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Assessing bio-physical effects of Offshore Wind Farms on the North Sea pelagic ecosystem using a TRIAXUS ROTV

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The effects of Offshore Wind Farms (OWFs) on marine ecosystem functioning are largely unknown. OWF foundations may lead to locally increased turbulence levels in the pelagic zone, and as turbines deflect the wind field, the extraction of energy may induce up- and downwelling dipoles in the water column. As a consequence, upwelling cells and locally increased vertical mixing will likely transport nutrients and phytoplankton into the nutrient-depleted surface layer of the stratified water column in summer. Subsequently, locally enhanced primary production could potentially be channelled to higher trophic levels and may lead to an increased habitat quality for demersal & pelagic fish. Here, we present field measurements that allow us to assess the bio-physical effects of OWFs on the North Sea pelagic ecosystem. Data were obtained using a TRIAXUS (a remotely operated towed vehicle, ROTV) during a survey in summer 2014, which included three OWFs located in water depths between 20m and 40m. TRIAXUS is designed to record high-frequency synoptic measurements of biological and physical oceanographic properties. The instrument is equipped with CTD, oxygen, light and fluorescence sensors as well as a Laser Optical Plankton Counter (LOPC) and a Video Plankton Recorder (VPR). Fisheries hydroacoustic and ADCP data were recorded in parallel. Hydrodynamic modelling supported the analysis by backtracking the drift routes of water bodies from which nutrient contents were analysed. To isolate the OWF effects from natural variability in the bio-physical properties of the German Bight, we also analysed spatially and seasonally similar SCANFISH transect data from pre-OWF years (2010, 2011). The survey provided first insights into the potential bio-physical effects of OWFs on the North Sea pelagic ecosystem, e.g., small scale areas of increased mixing, local upwelling and changes in the magnitude of the surface layer with distinct phytoplankton discontinuities.