Aerosol optical depth trend over the Middle East

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We use the combined Dark Target/Deep Blue aerosol optical depth (AOD) satellite product of the Moderate-resolution Imaging Spectroradiometer (MODIS) collection 6 to study trends over the Middle East between 2000 and 2015. Our analysis corroborates a previously identified positive AOD trend over large parts of the Middle East during the period 2001 to 2012.

By relating the annual AOD to precipitation, soil moisture and surface wind, being the main factors controlling the dust cycle, we identify regions where these attributes are significantly correlated to the AOD over Saudi Arabia, Iraq and Iran. The Fertile Crescent turns out to be of prime importance for the AOD trend over these countries.

Using multiple linear regression we show that AOD trend and interannual variability can be attributed to the above mentioned dust cycle parameters, confirming that the AOD increase is predominantly driven by dust. In particular, the positive AOD trend relates to a negative soil moisture trend. This suggests that increasing temperature and decreasing relative humidity in the last decade have promoted soil drying, leading to increased dust emissions and AOD; consequently an AOD increase is expected due to climate change.

Based on simulations using the ECHAM/MESSy atmospheric chemistry-climate model (EMAC), we interpret the correlations identified in the observational data in terms of causal relationships.