

Eddy currents affect flux of salt more than heat

May 6 2019



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Modeling the 3-D structure of Red Sea eddies shows how transport of energy and biochemical materials influences circulation patterns in the Red Sea.

A study of eddy-induced transport of [energy](#) and biochemical particles and its influences on circulation patterns in the Red Sea reveals a mechanism that balances fluctuations in both salt and heat in the basin.

Mesoscale eddies, often described as the [weather](#) of the ocean, are 3-D structures typically hundreds of kilometers wide and hundreds of meters deep. They are characterized by temperature, salinity and [flow properties](#) that differ to the surrounding water, enabling them to transport energy and materials around the ocean.

Although the circulation of the Red Sea is distinguished by a large number of [mesoscale eddies](#), little is known about their 3-D structures.

Led by Ibrahim Hoteit, Peng Zhan and colleagues at KAUST are investigating eddies circulating in the Red Sea.

"Ocean eddies are usually faster flowing compared with mean ocean circulation and therefore contribute significantly to the transport of energy and materials," says Zhan. "Studying three-dimensional eddy-induced transport will deepen our understanding of the circulation of the Red Sea and identify the important role that eddies play in both horizontal and vertical transport and air-sea interactions."

The team used the Massachusetts Institute of Technology general circulation model (MITgcm), specifically configured to cover the entire Red Sea. This meant they could simulate dynamics of the Red Sea spanning a 14-year period from 2001-2014 with sufficient spatial and [temporal resolution](#) to resolve mesoscale eddies, allowing them to investigate their 3-D characteristics.

They found that eddy-induced transport is more active in the central and northern Red Sea. They also found that variability in eddies accounted for around 8 percent of the total variance in the surface heat flux and for

about 39 percent in the salt flux.

"These are the regions where heat, salt and biogeochemical particles are more likely to be dispersed and promote the regional exchange of energy and materials," explains Zhan.

This work highlights the significant role that eddy-induced transport and air-sea exchange play in the [circulation](#) of the Red Sea. It has also led to the discovery of a negative feedback mechanism between eddies and steepness of the mixed-layer depth that balances heat and eddy-induced transport in the Red Sea.

"We are now developing a data assimilation system for the Red Sea by focusing on enhancing our abilities to model eddy-induced [transport](#)," says Zhan, "as well as developing an ocean-atmosphere coupled model to further investigate the atmospheric response to the mesoscale eddies in the Red Sea."

More information: Peng Zhan et al. Three-Dimensional Signature of the Red Sea Eddies and Eddy-Induced Transport, *Geophysical Research Letters* (2019). [DOI: 10.1029/2018GL081387](https://doi.org/10.1029/2018GL081387)

Provided by King Abdullah University of Science and Technology

Citation: Eddy currents affect flux of salt more than heat (2019, May 6) retrieved 25 April 2024 from <https://phys.org/news/2019-05-eddy-currents-affect-flux-salt.html>

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