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Impacts of anthropogenic forcing on regional climate simulation for CORDEX-East Asia

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Impacts of greenhouse gas and aerosol on climate change are crucial, so that it is trivial for CMIP models to consider anthropogenic forcing for current climate simulations and future projection as well. Meanwhile, for regional climate models, it is still ambiguous if those forcings are duplicated or not, since the large-scale information is provided from the GCM models through the lateral boundary condition. To answer this question, four experiments using the HadGEM3-RA were conducted within the CORDEX framework for the East Asia domain, which are defined as FIXF (Fixed forcing experiment), GHGS (Greenhouse gases forcing only on the FIXF), AERO (Aerosol forcing only on the FIXF), and ALL (Both forcings on the FIXF) experiments. All experiments were driven by the same GCM forcing, i.e. HadGEM2-AO. Simulation results for the current (27 years for 1979-2005) and future (30 years for 2071-2100) climate were analyzed.
FIXF experiment simulated significant cold biases near the northwestern China and Mongolia. Compared to results from the FIXF, those from the ALL and AERO were better, particularly for the temperature in northwestern China and for the precipitation in southern China, Indonesia and northwestern Pacific. Reduced cold bias in northwestern China is highly associated with the aerosol forcing, and marginally associated with the greenhouse gases forcing. As a result, temperature simulated by ALL experiment shows less bias than any other experiments. In the future, surface air temperature was projected stronger in ALL than FIXF experiment in late 21st century. Especially, based on the future projection from the ALL experiment, increase in domain-averaged surface air temperature is about 3.0oC (4.2oC) under the RCP 4.5 (RCP8.5) scenario. In future change of precipitation, regardless of forcing experiments, annual mean precipitation over maritime continent and northwestern Pacific are expected to increase. And percent change in annual mean precipitation of ALL experiment is 8.2 % and 17.4% for RCP 4.5 and 8.5, respectively.