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Analyses of convective event climatology in the Arabian Peninsula and forecast opportunity at S2S time scale

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Severe weather associated with organized convective systems is becoming more intense globally and is also observed in the Arabian Peninsula (AP). The extreme rainfall-associated flooding in low soil infiltration region like the AP often lead to significant social and economic losses within a very short period. Improving forecast capability at sub-seasonal to seasonal (S2S) timescale can potentially assist disaster risk mitigation, and water resource management.

A series of S2S regional climate model reforecasts were completed using the Weather Research and Forecasting Model (WRF) at convective-permitting resolution (4 km) for the AP. We dynamically downscale 20 years of winter season from the European Centre of Medium-range Weather Forecasts (ECMWF) S2S reforecast product. WRF simulations were initialized weekly with 1-month simulation duration between November and April. A total of 191,400 hindcast days have been generated to evaluate the predictability of winter rainfall associated with convective activities.

Methods designed to evaluate the S2S forecast skills considers the probability of detection of precipitation at neighboring grids, determining the rate of forecast agreements between ensemble members, and running evaluation of the probability of forecast from 1-week to 4-week lead time. We evaluated all rain gauge measurement and gridded precipitation datasets available for the study period and determined the following datasets as our ground-base reference: satellite based Global Precipitation Mission (GPM) and 4-km reanalysis data produced by the King Abdullah University of Science and Technology (KAUST-RA). The WRF S2S downscaled reforecasts significantly improved from the driving ECMWF reforecast climatology, as evaluated against the GPM and the KAUST-RA dataset. Our WRF results also produced reasonable winter precipitation climatology over the AP as compared to the satellite observations and high-resolution reanalysis products, at 1-week, 2-week, 3-week and 4-week forecast lead times.