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The Southeast Asia Regional Climate Downscaling (SEACLID) / CORDEX Southeast Asia Project and The Results of Its Sensitivity Experiments of RegCM4 Cumulus and Ocean Fluxes Parameterization Schemes on Temperature and Extremes.

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The Southeast Asia (SEA) region is one of the more vulnerable regions to the impacts of climate change because of the large population exposed to climate-related hazards, mostly living in countries with low adaptive capabilities. In order to adequately prepare and adapt to these future climate change impacts, it is therefore crucial for high-resolution climate projections to be available for this region. The Southeast Asia Regional Climate Downscaling/CORDEX Southeast Asia (SEACLID/CORDEX-SEA) project aims to provide these projections through a collaborative effort in regional climate downscaling. As a first step, model simulations with the 4th version of Regional Climate Model system (RegCM4) developed by International Centre for Theoretical Physics (ICTP) were performed for the SEA domain (80°E-145°E; 15°S-40°N) at 36 km spatial resolution, to determine an optimal configuration of the model for the region. Using the ECMWF ERA Interim data as boundary condition, a total of 18 sensitivity experiments were done with different cumulus parameterization and ocean flux schemes for the period of 1989-2008. In this study, the model's performance in simulating mean temperature is evaluated against APHRODITE, a gridded observed temperature dataset. Initial results showed that RegCM4 tends to enhance the cold bias from the boundary forcing. There is also a consistent cold bias among all simulations over the Tibetan plateau and Indochina, especially during the boreal winter. Consequently, simulations had the smallest biases during boreal summer. The correlation of the model with the observed data is high over the northern half of the region, in contrast with the low correlation over the southern half, which may be due to uncertainties in the APHRODITE dataset over this region. Consistent with the spatial analysis, the analysis of the regional means indicates an overall better performance of the MIT Emanuel scheme, in terms of seasonality and spatial distribution. The choice of the ocean scheme can also affect the model's temperature bias, but not as much as the cumulus parameterization. For extremes, 14 indices for both rainfall and temperature were estimated. To measure the degree of similarity of the 18 experiments in both phase and shape, a statistical omega index was used. Results showed relatively higher similarities among the experiments over the mainland Asia compared to those over the Maritime continents for both seasonal and inter-annual variabilities. The extreme rainfall indices had a lower omega than those of temperature. Observed daily rainfall and temperature data at 123 meteorological stations over the SEA region were also used to validate the simulated extreme rainfall and temperature indices. Results showed higher correlations between simulated extremes and the observed ones over the mainland Asia continent compared to those over the Maritime Continent, suggesting an inappropriate quality of the extreme indices simulated by RegCM4 over the later region. Our analysis also pointed out the regions within SEA at which simulated extreme indices were more sensitive to cumulus parameterizations and ocean fluxes treatment. These results thereby highlight the need to choose the appropriate configuration for RegCM4, particularly for the SEA region, before downscaling global climate projections.