Title:	Diagnostic evaluation of extreme winter rainfall events over the Arabian Peninsula using high-resolution weather research and forecasting simulations
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Abstract:	The sensitivity of different cumulus physical parameterization schemes for simulating extreme winter precipitation events over the Arabian Peninsula (AP) is investigated using a high-resolution weather research and forecasting (WRF) model. For winters in 2001–2016, the following three parameterization schemes are examined: (i) Kain–Fritsch (KF), (ii) Betts–Miller–Janjić (BMJ), and (iii) Grell–Freitas (GF). The simulation results suggest that the AP extreme winter rainfall events are best simulated using the KF, followed by the BMJ, in terms of spatial distribution and intensity. The spatial pattern correlation coefficient between the model-simulated and observed rainfall is highest with KF (0.94), followed by BMJ (0.91) and GF (0.76). These results are attributed to a better representation of the moisture transport associated with upper-tropospheric cyclonic circulation and potential vorticity intrusions. By contrast, the GF scheme fails to simulate moisture convergence and updrafts, leading to an unrealistic representation of cloud hydrometeors and an improper organization of convection and associated extreme rainfall intensities. Meanwhile, the KF and BMJ also successfully simulate the dynamics and thermodynamics of extreme rainfall events that are usually driven by synoptic forcing. The study results suggest that the choice of cumulus parameterization schemes in the WRF model is critical for reliable simulation of extreme rainfall in the hyperarid AP region.
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