

## FINAL REPORT PROGRAM LEFE

Program LEFE/ GMMC	Project Title AFRICA	Years 2018 – 2021
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### Context

Due to the sparsity of observations and the complexity of ocean dynamics in the Greater Agulhas Current System, the use of oceanic general circulation models seems inevitable ; yet, biases remain in all representations of the Agulhas Current, which compels to examine how results obtained with a single OGCM depend on the intrinsic specificities of that model.

### Objectives / scientific questions

The overall objective of this project is to understand better the dynamics of the Greater Agulhas Current, clarify its impacts on biogeochemical cycles and ecosystems and on the larger scale ocean circulation and climate.

### Main results

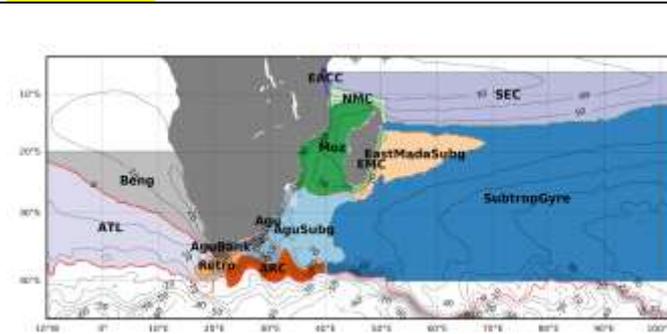


Figure 1 : identification of the different subregions relevant for analysis of the barotropic PV balance (colours) and mean barotropic streamfunction (black lines) in CROCO simulation.

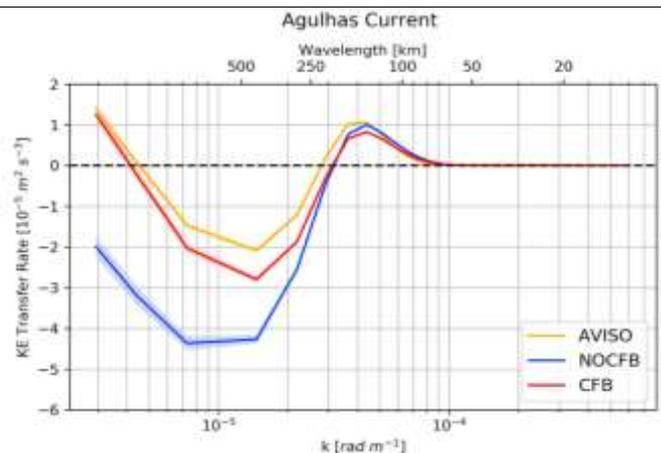


Figure 2 : Spectral flux of surface oceanic geostrophic kinetic energy in the Agulhas Current, in observations (yellow) and for coupled simulations with current feedback (CFB, red) and without current feedback (NOCFB, blue). The shaded curves represent the associated error as estimated using a bootstrap method. Model outputs are processed with time and spatial filtering so as to mimic effective resolution of AVISO.

As a first step in understanding better the physical mechanisms driving the Greater Agulhas Current, we applied online diagnostics on barotropic potential vorticity in regional simulations (using CROCO) at  $1/4^\circ$  configuration, averaged over 1993-2014. However, when interpreting these diagnostics, it is crucial to separate the area into different sub-regions (as shown in Figure 1), as it is exclusively in the interior of the subtropical gyre (sub-region SubtropGyre) that Sverdrup balance actually works. In other regions, advection and bottom pressure torque are not negligible.

In the perspective of clarifying the role of air-sea coupling processes on the Agulhas Current dynamics, we produced CROCO-WRF coupled simulations with and without the current feedback, and analyzed the spectral

flux of surface geostrophic kinetic energy over the Agulhas Current (Figure 2). Fully coupled simulations (with the current feedback) have a more realistic energy flux with respect to AVISO, which highlights the importance of factoring in these processes in future simulations.

#### **Future of the project :**

The collaboration between LOCEAN, LOPS and LEGOS will continue as initiated within AFRICA, in order to address the following scientific objectives :

- introducing PV and energy diagnostics in NEMO
- running more sensitivity experiments to test influence of ocean-atmosphere and wave feedbacks
- understanding further the impact of spatial resolution on mean PV balance
- clarifying the role of mixing processes for BGC cycles hence ecosystems

Partners of the project have already engaged in future international collaborations :

- Summer Schools and workshops dedicated to ocean modeling will be organized in 2022, 2023, and 2024 (GdRI-Sud CROCO and SA-NRF)
- RESILIENCE Cruise: fRonts, EddieS and marine Life in the wEstern iNdiAN oCEan, R/V Marion Dufresne, 18 April 2022 - 23 May 2022

#### **Nombre de publications, de communications et de thèses**

PhD of Pauline Tedesco, LOPS

Penven, P., P. Tedesco, J. Gula et C. Ménesguen, Mean barotropic vorticity balance in the South Western Indian Ocean, 2021, Proceedings of the Nansen Tutu Center 10th anniversary symposium: Ocean, weather and climate, science to the service of society, 10-12 March 2020, Cape Town, Afrique du Sud, 65-68.

Renault L., P. Marchesiello, S. Masson, J. McWilliams, Remarkable Control of Western Boundary Currents by Eddy Killing, a Mechanical Air-Sea Coupling Process, GRL, 2019, doi:10.1029/2018GL081211

Tedesco, P., J. Gula, P. Penven, C. Ménesguen, Mesoscale Eddy Kinetic Energy budgets and transfers between vertical modes in the Agulhas Current, J. Phys. Oceanogr., in revision

