Laboratoire : LEGOS (OMP), Toulouse, FRANCE
Titre du stage : **Validation of a realistic high-resolution coupled simulation of the Benguela Upwelling System**
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Sujet du stage :

Eastern Boundary Upwelling Systems (EBUS), such as the Benguela Upwelling System (BUS), belong to the most productive coastal environments, supporting some of the world's major fisheries. The BUS and its productivity present a seasonal variability with a favorable upwelling season during Austral Summer, where high biological productivity is largely determined by wind-driven upwelling. As for the other EBUS (*e.g.,* California), equatorward winds drive coastal upwelling, Ekman pumping, alongshore currents, and then productivity. Additionally, coastal currents and significant oceanic mesoscale variability contribute to cross-shore exchanges of heat, salt, and biogeochemical tracers between the open and coastal oceans.

The ocean can couple with the atmosphere through both the oceanic thermal feedback (TFB, *e.g.*, Chelton et al. 2004) and the current feedback (CFB, *e.g; Renault et al. 2016, 2017a*). Both coupling processes strongly involve mesoscale eddies. At the mesoscale, the TFB can wind anomalies that can be felt up to the troposphere (*Minobe et al., 2008*). It can also modulate the clouds and the precipitations (*e.g., Desbiolles et al., 2018*). Recent studies show the CFB can reduce long-lasting biases in ocean models. There are two main effects of the current feedback on the ocean: a large-scale effect and a local effect. At the large scale, neglecting the CFB when estimating the surface stress leads to an overestimation of the mean wind work and, thus, of the total energy of the ocean (e.g., Renault et al. 2016ab). Such an overestimation leads to too strong simulated mean oceanic currents. The local effect of the CFB consists in drastic reduction of the mesoscale activity via an "eddy killing", *i.e.*, a sink of energy from the geostrophic currents to the atmosphere (negative eddy wind work) (Renault et al., 2016a, 2017). For the California Upwelling, the mesoscale activity is for example reduced by about 40%.

This internship aims at improving our understanding of the dynamics at play over the BUS. We will use existing outputs from a realistic ocean-atmosphere coupled simulation (that considers both the TFB and the CFB) for the Benguela Upwelling System. Comparison with satellite data will be first performed in order to assess the realism of this simulation. Then, an analysis of the simulation outputs will allow to better understanding the characteristics of the BUS, such as the SST, the vertical velocities, mesoscale activity, wind drop-off and the role of the oceanic current structure in determining the water masses characteristics.

- • Chelton, Dudley B., et al. "Satellite measurements reveal persistent small-scale features in ocean winds." *science* 303.5660 (2004): 978-983.
- • Desbiolles, Fabien, et al. "Upscaling impact of wind/sea surface temperature mesoscale interactions on southern Africa austral summer climate." *International Journal of Climatology* (2018).
- • Minobe, Shoshiro, et al. "Influence of the Gulf Stream on the troposphere." *Nature* 452.7184 (2008): 206.
- • Renault, Lionel, et al. "Modulation of wind work by oceanic current interaction with the atmosphere." *Journal of Physical Oceanography* 46.6 (2016): 1685-1704.
- • Renault, Lionel, James C. McWilliams, and Sebastien Masson. "Satellite observations of imprint of oceanic current on wind stress by air-sea coupling." *Scientific reports* 7.1 (2017a): 17747.
- • Renault, Lionel, James C. McWilliams, and Pierrick Penven. "Modulation of the agulhas current retroflection and leakage by oceanic current interaction with the atmosphere in coupled simulations." *Journal of Physical Oceanography* 47.8 (2017b): 2077-2100.