Improving Sea Ice Information and Weather Forecasting for Operational Purposes

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ABSTRACT

Shipping in sea ice and Ice Management (IM) encounter a number of challenges, starting from assessment of climatological conditions to critical tactical decision-making. The Finnish Meteorological Institute (FMI) holds a broad field of expertise with over a century of experience in sea ice and weather services in harsh winter conditions. Close collaboration with the Baltic Sea icebreaking management, which has evolved and been honed for optimal winter navigation, has brought up a hands-on feel for operation in ice-covered seas. Through high-level research robust know-how of operating in Arctic conditions with its demanding technical requirements has been built up.

FMI has developed real-time, high-resolution and fast update rate approaches to automated ice thickness charts.

INTRODUCTION

Automated ice thickness chart process: Combines good spatial resolution of the satellite image and ice thickness from an ice model. FMI has developed sea ice thickness product high-resolution and fast update rate approaches to ice monitoring. Ice thickness chart: Safe ice navigation and safety of the oil drilling and exploration platforms in ice is an important issue. For safety in winter conditions, reliable near-real-time ice information is necessary. As a result we produce an estimate of the ice concentration and ice thickness at a high resolution of 100m x 100m. These products can then be delivered to end-users over the area, either as thematic maps or in a gridded numerical format.

EO SAR CLASSIFICATION

Even if high information content is obtained by SAR data alone, additional information (ground truth data, oceanographic models, aerial reconnaissance) improve the accuracy of operationally available ice charting products.

Based on SAR data, estimation of thickness and ice concentration has been developed at FMI [Karvonen et. al. 2012]. Because SAR does not measure the ice thickness directly, the ice thickness estimation requires a background ice thickness distribution for the particular sea area studied. The background ice thickness can be provided by as a combination of modeled ice thickness distribution, observations and estimates from radiometric satellite data. Then SAR data is then used to identify the spatial extent of different thickness categories.

In our processes the SAR image is segmented by using a variant of the ICM (iterated conditional modes) algorithm. SAR segmentation is performed using Markov Random Field (MRF) segmentation. The number of labels is defined automatically for each image separately. A new Gaussian decomposition of the image histogram is then produced using these segment labels. (for details, see Karvonen, 2015, http://www.sciencedirect.com/science/article/pii/S0273117715002410).

The ice thickness is estimated by modulating the modeled background ice thickness field by a SAR texture feature describing the local amount of (small-scale) deformation. If no ice thickness measurements are available, we use points of open water and fast ice.

Based on qualitative comparisons the results of the ice thickness estimation have been promising when compared to local ice charts, even if calibration and validation with in-situ