Shipping Emissions Introduction

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Motivation

- Oceanic shipping contributes $\sim$ 3% of global GHG emissions
- IMO ranks $\sim$6th as a country
- Target of 50% reduction by 2050
- No technological 'silver bullet'
  - Alternative fuels have drawbacks and are undeveloped

Shipping Emissions

1. Container ships:
   - Manufactured goods
   - Concentrated
   - Fixed routes
2. Bulk carriers:
   - Iron ore, coal, grain...
   - Unconcentrated
   - Operate like taxis
   - Size categories/markets: Handysize, Handymax, Panamax, Capesize
3. Oil tankers
   - 'In-between'
   - Don't have tracking data

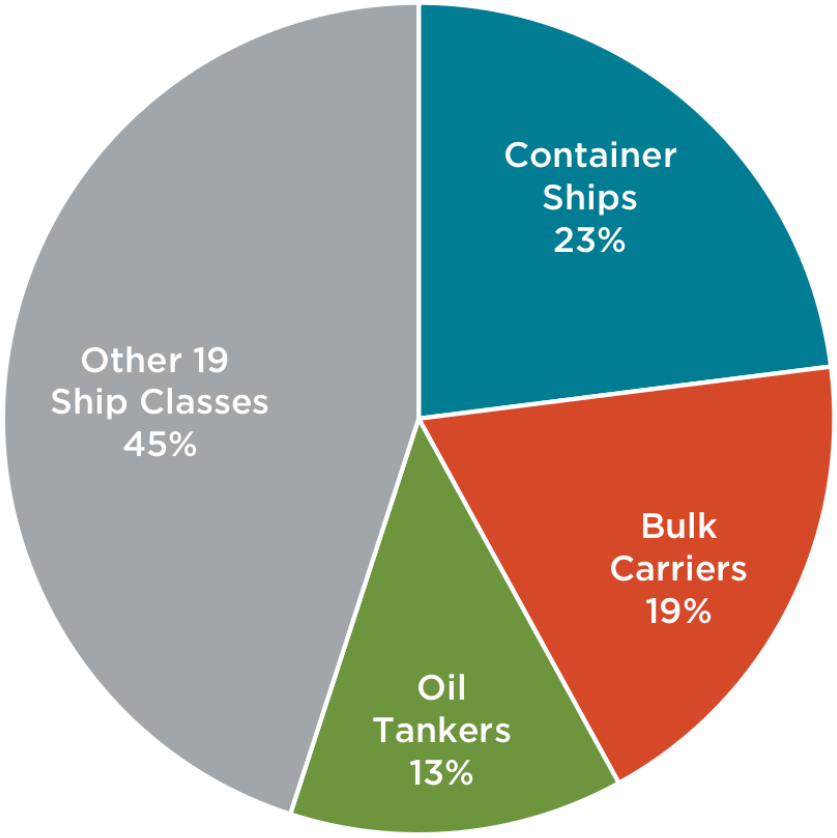

Figure 5. Average percent share of CO_2 emissions by ship class, 2013–2015

Olmer et al. 2017

World Fleet Register

- All existing ships plus those retired in last three years and many under construction
- ID: CVN, IMO number, Name, MMSI
- Type, built date, capacity
- Engine Power, fuel, environmental details
- Direct ownership, group ownership, flag state
- Secondhand price from 2005 (where available)
- Newbuild price (where available)
- + 100s more...

Do Not Share This Data!

AIS Ship Tracking Data

- All bulkers (∼6000) and container ships (not tankers)
- MMSI, location, speed, heading, draft...
- Automatic: latitude, longitude, speed, heading, etc.
- Manual: draft, desination, eta, etc.
- Last observation in each hour
- Covers three years (2019-2021)
- Factsheet and terms @ /resources/Spire Data/

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MRV Emissions Data

Annual Efficiency to/from EU:

- All ships that entered the EU (∼44%, ∼30% in a given year)
- ID, annual emissions, fuel usage, efficiency for trips to/from EU ports
- Three years (2018-2020)
- data @ /src/data/MRV

Shipping Intelligence Network

Shipping contracts:

- A sample of contracts for all types of ships
- Ship, date, price, origin, destination, sometimes cargo
- Three years (2019-2021)

Various longer-run time series:

- Entries, exits, total fleet size
- Fuel prices
- Shipping price indices

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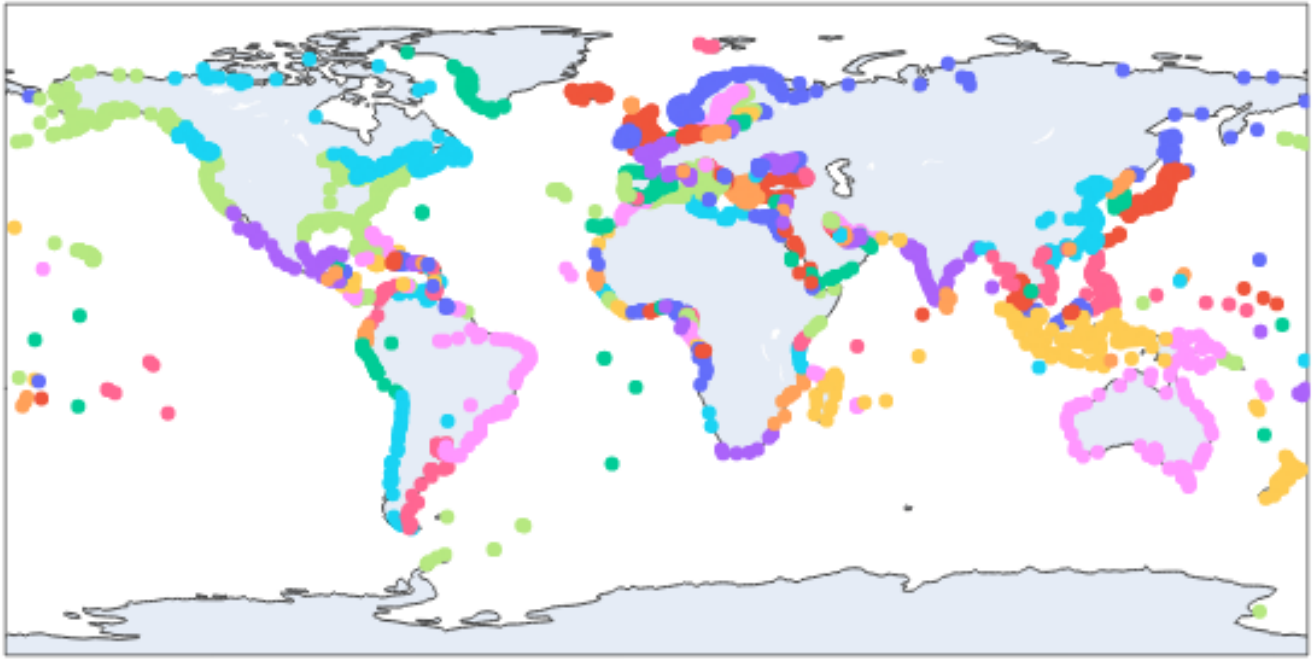
World Port Index

Ports



Linking

$$MRV \xleftrightarrow{IMO\#} WFR \xleftrightarrow{MMSI} AIS$$

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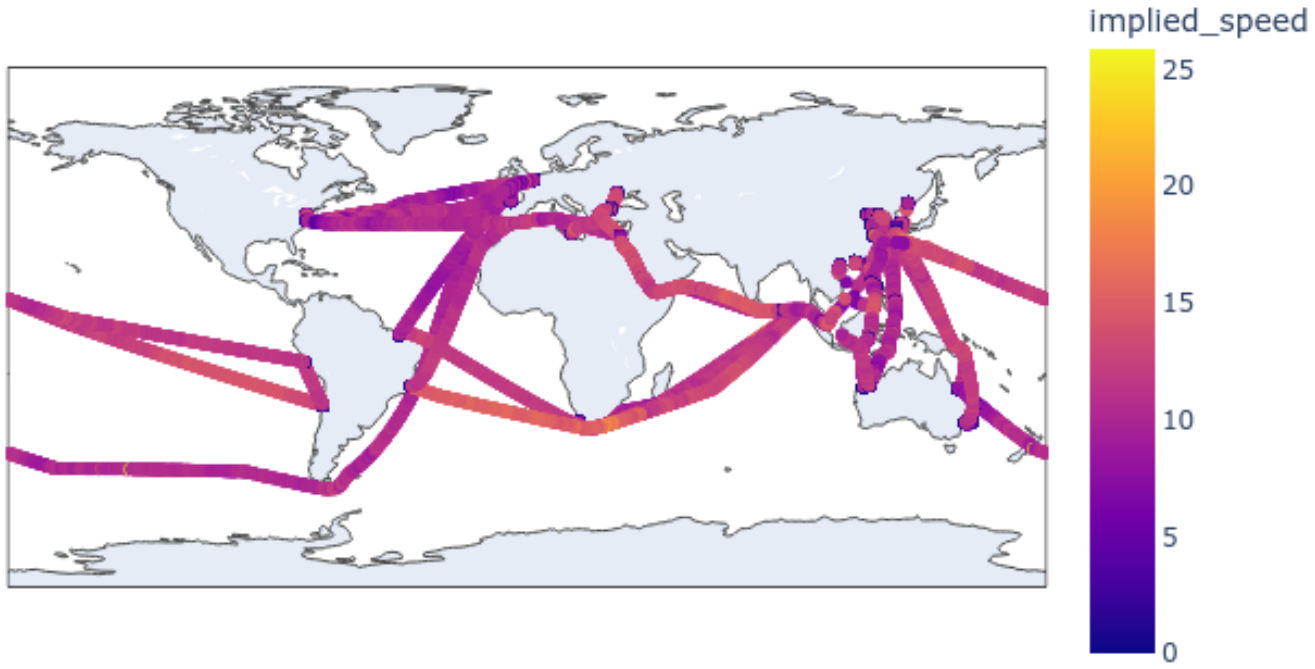

Code

- Tracking data is currently a 20GB+ set of parquet files
- Divided into separate files ('partitions') to allow for larger-than-memory processing
- Each partition contains all observations of a given mmsi and is sorted by date
- Python
  - Dask
    - Allows cluster computing / parellelization
    - Operations are lazy
    - Use dd.map.partition() to operate on each partition as a Pandas dataframe
  - Pandas
- R (tidyverse)

Matching MRV and AIS

- MRV reports annual fuel consumption for 'trips' in and out of 'EU'
- Need to identify these trips in the tracking data:
  - Trip: a voyage with at least one port call within an EU territory
  - Port call: loading or unloading (not refuelling for example)
  - EU territory (Continental EU countries plus Norway, Icelancd (minus UK after 2020) plus territories)

Steps:

1. Detect port calls
2. Number trips
3. Filter EU trips
4. Aggregate variables of interest

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