Salt intrusion monitoring in the Po River Delta branches (Italy)

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The Po River Delta is the outlet of the Po basin, the biggest catchment in Italy; it is composed of the branches of Goro, Gnocca, Maistra, Tolle and Pila, spanning over a 700 km² area, nowadays inhabited by around 50,000.

Modeled by the human presence through channels, levees and other hydraulic infrastructures, this is a “young territory”, originated from the “Taglio di Porto Viro” done by the Republic of Venice, around 1600, in order to divert the Po river mouth southward and avoid silting of lagoon harbors.

Beyond its high natural, economic and cultural value, this area is exposed to multiple hazards related to floods and storm surges, droughts, erosion, subsidence, water pollution and loss of biodiversity, exacerbated by soil consumption and climate change; one of the highest threats is the salinization of surface, groundwater and soils, due to the increasing of duration and extension of salt intrusion from the Adriatic Sea (Enhance, 2016; Allodi, 2022).

Particularly during low flows, as in Summer 2022 (GDO, 2022), salt intrusion reduces fresh water availability for drinking supply, agriculture and industry, as also for balancing habitat salinity and guaranteeing ecological benefits.

For many years this fragile and dynamic context has been under systematic observation, related to salt intrusion as also to liquid discharges, solid transport, topography, hydrodynamics, tides and beach morphology (Visentini, 1940; Cati, 1981).

Within the current multi level-multi actor governance system, since 1995 the Emilia-Romagna Regional Agency for Prevention, Environment and Energy (Arpae) is involved in the integrated monitoring of the Po River Delta, supporting water protection and use, flood management and the general sustainability of human activities.

Through the Idro Meteo Climate (SIMC) and the "Daphne" Oceanographic Structures, Arpae collects river, delta and sea water level observations from telemetry networks and discharge measurements and salinity observations from field campaigns.

From these monitoring activities it is first possible to maintain stage-discharge equations,
particularly at the Pontelagosuro Station upstream the delta, and consequently to maintain the
discharge repartition equations in the delta, depending not only on upstream discharge but also
on hydraulics of each branch and sea level conditions (Settin, 2012); secondly it is possible to
support salt intrusion length assessment and estimation in each delta branch, mainly depending
on river discharges, their repartition in each delta branch and sea levels conditions (Comune,
Turolla, 2023).

Territorial knowledge and conservation, based on the integration of in situ monitoring and control,
historical data, other data sources (topography, groundwater, water quality), satellite products,
models (including digital twins), artificial intelligence, uncertainties management and high
computing capacities, may help better understand earth systems and better simulate future
scenarios depending on climate, land use and social changes.

Monitoring of the Po River Delta, is therefore indispensable for theoretical assessment, supporting
from-short-to-long-term awareness, decision making and action by public institutions, private
enterprises, associations and local community, in order to assuring sustainable and fair water uses
and ecosystem services in a vulnerable area exposed to increasing threats and at the same time
rich in opportunities and beauty.