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Dynamics of East Asian summer monsoon in past and future warmer climates: mid-Pliocene versus RCP4.5 scenario

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The mid-Pliocene warm period is the most recent warm equilibrium climate in earth's history with higher (405ppm) than present CO_2 level. It offers a test bed to investigate the atmospheric dyanmics in a past warmer climate changes of many parallels as the future scenario. This study aims to examine the dynamics of East Asian summer monsoon (EASM) in past and future warmer climates and to answer a question "is mid-Pliocene climate an analogue for the East Asian monsoon climate in the future? "
Large consistence of model and proxy data increases the reliability of EASM changes in mid-Pliocene. We perform a comparative study of EASM climate between mid-Pliocene and RCP4.5 scenario regarding phenomena, physical processes behind this phenomena and underlying mechanisms. Our results show that EASM precipitation is increase in both mid-Pliocene and RCP4.5 scenario (phenomena). Moisure budget is used to examine the physical processes on the increasing response of EASM precipitation to the past and future global warming. Thermodynamic procesesses are both contributed to the enhancement of EASM precipitation in both warmer climtes. In constrast, dynamical processes associated with atmospheric circulation changes contribute differently to EASM precipitation changes in both warmer climates, with positive contribtuion on mid-Pliocene precipitation and negative contribution on projected precipiation. Moist static energy is used to reveal physical mechanism controlling the EASM precipitation changes in past and future warmer climates. The present work highlights the thermal control of large scale similarity and dynamical control of local differences. i.e. the increases of zonal thermal contrast in both warmer climates strenghen the large-scale monsoon circulation assoiciated moisture transport into EASM domain and resultant precipitation increase in monoonal regime. The staionary eddy circulation is of different features beween mid-Pliocene and RCP4.5 scenario, with local convergence in mid-Pliocene and divergence for RCP4.5.