Postdoctoral project of
P-Campus Graduate School

A simple indicator-based approach for risk assessment of subsurface phosphorus export to the Baltic Sea from coastal sub-catchments

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Institutes:	Soil Physics
Duration of funding:	1. Dr. Marian Koch: 01.02.2020 – 15.04.2020 2. Dr. Sate Ahmad: 01.04.2021 – 30.04.2022
University and Faculty:	Faculty of Agricultural and Environmental Sciences, University of Rostock
*Date of submission:	N/A
*Date of defence:	N/A
*Date of acceptance:	N/A

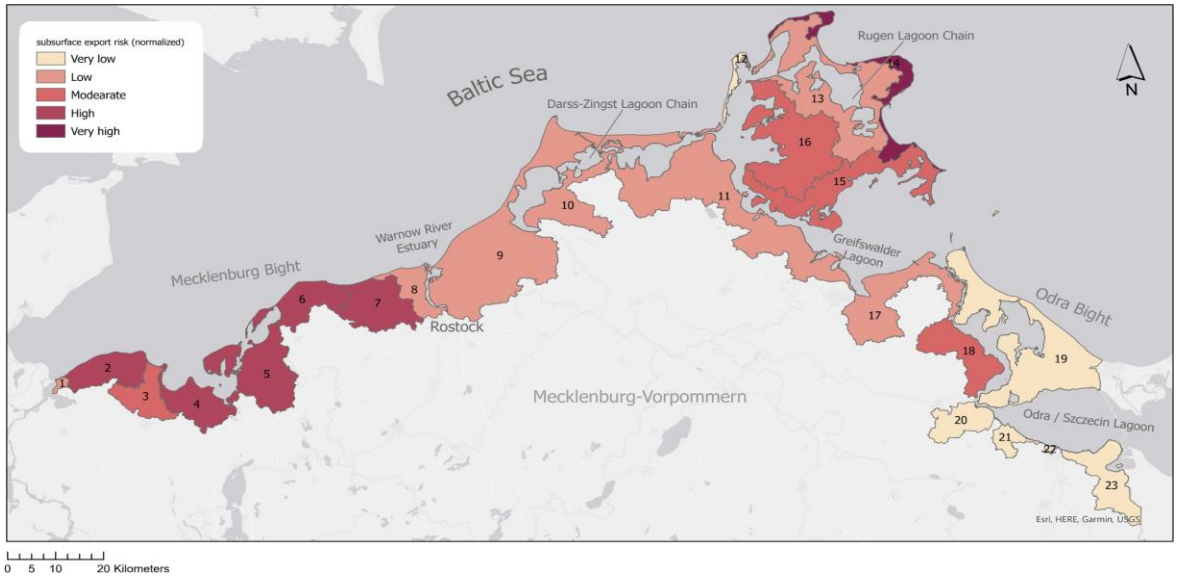
Nutrient export risk to the Southern Baltic Sea from disconnected coastal sub-catchments

Highlights

- A subsurface nutrient export risk map of coastal Mecklenburg–Western Pomerania was generated using a simple, yet novel indicator-based approach.
- These indicators are hydraulic head and agricultural area density at the catchment scale.
- The risk map indicates that there is high heterogeneity of the nutrient export risk across the coastal catchments with a general increasing risk from east to west.
- [There is substantial subsurface export risk to not only to the Baltic Sea, but also into rivers, as indicated by groundwater contours and their associated flow directions.]
- Future research should aim at refining the approach to derive quantitative rather than qualitative values to allow validation with measured values from the shallow sea water.

Abstract

The land along the coast is often hydrologically disconnected from the prevailing river systems. Water flow and nutrient transport from these disconnected coastal sub-catchments follow diffusive pathways and can hardly be quantified. As a result, it is unknown as to what extent coastal waters might be affected by diffusive nutrient inputs. Here, we develop a GIS-based method to derive hydraulic heads and gradients (groundwater) in coastal sub-catchments aiming at estimating the pollution risk of the coastal sea with nutrients originating from agricultural activity. The nutrient export risk from the land was defined as the product of hydraulic gradient (groundwater) and land-use intensity. The developed method was tested for the Southern Baltic Sea coast of the Federal State of Mecklenburg–Western Pomerania in Germany. It was found that the nutrient export risk generally increases from the east to the west with the Rügener Lagoon being an exception. For the sub-catchment discharging into the Rügener Lagoon steep groundwater gradients were detected. The calculated high nutrient export risk coincides with high concentration values, which have been reported for the limnic-marine transitional waters of the Rügener Lagoon. The presented method has a good potential to be further developed by including meteorological data to eventually allow the quantification of water and nutrient fluxes from disconnected coastal catchments.



Risk map for subsurface nutrient export from coastal sub-catchments into the Baltic Sea