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# Modelling groundwater–seawater interactions in the Aral Sea region

**Y. Shibuo**, J. Jarsjö and G. Destouni

Department of Physical Geography and Quaternary Geology, Stockholm University, Stockholm, Sweden (yoshihiro.shibuo@natgeo.su.se / Fax: +46 8 164818 / Phone: +46 8 6747884)

The Aral Sea, the former world's fourth biggest inland water body in 1960, has experienced dramatic shrinkage due to the failed mega scale hydrological engineering, which resulted in losing nine tenth of its original sea volume. Furthermore, the salinity has increased from about 10 g/L in the 1960's to about 90 g/L presently. Such dramatic changes must also affect the coastal aquifers in the region. In particular, the risk of salt water intrusion (SWI) into these aquifers must be considered when using the groundwater as local fresh water supply. While, on the one hand, the potential risk of SWI may have decreased in the region due to the increasing distance between the receding sea and the freshwater aquifers, the considerably increased sea water density may, on the other hand, imply an increased potential risk of SWI.

We address the effects of the sea level lowering and the increased sea water salinity on the salinity transition zone in coastal aquifers, as well as the submarine groundwater discharge (SGD: a mixed flow of salt water originating from the sea and fresh groundwater discharge) pattern in the region. Using observed field data, we perform numerical simulations of density-driven flow in the vicinity of the original (pre-1960) Aral Sea coast line. During the simulation period, the boundary conditions dynamically change due to the rapidly receding shoreline and the increasing salinity of the sea. Results show that coastal groundwater remains essentially brackish in two different representative cross-sections of the Aral Sea coast region (accounting for steep and shallow near shore bathymetry), implying that the SWI risk into the coastal aquifers remains, even at locations where the shoreline recession was considerable. Using this modeling approach, we also further investigate different SGD and SWI development patterns.