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Persistent Early Retroflection of the Agulhas Current: Hysteresis?

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In late 2000, the Agulhas Current moved into a state of exceptionally early retroflection. Normally, the western terminus of the current shifts fairly regularly between $21^{\circ}E$ and $15^{\circ}E$ where Agulhas Rings are shed in to the Atlantic. The early retroflection moved the retroflection loop several hundred kilometers east, to around $26^{\circ}E$. More spectacular, the current remained in this position for about half a year, and the formation of Agulhas Rings was suspended during this period.

Here, we hypothesize on the mechanisms of (1) the formation of the early retroflection, and (2) its persistence. In the formation, an anomalous train of dipole eddies formed at the southern tip of Madagascar seems to play an important role. The persistence of the early retroflection may be attributed to the hysteresis found in the behavior of western boundary currents encountering a gap in the coastline [Sheremet, JPO 2001]. Leaping of the 250 km gap km between the African continental shelf and the Agulhas plateau to the South is, once realized by external forces, relatively easily maintained by the inertia of the Agulhas current. Considerable weakening of the current or an external force is needed to return the system 'back to normal'.

The existence of a relatively stable 'early retroflection' state may be of relevance in explaining the observed variability in the Indian-Atlantic Ocean exchange. It offers an alternative mechanism by which such variability may be achieved, not requiring a large shift in the positions of the frontal regions.