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The Riverplume Workflow - Impact of riverine extreme events on coastal biogeochemistry

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Fluvial extreme events, such as floods and droughts, have an impact beyond the river bed. The change in river discharge and concentration of nutrients and pollutants in freshwater also affects coastal waters, esp. their biogeochemistry. Examining these impacts has been traditionally difficult, as one needs to first detect the river plume in the seawater and then infer its spatio-temporal extent. The River Plume Workflow was developed to support researchers with these tasks and enable them to identify regions of interest, as well as provide tools to conduct a preliminary analysis of the riverine extreme events' impacts on the coastal waters.

The Riverplume Workflow is an open source software tool to detect and examine freshwater signals as anomalies in marine observational data. Data from a FerryBox, an autonomous measuring device installed on a commercial ferry, provide regular coverage of the German Bight, the region for which we developed this toolbox. Combined with drift model computations, it is possible to detect anomalies in the observational data and to comprehend their propagation and origin.

The Riverplume Workflow uses the Data Analytics Software Framework (DASF) that was developed as part of the Digital Earth project. Through its modular structure, DASF supports collaborative and distributed data analysis. The Riverplume Workflow's main feature is an interactive map with various data visualization options that allows users to examine the data closely and either manually select a presumed anomaly for analysis or use an automatic anomaly detection algorithm based on Gaussian regression. The Workflow offers a statistical analysis feature to compare the composition of the selected data to the surrounding measurements. Simulated trajectories of particles starting on the FerryBox transect at the time of the original observation and modelled backwards and forwards in time help verify the origin of the river plume and allow users to follow the anomaly across their area of interest. In addition, the workflow offers the functionality to assemble satellite-based chlorophyll observations along model trajectories as a time series. They allow scientists to understand processes inside the river plume and to determine the timescales on which these developments happen.

The FerryBox data used in the Riverplume Workflow are pre-processed automatically and updated daily. Synoptic drift model data is provided for all Elbe extreme events since 2013. We plan to automatize the provision of model data as well.

We currently use the Riverplume Workflow to monitor the impacts of Elbe extreme events in the German Bight, though we plan to adapt it to other regions or types of anomalies. The Workflows' code and all components are available under open source licenses and registered under the DOI https://doi.org/10.5880/GFZ.1.4.2022.006.