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New developments in the field of global coastal groundwater salinity modelling and mapping

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Freshwater availability at densely populated coastal zones around the world is at risk. The need for freshwater sources will increase the coming decennia as a result of population growth, higher demand of freshwater of good quality, sealing of groundwater systems in urbanized areas, and climate change leading to sea-level rise and increased storm surges (causing saline water overwash). As water quantity and quality requirements for agricultural, industrial and domestic use in many coastal areas around the world are regularly not satisfied by surface waters, coastal fresh groundwater is normally a reliable alternative. But this may change for the worse as salinization processes and overexploitation jeopardizes fresh groundwater resources, negatively affecting health via too salty drinking water and/or food production.

To give better advice to different clients on optimal sustainable freshwater use, we need to increase our understanding and quantification of coastal groundwater salinization, particularly at places where limited data availability and system understanding hinder the proper use of fresh groundwater. This presentation will enlighten some recent developments in the field of global modeling and mapping of coastal groundwater salinity. These developments make it possible to create global-scale groundwater salinity models that can be used to create storylines of, for instance, fresh groundwater availability in the coastal zone, offshore fresh groundwater volumes, submarine groundwater discharge. It supports the achievement of sustainable development goals like SDG6 (clean water and sanitation), and indirectly SDG1 (no poverty), SDG2 (zero hunger) and SDG3 (good health and well-being via drinking water quality and effect groundwater salinization on the risks of heart diseases).

We are currently close to creating a global-scale groundwater salinity model for coastal zones for several reasons. This presentation will elaborate on that. The widely used SEAWAT code for groundwater salinity modelling has been made parallel, which allows for faster and more accurate global projections at high spatial resolutions. Additionally, the number of open source global hydrogeological databases available on web portals is increasing. These databases, along with text and data mining techniques, make it possible to collect hydrogeological data from articles and grey literature. The regional and local data is used to improve the reliability of the model via calibration and validation.

Innovative data collection methods, such as using rapid and cost-effective airborne EM surveys, drones for remote areas, and smartphone apps for citizen-generated data collection, are also being used to map groundwater salinity on a regional scale. Advanced interpolation techniques are available to transform the collected data into 3D groundwater salinity distributions. Initiatives like GROMOPO are working to improve coastal geology (beyond GLHYMPS) and associated flow parameters. Parallel computer power is used to simulate reconstruction of past hydrogeological conditions in data-poor areas to improve understanding of present groundwater salinity.

The model can assess the impact of "compound events" on saltwater intrusion, such as sea level rise and storm surges in subsiding over-exploited coastal areas while freshwater infiltration is reduced by urban development. It can also be used to develop strategies for managing fresh groundwater, such as Managed Aquifer Recharge.