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Understanding the coupled land-sea system dynamics in coastal regions through a participatory approach: A Baltic case study

Samaneh Seifollahi-Aghmiuni, Zahra Kalantari, and Georgia Destouni

Department of Physical Geography and Bolin Centre for Climate Research, Stockholm University, Stockholm, Sweden
(samaneh.seifollahi@natgeo.su.se)

Eutrophication and water quality issues in the Baltic Sea and its coastal zones have strong human dimensions, including also land and water uses and their management in hinterland areas. Solutions require participatory approaches to inspire integrated long-term 'land-sea' systems management, and contribute to the development of harmonized guidelines at different spatial scales. Considering the source to sea case of Swedish Norrström drainage basin, its surrounding coastal areas, and the associated marine basin of the Baltic Sea, this study has used a participatory approach to enhance understanding of the land-sea system links and dynamics, and facilitate exploration of cross-system/sector cooperation opportunities for addressing water-related high-impact issues, including water pollution and eutrophication. Employing a problem-oriented system thinking approach, we investigate the following questions based on various sector perspectives in the study region: (i) What are the key underlying land-sea system elements and their interlinkages? (ii) What are the most relevant and important dynamics for evaluation of land-sea system behavior? and (iii) What are the main challenges and opportunities for sustainable coastal management and development? Different groups of relevant stakeholders are asked to co-create causal loop diagrams for characterizing the land-sea system dynamics based on their perceptions of and answers to the questions (i)-(iii). From the co-created causal loop diagrams, sector-specific and general issues, challenges, opportunities, and barriers to sustainable coastal development in the study region are identified. In further analysis, various scenarios of the land-sea system dynamics and the importance of feedback mechanisms are investigated. The scenario results and associated system behavior are also validated by stakeholders. Selected scenarios are further quantified by systems dynamics modeling, exploring the impacts of associated coastal development and policy options on the regional water-related issues and potential sustainable solutions. The scenario analysis outcomes highlight the necessity and usefulness of combining scientific knowledge with local expertise for synergistic and strategic planning of sustainable coastal region development.