

2.7 Explore Projections (Advanced)

The Explore Projections section provides two ways of exploring future climates: Detailed Projections and Compare Projections (Figure 1).

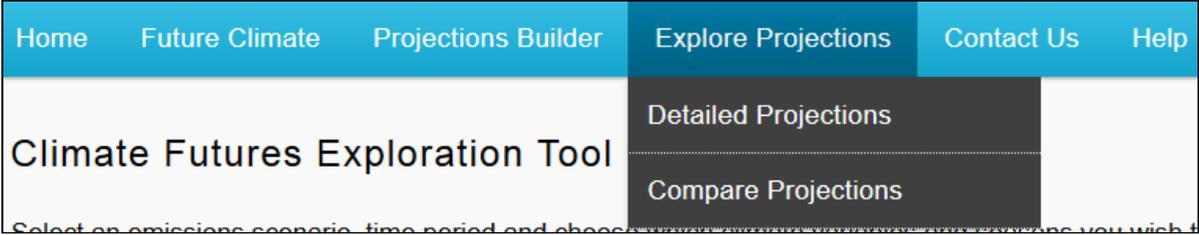


Figure 1. Accessing the Explore Projections functionality from the top menu.

Detailed Projections

The Detailed Projections module (Figure 2) provides the most sophisticated level of projections exploration that *Climate Futures* offers.

With the Detailed Projections interface, you can define the Climate Futures matrix according to any two climate variables and any season of your choosing. You can also populate the matrix with the individual projected change results from each model and compare them to the multi-model average or the other individual models.

STEP 1. SELECT AN EMISSIONS SCENARIO

Scenario ----- i

STEP 2. SELECT A TIME PERIOD

Year -----

STEP 3. SELECT CLASSIFYING VARIABLES AND SEASONS

Columns: Surface Temperature Annual i

Rows: Rainfall Annual

DISPLAY OPTIONS

Climate variables

<input type="checkbox"/> Surface Temperature	<input type="checkbox"/> Minimum Daily Temperature	<input type="checkbox"/> Sea Surface Temperature
<input type="checkbox"/> Rainfall	<input type="checkbox"/> Humidity	<input type="checkbox"/> Sea Level Pressure
<input type="checkbox"/> Wind Speed	<input type="checkbox"/> Evaporation	<input type="checkbox"/> Evapotranspiration
<input type="checkbox"/> Maximum Daily Temperature	<input type="checkbox"/> Solar Radiation	<input type="checkbox"/> Strong Wind (Cmp3)
<input type="checkbox"/> Heavy Rainfall (Cmp3)		
<input type="checkbox"/> 1-In-20Y Rainfall (Cmp5)		
<input type="checkbox"/> 1-In-20Y Wind Speed (Cmp5)		

Clear

Seasons

<input type="checkbox"/> Annual	<input type="checkbox"/> April	<input type="checkbox"/> August	<input type="checkbox"/> December	<input type="checkbox"/> September - November (SON)
<input type="checkbox"/> January	<input type="checkbox"/> May	<input type="checkbox"/> September	<input type="checkbox"/> December - February (DJF)	<input type="checkbox"/> November - April (NDJFMA)
<input type="checkbox"/> February	<input type="checkbox"/> June	<input type="checkbox"/> October	<input type="checkbox"/> March - May (MAM)	<input type="checkbox"/> May - October (MJJASO)
<input type="checkbox"/> March	<input type="checkbox"/> July	<input type="checkbox"/> November	<input type="checkbox"/> June - August (JJA)	

Select Months
Select Quarters
Clear

MODELS SELECTION ↓

GENERATE CLIMATE FUTURES FOR A REGION OF INTEREST



Figure 2. Detailed Projections interface.

In addition to the settings described previously, the Detailed Projections landing page has the following settings.

1. Drop down menu for selecting an **emissions scenario**.
2. Drop down menu for selecting a **time period**.

3. **Info** buttons  providing more details– or refer to the [Glossary of Terms](#).
4. Drop down menus to select the “**classifiers**” used to define the climate futures matrix: two climate variables and their associated seasons (default climate variables are temperature and rainfall, and the default season is annual).
5. **Display Options** to create a more detailed Climate Futures Matrix.
6. **Expandable models selection panel** – allows exclusion of particular climate models.
7. Map of the PCCSP/PACCSAP countries – click to explore “climate futures”.

Setting the Classifying Variables and Seasons

Two climate variables are required to generate the projected climate futures. By default, Surface Temperature and Rainfall are used. There are 11 variables to choose from:

- Surface Temperature
- Rainfall
- Wind Speed
- Maximum Daily Temperature
- Minimum Daily Temperature
- Humidity
- Solar Radiation
- Evapotranspiration (CMIP5 only)
- Evaporation (CMIP3 only)
- Strong Wind (CMIP3 only)
- Heavy Rainfall (CMIP3 only)
- 1-in-20 year Rainfall (CMIP5 only)
- 1-in-20 year Wind Speed (CMIP5 only)
- Sea Surface Temperature
- Sea Level Pressure

These features are described in detail in the following sections (apart from those features already described).

Click on the arrow on the drop down menu to see a list of the 11 climate variables then click on your selection (Figure 3):

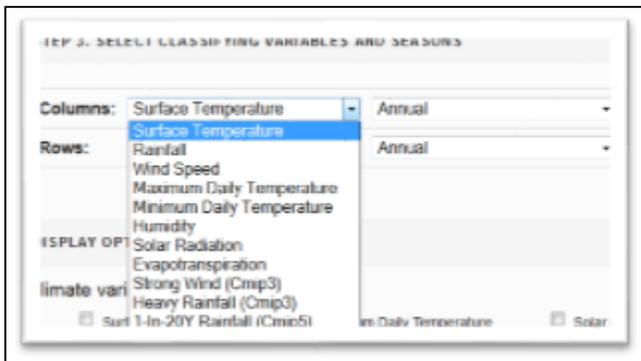


Figure 3. Selecting classifying variables

Note: “Strong” and “Heavy” are defined as the 99th percentile, i.e. the heaviest 1% of events. These variables are only available from the older CMIP3 models. See the [Glossary of Terms](#) for a detailed description of the climate variables or click the little blue information button .

For each climate variable a season can be selected. You have the following options to choose from:

- Annual (all seasons)
- December-February
- March-May
- June-August
- September-November
- November-April
- May-October
- Individual months

In order to change the default value (annual) just click on the little arrows on the drop down menu to show the seasons available and click on your choice (Figure 4).

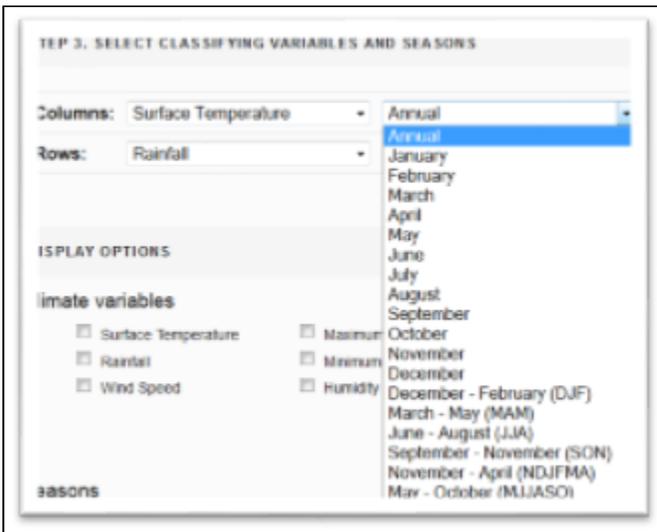


Figure 4. Setting classifying season

Seasonal “climate futures” provide more information about when the largest and smallest changes are likely to occur. In some cases, little change in the annual average can mask large compensating increases and decreases in particular seasons. This can be important for activities in which the timing of climatic events is critical, such as planting or harvesting crops.

There are several display options that result in a more detailed output and the chance to decide which of the models should be included in generating “climate futures” for a region of interest.

Once all input variables are selected, click on a region of interest on the map to create and explore its “climate futures”. Like in Intermediate Mode, the results are displayed in a (more detailed) Climate Futures Matrix. The Advanced Mode allows you to narrow down the range of climate projections for specific applications and facilitates the process of choosing climate models appropriate for a designated impact assessment.

Setting Display Options

The display options panel (Figure 5) allows you to select which of the climate variables available in *Pacific Climate Futures* you would like to display within the climate futures matrix. You can select one, several, or all of the 11 variables. It is important to understand which variables ‘belong’ within a given climate future for a given pair of classifying variables. In general, only variables that change in a similar way to changes in one of the classifying variables (*i.e.* that are ‘correlated’) should be displayed within the matrix. Table 1 shows which variables correspond with each of the three most commonly used classifying variables, Surface Temperature, Rainfall and Wind Speed.

Table 1 : Appropriate variables to use with each of the three most commonly used Classifying Variables. Variables marked with an asterisk (*) will not always be correlated.

Surface Temperature	Rainfall	Wind Speed
Surface Temperature	Rainfall	Wind Speed
Maximum Temperature	Heavy Rainfall*	Strong Wind*
Minimum Temperature	Solar Radiation	
Evaporation	Relative Humidity	

For example, projected changes in Solar Radiation are ‘correlated’ to changes in Rainfall. This means that the changes in Solar Radiation that fall within a given climate future classified by Rainfall (plus any other classifier) can be regarded as ‘belonging’ to that climate future (*i.e.* the values for Solar Radiation that fall within the ‘most likely’ climate future are the ‘most likely’ changes in Solar Radiation, and so on).

It is important to note, however, that the variables, Heavy Rainfall and Strong Wind will not always be well correlated with Rainfall and Wind Speed, respectively. The nature of the relationship between these variables can be investigated with the climate futures matrix. For example, to investigate the relationship between Wind Speed and Strong Wind, set these two variables as the Classifying Variables and examine the resultant matrix. If there is a tendency for Strong Wind to increase or decrease as Wind Speed increases, there is a correlation. However, if changes in one variable generally correspond to little or no change in the other, there is little or no correlation.

Figure 5. Display options to set detailed data to be generated

You can also choose a corresponding season of interest. Detailed data are available for the whole year, individual months, as well as December-February, March-May, June-August, September-November, November-April and May-October.

Note: This selection of climate variables and seasons affects the information presented *within* the cells of the output matrix but not the classification of projections. It provides more detailed information for the climate variables chosen.

Select which climate models to exclude if necessary

The PCCSP and PACCSAP programmes undertook extensive evaluation of the global climate models used in the Fourth and Fifth Assessment Reports of the Intergovernmental Panel on Climate Change (IPCC). The models were carefully assessed to see how well they reflect past and current conditions, such as how each model reproduces the El Niño Southern Oscillation in the Pacific region. As a result of this evaluation, seven models (six CMIP3, one CMIP5) were considered unsuitable for use in climate projections over the PCCSP/PACCSAP region, leaving 18 CMIP3 and more than 45 CMIP5 models for use in *Pacific Climate Futures*.

By default, all models are selected. To exclude one or more models from the projections, click the  expand button to display the model selection panel (Figure 6). Individual models can be de-selected by clicking on the tick-boxes to remove the tick.

Important note: Models should only be excluded if there are good reasons to do so. For example, some of the models perform poorly in certain countries. When generating projections for these countries, it may be desirable to exclude them. In general though, the climate futures matrix should be generated with as many models as possible to ensure the full range of possible climate futures is shown.

Excluded models can be re-included by clicking the tick-boxes again. Information about the climate model can also be obtained by clicking on the model name.

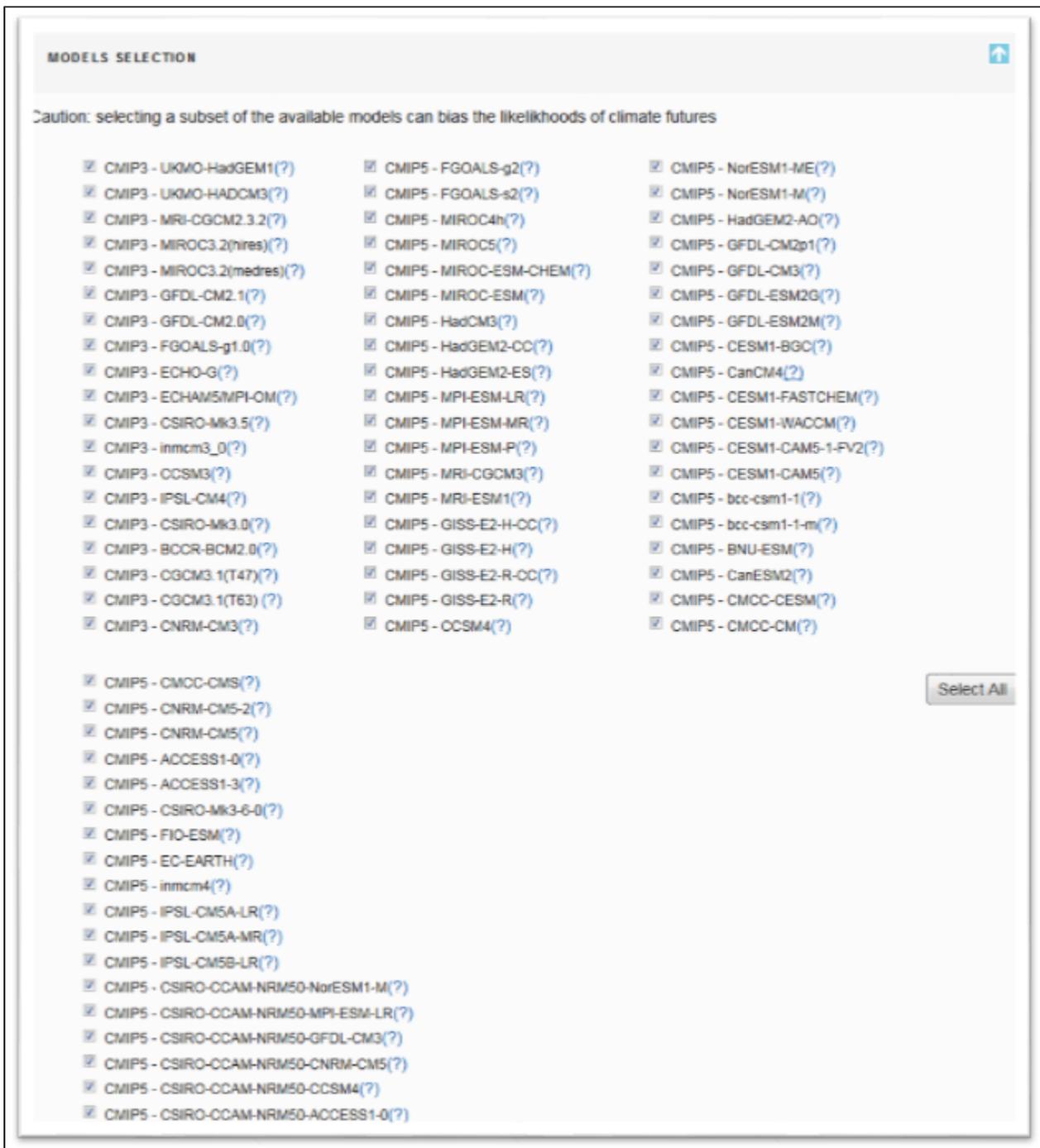


Figure 6. Models Selection Panel

Generate the Climate Futures Matrix

Once the above settings have been selected, you can generate “climate futures” for your region of interest. Just click on a region on the map. The Climate Futures Matrix will then be displayed.

Displaying the projections: The Climate Futures Matrix Results

As described earlier (see [The Climate Futures Matrix](#)) matrix shows projected climate futures for the chosen time period, emissions scenario and the two classifying climate variables averaged over the region of interest. The cells of the matrix can be expanded by clicking on the + symbol in the top right corner of each cell (Figure 7). This reveals results for each model as well as some basic summary statistics for the cell. It is important to understand that the change values displayed are a 20-year average projected change relative to the 20-year period centred on the chosen baseline (or reference) period (see [Accessing and Setting User Preferences](#)).

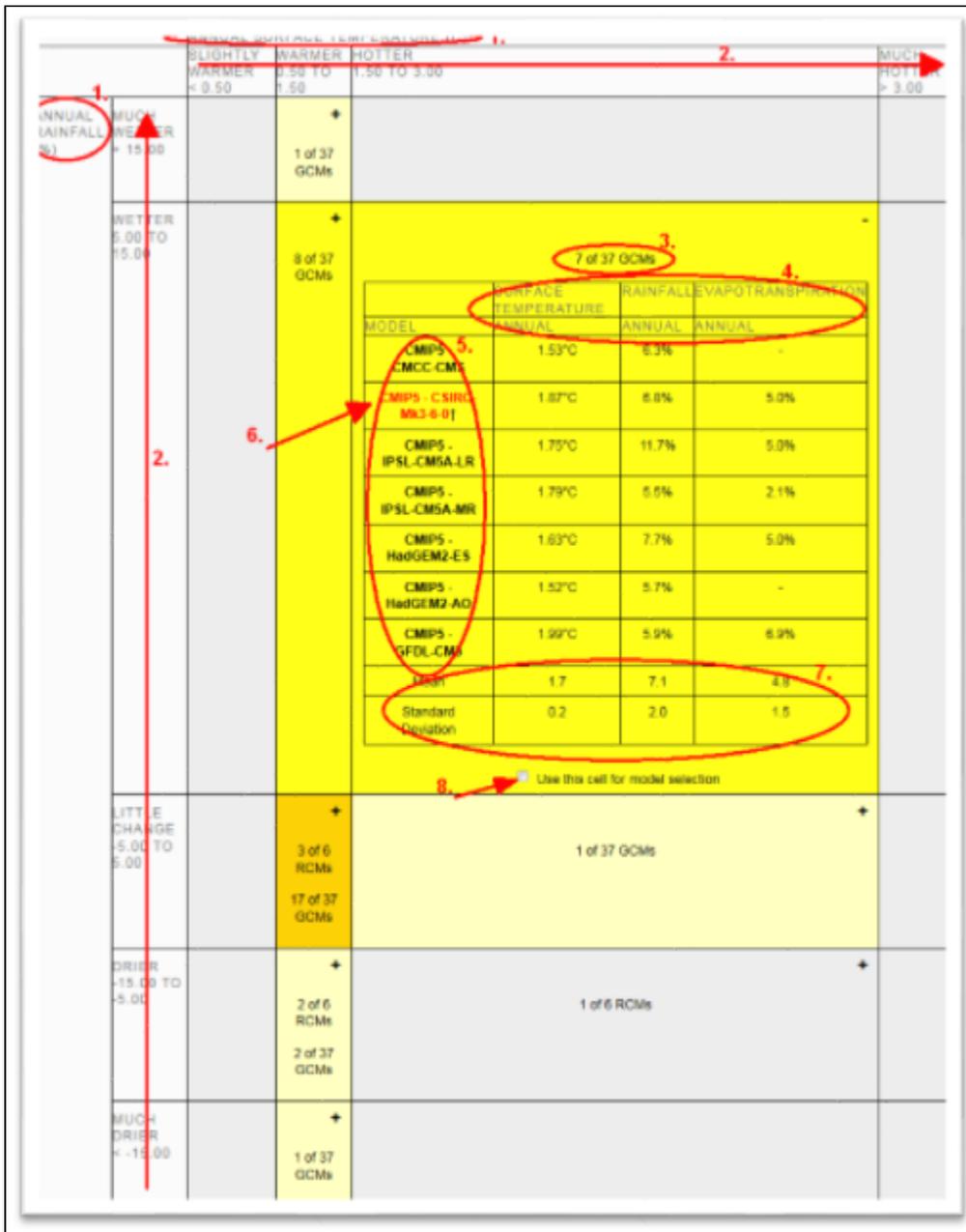


Figure 7 Example detailed Climate Futures Matrix

1. The **classifying climate variables** and corresponding **seasons** that you have selected are found along the top and left of the matrix.
2. The pre-defined **categories** for the classification. For temperature and rainfall they range from: "Slightly Warmer" to "Much Hotter" and "Much Drier" to "Much Wetter".
3. Two types of **Model consensus** information is provided for each climate future: the number of models whose results fall within the climate future compared to the total number and, a colour shading (see the legend in Figure 6).
4. The **climate variables** and **seasons** you have selected in the display options panel appear in corresponding cells in the Climate Futures Matrix.
5. The **models** used to generate the projections are listed alongside their corresponding results.
6. Any models for which there is important model skill information that should be considered are highlighted in red. Details are provided below the matrix in the "Confidence Statements" section.
7. Summary statistics are provided for each climate future.
8. A tick-box allows one or more climate futures to be selected for analysis in the Representative Model Wizard.

Selecting a representative model: The Representative Model Wizard

In many impact assessments it is not practical to evaluate the impacts for all climate models from each "climate future". In such cases it is often appropriate to select one or two models suitable for your application. The "Representative Model Selection Wizard" is a tool for objectively selecting a climate model from a sub-set or "climate future" of interest.

To access this feature, first select the “Use this cell for model selection” tickbox of each climate future that you wish to include for model selection, then click on the **Representative Model Wizard** button below the matrix. You will then be presented with the model selection wizard (Figure 8).

REPRESENTATIVE MODEL SELECTION WIZARD

Models are ranked based on a multivariate ordering technique (Kokic et al., 2002). The variable/season combinations can be assigned an importance (Rank) and ranking method (mean, min, max). The mean method will find the model that is closest to multi-model mean while min and max will find the largest and smallest values for the variable/season combination.

Quick Tips

- To find a representative model that is closest to the multi-model mean for all variable/seasons leave the defaults (Method: mean, Rank: 1)
- To find a representative model that has the smallest or largest increase for a variable/season use 'min' or 'max' for the rank function.

Surface Temperature Mean ▾ 1 ▾

Variable	Season	Rank Method	Rank
Surface Temperature	Annual	Mean ▾	1 ▾

Rainfall Mean ▾ 1 ▾

Variable	Season	Rank Method	Rank
Rainfall	Annual	Mean ▾	1 ▾

Evapotranspiration Mean ▾ 1 ▾

Variable	Season	Rank Method	Rank
Evapotranspiration	Annual	Mean ▾	1 ▾

Rank

Figure 8. Representative Model Wizard settings screen

1. The model selection wizard displays each combination of **climate variable** and **season** that was displayed in the Climate Futures Matrix.
2. The “Rank” settings can be used to assign relative weightings or **priorities** to individual variable-season combinations. For example, if surface temperature in November to April is the most important for an impact assessment, it would be ranked “1”. The other variable-season combinations would be assigned lower rankings.
3. The “Rank Method” settings are used to determine which **statistical measure** will be used to evaluate each model within a particular “climate future”. For example, if you wish to select a model that is representative of the mid-range of a particular sub-set, you should set the Rank Method to ‘mean’. If you wish to select a model that is representative of the upper or lower end of the range of a certain “climate future”, set the Rank Method to Max or Min by clicking on the little arrows in the drop down boxes.

Once you are done, click on the “Rank” button at the bottom. You are then presented the ranking results for your chosen settings (Figure 8). You see that each model that fell into your chosen climate future **and** provided all desired variables is assigned a score. The climate model having the lowest score (at the top) depicts the most representative model based on your ranking criteria.

Model	Score	Export
MIP5 - NorESM1-ME	4.7	Export
MIP5 - GISS-E2-H-CC	5.0	Export
MIP5 - GISS-E2-H	5.1	Export
MIP5 - HadGEM2-CC	5.2	Export
MIP5 - MIROC5	7.1	Export
MIP5 - GISS-E2-R	7.2	Export
MIP5 - ACCESS1-0	10.1	Export
MIP5 - GISS-E2-R-CC	11.0	Export
MIP5 - IPSL-CM5B-LR	13.0	Export
MIP5 - MRI-CGCM3	13.5	Export
MIP5 - GFDL-ESM2G	14.0	Export
MIP5 - CESM1-BGC	14.8	Export
MIP5 - ACCESS1-3	16.7	Export
MIP5 - CCSM4	18.4	Export
MIP5 - Inmcm4	19.1	Export

Figure 9 Sample results of ranking from Representative Model Wizard

The “Export” button next to each climate model and score can be used to download data.

Exporting Data for Impact Assessments

Once representative models have been selected for the climate futures of relevance to the impact assessment, the projected change values for that model can be obtained directly from *Pacific Climate Futures*. To export data, just click on the “Export” button in the Representative Model Selection Wizard (Figure 9).

Then, a download menu opens up providing the option to save a template Excel spreadsheet to your computer. This spreadsheet will look similar to the one shown in Figure 10.

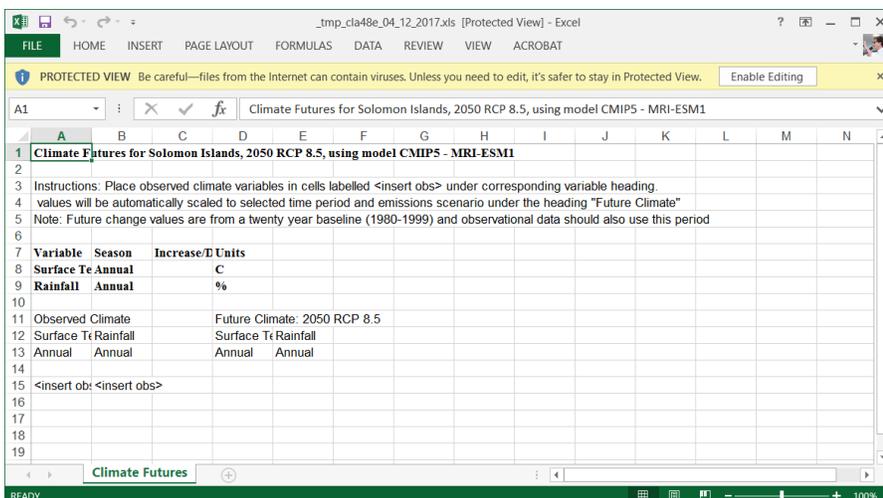


Figure 10. Template Excel Spreadsheet

When first displayed, you may see a message at the top of the screen saying the spreadsheet is in "PROTECTED VIEW" - click on "Enable Editing" to show the data and allow you to work with the spreadsheet. Note also that the spreadsheet has been given a temporary name. You should rename this to something meaningful immediately. For example, if the data are from the representative model for the 'Worst Case' climate future, you could name the file accordingly.

Enter your observed climate values in cells labelled "<insert obs>" under the corresponding variable heading. The values will be automatically scaled to the selected time period and emissions scenario under the heading "Future Climate" (columns D and E in Figure 10).

The spreadsheet can also be used as the basis for more advanced calculations. For example, if you have a time-series of annual rainfall totals and temperature averages, you can copy the formulas from the "Future Climate" cells and pasting them into the cells below. Then if you enter the annual values in columns (starting in cell A15 and B15 in the example shown in Figure 10), the future values will be calculated automatically and shown in the corresponding Future Climate cells. An example spreadsheet that has been edited in such a way is shown in Figure 11.

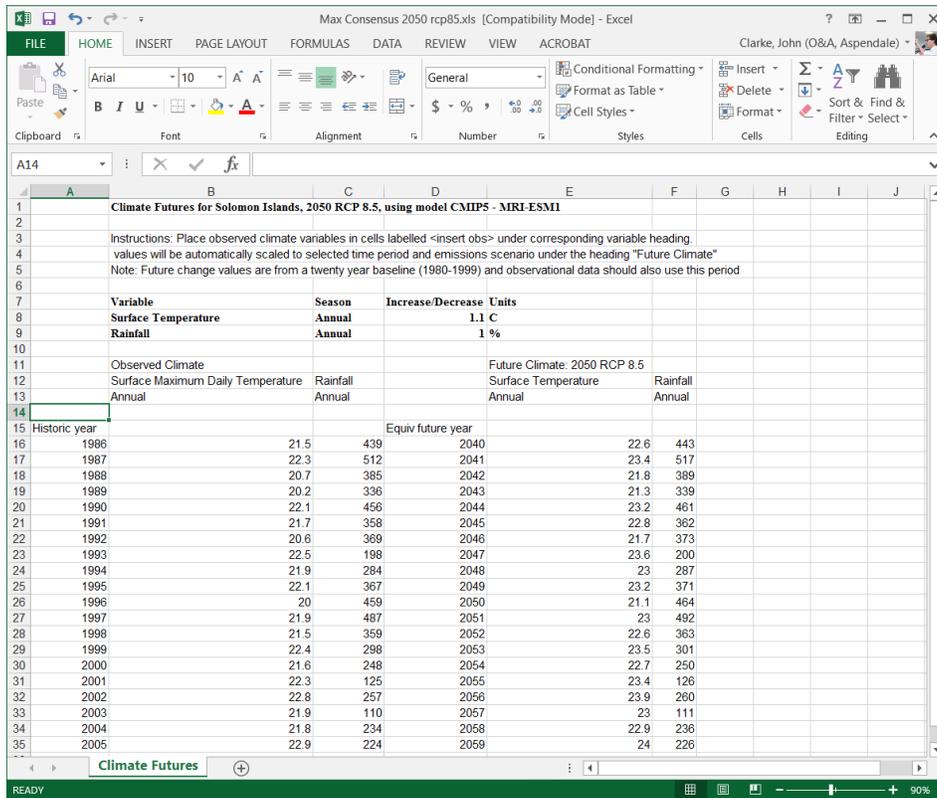


Figure 11. Example of an edited Excel Spreadsheet based on the standard export