Title:	Evaluating Cumulus Parameterization Schemes for the Simulation of Arabian Peninsula Winter Rainfall
Authors:	Attada, Raju (/jspui/browse?type=author&value=Attada%2C+Raju)
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Abstract:	This study investigates the sensitivity of winter seasonal rainfall over the Arabian Peninsula (AP) to different convective physical parameterization schemes using a high-resolution WRF Model. Three different parameterization schemes, Kain–Fritch (KF), Betts–Miller–Janjić (BMJ), and Grell–Freitas (GF), are used in winter simulations from 2001 to 2016. Results from seasonal simulations suggest that simulated AP winter rainfall with KF is in best agreement with observed rainfall in terms of spatial distribution and intensity. Higher spatial correlation coefficients and fewer biases with observations are also obtained with KF. In addition, the regional moisture transport, cloud distribution, and cloud microphysical responses are better simulated by KF. The AP low-level circulation, characterized by the Arabian anticyclone, is well captured by KF and BMJ, but its position is displaced in GF. KF is furthermore successful at simulating the moisture distribution in the lower atmosphere and atmospheric water plumes in the middle troposphere. The higher skill of rainfall simulation with the KF (and to some extent BMJ) is attributed to a better representation of the Arabian anticyclone and subtropical westerly jet, which guides the upper tropospheric synoptic transients and moisture. In addition, the vertical profile of diabatic heating from KF is in better agreement with the observations. Discrepancies in representing the diabatic heating profile by BMJ and GF show discrepancies in instability and in turn precipitation biases. Our results indicate that the selection of subgrid convective parameterization in a high-resolution atmospheric model over the AP is an important factor for accurate regional rainfall simulations.
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