Title:	Retrospective sub-seasonal forecasts of extreme precipitation events in the Arabian Peninsula using convective-permitting modeling
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Abstract:	This work demonstrates the potential of extreme cool-season precipitation forecasts in the Arabian Peninsula (AP) at sub-seasonal time scales, identifies regions and periods of forecast opportunity, and investigates the predictability of synoptic-scale forcing at sub-seasonal time scales. To this end, we simulate 18 extreme precipitation events using the convective-permitting Weather Research and Forecasting (CP-WRF) model with lateral boundary forcing from the European Centre of Medium-range Weather Forecasts sub-seasonal to seasonal reforecasts (ECMWF S2S reforecasts). The simulations are initiated at one-, two-, and three-week lead times. At all lead times, the CP-WRF improves the mean accumulated precipitation in the extratropical synoptic regimes over the west coastal and central AP and the central Red Sea compared to ECMWF S2S reforecasts as evaluated against the Global Precipitation Measurement Final (GPMF) and King Abdullah University of Science and Technology reanalysis (KAUST-RA) precipitation products. Based on categorical statistics with a threshold of 20 mm accumulated precipitation over 7 days, the CP-WRF skillfully forecasts the precipitation over Jeddah, the west coast of AP, and the central Red Sea up to three-week lead time. The relative operating characteristic curve reconfirmed the high forecast skill of the CP-WRF, with an area under the curve above 0.5 in most of the events at all lead times. Finally, the correlation coefficients between the ECMWF S2S reforecast and ECMWF reanalysis interim 500 hPa geopotential heights are higher in the events associated with an extratropical synoptic regime than in those associated with a tropical synoptic regime, regardless of lead time. Therefore, the convective-permitting model can potentially improve the accuracy of extreme winter precipitation forecasts at two-and three-week lead times over Jeddah, the west coast of AP, and the central Red Sea in the extratropical synoptic regime.
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