Geoelectrical and electromagnetic monitoring for saltwater penetration on the Po di Goro river (Italy)

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The climate change is heavily affecting our earth and the coastal zone is strongly sensitive to this changing. The sea-level rise and the reduction of river discharge are driven by climate change and they are controlling factors on the saltwater penetration in the delta system. The delta systems are characterized by complex dynamic between freshwater coming from continent and saltwater. Consequently, the upstream extent of the mixing zone leads to an increase of the salt content in aquifers and surface waters. These conditions can hinder the water use for irrigation purpose leading to salinization of soils. This summer all the world's news reports showed the Po River saltwater intrusion crisis, the Italian's largest river delta system is affecting seawater penetration endangering the sustainability of the freshwater resources. The typical approach to detect chemical-physical parameters (i.e. electrical conductivity-EC) is the multiparameter probe for water quality, but with a punctual acquisition system it is not simple to monitor a very long river (> 50km). Therefore, the research group proposed a fast geophysical approach for the monitoring of the saltwater penetration affecting the Po di Goro river, that is one of the Po river branches. Two geophysical methods, ERT and EM profiling, were applied detecting the water salinity in the river and its dynamic iteration with the subsoil around the riverbanks. The field activities are planned in two different periods (July and October 2022). During the first period, three Electrical Resistivity sections, four EM map surveys and a long EM profile were carried out in different areas along the Po di Goro river (Figure). The ERT sections highlighted how the river water interacts with the surrounding subsoil, while the EM data sets define the dynamic system between the saltwater penetration and the freshwater in the river detecting the salty plume front. The first results highlight the great potential of the proposed geophysical approach to monitor the saline plume during crisis periods. In the second period, the same geophysical approach will be applied, in order to monitor the withdrawal of the saltwater penetration.

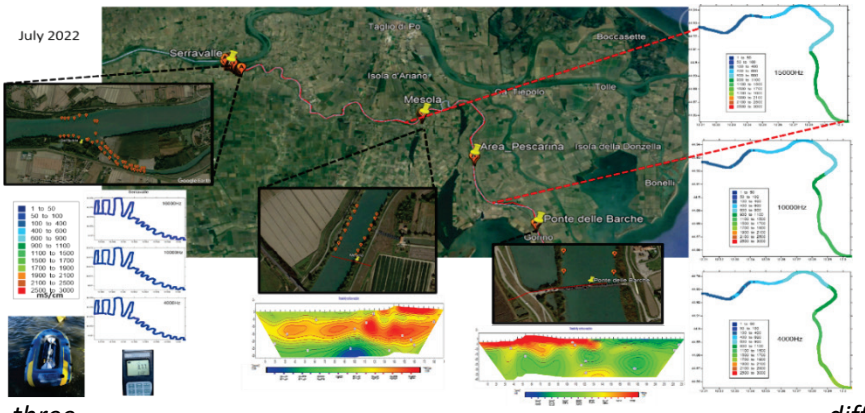

Figure: The map shows the four test sites. Several EM profiles were carried out across the river by AMP-300 instrument located on an inflatable boat pulled by a kayak. Three ERTs were acquired with electrodes floating on the water and some installed on the land across the riverbanks. A long continuous EM profile was carried out along part of Po di Goro river (15km) using three different frequency of AMP-300 instrument located on an inflatable boat pulled by a kayak. All the data were calibrated by an EC probe.