Numerical simulation of eddies in the Bay of Bengal and role of Andaman Islands

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We Simulate numerical eddies in the Bay of Bengal (BoB) using an ocean general circulation model (OGCM) called Regional Ocean Modeling System (ROMS). Eddy detection and tracking algorithm (Mason et al., 2014) applied to the sea level anomaly (SLA) using satellite observations and ROMS.

Objective:

(1) Eddy statistics in the BoB using ROMS.

(2) Role of Andaman islands in the formation of eddies in the BoB.

Numerical experiments

(1) ROMS is forced by the 6 hourly atmospheric fields from Global Forecast System (GFS) at a horizontal resolution of 0.25°, obtained from NCMRWF (http://www.ncmrwf.gov.in/t254-model/t254_des.pdf; Prasad et al. (2011)) and it is initialized using the solution of INCOIS-GODAS (Ravichandran et al., 2013) from 01 January, 2010.

(2) In order to identify the role of Andaman and Nicobar islands, we have removed the islands from the model grid (hereafter $ROMS_{NAI}$).

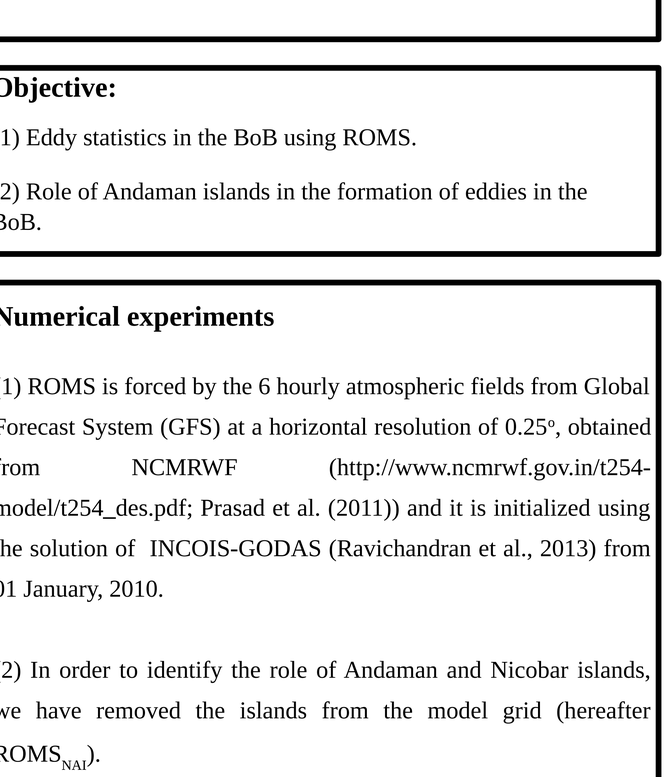

Figure 1: Location of interest (square box) in the Bay of Bengal (BoB). Colour level Shows ocean depth in m.

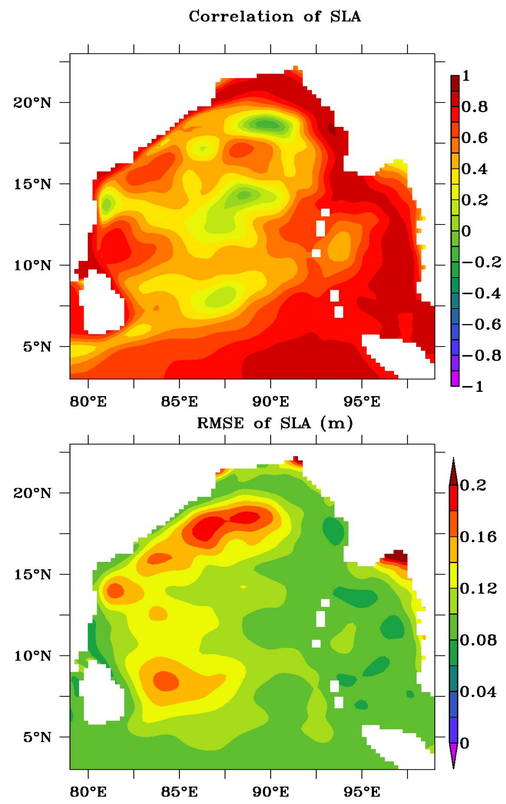

Figure 2: Correlation and RMSE (Root Mean Square Error) between ROMS and altimeter SLA.

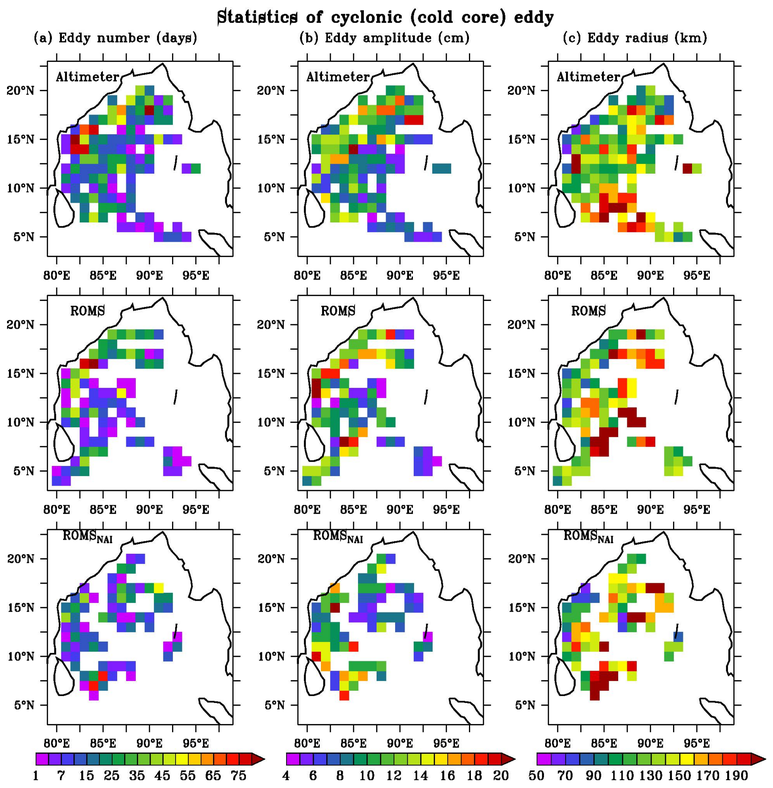

Figure 3: (a) Comparison of cyclonic eddy number among altimeter, ROMS and $ROMS_{NAI}$. (b) Average eddy amplitude comparison among altimeter, ROMS and $ROMS_{NAI}$. (c) same as (b), but for eddy radius.

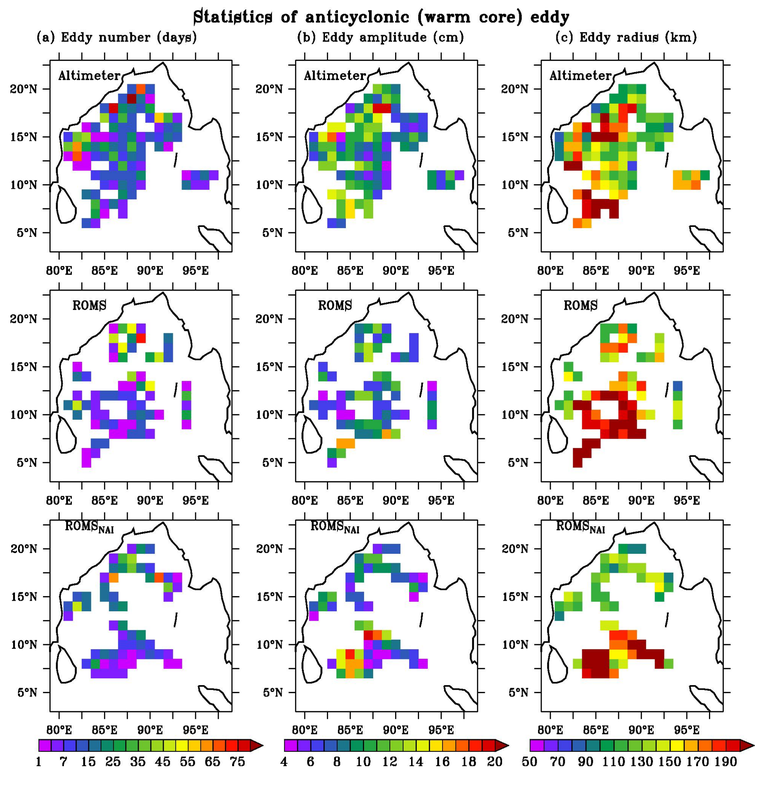

Figure 4: Same as Figure 3, but for anticyclonic eddy.

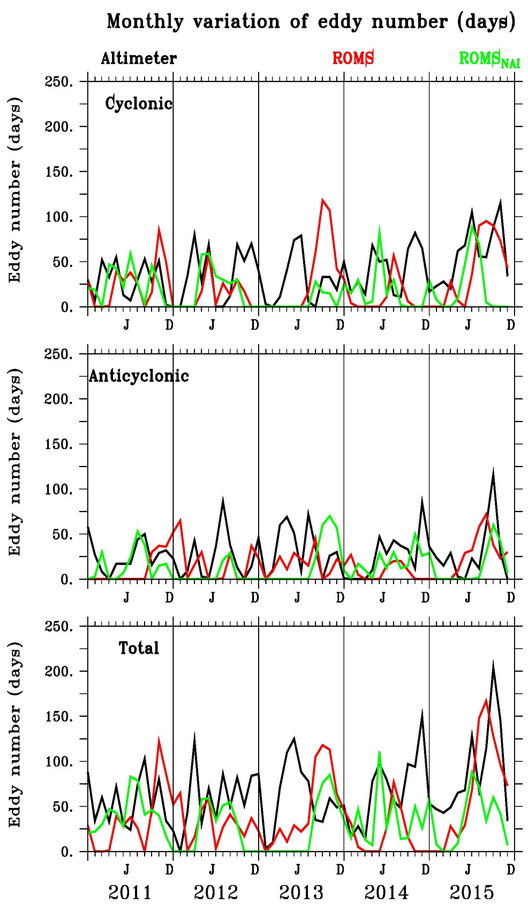

Figure 5: Monthly variation of eddy number during January 2011 – December 2015 for cyclonic (top panel), anticyclonic (middle panle) and total (bottom panel). Black, red and green line shows altimeter, ROMS and ROMS model with no Andaman islands ($ROMS_{NAI}$).

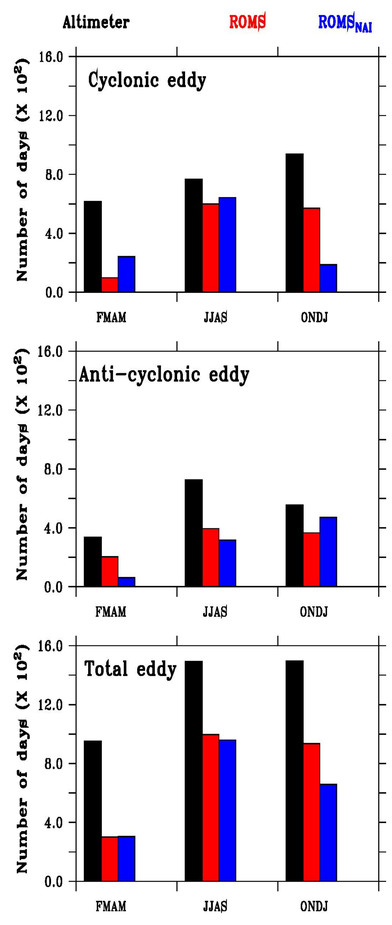

Figure 6: Histogram shows seasonal variation of eddy number between January 2011 – December 2015 for cyclonic (top panel), anticyclonic (middle panle) and total (bottom panel). Black, red and green line shows altimeter, ROMS and ROMS model with no Andaman islands ($ROMS_{NAI}$).

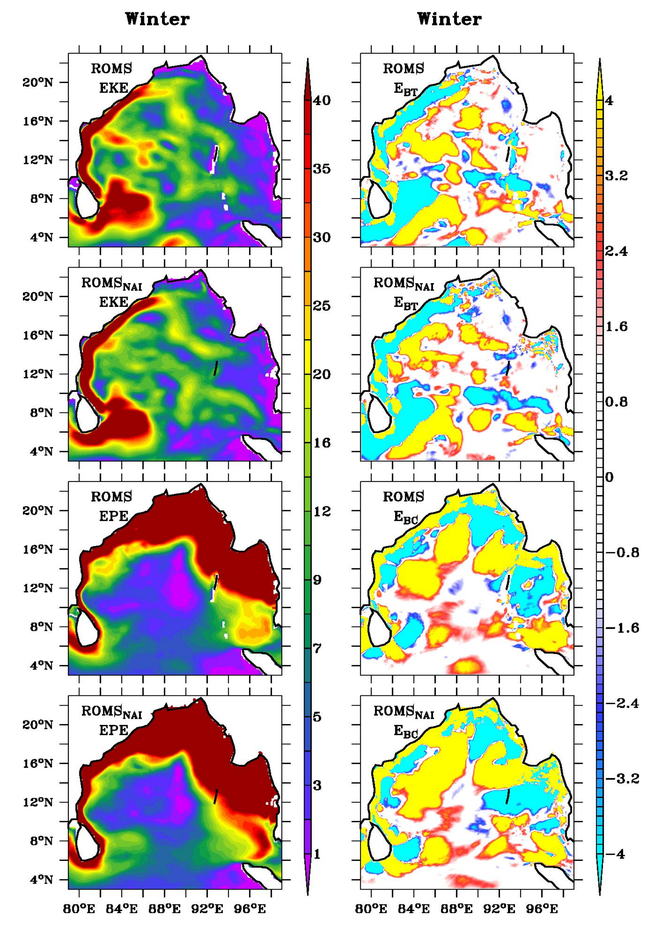

Figure 7: First column shows for climatological winter the eddy kinetic energy (EKE, 10^{-3} $m^2 s^{-2}$), Eddy potential energy (EPE, 10^{-3} $m^2 s^{-2}$). Last Column shows for climatological winter the barotropic instability (E_{BT}, 10^{-3} $m^2 s^{-2}$) and Baroclinic instability (E_{BC}, 10^{-3} $m^2 s^{-2}$).

Summary :

(1) We have found a strong region of eddy formation in the central part of the western boundary of the Bay of Bengal (WBoB) compared to northen and southern.

(2) High eddy amplitude and radius for both cyclonic and anticyclonic eddy are observed in the interior BoB compared to WBoB. Total eddy number is high during summer and winter compared to spring.

(3) The performance of the ROMS are better in simulating mesoscale (radius and amplitude of the eddies are more than 50 km and 4 cm respectively) cyclonic eddies compared to anticyclonic.

(4) Andaman and Nicobar islands in the interior BoB play an important role in the cyclonic eddy formation during winter compared to summer and spring. Eddy to mean energy conversion suggest that this is due to formation of high EKE using barotropic instability.