THE UNIVERSITY OF NEW SOUTH WALES
SYDNEY • AUSTRALIA

NARCliM: NSW/ACT Regional Climate modelling project

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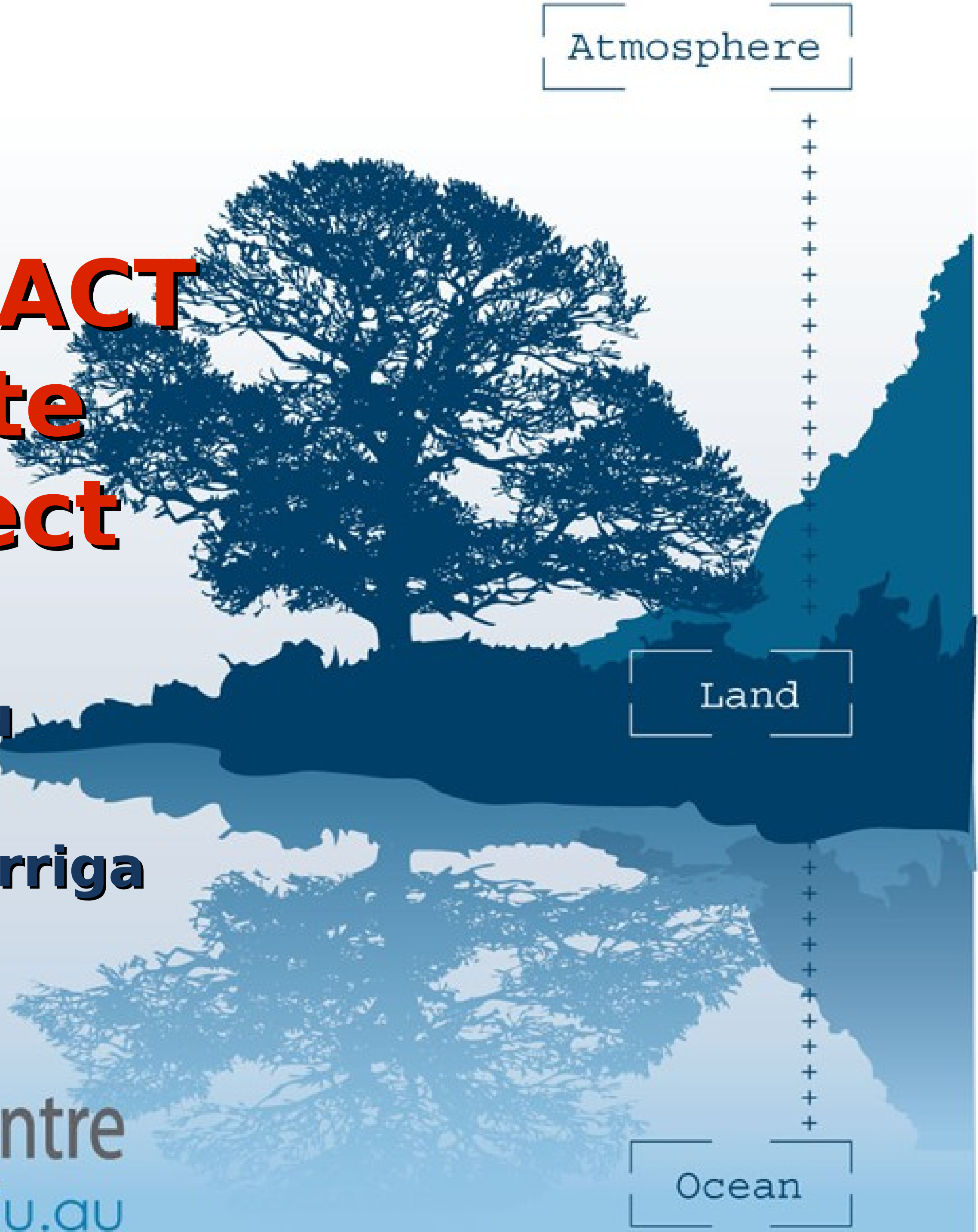

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www.ccrc.unsw.edu.au

Outline

- Austral-Asia CORDEX community
  - Groups and on going projects
- NARCliM. A regional climate model ensemble
  - Choosing the Global Climate Models
  - Choosing the Regional Climate Models
- What output will be produced?
- Questions

Austral-Asia CORDEX community

- NARCliM project (led by Jason P. Evans, *Climate Change Research Center*, NSW, Sydney Australia)
- Perth WRF-CORDEX project (led by Prof. Tom Lyons, *Murdoch University*, Perth, Western Australia, in "collaboration" with *UNSW-CCRC*, J. Kala):
  - _ Currently running: ERA interim, [1981-2010], CSIRO Mk3.5 GCM, [1970-1999] and [2030-2059] A2 scenario.
  - _ Future: ECHAM5 and MIROC3.2, [1970-1999] and [2030-2059] A2 scenario
- UNSW WRF-CABLE: (led by A. Pitman, *ARC Centre of Execelence for Climate Sciences*, Sydney, Australia)
  - _ Currently running: ERA interim, [1981-2010]
  - _ Future: CSIRO3.5, ECHAM5, MIROC3.2
- COSMO-CLM(-CLandM) Australia (led by M. Demuzere, *Regional Climate Studies Group from the Earth and Environmental Department*, KU Leuven, Belgium)
- CCLM (= COSMO-CLM) Australia (led by B. Rockel, *Institute of Coastal Research / Helmholtz-Zentrum Geesthacht*, Germany)
- Wiki-web page: http://cordex-australasia.wikidot.com/start

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NARCliM. Outline

- NSW / ACT regional climate projections
- Adaptation to climate change on NSW and ACT
- Steering committee combination of government agencies and Scientists
- ENSEMBLE of 12 simulations:
  - 4-GCMS (A2 scenario)
  - 3-WRF configurations
  - 3 time-windows: 1990-2010, 2040-2060, 2060-2080
  - Control period: NCEP re-analysis 1950-2010
  - 2 domains: AUS-44 (CORDEX, 50km), NSW/ACT (10km)

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NARCliM. Sterring Committee

- NARCliM designed by stake-holders and researches
  - 6 NSW and 2 ACT gov. agencies & CCRC (id J. Evans)
  - Ensure involvement of government agencies
  - Meet specifications end-users
  - Mutual interaction researchers-government
  - Ensure exploitation of results
  - Increase control of process/execution

NARCliM. Sterring Committee

- Faced issues:
  - Understanding of the technical challenges
  - Re-adjustments in the schedule
  - Variables required
  - File formats: netCDF → ASCII, CVS, GIS...
  - Projection issues
  - Acquisition of climatological 'knowledge'
  - Data management (600 TB)

NARCliM. Experiment setup

- Two domains of simulation
  - CORDEX AUS-44 as mother domain (50 km)
  - NSW/ACT (South-East Australia) at (10km)
  - Continuous runs (60 yrs for control runs, 20 yrs for GCMs)
  - SRES A2
  - 1 month spin-up
  - WRFv3.3 with clWRF+CCRC modifications
  - Spectral nudging on first domain

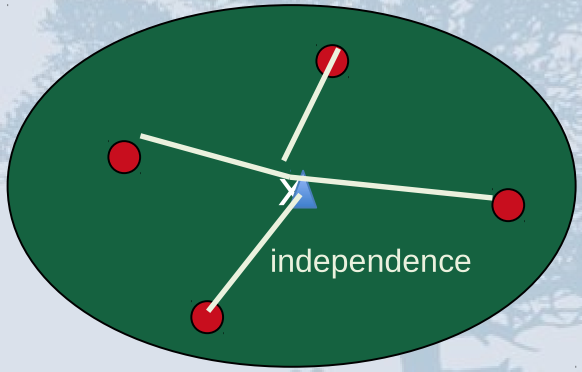
Choosing GCMs

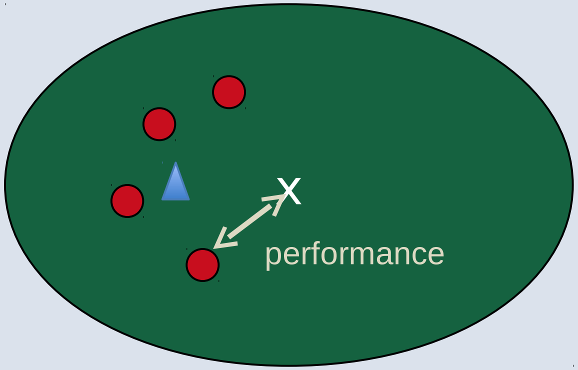
- A literature revision of all the analyses of the CMIP3 models for Australia was made
  - Addition of new studies into Meta-analysis of Smith & Chandler (2010)
  - 11 studies (A to K)
- A combined metric with the results of the studies was made

Assessment region		Australia							MDB		SE Australia	
Model	Frac. Dem.	A	B	C	D	E	F	G	H	I	J	K
GFDL-CM2.0	0.125	0	yes	2	671	yes			no	yes		252
EFCHAM5/MPI	0.222	0	yes	1	700	yes			no	no	0.79	173
NCAR CCSM3	0.273	0	no	2	677	no	4	6	no		0.68	245
….												

Choosing GCMs. Independence

- An independence selection criteria (Abramowitz and Bishop, 2010) ranks all GCMs





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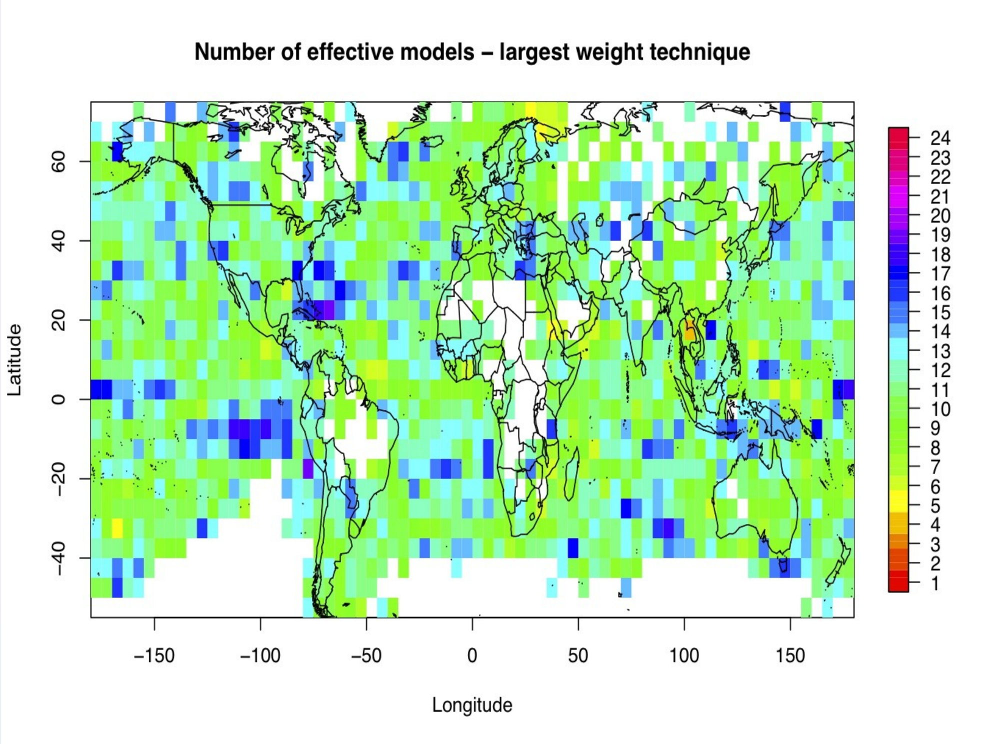
Choosing GCMs. Independence

- A measure of model independence based on the correlation of model errors.
- After some fancy maths we obtain an estimate of the independence of each model and hence a number of effective models.



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Choosing GCMs

- Projected future changes in precipitation and temperature are used to group GCMs together

models	temperature	precipitation	average	rank
miroc3_2_medres	0.3525	0.0364	0.3889	1
ukmo_hadgem1	0.1361	0.0694	0.2055	2
inmcm3_0	0.1605	0.0436	0.2041	3
gfdl_cm2_0	0.0729	0.1078	0.1807	4
mpi_echam5	0.0704	0.0921	0.1625	5
mri_cgcm2_3_2a	0.0624	0.0847	0.1470	6
miub_echo_g	0.0868	0.0414	0.1282	7
gfdl_cm2_1	0.0290	0.0799	0.1090	8
cccma_cgcm3_1	0.0233	0.0733	0.0966	9
ukmo_hadcm3	0.0331	0.0602	0.0932	10
csiro_mk3_5	0.0059	0.0860	0.0919	11
csiro_mk3_0	0.0398	0.0503	0.0901	12
ncar_ccsm3_0	0.0091	0.0726	0.0817	13
cnrm_cm3	0.0061	0.0513	0.0575	14

- GCMs that perform well and are independent based on present data, and that span the future changes projected by all GCMs are chosen. The first 4 GCMs were not available to run WRF, second set is used
- Final selection: MIROC, ECHAM5, CCCMA, CSIRO mk3.5

Choosing RCMs

- 36 WRF model configurations are tested: cu, mp, lw/sw ra and pbl
- 7 precipitation + 1 extreme fire weather events are used (J. Evans, 2011)
- Analysis is based on gridded observed: precipt., min/max temp. and sfp
- Independence criteria is also applied

WRF	pbl/sfclay	cu	mp	sw/lw rad
R1	MYJ/ETA	KF	WDM5 class	Dudhia/rrtm
R2	MYJ/ETA	BMJ	WDM5 class	Dudhia/rrtm
R3	YSU/MM5	KF	WDM5 class	CAM/CAM

Output

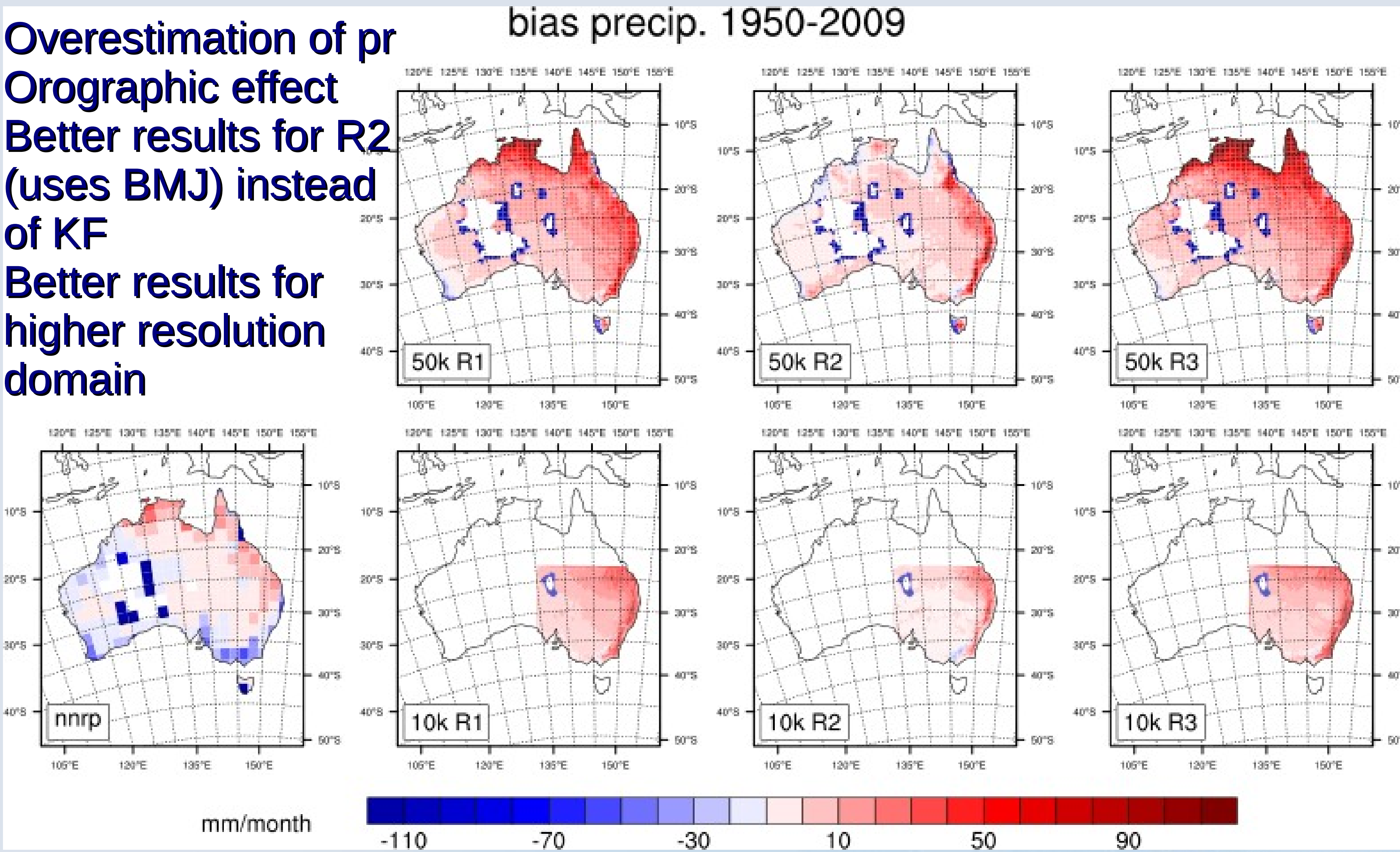
- Output will meet CORDEX specifications
- Modified/enhanced version of post-process from *Universidad de Cantabria*, Santander, Spain
- Issues with projection and visualization
- Web portal with open access for data delivery will be developed at the end of the project CliMDDIR website www.climddir.org

Preliminary control-period results

- NCEP re-analysis driven simulations (1950-2009)
- Validated with AWAP gridded observational-based (Bureau of Meteorology, 5 km resolution entire Australia)
- Mean precipitation, minimum and maximum temperature for both domains.

Preliminary results

- Overestimation of pr
- Orographic effect
- Better results for R2 (uses BMJ) instead of KF
- Better results for higher resolution domain



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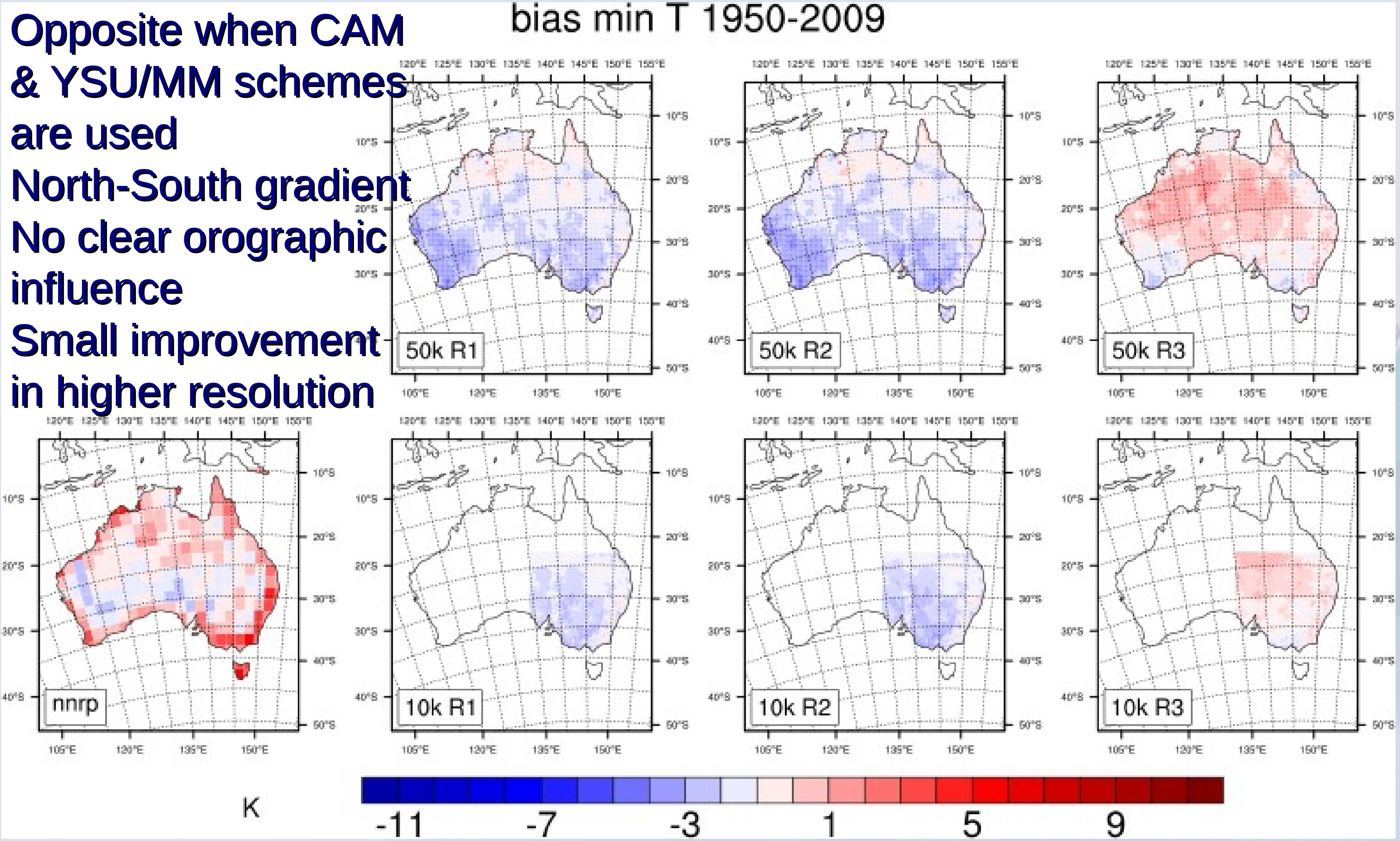
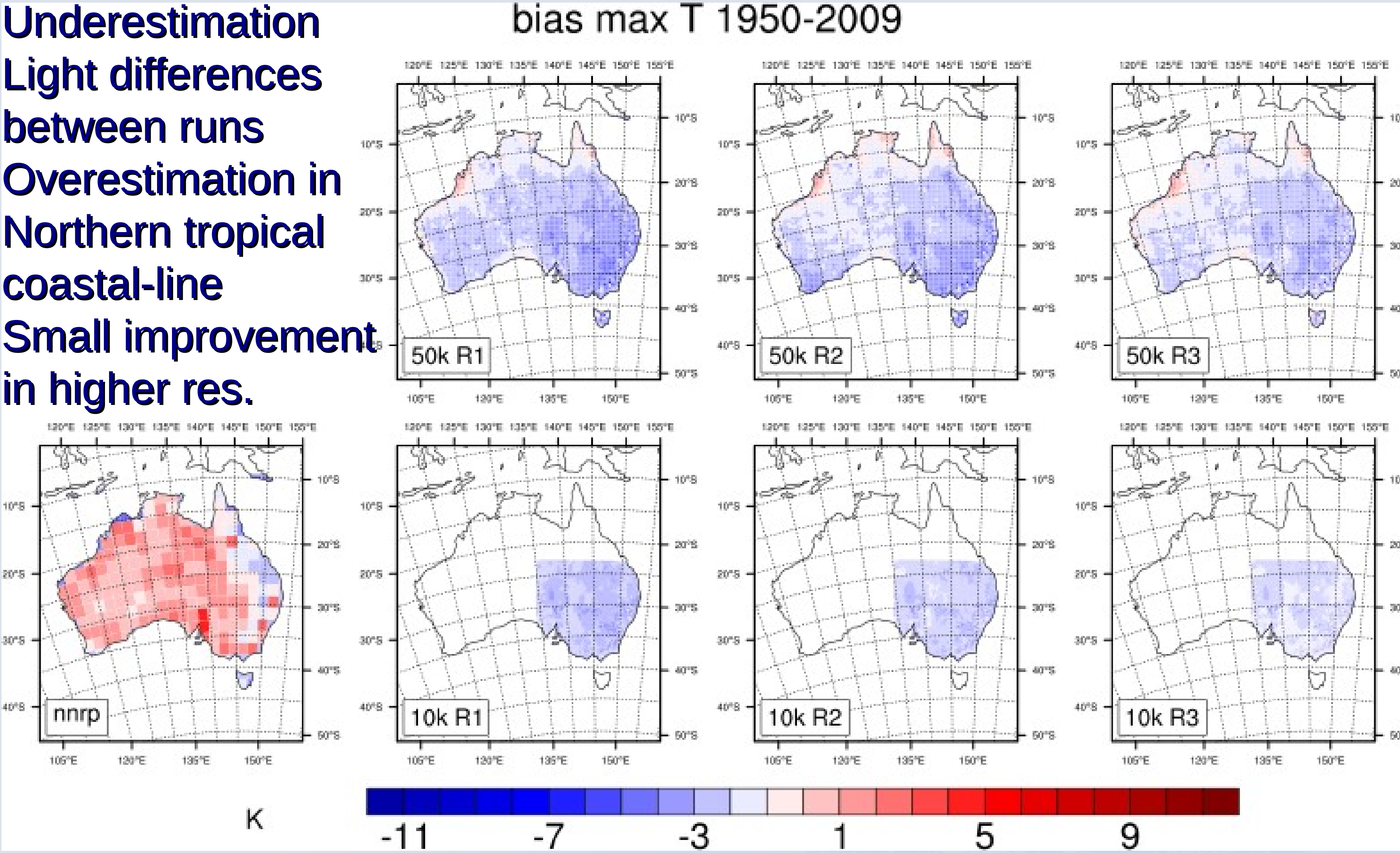
Preliminary results

- Opposite when CAM & YSU/MM schemes are used
- North-South gradient
- No clear orographic influence
- Small improvement in higher resolution



Preliminary results

- Underestimation
- Light differences between runs
- Overestimation in Northern tropical coastal-line
- Small improvement in higher res.

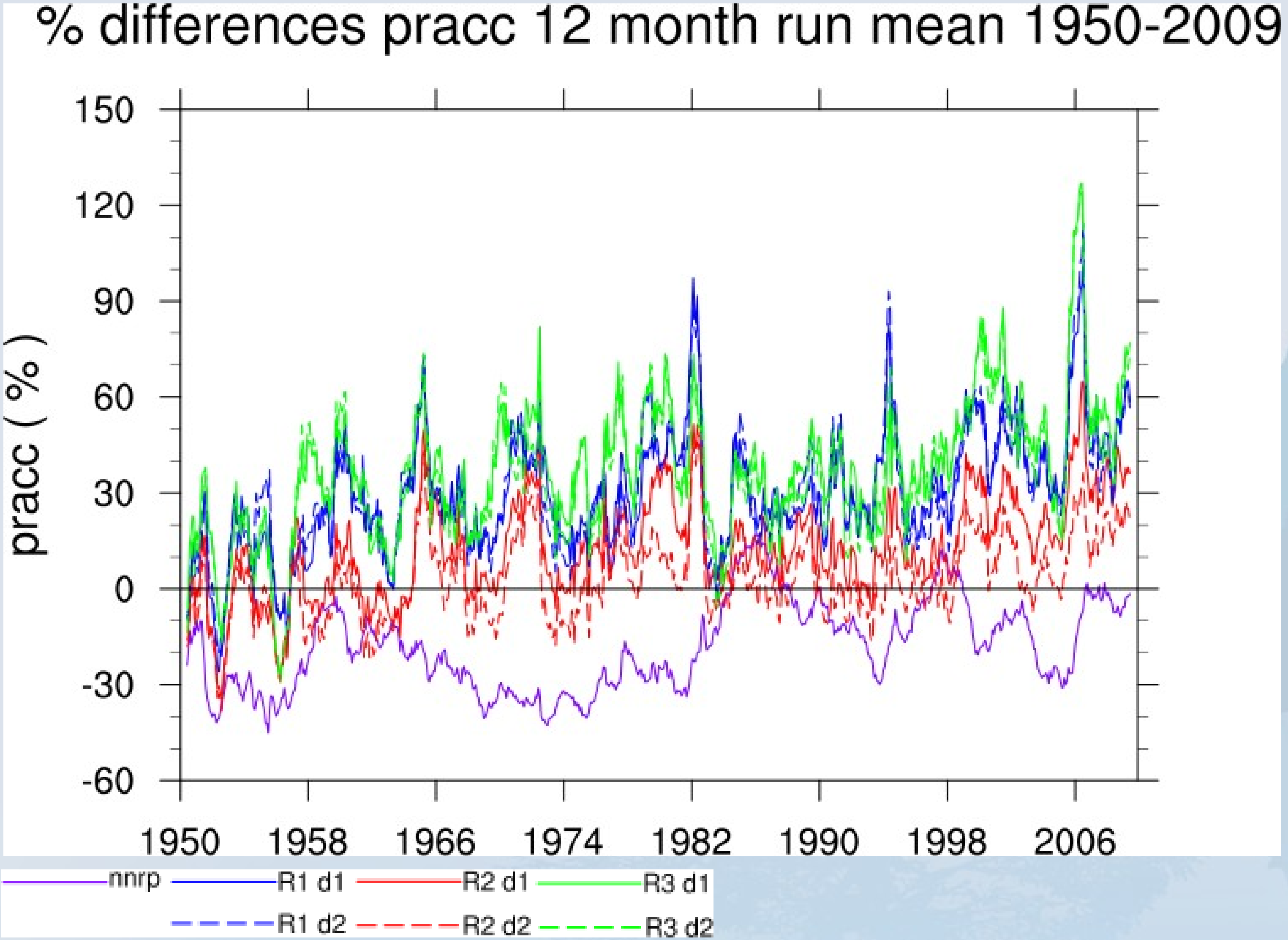


Preliminary results

- Temporal evolution is analyzed in a lat/lon box area
- Spatial averaged values are computed for the entire area
- Temporal smoothed time-series are computed using a 12-month moving average filter
- Evolution of differences with observation are presented

Preliminary results

* Overestimation all simulations
* No differences between domains
* Increasing trend in all runs
* Best results with R2 (BMJ)



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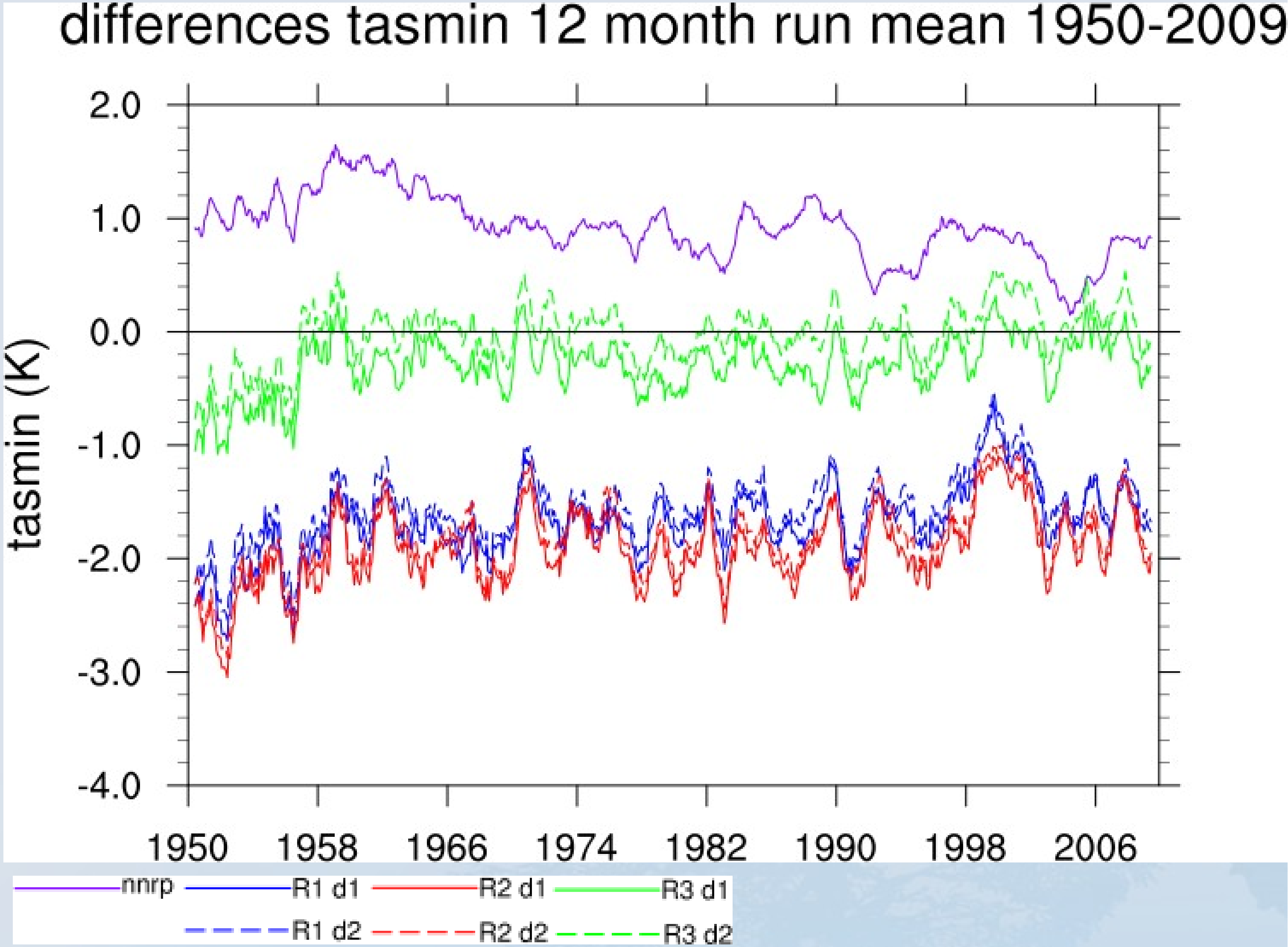
Preliminary results

* Differences between R1,R2 (MYJ/ETA) and R3 (YSU/MM5)
* No differences between resolutions
* Improvement on time
* WRF runs with different trend than re-analysis



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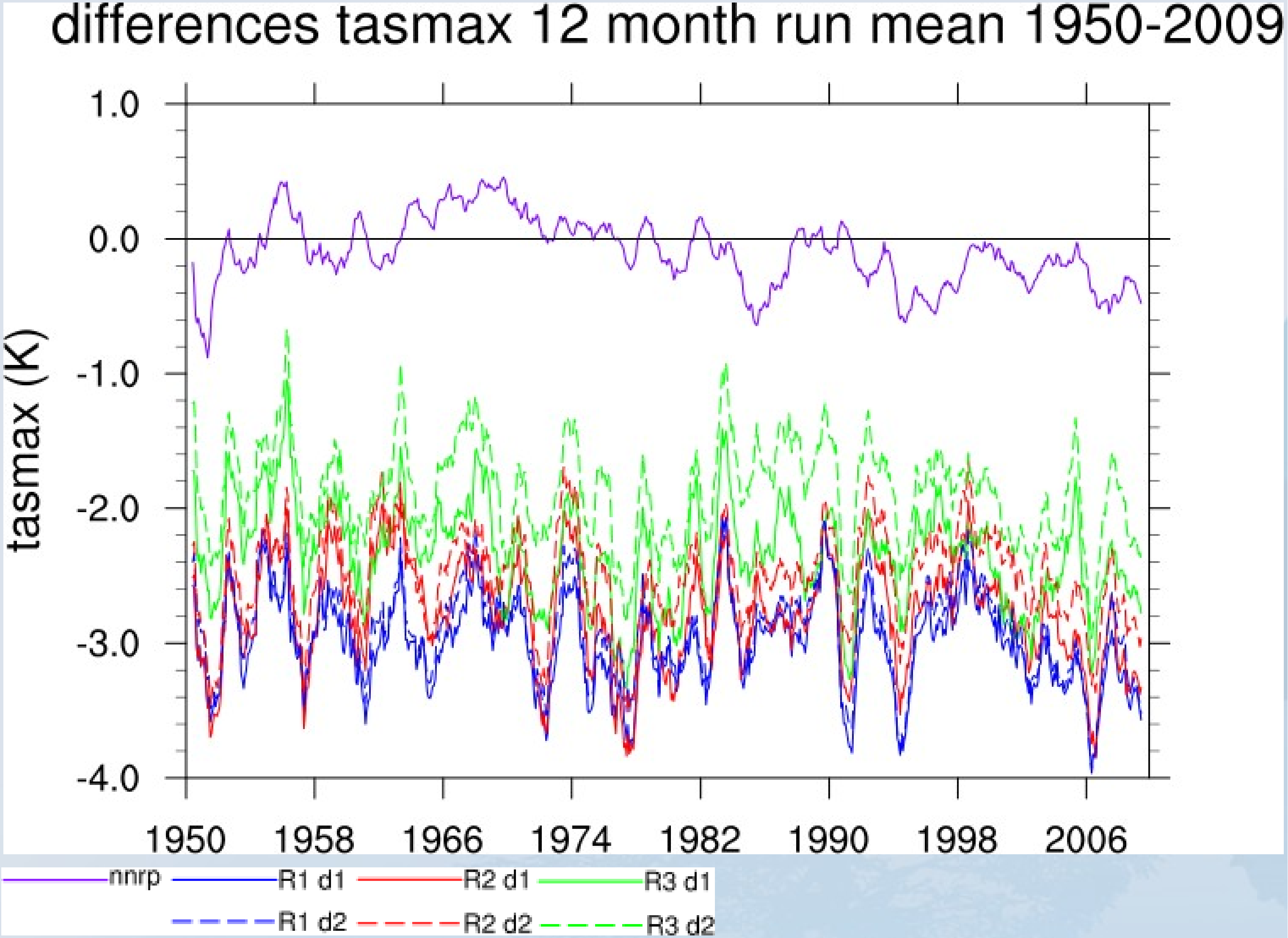
Preliminary results

* Underestimation
* Best results from re-analysis
* Best results with R3 (YSU/MM5)
* Wider variability



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CONCLUSIONS

- Steering committee as mixture of scientists and stakeholders positive for all the aspects of the project
- Preliminary results show:
    - Improvement from NCEP
    - No single best configuration for WRF
    - Spatial differences on bias
    - Temporal evolution on differences with observations
    - Consistent bias for max. temperature
    - BMJ better for precipitation
    - YSU/MM5 better for temperature

- More information: http://www.ccrc.unsw.edu.au/NARCliM/