



ILMATIETEEN LAITOS  
METEOROLOGISKA INSTITUTET  
FINNISH METEOROLOGICAL INSTITUTE

# TFEIP - Transport

Jukka-Pekka Jalkanen



# Shipping

- Waterborne traffic
  - National, international
  - Ocean/Inland
  - Recreational boating
- Vessel activity
  - AIS, LRIT, VMS, radar, departure/arrival times, ICOADS, AMVER...
  - Anything with timestamp, location & identity; know the strengths and weaknesses of each
- Tasks from European Sustainable Shipping Forum
  - Emission factors
  - Ship emission modeling
  - Primary/Secondary PM, especially BC
  - Impact of emission abatement

Requirements go beyond  
Tier 3 inventory preparation approach;  
Activity data affects EFs

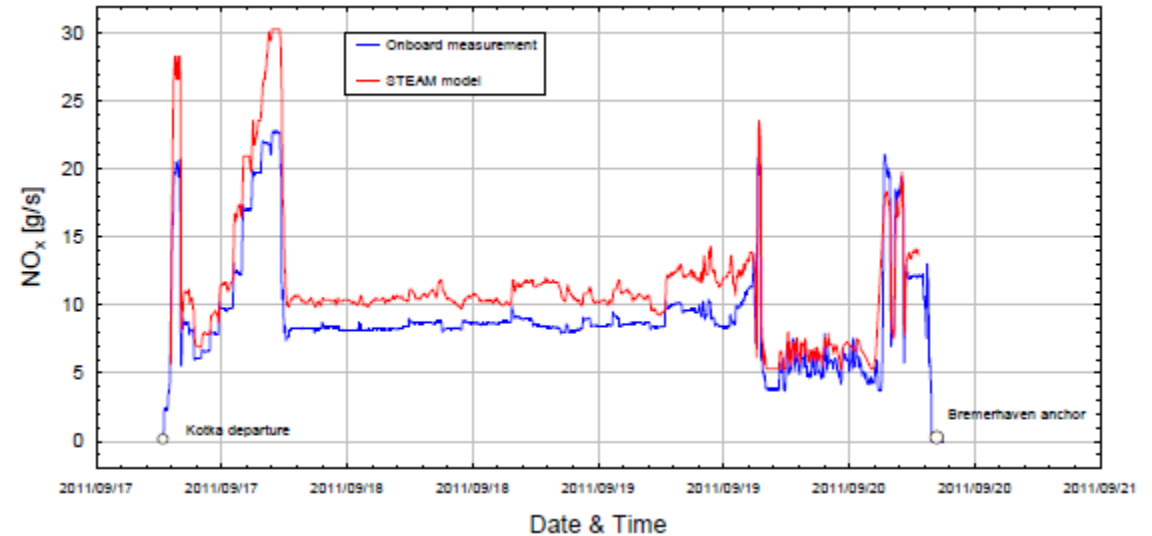
# What is ESSF



- Several subgroups
  - Air emissions from ships (Compliance monitoring, fuel switching, emission modeling)
- Round table, consists of
  - Commission: DG ENV, MOVE, CLIMA, EMSA
  - All EU member states
  - Research partners
  - Engine/Equipment manufacturers
  - NGOs
  - Shipping companies, stakeholder organisations
    - ECSA, ESPO, also national level
- Purpose: Provide a forum for exchange of information and discussion
  - May feed to IMO submissions

# Emission factors

- Lot of the work still relies on emission factors from 1995 Lloyds Register campaign
- Fuel consumption modeling
  - Equivalence between g/kWh and g/kg
- Load dependency of emission factors
  - Not just weighted average of ISO 8178, but the values themselves
  - Emphasize onboard measurement campaigns
  - Continuous measurements
- HFO, MDO, MGO, LNG, biofuels
  - Methane slip
    - Diesel
    - Otto



NO <sub>x</sub>	SO <sub>x</sub>	CO
CO <sub>2</sub>	<b>BC</b>	<b>PM</b>
<b>VOC</b>	<b>CH<sub>4</sub></b>	<b>PN</b>

# Emission abatement

- Repeat the same table, but include the impact of each emission abatement technique on various pollutants
- Most relevant ones: SCR, SOx scrubbers
  - (DWI, HAM, DOC, WiFE, NTP...)

NOx	SOx	CO
CO2	BC	PM
VOC	CH4	PN

- SCR temperature window; OK for 350°C, but significantly less for 270°C
  - Low load operation may be a problem for SCR → Port areas
- Scrubber: Increase of fuel consumption (few %), SOx removal, impact on PM, especially on BC
- LNG

# Products of incomplete combustion

- EC/OC; BC
- Black Carbon emissions from marine engines using various fuels
  - Connected to both engine operation and fuel, not necessarily to sulphur content of fuel
  - New common rail engines, electronically controlled ≠ older mechanically controlled engines
  - Scrubbing reduces BC, but only slightly
- VOC emissions much lower (1/6) with modern engines than the 1995 campaign suggests
  - VOC speciation important: volatile, non-volatile, semivolatile
    - Not available if ISO 8178 is required (THC from FID) → GC-MS?
  - Secondary PM formation needs this information, big problem for CTMs
    - Plan A: PM as non-volatile, speciation of VOCs → CTMs take care of relevant processes
    - Plan B: PM includes the condensed fraction → Emission models take care of the condensing fraction
- CO, a function of engine load, but also a function of load change
  - For old engines, transitional loads will produce peaks of CO

