



Machine-learning-based analysis and reconstruction of high-resolution sea-surface temperatures for the North Sea and Baltic Sea

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The Federal Maritime and Hydrographic Agency of Germany performs weekly analyses of sea surface temperatures (SST) for the North Sea and Baltic Sea on an operational basis. The analysis is based on in-situ observations and satellite retrievals. Existing procedures require manual quality control and subjective decisions on plausibility of measurements combined with simple interpolation techniques. This study presents ongoing work to develop new procedures based on a machine learning approach, designed to fill in gaps in observational data fields. The employed inpainting technique makes use of a convolutional neural network (CNN) that is trained with complete SST-fields from high-resolution (~3 km) ocean model simulations and masks derived from satellite retrievals to ignore regions covered by clouds on respective days.

First validation efforts for the North Sea based on reconstructing modelled fields that were excluded from training data indicate very promising results, that is an RMSE of ~ 0.5 K or less for most regions of the North Sea. However, areas with high variance such as waters very close to the coast and the Norwegian Channel exhibit larger errors up to 1 K. Additionally, we can show that errors tend to be larger when less observational data are available, e.g. on days with lots of clouds.

It will be tested if optional features of the algorithm may help to improve results in these cases. Especially the possibility to use “memory” of preceding days – potentially featuring less clouds – seems promising in this respect. Furthermore, it will be elaborated if the option of overwriting existing observational data with values better fitting the patterns learned by the CNN is suitable to improve the overall results and hence may be an alternative to external (manual) quality control and plausibility checking.

The final aim of this study is to establish an approach suitable for the operational analysis of daily SSTs with a horizontal resolution of approx. 5 km and the production of an SST reanalysis of North Sea and Baltic Sea SSTs starting in 1990.