MAPPING THE UNDERWATER NOISE OF RECREATIONAL BOATS

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Background and motivation

- 864,200 recreational boats in Sweden (2020)
  - One boat per 12 persons
  - Global merchant fleet 127,000 (2022, Equasis)
- Shallow costal areas
  - High biodiversity
  - Mostly recreational boats

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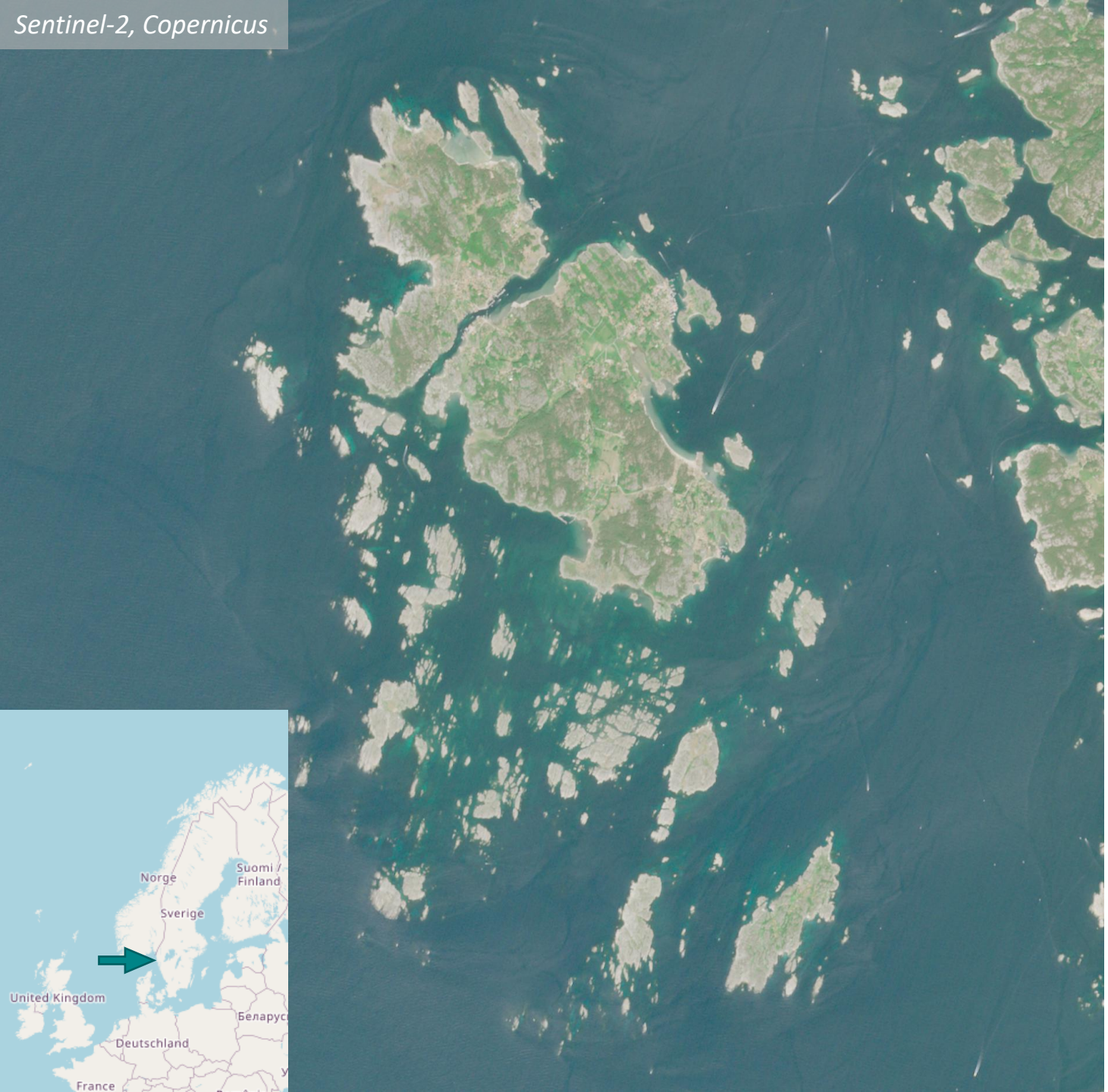

Koster Islands

- Marine national park
- 389 km^2
- 90,000 visitors
- Many rare marine species

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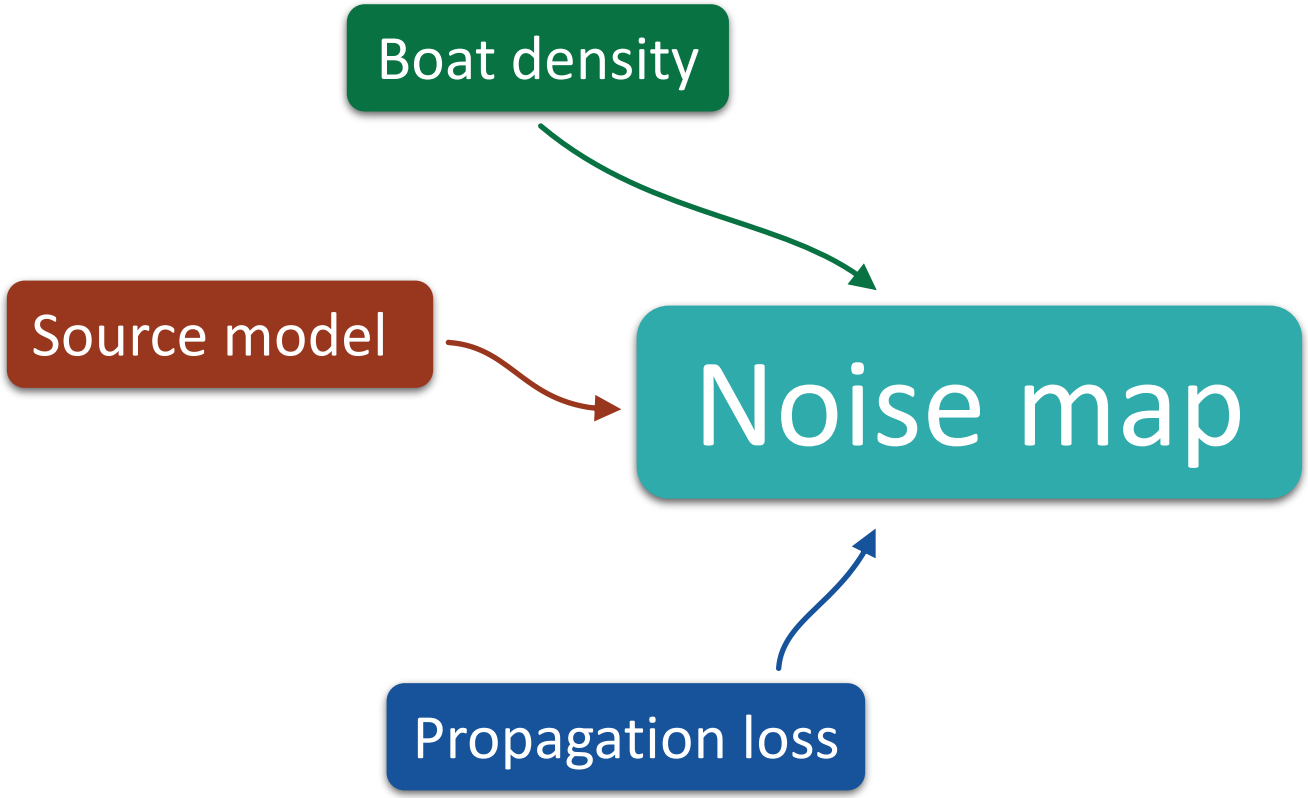
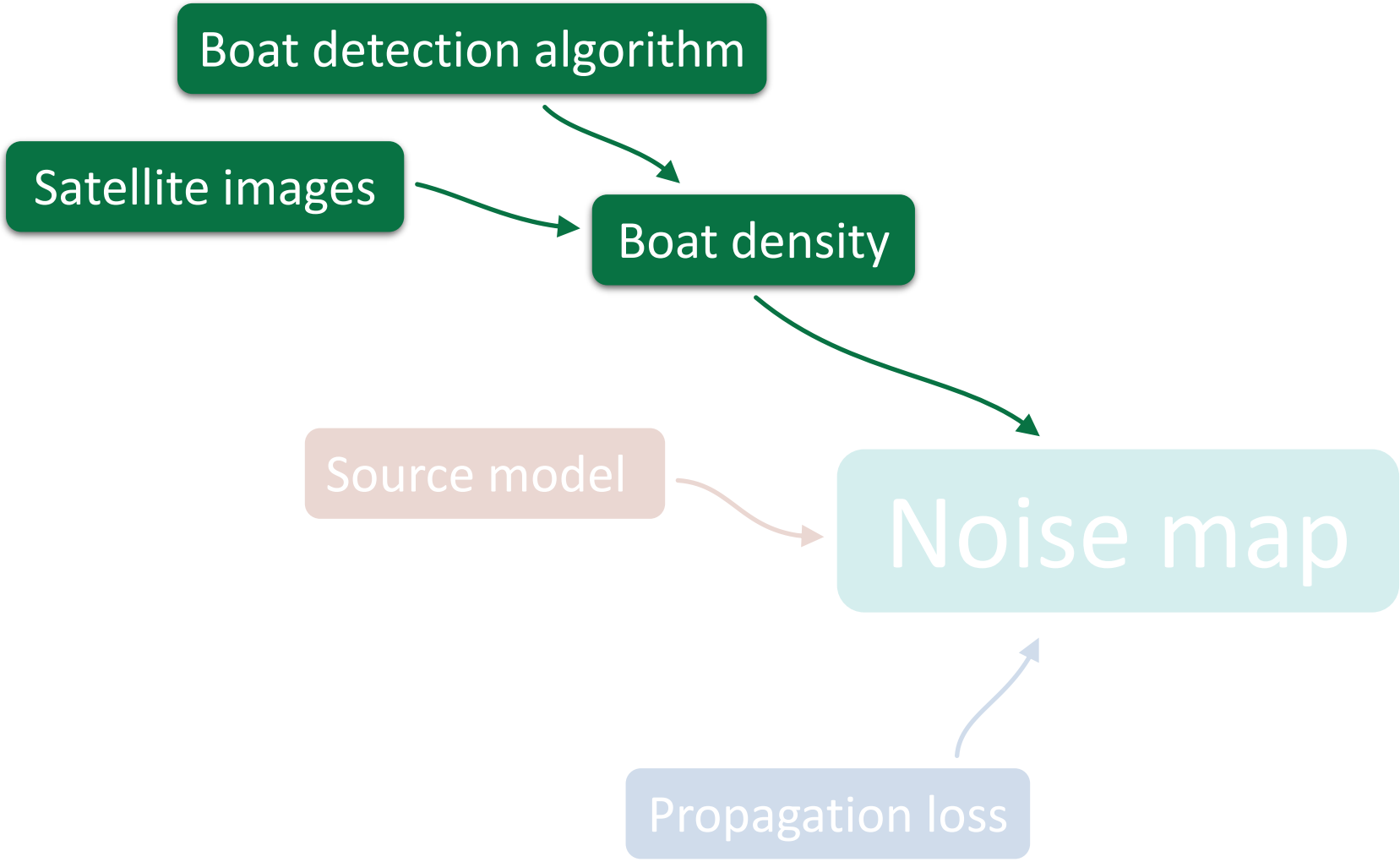

Boat density
Source model
Noise map
Propagation loss



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Satellite imagery

- Sentinel-2
- Resolution: 10m / pixel
- 12 images, 8 in clear weather

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- Resolution: 10m / pixel
- 12 images, 8 in clear weather
- Canny edge detection
- Difficulty handling clouds

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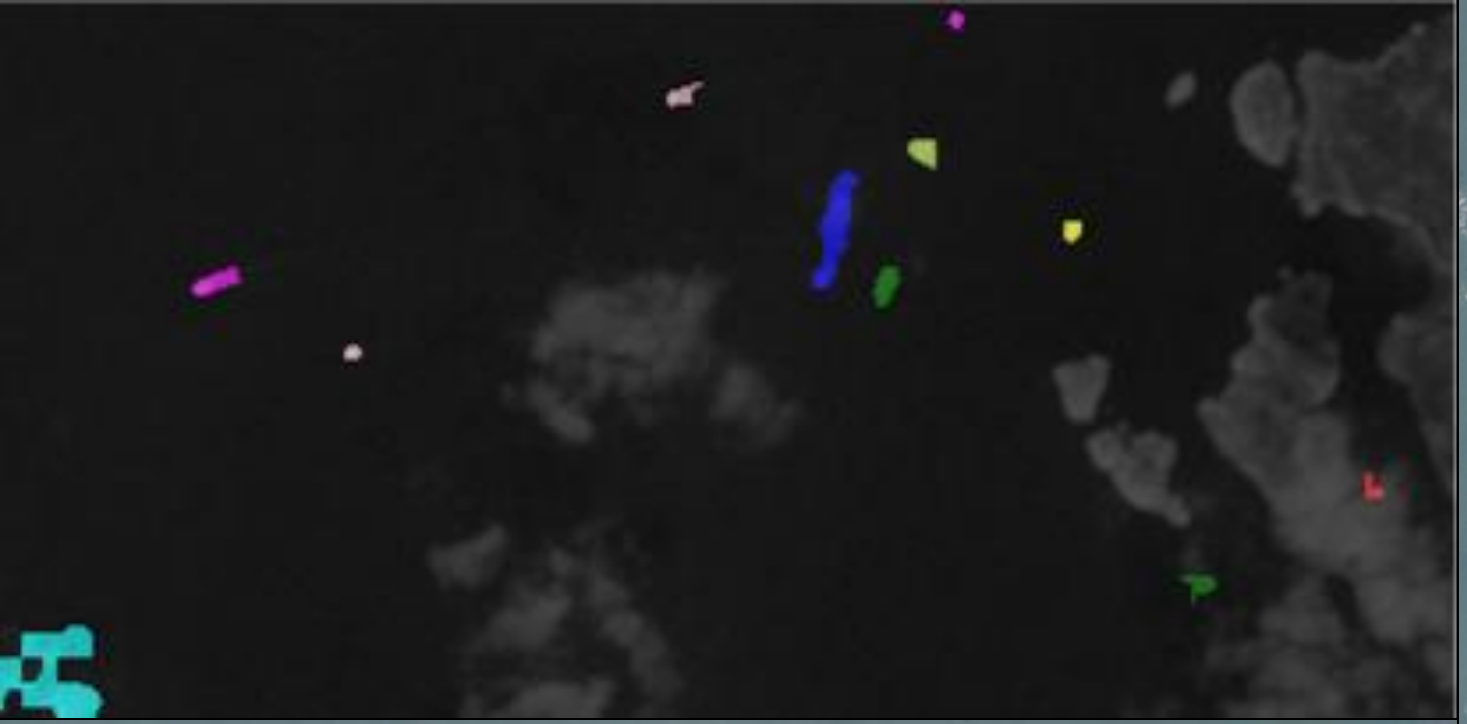
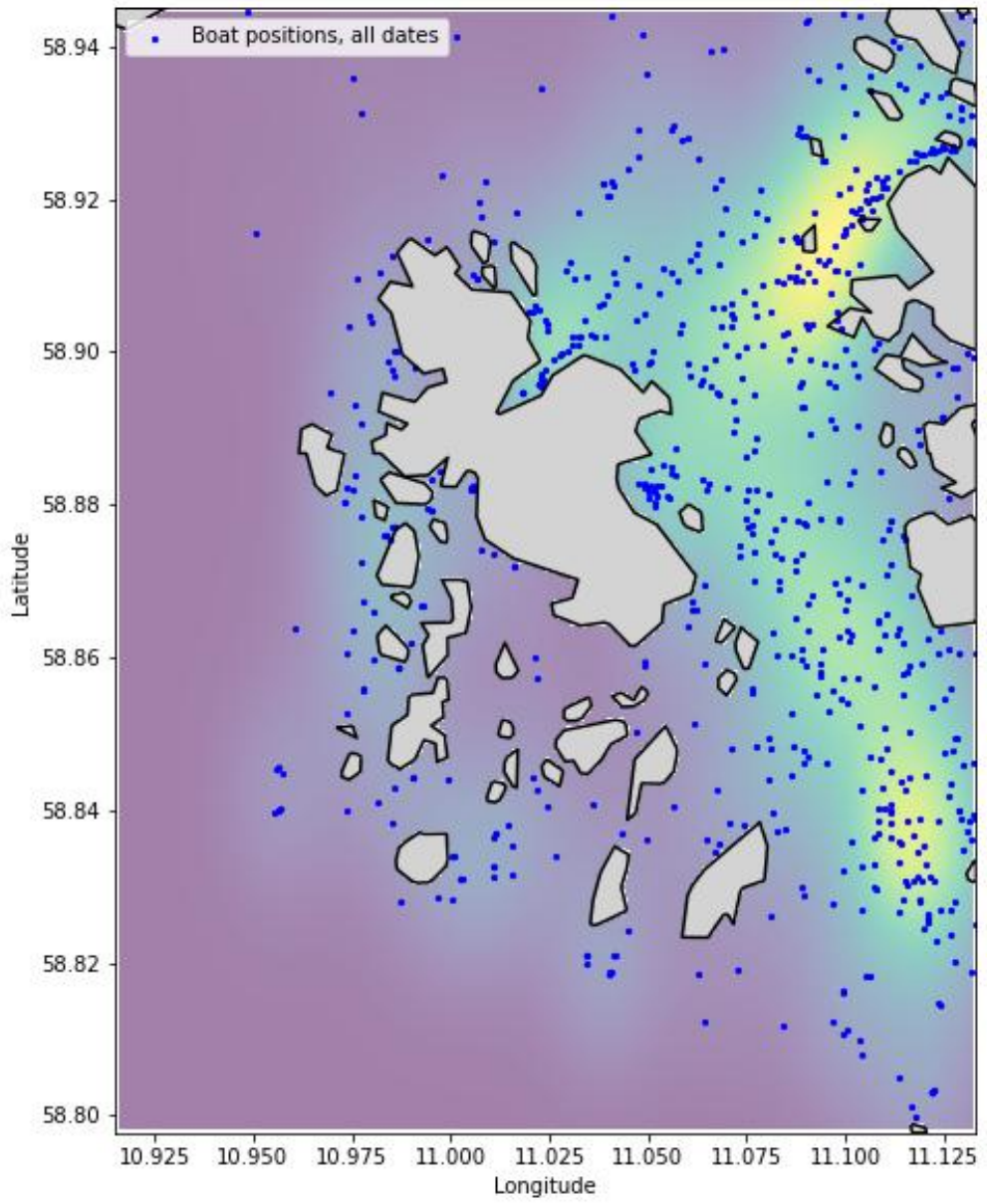



Sentinel-2, Copernicus

Boat density

- 500 boat detections
- KDE smoothing
  - Output: number of boats / area
  - Proportional to e.g. ship-hours / month / area
- Bias to daytime and fair weather
  - Similar to boating activity



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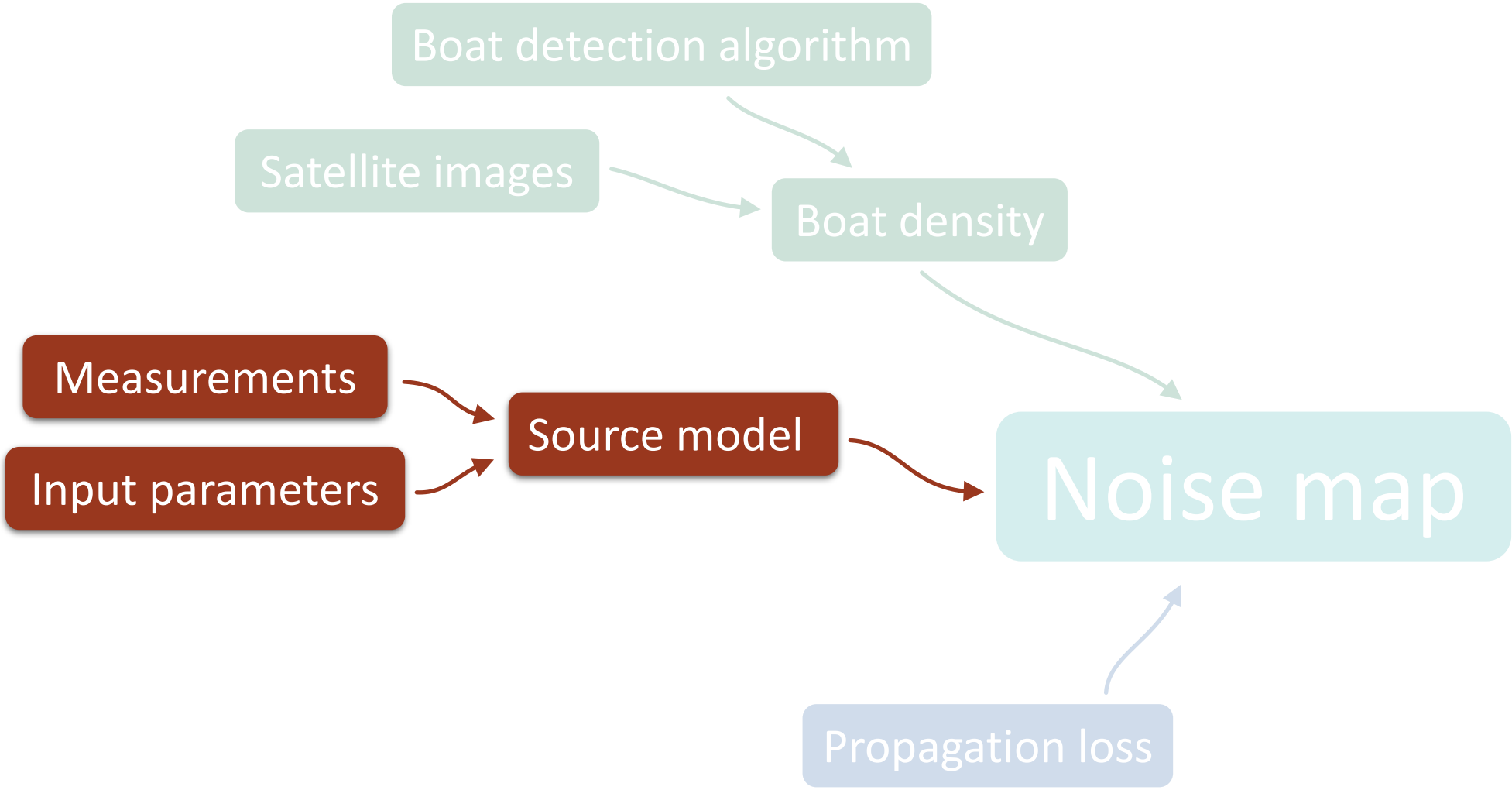

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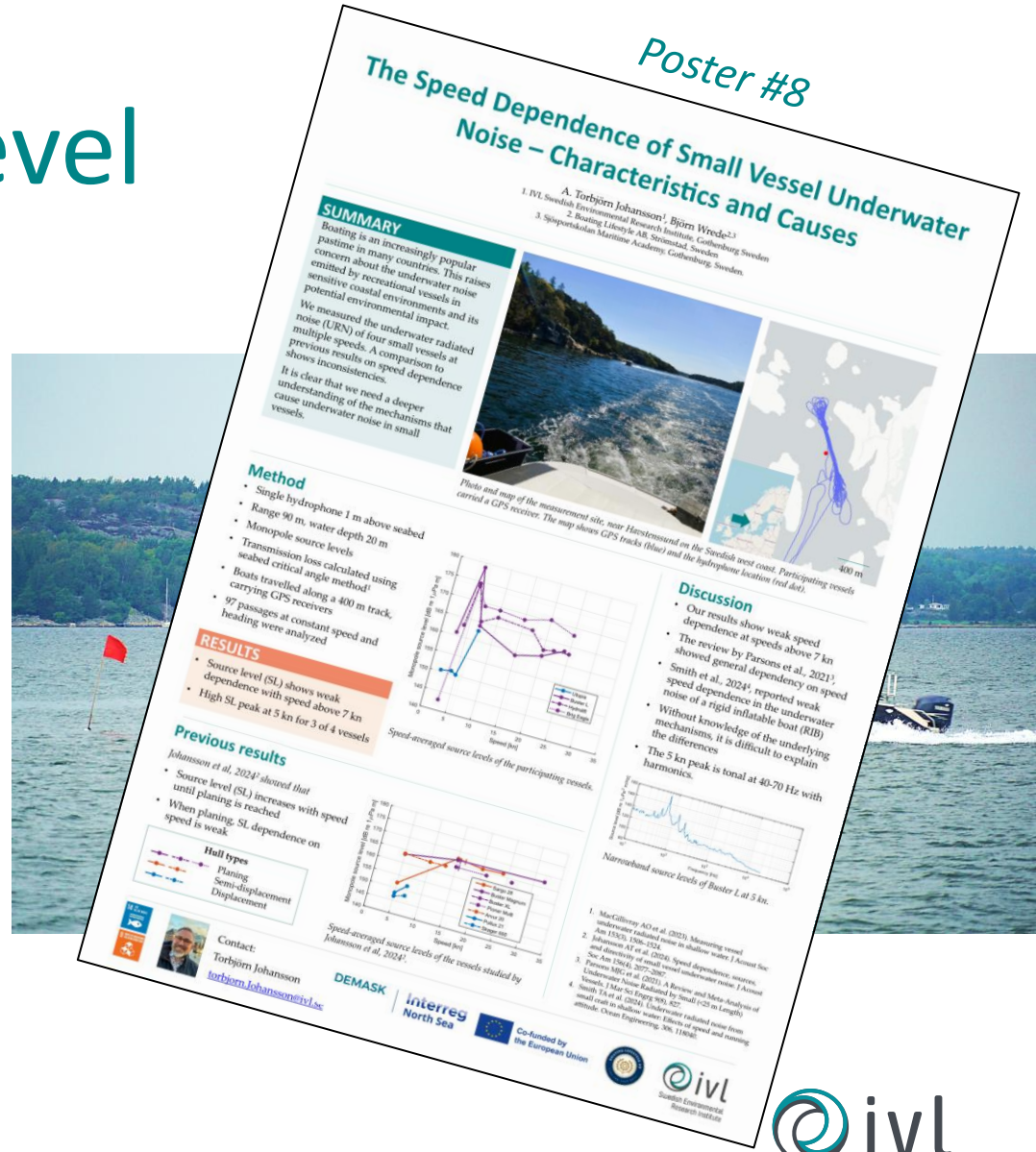
Measurements of source level

- Dedicated measurements of 25 boats
  - Collaboration with FOI and KTH
- 3 knots – 30 knots
- Inconsistent results regarding speed
- Work in progress
- More data is needed!



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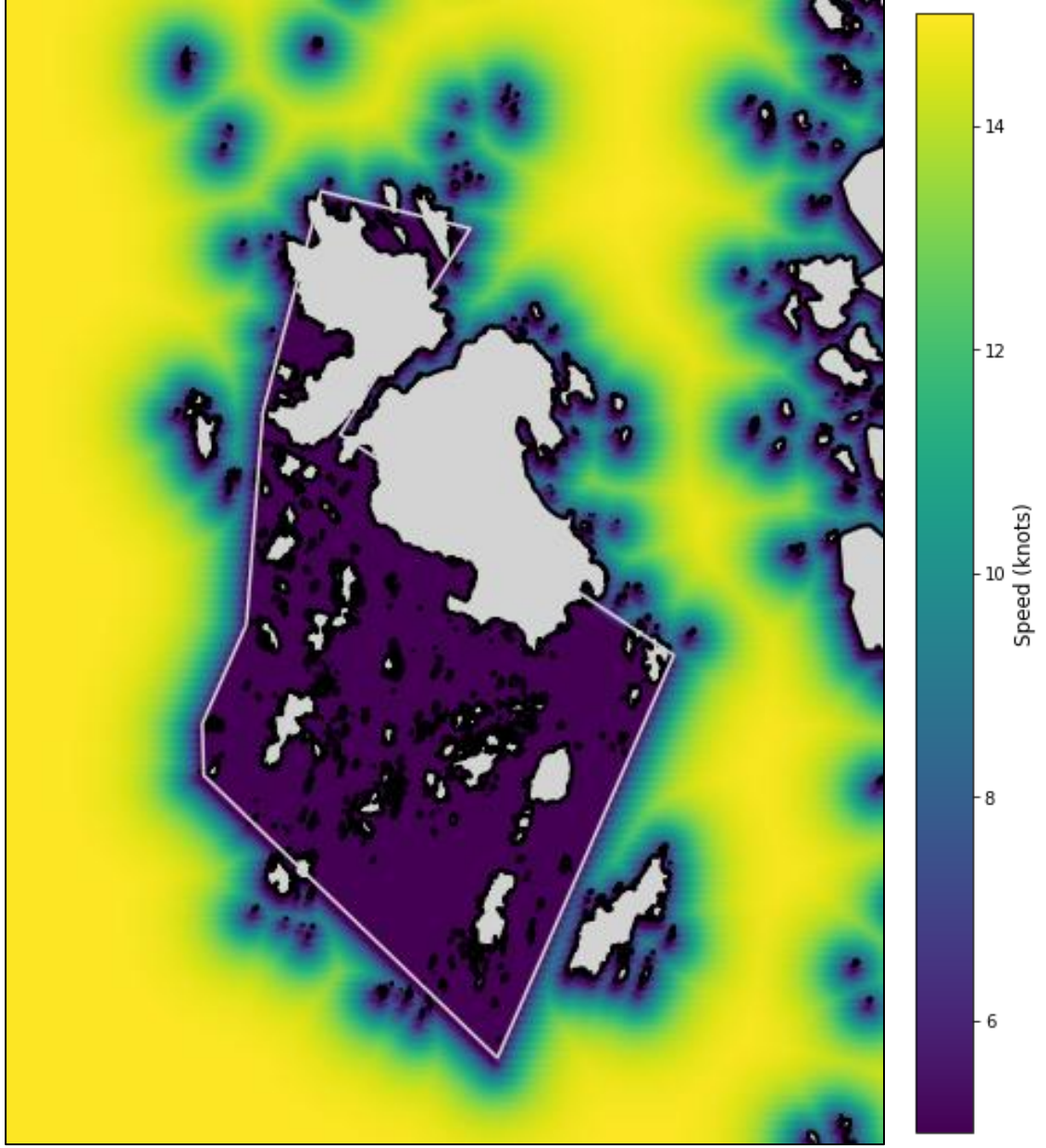
Source model inputs

- Vessel speed – distance from land and speed restrictions



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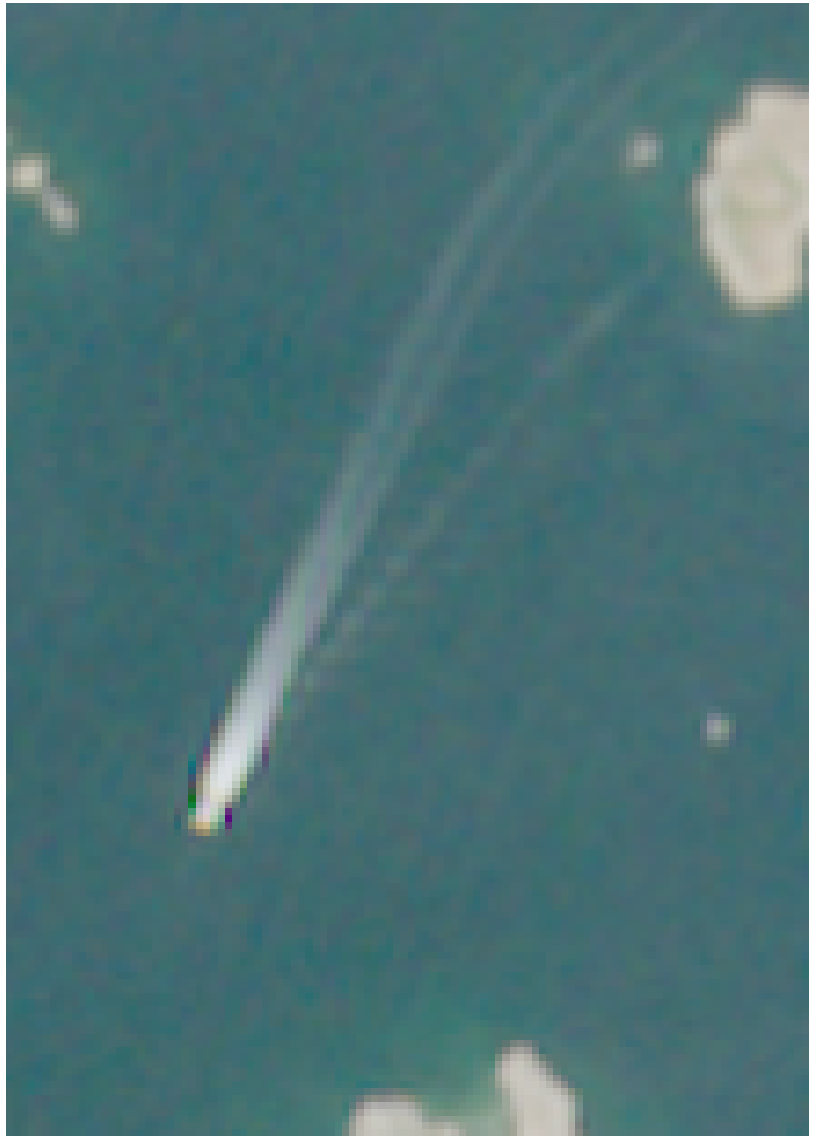
Source model inputs

- Vessel speed – distance from land and speed restrictions
- Size – unknown
- Vessel/hull type – unknown
- Engine size – unknown



Source model inputs

- Vessel speed – distance from land and speed restrictions
- Size – unknown
- Vessel/hull type – unknown
- Engine size – unknown
- Potential with higher resolution imagery

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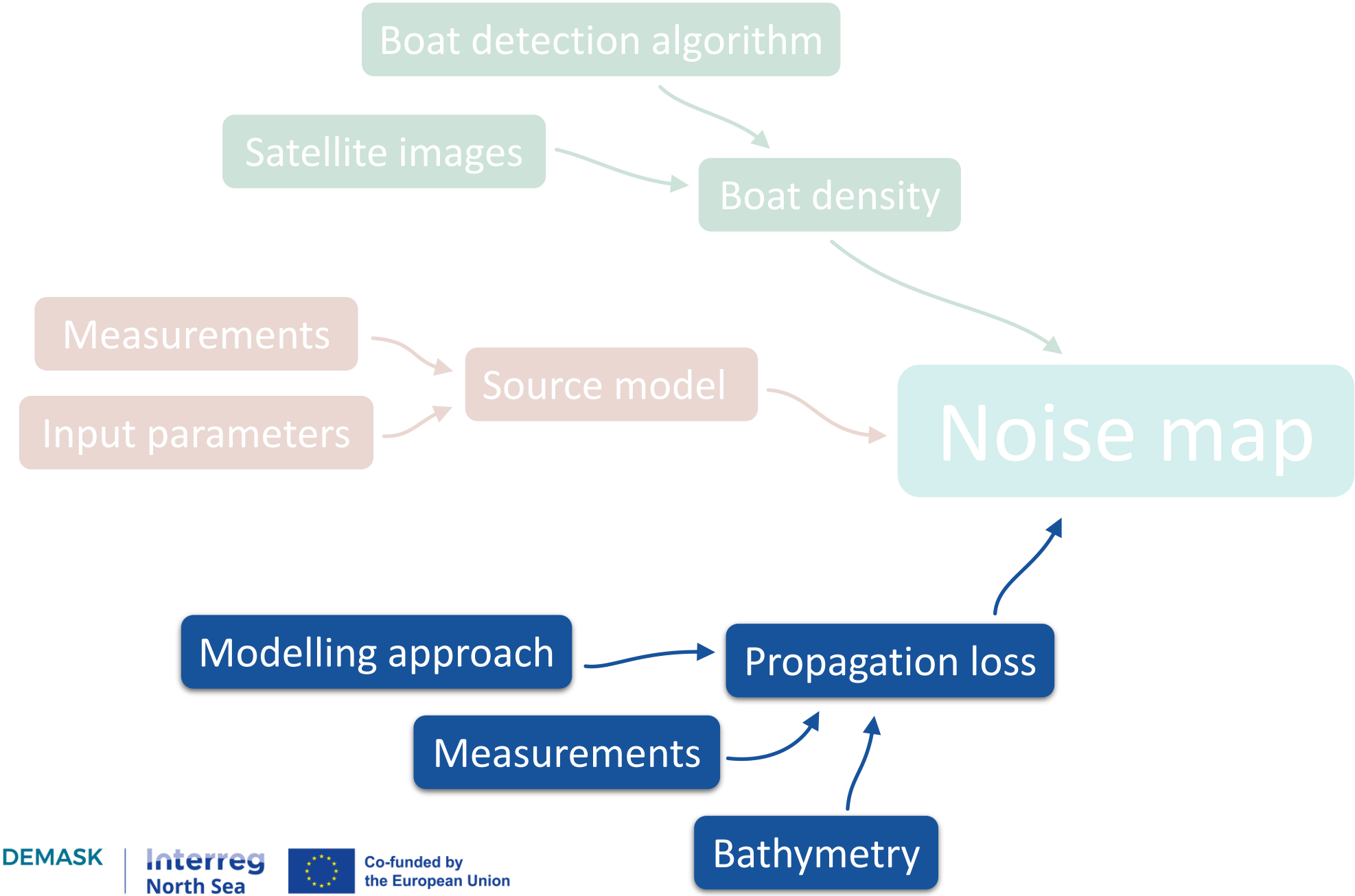

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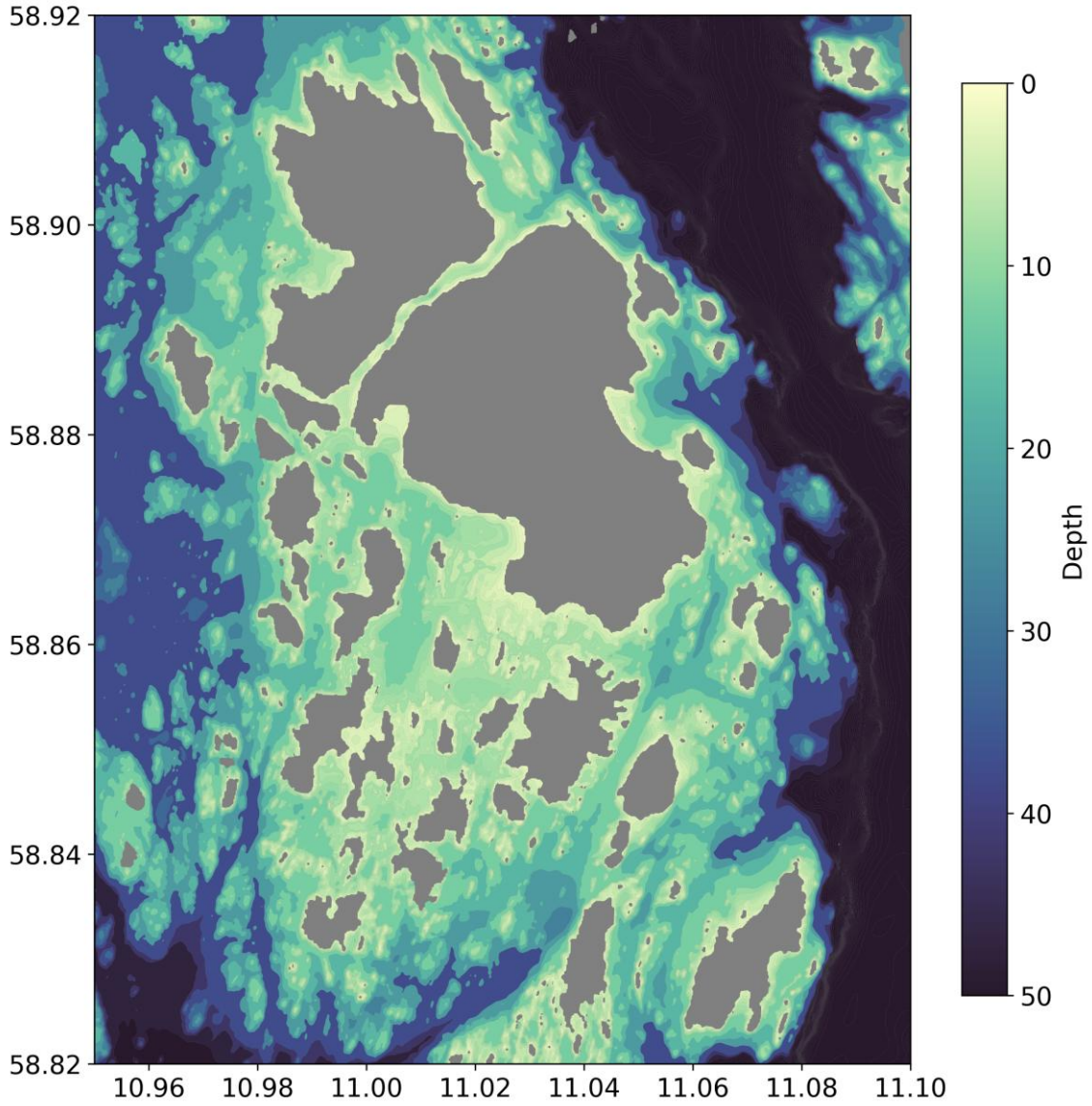
Bathymetry

- Generally shallow waters
- Deep trench with fairway
- 400 islands
- Need to handle propagation around islands



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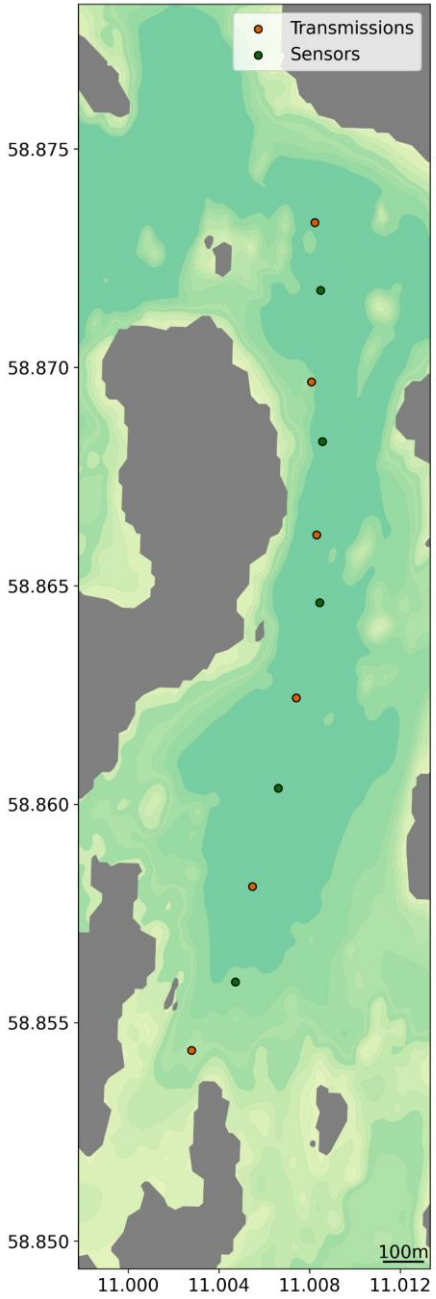
Measurements

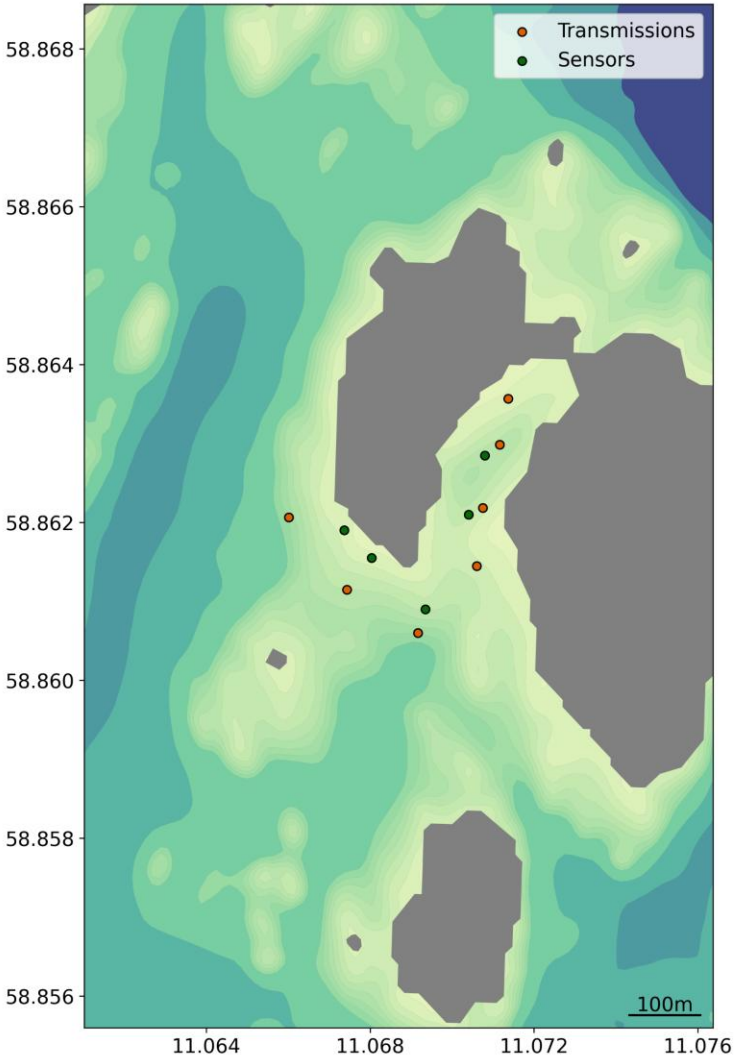
- Point-to-point propagation loss
- Frequency sweeps
- Lubelle Labs model 1424 source
- “Stationary” boat
- Bottom-anchored autonomous hydrophones

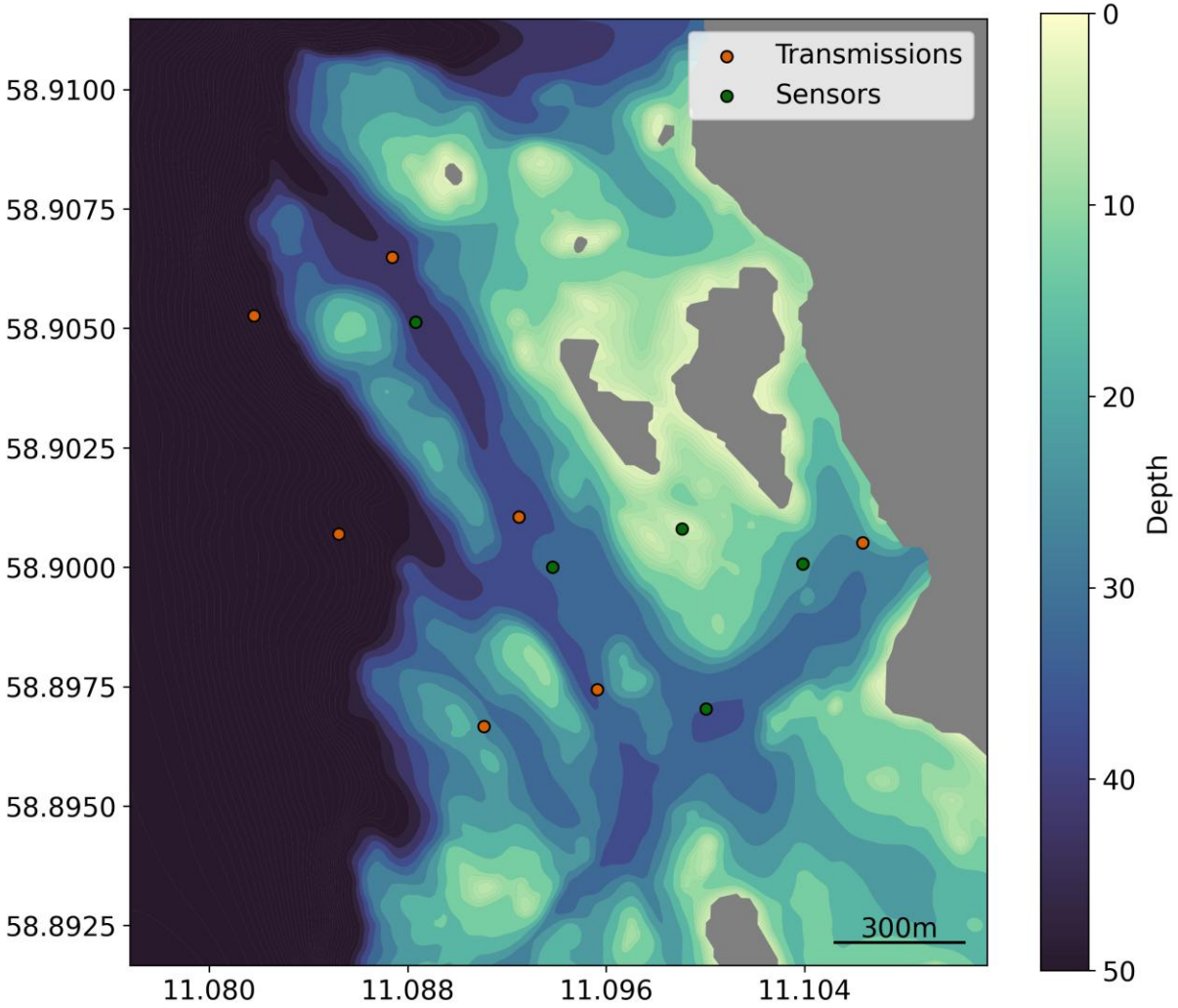
Measurements

- 8 sites
- 5 hydrophones per site
- 6 or 7 transmission locations per site
- 5 decidecade bands + broad band
- Several repetitions
- In total 7880 point-to-point measurements

Example sites







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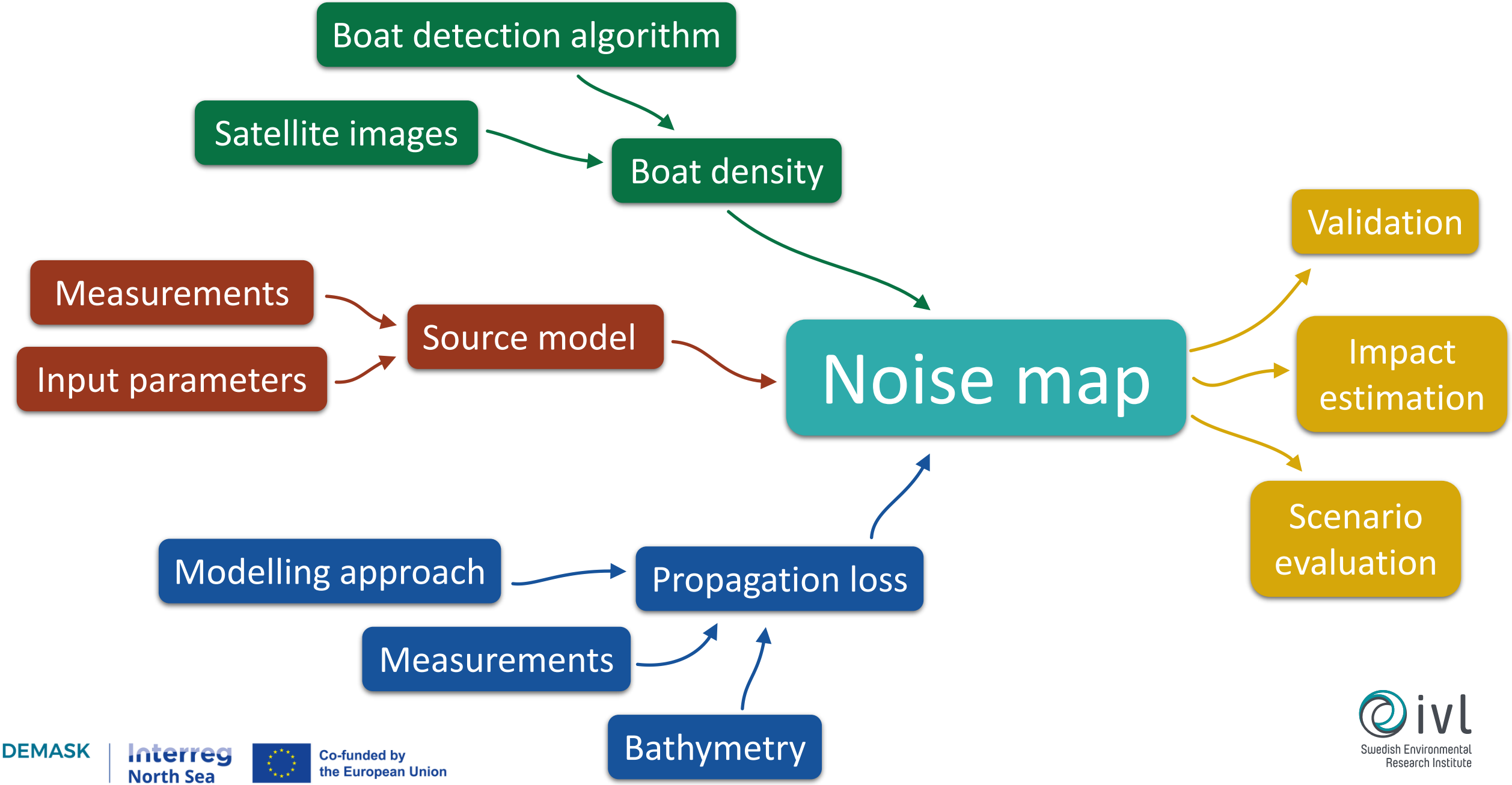

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