Combining data-based and physics-based modelling approaches to develop a hybrid hydrodynamical model for coral reef environments

About 10% of the world's population relies on coral reefs as source of food and income, and as protection against storm-induced surges. However, coral populations have dramatically declined worldwide. Their resilience strongly depends on larval exchanges between reefs (i.e. connectivity), which are usually evaluated using hydrostatic biophysical model simulating larval transport by ocean currents. However, current patterns are particularly complex over reefs and require the use of fine-scale nonhydrostatic models to be accurately captured. Such models are however computationally very expensive and are thus limited to small areas. One promising approach to tackle this issue is to use machine learning (ML) algorithms to locally emulate the dynamics of a complex high-resolution model and hence speed up the computational process. In this project, we will couple the SLIM ocean model with ML algorithms trained with the outputs of more complex non-hydrostatic models and high-resolution reef morphology information. We will then use the outputs of this hybrid model to improve the simulation of ocean currents over coral reefs in the Great Barrier Reef (Australia), and hence better estimate larval exchanges between coral reefs and the resulting connectivity. This information will subsequently be used to inform reef conservation and restoration projects.

Arno Van de Vyver, UCLouvain