EGU General Assembly 2021

EGU21-12206
https://doi.org/10.5194/egusphere-egu21-12206
EGU General Assembly 2021

On the connection between coastal Ekman upwelling and wind-stress-curl-driven upwelling off the southwest African coasts

Mohammad Hadi Bordbar, Volker Mohrholz, and Martin Schmidt
Leibniz-Institut for Baltic Sea Research Warnemünde - IOW, Physical Oceanography, Rostock, Germany (hadi.bordbar@io-warnemuende.de)

Spatial and temporal variations of nutrient-rich upwelled water across the major eastern boundary upwelling systems are primarily controlled by the surface atmospheric flow with different, and sometimes contrasting, impacts on coastal and open-ocean upwelling systems. Here, concurrently measured wind-fields, satellite-derived Chlorophyll-a concentration along with a state-of-the-art ocean model simulation spanning 2008-2018 are used to investigate the connection between coastal and offshore physical drivers of the Benguela Upwelling System (BUS). Our results indicate that the spatial structure of long-term mean upwelling derived from Ekman theory and the numerical model are fairly consistent across the entire BUS and closely followed by the Chlorophyll-a pattern. The variability of the upwelling from the Ekman theory is proportionally diminished with offshore distance, whereas different and sometimes opposite structures are revealed in the model-derived upwelling. Our result suggests the presence of sub-mesoscale activity (i.e. filaments and eddies) across the entire BUS with a large modulating effect on the wind-stress-curl-driven upwelling off Lüderitz and Walvis Bay. In Kunene and Cape Frio upwelling cells, located in the northern sector of the BUS, the coastal upwelling and open-ocean upwelling frequently alternate each other, whereas they are modulated by the annual cycle and mostly in phase off Walvis Bay. Such a phase relationship appears to be strongly seasonal dependent off Lüderitz and across the southern BUS. Thus, our findings suggest this relationship is far more complex than currently thought and seems to be sensitive to climate changes with short- and far-reaching consequences for this vulnerable marine-ecosystem.