

Precipitation controls in the tropics

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Some basic precipitation biases over the tropics

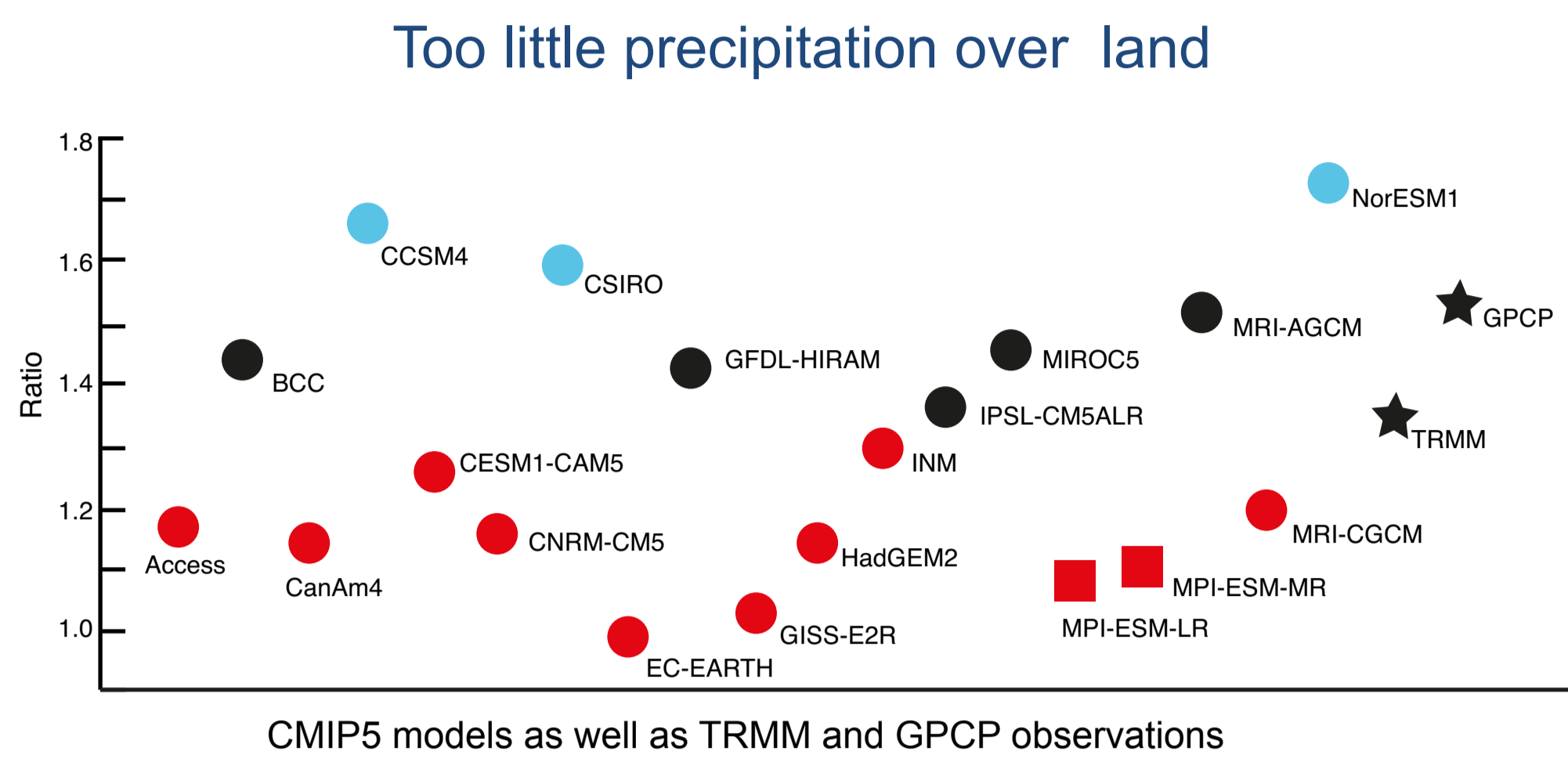


Fig. 1: Simulated and observed land to ocean ratio of tropical precipitation.

- Long-standing precipitation biases over the tropics
- Common to many climate models
- Limit our confidence in climate simulations.

Wrong diurnal cycle of precipitation

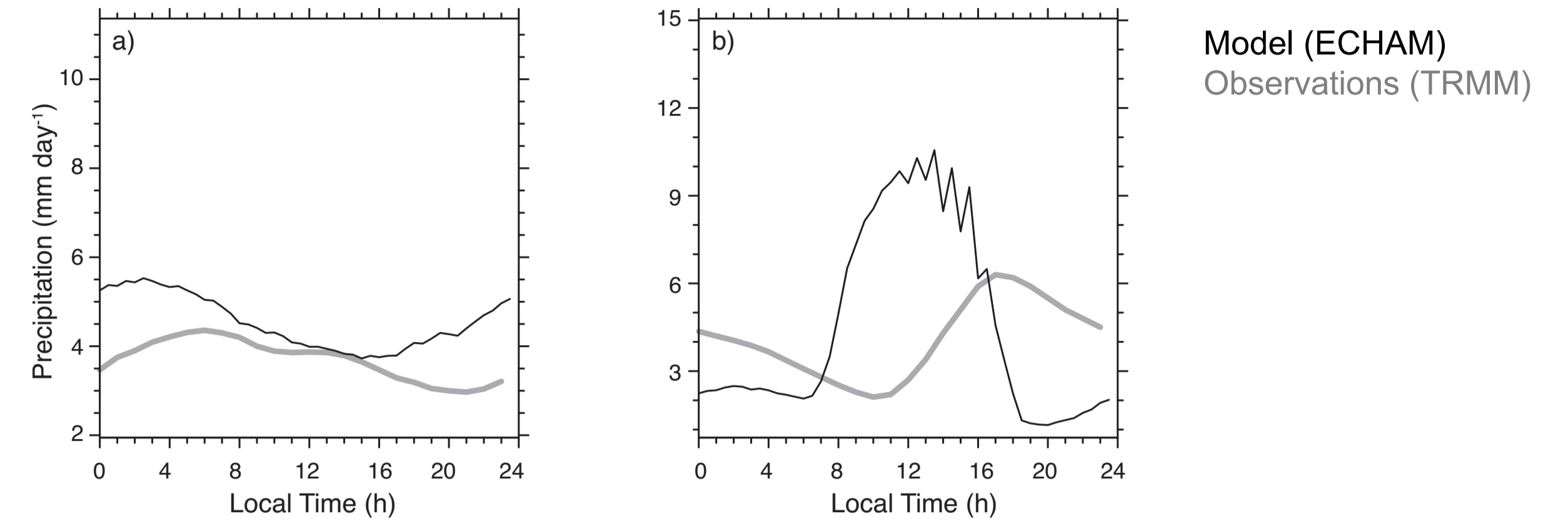


Fig. 2: Monthly mean diurnal cycle of tropical precipitation averaged over (a) ocean and (b) land.

Goals

- What controls the precipitation distribution over the tropics?
- How do parameterization choices control the precipitation distribution?

Strategy

- Climate simulations with ECHAM and MPI-ESM
- Sensitivity studies, especially by perturbing the convection scheme.

Example: controls on and impacts of the diurnal cycle of deep convection

Questions

- Can we control the convective diurnal cycle by controlling the convective entrainment rate?
- How sensitive is the tropical climate to the convective diurnal cycle?

Method

- ECHAM (T63L47) with fixed SST
- Changing turbulent entrainment ϵ_{turb} and detrainment δ_{turb} rates for deep convection (Fig. 3)

Results I

- Over ocean the convective diurnal cycle can be controlled by entrainment (Fig. 4a)
- Over land the convective diurnal cycle cannot be fully controlled (Fig. 4b)
- The distinct nature of convection triggering over land and ocean explains the latter differences.

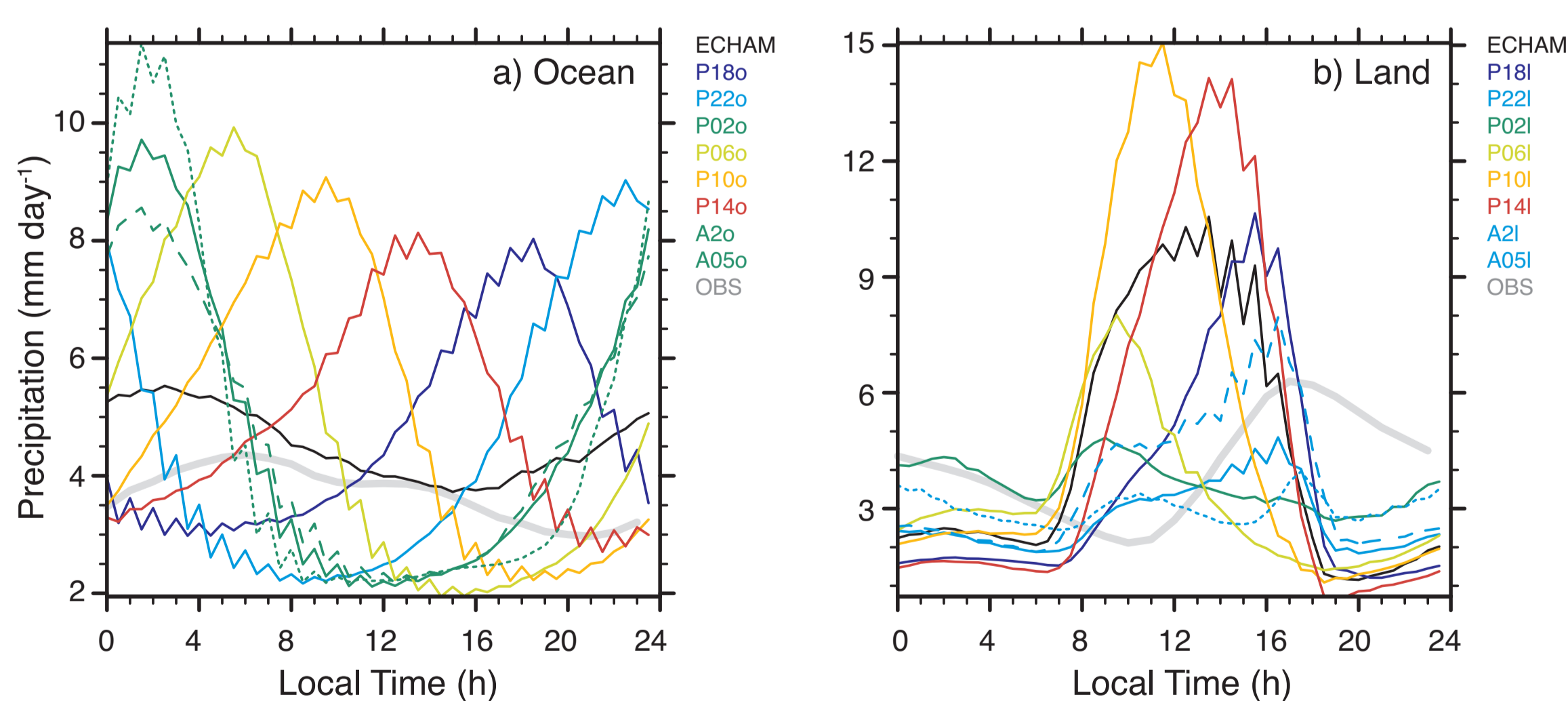


Fig. 4: Monthly mean diurnal cycle of precipitation averaged over tropical (a) ocean for the oceanic experiments and (b) land for the land experiments.

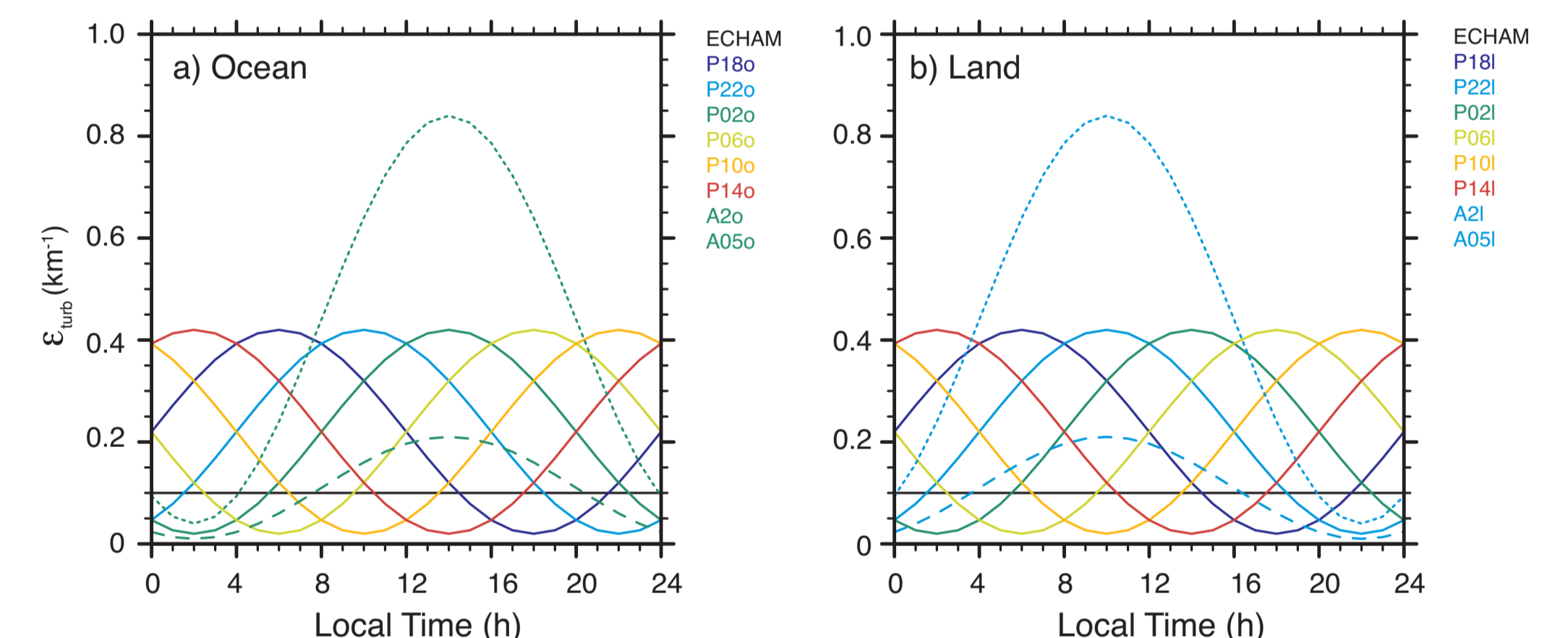


Fig. 3: Imposed diurnal cycle in ϵ_{turb} over (a) oceanic and (b) land points. Only the ocean values are modified in (a). Similar is true for the land experiments in (b). δ_{turb} equals ϵ_{turb} .

Results II

- Impact of different convective diurnal cycles on overall precipitation small (Fig. 5)

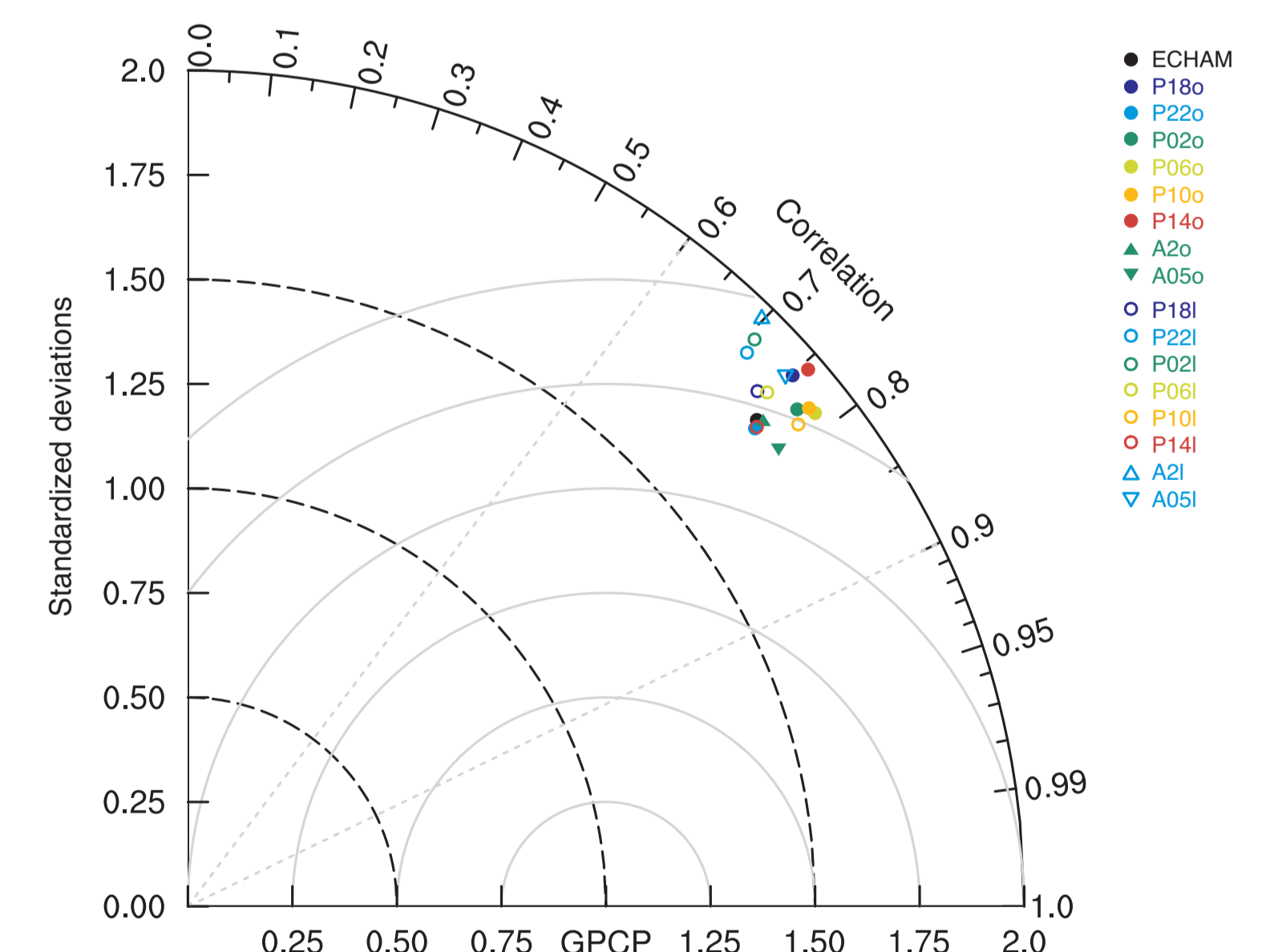


Fig. 5: Taylor diagram of mean tropical precipitation averaged for the various experiments.

C. Hohenegger and B. Stevens, 2013: Controls on and impacts of the diurnal cycle of deep convection. *J. Adv. Model. Earth Systems*, submitted.

