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Added value of the regionally coupled climate modeling system over an East Asian summer monsoon area

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The socio-economic dynamics in the whole East Asia are significantly affected by the evolution and variability of the East Asian monsoon, especially during summer. In order to provide reasonable climate change information at the regions strongly influenced by the East Asian summer monsoon (EASM) such as the Yangtze river basin, the climate modeling based on the coupled regional atmosphere – global ocean model ROM (REMO-OASIS-MPIOM) and the stand-alone atmospheric component REMO were carried out over the EASM area for the period of 1980-2012. The performances of the two models were evaluated with the aim of identifying the added value of the coupled system during the EASM.

The ROM simulations captured well the summer mean surface air temperature of the advanced observation datasets over China (CN05.1), while the REMO results showed more similarity to the ERA Interim reanalysis, which may be associated with the difference of the used sea surface temperature conditions. The coupled model ROM reduced the warm biases of the REMO simulation. The summer precipitation was also well simulated by ROM over the East China, but with wet biases over the South China. According to the spatial patterns obtained from the Empirical Orthogonal Function (EOF) analysis of the summer total precipitation, ROM better represented the precipitation distribution over the South and East China, especially over the Meiyu rainband alongside the middle and lower reaches of the Yangtze River Valley.

With respect to the low-level wind, the REMO simulations were characterized by stronger and too far eastward westerlies associated with the Indian summer monsoon, with the convergence shifting eastward into the western North Pacific, which led to similar structures to the moisture fluxes. On the other hand, the water vapor pathways and their convergences were reasonably represented in the ROM simulation. Overall, the air-sea coupling significantly improved the simulations of low-level wind, subsequently the moisture fluxes. Moreover, lower temperatures characterized the sea surface layer, particularly in the western North Pacific. As a result, the coupled model ROM reproduced well the anticyclone over that region, which strengthened the western Pacific subtropical high and weakened the too far eastward westerlies.

In general, the regionally coupled atmosphere-ocean model ROM can reproduce the EASM system better than the stand-alone REMO, which signifies the importance of atmosphere and ocean coupling region. This coupled modeling system should be considered in providing climate change information in this region.