Submitted Abstract

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Abstract

We set up WRF with three nested domains using initial and lateral boundary conditions from ERA-Interim data. We performed six experiments using three microphysics (MP3, MP8, and WSM6) and two cumulus (KF, and BMJ) schemes. During DJF, MP8 $_{K}$F, MP3 $_{B}$MJ, and MP8 $_{B}$MJ showed relatively lesser precipitation, however, WSM6 $_{K}$F (~6.4 mm day-1) and WSM6 $_{B}$MJ (~6.2 mm day-1) were found to have maximum precipitation. During JJAS, four (MP3 $_{K}$F, MP3 $_{B}$MJ, MP8 $_{K}$F, WSM6 $_{K}$F) out of six experiments failed to show the precipitation features in downstream foothills at the basin terminal, having average precipitation of ~3 mm day-1, which is much lower in comparison to APHRODITE (~7 mm day-1).

Afterwards, we performed the WRF-Hydro calibration using the WRF downscaled meteorological forcing (MP8KF, and WSM6 $_{B}$MJ). The model was calibrated for the year 2003 and validated for 2004-2005. We found JJAS discharge was underestimated for MP8KF, possibly due to underestimation in the JJAS precipitation in MP8KF simulations. WSM6BMJ did reasonably well for the JJAS, but it showed some erroneous high peaks for the non-JJAS. Further, we utilized the best performing setup out of these simulations, each for MP8 $_{K}$F and WSM6 $_{B}$MJ meteorological forcing. We found that the weighted ensemble of these simulations produces satisfactory results (NSE=0.5), alongside the accuracy increased for the validation period (NSE=0.6).

The higher peaks and ridges of the basin are expected to experience lesser precipitation under both RCP4.5 and RCP8.5, having the largest decline towards the end-21st-century under RCP8.5. It is noted that DJF precipitation to be decreased over the peaks, whereas JJAS is becoming wetter over the downstream region under RCP8.5. The near-surface air temperature is rising throughout the year under both RCP4.5 and RCP8.5. The study region is expected to become warmer during JJAS (DJF) by 1-3 (2.5-3.5) ˚C under RCP4.5 and 3-4 (4.5-5) ˚C under RCP8.5 for the end of the 21st century

The surface runoff is expected to decrease almost throughout the basin with largest decline over high altitude regions under both RCP4.5 and RCP8.5 at the end-21st-century. Whereas it is found to be increased over high peaks under RCP4.5 (RCP8.5) for early-21st-century (mid-21st-century). In addition, the snow water equivalent (SNEQV) was found to be decreased under RCP4.5, while increased for the higher elevated regions (> 5 Km). However, at the end-21st-century, SNEQV is expected to decline throughout the year across the region under RCP8.5.