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Deriving Nitrogen Oxide emissions from inland waterway vessels using MAX-DOAS measurements

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Inland waterway shipping is an important mode of freight transport in Europe with an extended network especially in Germany, e.g. the Rhine and Danube Rivers, and a variety of artificial channels. Nitrogen oxides ($\text{NO}_x = \text{NO} + \text{NO}_2$), which are also emitted by ships, play an important role in tropospheric chemistry. NO_x contributes to the formation of tropospheric ozone and thus photochemical smog. Moreover, NO_x affects human health and increases the acidification of ecosystems. Monitoring of NO_x emissions from inland waterway vessels could provide cities that are located along the rivers with valuable information about ship contribution to the pollution.

In this study, ground-based MAX-DOAS (Multi AXis-Differential Optical Absorption Spectroscopy) measurements were performed along the Rhine River. The aim is to derive NO_2 emissions from individual ships. First sensitivity measurements showed that our Tube MAX-DOAS instrument is sensitive enough to detect a NO_2 signal that can be attributed to passing ships. However, finding the optimal measurement mode to determine the emissions proves to be a challenging endeavour.