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Interpolation of AMSR2 data for improvement of ice charting

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ABSTRACT

Today, ice charts in Greenland waters are produced manually by the Danish Meteorological Institute (DMI) for selected regions depending on season and shipping routes. The project "Automated Downstream Sea Ice Products for Greenland Waters" or shorter "Automated Sea Ice Products" (ASIP) attempts to automate this process by means of fusion of data from instruments with different resolutions and modalities. As a part of this process data from the Advanced Microwave Scanning Radiometer (AMSR2) will be interpolated to the geometry of the SAR data acquired by Sentinel-1. In a preparatory leave-one-out cross-validation (LOOCV) study, different interpolation methods including ordinary kriging (OK) are compared. Using bias and root-mean-squared error (RMSE) as measures of precision, OK using 20-30 nearest neighbours outperforms other often used methods such as inverse distance (ID) weighting. This comes at a cost: more work needs to be done by both the operator and the computer.

1. INTRODUCTION

The project "Automated Downstream Sea Ice Products for Greenland Waters" or shorter "Automated Sea Ice Products" (ASIP) is a cooperation between the Danish Meteorological Institute (DMI), two departments at the Technical University of Denmark (DTU), the National Space Institute (DTU Space) and the Department of Applied Mathematics and Computer Science (DTU Compute), and Harnvig Arctic & Maritime. The project is funded by Innovation Fund Denmark.

The objective of ASIP is to develop an automatic sea ice product service for Greenland waters which can meet the increasing demands for sea ice information coming from the growing group of users operating in Greenland waters. In the span from traditional, manually produced ice charts and daily downstream sea ice products at coarse resolution, there is a lack of high resolution products delivered in near-real time. ASIP intends to meet this demand by taking advantage of the vast amount of new data from the Copernicus Sentinel satellites and by using a new and innovative data fusion approach and state-of-the-art mathematical/statistical data processing methods: utilization of data from satellite sensors with different modalities/capabilities will facilitate the making of ice products that are reproducible, independent of operator, daylight, weather and season and will result in a significant increase in product temporal frequency and geographical coverage compared to existing ice products.

The statistical algorithms work directly in the Sentinel-1 scene coordinate system. In order to make use of the information in the AMSR2 data along with the radar data an alignment of the AMSR2 data to the radar coordinate system is therefore necessary. In this process of interpolating AMSR2 data to the Sentinel SAR data, in a preparatory study six methods are compared by means of leave-one-out cross-validation (LOOCV)

1. nearest neighbour (NN, one neighbour only),
2. triangulated irregular network (TIN, three neighbours only),

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3. local mean (LM),
4. inverse distance (ID),
5. inverse squared distance (ID2), and
6. ordinary kriging (OK).

Bias and and root-mean-squared error (RMSE) are used as measures of precision, see Figure 1. OK with 20-30 nearest neighbours obtains a LOOCV bias of around 0.001 K and RMSE of around 1.1 K. The second best of the six methods is ID2 which with 5-10 nearest neighbours gives a LOOCV bias of around 0.01 K and RMSE of around 3 K. When we use kriging we must estimate semivariograms and model them, this takes operator as well as computer time.

The project homepage `https://asip.dk` will be launched soon.

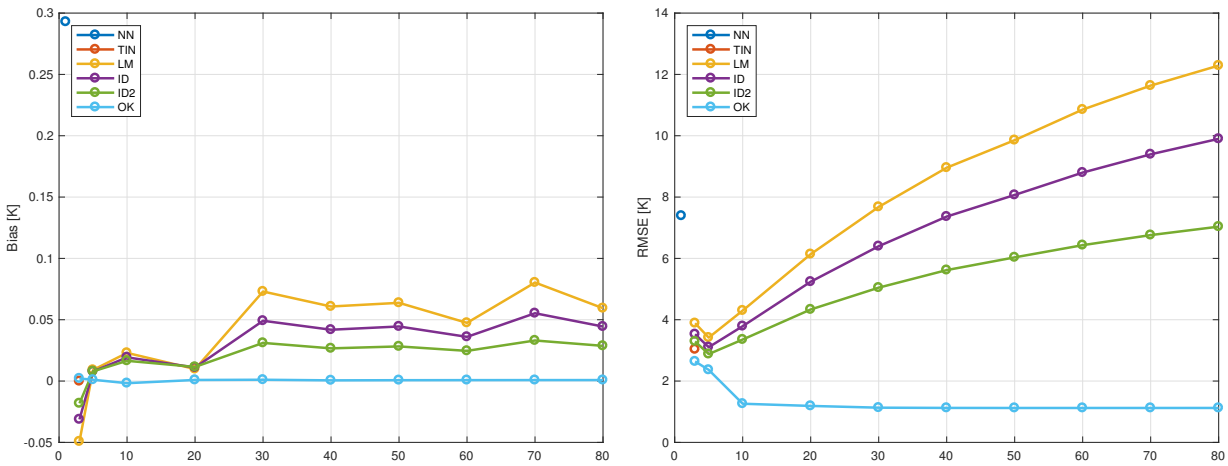

Figure 1. Bias (left) and RMSE (right), LOOCV for six different interpolation methods.