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Total Reactive Nitrogen (NO_y) Measurements with Thermal Dissociation Cavity Ringdown Spectroscopy (TD-CRDS) during the 2017 AQABA Ship Campaign in the Arabian Basin

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Total Reactive Nitrogen (NO_y= NO + NO_2 + NO_3 + N_2O_5 + HNO_3 + pNO_3 + $RONO_2$+ RO_2NO_2 + [. . .]) plays an important role in photochemical ozone generation in the lower atmosphere and in transport of NO_x from urban to remote locations. We present first results from a Thermal Dissociation Cavity Ringdown Spectrometer (TD-CRDS) for field measurements of NO_y, in which a two channel, 405 nm CRDS is used to detect NO_2 via heated/unheated inlets sampling ambient air.

A quartz tube heated to 850 ˚C acts as the hot inlet of the instrument, a second inlet samples air at ambient temperatures. At 850 ˚C NO_y species, apart from NO, dissociate thermally to NO_2. NO is therefore converted to NO_2 by addition of ozone downstream of the oven. Consequently, NO_y is detected via the hot and NO_x via the cold channel of the instrument. From the difference between the two channels NO_z (=NO_y-NO_x) mixing ratios can be derived. Intensive laboratory investigations of potential interferences were performed, including the measurement of thermograms for individual NO_y species and the characterisation of interfering chemical reactions in the hot inlet.

The instrument was deployed for the first time during the 2017 AQABA ("Air quality and climate change in the Arabian Basin") ship campaign on a route from the south-eastern Mediterranean through the Suez Channel, Red Sea, Indian Ocean and Arabian Gulf to Kuwait and back. On this route, very diverse chemical environments and air masses were encountered and identified. We obtained NO_x and NO_y data sets in air masses that were influenced by megacity emissions, petrochemical activity, desert dust emissions as well as Indian Ocean background.