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The Northwest African upwelling area: region-wide organic carbon export deduced from sediment-trap to surface relation

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High variability typically associated with high production founds the importance of upwelling systems. Ocean margins in general receive increasing attention due to their high contribution to global carbon export as an part of the global carbon cycle.

We developed an empirical model in order to assess the quantity of particulate organic carbon that is exported to the deep sea in the area of upwelling induced high production off Northwest Africa. We determined the relation of deep sea particulate organic carbon flux and surface chl-a using SeaWiFS chl-a data from Spt 1997 through Feb 2002 and sediment trap data collected from Jun 1998 through Nov 1999 off Cape Blanc.

The derived regression model was applied to surface chl-a data in the zone of high chlorophyll concentration ($>$ 1 mg mˆ-3) which was identified on a daily basis. Since the relation of surface chl-a concentration and deep sea particulate organic carbon flux changes with changing surface chl-a concentration, we restricted the application of the regression model to the high chlorophyll zone to ensure a reliable fit. Before establishing the surface to deep sea regression, we performed an extensive correlation analysis to find a better approximation to the surface source area of the material sampled by the sediment trap. This correlation approach improved the relation of surface to trap significantly in contrast to the mere selection of a rectangular box-area near the trap as the assumed source area.

The average organic carbon export within the area of high chlorophyll concentration, normalized to the 1000 m level, was 20.6 mg m^{-2} d^{-1} comparable to 13.3 mg

m^{-2} d^{-1} as found in the sediment trap results, if also normalized to the 1000 m. During the examined time-span of chl-a data the resulting zone of high chlorophyll concentration was 20,000 – 800,000 km^2 large and yielded a yearly export of 1.123 to 2.620 Tg organic carbon. We found strong interannual variability in export. The period autumn 1998 to summer 1999 was exceeding the mean of the other three comparable periods by a factor of 2.25.

In particular in 1999, a year that followed a strong El Niño event, the area of extensive organic carbon export was found to extend up to 1300 km westward of the NW African coast deeply penetrating into the North Atlantic Subtropical Gyre, which is normally considered as an oligotrophic production system.