Impact of horizontal resolution changes on the simulated rainfall bias over the Maritime Continent

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(With special thanks to Faina Tseitkin and Martin Dix)

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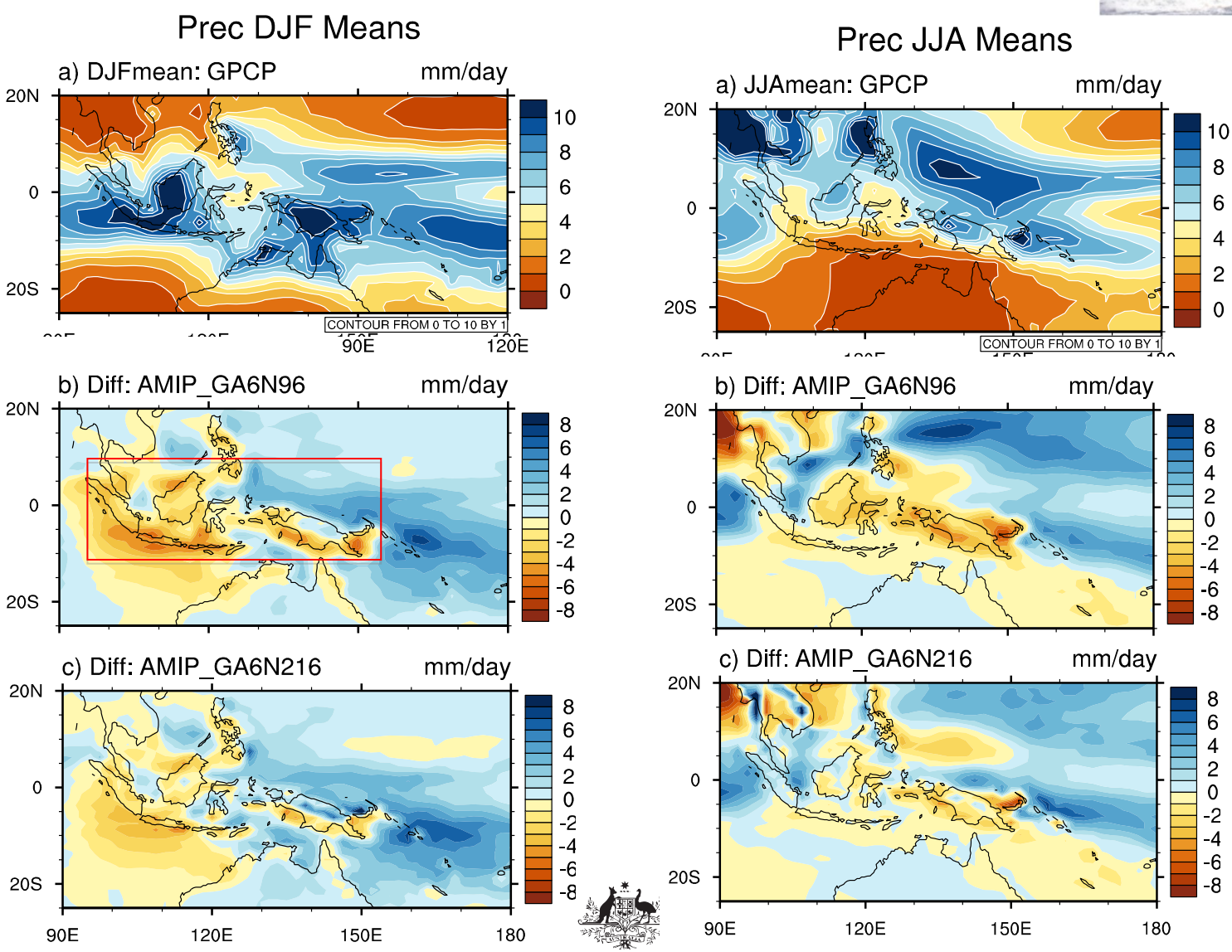
Model simulations and analyses

- **Two 30-yr AMIP experiments (1982-2011):**
  - UM 8.5 (GA6 configuration) with **N96**L85 resolution
  - UM 8.5 (GA6 configuration) with **N216**L85 resolution

- **Analyses of simulated rainfall:**
  - Rainfall bias in AGCMs
  - Moisture budget analysis
  - Joint Probability distributions (regime sorting)
  - Dynamic or thermodynamic controls?

- **The Maritime continent plays an important role in:**
  - The global hydrological and energy cycles
  - Global teleconnections

Rainfall bias in the UM (w.r.t. GPCP)



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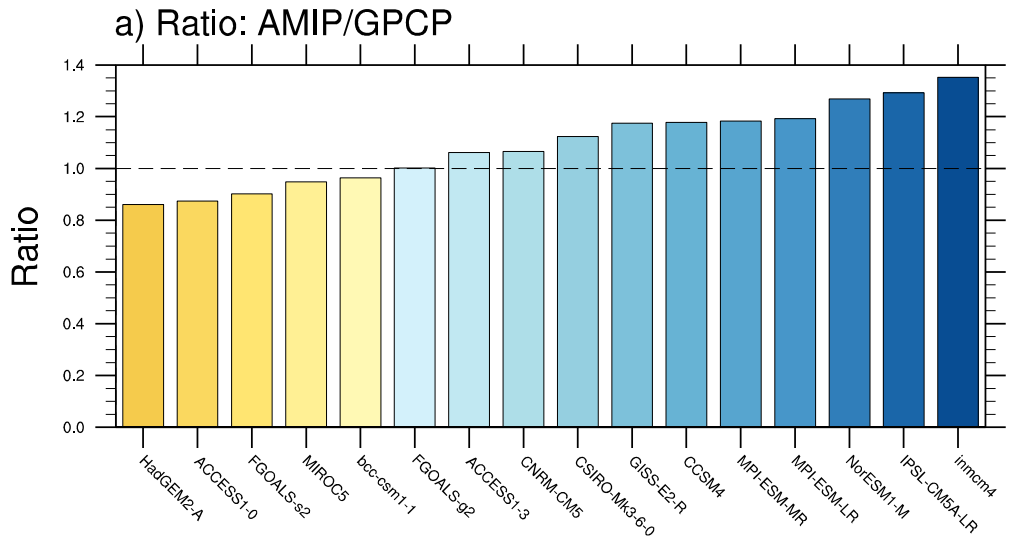
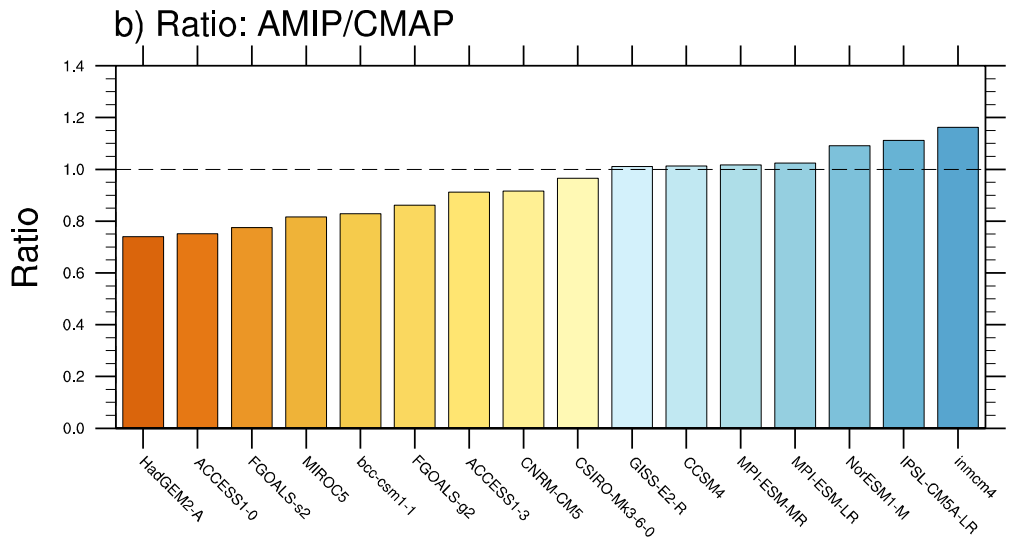
Rainfall bias in AMIP5 models (wrt GPCP & CMAP)

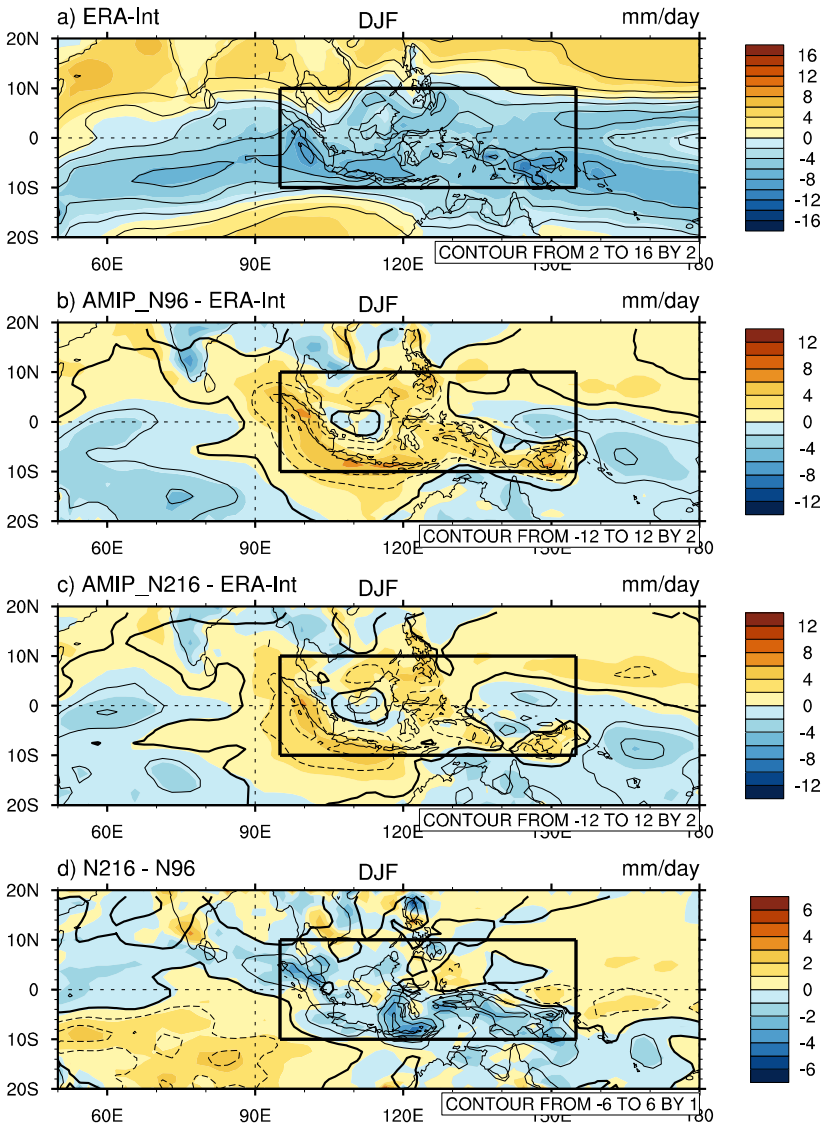


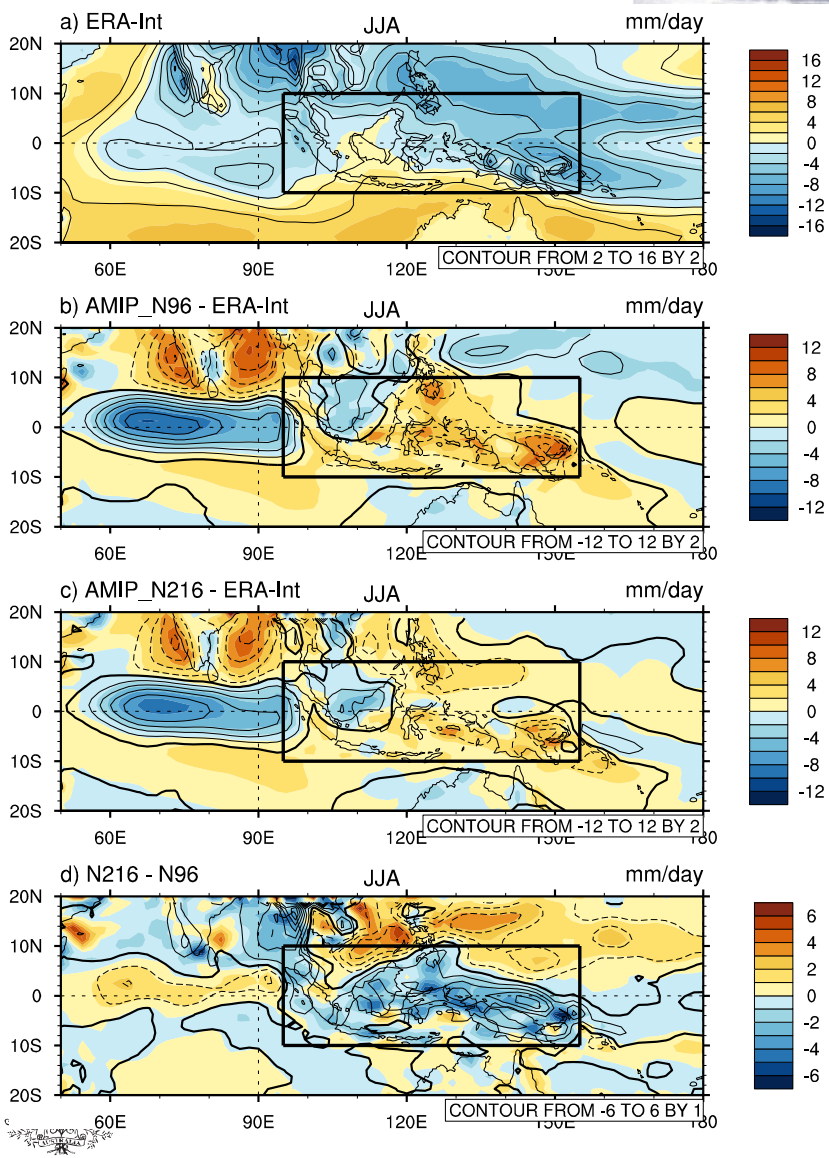
5 (11) out of 16 models have dry (wet) bias wrt GPCP



9 (7) out of 16 models have dry (wet) bias wrt CMAP

Moisture flux divergence (shades) and rainfall (contours)





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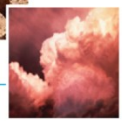
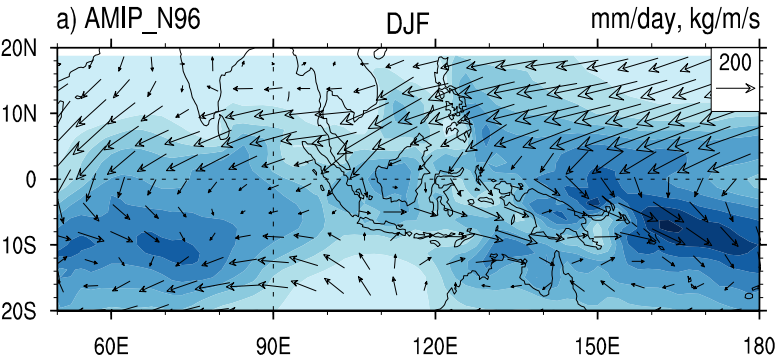
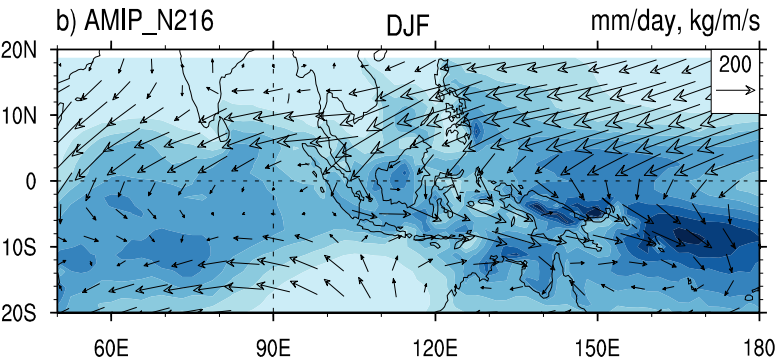
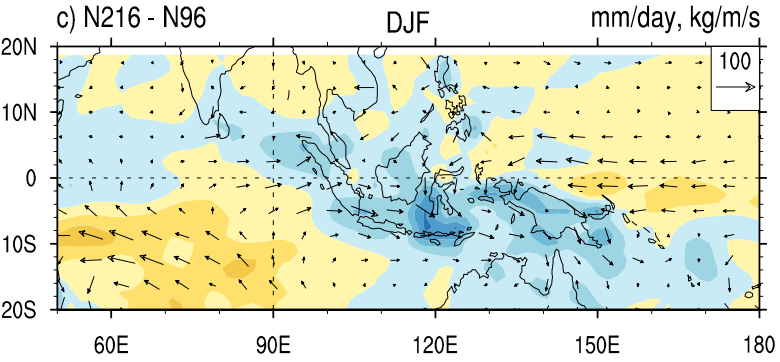
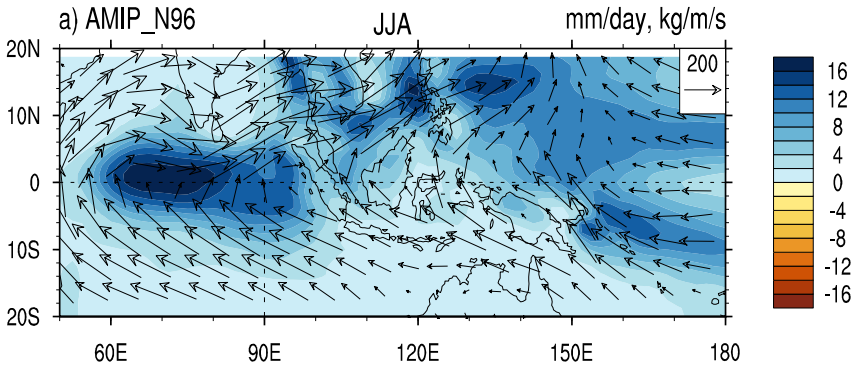
Precip (shades) and moisture fluxes (vectors)

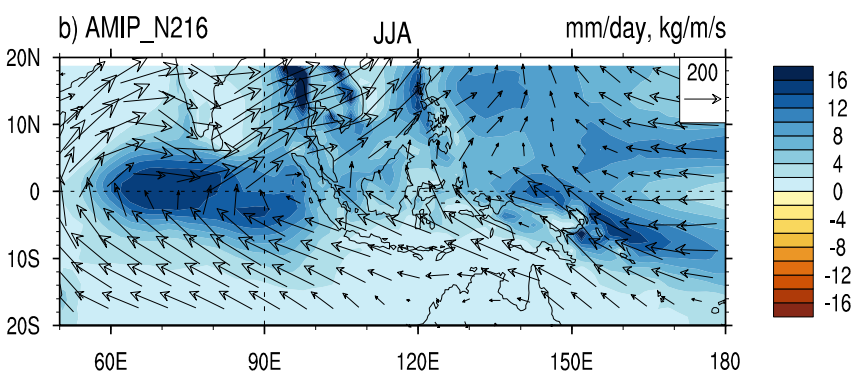



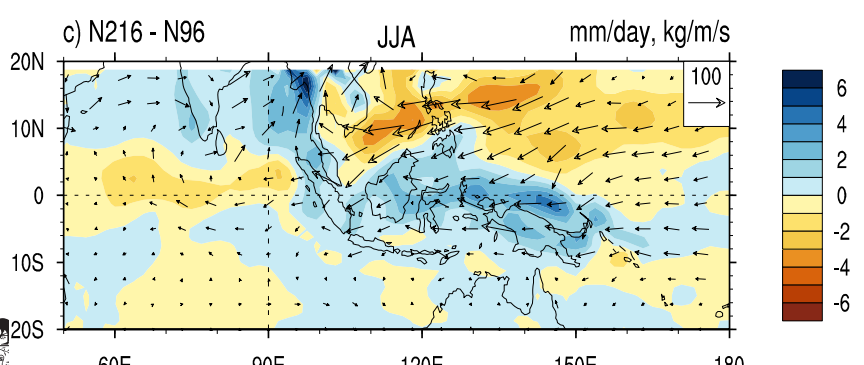













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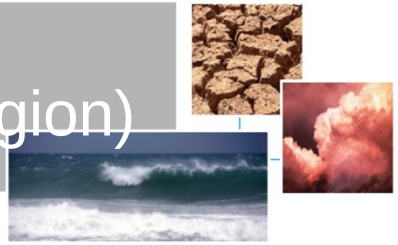
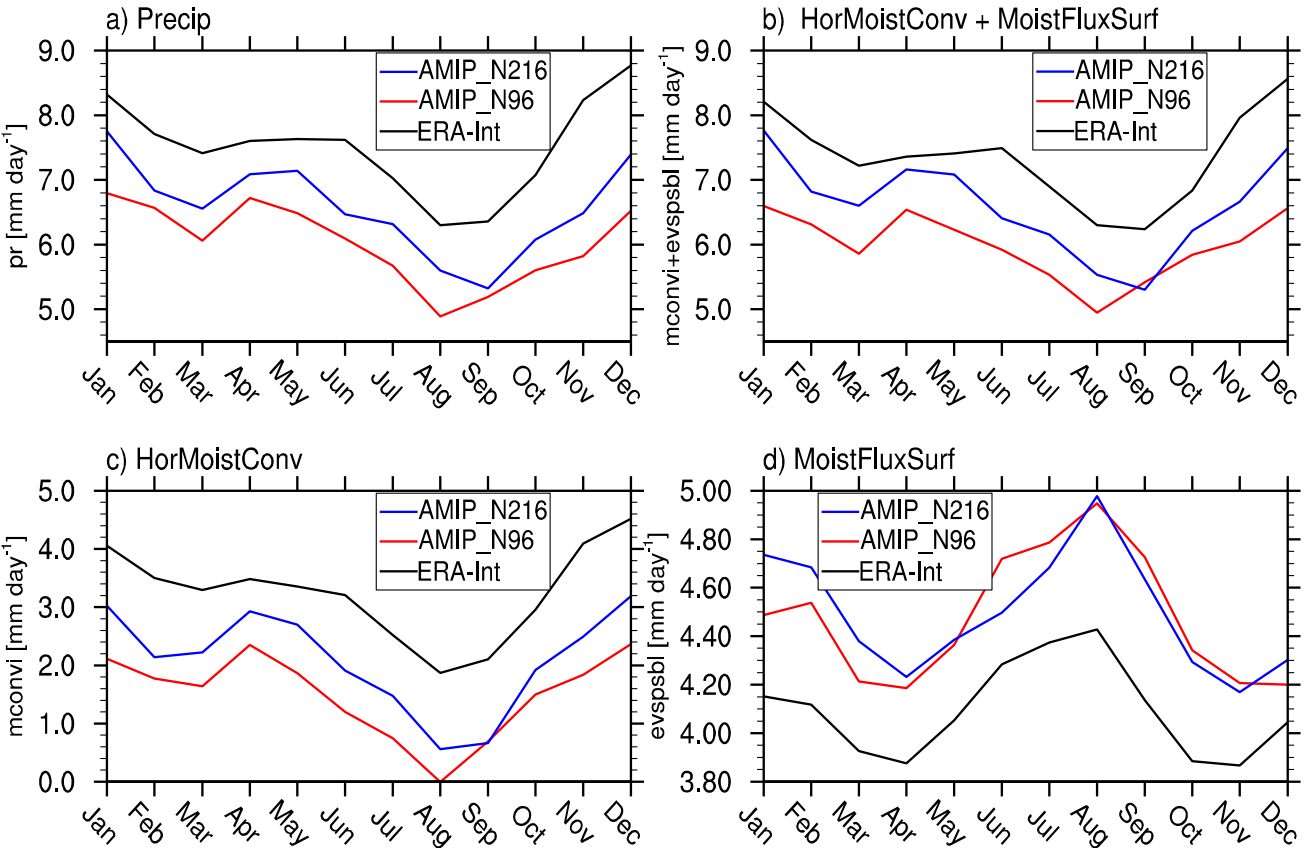
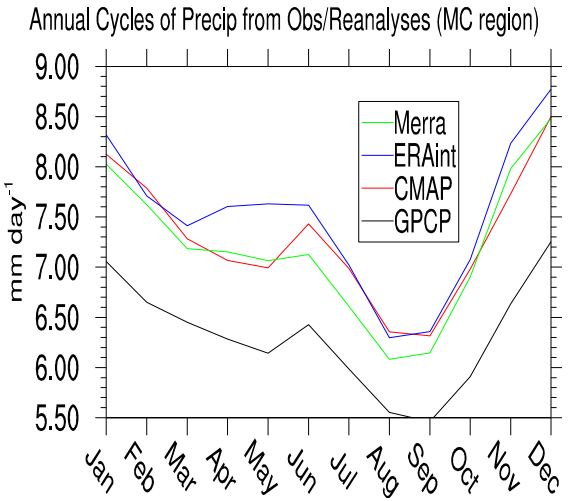
Annual cycles of precip and moisture budget (MC region)





1. The modelled rainfalls are underestimated w.r.t ERA-Int. (But, the N216 rainfall compares well with GPCP.)
2. The evaporative flux dominates the moisture budget
3. However, it is the difference in the horizontal moisture convergence that contributes to the precip difference in the two models.

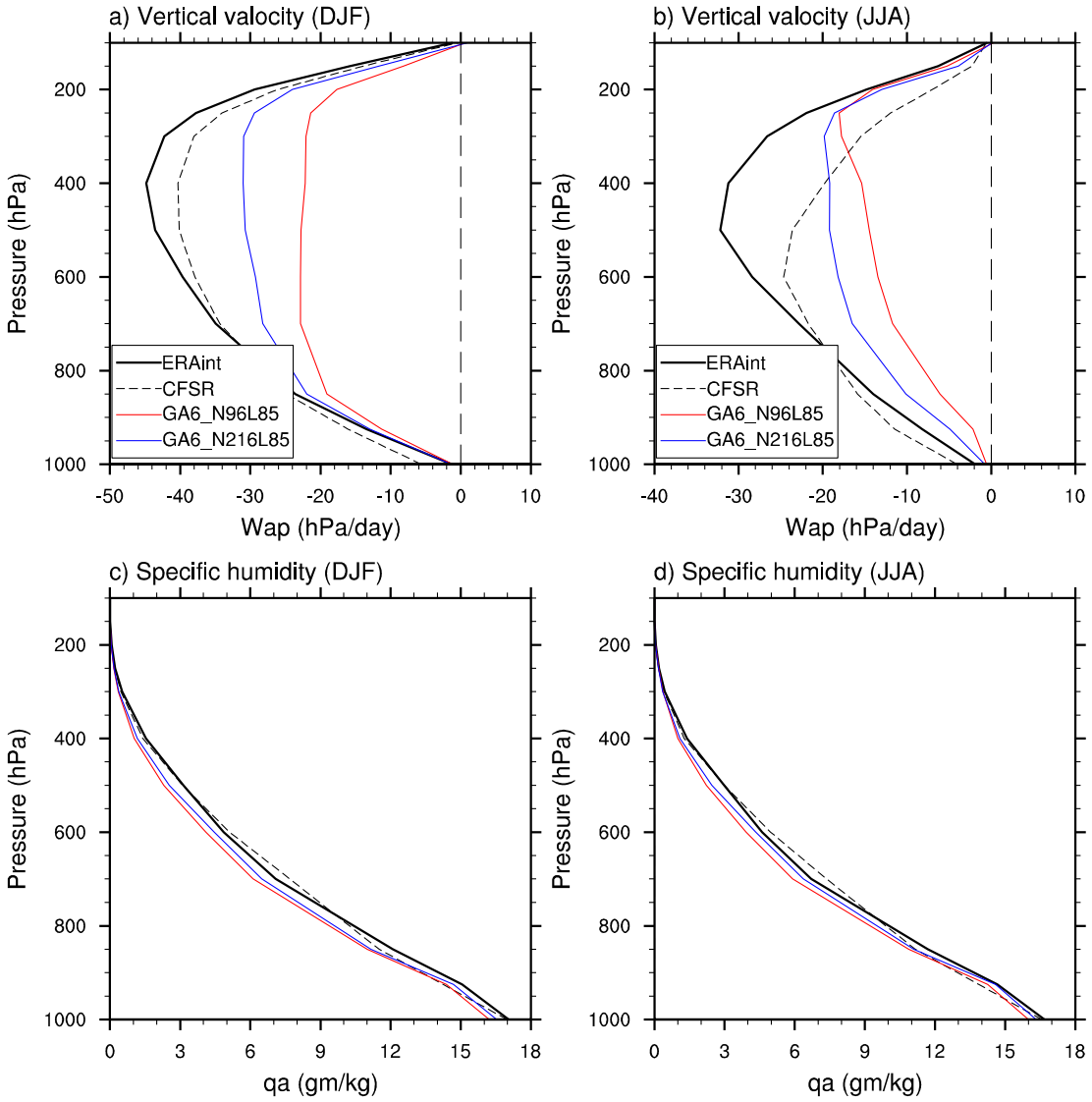


$$\frac{\partial}{\partial t}\overline{\langle q \rangle} + \overline{\langle \nabla \cdot q\mathbf{v} \rangle} = \overline{E} - \overline{P}_s$$

<>: Vertical integration (1000-200 hPa)

Over bar: Horizontal average over MC

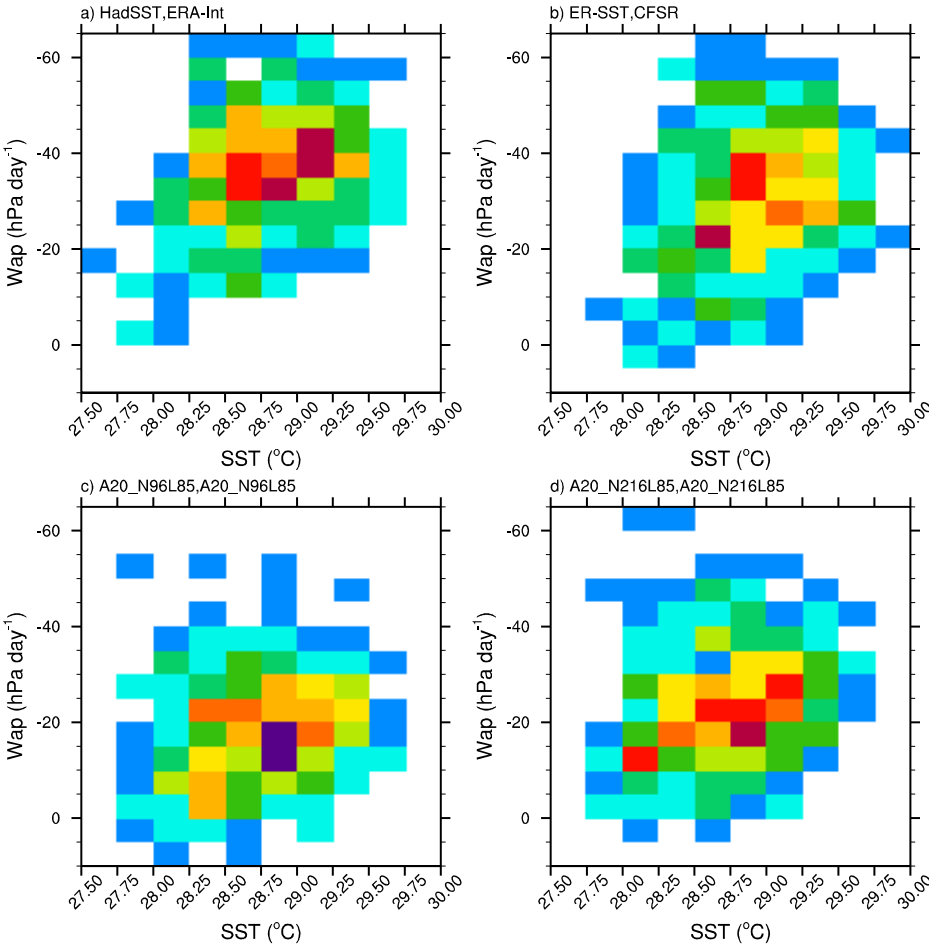
Vertical profiles of Wap and Sp.Humidity (MC region)



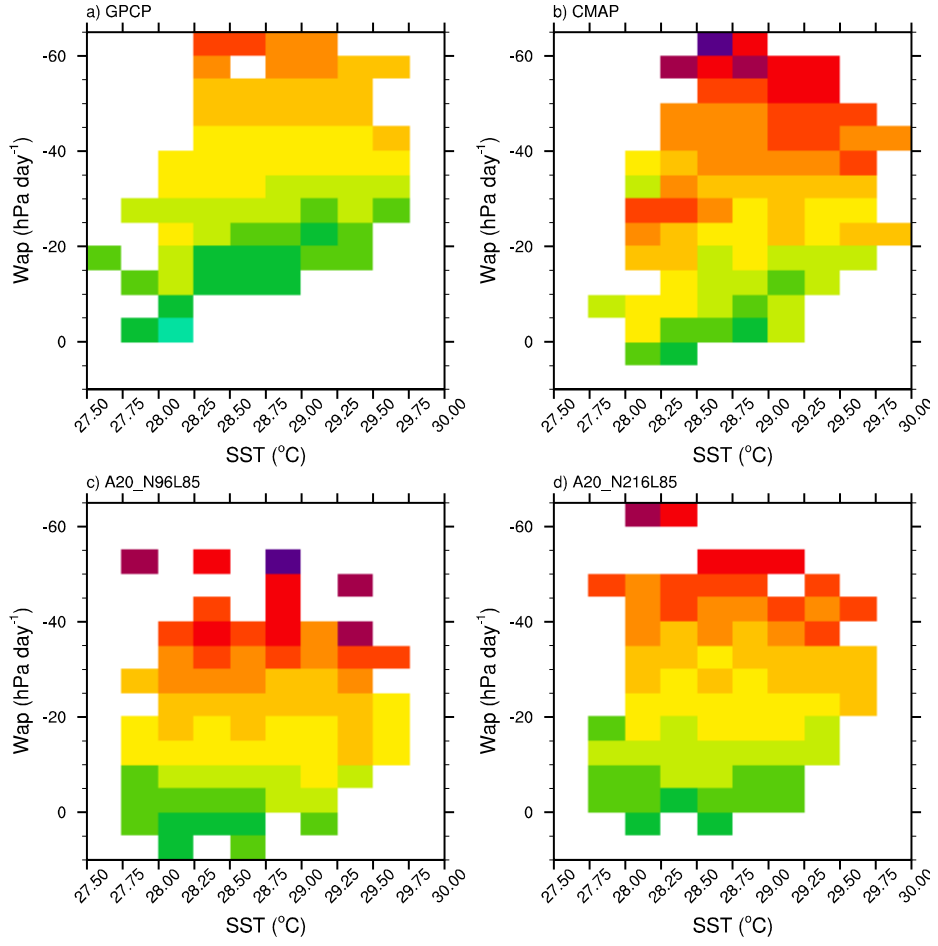
- The convection over the MC region is stronger in DJF than in JJA
- The modelled convections are weaker than those in the reanalyses
- The N216 has a stronger convection than the N96
- The sp. humidity profiles are consistent with the strengths of convection

Joint PDFs of Precip as functions of SST and Wap

Frequency (%) of SST, Wap



JointPDF of Precip (Avg; mm/day) as functions of SST & Wap



In 0.25 C and 5 hPa/day bins

Rainfall shows a greater sensitivity to Wap than to SST

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Summary

- There is a dry rainfall bias over the Maritime continent. Increasing the horizontal resolution reduces this bias.

- Deficiencies in the horizontal moisture fluxes appear to be partly responsible for the bias.

- The modelled convective activity is weaker than that in the reanalyses year round.

- Rainfalls show a greater sensitivity to Wap than to local SST, and this sensitivity is larger for the simulated rainfalls than for the observed.