



## Impacts and Achievements of the MTSRF

Copy of abstract and presentation given at the  
2010 Annual Conference of the  
Marine and Tropical Sciences Research Facility (MTSRF)  
[http://www.rrrc.org.au/news/2010\\_conference.html](http://www.rrrc.org.au/news/2010_conference.html)

Showcasing the Australian Government's investment  
in the MTSRF for improved sustainability of the  
North Queensland region, and Australia

18-20 May 2010  
Pullman Reef Hotel & Casino  
Cairns, North Queensland



### Abstract

#### [MTSRF Project Number 2.5ii.1](#)

### An ensemble of high-resolution climate simulations for the MTSRF region

John L. McGregor and Kim C. Nguyen

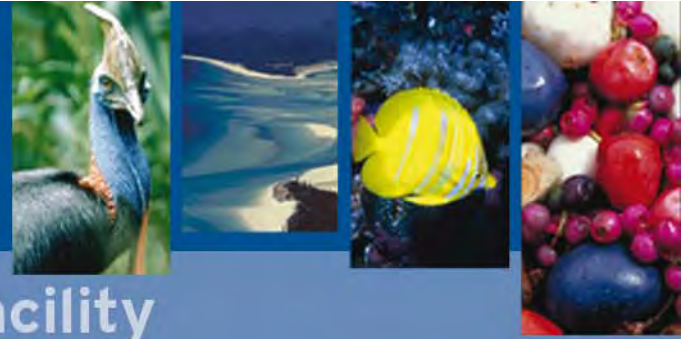
*CSIRO Marine and Atmospheric Research, Aspendale, Vic 3195 Australia*

An ensemble of 6 dynamically downscaled climate simulations is being run at 14 km resolution over the MTSRF region. These simulations are being carried out using CCAM, for 1971-2000 and 2061-2090 for the A2 emissions scenario. The underlying forcing is provided from the following coupled atmosphere-ocean Global Climate Models (GCMs): CSIRO Mk3.5, ECHAM5, GFDL2.0 and GFDL2.1, ECHAM5 and Miroc-Medres. The simulations are proceeding via intermediate quasi-uniform global 200 km CCAM simulations. The 200 km simulations are driven by the sea-surface temperatures (SSTs) and sea-ice distributions of the 6 coupled GCMs. Bias-correction is applied to each month of the SSTs so as to compensate for the present-day SST biases of the coupled GCMs. The subsequent dynamical downscaling to 14 km resolution also employs a digital filter technique to preserve large-scale synoptic features from the 200 km simulations. The presentation will describe the methodology and show the validation for present-day climatology. A selection of fields will also be shown from the simulated future climate. By using an ensemble of simulations, a measure can be provided of the uncertainties associated with the climate change signal. Data from the simulations can be provided to end users.



Australian Government

Department of the Environment, Water, Heritage and the Arts



Marine and Tropical Sciences Research Facility

# An ensemble of high-resolution climate simulations for the MTSRF region

John McGregor and Kim Nguyen  
CSIRO Marine and Atmospheric Research



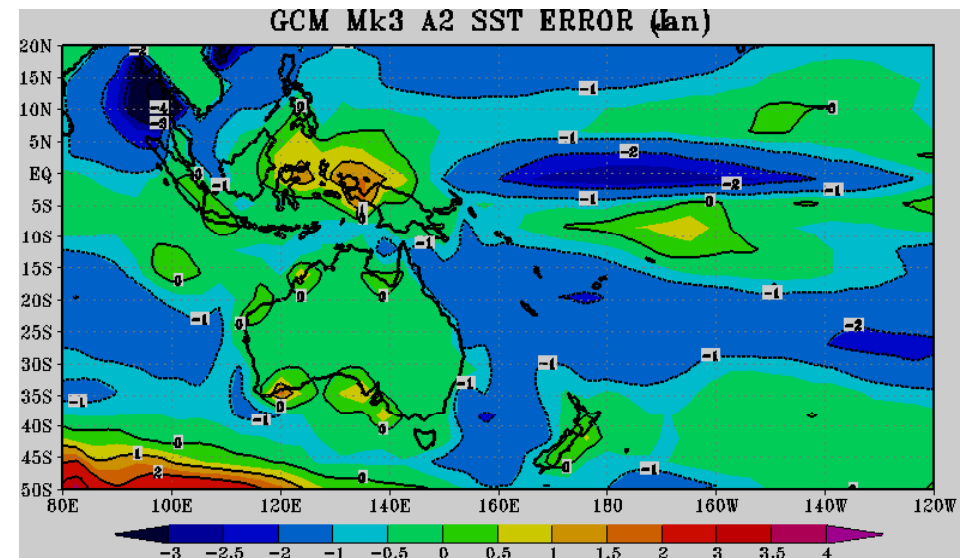
## Motivation

- Increasing requirement for more accurate, climate projections at finer scales of resolution
- IPCC climate change projections are available globally
  - limited ability to utilise this information on a regional scale as the resolution is too coarse (about 200 km)
- CSIRO dynamical downscaling activities are focussed over Australia, Indonesia and Pacific Island countries
- Also big demand for downscaling from an ensemble of AR4 GCMS



## Dynamical downscaling difficulties for tropical regions

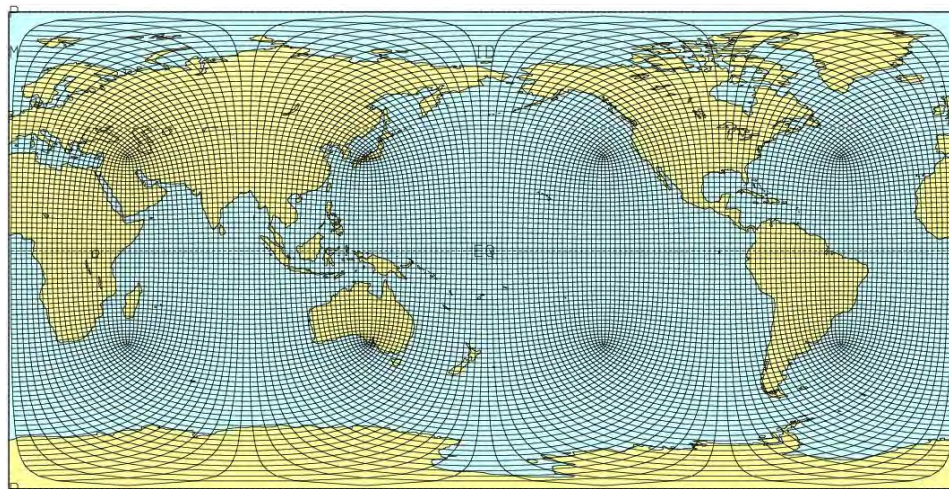
- A major difficulty comes from biases in the host coupled GCMs, especially for SSTs, for example the common “cold-tongue bias” over the equator
- These biases produce errors in the trade winds over the South Pacific and in the location of the South Pacific Convergence Zone (SPCZ)
  - leads to incorrect downscaled tropical rainfall
- Regard the most credible output of coupled GCMs to be their **changes** in SST patterns and sea-ice



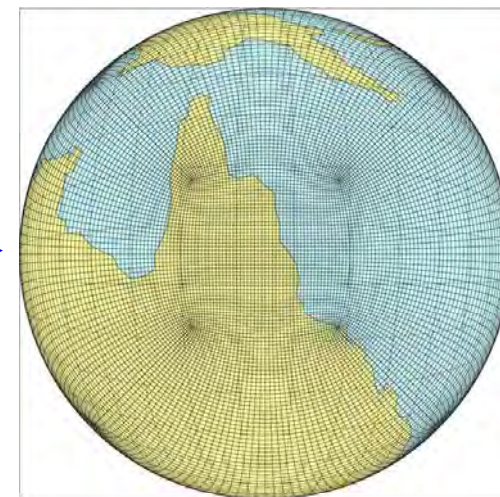


## CSIRO dynamical downscaling methodology

- Methodology is to run a quasi-uniform 200 km CCAM atmospheric GCM simulation driven by the monthly-bias-corrected SSTs
- Run CCAM at 200 km resolution, then at 14 km resolution - applying a digital filter every 6 h to preserve large-scale patterns of the coarser run



Quasi-uniform C48 CCAM grid  
with resolution about 200 km.



Stretched C48 grid with resolution  
about 14 km over MTSRF region





## Ensemble of climate simulations

Have performed an ensemble of simulations over MTSRF region  
Ensemble provides an estimate of the range of expected changes

A2 scenario

14 km resolution

Many output variables written 6-hourly

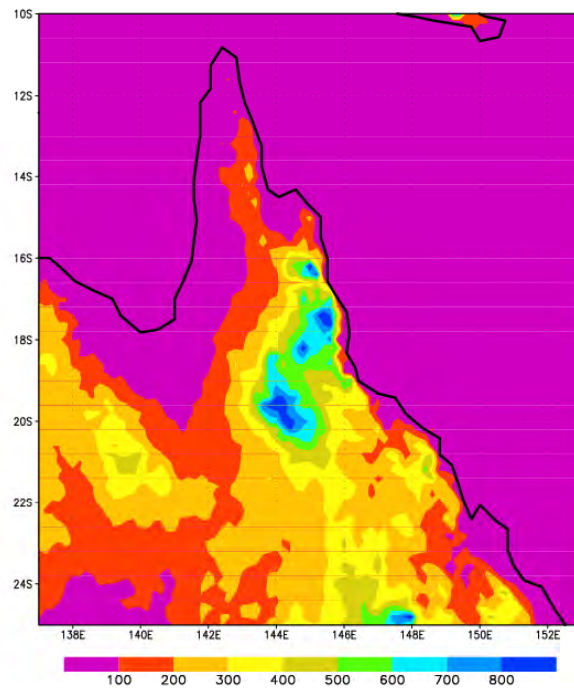
1971-2000 and 2061-2100

- Mk3.5
- GFDL 2.1
- GFDL 2.0
- ECHAM5
- HADCM3
- MIROC-Med res



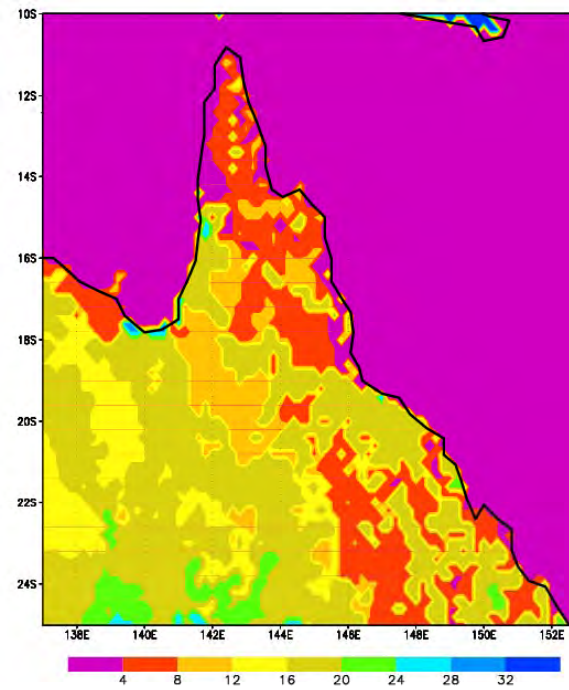
## Surface characteristics

Orography m



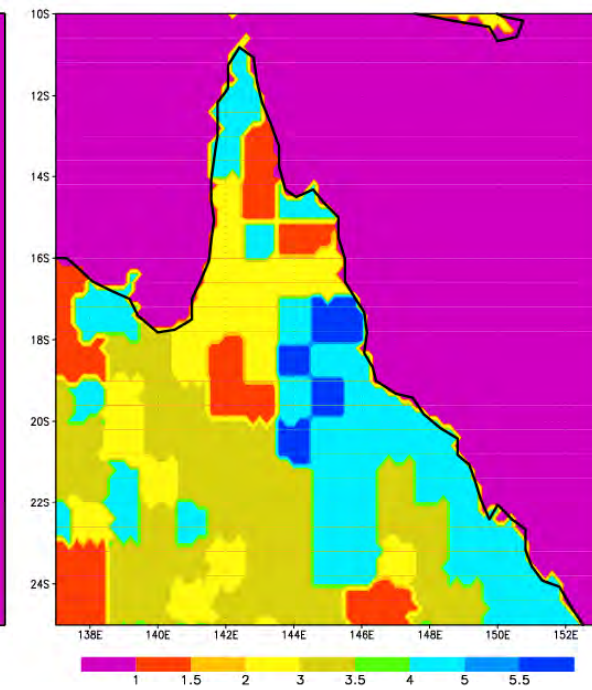
GrADS: COLA/IGES

Vegetation type



GrADS: COLA/IGES

Soil type

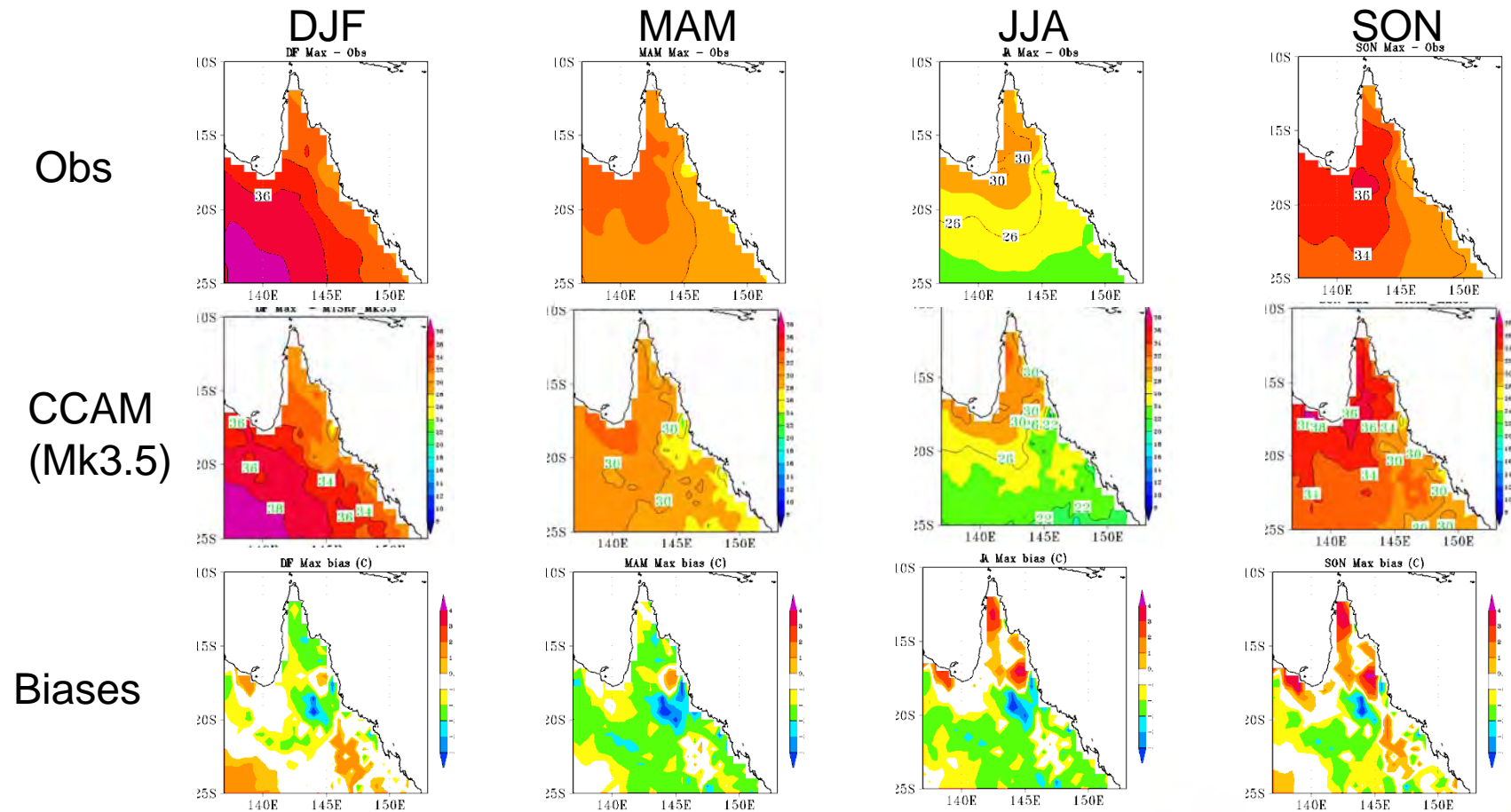


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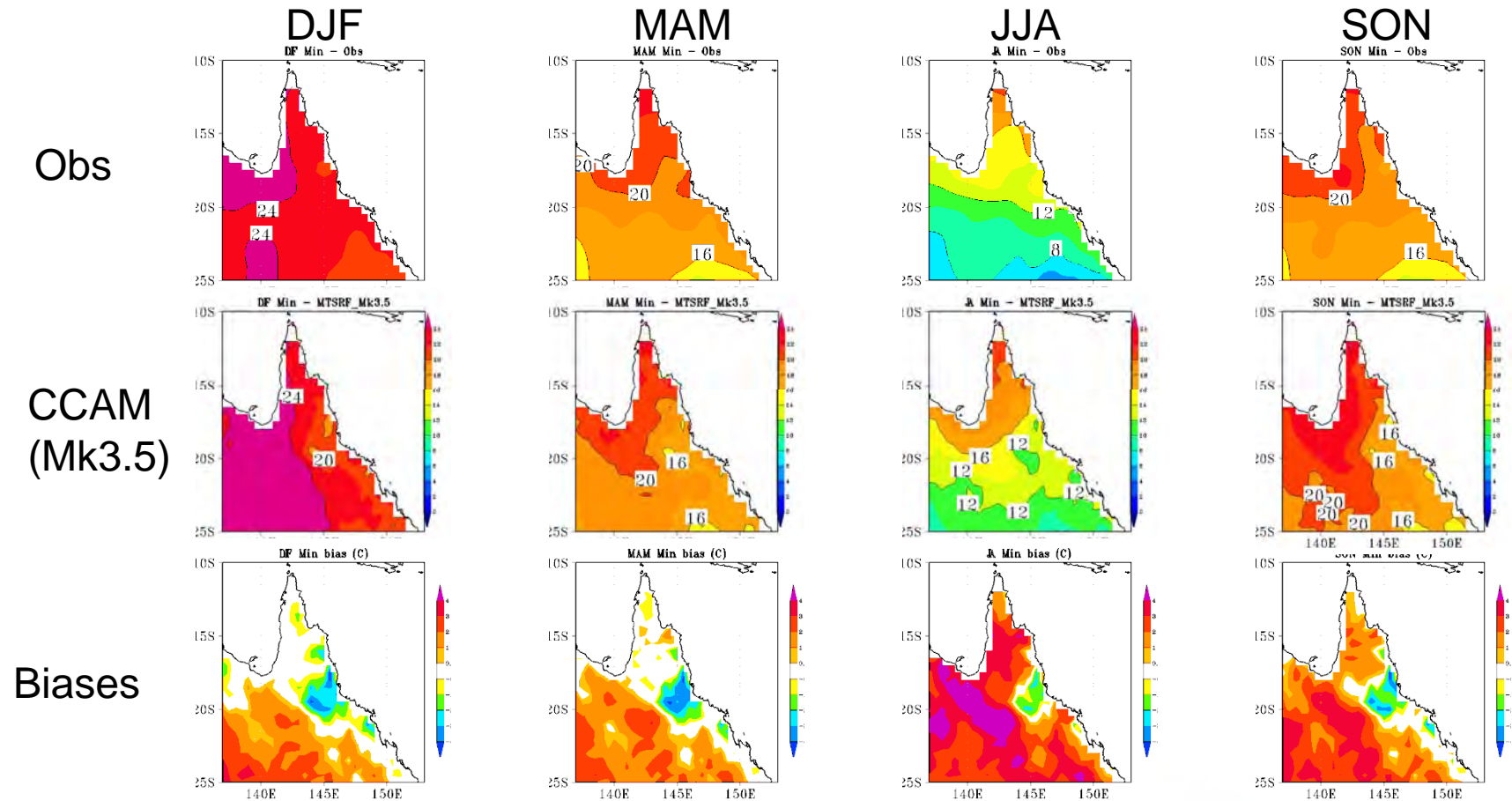


## Simulated present-day Tmax and biases



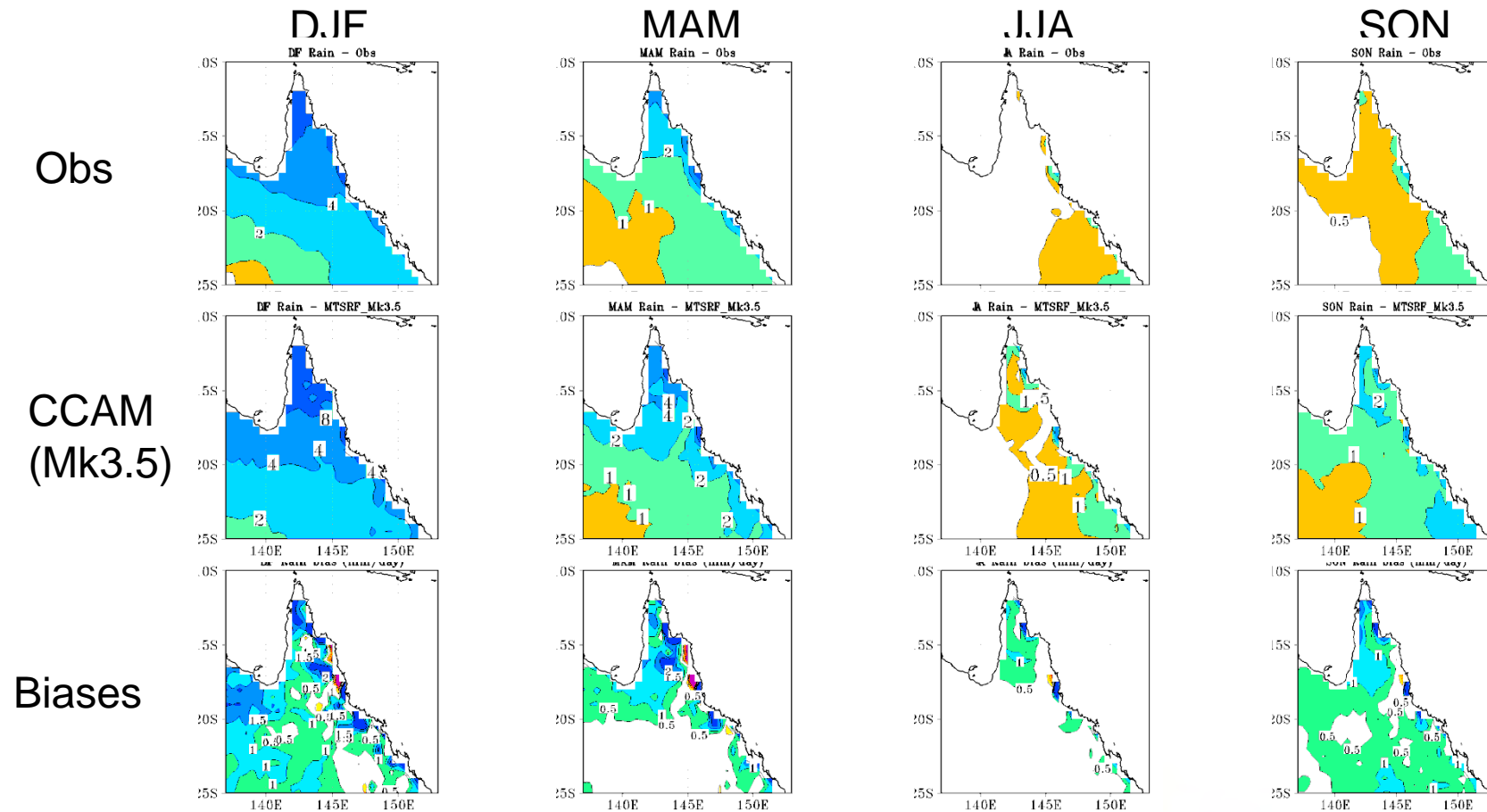


## Simulated present-day Tmin and biases



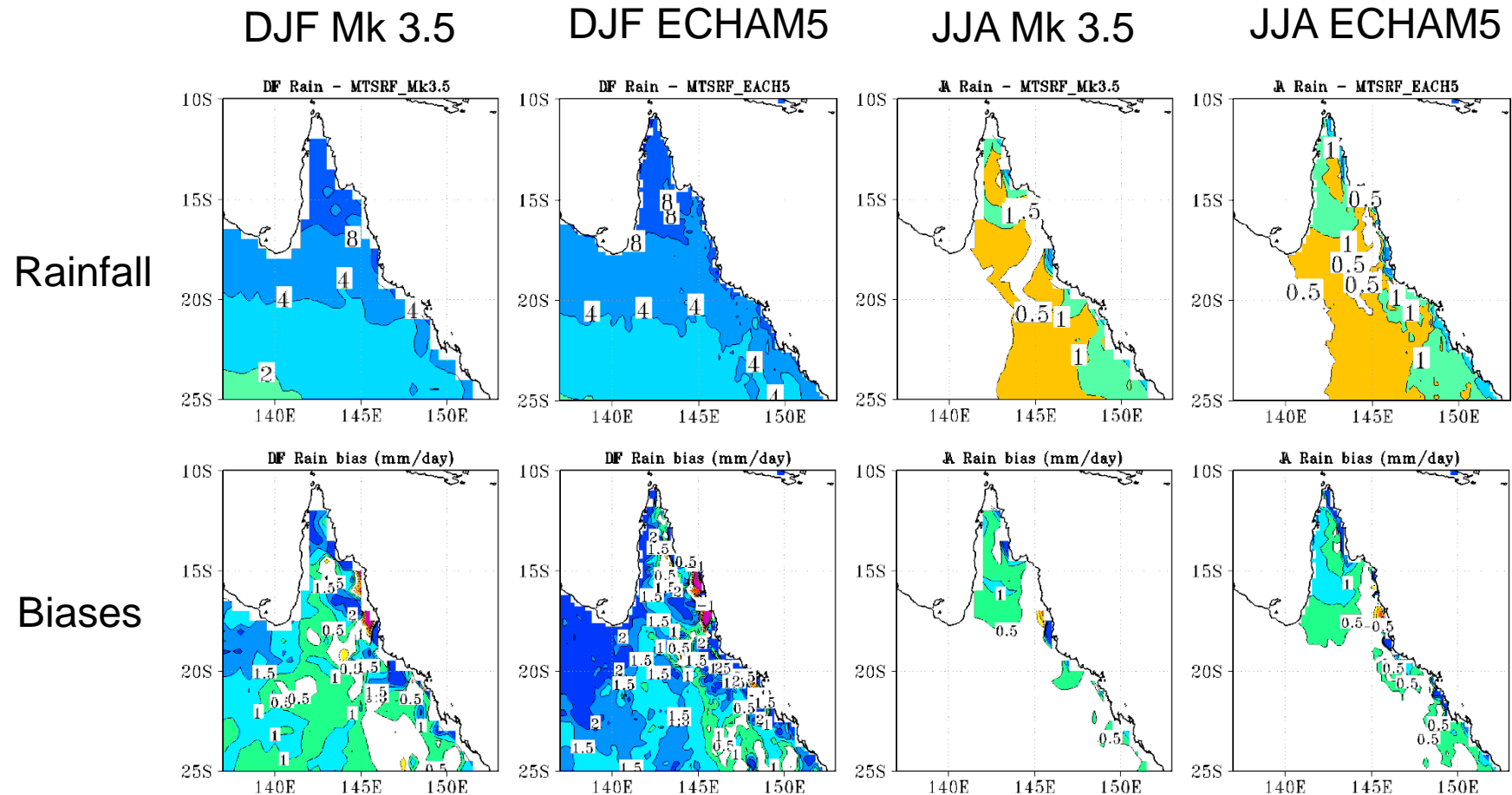


## Simulated present-day rainfall and biases



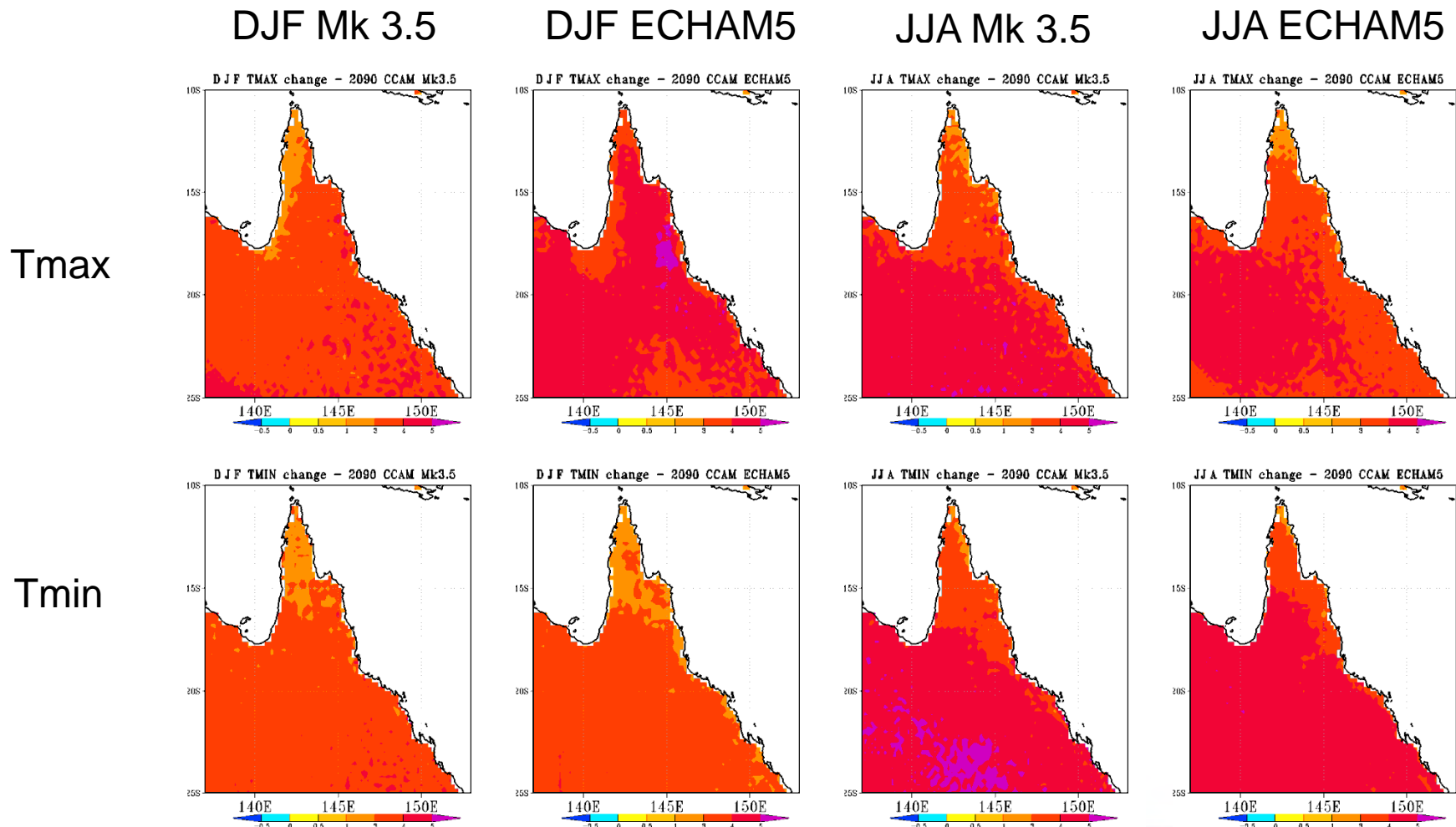


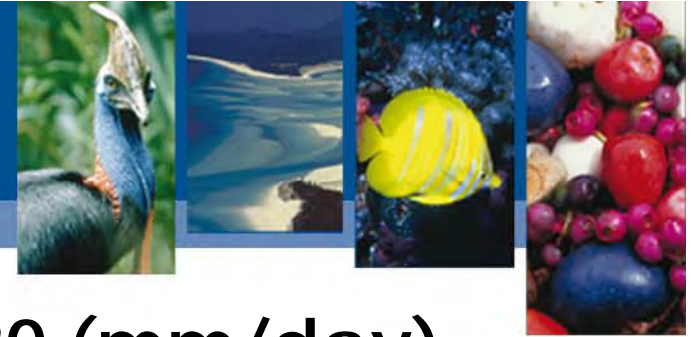
## Simulated present-day rainfall and biases - comparing 2 host models



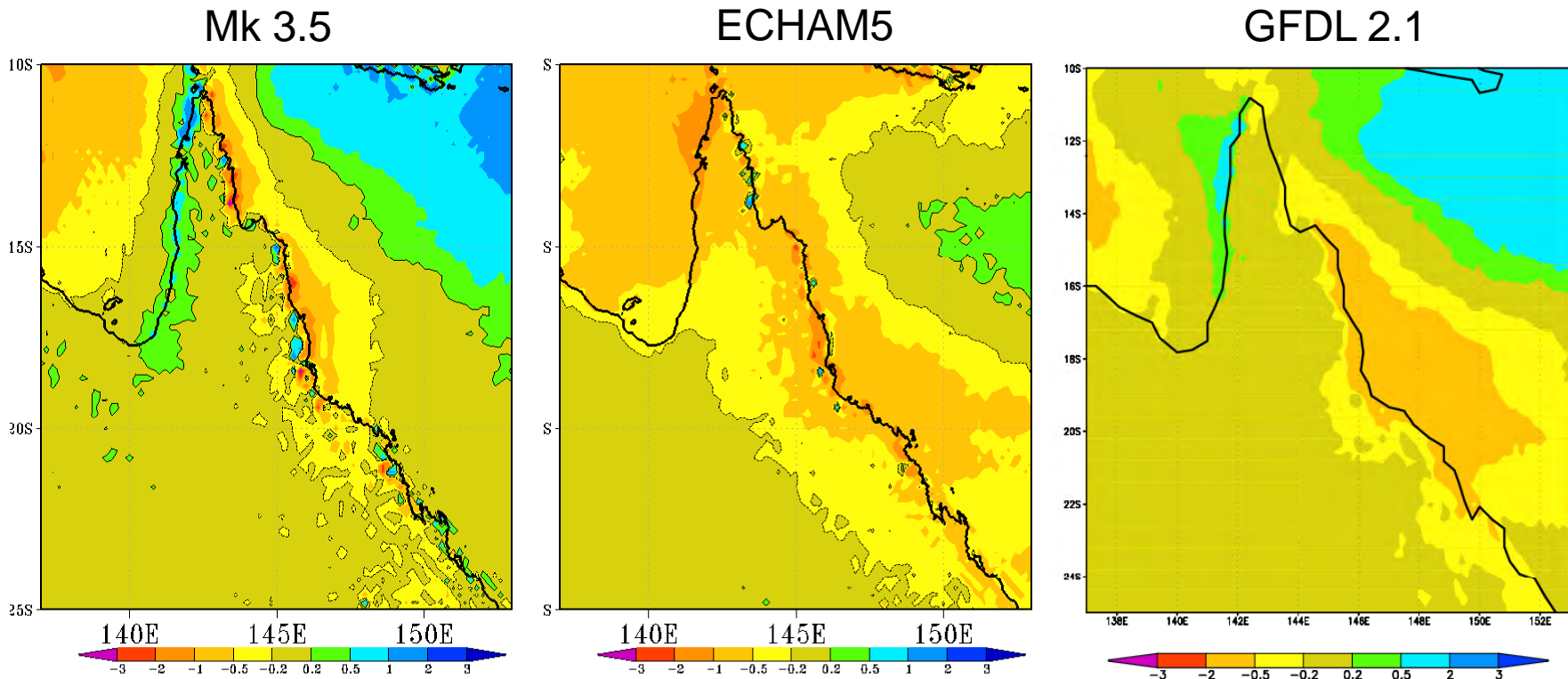


## Simulated temperature changes by 2080





## Annual rainfall changes by 2080 (mm/day)

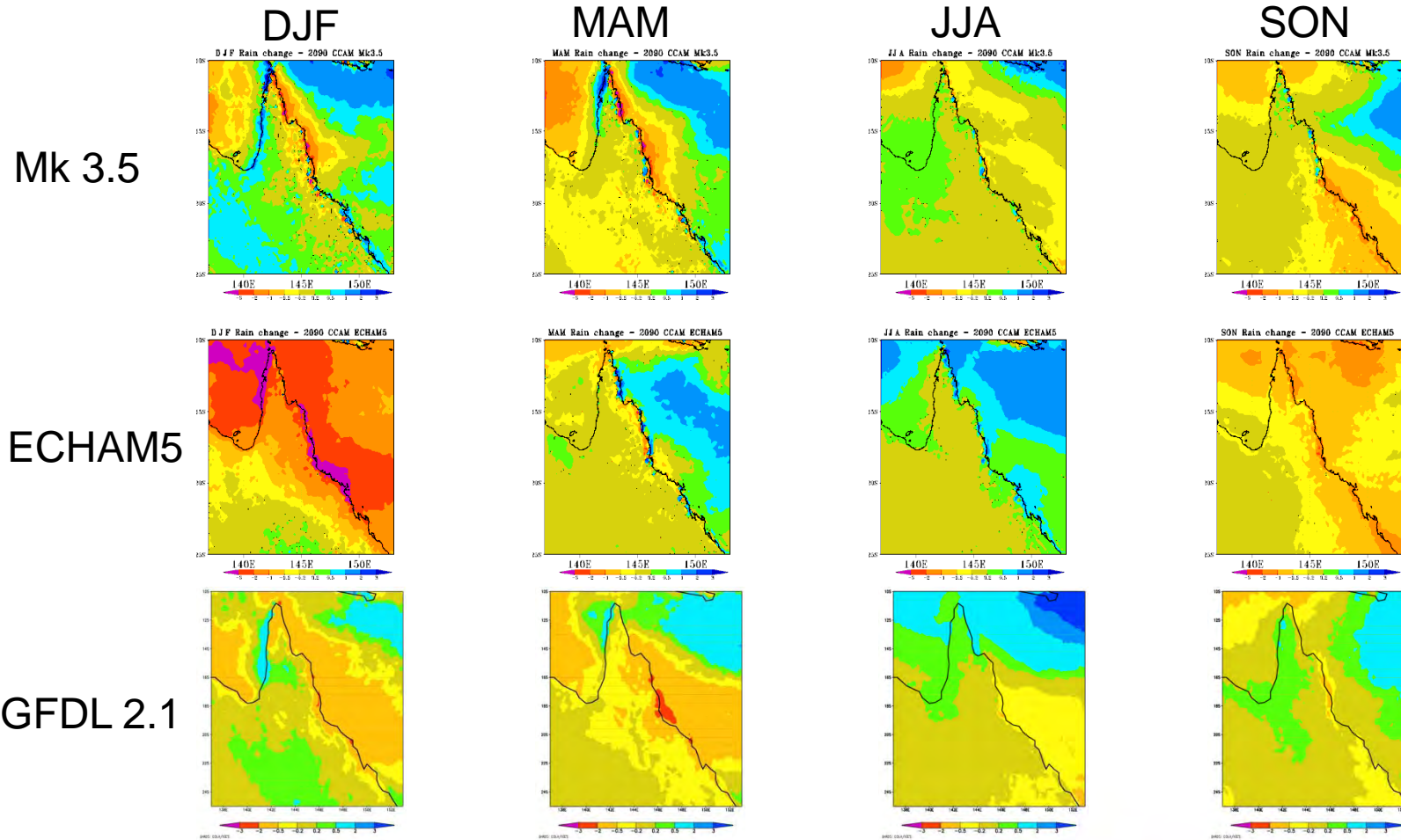


Downscaled from 6 coupled GCMs for A2 scenario. Three shown above.  
Most simulations indicate coastal rainfall decreases, especially along coast, and in summer and spring.



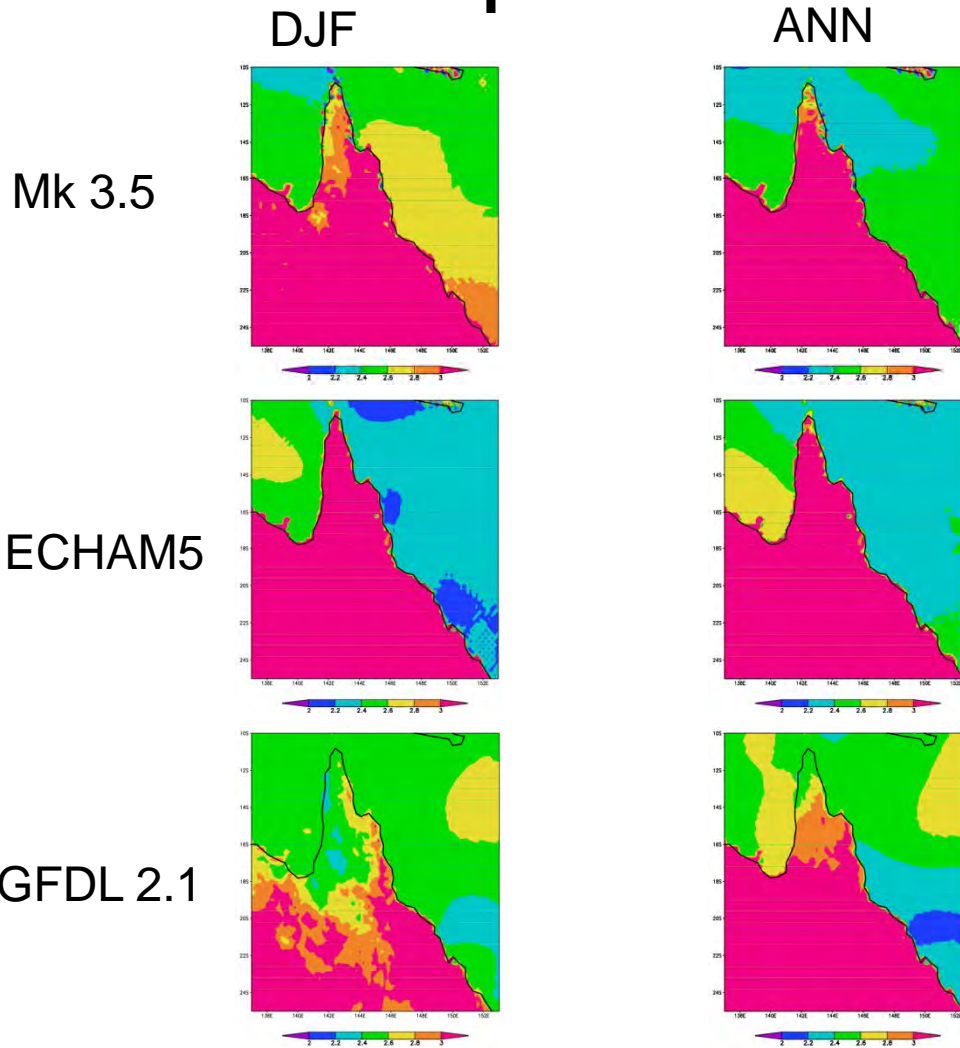


## Seasonal rainfall changes by 2080





## Surface temperature changes by 2080

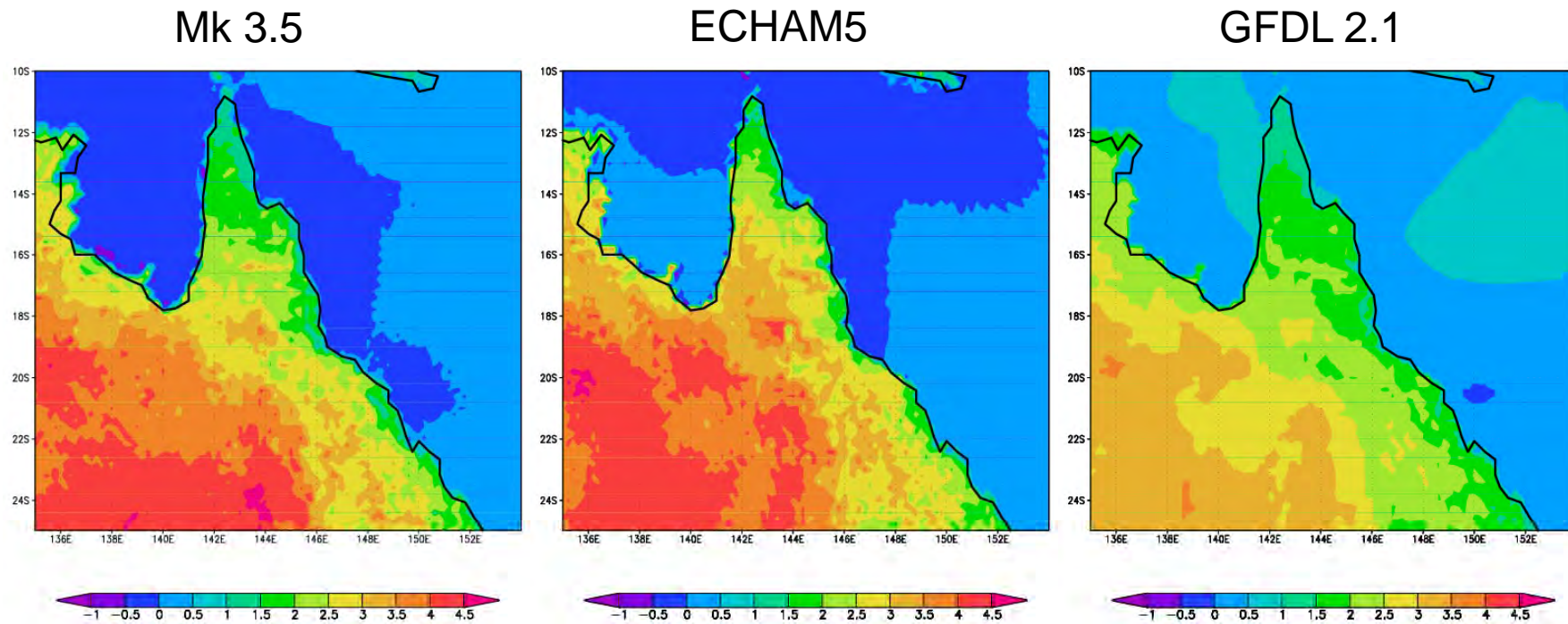


Note that most differences in the various simulations can be attributed to different SST changes among the host models





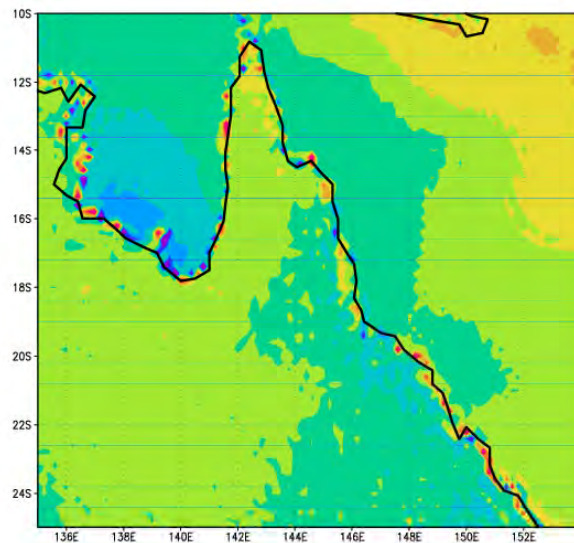
## Changes in pan evaporation by 2080 (mm/day)





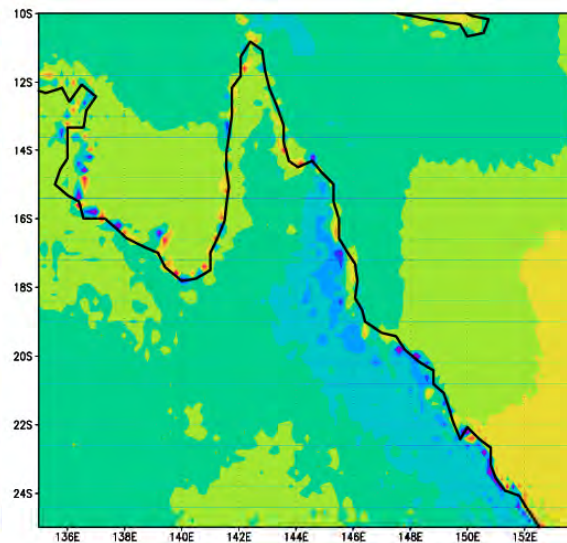
## Changes in total evaporation by 2080 (mm/day)

Mk 3.5



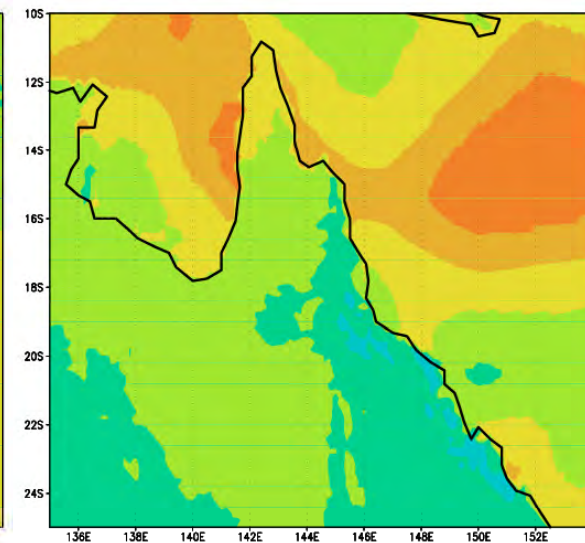
GRADS: COLA/IGES

ECHAM5



GRADS: COLA/IGES

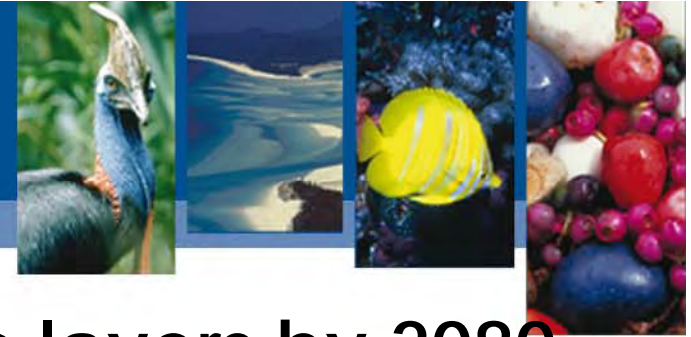
GFDL 2.1



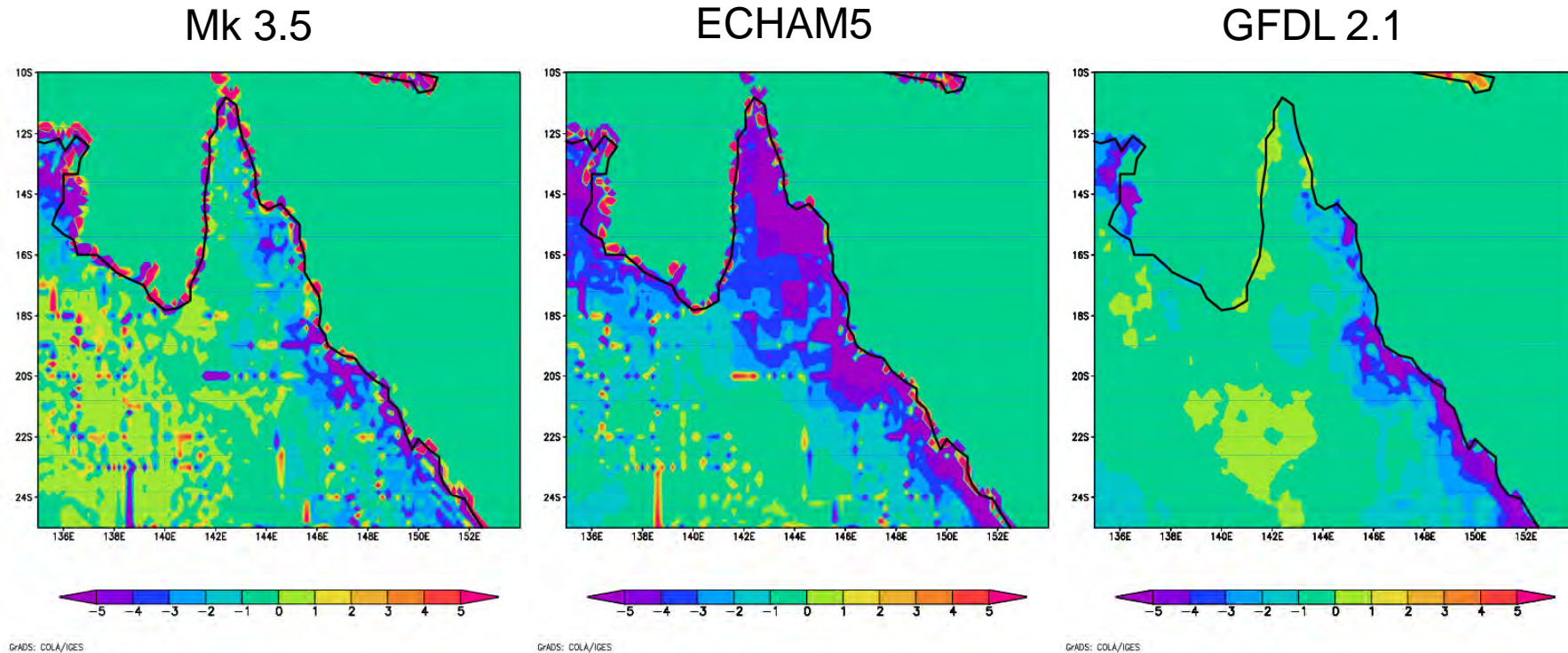
GRADS: COLA/IGES

Small decreases along coast, some small increases inland



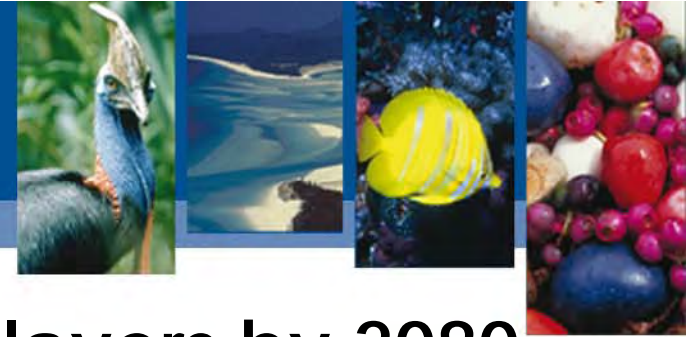


## Changes in upper soil-moisture layers by 2080 as % change in moist fraction

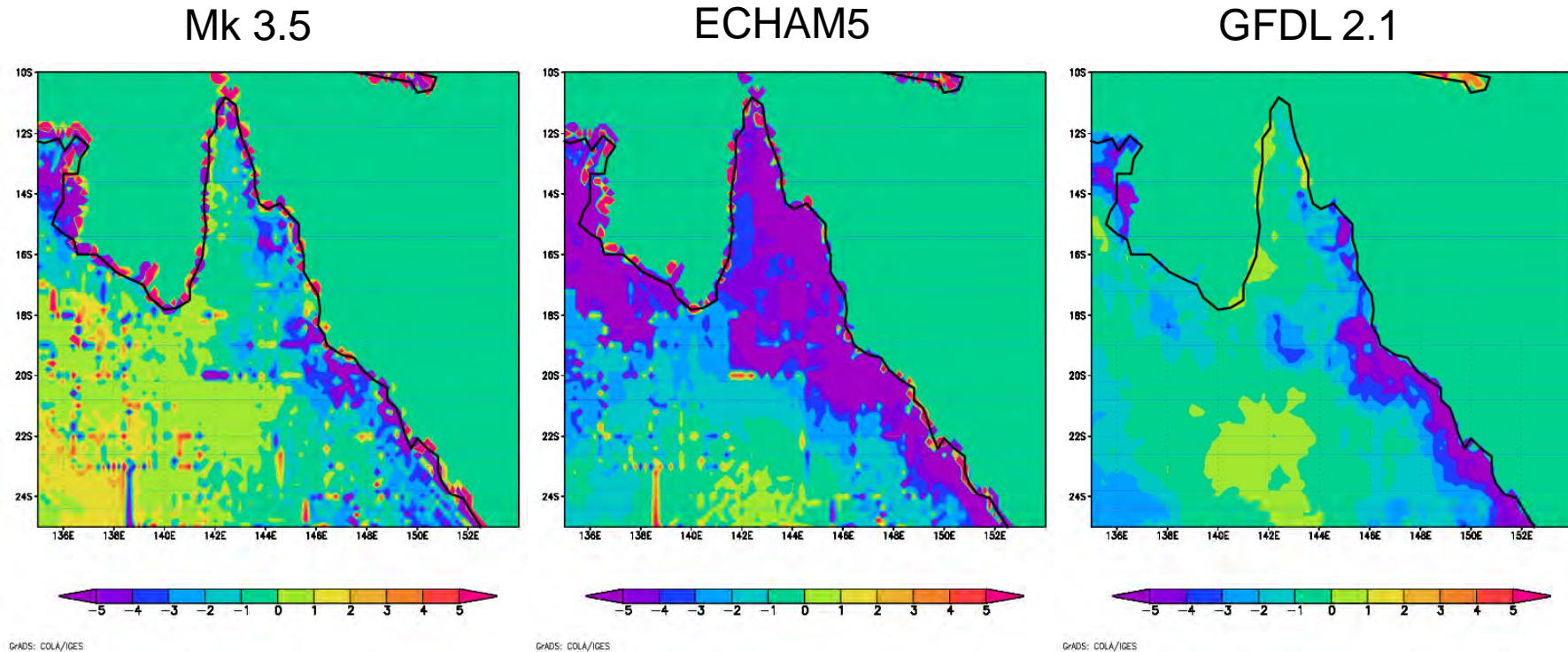


Generally a decrease, especially near the coast





## Changes in root soil-moisture layers by 2080 as % change in moist fraction



Generally a decrease, especially near the coast





Thank you!

