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Abstract n°2400

Delineation of groundwater potential zones using non-invasive techniques to improve conceptual modelling of recharge in a non-instrumented weathered crystalline aquifer in South India

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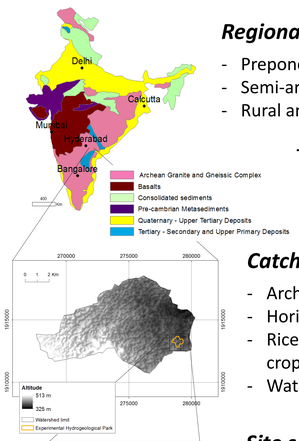
- When working in data-scarce areas, especially in heterogeneous environments, obtaining a sufficient amount of data to properly characterize hydrogeological fluxes is a crucial yet complicated task.
- Here we present the use of non-invasive techniques such as remote sensing and geophysics to delineate groundwater potential zones with distinctive characteristics and behaviour, emphasizing large scale surface data
- In term, this will allow us to create spatially distributed input parameter sets to improve conceptual modelling of groundwater recharge

Context



Regional scale

- Preponderance of igneous rock
- Semi-arid environment
- Rural and agricultural

→ Strong reliance on fractured crystalline aquifers

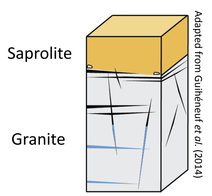
Catchment scale 56 km²

- Archean granitic complex
- Horizontal heterogeneity
- Rice paddies as dominant crop
- Water scarcity issues

Site scale (EHP) 0.4 km²

- Well equipped (>20 boreholes)
- Controlled conditions
- Continuous high frequency monitoring

Log scale



- Vertical and lateral heterogeneity
- Deep water levels from overexploitation (>15 m)
- Compartmentalization enhanced by groundwater depletion

- How is the EHP study site representative of catchment scale properties ?
- Can *surface* characteristics be used as a proxy to map *groundwater* characteristics ?
- Can we optimize data collection to improve conceptual modelling of groundwater processes and recharge ?

HGU delimitation – Methodology

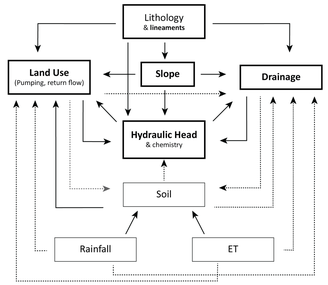
Hydrogeomorphological Units

One unit = specific groundwater occurrences and processes

An HGU comprises one or more terrain units presenting a certain *drainage pattern*, *local topography* and the *soil and weathered zone characteristics* which govern the recharge, storage of groundwater and outflow.

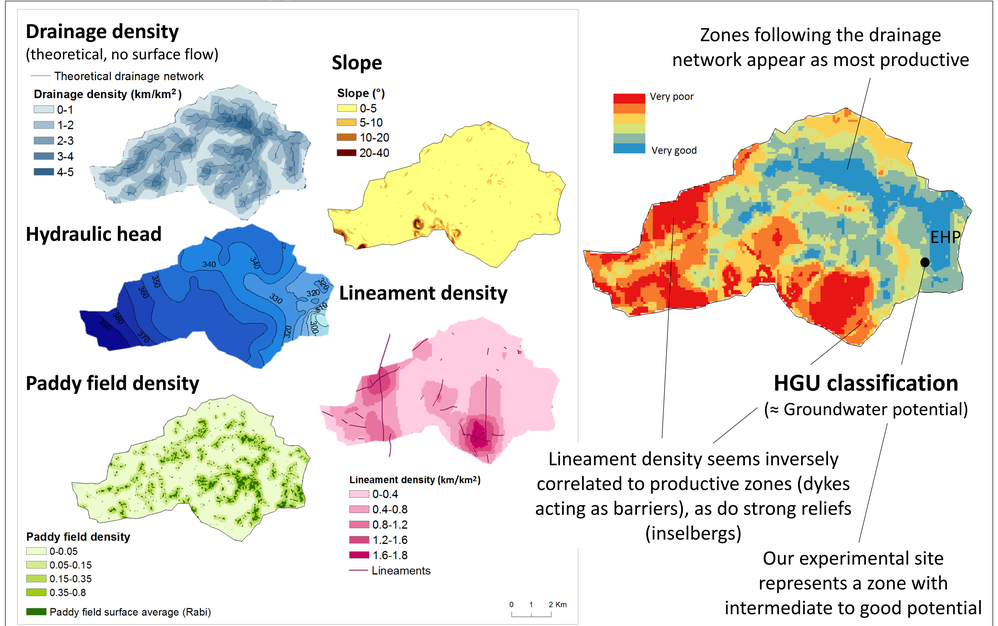
Each influencing factor is assigned a weightage relating to the extent of their influence on other factors

- Major effect (1 point)
- Intermediate effect (0.5 point)
- Minor effect (0.25 point)
- Influencing factors
- Factors selected



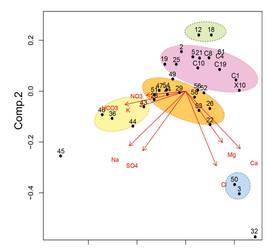
Method further described in Magesh *et al.* (2012)

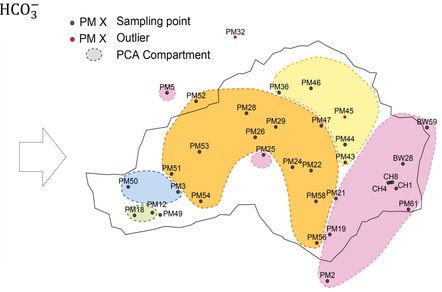
HGU delimitation - Application



Correlation with groundwater compartmentalization

$Na^+, K^+, Ca^{2+}, Cl^-, Mg^{2-}, SO_4^{2-}, NO_3^-, HCO_3^-$





Compartmentalization shown by the PCA correlates relatively well with the groundwater potential zones

PCA performed on 35 groundwater samples collected from available boreholes in July 2016 (Rabi season)

Verification through complementary field data collection

Verify the validity of the outlined hydrogeomorphological units through field data collection ⟷ Use HGU categories to facilitate field data collection

- Hydraulic tests
- Applied geophysics

If representative HGUs may be defined for describing groundwater processes, then necessary data point density could be decreased

Conclusion

Surface characteristics correlate with groundwater compartments

This finding is encouraging regarding the establishment of proxies from surface data for groundwater model parameters

Overall, separating a catchment into HGUs, for which validation is necessary through data collection, is a promising method to allow reservoir model calibration in heterogeneous non-instrumented environments

Perspective: conceptual modelling

Objective: Create a conceptual model whose parameters are defined within each HGU category and which can be calibrated with hydraulic head (as there is no perennial discharge)

Establish proxies for reservoir model parameters using **remote sensing** and optimized **field data** collection

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Calibration on a well-instrumented watershed with marked heterogeneity and where long-term piezometric time series are available

(i) Guihéneuf, N., Boisson, a., Bour, O., Dewandel, B., Perrin, J., Dausse, A., … Maréchal, J. C. (2014). Groundwater flows in weathered crystalline rocks: Impact of piezometric variations and depth-dependent fracture connectivity. *Journal of Hydrology*, *511*, 320–324. http://doi.org/10.1016/j.jhydrol.2014.01.061

(ii) Magesh, N. S., Chandrasekar, N., & Soundranayagam, J. P. (2012). Delineation of groundwater potential zones in Theni district, Tamil Nadu, using remote sensing, GIS and MIF techniques. *Geoscience Frontiers*, *3*(2), 189–196. http://doi.org/10.1016/j.gsf.2011.10.007

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