

Atmos. Chem. Phys. Discuss., referee comment RC1
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Comment on acp-2020-1086

Anonymous Referee #1

Referee comment on "Measurement report: Characterization of uncertainties in fluxes and fuel sulfur content from ship emissions in the Baltic Sea" by Jari Walden et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2020-1086-RC1>, 2021

Walden et al use a gradient method to investigate sea-atmosphere fluxes of various species. The detection limit of the gradient method is not sufficient to observe exchange fluxes for most gases. The authors report particle deposition fluxes, likely originating from ship emissions. Additionally FSC is assessed. The FSC in my opinion is the most interesting part of the manuscript, why weren't concomitant NO_x and particle plumes tracked, as this would seem a natural extension of the experiment. As for the flux analysis a number of major issues arise when reading the paper. While presenting CFD calculations to support the measurement site setup, it is not clear whether stationarity criteria were fulfilled due to passing ships and associated plumes being advected over the site. I disagree that stationarity is primarily characterized by concentration trends, which are part of the longer wave spectrum, often filtered out by turbulence averaging intervals. There are better ways to investigate stationarity (see standard textbooks on micrometeorological data pre-processing). As such the interpretation of fluxes needs to be evaluated carefully, because many fundamental criteria often implied for flux measurements might not be fulfilled. This might also relate to different footprints of individual levels of the gradient tower (e.g. is the lowest level even seeing the water surface or partially also influenced by the island?)

The fact that ship plumes on the order of a few seconds were observed suggests that homogeneity and stationarity was largely not fulfilled for quantifying fluxes from ships.

A comparison between CO₂ eddy covariance fluxes and gradient measurements is shown, but it is not indicated what QAQC criteria (e.g. u^* , ICT, stationarity,??) were used to filter data, and how much of the original data was used for the analysis after QAQC filtering. Were storage fluxes considered? To that end it would also be good to quantitatively compare the two flux methods for CO₂, as it could help validating the gradient method. In this context I would expect to see a scatter plot and regression of both fluxes, - how well did the two methods really compare?