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Identification of a HCHO signal in S5P/TROPOMI data over shipping lanes in the Indian Ocean

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Formaldehyde (HCHO) is an operational L2 product of the TROPOspheric Monitoring Instrument (TROPOMI) on the Sentinel-5 Precursor platform (S5P) (De Smedt et al., 2018).

International shipping is a significant source of pollutants including CO₂, nitrogen oxides (NO_x), sulfur oxides (SO_x), volatile organic compounds, particulate matter, and black carbon. Shipping lanes are well known to be detected in NO₂ satellite observations (e.g., Beirle et al., 2004; Richter et al., 2004, 2011; Vinken et al. 2014, Georgoulias et al., 2019). SO₂ signal from ships has also been reported in OMI SO₂ observations (Theys et al. 2014). However, so far only one study has reported the detection of an HCHO signal from ships using GOME-1 observations (Marbach et al. 2009). In a recent paper, it has been shown that the TROPOMI measurements allow for the detection of NO₂ pollution plumes from individual ships (Georgoulias et al., 2020).

In this work, we investigate the detection of a HCHO signal over shipping lanes in the Indian Ocean. When averaging several months of TROPOMI HCHO observations, at least two shipping lanes are clearly visible in the Indian Ocean. They are located over known shipping corridors from India and from Africa. We estimate the intensity of the HCHO columns along those tracks as a function of the season. We compare their location and relative intensity with TROPOMI NO₂ observations. The possible impact of the a priori profiles is considered, as well as the impact of cloud filtering. Wind fields, which have been recently added in the HCHO L2 files, are used in order to study the intensity of the signal as a function of wind speeds. The HCHO background transported from continental sources is removed using a first-order estimation. The OMI QA4ECV HCHO and NO₂ datasets between 2005 and 2020 are included in the analysis using 5 years averaged data, in order to study possible changes in the respective line intensities and locations. The detection of such a small signal is an illustration of the improved detection limit of HCHO columns with TROPOMI measurements.