

# Mechanisms improving tropical rainfall diurnal cycle in convection-permitting WRF

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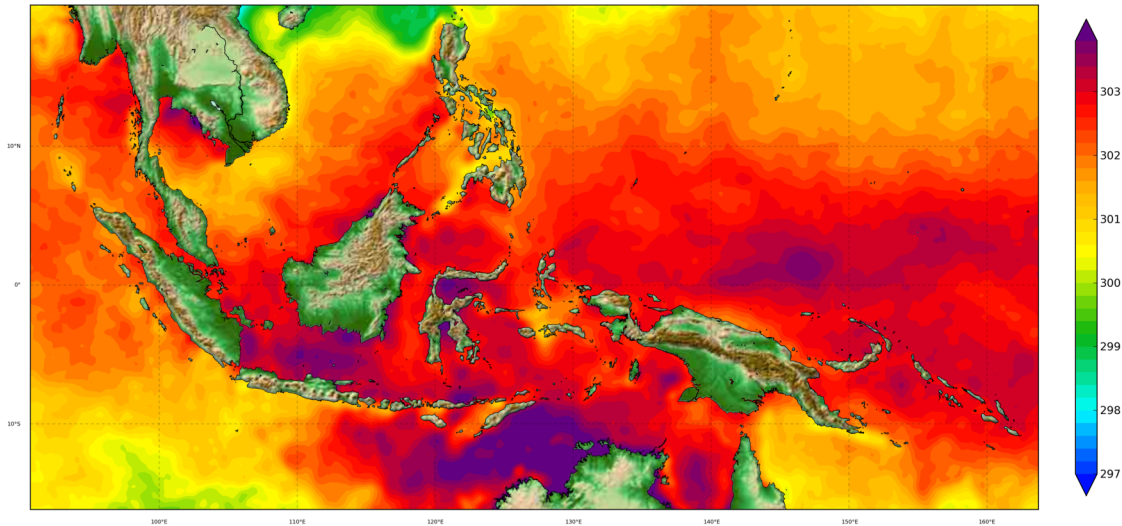


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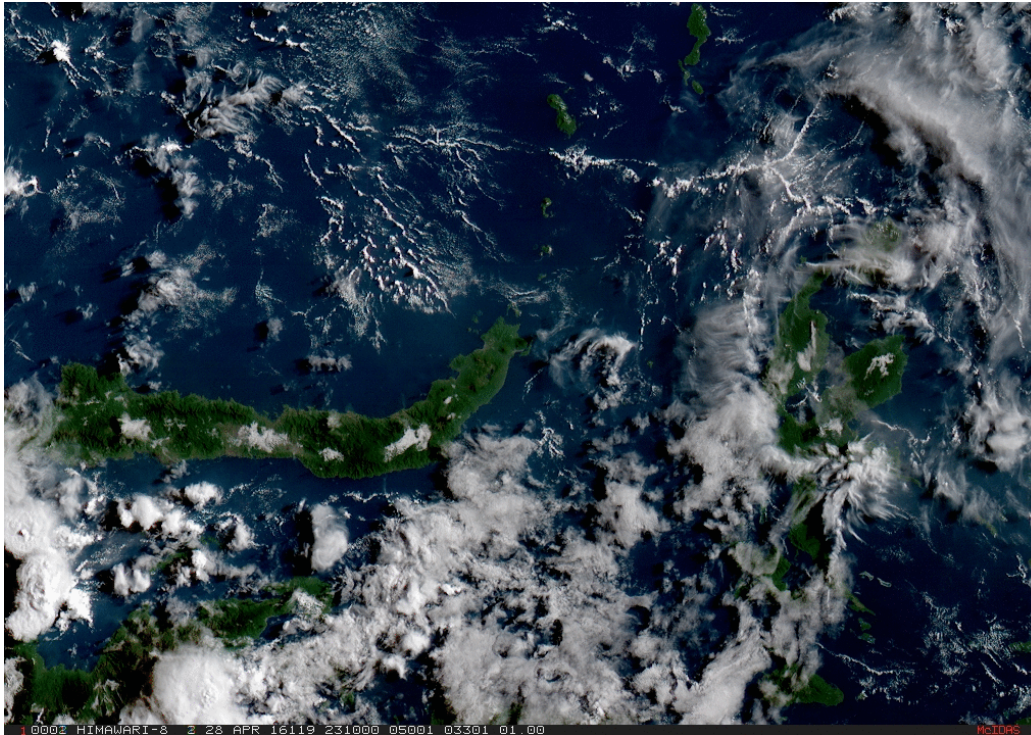
# The Maritime Continent is challenging for models



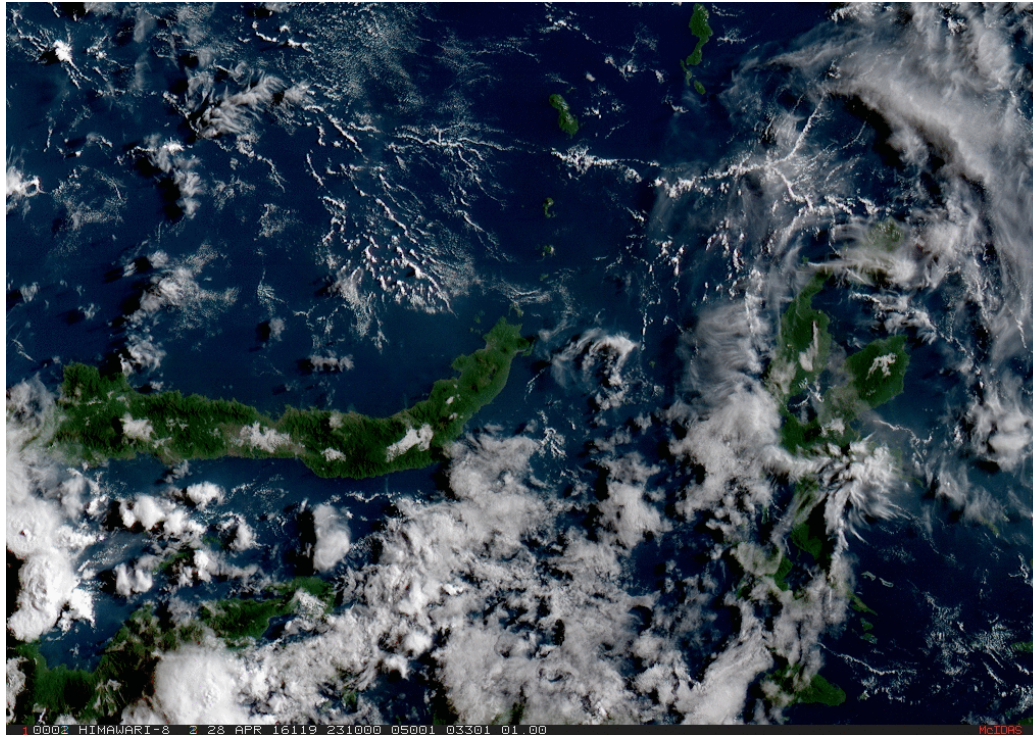
Maritime Continent features:

- Complex topography and coastlines
- Warm ocean
- Highly convective
- Strong diurnal cycle
- Interaction across scales

# The Maritime Continent is challenging for models



# The Maritime Continent is challenging for models



Precipitation errors across models

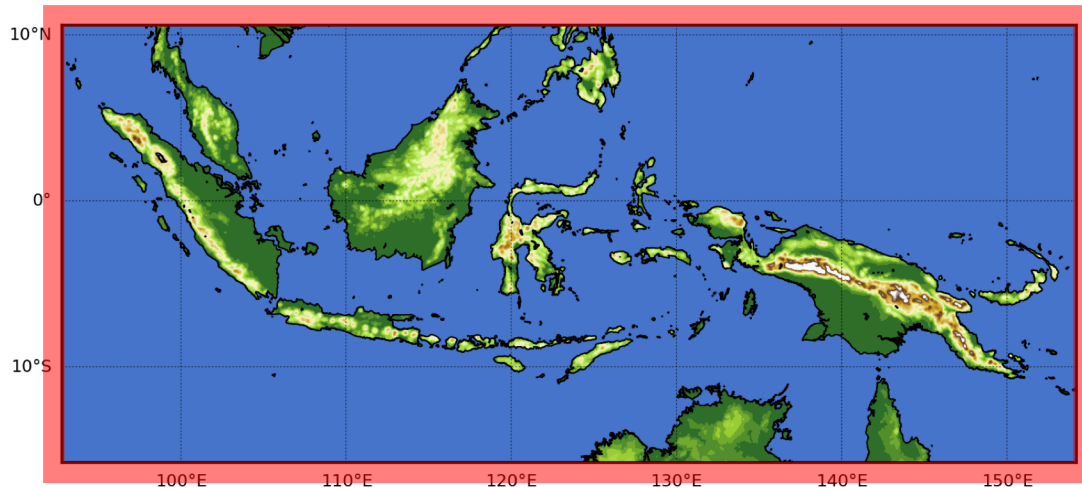
- Diurnal cycle too early
- Too strong diurnal cycle
- + bias over land
- -/+ bias over ocean

Possible causes

- Model resolution
- Convective scheme
- Air-sea interactions
- Sea-breeze circulation
- Land-Surface evaporation



# Experimental design



Bdy cond's: ERA5

10-day  
Spin up

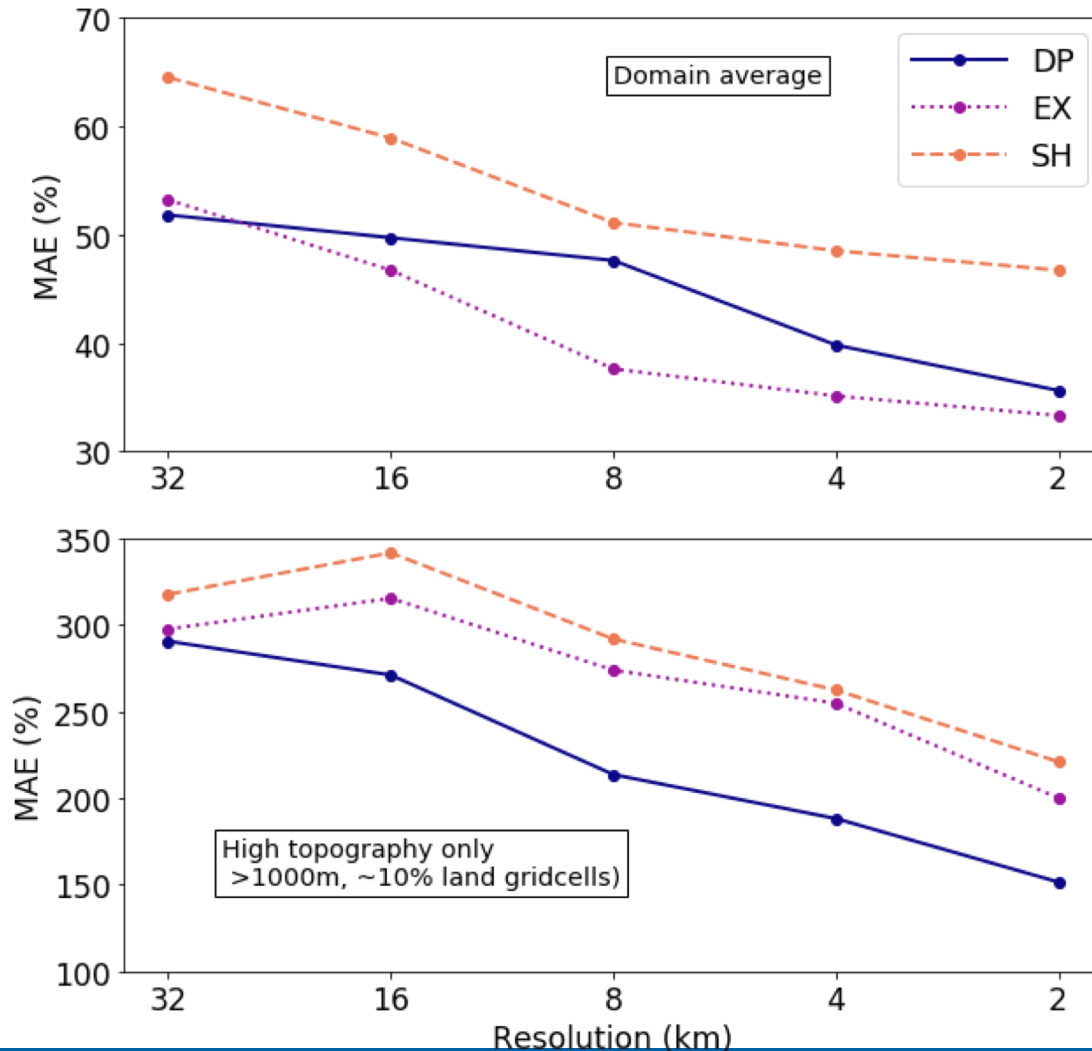
4 month simulation (NDJF)

## Simulations:

- WRF 3.9.1
- 32, 16, 8, 4, 2 km resolution.
- No nesting (entire domain)
- Austral summer (NDJF 15/16)
- 50 vertical levels
- 3 experiments each:
  - BMJ conv. scheme (DP)
  - GRIMS shallow conv. (SH)
  - Explicit convection (EX)

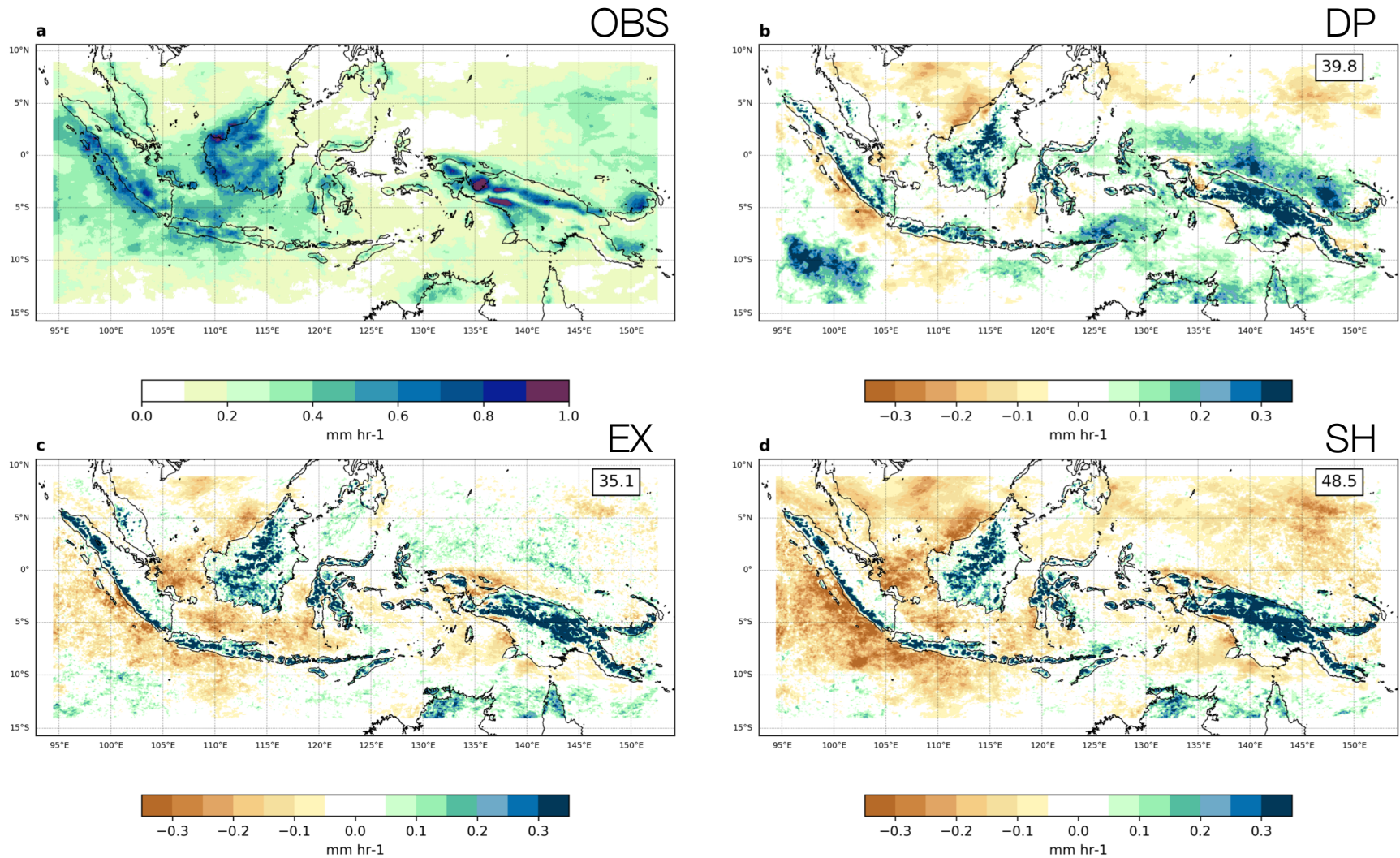
Total of 15 experiments

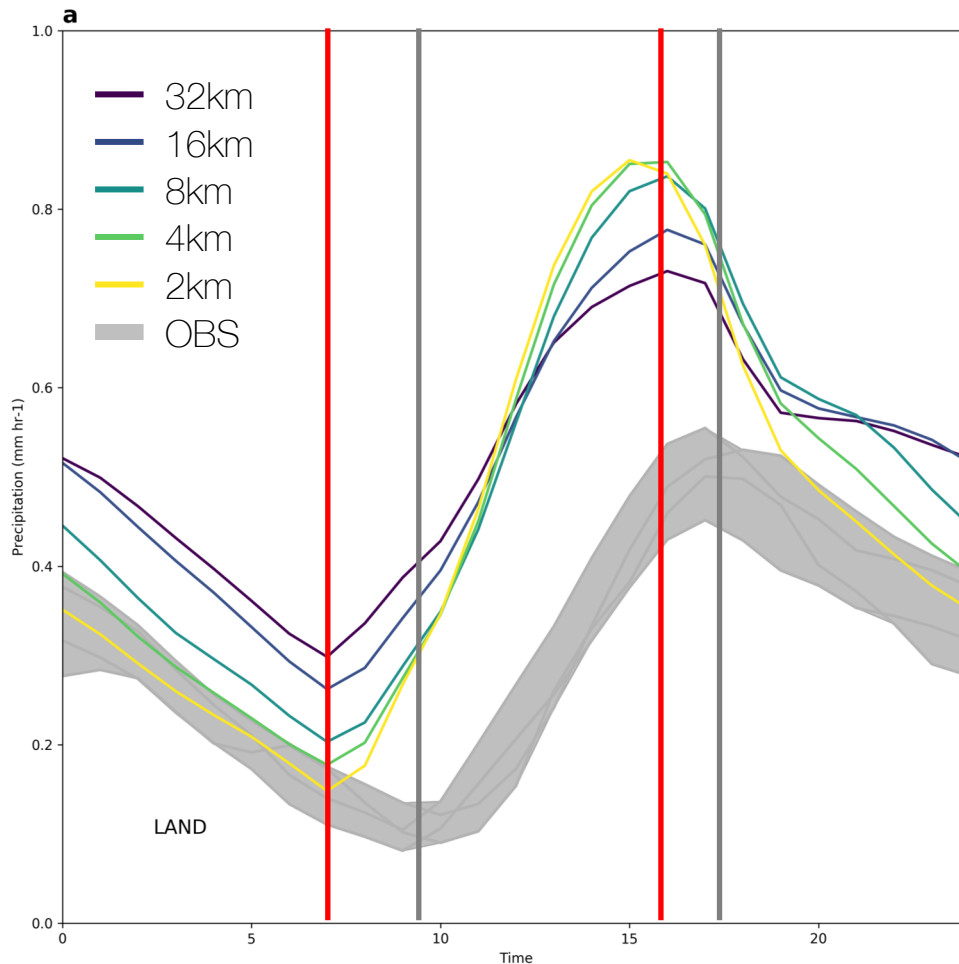
# Impact of resolution



MAE with respect to CMORPH:  
resolution has a positive impact on errors

# Spatial distribution of biases at 4km

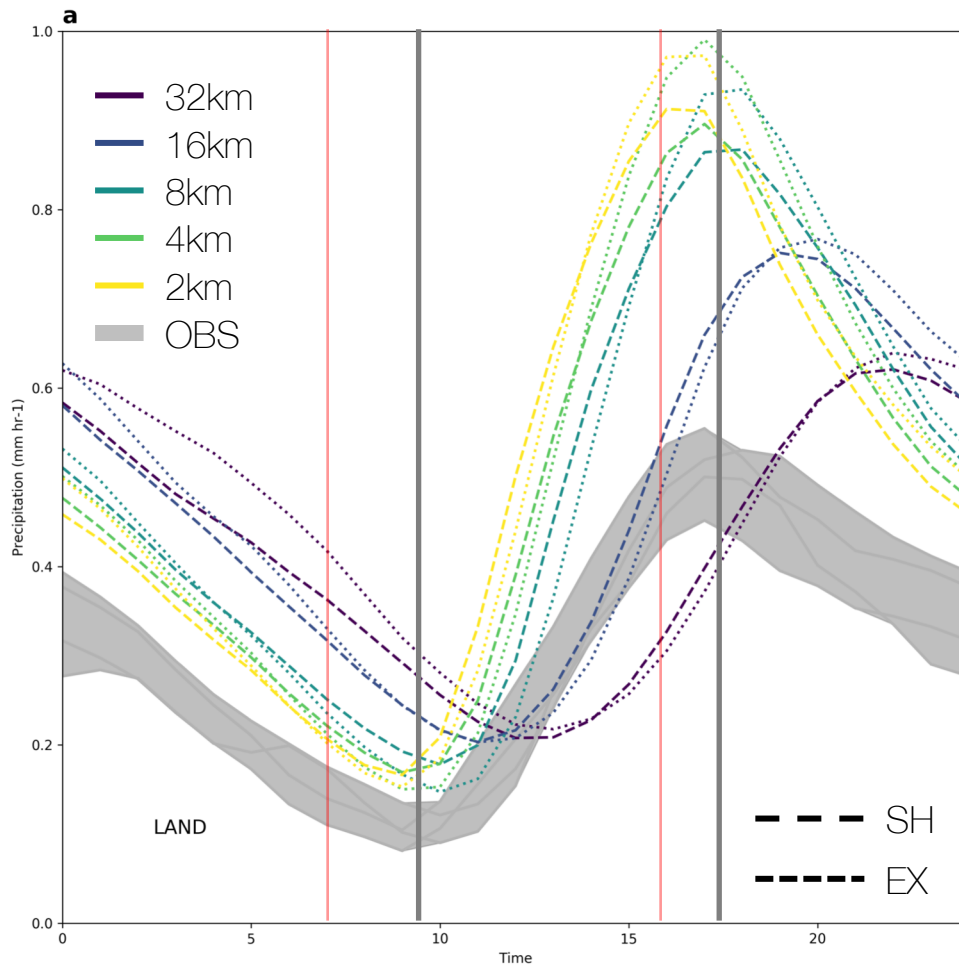




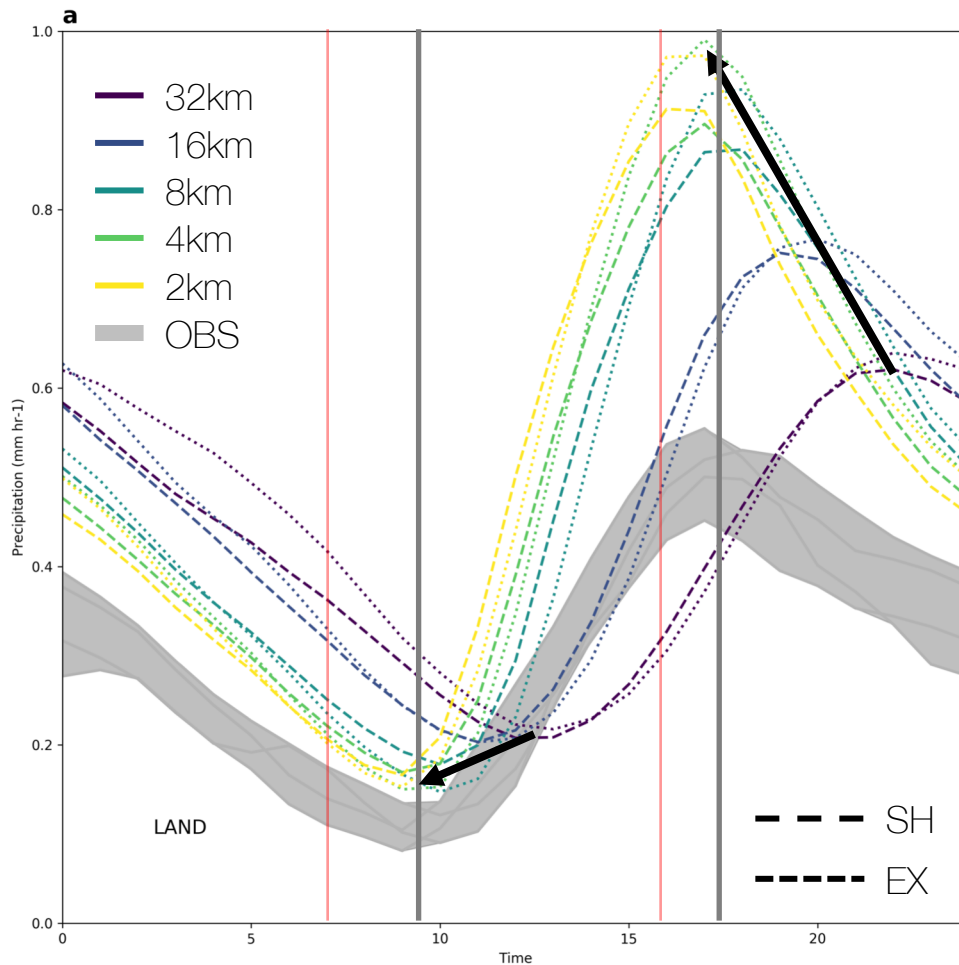
Diurnal cycle of precipitation on land with parameterized convection:

- Too early in all resolutions
- Amplitude enhanced with resolution





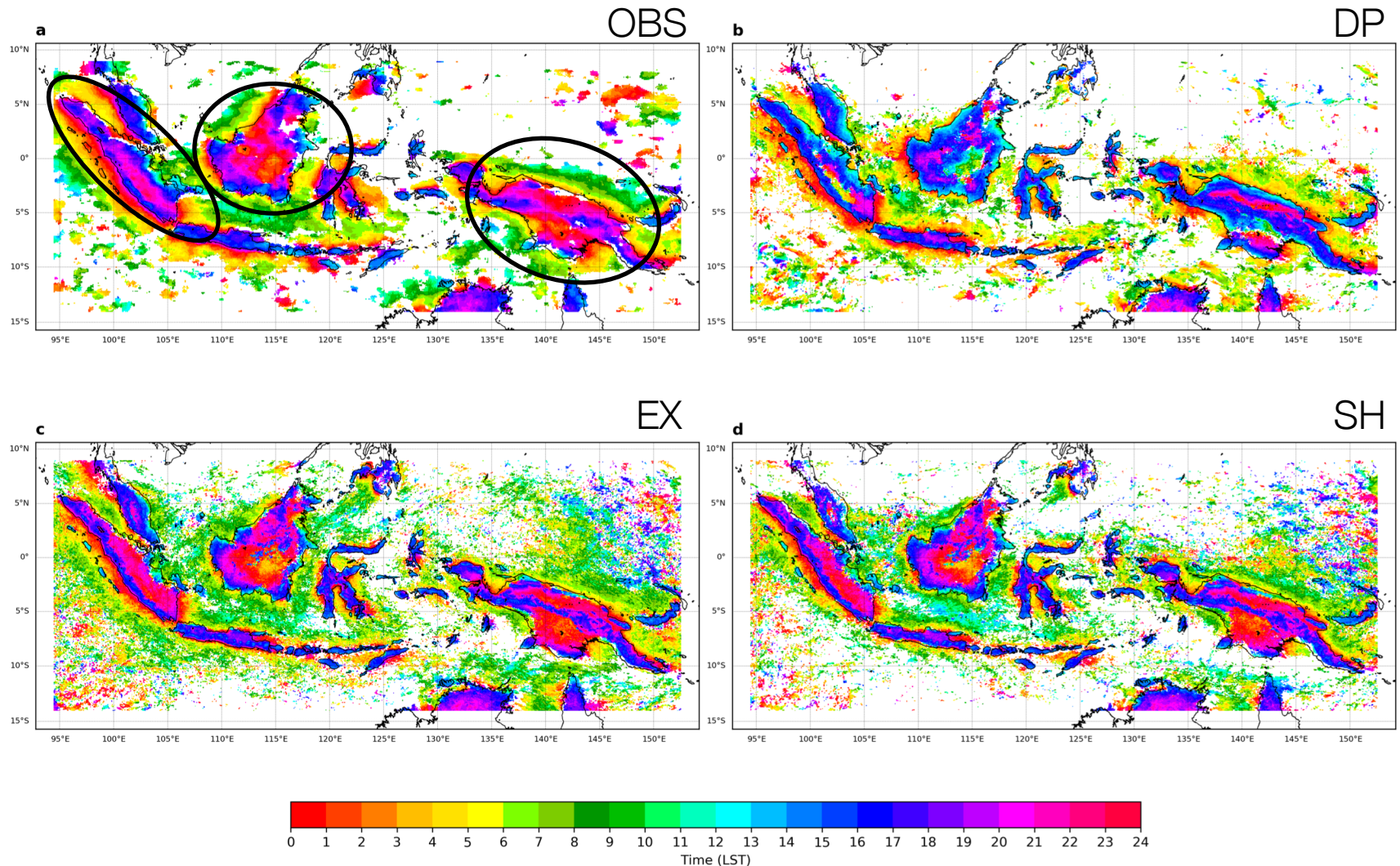
Diurnal cycle of precipitation on land with explicit deep convection:



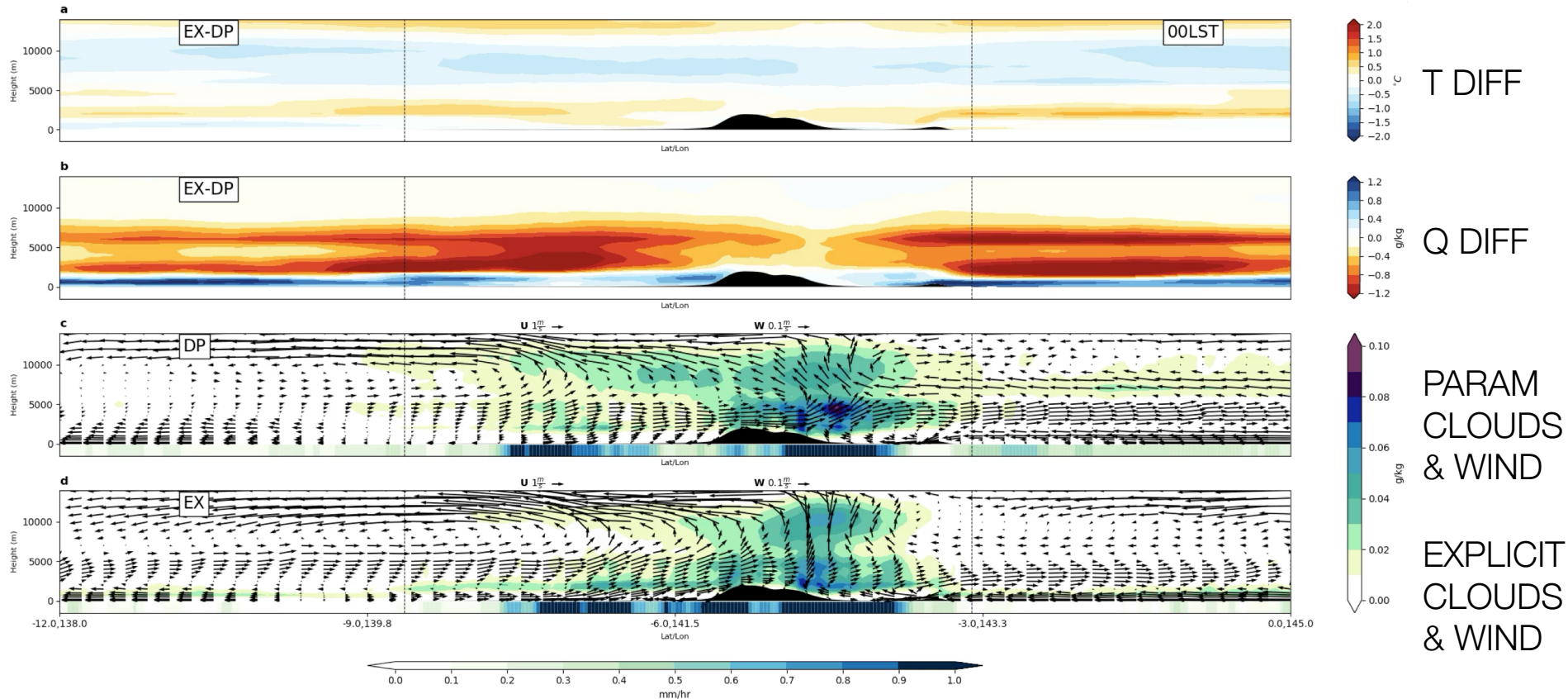
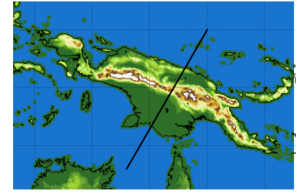
Diurnal cycle of precipitation on land with explicit deep convection:

- High-resolution advances cycle until right timing
- Too intense amplitude

# Better timing of diurnal rainfall in islands

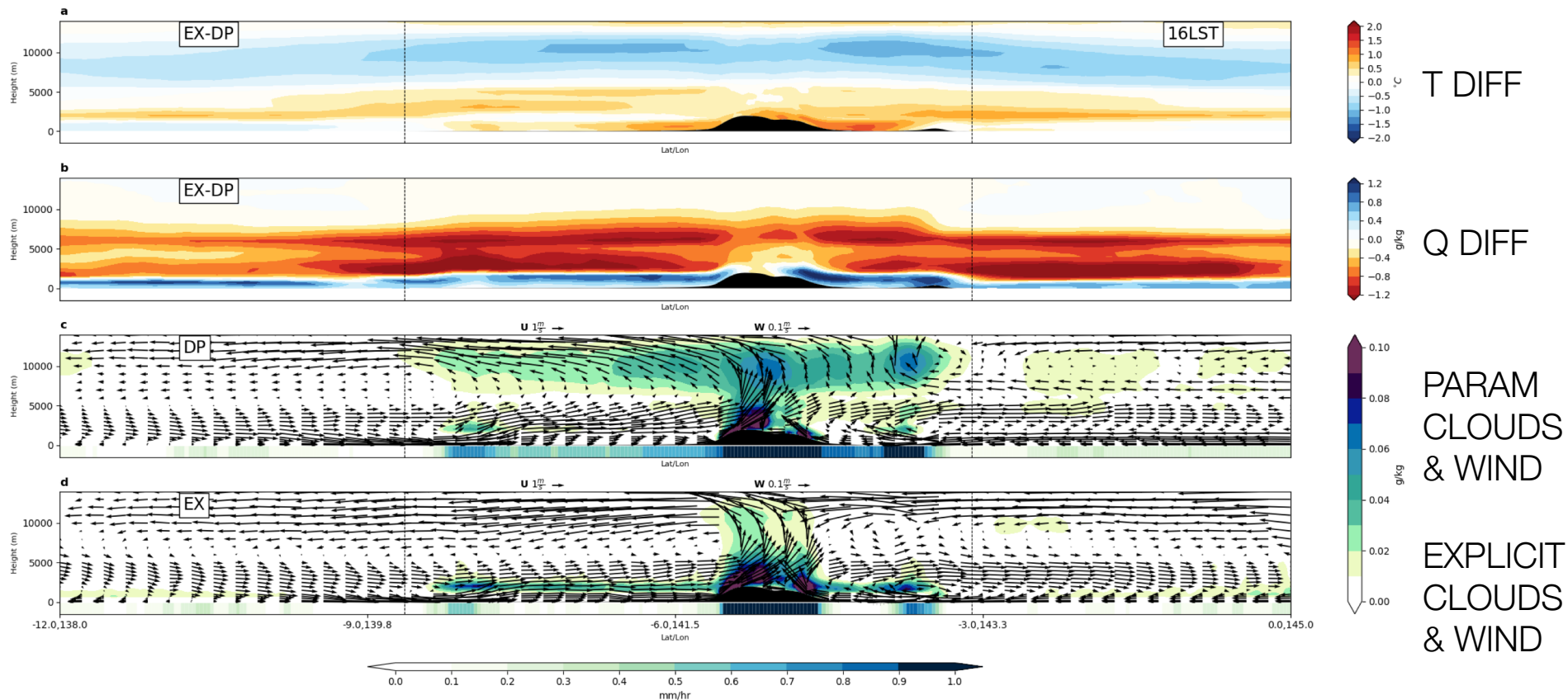


# Vertical structure of the atmosphere



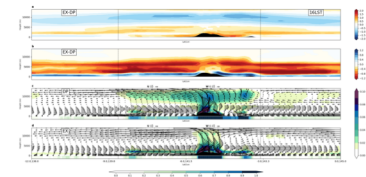
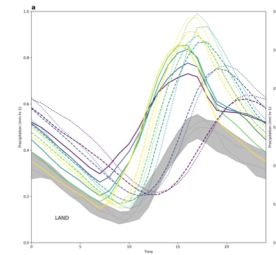
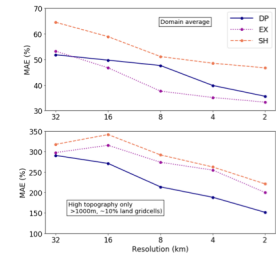


# Vertical structure of the atmosphere



# Conclusions

- Positive impact of resolution – particularly in high topography
- Explicit convection & high-resolution : better phase, too strong amplitude of diurnal cycle
- Explicit convection modifies the vertical structure of the atmosphere up to the upper troposphere. Changes in humidity, temperature and clouds profiles.

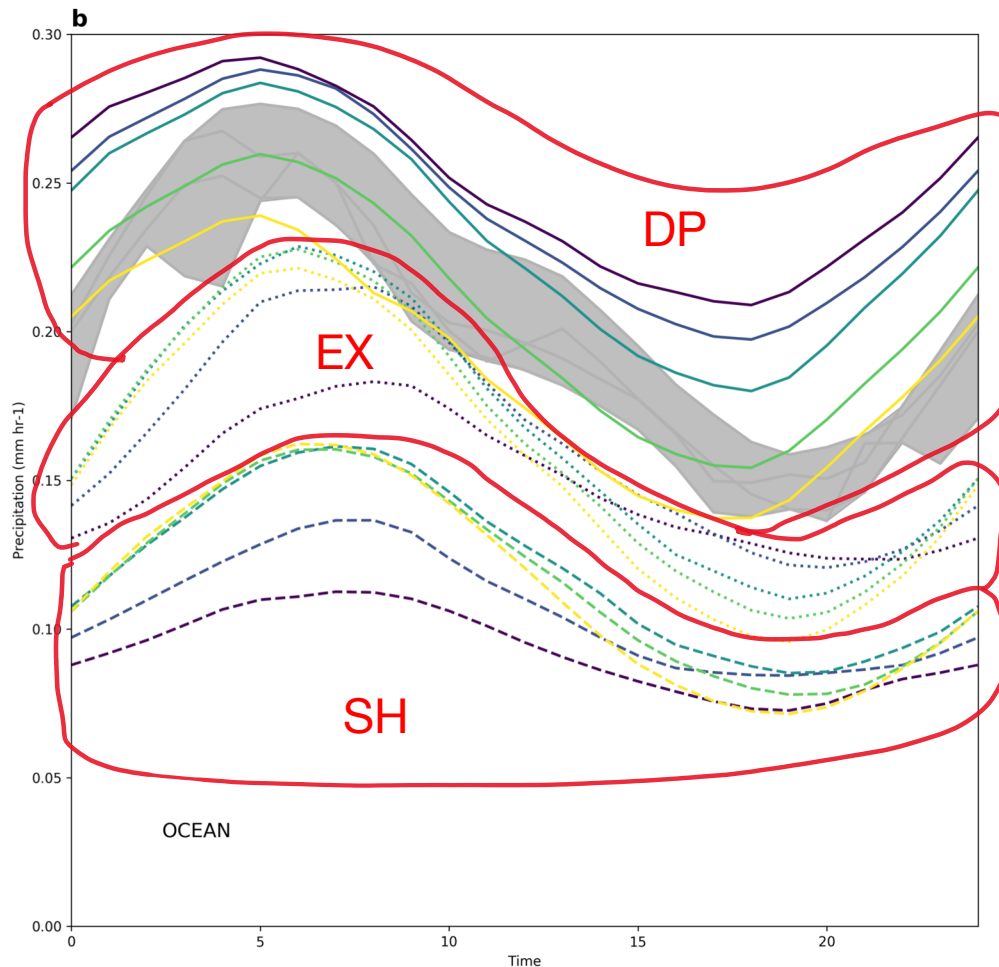






# Thanks



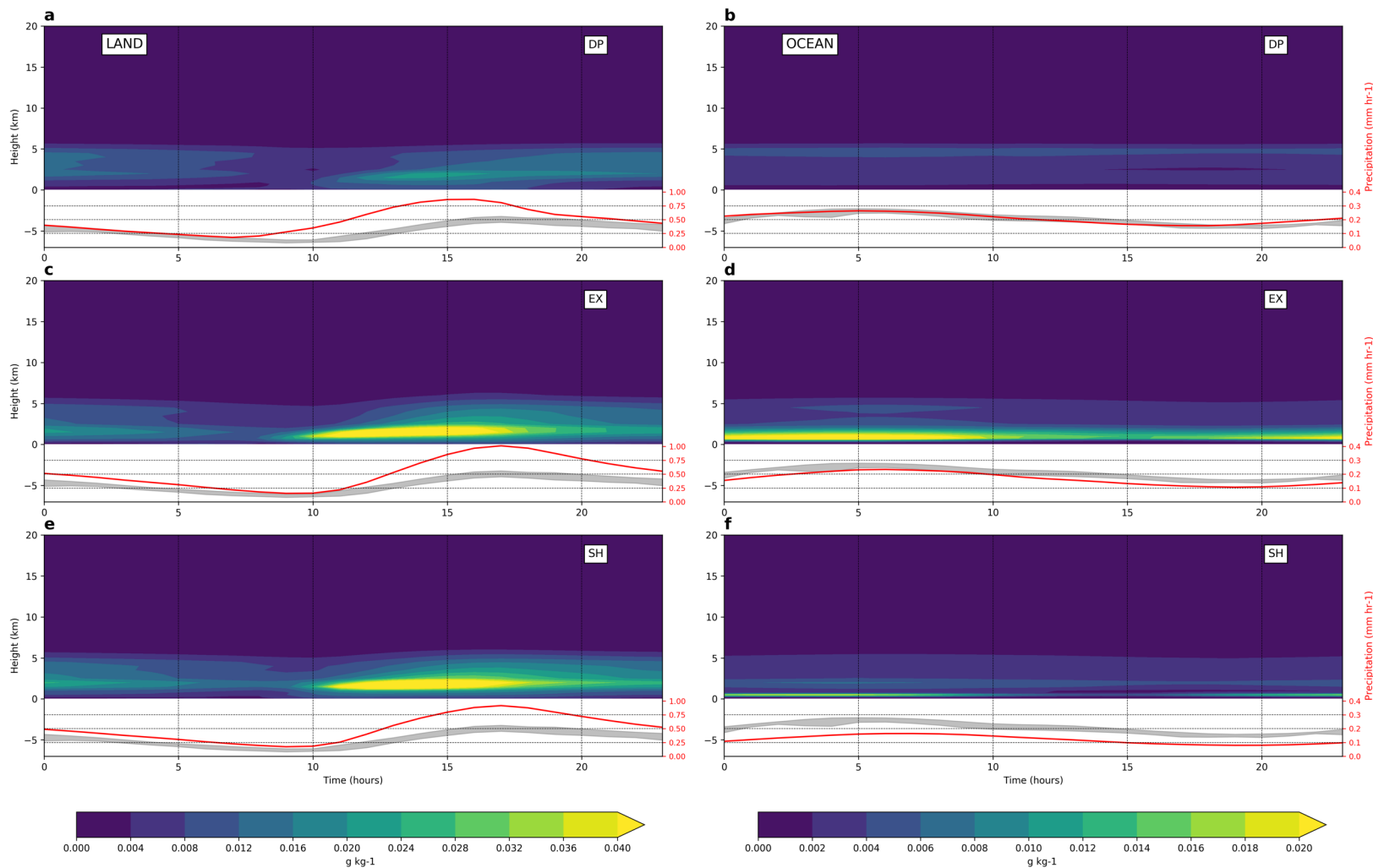


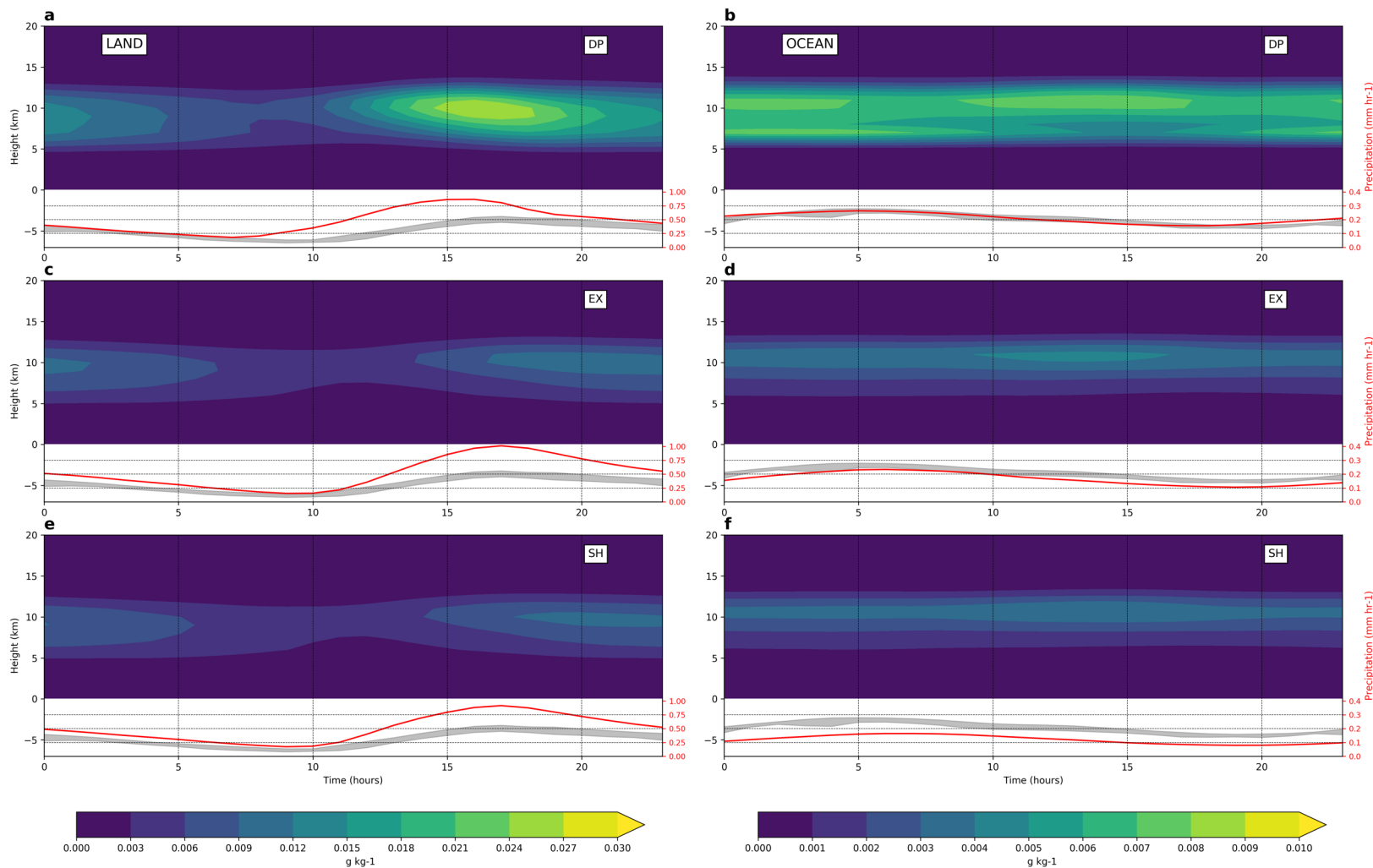
## Extras

Diurnal cycle of precipitation over the ocean:

- More coherent response to resolution and convection representation
- DP and EX converging at high resolution

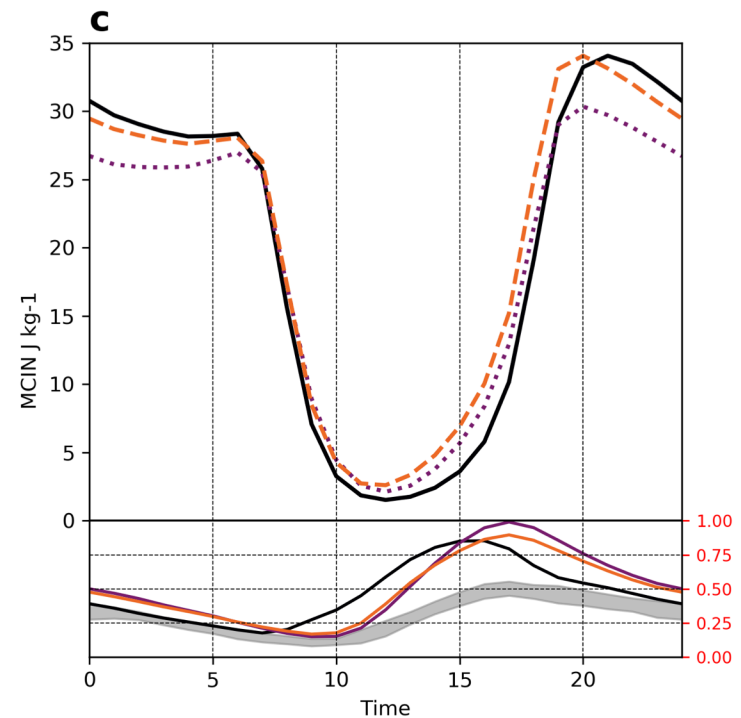
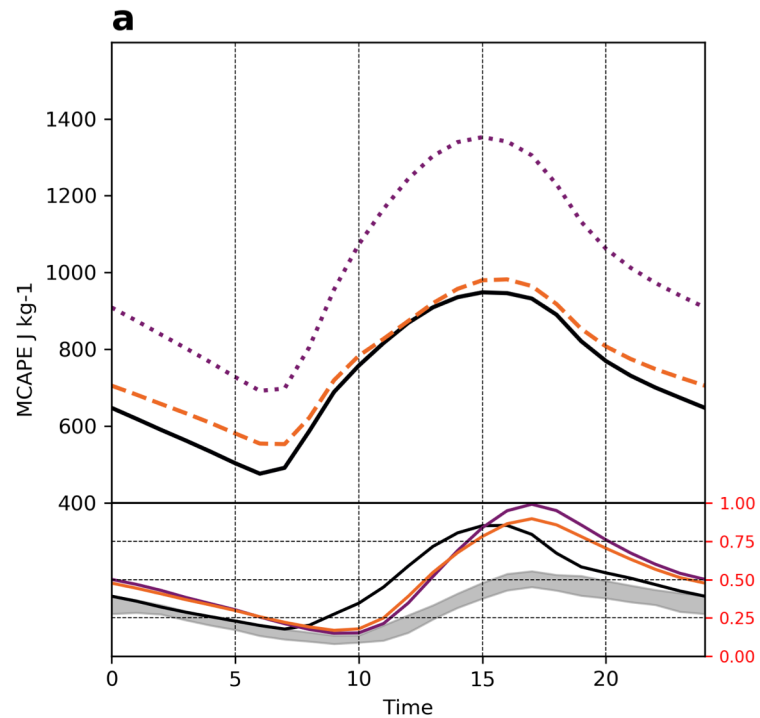






# Land CAPE and CIN

Extras



## Ocean CAPE and CIN

Extras

