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Investigating future changes in Southern China precipitation characteristics based on dynamically downscaled CMIP5 climate projections

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In this study, general circulation model (GCM) products were dynamically downscaled using the Regional Climate Model system version 4 (RegCM4), in order to study changes in the hydrological cycle - including extreme events - due to a warmer climate by the end of the 21st century over Southern China. The performance of 22 GCMs participating in the Coupled Model Intercomparison Project Phase 5 (CMIP5) in simulating the climate over the East Asian- western north Pacific region was first evaluated. It was found that MPI-ESM-MR, CNRM-CM5, ACCESS1-3, and GFDL- CM3 can reasonably reproduce the seasonal mean atmospheric circulation in that region, as well as its interannual variability. Outputs from these GCMs were subsequently downscaled, using the RegCM4, to a horizontal resolution of 25 km × 25km, for the period of 1979 to 2003, and also from 2050 to 2099, with the latter based on GCM projection according to the RCP8.5 scenario. Results show that the whole domain would undergo warming at the lower troposphere by 3 – 4 °C over inland China and ~2 °C over the ocean and low-latitude locations. Compared to the 1979-2003 era, during 2050-2099 boreal summer, the mean precipitation is projected to increase by 1 – 2 mm/day over coastal Southern China. There is also significantly enhanced interannual variability for the same season. In boreal spring, a similar increase in both the seasonal mean and also its year-to-year variations is also found, over more inland locations at about 25°N. Extreme daily precipitation is projected to become more intense, based on analyses of the 95th percentile for these seasons. On the other hand, it will be significantly drier during autumn over a broad area in Southern China: the mean rainfall is projected to decrease by ~1 mm/day. In addition, changes in the annual number of consecutive dry days (CDD) throughout the whole calendar year was also examined. It was found that CDD over the more inland locations will increase by ~5 days. Thus, there will be a lengthening of the dry season in the region. Global warming's potential impact on sub-daily rainfall is also examined. For the rainfall diurnal cycle (DC), there is no significant change in both spatial and temporal patterns. Moisture budget analyses are also carried out, in order to ascertain the importance of change in background moisture, versus that in wind circulation, on the intensification of MAM and JJA mean rainfall as well as their interannual variability. The implication of these results on water management and climate change adaptation over the Southern China region will be discussed.