Trafi Finnish Transport Safety Agency

CompMon- project

Compliance Monitoring for Marpol Annex VI

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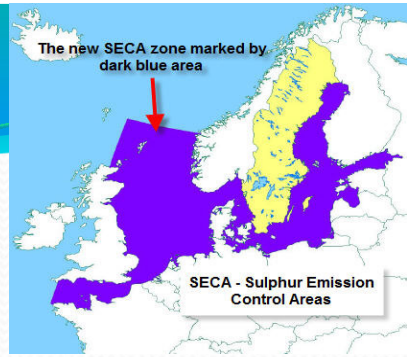
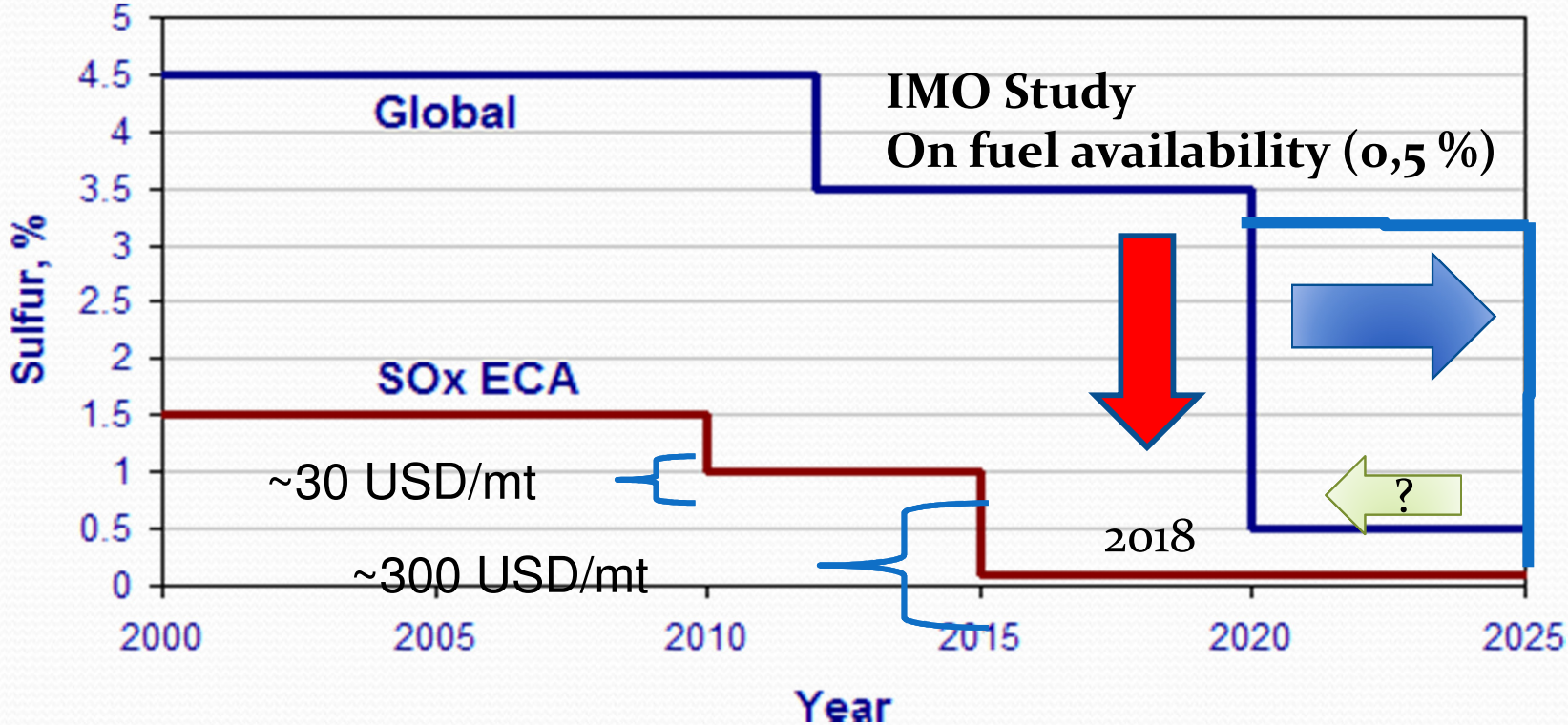
7 May 2015, Copenhagen

Responsible traffic.
Bravely together.



IMO sulphur limit implementation



Need for compliance monitoring

- Compliance of individual ships with emission regulations, especially SOx
  - **Benefit of non-compliance due to difference in fuel prices** [> = 10 k€ / day (Capesize, 300 USD/tn price difference; Jan 26, 2015 around 30% lower]
  - Total costs of compliance 4-6 bn USD/y (NS-BS)
- **Currently inspections (PSC) cover only some % of vessels**
  - Prior to 2016, no obligation for MS to enhance inspections
  - A cost-efficient way to increase coverage for SOx compliance is needed

Global challenge

Global traffic to be monitored

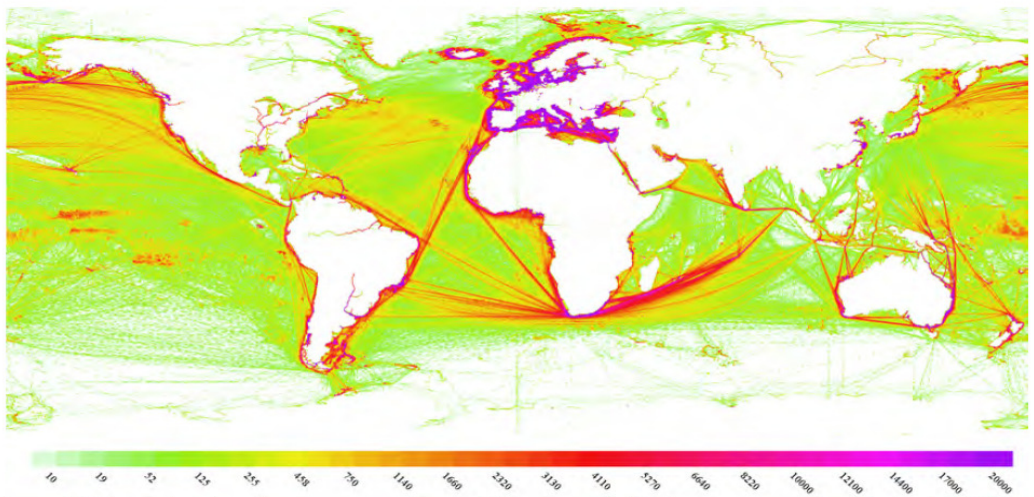
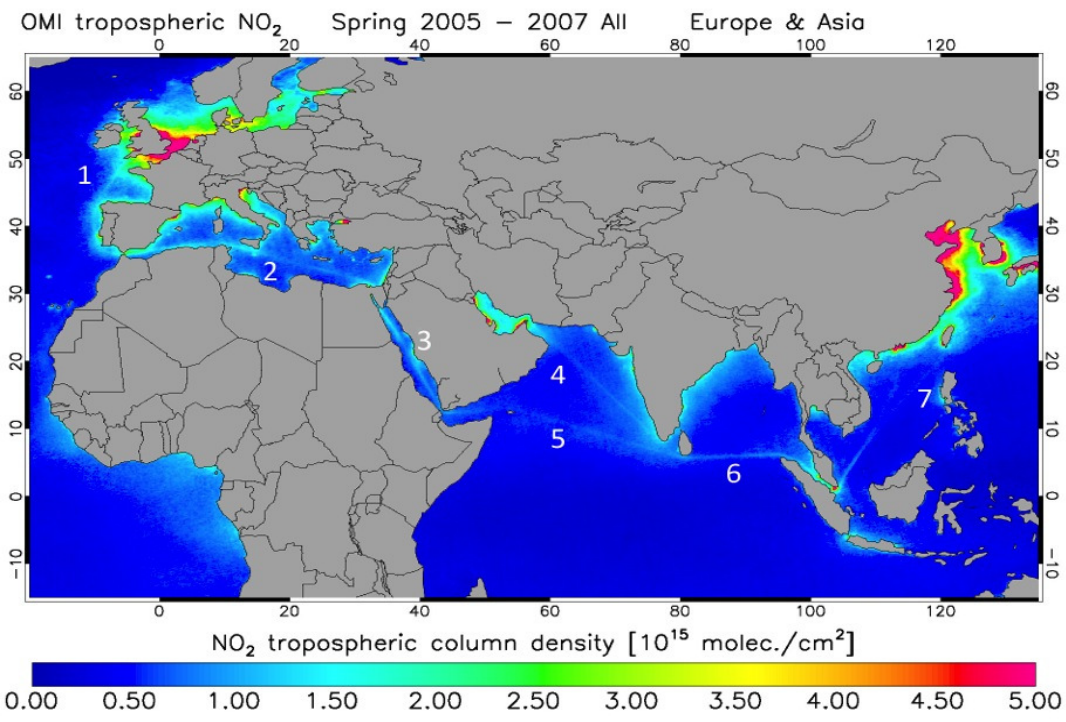


Figure 24 Chart showing the coverage of one of the merged AIS datasets used in this study (2012, all sources, but no LRIT).

(Source: IMO GHG study 2014 / FMI)

Current satellites see NOx, not SOx



(Source: KNMI / ESA SAMBA study)

Main objectives of CompMon

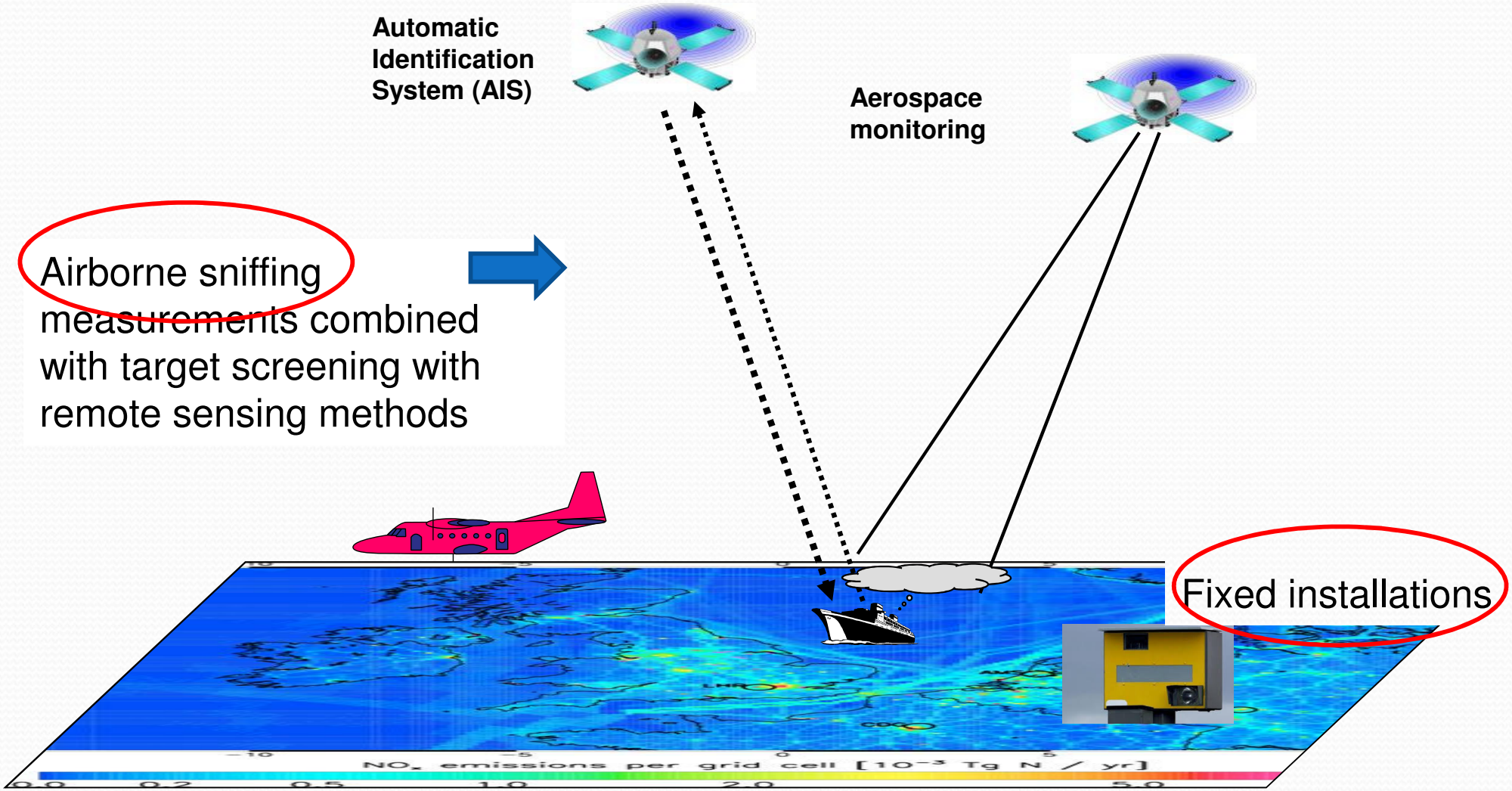
- To join Member States' forces in voluntary piloting of effective targeting for the enforcement of IMO MARPOL Annex VI and EU`s sulfur directive
- To pilot the enforcement of new sulfur regulations in territorial seas of the MSs
- To share best practices in the implementation of targeting methods
- To communicate the experiences to e.g. regional conventions

Partners

- Member states authorities which are responsible for the enforcement of the EU´s sulfur directive (+ MARPOL Annex VI)
  - Finland, Sweden, Germany, the Netherlands, Belgium,

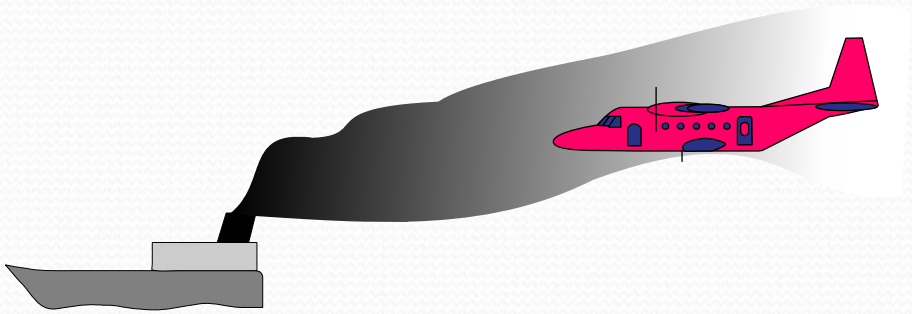
  (Norway, Denmark)
- Implementing organizations
  - Public sector institutes: Finnish Meteorological Institute, Chalmers University, Danish Technological Institute, Royal Dutch Meteorological Institute, MUMM, (University of Bremen)

CompMon solution



Airborne measurements by sniffing:

By measuring SO_2, NO_x, CO_2, CH_4, etc. from individual ships (20-30% accuracy). Approx 200 ships measured.



Beecken, J., Mellqvist, J: Airborne emission measurements of SO2, NOx and particles from individual ships using sniffer technique, Atmos. Meas. Tech 2013.

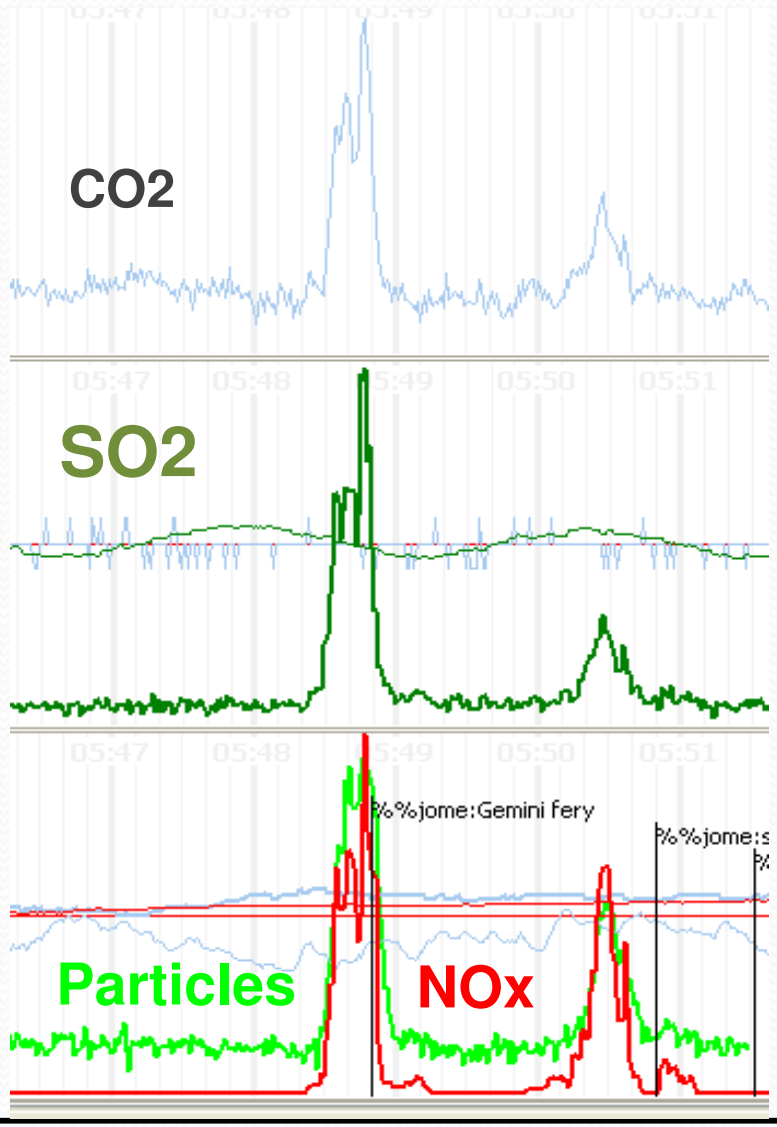
Sniffer Method

- Emission factors in **gram emission per kg of consumed fuel** from exhaust plume

  X/CO_2

  (**X**: SO_2,NOx,particles…)

- Exactly the method approved by IMO and used in scrubber installations



Beecken, J., Mellqvist,, "Airborne emission measurements of SO_2, NOx and particles from individual ships using sniffer technique", Atmos. Meas. Tech. Discuss., 6, 10617-10651, doi:10.5194/amtd-6-10617-2013, 2013

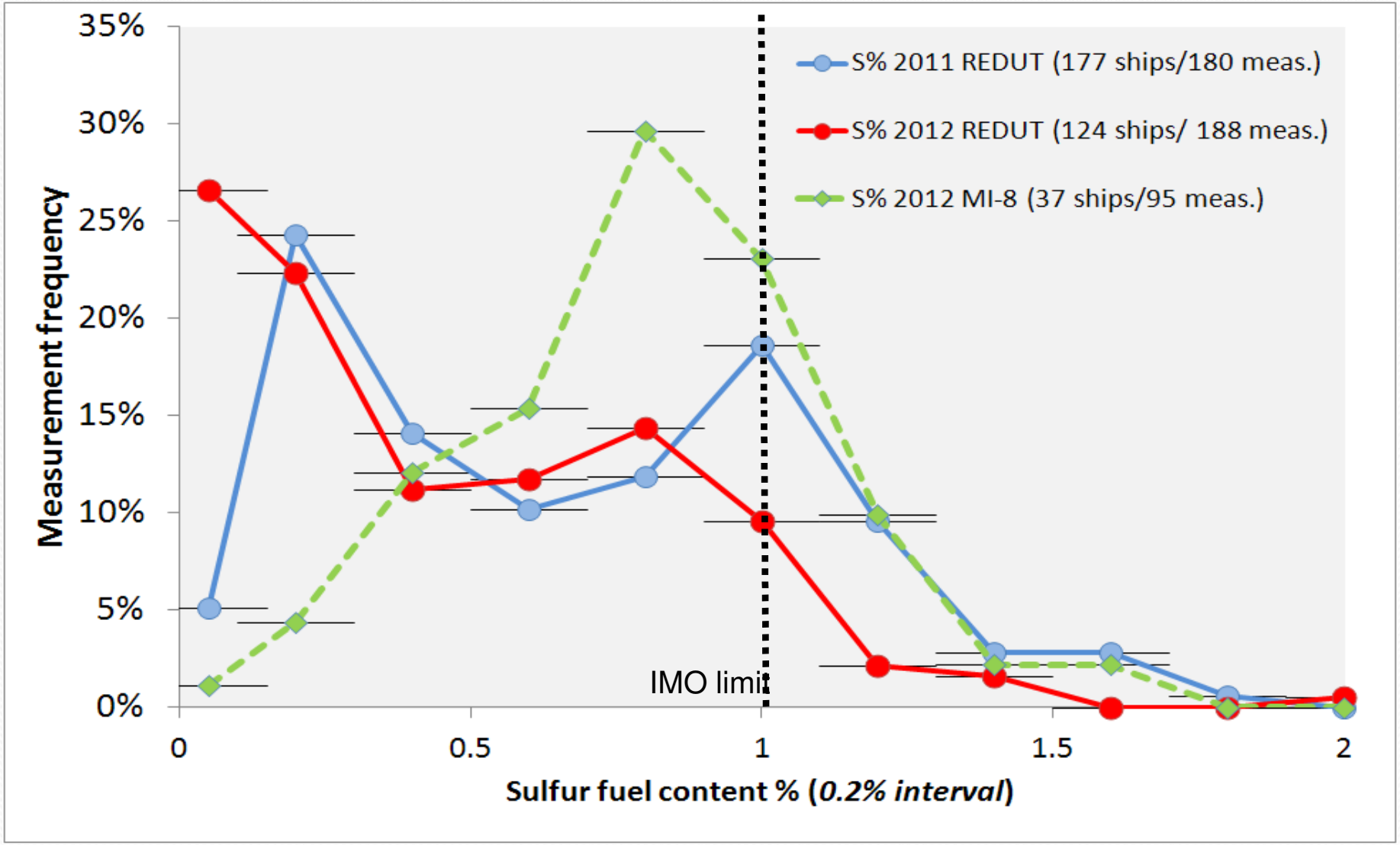
Airborne compliance monitoring in practice

- Feasibility established with trials using various small aircraft and helicopters
- Certification needed for regular operations: expensive and long process.
- 2-3 planes are certified for routine operation of compliance measurements from 1 January 2015.
- **Funding for implementation needed**.

Airborne package contains a full suite of instruments (optical, sniffer AIS receiver) for Sulphur, NOx and PMs and a **software which plots ships and calculates the sulfur fuel content in realtime** for individual ships.

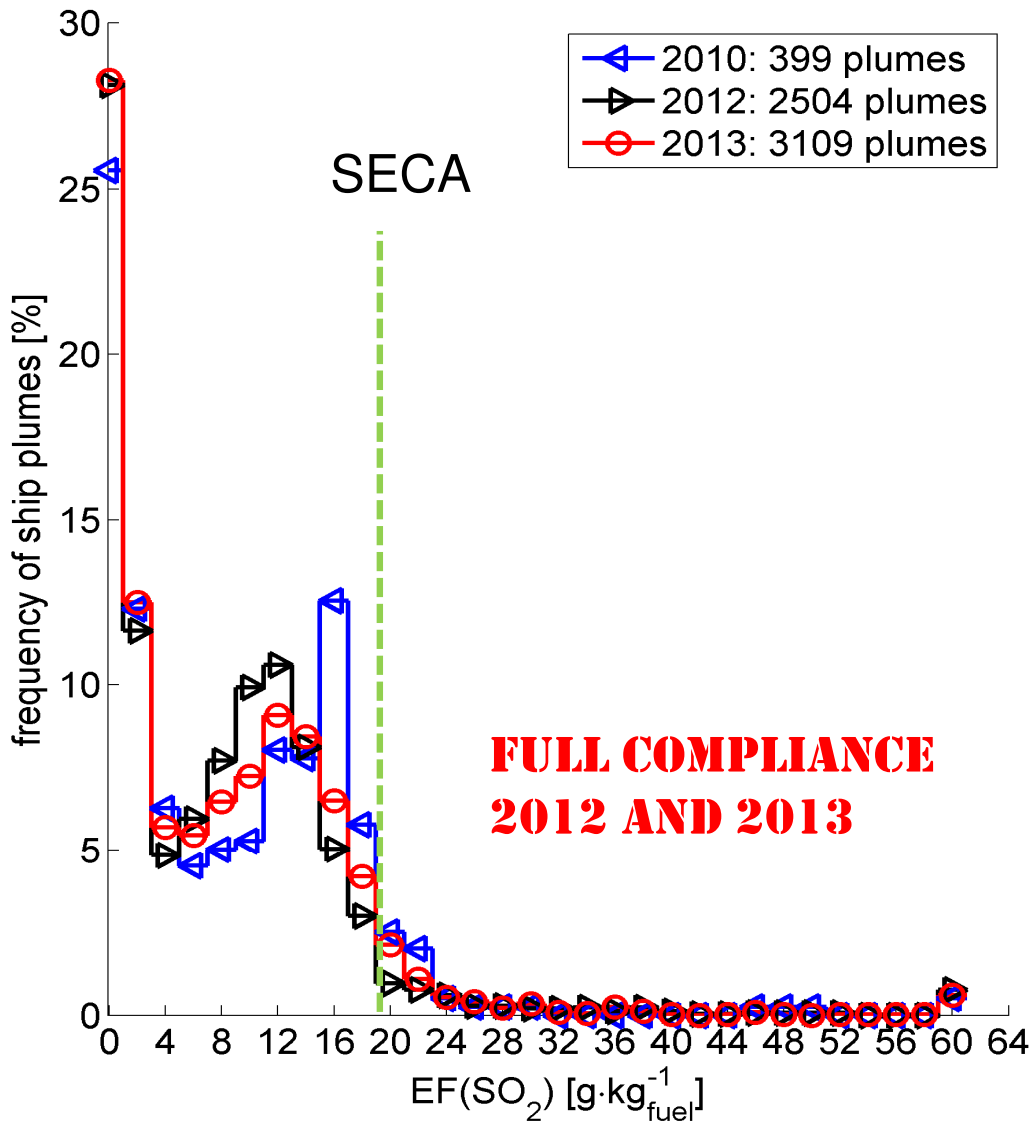
Ship measurements from a MI-8 helicopter in Neva bay outside St Petersburg. BSR-Innoship project, using the IGPS measurement package

Sulphur fuel content for ships in Neva bay and Gulf of Finland 2011 and 2012 measured from harbor vessel M/S Redut and MI-8 helicopter (BSR InnoShip project and IGPS, with Russian permission)



Sniffer measurements at a fixed site (Gothenburg)

- Continuous operation since 2012 in Gothenburg
- Sulfur fuel content in 5000 ships has been determined
- Package with a water tight box
- Automatic real time identification of sulfur content of fuel in individual ships

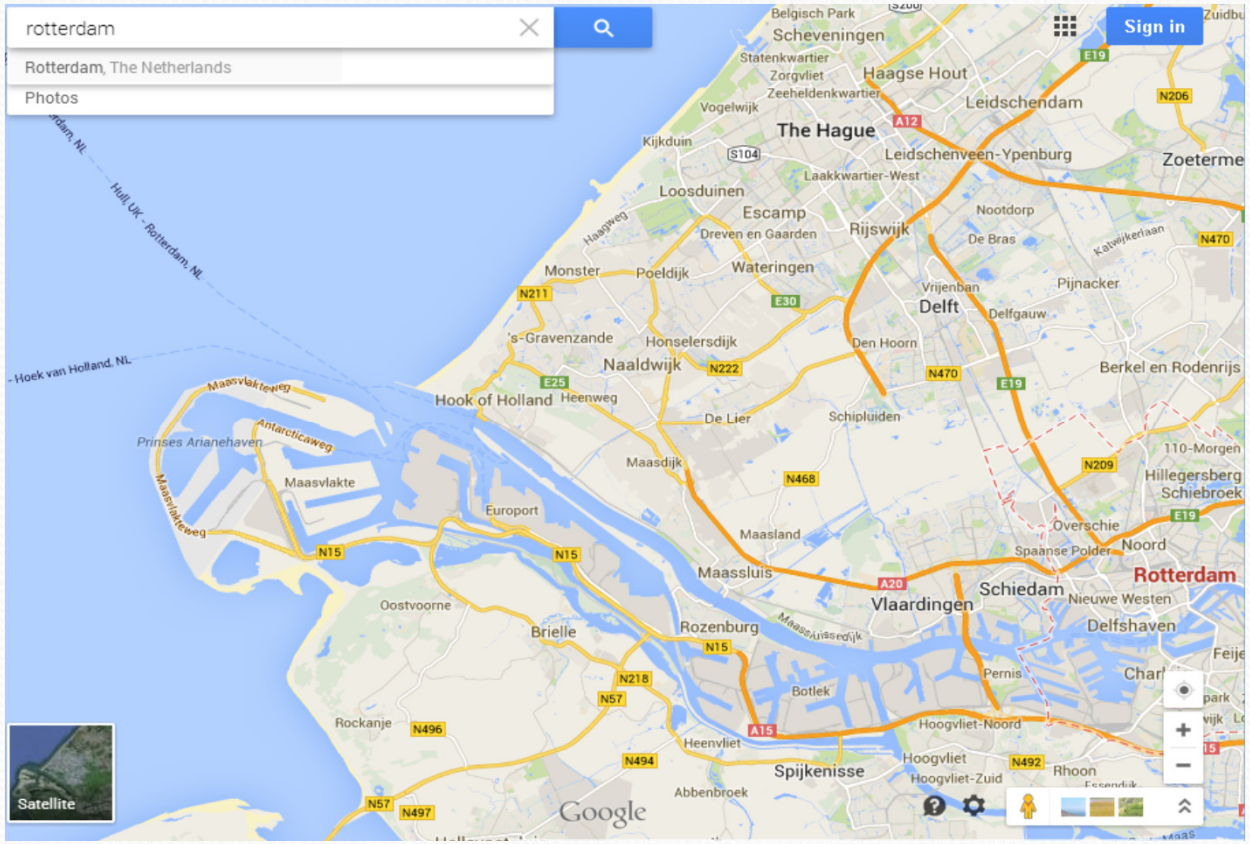


MeSmart (DE)

- BSH in Germany responsible

Rotterdam

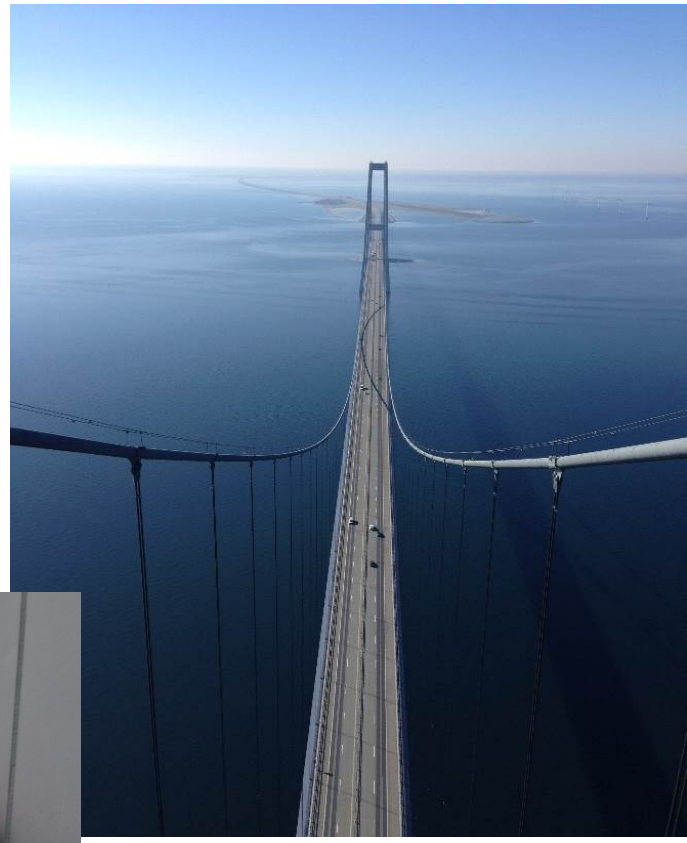
- Pilot monitoring in several years



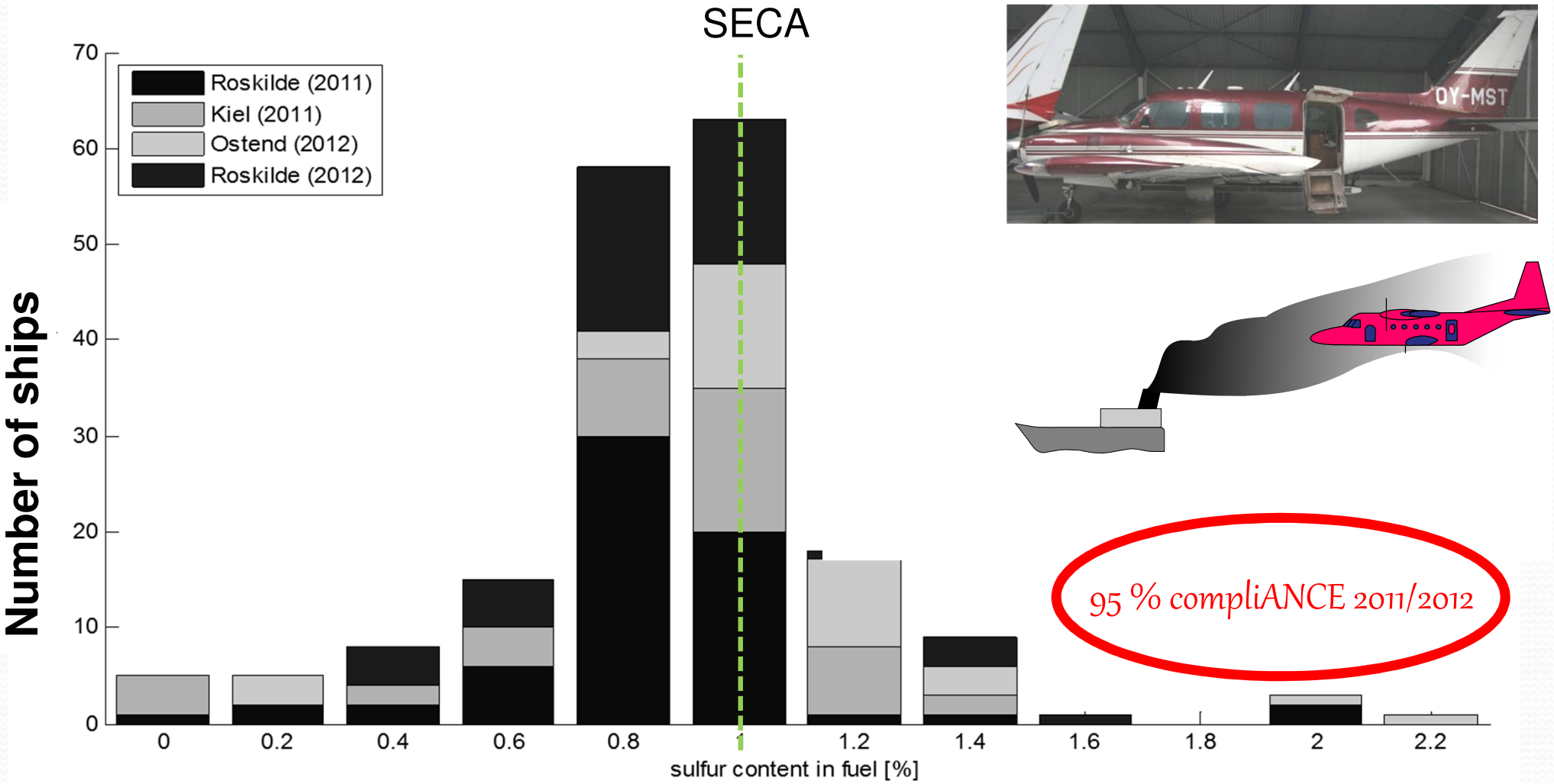
Balzani Lööv J M.... J. Mellqvist, et al., Field test of available methods to measure remotely SOX and NOX emissions from ships, Atmos. Meas. Tech, 2013,

Great Belt Bridge "sniffer" (proof of concept)

- Objective: Development and implementation of cost-efficient sensors for distinguishing different fuel types (indicative classification)
- Estimation of sulphur content by plume measurements (SO_2 and CO_2) from a few 100 meters when ships are passing the Great Belt Bridge
- Duration: 2013-2015 (two years)
- Co-financed by the Danish EPA



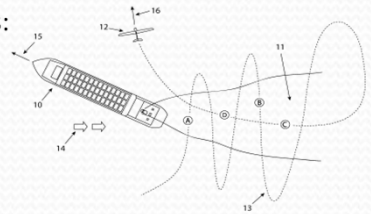
Airborne compliance control of the sulfur content in 160 individual ships in the open sea (Baltic and North sea) from 4 campaigns



Sulfur fuel content %

Project Sense: Environmental monitoring of ship emissions using cost-efficient drone technology

- **Project Sense** uses low-cost drones equipped with electro-chemical and NDIR sensors in combination with AIS data and advanced sensor analysis to sample emission plumes.
- Based on the AIS data, the system can intelligently seek out, detect and document non-compliant behavior and report back in real-time.
- **Key elements of the technology:**
  - Flight mission module based on real-time AIS data.
  - On spot emission analysis: CO_2, SO_2, NO_2 and NO).
  - Autonomous flight, no pilot skills required
  - Cloud-based real-time data acquisition platform
  - Easy to use administration and reporting module accessible from any browser or via app.



- **Project Sense** is a highly scalable "ready-to-fly" solution with no special requirements for training, pilot licensing or operational deployment.
- Quality is secured through pre-flight calibration protocols and regular sensor testing.
- **Specifications:**
  - Wing span: 300 cm
  - Cruise speed: 50 km/h
  - Max speed: 130 km/h
  - Battery: 6S 10 Ah
  - Weight: 5 kg (max payload)
  - Flight time: 2-3 hours
  - Sensors: CO2, SO2, NO2, NO
  - Real time data feed
  - Software applications: Flight planning, analysis and documentation, pre-flight check and maintenance log

Test flight in plume: CO_2 reading

Test flight in plume: SO_2 and NO_2

Partners: FORCE TECHNOLOGY · Danish Ministry of the Environment, Environmental Protection Agency · Danish Maritime Authority · Danmarks Rederiforening, The Danish Shipowners' Association

Utilization of con-compliance alerts

- Will enable cost-efficient targeting of port inspections
  - "From 1 % coverage to 100 % coverage"
  - Establishing a credible risk of getting caught (THETIS-S)
- Expectation: the port inspection will collect the prima facie evidence (PSC)
  - High precision sniffer evidence collected with an audit trail and QA controls could in principle qualify as prima facie evidence?
- In combination with a penalty system, monitoring
  - ➢ **enables a good enforcement**

Long-term vision

- **2015:** make best use of current assets and proven technologies
  - **Fixed installations** "cherry-picking" most cost efficient locations (~10-20 locations); co-financing
  - **Airborne sniffing as a shared resource**; initiation of a service market and/or extensive burden-sharing among governments
- **2016-2020 (2025):** consolidation of R&D, efficiency drive, demonstrations
  - Long-range RPAS/UAV demonstrators with sniffing and remote sensing (e.g. in co-operation with ESA)
  - New satellite sensor deployment and development (e.g. EU Sentinel 5, other ESA initiatives)
  - Low-cost high quality sensors for remote fixed installations (e.g. H2020)
- **2020 (2025):** global compliance monitoring capability
  - Most likely with RPAS/UAVs; advanced satellite instruments

Current situation

- Methods proven with research in past years and
- Ready for piloting for operational use
- New state budget allocations confirmed in Finland, Denmark; political support in Sweden, Netherlands, Belgium; progressing in Germany and Norway

- Funding have been applied from EU and the decision is expected to be made by EU in June – July 2015

- Flag ship project status application submitted and under consideration in EUSBSR PA Ship

- Partners are at the moment more or less waiting for the decision of EU funding yet also continuously working towards the common goal.

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Thank you for your attention!

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