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Scales and scaling in turbulent ocean sciences; physics-biology coupling

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Geophysical fields possess huge fluctuations over many spatial and temporal scales. In the ocean, such property at smaller scales is closely linked to marine turbulence. The velocity field is varying from large scales to the Kolmogorov scale (mm) and scalar fields from large scales to the Batchelor scale, which is often much smaller. As a consequence, it is not always simple to determine at which scale a process should be considered. The scale question is hence fundamental in marine sciences, especially when dealing with physics-biology coupling. For example, marine dynamical models have typically a grid size of hundred meters or more, which is more than 10^5 times larger than the smallest turbulence scales (Kolmogorov scale). Such scale is fine for the dynamics of a whale (around 100 m) but for a fish larvae (1 cm) or a copepod (1 mm) a description at smaller scales is needed, due to the nonlinear nature of turbulence. The same is verified also for biogeochemical fields such as passive and actives tracers (oxygen, fluorescence, nutrients, pH, turbidity, temperature, salinity...)

In this framework, we will discuss the scale problem in turbulence modeling in the ocean, and the relation of Kolmogorov's and Batchelor's scales of turbulence in the ocean, with the size of marine animals. We will also consider scaling laws for organism-particle Reynolds numbers (from whales to bacteria), and possible scaling laws for organism's accelerations.