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Historical and future climates over the Upper and Middle Reaches of the Yellow River Basin revealed by a regional climate model in CORDEX

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Despite the importance of the Yellow River to China, regional climate change over the middle reach of the Yellow River Basin (YRB) is much less assessed than other regions. This work focuses on historical and future spatiotemporal changes in mean and extreme temperature and precipitation over the upper and middle reaches of the YRB. The future mean and extreme climates for near-term (2021−2040), mid-term (2041−2060), and far-term (2081−2100) in relation to the historical (1976−2005) period are investigated based on the latest REgional MOdel (REMO). REMO driven by three CMIP5 GCMs under historical and future (RCP 2.6 and 8.5) forcings, following the Coordinated Regional Climate Downscaling Experiment (CORDEX) protocol for the East Asia domain at a spatial resolution of 0.22°, are provided by the Climate Service Center Germany (GERICS). The results show that REMO reproduces the historical mean climate state and six selected climate extreme indices reasonably well, although cold and wet biases still exist. For the far-term, mean temperature rise in winter is most remarkable, with an average of 5.9 °C under RCP8.5. As expected, future temperatures of the warmest day and the coldest night would increase and the number of frost days (FD) would decline considerably. Further, high altitude region would experience a higher mean temperature increase than low altitude region, which is likely caused by the snow-albedo feedback. The decline in FD would increase with elevation, especially under a higher emission. A substantial precipitation increase (32%) would occur in winter under RCP8.5 for the far-term period. Precipitation projections in summer and autumn vary spatially, decrease under RCP2.6 whereas increase under RCP8.5 in the whole YRB for the far-term period. Meanwhile, interannual variability of mean precipitation is expected to increase over most parts of the YRB. Future precipitation extremes, such as the daily intensity and maximum five-day precipitation are projected to increase, and the number of consecutive dry days would decline by the end of the 21st century under the RCP8.5 scenario. The results highlight that the pronounced warming in the high-altitude region together with more intense rainfall extremes could lead to increased future flood risk in the middle and lower reaches of the YRB if the high GHGs emission pathway will be followed.