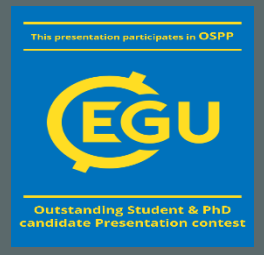
Long-term Trends and Variations in Sea Level of the Black Sea

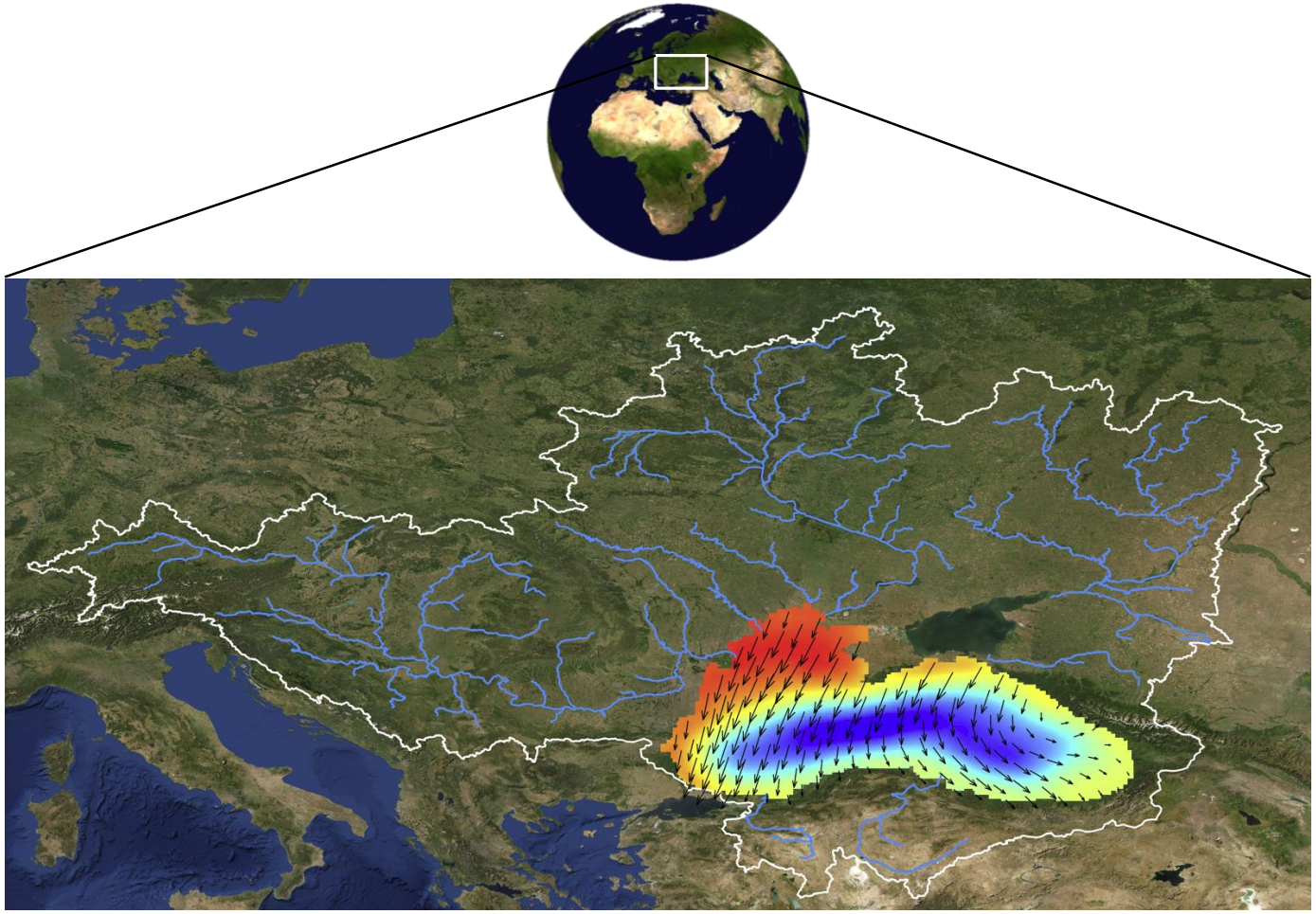
Şehriban Saçu and Olgay Şen

Hydraulics Division, Istanbul Technical University, Turkey



sacus@itu.edu.tr

INTRODUCTION



* White and blue lines represent Black Sea catchment area and rivers. The vectors represent wind field and the color map represents sea level.

Observations

- River Discharge (GRDC)
- Satellite altimetry (Copernicus)
- Tide gage measurements (PSMSL)
- Gravity measurement (GRACE)

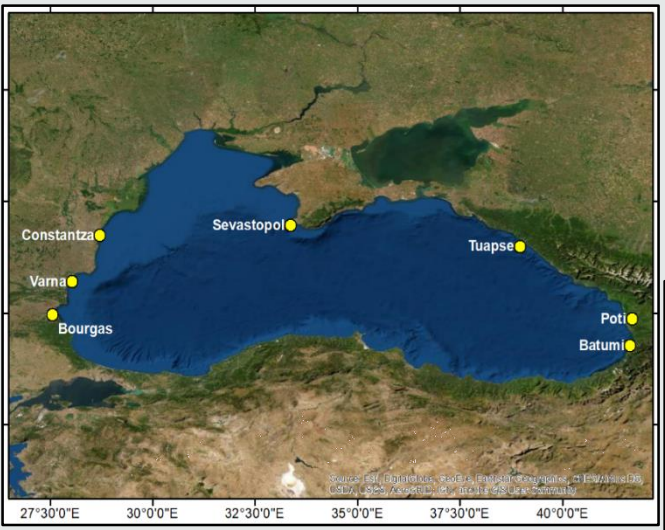
Models

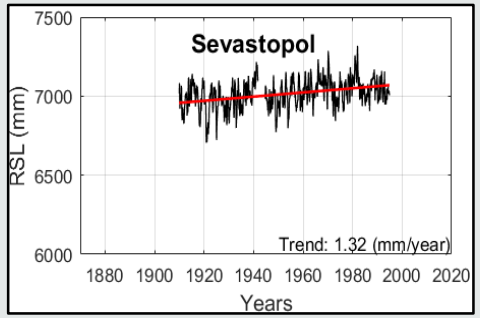
- River Discharge (EFAS)
- Atmospheric forcing (ERA5)

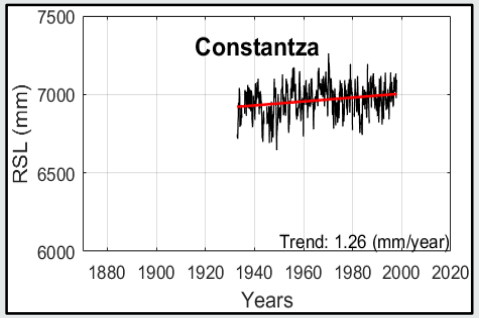
- Is there a significant trend in sea level ?
- What governs year to year sea level variability ?

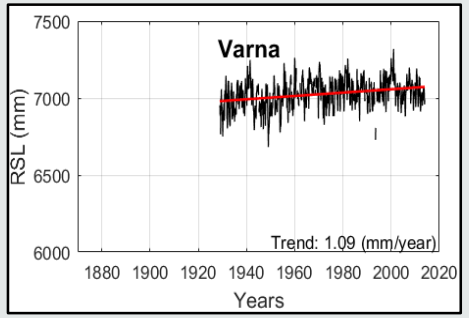
sacus@itu.edu.tr

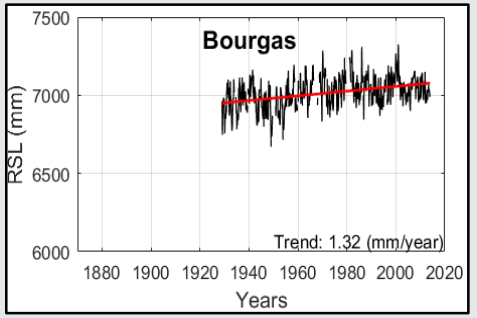
RESULTS

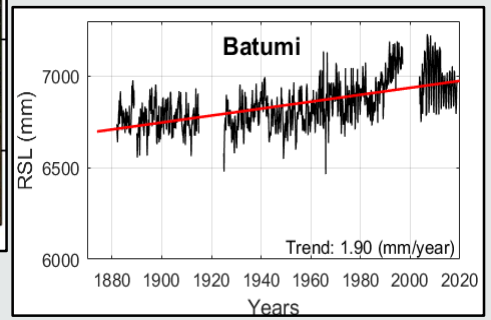


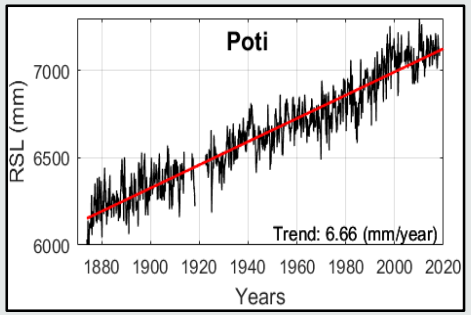


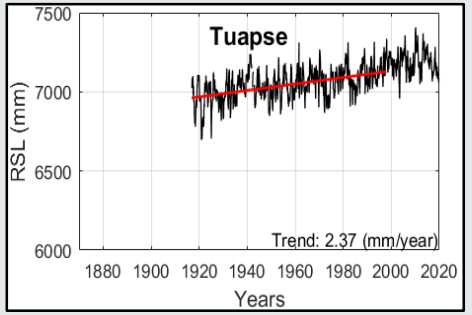


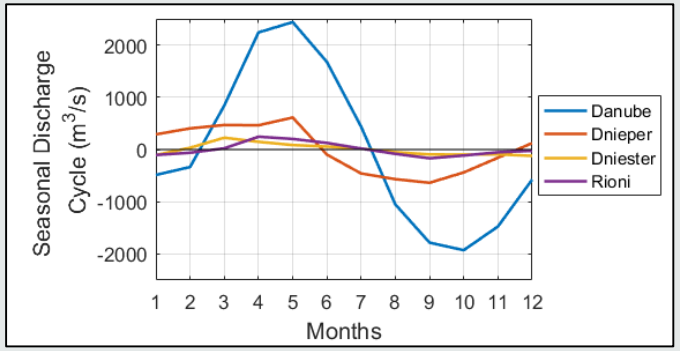


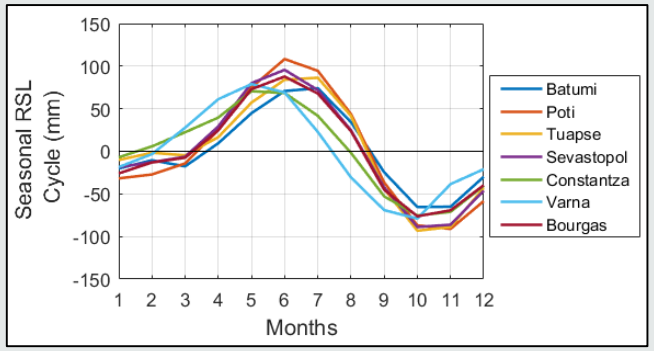


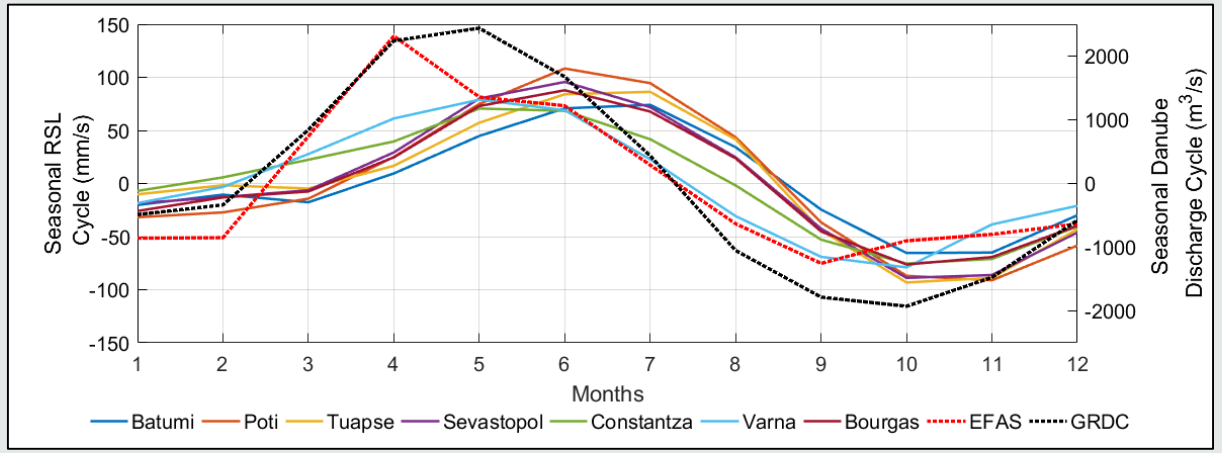






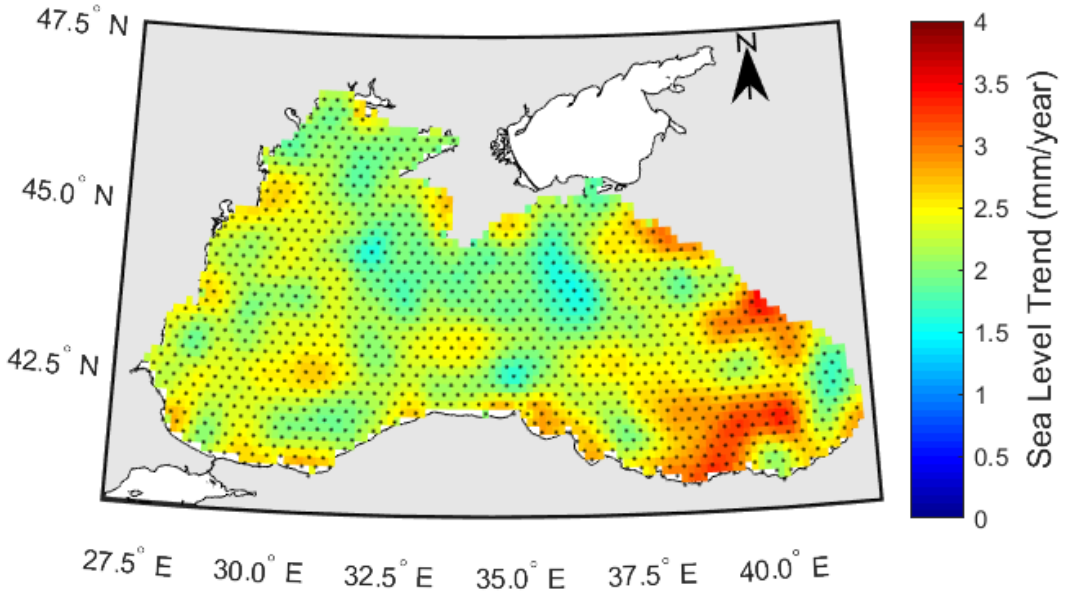


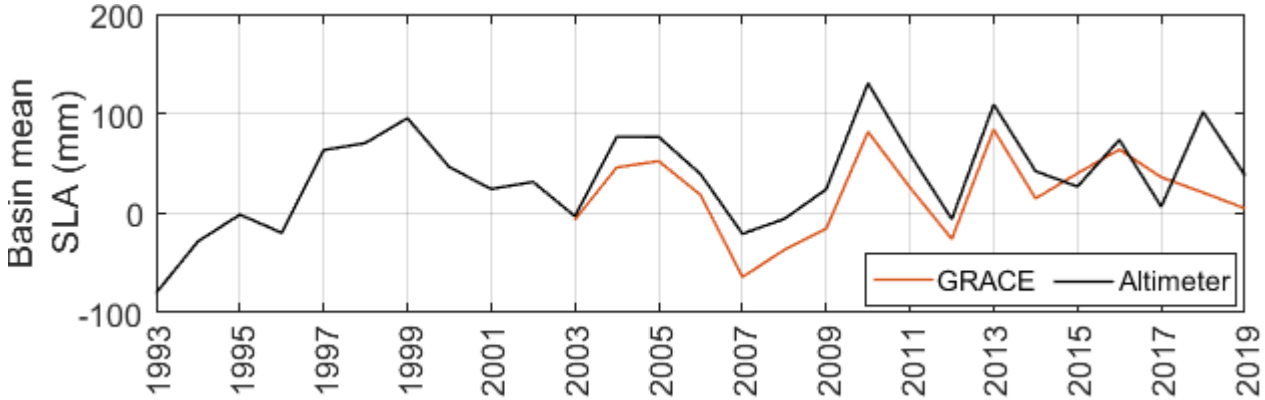




sacus@itu.edu.tr

RESULTS



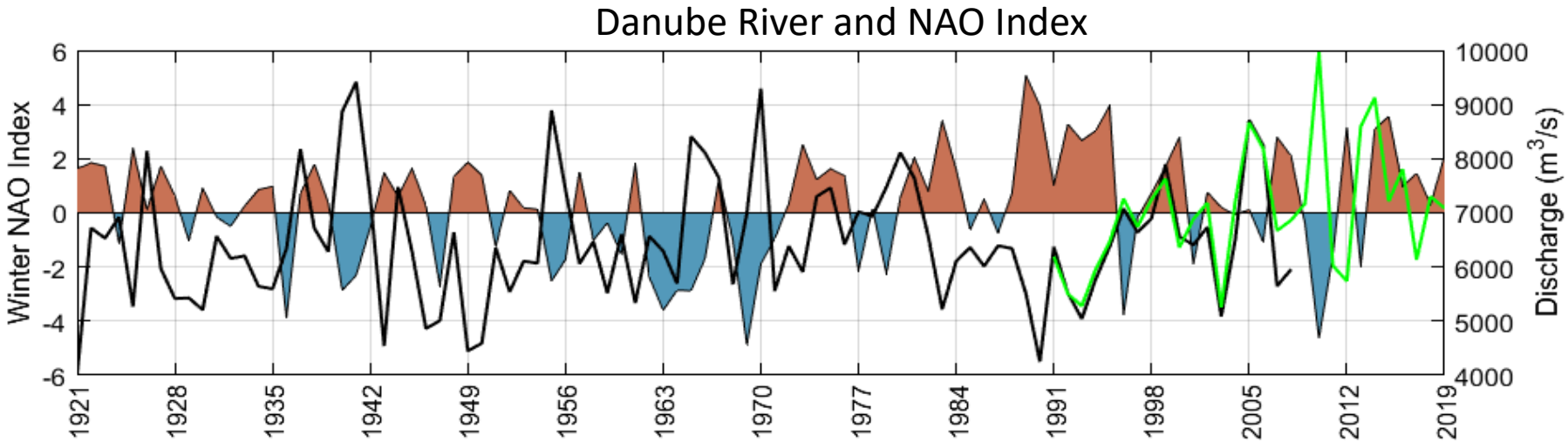


- The sea level rising trend varies between 1.5-3.5 mm/yr.
- The altimeter derived basin mean SLA agrees well with the sea level obtained from gravity measurements, GRACE.
- The basin mean SLA does not show significant trend between years 2003-2019.

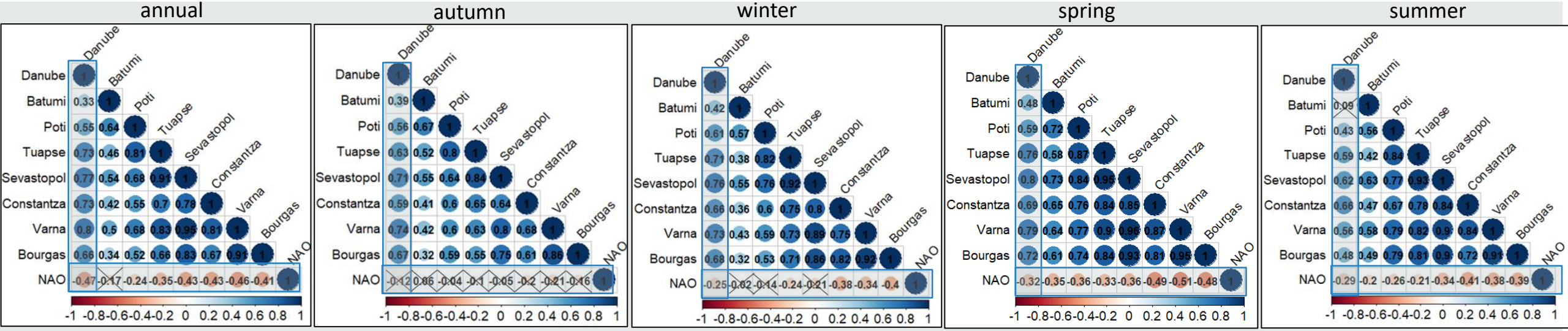
* Stippling in the map indicates the 95% confidence level.

sacus@itu.edu.tr

RESULTS



* Solid black line represents GRDC data and green solid line represent EFAS data. NAO index is taken from Hurrell and NCAR Staff (2020)

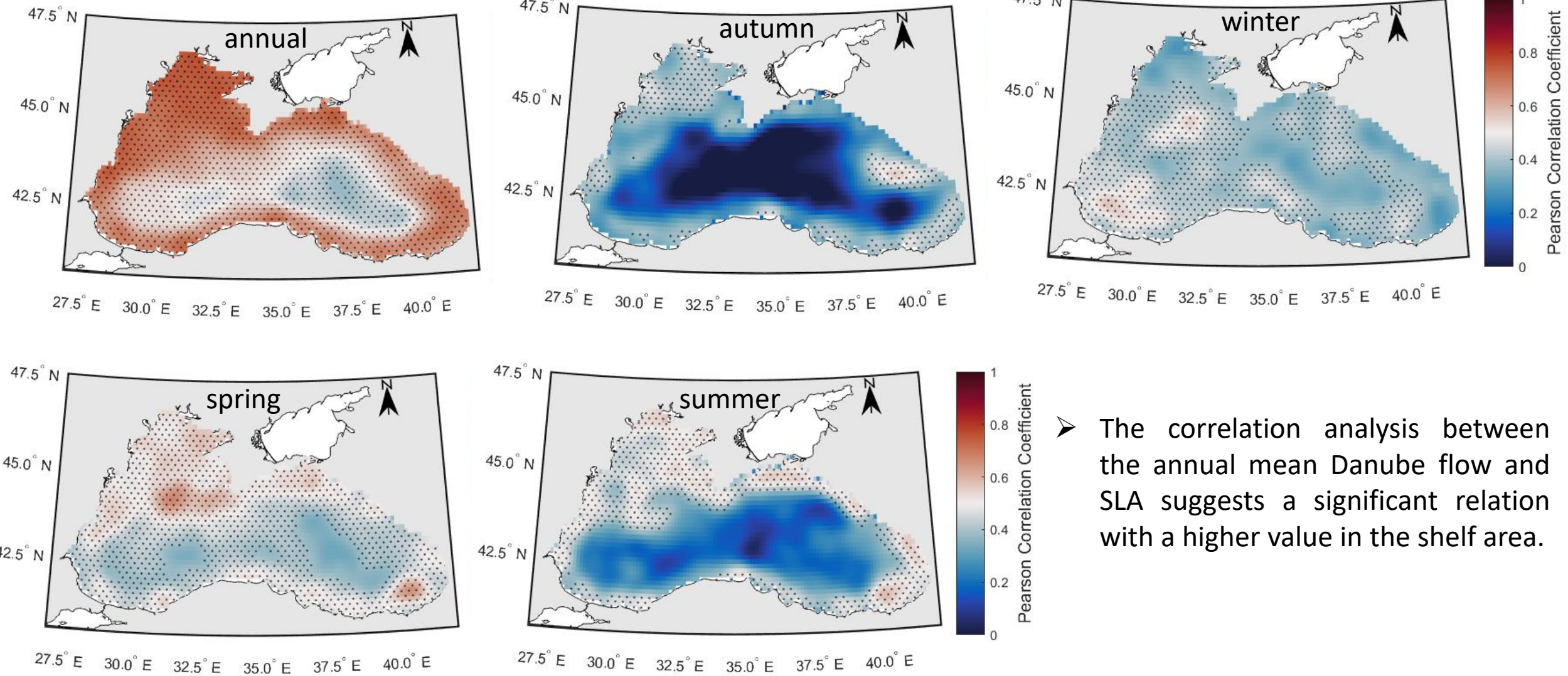


* The crosses indicates correlations under 95% confidence level.

Hurrell, James & National Center for Atmospheric Research Staff (Eds). Last modified 24 Apr 2020. "The Climate Data Guide: Hurrell North Atlantic Oscillation (NAO) Index (station-based)." Retrieved from https://climatedataguide.ucar.edu/climatedata/hurrell-north-atlantic-oscillation-nao index-station-based.

sacus@itu.edu.tr

RESULTS

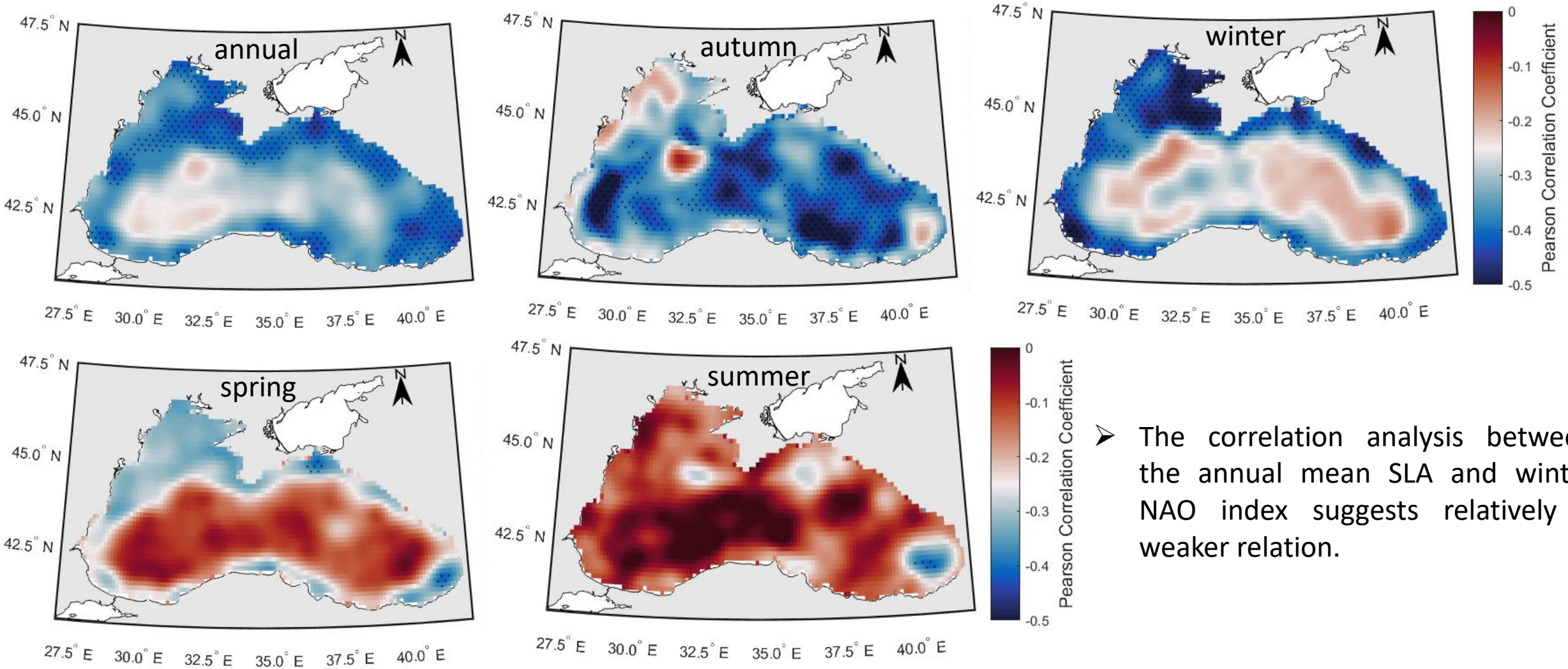


* Stippling in the maps indicates the 95% confidence level

- The correlation analysis between the annual mean Danube flow and SLA suggests a significant relation with a higher value in the shelf area.

sacus@itu.edu.tr

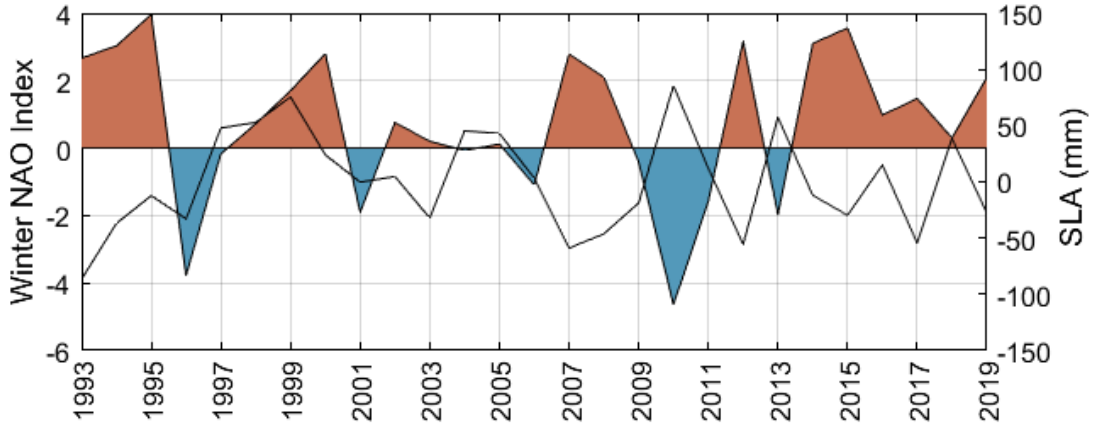
RESULTS



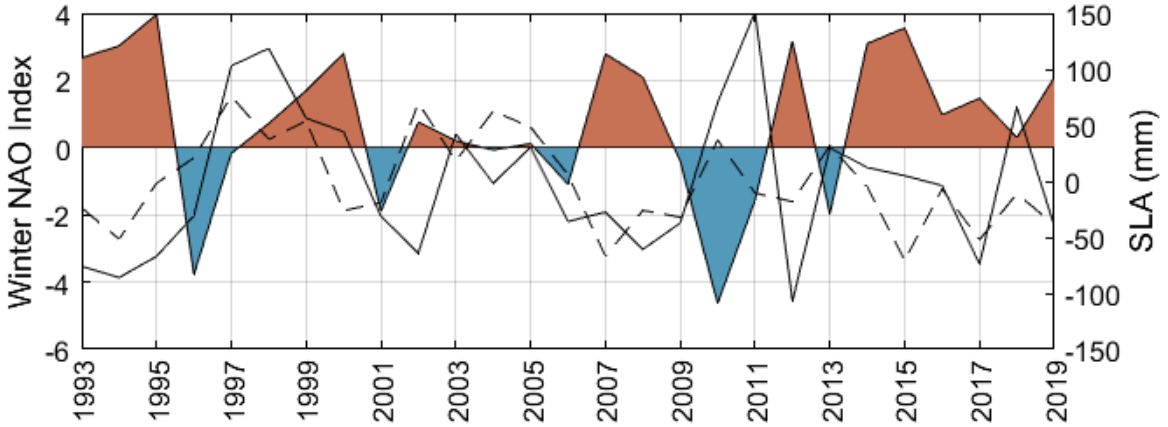
- The correlation analysis between the annual mean SLA and winter NAO index suggests relatively a weaker relation.

sacus@itu.edu.tr

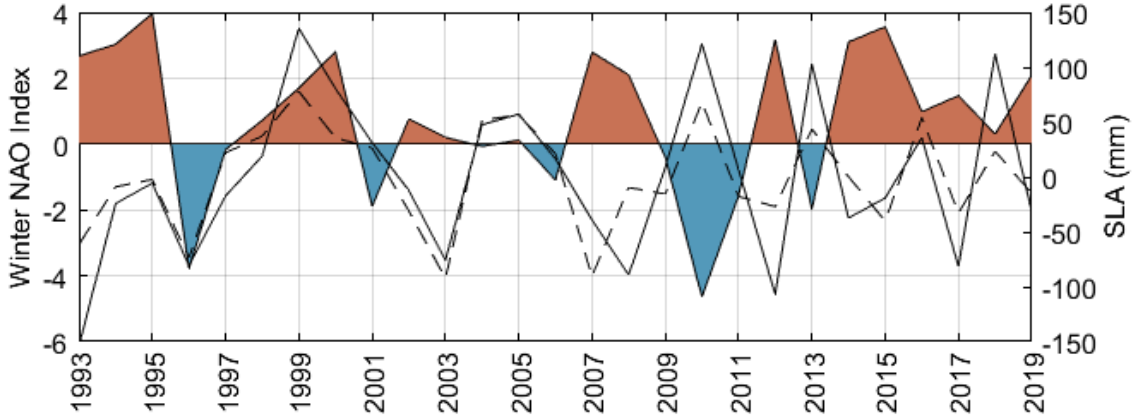
RESULTS



* Solid line represent annual basin mean sea level.



* Solid and dashed lines represent winter and autumn basin mean sea level, respectively.

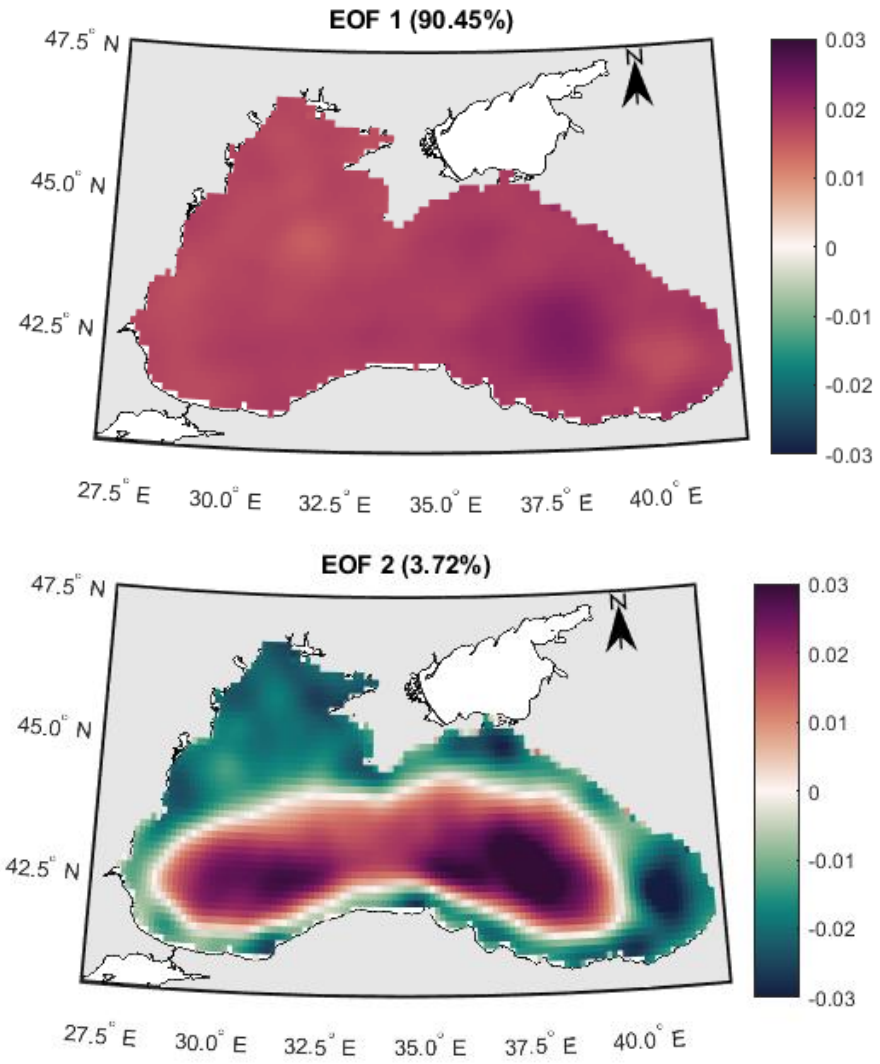


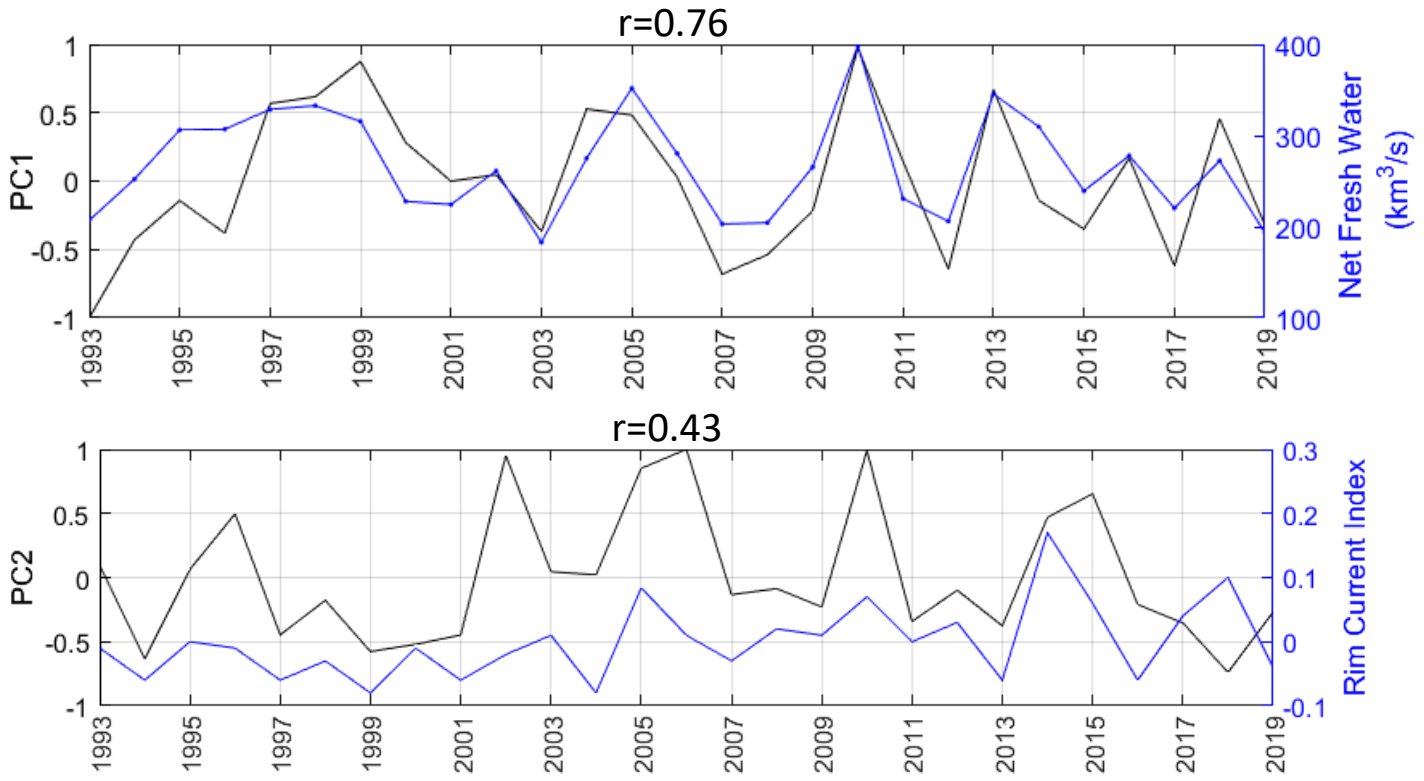
* Solid and dashed lines represent spring and summer basin mean sea level, respectively.

SLA (mm)	Annual	Winter	Spring	Summer	Autumn
Corr. Coef.	-0.48	-0.39	-0.37	-0.245	-0.47
p-value	0.011	0.041	0.061	0.217	0.014

sacus@itu.edu.tr

RESULTS





* Rim Current Index is taken from study of Peneva et al. (2021).

- EOF1 explains about 90.45% of the total variability (81.9 % on monthly scales). The PC1 shows interannual variations in accordance with freshwater budget ($r=0.76$, $p<0.05$).
- EOF2 accounts for 3.72% of the total variability (5.7% on monthly scale). It could be related to the Rim Current intensity governed by wind curl ($r=0.43$, $p<0.05$).

Peneva, E., Stanev, E., Ciliberti, S., Lima, L., Aydogdu, A., Marinova, V., & Valcheva, N. (2021). Interannual variations of the Black Sea Rim Current. Journal of Operational Oceanography, 14(S1), 53-58.

sacus@itu.edu.tr

SUMMARY

- The sea level rising trend is between 1.0 – 3.5 mm/yr but it is not uniform over the basin.
- The basin mean SLA does not have a statistically significant trend over years of 2003-2019.
- The sea level variability mostly influenced by fresh water input (riverine flow + precipitation - evaporation) mostly Danube riverine flow.
- The NAO is also another important factor affecting sea level variations on interannual time scales.

NEXT

- Determine role of the Bosphorus flux and thermohaline properties.
- Determine future SLA variations under different climate change scenarios.

Thank you for listening!

sacus@itu.edu.tr