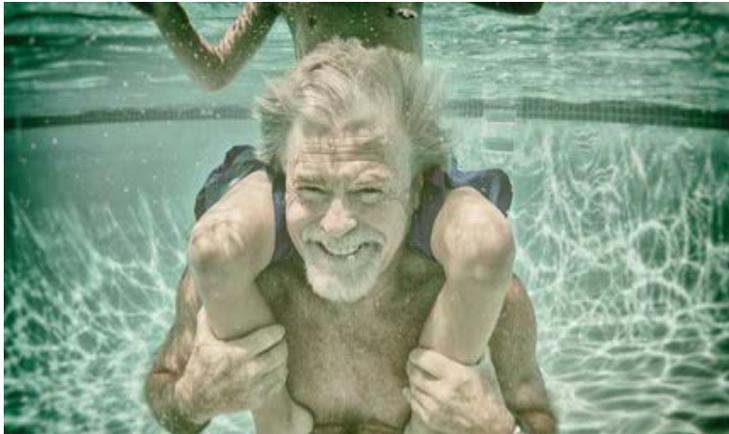


# INTERCOMPARISON OF SHIP EMISSION DATA MODELS FOR THE NORTH AND BALTIC SEA REGION



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 **Helmholtz-Zentrum  
Geesthacht**

Centre for Materials and Coastal Research

## Objective:

- Quantify the impact of shipping emissions on air quality and the deposition of pollutants into North Sea (recent state and future development)

## Problem:

- Need for an inventory of ship activity and emissions

## Possible solution:

- Reference ship model STEAM and its data provided at ECCAD database (Emissions of atmospheric Compounds and Compilation of Ancillary Data)
- **but:**

# MOTIVATION

## Objective:

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## Problem:

- Need for an inventory of ship activity and emissions

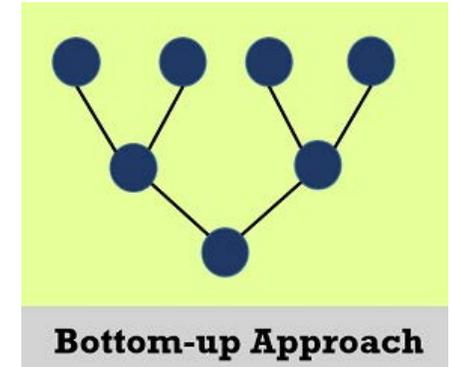
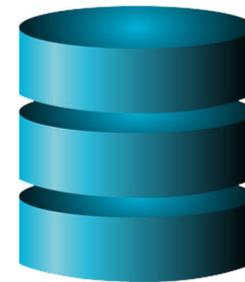
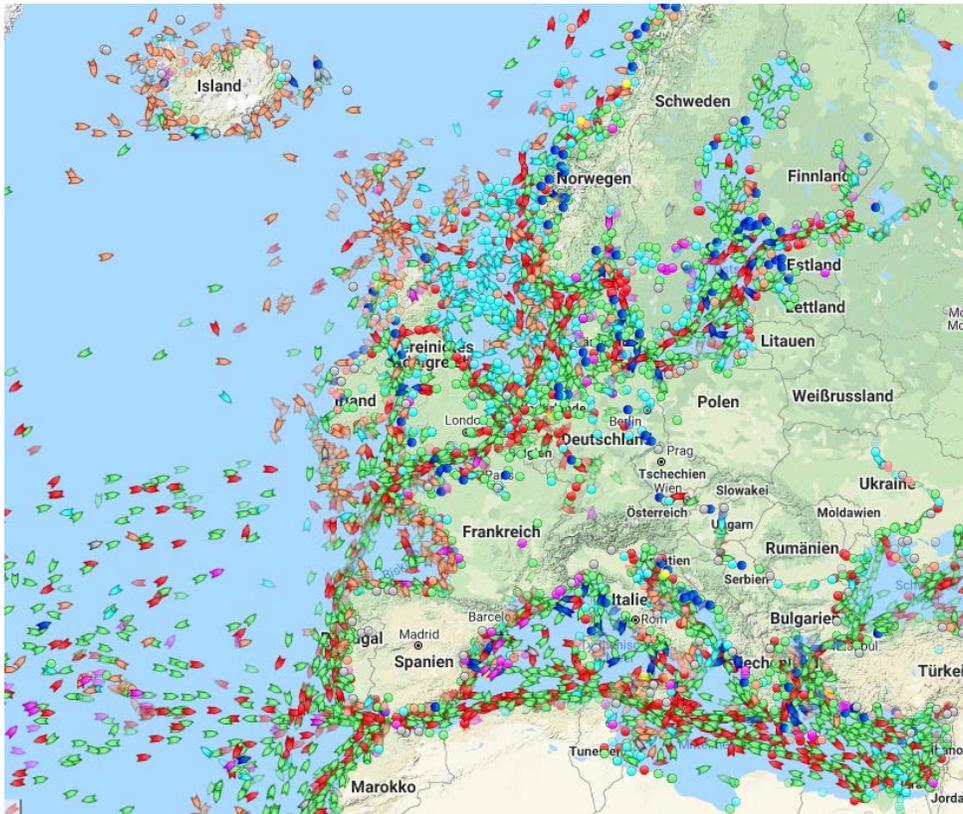
## Possible solution:

- Reference ship model STEAM and its data provided at ECCAD database (Emissions of atmospheric Compounds and Compilation of Ancillary Data)
- **but:**
  - how to treat specific ship types?
  - how to consider future developments in fleet, cargo and passenger transport and routes

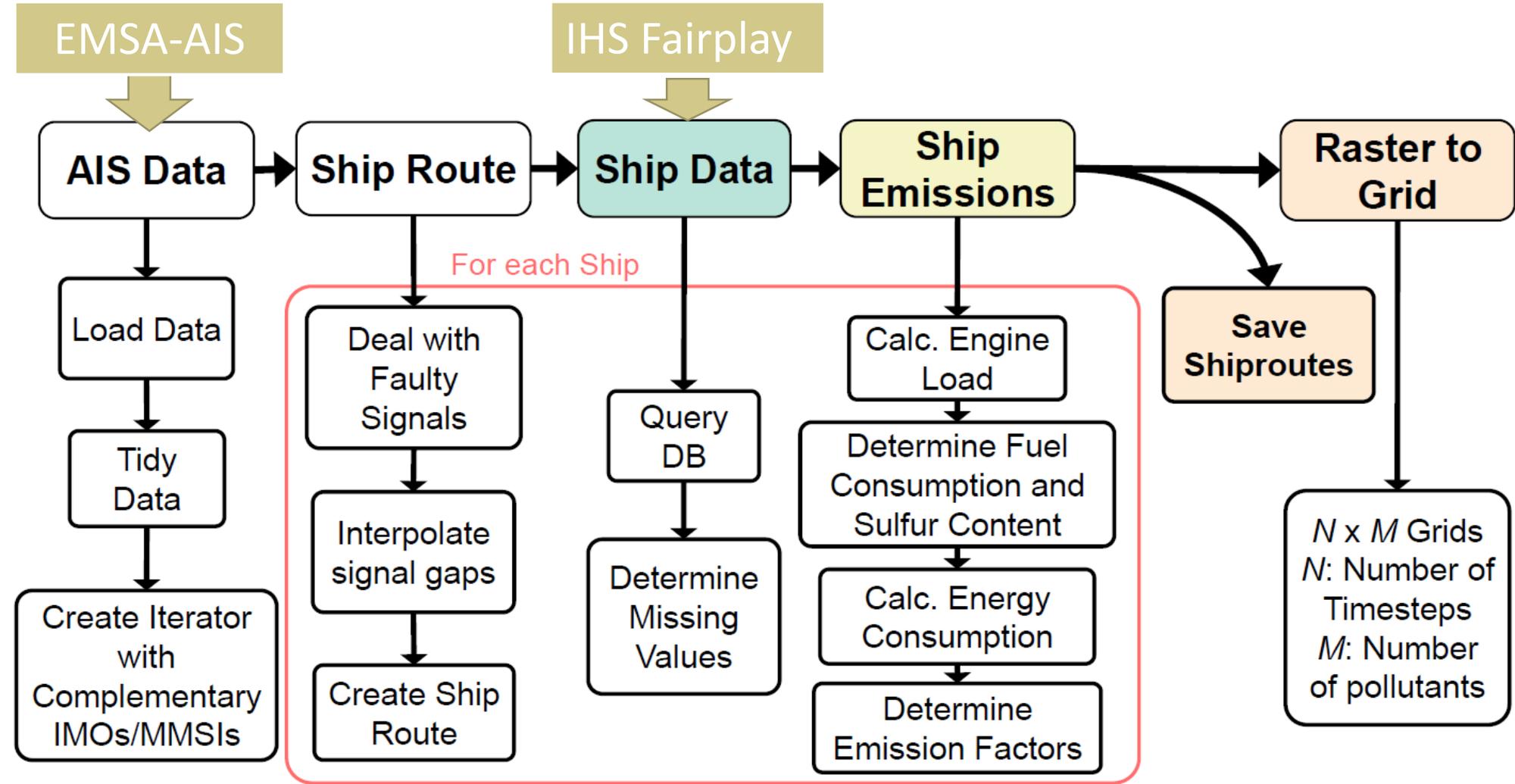


# SHIP EMISSION MODEL HZG-SHIPEMIS (HZG)

General approach to estimate the ship emissions from activity data and ship characteristic databases



# SHIP-EMISSION MODEL OF HZG

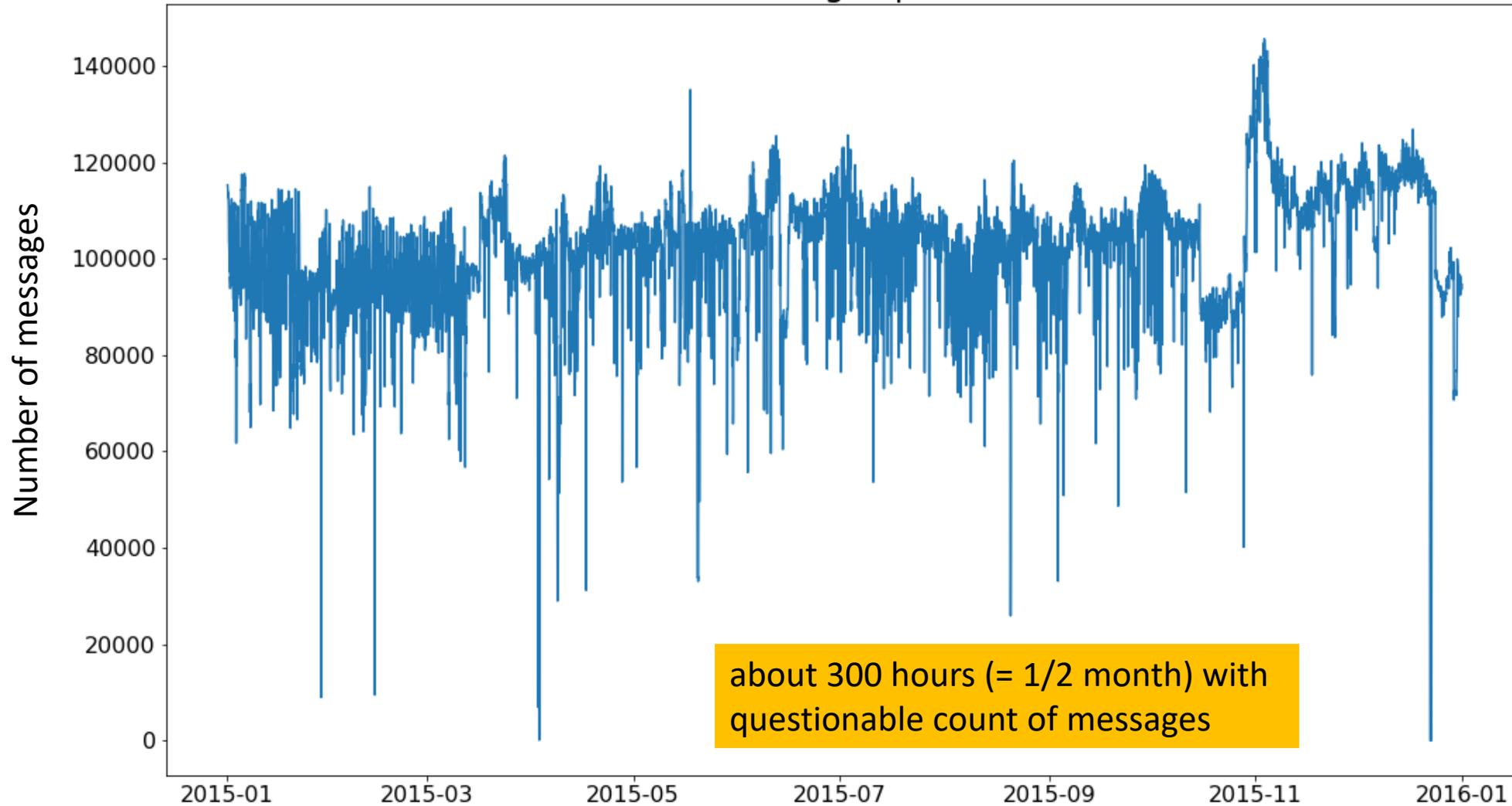




$$E_m = f(L, P, F, Y, T) * E$$


# EMSA-AIS 2015, DATA QUALITY

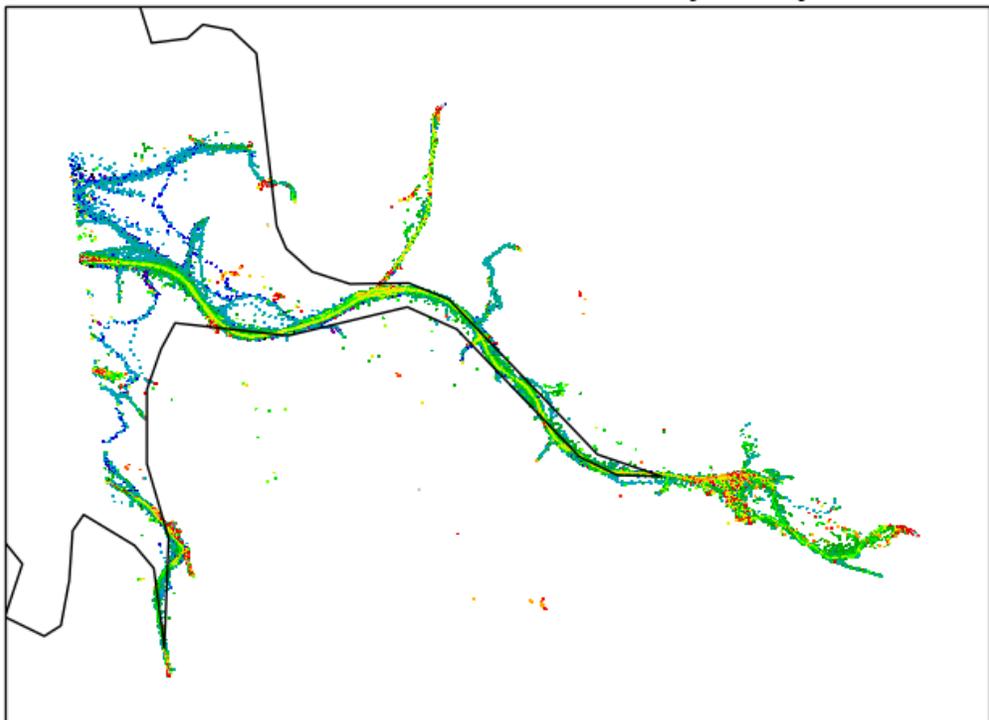
AIS Messages per hour



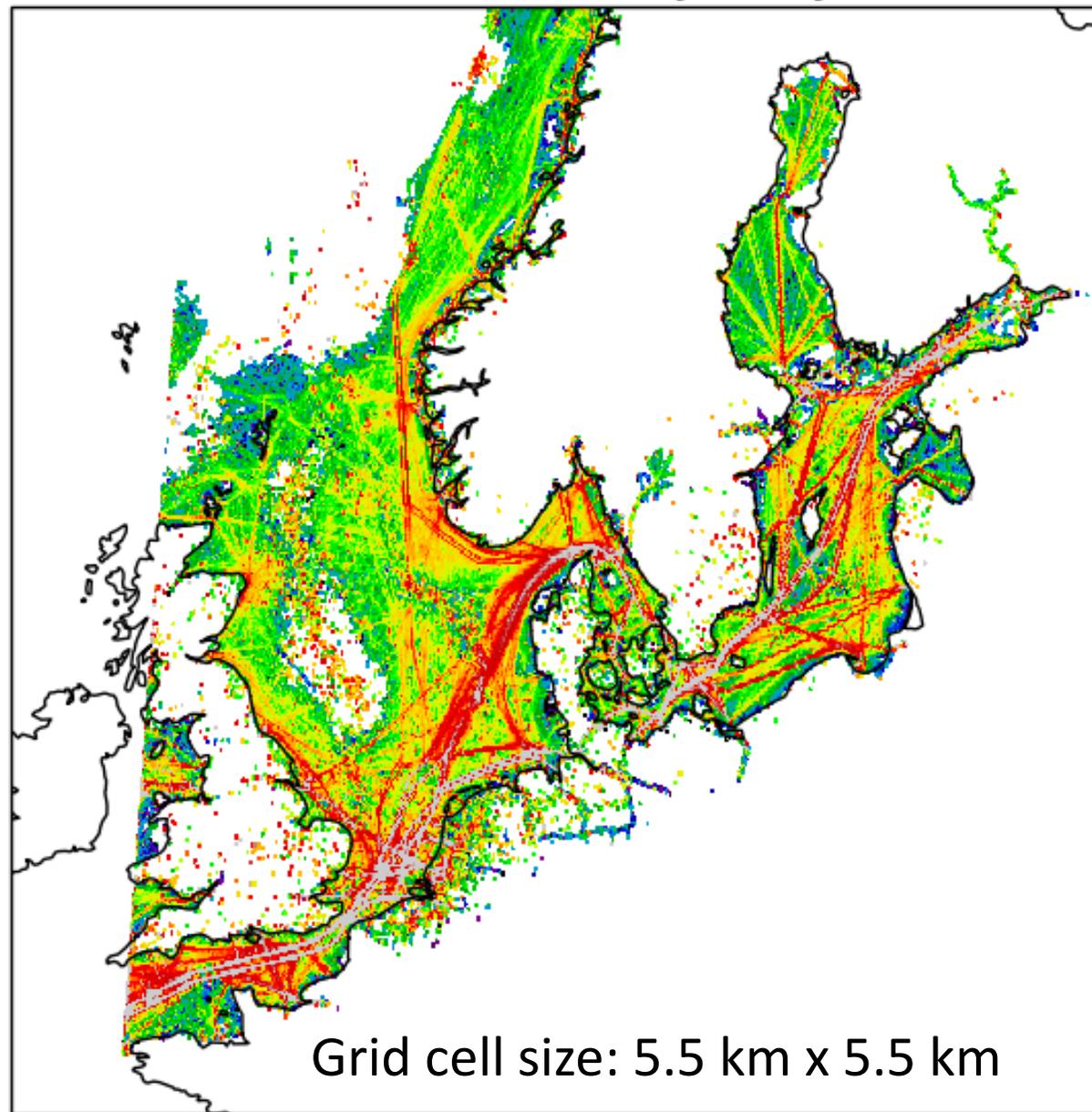
# EMISSION INVENTORY, CO2, JANUARY 2015

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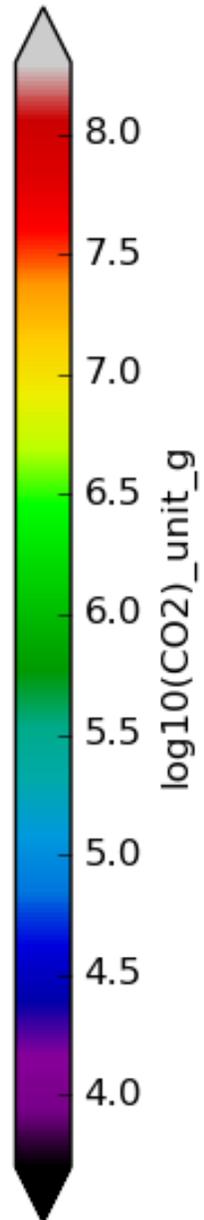
CO2, emissions for January



CO2, emissions for January



Grid cell size: 5.5 km x 5.5 km



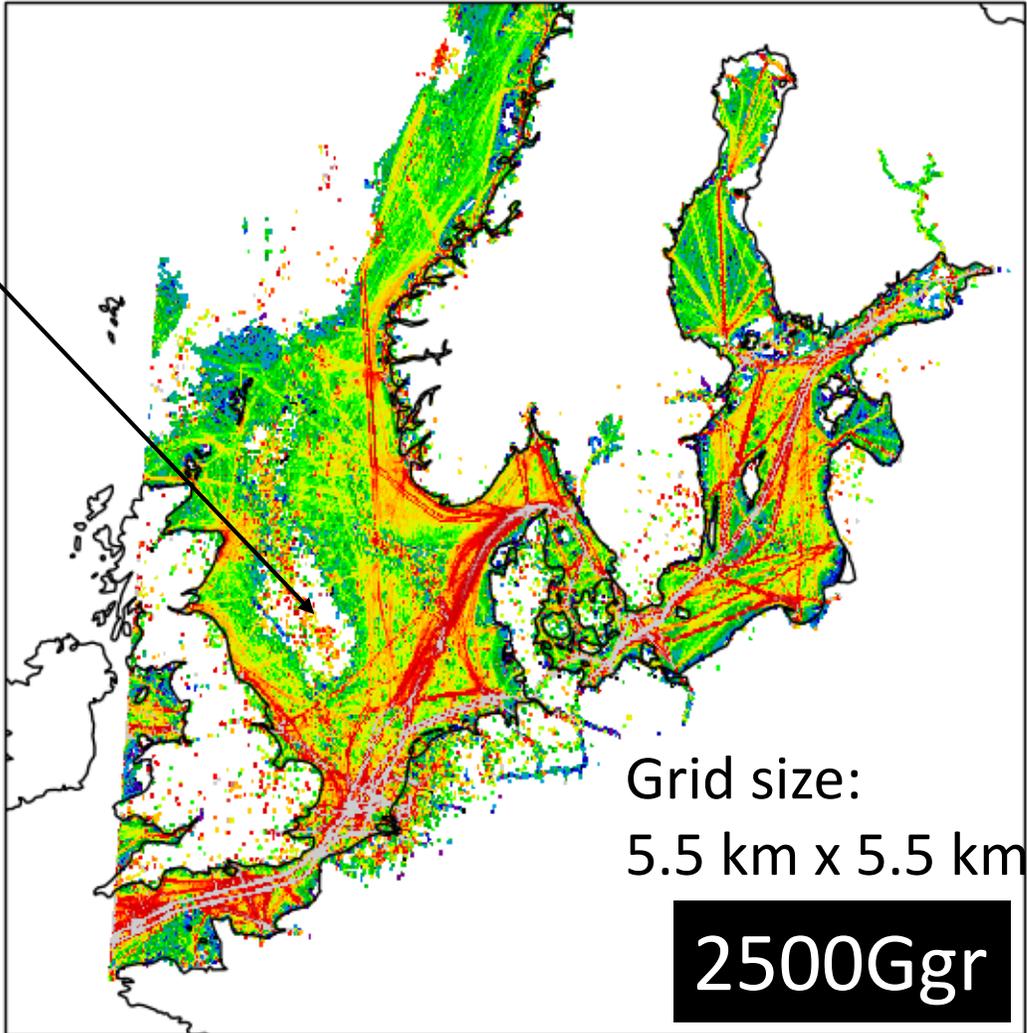
# COMPARISON WITH DATA FROM STEAM MODEL

- Received data on a grid with  $0.1^\circ \times 0.1^\circ$  resolution
- Frequency of one day
- Region of Interest: SECA of the North and Baltic Sea

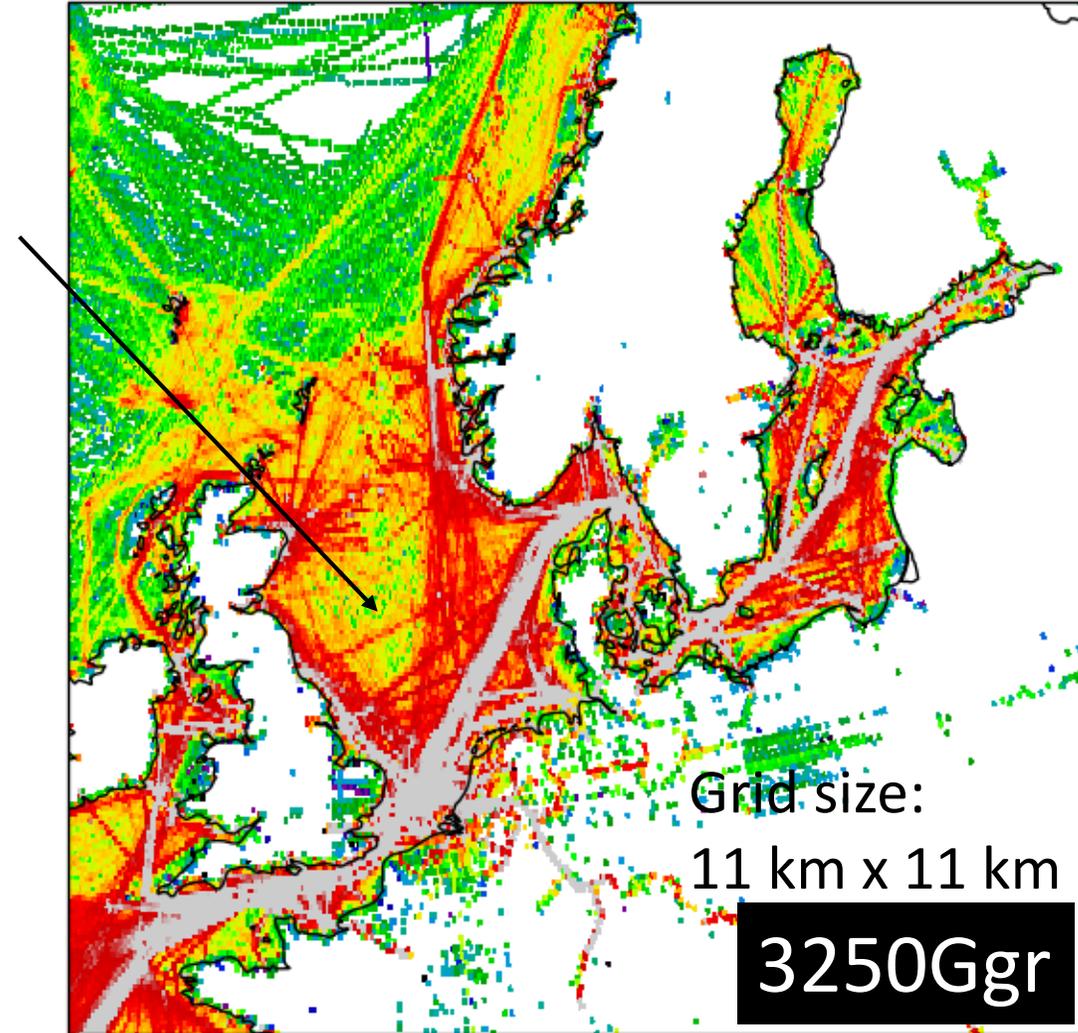
# COMPARISON OF CARBON DIOXIDE, JANUARY 2015

FMI-STEAM ECCAD: Consideration of surfaces on Earth

CO<sub>2</sub>, emissions for January



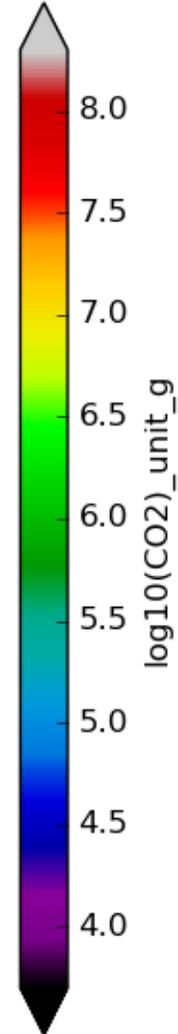
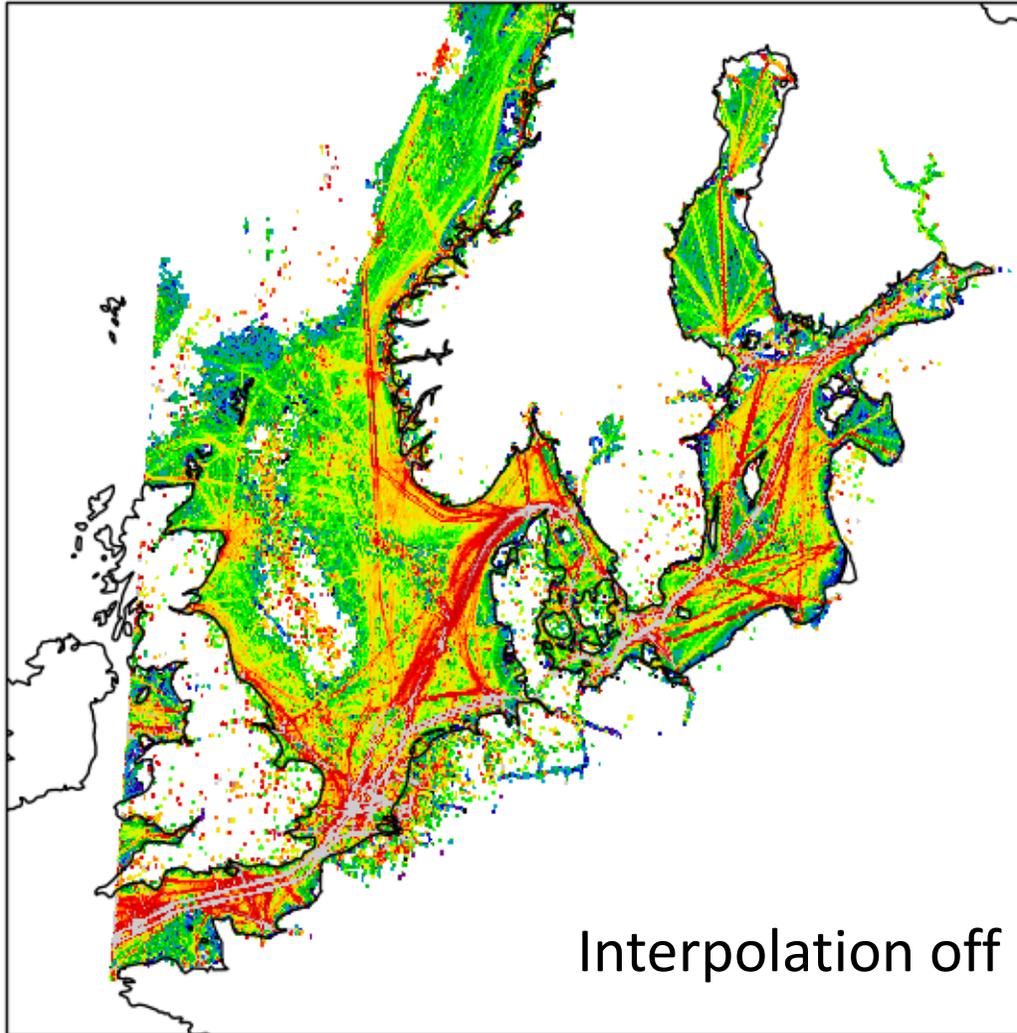
STEAM:CO<sub>2</sub>, emissions for January



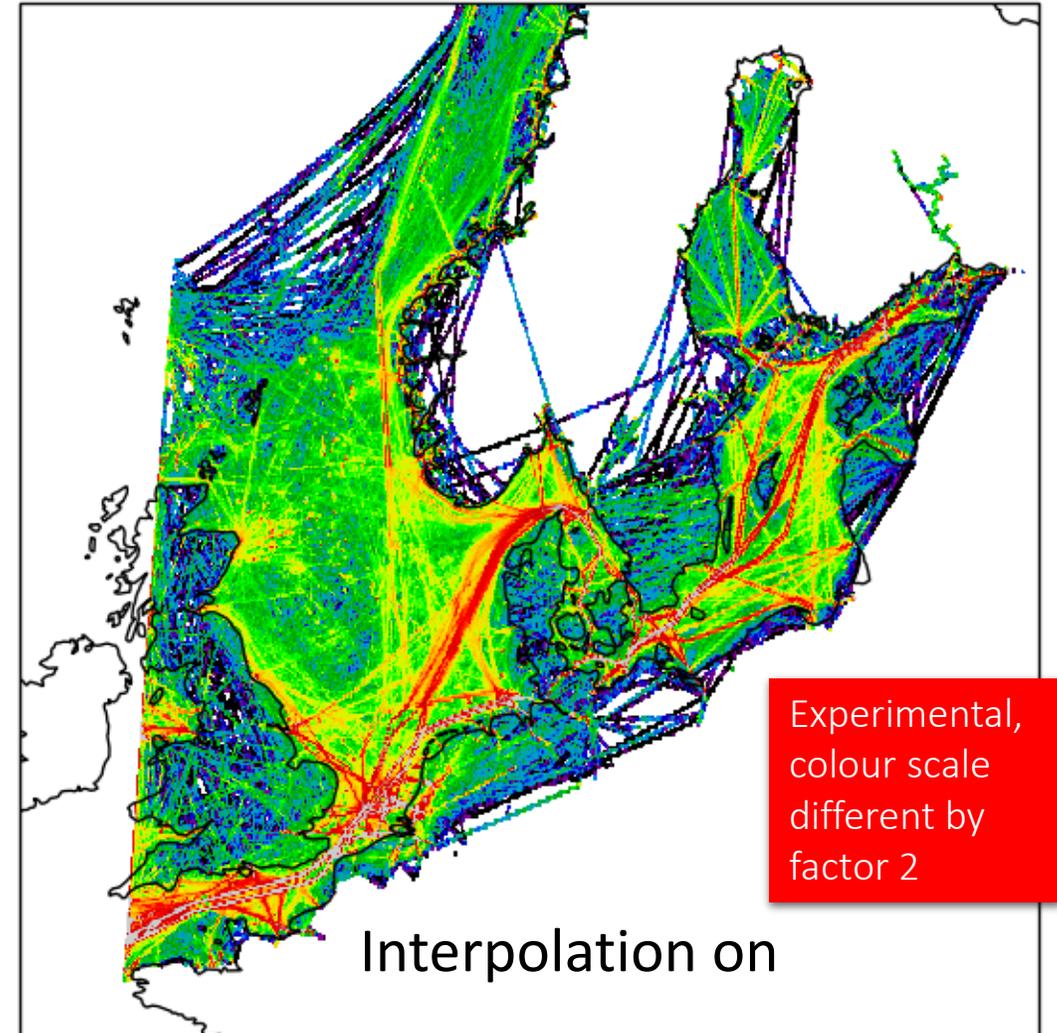
# COMPARISON OF CARBON DIOXIDE, JANUARY 2015

## Experiment: Impact of route interpolation

CO<sub>2</sub>, emissions for January

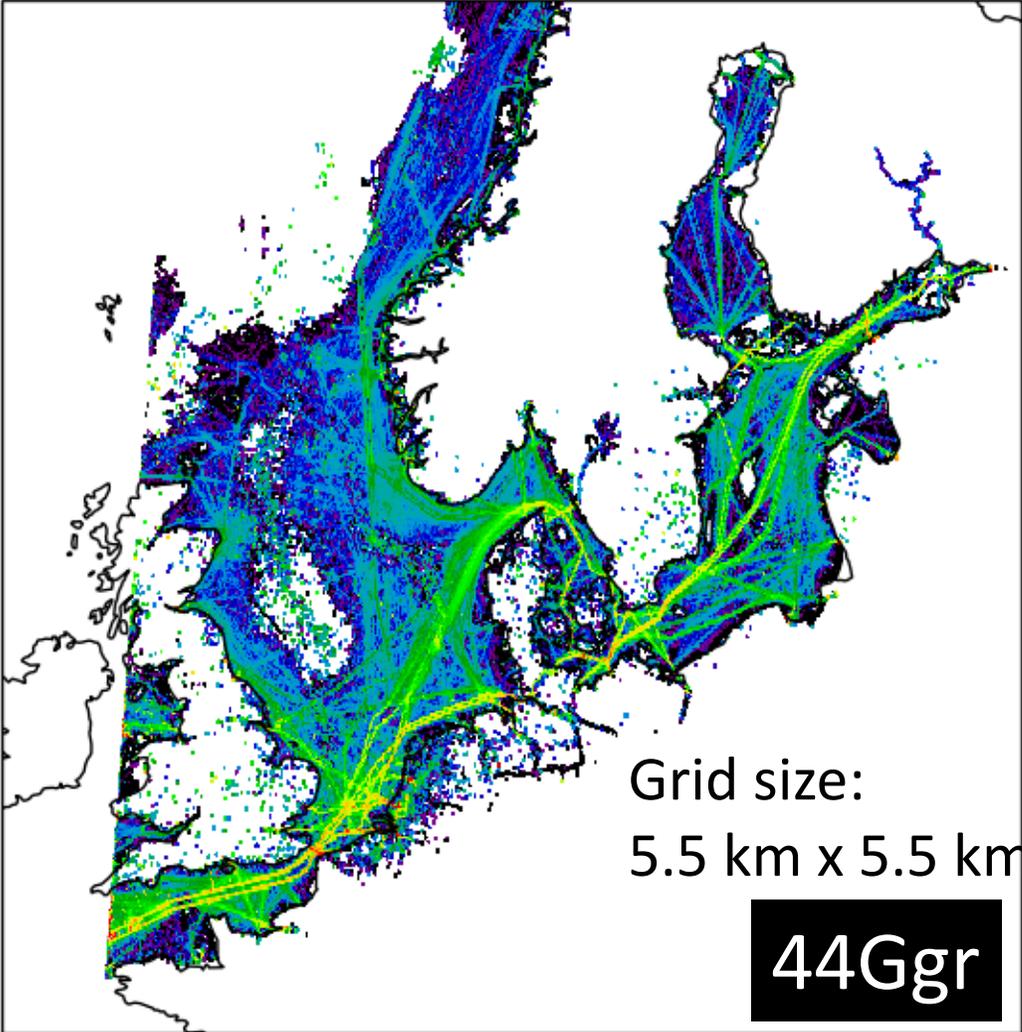


CO<sub>2</sub>, emissions for January

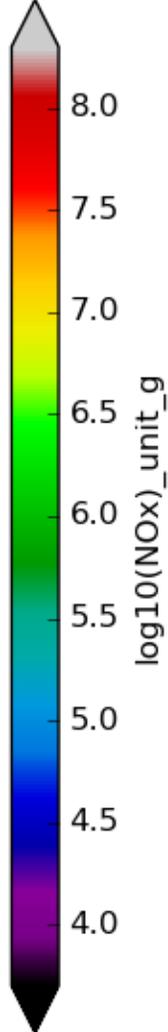
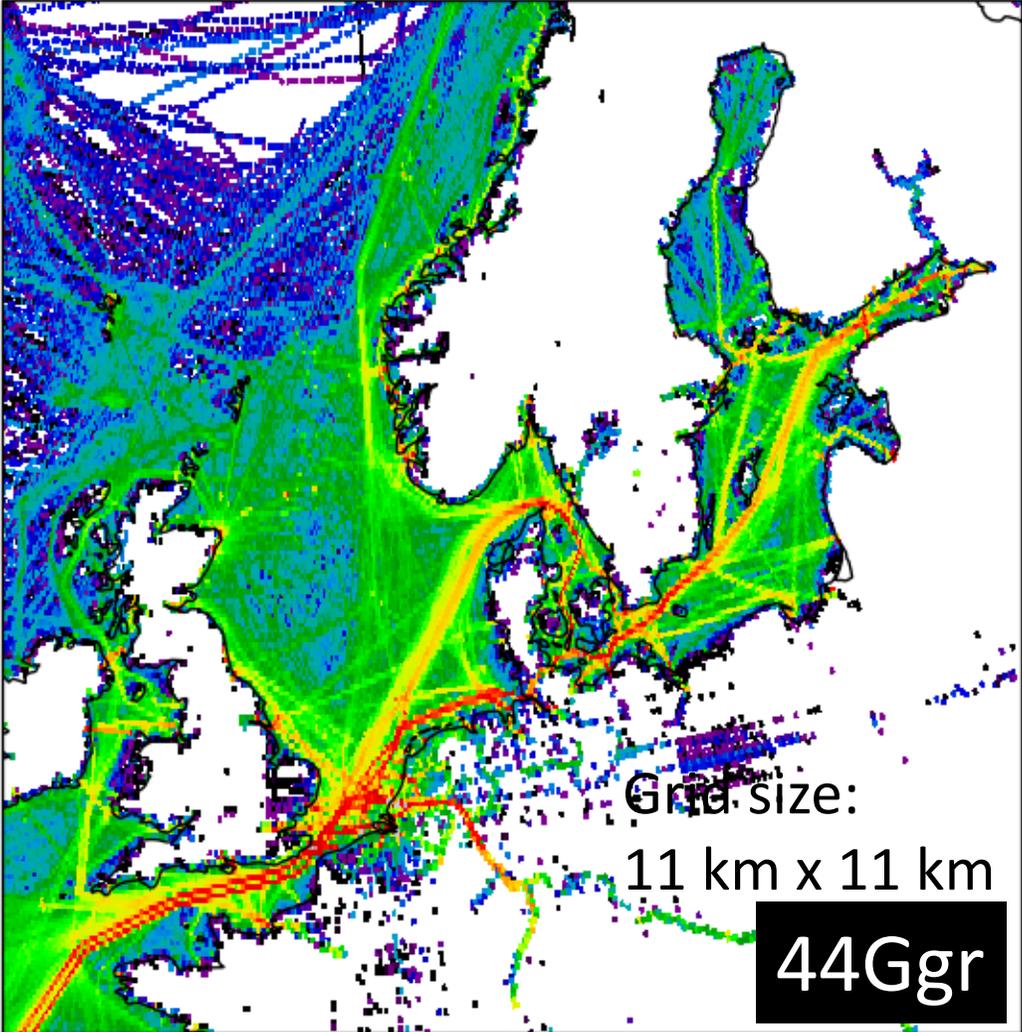


# COMPARISON OF NOX, JANUARY 2015

NOx, emissions for January

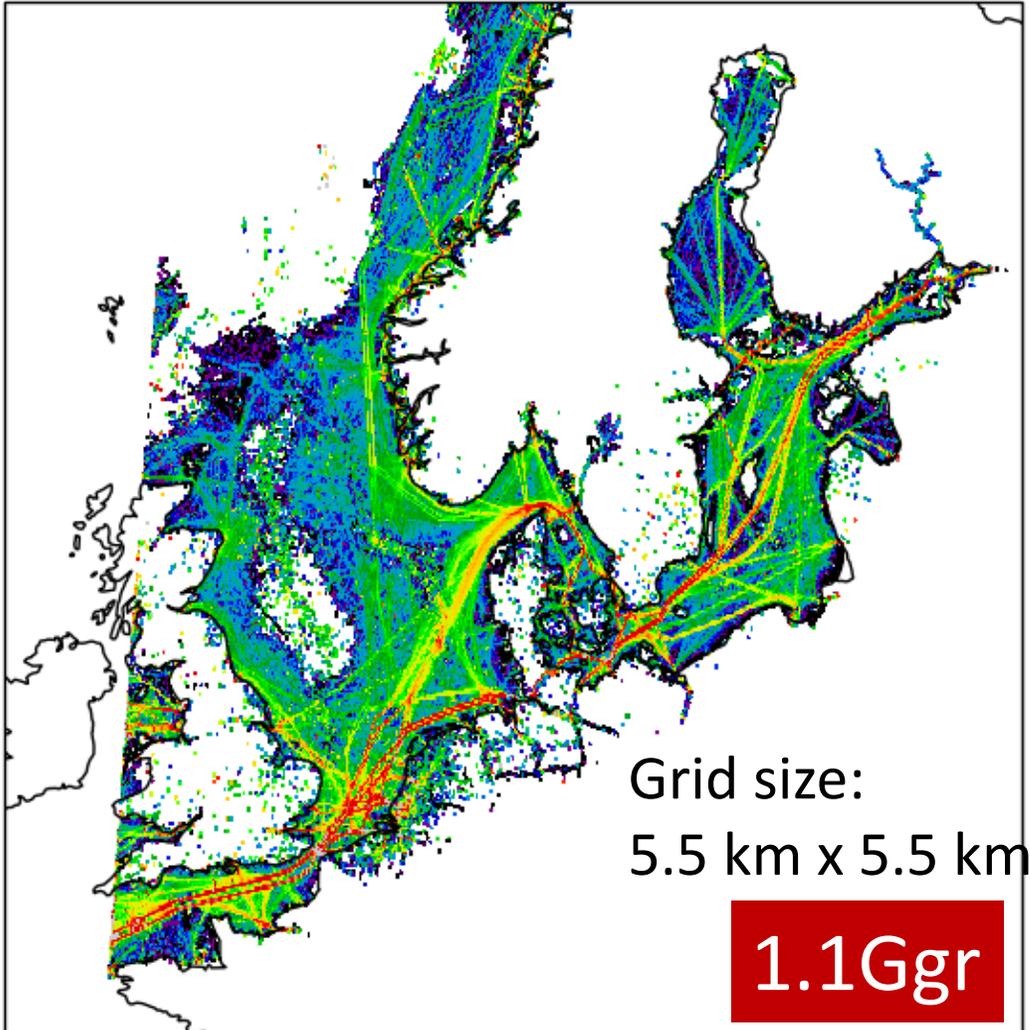


STEAM:NOx, emissions for January

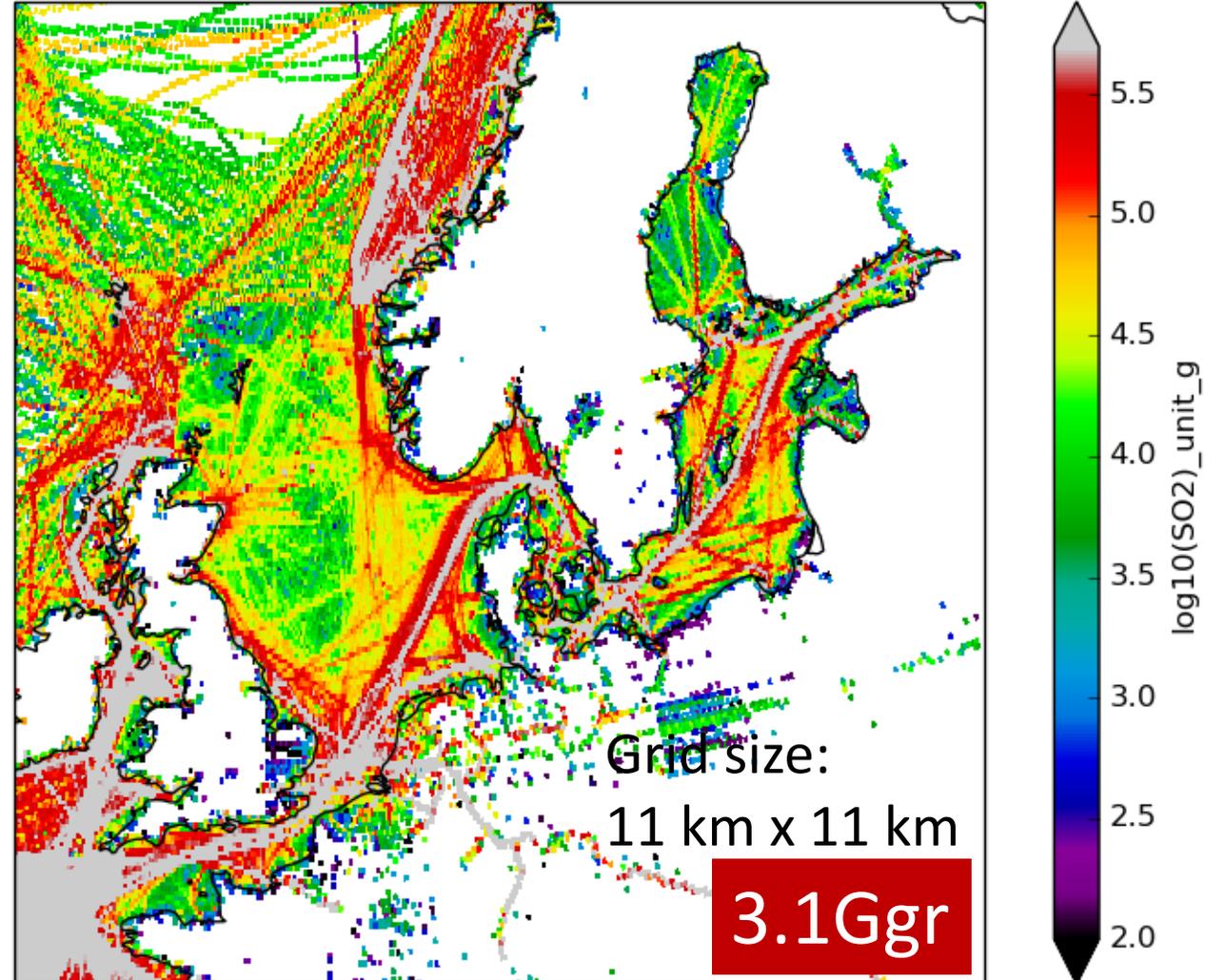


# COMPARISON OF SO<sub>2</sub>, JANUARY 2015

SO<sub>2</sub>, emissions for January

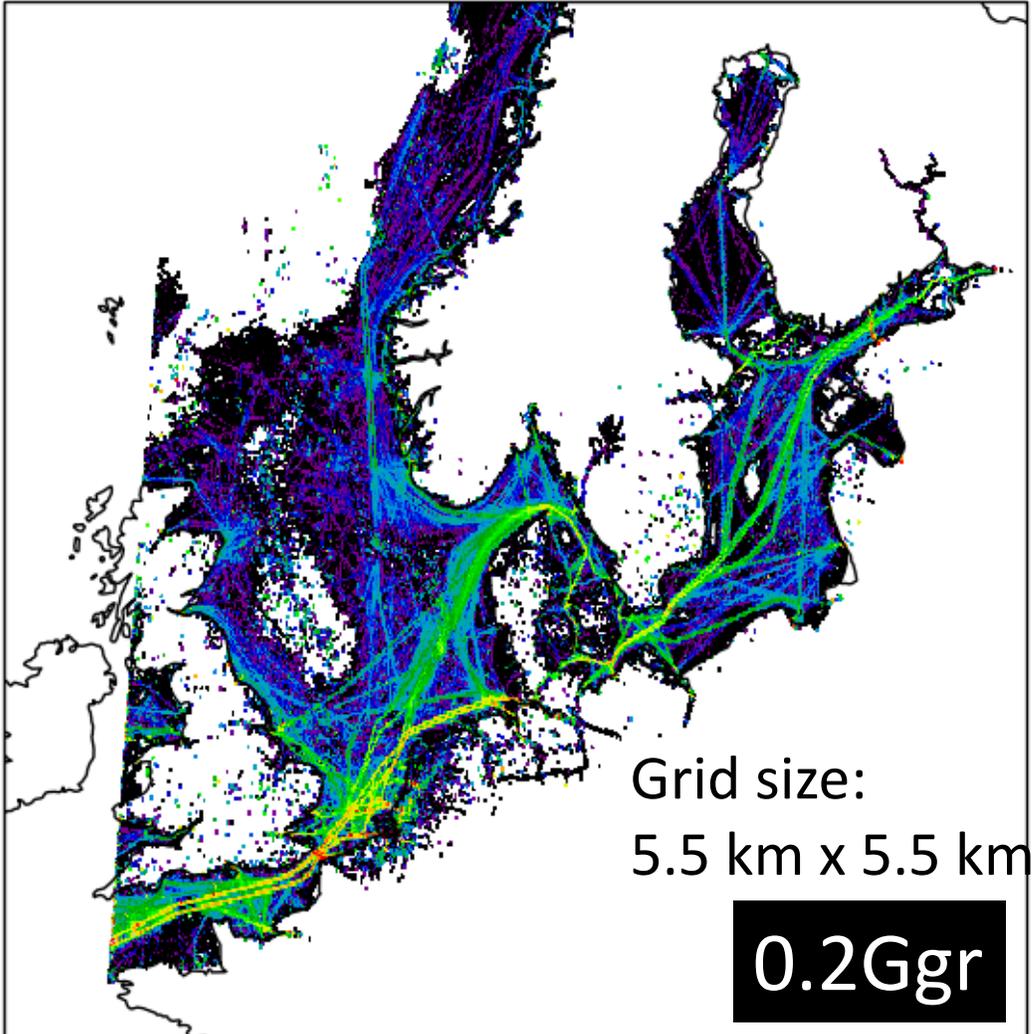


STEAM:SO<sub>2</sub>, emissions for January

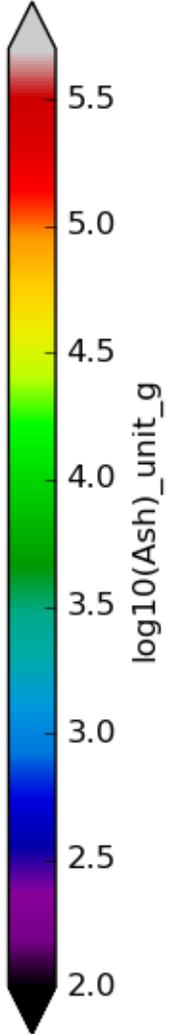
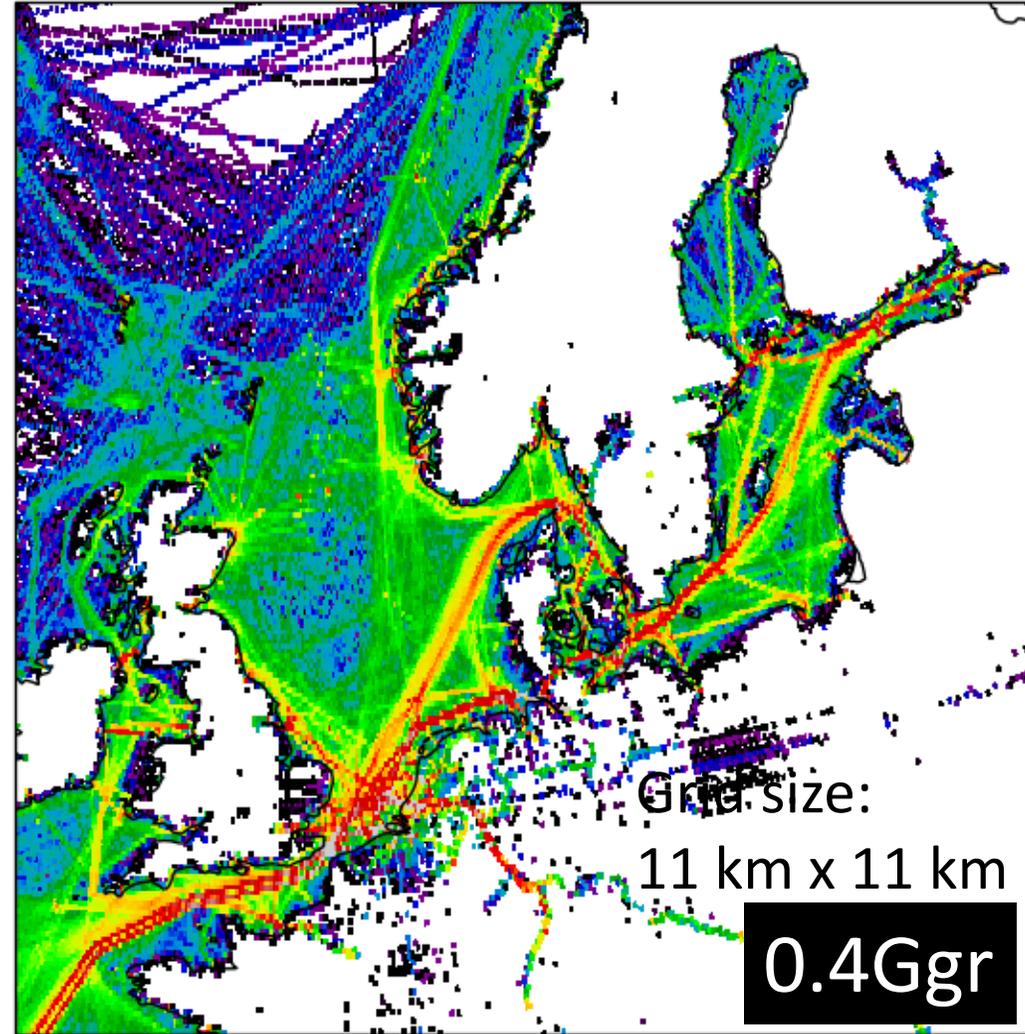


# COMPARISON OF ASH, JANUARY 2015

SCHWARZK:ma, emissions for January



STEAM:Ash, emissions for January



# IMPLICATIONS FROM COMPARISON (JANUARY 2015)

## HZG-ShipEmis and STEAM

- HZG-ShipEmis provides reasonable results
- more activity in STEAM due to small vessels (GT<100) or more elaborated AIS data (satellites)?
- Interpolation of shipping routes as a crucial point for emission inventories over open sea
- Emission factors or regulations very likely considered differently (SO<sub>2</sub> with factor 3) → uncertainties for the chemical transport modelling

Emissions in SECA [Ggramm]

	HZG	STEAM
CO <sub>2</sub>	2460	3250
NO <sub>x</sub>	44	44
SO <sub>x</sub>	1.1	3.1
Ash	0.2	0.4
CO	2	5.2
BC/EC	0.5	0.5
NMVOC	1.8	corrupt