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A Numerical Modeling Study of the Impact of Regional Emissions on Air Quality in the Sultanate of Oman

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The Arabian Peninsula is located in southwest Asia and it comprises a range of geographical characteristics: e.g. plateau, deserts, mountains and coastal lands. It is bordered by the Red Sea and Gulf of Aden to the west, the Arabian Sea to the southeast and the Oman Sea, the Strait of Hormouz and the Arabian Gulf to the northeast. As a consequence of the geography of the area most of the population and the industrial area are located along the coasts. The Arabian Peninsula is characterized with frequent dust storms. Furthermore, anthropogenic emissions from local fossil fuel combustion and industrial activity and long-range transport, coupled with favourable conditions for photochemical reactions results in additional contribution to degraded air quality in the region. Various air pollutants have been reported to be associated with poor air quality in the Arabian Peninsula, e.g. NO_x, O_3, VOCs, CO, SO_2, respirable particulate matter ($PM_{2.5}$ and PM_{10}). Since the Arabian Peninsula is characterized by large pollutant fluxes and rapid changes in the local scale wind and circulation system, an online-coupled model might significantly improve evaluation of the impact of the rapid economic and population growth and associated energy consumption pattern in the region. In the present study, WRF-Chem version 3.8.1 has been used to simulate the regional gas and aerosol pollution for couple of weeks in July and August over the Middle East (at 36 x 36 km grid spacing), with offline nesting down to the Arabian Peninsula (at 12 x 12 km) and northern part of the Sultanate of Oman (at 4 x 4 km). The gas-phase chemical mechanism is the Carbon Bond Mechanism version Z (CBM-Z), which was originally developed by Zaveri and Peters (1999), is adopted. Two different boundary layer schemes have been implemented to examine the most appropriate boundary layer scheme for the study region, since the Planetary Boundary Layer (PBL) height is very important meteorological parameter controlling the air quality in the study area. Here we show the preliminary results from the PBL sensitivity simulations and the impact of the regional anthropogenic emissions on the air quality of the northern part of Oman.

Reference: Zaveri, R. A. and Peters, L. K.: A new lumped structure photochemical mechanism for large-scale applications, J. Geophys. Res., 104, 30387–30415, 1999.