Geophysical Research Abstracts
Vol. 21, EGU2019-11277, 2019
EGU General Assembly 2019

Formaldehyde around the Arabian Peninsula – A comparison of marine boundary layer measurements with the general circulation model EMAC

Dirk Dienhart, Bettina Hottmann, Ivan Tadić, Uwe Parchatka, Andrea Pozzer, Benedikt Steil, Jos Lelieveld, and Horst Fischer

Max Planck Institute for Chemistry, Atmospheric Chemistry, Mainz, Germany (D.Dienhart@mpic.de)

Formaldehyde (HCHO) is directly emitted from incomplete combustion processes or produced by the photochemical oxidation of hydrocarbons in the troposphere, it can act as a tracer to identify anthropogenic pollution and challenge the current state of understanding the self-cleaning process of the troposphere, because it directly affects hydroxyl (OH) and hydroperoxyl (HO_2) photochemistry. Therefore, marine boundary layer measurements with a Hantzsch monitor are compared to the global chemistry climate model EMAC (ECHAM/MESSy Atmospheric Chemistry).
The AQABA (Air Quality and Climate Change in the Arabian Basin) research campaign characterized various trace gas and aerosol species in the Arabian Gulf area and around the Arabian Peninsula. Starting in Toulon, France, the research vessel Kommandor Iona passed through Suez Canal, the Red Sea and the Indian Ocean into the Persian Gulf with Kuwait as the halfway point. During this field experiment, air with widely ranging conditions has been sampled, i.e. representing clean conditions combined with dust events, aged pollution, ship emissions as well as the unique air masses over the Arabian Gulf. To avoid local contamination, the dataset was filtered to the signature of stack emissions caused by the own or passing ships thanks to simultaneous NO and CO observations. The variety of this dataset offers a good opportunity to test if the global chemistry model EMAC is able to reproduce HCHO under various conditions.
HCHO mixing ratios in the Suez Canal reached a maximum of 7.6 ppb with a mean of 1.9 ppb during the first and 1.2 ppb during the second leg. The northern Red Sea (1.3 and 0.7 ppb) showed higher pollution than the southern part, where the lowest HCHO ratios were detected (0.4 and 0.3 ppb). In the Arabian Gulf area (4.5 and 2.3 ppb), two high pollution events from the western coast, with values up to 12.1 ppb were measured. EMAC results of two mechanisms, MOM (Mainz Organics Mechanism) and MIM1 (Mainz Isoprene Mechanism), show a general good representation of HCHO with most of the data within a factor of two. The comparison shows that both MOM and MIM1 underestimate the immensely polluted Arabian Gulf conditions, although MOM is in better agreement with a deviation of just up to 50%. Whereas in very clean regions, like the southern Red Sea, both models seem to overestimate HCHO. Furthermore, the dataset comparison points out that EMAC reproduces HCHO and its diurnal cycle best in aged air masses during daytime, indicating that physical processes like dry deposition, transport or dilution depending on the boundary layer height are the reason for a larger discrepancy at night.