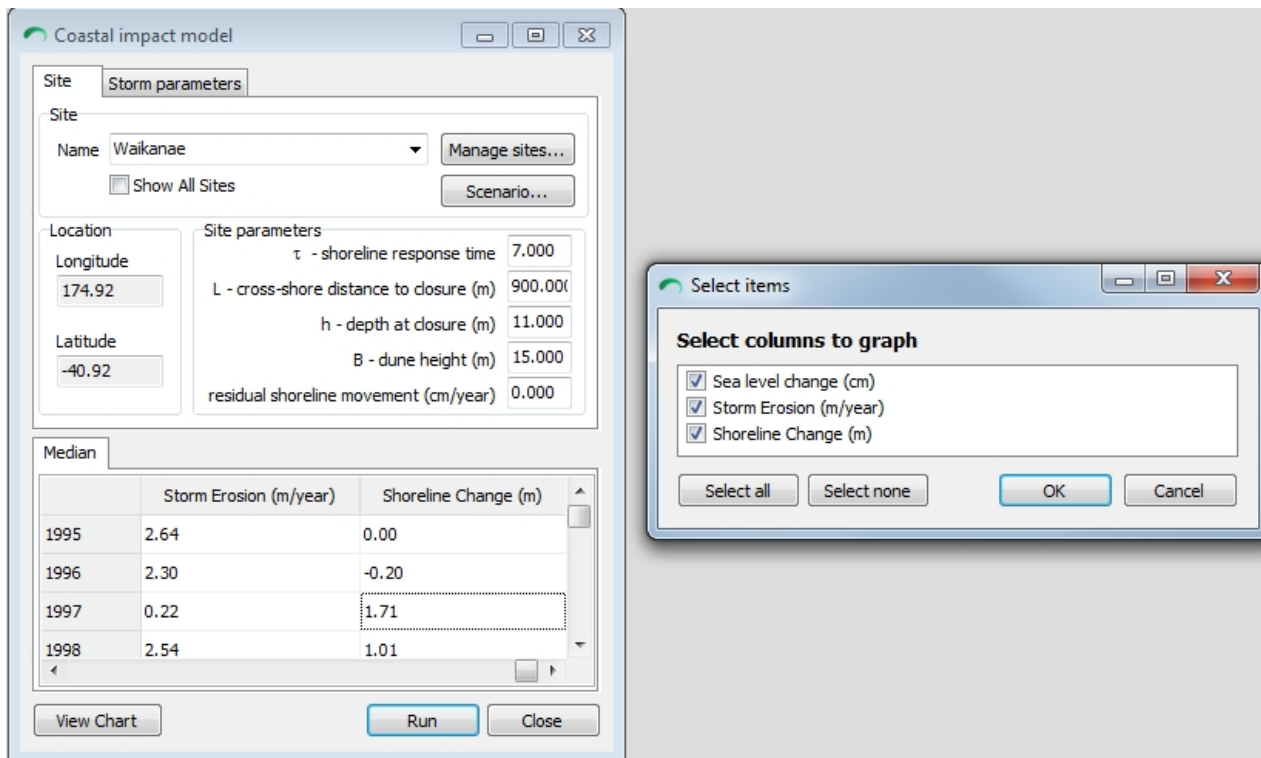
For more sophisticated analyses in which the user is interested in the statistical properties of such storm effects, the user can tick the **Monte Carlo Simulation** option (see dialogue box above). With this option, the model is run repeatedly in order to obtain a sample from which the mean and distribution for each year can be described. The user selects *the number of simulations* (i.e. the sample size) and the *confidence interval* to be displayed graphically. This analysis can provide information on the average conditions as well as an assessment of risks arising from the natural variability in the system.

ADDING YOUR OWN STUDY AREA:

Adding your own study area is very easy to do. Simply clear the 'select a site text from the name box and type in an identifier for your new study area. Assign an ID number and input the latitude and longitude (see below). Click on  and you are ready to enter the Information for the site and begin to run different scenarios.



Results: To run the model, click on **Run Simulation** at the bottom of the dialogue box. The model begins running in 1940 (in order to “warm up” the model) and ends in 2100. The results of the analysis immediately appear in tabular form. To view the results graphically, click on a column heading, which will give you the choice of outputs to view. Choose the outputs to view and click OK, which will bring up a graph. In most cases, the key output variable to examine is the *current shoreline*.



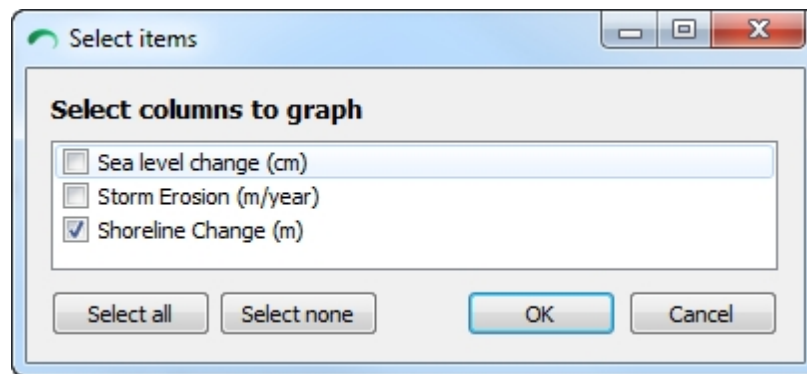
Example of model results showing changes in shoreline position

An example of the model results is shown in Figure 2. Although the model begins in 1940, at

least the first decade of results should be ignored as the model is “winding up”. The vertical axis shows the change in shoreline position from the “equilibrium” position in 1940 (i.e. zero). The negative values indicate shoreline retreat in metres. In order to estimate the result of the chosen scenario of sea level rise, one should take the difference between the average shoreline positions around 1990 and the future date of interest (e.g. 2050). This difference can be estimated visually. For example, in the Figure above, the retreat of the shoreline between 1990 and 2100 is about 22 metres.

There are a host of other outputs that can be produced as depicted in the dialogue box below.

Simply click on the boxes for the ones you want and click  to have them displayed graphically.



INTERPRETATION OF COASTAL IMPACT MODEL RESULTS

It is very important to bear in mind that the coastal impact model is not a “predictive” model, in the same sense that more sophisticated dynamic coastal models based on physical processes are able to predict coastal responses from first principles. Rather, it is a “simulation” tool. While it produces realistic shoreline behaviour (i.e. shoreline retreats when sea level rises; decadal and interannual scale variations in shoreline position are generated that match observations; etc), such responses are not “determined” from actual physical processes.

Thus, in terms of application, the coastal impact model is not a scientific tool for predictive modelling. Rather, it is a tool that can produce scientifically reasonable shoreline behaviour in response to sea-level changes and is useful for asking “what if” questions about coastal changes as a basis for impact assessments, coastal planning and management.

References cited:

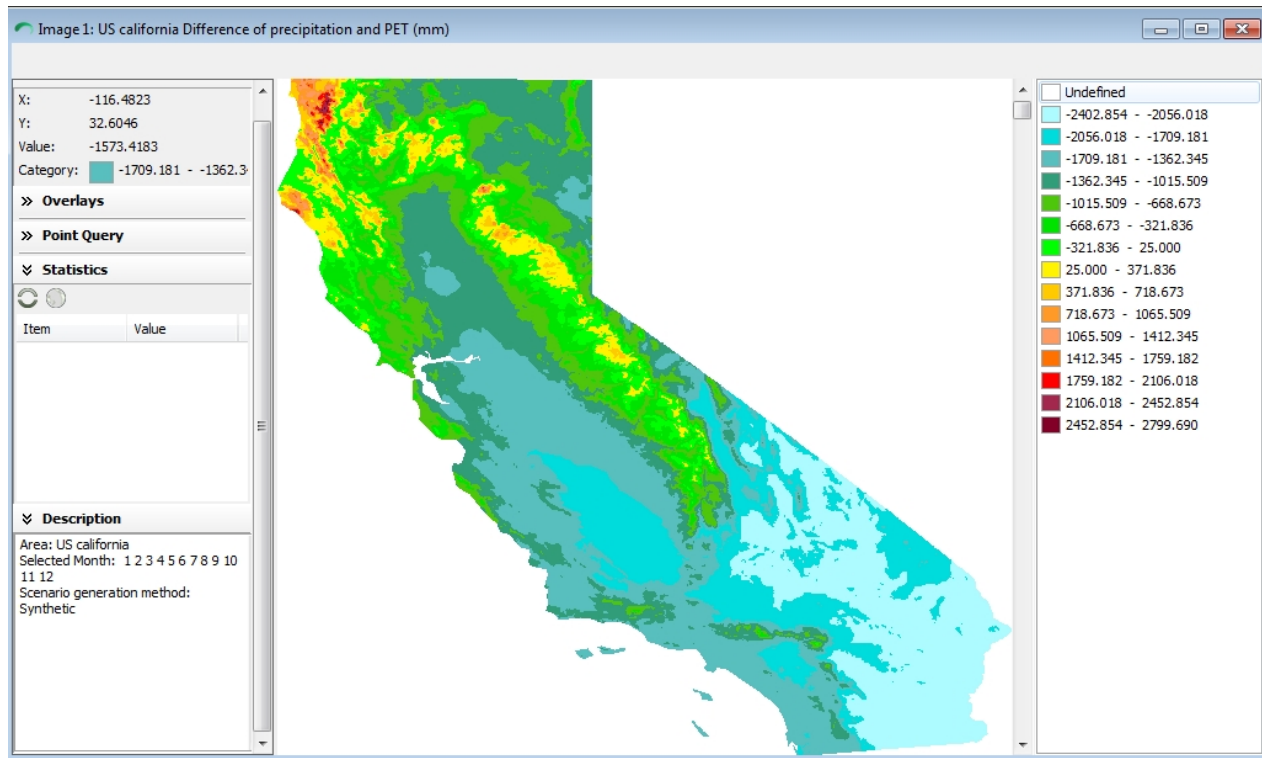
- Bruun, P. 1962: Sea level rise as a cause of shore erosion. *Journal of the Waterways and Harbours Division, Proceedings of the American Society of Civil Engineers*, Vol. 88, pp. 117-130.
- Benioff, R., S. Guill and J. Lee (eds), 1996: *Vulnerability and Adaptation Assessments: An International Handbook*. Kluwer Academic Publishers, Dordrecht
- Feenstra, J.F., I Burton, J.B. Smith and R.S.J. Tol (eds), 1998: *Handbook on Methods for Climate Change Impact Assessment and Adaptation Strategies*. United Nations Environment Programme (UNEP), Nairobi, Kenya, and the Institute for Environmental Studies, Amsterdam, The Netherlands.

PET

Potential Evapotranspiration

The most general and widely used equation for calculating reference ET is the Penman equation. The Penman-Monteith variation is recommended by the Food and Agriculture Organization[5] and the American Society of Civil Engineers. The Penman equation describes evaporation (E) from an open water surface, and was developed by Howard Penman in 1948. Penman's equation requires daily mean temperature, wind speed, air pressure, and solar radiation to predict E. Simpler Hydrometeorological equations continue to be used where obtaining such data is impractical, to give comparable results within specific contexts, e.g. humid vs arid climates.

Numerous variations of the Penman equation are used to estimate evaporation from water, and land. Specifically the Penman-Monteith equation refines weather based potential evapotranspiration (PET) estimates of vegetated land areas.[1] It is widely regarded as one of the most accurate models, in terms of estimates.



Water Tank Model: Drought and Domestic Water Supply Example

DROUGHT AND DOMESTIC WATER SUPPLY

THE PROBLEM CONTEXT: A CASE STUDY AS AN EXAMPLE

Residential expansion into rural areas adjacent to Rotorua is becoming increasingly constrained by water supply. With the rising demands for water, the pressure on existing water supplies in the region is increasing and reaches crisis proportions during prolonged **drought periods**. To make matters worse, regional projections of future climate change suggest a **drying trend** for the Bay of Plenty.

For these reasons, a new subdivision in the outskirts of Rotorua is seeking to become self-sufficient in water supply. This will be accomplished principally through the installation of individual home **water tanks** which are fed from roof runoff.

The size and configuration of the water tank systems have to be decided before development approval is given for the subdivision. The decision will depend on such factors as climate variability and change, anticipated willingness of homeowners to modify their water demands, cost, and the degree of risk that the homeowners are willing to accept.

Your job is to conduct an initial analysis of such factors and advise council accordingly. If you are too stringent in your recommendations, the subdivision developers will scream that the costs are too high. If you skimp, you will surely draw the wrath of the public when the tanks run dry...

Your job is divided into two parts:

Part 1 involves examining the possible future **changes in regional rainfall** during the low rainfall season, i.e. **Jan-Mar**.

Part 2 involves an analysis for recommending the **design of water tank systems**, taking account of current rainfall variability and future change.

For both parts, your **planning horizon is 50 years (i.e. to the year 2065)**

PART 1: SPATIAL PATTERNS OF RAINFALL CHANGE

TASKS:

(1) Examine the regional variation in rainfall under current climate (for your particular area):

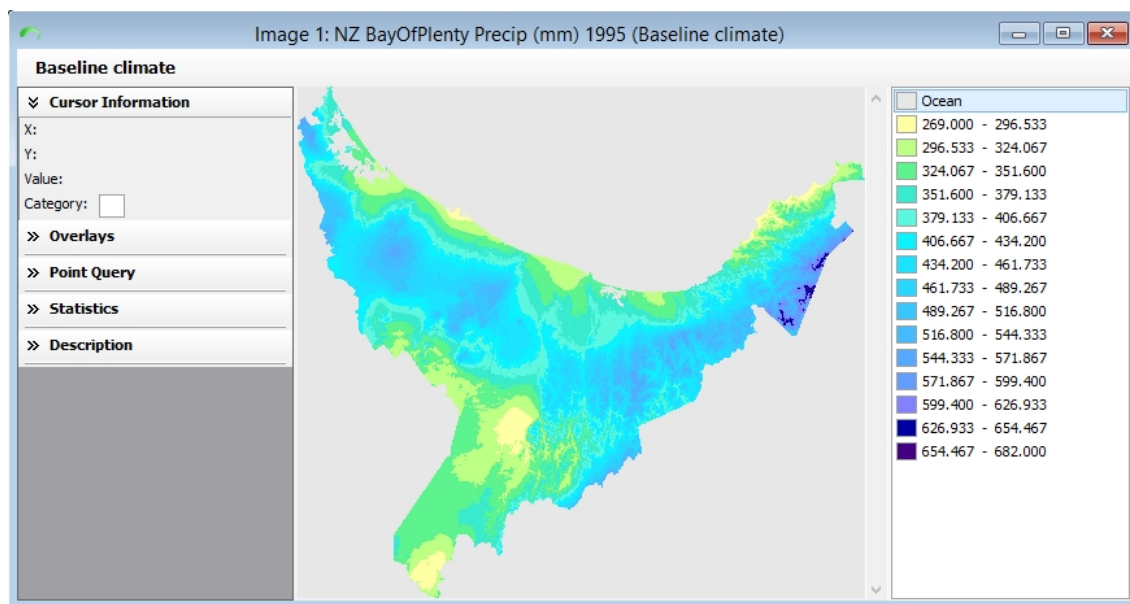
Steps for Using SimCLIM 4.0 for Desktop:

Make certain that you have first selected the **Bay of Plenty** from the **drop-down menu** at the far right-side of the screen. Then choose

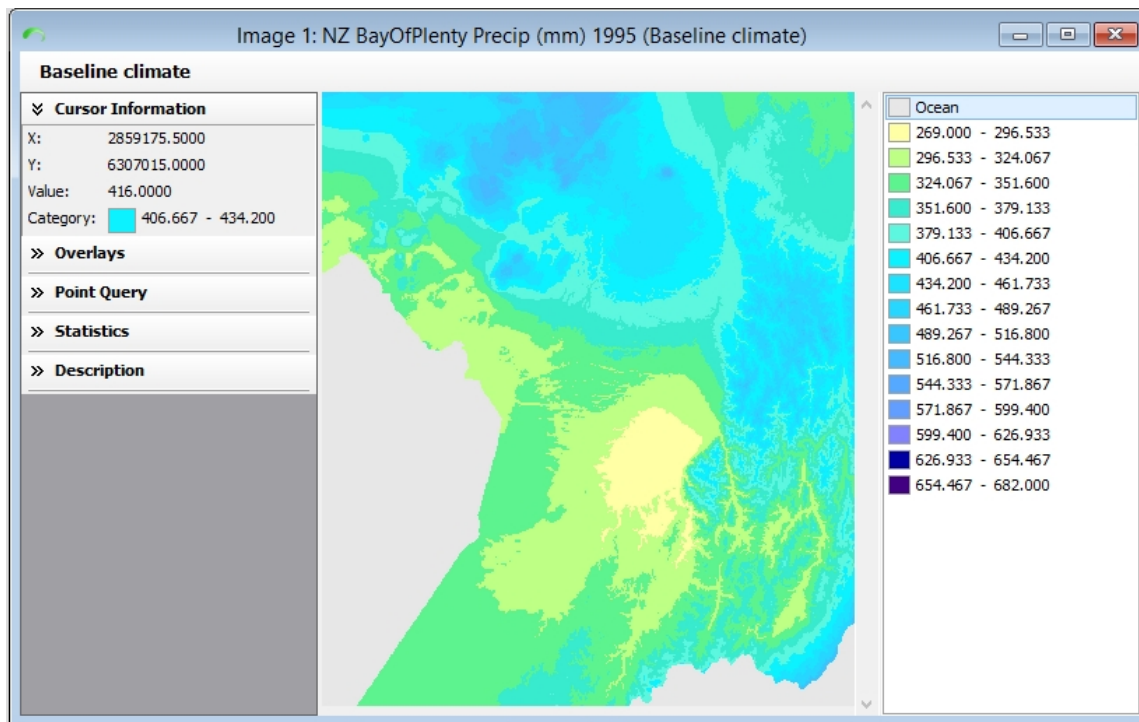
the **Spatial Scenario Generator** option



and select **Precipitation**, then the **Linked tab**; choose the year “**1995**” as the **baseline year**, which gives 30-year historical averages; and select the months **Jan, Feb, Mar** inclusive, then **Generate**.



You might have to wait a bit for the image to appear. By dragging the borders of the image you can enlarge the image for the Rotorua area.



The coordinates of your new subdivision are: lat 2838604 and 6304643. As you move the cursor over the image, its coordinates are registered as the first two numbers in the top-right portion of the screen. The last number is rainfall amount (in mm).

What is the average dry season (Jan-Mar) rainfall for your subdivision location?

Approximately 293mm of rainfall in the dry season.

(2) Construct a scenario of climate change for precipitation:

When it comes to water, government agencies are well aware that the public prefers wide safety margins for dependable supply. Thus, from the range of uncertainty, you are advised to be cautious and develop a “conservative” scenario of possible future changes in rainfall. Better to be on the safe side...

Return to the Spatial Scenario Generator and select **Precipitation** and select:

Year: 2065

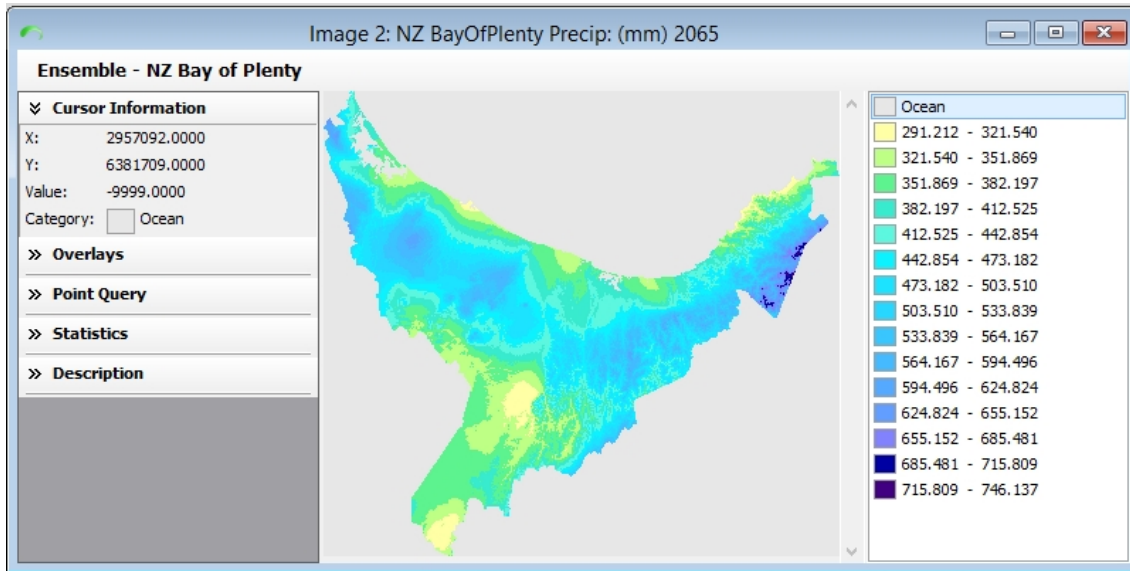
GCM: Ensemble

Global Projection: RCP8.5 (a high projection of greenhouse gas concentrations)

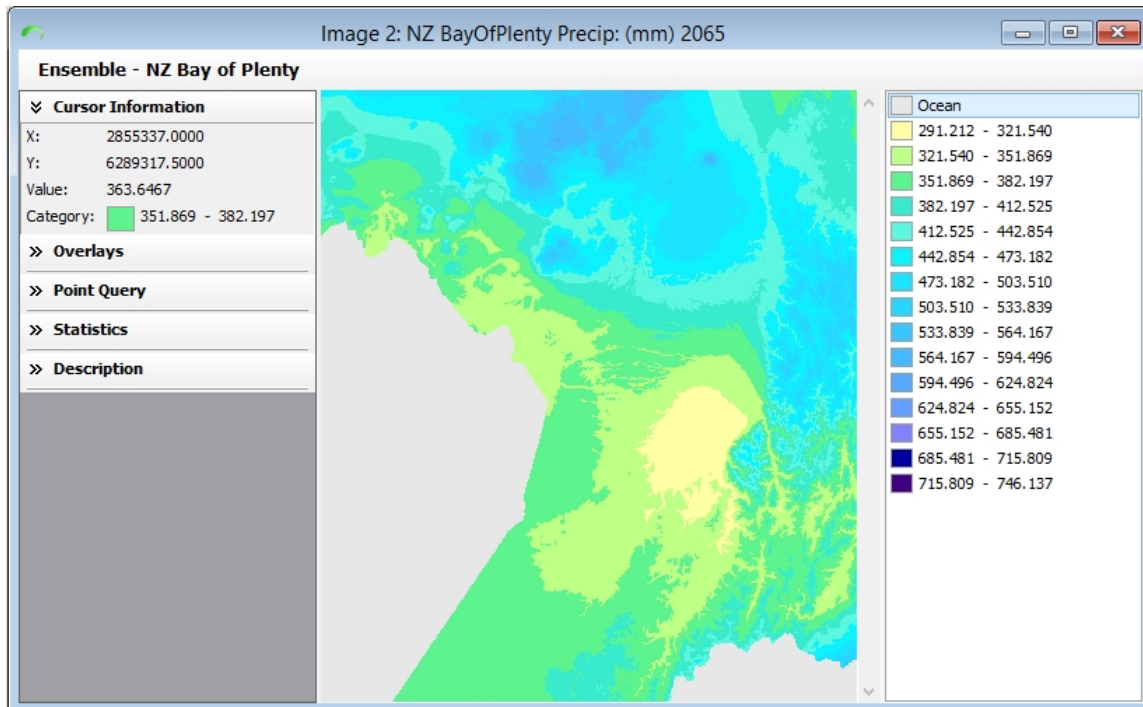
Climate Sensitivity: HIGH (at the high end of modeling uncertainties)

Select months **Jan, Feb and Mar** inclusive, then **Generate**.

Enlarge the image for the study area. Position the cursor over the location of the proposed subdivision.

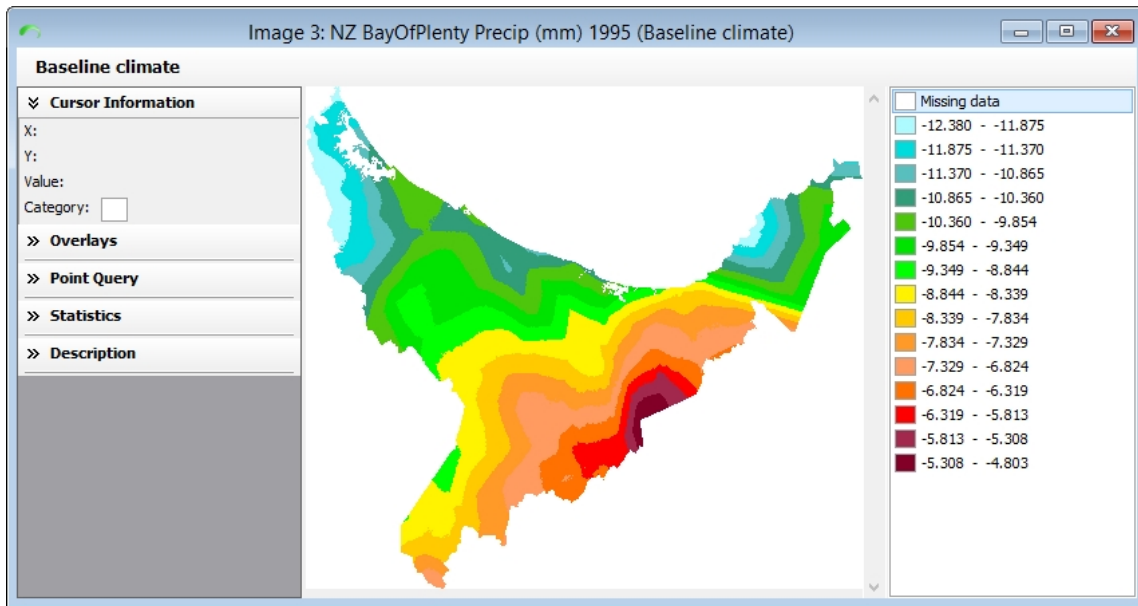


Bay of Plenty 2065 Precipitation (Jan-Mar scenario)



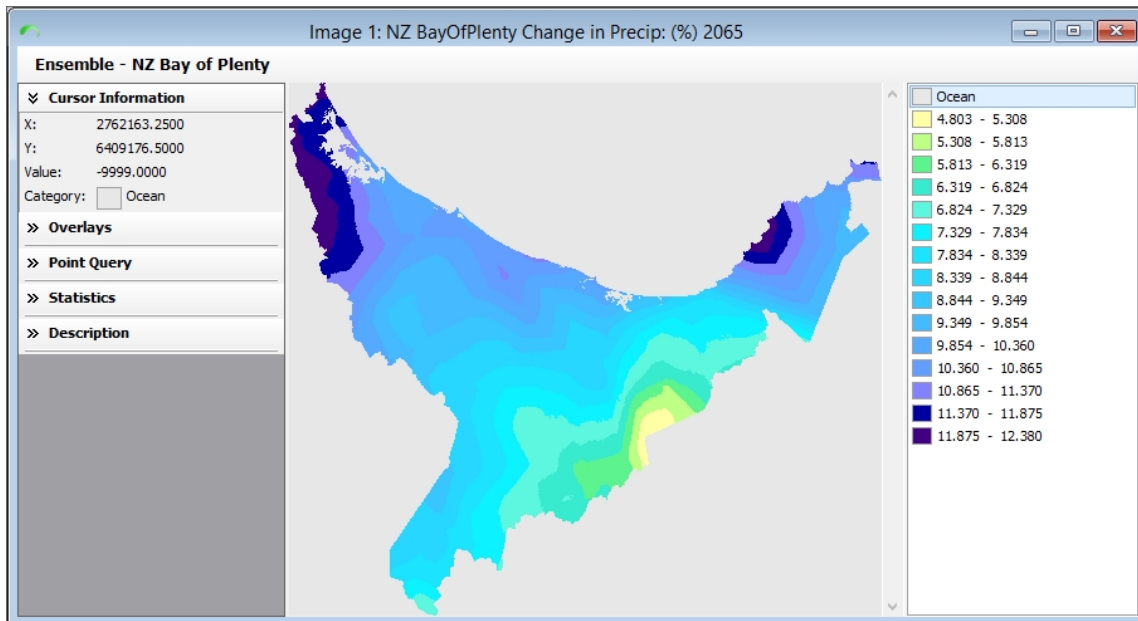
Rotorua study area 2065 Precipitation (Jan-Mar scenario)

What is the projected percentage change in rainfall for this location?



Map of the projected rainfall change between baseline and 2065 scenarios. This shows a projected decrease in rainfall of approximately 6-8% by 2065.

Produced by generating 1995 (image 1) and 2065 (image 2) scenarios, and subtracting image 2 from image 1 (using the calculator function), then dividing by image 1 and multiplying the result by 100.



Change in precipitation by 2065, produced by selecting 'Output change from baseline' in the scenario generator tool. (However, change is negative, though values here are positive...)

What are the general implications for water supply and demand?

The projections are for a general decrease in precipitation over the dry season that would be expected to result in an overall decrease in supply and increase in demand (linked to such uses residential sprinkler systems and other domestic uses such as bathing. (Large scale irrigation systems will also demand more water to compensate for lower water availability in the soil, and increased demand by hydropower stations to generate more power, for increase cooling

systems in the region).

PART 2: ANALYSIS OF WATER TANK SYSTEMS

This part of the analysis involves the use of a Water Tank model, which is attached to, and driven by, the climate scenario generator of SimCLIM. This model simulates the performance of a water tank system using time-series rainfall data. Please use the Water Tank model to analyse the adequacy of design features of the water tank systems for the subdivision.

TASKS:

(1) Analyse the adequacy of the subdivision developer's plans under current climate

Steps for Using SimCLIM:

On the Main Menu, choose **NZ Bay of Plenty** (far right-hand side of screen). From the Tools drop-down menu, select the **Run an impact model option**, then select the, **Rain water collection** model from the Show All tab.

On the screen, you should now have a dialogue box and a map (grab the lower border and drag down to get the full view). You are first offered **Station** options. Of the choices offered therein, choose:

- **Station:** Rotorua (this is the closest station to the subdivision and has a similar rainfall regime)
- **Start and End Years:** 1964 and 1990 (this gives a 26-year record without missing data and is very close to the 30-year period recommended by World Meteorological Organisation for climatological analyses)

Now switch to the other tab called **Model Inputs**. Here is where you set the model parameter values. **Figure 1 (see last page)** provides a brief explanation of the parameters, the developer's assumptions, and some alternative options and their costs. The values consistent with the subdivision plans are:

Daily water consumption (litres): 1000
Water tank size (litres): 66,000
Water catchment area (m²): 210
Initial water storage (%): 20
Tolerance threshold for empty tank in day(s): 2

Select **Run Model**. The model has now used 26 years of daily rainfall data to simulate the system's performance.

In the output box, select the **Results** tab. There are two outputs, as explained in **Figure 1. These have to be interpreted subjectively.** In your judgment:

As shown in this simulation, is the risk of an extreme prolonged period without tank water over a 26-year period acceptable?

The longest period of an empty tank between the years 1964-1990 is 66 days. This is unacceptable.

Is the number of occurrences of system failure within a 27-year period acceptable?

994 times in a 100-year period of the system failure exceeding the tolerance threshold. This would mean approximately 258 failures in the 26-year period, which would seem unacceptable.

(2) Re-design the system to meet your requirements for an acceptable level of risk.

As suggested in **Figure 1**, there are opportunities for modifying supply and demand – at a cost, however. You should not wish to place undue financial burdens on the developer, but, on the other hand, you have a responsibility to consider the risks to the public. There will always be a residual risk of running out of water. The issue is, what is acceptable?

Using the guidance provided in Figure 1, systematically alter the parameters of the system until you achieve outputs that you consider acceptable. **Make note of the parameter values and any extra costs** that are entailed in modifying the system.

	Adaptation measure				Extra Costs (\$)
	Daily water consumption (L)	Water tank size (L)	Water catchment area (m ²)	Initial water storage %	
Longest period of an empty tank = 1 day Freq of empty tanks in every 100-year period = 0	500	66,000	250	20	2000
Longest period of an empty tank = 0 Freq of empty tanks in every 100-year period	200	66,000	210	20	Cost of implementing the additional water conservation technologies
Longest period of an empty tank = 0 Freq of empty tanks in every 100-year period = 0	500	66,000	210	50	Cost of implementing the additional water conservation technologies
Longest period of an empty tank = 0 Freq of empty tanks	180	210	66,000	50	1500

in every 100-year period = 0					
------------------------------	--	--	--	--	--

(3) Examine the implications of climate change

From Part I of this exercise, you constructed a scenario of the percentage change in rainfall for the subdivision for the year 2057. After ensuring that all other parameter values are consistent with your re-design of the water system, enter this percentage change in rainfall into the box **Rainfall Change in Percentage** (do not forget to put the negative sign before the number)

Rainfall change percentage for the subdivision area = -8.8%

How does climate change affect the outputs of the simulation. What are the implications for your acceptable level of risk?

Climate change affects the outputs such that the:

- * Longest period of an empty tank in days = 74, and
- * Frequency of empty tanks in every 100 years (exceeding tolerance threshold) = 1253

This presents a completely unacceptable level of risk to the community into the future and would require significant adaptation options to be implemented to mitigate the effects to an acceptable level.

(4) Suggest further modifications to the design in order to adapt to climate change

In order to maintain your acceptable risk level (as determined in Task 2 above) under climate change, it will be necessary to make further modifications of the systems -- in other words, *adaptation*.

Fine-tune the parameters in order to reduce the risks to acceptable levels. Make note of the incremental costs involved.

What are the adaptation measures you chose and their incremental costs?

	Adaptation measure				Extra Costs (\$)
	Daily water consumption (L)	Water tank size (L)	Water catchment area (m ²)	Initial water storage %	
Longest period of an empty tank = 0 day Freq of empty tanks in every 100-year period = 0	500	66,000	210	50	Some water conservation technologies implemented

Longest period of an empty tank = 0 Freq of empty tanks in every 100-year period = 0	500	66,000	250	50	Cost of implementing the additional water conservation technologies + 2000 for extra 40m ²
Longest period of an empty tank = 0 Freq of empty tanks in every 100-year period = 0	200	66,000	250	50	Cost of implementing the additional water conservation technologies + 2000 for extra 40m ²
Longest period of an empty tank = 0 Freq of empty tanks in every 100-year period = 0	180	66,000	210	50	1500 for additional water conservation technologies and drip-feed irrigation

Given the uncertainties of surrounding the climate change scenarios, do you have any suggestions regarding the current commitment to, and timing of, the adaptation measures?

The only measure that seems to significantly reduce the risk of empty tanks and failures, is to reduce water consumption. This is a no regret option, and the suggestion is that these measures need to be put in place so as to reduce current vulnerability to empty tanks and systems failures. Reducing water consumption to **500L**, already reduces the number of days of an empty tank to 0, and the frequency of empty tanks in every 100 years (exceeding the tolerance threshold) to 0 as well. This could be done in the next few years and you will already have ‘ensured’ that you maintain a 0 ‘empty tanks’ situation with a –potential -8.8% reduction in precipitation by 2065. Whether it eventuates or not, you are already more resilient under the current conditions, and so it is wise to implement this strategy also from the point of view of more sustainable resource consumption.

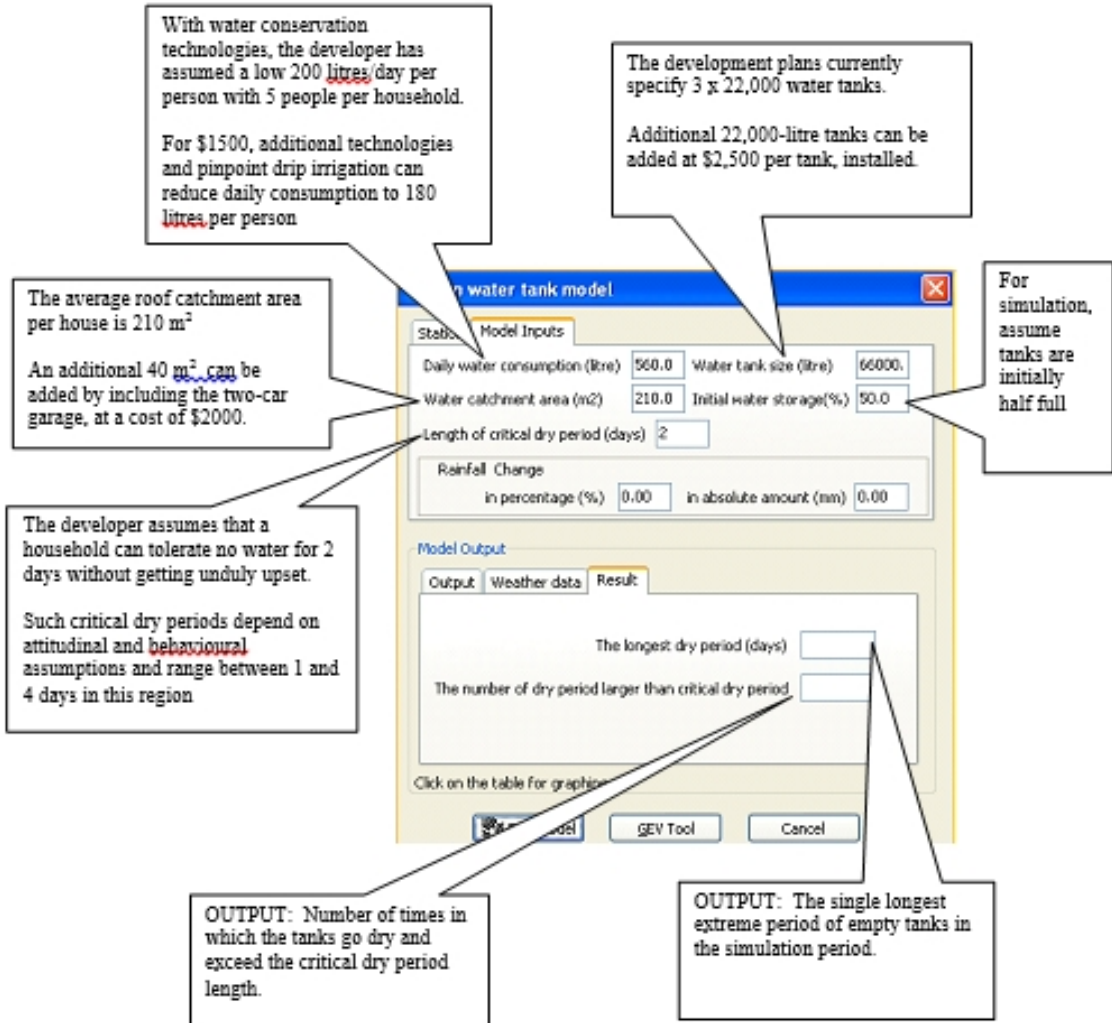


Figure 1: The water tank model inputs and outputs.

SWAT

The Soil and Water Assessment Tool (SWAT) is a public domain model, which is a small watershed to river basin-scale model to simulate the quality and quantity of surface and ground water and predict the environmental impact of land use, land management practices, and climate change. SWAT is widely used in assessing soil erosion prevention and control, non-point source pollution control and regional management in watersheds.

The ArcSWAT ArcGIS extension is a graphical user interface for the SWAT (Soil and Water Assessment Tool) model (Arnold et al., 1998). The model is physically based and computationally efficient, uses readily available inputs and enables users to study long-term impacts. For a detailed description of SWAT, see Soil and Water Assessment Tool input/Output and Theoretical Documentation, Version 2012 (Arnold et al., 2012a; 2012b), published by the Agricultural Research Service and the Texas Agricultural Experiment Station, Temple Texas. ArcSWAT extension of ArcGIS creates an ArcMap project file that contains links to your retrieved data and incorporates all customized GIS

functions into your ArcMap project file. The project file contains a customized ArcMap Graphical User Interface (GUI) including menus, buttons, and tools.

SWAT and the ArcSWAT interface are public domain software. Support is provided through the SWAT user website and several user groups and discussion forums. The following are links to SWAT related user support sites.

SWAT user web site: <http://www.brc.tamus.edu/swat/>

SWAT forums and user groups:

<http://www.brc.tamus.edu/swat/userforums.html>

ArcSWAT user web site: <http://www.brc.tamus.edu/swat/ArcSWAT.html>

ArcSWAT Google user group: <http://groups.google.com/group/ArcSWAT>

Usability

(1) SWAT and ArcSWAT is public software, free of charge, but with the research standard and scientific merit. They are widely applied for PhD water studies around the world.

(2) ArcSWAT provides friendly Graphic User Interface (GUI) to prepare SWAT input data and visual the output, once the data are prepared.

(3) SWAT can run without using ArcGIS, this provides the flexibility for non ArcGIS users.

(4) From SWAT and ArcSWAT user group one can get most the question answered.

Data availability

Most of the input data required by SWAT are public available, including DEM, soil land use/cover data wind 1km resolution should be enough for national level assessment.

SWAT can be applied in monthly steps, monthly precipitation and temperature data can be obtained from varies sources, including local station observations and international data. Other required variable also could be calculated.

CLIMsystems can assist clients with the preparation of data for use with SWAT either off-line or through SimCLIM 4.0 for Desktop. Contact info@climsystems.com for more information.

Sample List of Publications and Reports

Sample Publications Applying SimCLIM Outputs

Li, Y., Urich, P. (2018). Timor-Leste coffee growing area climate change risk and vulnerability assessment. Asian Development Bank Report. Pgs. 32.

Ky Phung, Nguyen. (2018). PRECIPITATION SCENARIOS IN HO CHI MINH CITY IN THE CONTEXT OF CLIMATE CHANGE. Vietnam Journal of Science and Technology. 55. 115. 10.15625/2525-2518/55/4C/12139. This work aimed at developing precipitation scenarios in Ho Chi Minh City (HCMC) corresponding to scenarios of RCP2.6, RCP4.5, RCP6.0, and RCP8.5.

Li, Y, Urich, P. (2018). Report on Climate Projections Pertinent to Project Design of the Urban Water Supply and Sanitation Project (UWSSP), Papua New Guinea. Asian Development Bank. Pgs 35.

Amin, Asad & Jatoi, Wajid & Fahad, Shah & Turan, Veysel & Ali, Shaukat & Ahmad, Shakeel & Rasool, Atta & Saleem, Nadia & Hammad, Hafiz & Sultana, Syeda & Mubeen, Muhammad & Bakhat, Hafiz & Ahmad, Naveed & Shah, Ghulam & Adnan, Muhammad & Noor, Muhammad & Basir, Abdul & Saud, Shah & Rahman, Muhammad & Paz, Joel. (2018). Evaluation and analysis of temperature for historical (1996–2015) and projected (2030–2060) climates in Pakistan using SimCLIM climate model: Ensemble application. Atmospheric Research. 213. 10.1016/j.atmosres.2018.06.021.

Li, Y., Urich, P. (2018). Air Quality Improvement in the Greater Beijing-Tianjin-Hebei Region China Energy Conservation and Environment Protection Group's Emission Control and Pollution Reduction Facility. CVRA Report. Asian Development Bank. Pgs. 131.

Jatoi, Wajid & Amin, Asad & Fahad, Shah & Awais, Muhammad & Khan, Naeem & Mubeen, Muhammad & Wahid, Abdul & Turan, Veysel & Rahman, Muhammad & Ihsan, Muhammad & Ahmad, Shakeel & Hussain, Sajjad & Mian, Ishaq Ahmad & Khan, Bushra & Jamal, Yousaf. (2018). Future risk assessment by estimating historical heat wave trends with projected heat accumulation using SimCLIM climate model in Pakistan. Atmospheric Research. 205. 10.1016/j.atmosres.2018.01.009.

Li, Y., Urich, P. (2018). Drought Risk Assessment: Papua New Guinea. World Bank. Pgs.22.

Al Mozahid, F. (2018). Regional climate assessment of precipitation and temperature in Southern Punjab (Pakistan) using SimCLIM climate model for different temporal scales.

Wilcock, R.; Urich P.B. (2017). An Assessment To Increase Alaskan Community And Infrastructure Resilience. Two Bears Consulting. Pgs. 69.

Li, Y.; Urich, P.B.; Yin. C. (2017). Review of Potential Methodologies for Perturbing Time Series Precipitation for King County, Seattle: A Literature Review. CH2M. Pgs 20.

Li, Y.; Urich, P.B.; Yin. C. (2017). St. Petersburg, Florida 15 Minute Precipitation Data Climate Change Perturbation Methodology. CH2M. Pgs. 20.

Li, Y.; Urich, P.B. (2017). Climate Change Impact Assessment for Lugonville, Vanuatu. Asian Development Bank Report. Pgs. 30.

Ramachandran, Andimuthu & Khan, Saleem & Palanivelu, Kandasamy & Prasannavenkatesh, Ramachandran & Jayanthi, N. (2017). Projection of climate change-induced sea-level rise for the coasts of Tamil Nadu and Puducherry, India using SimCLIM: a first step towards planning adaptation policies. Journal of Coastal Conservation. 1-12. 10.1007/s11852-017-0532-6.

Li, Y.; Urich, P.B. (2017). Climate Change Impact Assessment for Nuku'Alofa, Tonga. Asian Development Bank Report. Pgs. 31.

Li, Y.; Urich, P.B. (2017). Climate Change Impact Assessment for Majuro, Marshall Islands. Asian Development Bank Report. Pgs. 34.

Li, Y.; Urich, P.B. (2017). Climate Change Impact Assessment for Honiara, Solomon Islands. Asian Development Bank Report. Pgs. 29.

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Legacy map tools

Reclassify Images

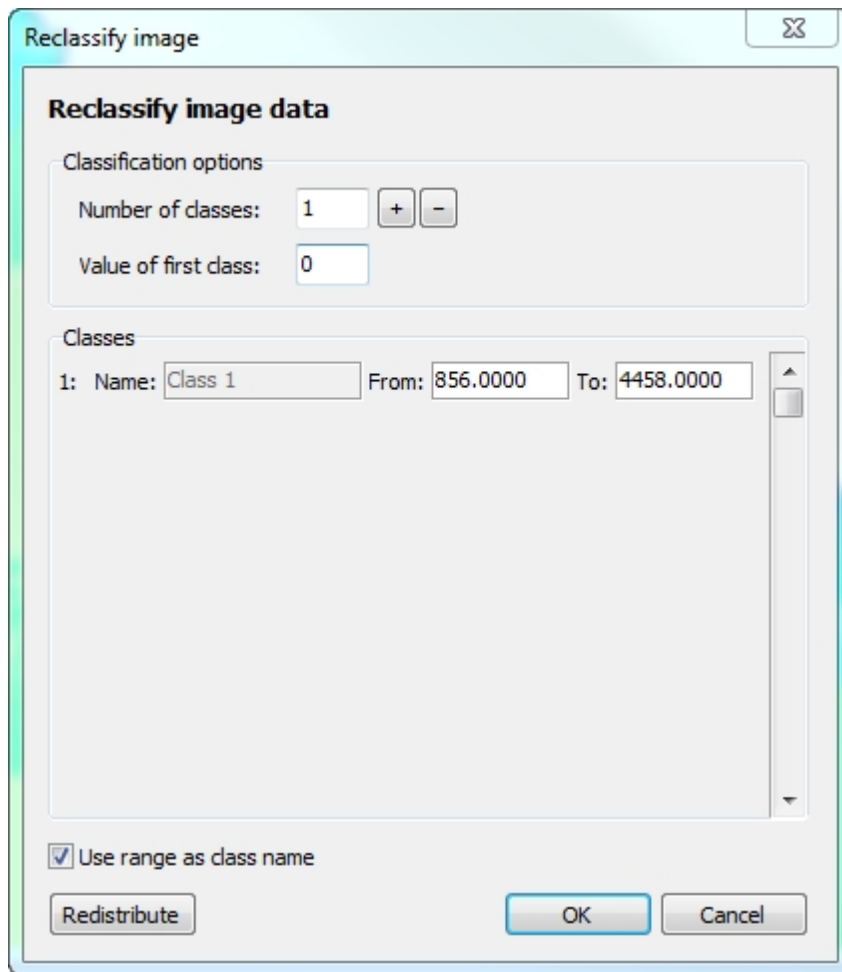
Reclassify Images

Activity: Reclassify images. Often the legend that is produced with SimCLIM 4.x for Desktop is not appropriate for the end users needs. The reclassifying tool provides the end user with the opportunity to customise the units for display and to label them as required.

Note: We will now look at reclassifying images. This process MUST be done (if it going to be done) before images are linked and it MUST be done in a consistent manner!

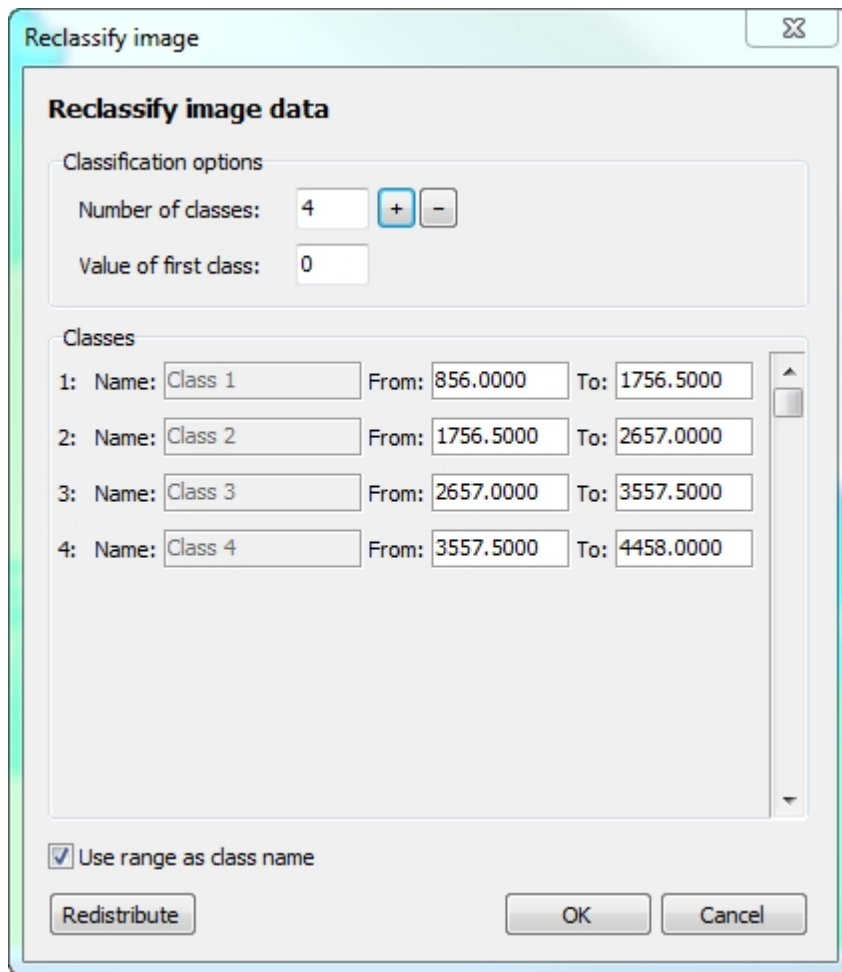
With any image open (i.e. produce a scenario map of your choice for a study area and variable), perhaps a rainfall image would be easiest to work with to start, click on the reclassify image

tool in the left margin toolbar  .



Change the number of classes to 4 by either entering the number directly in the box or by toggling up (or down).

As you add a new class the range is redistributed evenly. You can also redefine these manually. At this point let them be automatically allocated a value.



The image shows a 'Reclassify image' dialog box with the following fields and controls:

- Classification options:**
 - Number of classes: 4 (with '+' and '-' buttons)
 - Value of first class: 0
- Classes:**

Class	Name	From	To
1	Class 1	856.0000	1756.5000
2	Class 2	1756.5000	2657.0000
3	Class 3	2657.0000	3557.5000
4	Class 4	3557.5000	4458.0000
- Use range as class name
- Buttons: Redistribute, OK, Cancel

You can now rename the classes. First you must unselect the Use range as class name Use range as class name name box so that you can add text.

Reclassify image data

Classification options

Number of classes: 4 + -

Value of first class: 0

Classes

1:	Name: Dry	From: 856.0000	To: 1756.5000
2:	Name: Moist	From: 1756.5000	To: 2657.0000
3:	Name: Wet	From: 2657.0000	To: 3557.5000
4:	Name: Very Wet	From: 3557.5000	To: 4458.0000

Use range as class name

Redistribute OK Cancel

When you have completed this click on Reclass and view your new image.

If you wish to reclass the image again you will need to reconstruct the original image to do so (using the scenario generator).

Try to reclass several images (for different variables) before proceeding to the next activity. This will require you to produce more scenarios which is good practice.

Activity: Customised values.

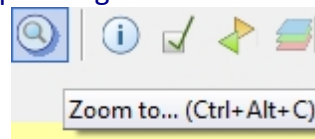
Be sure to enter customised values. You will need to leave the lowest value and highest values intact. The other values can be changed to suit your needs. See the box below for an example.

Classes			
1: Name:	<input type="text" value="Dry"/>	From: <input type="text" value="856.0000"/>	To: <input type="text" value="1756.5000"/>
2: Name:	<input type="text" value="Moist"/>	From: <input type="text" value="1756.5000"/>	To: <input type="text" value="2657.0000"/>
3: Name:	<input type="text" value="Wet"/>	From: <input type="text" value="2657.0000"/>	To: <input type="text" value="3557.5000"/>
4: Name:	<input type="text" value="Very Wet"/>	From: <input type="text" value="3557.5000"/>	To: <input type="text" value="4458.0000"/>

Manual Zoom

Manual Zoom

Occasionally you may wish to zoom into multiple images and have them all displayed to exactly



the same coordinates. To achieve this use the manual zoom function from the toolkit toolbar. With an image open click on the icon and a panel with four coordinates becomes available.

Manual Zoom ✖

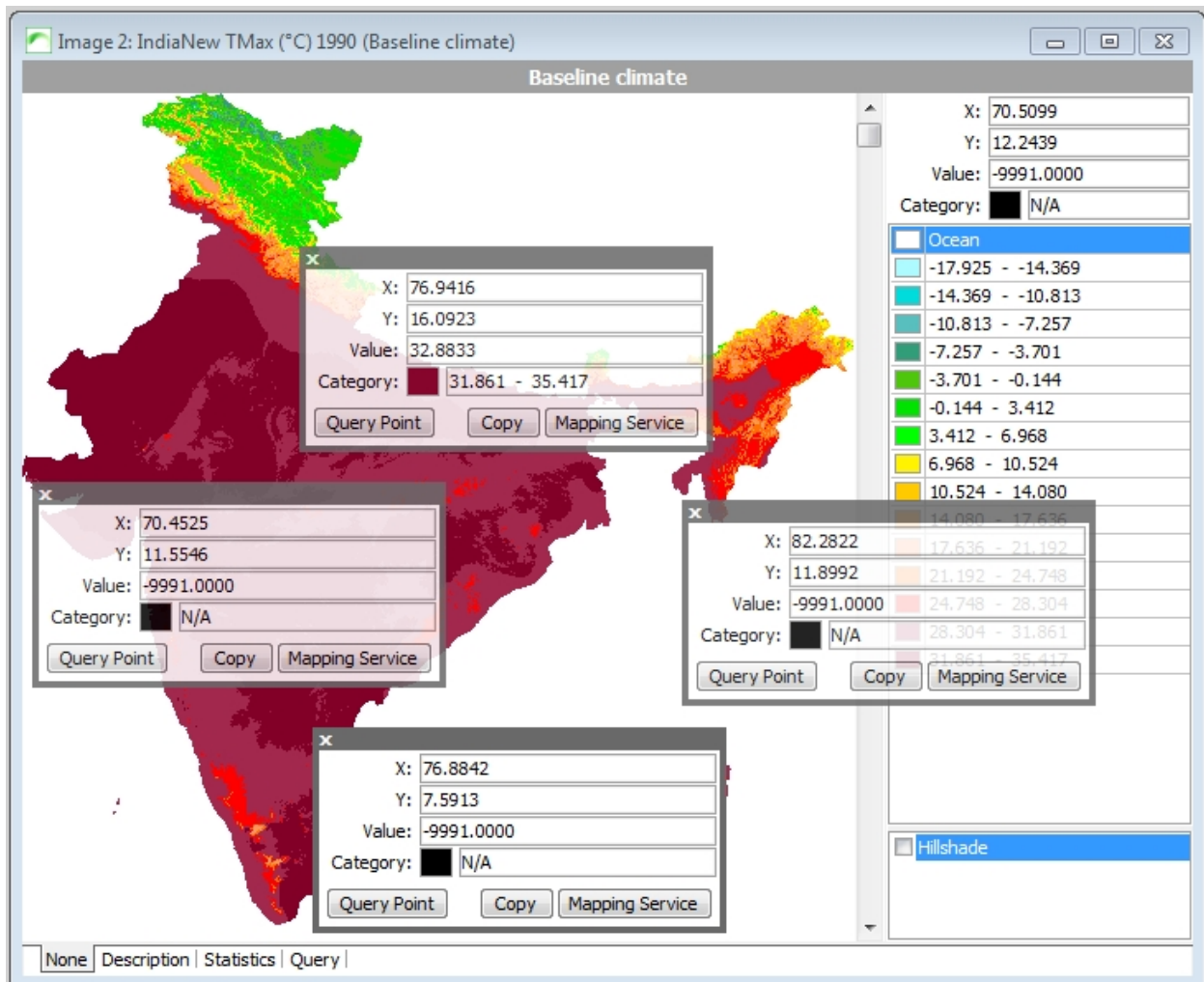
Enter manual zoom coordinates

Top:

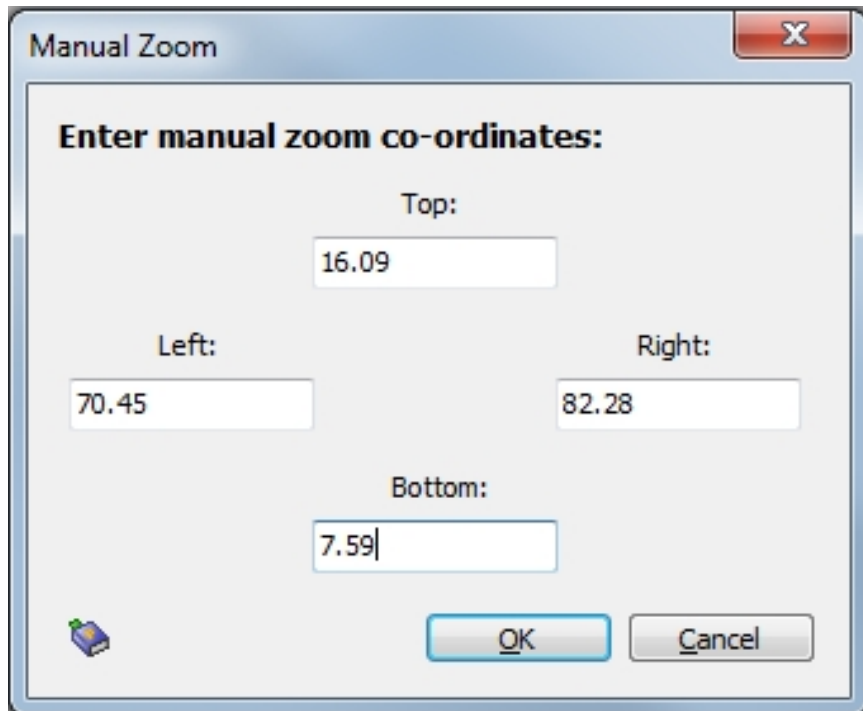
Left: Right:


Bottom:

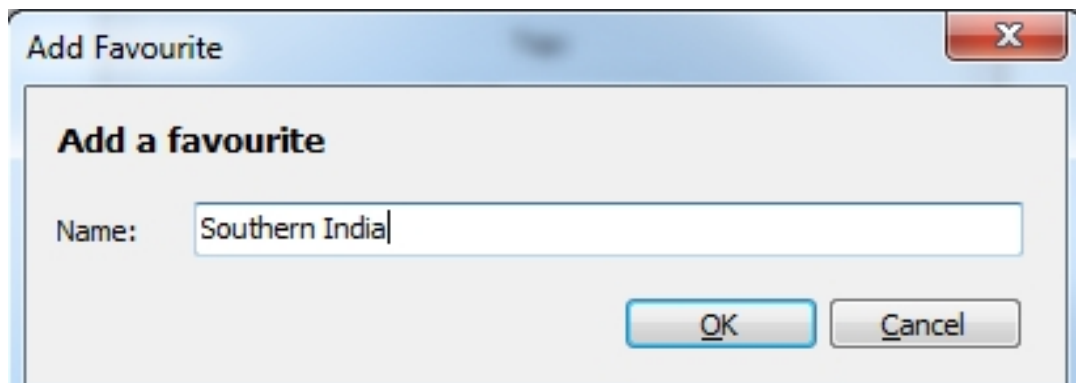
Left click on the map to define your top, bottom, left and right coordinates. For example, we will create a special zoomed in area for Southern India. With the entire map of India open we clicked on the left edge of the area we wanted along with the top, right and bottom. These query boxes are displayed in that order below:



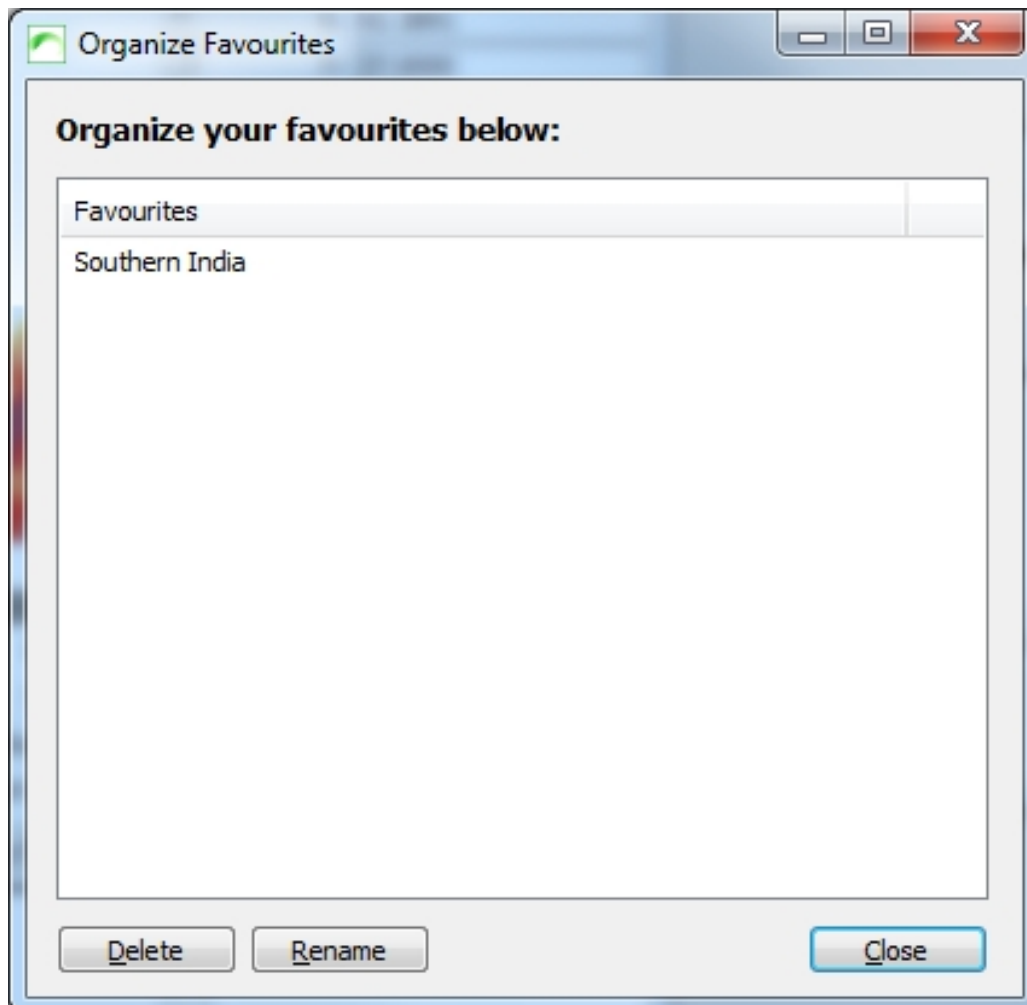
From these boxes you ‘harvest’ the corners of the zoomed area. The left margin = X 70.45, the top is Y=16.09, the right side is X = 82.28 and the bottom is X = 7.59. (X = longitude and Y = latitude)!



Click on the  icon to name the zoomed area as a favourite and to view and manage other favourites.

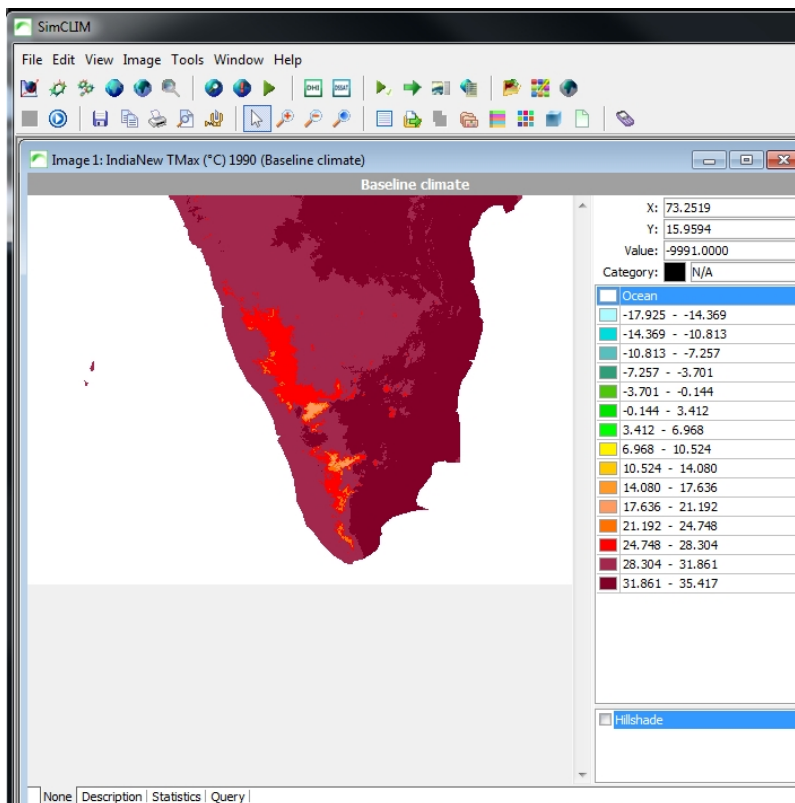
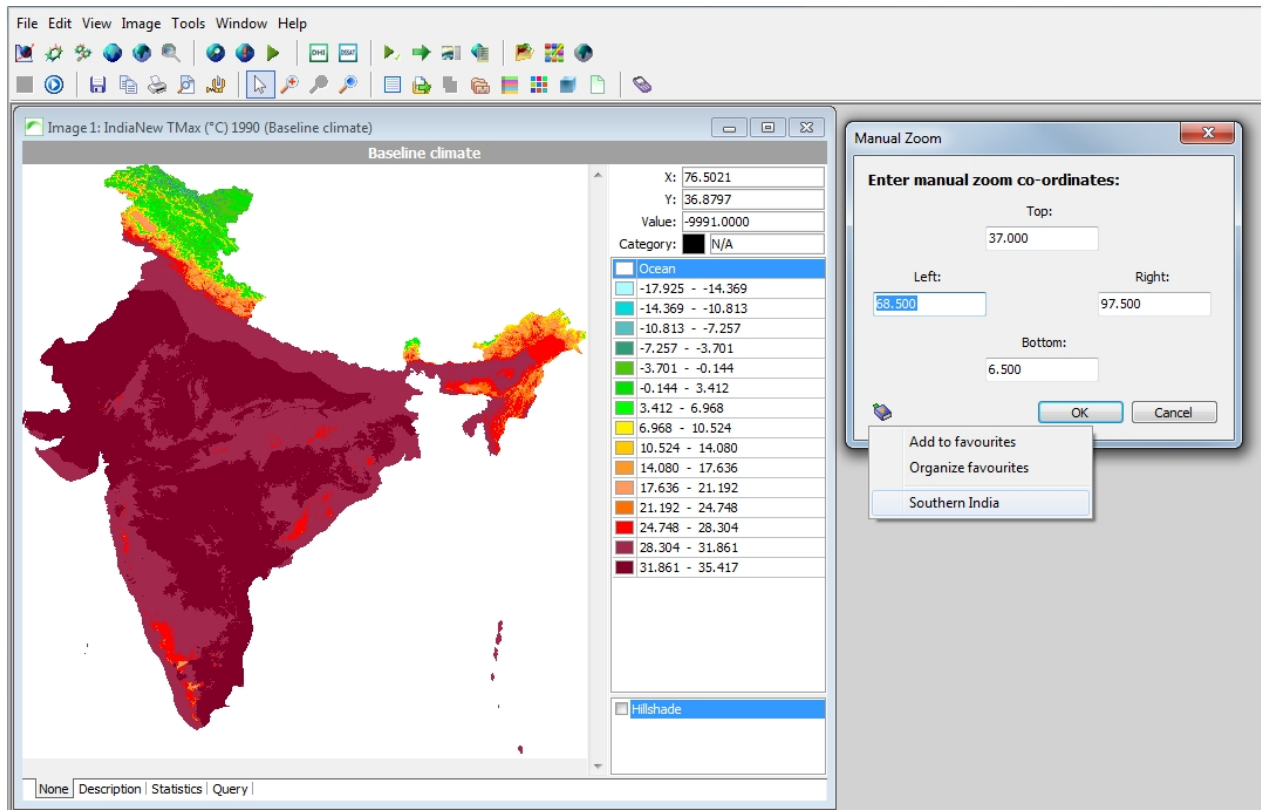


Before applying the saved coordinates to a new map of the same region have a look at the other options such as Organize Favourites:



Here you can either delete favourites or rename them.

You can now go to a map of all of India, click on manual zoom and go to your favourites and click on Southern India:




This function can be applied to many images of, for example India, so you are always working with the same area.

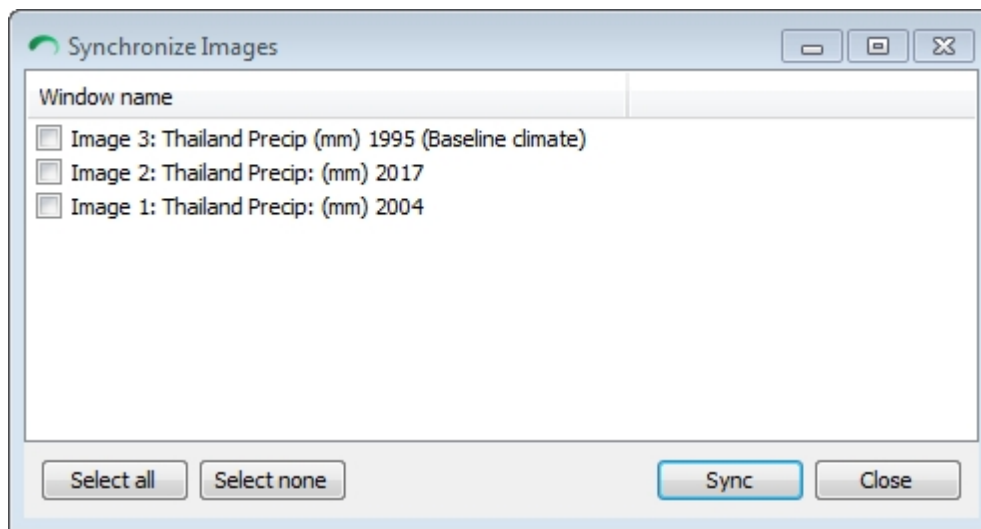
Standardising Legends for Comparative Purposes

Standardising Legends for Comparative Purposes

With two or more images open that have been generated using the same criteria (study area, variable, time frame (months, year)) but different scenario criteria we will standardise the legends for easy visual comparison.

It can be advantageous to minimise images before you begin but this is optional.

After minimising (if you have chosen to do so) click on the Sync Images tool  from the toolbar.



It is important to link the image with greatest temperature (for example) with those of lesser temperature. If you fail to do this the results will not be satisfactory.

Typically your image with the latest date (2075 over 2025) will become your new base from which other images will be linked.

Select Image 1 and then a second image to be standardised to the legend of the first image.

If you have more than two images open proceed to link the third image to the first image by placing the image in the Image 2 dialogue box. You can proceed to do this for however many images you have open.

Now you can compare your outputs as they will have a standardised legend.

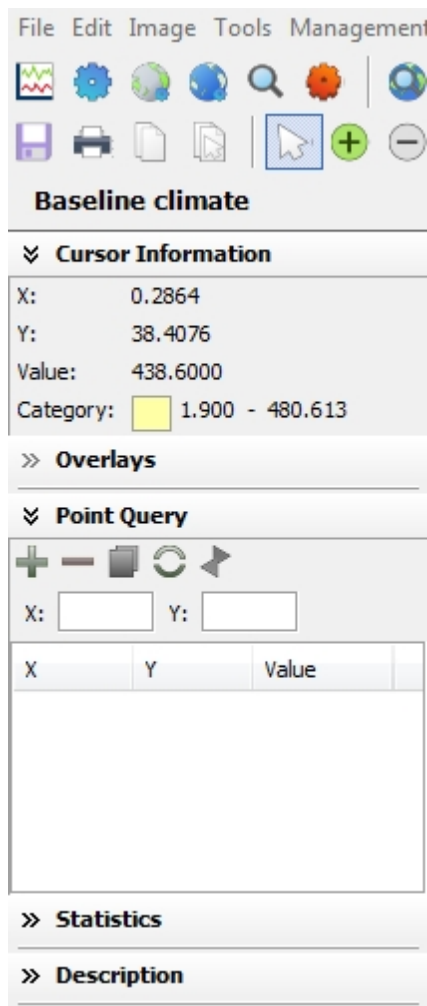
Activity: Close all the windows you have open and create new images for each variable (mean, minimum and maximum temperature (if you already did precipitation) and link the images for comparative purposes.

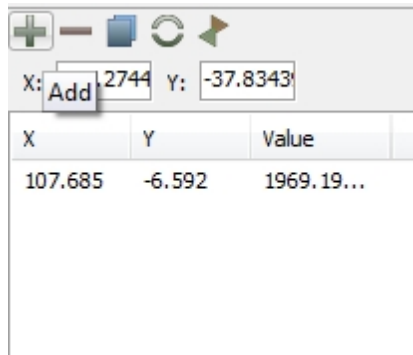
This will take some time and concentration. Do each variable as a separate project i.e. open and standardise the legend for mean temperature, then close that project and do maximum temperature and so on.

Spot Values

Spot Values

Sometimes you will want to check the spot values on spatial images and to do this in a consistent manner – i.e. exactly the same spot of multiple images. This can be done by right clicking on the spot of your choice on the first map. A small dialog box will appear. Click on Add Query Point.





As you click on the spots for which you want site data click on the map to add to it to the query box and a new dialogue box will appear. You can either cancel the point by closing the box by clicking on the X in the top left of the box or you can click on **Query Point** which will add the data for that point to the table below.

You can also copy the dialogue box so that the data becomes available in a text format as seen below (simply click on Copy and paste it into a word program):

Item	Value
Sum	214181920.0...
Avg	826.3192
StdDev	693.0812

To find the values for exactly the same spots on a second, third or more images (that are already open), click on the **Sync** tool and the list of open images will appear. Click on the image that you wish the corresponding data for and it will be generated. The values will appear in a similar, new dialogue box at the bottom of the second image. This can be done for several images if you wish.

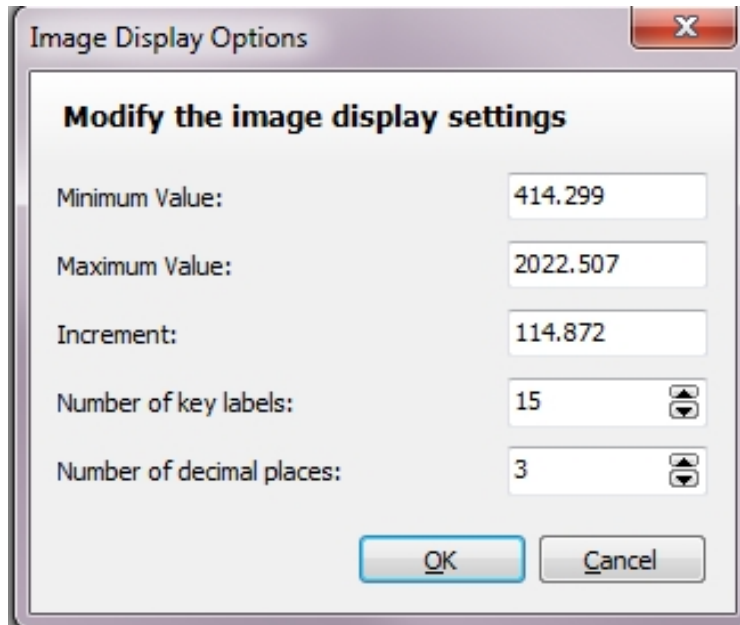
The data can be easily exported to another program by clicking on the **Copy table** icon. They can then be pasted in Excel or a similar program for graphing and further analysis.

You can also learn more about the area of concern by clicking on the Open in Mapping Service and the site will display in Google Maps!

Image Display Options

Another tool that can be applied to spatial images is the image display option .

Open another spatial analysis of your choosing then click on the image display icon. The following dialogue box will be displayed with the range of values based on your current analysis.

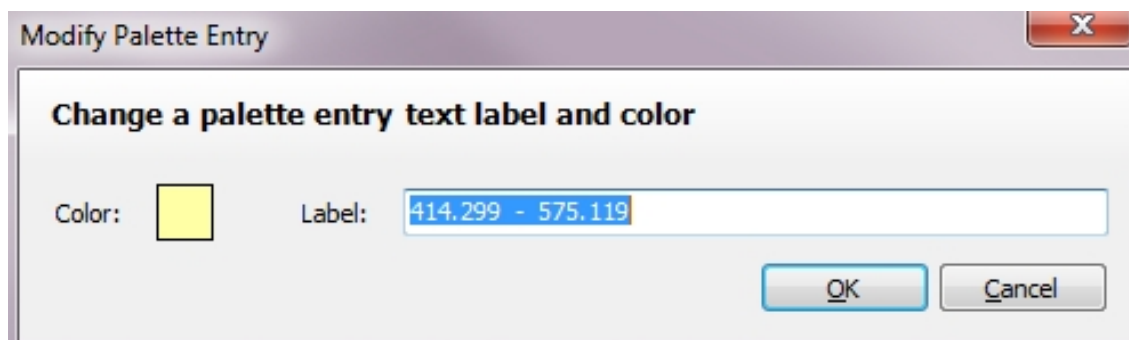


Sometime it could be necessary to display certain very tightly defined areas on your map that have particular climatological characteristics – such as rainfall amounts or temperature ranges. This is often done in threshold studies such as with species diversity.

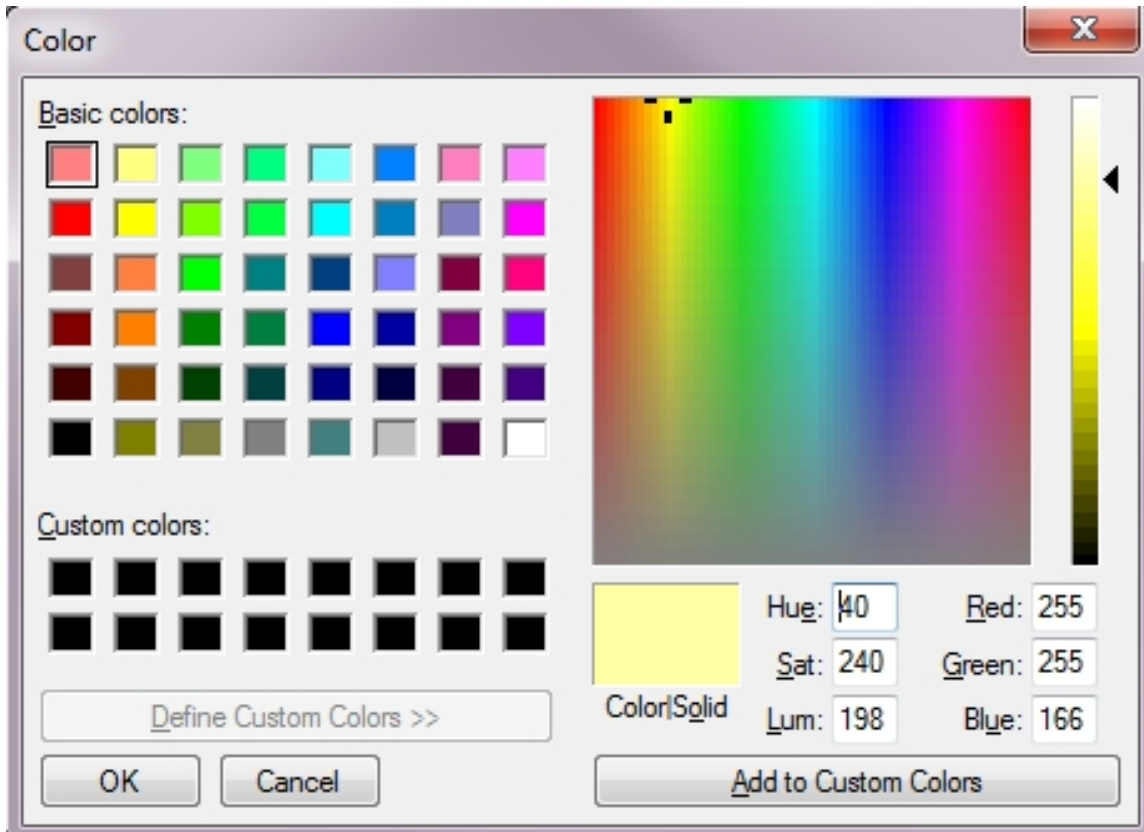
With your current image, imagine a certain threshold that you wish to display and ‘extract’ the minimum and maximum value for that from your map. Set the number of labels at 1 and then set the minimum and maximum value. Click on OK and look at the display.

You may enhance or place more emphasis on your outputs by changing the display colour.

Left click on the colour currently displayed in the legend and a Modify Palette Entry dialogue box will open.

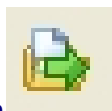
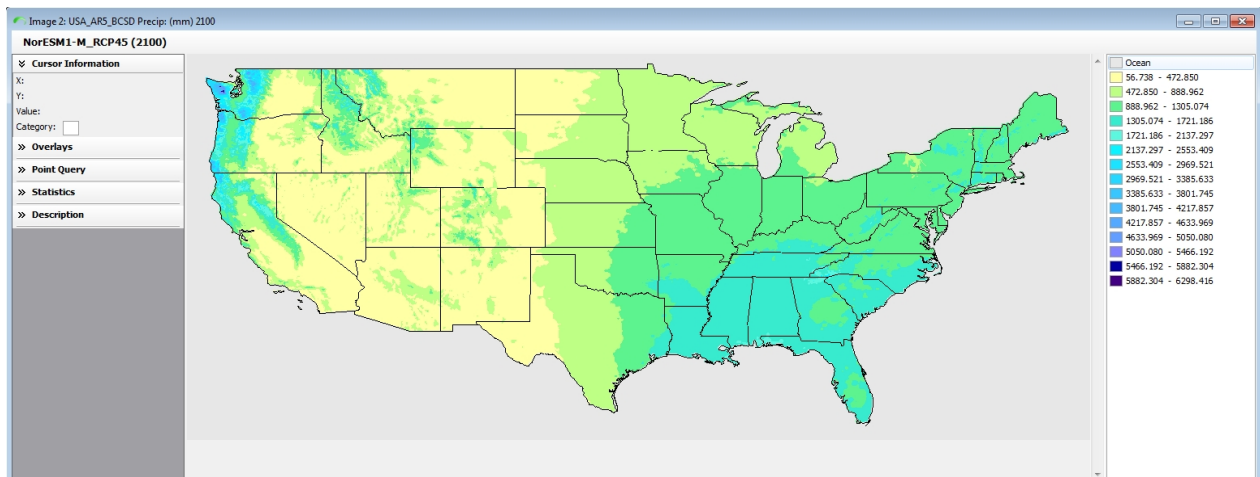


Click on the colour box and a range of colours will be displayed.

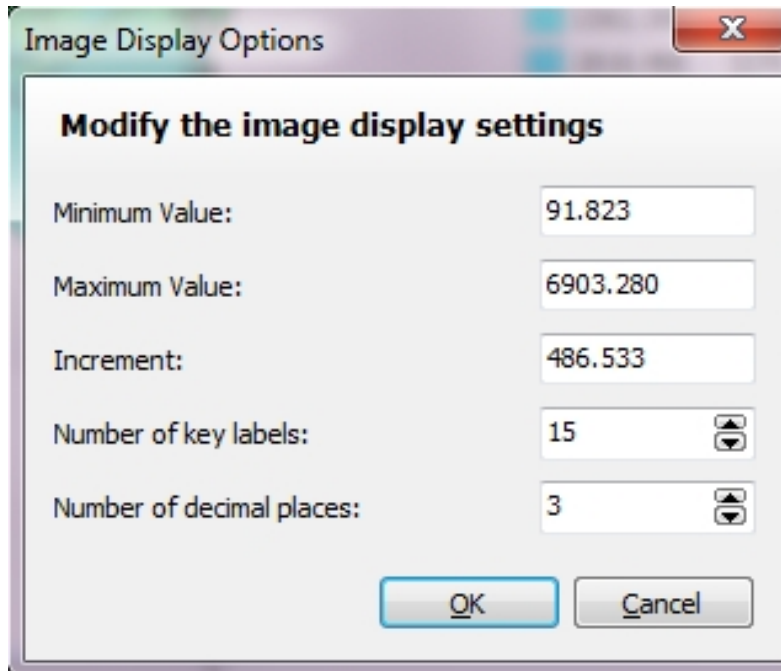


You can also customise your colours and save a customised colour for use later. Click on customised colours to see the full range of options as displayed above. You can change the values in Hue etc to see how a colour is changed.

We provide one example of how this could be used. The following is of precipitation for the USA.

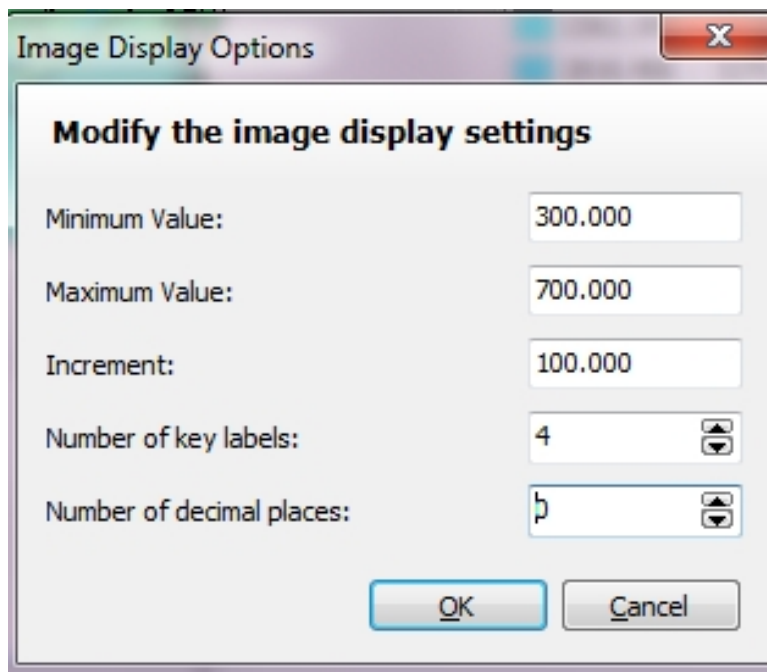


Click on the image display option .



We are interested in the area of the USA that receives between 300 and 700 mm of rainfall a year and we wish to see this in 100 mm intervals.

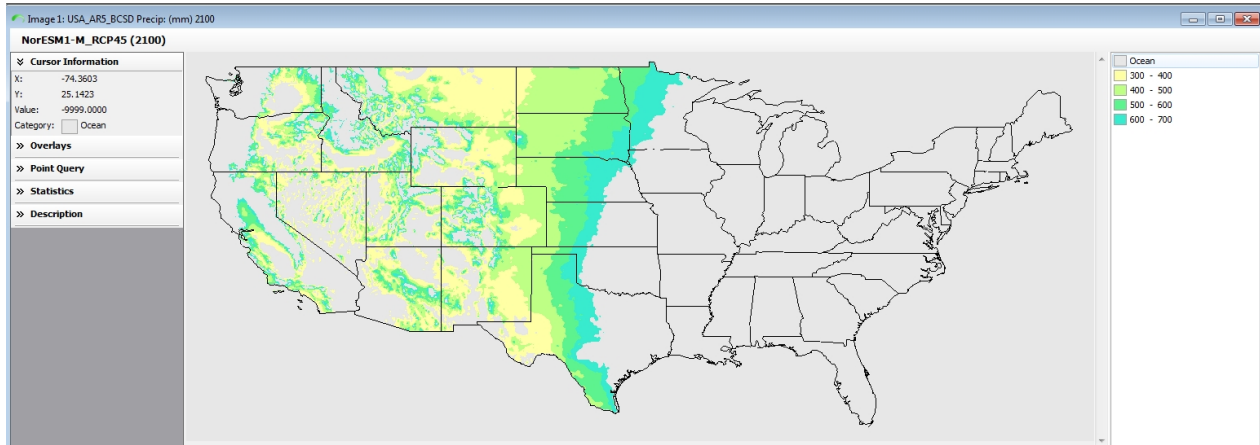
To do this we redefine the values as follows:



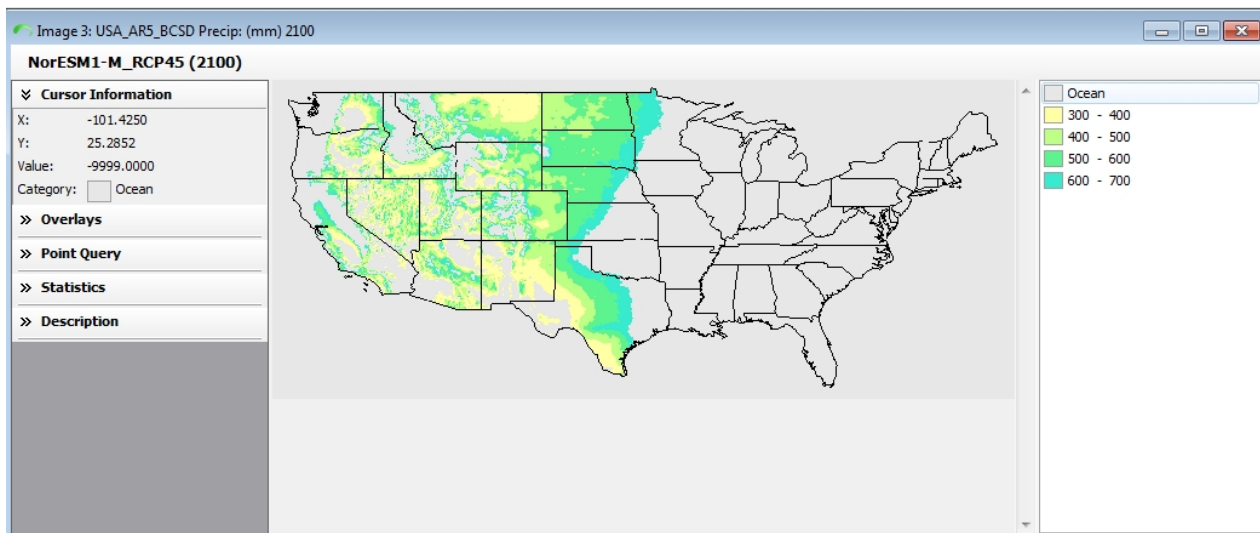
The maximum is 700 and the minimum is 300 i.e. a difference of 400 and we have asked for 4 key labels hence the increment is 100 mm.

NOTE: SOME OF THE VALUES ARE AUTOMATICALLY CALCULATED AS YOU CHANGE ANOTHER. BE SURE TO CLICK IN ALL THE BOXES BEFORE CLICKING OK TO BE SURE THAT ALL THE VALUES ARE DISPLAYED PROPERLY!


The results can be seen below:



For example, see below the same range 300-700 for the year 2100 with a RCP 8.5 scenario, mid sensitivity and Nor_ESM1-M GCM.



Activity: The Image Display tool is extremely powerful and we suggest you spend some time now exploring it further by experimenting with different outputs other than precipitation and comparing different scenarios.

- 1] Create a scenario (baseline) of your choice.
- 2] Open the Image Display tool  and carve out a particular range to display based on your 'expert' knowledge.
- 3] Alter the colours of the display to emphasise the purpose for your analysis.

4] Open a second image for the same area and variable but with a climate change scenario applied.


NOTE: REMEMBER TO 'LINK IMAGES' BEFORE USING THE DISPLAY IMAGE FUNCTION

5] Change the image display to correspond with your first image and compare the results.

6] Do this for different climate variables or try a different study area.

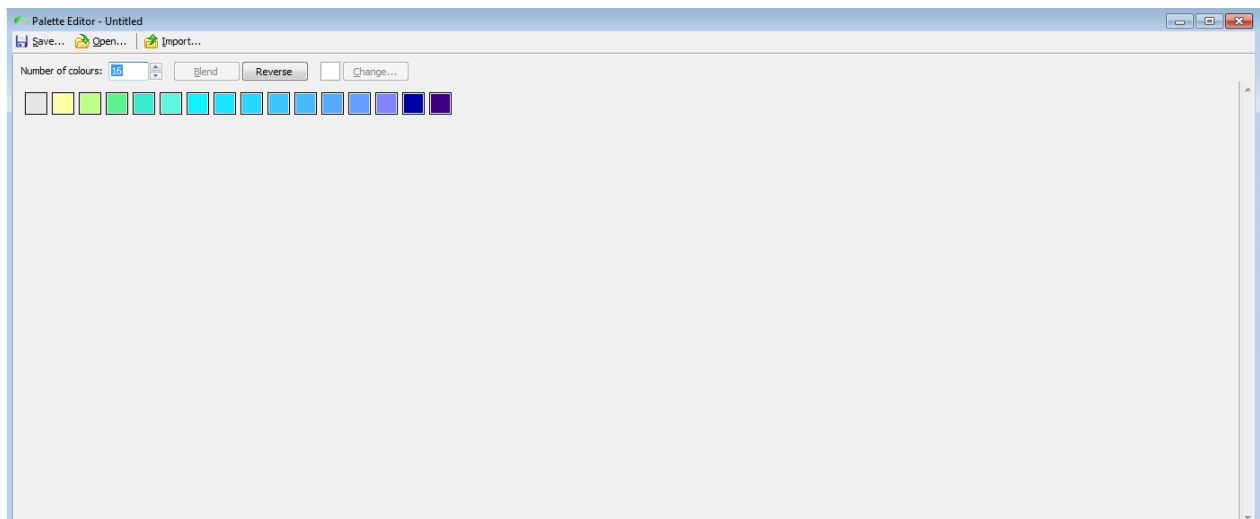
Finalising Your Display Colours

Finalising Your Display Colours

One of the last things you will do before exporting your images for another presentation is setting your display colours in your legend. It is critical that you 'communicate' the climate message and hence your choice of colours can be critical. SimCLIM 4.0 for Desktop offers you many choices through the Edit Palette For Active Windows function  in the toolkit toolbar.

With an image open and active (on the top of other images) click on the palette icon .

The following window (with different colours depending on your active window) will be displayed.



You have several options for customising your colours:

1] Highlight one colour by clicking on it and then click on Pick to select from a range of colours.

2] Highlight one colour by clicking on it and then slide the red, green or blue slide bars to the left or right to produce the colour of your choice.

3] You can also expand the range at this point by adding an additional colour. Try this and see

how it alters your legend and select and additional colour.

The Palette tool offers the user many options. It is worth spending a little bit of time now exploring them.