



Blowholes, Tongatapu

Appendix 1

CMIP3 Models Used in Climate Projections

For many of the climate projections presented in Chapters 6 and 7, CMIP3 data were either analysed directly (e.g. temperature, rainfall) or used to calculate a climate variable (e.g. surface relative humidity, potential evapotranspiration) or diagnostic (e.g. Genesis Potential Index, aragonite saturation state) of interest (Table A1). However, many research institutions participating in CMIP3 did not provide data for all the model variables and SRES emission scenarios requested by the project organisers. As such, data availability is inconsistent for different variables, emission scenarios (i.e. A2, A1B and B1) and output frequencies (i.e. daily or monthly).

Information on the CMIP3 model data used in providing information on each PCCSP climate variable / diagnostic is therefore provided here (Table A2, Table A3, Table A4). It should be noted that:

- For any given variable and timescale, where data are available for one or more of the A2, A1B or B1 scenarios, data are also available for the corresponding 'Climate of the Twentieth Century' (20c3m) simulation.
- Due to high data archiving costs, daily GCM data are typically only available for the periods 1980–1999, 2046–2065 and 2080–2099. No such limitations apply for monthly data.

- For certain variables and emission scenarios, modelling groups provided data for multiple simulations of the same model, using slightly different initial conditions. The information outlined here indicates the models for which at least one simulation is available.
- The CMIP3 data are freely available, along with detailed documentation, from the Program for Climate Model Diagnosis and Intercomparison at Lawrence Livermore National Laboratory (www-pcmdi.llnl.gov).

Table A1. CMIP3 model variables required to provide information on each PCCSP variable / climate diagnostic.

| PCCSP variable / climate diagnostic | Required model output (CMIP3 naming convention) |
|--|---|
| Surface air temperature | Surface air temperature (tas) |
| Daily maximum surface air temperature | Daily maximum surface air temperature (tasmax) |
| Daily minimum surface air temperature | Daily minimum surface air temperature (tasmin) |
| Rainfall | Precipitation (pr) |
| Surface wind | Calculated from zonal surface wind speed (uas) and meridional surface wind speed (vas) |
| Solar radiation | Surface downwelling shortwave radiation (rsds) |
| Surface relative humidity | Calculated from surface specific humidity (huss), sea level pressure (psl), surface altitude (orog) and surface air temperature (tas) data |
| Potential evapotranspiration | Calculated from surface downwelling shortwave radiation (rsds), surface air temperature (tas), surface altitude (orog), (calculated) surface relative humidity and precipitation (pr) data (Morton, 1983) |
| Sea surface temperature | Sea surface temperature (tos) |
| Sea surface salinity | Salinity (so) |
| Ocean temperature | Sea water potential temperature (thetao) |
| Ocean salinity | Salinity (so) |
| Ocean density | Calculated from potential temperature (thetao) and salinity (so) data |
| Ocean circulation | Calculated from eastward seawater velocity (uo) and northward seawater velocity (vo) |
| Buoyancy frequency squared | Calculated from potential temperature (thetao) and salinity (so) data |
| Steric sea level | Calculated from potential temperature (thetao) and salinity (so) data |
| Dynamic component of sea level | Sea surface elevation (zos) |
| Genesis potential index | Calculated from sea surface temperature (tos), sea level pressure (psl), air temperature (ta), specific humidity (hus), zonal wind speed (ua) and meridional wind speed (va) data |
| Curvature vorticity parameter | Calculated from air temperature (ta), specific humidity (hus), zonal wind speed (ua) and meridional wind speed (va) data |
| CSIRO direct detection method | Requires sea level pressure (psl), air temperature (ta), zonal wind speed (ua), meridional wind speed (va) data |
| Aragonite saturation state (Ω_{ar}) | Requires sea surface temperature (tos) and sea surface salinity (so) data |

Table A2. CMIP3 models used in calculating atmospheric projections requiring daily timescale data.

| | | Temperature ^a | | | Rainfall | | | Tropical cyclones ^b | | |
|----|--------------------------|--------------------------|-----------|-----------|-----------|-----------|-----------|--------------------------------|-----------|-----------|
| | | A2 | A1B | B1 | A2 | A1B | B1 | CVP | CDD | GPI |
| 1 | BCCR-BCM2.0 | | | | | | | | | |
| 2 | CCSM3 | | | | | | | | | |
| 3 | CGCM3.1 (T47) | | | | | | | | | |
| 4 | CGCM3.1 (T63) | | | | | | | | | |
| 5 | CNRM-CM3 | | | | | | | | | |
| 6 | CSIRO-Mk3.0 | | | | | | | | | |
| 7 | CSIRO-Mk3.5 | | | | | | | | | |
| 8 | ECHAM5/MPI-OM | | | | | | | | | |
| 9 | ECHO-G | | | | | | | | | |
| 10 | FGOALS-g1.0 | | | | | | | | | |
| 11 | GFDL-CM2.0 | | | | | | | | | |
| 12 | GFDL-CM2.1 | | | | | | | | | |
| 13 | <i>GISS-AOM</i> | | | | | | | | | |
| 14 | <i>GISS-EH</i> | | | | | | | | | |
| 15 | <i>GISS-ER</i> | | | | | | | | | |
| 16 | <i>INGV-SXG</i> | | | | | | | | | |
| 17 | <i>INM-CM3.0</i> | | | | | | | | | |
| 18 | IPSL-CM4 | | | | | | | | | |
| 19 | MIROC3.2 (hires) | | | | | | | | | |
| 20 | MIROC3.2 (medres) | | | | | | | | | |
| 21 | MRI-CGCM2.3.2 | | | | | | | | | |
| 22 | <i>PCM</i> | | | | | | | | | |
| 23 | UKMO-HadCM3 | | | | | | | | | |
| 24 | UKMO-HadGEM1 | | | | | | | | | |
| | Total models used | 11 | 15 | 15 | 14 | 16 | 16 | 4 | 10 | 14 |

Pale blue cells denote those models and scenarios used in calculating projections. Italicised model names indicate those models excluded due to unacceptable performance in simulating the current climate (Section 5.5.1)

^aRefers to both the daily maximum and minimum surface air temperature

^bThe Curvature Vorticity Parameter (CVP), CSIRO Direct Detection (CCD) scheme and Genesis Potential Index (GPI) were only calculated for the A2 emission scenario.

Table A3. CMIP3 models used in calculating atmospheric projections requiring monthly timescale data.

| | Model name | Surface air temperature, rainfall | | | Surface wind | | | Solar radiation | | | Surface relative humidity, potential evapotranspiration | | |
|----|--------------------------|-----------------------------------|-----------|-----------|--------------|-----------|-----------|-----------------|-----------|-----------|---|-----------|-----------|
| | | A2 | A1B | B1 | A2 | A1B | B1 | A2 | A1B | B1 | A2 | A1B | B1 |
| 1 | BCCR-BCM2.0 | | | | | | | | | | | | |
| 2 | CCSM3 | | | | | | | | | | | | |
| 3 | CGCM3.1 (T47) | | | | | | | | | | | | |
| 4 | CGCM3.1 (T63) | | | | | | | | | | | | |
| 5 | CNRM-CM3 | | | | | | | | | | | | |
| 6 | CSIRO-Mk3.0 | | | | | | | | | | | | |
| 7 | CSIRO-Mk3.5 | | | | | | | | | | | | |
| 8 | ECHAM5/MPI-OM | | | | | | | | | | | | |
| 9 | ECHO-G | | | | | | | | | | | | |
| 10 | FGOALS-g1.0 | | | | | | | | | | | | |
| 11 | GFDL-CM2.0 | | | | | | | | | | | | |
| 12 | GFDL-CM2.1 | | | | | | | | | | | | |
| 13 | <i>GISS-AOM</i> | | | | | | | | | | | | |
| 14 | <i>GISS-EH</i> | | | | | | | | | | | | |
| 15 | <i>GISS-ER</i> | | | | | | | | | | | | |
| 16 | <i>INGV-SXG</i> | | | | | | | | | | | | |
| 17 | <i>INM-CM3.0</i> | | | | | | | | | | | | |
| 18 | IPSL-CM4 | | | | | | | | | | | | |
| 19 | MIROC3.2 (hires) | | | | | | | | | | | | |
| 20 | MIROC3.2 (medres) | | | | | | | | | | | | |
| 21 | MRI-CGCM2.3.2 | | | | | | | | | | | | |
| 22 | <i>PCM</i> | | | | | | | | | | | | |
| 23 | UKMO-HadCM3 | | | | | | | | | | | | |
| 24 | UKMO-HadGEM1 | | | | | | | | | | | | |
| | Total models used | 15 | 18 | 17 | 13 | 16 | 15 | 15 | 18 | 16 | 9 | 11 | 10 |

Pale blue cells denote those models and scenarios used in calculating projections. Italicised model names indicate those models excluded due to unacceptable performance in simulating the current climate (Section 5.5.1).

Table A4. CMIP3 models used in calculating oceanic projections requiring monthly timescale data.

| Model name | Sea surface temperature | | | Sea surface salinity ^a | | | T, S, density, buoyancy, steric sea level ^b | Dynamic sea level | Circulation | Qar |
|--------------------------|-------------------------|-----------|-----------|-----------------------------------|-----------|-----------|--|-------------------|-------------|----------|
| | A2 | A1B | B1 | A2 | A1B | B1 | | | | |
| 1 | BCCR-BCM2.0 | | | | | | | | | |
| 2 | CCSM3 | | | | | | | | | |
| 3 | CGCM3.1 (T47) | | | | | | | | | |
| 4 | CGCM3.1 (T63) | | | | | | | | | |
| 5 | CNRM-CM3 | | | | | | | | | |
| 6 | CSIRO-Mk3.0 | | | | | | | | | |
| 7 | CSIRO-Mk3.5 | | | | | | | | | |
| 8 | ECHAM5/MPI-OM | | | | | | | | | |
| 9 | ECHO-G | | | | | | | | | |
| 10 | FGOALS-g1.0 | | | | | | | | | |
| 11 | GFDL-CM2.0 | | | | | | | | | |
| 12 | GFDL-CM2.1 | | | | | | | | | |
| 13 | GISS-AOM | | | | | | | | | |
| 14 | GISS-EH | | | | | | | | | |
| 15 | GISS-ER | | | | | | | | | |
| 16 | INGV-SXG | | | | | | | | | |
| 17 | INM-CM3.0 | | | | | | | | | |
| 18 | IPSL-CM4 | | | | | | | | | |
| 19 | MIROC3.2 (hires) | | | | | | | | | |
| 20 | MIROC3.2 (medres) | | | | | | | | | |
| 21 | MRI-CGCM2.3.2 | | | | | | | | | |
| 22 | PCM | | | | | | | | | |
| 23 | UKMO-HadCM3 | | | | | | | | | |
| 24 | UKMO-HadGEM1 | | | | | | | | | |
| Total models used | 14 | 16 | 16 | 11 | 15 | 13 | 11 | 13 | 15 | 6 |

Pale blue cells denote those models and scenarios used in calculating projections. Italicised model names indicate those models excluded due to unacceptable performance in simulating the current climate (Section 5.5.1)

^aModel numbers are greater for sea surface salinity than for salinity through the depth of the ocean, as PCCSP researchers approached CMIP3 modelling groups requesting additional surface salinity data.

^bRefers to the potential temperature (T), salinity (S), potential density and buoyancy frequency squared through the depth of the ocean.

^cThe same models were used for the A2, A1B and B1 scenarios.

Qar = Aragonite saturation state.