

Persistent and recurrent pathways in the Black Sea: A Resource for Oil Spill Analysis

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Introduction

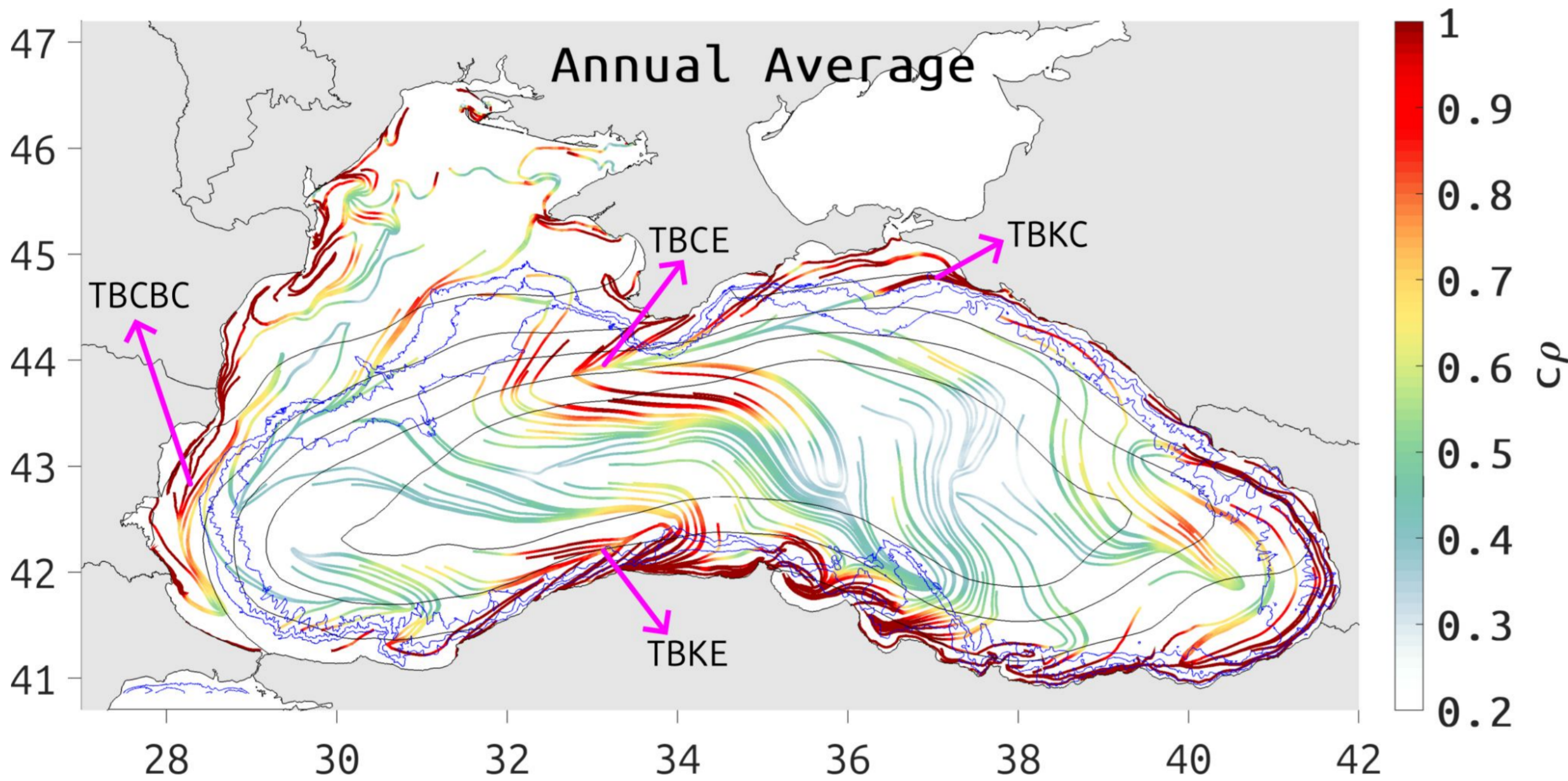
Accidental oil spills occur monthly in the Black Sea during the transport of crude oil. In addition to these incidents, the expansion of offshore oil exploration represents a significant risk to the marine ecosystem. Dynamical systems theory has contributed to the study of emergency response to oil spills. The climatological Lagrangian coherent structures (cLCS), demonstrating particular efficacy in the trajectory prediction of pollutants such as oil spills.

Metodologia

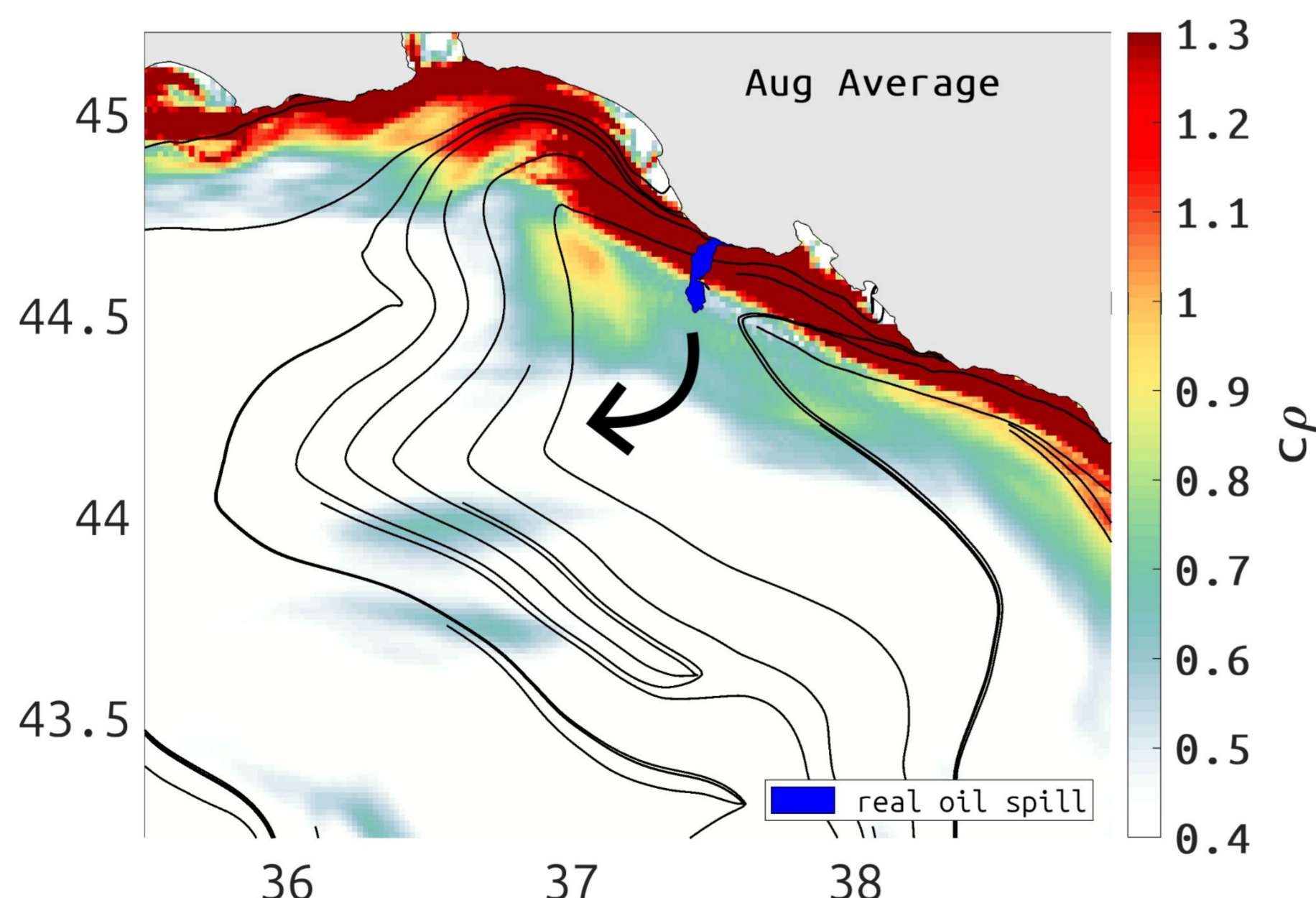
- Daily reanalysis data from the CMEMS Black Sea region.
- Monthly cLCS.
- Two oil spill simulation (Opendrift) using DUACS data as input.
- A real oil spill occurred on August 8, 2021, near Novorossiisk.

Results

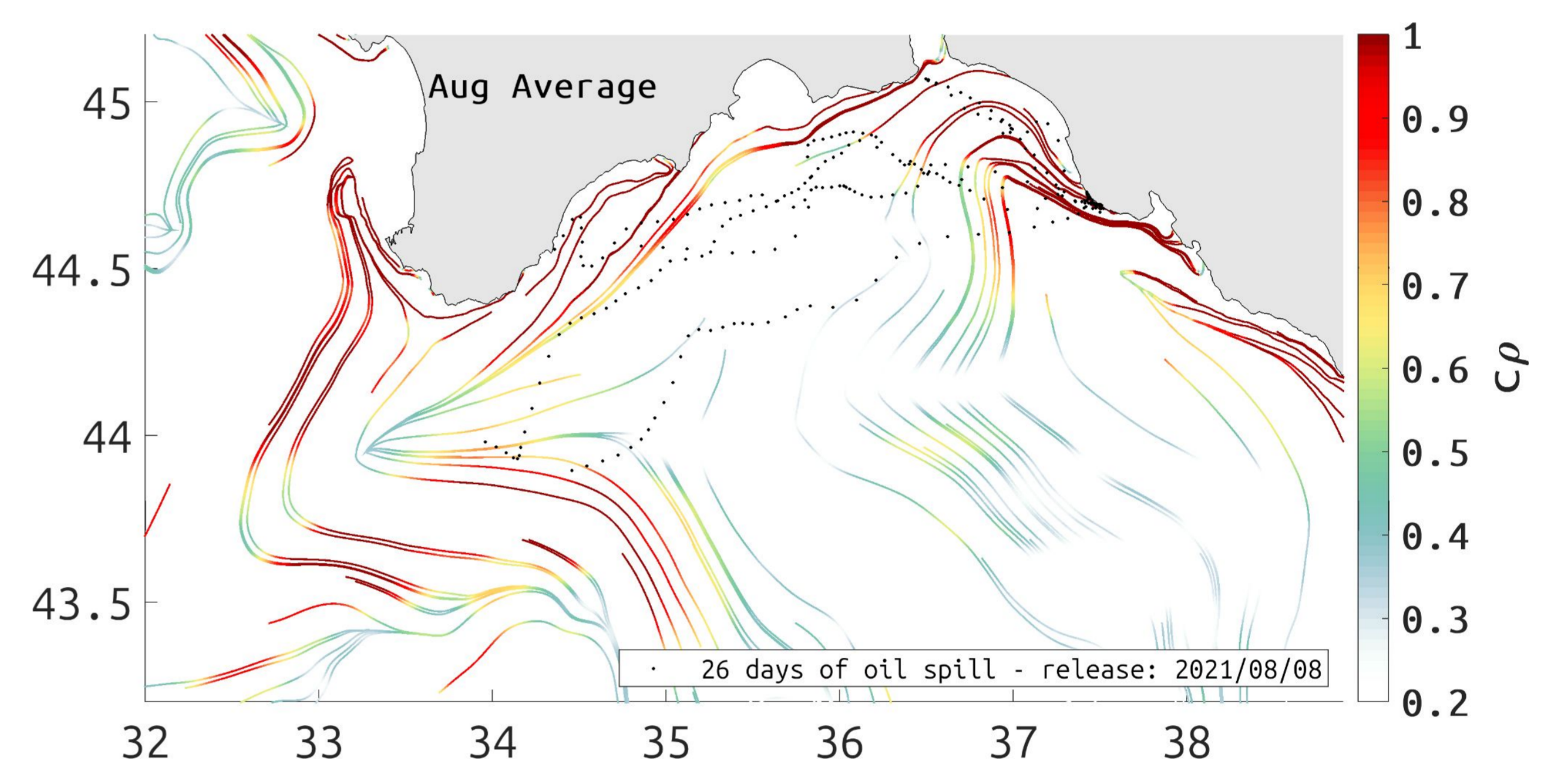
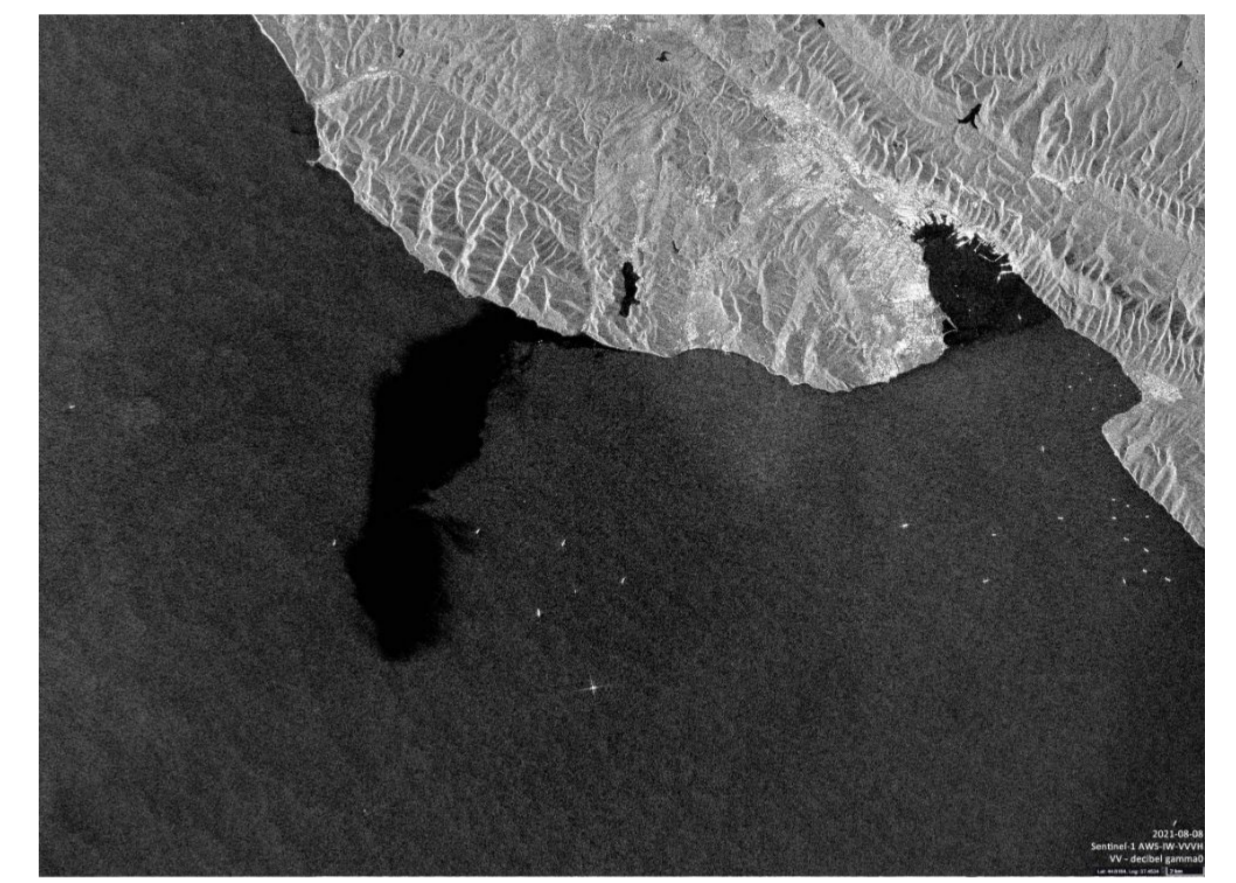
- The cLCS have identified and quantified four efficient transport barriers in the Black Sea.



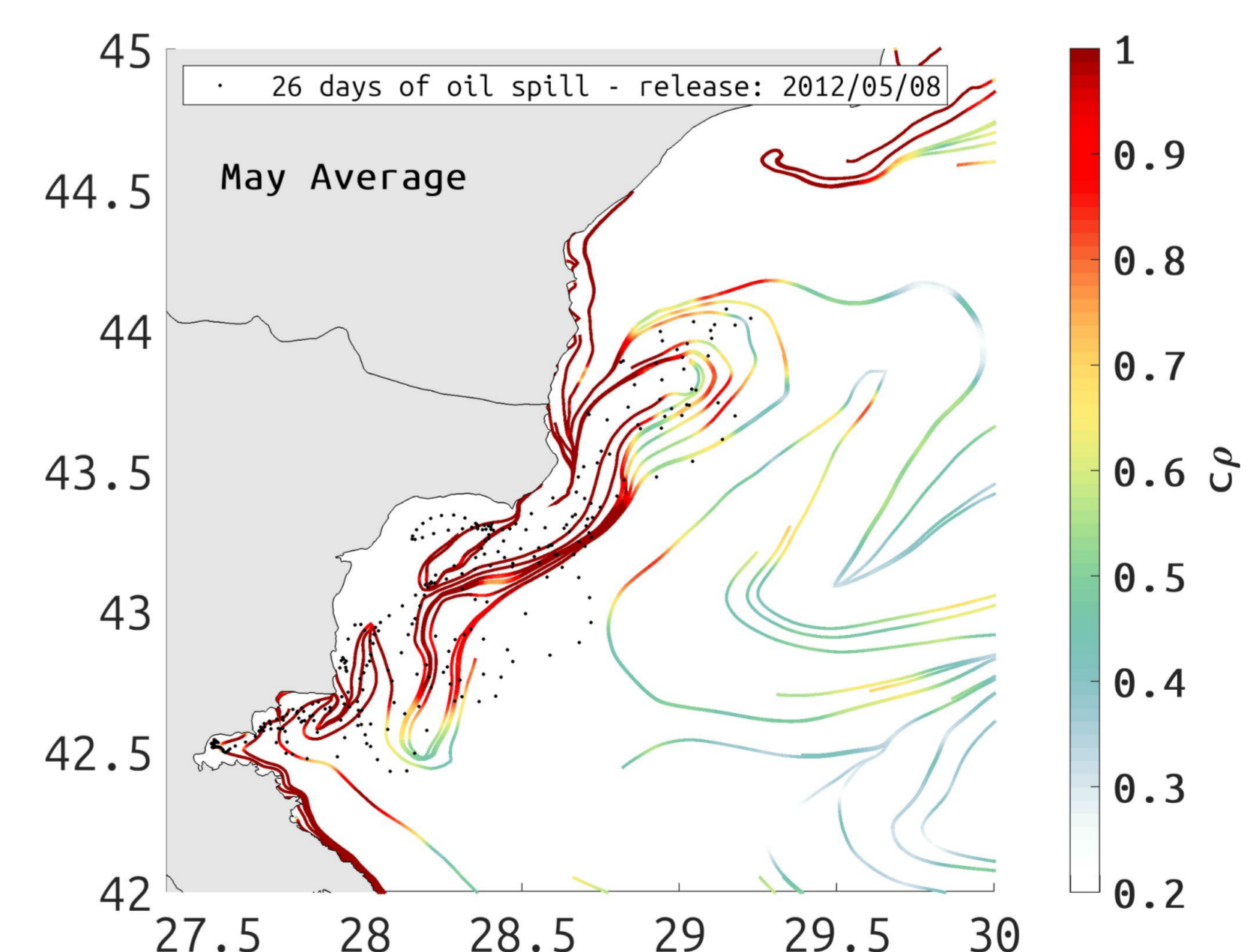
- These transport barriers attract nearby water parcels and passive tracers, guiding them along their path and inhibiting the transport across it.
- The oil spill is directed southwest and emulsifies within three days.



- The cLCS indicate that the oil spill was being driven by the transport barrier (TBKC) which would drive it in a northeasterly direction.
- A simulation of an oil spill whose advection would last 26 days illustrates the northwestward transport.



- The cLCS indicate that the oil spill was being driven by the transport barrier (TBKC) which would drive it in a northeasterly direction.
- A hypothetical oil spill simulation conducted on May 8, 2021, with a 26-day advection period, in the vicinity of the Bulgarian coastal region, underscores the significance of an additional transport barrier (TBCBC).



Conclusions

- The four transport barriers are effective and vital for the persistent lagrangian transport of nearby water parcels and passive tracers.
- The cLCS provides insights into the intricate transport dynamics of the Black Sea ecosystem, with significant implications for marine dynamics.