Evaluating Spatio-Temporal Variability in Sea Level and Eddies in the Azores Region

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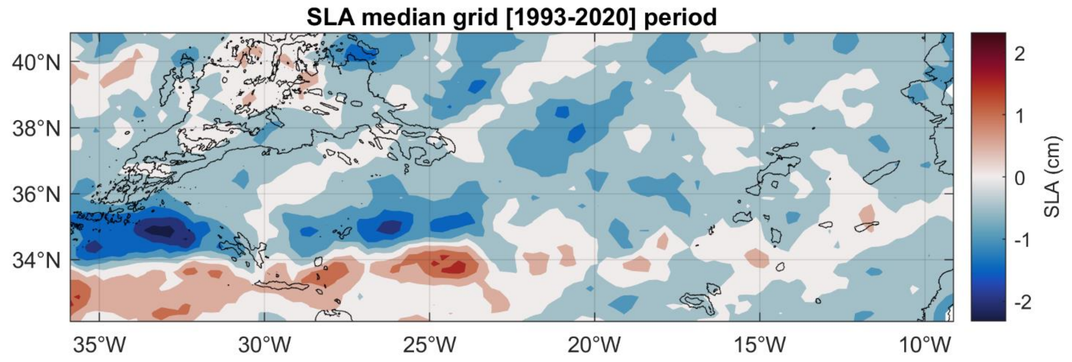
INTRODUCTION

- Understanding the Azores Current (AzC) variability and trend is of utmost importance not only in the context of global climate change but also when addressing critical research areas, such as marine litter transport or deep-sea mining activities, among others.
- Satellite altimetry is a pivotal data source in providing measurements to advance the understanding of ocean dynamic processes, phenomena and their evolving patterns.
- This study intends to understand the space-time variability of oceanographic variables derived from satellite altimetry in the AZC region.

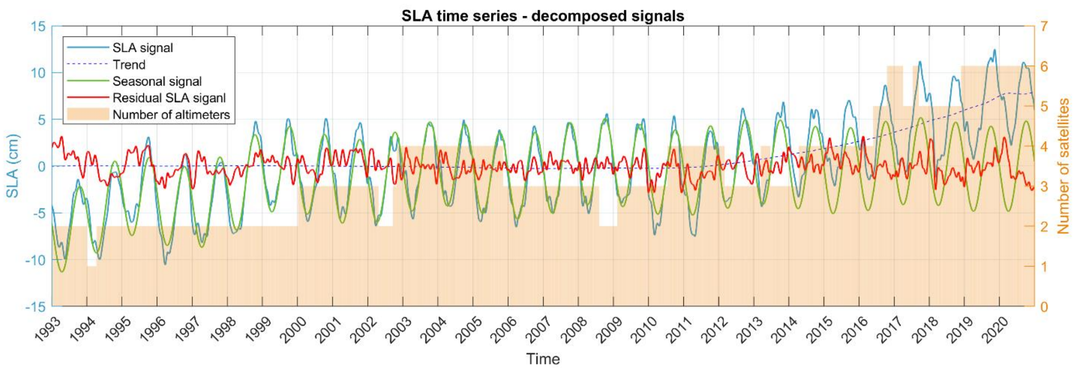
METHODS

- Data: DUACS L4 vDT2021 0.25°x0.25° daily gridded products for the period 1993-2020
- Study region: 32°N ≤ φ ≤ 41°N; 36°W ≤ λ ≤ 9°W;
- SLA grids underwent correction to align with the study period;
- EKE and geostrophic velocity anomalies calculated with corrected SLA grids;
- An eddy detection algorithm was applied (github.com/chouj/SimpleEddyDetection);
- Eddies were tracked day by day to represent their trajectories using a method based on distances between structures.

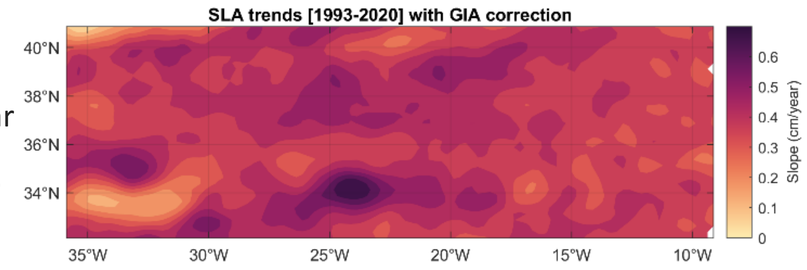


- AzC axis is noticeable along the zero SLA median.

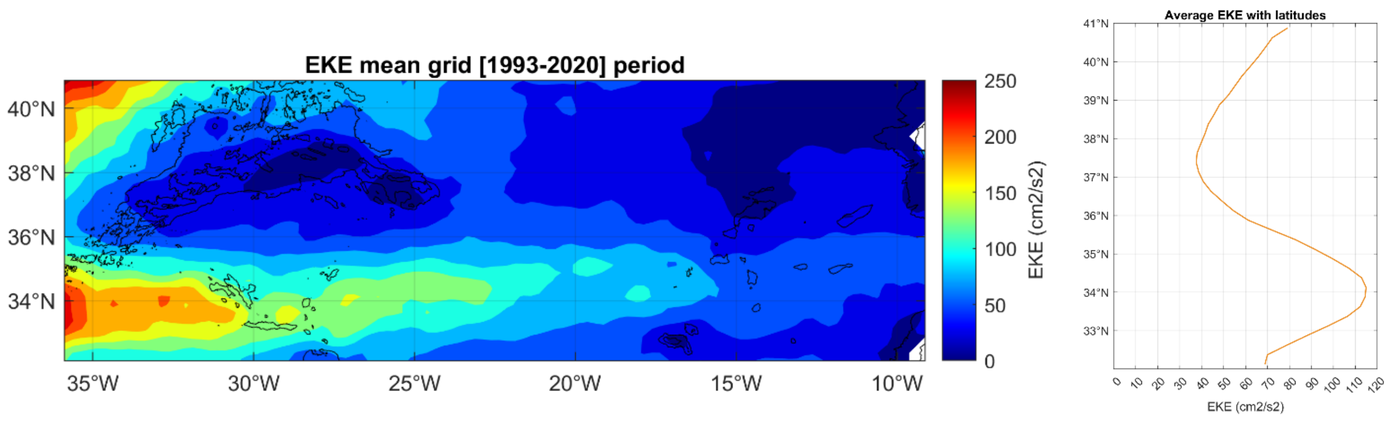
RESULTS

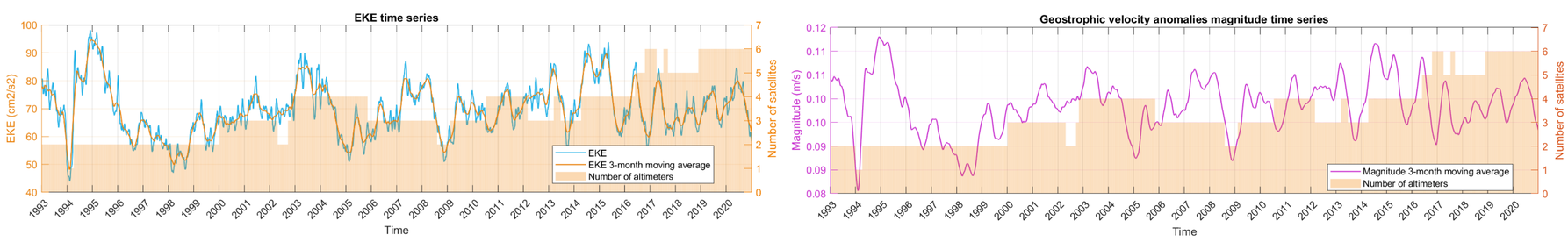


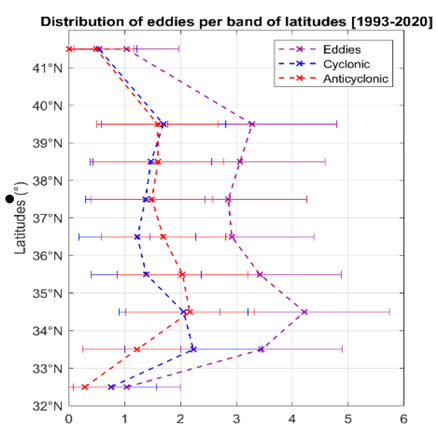
- Averaged SLA timeseries for the study region revealed a seasonal cycle with maximum peak during fall and minimum during spring.
- Linear positive trends up to 7 mm/year have been observed in the study region.

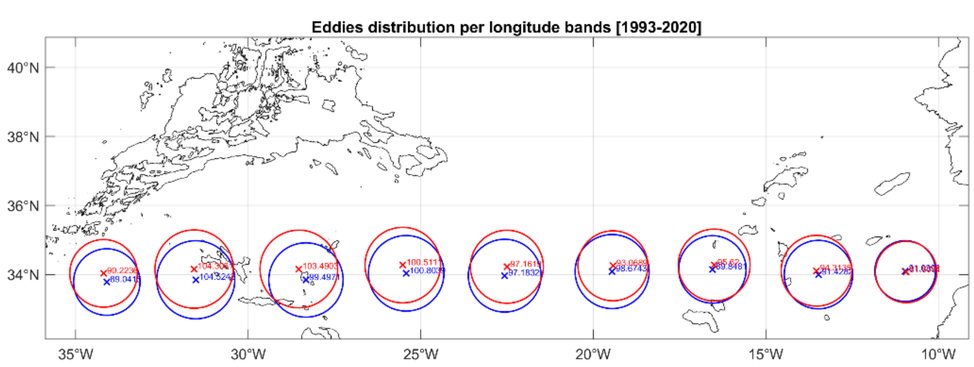


- EKE averaged for 1993-2020 reveals a quasi-zonal band of maximum energy at 34°N decreasing from west to east;
- Secondary EKE maximums were found north of 40°N (Gulf Stream).
- EKE temporal variability shows periods of high activity linked to the seasonal cycle and to the zonal geostrophic currents.
- The magnitude of the geostrophic current is a valuable indicator of the eddy field: the greater the presence of meanders, the more likely it is to generate more eddies.

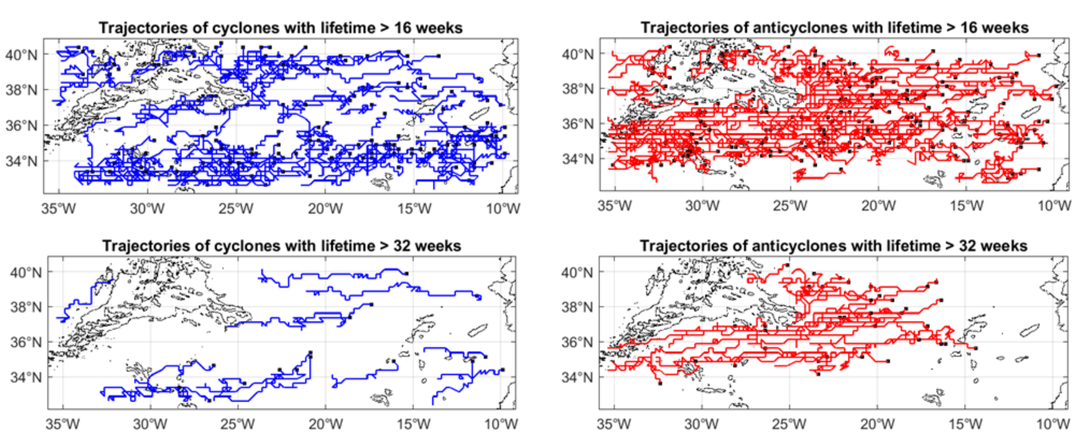








- The highest number of eddy structures was found around the Azores Current axis (34°N).
- Anticyclones eddies are mostly found to the north of the axis, while cyclones are typically located to the south.
- Eddies present westward propagation, and their radius increases from east to west, like the Rossby waves.



Eddy's radius	Mean number/day	Max. number	Min. number
45 – 80 km	11.1	24	0
80 – 155 km	10.6	20	1
115 – 150 km	3.50	10	0

Lifetime	≥ 4 weeks	≥ 16 weeks	≥ 32 weeks	≥ 52 weeks
Cyclones	1 401 (51%)	168 (46%)	17 (32%)	2 (40%)
Anticyclones	1 337 (49%)	195 (54%)	36 (68%)	3 (60%)
Total	2 738	363	53	5

- Eddies in the AzC present median/small sizes.
- Most eddies with less than 16 weeks lifetime.
- Longer lifetime observed for anticyclones.
- Stronger SLA amplitude observed for cyclones.

CONCLUSIONS

- The AzC core is located around 34°N and has an asymmetrical distribution on both sides of this axis; energy diminishes from west to east.
- Baroclinic instability in the AzC leads to the formation of eddies: cyclones are typically found in the southern part, while anticyclones are more common in the north.
- Eddies travel westward as Rossby waves, gradually increasing in size; anticyclones tend to last longer, while cyclones have greater SLA amplitude.
- The position and strength of the AzC current also show interannual variation, with periods of high eddy kinetic energy (EKE) linked to geostrophic velocity flow.

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