



Cook Islands

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Niue

## Glossary

## A

### Anthropogenic

Resulting from or produced by human beings.

### Anthropogenic emissions

Emissions of greenhouse gases, greenhouse gas precursors, and aerosols associated with human activities, including the burning of fossil fuels, deforestation, land-use changes, livestock, fertilisation, etc.

### Anthropogenic forcing – see [Forcing](#)

### Anomaly

In climate science, a deviation from the normal value of a variable. It is usually the deviation of a variable from the average value at a specific place and time.

### Aragonite saturation state – see also [Ocean acidification](#)

Aragonite is a form of calcium carbonate that makes up the shells and skeletons of key organisms in reef ecosystems, including reef-building corals. The saturation state of aragonite in seawater (known as  $\Omega$ ) is a measure of the potential for the mineral to form or to dissolve. When the  $\Omega = 1$ , the seawater is in equilibrium with respect to aragonite, so aragonite does not dissolve or precipitate. When  $\Omega > 1$  seawater is supersaturated with respect to aragonite and aragonite will precipitate, and when  $\Omega < 1$  aragonite will dissolve. Aragonite saturation states above about 4 are considered optimal conditions for healthy coral reef ecosystems, with values below 3.5 becoming increasingly marginal for supporting healthy coral reef growth.

## B

### Bias – see also [Model bias](#), [Cold-tongue bias](#)

For climate studies, bias is a systematic difference between one set of data and another (e.g. a model and an observation) that may affect the confidence that a conclusion is correct.

## C

### Climate

Climate in a narrow sense is usually defined as the average weather, or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period for averaging these variables is 30 years, as defined by the World Meteorological Organization. The relevant quantities are most often surface variables such as temperature, precipitation and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. In various parts of this publication different averaging periods, such as a period of 20 years, are also used.

### Climate change – see also [Climate variability](#)

Climate change refers to a change in the state of the climate that can be identified (e.g. by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external **forcings**, or to persistent **anthropogenic** changes in the composition of the atmosphere or in land use.

### Climate projection – see also [Projection](#)

A projection of the response of the climate system to emission or concentration scenarios of greenhouse gases and aerosols, or **radiative forcing scenarios**, often based upon simulations by climate models. Climate projections are distinguished from climate predictions in order to emphasise that climate projections depend upon the **radiative forcing scenario** used, which are based on assumptions concerning, for example, future socioeconomic and technological developments that may or may not be realised and are therefore subject to substantial uncertainty.

### Climate variability – see also [Climate change](#), [Modes of climate variability](#)

Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all spatial and temporal scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system, or to variations in natural or **anthropogenic** external **forcing**.

### Climatology

- The description and scientific study of climate.
- The long-term average state of a particular climate variable or process (e.g. the 30-year average temperature at a location). Climatology is used in this context within this report.

**CMIP3 (Coupled Model Intercomparison Project Phase 3)** – see also **CMIP5**

Coupled Model Intercomparison Project (Phase 3) is a set of climate model experiments conducted during 2005-2006 by 17 groups in 12 countries with 24 models simulating the past, present and future climate collected by the Programme for Climate Model Diagnosis and Intercomparison at Lawrence Livermore National Laboratory in the US. The resulting CMIP3 dataset was used to inform the 4th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) in 2007.

**CMIP5 (Coupled Model Intercomparison Project Phase 5)** – see also **CMIP3**

Coupled Model Intercomparison Project (Phase 5) is a new set of coordinated climate model experiments subsequent to the CMIP3 dataset. From 2008 to 2011, 20 climate modelling groups from around the world developed a new set of coordinated climate model experiments which provide a wider range of emissions scenarios, and improved models and simulation. The resulting CMIP5 dataset was used to inform the 5th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) in 2013. The CMIP5 dataset is also used in this report.

**Cold tongue**

This is a region of relatively cool surface water in the equatorial eastern Pacific Ocean and along the west coast of South America.

**Cold tongue bias** – see also **Anomaly, Bias, Model bias**

The cold tongue bias is an anomaly in climate models in which the equatorial cold tongue is simulated as too cold, extends too far into the west Pacific warm pool and is too confined near the equator. This bias is associated with a rainfall bias at the equator and also in the **Inter-Tropical Convergence Zone (ITCZ)** and **South Pacific Convergence Zone (SPCZ)**, and is one of the most persistent and problematic model biases that affect confidence in regional climate projections for the Pacific.

**Convergence**

In meteorology where winds flow from different directions toward each other, thus meeting at one point or along one line. Similarly, in oceanography, where water currents flow toward each other and meet. Horizontal convergence usually forces vertical motion to occur, such as convection.

**Coral bleaching**

Coral bleaching results from a breakdown of the symbiotic relationship between corals and unicellular algae (zooxanthellae). The symptoms of bleaching include a gradual loss of colour as the algae are expelled from the coral tissue, in severe cases can result in the death of the coral. The stress factor most commonly associated with bleaching is elevated sea temperature, although it also occurs in response to any number of environmental pressures, whether natural or anthropogenic, such as: changes in solar radiation, salinity (freshwater input), disease, sedimentation, nutrients and pollution.

**D**

**Downscaling** – see also **Dynamical downscaling**

Downscaling refers to techniques that derive small-scale (at a single location or region) information from data on larger spatial scales, such as **Global Climate Model** output. Two main methods are generally applied: **dynamical downscaling** (using fine-resolution global or regional climate models) and statistical downscaling (using statistical relationships).

**Dynamical downscaling**

Dynamical downscaling uses a finer resolution atmospheric climate model, driven by large-scale data from a global climate model to derive local or regional scale information. The fine resolution model provides better representation of topography and land/sea boundaries. This method is computationally intensive and the results are strongly dependent on the choice of both the global climate model and the atmospheric model.

**Driver (of climate change)**

Any natural or human-induced factor that directly or indirectly causes a change.

**Dynamic Response (of ice sheets)**

Rapid disintegration of ice sheets through dynamic processes.

**E**

**El Niño** – see also **El Niño-Southern Oscillation (ENSO), La Niña**

This is the warm phase of the **El Niño-Southern Oscillation (ENSO)**. El Niño events occur on average once every two to seven years. They are associated with basin-wide warming of the tropical Pacific Ocean east of the dateline and a weakening of the **Walker Circulation**.

### **El Niño-Southern Oscillation (ENSO)** – see also [El Niño](#), [La Niña](#)

The term **El Niño** was initially used to describe a warm-water current that periodically flows along the coast of Ecuador and Perú, disrupting the local fishery. It has since become identified with a basin-wide warming of the tropical Pacific Ocean east of the dateline. This oceanic event is associated with a fluctuation of a global-scale tropical and subtropical surface pressure pattern called the Southern Oscillation. This naturally occurring coupled atmosphere-ocean phenomenon, with time scales of approximately two to seven years, is known as the El Niño-Southern Oscillation (ENSO). The state of ENSO is often measured by the **Southern Oscillation Index (SOI)** and sea-surface temperatures in the central and eastern equatorial Pacific.

During an ENSO event, the prevailing trade winds weaken, reducing upwelling and altering ocean currents such that the sea-surface temperatures warm, further weakening the trade winds. This event has a great impact on the wind, sea-surface temperature and precipitation patterns in the tropical Pacific. It has climatic effects throughout the Pacific region and in many other parts of the world. The cold phase of ENSO is called **La Niña**.

### **Ensemble**

An ensemble refers to a group of model simulations used for **climate projections**. It may refer either to a group of simulations from different models; or to a group of simulations run on the same model but using slightly different starting conditions.

### **Evapotranspiration**

Evapotranspiration is the sum of evaporation from the land surface (e.g. from the soil and bodies of water such as lakes and rivers) and transpiration from vegetation.

**External forcing** – see [Forcing](#)

### **Extreme weather event**

An event that is rare at a particular place and time of year. An extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile of the observed distribution. For example, warm nights or hot days are those exceeding the 90th percentile of temperature, while cold nights or days are those falling below the 10th percentile.

## **F**

### **Forcing**

An agent that causes a change in the climate system. **External forcing** refers to agents outside the climate system. Volcanic eruptions, solar variations, anthropogenic changes in the composition of the atmosphere and land use change are external forcings. **Anthropogenic forcing** is a forcing that is caused by human activities including changes in greenhouse gas and aerosol concentrations and land-use changes. **Radiative forcing** refers specifically to external forcings that change the net radiation at the tropopause.

## **G**

### **Global Climate Model (GCM)**

This is a numerical representation of the climate system based on the physical, chemical and biological properties of its components, their interactions and feedback processes, and accounting for all or some of its known properties. Coupled Atmosphere-Ocean General Circulation Models provide a representation of the climate system that is near the most comprehensive end of the spectrum currently available. There is an evolution towards more complex models with interactive chemistry and biology.

**Gridded Datasets** – see also [Reanalysis](#)

A set of climate data that are given for the same time or average period on a regular grid in space. Data at each grid point represent the average value over a grid box whose size is determined by the spacing between the grid points (also called the grid resolution). Global climate model and **reanalysis** data are produced as gridded data.

## **H**

**Hindcast** – see also [Reanalysis](#)

A statistical calculation determining probable past conditions. In this case, **reanalysis** wind data, (i.e. wind data which has been calculated for a regular global grid based on directly and indirectly measured data on an irregular grid), is applied to a wave model to compute the likely wave structure over an historical time period, in lieu of directly sensed wave data.

**Homogenisation** – see also [Inhomogeneities](#)

Climate data homogenisation aims to adjust data if necessary, so that all variations in the data series are caused by real changes in the climate, and not due to artificial changes in the way or location at which the data have been recorded.

**Humidity** – see [Relative Humidity](#)

## I

### Index/Indices

A number representing a measure of a particular feature of the climate system at a given time, varying with time and used as some measure of variability.

### Inhomogeneities – see also [Homogenisation](#)

Inhomogeneities in climate data are caused when artificial changes affect the climate observations through time. These changes may be abrupt or gradual. The main causes of inhomogeneities are changes in instrumentation, station moves, changes in the local environment such as urbanization, or the introduction of different observing practices. These inhomogeneities can interfere with the proper assessment of any climate trends and extremes. To account for these artificial changes, [homogenisation](#) methods are applied to the data.

### Interannual

From year to year.

### Interdecadal Pacific Oscillation (IPO) – see also [Pacific Decadal Oscillation \(PDO\)](#)

The Interdecadal Pacific Oscillation is a natural recurring pattern of variability in tropical Pacific Ocean sea-surface temperatures occurring on periods of about 15 years and longer. While defined differently the IPO and PDO ([Pacific Decadal Oscillation](#)) describe essentially the same variability.

### Inter-Tropical Convergence Zone (ITCZ) – see also [Trade winds](#)

An east-west band of low-level wind convergence near the equator where the Southeast [trade winds](#) of the Southern Hemisphere meet the Northeast [trade winds](#) of the Northern Hemisphere. It has an associated band of heavy rainfall as the winds converge and moist air is forced upward.

## L

### La Niña – see also [El Niño](#), [El Niño–Southern Oscillation \(ENSO\)](#)

The most common of several names given to cold phase of the [El Niño–Southern Oscillation \(ENSO\)](#).

La Niña is the counterpart to the [El Niño](#) warm event, although La Niña events tend to be somewhat less regular in their behaviour and duration. La Niña is associated with large-scale cooling of the surface waters of the eastern tropical Pacific Ocean and a strengthening of the [Walker Circulation](#).

## M

### Mean Sea Level – see also [Relative sea level](#), [Sea-level change/rise](#)

Mean sea level is normally defined as the average relative sea level over a period, such as a month or a year, long enough to average out transients such as waves and tides.

### Meridional – see also [Zonal](#)

In meteorology, a flow in a direction that is parallel to a line of longitude; along a meridian; northerly or southerly; as opposed to [zonal](#).

### Model bias – see also [Anomaly](#), [Bias](#), [Cold tongue bias](#)

Model biases are spurious differences between climate model simulations and observations. These may be caused by a number of factors including a lack of model resolution or an insufficiently realistic representation of certain physical processes. Systematic biases are errors that are common to a majority the climate models.

### Modes of climate variability – see also [Climate variability](#)

Natural variability of the climate system, in particular on seasonal and longer time scales, predominately occurs with preferred spatial patterns and time scales, through the dynamical characteristics of the atmospheric circulation and through interactions with the land and ocean surfaces. Such patterns are often called regimes or modes. Modes of variability often involve a connection between a remote driver and a local effect, termed a teleconnection. Examples are the [El Niño–Southern Oscillation \(ENSO\)](#) and the [Southern Annular Mode \(SAM\)](#).

## O

### Ocean acidification

Ocean acidification is the name given to the ongoing decrease in the pH and carbonate concentration of the Earth's oceans, caused by their uptake of [anthropogenic](#) carbon dioxide from the atmosphere. Calcium carbonate is used by corals and other organisms (e.g. oysters, clams, crabs, lobsters and starfish) to form reef structures and hard shells. The reduction of carbonate in the ocean means it will be harder for these creatures to make their shells and to build and repair reef structures. The decrease in pH is likely to have impacts on the entire marine ecosystem, impacting reproductive health, growth and physiology, species composition and diversity.

## P

### **Pacific-Australia Climate Change Science Adaptation Planning program (PACCSAP)**

– see also **PCCSP**

The 2011–2014 Pacific-Australia Climate Change Science Adaptation Planning program (PACCSAP) is building on the success of the 2009 - 2011 Pacific Climate Change Science Program (PCCSP). With support from AusAID, the Department of the Environment (DOE), the Australian Bureau of Meteorology and the Commonwealth Scientific and Industrial Research Organisation (CSIRO), PACCSAP continues the collaborative partnership between Australian scientists, 14 Pacific island countries and East Timor, and regional and non-government organisations in the western tropical Pacific. Using climate observations, projections and targeted communication, it is helping to fill the climate information and knowledge gap and to generate scientific insight into the state of climate change in the Pacific region now and in the future.

### **Pacific Climate Change Science Program (PCCSP)**

– see also **PACCSAP**

The Pacific Climate Change Science Program (PCCSP) was a collaborative research partnership between the Australian Bureau of Meteorology and the CSIRO, Australian Government agencies (AusAID and the Department for Climate Change and Energy Efficiency), 14 Pacific island countries and East Timor, and regional and international organisations which ran from 2009-2011. It provided critical climate scientific research and was instrumental in building the capacity of Pacific Island countries to manage the effects of climate change.

### **Projection** – see also **Climate projection**

The term projection is used in two senses in the climate change literature. In general usage, a projection can be regarded as any description of the future and the pathway leading to it. However, a more specific interpretation has been attached to the term **climate projection** by the IPCC when referring to model-derived estimates of future climate.

## R

### **Radiative Forcing** – see also **Forcing**

Radiative forcing is the change in the net vertical irradiance (expressed in Watts per square metre;  $Wm^{-2}$ ) at the tropopause due to an internal or external **forcing** of the climate system, such as a change in the concentration of  $CO_2$  or the output of the Sun.

Radiative forcing is a measure of the influence a factor has in altering the balance of incoming and outgoing energy in the Earth-atmosphere system and is an index of the importance of the factor as a potential climate change mechanism.

A positive forcing (more incoming energy) warms the system, while negative forcing (more outgoing energy) cools it.

### **Radiative forcing scenario**

A radiative forcing scenario is a plausible representation of the future development of **radiative forcing** associated with changes in atmospheric composition or land use change or with external factors such a variation in solar activity. Radiative forcing scenarios can be used as input into climate models to compute climate projections.

### **Reanalysis** – see also **Gridded data, Hindcast**

An analysis combining many irregular meteorological or oceanographic observations from close to the same time into a physically consistent, complete **gridded data** set for a given time and usually for the whole globe. A reanalysis may be used to drive a **hindcast**.

### **Relative humidity**

Relative humidity is defined as the amount of water vapour in the air, relative to the maximum amount of water vapour that the air is able to hold, without it condensing (expressed as a percentage).

### **Relative sea level** – see also **Mean sea level**

Relative sea level is sea level measured by a tide gauge with respect to the land upon which it is situated.

### **Relative sea-level change/rise** – see also **Mean sea level, Sea-level change/rise**

Relative sea-level rise occurs where there is a local increase in the level of the ocean relative to the land, which might be due to ocean rise and/or land level subsidence.

### **Representative Concentration Pathways (RCPs)** – see also **Scenario**

Representative Concentration Pathways (RCPs) are four greenhouse gas and aerosol concentration pathways for modelling experiments and climate projections. Projections for these RCPs are used by the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report in 2013.

The four RCPs span the range of plausible **radiative forcing** scenarios produced by the end of the 21st century (i.e. future climate **scenarios** from greenhouse gas emissions due to human activities). **Radiative forcing** is the extra heat the lower atmosphere will retain as a result of additional greenhouse gases, measured in Watts per square metre ( $W/m^2$ ) by 2100. The RCPs represent **radiative forcing** of 2.6, 4.5, 6.0 and  $8.5 W/m^2$  and are referred to as:

- RCP2.6 (very low emissions)
- RCP4.5 (low emissions)
- RCP6 (medium emissions) and
- RCP8.5 (very high emissions).

These four new pathways cover a broader range of possibilities compared with the emission scenarios (B1-low, A1B-medium, and A2-high) used for the previous projections presented in the Australian Bureau of Meteorology and CSIRO report in 2011.

## **S**

### **Scenario** – see also **Representative Concentration Pathways (RCPs)**

A scenario is a coherent, internally consistent and plausible description of a possible future state of the world. It is not a forecast; rather, each scenario is one alternative image of how the future can unfold. A set of scenarios is often adopted to reflect the range of uncertainty in projections.

### **Sea level change/rise** – see also **Mean sea level, Relative sea-level change/rise**

Sea level can change, both globally and locally, due to; (1) changes in the shape of the ocean basins; (2) changes in the total mass of water and, (3) changes in water density.

Factors leading to sea level rise under global warming include both increases in the total mass of water from the melting of land-based snow and ice, and changes in water density from an increase in ocean water temperatures and salinity changes.

### **Sea-surface temperature (SST)**

The temperature of the ocean surface. The term sea-surface temperature is generally representative of the upper few metres of the ocean as opposed to the skin temperature, which is the temperature of the upper few centimetres.

### **Southern Annular Mode (SAM)**

The Southern Annular Mode (SAM) is the most important recurring pattern of natural variability in the Southern Hemisphere outside of the tropics. Oscillations in the SAM are associated with shifts in the position and strength of the mid-latitude westerly winds and changes in heat and precipitation.

### **Southern Annular Mode Index**

Index measuring the difference in surface pressure between latitudes  $40^{\circ}S$  and  $65^{\circ}S$ . A positive SAM index corresponds to a southward movement and intensification of the sub-tropical westerly winds.

### **Southern Oscillation** – see also **El Niño-Southern Oscillation (ENSO)**

Fluctuation of a global-scale tropical and subtropical surface pressure pattern.

### **Southern Oscillation Index (SOI)**

The Southern Oscillation Index (SOI) is calculated from the monthly or seasonal fluctuations in the air pressure difference between Tahiti and Darwin.

### **South Pacific Convergence Zone (SPCZ)**

A persistent and greatly elongated zone of low-level convergence extending from approximately  $140^{\circ}E$  near the equator to approximately  $120^{\circ}W$  at  $30^{\circ}S$ . The zone is not quite linear, but is oriented more west to east near the equator and has a more diagonal orientation (northwest to southeast) at higher latitudes.

### **Standardized Precipitation Index**

The Standardised Precipitation Index (SPI) is an index based on the probability of recording a given amount of precipitation. The probabilities are standardized so that an index of zero indicates the median precipitation amount. The index is negative for drought, and positive for wet conditions.

### **Storm surge**

The temporary increased height of the sea above the level expected from tidal variation alone at that time and place due to extreme meteorological conditions.

### **Surface Mass Balance (SMB)**

The mass balance is the net gain or loss of ice and snow for an ice sheet. It is related to difference between snow accumulation versus melt, runoff and iceberg calving.

## T

### **Thermal Expansion** – see also **Sea-level change/rise**, **Mean sea-level**

The increase in volume (and decrease in density) that results from warming water.

### **Time series**

The values of a variable generated successively in time. Graphically, a time series is usually plotted with time on the horizontal axis (x-axis), and the values of the variable on the vertical axis (y-axis).

### **Trade winds** – see also **Inter-Tropical Convergence Zone (ITCZ)**

The wind system, occupying most of the Tropics that blow from the subtropical high pressure areas toward the equator.

### **Tropical Cyclone**

A tropical cyclone is a tropical depression of sufficient intensity to produce sustained gale force winds (at least 63 km per hour). A severe tropical cyclone produces sustained hurricane force winds (at least 118 km per hour). Severe tropical cyclones correspond to the hurricanes or typhoons of other parts of the world.

## W

### **Walker Circulation**

The Walker Circulation is the east-west circulation of air, oriented along the Equator, across the Pacific region.

### **Warm Pool (also known as West Pacific Warm Pool)**

An extensive pool of the world's warmest water, with temperatures exceeding 28-29°C extending from the central Pacific to the far eastern Indian Ocean.

### **West Pacific Monsoon**

A monsoon is a tropical and subtropical seasonal reversal of both surface winds and associated rainfall, caused by differential heating between a continental scale land mass and the adjacent ocean. The West Pacific Monsoon is the eastern edge of the Indonesian or Maritime Continent Monsoon, and the southern extension of the larger Asian-Australian Monsoon system.

## Z

### **Zonal** – see also **Meridional**

In meteorology, latitudinal, that is, easterly or westerly; opposed to **meridional**.



FSM

## **Appendix A**

Models included for each analysis  
for each scenario

(y = yes included; n = not included; blank = insufficient models available so the results are not presented).

Note: Climate models MIROC-ESM and MIROC-ESM-CHEM were not included for countries adjacent to the South Pacific Convergence Zone.

Variable	model	RCP2.6				RCP4.5				RCP6.0				RCP8.5			
		2030	2050	2070	2090	2030	2050	2070	2090	2030	2050	2070	2090	2030	2050	2070	2090
maximum one-day rainfall (rx1day)	ACCESS1-0	n	n	n	n	y	y	y	y					y	y	y	y
	ACCESS1-3	n	n	n	n	n	n	n	n					y	y	y	y
	bcc-csm1-1	y	y	y	y	y	y	y	y					n	n	n	n
	CanCM4	n	n	n	n	n	n	n	n					n	n	n	n
	CanESM2	y	y	y	y	y	y	y	y					y	y	y	y
	CCSM4	y	y	y	y	y	y	y	y					n	n	n	n
	CNRM-CM5	y	y	y	y	y	y	y	y					y	y	y	y
	GFDL-CM3	y	y	y	y	n	n	n	n					y	y	y	y
	GFDL-ESM2G	y	y	y	y	y	y	y	y					y	y	y	y
	GFDL-ESM2M	y	y	y	y	y	y	y	y					y	y	y	y
	GISS-E2-H	n	n	n	n	n	n	n	n					n	n	n	n
	GISS-E2-R	n	n	n	n	n	n	n	n					n	n	n	n
	HadCM3	n	n	n	n	n	n	n	n					n	n	n	n
	HadGEM2-CC	n	n	n	n	y	y	y	n					y	y	y	n
	HadGEM2-ES	y	y	y	n	y	y	y	n					y	y	y	n
	INMCM4	n	n	n	n	n	n	n	n					n	n	n	n
	IPSL-CM5A-LR	y	y	y	y	y	y	y	y					y	y	y	y
	IPSL-CM5A-MR	y	y	y	y	y	y	y	y					y	y	y	y
	MIROC4h	n	n	n	n	n	n	n	n					n	n	n	n
	MIROC5	y	y	y	y	y	y	y	y					y	y	y	y
MIROC-ESM	y	y	y	y	y	y	y	y					y	y	y	y	
MIROC-ESM-CHEM	y	y	y	y	y	y	y	y					y	y	y	y	
MPI-ESM-LR	y	y	y	y	y	y	y	y					y	y	y	y	
MRI-CGCM3	y	y	y	y	y	y	y	y					y	y	y	y	
NorESM1-M	y	y	y	y	y	y	y	y					y	y	y	y	
NorESM1-ME	n	n	n	n	n	n	n	n					n	n	n	n	
maximum temperature (txx)	ACCESS1-0	n	n	n	n	y	y	y	y					y	y	y	y
	ACCESS1-3	n	n	n	n	y	y	y	y					y	y	y	y
	bcc-csm1-1	y	y	y	y	y	y	y	y					n	n	n	n
	CanCM4	n	n	n	n	n	n	n	n					n	n	n	n
	CanESM2	y	y	y	y	y	y	y	y					y	y	y	y
	CCSM4	y	y	y	y	y	y	y	y					n	n	n	n
	CNRM-CM5	y	y	y	y	y	y	y	y					y	y	y	y
	GFDL-CM3	y	y	y	y	n	n	n	n					y	y	y	y
	GFDL-ESM2G	y	y	y	y	y	y	y	y					y	y	y	y
	GFDL-ESM2M	y	y	y	y	y	y	y	y					y	y	y	y
	GISS-E2-H	n	n	n	n	n	n	n	n					n	n	n	n
	GISS-E2-R	n	n	n	n	n	n	n	n					n	n	n	n
	HadCM3	n	n	n	n	n	n	n	n					n	n	n	n
	HadGEM2-CC	n	n	n	n	y	y	y	n					y	y	y	n
	HadGEM2-ES	y	y	y	n	y	y	y	n					y	y	y	n
	INMCM4	n	n	n	n	n	n	n	n					n	n	n	n
	IPSL-CM5A-LR	y	y	y	y	y	y	y	y					y	y	y	y
	IPSL-CM5A-MR	y	y	y	y	y	y	y	y					y	y	y	y
	MIROC4h	n	n	n	n	n	n	n	n					n	n	n	n
	MIROC5	y	y	y	y	y	y	y	y					y	y	y	y
MIROC-ESM	y	y	y	y	y	y	y	y					y	y	y	y	
MIROC-ESM-CHEM	y	y	y	y	y	y	y	y					y	y	y	y	
MPI-ESM-LR	y	y	y	y	y	y	y	y					y	y	y	y	
MRI-CGCM3	y	y	y	y	y	y	y	y					y	y	y	y	
NorESM1-M	y	y	y	y	y	y	y	y					y	y	y	y	
NorESM1-ME	n	n	n	n	n	n	n	n					n	n	n	n	

Variable	model	RCP2.6				RCP4.5				RCP6.0				RCP8.5			
		2030	2050	2070	2090	2030	2050	2070	2090	2030	2050	2070	2090	2030	2050	2070	2090
minimum temperature (tnn)	ACCESS1-0	n	n	n	n	y	y	y	y					y	y	y	y
	ACCESS1-3	n	n	n	n	n	n	n	n					y	y	y	y
	bcc-csm1-1	y	y	y	y	y	y	y	y					n	n	n	n
	CanCM4	n	n	n	n	n	n	n	n					n	n	n	n
	CanESM2	y	y	y	y	y	y	y	y					y	y	y	y
	CCSM4	y	y	y	y	y	y	y	y					n	n	n	n
	CNRM-CM5	y	y	y	y	y	y	y	y					y	y	y	y
	GFDL-CM3	y	y	y	y	n	n	n	n					y	y	y	y
	GFDL-ESM2G	y	y	y	y	y	y	y	y					y	y	y	y
	GFDL-ESM2M	y	y	y	y	y	y	y	y					y	y	y	y
	GISS-E2-H	n	n	n	n	n	n	n	n					n	n	n	n
	GISS-E2-R	n	n	n	n	n	n	n	n					n	n	n	n
	HadCM3	n	n	n	n	n	n	n	n					n	n	n	n
	HadGEM2-CC	n	n	n	n	y	y	y	n					y	y	y	n
	HadGEM2-ES	y	y	y	n	y	y	y	n					y	y	y	n
	INMCM4	n	n	n	n	n	n	n	n					n	n	n	n
	IPSL-CM5A-LR	y	y	y	y	y	y	y	y					y	y	y	y
	IPSL-CM5A-MR	y	y	y	y	y	y	y	y					y	y	y	y
	MIROC4h	n	n	n	n	n	n	n	n					n	n	n	n
	MIROC5	y	y	y	y	y	y	y	y					y	y	y	y
MIROC-ESM	y	y	y	y	y	y	y	y					y	y	y	y	
MIROC-ESM-CHEM	y	y	y	y	y	y	y	y					y	y	y	y	
MPI-ESM-LR	y	y	y	y	y	y	y	y					y	y	y	y	
MRI-CGCM3	y	y	y	y	y	y	y	y					y	y	y	y	
NorESM1-M	y	y	y	y	y	y	y	y					y	y	y	y	
NorESM1-ME	n	n	n	n	n	n	n	n					n	n	n	n	
rainfall (pr, both seasons)	ACCESS1-0	n	n	n	n	y	y	y	y	n	n	n	n	y	y	y	y
	ACCESS1-3	n	n	n	n	y	y	y	y	n	n	n	n	y	y	y	y
	bcc-csm1-1	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
	CanCM4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	CanESM2	y	y	y	y	y	y	y	y	n	n	n	n	y	y	y	y
	CCSM4	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
	CNRM-CM5	y	y	y	y	y	y	y	y	n	n	n	n	y	y	y	y
	GFDL-CM3	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
	GFDL-ESM2G	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
	GFDL-ESM2M	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
	GISS-E2-H	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
	GISS-E2-R	n	n	n	n	y	y	y	y	n	n	n	n	y	y	y	y
	HadCM3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	HadGEM2-CC	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	HadGEM2-ES	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	INMCM4	n	n	n	n	y	y	y	y	n	n	n	n	y	y	y	y
	IPSL-CM5A-LR	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
	IPSL-CM5A-MR	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
	MIROC4h	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	MIROC5	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
MIROC-ESM	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	
MIROC-ESM-CHEM	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	
MPI-ESM-LR	y	y	y	y	y	y	y	y	n	n	n	n	y	y	y	y	
MRI-CGCM3	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	
NorESM1-M	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	
NorESM1-ME	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	

Variable	model	RCP2.6				RCP4.5				RCP6.0				RCP8.5			
		2030	2050	2070	2090	2030	2050	2070	2090	2030	2050	2070	2090	2030	2050	2070	2090
sea surface temperature (tos)	ACCESS1-0	n	n	n	n	y	y	y	y	n	n	n	n	y	y	y	y
	ACCESS1-3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	bcc-csm1-1	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	CanCM4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	CanESM2	y	y	y	y	y	y	y	y	n	n	n	n	y	y	y	y
	CCSM4	y	y	y	y	y	y	y	y	n	n	n	n	y	y	y	y
	CNRM-CM5	y	y	y	y	y	y	y	y	n	n	n	n	y	y	y	y
	GFDL-CM3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	GFDL-ESM2G	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	GFDL-ESM2M	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	GISS-E2-H	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
	GISS-E2-R	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
	HadCM3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	HadGEM2-CC	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	HadGEM2-ES	y	y	y	y	n	n	n	n	y	y	y	y	y	y	y	y
	INMCM4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	IPSL-CM5A-LR	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
	IPSL-CM5A-MR	y	y	y	y	y	y	y	y	n	n	n	n	y	y	y	y
	MIROC4h	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	MIROC5	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
MIROC-ESM	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	
MIROC-ESM-CHEM	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	
MPI-ESM-LR	y	y	y	y	y	y	y	y	n	n	n	n	y	y	y	y	
MRI-CGCM3	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	
NorESM1-M	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	
NorESM1-ME	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	
surface air temperature (tas)	ACCESS1-0	n	n	n	n	y	y	y	y	n	n	n	n	y	y	y	y
	ACCESS1-3	n	n	n	n	y	y	y	y	n	n	n	n	y	y	y	y
	bcc-csm1-1	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
	CanCM4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	CanESM2	y	y	y	y	y	y	y	y	n	n	n	n	y	y	y	y
	CCSM4	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
	CNRM-CM5	y	y	y	y	y	y	y	y	n	n	n	n	y	y	y	y
	GFDL-CM3	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
	GFDL-ESM2G	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
	GFDL-ESM2M	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
	GISS-E2-H	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
	GISS-E2-R	y	y	y	y	y	y	y	y	n	n	n	n	y	y	y	y
	HadCM3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	HadGEM2-CC	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	HadGEM2-ES	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	INMCM4	n	n	n	n	y	y	y	y	n	n	n	n	y	y	y	y
	IPSL-CM5A-LR	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
	IPSL-CM5A-MR	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
	MIROC4h	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	MIROC5	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
MIROC-ESM	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	
MIROC-ESM-CHEM	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	
MPI-ESM-LR	y	y	y	y	y	y	y	y	n	n	n	n	y	y	y	y	
MRI-CGCM3	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	
NorESM1-M	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	
NorESM1-ME	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	

Variable	model	RCP2.6				RCP4.5				RCP6.0				RCP8.5			
		2030	2050	2070	2090	2030	2050	2070	2090	2030	2050	2070	2090	2030	2050	2070	2090
mean sea level	ACCESS1-0	n	n	n	n	y	y	y	y	n	n	n	n	y	y	y	y
	ACCESS1-3	n	n	n	n	y	y	y	y	n	n	n	n	y	y	y	y
	bcc-csm1-1	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
	CanCM4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	CanESM2	y	y	y	y	y	y	y	y	n	n	n	n	y	y	y	y
	CCSM4	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	CNRM-CM5	y	y	y	y	y	y	y	y	n	n	n	n	y	y	y	y
	GFDL-CM3	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
	GFDL-ESM2G	y	y	y	y	n	n	n	n	y	y	y	y	y	y	y	y
	GFDL-ESM2M	n	n	n	n	n	n	n	n	y	y	y	y	y	y	y	y
	GISS-E2-H	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	GISS-E2-R	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
	HadCM3	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	HadGEM2-CC	n	n	n	n	y	y	y	y	n	n	n	n	y	y	y	y
	HadGEM2-ES	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
	INMCM4	n	n	n	n	y	y	y	y	n	n	n	n	y	y	y	y
	IPSL-CM5A-LR	y	y	y	y	n	n	n	n	y	y	y	y	y	y	y	y
	IPSL-CM5A-MR	y	y	y	y	y	y	y	y	n	n	n	n	y	y	y	y
	MIROC4h	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n
	MIROC5	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
	MIROC-ESM	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y
MIROC-ESM-CHEM	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	
MPI-ESM-LR	y	y	y	y	y	y	y	y	n	n	n	n	y	y	y	y	
MRI-CGCM3	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	
NorESM1-M	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	y	
NorESM1-ME	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	
aragonite saturation	ACCESS1-0	n	n	n	n	n	n	n	n					n	n	n	n
	ACCESS1-3	n	n	n	n	n	n	n	n					n	n	n	n
	bcc-csm1-1	n	n	n	n	n	n	n	n					n	n	n	n
	CanCM4	n	n	n	n	n	n	n	n					n	n	n	n
	CanESM2	y	y	y	y	y	y	y	y					y	y	y	y
	CCSM4	n	n	n	n	n	n	n	n					n	n	n	n
	CESM1-BGC	y	y	y	y	y	y	y	y					y	y	y	y
	CNRM-CM5	y	y	y	y	y	y	y	y					y	y	y	y
	GFDL-CM3	n	n	n	n	n	n	n	n					n	n	n	n
	GFDL-ESM2G	n	n	n	n	n	n	n	n					n	n	n	n
	GFDL-ESM2M	y	y	y	y	y	y	y	y					y	y	y	y
	GISS-E2-H	n	n	n	n	n	n	n	n					n	n	n	n
	GISS-E2-R	n	n	n	n	n	n	n	n					n	n	n	n
	HadCM3	n	n	n	n	n	n	n	n					n	n	n	n
	HadGEM2-CC	y	y	y	y	y	y	y	y					y	y	y	y
	HadGEM2-ES	y	y	y	y	y	y	y	y					y	y	y	y
	INMCM4	n	n	n	n	n	n	n	n					n	n	n	n
	IPSL-CM5A-LR	n	n	n	n	n	n	n	n					n	n	n	n
	IPSL-CM5B-LR	y	y	y	y	y	y	y	y					y	y	y	y
	IPSL-CM5A-MR	y	y	y	y	y	y	y	y					y	y	y	y
	MIROC4h	n	n	n	n	n	n	n	n					n	n	n	n
MIROC5	n	n	n	n	n	n	n	n					n	n	n	n	
MIROC-ESM	n	n	n	n	n	n	n	n					n	n	n	n	
MIROC-ESM-CHEM	n	n	n	n	n	n	n	n					n	n	n	n	
MPI-ESM-LR	y	y	y	y	y	y	y	y					y	y	y	y	
MPI-ESM-MR	y	y	y	y	y	y	y	y					y	y	y	y	
MRI-CGCM3	n	n	n	n	n	n	n	n					n	n	n	n	
NorESM1-M	n	n	n	n	n	n	n	n					n	n	n	n	
NorESM1-ME	n	n	n	n	n	n	n	n					n	n	n	n	

Variable	model	RCP2.6				RCP4.5				RCP6.0				RCP8.5			
		2030	2050	2070	2090	2030	2050	2070	2090	2030	2050	2070	2090	2030	2050	2070	2090
SPI (drought)	ACCESS1-0	n	n	n	n	y	y	y	y					y	y	y	y
	ACCESS1-3	n	n	n	n	y	y	y	y					y	y	y	y
	bcc-csm1-1	y	y	y	y	y	y	y	y					y	y	y	y
	CanCM4	n	n	n	n	n	n	n	n					n	n	n	n
	CanESM2	y	y	y	y	y	y	y	y					y	y	y	y
	CCSM4	y	y	y	y	y	y	y	y					n	y	y	y
	CNRM-CM5	n	y	y	y	n	y	y	y					y	y	y	y
	GFDL-CM3	y	y	y	y	y	y	y	y					y	y	y	y
	GFDL-ESM2G	y	y	y	y	y	y	y	y					y	y	y	y
	GFDL-ESM2M	y	y	y	y	y	y	y	y					y	y	y	y
	GISS-E2-H	n	n	n	n	y	y	y	y					y	y	y	y
	GISS-E2-R	n	n	n	n	n	n	n	n					n	n	n	n
	HadCM3	n	n	n	n	n	n	n	n					n	n	n	n
	HadGEM2-CC	n	n	n	n	y	y	y	y					y	y	y	y
	HadGEM2-ES	y	y	y	y	y	y	y	y					y	y	y	y
	INMCM4	n	n	n	n	y	y	y	y					y	y	y	y
	IPSL-CM5A-LR	y	y	y	y	y	y	y	y					y	y	y	y
	IPSL-CM5A-MR	y	y	y	y	y	y	y	y					y	y	y	y
	MIROC4h	n	n	n	n	n	n	n	n					n	n	n	n
	MIROC5	n	y	y	y	y	y	y	y					y	y	y	y
MIROC-ESM	y	y	y	y	y	y	y	y					y	y	y	y	
MIROC-ESM-CHEM	y	y	y	y	y	y	y	y					y	y	y	y	
MPI-ESM-LR	y	y	y	y	y	y	y	y					y	y	y	y	
MRI-CGCM3	n	y	y	n	n	y	y	n					n	y	y	n	
NorESM1-M	y	y	y	y	y	y	y	y					y	y	y	y	
NorESM1-ME	y	y	y	y	y	y	y	y					y	y	y	y	





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