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High resolution WRF-FDDA seasonal precipitation over complex terrain

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The seasonal precipitation patterns over the Levant region are particularly interesting as they show large gradients over a relatively small geographical area. These gradients are due to the preferred tracks followed by the cyclones, which determine most of the precipitation during the cold season, as well as to the complex terrain characteristics which give rise to orographic precipitation enhancement. Although part of the area is monitored by a dense network of precipitation gauges (e.g., over Israel), precipitation distribution and gradients in the region are in general not resolved. Monitoring and forecast of the seasonal precipitation is of significant importance for hydrological planning. In this work, the WRF-FDDA system has been run with a 4 nested domains configuration (40.5, 13.5, 4.5 and 1.5 km grid-sizes) with continuous data assimilation of surface, upper air and aircraft observations over the 2008-09 precipitation season. The model analyses are verified against a vast range of gauges, radar and satellite (CMORPH) retrieved precipitation measurements. Furthermore, the simulated precipitation events are classified using a self organizing maps (SOM) procedure, according to the precipitation spatial distribution and associated to the synoptic flow features (cyclone location and depth), to the sea-land temperature gradients and to the interaction of these with the complex orography.. The verification results show that WRF-FDDA analyses accurately reproduce the spatial precipitation distribution. High resolution modeling down to 1.5 km grid size is important for correctly reproducing the seasonal precipitation spatial fine patterns and amounts dictated by the complex terrain. These fine patterns are not accurately retrieved by other measurements such as CMORPH. The results of this research suggest the potential use of high resolution WRF-FDDA precipitation re-analysis for supporting statistical downscaling of global seasonal precipitation forecasts over complex terrain areas.