Added value of a Convection Permitting Model in simulating Atmospheric Water cycle over Asian Water Tower

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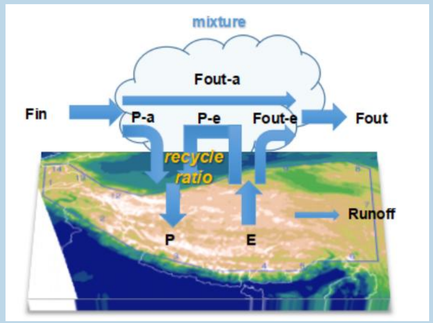
ResearchGate:

Motivation

To understand the **wet bias** in simulating precipitation over the Tibetan plateau through the comparison of the **armospheric water cycle** between **convection parameterized and permmiting models**.



Atmospheric Water cycle

- ✓ External water vapor **transport** → Fin & Fout
- ✓ Atmospheric moisture **converting** into precipitation → P-a & P-e
- ✓ **Precipitation recycling ratio** → P-e / P
  - significantly and positively correlated with convection
  - indicate intensity of the land-atmoshpere interaction

Model

Met Office Unified Model

LSM - large scale model	**CPM** - convection permitting model
horizontal resolution of 13.2km	horizontal resolution of 4.4km
convection parameterized	**convection permitting**

Simulation period: April to Septmber in 2009

Method

Brubaker (1993) Bulk Method

$$\rho = \frac{EA}{EA + 2F^{in}}$$

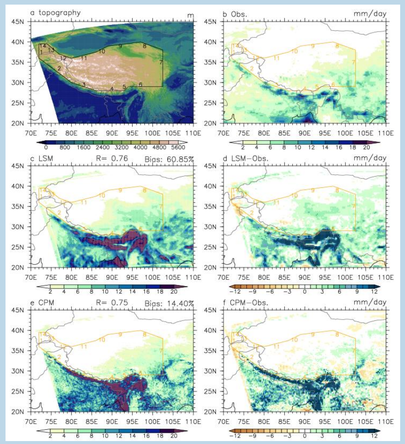


Fig 1. a. Topography (m). **b. and c. and e.** Spatial patterns of the precipitation over TP in observation, LSM and CPM, respectively,units: mm/day. **d. and f.** Difference between LSM/CPM and observation. *R* means pattern correlation coefficients and *Bias* means model bias relative to the observation.

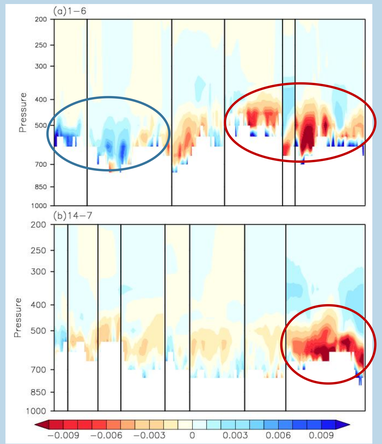


Fig 2. The vertical profile of the water vapor transport (kg/kg m/s) through the 14 edges of the TP in terms of the difference between CPM and LSM. **a.** Edges from 1 to 6. **b.** Edges from 14 to 7. **Blue represents inflow while red represents outflow.**

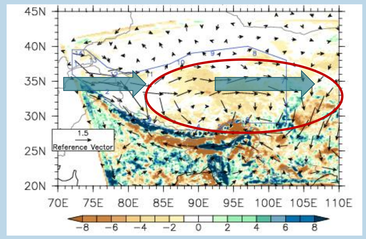


Fig 3. The difference in the precipitation (shading, mm/day) and the horizontal winds (vector, m/s) at 500hPa over the TP between the CPM and LSM simulations.

For more details

Yin Zhao; Tianjun Zhou; Puxi Li; Kalli Furtado; Liwei Zou; Added value of a Convection Permitting Model in simulating Atmospheric Water cycle over the Asian Water Tower, ***JGR-A***, 2021, 126(13): e2021JD034788.

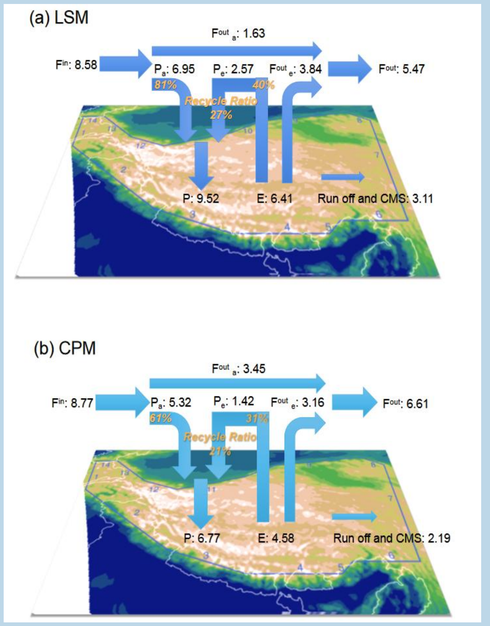


Fig 4. The schematic diagrams of the water cycle over the TP in **a.** LSM and **b.** CPM. Units: 10^7 kg s^{-1}.

Why does convection parameterized model have larger wet bias?

- More external moisture inflow ? NO.
- The total moisture inflow is even larger in the CPM.
- Less net moisture convergence in CPM is dominated by stronger outflow rather than inflow.

- More water vapor converting to precipitation? Yes.
- Larger fraction of the advected and evaporated moisture converts to precipitation, and thereby results in a larger wet bias in the LSM simulation.
- **LSM has overestimated the atmospheric water cycle over the TP.**

- Larger precipitation recycling ratio? Yes.
- The larger precipitation recycling ratio in the LSM indicates more convection due to the deep convection parameterization and an overestimation of the land-atmospheric interaction.