

Shipping Emissions Introduction

Allen Peters

Vancouver School of Economics, University of British Columbia

apeters@protonmail.com

April 26, 2022

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Motivation

- Oceanic shipping contributes $\sim 3\%$ of global GHG emissions
- IMO ranks ~ 6 th 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

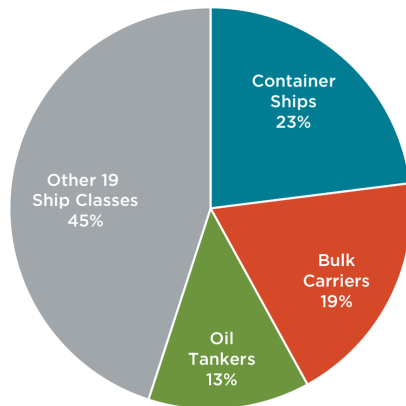


Figure 5. Average percent share of CO₂ emissions by ship class, 2013–2015

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 ($\sim 44\%$, $\sim 30\%$ 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)

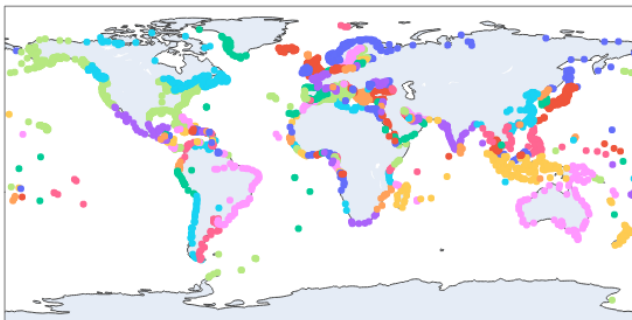
Various longer-run time series:

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

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World Port Index

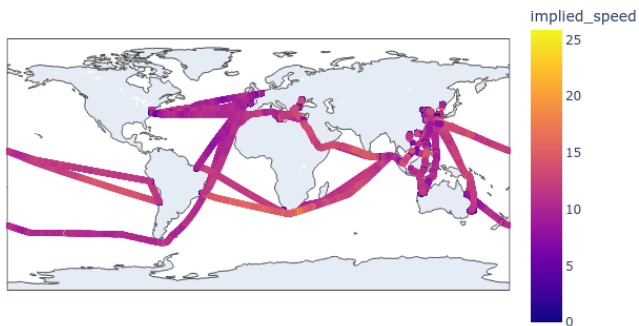
Ports



Linking

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

205569000



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 / parallelization
 - 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, Iceland (minus UK after 2020) plus territories)

Steps:

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