Surveillance of sulphur and particle pollution from ships

"Great Belt Bridge Sniffer"

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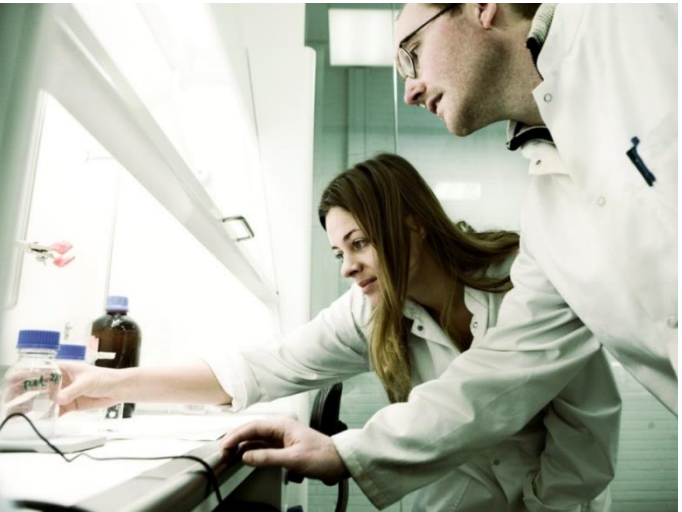
Danish Technological Institute

TEKNOLOGISK INSTITUT

- Founded 1906
- An independent, not-for-profit institution
- Approved as a technological service institute by the Danish Ministry of Science, Technology and Innovation.
- >1,000 employees
- Annual turnover ~ DKK 1 billion



Project consortium:

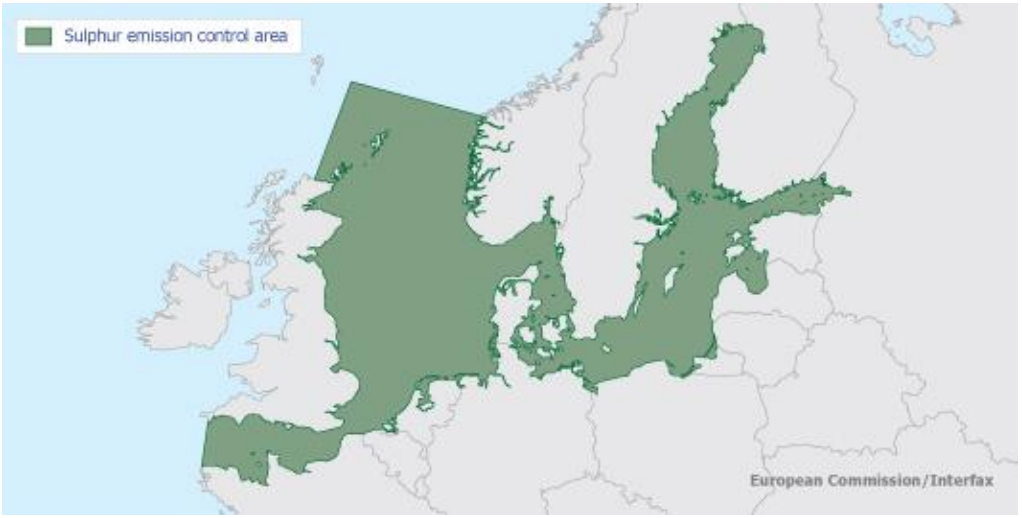
- ZenZors A/S
- A/S Storebælt
- Danish Shipowners Association
- Nordic Tankers Marine A/S
- Danish Technological Institute
- (Maersk Maritime Technology)

Co-financed by the Danish EPA with 1 mio. DKK

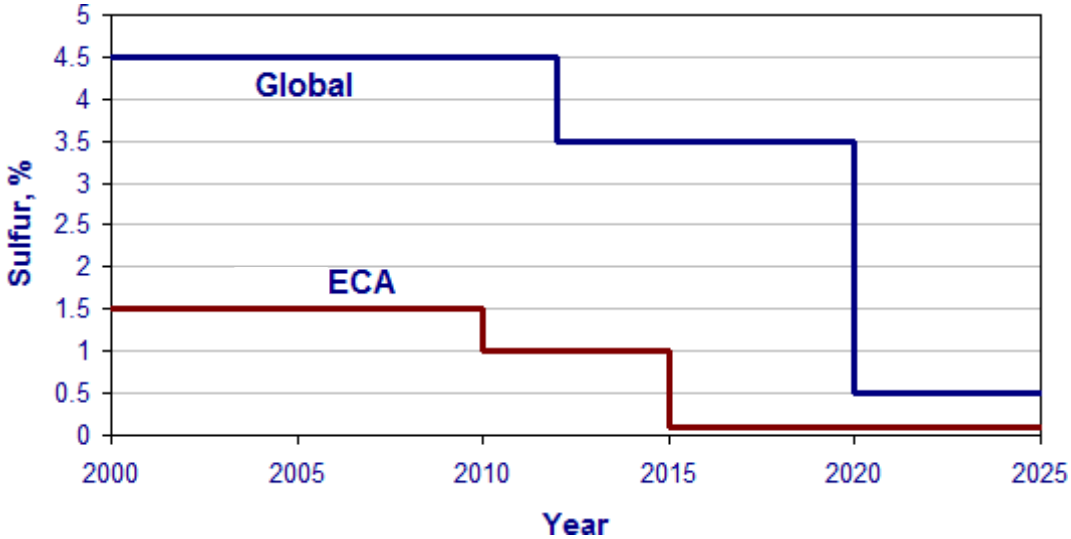
Duration: 2013 – 2015

Background

- Ship owners faced with requirements relating to fuel sulphur content in ECAs (Emission Control Areas)
  - 2010: 1% sulphur (max)
  - 2015: 0.1% sulphur (max)



- Two mitigation strategies are being exploited:
  - Lowering of the sulphur-content in fuel
  - Emission reducing technologies (such as scrubbers)

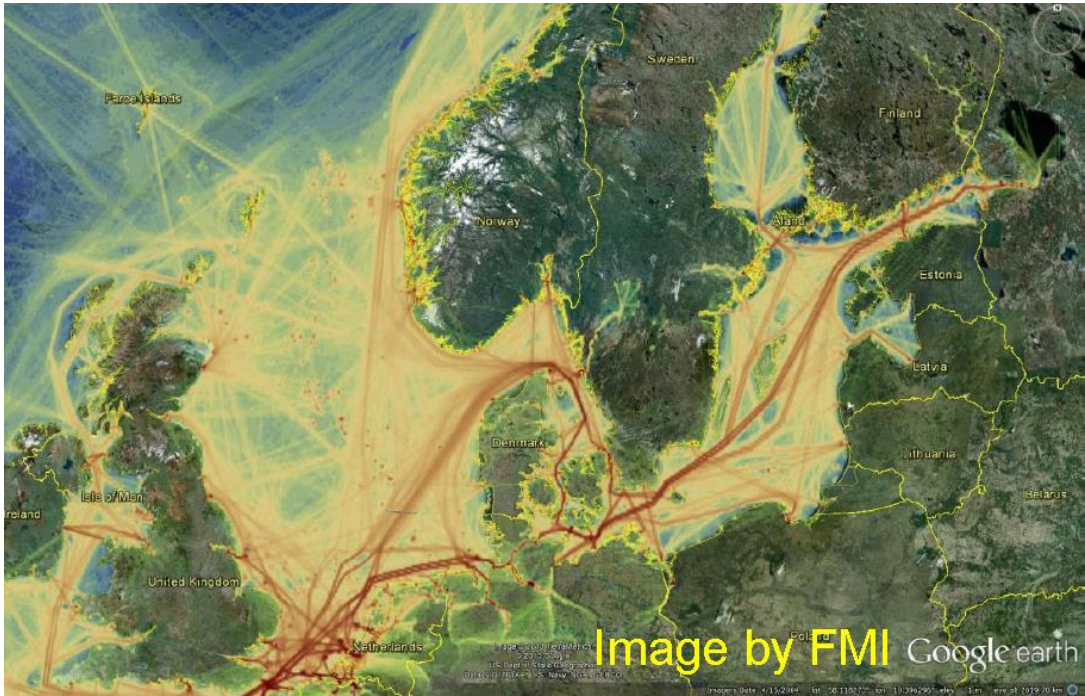


Background and objective

- Effective enforcement calls for a simple and robust control method
  - Not commercial avaliable today – or at least quite expensive
  - Today the fuel of the ships is controlled by:
    - random checks of bunker delivery notes
    - fuel logs
    - occasional fuel sample analyses in harbors

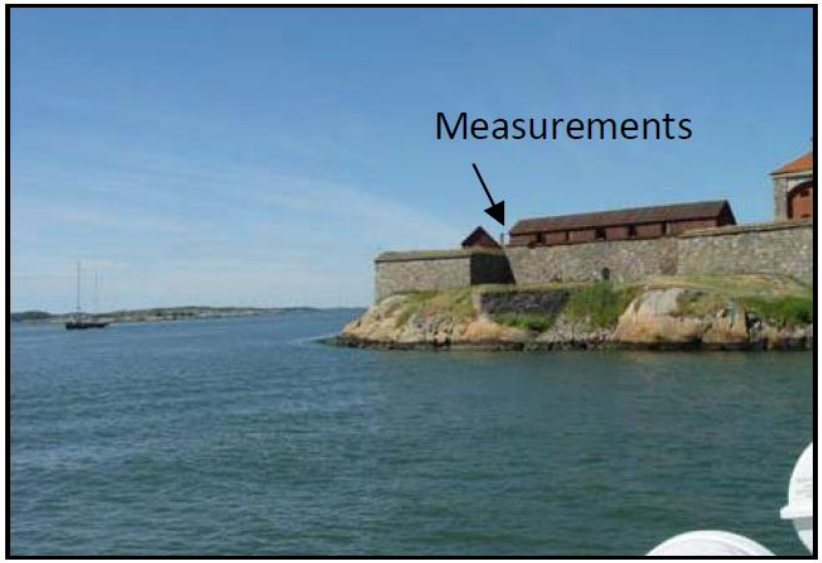
- <u>Project objective:</u> Development and implementation of cost-efficient sensors for distinguishing different fuel types (indicative classification)

- Proof-of-concept at the Great Belt Bridge



Other work

- Inspection of setup in Gothenburg channel together with Chalmers
- Chalmers group working with compliance for 5-10 years



Chalmers visit – learnings

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- Operational system in Göteborg channel for ~2 years
- Precise but expensive solution (in total ~150,000 Euro)
- Harbor makes use of sulphur measurements – to our knowledge not yet authorities
- Aim: Direct enforcement with no additional fuel analysis

Idea – Great Belt Bridge "sniffer"

- Prime focus: Monitoring of ship emissions when passing the Great Belt Bridge (proof of concept)
  - Majority of traffic passing DK either passes the Great Belt or Øresund
  - Monitoring can provide a fast screening of ships
  - Monitoring of SO_2, CO_2 and particles

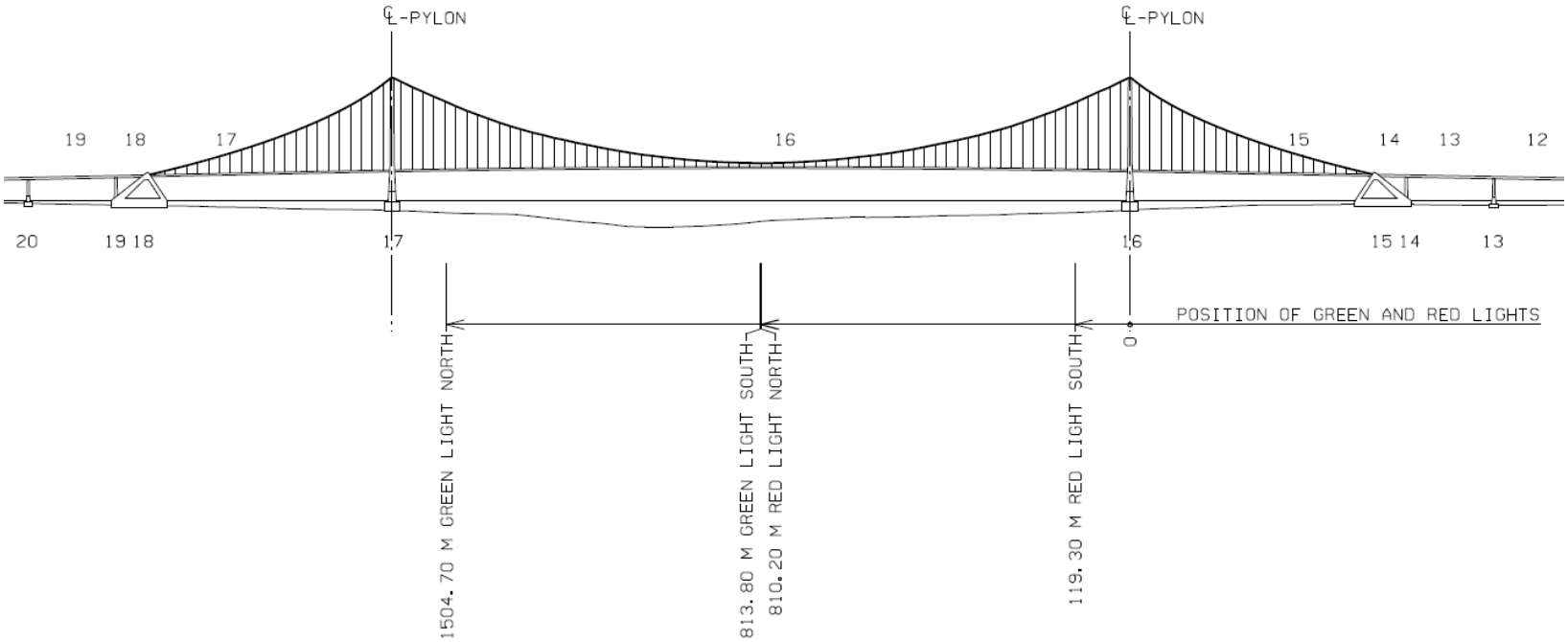
Idea

- SO_2/CO_2 can be correlated with S-content in fuel.
- Accepted method for calculating sulphur equivalents in exhaust gas

$$\%S\ in\ fuel = \frac{\sum SO_2}{\sum CO_2} \cdot 0.232$$

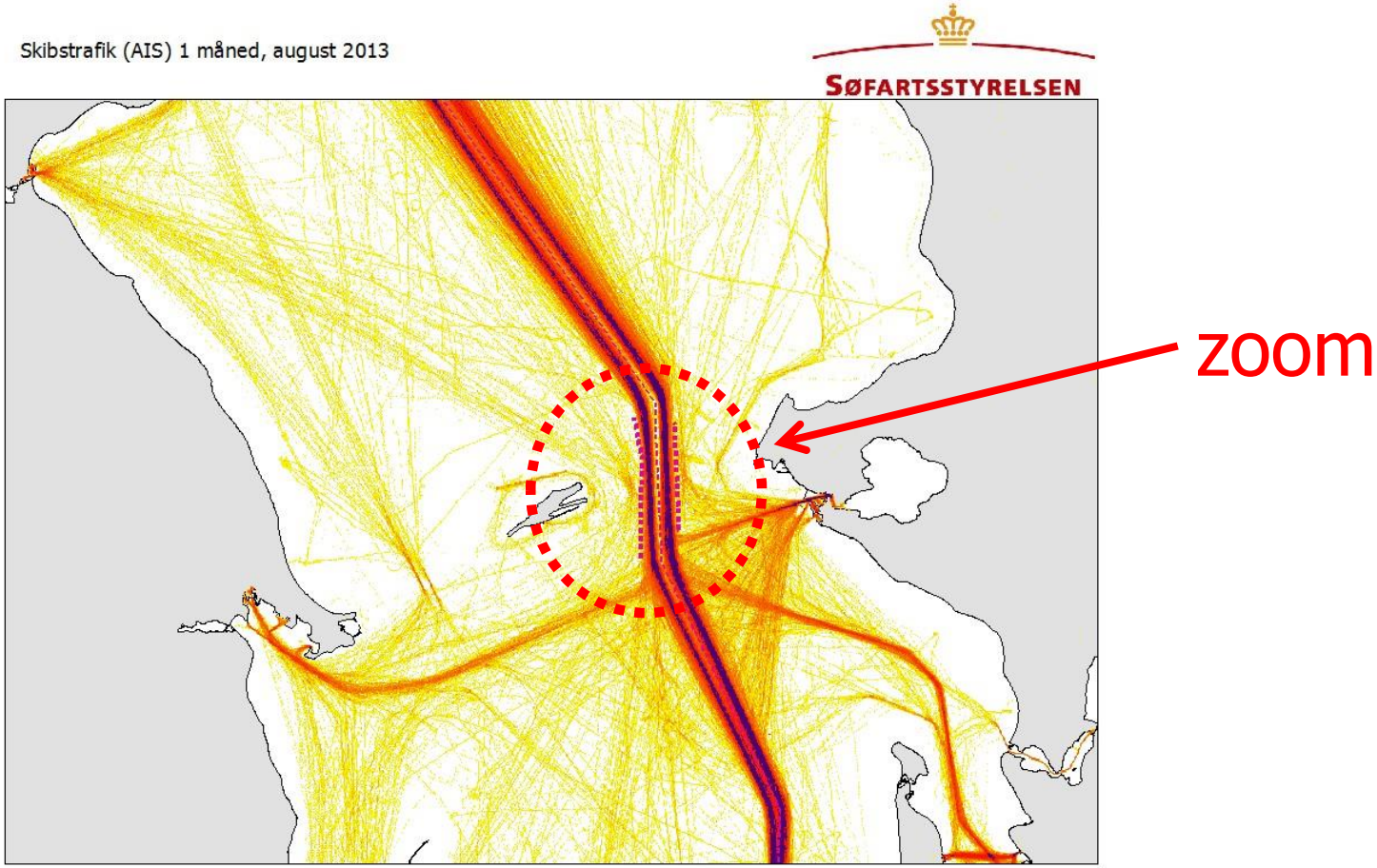
Idea

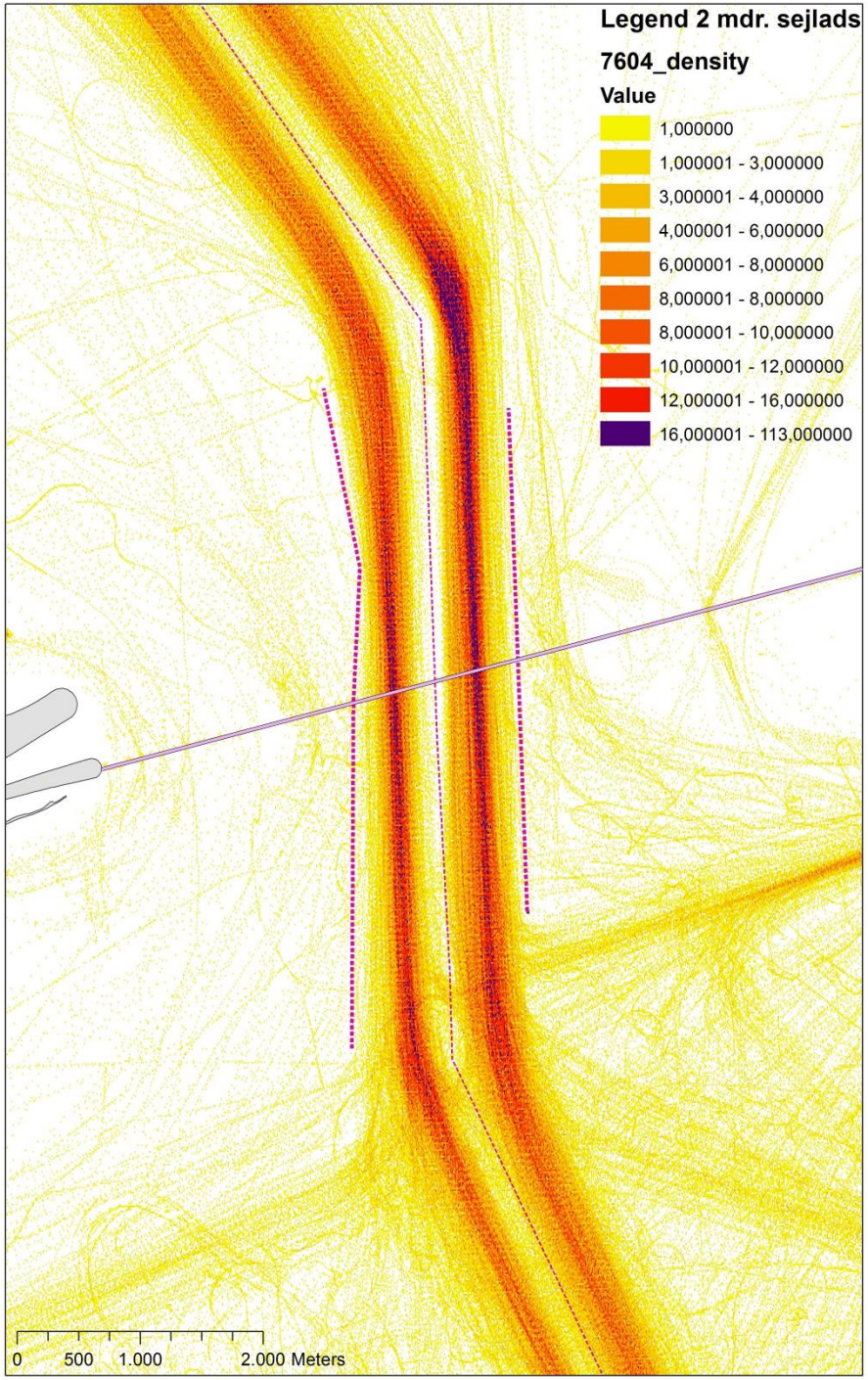
- Equipment to be mounted at the eastern bridge between the pylons
  - Pylon platform or at lantern position below the bridge
  - Aim for two measurement campaigns during autumn 14 / spring 15
  - Correlation with fuel samples / fuel info when passing the bridge
  - Correlation with AIS data from VTS Storebælt, road traffic, wind, …



Traffic density plot

- ~1,700 passages in August 2013 – ~3 vessels per hour





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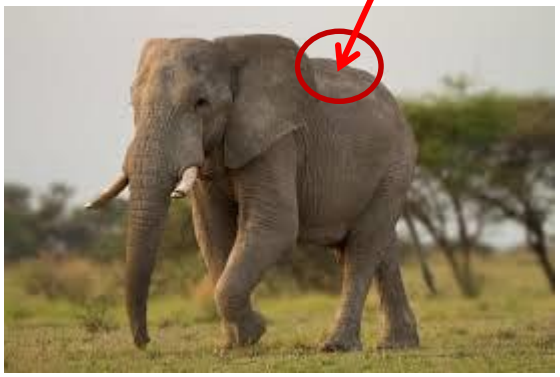
Traffic density plot – zoom

Aug-sept 2013

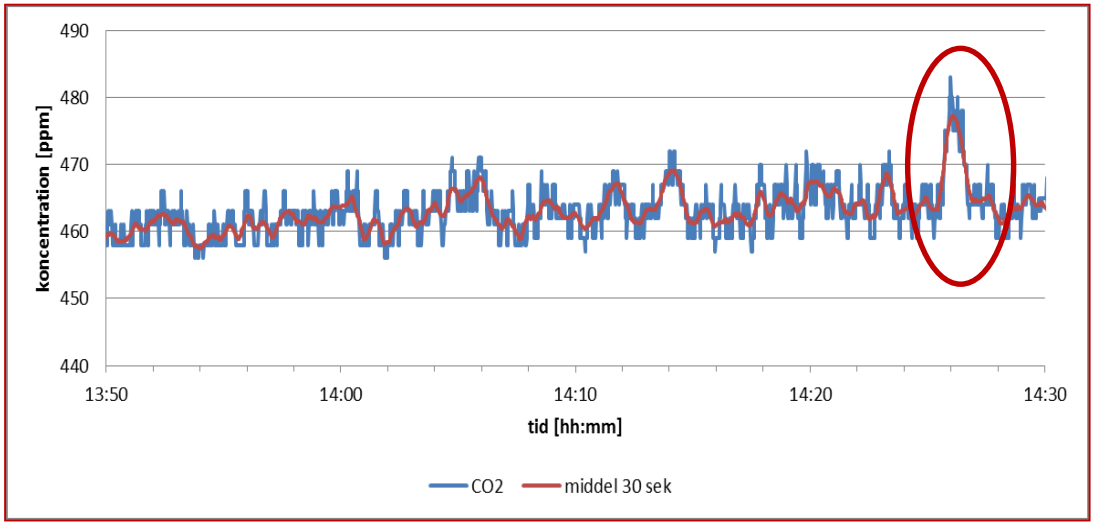
Main activities so far



- Prime focus on CO_2 sensor technology + particle measurements (vessel indicator)
  - ~400 ppm CO_2 in ambient air
  - Low ambient particle conc. (and SO_2)

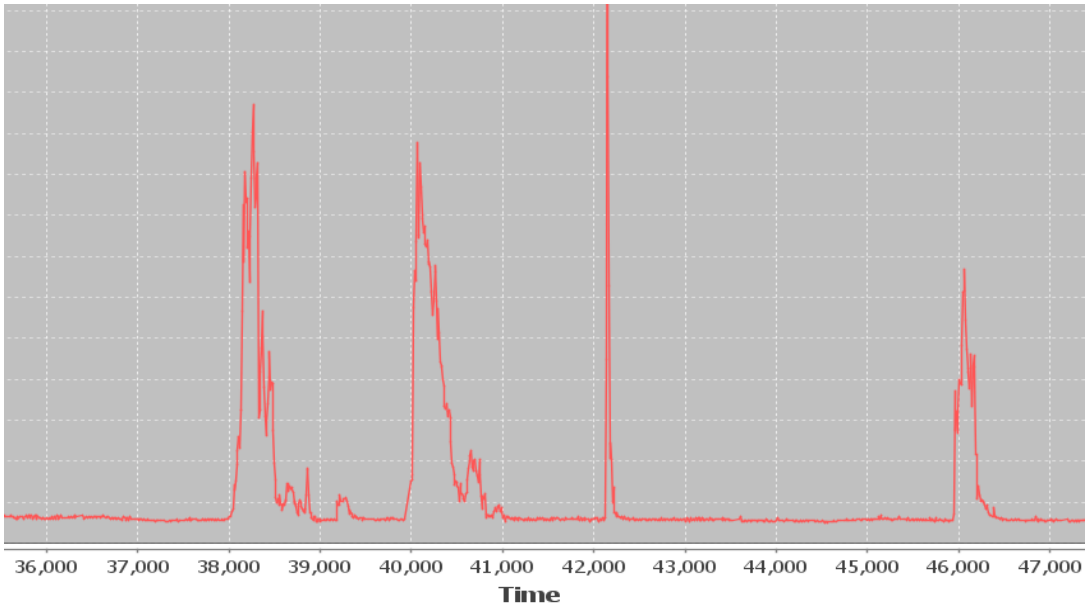
- Prel. measurement campaigns at
  - Aarhus harbour + Sjællands Odde
  - Storebælt

Measurements

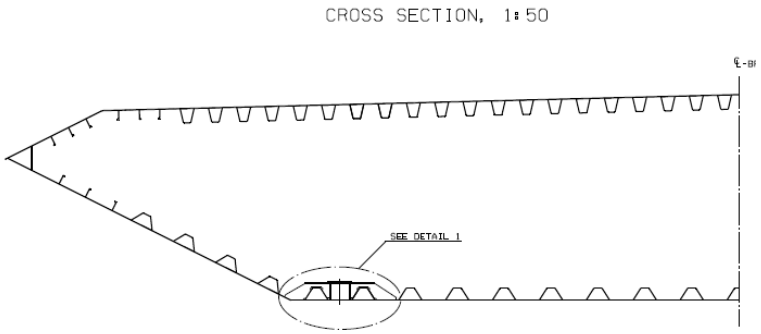


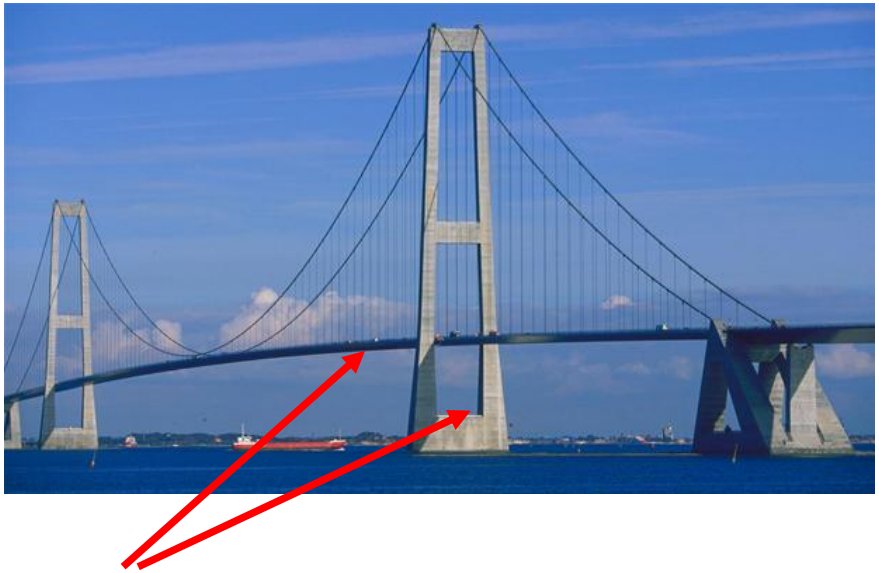
CO_2 – low signal/noise ratio

Nanoparticles



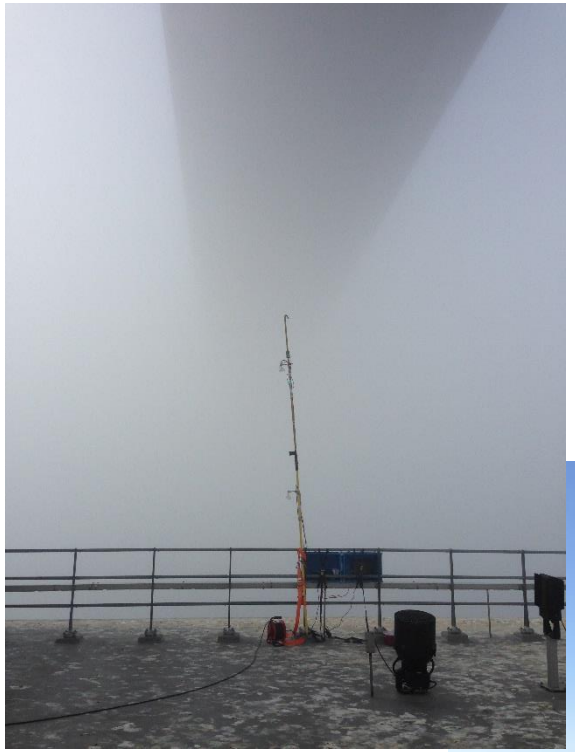
Defining the location

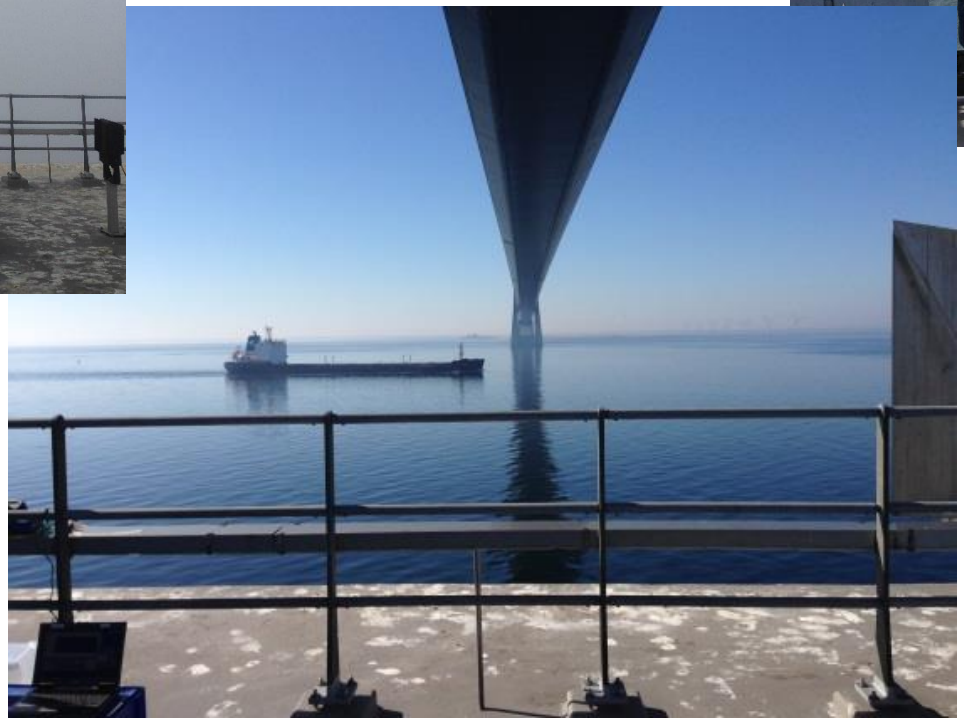




Where is the optimum signal?

Facing different scenarios…





Considerations…

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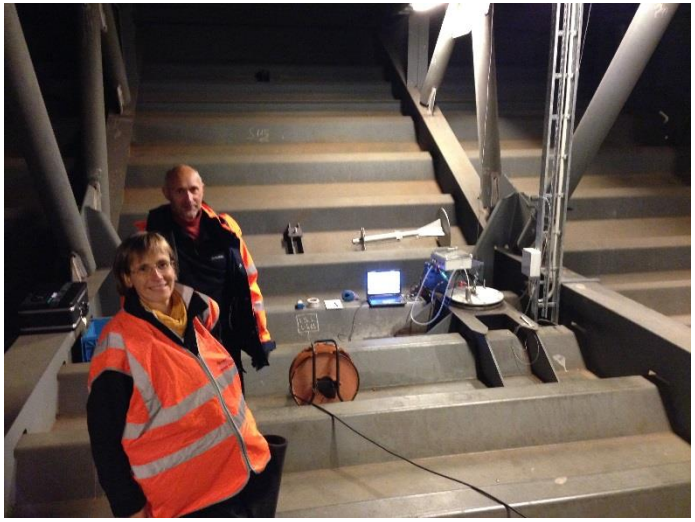
- Which mechanisms will be initiated if a potential non-compliant ship is identified?
  - Jurisdiction across borders – complicated
  - Who has the responsibility and what are the consequences?
- Who is the *driver* for implementation and who is the costumer?
  - important for the companies involved and their business case
- Economic advantage by **<u>not</u>** following the SECA regulation.
  - Further enhanced in 2015
- No real surveillance or sanctions today…

Project – 2nd half

- Defining final measurement position and setup at Storebælt – platform or lantern?
  - Very likely applying more sensitive CO_2 sensor technology

- Dedicated measurement campaign at Storebælt (this autumn + spring 15)
  - Correlation of measurements with vessel fuel samples



Perspective

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- Functional and permanent installation(s) at Storebælt
- Direct communication with relevant authority
- Implementation at other bridges, inland waterways, port entrances, etc.?
- International collaboration, result sharing and integration of data in common database
- Network of strategically placed ”sniffers”; also involving drones?

<u>What will it take / how do we get there?</u>

- Additional funding for developing cost-efficient sensor monitoring platform
- In our opinion – this technology platform should be further investigated. Perhaps in parallel with more established technologies