Geophysical Research Abstracts
Vol. 19, EGU2017-2236, 2017
EGU General Assembly 2017

Subsurface coherent eddies: Hypoxic stewpots and biogeochemical highways

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Extreme low-oxygen anomalies associated with subsurface (sub)mesoscale eddies have been the focus of recent observational studies. These anticyclonic eddies shed from the poleward flowing coastal undercurrents of the eastern boundary upwelling systems (EBUS) and subsequently propagate westward into the subtropical gyres. They are hypothesized to (i) trap and transport waters over long distances, and (ii) facilitate anaerobic processes outside the climatological boundary of oxygen minimum zones due to their low oxygen levels. Existing observations provide a glimpse of individual eddies, yet they do not allow a comprehensive census, nor a quantification of their effects. In this study, we use a high-resolution coupled model simulation to detect and track the subsurface eddies and estimate their large-scale effects on ocean biogeochemistry. Our results suggest that at the depth range they reside the eddies' effects are between O(1) and O(10)%, for instance the eddy-induced decrease of climatological oxygen. This is a systematic though not a first order effect. However, it may require parameterizations for non eddy-resolving models that aim is to capture the details of exchanges between EBUS and subtropical gyres, and the sub-surface oxygen and nutrient distributions of the low- to mid-latitudes.