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Effect of nudging in regional hydro-climatic simulations for the eastern Mediterranean

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In this study, we investigate the effect of different nudging options in regional hydro-climatic simulations over the Eastern Mediterranean (EMME) climate change hot-spot. We perform ten one-year-long simulations for the hydrological year October 2001 – September 2002 using the Weather Research and Forecasting (WRF) model. As boundary conditions, we use the ERA-Interim reanalyses. The limited area model is configured in an intermediate-to-high horizontal resolution of 12-km, centered over the eastern Mediterranean Basin. Both grid and spectral nudging options are tested using a number of model configurations and nudging coefficients. We focus on key surface variables, such as precipitation and temperature, which are most relevant for impact studies and directly affect hydrological processes. Additionally, other output variables such as the total column water vapour and geopotential height were used as diagnostics and were compared with observations and/or reanalyses. Due to the large observational uncertainty over the region of interest, we compare the model with various satellite and station-based meteorological data (CRU, E-OBS, TRMM, CHIRPS, CY-OBS). The effect of nudging is tested for both mean conditions and extremes. The selected WRF setup is found to reproduce the mean weather conditions reasonably well, but also several aspects of rainfall extremes over EMME. Our findings highlight the fact that within the WRF modeling system nudging is much more critical for rainfall than for temperature. The application of such interior constraint methods is found to have different impacts on various rainfall regimes. For the hyper arid parts of the domain, nudging is not improving the simulation of precipitation, while it definitely adds value for the wetter rainfall regimes. Nudging that involves specific humidity within the Planetary Boundary Layer is strongly inadvisable.