Kilometer-scale ocean processes behind the variability of the Island Mass Effect in the Maldives - Supplementary Material

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1 Regional environmental variables

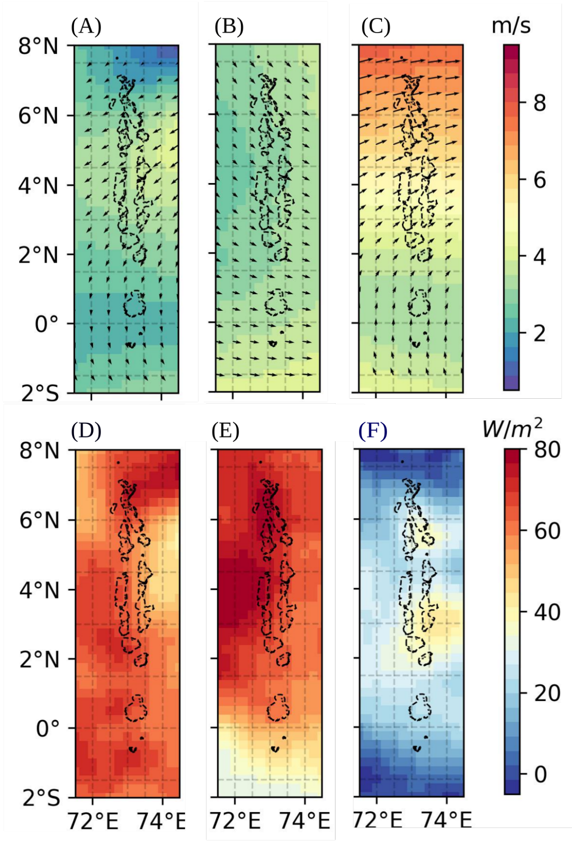

Fig. S1 (A),(B),(C): 10m winds; (D),(E),(F): surface net heat flux (shortwave radiation + longwave radiation + sensible heat + latent heat) from ERA5 for February (left), April (centre) and June (right) 2013 respectively.

2 Model output and validation

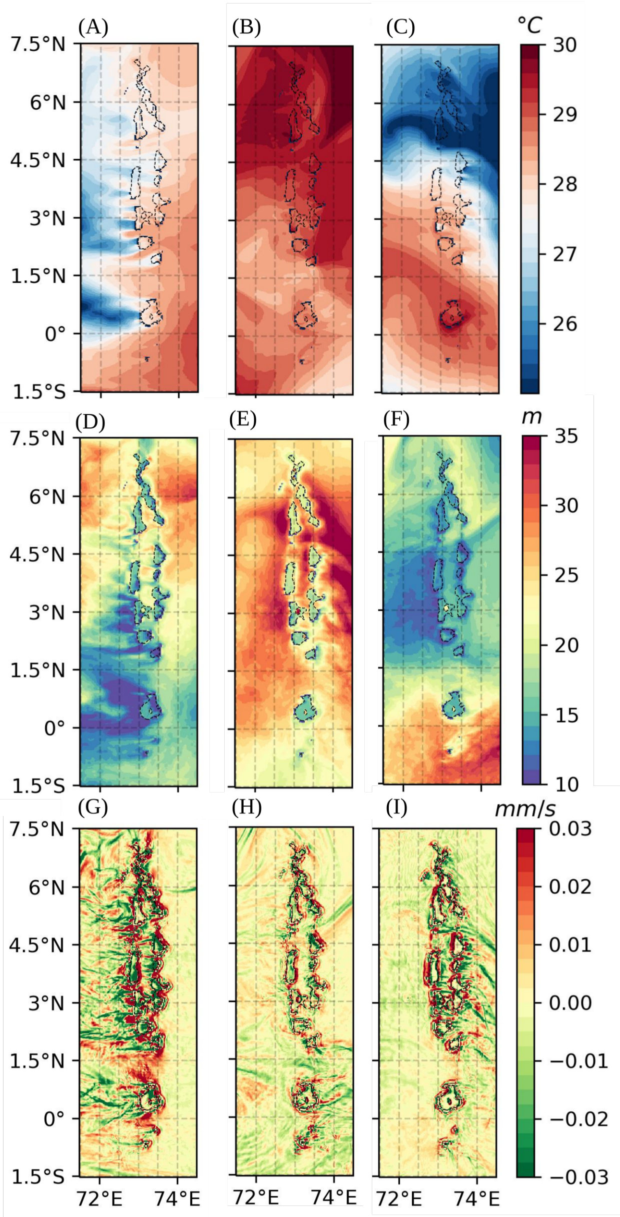

Fig. S2 (SST (A), (B), (C); Mixed Layer Depth (D),(E),(F) and vertical velocity (positive upwards) at 15 m depth (G), (H), (I). Averaged over the first 15 days of February (left), April (centre) and June (right) 2013 respectively from the CROCO simulations used for the Lagrangian particles tracking.

The validation of the modeled fine scale variability is not an easy task because high resolution datasets that cover our domain are derived from remote observations and are subject to interpolation and/or downscaling. Here we compare the power spectra of the SSTs from CROCO 1.6km and 5km with GHRSST-OSTIA which has a nominal resolution of 0.054°and GHRSST-MUR [1]. The Group for High Resolution Sea Surface Temperature (GHRSST) Multiscale Ultrahigh Resolution (MUR) dataset is a Level 4 sea surface temperature analysis with a resolution 0.01°. The power spectra of CROCO 1.6 falls in the middle of the two observational datasets (Fig. S3). It has higher energy than the OSTIA, which has a lower resolution than CROCO 1.6 and lower energy than MUR, which has a higher resolution than the model set up; showing that CROCO is reproducing fine scale variability within the limits of its own resolution. Furthermore, CROCO run at 5km has lower energy at high wavenumbers and a spectra similar to OSTIA.

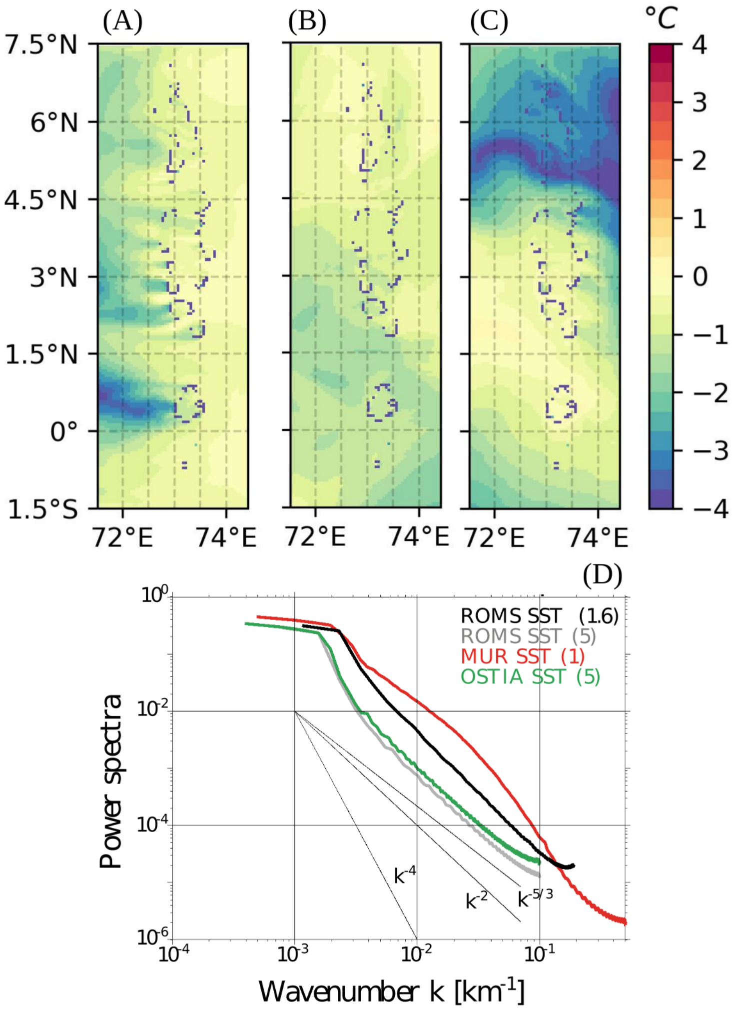

Fig. S3 Mean SST bias for first 15 days of February (A), April (B), June (C) calculated as the difference between CROCO 1.6km simulation and GHRSST OSTIA data. Power spectra (D) 10-day time-average wavenumber spectra of SST from OSTIA (green line), MUR (red line) and simulations at 5km and 1.6km of horizontal resolution for the gray and black lines, respectively. The spatial spectra are computed over the domain corresponding to the CROCO high-resolution simulations and the unit is K^2km. The spectra are computed over the native grid of their respective product and normalized by the power of the lowest wavenumber. The theoretical slopes k-3/5, k-2, and k-4 are drawn for comparison. To compare with a product with a more detailed representation of fine scales we have added the high resolution (1km) MUR dataset.

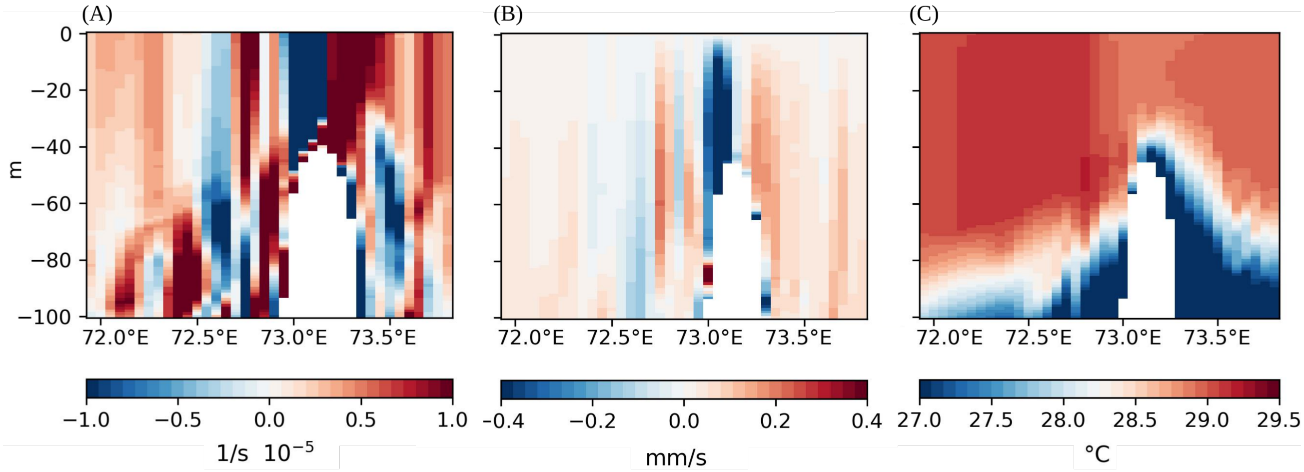

Fig. S4 Vertical transects crossing the atoll of Thaa (marked in figure ??B) for an instant in February 2013 from the 5km resolution simulations. (A) Horizontal divergence, (B) vertical velocity (positive upwards), (C) temperature.

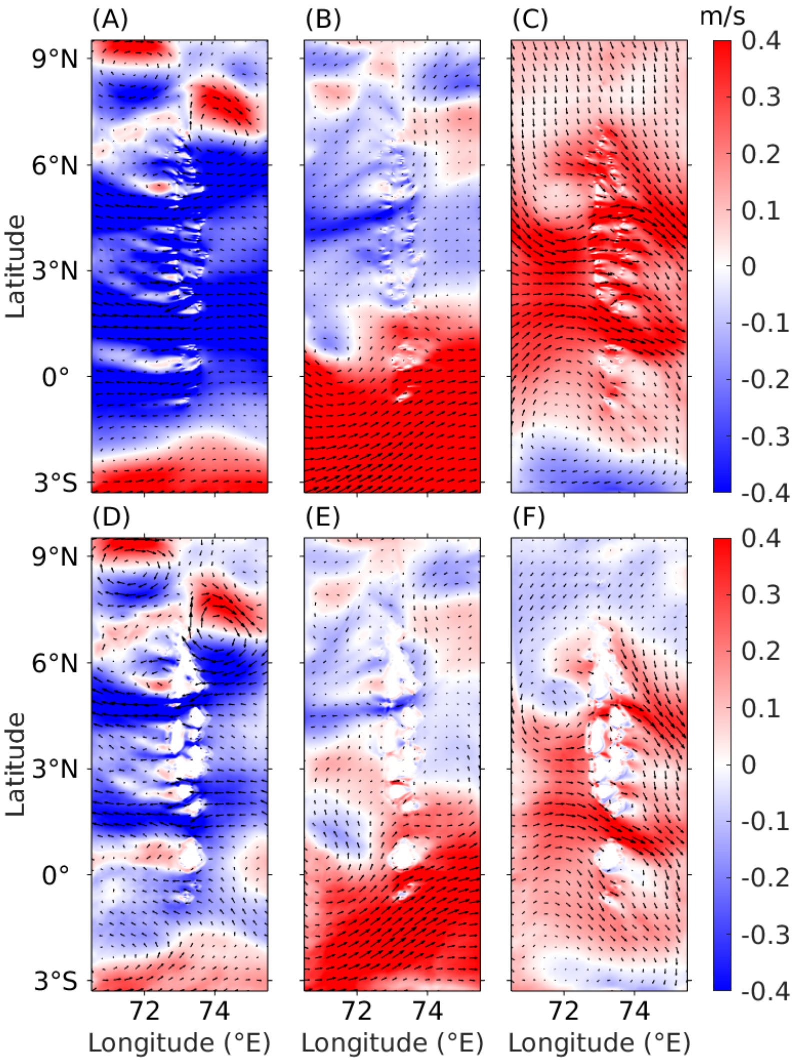

Fig. S5 Average zonal velocity magnitude (colorscale) and velocity vector (arrows). Surface: panels A,B,C and at 80 m depth: panels D,E,F. The averages are computed over the first 15 days of (A,D) February, (B,E) April and (C,F) June 2013.

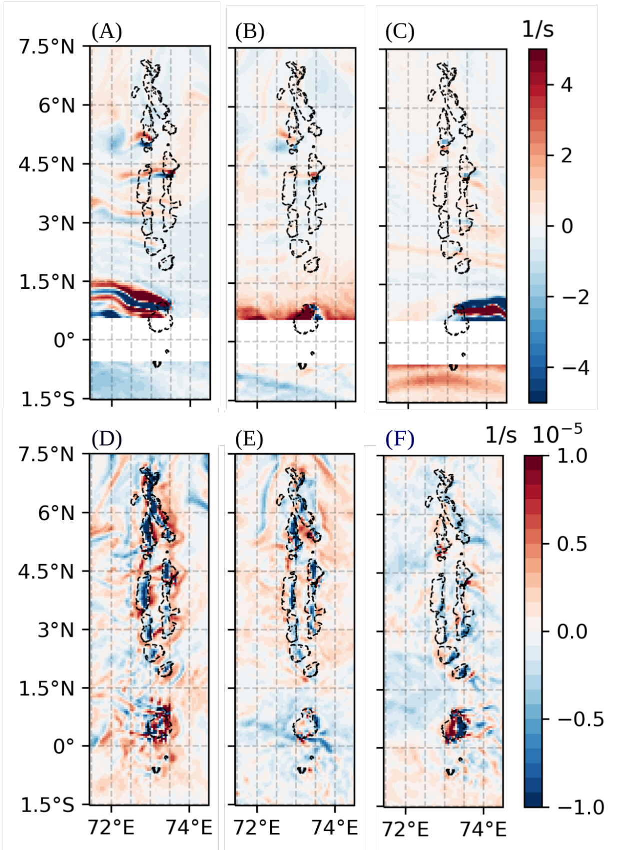

Fig. S6 (A),(B),(C): instantaneous snapshots of surface relative vorticity normalized at each latitude by the Coriolis parameter to visualize the local Rossby number $Ro = |vorticity|/f$. The latitudinal band around the equator is removed; (D),(E),(F): instantaneous lateral divergence at the ocean surface, 5 km resolution runs. Left column is for mid February, middle column for mid April and right column for mid June 2013.

References

[1] NASA/JPL. GHRSST Level 4 MUR Global Foundation Sea Surface Temperature Analysis (v4.1) (2015). URL http://podaac.jpl.nasa.gov/dataset/MUR-JPL-L4-GLOB-v4.1.