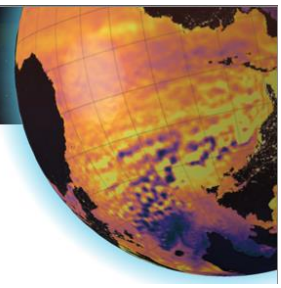

Model-Based Feasibility of Using Data-Driven Techniques to Reconstruct Ocean Interiors from Surface and In-Situ Data

This work uses data-driven approaches to study the feasibility of reconstructing ocean interior variables (temperature and salinity) from surface observations provided by satellites and interior observations provided by buoys. The feasibility of the approach is based on an Observing System Simulation Experiment (OSSE) in which we use the outputs from an ocean numerical model as the ground truth, and simulate a real observing system of the ocean, taking the surface of the model and vertical profiles in the same locations as the real buoys. Different artificial intelligence models are designed and implemented to simulate the observations, supported by cloud computing systems provided by the Horizon Europe project AI4EOSC and IFCA (Instituto de Física de Cantabria). All models trained in this work use a pixel-to-pixel approach, which means that we took the actual in-situ positions to train our model instead of relying on a gridded product. Furthermore, we use daily datasets in a 10-day window (same as the cycle length of the Argo floats [1]) instead of monthly means. On one hand, we study the feasibility of the reconstruction using a RFR(Random Forest Regressor), which is a simple machine learning model that can represent the non-linear relationship between the salinity and temperature. Second, we follow the approach suggested by [1] and use a neural network that uses LSTM layers to predict the depth series. The outputs of those models helped us determine the feasibility and precision of the reconstruction. The salinity reconstruction achieves a R^2 score of 0.96 using the LSTM architecture and 0.84 in the case of the temperature. The RFR achieves similar precisions (0.95 and 0.84 respectively) but is cheaper and easier to train. The good quality of the reconstruction enabled us to transform the model into a valuable Salinity and Temperature 4D product that can serve the ocean scientific community in studying the interior of the ocean. [1] Argo: Global array of profiling floats observing the ocean in real-time. Journal of Atmospheric and Oceanic Technology, 26(11):2070–2079, 2009 [2] Bruno Buongiorno Nardelli. A Deep Learning Network to Retrieve Ocean Hydrographic Profiles from Combined Satellite and In Situ Measurements. Remote Sens., 12(19):3151, September 2020.

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