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Influence of the Agulhas Current on the physical oceanography of the southeast African shelf

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The southeast African shelf is situated between the southeast coast of South Africa and the western edge of the Agulhas Current. Similar to the other western boundary currents of the world, the Agulhas Current strongly influences the oceanographic conditions of its adjacent shelf system. Limited societal drivers have resulted in an *in situ* sample deficit which has led to the majority of studies conducted in the region to have been carried out using satellite data and modelling. In this study, high-resolution *in situ* data, acquired during two hydrographic surveys in January/February (austral summer) and July/August (austral winter) 2017, were used to identify and characterise the physical oceanographic processes modifying hydrographic conditions on the shelf. The same five water masses, Tropical Surface Water (TSW), Subtropical Surface Water (STSW), South Indian Central Water (SICW), Red Sea Water (RSW) as well as Antarctic Intermediate Water (AAIW), were observed during each survey. Indications of seasonality in temperature and salinity, were observed in the upper water masses (TSW and STSW) but not within the deeper water masses (SICW, AAIW and RSW). The influence of river outflow on the nearshore upper waters, located in close proximity to the river mouth, was found to be more intense during January/February than in July/August. The Agulhas Current, as well as cyclonic mesoscale eddies along the inshore edge of the Current, were observed to strongly drive conditions on the shelf region during each survey. Three types of subsurface upwelling (i.e. divergence induced upwelling, Ekman pumping at the centre of cyclonic eddies and Ekman veering in the bottom boundary layer along the slope) were found to essentially prime the lower levels of the shelf with cold nutrient-rich water. The 'secondary pump' known as wind-driven upwelling, induced by offshore Ekman transport and vertical mixing, resulted in the surfacing of this cold (10-15 $^{\circ}$C) nutrient-rich water from below at several inshore sites. These processes, which introduce nutrient-rich water onto an essentially mesotrophic shelf, strongly influence ecosystem functioning, as evidenced by substantially higher chlorophyll a concentrations in response to upwelling induced by the cyclonic eddy during January/February 2017. While the observations of these processes along the southeast African shelf are not new, this study provides a description of the first high-resolution shelf wide hydrographic surveys of the region, setting a baseline of oceanographic conditions occurring on the shelf as well as the processes affecting it.