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Impacts of an extreme flood event on the physical and biogeochemical structure of a coastal system: a model-based analysis

Onur Kerimoglu (1), Yoana G. Voynova (1), Ivan Kuznetsov (1), Justus E.E. van Beusekom (1,2)

(1) Institute of Coastal Research, Helmholtz-Zentrum Geesthacht, Geesthacht, Germany (kerimoglu.o@gmail.com), (2) Institute for Hydrobiology and Fisheries Science (IHF), University of Hamburg, Hamburg, Germany

Frequency of extreme rainfall, and flood events has been observed to increase with changing climate, consistent with model-based projections. A better understanding of the impacts of such events on the biogeochemistry of coastal systems is therefore necessary. The June 2013 Elbe flood was one such extreme event, being the largest summer daily discharge in the last 140 years (Voynova et al. 2017). Up to two months after the flood, the patterns in stratification, salinity, nitrate, dissolved oxygen and pH in the adjacent coastal region of the German Bight were considerably different from the previous year (Voynova et al. 2017). Here we use a 3-D physical-biogeochemical model of the southern North Sea (Kerimoglu et al. 2017) and unpublished observations, in order to gain a better understanding of the spatio-temporal coverage of the impacts of the flood, and the specific processes driving the changes. The relatively high resolution model was shown to realistically reproduce the in-situ temperature, salinity, nutrient and chlorophyll measurements both in the shallow near-shore, and deeper off-shore regions of the German Bight (Kerimoglu et al. 2017). The model accurately captures the changes in surface salinity during and after the flood, measured by an on-board FerryBox platform and by several monitoring stations, indicating that the hydrodynamic environment and transport rates are realistically simulated. In agreement with the measurements by fixed monitoring stations along the north Frisian coast, simulated nitrogen concentrations within an area bounded by the 30m isobath to the west and about 60 km north of the mouth of the Elbe Estuary (up to Westerhever, Germany) were altered by the flood. However, chlorophyll concentrations remained within the natural range of variability, which, according to model results, was caused by phosphorus limitation of phytoplankton growth. The drawdown of dissolved oxygen following the flood event as observed in several monitoring stations was also captured by the model. We elaborate the effects of organic matter loading, freshwater discharge and the meteorological conditions on the primary production and oxygen depletion through a scenario analysis.

Kerimoglu O. et al. 2017, Biogeosciences 14, 4499–4531
Voynova Y.G. et al. 2017, Biogeosciences 14, 541–557