

Sensitivity of Global Summertime Precipitation on the Resolution and Dynamical Core of MMF

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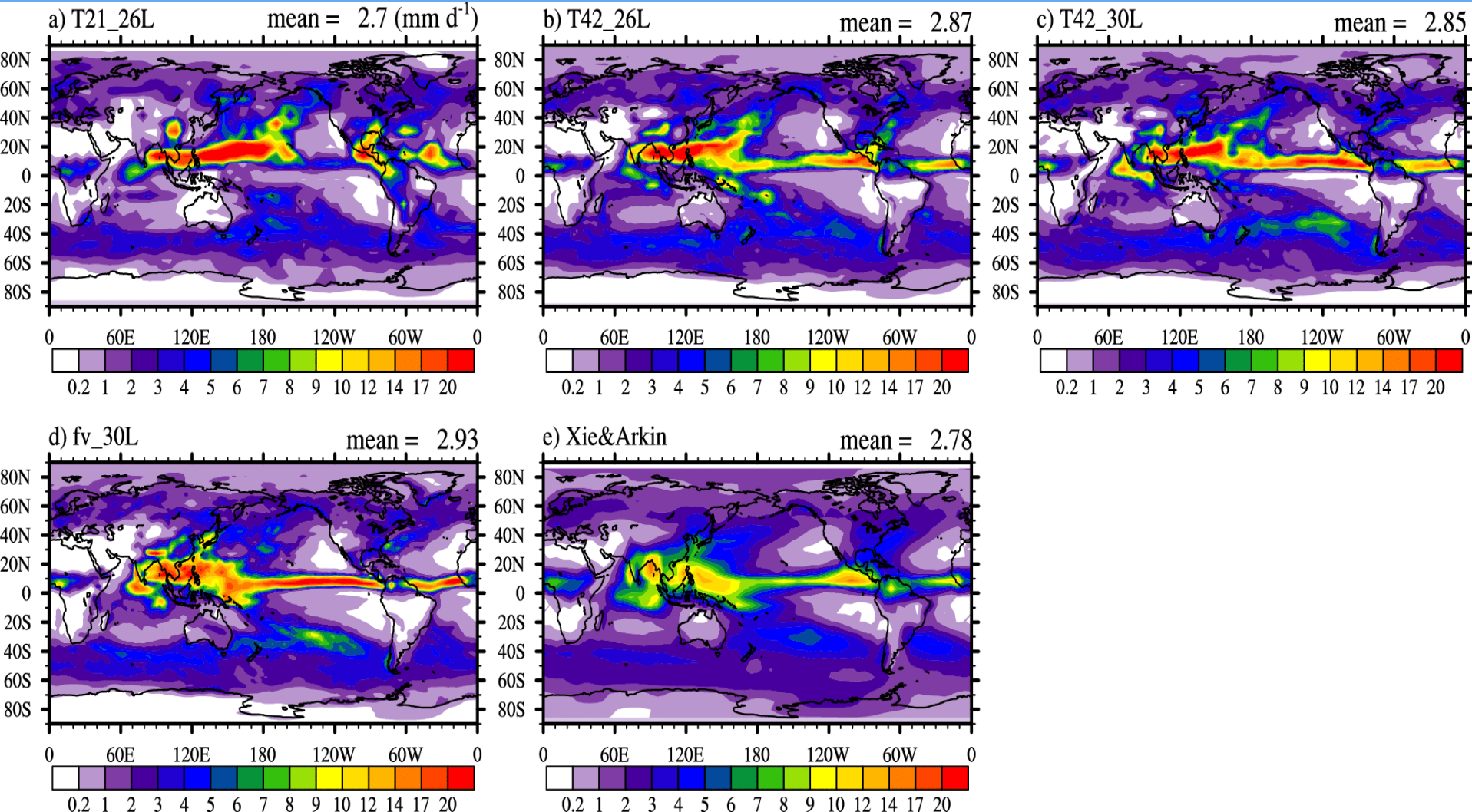
Introduction

- Surface precipitation is a major source and critical component of the hydrological cycle.
- Multiscale modeling framework (MMF), however, seriously overestimates surface precipitation at the Western Pacific warm pool, the so-called “great red spot”.
- The role of vertical and horizontal resolution and the dynamical core played is explored in this study.

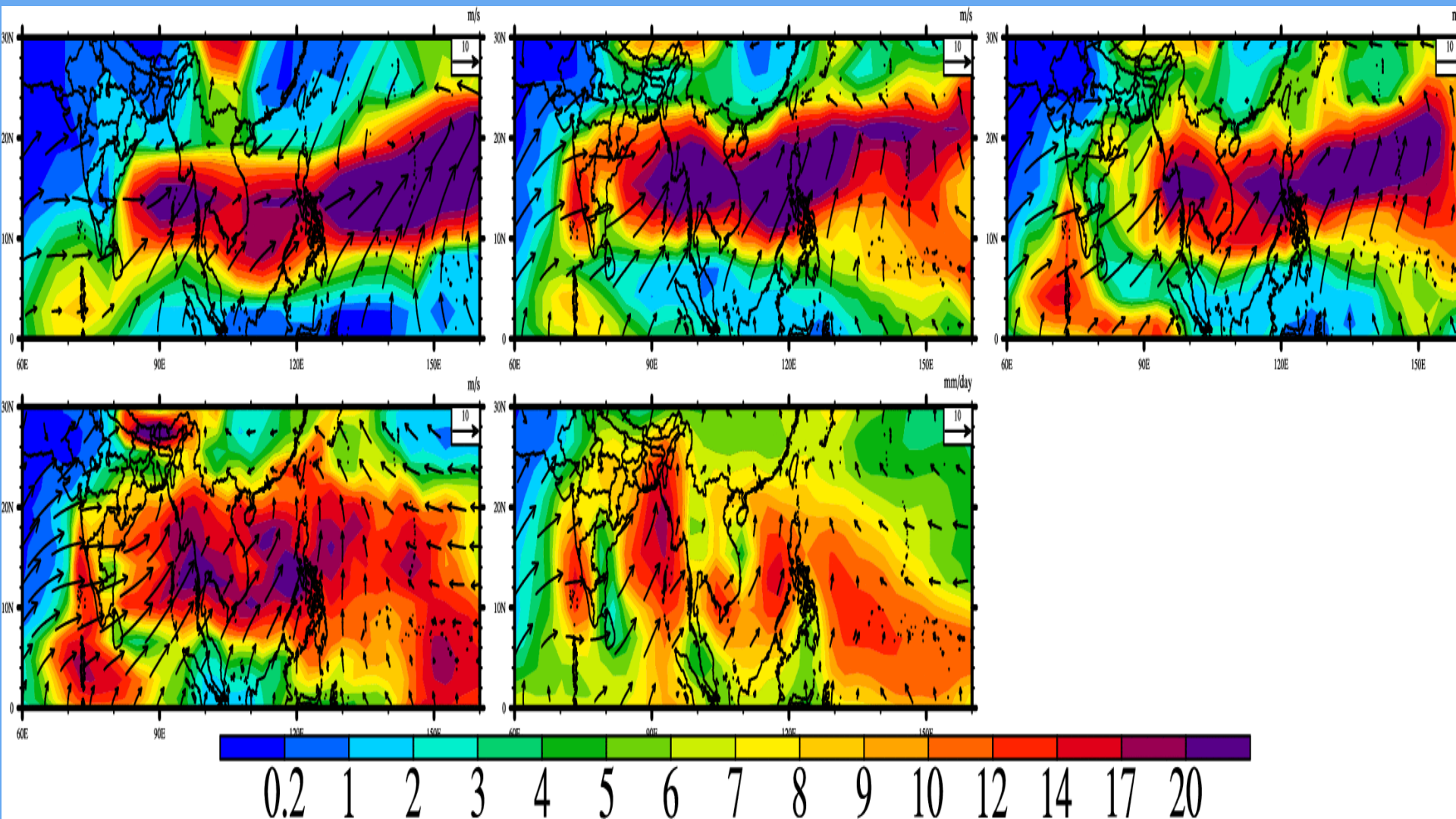
Experiment Design

- Control experiment (T21): standard Community Atmosphere Model (CAM3.5) with a 2D System for Atmospheric Modeling (SAM) embedded; T21 with 26 levels in vertical direction for CAM3.5; same vertical levels and 32 Columns in horizontal with 4 km grid-size for SAM;
- Experiment T42: Same as T21 except using T42 dynamical core.
- Experiment T42_30L: Same as T42 except increasing vertical levels to 30 layers .
- Experiment fv_30L: Same as T42_30L except using finite volume $1.9^\circ \times 2.5^\circ$ dynamical core.
- All experiments were integrated for one year starting from September. Only the summertime results are shown.

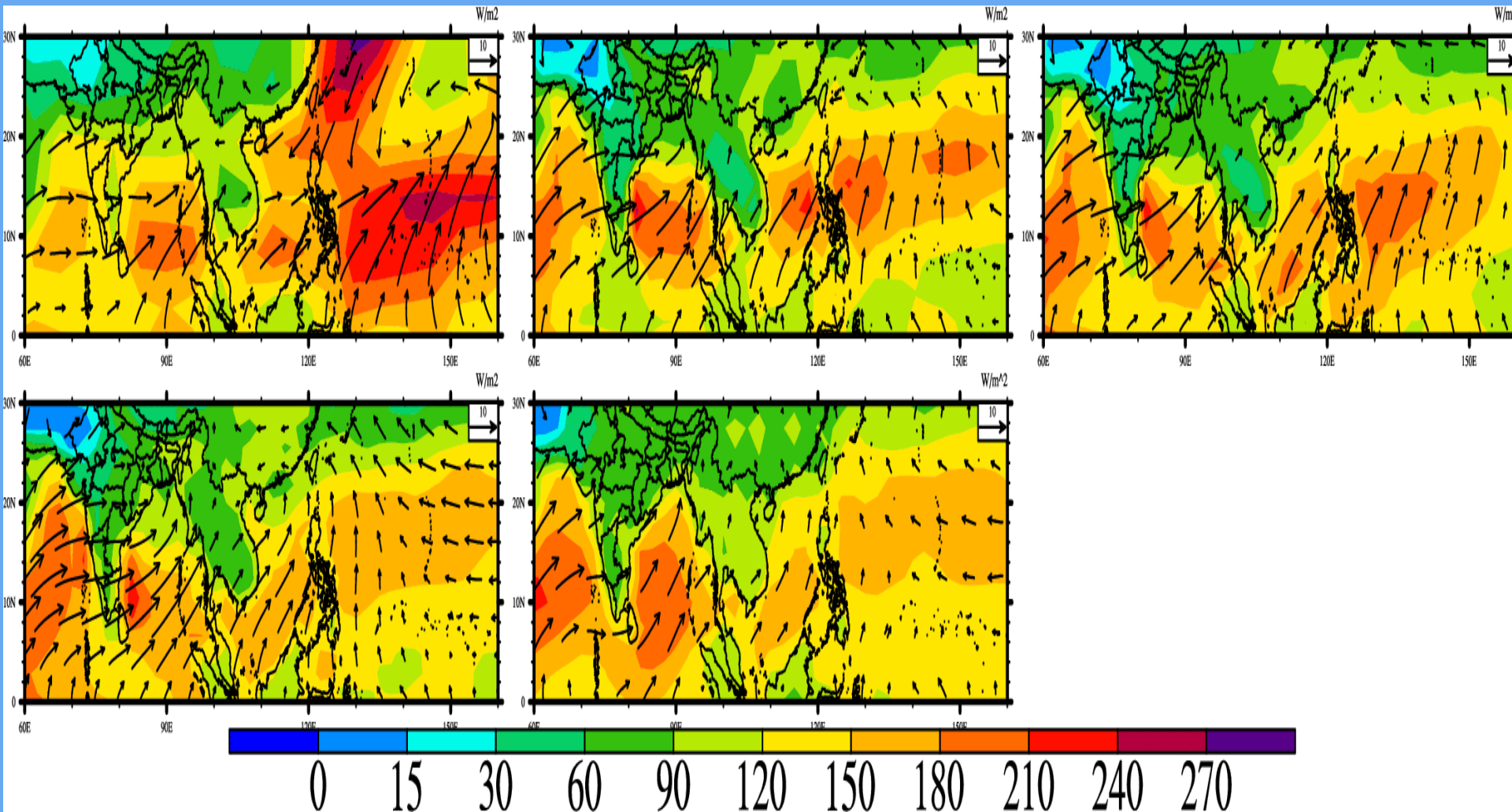
Global Distribution of JJA Surface Precipitation



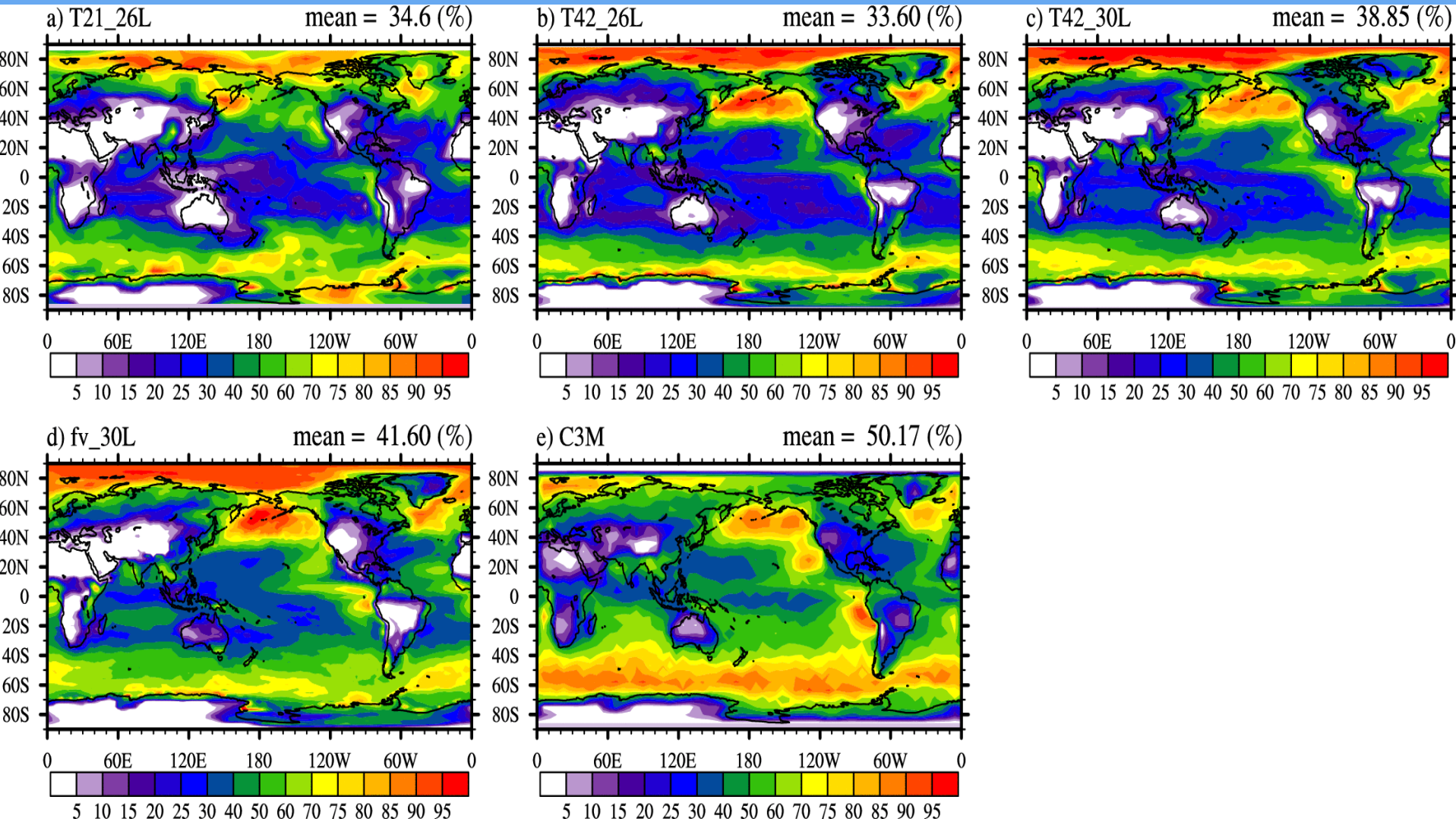
JJA Surface Wind and Precipitation over Tropical Indian/Western Pacific



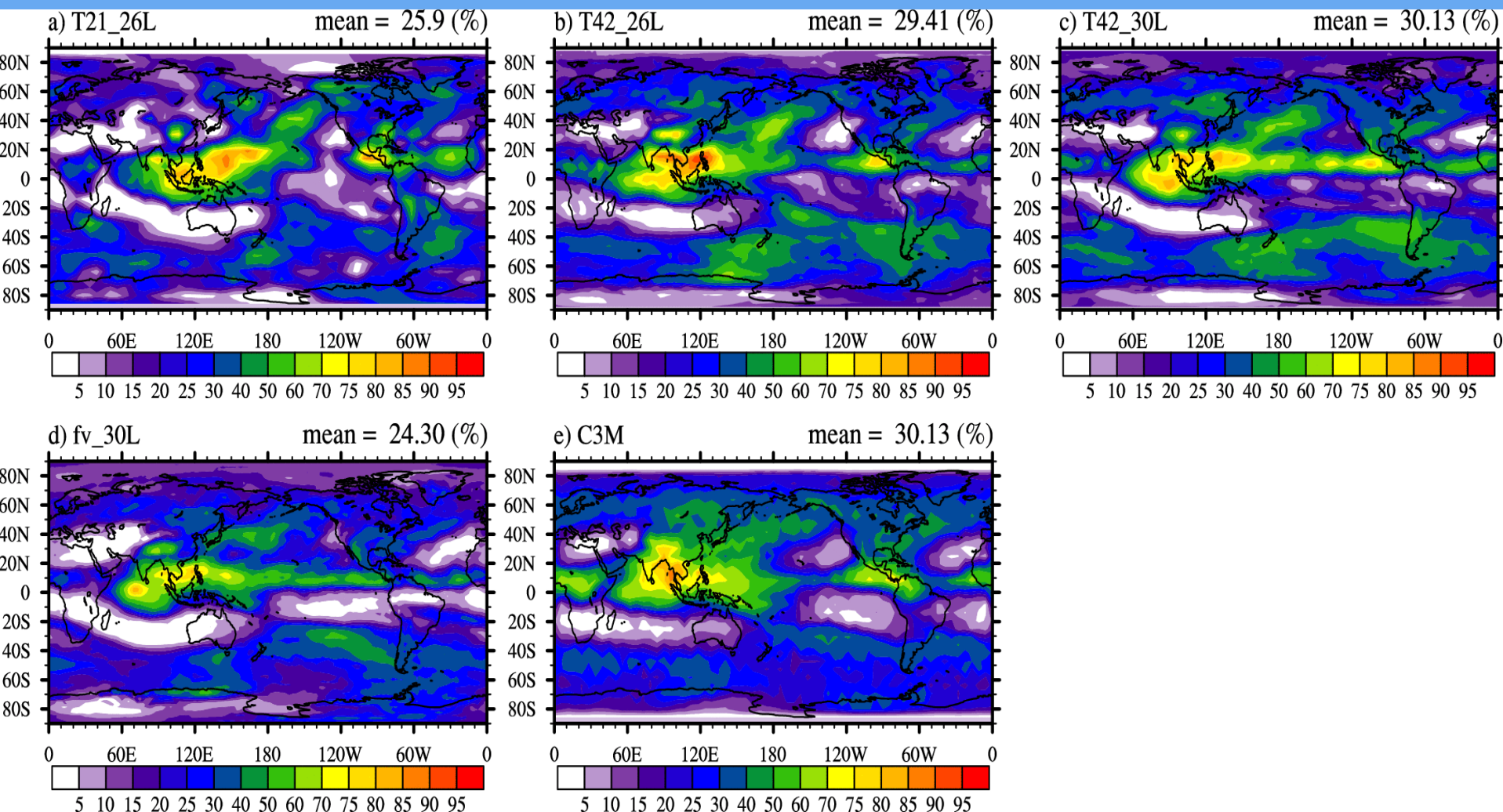
JJA Mean Surface Wind and Latent Heat Flux over Tropical Indian/Western Pacific



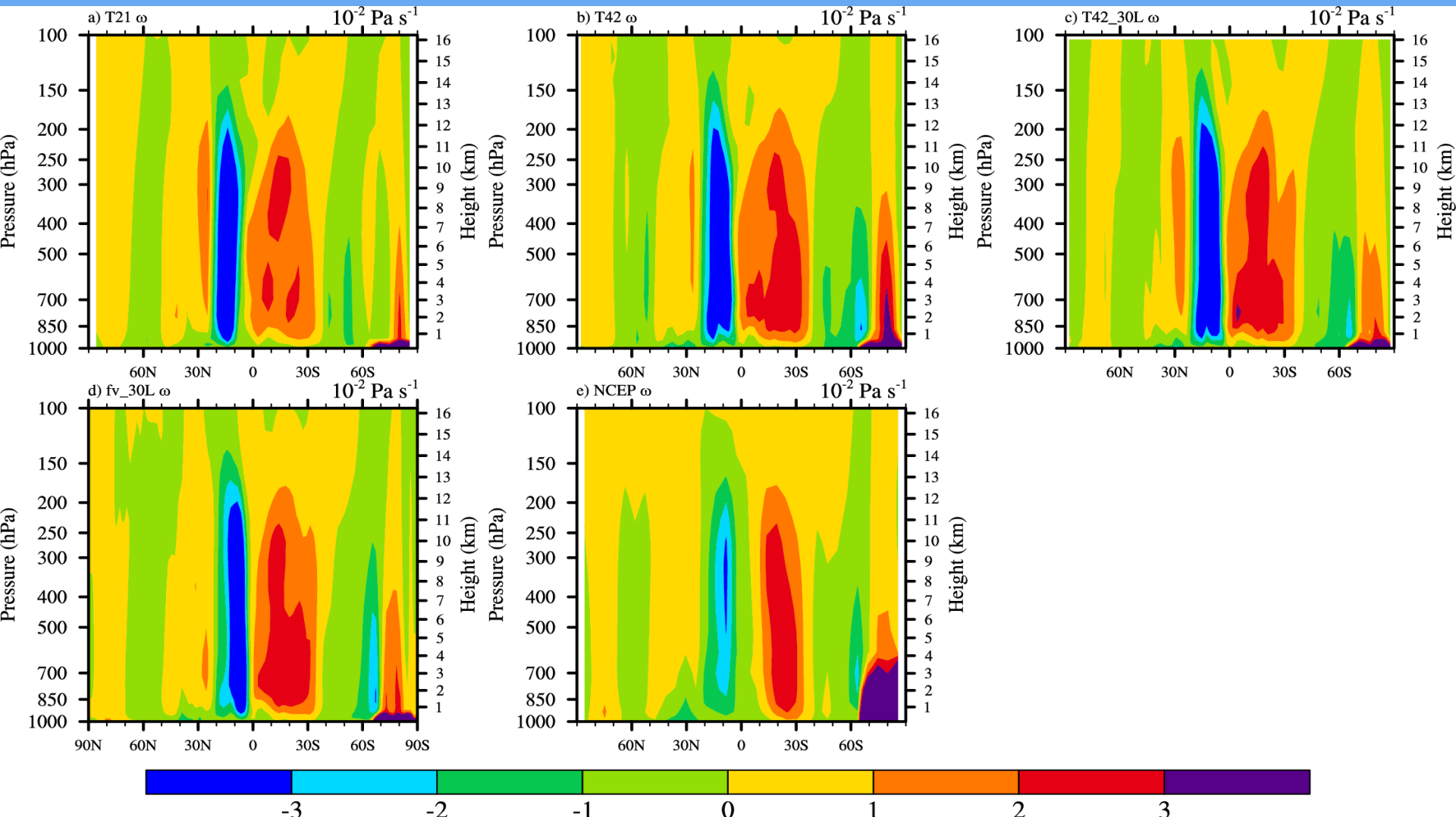
Global Distribution of JJA Low-Level Clouds



Global Distribution of JJA High-Level Clouds



Zonal-annual Mean Vertical Velocity



Summary

- Increasing the horizontal resolution from T21 to T42 results in less low-level convergence in the Western Pacific, so less precipitation.
- Increasing the vertical resolution from 26 layers to 30 layers causes 5% increase of low-level clouds and more precipitation from the central Pacific to the Eastern Pacific.
- The finite volume dynamical core with 30 vertical layer produces the most reasonable combination of surface precipitation, surface latent heat fluxes, and low-level wind field in the Western Pacific. However, the surface precipitation is still overestimated.
- The strength of the Hadley cell in all simulations is stronger than the NCEP reanalysis.