AIS DATA FOR INCREASED INSIGHT OF NAVIGATIONAL IMPACTS POST-INSTALLATION OF MAN-MADE STRUCTURES AT SEA

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PROBLEM DESRIPTION

The situation for the Norwegian coast is expected to be characterised by increased activity within exposed aquaculture and sea based renewable energy solutions combined with growth in the ship traffic. The importance of maintain a high safety level at sea to protect lives, assets, and the environment, is therefore high. At the same time is it important to facilitate this development in order to maintain Norway's position as leading within the Maritime industry. The motivation behind this study, is to increase the knowledge about actual traffic changes post installation of man-made structures at sea. Today, few studies of this kind is performed. This information is believed to be important for improved spatial planning and as guidance for stakeholders in order to take better informed decisions. The objective is, through analysis of 'pre'- and 'post'-installation scenarios for several locations along the coast, to be able to say something about potential traffic changes and -if present, repeating trends in vessel behaviour.

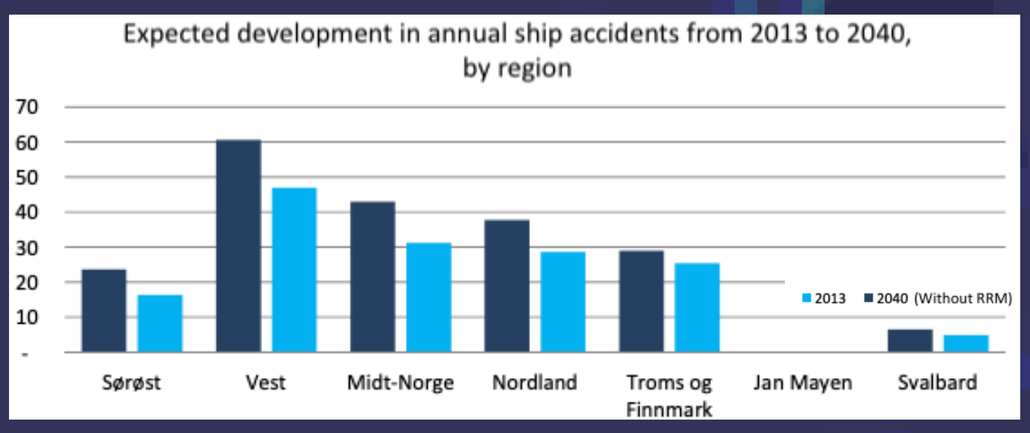


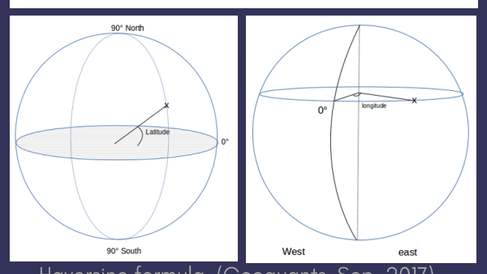
Figure: Expected development in annual ship accidents from 2013 to 2014, by region [1]

METHOD

- Situational study and search for feasible objects/ areas for investigation.
- AIS data: extraction of relevant information
- Exploration of vessel movements, comparison of pre/post-installation scenarios:
  - Min passing distance from object
  - No. of vessels passing within given distance
  - Critical COG: defined as course in direction of object
  - Collision candidates: vessels within a given distance from the object combined with critical COG.
- Use findings from behavioural analysis to assess risk.
- Comparison of findings for cases: search for repeating behaviour.

Haversine formula, which gives the great circle distance between two points, is used to calculate the distance between passing vessels and objects. Here, r corresponds to the Earths mean radius (6372800m), while φi and λi represents respectively the latitudinal and longitudinal position of the vessels and objects, in radians [2].

$$d = 2r\arcsin\left(\sqrt{\sin^2\left(\frac{\varphi_2-\varphi_1}{2}\right)+\cos(\varphi_1)\cos(\varphi_2)\sin^2\left(\frac{\lambda_2-\lambda_1}{2}\right)}\right)$$



Haversine formula. (Geoquants, Sep. 2017)

Prediction of expected number of collisions is based on the well known model by Pedersen et. al (1995): *N_collisions = N_a * P_c [3].* N_a is defined as the number of possible accidents, and if multiplied with P_c, the causation probability, the number of collisions can be found. Instead of traffic flow heading in one direction as defined by Pedersen, the number of possible accidents (or collision candidates) are taken as vessels within a given distance from the object with course towards the object.

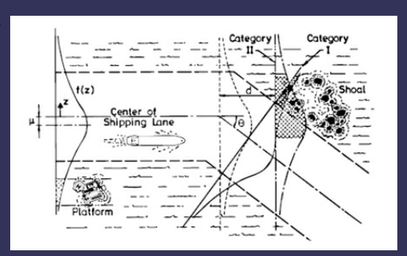


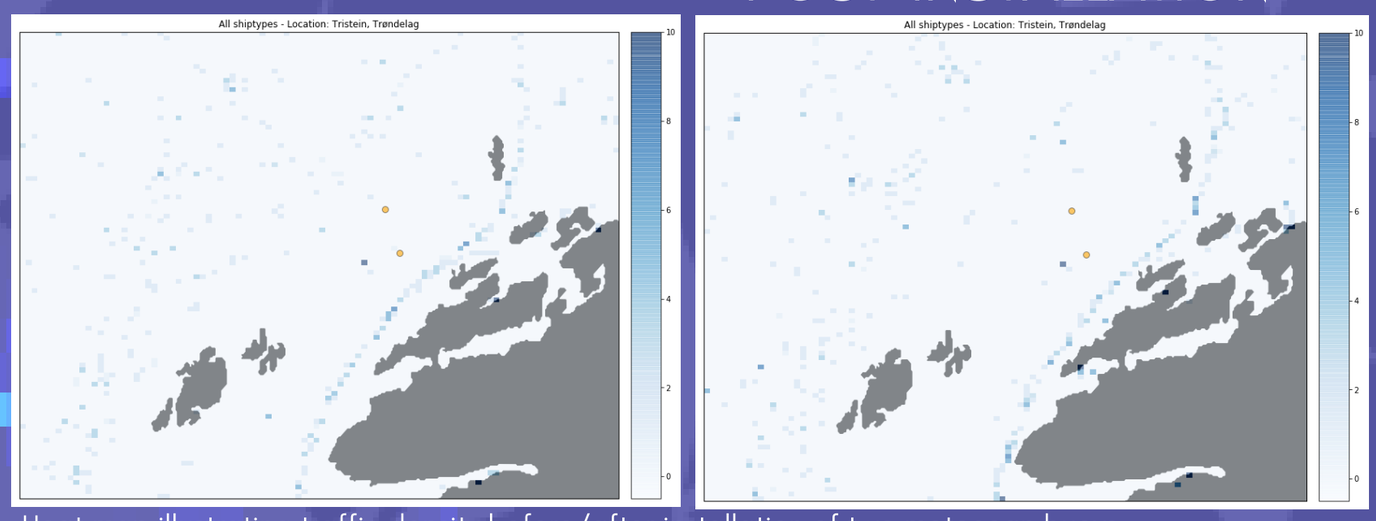
Figure: (Pedersen et. al, 1995)

CASE STUDY

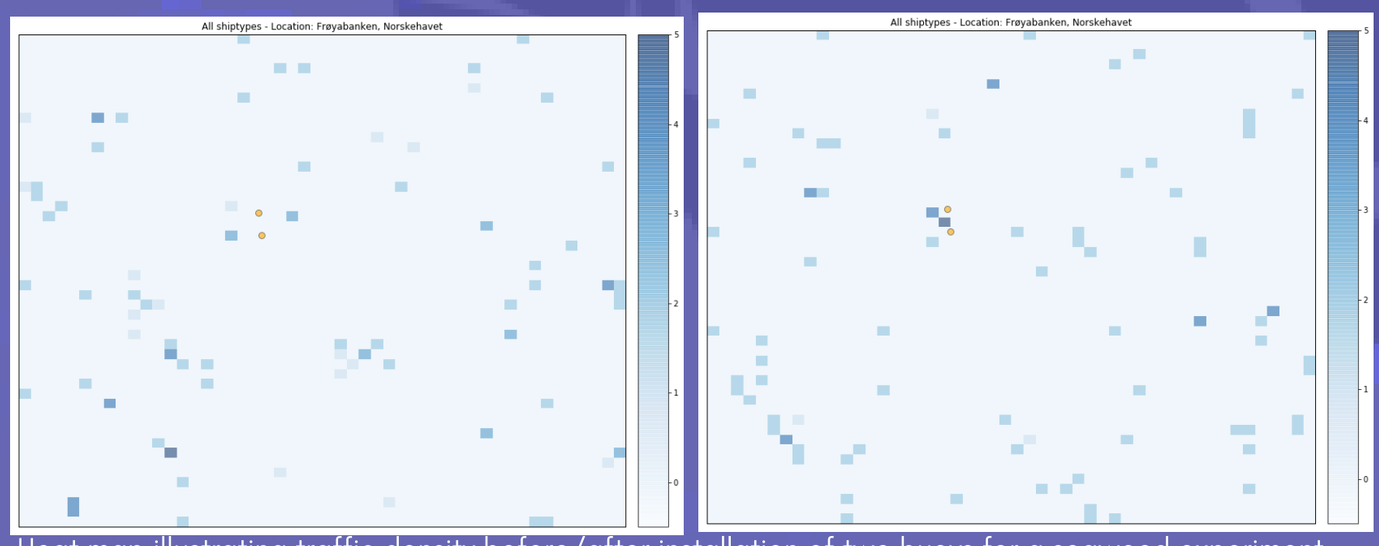
- Study of "pre" and "post"-installation scenarios for various areas and objects.
- Visualisation:
  - Scatter plots, heat maps
- Statistical analysis:
  - No. AIS records, unique vessels, and vessel types in the area.
  - Closest Point of Approach
  - Collision candidates
- Risk assessment:
  - Number of expected accidents calculated based on causation probabilities from litterature and identified collision candidates.

PRE-INSTALLATION

POST-INSTALLATION

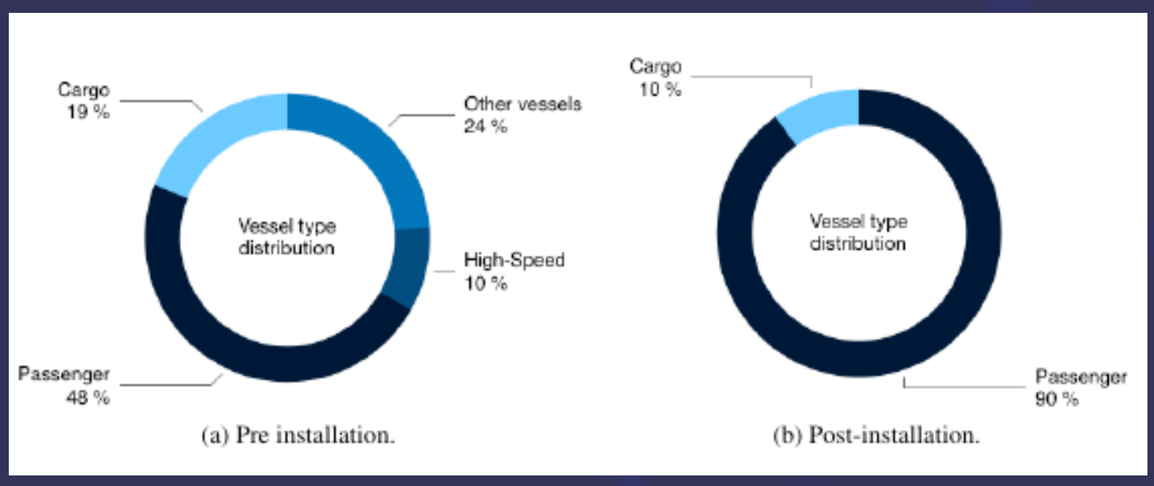


Heat map illustrating traffic density before/after installation of two metocean buoys.



Heat map illustrating traffic density before/after installation of two buoys for a seaweed experiment.

CURRENT RESULTS



References

[1] Lasselle et al. (2018). Prognoser for skipstrafikken mot 2014 - Sjøsikkerhetsanalysen. DNV GL Maritime for The Norwegian Coastal Directory.
[2] Sinnott, R. W. (1984). Virtues of the Haversine. Sky Telesc., 68, 1
[3] Pedersen, P. T. et al. (1995). Collision and Grounding mechanics. Proceedings of WEMT. (125-157)

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