



Ricardo  
Energy & Environment



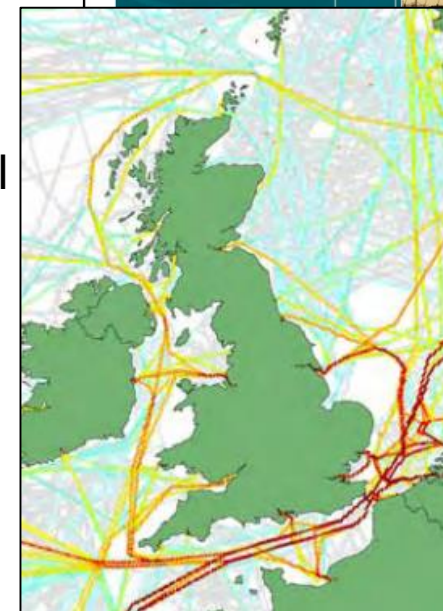
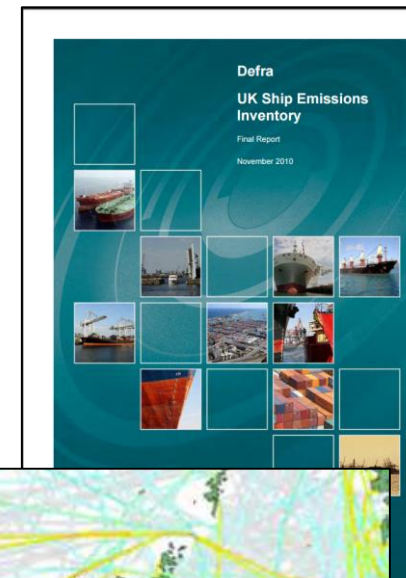
## UK Shipping Improvement Work

TFEIP Expert Panel – Transport  
Yvonne Pang and Tim Scarbrough  
11<sup>th</sup> May 2017

- **Why did we do this?**
  - Background to current UK shipping emission inventory and the need to improve it
  - Aims and objectives of this ongoing shipping improvement work
- **New methodology**
  - New activity data: Using Automatic Identification System (AIS) data from the UK Maritime & Coastguard Agency
- **What are the benefits and challenges**

## Current inventory good but had some limitations

- Good
  - Bottom-up tier 3 method based on Lloyd's (LMIU) data
  - Domestic/international split by port origin/arrival listed by LMIU
  - Detailed consideration of vessel types, engines, fuels
  - Spatially distributed (5x5km) based on *estimated* routes
  - 2007 base year of activity data
- BUT
  - **Incomplete:** poor capture of vessels not engaged in international trade (smaller vessels, fishing vessels, offshore, service)
  - **Accuracy could be improved:** Blanket assumptions on vessel speeds (→ engine loads)
  - **Spatial accuracy could be improved:** No capture of *actual* vessel routes limits spatial granularity
    - Poor understanding of vessels starting/finishing at same port

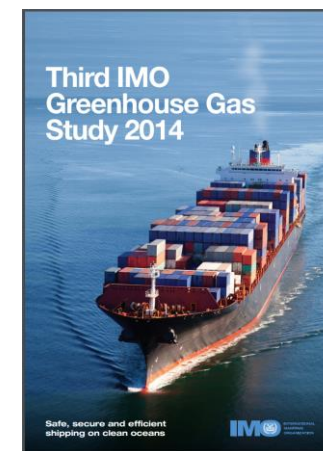


## What? – Aims and objectives

- Project for the UK Department for Business, Energy & Industrial Strategy (BEIS) under UK Inventory Improvement Programme
- Review and update the methodology for estimating emissions from UK shipping
- Try to improve upon previous methodology for known high uncertainties of
  - Vessels that move from and to the same port
  - Small vessels
  - Fishing vessels
- Backcasting annual emission estimates to 1990 + projections to 2035
- Led by Ricardo team, partners at University College London – emissions calculations

## First stage in improvement work: review available options

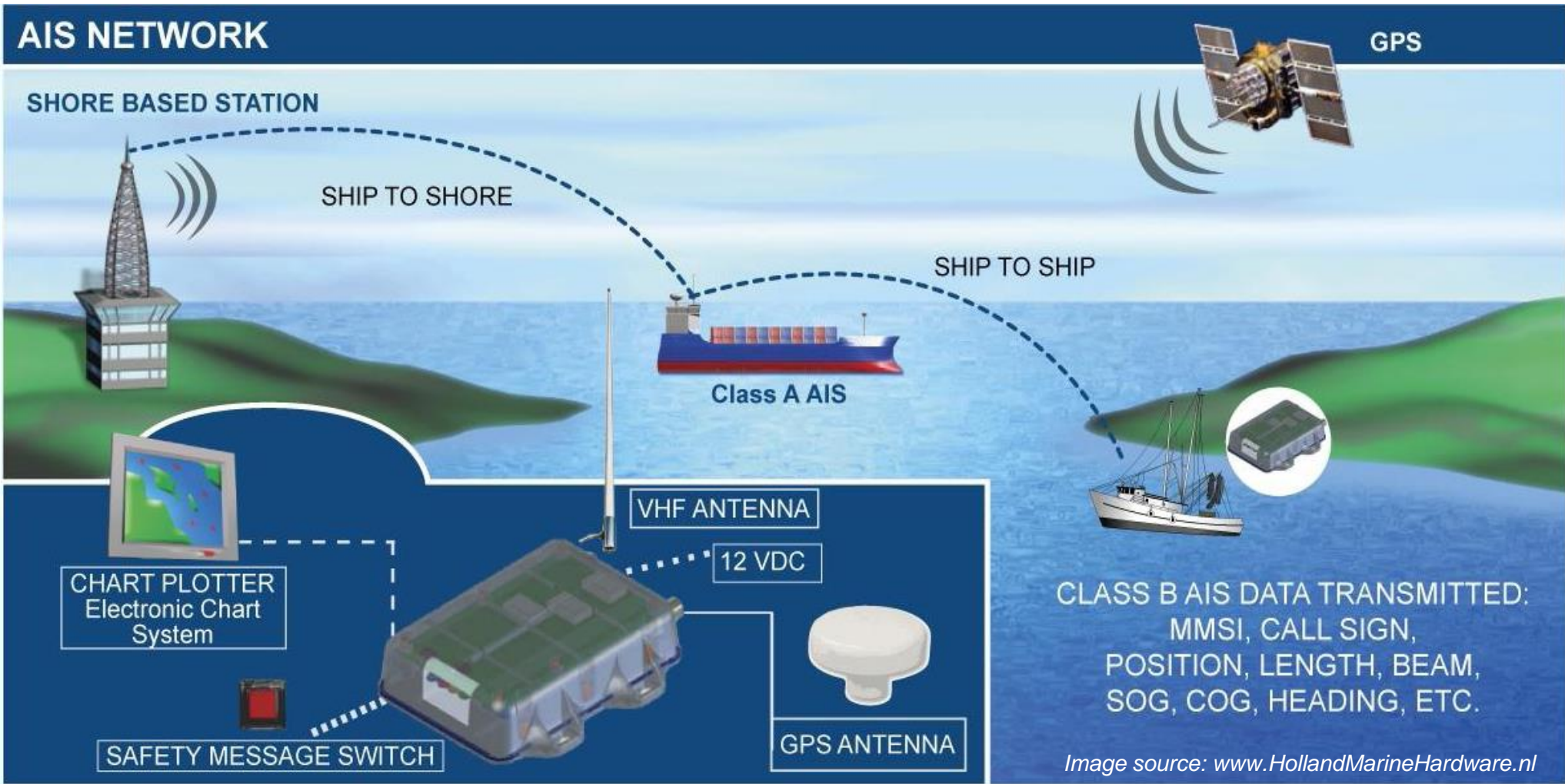
- Review of **activity** data. Data samples from multiple providers critically assessed.
  - Automatic Identification System (AIS) data
    - Terrestrial
    - Terrestrial plus satellite
    - Commercial and Government
  - Non-AIS options – using Lloyd's again
- Review of **emission factors**
  - Comparison of existing assumptions assessed against leading work by International Maritime Organization (IMO)
- → **Outcome: selected new methodology using terrestrial AIS data from the Maritime and Coastguard Agency**
  - Best available data for the UK situation
  - More detailed activity data than the majority of national shipping emission inventories





# Our solution: develop new methodology using Automatic Identification System (AIS) data from Maritime & Coastguard Agency

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# AIS data – example resolution



# Overview of new methodology

- **Highly granular raw activity data**
  - Vessel positions up to every few seconds when in range of terrestrial network
  - Satellite AIS data not used
  - Unknown route (+destination) of vessels after leaving range of terrestrial AIS
- **Estimate emissions for every vessel position, after linking each vessel to Clarksons technical vessel characteristics database, taking into account:**
  - Vessel type
  - Engine power (main, auxiliary, boilers) of each vessel
  - Engine load, accounting for speed and draught at each position
  - Time until next position
  - Speed dependent emission factors
  - Location (at berth, at sea in a SECA/not in a SECA)



# This is a big data project

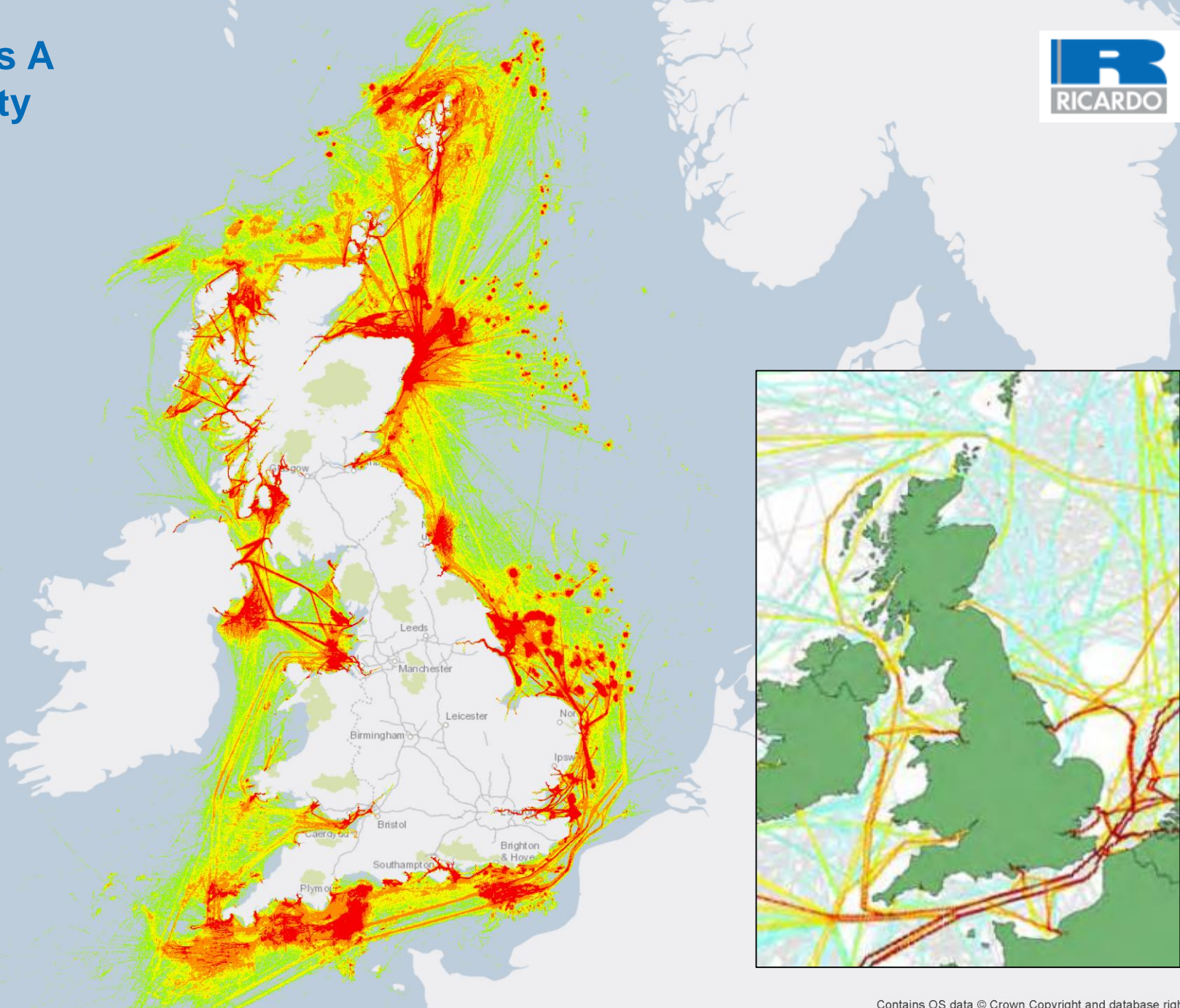
- >2 billion data points were temporally thinned to a more manageable 100 million
- Large storage requirements
- Raw data are not clean data, many gaps and errors
  - → substantial time for data cleaning and algorithm development
- QA/QC of very large dataset is time consuming
  - Use visual inspection of mapped data to critically assess for spurious data
  - Long lead times to run queries

## Improved data for UK energy statistics

## Enhanced spatial resolution on key sources and AQ impacts in ports

- **Enhanced vessel coverage compared to current estimates**
  - Offshore, Fishing, Small service vessels, Passenger

# Domestic class A position density



## Improved data for UK energy statistics

### Enhanced spatial resolution on key sources and AQ impacts in ports

- **Enhanced vessel coverage compared to current estimates**
  - Offshore, Fishing, Small service vessels, Passenger ferries
- **Accounts for actual routes that vessels have taken**
- **Refined emission factors**
  - Main engine load now speed and draught dependent, varying for each position report
  - Auxiliary engine loads now vary by vessel category, size and by mode
  - Auxiliary boiler fuel consumption and emissions now estimated
- **...New activity data improves overall capture rate of vessel movements, but adds new challenge of distinguishing domestic shipping from international shipping**
- **Higher spatial resolution** is valuable to local (port) authorities managing their understanding of local pollution sources





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**Tim Scarbrough**

**[Tim.Scarbrough@ricardo.com](mailto:Tim.Scarbrough@ricardo.com)**

**+44 1235 75 3159**

**Yvonne Pang**

**[Yvonne.Pang@ricardo.com](mailto:Yvonne.Pang@ricardo.com)**

**+44 1235 75 3444**

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**Spare slides**

| Vessel category   | Requirement to fit AIS Class A  |
|-------------------|---|
| Cargo vessels     | All vessels over 300 GT on international voyages  |
| Passenger vessels | All vessels. But Member States can exempt passenger vessels that are either <15m length or <300GT and which are engaged on non-international voyages from this requirement. It is unclear to what extent this exemption has been implemented and thus affecting vessels travelling in UK waters.  |
| Fishing vessels   | <p>All vessels with overall length &gt;15m as follows:</p> <ul style="list-style-type: none"> <li>Existing vessels &gt;24m should have been fitted by 31 May 2012</li> <li>Existing vessels 18m to 24m should have been fitted by 31 May 2013</li> <li>Existing vessels 15m to 18m should have been fitted by 31 May 2014</li> <li>new-built fishing vessels &gt;15m should have been fitted from 30 November 2010</li> </ul> |
| Other, naval      | No requirement.   |

# Backcasting / forecasting the base year inventory unchanged



- **Backcasting to 1990 – approach unchanged**

- Scale base year according to indices set at base year = 1, accounting for changes in
  - Activity (DfT statistical time series)
  - Fuel type and/or emission factor (e.g. SECAs)
- Updated vessel categorisation (was 8, now 19 vessel categories)
  - Updated separate more cargo types (previously all cargo split just into unitised and non-unitised)

- **Forecasting to 2035 – approach unchanged**

- Accounts for projected changes in
  - Activity
  - Transport efficiency
  - Fuel type and/or emission factors
- Cannot anticipate structural or route changes
- Specific considerations for 4 ports (Southampton, Immingham, Liverpool Felixstowe)