Proposition de stage de Master 2

Downscalling of geophysical fields by fusion of heterogeneous ocean observations using Deep Learning algorithms

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Mots-clés : Deep Learning, Downscalling, Modélisation numérique, Remote sensing, oceanic circulation

Contexte :

For several decades, a large variety of sensors has allowed to improve the knowledge of the state of Planet earth and its potential evolution through remote sensing imagery that provides a global coverage of the ocean. The satellite sensors observe a multitude of geophysical parameters with various sampling processes and at different resolution. They have permitted to better know the ocean state of different variables such as the Sea Surface Temperature (SST hereinafter), the Sea Surface Height (SSH) and the Ocean circulation given by the velocity vector (U, V). These satellite sensors contribute to detect changes in the response of the ocean to global warming, the finer the observation of the variables the better the understanding of the physics of the ocean. The aim of the research is to use the existing fine resolution of the SST to increase the coarse SSH resolution provided by a satellite altimeter and to retrieve simultaneously the 2 components of the current with this improved resolution.
Owing to the high-resolution data fields we deal with and the large area under study, Deep Learning technique (DL) proposes suitable methods to solve this complex problem.

A first study that uses simulated data provided by the output of the NATL60 high-resolution ocean numerical model (https://meom-group.github.io/swot-natl60/virtual-ocean.html) has shown the ability of Convolutional Neural Networks (CNN) to deal with this problem. A CNN architecture (RESACnet) allows the retrieval of SSH, U and V with a resolution of 13×14 km using SSH at 120×122 km and SST at two distinct resolutions: an intermediate resolution of 40×41 km and the resolution at 13×14 km.

Objectives:
During the first approach presented above, data issued from the NATL60 high-resolution ocean model were used to determine and train RESACnet.

The first goal of the project will be to use the same simulated data and to propose a CNN architecture improving the accuracy of RESACnet up to 4kmx4km (RESACnet_2).

The second part of the project will use real satellite data products. We will use the SSH issued from the Global Ocean Multimission altimeter satellite, from Copernicus Marine Service (CMS). The resulted SSH satellite product has a resolution of 0.25×0.25 degree, equivalent to a resolution in distance of 23×28 km (considering the

latitudes of the region of study at the North Atlantic Ocean). For SST we will use product issued from multiple satellite sources (data from the ATSRs, SLSTR and the AVHRR series of sensors) also from CMS. The SST satellite product is finer and has a resolution of 0.05×0.05 degree, equivalent to 4.5×5.5 km. The first experiment will be to estimate the performances of the RESACnet_2 when using these data as inputs and if necessary, to enlighten the principal drawbacks of the method. An improved version of the algorithm dedicated to the processing of actual satellite data will be proposed.

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Niveau du stage :M2
Master(s) où sera proposé le sujet : TRIED, WAPE, École d'ingénieur
Thème scientifique de l'IPSL concerné : Downscalling, Deep Learning, remote sensing
Durée du stage : 6 mois
Période : 01/04/2021 -→ 30/09/2021
Est-il prévu une thèse dans le prolongement du stage ? selon résultats