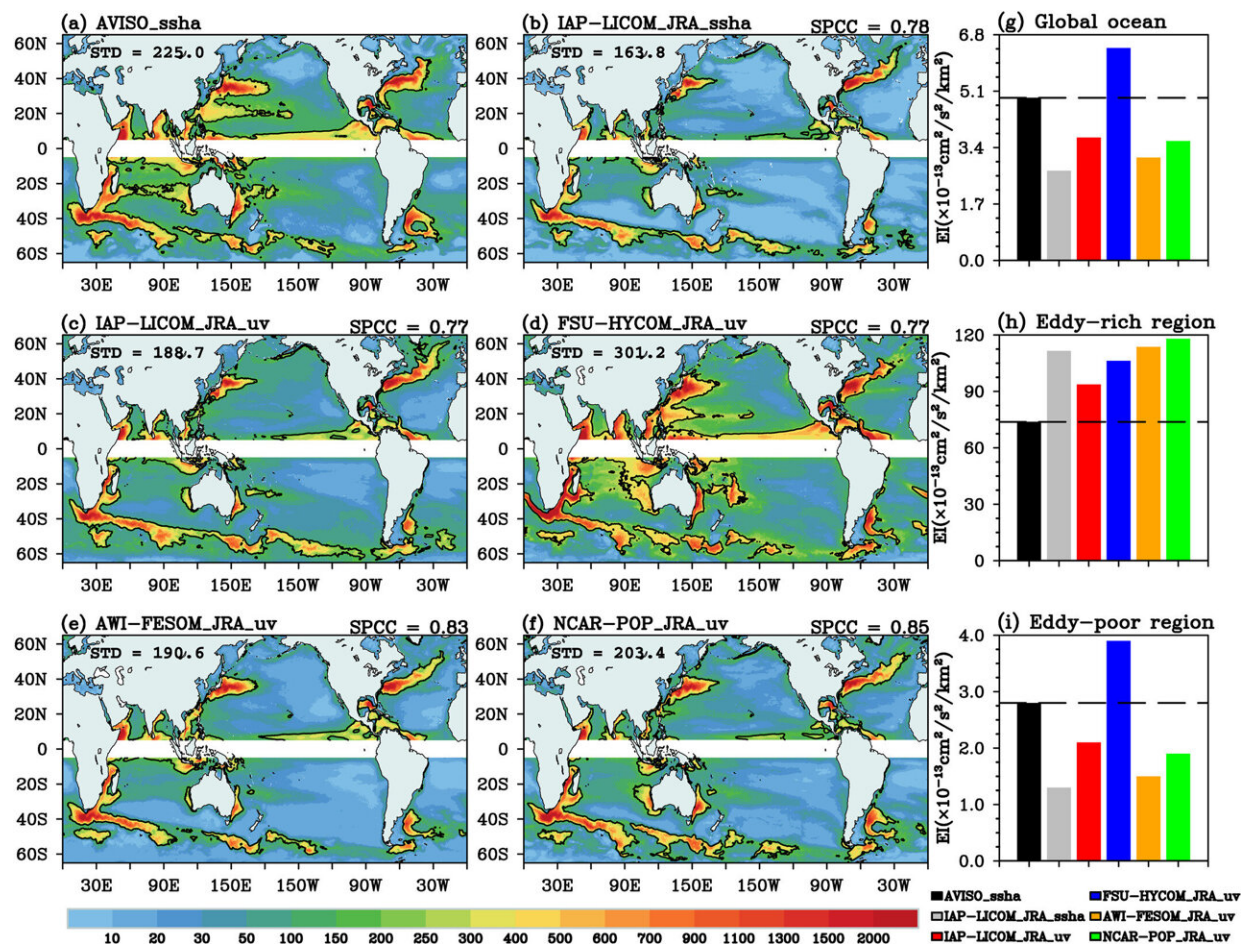


Improving ocean general circulation models

June 10 2022, by Li Yuan



Mean surface eddy kinetic energy (EKE, cm^2/s^2) for (a) AVISO_ssh, (b) IAP-LICOM_JRA_ssh, (c) IAP-LICOM_JRA_uv, (d) FSU-HYCOM_JRA_uv, (e) AWI-FESOM_JRA_uv, and (f) NCAR-POP_JRA_uv during 1993–2018. The black contours in (a)–(f) are the global spatial standard deviation (STD; labeled in each panel) for each mean EKE distribution. The spatial pattern correlation coefficients (SPCCs) between each simulation and AVISO_ssh are also labeled in the top right of panels (b)–(f). The energy intensity (EI, $\text{cm}^2/\text{s}^2/\text{km}^2$) for

AVISO_ssha (black bars) and different simulated EKE data sets (colored bars) over (g) the global ocean, (h) eddy-rich regions, and (i) eddy-poor regions are also shown, respectively. The black dashed lines in (g)–(i) are the results for AVISO_ssha. Credit: *Geophysical Research Letters* (2022). DOI: 10.1029/2022GL098370

Ocean general circulation models (OGCMs) have become increasingly important for understanding oceanic dynamic processes and ocean environment forecasting. In recent decades, OGCMs have been developed with finer resolution (10km for eddy-resolving OGCMs) given the large computational resources.

"However, the state-of-the-art eddy-resolving OGCMs tend to simulate a less energetic surface [ocean](#) on the global scale. In addition, there is so far no comprehensive and systemic evaluation of the model performance in simulating global [mesoscale eddies](#). Many issues have therefore not been fully discussed," said Liu Hailong, one of the corresponding authors of a study recently published in *Geophysical Research Letters*.

To address these issues, a research group from the Institute of Atmospheric Physics (IAP), Chinese Academy of Sciences (CAS), investigated the performances of eddy-resolving OGCMs in simulating mesoscale eddies using four eddy-resolving OGCMs forced by different atmospheric reanalysis products, including the self-developed LASG/IAP Climate system Ocean Model version 3 (IAP-LICOM3).

Results show that the eddy-resolving OGCMs tend to simulate more (less) energetic eddy-rich (eddy-poor) regions with a smaller (larger) spatial extent. Quantitatively, there is an approximately 27–60% overestimation of eddy kinetic energy intensity (EI) in the eddy-rich regions, which are mainly located in the Kuroshio-Oyashio Extension,

the Gulf Stream, and the Antarctic Circumpolar Currents regions, although the global mean EI is underestimated by 25–45%. Apparently, EI in the eddy-poor region is underestimated.

Further analyses after eddies are identified and tracked show that the overestimation in the eddy-rich regions is mainly caused by the coherent mesoscale eddies' intensity rather than frequency and is more prominent when [mesoscale](#) eddies are in their growth stage.

"It's an interesting story, as the eddy-rich regions are simulated more energetic while eddy-poor regions are simulated less energetic," said Liu. "It points out some of the shared problems model developers face before taking further efforts to improve the [eddy](#)-resolving ocean models."

More information: Mengrong Ding et al, Overestimated Eddy Kinetic Energy in the Eddy-Rich Regions Simulated by Eddy-Resolving Global Ocean–Sea Ice Models, *Geophysical Research Letters* (2022). [DOI: 10.1029/2022GL098370](#)

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