



## **Tropospheric NO<sub>2</sub>, SO<sub>2</sub>, and HCHO over the sea area between China and Korea, using ship-based MAX-DOAS observations**

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In this study, ship-based Multi-Axis Differential Optical Absorption Spectroscopy (MAX-DOAS) measurements were performed over the sea area between China and Korea during winter 2018 and spring 2019. Through the Differential Optical Absorption Spectroscopy (DOAS) technique analysis we obtain the spatial distribution of Vertical Column Densities (VCDs) of nitrogen dioxide (NO<sub>2</sub>), sulfur dioxide (SO<sub>2</sub>), and formaldehyde (HCHO) along the cruise of ship-based observation. In addition, the ship-based MAX-DOAS trace gases VCDs were compared with satellite observations of Ozone Monitoring Instrument (OMI) and achieved a good agreement between two data sets. Besides the trace gases spatial distribution information, combine with the meteorological condition, we have also quantified the contributions of external transmission and local emission of pollutants. Meanwhile, the vertical profiles of these trace gases are achieved from the measured Differential Slant Column Densities (DSCDs) at different elevation angles using optimal estimation method. The retrieved profiles displayed the typical vertical distribution characteristics, which exhibits the low concentrations of trace gases in clean area of the marine boundary layer far from coast while the high value was detected close to the ports or even large ships. This study provided further understanding of the main air pollutants in the marine boundary layer of the sea area between China and Korea and also benefited to quantify the pollutants transport between the China and Korea continental region