Geophysical Research Abstracts
Vol. 17, EGU2015-7417, 2015
EGU General Assembly 2015
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Occurrence and characteristics of mesoscale eddies in the tropical northeast Atlantic Ocean

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Coherent mesoscale features (referred to here as eddies) in the tropical northeast Atlantic (between 12°N - 22°N and 15°W - 26°W) are examined and characterised. Surface signatures of eddies were analysed using an eddy detection method based on 18 years of satellite altimetry data. Mean spatial eddy surface pattern of satellite derived anomalies of sea level (SLA), sea surface temperature (SST), salinity (SSS) and chlorophyll concentration (Chl) were obtained from composites of all snapshots around identified eddy cores. Three types of eddies could be identified: anticyclones, cyclones and anticyclonic-mode-water eddies.

Anticyclones and cyclones can be distinguished due to their elevation/depression of SLA. In general, they are associated with warm/cold SST, reduced/enhanced Chl and enhanced/reduced SSS, respectively. However, 18% of all detected anticyclones show instead cold SST, enhanced Chl and reduced SSS. This kind of eddies are classified as anticyclonic-mode-water eddies.

For all types of eddies three main eddy generation regions in the coastal upwelling region associated with headlands are identifiable. From these three generation regions, almost all eddies propagate westward along corridors with distinct meridional deflection (anticyclones – equatorward, cyclones – poleward, anticyclonic-mode-water eddies - no deflection). The generation of eddies follows distinct seasonal cycles with anticyclones predominantly generated during late boreal summer, cyclones during boreal winter and anticyclonic-mode-water eddies during early boreal summer.

The mean vertical structure of the three eddy types was determined combining SLA eddy detection with all available in-situ temperature, salinity and oxygen profile data (Argo, ship, mooring data). Core depths of anticyclones/cyclones are at ∼50m/∼40m, respectively. The core depth of anticyclonic-mode-water eddies is at ∼70m depth with positive/negative density anomaly above/below its core depth. The mean oxygen profile for the different eddy types suggests that anticyclones (cyclones) transport waters with high (low) oxygen concentration. In anticyclonic-mode-water eddies extremely low oxygen levels reaching suboxic or close to anoxic conditions have been observed. These open-ocean low–oxygen zones can develop due to a combination of eddy dynamics and biogeochemical cycling. The available oxygen datasets indicate that eddies with exceptionally low oxygen concentrations at shallow depth are present in the latitude range from about 20°N to 5°N.