Geophysical Research Abstracts
Vol. 20, EGU2018-12750, 2018
EGU General Assembly 2018

Data-Driven methods for the restoration of SWOT data

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The future SWOT (Surface Water Ocean Topography) space mission (CNES/NASA) offers an unprecedented opportunity for observing oceanic small-scale processes and for assessing their impact on global ocean circulation and climate. Observations of sea surface height (SSH) at scale $\leq 100km$ could indeed allow to better understand energy cascades toward dissipative scales in the ocean, and to better understand the processes involved in vertical exchanges of heat and tracers between the ocean surface and the ocean interior. This potential is tied to the ability of SWOT instrument to provide measurements of horizontal gradients of SSH at scales $\leq 100km$ thanks to the two-dimensional nature of swath observations.

However, to fully use the promised offerings of SWOT, processing SWOT data must first go through a restoring phase that aims to remove the noise (denoising) and interpolate the missing data between the two 2D swaths (inpainting). Formulating adequate inverse problems is then of high interest.

Over the last decade, data-driven approaches for tackling inverse problems have reached a good level of maturity with interesting applications in geoscience and satellite remote sensing. In this work, we benefit from the SWOT simulator based on the NATL60 simulation as distributed to SWOT Science Team by the MEOM group, and build a database of corrupted SSH maps and their corresponding clean SSH maps. We then investigate and compare selected model-driven methods with several data-driven methods for the blind restoration of the corrupted SSH maps, namely, PCA-based methods, Multilayer perceptrons and Convolutional Neural Networks.