Multi-decadal scenario simulation over Korea using a one-way double-nested regional climate model system

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This study investigates the capability of the regional climate model RegCM3 to simulate the recent climate and future climate change with a focus on the Korean peninsula. The model is run in one-way double nested mode, with a 60 km grid point spacing "mother" domain encompassing the eastern regions of Asia and a 20 km grid point spacing nested grid covering the Korean peninsula. We carried out two 30-year long experiments, one for present day conditions (covering the period 1971-2000) and one for near future climate conditions (covering the period 2021-2050). Initial and time-dependant lateral boundary conditions are provided from ECHO-G fields based on IPCC SRES B2 emission scenario. Not only mean climate but also frequency and intensity of extreme climate events are investigated on various temporal and spatial scales.

In order to obtain the confidence in a future climate projection, we first verify the model basic performance of how the reference simulation is realistic in comparison with a fairly dense observation. The reference result shows a good performance in reproducing both the climatological and regional characteristics, although some persistent biases are present. RegCM3 successfully simulates the fine scale structure of the temperature field due to topographic forcing but it shows a systematic cold bias mostly due to an underestimate of maximum temperature. The RegCM3 simulation adequately captures the seasonal evolution of precipitation related to the East Asia monsoon. In particular, winter precipitation is remarkably good, clearly showing typical precipitation phenomena that occur on the northwestern side of Japan during the winter monsoon. Heavy rainfall phenomena exceeding 300 mm/day are simulated only at the high resolutions of the double nested domain.

Regarding the projected 30-year mean climatology, substantial warming is evident all around regions and seasons in the range of 1-3_. The projected surface warming is pronounced in higher latitude and in winter season. Large reduction in snow depth is analyzed in relation to the increase of winter minimum temperature induced by greenhouse warming. In contrast to the temperature change, change in precipitation shows a distinct seasonal variation accompanying a substantial regional dependency. In summer, projected precipitation is not directly responded to the increase of the greenhouse gases, whereas the increase of the wintertime precipitation is identified over broad region in East Asia due to higher water vapor holding capacity in warmer atmosphere. The regional distribution of warm rain episodes changes considerably, indicating changes in flood vulnerable regions. The climate change signal shows pronounced fine scale signal over Korea, indicating the need of high resolution climate simulations there.

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