Southeast Asia Climate Analysis and Modeling (SEACAM)

A Regional Climate Modelling Experiment for Southeast Asia

Using PRECIS Regional Climate Model and selected CMIP3 Global Climate Models

On Behalf of Project Members:

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Universiti Kebangsaan Malaysia (UKM)
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Department of Meteorology and Hydrology, Myanmar (DMH)
Regional Integrated Multi-Hazard Early Warning System (RIMES, Thailand)
Centre for Climate Research, Singapore (CCRS)
Malaysian Meteorological Department (MMD)
University Brunei Darussalam (UBD)
Vietnam Institute of Meteorology, Hydrology and Environment (IMHEN)
Department of Meteorology, Cambodia
University Malaya (UM)

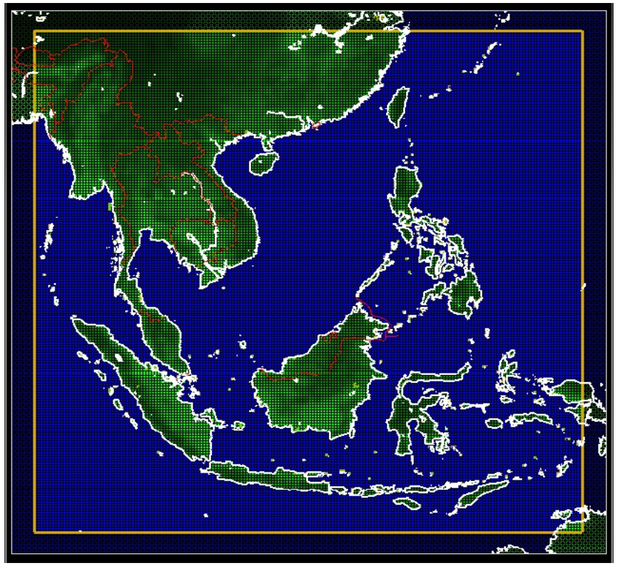
Meteorological Service Singapore
Centre for Climate Research Singapore

Met Office Hadley Centre

- Funders:
  - Meteorological Service Singapore – Center for Climate Research Singapore
  - Met Office Hadley Centre
  - UK Foreign Commonwealth Office
- Project was carried out in two phases
- Phase 1
  - commenced June 2012
  - Six 150-year PRECIS regional climate model experiments (nicknamed DURIAN)
  - Driven by 5 HadCM3Q's QUMP + ECHAM5.
  - Workload sharing basis.
- Phase 2
  - Joint-analysis of the simulations output of the DURIAN experiment by over 30 regional climate experts
  - first meeting: Phnom Penh, Cambodia, August 2013
  - Second meeting: CCRS-MMS, Singapoare Febuary 2014
- Current status
  - Draft of final report (under-review)

SEACAM team member involves in the analysis
(2nd workshop at MSS-CCRS)

SEACAM domain and simulation setup



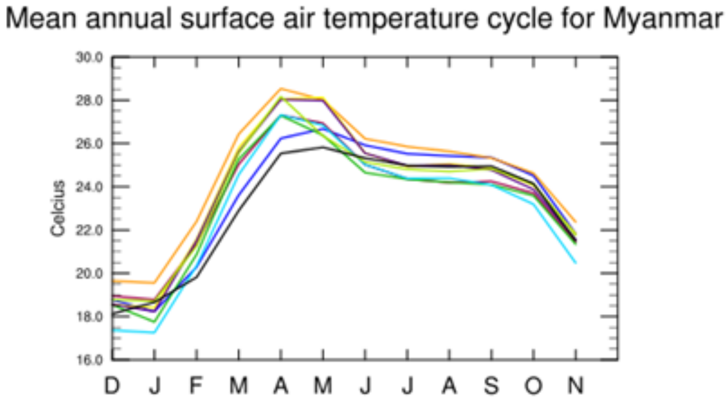
- Resolution 0.22°×0.22°
- Scenario A1B.
- LBC
  - ERA40 (1957 – 2001)
  - QUMP{0,3,10,11,13} (McSweeney et al., 2012)
  - ECHAM5 (1949-2000, 2031 – 2060, 2071 – 2100)
- Validation
  - APHRODITE
  - CRU TS3

- Evaluation/analysis/projections focuses on:

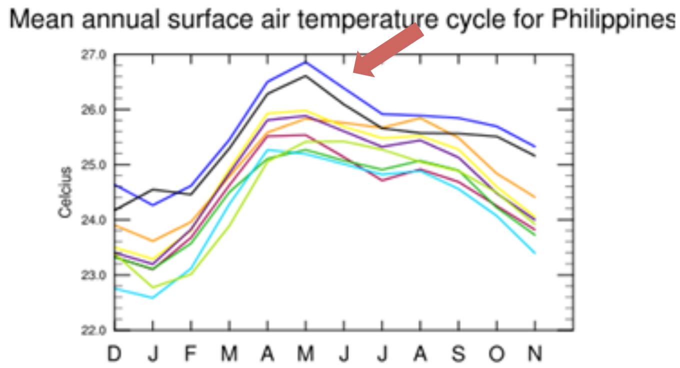
1. Annual cycle of temperature and precipitation
2. Mean temperature and precipitation spatial patterns
3. Circulation patterns during the Northeast and Southwest Monsoons, and
4. Extreme precipitation and temperature.

Annual Cycles (Temperature)

- Checked Individual country (show some):



(c)



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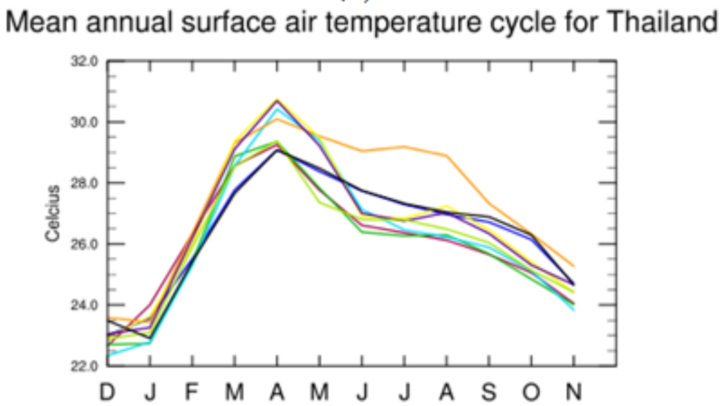

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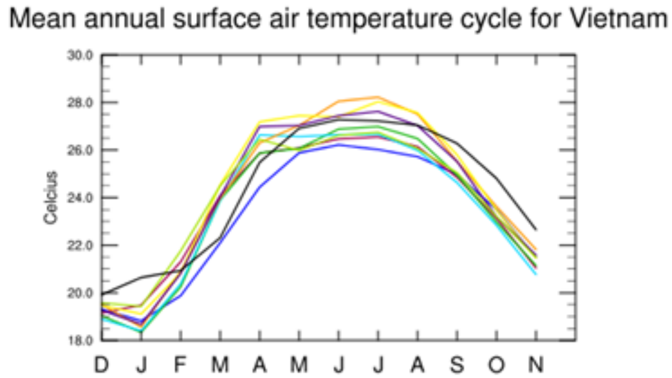
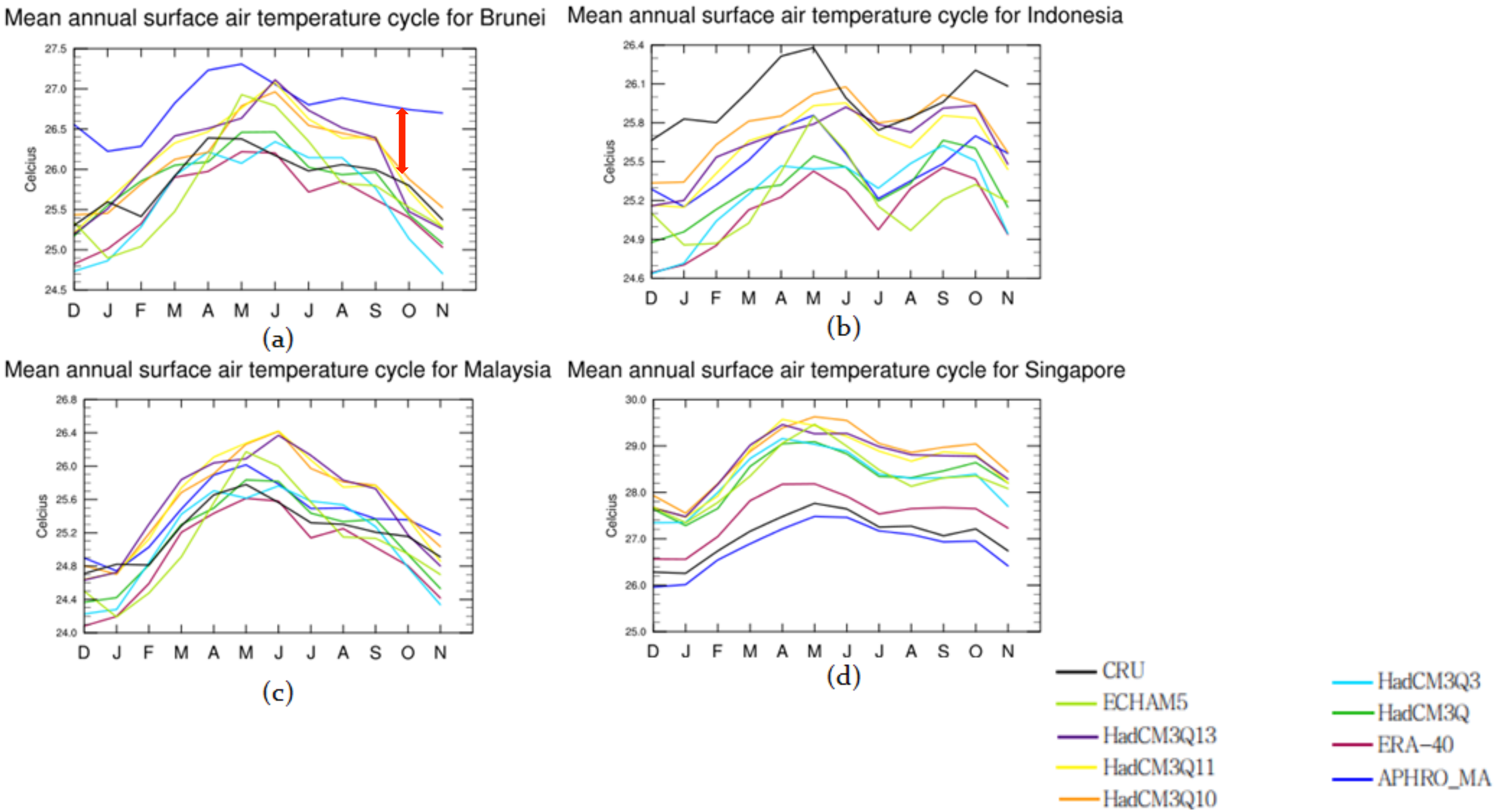


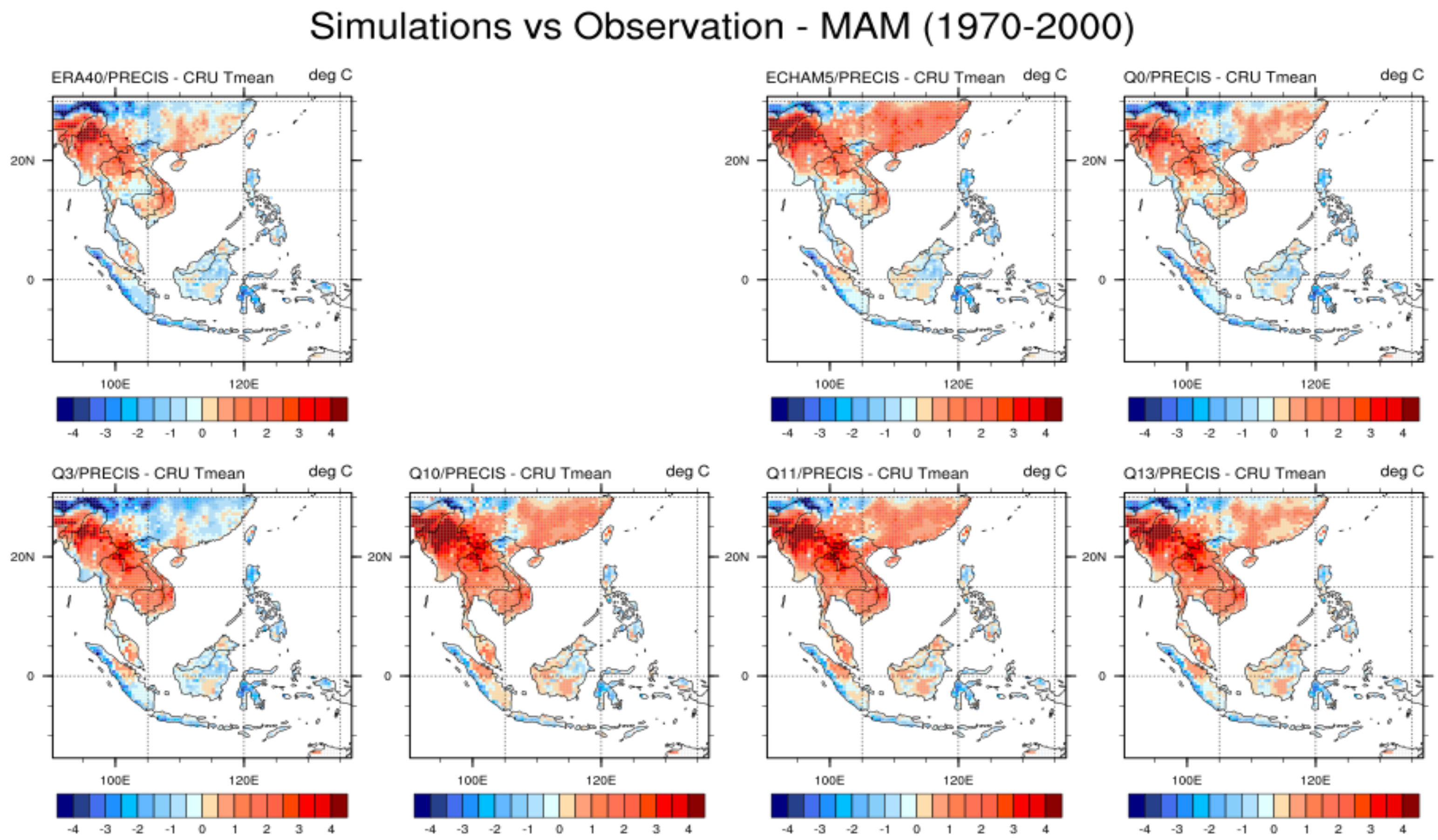
(f)

Biases magnitude: 1 – 2°C



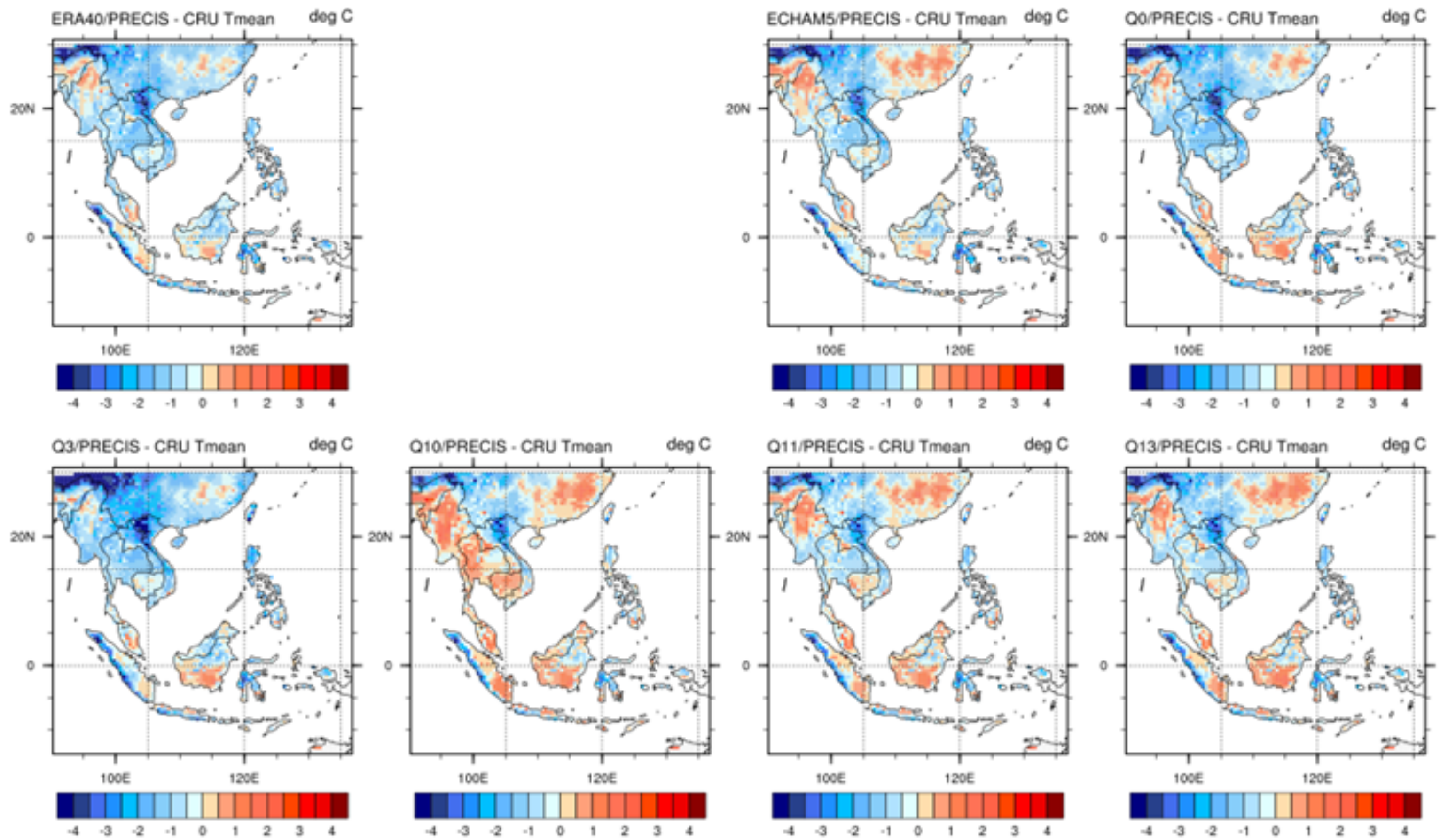
- For regions/countries near the equator, the inter-simulation variations are slightly larger compare to those at the higher latitudes.
- However, note that the differences between the OBS dataset are large.

Spatial distribution of temperature biases



- Larger biases (as high as 4°C) over the SEA continent during spring.
- Larger inter-simulation variations close to the northern boundary.

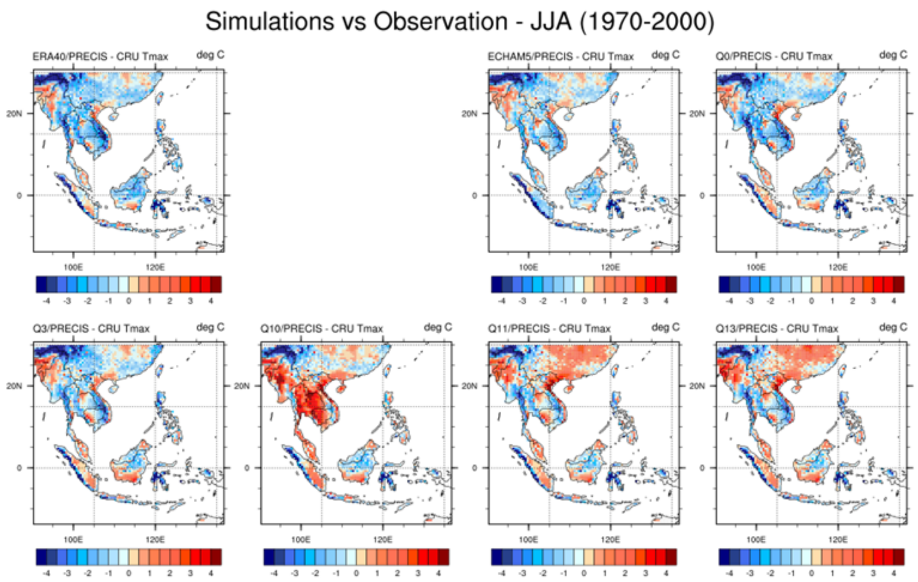
Simulations vs Observation - SON (1970-2000)



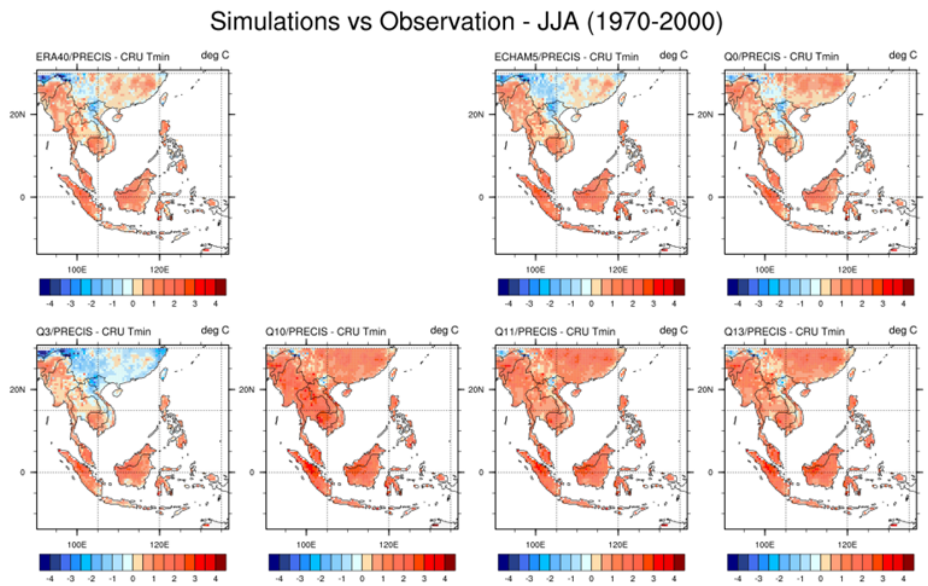
- Smaller biases during the autumn in general.
- The biases spatial distribution of the GCMs driven simulations are largely similar to those driven by ERA40 → suggests likely that error could be the result of RCM's deficiency.

Max/Min Temperature

Max temperature

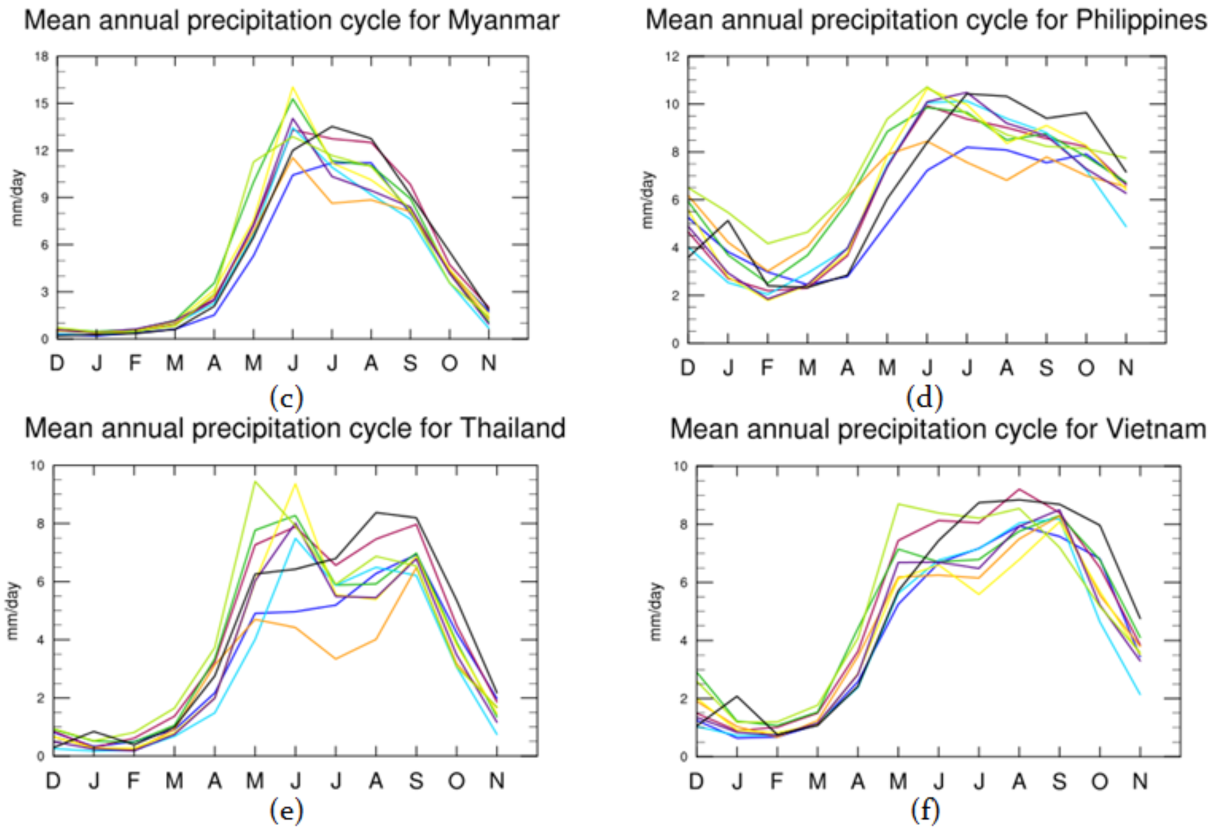


Min temperature



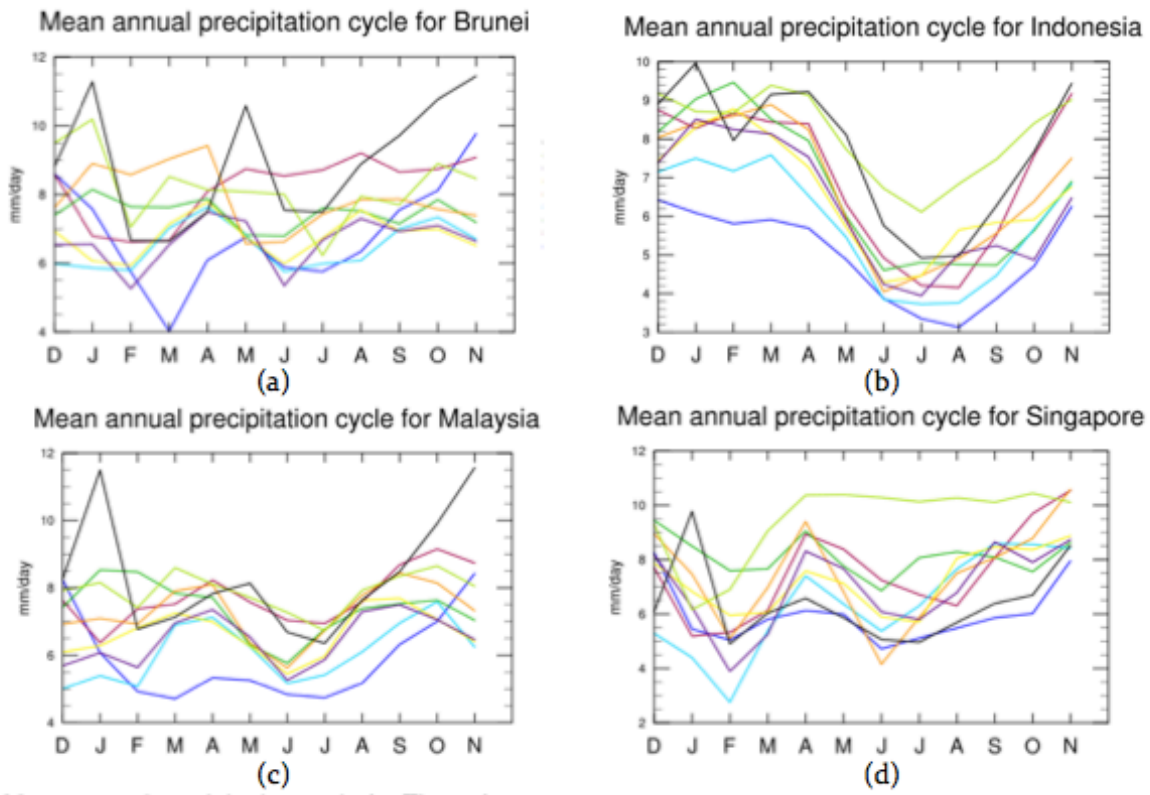
- Simulations produce cooler maximum temperature but warmer minimum temperature > Smaller diurnal temperature range.

Seasonal Cycle (Rainfall)



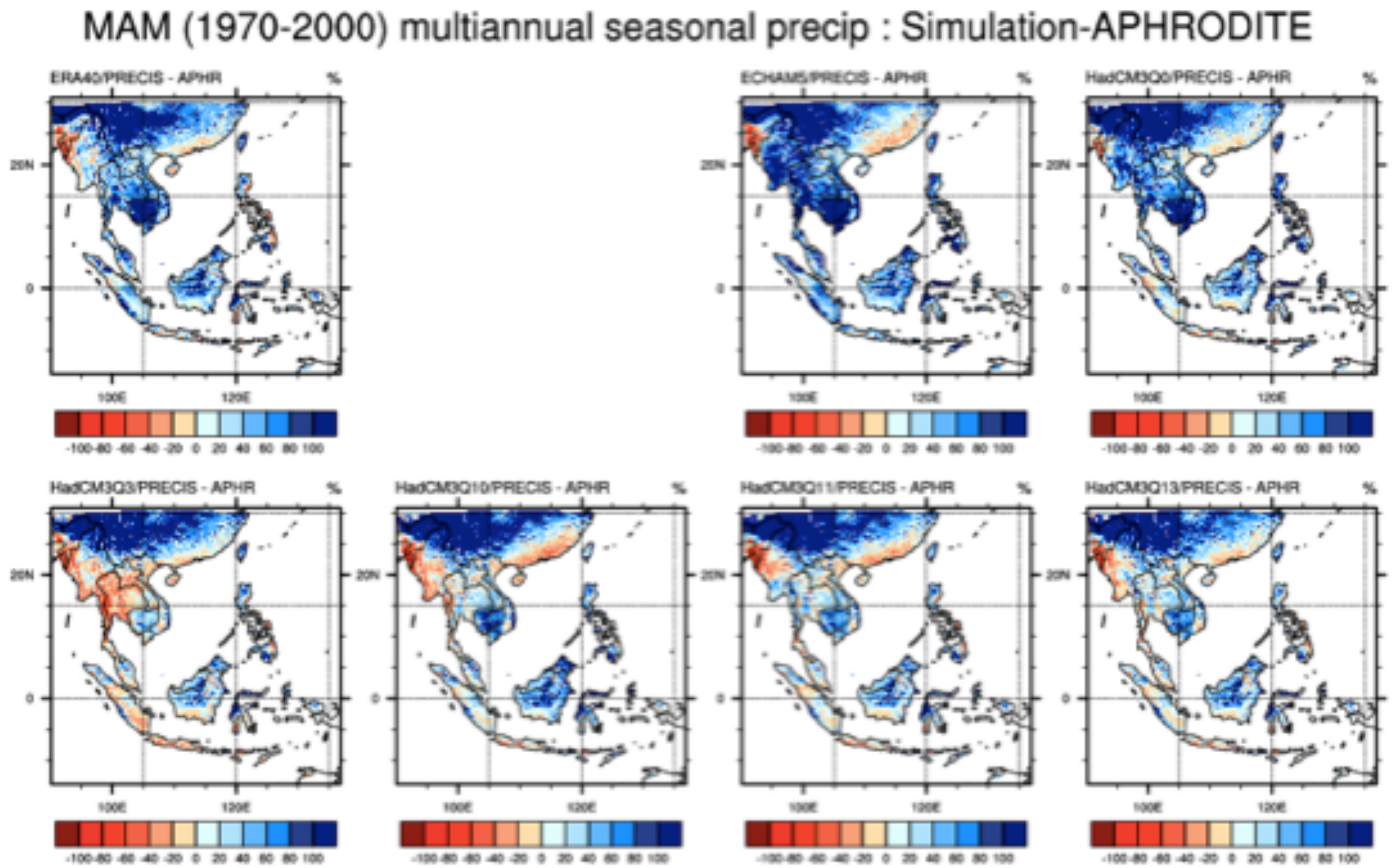
- The simulations generally reproduced reasonably the rainfall annual cycle over the continental SEA regions.

Seasonal Cycle (Rainfall)

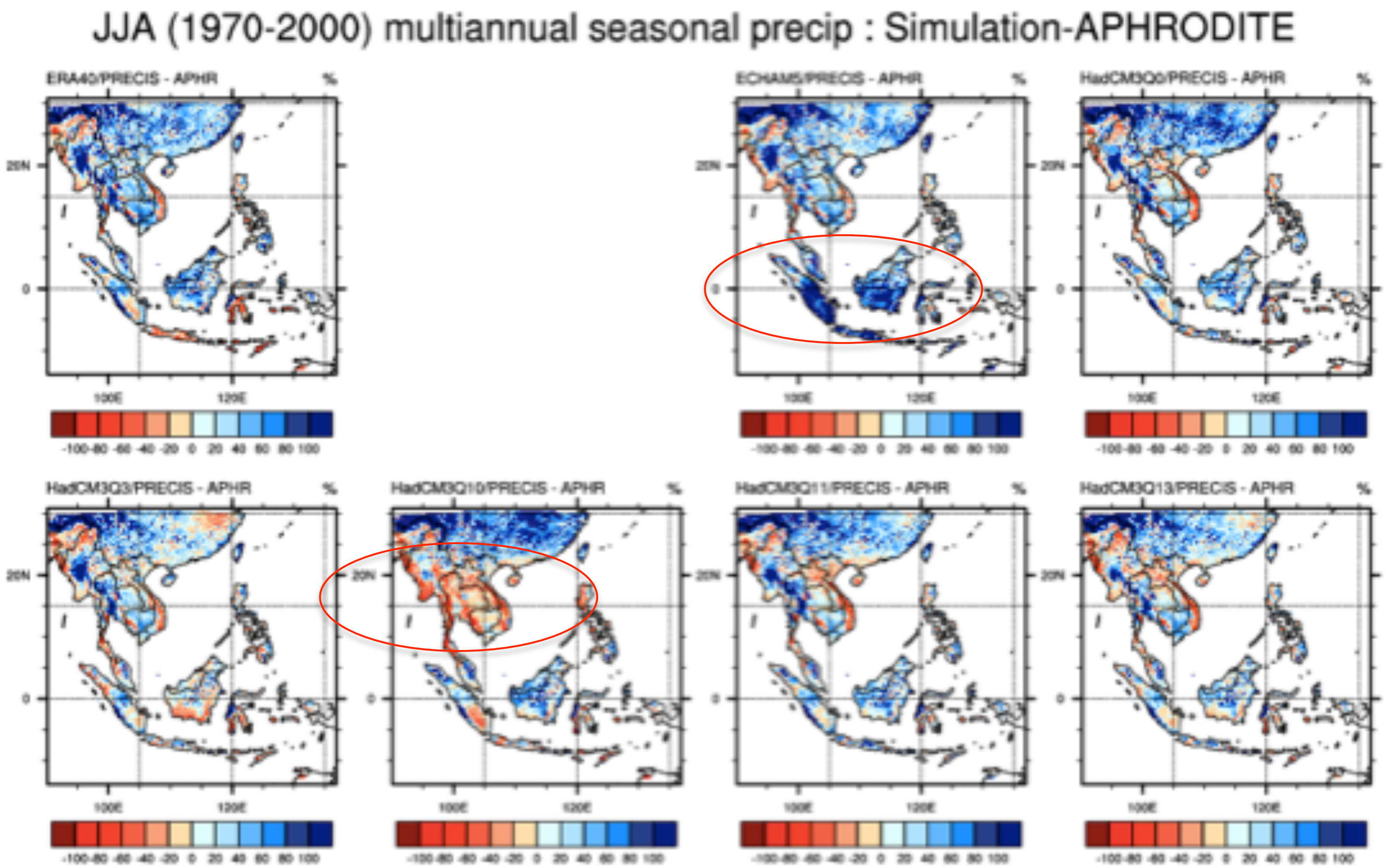


- Over the equatorial regions, the simulations tends to have larger inter-simulation variations and the quality of the simulations depend a lot on the driven model.

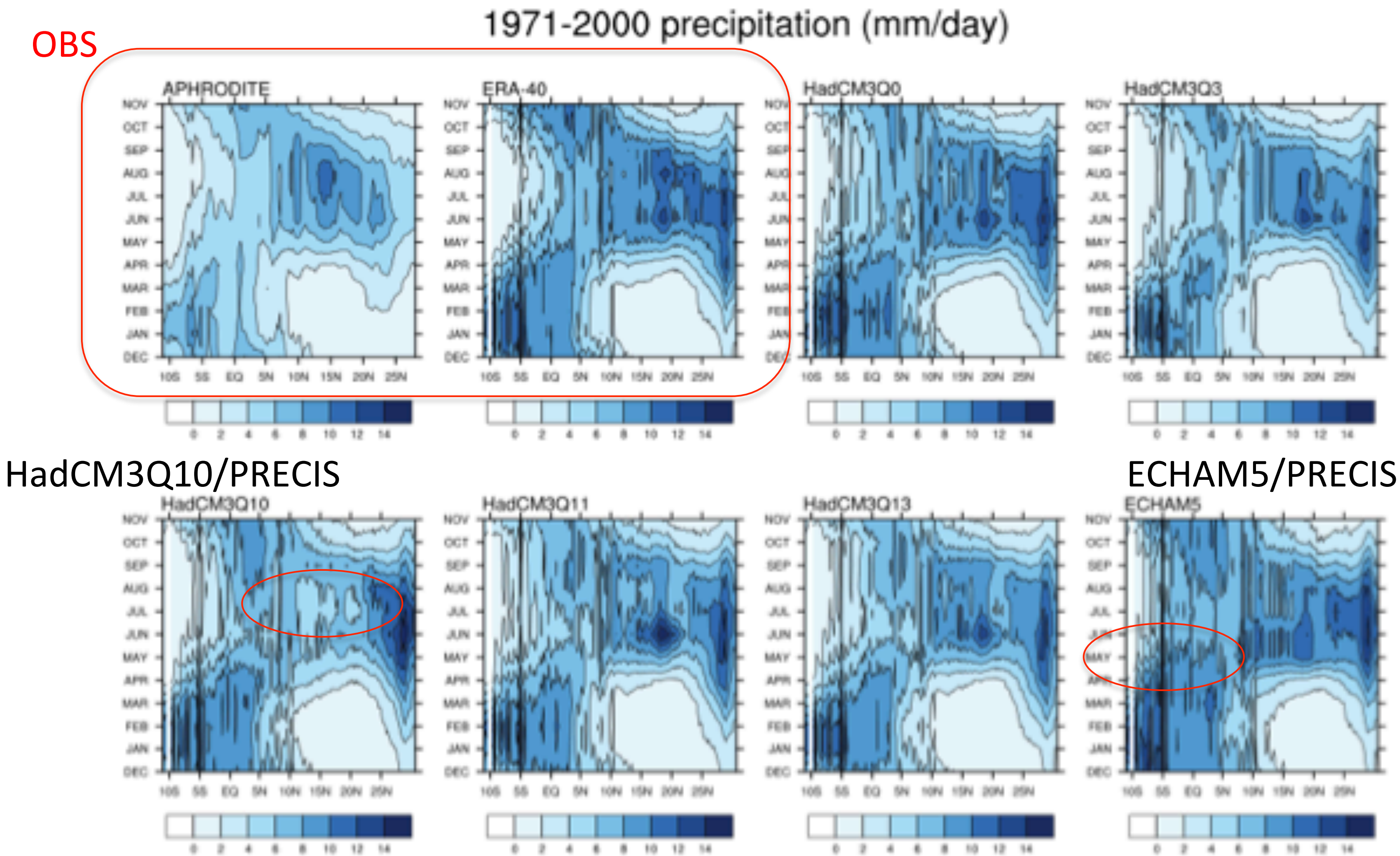
Spatial pattern of the rainfall biases



- The simulations produce moderate wet biases of about 20-40% through the years, except over the western part of the Continental S.E. Asia where the biases are largely negative.
- The simulation driven by ECHAM5 is commonly wetter.

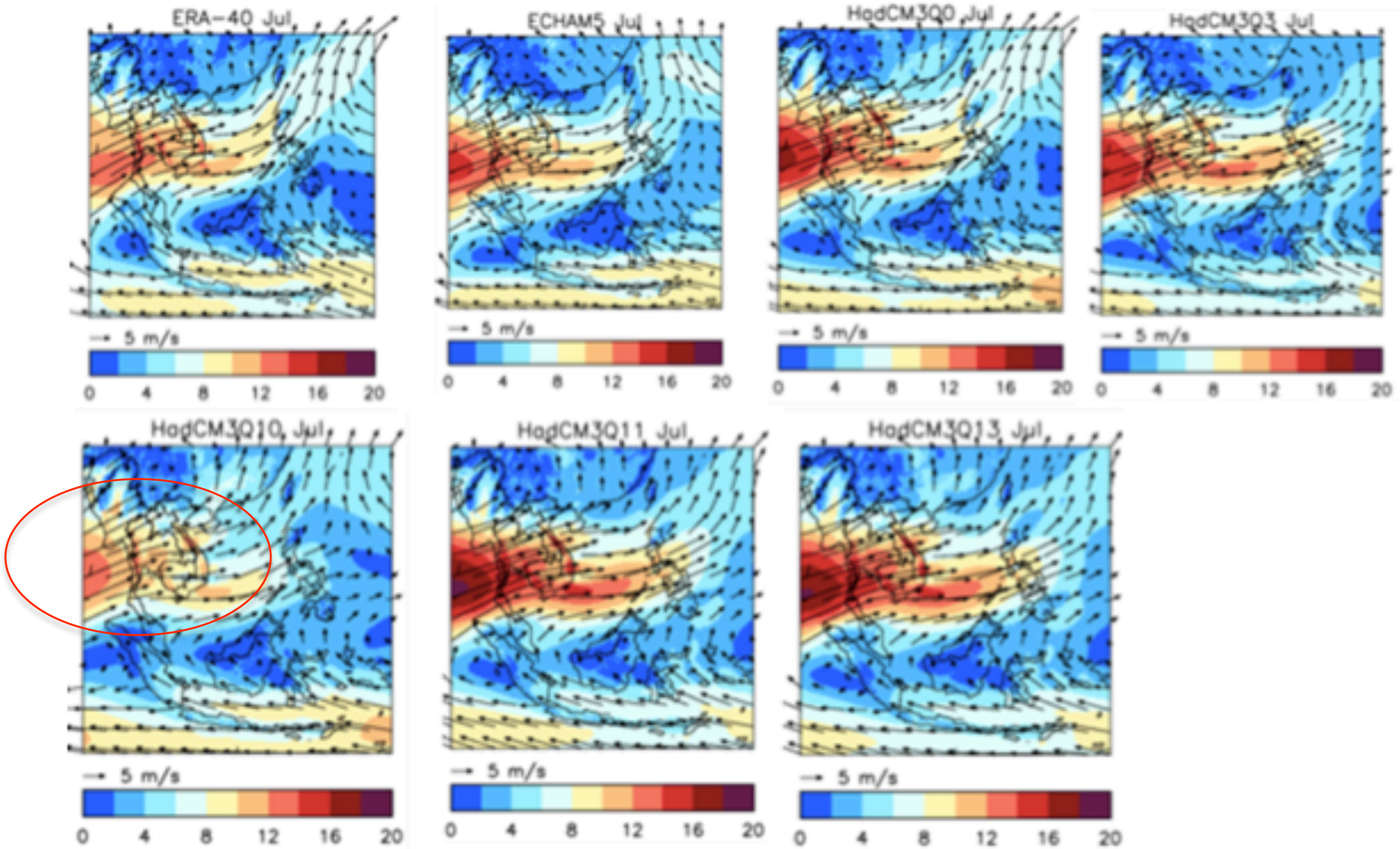


- During summer, HadCM3Q10 driven simulations produced much drier climate over the continental regions of the SEA.



- The HadCM3Q10/PRECIS simulations produced drier summer.
- The raining season close to the equator extended longer into May in the ECHAM5/PRECIS.

Summer circulation (850 hPa)



- Stronger circulation in the simulations, except that driven by HadCM3Q10.
- Hence drier summer monsoon in HadCM3Q10/PRECIS.

The future projection

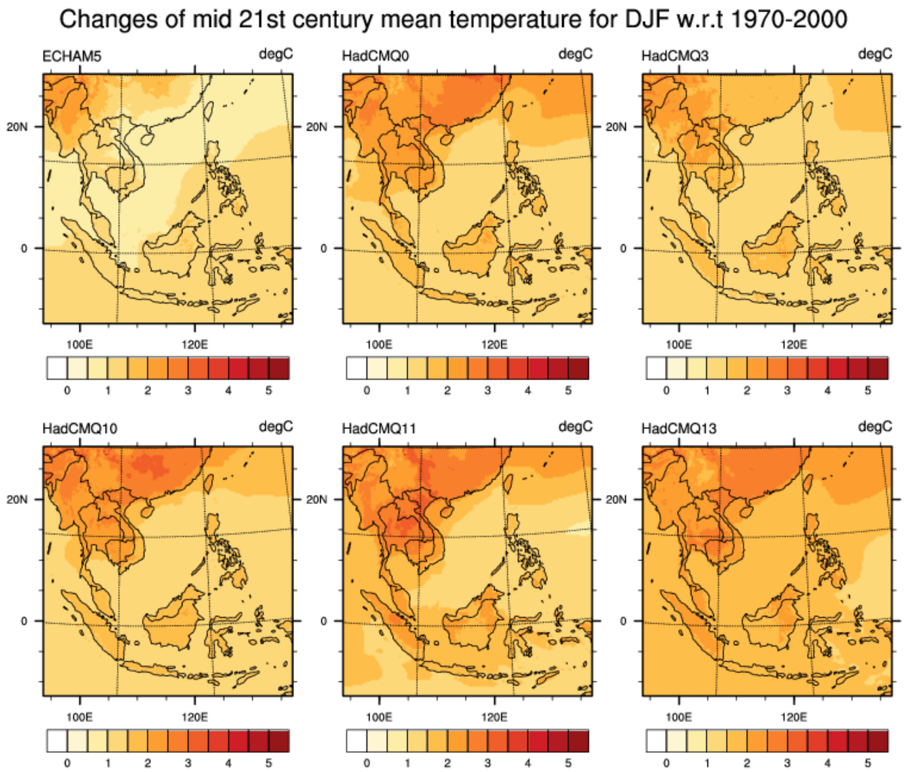
(A1B emission scenario)

Annual Temperature changes (summary from all the simulations)

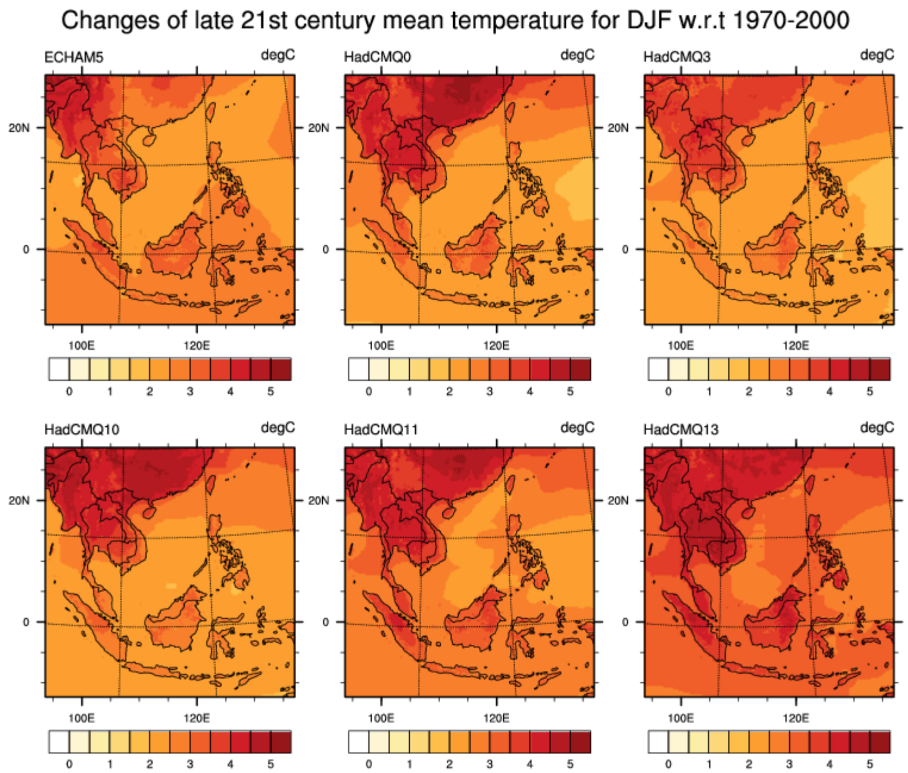
Country	Approx. mid-term change projections (°C)	Approx. long-term change projections (°C)	Significant projections
Cambodia	2.0 – 3.0	4.0 – 5.0	All
Laos	2.0 – 3.0	3.0 – 4.0	
Myanmar	Up to 2.0	Up to 4.0	
Philippines	Up to 1.5	Up to 3.0	
Thailand	2.0 – 3.0	4.0 – 5.0	
Vietnam	2.0 – 3.0	3.0 – 4.0	
Brunei	2.0 – 3.0	3.0 – 4.0	All
Indonesia	2.0 – 3.0	3.0 – 4.0	
Malaysia	2.0 – 3.0	3.0 – 4.0	
Singapore	Up to 1.5	Up to 3.0	
Timor Leste	1.5 – 2.0	3.0 – 4.0	

Spatial patterns of DJF mean temperature changes

Mid-century



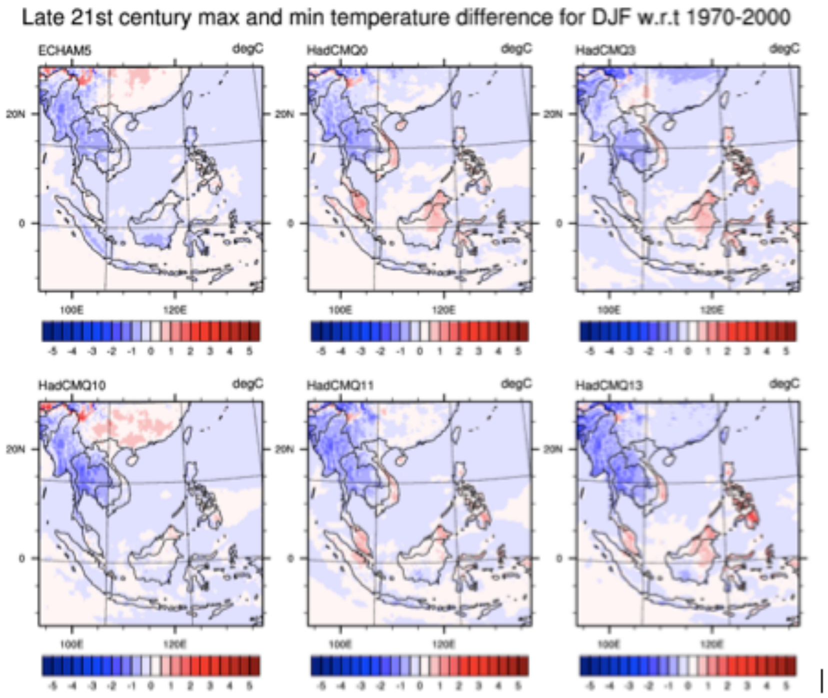
Late-century



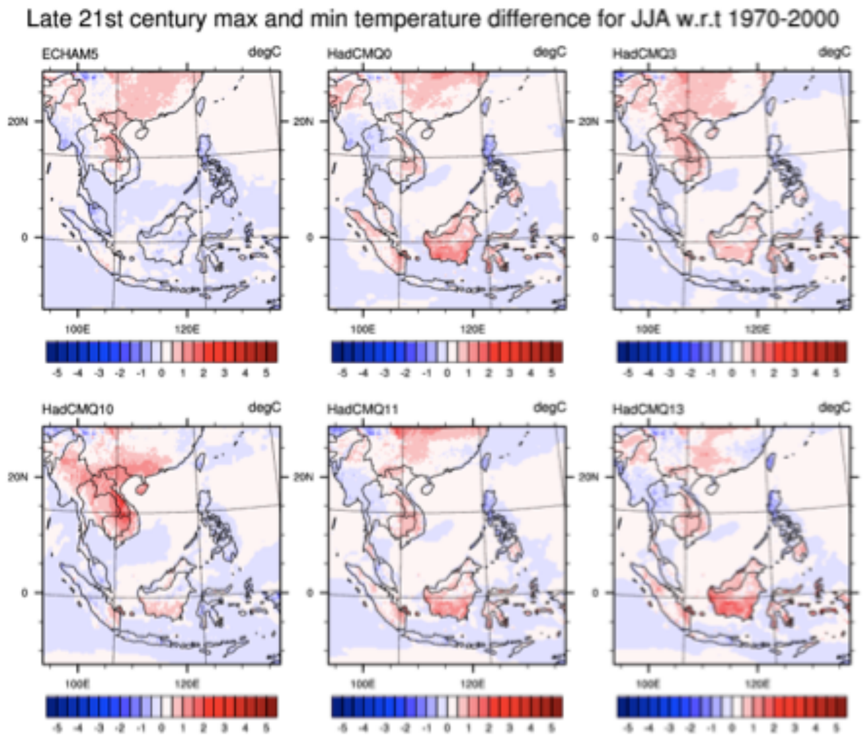
- Larger change signals over the continental regions.
- ECHAM5 – west of continental SEA (DJF)
- HadCM3Q – the eastern regions (DJF).

Spatial patterns of diurnal temperature changes (mid century)

DJF

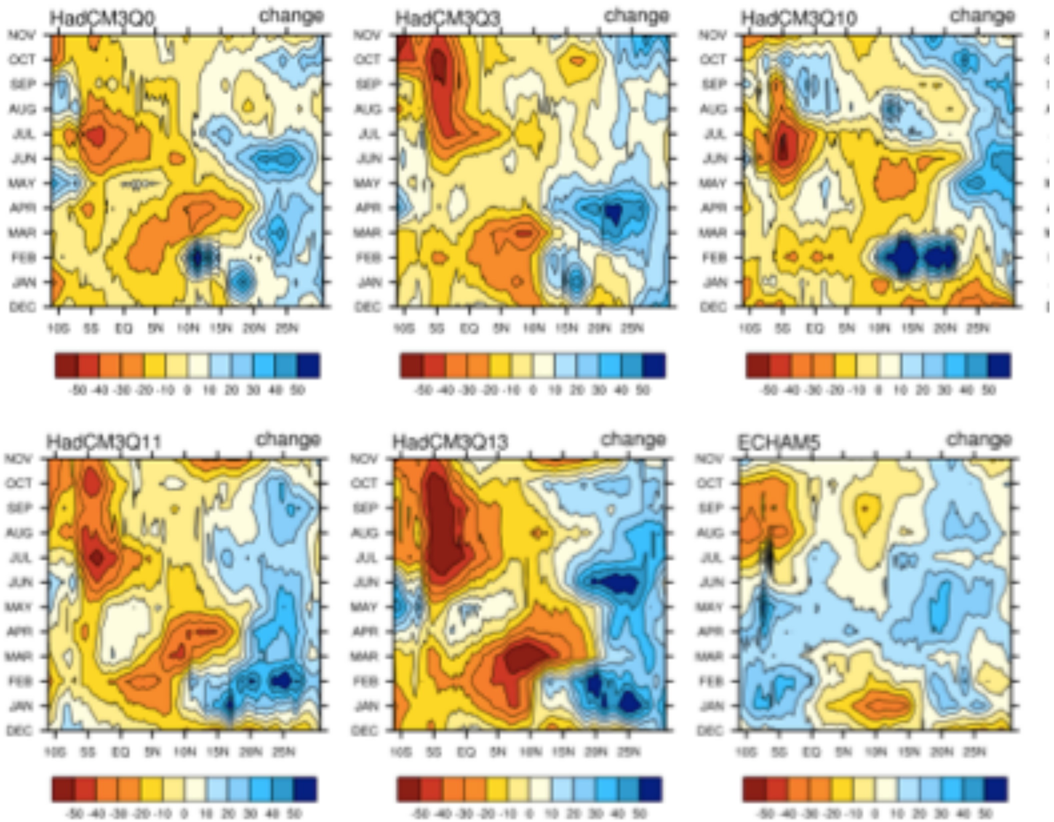


JJA

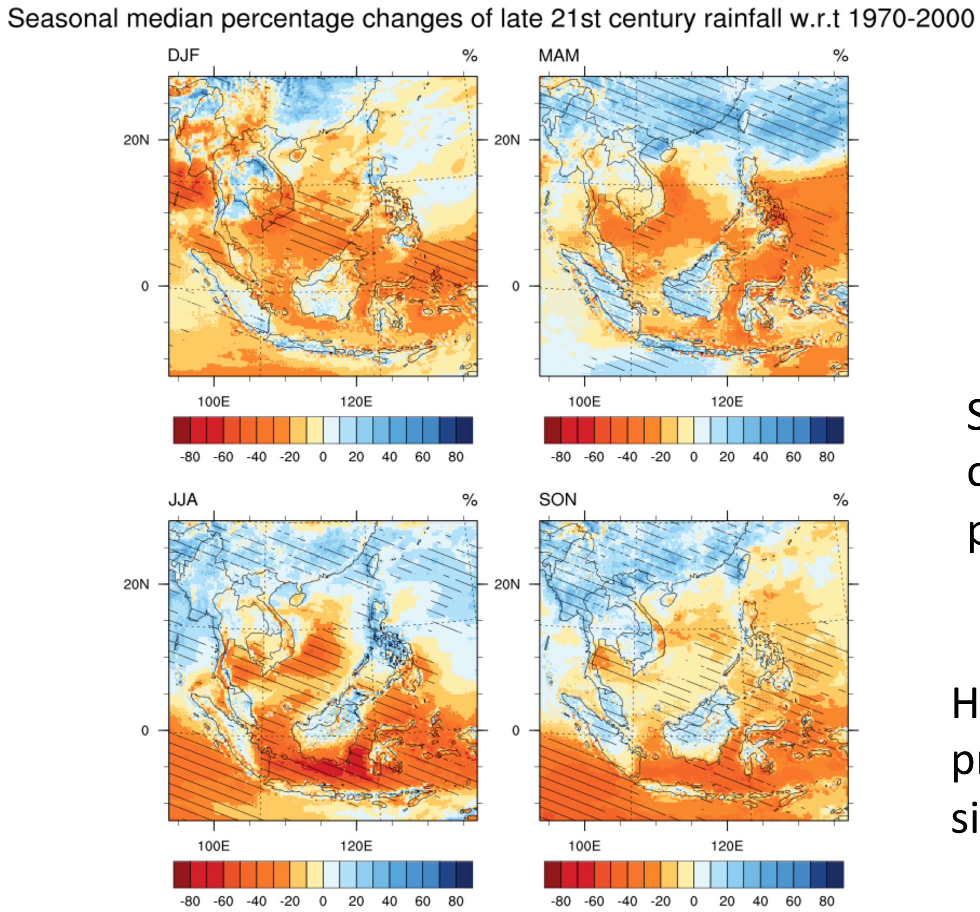


- Winter – diurnal temperature ranges were projected to reduced.
- Summer – the mean max temperature warms faster than the mean minimum temperature leading to larger diurnal temperature ranges.

Changes of precipitation (late of century)



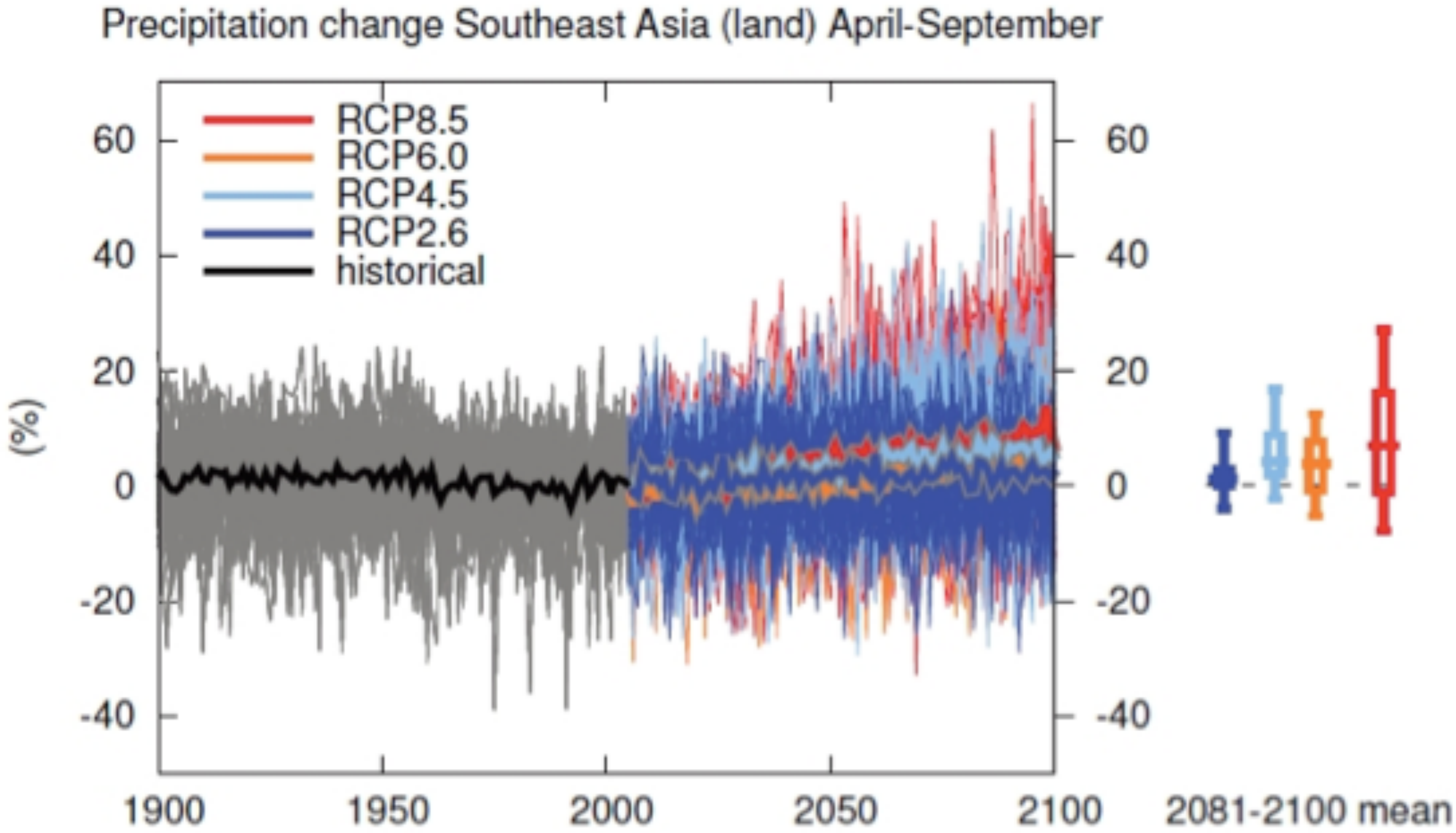
- Drier over regions close to equator but wetter conditions over the northern part of the domain.



Shading - Median values (% changes) from the 6 set of projections.

Hatching – areas where all 6 projections suggested identical sign of changes.

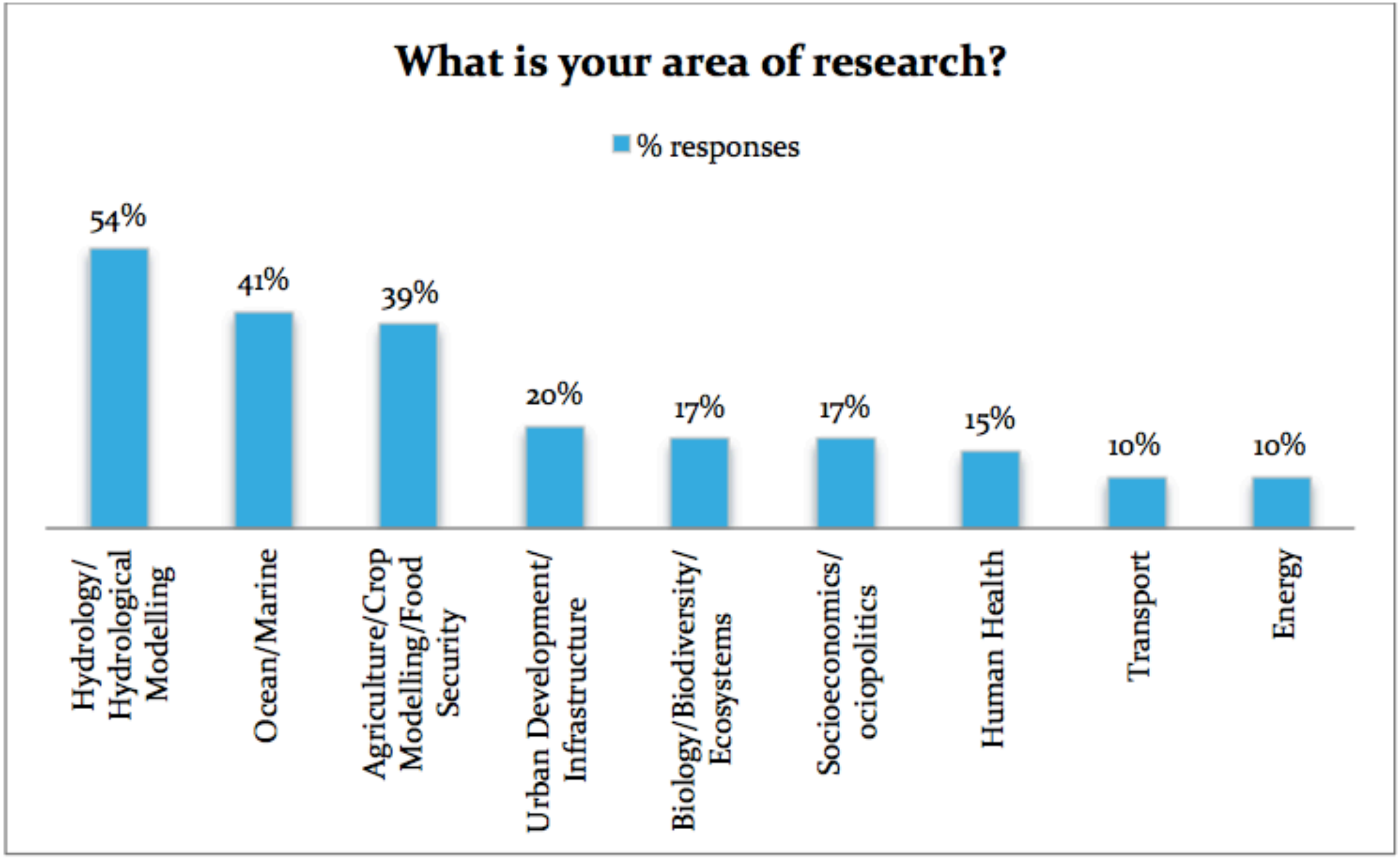
- There are clear north-south oriented opposite changing signal.
- However, over the land area all the projection suggested increasing

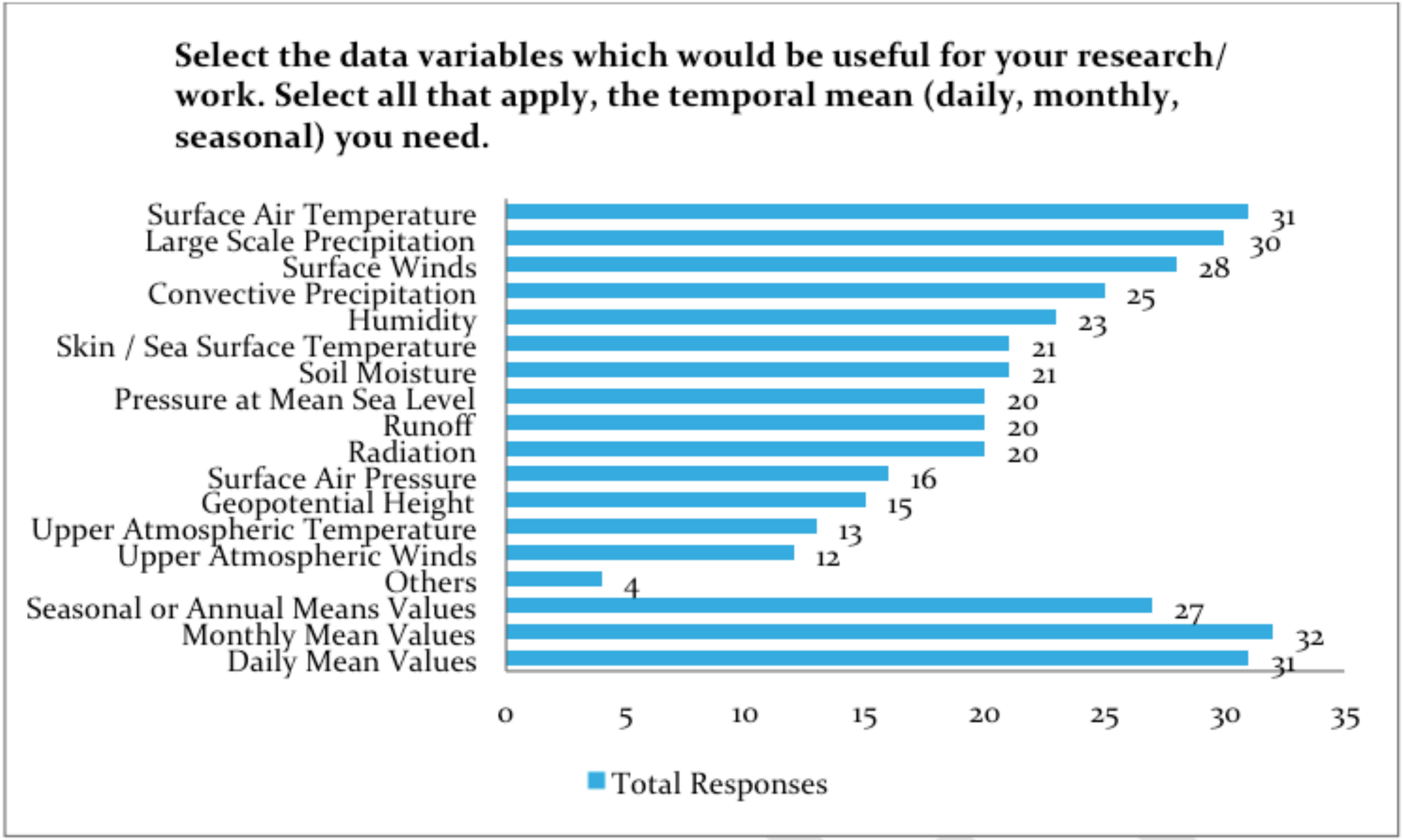


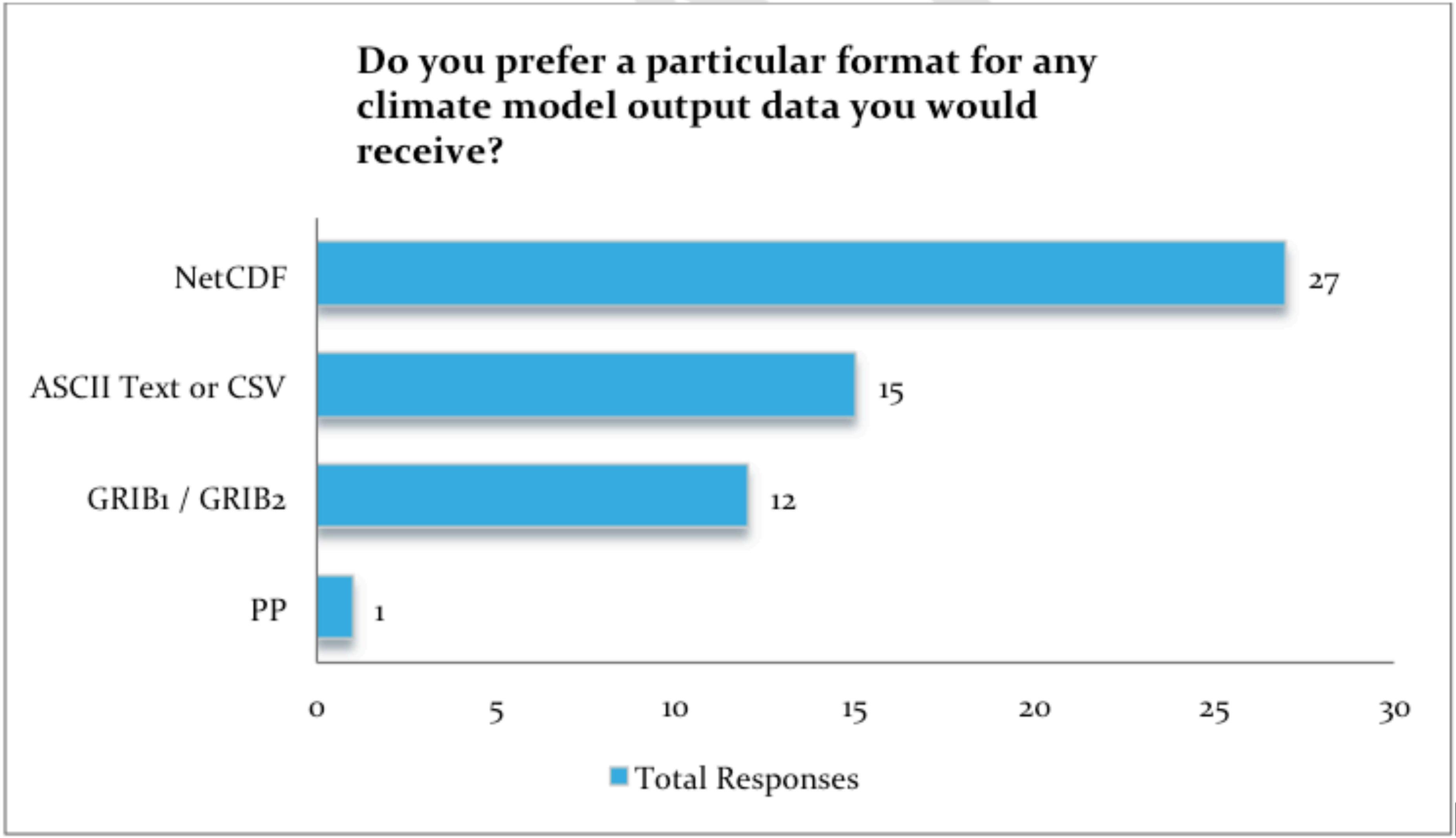
Precipitation change Southeast Asia (land) April-September
RCP8.5
RCP6.0
RCP4.5
RCP2.6
historical
(%)
60
40
20
0
-20
-40
1900
1950
2000
2050
2100
2081-2100 mean

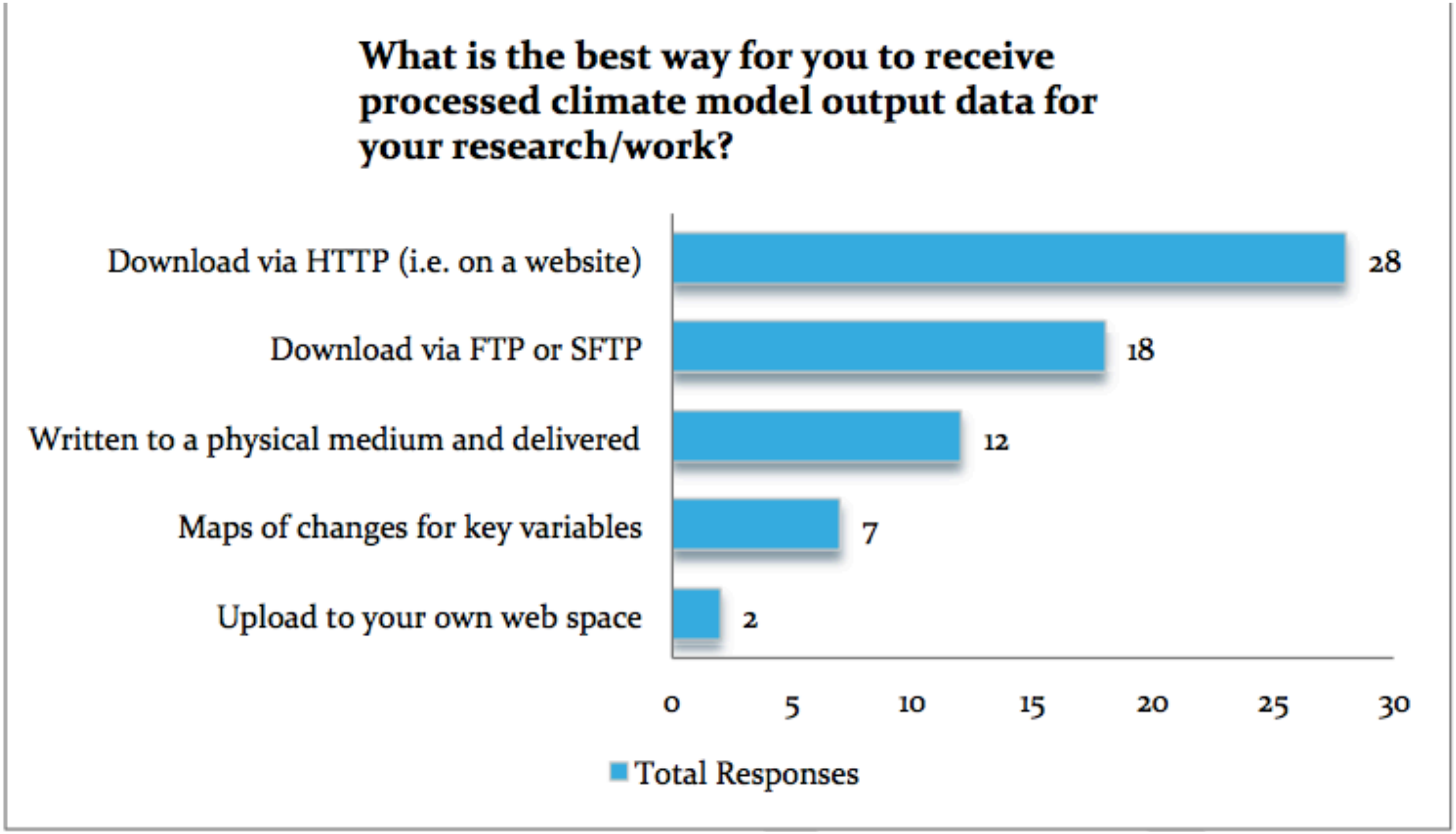
Interaction with potential users

- Questionnaire: 41 respondents from 25 national agencies

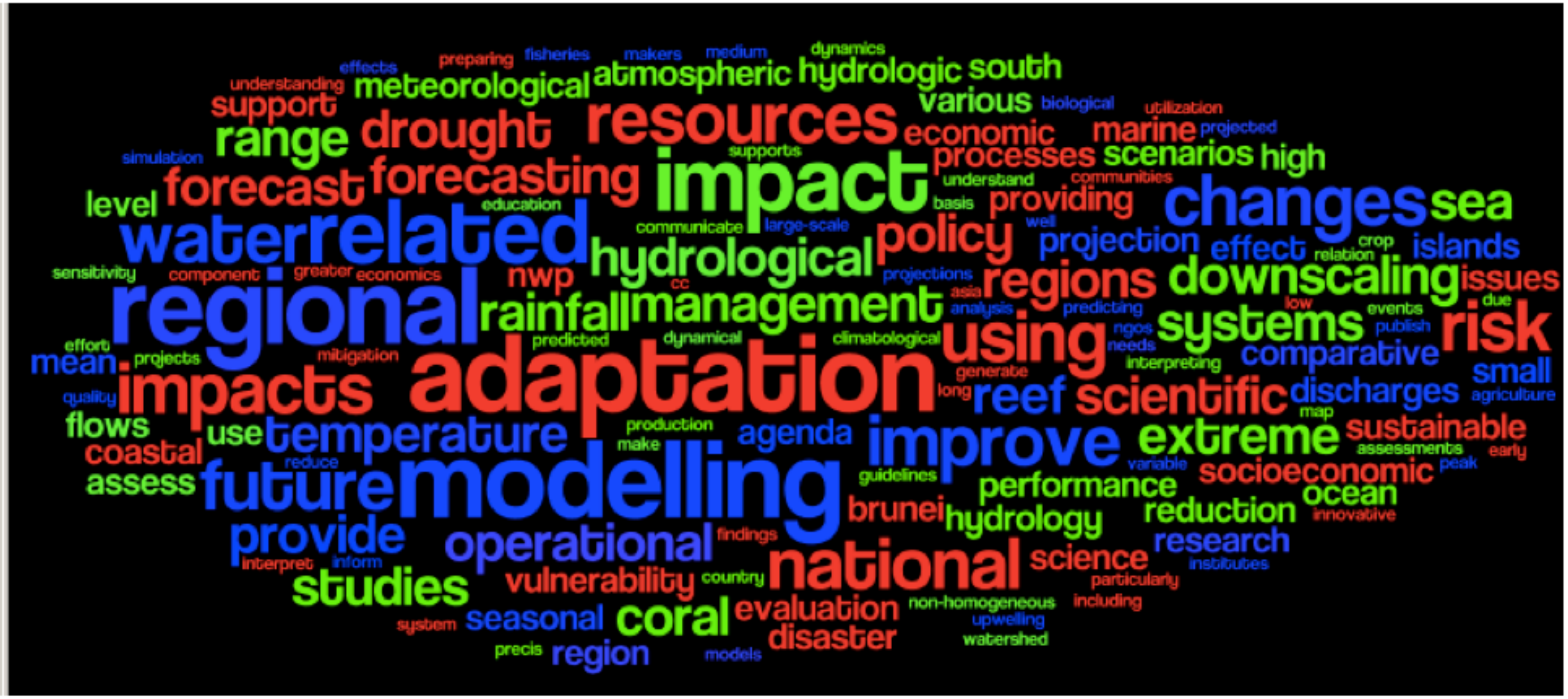



Select the data variables which would be useful for your research/ work. Select all that apply, the temporal mean (daily, monthly, seasonal) you need.
Surface Air Temperature 31
Large Scale Precipitation 30
Surface Winds 28
Convective Precipitation 25
Humidity 23
Skin / Sea Surface Temperature 21
Soil Moisture 21
Pressure at Mean Sea Level 20
Runoff 20
Radiation 20
Surface Air Pressure 16
Geopotential Height 15
Upper Atmospheric Temperature 13
Upper Atmospheric Winds 12
Others 4
Seasonal or Annual Means Values 27
Monthly Mean Values 32
Daily Mean Values 31
0 5 10 15 20 25 30 35
Total Responses


Do you prefer a particular format for any climate model output data you would receive?
NetCDF
ASCII Text or CSV
GRIB1 / GRIB2
PP
27
15
12
1
0
5
10
15
20
25
30
Total Responses


What is the best way for you to receive processed climate model output data for your research/work?
Download via HTTP (i.e. on a website)
28
Download via FTP or SFTP
18
Written to a physical medium and delivered
12
Maps of changes for key variables
7
Upload to your own web space
2
0
5
10
15
20
25
30
Total Responses

What are your research or work objectives?



Some Remarks

- Larger inter-simulation variations, especially over the equatorial regions.
- On the other hand, variations among OBS are large too -> better validation/comparison strategies?
- Temperature projection: larger changes over the land compare to the ocean.
- Changes: 2-4°C.
- Rainfall projection: north-south opposite signals.
- However, most of the land areas are projected to be wetter.
- Engaging the user community at early stage is crucial.

The END