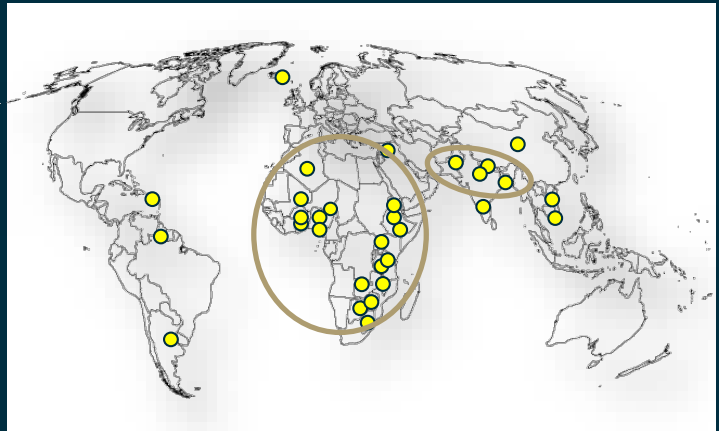
PROF ALAN MACDONALD

Transboundary data sets: African groundwater atlas and Indo-Gangetic Aquifer

British Geological Survey

Introduction

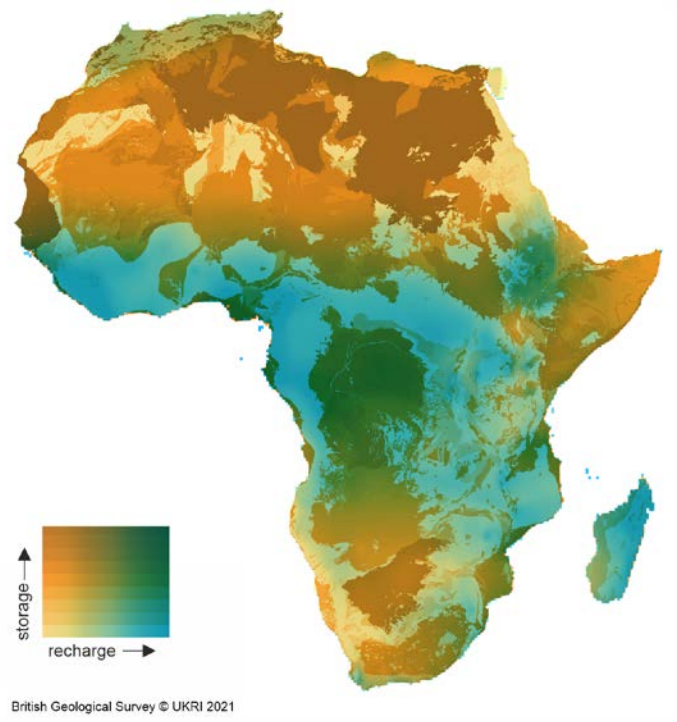
1. Developing quantitative groundwater maps of Africa
2. Informing water security
3. Online African groundwater atlas
4. Collaborative quantitative groundwater maps of the Indo-Gangetic Aquifer
5. Making historic data available
6. Conclusion



Recent BGS groundwater projects

Since 2010, BGS with partners have been developing quantitative maps for groundwater:

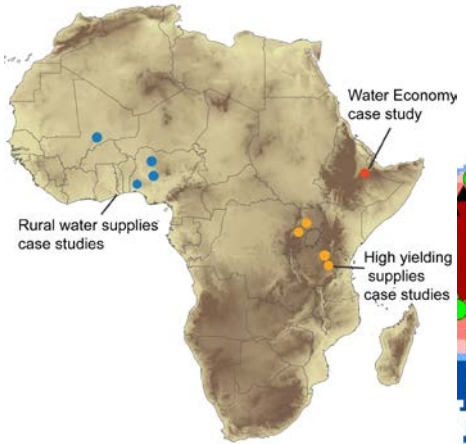
- Groundwater storage
- Depth to groundwater
- Potential aquifer yield
- Aquifer recharge
- Depletion
- Salinity (in progress)

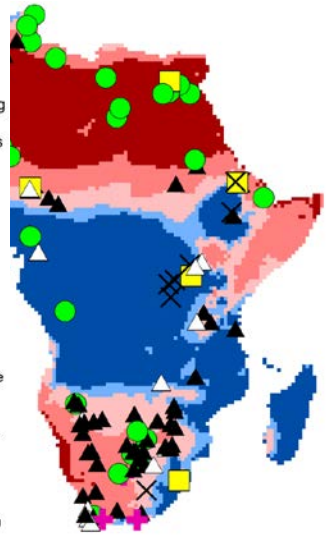


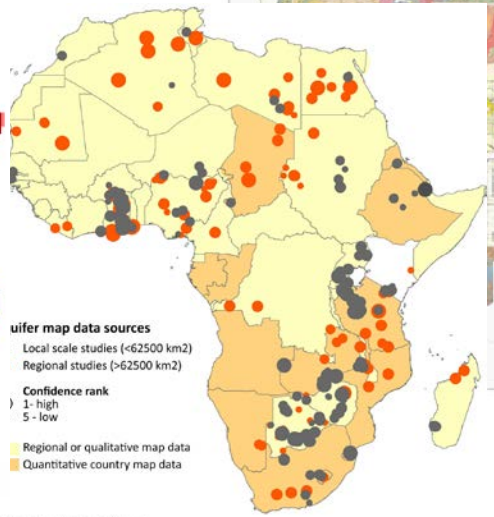
https://doi.org/10.1088/1748-9326/abd661

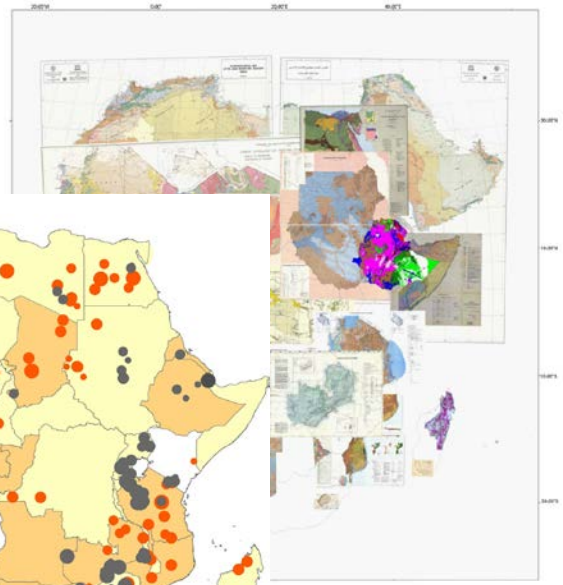
….to inform discussion on water security

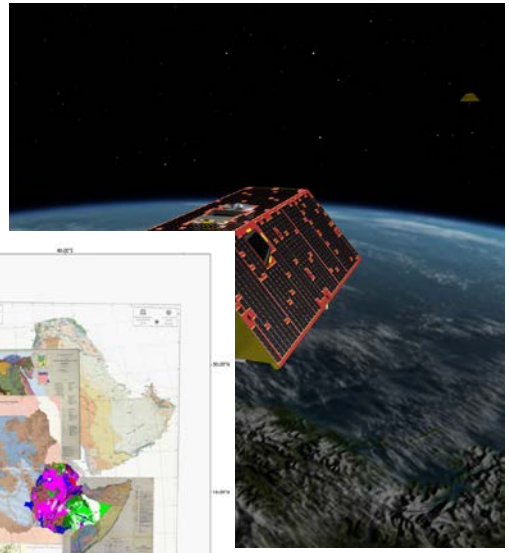
Methods


Water Economy case study
Rural water supplies case studies
High yielding supplies case studies


semi-arid
dry sub-humid
humid
chloride mass balance
groundwater model
environmental tracers
soil moisture balance
water balance
water-table fluctuation


uifer map data sources
Local scale studies (<62500 km2)
Regional studies (>62500 km2)
Confidence rank
1- high
5 - low
Regional or qualitative map data
Quantitative country map data





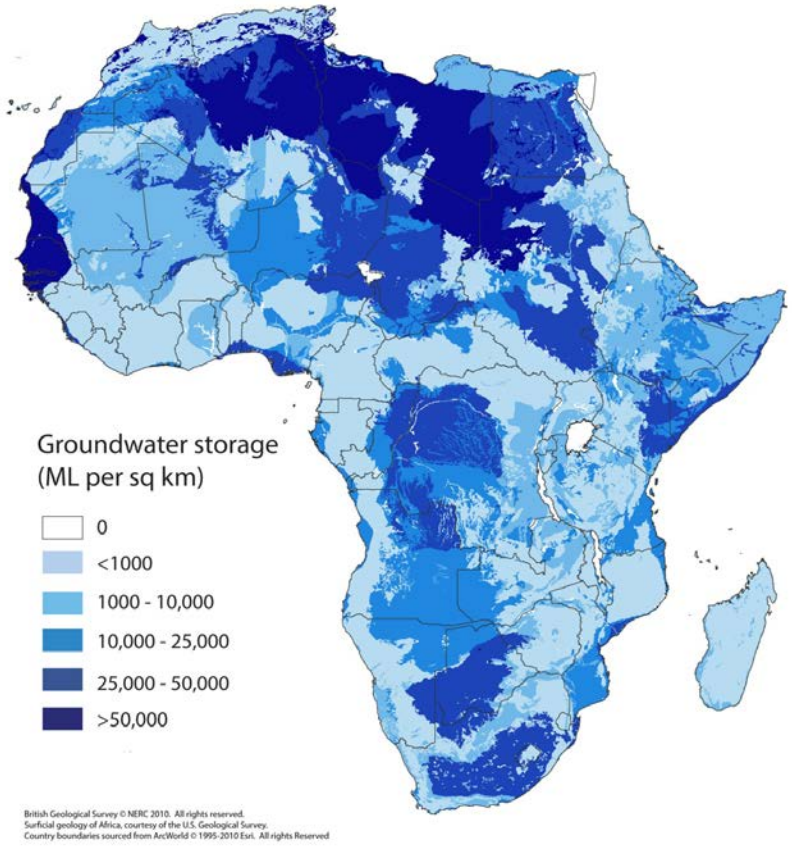
Groundwater storage

- Overall storage high:
- 0.5 - 1 million km^3

- 20 times that stored in rivers and lakes

- 100 times the annual renewable freshwater

- Even in low storage areas, often 5 x the annual requirement for hand pump



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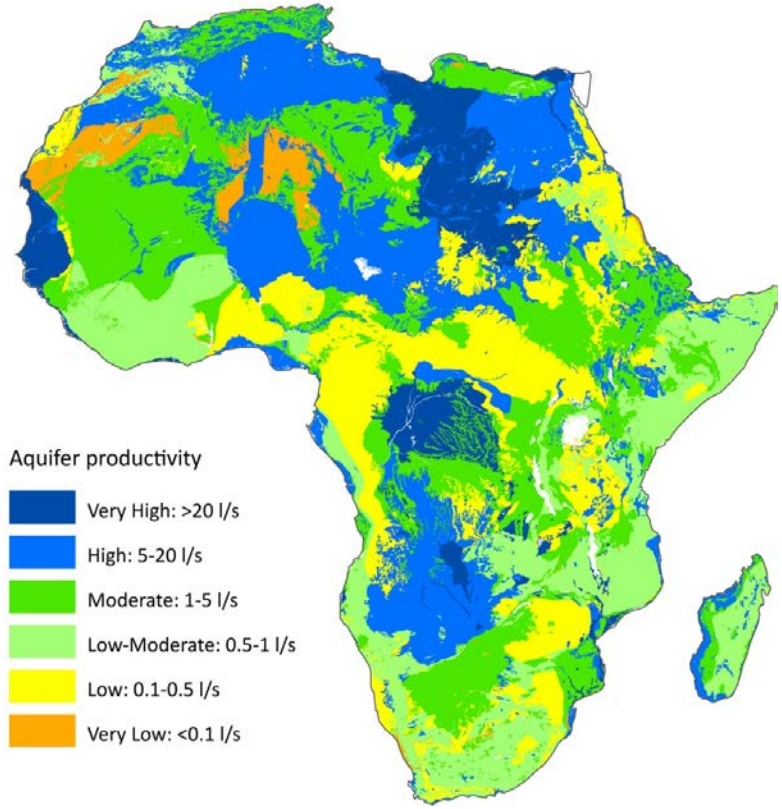
Borehole yields

- Yields for handpumps generally OK
- Small scale irrigation possible
- Large scale irrigation difficult



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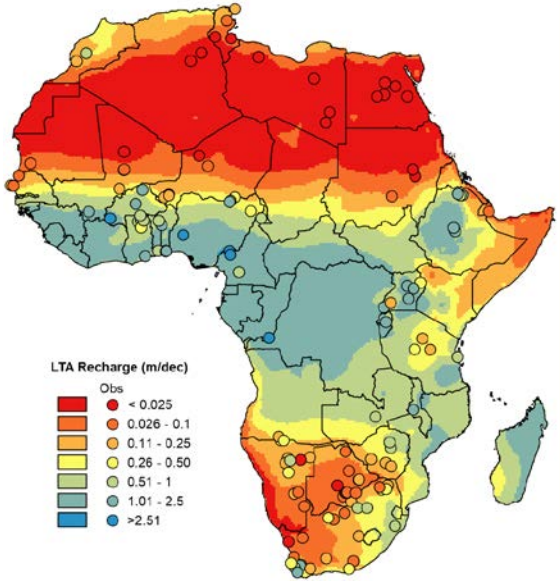
Other maps



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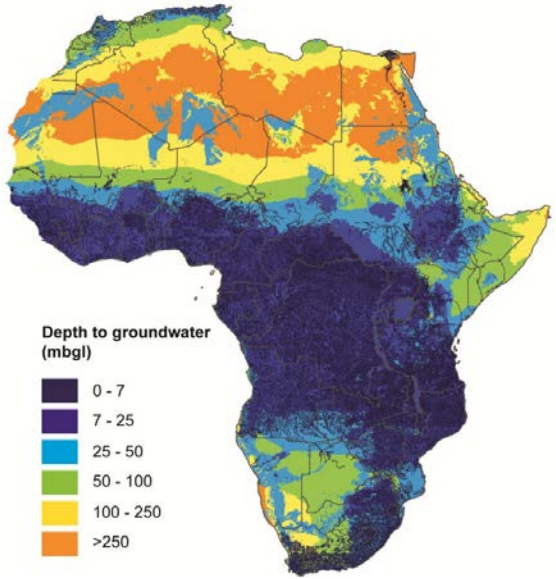
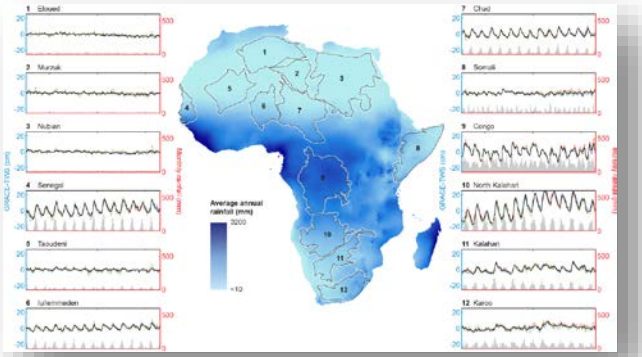
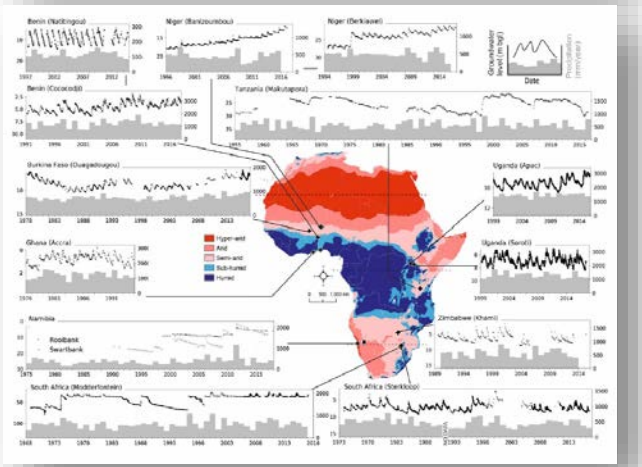


http://nora.nerc.ac.uk/id/eprint/17907/1/OR11067.pdf





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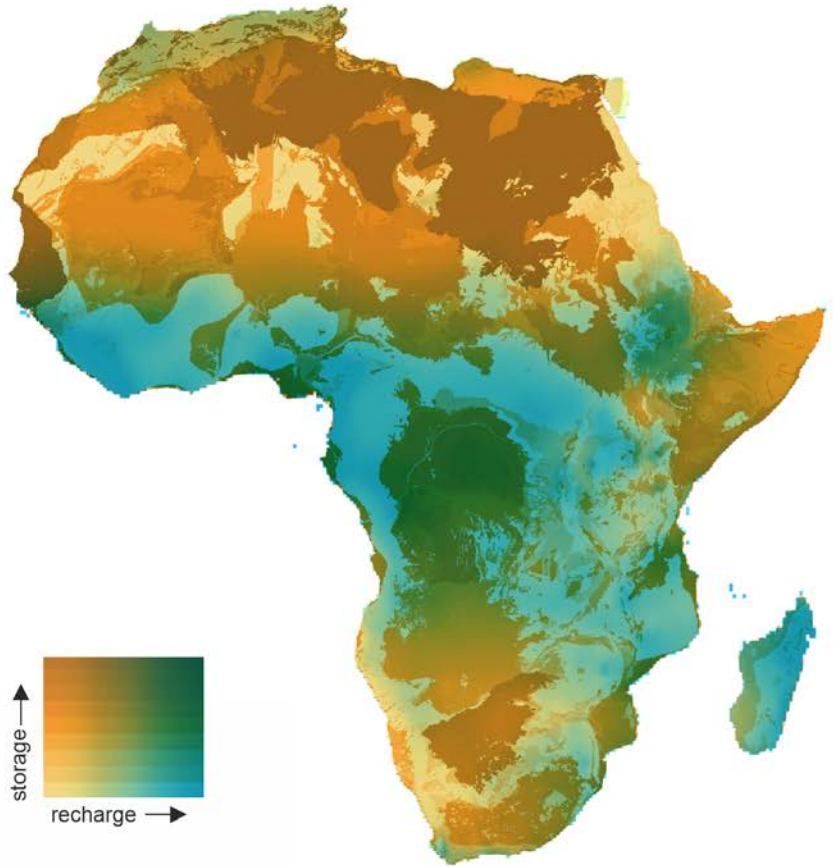
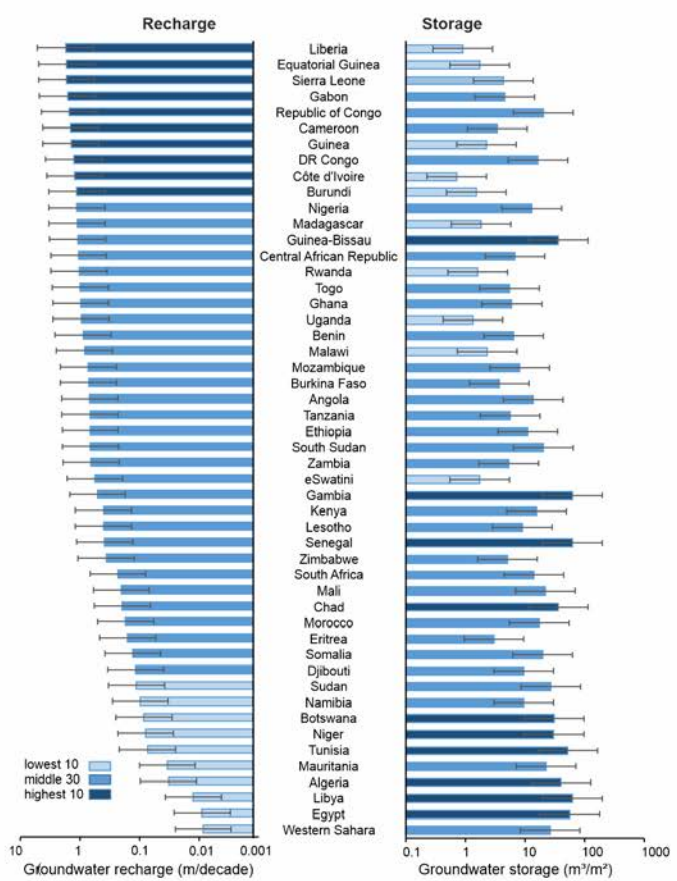
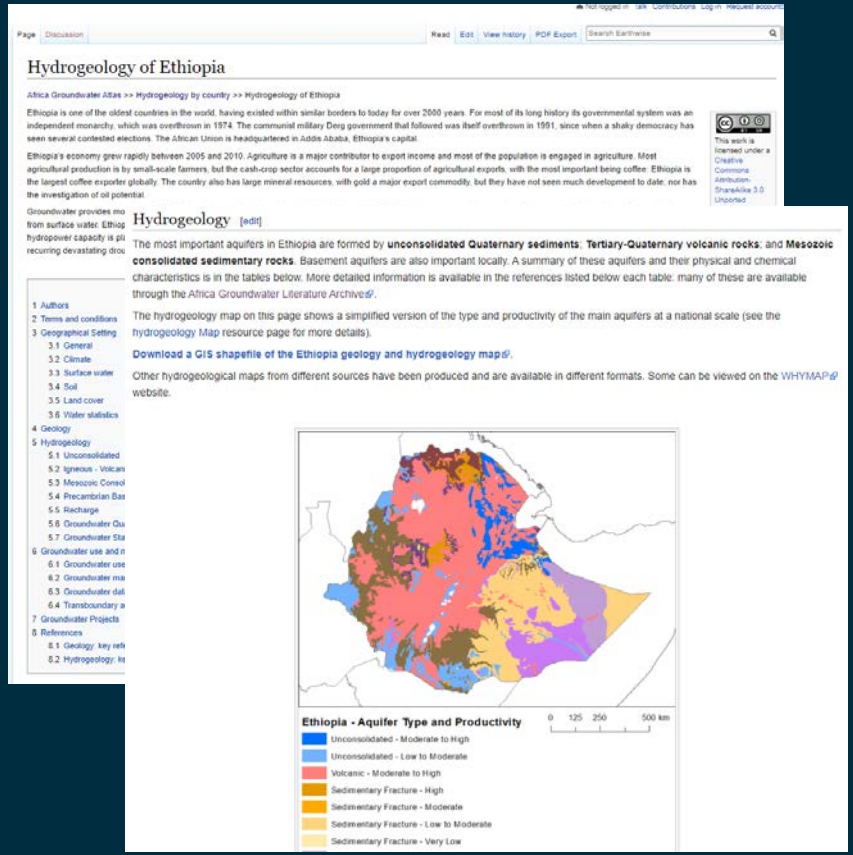
Informing water security





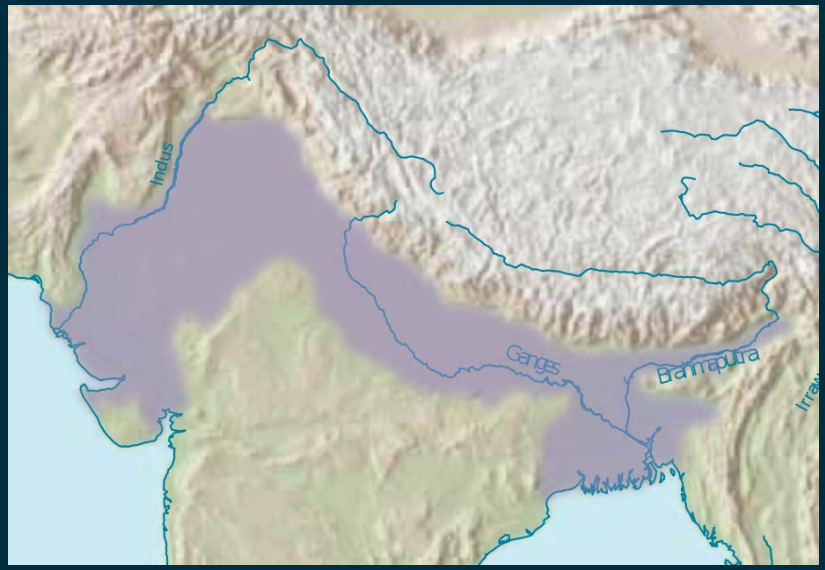
WIKI ONLINE ATLAS

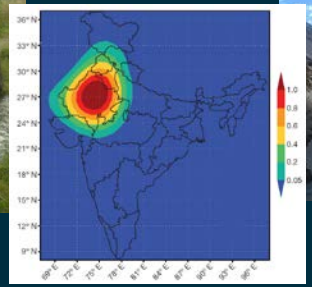
- Entries for every African country
- >50 authors
- 1000 accesses per month
- >3000 data downloads from 60 countries
- NGOs, Government, Development Banks, ODA, Academics, students
- Google groundwater + [country]
- USD 700k investment



Groundwater in the IGB

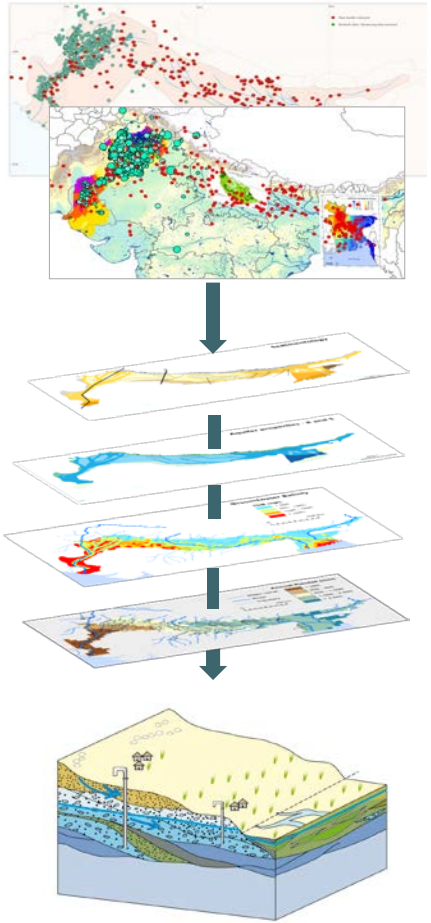
- Transboundary: Pakistan, India, Nepal, Bangladesh
- One of most developed global aquifers (> 200 km^3 per year)
- Contentious narrative of over exploitation
- Highly complex hydrological processes
- Additional environmental pressures



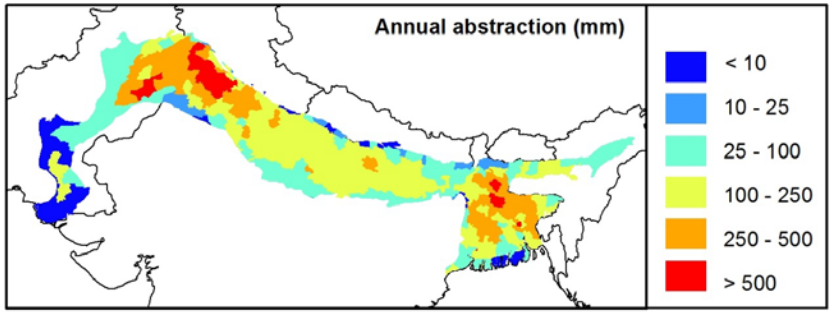


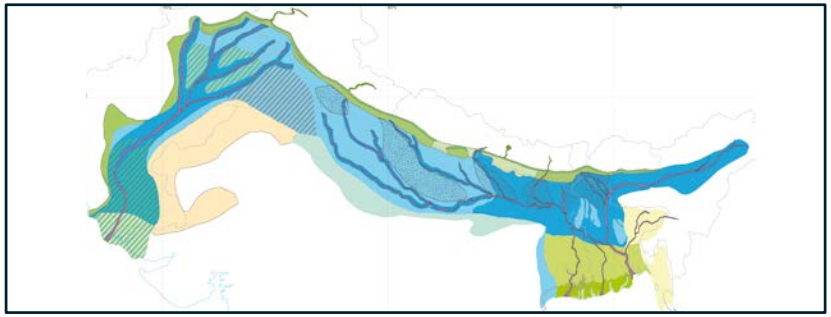
Methods

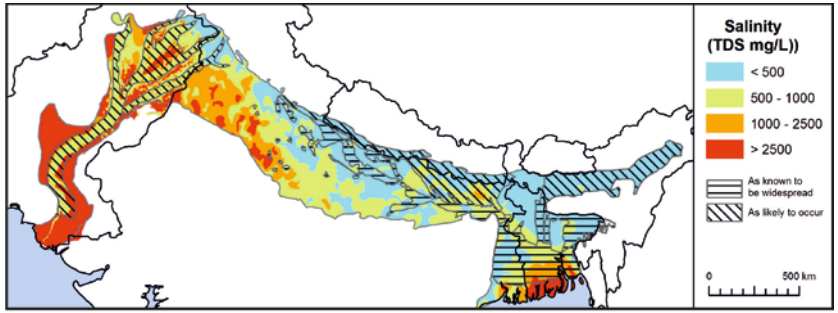
- International team: Nepal, Pakistan, India, Bangladesh, UK
- Mainly academics, but also government
- Large data assimilation
- Additional case studies to fill significant gaps
- Workshops, review
- International publication (Nature GeoScience)



1. Recharge from rainfall, canals and rivers
2. GW **storage 30,000 km³** 20 times the annual flow in the GMB + Indus, 100 x storage in dams
3. Yields > 20 l/s - often higher
4. Large **systematic variations in aquifer**: permeability, storage and anisotropy
5. Salinity is both natural and man made
6. Arsenic natural and associated with Holocene deposits and organic soils





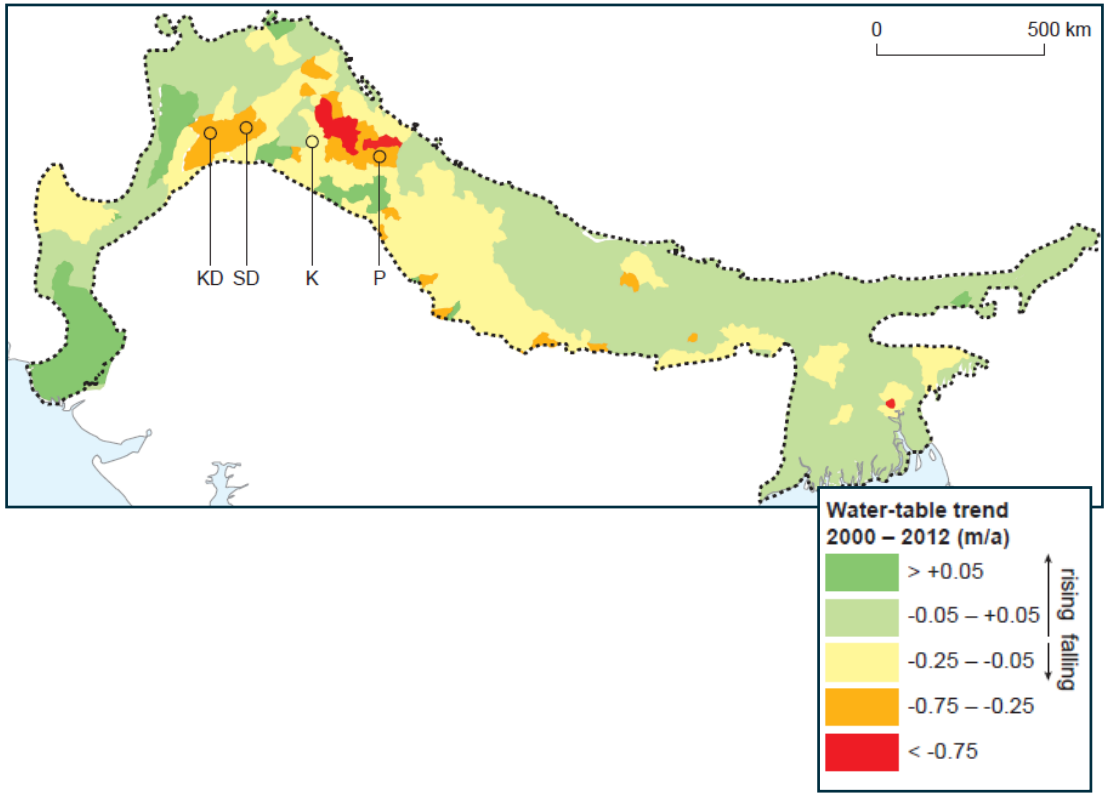


Depletion

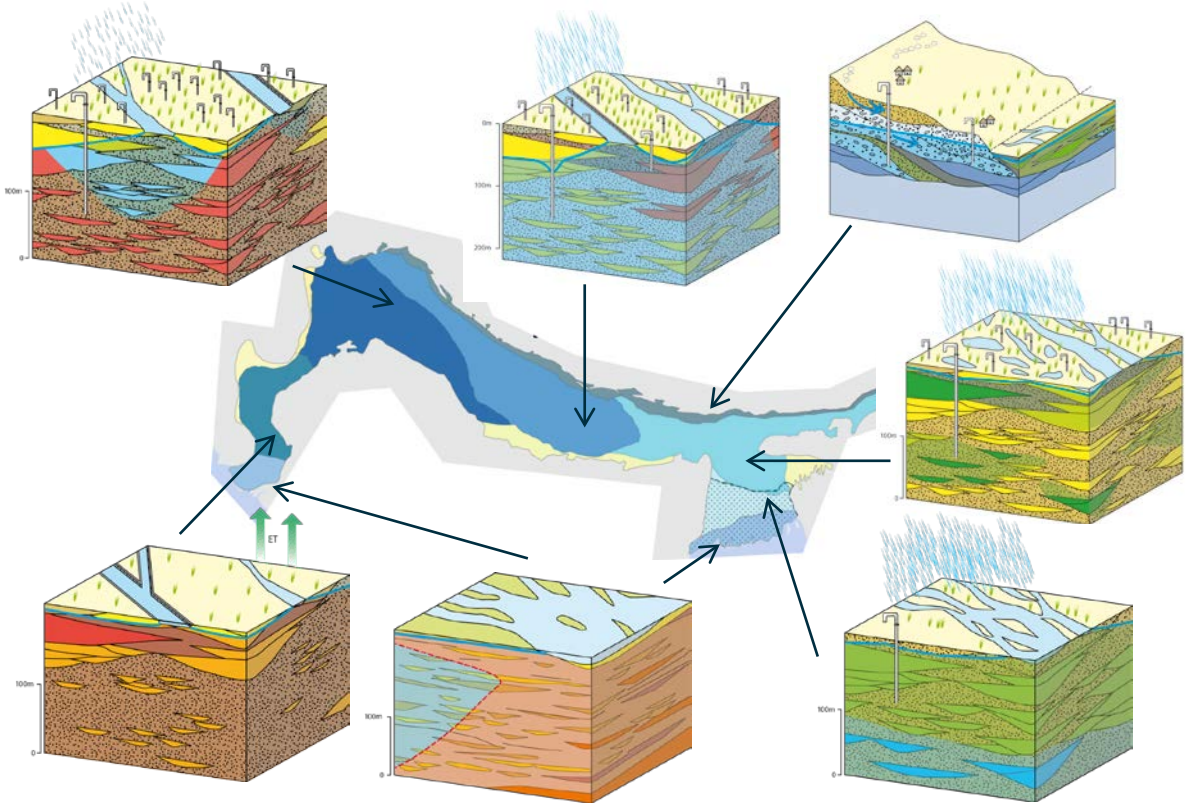
Water table is near stable across 70% of the aquifer, falling in 33%

Complex pattern influenced by rainfall, canals, abstraction

Net depletion of 8 km^3 per annum



3D groundwater typologies



Helps explain different behaviour

Typologies cross borders

Conclusions

1. Developing transboundary maps possible
2. Reveals new patterns not observed at smaller scales
3. Different view of water security
4. Vehicle for cooperation and consensus
5. Publication and peer review helpful
6. Open access outputs widely used
7. Spring board for more detailed work