Dynamical clustering of global oceanic observations

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In addition to repeated hydrographic measurements from the GOSHIP program, the oceanographic community has benefited greatly from the development of global observing systems measuring sea level through satellite altimetry from the 1990s and, since ~2004, by measuring hydrography from the sea surface to 2000m depth through the ARGO float program. These datasets provide high quality physical variables which capture a very rich range of dynamical behaviour, from the “submesoscale” to “mesoscale” with horizontal scale of a few kms to a few 100kms, to the “basin scale” (several 1,000 of kms).

To understand how the global ocean is changing and responding to anthropogenic greenhouse gases emission, we would ideally be able to measure how these different scales of motions change and respond. One inviting possibility is that in vast parts of the ocean changes are controlled by the large scale dynamics, the smaller scales of motions then responding to the associated changes in large scale density structure (Pedlosky, 1984). It is however difficult to “extract” the large scale component of the circulation: for example, spatial filtering produces closed circulations, which we know the large scale dynamics can’t provide (Storer et al., 2022).

In this PhD project we wish to apply Machine Learning techniques such as unsupervised ML k-means algorithm and information criteria model selection (Sonnewald and Lguensat, 2021) to the so-called “thermocline equation” and the global datasets described above. The goals are (i) to “extract” the large scale dynamics from these datasets, in particular its temporal evolution, and (ii) to single out the processes which are key to select, out of many, one particular solution of the thermocline equation.

References:

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