

# Geophysical-based approach for studying the submarine groundwater discharge: the SUBGEO Project

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The problem of water supply represents a priority for not only the Mediterranean Area but for the World if we consider the age-old problem of the drought exacerbated by the climate change events that are constantly seen [Jiao and Post, 2019]. Coastal aquifers are fundamental for water supply and innovative strategies are strongly required to detect and preserve water resources under increasing pressure. Developing new knowledge and innovative solutions for a systemic and inclusive approach of water management represents a big challenge for the scientific community.

Indeed, delineating coastal hydrogeologic structures, or hydrostratigraphy, is a crucial step for the characterization of groundwater flow and management of groundwater resources. Furthermore, hydrostratigraphic complexities play a fundamental role in the interactions occurring between coastal aquifers and marine ecosystems and influence the transport of solutes to coastal waters, and the response to climate change [Befus et al., 2014]. However, as coastal groundwater investigations are addressed to characterize and monitor the onshore resources and coastal fringe processes, the interactions between fresh groundwater within submarine aquifers remain poorly explored [Post et al., 2013; Knight et al., 2019]. The increasing water demand on the global scale because of per capita demand and population increases causes a strongly increasing exploitation of the available high-quality water resources, increasing the risk of salinization via mixing for seawater intrusion. These trends can be further worsened in large areas by the enduring effects of climate change. All these conditions are causing stress on the water resources of coastal aquifers. The management efforts require more knowledge of coastal springs and submarine groundwater discharge (SGD), to preserve residual fresh resources and to find the freshest possible groundwater for desalination [Polemio et al., 2020]. However, coastal areas, are challenging places for the application of geophysical methods due to their being highly dynamic and fragile systems and because they are constituted by two different operational conditions: land onshore and sea offshore. At present time, the relatively few surveys aimed to characterize the coastal areas are usually performed by joint together land and marine surveys. This practice, whereas of simple applications, has a relevant limit. The boundary area between the sea and the land, the area close

to the shore, remains poorly or not investigated either by the land surveyor by the marine one. Consequently, missing information on the area where seawater and groundwater start to interact, the reconstruction of the hydrogeological processes in the coastal area may be inaccurate or incomplete.

In this framework, the University of Bari (UNIBA) and the two CNR Institutes, IMAA and IRPI, have proposed the two-year Research Project of National Relevance (PRIN PNRR 2022) SUBGEO (Submarine groundwater discharge analysis with an innovative and integrated geophysical approach) addressed to develop and employ an innovative strategy based on the integrated multiscale and multiresolution geophysical investigation approach for the coastal underground freshwater reservoir non-invasive characterization.

SUBGEO aims to setup an innovative investigation strategy able to furnish continuous information from the land to the sea useful to define the water fluxes dynamics. A two-level strategy is proposed. In the first level, the investigations will provide an expeditious and not expensive overall characterization of the geophysical framework of the investigated area). The second investigation level will include a more complex integration of electrical and electromagnetic geophysical methodologies and will be more informative. The expected results will consist of a multiscale and multiresolution subsoil characterization from land to sea, that crossing the shoreline, will not have any spatial informational gap. The outcome of the second investigation level will support the creation of optimized hydrogeological models of the investigated area and can also be directly used by the decision-maker to implement sustainable water resources management strategies.

SUBGEO is addressed to gain useful tools for the optimal and sustainable management of the coastal areas and resources, operating on the largest Italian coastal aquifer, the Apulia region where the coastal aquifers fed the highest concentration of submarine springs and SGD [Polemio, 2016]. The project will develop an innovative geophysical approach based on the integrated use of aerial, land, land-marine and marine geophysical electric and electromagnetic techniques to provide spatially continuous and high-resolution information on the subsoil structure from the offshore areas, where the outward fluxes mix with the seawater, to the onshore ones. Finally, SUBGEO will be tuned by small-scale laboratory experiments and numerical simulations to define the best acquisition procedures and check the sensitivity of the strategy for different subsurface conditions.

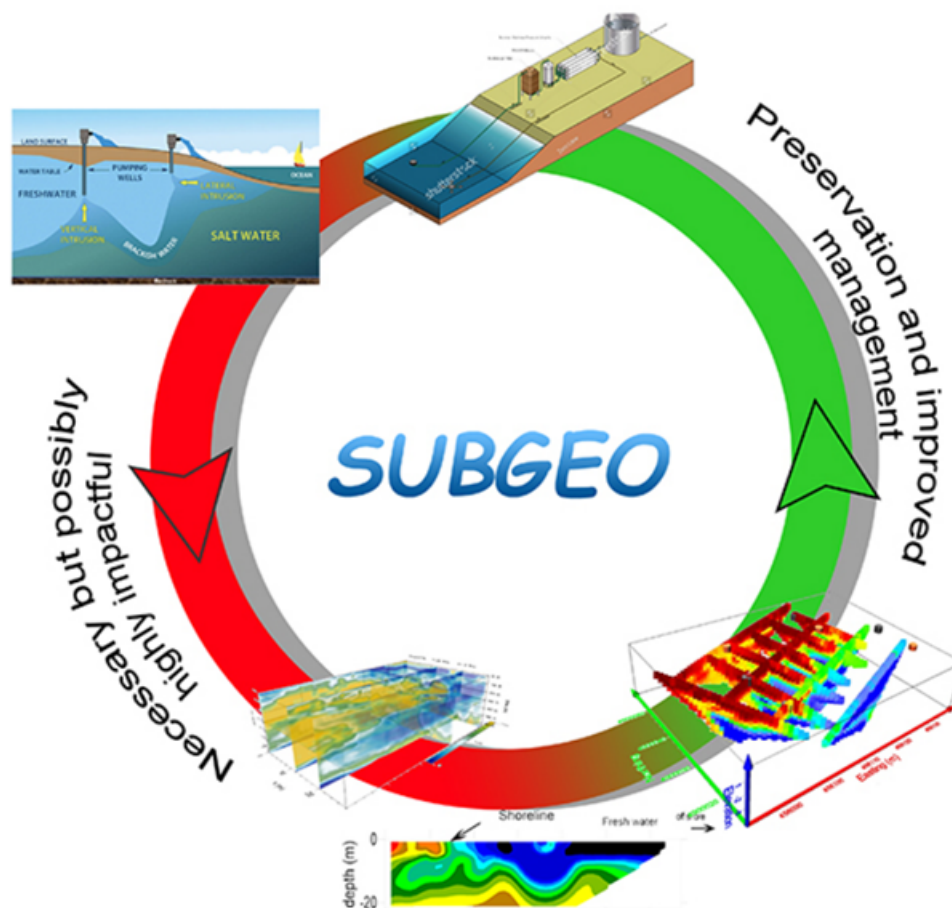


Fig. 1 - The proposed geophysical approach for characterizing coastal areas of SUBGEO

## References

- Befus et al., 2014, Geoelectrical signals of geologic and hydrologic processes in a fringing reef lagoon setting, *J. Hydrol*, 517, 10.1016/j.jhydrol.2014.05.070.
- Jiao J., and V. Post, *Coastal hydrogeology*. Cambridge University Press, 2019.
- Knight et al., 2019, Combined geophysical and analytical methods to estimate offshore freshwater extent, *J. Hydrol*, 576, 10.1016/j.jhydrol.2019.06.059
- Polemio M., 2016, Monitoring and Management of Karstic Coastal Groundwater in a Changing Environment (Southern Italy) A Review of a Regional Experience. *Water*, 8, 10.3390/w8040148
- Polemio, M. et al. 2020, Review of Utilization Management of Groundwater at Risk of Salinization. *J. Water Resour. Plan. Manag*, 146
- Post et al., 2013, Offshore fresh groundwater reserves as a global phenomenon. *Nature*, 504, 10.1038/nature12858

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