QUEENSLAND FUTURE CLIMATE SCIENCE PROGRAM:
Tailoring modelling, analysis and services for decision-making

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Background

- Collaborative Science Program between Queensland Government and The University of Queensland
- Applied climate science to underpin decision making
- Support climate adaptation and natural disasters preparedness (Trancoso et al., 2020; Eccles et al 2021)
- Underlying resource for Queensland Climate Adaptation Strategy (QCAS) and Queensland Climate Action Plan (QCAP) (Fig 1)
- Previously downscaled CMIP5 models
- Currently downscaling CMIP6 models (Fig 2)

***Fig 1**. Applied climate science to support climate adaptation, risk and hazard assessments*

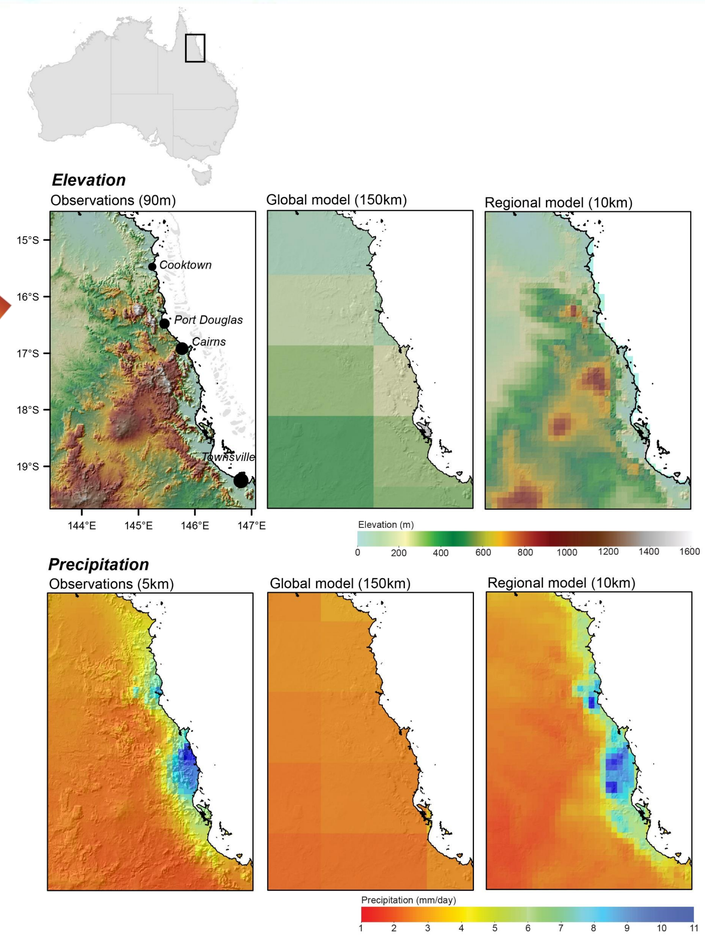


***Fig 2**. Downscaled climate models best represent elevation, sea-land contrasts and precipitation gradients across Australian regions*

Modelling

- Dynamical downscaling using Conformal Cubic Atmospheric Model (Fig 3; Syktus et al., 2020)
- Selection of CMIP6 GCMs based on skill, climate change signal and independence (Fig 4)
- Downscaling of 15 ensemble runs under three emissions scenarios (45 ensembles; Table 1)
- CORDEX compliant projections to be made available on NCI and ESGF Australian node (Fig 5)

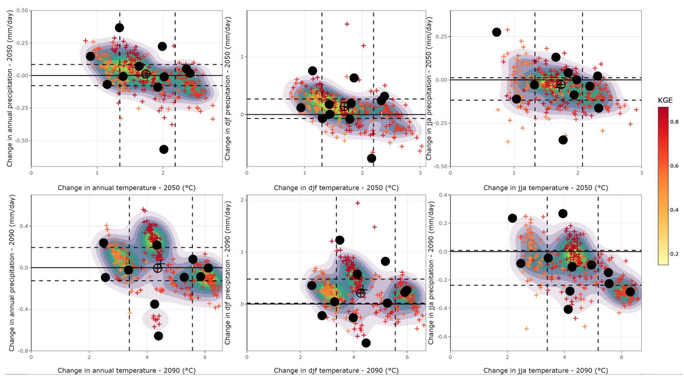
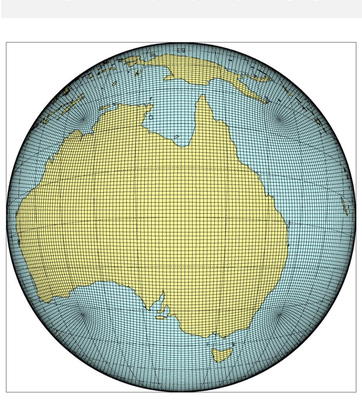


***Fig 4**. Selection of CMIP6 GCMs to downscale using the Skill Spread Selection approach*



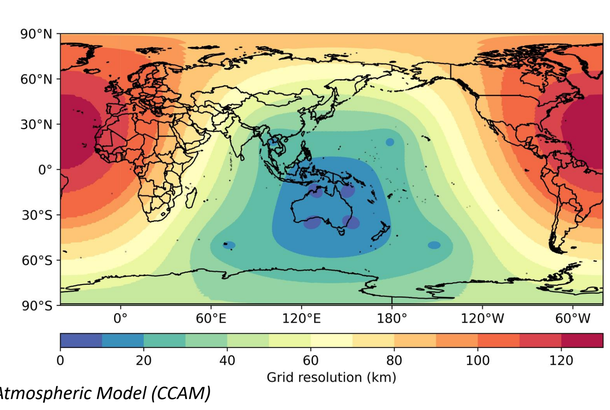


***Fig 3**. Stretched grid of the Conformal Cubic Atmospheric Model (CCAM)*

***Table 1.** Dynamically downscaling of 12 CMIP6 models using CCAM*

CMIP6 model	Model full name
ACCESS-ESM1-5	Australian Community Climate and Earth System Simulator, version 1.5
ACCESS-ESM1-5_oc	Australian Community Climate and Earth System Simulator, version 1.5, CCAM ocean coupled version
ACCESS_CM2_oc	Australian Community Climate and Earth System Simulator, coupled model, version 2.0
CMCC-ESM2	Centro Euro-Mediterraneo sui Cambiamenti Climatici
CNRM-CM6-1-HR	Centre National de Recherches Météorologiques Coupled Global Climate Model, version 6.1, high-resolution
CNRM-CM6-1-HR_oc	Centre National de Recherches Météorologiques Coupled Global Climate Model, version 6.1, high-resolution, CCAM ocean coupled version
EC-Earth3	European Community Earth-System Model, version 3
FGOALS-g3	Flexible Global Ocean-Atmosphere-Land System Model, grid point version 3
GFDL-ESM4	Geophysical Fluid Dynamics Laboratory Earth System Model, version 4
GISS-E2-2-G	Goddard Institute for Space Studies Model E2.2G
MPI-ESM1-2-LR	Max Planck Institute Earth System Model, version 1.2, low resolution
MRI-ESM2-0	Meteorological Research Institute Earth System Model, version 2.0
NorESM2-MM	Norwegian Earth System Model, version 2, 1 degree resolution
NorESM2-MM_oc	Norwegian Earth System Model, version 2, 1 degree resolution, CCAM ocean coupled version

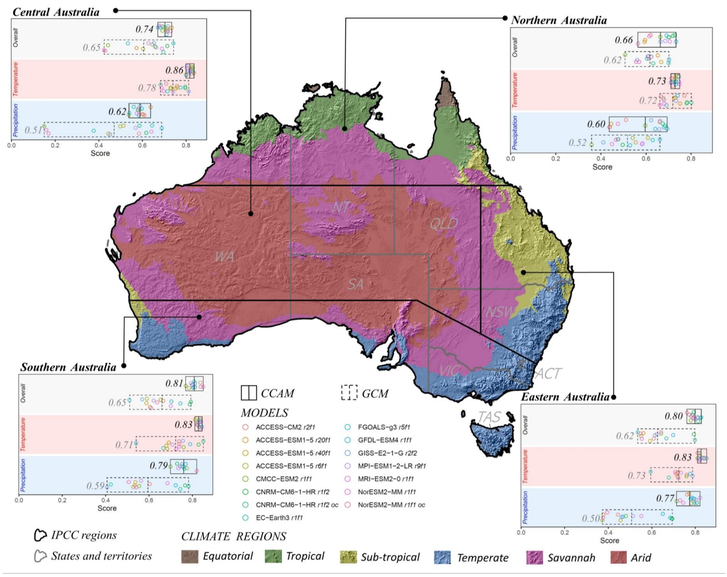


***Fig 6**. CMIP6 downscaled projections outperform their host models for the four IPCC Australian regions (Chapman et al, 2023)*

Expertise and Analysis

- **Climate extremes**
  - Heatwaves
  - Extreme temperature
  - Extreme precipitation
  - Drought
  - Wetness and floods
  - Fire weather
  - Tropical cyclones
  - Convective extremes
  - Compound extremes
  - Marine hazards
- **Climate analytics**
  - Global Climate Models analysis (Fig 4)
  - Regional Climate Models analysis
  - Model evaluation (Fig 6-7)
  - Data visualization
  - Bias correction (Fig 8)
  - Generalized Extreme Value
  - Machine Learning

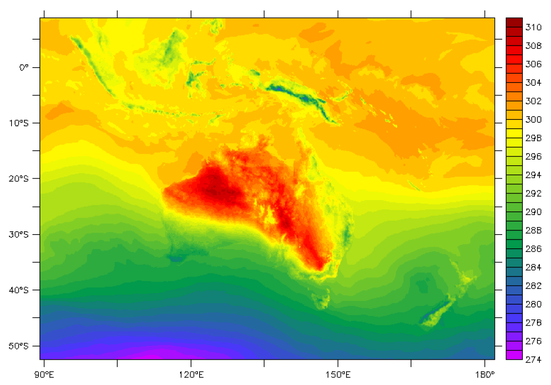


***Fig 5**. CMIP6 downscaled projections for CORDEX Australasia domain for surface air temperature (K)*

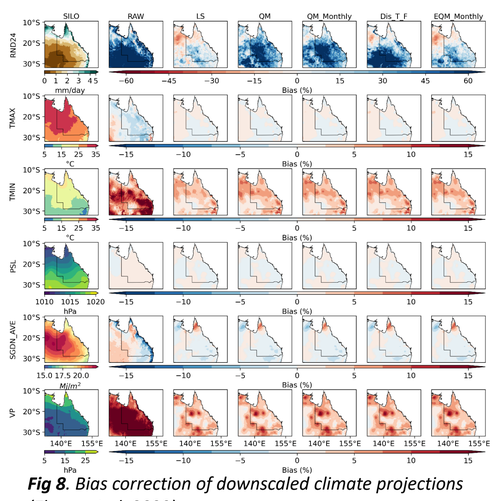


***Fig 8**. Bias correction of downscaled climate projections (Zhang et al, 2023)*

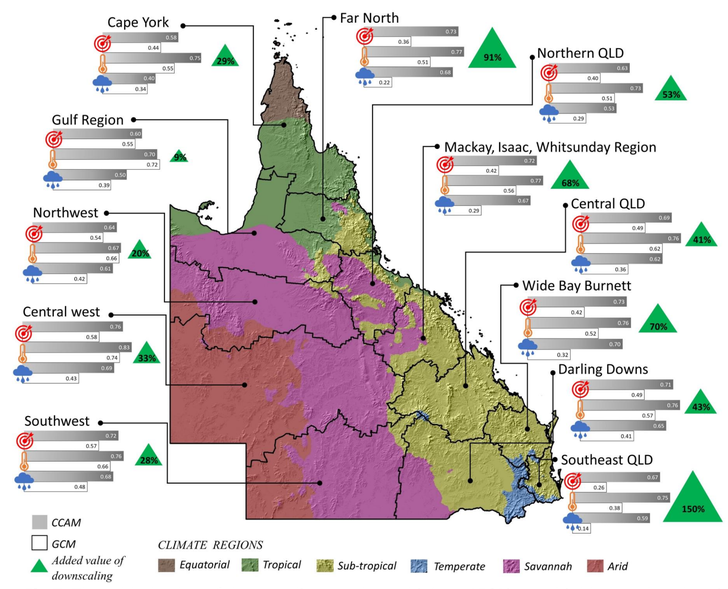


***Fig 7**. The added value of downscaling can be as high as 150% over highly populated regions*

Data and Services

- CMIP6 CORDEX compliant downscaled simulations on NCI from December 2023 for 45 ensembles and three emissions scenarios https://opus.nci.org.au/display/CMIP/CMIP6-CORDEX+datasets
- Queensland Future Climate Dashboard: https://longpaddock.qld.gov.au/qld-future-climate/dashboard/
- Tropical Cyclone Hazard Dashboard: https://longpaddock.qld.gov.au/qld-future-climate/tropical-cyclone/
- TERN CMIP5 website: https://portal.tern.org.au/metadata/21735
- Visit our portal from December 2023 and check our new regional timeseries and table summaries

https://longpaddock.qld.gov.au/qld-future-climate/

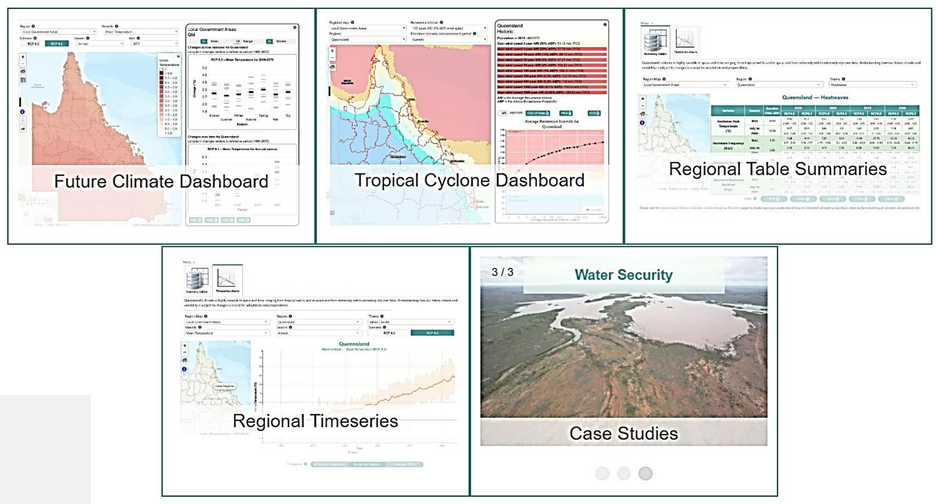


***Fig 9**. Queensland Future Climate services to be updated in December 2023*

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