EGU21-5210
https://doi.org/10.5194/egusphere-egu21-5210
EGU General Assembly 2021

Use of co-created causal loop diagrams and fuzzy-cognitive scenario analysis for water quality management

Samaneh Seifollahi-Aghmiuni[1,2], Zahra Kalantari[1,2,3], and Georgia Destouni[1,2]
[1]Stockholm University, Department of Physical Geography and Bolin Centre for Climate Research, Stockholm, Sweden (samaneh.seifollahi@natgeo.su.se)
[2]Navarino Environmental Observatory, Costa Navarino, Navarino Dunes Messinia, Greece
[3]Department of Sustainable Development, Environmental Science and Engineering (SEED), KTH Royal Institute of Technology, Stockholm, Sweden

Current understanding is fragmented of the environmental, economic, and social processes involved in water quality issues. The fragmentation is particularly evident for coastal water quality, impacted both by local land catchment and larger-scale marine pressures and impacts. Research and policy so far has primarily addressed coastal water quality issues from either a land-based or a sea-based perspective, which does not support integrated management of the coupled land-coast-sea systems affecting coastal waters. For example, mitigation measures for improving the severe Baltic Sea eutrophication have mostly focused on land-based drivers, and not yet managed to sufficiently improve coastal or marine water quality. The strong human dimension involved in these water quality issues also highlights a need for participatory approaches to facilitate knowledge integration and drive synergistic strategic planning for sustainable management of coastal water quality. Considering the Swedish water management district of Northern Baltic Proper, including its main Norrström drainage basin and surrounding coastal catchment areas and waters, this study has used a participatory approach to evaluate various land-sea water quality interactions and associated management measures. A causal loop diagram has been co-created with different stakeholder groups, following a problem-oriented system thinking approach. This has been further used in fuzzy-cognitive scenario analysis to assess integrated land-coast-sea system behavior under changing human pressures and hydro-climatic conditions. Results show that synergy of several catchment measures is needed to improve coastal water quality locally, while cross-system/sector cooperation is also needed among all contributing national catchments to mitigate coastal eutrophication at the scale of the whole Baltic Sea. Furthermore, large-scale hydro-climatic changes and long-lived nutrient legacy sources also need to be accounted for in water quality management strategies and measures. System dynamics modelling, based on co-created causal loop diagrams and fuzzy-cognitive scenario analysis like those developed in this study, can support further quantification and analysis of the impacts of various mitigation strategies and measures on regional water quality problems and their possible sustainable solutions.