Characterization of the East India Coastal Current using a Drifter, HF Radars and Altimetry during October – November 2015

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Abstract

This study presents the characterization of the equatorward propagating East India Coastal Current (EICC) using a drifter during October – November 2015 (source: NOAA) and the coastal High Frequency Radars (source: INCOIS and NIOT, India). The altimetry-derived sea surface height anomaly (SSHA, source: AVISO) and geostrophic currents indicate that the EICC is associated with three mesoscale cyclonic eddies along the western Bay of Bengal (BoB). The drifter follows the edges of these eddies (~0.12 m SSHA contour) on the inshore part of the EICC. The drifter currents are validated with the geostrophic currents (daily) as well as the HF Radar-derived surface currents (three hourly). The speed of the EICC is less (~ 0.6 m/s) on the north-western BoB, which increases to ~ 1.0 m/s in the western-central regions and further reaches to ~1.4 m/s at southern BoB. The comparison of drifter and daily geostrophic currents show higher correlation (~ 0.93) and lower errors (~0.16 m/s) when the drifter track is away from the coast, whereas, comparatively lower correlation (~ 0.41) and higher errors (~0.43 m/s) is observed when the track is near the coastline. This mismatch very near to the coasts is possibly due to the low quality of altimetry datasets. The drifter passes through the three HF Radar domains along the Indian coast of the BoB. The comparisons with HFRs indicate reasonable correlation (0.76, 0.71) and errors (0.19 m/s, 0.32 m/s) at the Odisha and Tamil Nadu coast.

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ABSTRACT

The East India Coastal Current (EICC) flows along the western boundary of the Bay of Bengal (BoB), which has a characteristic feature of flowing, equatorward during October – December. This study presents the characterization of the southward EICC from multiple observational platforms during October – November 2015. The various datasets include a drifter, the coastal HF Radars and the altimetry-derived sea surface height anomaly (SSHA). A steady rise in the EICC speed has been observed as it propagates towards the southern BoB.

INTRODUCTION

- The circulation pattern along the wBoB consists of the northward flowing WBC during Mar – May [1, 2, 3] and the southward flowing EICC during Nov – Dec [4, 5, 6, 7]. EICC plays a crucial role in maintaining the freshwater balance along the western and northern BoB and exports the low saline water from BoB to AS [8].
- The circulation pattern in the BoB is mainly influenced by the winds, and the coastal Kelvin and Rossby waves (remote forcings from the equator) [9].
- Recently, the HF Radar currents are used to describe the coastal circulation pattern [3, 7, 10], track the propagation of eddies [6] and inter-seasonal variability of tidal currents along western BoB [7].

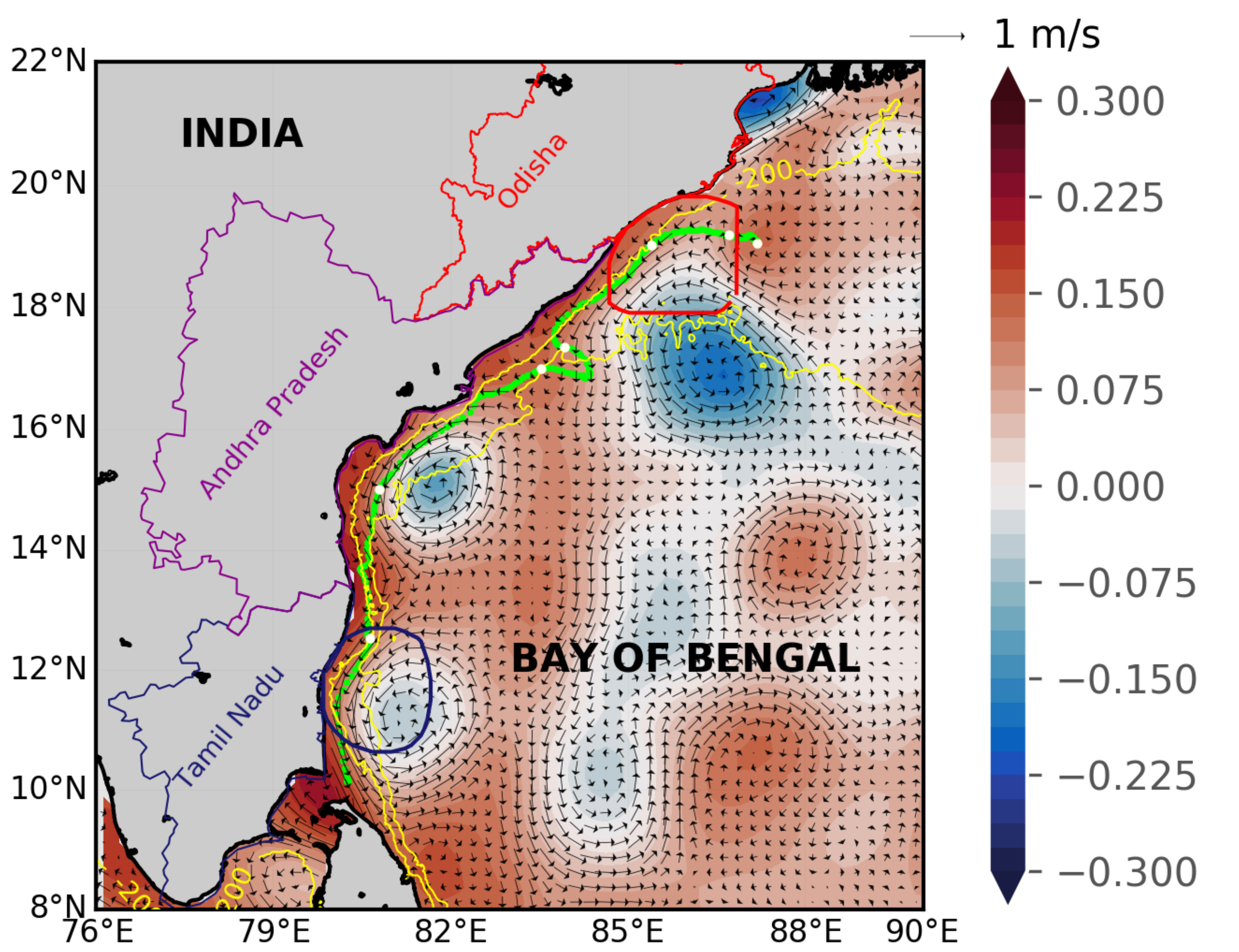

Fig . 1: The map shows the track of drifter during 20th Oct to 22nd Nov 2015 (lime). Yellow lines denote the -200 and -2500m isobaths from GEBCO. The shaded background shows the monthly averaged SSHA during the time period. The HFR domains are shown in color of their state boundaries.

DATA AND METHODOLOGY

Instrument	Parameters Used	Resolution
Drifter (NOAA)	U,V	3 Hourly
HF Radar (INCOIS and NIOT, India)	U,V	1 Hourly
Altimetry (AVISO)	SSHA, U, V	0.25° (daily)

- Inter-validation of the near-surface drifter currents (Fig. 1), HFR surface currents and geostrophic currents at multiple time scales using collocation methodology.
- Spatio-temporal variability of the southward flowing EICC.

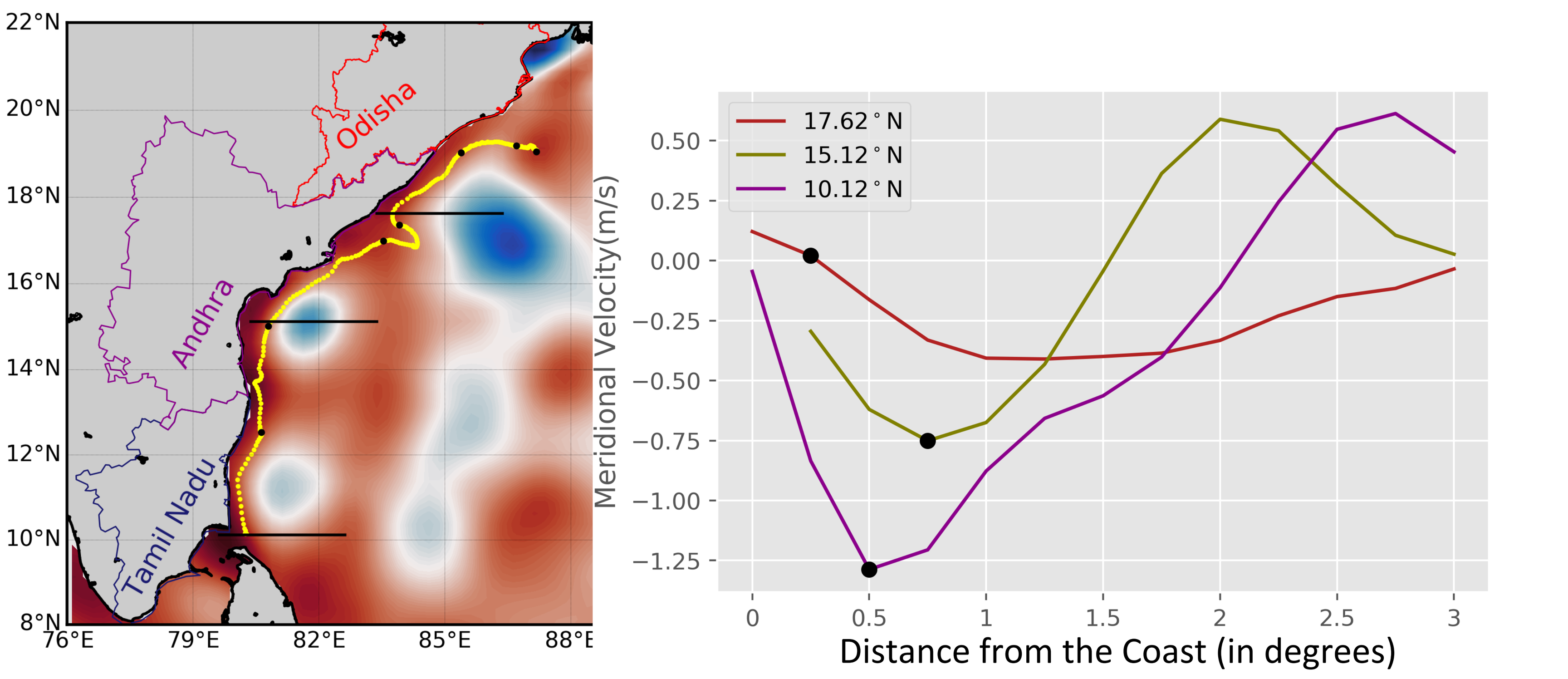

Fig . 2: Domain and sections selected to study the EICC and the presence of eddy using meridional geostrophic current. Black dot represents the location of drifter on the different transacts to show the meridional current variability along the different latitudes (right panel).

RESULTS AND DISCUSSION

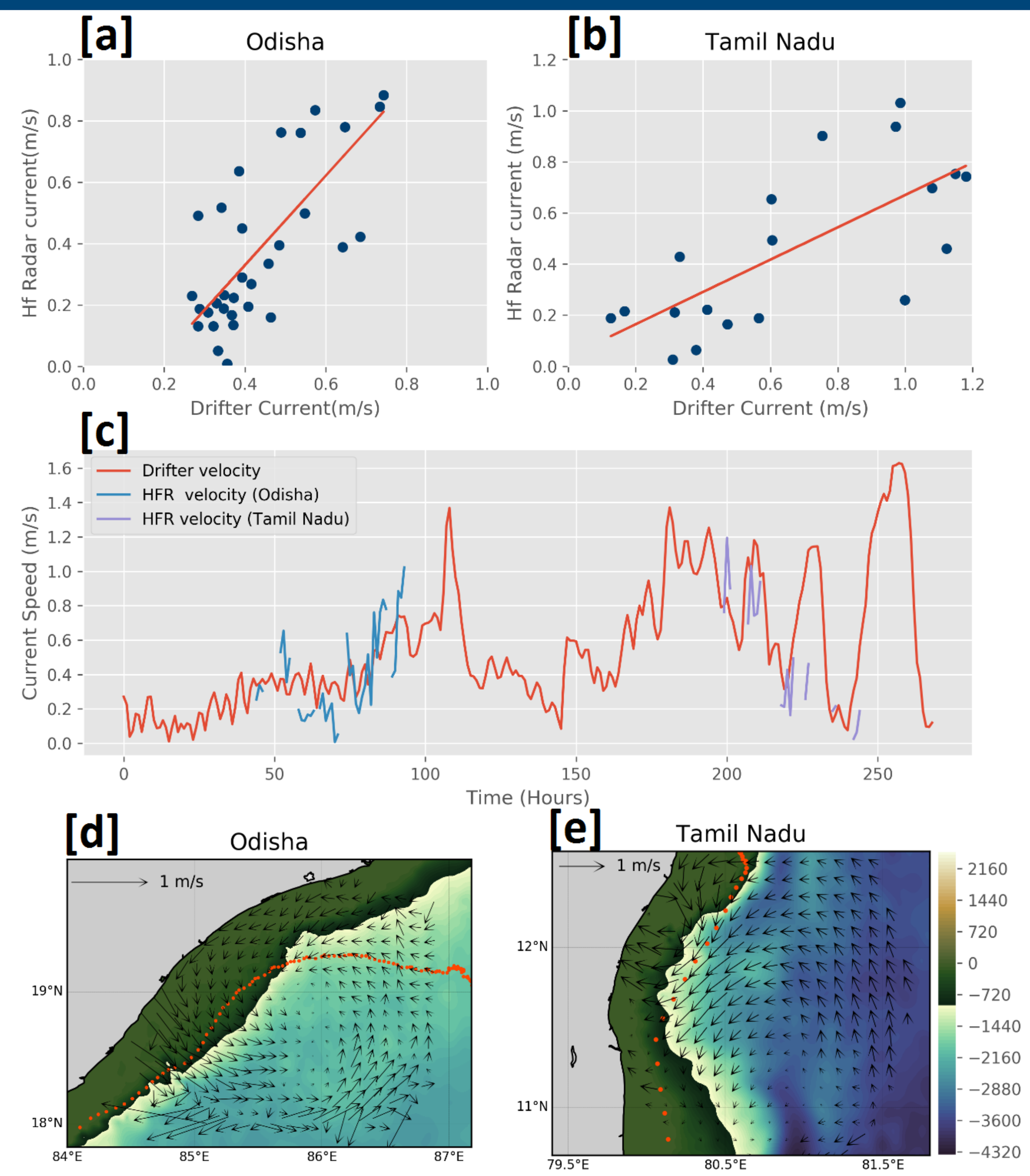

Figure 3: The scatter plot of Drifter currents with HFR currents at (a) Odisha Coast and (b) Tamil Coast. The red line represents the best fit line (c) The time series comparison of current speed (m/s) the different HFR domains. The mean circulation pattern from the HFR surface current, when the drifter passed (d) through the Odisha coast during 24-Oct-2015 to 01-Nov-2015, and (e) through the Tamil Coast during 16-Nov-2015 to 22-Nov-2015. The red dots indicate the drifter locations in the HFR domains.

CONCLUSIONS

- The surface currents from the drifter match well when compared with HFR surface currents with a correlation coefficients of 0.76 (0.71) and RMSE of 0.19 (0.32) m/s at the Odisha (Tamil Nadu) coast (Fig. 3a and 3b).
- Along the north-western BoB, drifter current speed of ~0.4 m/s at the offshore regions (Fig. 3c) is observed.
- As the current flows to the Odisha coast, the current speed has increased to 0.65 m/s as observed both from the drifter and HFRs (Fig. 3d).
- A steady and eventual increase in drifter velocity is observed along the Andhra Pradesh coast (~1.0 m/s) along with the signatures of another cyclonic eddy (Fig. 2 and 3c).
- Further, the drifter got advected towards the Tamil Nadu coast in the HFR domain with the current speed of ~1.4 m/s (Fig. 3c and 3e), which is supported by both the HFR and altimetry currents (Fig. 2).

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