Groundwater Recharge

High resolution modelling of groundwater recharge for assessment of sustainable yield of deep and regional aquifers in Somalia

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Agenda

- Background project
- Method
- Results
- Questions

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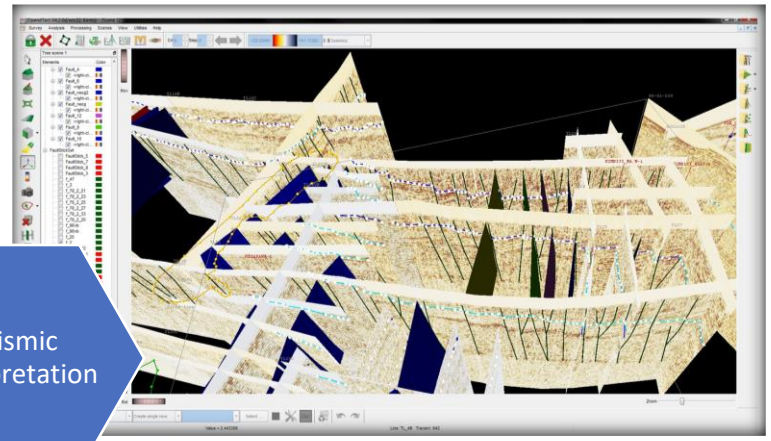
The Search Model

The search for deep groundwater



Literature Review

Locate Fresh Water

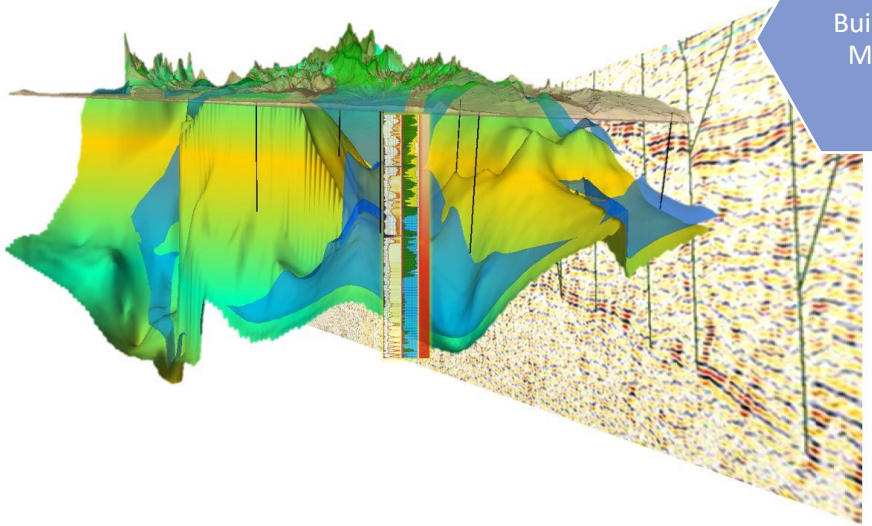
Seismic Interpretation

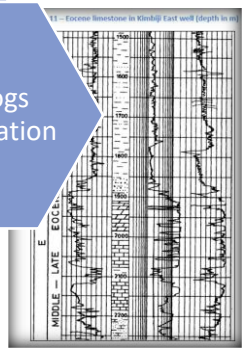
THE SEARCH MODEL

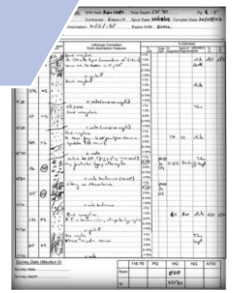
Build the Model

Well Logs Interpretation

Drillers Report







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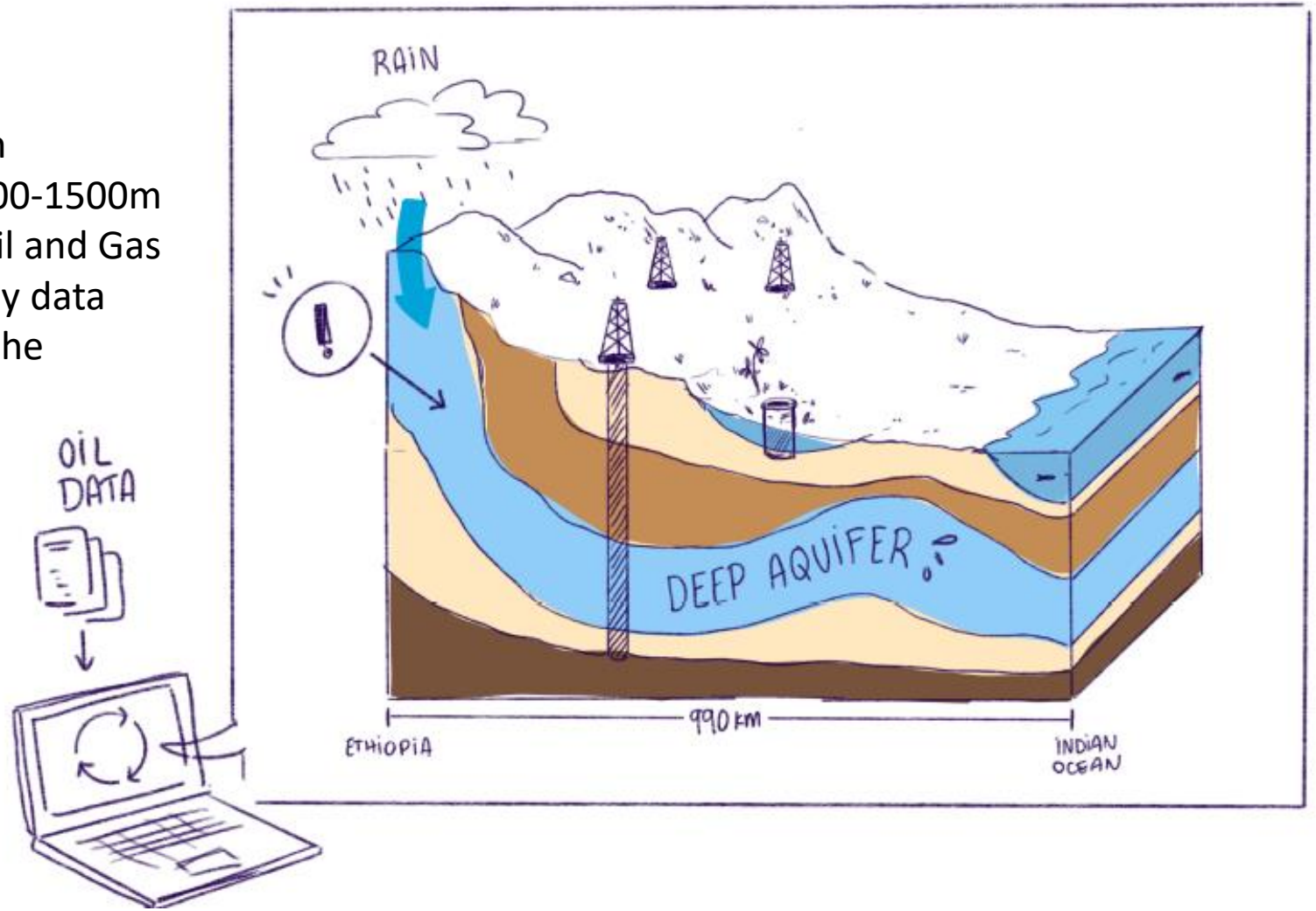
Somalia project

Ruden Water looks for opportunities of fresh groundwater **deeper in the subsurface**, at 300-1500m depth, making use of data obtained in the Oil and Gas industry, combined with traditional hydrology data and methodology, to look for indications of the presence of fresh groundwater.



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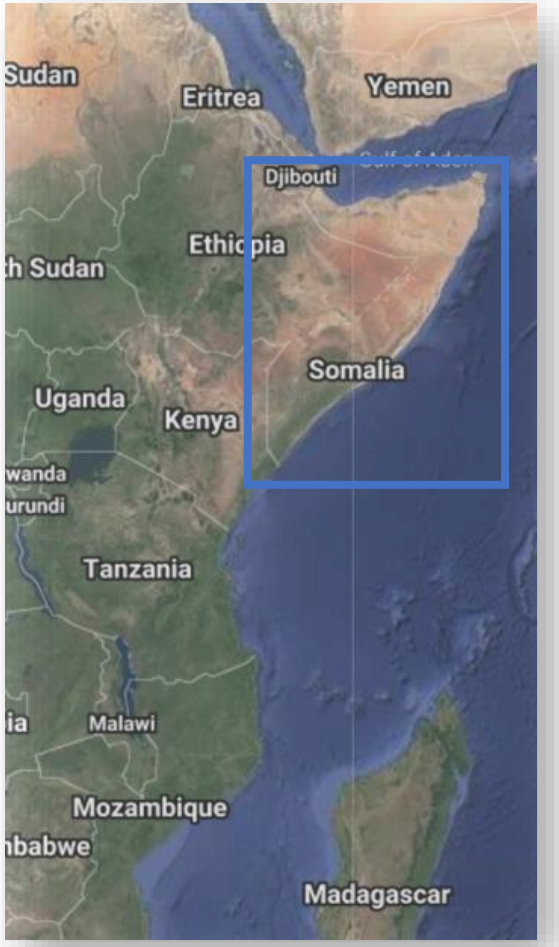
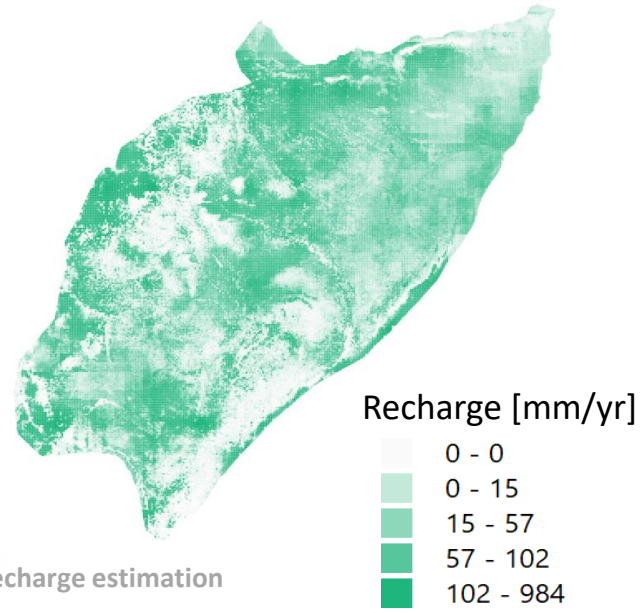
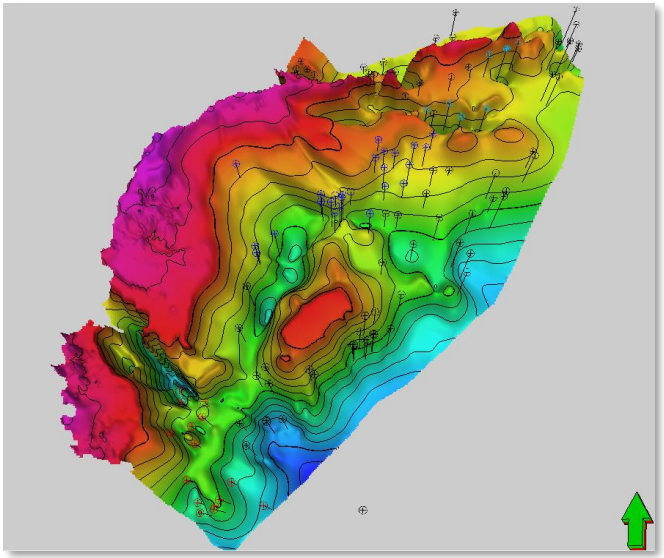
Somalia
Current project where the search model is applied



Based on open-source data, and data from the oil and gas industry, the whole of Somalia, including parts of Ethiopia and Kenya, are mapped.



Recharge estimation



3D mapping of the Geology

Data from traditional hydrogeology is combined with this Oil and Gas data to identify freshwater zones and map the depth and size of these aquifers.

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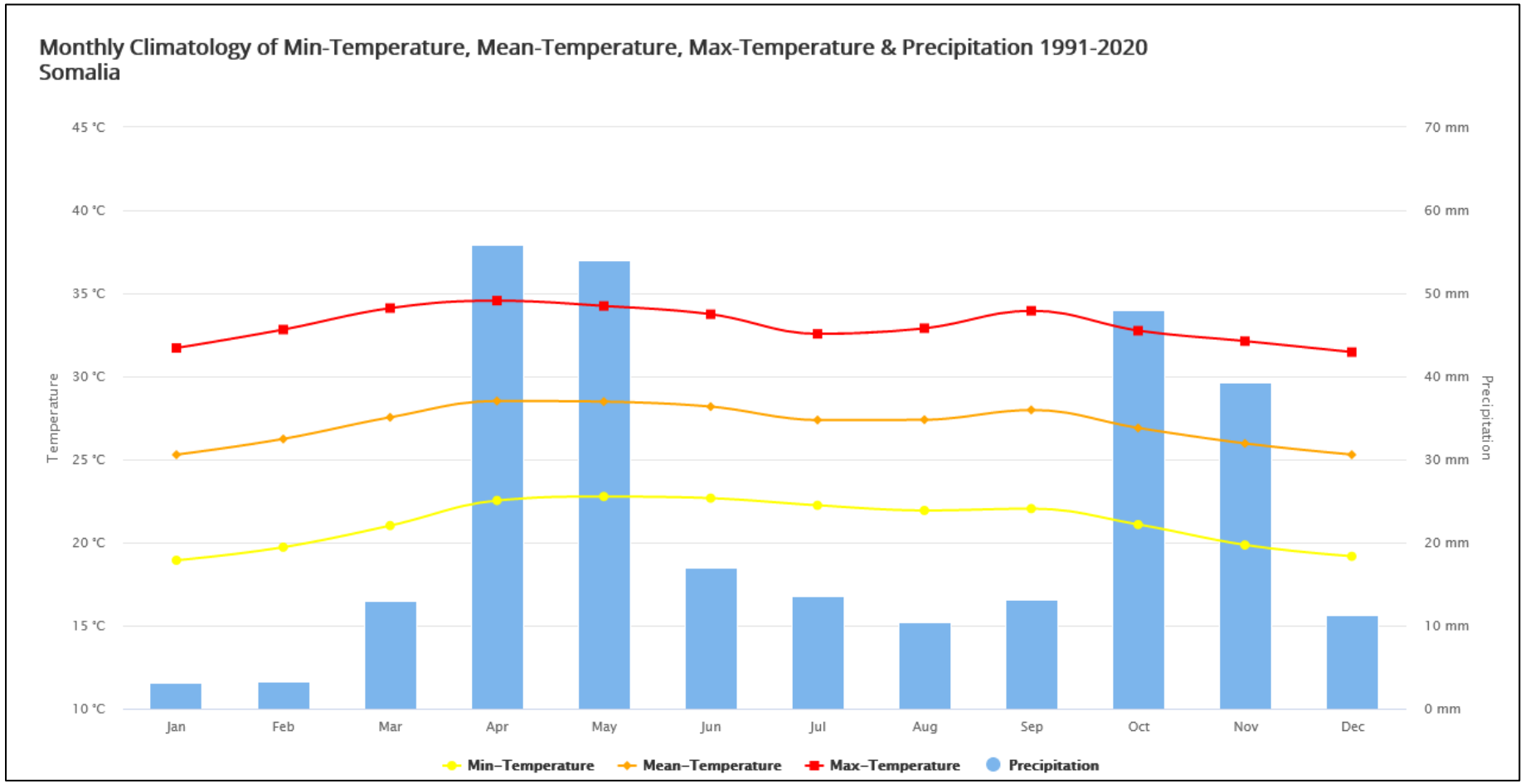
Somalia

Yearly average rainfall



Source: https://climateknowledgeportal.worldbank.org/country/somalia/climate-data-historical

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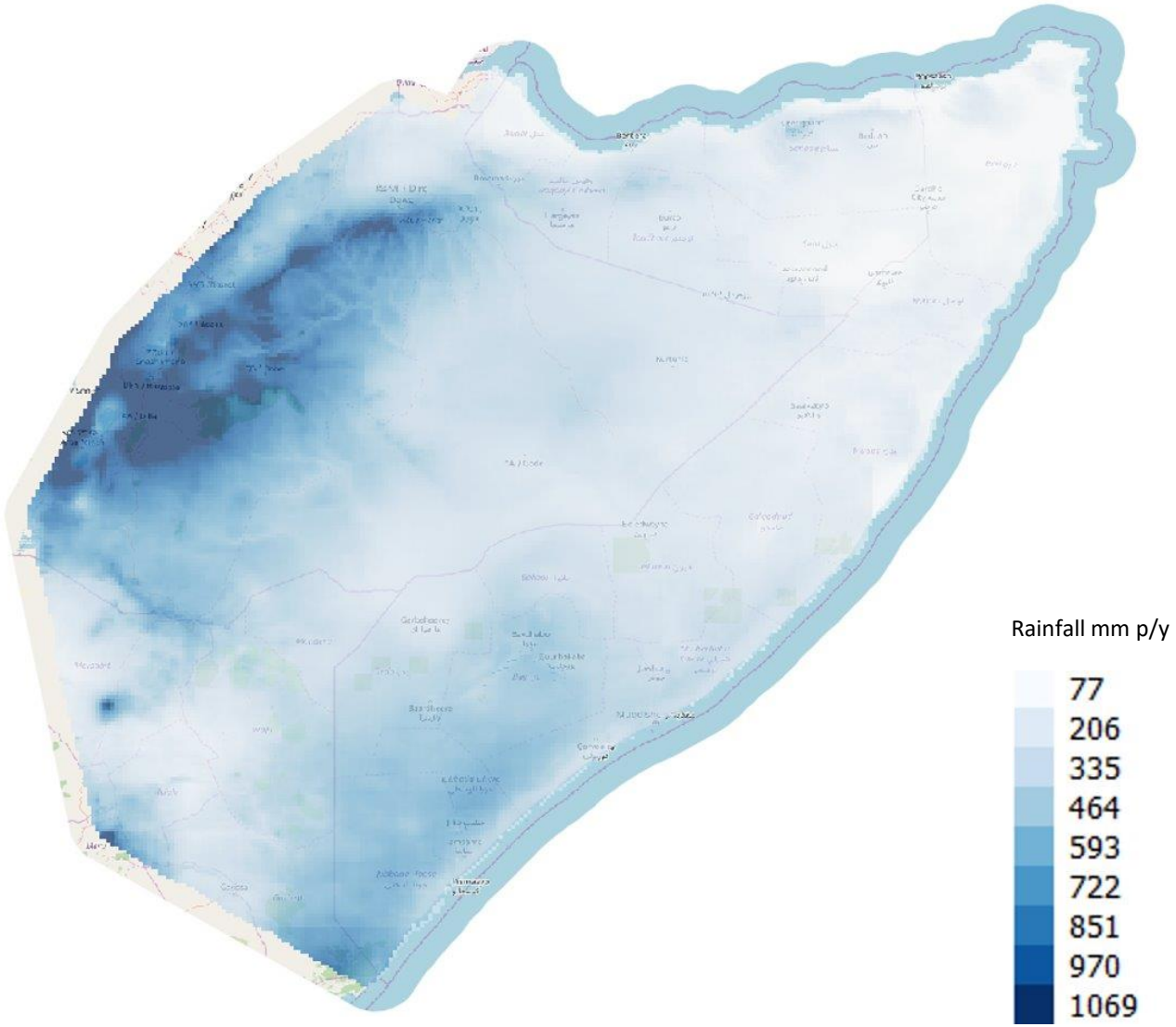
Yearly average rainfal



Average rainfall per year, data from 1981-2019

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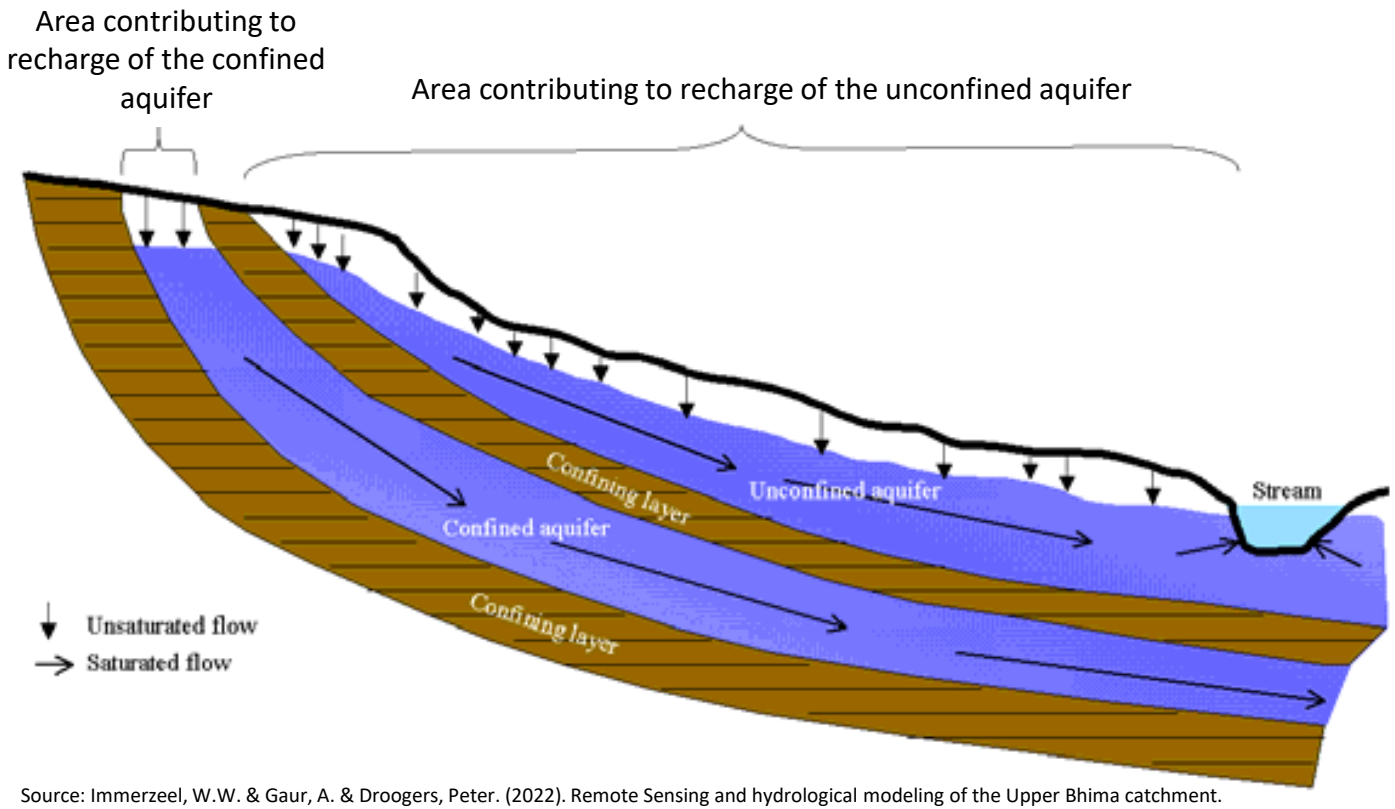
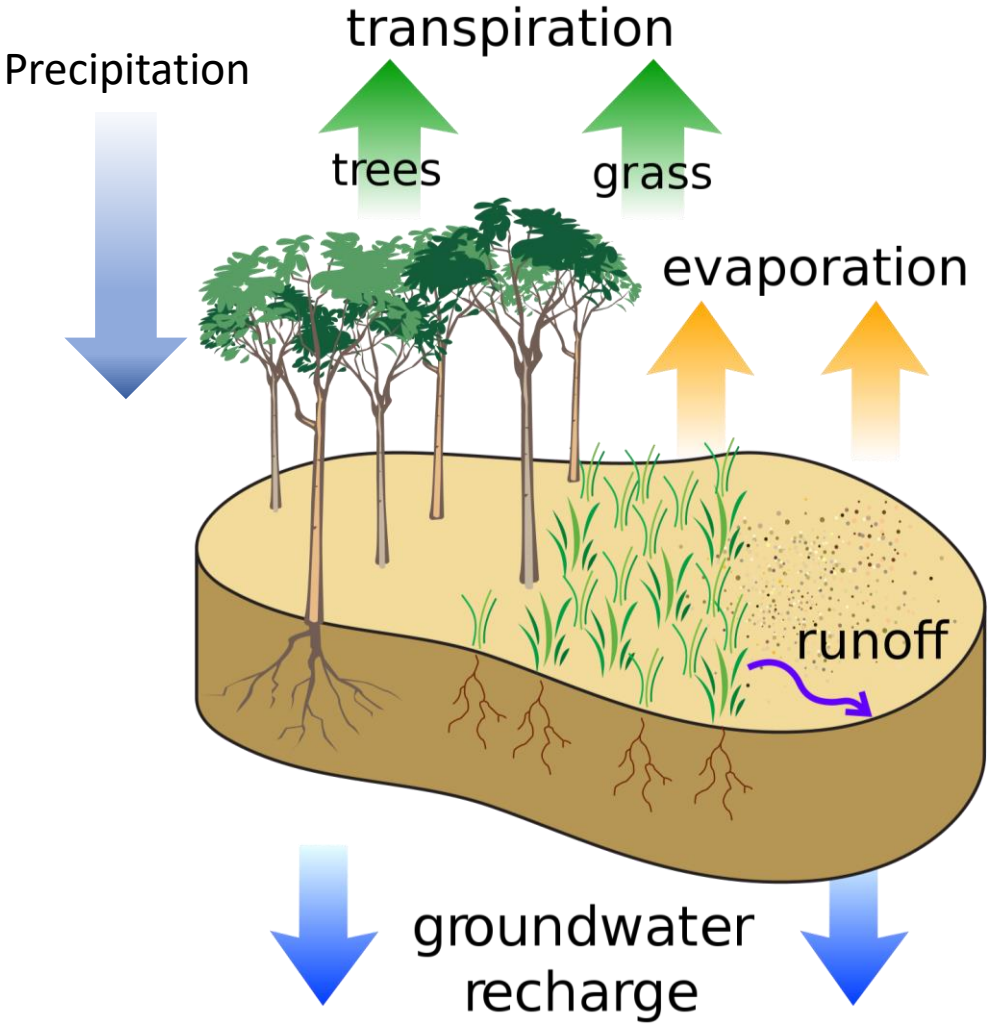
Groundwater recharge

- Recharge = Precipitation – Runoff – ET



Source: Immerzeel, W.W. & Gaur, A. & Droogers, Peter. (2022). Remote Sensing and hydrological modeling of the Upper Bhima catchment.



Source: Wikipedia, M. W. Toews, 2007

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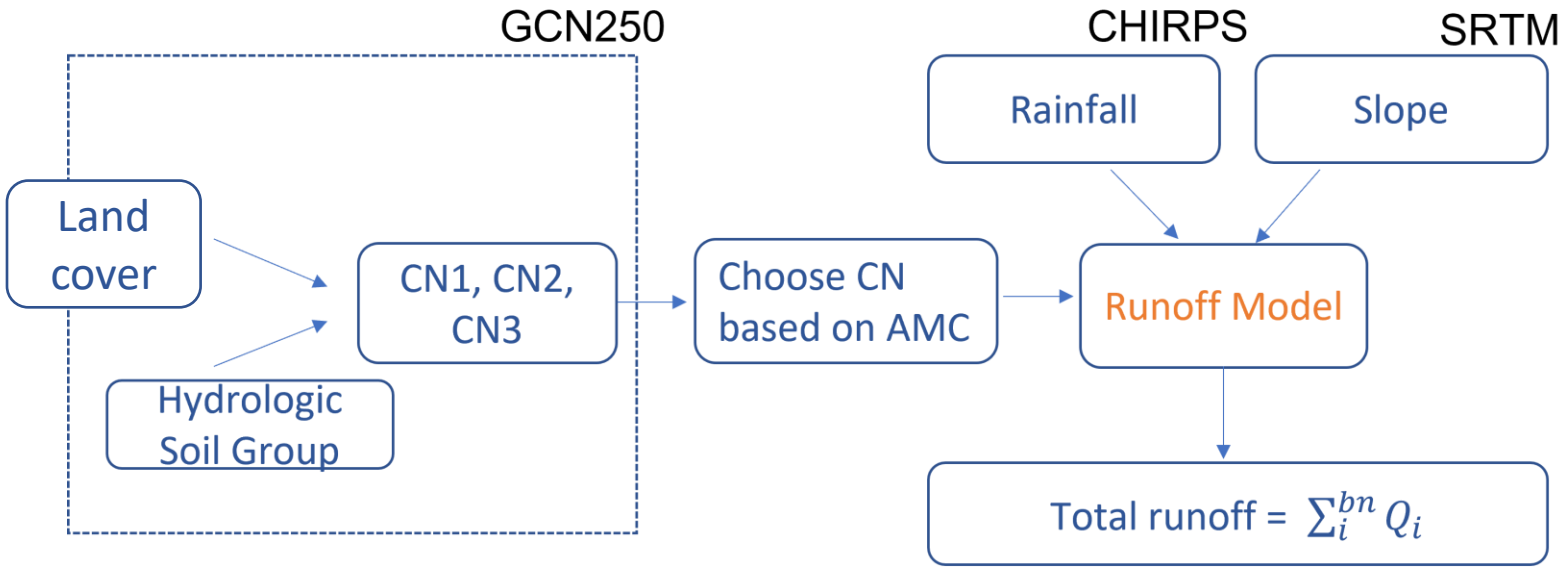
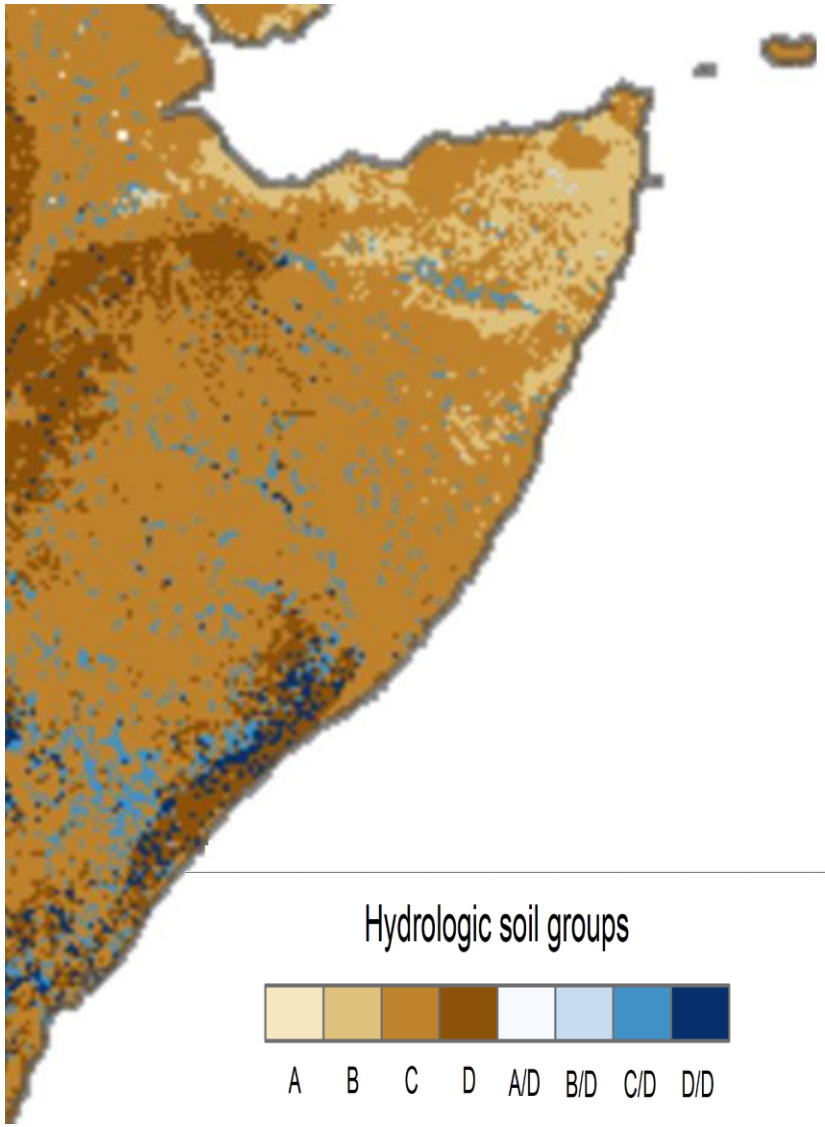
SCS Curve Number runoff method





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Curve Number dataset

SCIENTIFIC DATA

OPEN

DATA DESCRIPTOR

Received: 22 February 2019
Accepted: 23 July 2019
Published online: 12 August 2019

GCN250, new global gridded curve numbers for hydrologic modeling and design

Hadi H. Jaafar, Farah A. Ahmad & Naji El Beyrouthy

The USDA curve-number (CN) method is fundamental for rainfall-runoff modeling. A global CN database is not currently available for geospatial hydrologic analysis at a resolution higher than 0.1°. We developed a globally consistent, gridded dataset defining CNs at the 250 m spatial resolution from new global land cover (300 m) and soils data (250 m). The resulting data product – GCN250 – represents runoff for a combination of the European space agency global land cover dataset for 2015 (ESA CCI-LC) resampled to 250 m and geo-registered with the hydrologic soil group global data product (HYSOGs250m) released in 2018. Our analysis indicated that medium to high runoff potential currently dominates the globe, with curve numbers ranging between 75 and 85. Global curve numbers were 62, 78, and 90 for dry, average, and wet antecedent runoff conditions, respectively. Australia has the highest runoff potential, while Europe has the lowest. Runoff ratios compare well with GLDAS. The potential application of this data includes hydrologic design, land management applications, flood risk assessment, and groundwater recharge modeling.

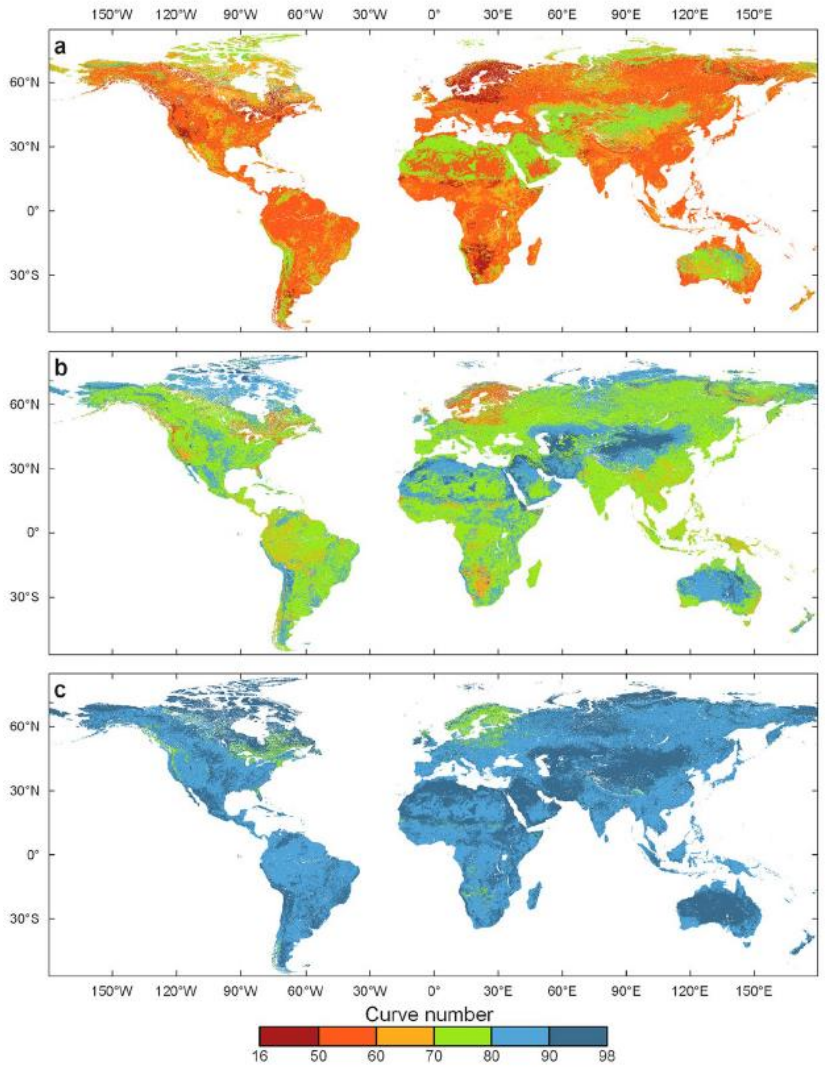

Fig. 2 The three global curve number maps (GCN250). (a) Dry (ARCI), (b) average (ARCII), and (c) wet

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SCS curve number parameterization

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S}$$

$$I_a = 0.2S$$

$$CN = \frac{100}{S} - 1$$

- Q is runoff
- P is rainfall depth
- I_a is part of abstraction
- S is potential maximum retention

The parameter S varies between 40 & 98 (Van Mullem, 1989), and depends on

- Soil type
- Land use
- Antecedent Moisture Condition
- Evapotranspiration

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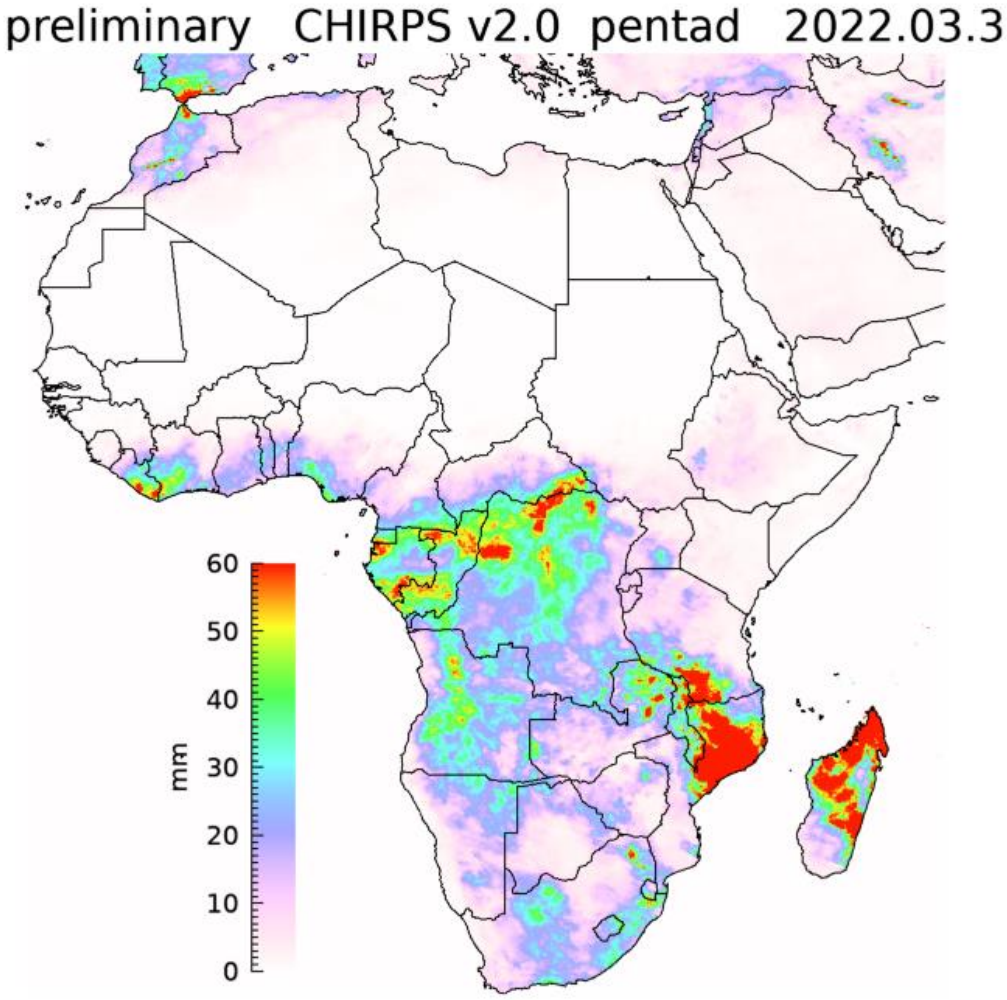
Rainfall: CHIRPS

CHIRPS Overview

Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS) is a 35+ year quasi-global rainfall data set. Spanning 50°S-50°N (and all longitudes) and ranging from 1981 to near-present, CHIRPS incorporates our in-house climatology, CHPclim, 0.05° resolution satellite imagery, and in-situ station data to create gridded rainfall time series for trend analysis and seasonal drought monitoring.

Read more about CHIRPS here:
https://www.nature.com/articles/sdata201566



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Actual Evapotranspiration

WAPOR

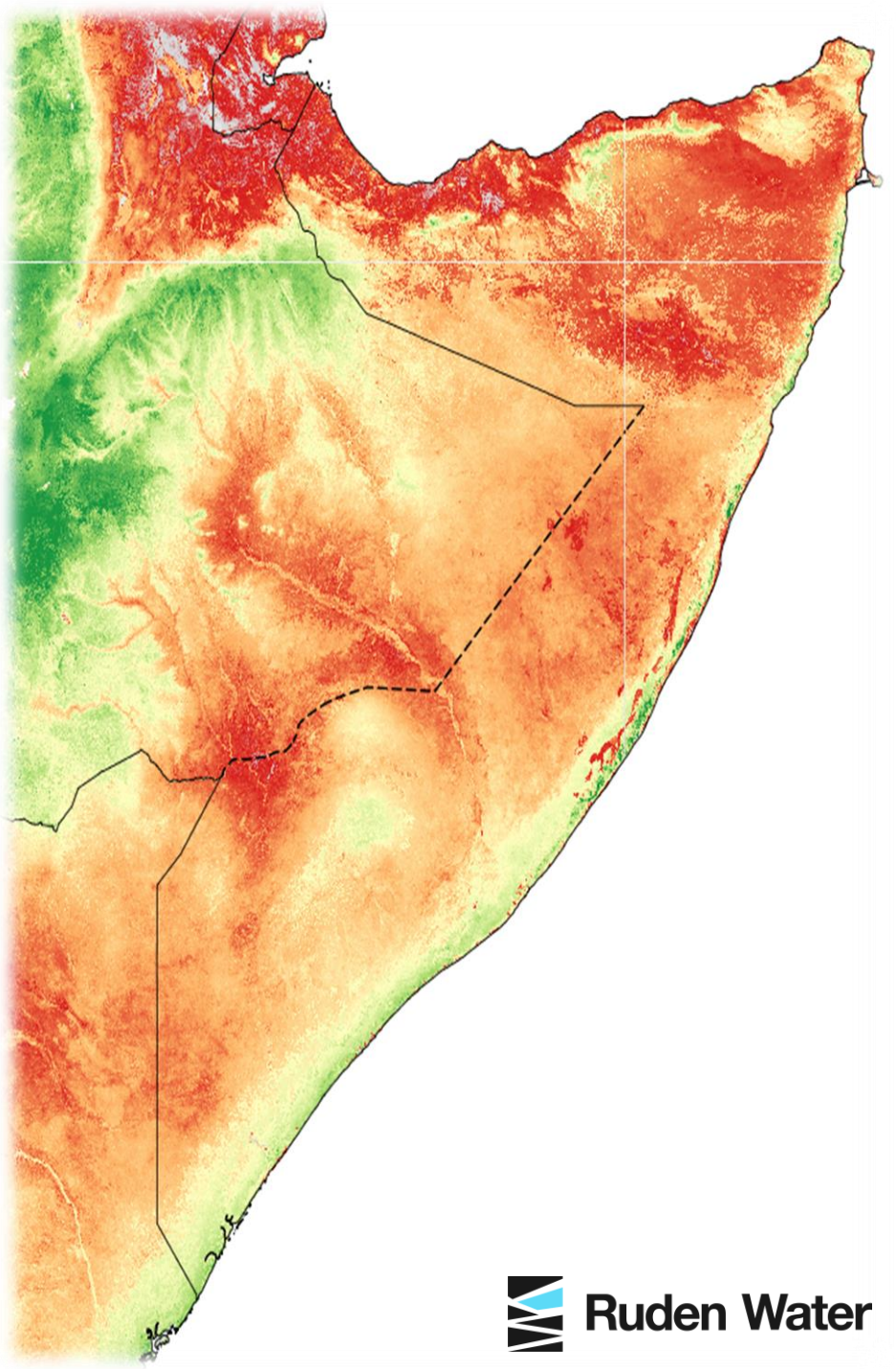
Actual Evapotranspiration and Interception

At Continental Level resolution (250 m) at dekadal time step

https://www.fao.org/in-action/remote-sensing-for-water-productivity/wlpa-introduction/introduction/en/

LSAF

New product being tested



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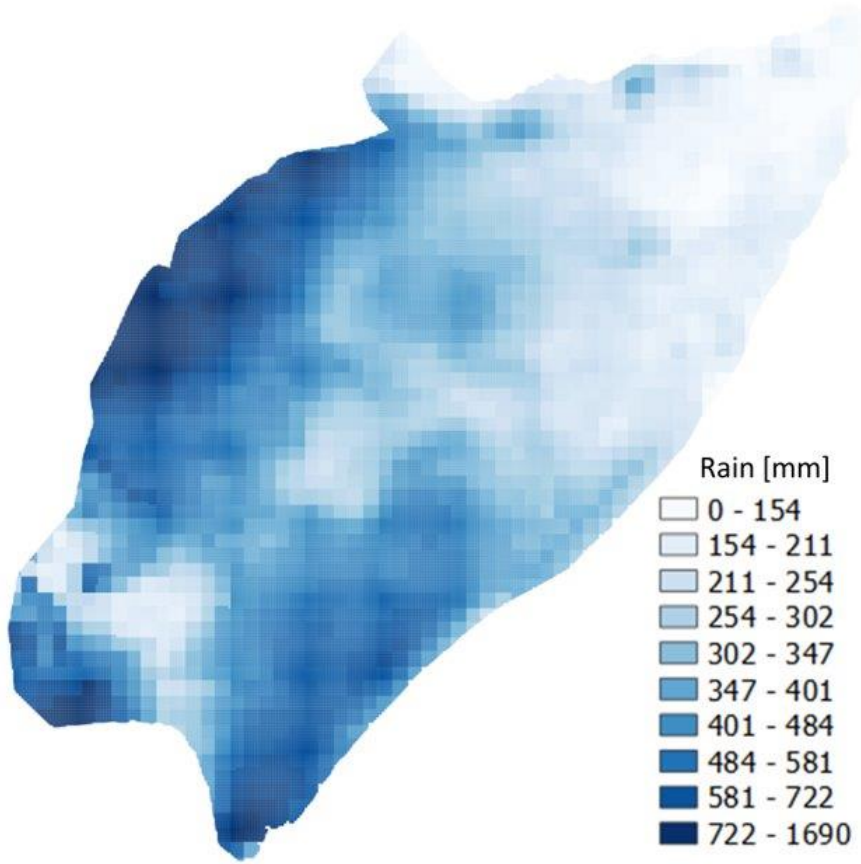
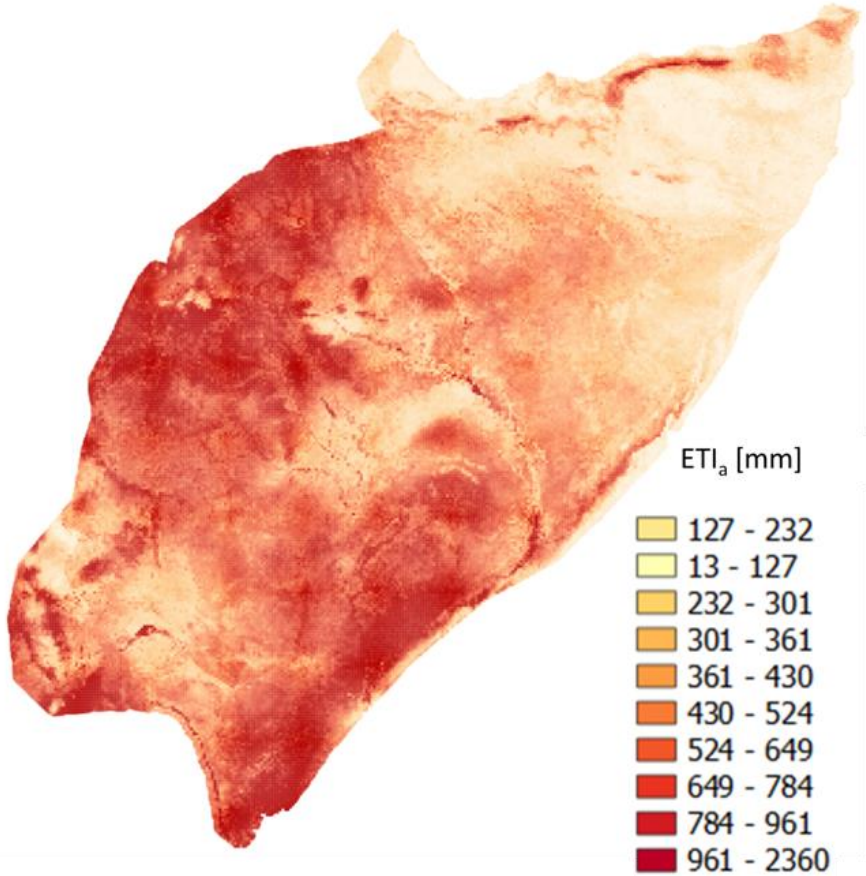
Groundwater recharge work

Input





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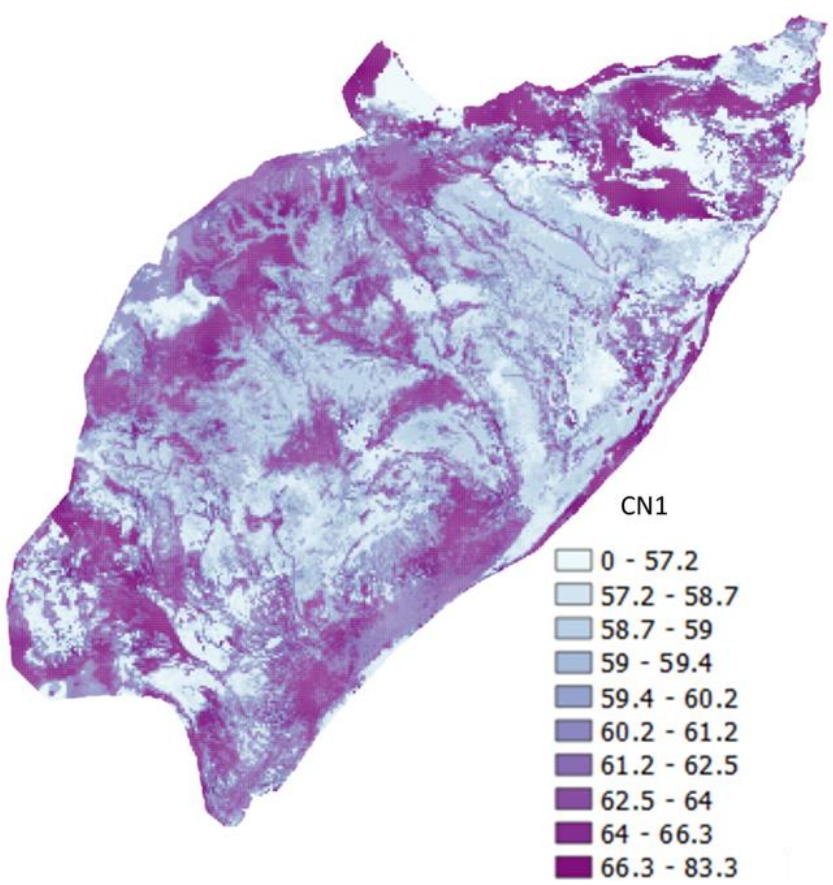
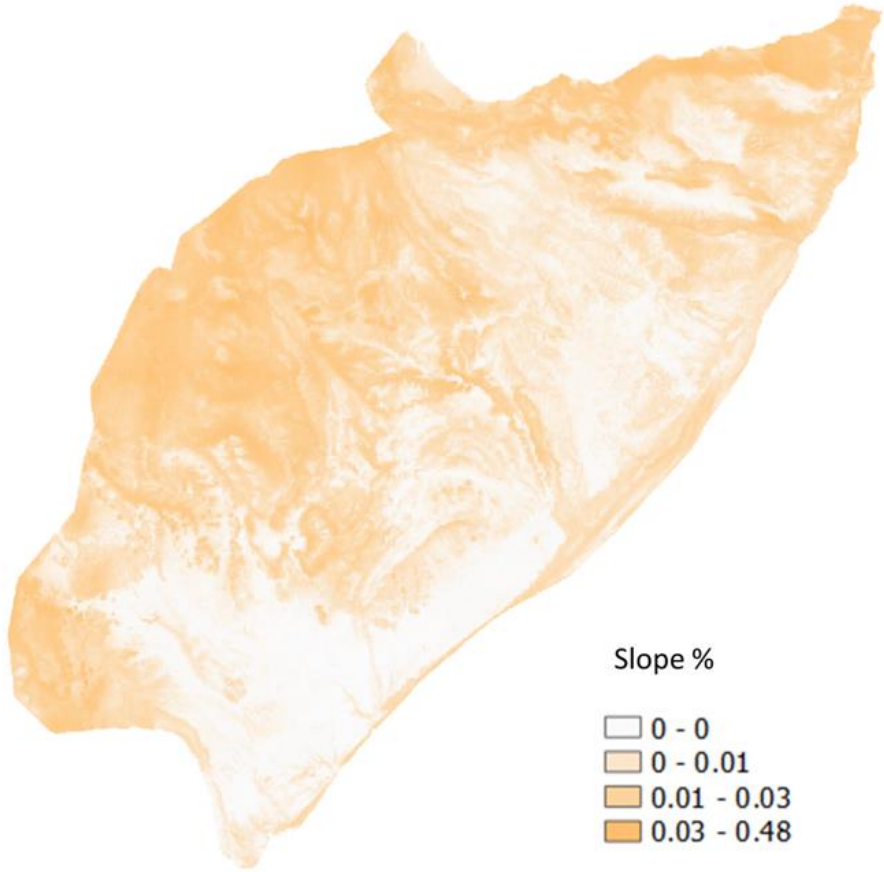
Groundwater recharge work

Input





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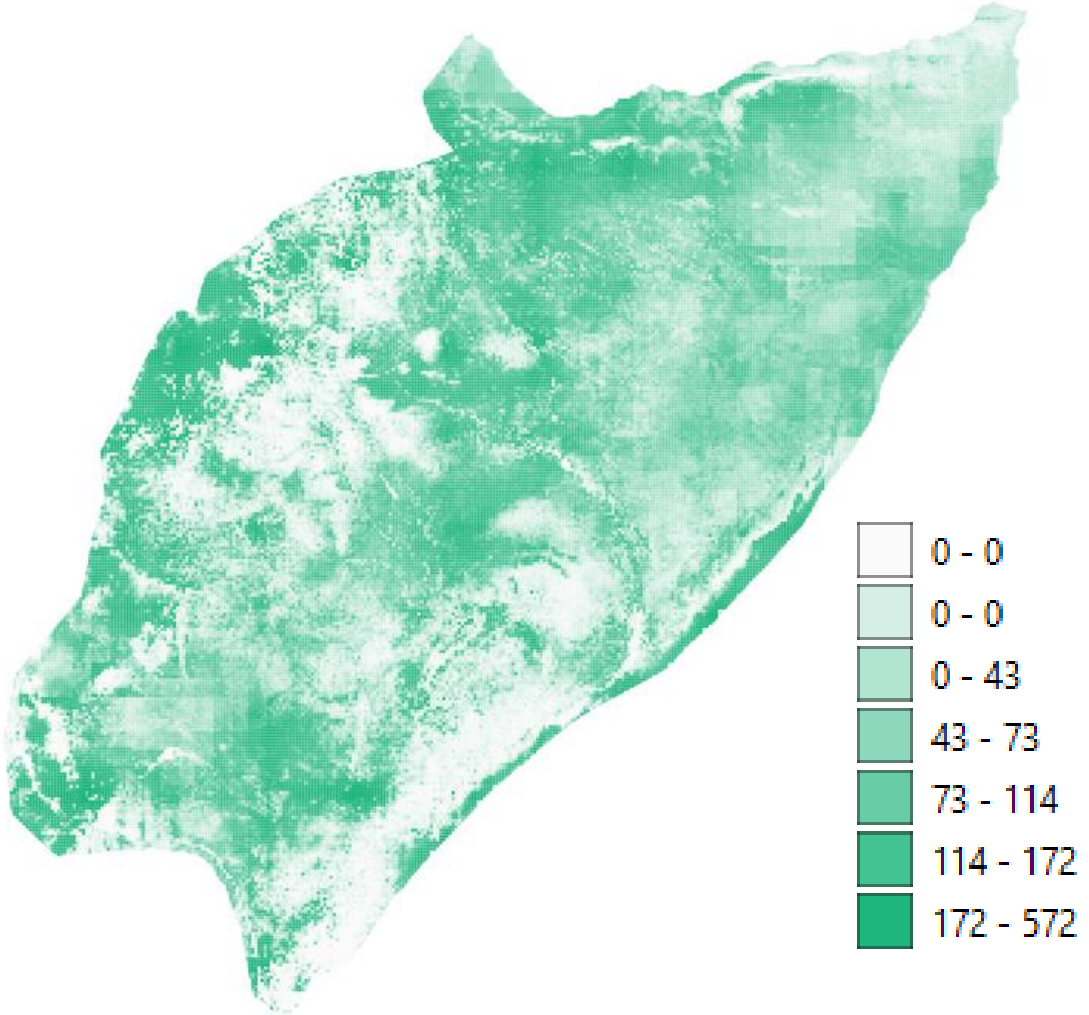
Recharge estimate

First results

Quality check ongoing vs literature and insitu data

Input for groundwater models



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Questions?

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