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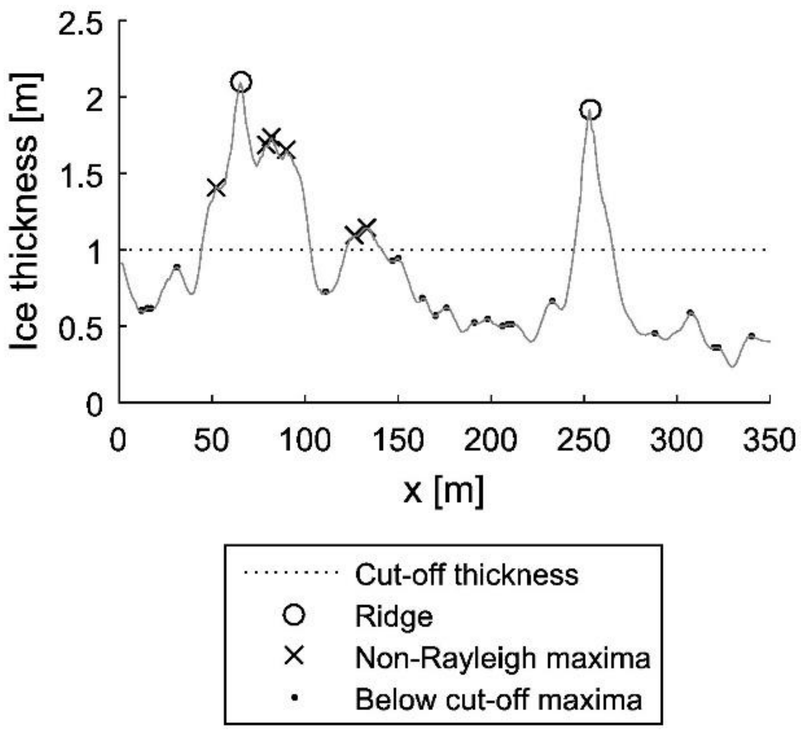
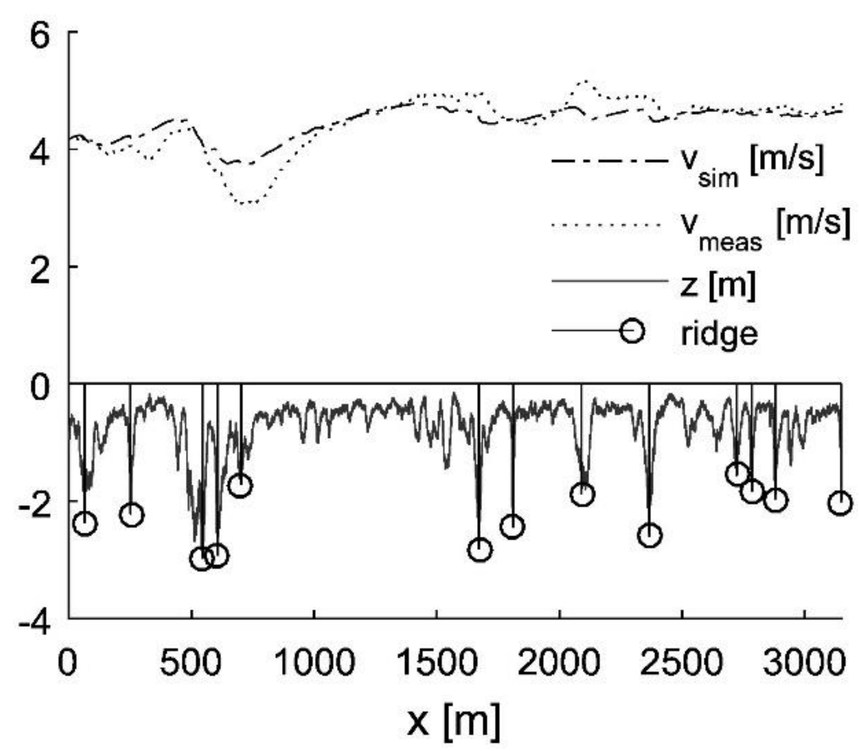
Ship Transit simulation in ice

Transit simulation focuses on the efficiency and operability of ships going through various types of ice conditions. It is important for route optimization, pollution evaluation and economic analysis. Transit simulation acts as a tool for decision makers to build a smoother and more efficient winter navigation system.

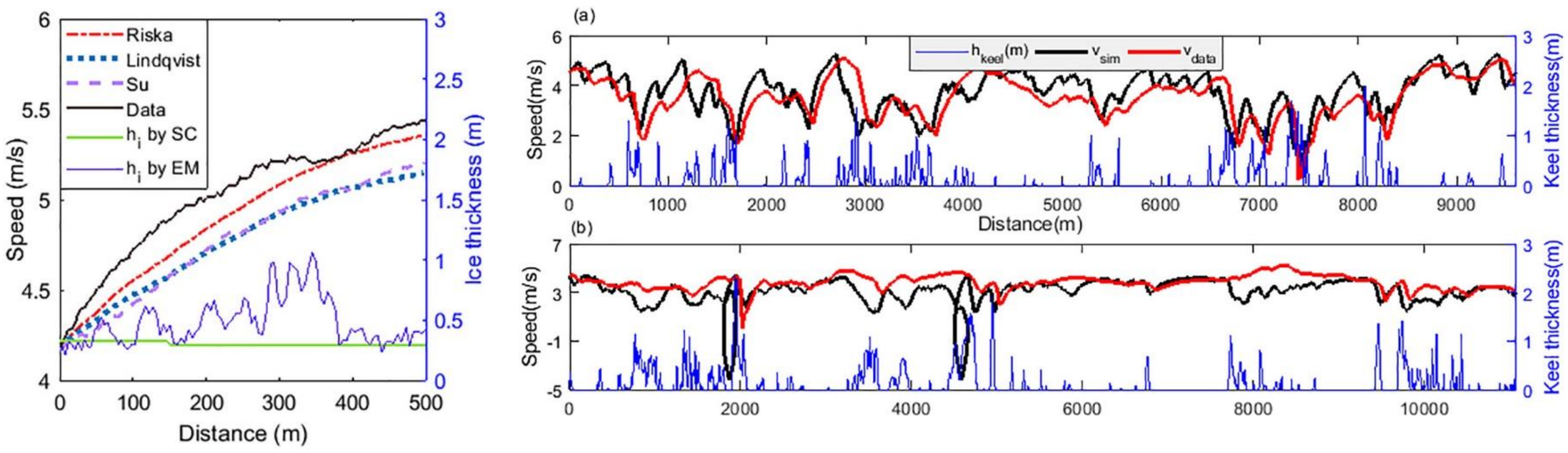
We revised a method for estimating ship's resistance caused by sea ice ridge keels and used it as a part of a method for predicting performance of ships in ridged ice conditions. The results give prediction on ship performance in terms of attainable speed distribution for given ice conditions and probability of the ship being able to operate independently [1].



Ice ridges are identified from the measurement by an electromagnetic device. Rayleigh separation is used to classify whether a maxima can be seen as a ridge.



Simulated ship speed vs recorded actual speed at an real ridge field measured by electromagnetic device. The simulation gives good prediction compared to full scale data.



Ship transit simulation in level ice (left) and ridged ice (right) fields. Generally reasonable predictions are given, while existing uncertainties introduce local deviations.

We use full scale data to evaluate current transit simulation methods. The data are collected by instruments from ship's sea trial on Baltic sea. Level ice, ridged ice and channel ice are considered for a comprehensive view of current methods. Due to the complex nature of ice, uncertainties exist in both measurements and calculation. Methods can be improved with better understanding of icebreaking process. [2]

[1] Kuuliala, L., Kujala, P., Suominen, M., & Montewka, J. (2016). Estimating operability of ships in ridged ice fields. Cold Regions Science and Technology, 135, 51–61.
[2] Li, F., Goerlandt, F., Kujala, P.,Lehtiranta, J., Lensu, M. (2018). Evaluation of selected state-of-the-art methods for ship transit simulation in various ice conditions base on full-scale measurement. Cold Regions Science and Technology. In press.

More information: mecheng.aalto.fi/en/research/marine_technology