Title:	Seasonal simulations of summer aerosol optical depth over the Arabian Peninsula using WRF-Chem: Validation, climatology, and variability
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Abstract:	(AOD) over the Arabian Peninsula (AP) using a long-term high-resolution Weather Research and Forecasting model coupled with the chemistry module (WRF-Chem) simulation, available ground-based and satellite observations, and reanalysis products from 2008 to 2018. The simulated spatial distribution of the summer AOD agrees well with the satellite observations and reanalysis over the AP, with spatial correlation coefficients of 0.81/0.83/0.89 with MODIS-A/MODIS-T/MERRA-2, respectively. Higher values of summertime AOD are broadly found over the eastern AP regions and the southern Red Sea and minima over the northern Red Sea and northwest AP, consistent with observational datasets. The WRF-Chem simulation suggests that the two regions of high AOD are associated with dust advected from the Tigris–Euphrates by the northwesterly summer Shamal wind in the eastern AP and from the African Sahara via Sudan by westerly winds through the Tokar Gap for the southern AP. The high AOD over the south-central east AP is due to locally generated dust by the action of northerly winds, modulated by variations in relative humidity, vertical motion, soil moisture, and soil temperature over the desert regions. The vertical extent of this dust is primarily driven by upward motion triggered by thermal convection over the local source region. In terms of interannual variability, summer AOD exhibits significant year-to-year variations over the AP region. In particular, enhanced (reduced) AOD over the southern AP (Persian Gulf) is observed during La Niña conditions, favoured by stronger (weaker) Tokar westerly (northwesterly summer Shamal) winds.
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