

## **Anonymous Referee # 1**

We would like to thank the reviewer for his / her useful comments.

### **1. The measured NO<sub>x</sub> and SO<sub>2</sub> concentration and their emission rates should be validated with the measured data.**

Comparison of the concentrations of the in situ measurements and the DOAS measurements is not straight forward, as both systems measure different air masses. The insitu measurements rely on the transport of air masses to the measurement site, while the LP-DOAS measures the integrated number density of the respective absorbers along the light path. As only a small portion of the light path is affected by a plume, the LP-DOAS measures a lot of background concentration and possible enhancements of NO<sub>2</sub> or SO<sub>2</sub> are lower than for the insitu instruments. Nevertheless both measurement systems show similar results (e.g. Figure 1).

Modified Section 2.4 to include this information.

### **2. How to characterize the emission concentration and emission rates of NO<sub>x</sub> and SO<sub>2</sub> at the ship chimney mouth?**

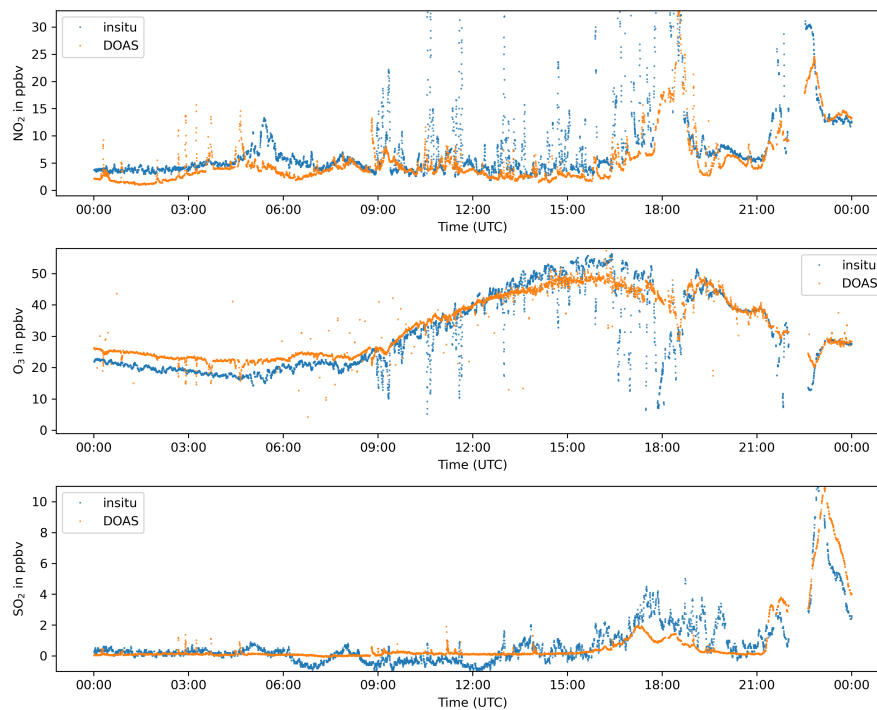
The presented emission rates are the emission rates encountered at the ships chimney mouth.

The emission concentration at the ships chimney mouth depend on the dimensions of the ships chimney. Comparing two chimneys with different sizes, but same emission rate would lead to different emission concentrations at the mouth of the chimney, where the smaller chimney would have higher concentrations compared to the larger one, but their mass flow through the cross section of the chimney mouth would be the same.

### **3. During the analysis, the authors should quantify the impact of NO<sub>x</sub> photolysis.**

Generally the plumes are measured quite shortly after their emission. The time difference between measured peak and assigned AIS position is between 4 to 100 seconds with a median and mean of about 20 seconds. Therefore the effects of NO<sub>2</sub> photolysis are small compared to other influencing factors and can be neglected.

Modified Section 2.4.3 to include this information.



**Figure 1:** Time series of NO<sub>2</sub>, O<sub>3</sub> and SO<sub>2</sub> measured by the insitu instruments (blue) and the LP-DOAS (orange) on 20th July 2018.