

Interactive comment on “An Undercurrent off the East Coast of Sri Lanka” by Arachaporn Anutaliya et al.

Anonymous Referee #1

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Modelling studies have shown the existence of seasonal undercurrents along the east coast of Sri Lanka, and a few papers have explained the possible reasons that lead to the formation of these undercurrents. However, there were hardly any data available to validate the subsurface flow seen in these models. The present study describes the undercurrent off the east coast of Sri Lanka using both observations and models. The authors follow the data and method from Wijesekra 2015 and Lee 2016 to examine the characteristics of undercurrents, particularly at 8N. (The two papers focused on the surface circulation along the east coast of Sri Lanka.)

The highlight of this manuscript is the description of the undercurrents for the first time using available observational data. The authors further examine the spatial variation of the undercurrent using the model data.

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Specific Comments:

1. P4 L1-12. The level of no motion for the calculation of geostrophic velocity is not very clear here. If the level of no motion was picked at 1000 m, where the currents are relatively strong, there would be a bias in the geostrophic calculations. The motion would be more relative and not absolute.
2. Page 4, L2. Though the structures are in good agreement, there are differences in the intensity. For example, the offshore currents are very weak in the model, especially during March.
3. P4, L12. The undercurrents are confined to west of 82.5E only for the month of March. During June, it extends till 83.5E. That should be roughly 180 km wide. I would say that the under currents are broader during summer compared to spring. Also, why is the width of undercurrents kept as 140 km in the abstract? The value is never mentioned in the text anywhere. Same goes for the maximum speed of 45 cm/s.
4. P4, L35. The strongest southward undercurrent during March-April is not very evident in the observations, especially in the glider data. For the CTD-Argo data, there is no evident undercurrent in April, when the strongest sub-surface flow is observed.
5. P4, L35. In the previous line, it is mentioned that the core of the undercurrent is observed at around 300 m. All of a sudden, without any justification, the undercurrents at 729 m is shown to highlight the spatial circulation. As the core of undercurrent changes from season to season, a decent justification should be provided to pick the 729 m depth. How different is the circulation at 729 m from that of 300 m?
6. P5, L1-11. The evidence of upward phase propagation (generally implies remote forcing) is not highlighted here. The phase propagation is possibly caused by interior Ekman pumping (McCreary et al. 1996, Fig 6c), and is not observed during spring. Note that the propagation is not evident in the CTD/Argo data though.
7. P6, L19-22. Why is the statistics presented only for fall and winter? Please show for

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other seasons too and tabulate them.

8. P6, L1. How does undercurrent play an important role in salt exchange, when it is mentioned later in the text that its contribution is only 1% of the total salt transport in BoB? This is even mentioned in the abstract. The statement should be made more clear.

9. P7 1-12. What is the surface current transport, undercurrent current transport, and the total transport at 8N? Please quantify them. Do undercurrents roughly follow the total transport or not? Try replicating Figure 4 of McCreary et al. (1996) at 8N. The ship drift velocity could be replaced with the undercurrent velocity or transport. I'm curious. Because, the transport reverses during the summer monsoon along the east coast of India and not the surface circulation (McCreary, 1996). Therefore, the surface currents have a strong annual cycle, whereas the transport has a semiannual cycle. Is the reverse true here?

10. P7 14-25. Why is the comparison made between Mindanao undercurrent (which in the Pacific Ocean)? Undercurrents are present all around the world. A general comparison would have made more sense. I would have preferred a comparison with the undercurrents observed along the east coast of India. The dynamics of both these regions are interlinked. For example, direct current measurements show that the seasonal undercurrents are not very prominent (in the top 300 m) north of 12N (See Mukherjee et al. 2014) along the east coast of India. The undercurrents at 12N are evident at a shallower depth and are present because of strong upward phase propagation. A similar comparison with earlier hydrographic observations could also be made where the transport estimates are available.

11. Theoretical studies have shown a presence of undercurrents during the winter (McCreary et al. 1996). This difference has not been highlighted well in the study. The absence of the winter undercurrent leads to an annual cycle, which is in contrast to surface currents, where the semi-annual component is prominent. Note that the winter

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undercurrent is present in the CTD-Argo data implying the presence of semi-annual cycle during some years. This point is not mentioned in the text.

12. It would be good to summarize the characteristics of undercurrents in a table. For example, you could divide the columns into seasons and mention the transport estimates, maximum current velocity, depth of the maximum velocity, and their necessary statistics (from both observations and model).

13. The discussion section, in general, could be improved.

The authors should further note that currents along the coast of Sri Lanka are complex. The complexity arises because the contribution from each of the forcing varies from year to year. For example, the climatology of alongshore currents from ship drift data show equatorward flow south of 8N (Mukherjee et al 2014), and the satellite data shows an annual cycle both south and north of 8N (Mukherjee et al 2014, Lee et al 2016). It's around 8N that the semi-annual cycle is more evident and this location may not represent the actual circulation along the entire Sri Lankan east coast.

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