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Preface

Coastal Biogeochemistry

Coastal zones play a key role in Earth System functioning and form an "edge for society" providing a significant contribution to the life support systems. Goods and services derived from coastal ecosystems, which following recent estimates add up to more than half of the total global ecosystem services, depend strongly on multiple trans-boundary interactions with the land, atmosphere, open ocean and the sea floor. Increasing pressure on coastal resources driven by human habitation, food security, energy supply, recreation and transportation accelerate the exploitation of the coastal landscape and water bodies. On a global scale, many coastal areas and adjacent human populations are subject to increasing risks to natural and man-induced hazards such as flooding resulting from major changes in the hydrology of river systems. Changes in the hydrological cycle coupled with changes in land and water management alter fluxes of materials transmitted from river catchments to the coastal zone thus generating a major effect on the socio-ecological coastal systems. The increasing complexity and non-linearity of underlying processes and driving forcing functions of coastal changes are witnessed at a multiplicity of temporal and spatial scales frequently encompassing the whole water cascade.

Increasing demographic pressure keeps accelerating human interventions that impact natural coastal processes. The often competing demands for coastal resources and human security are further exacerbated by broad scale changes of climate patterns and oceanic circulation. This combination of anthropogenic drivers/pressures with their growing tendency to dominate in their interplay with natural system oscillation and change affect our environment to an extent that has culminated in what is now described as the "Anthropocene". However, at present our understanding of regional and global changes that impact coastal systems is still limited because of the lack of understanding the fundamental principles of individual coastal ecosystems and the coastal ocean as a whole entity. This lack might be somewhat surprising, since coastal areas certainly belong to the most intensely studied marine systems, at least with respect to selected issues such as hydrography or biogeochemical cycling or fisheries. However, it is the complexity of the interplay between climate and anthropogenic pressure in coupled socio-ecological coastal systems, including issues of social-choice, that calls for a substantially improved process understanding and forecasting in order to ultimately warrant their sustainable use through informed decision making.

During the recent decade many studies have been initiated with support from a wide range of institutions and organizations at national and international levels to gain insight in the biogeochemistry of coastal ecosystems. Fundamental research has been carried out to first understand the biogeochemical principles. These research lines are now being complemented by attempts to identify alterations of the coastal systems by climate change and anthropogenic impact and in turn by investigations on how these systems possibly control climate, i.e., on whether there are feedback mechanisms between the coastal systems and the external pressures. Obviously research cannot be confined to biogeochemical questions, since the social and human ramifications of coastal change directly affect coastal biogeochemistry and vice versa. The IGBP and IHDP core project Land-Ocean-Interaction-in-the-Coastal-Zone (LOICZ) just entered its second decade of collaborative global coastal change research with a mandate to promote and stimulate a stronger focus on interdisciplinary research aiming to bridge natural and social sciences.

During the first general assembly of the European Geosciences Union (EGU) a special session was devoted to coastal biogeochemistry. The session was co-sponsored by LOICZ and can be seen as a continuation of the previous sessions held during earlier meetings of the European Geophysical Society (EGS). It covered a wide range of biogeochemical issues. Participants were invited to contribute their presentations to this special issue, which was also open to papers, which were not presented during the session, however still strongly focused on coastal biogeochemistry.

The present issue, which also contributes to the global LOICZ project, comprises eight papers reporting from both observational and modeling studies. In the focus of all studies are matter fluxes (primarily, but not exclusively carbon) within coastal environments, assessed and investigated from different perspectives. Lueker reports an assessment of marine CO_2, oxygen and N_2O fluxes from atmospheric observations. Grégoire and Beckers simulated nitrogen fluxes at the shelf break area of the Black Sea and their controls by transport and biogeochemical processes. Also applying modeling tools Vichi et al. investigate long-term trends in the nutrient and oxygen cycles in the Baltic Sea thus establishing a direct link to anthropogenic pressures on this semi-enclosed system. Gypens et al. analyze carbon dynamics in the eutrophied Southern North Sea, which is also subject to investigations of the phosphorus cycle by van der Zee and Chou. Boullion et al. and Gazeau et al. focus on carbon fluxes within different (benthic) ecosystems. Thomas et al. establish a carbon budget by balancing the carbon fluxes across the North Sea boundaries.

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