THE ROLE OF THE AGULHAS SYSTEM IN THE GLOBAL CLIMATE USING A LAGRANGIAN APPROACH

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Abstract Agulhas Current is the western boundary current of the Southern Indian Ocean; it has a mean transport of $\sim 70\ Sv$ [1]; it flows along the coast of Mozambique and South Africa. Arrived to the homonymous Cape Agulhas the current changes direction (Agulhas Retroflection) and start flowing eastward along the Sub-Tropical Front. Due to instability, it sheds (Agulhas Leakage) eddies in the Atlantic Ocean (Agulhas Rings). This study aim to identify the the influence of Agulhas Leakage on the Atlantic Meridional Overturning Circulation. Satellite data of Sea Surface Temperature, geostrophic velocity and Heat fluxes are used. A positive trend in the eddy kinetic energy and in the surface temperature is found indicating an increase in the leakege.

Keywords: Agulhas Current, Satellite data, Climate,

Methods

Satellite data will be used to analyse surface proprieties of the water masses: **Sea surface temperature** (SST), geostrophic **velocities** and surface **heat fluxes** are used up to now.
Resolution of every dataset is $0.25° \times 0.25$.
Climatology will be the time mean of the dataset; *trends* will be the slope of a linear interpolation performed for every pixel.

Results

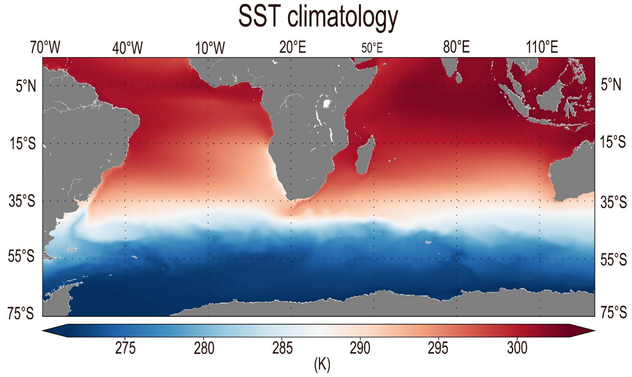

Figure 1: Sea surface temperature 1982-2018 climatology. Subtropical front is at $\sim 40°S$.

Sea surface temperature **climatology** (*ESACCI 1982-2018*) shows the position of the cold and relatively fresh Sub-tropical front, that flows eastward (fig. 1). Sea surface temperature **trend map** highlights a growing behavior in the retroflection region, meaning a south-shifting of the sub-tropical front (fig. 2).

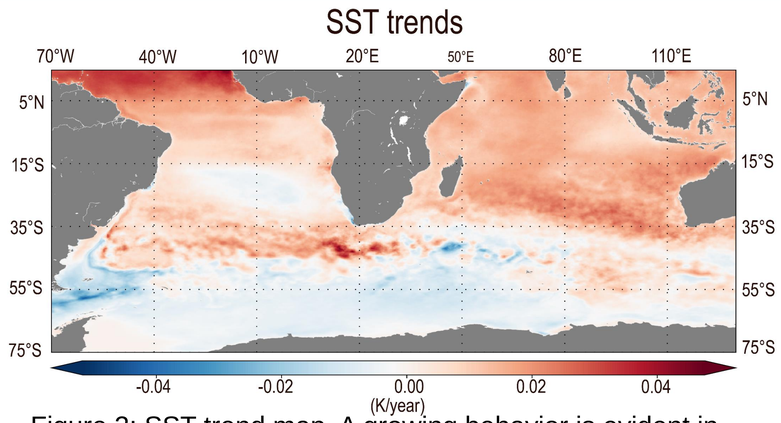

Figure 2: SST trend map. A growing behavior is evident in the Agulhas region.

A **south-shift** of the sub-tropical front implies a wider gap between Africa and the Antarctic Circumpolar Current. This increases Agulhas Leakage [1].

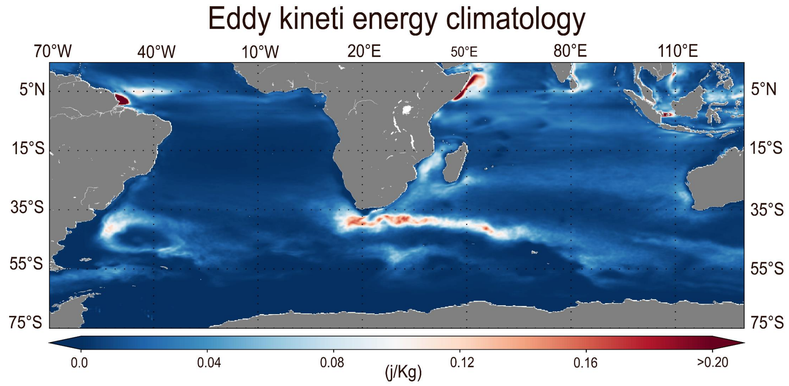

Figure 3: EKE climatology map. It is evident the turbulence in the Agulhas Region.

Eddy kinetic energy, or turbulent kinetic energy is defined as:

$$\boldsymbol{EKE} = \frac{u^2 + v^2}{2} - \frac{\bar{u}^2 + \bar{v}^2}{2}$$

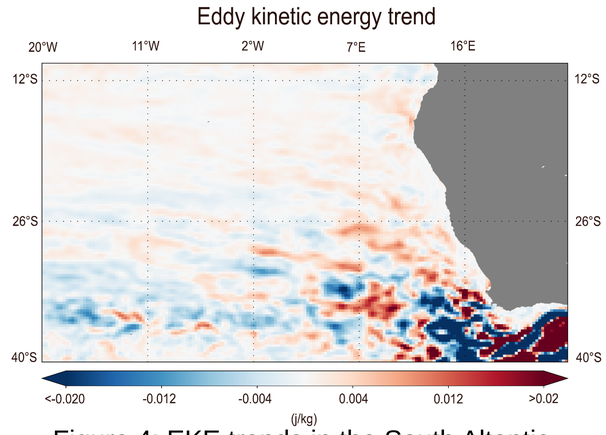

Figure 4: EKE trends in the South Atlantic. Averages are taken between $5°S$ and $25°S$.

Agulhas retroflection region is clearly turbulent and a brighter shade of higher eddy kinetic energy sheds into the South Atlantic (fig.3). *CMEMS 1993-2019 data.*

In the South Atlantic region, West from the Agulhas Leakage region (fig. 4), an average positive trend in eddy kinetic energy has ben evaluated (see also [3]).

Surface heat fluxes datasets come from *ERA5 1979-2019* and they show a strong heat loss in the Agulhas retroflection region due to evaporation and atmosphere convection.

Conclusions

Sub-Tropical Front south-shifting and an eddy kinetic energy positive trend in the South Atlantic are proofs of an increase in the Agulhas Leakage, since it means that more Agulhas rings are shed.
Warm water diffusion in the Atlantic can compete with the Greenland contribute: one strengthening and one reducing the Atlantic Meridional Overturning Circulation [3].

Bibliography

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