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LARGE SCALE MAPPING OF GROUNDWATER RESOURCES IN INDIA WITH RESULTS FROM TEST SITES IN DIFFERENT GEOLOGICAL TERRAIN

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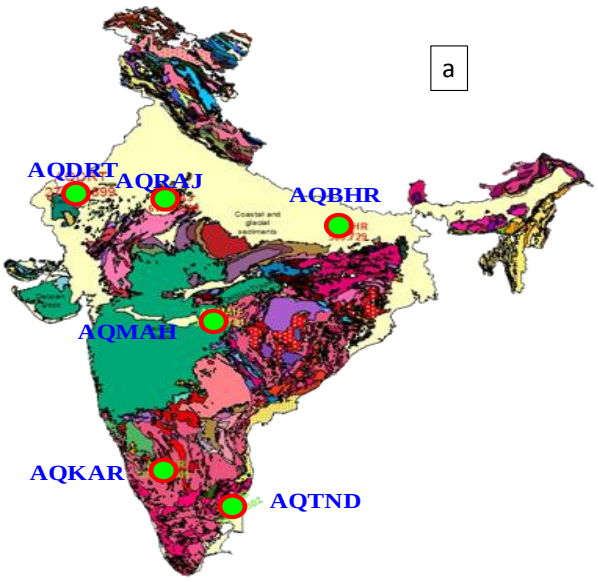
A GREAT CHALLENGE

As the most part of the world, India is also getting more and more dependency on groundwater resources and hence mapping and cautious management become imperative. Ministry of Water Resources of the Government of India has launched a flagship project to tackle this problem. AQUIM stands for pilot project on aquifer mapping and it is a great challenge, not merely because includes the acquisition, in less than one year, of 13,800 line-km of helicopter-borne transient electromagnetic (HTEM) data over six different areas across India (Figure 1), but also because its ultimate aim is to develop a cost-effective tool to locate, characterize, and, eventually, manage water resources. An accurate picture of groundwater through aquifer mapping allows water management plans at the appropriate scale to be effective for the protection of this invaluable resource, while it is becoming physically and economically scarcer and scarcer. This is a necessary prerequisite to achieve drinking water security, improve irrigation strategies and develop sustainability, especially in a country, like India, characterized by an impetuous economic and population growth. Depending on the outcomes, AQUIM is planned to be scaled across the entire country within the next decade. The original scientific plan of AQUIM starts with compiling of the existing database in the area and conceptualize the hydrogeological set up followed by SkyTEM survey, ground truthing and validation of the derived model by ground based data, joint inversion and data integration, deriving 2/3D hydrogeological model at 1:50,000 scale and demarcating the aquifer disposition precisely usable to village level up to 200 m in hard rock and 300 m depth in alluvial. CGWB will use the above information to carry out aquifer modeling for effective management and development of groundwater resources.

CSIR - National Geophysical Research Institute and the HydroGeophysics Group (HGG) at Aarhus University signed an agreement concerning the acquisition, processing and inversion of the HTEM data from the six areas of the AQUIM project.



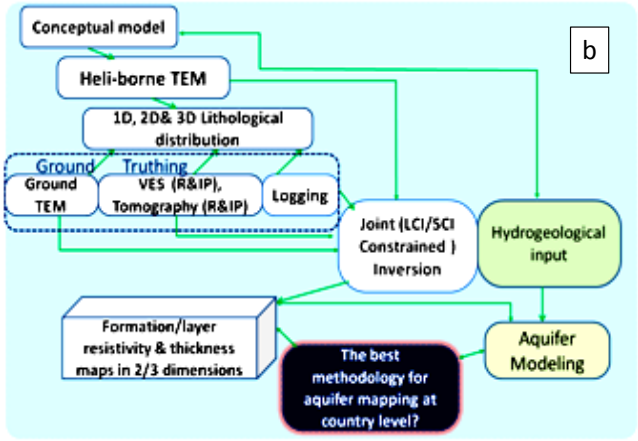


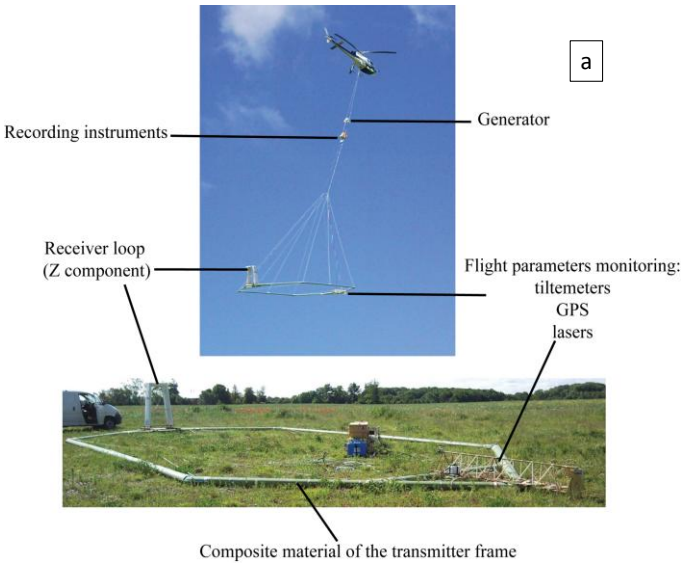
Figure 1.
a) Geological map of India with the location of the six areas selected for the AQUIM project and b) scientific plan.

THE SIX SURVEYS

The six investigated sites of the AQUIM project have been selected to be representative of the complexity of Indian hydrogeology. They include: Ganga Basin in Bihar (AQBHR in Figure 1), hard rocks and desert terrain in Rajasthan (AQRAJ and AQDRT), basaltic traps in Maharashtra (AQMAH), crystalline rocks in Karnataka (AQKAR), and costal sediments in Tamil Nadu (AQTND). More details about each area can be found in the two websites of the project: http://www.aquiferindia.org/ and http://hgg.au.dk/projects/aquim/.

The data of the six surveys will be collected by means of the SkyTEM system (Figure 2a), a system specifically developed for hydrogeophysical purposes. The particularity of all SkyTEM systems (Sørensen and Auken, 2004) is the measurement of both a low (LM) and a high (HM) moments. This dual-moment configuration allows getting information both from near surface and deep layers. The HM gives a depth of investigation of ~300 m (depending on the resistivity), and the LM, which is only ~10 µs from end of ramp, will give information in the very shallow near surface (top 5 meters, approximately).The data are then processed with Aarhus Workbench (Figure 2b), which includes sophisticated processing and inversion schemes (Auken et al., 2009; Viezzoli et al., 2008). The detailed processing and inversion is a requirement in complex geological conditions where we are seeking low-contrast anomalies. The main scientific difficulty in the processing of AQUIM data concerns the fact that, so far, the processing workflow for HTEM data has been designed for sedimentary environments, while several of the AQUIM areas (and the majority of aquifer systems in India) consist of fractured zones (e.g. AQRAJ) with a negligible primary porosity (Shakeel et al., 2008). The risk of the "standard" processing is to override those geological features that are actually fundamental for the water dynamics.

Here, we present the results from one of the area highlighting the way we tackled the specific difficulties related to that site.



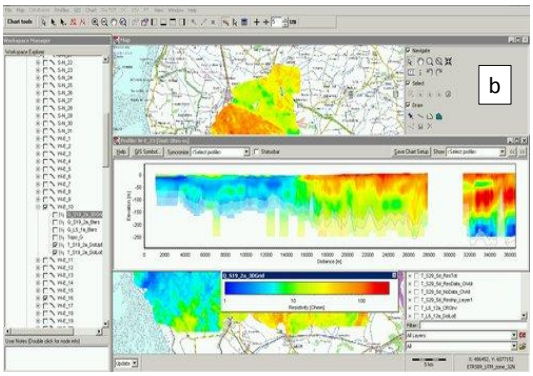


Figure 2.
a) The SkyTEM system used for the acquisition of the helicopter-borne TEM data along the 13,800 line-km in the six areas. b) A screen-shot of Aarhus Workbench, the software package used to process and invert the geophysical data of the AQUIM project.

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