

IAH network on “Coastal aquifer dynamics and coastal zone management”

QUESTIONNAIRE

the questionnaire in this page with as many details as possible.

1)	Location of aquifer (country, more specific location):	Coastal floodplain of the Po River, in Northern Italy
2)	Reported by:	Giambastiani B.M.S., Colombani N., Mastrocicco M., Fidelibus M.D.
3)	Type of medium (karst, porous, fracture)	porous
4)	Type of aquifer (phreatic or confined)	Confined and semi-confined
5)	Main lithology - (e.g. gravel, sand and clay)	From east to west, the majority of the sedimentary units consist of a wedge of permeable sand sediments deposited in shallow sea with intercalation of peat and silty layers, littoral sands formed in the foreshore and in the adjacent beach, and sand dune systems. Fine-grained deposits of silt and clay at the bottom of sand deposits form the confining unit.
6)	Hydrochemistry: fresh or saline	fresh, saline and hypersaline
7)	Saltwater intrusion: lateral from sea or lakes - upconing	Lateral seawater intrusion is proceeding inland at a very slow rate, especially at distance of 2-10 km from the coastline.
8)	Aquifer geometry: hydraulic characteristics	Porosity values range between 19% and 76% with an average value of 30%. The hydraulic conductivity resulting from permeability tests in the four piezometers decreases from 10 ⁻⁷ to 10 ⁻⁶ m/s from the top to the bottom of the aquifer, varying along the depth due to the presence of silt and fine sand lenses.
9)	Aquifer parameters: storage - annual water pumping - (in MCMA - millions cubic meters, annually)	The unconfined aquifer is not used for irrigation but is drained by pumping stations at a rate of approximately 200 Mm ³ /y
10)	Depth of aquifer (water level and bottom) - water level 5- 30 m - aquifer depth - 50-200 m	The aquifer thickness ranges from 16 to 22 m from the coast to inland areas. The thickness of freshwater lenses varies of 0.5-1 m.
11)	Major chemistry (anions - ?; Cations - ?):	High TDS values characterize almost the entire coastal aquifer with an average value of 34 g/l and maximum values up to 74 g/l. The most common water types found in the aquifer are CaHCO ₃ , NaHCO ₃ , and NaCl. Anions: HCO ₃ ⁻ , Cl ⁻ , SO ₄ ²⁻ . In the central and shallow parts of the aquifer, the depletion of Br ⁻ with Cl ⁻ /Br ⁻ ratios > 700 can result from the dissolution of soil salts or mixing with more brackish or saline water, imputing current and relict seawater contributions.
12)	Major salinity sources:	sea, relict seawater
13)	Population:	less than 50.000 inhabitants but can reach up to 400.000 during the summer
14)	Aquifer status: special features - e.g. thermal springs, major faults,...	The aquifer is connected to brackish and saline swamps and to a dense network of reclamation canals.
15)	Investigation methods - e.g. water level measurements, EC (electrical conductivity profiles), TDEM (geophysical),	permeability tests (Pumping test in four piezometers), Multi-level groundwater sampling (every 1 m from the top to the bottom of four piezometers) in order to acquire the other hydrochemical parameters (dissolved oxygen, pH, and redox potential).
16)	Numerical hydrological modeling, chemical and isotopic methods, age determination, IR survey, seepage meters (for Submarine Groundwater Discharge, SGD)	See papers from: Colombani et al. 2016 Water Resources Management; Caschetto et al. 2016 Hydrological Processes; Caschetto et al. 2016 Applied Geochemistry; Colombani et al. 2016 Journal of Hydrology; Colombani & Mastrocicco 2016 Environmental Earth Sciences.
17)	Monitoring methods applied and duration - water level measurements, EC (electrical conductivity profiles - seasonal)	Piezometers belonging to the regional monitoring network of the Emilia-Romagna Region, to monitor the groundwater quality and carry out hydraulic measures.
18)	Management methods:	
19)	Aquifer management actions:	the water table is kept below the ground surface by means of drainage ditches and canals connected to pumping stations
20)	Identification of existing or potential problems:	seawater intrusion
21)	Annexes:	
22)	Observations:	The hyper-salinity found in the deepest portion of the aquifer cannot be associated with conventional lateral intrusion or upconing of present seawater, but suggests the presence of relict seawater trapped in the back-barrier dunes and lagoonal environments during the Holocene interglacial phases. Salt deposits in fine grained sediments could have been preserved from rapid flushing and gradually released, leading to the formation of hypersaline groundwater