Eddy Detection and Tracking

The oceanic eddy parameter information was prepared 1993 – 2020 over Global Ocean using AVISO data. Merged and gridded satellite altimeter product of sea surface height (SSH) anomaly at 7-day interval having special resolution of 0.25^o has been used for present study. Mesoscale oceanic eddies have been identified and tracked in weekly merged altimeter product of Sea Surface Height (SSH) from AVISO. Eddies have been identified based on closed contour approach followed by shape criteria (Chelton et al. 2011 and Mason et al. 2014). An automated tracking algorithm has been employed to track these eddies with different lifetime. The trajectories of eddies have been computed from their time history. Present method has been used separately for cold core and warm core eddies.

The important steps of the eddy detection and tracking method is explained below,

1. Remove the long wavelength (consider 50-500 km scale)
2. In a region that is defined by a set of connected pixels a pixel is interior to the region if it's all the four neighbours (top, bottom, left and right) lie within the region.
3. An eddy is defined as a simply connected set of pixels. The closed contours Cc are sequentially identified and analysed.
4. Identifying outer most closed contour of SSH anomaly.
5. For a closed contour Cc to be potentially defining an eddy, it must satisfy following criteria:
    - All the pixels interior to the region are above (below) a given SSH threshold for anticyclonic (cyclonic) eddies.
    - The connected region should have at least 8 and maximum 1000 pixels.
    - There should not be more than one local maximum (minimum) of SSH for anticyclonic (cyclonic) eddies
    - The amplitude of eddy should be at least 1 cm.
6. Eddy amplitude for anticyclonic eddy, A = hmax-ho and for cyclonic eddy, A = ho-hmin
7. For an anticyclonic (cyclonic) eddy, the eddy is identified first by getting the maximum (minimum) value of SSH in the given eddy region enclosed within contour marked in blue (Ceff).
8. With Ceff as the contour, area of the enclosed region is calculated by summing the area of individual pixels within the blue contour.
9. In the next step this area is used to calculate the radius of a circle.
10. With this radius one can get the outer contour of the circle (Ctrk) and new centre (Ptrk) of the eddy. The new centre Ptrk is used to track the eddies with sequential SSH anomalies maps.
11. Eddy at time t, only those with amplitude and area lying between 0.25 and 2.5 times those of reference eddy are considered at time t+1.

12. The eddies which are not tracked in the next time step are considered to be dissipated.
13. The eddies were not present in the previous time step and have been detected in the present image are the ones which are new born.

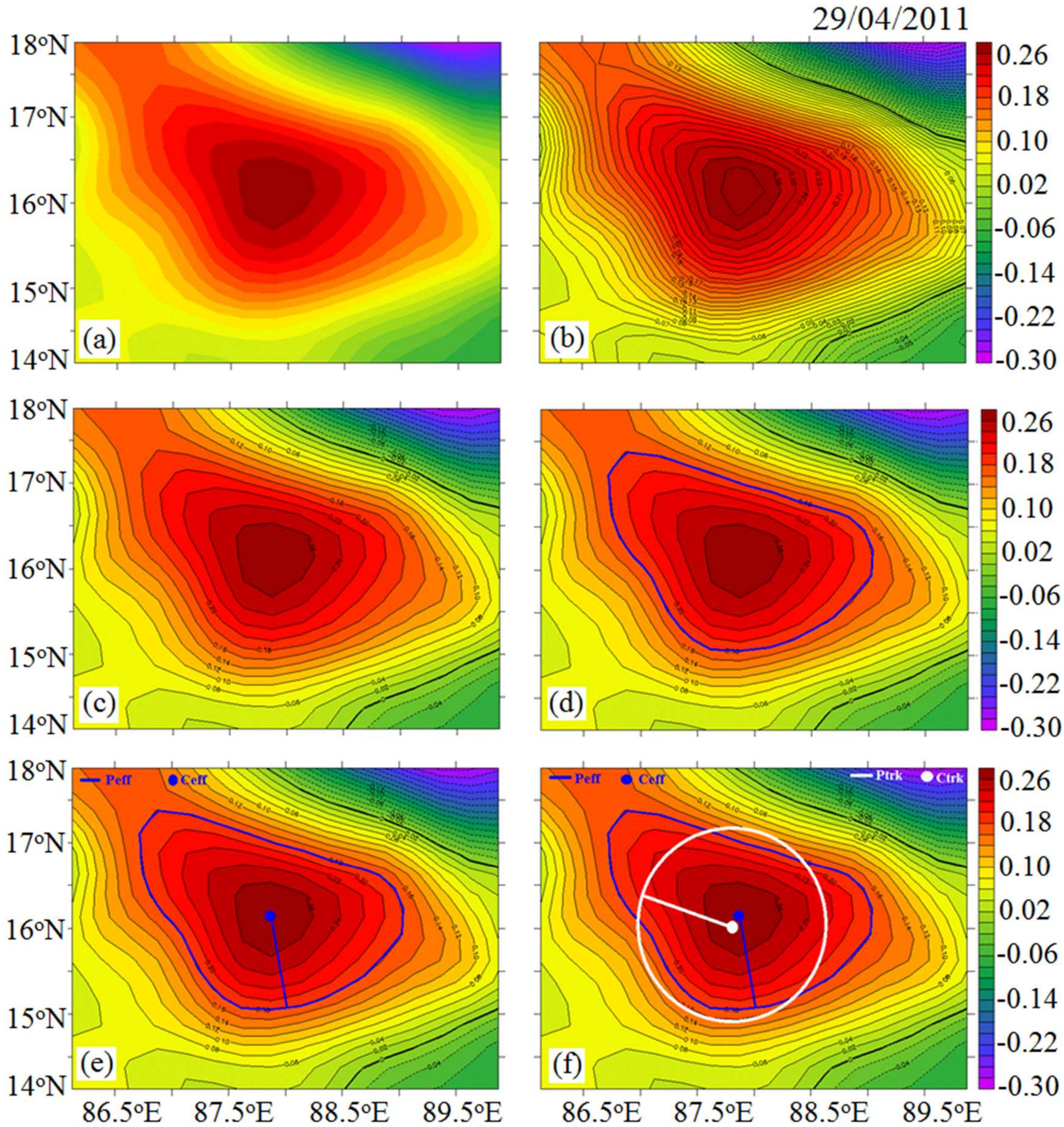

Figure: Different steps of eddy detection and tracking from SLA

We have detected eddies using the combination of two sets of threshold for amplitude and size

Region	Amplitude threshold (m)	Size threshold(km)
Tropics (15ºS to 15ºN)	0.02	600
Outside Tropics	0.05	400

References

- *Mason, E., Pascual, A., & McWilliams, J. C. (2014). A new sea surface height–based code for oceanic mesoscale eddy tracking. Journal of Atmospheric and Oceanic Technology, 31(5), 1181–1188.*
- *Chelton, D. B., Schlax, M. G., & Samelson, R. M. (2011). Global observations of nonlinear mesoscale eddies. Progress in oceanography, 91 (2), 167–216.*