

## IAH network on "Coastal aquifer dynamics and coastal zone management"

### QUESTIONNAIRE

IAH national committees, IAH members and non members from all around the world involved in SWI and SGD research and management are kindly asked to fill in the questionnaire in this page with as many details as possible.

A world database will be set up and made available, with basic coastal aquifer main characteristics.

We expect to gather standard and comparable information on the knowledge level and hopefully the state of the art of the research on SWI and SGD, and coastal aquifer management methods adopted around the world

- |                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                      |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>1)</b> Location of aquifer (country, more specific location):</p>                                                                                            | Italy,Emilia Romagna,Ravenna                                                                                                                                                                                                                                                                                         |
| <b>2)</b> Reported by:                                                                                                                                             | Pauline N. Mollema,Antonellini M.                                                                                                                                                                                                                                                                                    |
| <b>3)</b> Type of medium (karst, porous, fracture)                                                                                                                 | Porous medium                                                                                                                                                                                                                                                                                                        |
| <b>4)</b> Type of aquifer (phreatic or confined)                                                                                                                   | Acquifer system consisting of a phreatic part closer to the coast and a semiconfined levels by the presence of silt and clay deposits more landinward                                                                                                                                                                |
| <b>5)</b> Main lithology - (e.g. gravel, sand and clay)                                                                                                            | Gravel,sand,silt and clay deposits                                                                                                                                                                                                                                                                                   |
| <b>6)</b> Hydrochemistry: fresh or saline                                                                                                                          | Fresh,brackish and saline                                                                                                                                                                                                                                                                                            |
| <b>7)</b> Saltwater intrusion: lateral from sea or lakes - upconing                                                                                                | Saltwater intrusion from the Adriatic Sea (lateral) and upward seepage of trapped Holocene marine salt water                                                                                                                                                                                                         |
| <b>8)</b> Aquifer geometry: hydraulic characteristics                                                                                                              | The aquifer has a wedgeshape, pinching out land inward. Along the coast two sandy units are separated by silt-sand-clay layers of the so called Pro-Delta. Landinward the Prodelta unit is not present                                                                                                               |
| <b>9)</b> Aquifer parameters: storage - annual water pumping - (in MCMA - millions cubic meters, annually)                                                         | The average annual rainfall calculated on a long term database (1989-2008) is 635 mm (Mollema et al. 2012)                                                                                                                                                                                                           |
| <b>10)</b> Depth of aquifer (water level and bottom) - water level 5-30 m - aquifer depth - 50-200 m                                                               | water level:from - 4 masl to +0.3 masl<br>aquifer thickness: 8,80 - 29,40 m                                                                                                                                                                                                                                          |
| <b>11)</b> Major chemistry (anions - ?; Cations - ?):                                                                                                              | Aquifer depleted of Al , Ca , Fe, Mn, Cr, Co, Cu , Ni and Zn and enriched As, Ba , Cl , Mg , Mo , Sb .                                                                                                                                                                                                               |
| <b>12)</b> Major salinity sources:                                                                                                                                 | Low topography, natural and anthropogenic subsidence, destruction of the coastal dune belt, and scarcity of freshwater infiltration upward seepage of Holocene marine water, evapoconcentration, fast drainage of fresh superficial water needed to prevent flooding, salt water intrusion along rivers and channels |
| <b>13)</b> Population:                                                                                                                                             | Different land use : agricultural use , Settlements housing,beaches, forested areas , areas of quarry and wetlands, irrigation                                                                                                                                                                                       |
| <b>14)</b> Aquifer status: special features - e.g. thermal springs, major faults,...                                                                               |                                                                                                                                                                                                                                                                                                                      |
| <b>15)</b> Investigation methods - e.g. water level measurements, EC (electrical conductivity profiles), TDEM (geophysical),                                       | Geognostic,EC,T°,pH,SEV and water level measurements<br>Geophysical Data.                                                                                                                                                                                                                                            |
| <b>16)</b> Numerical hydrological modeling, chemical and isotopic methods, age determination, IR survey, seepage meters (for Submarine Groundwater Discharge, SGD) | Numerical Modeling (Seawat), Stable water isotopes (H and O)<br>Trace elements                                                                                                                                                                                                                                       |
| <b>17)</b> Monitoring methods applied and duration - water level measurements, EC (electrical conductivity profiles - seasonal)                                    | Water level,chemical analysis, EC measurements,T° and salinity<br>Many different studies from 2003 to now - see added pub. List.                                                                                                                                                                                     |
| <b>18)</b> Management methods:                                                                                                                                     | Irrigation and drainage is managed by the 'Consorzio di Bonifica', Pineforests and wetlands are in part managed by the Parco Regionale del Delta del Po                                                                                                                                                              |
| <b>19)</b> Aquifer management actions:                                                                                                                             | No management actions, as a far as I know. Aquifer is labeled as unfit for use                                                                                                                                                                                                                                       |
| <b>20)</b> Identification of existing or potential problems:                                                                                                       | Increasing salinity over time threatens the species richness in the natural areas and agriculture. All fresh potable water needs to come fro far: PO river or Apenines                                                                                                                                               |
| <b>21)</b> Annexes:                                                                                                                                                |                                                                                                                                                                                                                                                                                                                      |
| <b>22)</b> Observations:                                                                                                                                           |                                                                                                                                                                                                                                                                                                                      |