



Sea Level Mesoscale Mapping with Neural Network reduces effective resolution by 5 km with a computational time of only 13 minutes for a year

Introduction & Objectives

This study focuses on integrating the SWOT mission into multi-mission mapping systems and on improving mapping methodology by using neural networks to increase the scales of dynamics that can be resolved.

Methodology Overview & Data

Mapping methods:

The mapping method used is a UNet trained on the simulated model Mercator Glorys12v1 and inferred on real L3 SSHA data.

Supervised learning on simulated model:

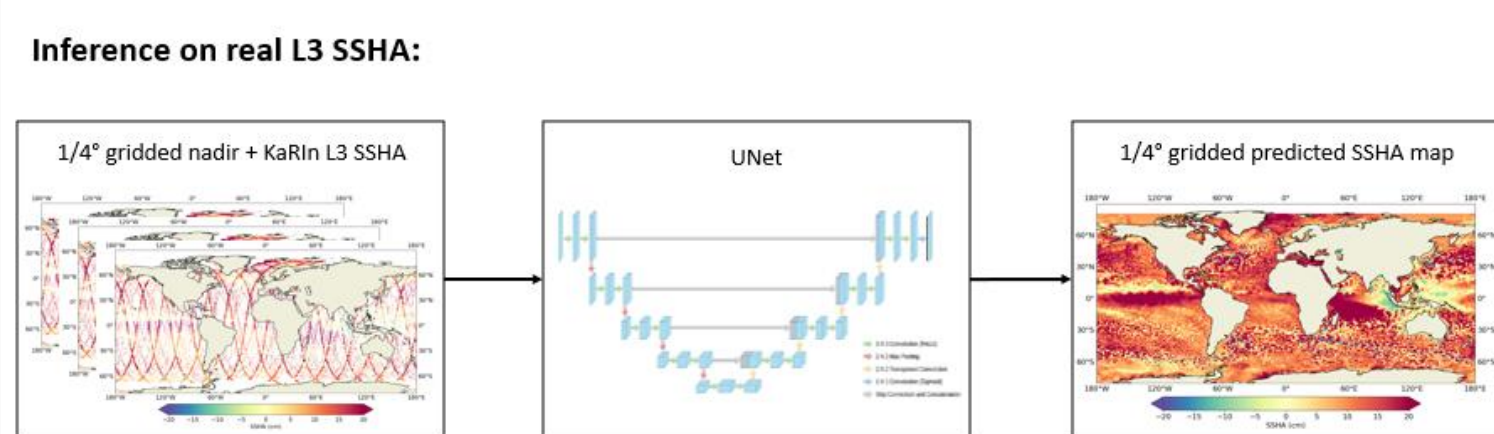
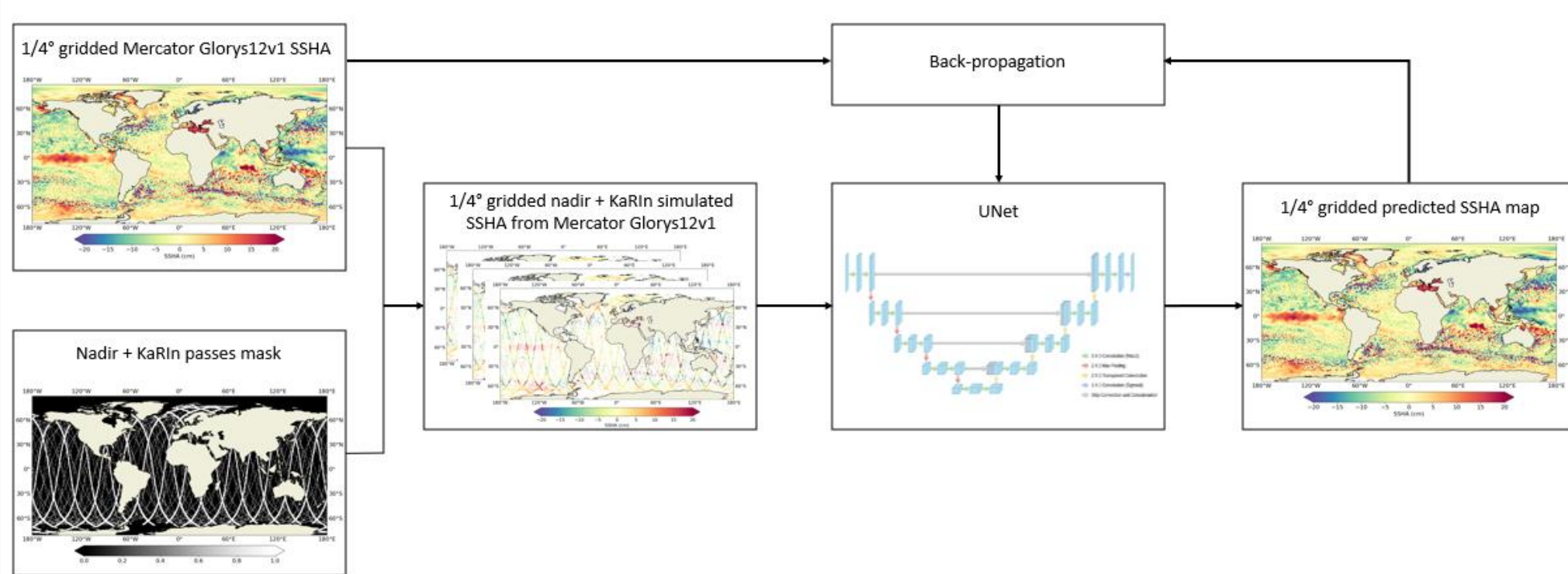


Figure: UNet workflow

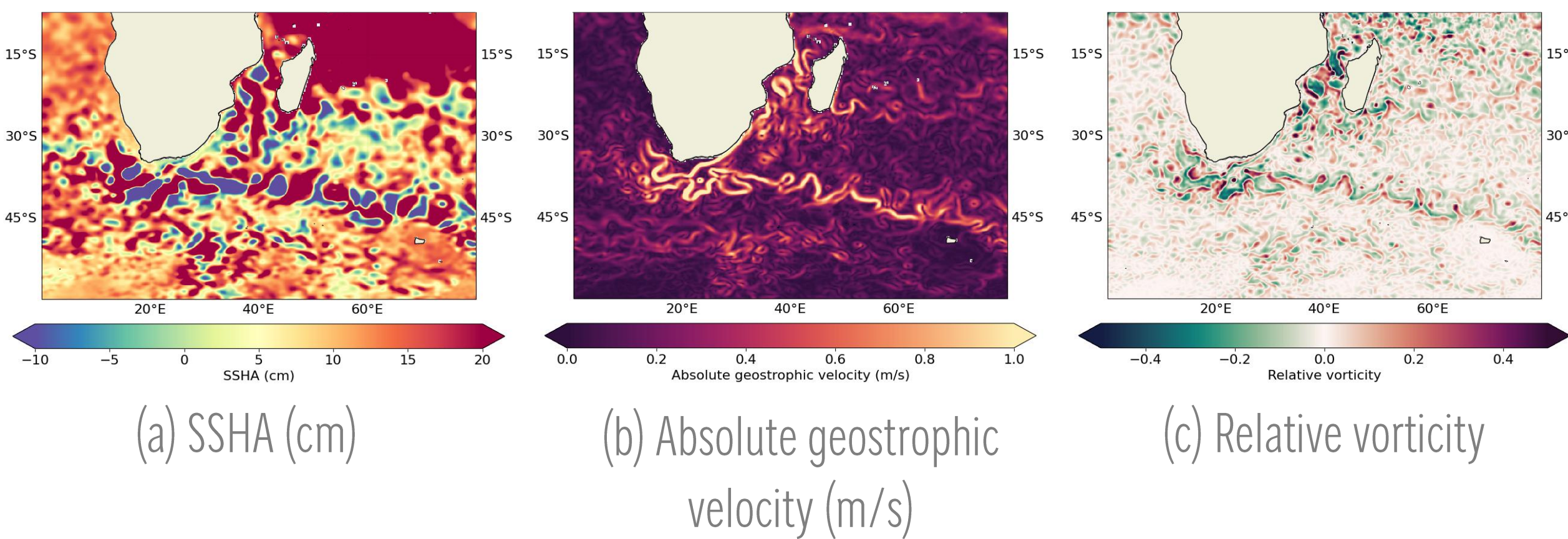
The UNet is compared to the state-of-the-art mapping method MIOST (Ubelmann et al., 2021).

Validation metrics:

One altimeter (SARAL/Altika) is excluded from the mapping to assess the mapping error. We focus here on the effective resolution metric, which is given by the wavelength λ_s where the Signal to Noise Ratio $SNR(\lambda_s)$ is 2, i.e., the wavelength where the SSH_{error} is two times lower than the signal $SSH_{alongtrack}$.

Integration of SWOT data into mapping

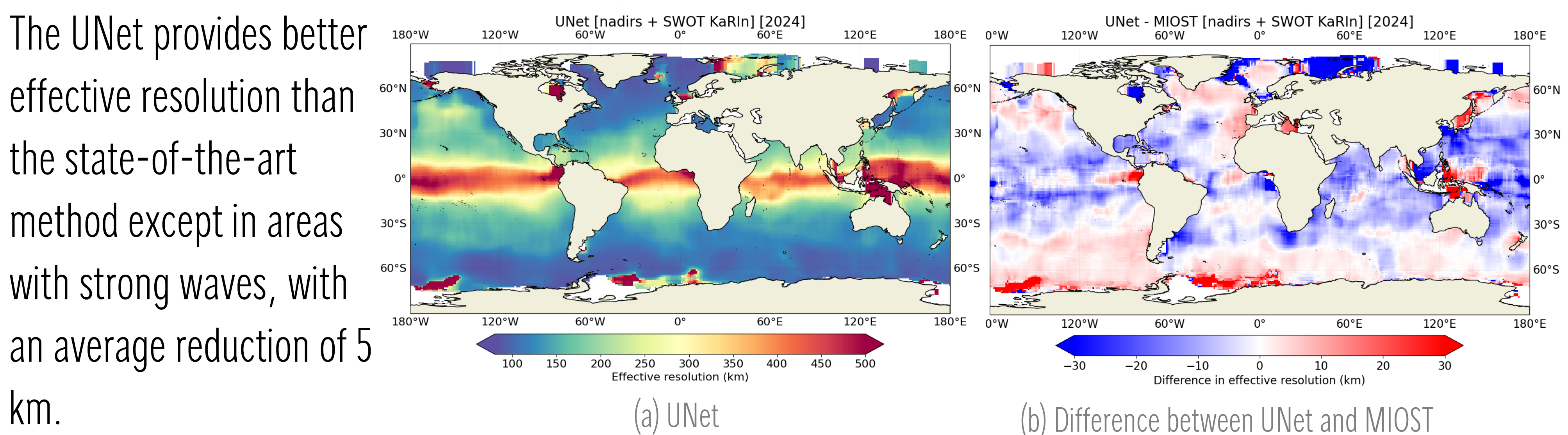
Figure: Example of mapping map generated with UNet



The UNet produces global maps that can integrate SWOT data with a very short computation time of only 13 minutes for one year on an A100 GPU node. An experimental product will soon be available on Aviso.

Effective resolution improvement compared to state-of-art method

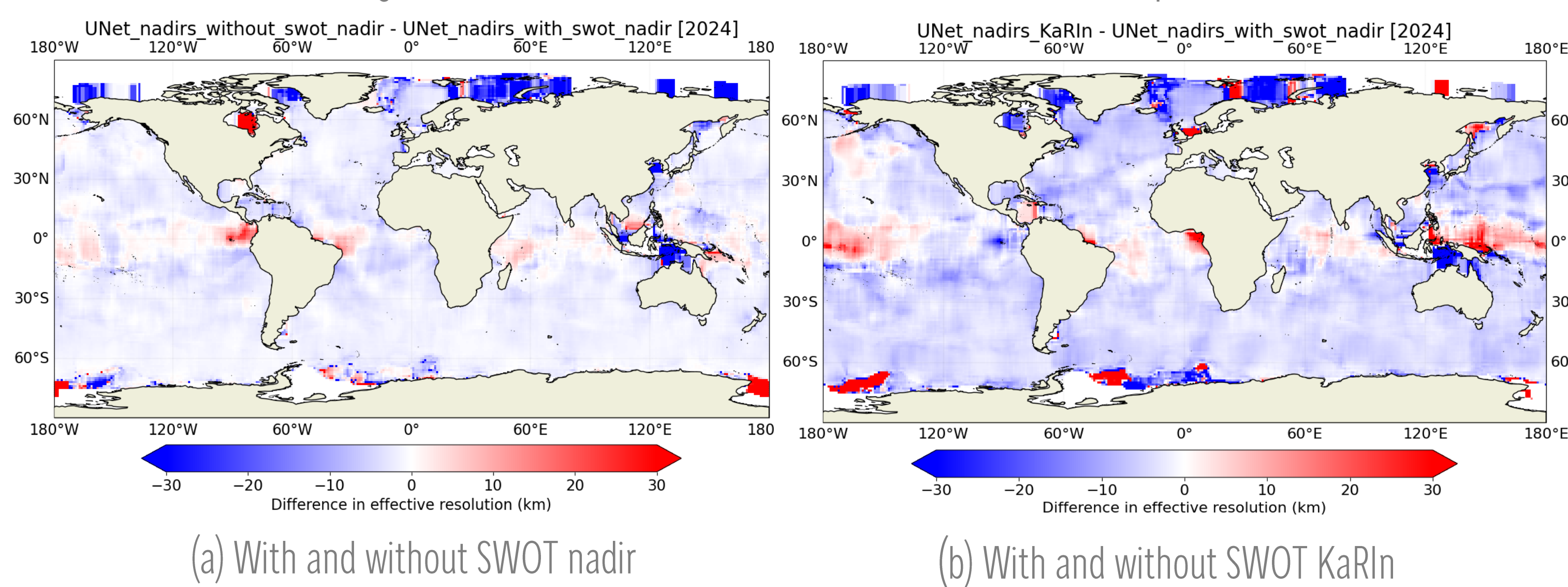
Figure: Effective resolution map with UNet and MIOST methods



The UNet provides better effective resolution than the state-of-the-art method except in areas with strong waves, with an average reduction of 5 km.

Cartography improvement by adding SWOT data

Figure: Difference of effective resolution for UNet maps



Adding SWOT KaRin in the mapping improves the concordance of the mapping currents with in-situ drifters of 0,31 cm/s in average and of 0,72 cm/s for high variability areas.

Adding SWOT data improves the mapping except at the equator, where results are mixed. Adding SWOT nadir reduces the effective resolution in average by 4 km and adding KaRin reduces it by an additional 7 km.

Figure: Difference of Mean Error Vector Amplitude for UNet maps with and without SWOT KaRin

