

Sulphur emission compliance monitoring of ships in German waters

A. Weigelt¹, L. Kattner^{1,2}, B. Mathieu-Ueffing^{1,2}, A. Seyler², F. Wittrock², and S. Schmolke¹

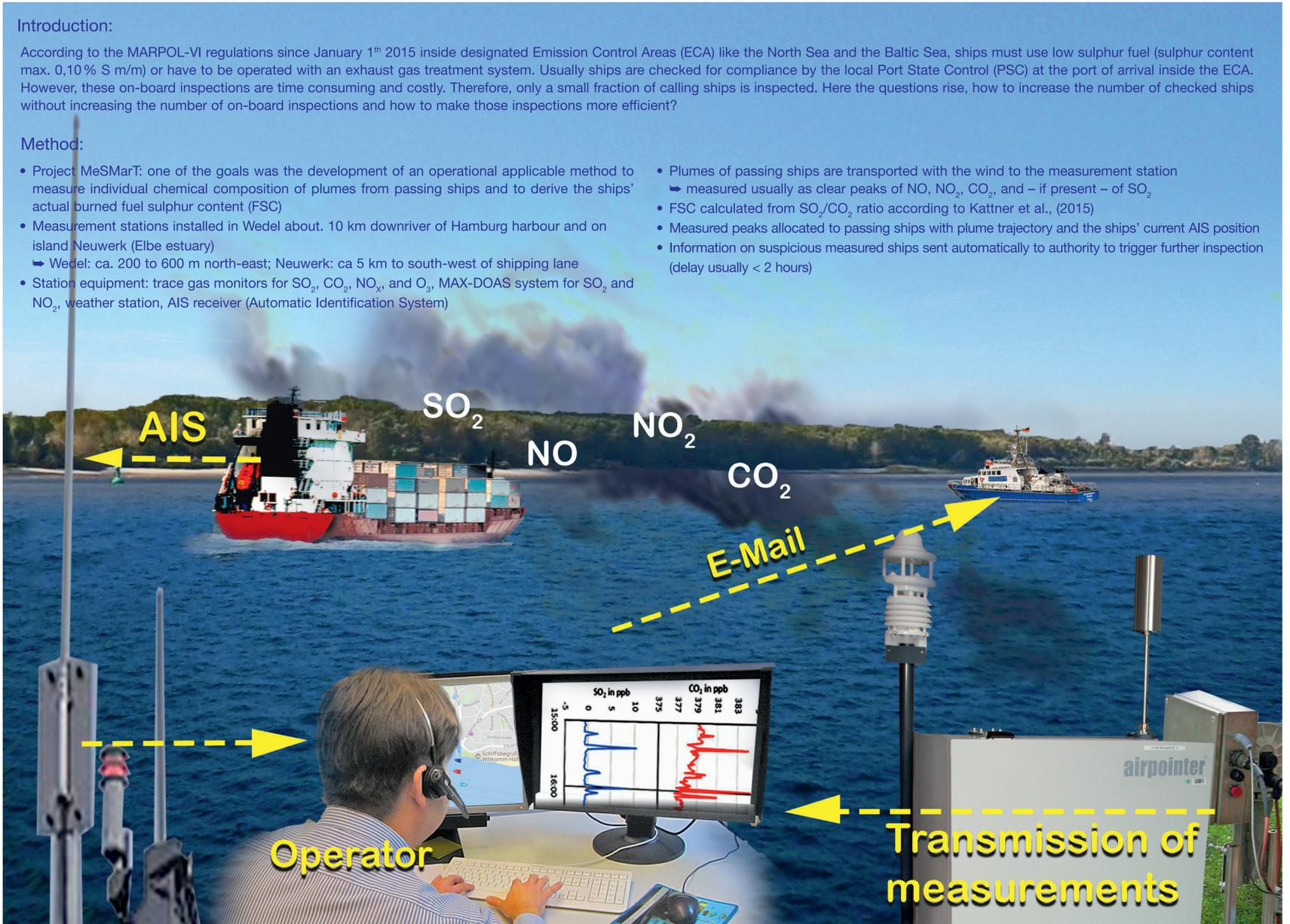


Figure 1: Remote measurement of shipping emissions and data analysis – schematic workflow

Results:

- At station Wedel until now more than 11.000 ship plumes measured and analysed, 165 ships were suspected to be probably non-compliant (1.5%)
- Near real time analysis since summer 2016; in 37 cases remote measurement triggered on-board inspection
 - in 75% same decision: compliant/non-compliant
- Please note: remote measurement shows a picture of the current situation on board, which might have changed in case of delay between remote measurement and on-board inspection
- Observed compliance rate of ca. 98.5% is constant in time and is in agreement with similar observations in coastal regions of Finland, Sweden, Denmark, and the Netherlands (observed compliance rate 93 to 99%; Kubel et al., 2016)
- Fraction of detected ships in Wedel: winter 20 to 25% summer 5 to 10% of all passing ships; reason: seasonal change in prevailing wind corridor
- From 2014 to 2015 significant decrease of atmospheric SO₂ concentration (30 to 80%) observed at both sites reason: on 1. January 2015 allowed FSC inside ECA was decreased from 1.0% to 0.10% S m/m
- No change in NO and NO₂ concentration observed, because no change in regulation

Table 1: Number of detected and probably non-compliant ships at station Wedel

Year	Measured ships	Probably non-compliant ships
2014 (since Sept.)	847	6
2015	3479	69
2016	4271	62
2017 (till Aug.)	2494	28
all	11091	165

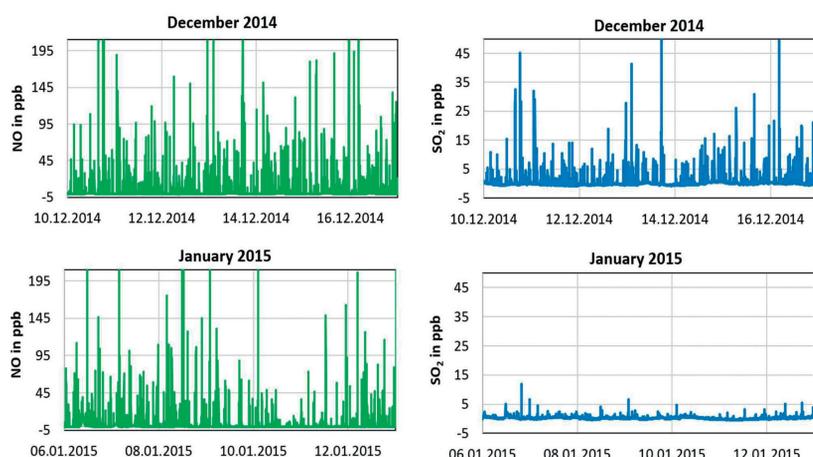


Figure 2: Comparison of NO and SO₂ concentration, measured in December 2014 and January 2015 at station Wedel. The figure was taken from Kattner et al., 2015.

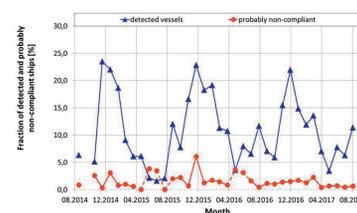


Figure 3: Fraction of detected and probably non-compliant ships at station Wedel

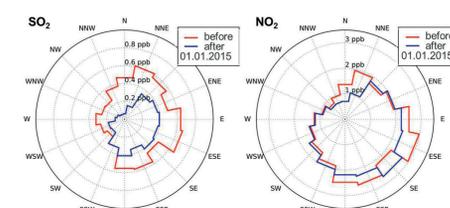


Figure 4: Comparison of SO₂ and NO₂ concentration, measured in 2014 and 2015 at station Neuwerk. Figure published in Seyler et al., (2017)

Kattner, L. et al., (2015): Monitoring compliance with sulfur content regulations of shipping fuel by in situ measurements of ship emissions, Atmos. Chem. Phys., 15, 10087-10092, doi:10.5194/acp-15-10087-2015.
 Kubel, D. et al., (2016): Compliance levels at different sea areas; Second CompMon Stakeholder Conference (8.12.2016), Brussels, http://compmo.eu/events/compmo2
 Seyler, A. et al., (2017): Monitoring shipping emissions in the German Bight using MAX-DOAS measurements, Atmos. Chem. Phys., 17, 10997-11023, https://doi.org/10.5194/acp-17-10997-2017

Acknowledgement: We thank the German Wasser und Schifffahrtsamt (WSA) for the support and the permit to carry out the presented measurements at the WSA facilities in Wedel and Neuwerk.

¹German Federal Maritime and Hydrographic Agency, 20359, Hamburg, Germany
²Institute for Environmental Physics, University of Bremen, 28359, Bremen, Germany

Contract: Andreas.Weigelt@bsh.de
 www.mesmart.de