How much do we know of African Groundwater Resources?

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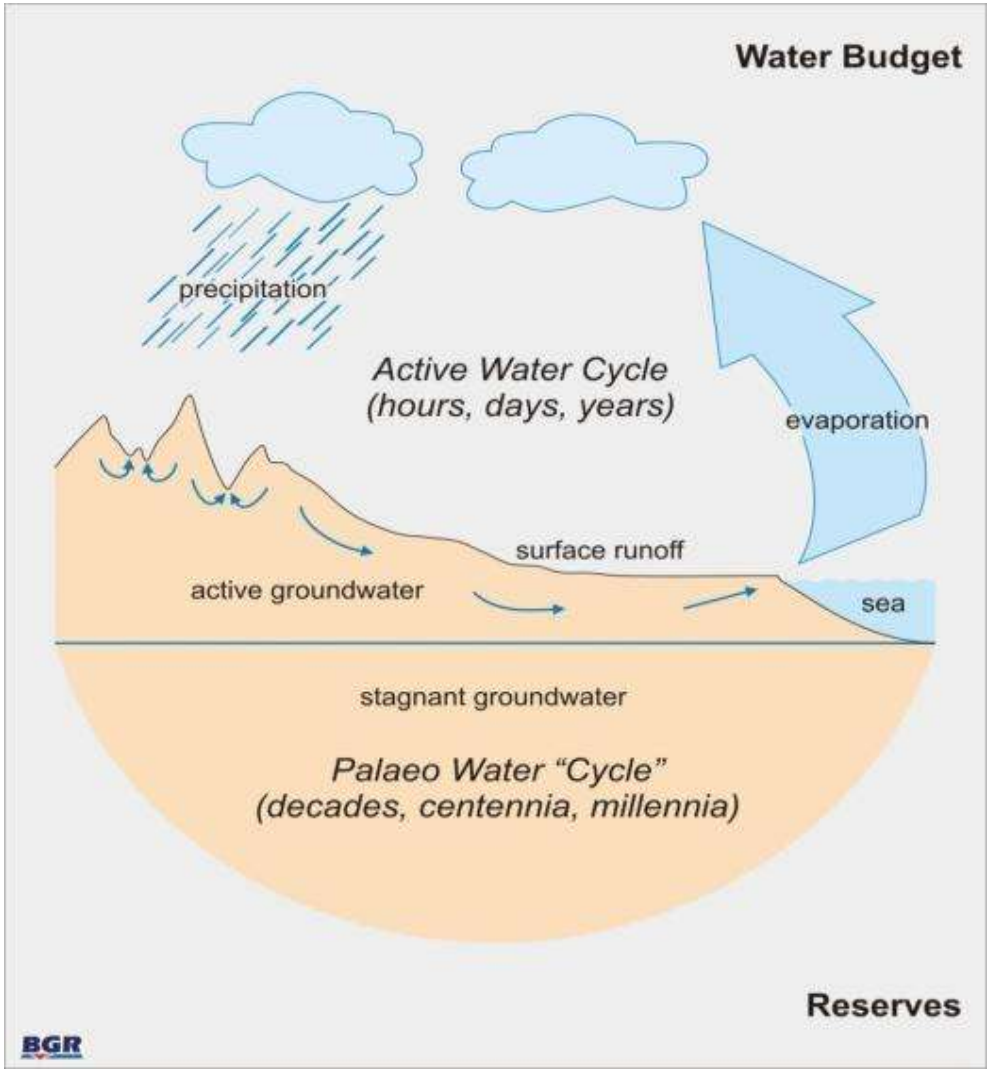
AMCOW Global Webinar on Groundwater,
"The role of groundwater in advancing Africa's socio-economic development",
20th May 2021

Setting the scene



Groundwater

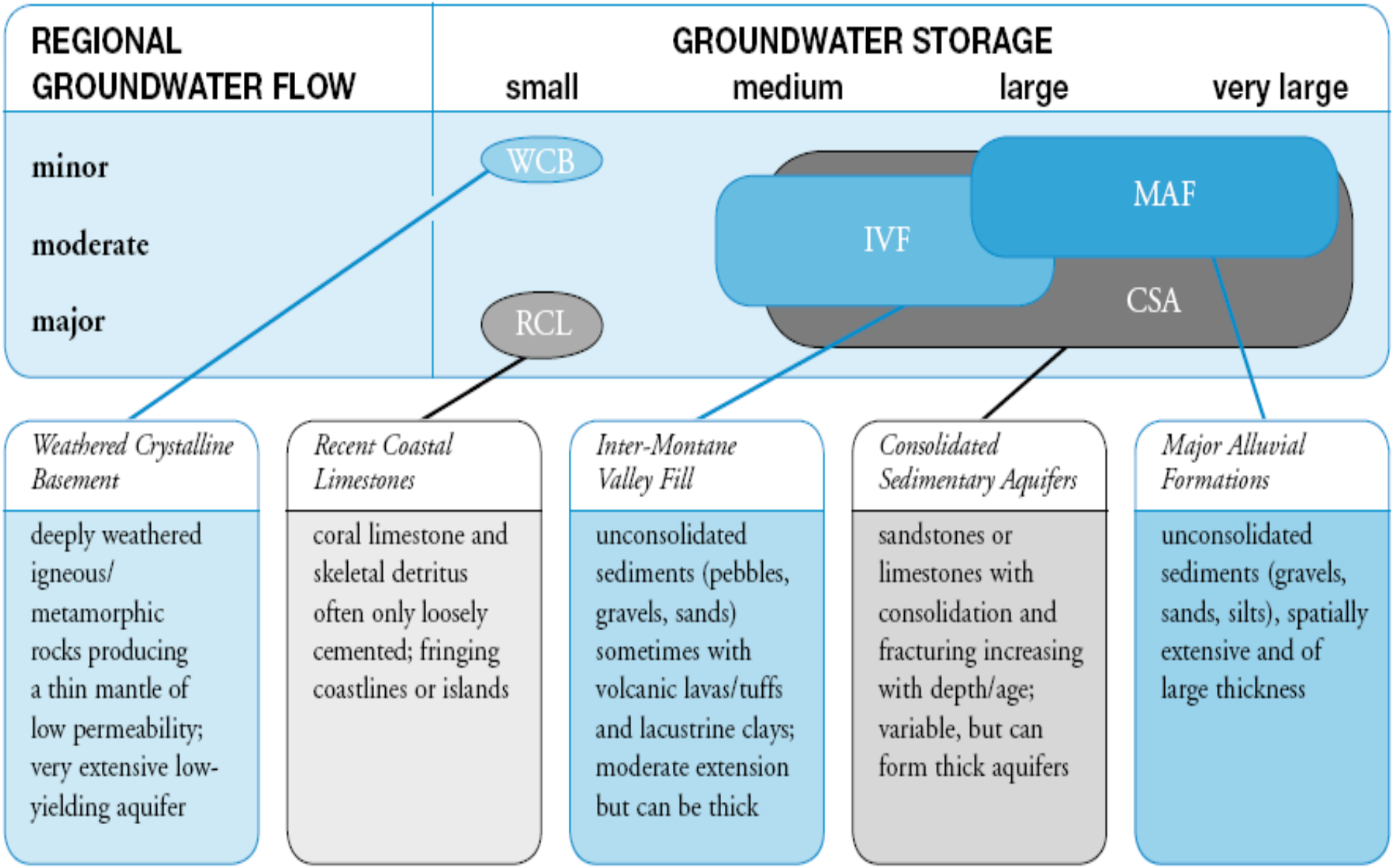
as an important part of

the Water Cycle

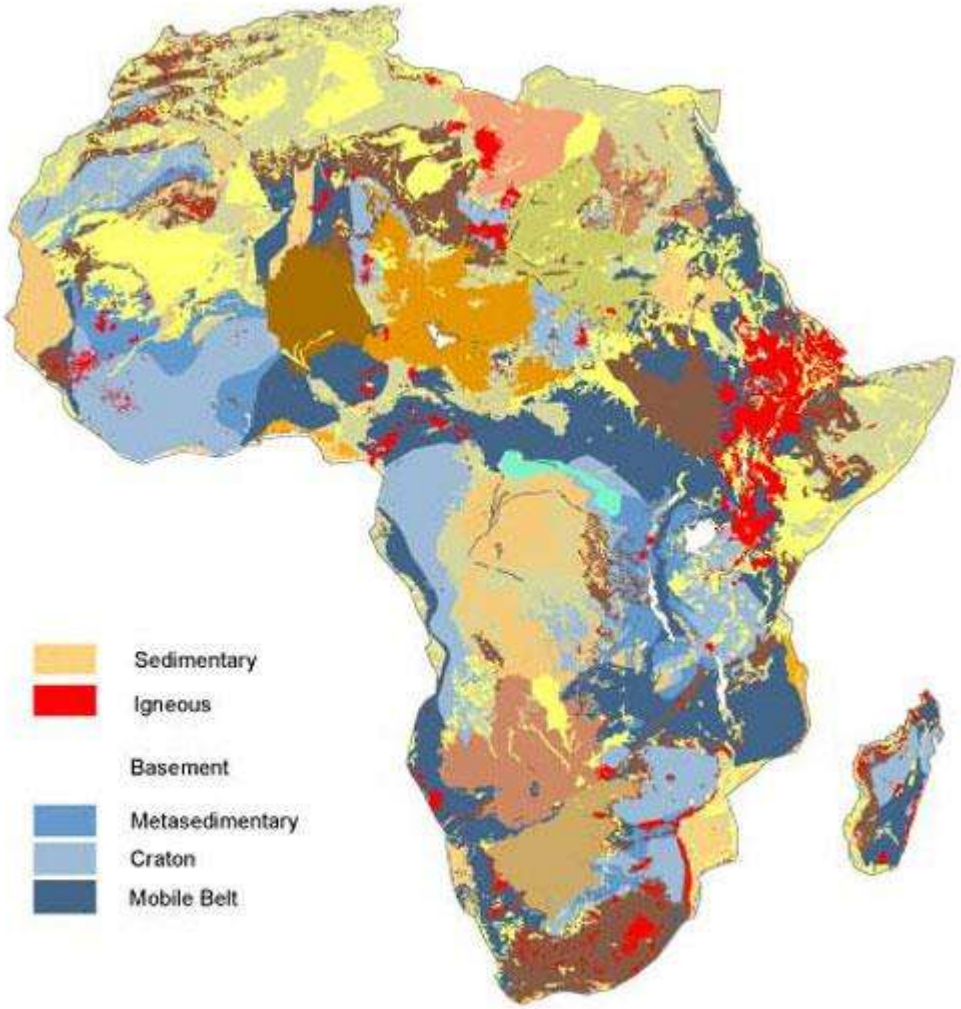
Groundwater stored

= Water resources inherited from the past millennia

Hydrogeological diversity and complexity



Geological setting of Africa

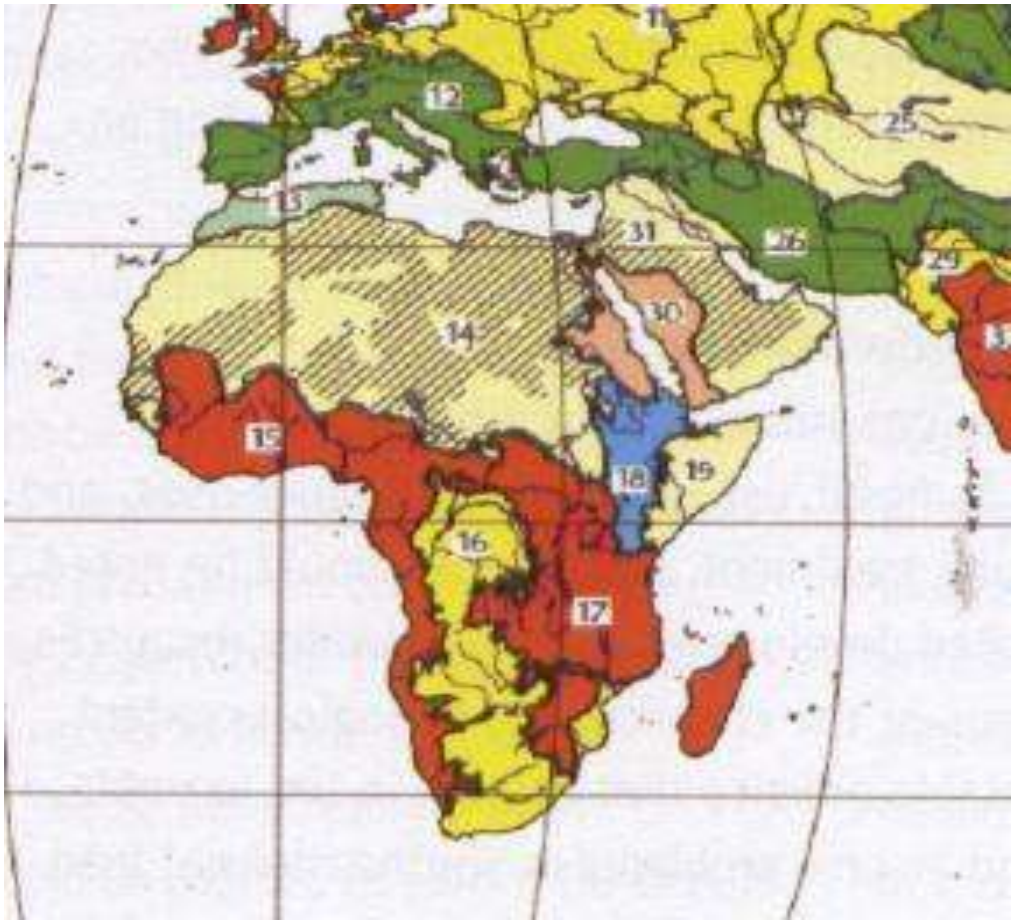


Boundaries of surficial geology of Africa, courtesy of the U.S. Geological Survey.

- 40 %: basement rocks
- 32%: consolidated sedimentary rocks
- 22%: unconsolidated sediments
- 6%: volcanic rocks

UNESCO 1:5 million geology used within the USGS superficial geology data.

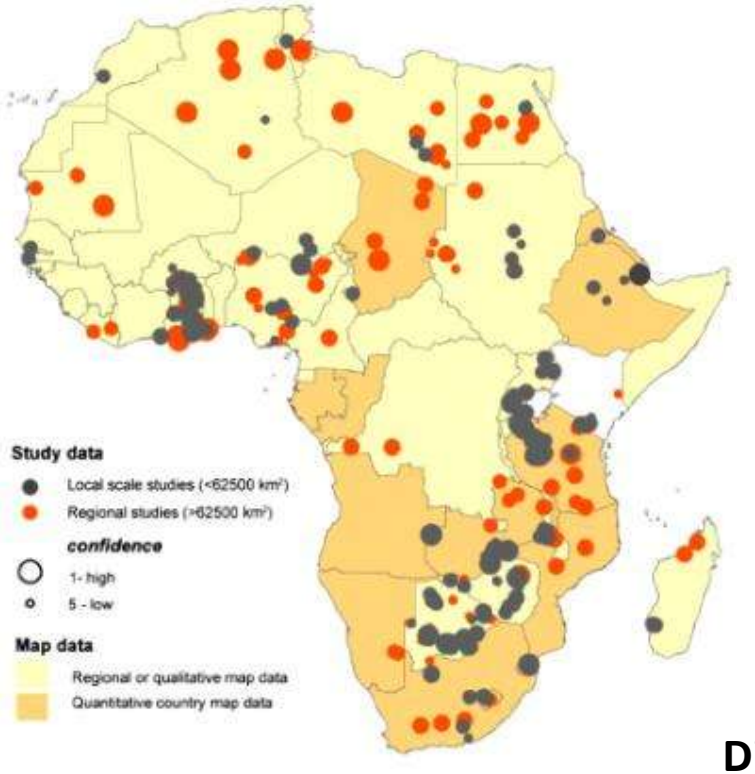
Major groundwater reservoirs in Africa



- 13 Atlas Mountains
- 14 Saharan basins
- 15 West African basement
- 16 Subsaharan basins
- 17 East African basement & Madagascar
- 18 Volcanics of East Africa
- 19 Horn of Africa basins

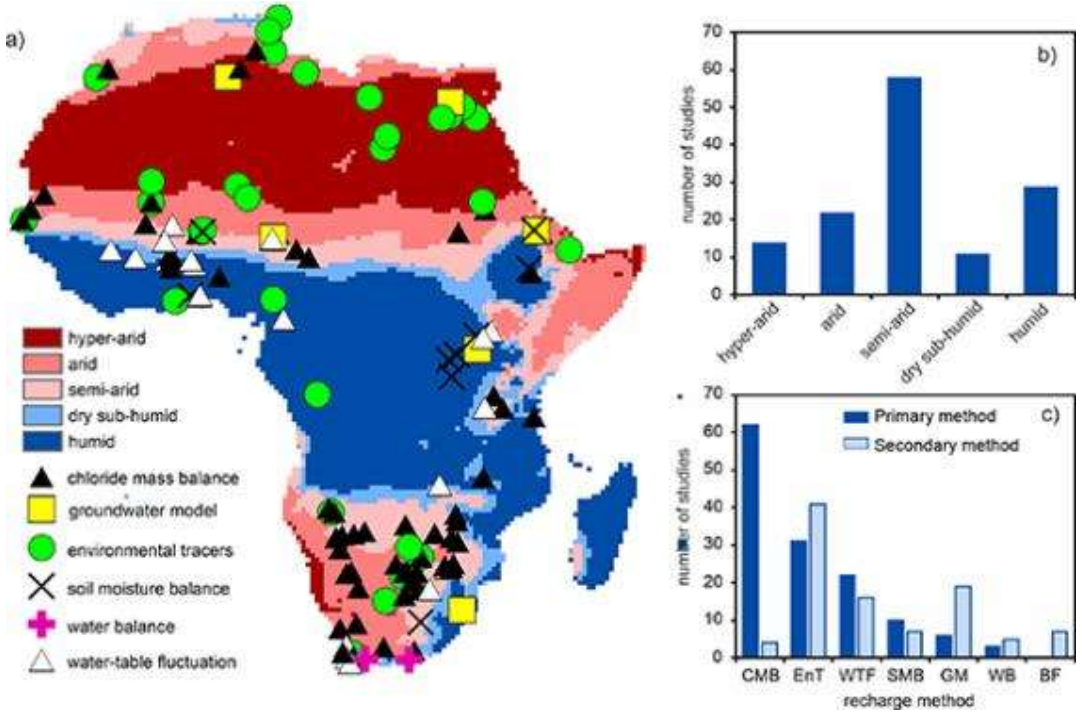
- Large variations of reservoir volumes, water storage and renewal rates in connection with aquifer types
- Depth of water occurrence
- Mainly low yielding aquifers
- Limited storage & little recharge
- Numerous transboundary aquifer systems

Where are we?



Distribution of data used to develop the continental maps

(MacDonald et al, 2012)



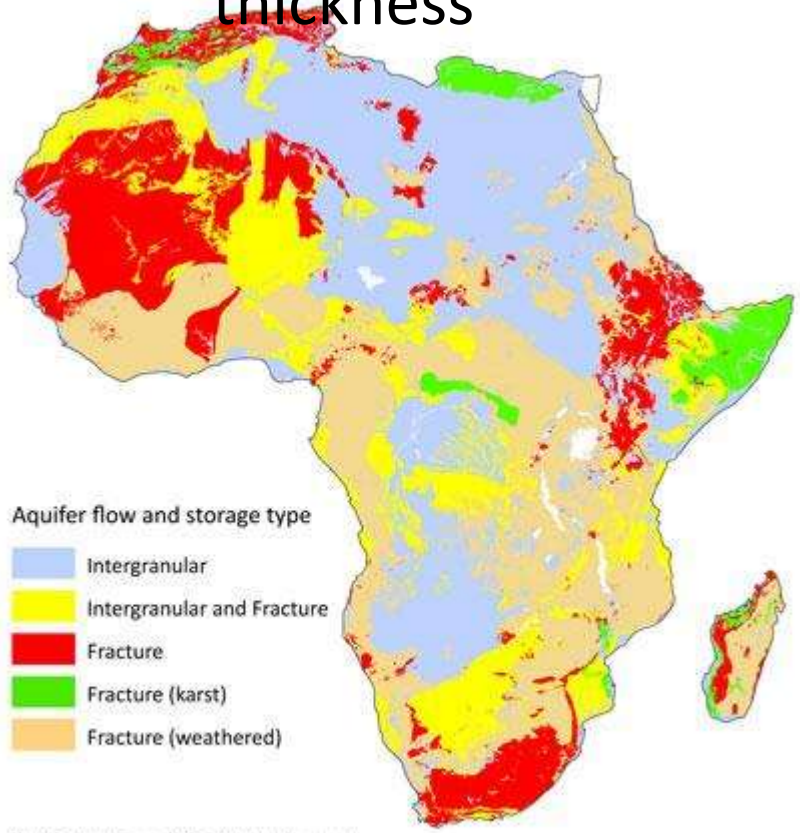
Distribution of quantitative recharge studies for Africa; (a) map of the location of the studies; (b) the number of studies according to aridity of study location; and (c) the type of methodologies used for calculating recharge.

(MacDonald A M et al, 2021)

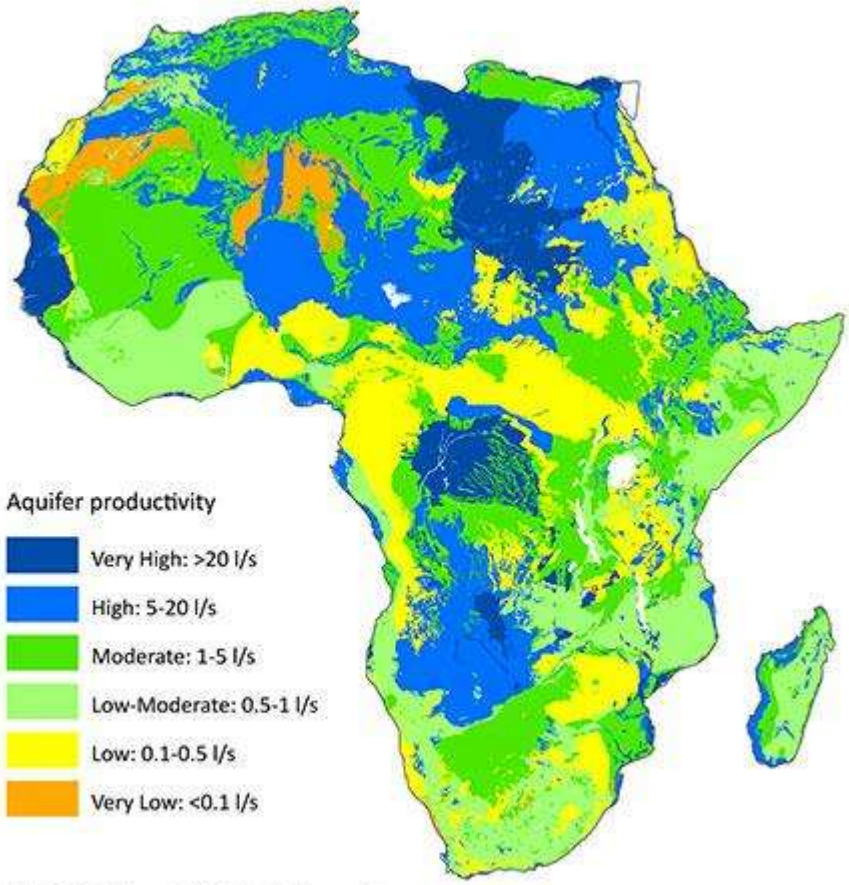
https://www2.bgs.ac.uk/groundwater/international/africanGroundwater/maps.html

Quantitative maps

Groundwater storage based on the effective porosity and saturated aquifer thickness

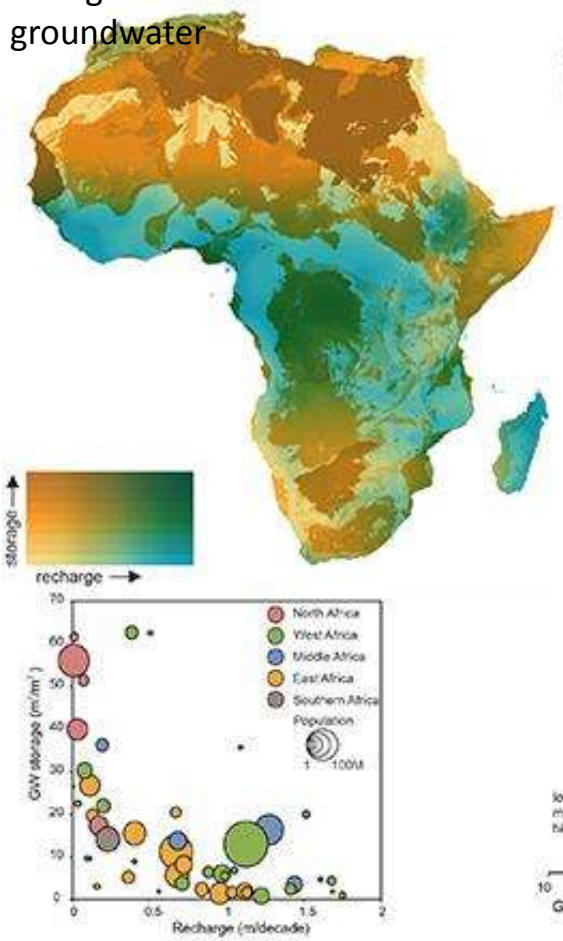


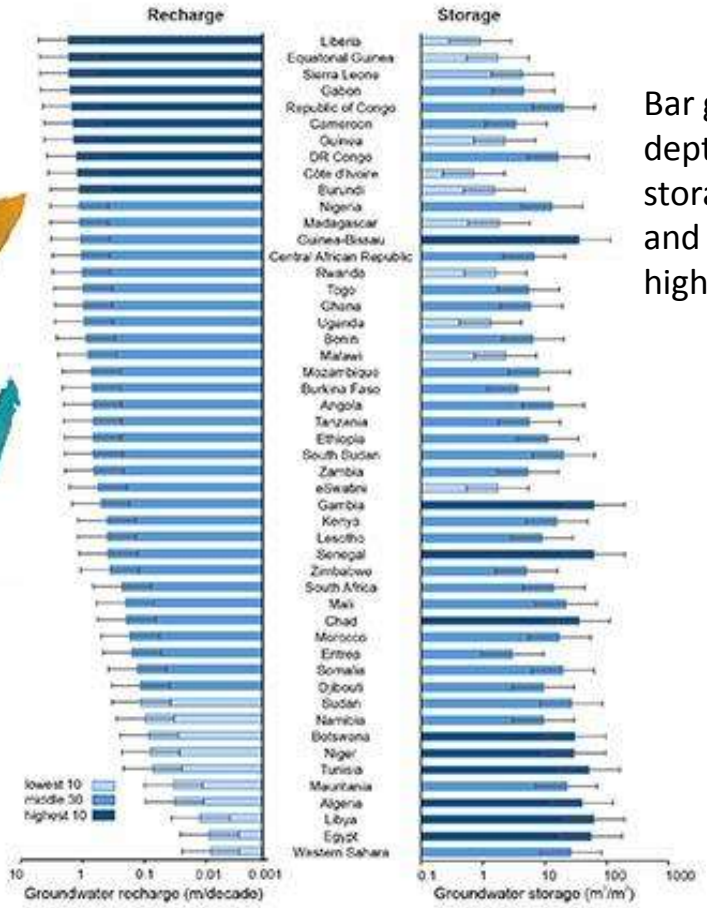
Aquifer productivity map



Groundwater recharge and storage

Map of Long term average recharge (LTA) and groundwater storage;





Bar graph of recharge depth and groundwater storage m−2 with ten top and bottom countries highlighted

Cross plot of groundwater storage and recharge for African countries scaled by population of the country.

Average groundwater recharge and groundwater storage for each African country

TRANSBOUNDARY AQUIFERS IN AFRICA

Seventy-two transboundary aquifers (TBAs) mapped.

Transboundary Aquifers and Groundwater Systems of Small Island Developing States: Status and Trends (UNESCO-IHP and UNEP, 2016;

: Nijsten, G.-J. et al, Journal of Hydrology: Regional Studies (2018), https://doi.org/10.1016/j.ejrh.2018.03.004

https://www.un-igrac.org/areas-expertise/transboundary-groundwaters

Take home messages

- wide variation in groundwater resources across the continent
- Relatively low yields of groundwater (< 5 l/s) are widely available at accessible depths and sufficient to sustain small communities and their development, but larger yields (>5 l s−1) suitable for urban development or major agricultural schemes are unlikely outside of the sedimentary terrain
- groundwater should be more widely used for a revolution in rural development
- Large sedimentary aquifers of Africa contain some 0.66 million km3 in storage but most of this water (0.44 M km3) is contained beneath eight Saharan countries and resources are accessible only to a very small fraction of the African population.
- Long-term recharge average with average decadal recharge depths in arid and semi-arid areas of 60 mm (30–140 mm) and 200 mm (90–430 mm)

Take home messages

- Big variability between high-storage/low-recharge sedimentary aquifers in North Africa, and low-storage/high-recharge weathered crystalline-rock aquifers across much of tropical Africa

- Distribution important for African water security, as many countries with low recharge possess substantial groundwater storage, whereas countries with low storage experience high, regular recharge.

- Water quality is often a limiting factor in quantifying usable fresh groundwater storage

- Sustainable management of groundwater resources including transboundary ones requires a good understanding of the groundwater systems based on data collected through monitoring programs and groundwater assessments/studies/research

- Special issue: Groundwater in Sub-Saharan Africa, Hydrogeology Journal, Volume 27, issue 3, May 2019
- Topical Collection: Determining groundwater sustainability from long-term piezometry in Sub-Saharan Africa, Hydrogeology Journal, Volume 27, February 2019