Impact of a Natal Pulse on the Surface Dispersion in the Natal Bight

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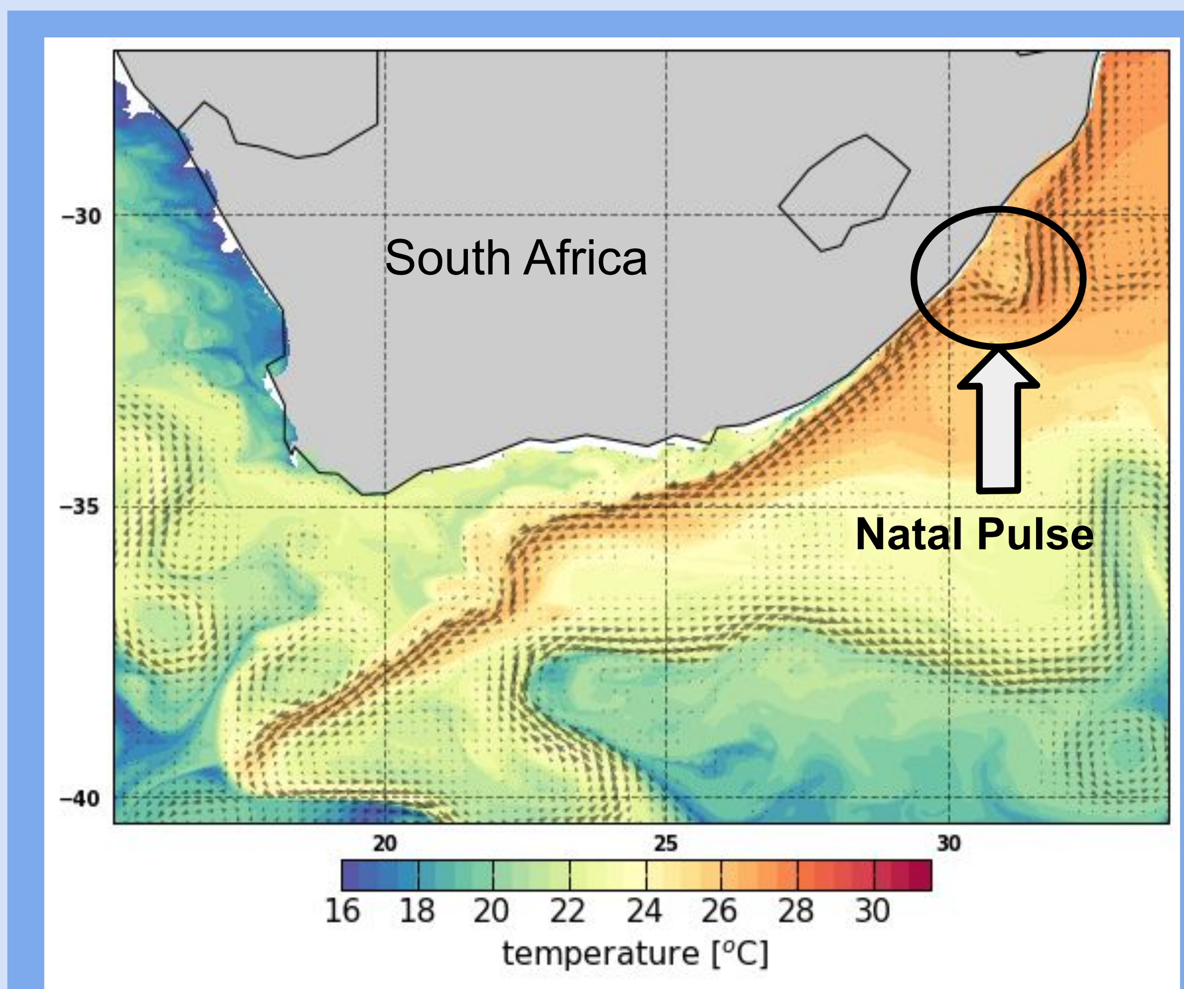


Figure 1: Model SST maps showing the meandering Agulhas Current on the 21st February 2012, which was selected for the particle tracking experiments. The grey arrows indicate the velocity fields of the current. No arrows were plotted for the data points at which the speeds were less than 0.2 m/s.

1. Introduction:

The KwaZulu-Natal (KZN) Bight has a widened shelf resulting in features such as upwelling cells and water retention, which create favourable conditions for recruitment. To protect this biologically important region, several marine protected areas (MPAs) have been established, including the iSimangaliso and the uThukela Banks MPAs.

The CAPTOR (Connectivity And disPersal beTween prOtected aReas) project aims at gaining a better understanding of the connectivity between these MPAs and this research will contribute to their information gathered. All of these MPAs have a close proximity to the Agulhas Current, which therefore has an influence on their connectivity. The current is generally remarkably stable, but undergoes large meanders known as Natal Pulses roughly 4-5 times a year.

2. Research question:

How do the particle dispersion pathways in the KZN Bight differ in a meandering compared to a steady Agulhas Current?

3. Data and Method:

- CROCO model (1/36° spatial resolution) for the virtual particle tracking
- Virtual particles released in the iSimangaliso MPA, then drift 32 days in a stable vs meandering Agulhas Current. Investigated what percentage moved inshore and their residence times.
- Comparable observational dataset: Global drifters (NOAA) and coastal drifters (from the CAPTOR project and Guastella study [1])

4. Results:

- Close to half of the virtual particles **(49.83 %)** end up on the shelf (inshore of the 200m isobath) when the current is **stable** (figure 2a).
- Fewer of the virtual particles move inshore of the 200m isobath **(9.52%)** when the current is **meandering** (figure 2b).
- The average virtual particle spends **7.71 days** on the shelf when the current is **stable**. Retention is strongest on the shelf (figure 3a).
- When the current is **meandering**, the average particle spends **6.94 days** on the shelf. Retention is strongest on the shelf (figure 3b).
- **Overall:** A stable current is more favourable for recruitment and has a stronger connectivity between the MPAs. It also allows more virtual particles to move onto the shelf and they have a longer average residence time on the shelf.

Figure 2: The trajectories of the virtual particles. Blue particles went inshore of 200m isobath and particles that went inshore of the 1000m isobath are either blue or red. The remaining particles are green. All the particles were released in the black box within the iSimangaliso MPA. In 2a, the current is stable (March 2014) and in 2b it is meandering (February 2012).

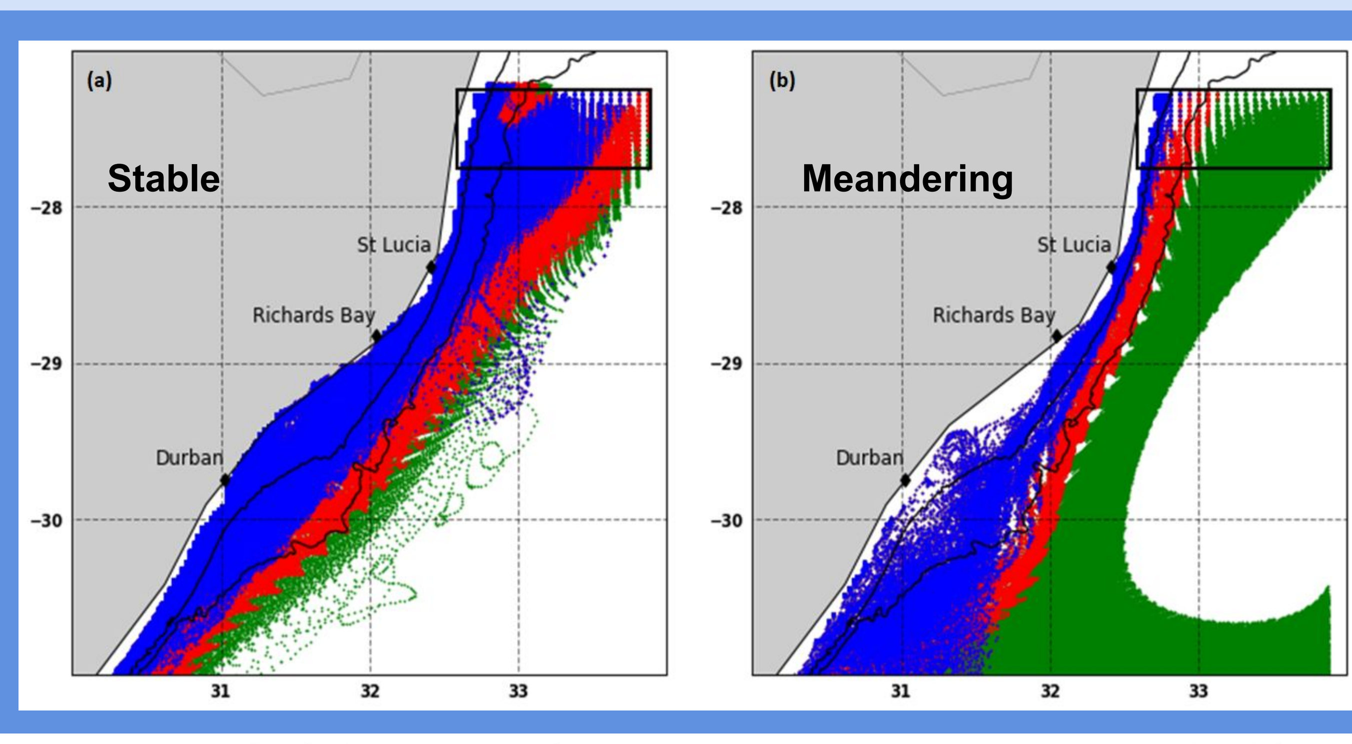
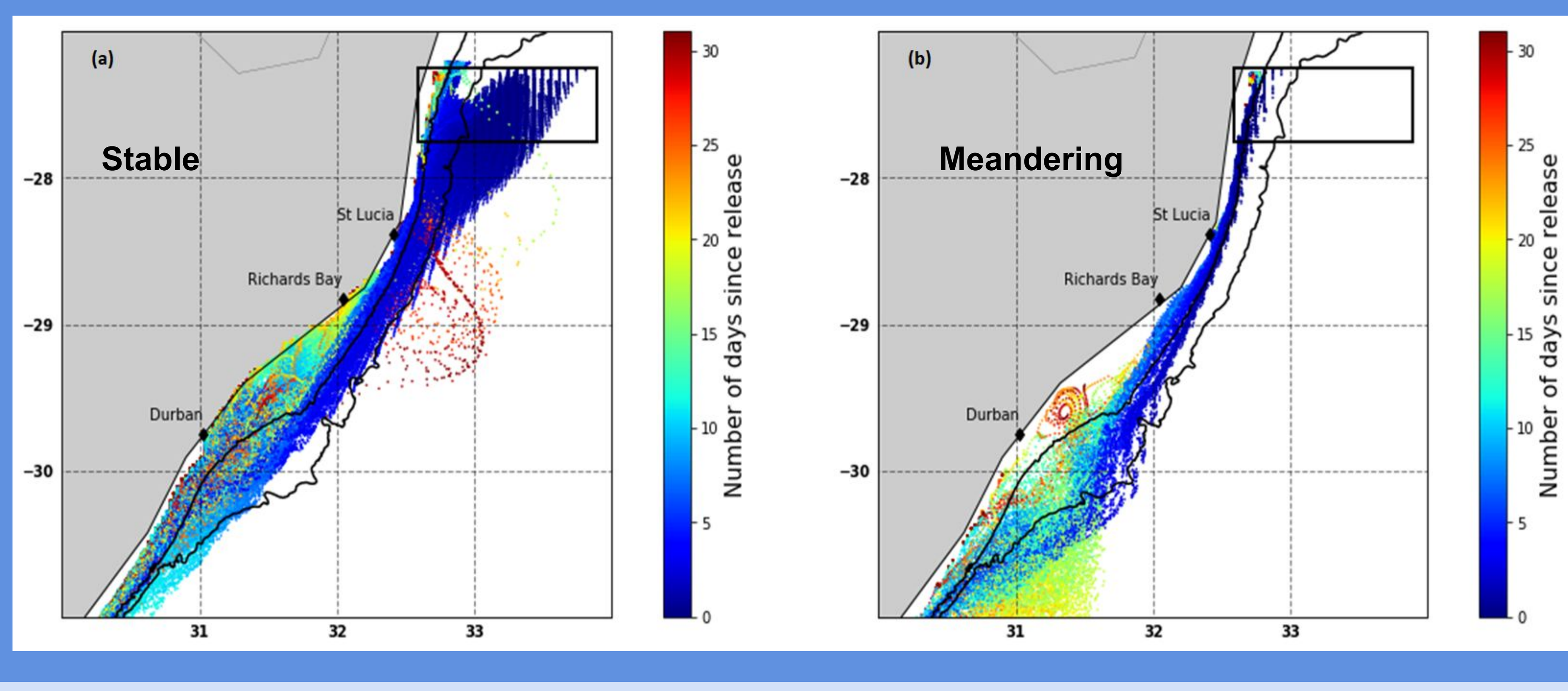


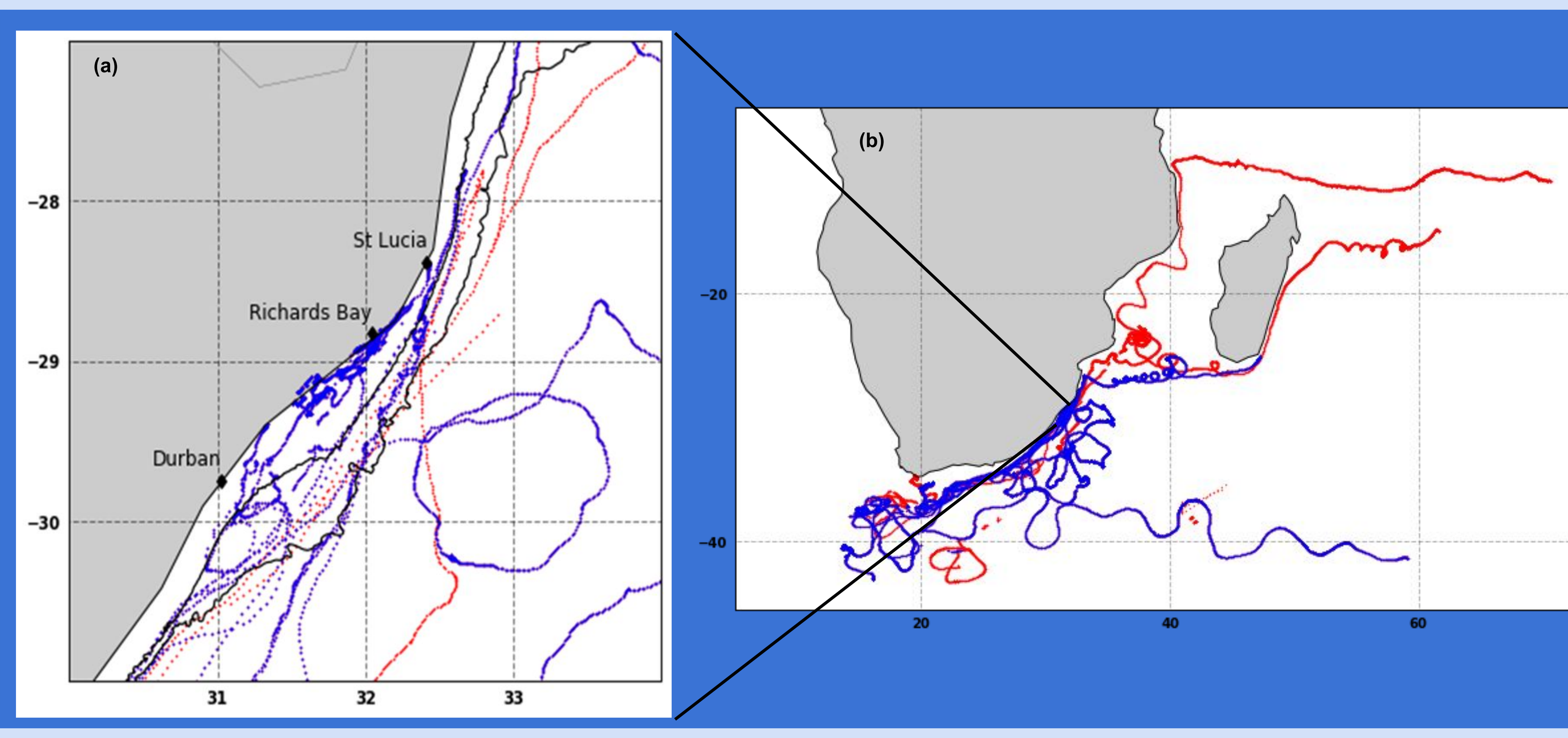
Figure 3: The virtual particles that move inshore of the 200m isobath. The trajectories are colour coded by the time in days that the particles spend in the water after being released. The particles are blue on the day on which they were released and on the last day of the month, the particles are red. The black box is the box in which the virtual particles were released. In 3a, the current is stable (March 2014) and in 3b it is meandering (February 2012).



5. Future Work:

- Increasing available drifter dataset, because only 16 drifters moved inshore of the 1000m isobath (figure 4)
- Investigating virtual particle depths and speeds
- Taking wind datasets into consideration
- Comparing multiple steady and meandering Agulhas Current examples

Figure 4: The trajectories of drifters passing the KZN Bight region. The pathways of drifters that went inshore of the 200m isobath are blue while the pathways of drifters that went inshore of the 1000m isobath, but not inshore of the 200m isobath, are red. 4a is a zoomed in map of 4b, which shows their whole pathways.



Reference:

[1]Guastella, L.A. and Roberts, M.J., 2016. Dynamics and role of the Durban cyclonic eddy in the KwaZulu-Natal Bight ecosystem. African Journal of Marine Science, 38(sup1), pp.S23-S42.

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