GLOBAL SYMPOSIUM on SOILS and WATER

02-05 October, 2023

Soil and water: a source of life

Breaking barriers in soil moisture assessment

Introducing FAO's WaPOR tool

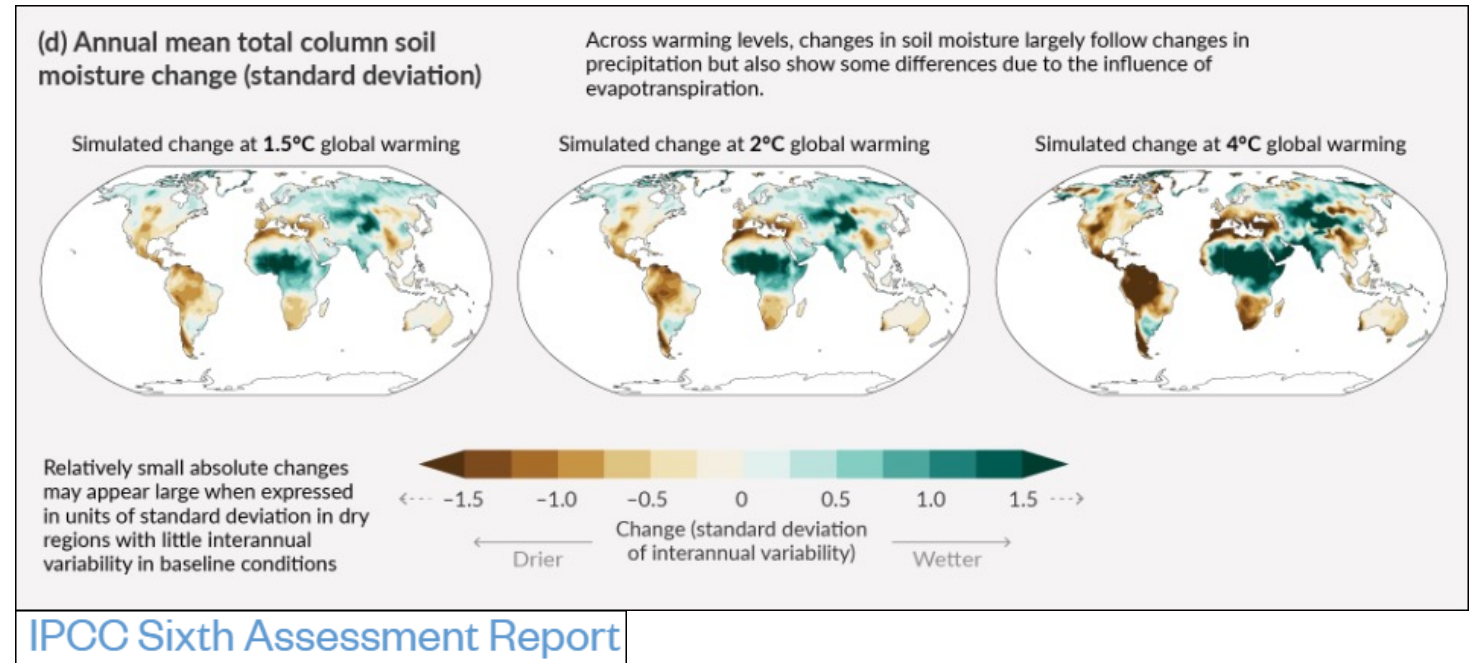Livia Peiser, Land and Water Division, FAO
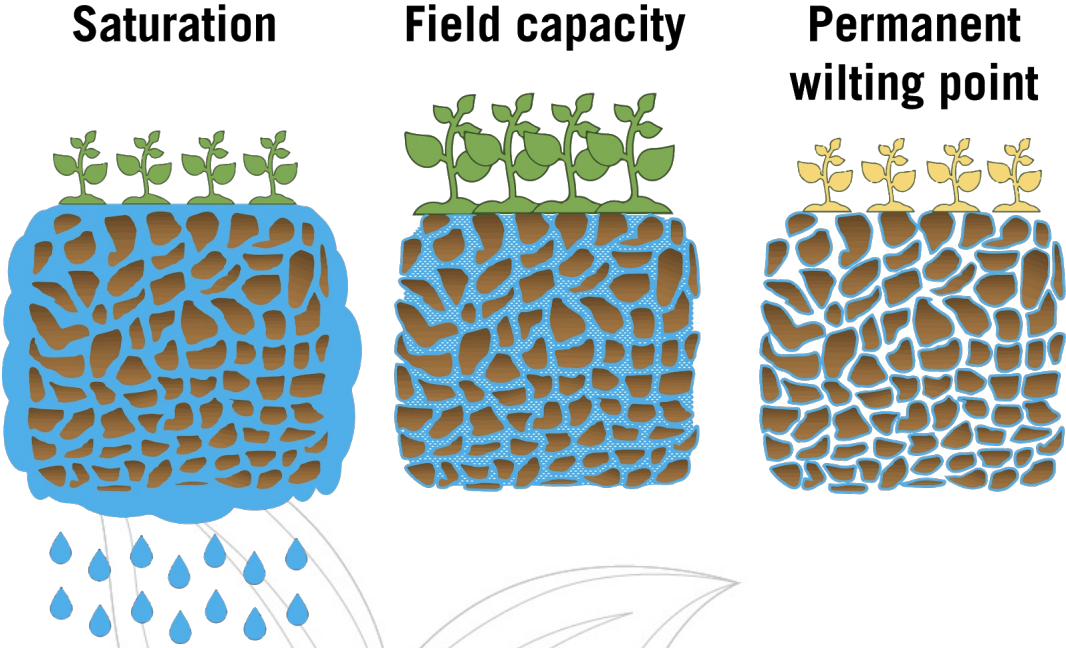
Soil moisture is an Essential **Climate** Variable

It influences hydrological cycle, partitioning precipitation into runoff and infiltration

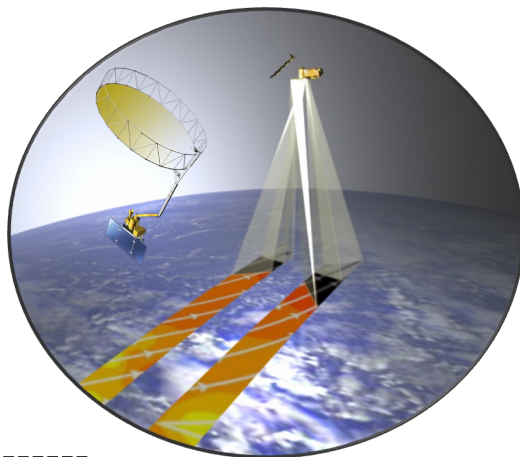It influences surface temperature

Soil moisture state is an important predictor of climate variations and its impacts (droughts, wildfires, …)

(d) Annual mean total column soil moisture change (standard deviation)

Across warming levels, changes in soil moisture largely follow changes in precipitation but also show some differences due to the influence of evapotranspiration.

Simulated change at **1.5°C** global warming

Simulated change at **2°C** global warming

Simulated change at **4°C** global warming

Relatively small absolute changes may appear large when expressed in units of standard deviation in dry regions with little interannual variability in baseline conditions

←--- −1.5   −1.0   −0.5   0   0.5   1.0   1.5 ---→

Change (standard deviation of interannual variability)

← Drier   Wetter →

IPCC Sixth Assessment Report

Soil moisture is also a **food security** variable

Saturation

Field capacity

Permanent wilting point

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Topsoil

Root zone

0cm
5cm

100cm

Satellite observations (including ASCAT, SMAP, etc.) Can monitor surface soil moisture

Experimental methodologies exist that extrapolate topsoil to root zone, based on the assumption of consistency of moisture variations throughout the profile

Soil moisture sensors can measure water content at different depths, but scalability remains challenging, particularly in low-income countries
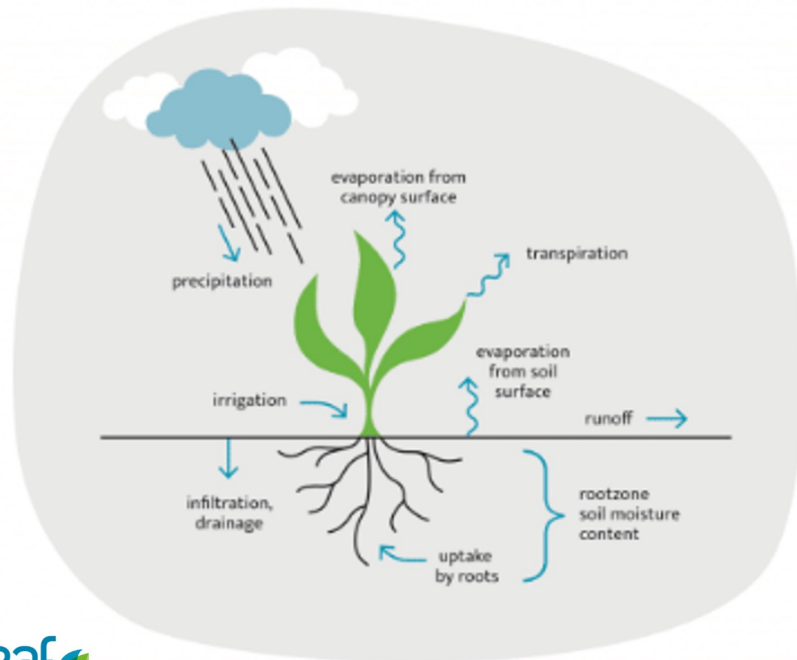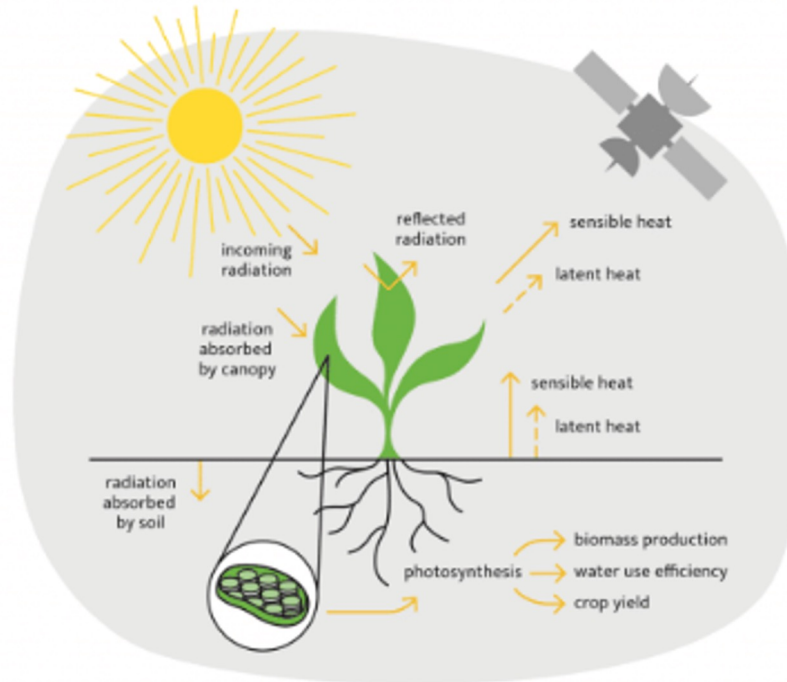
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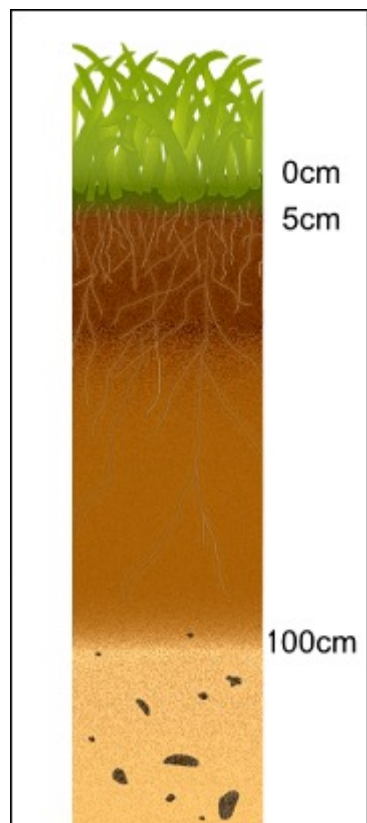
Relative Root Zone Soil Moisture (beta product)
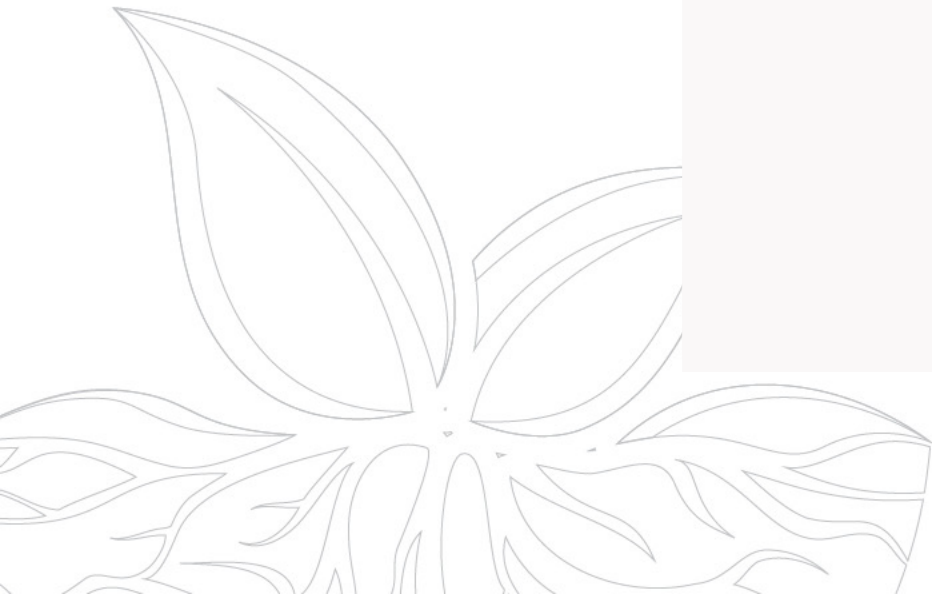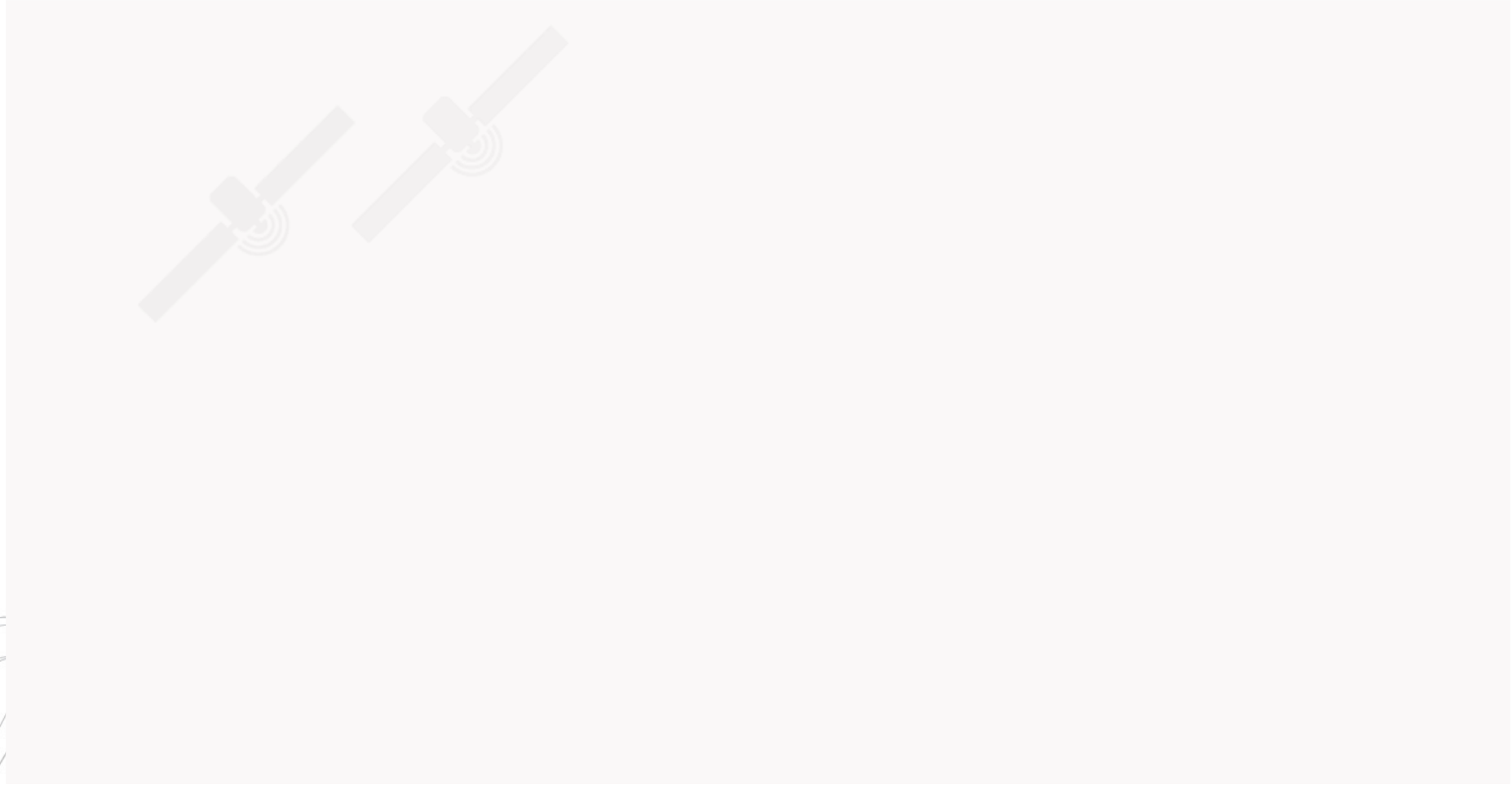

The methodology applied for calculating relative soil moisture content is based on the correlation between Land Surface Temperature (LST, derived from thermal infrared imagery), vegetation cover and soil moisture content.

Relative soil moisture content range between 0 and 1, where 0 is equal to the soil moisture content at wilting point and 1 is equal to the soil moisture content at field capacity

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How WaPOR works

1-10 January 2022, Ethiopia

Global data 300m

National data 100m

Sub-national areas 20m
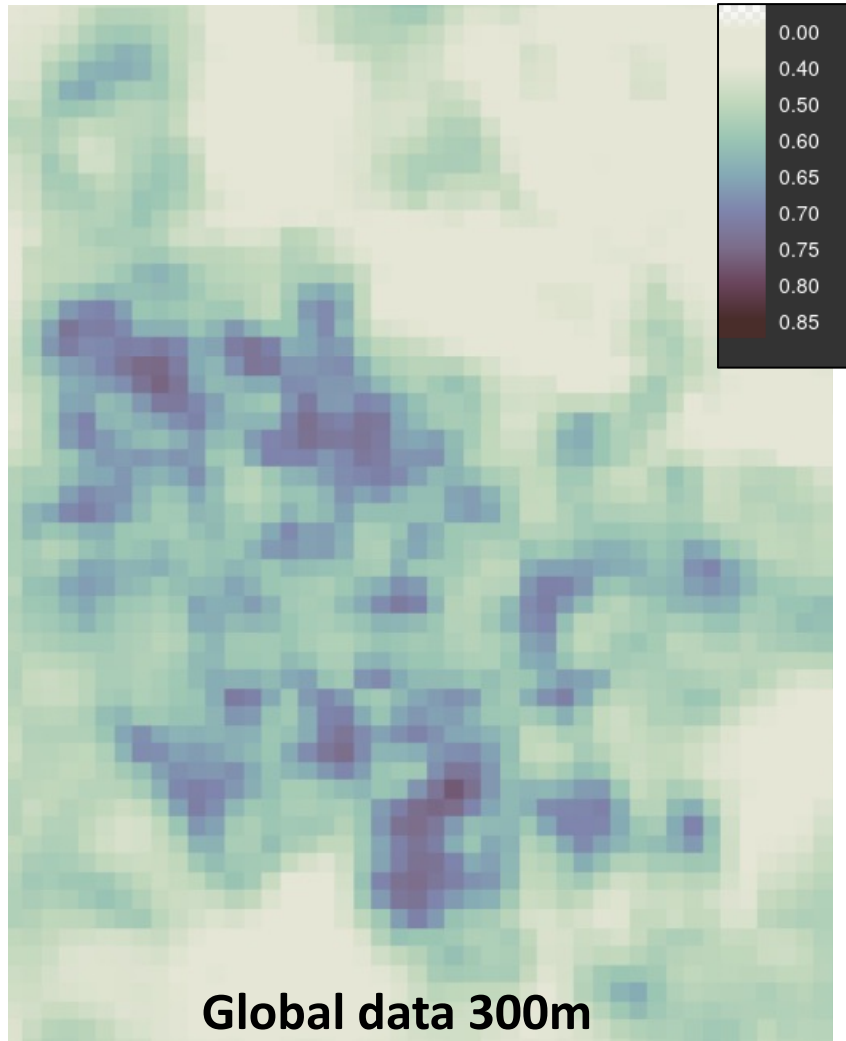
From global to field-scale soil moisture

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Applications: targeting water productivity improvements
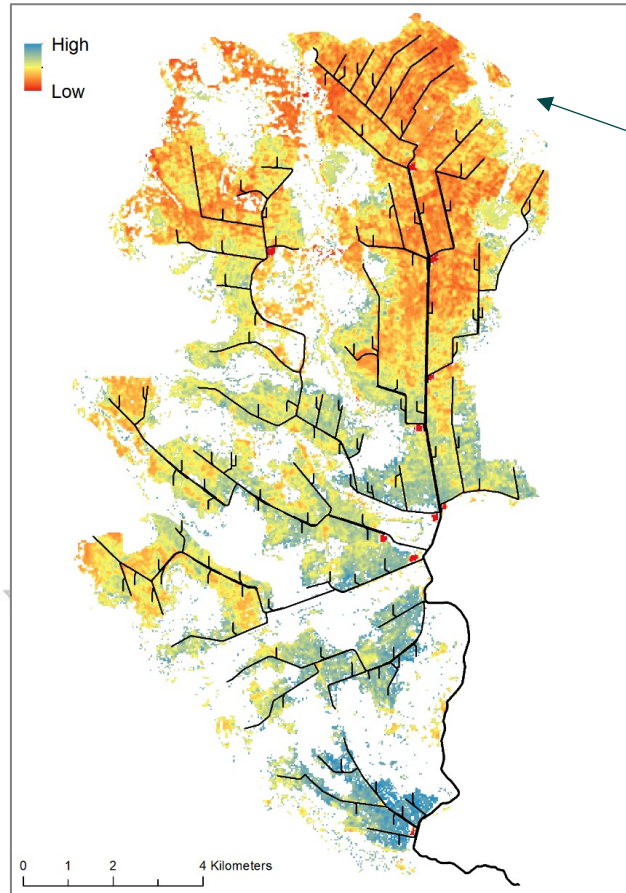
Distinct spatial pattern between head and tail end;

Tail end has lower Water Productivity;

During both rain-fed and irrigation seasons the head end demonstrates more productive use of the available water

RS data supports targeting of field interventions to improve land and water productivity with farmers

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International Water
Management Institute

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Applications

There is a wide range of applications of WaPOR data that go beyond water productivity.

ICT-based solution (app) for irrigation scheduling advice

IRWI (Egypt), LARI-LEB (Lebanon), IREY (Tunisia), WaFIRR (Jordan-under finalization) app help farmers know:

- how much water is required so that they can decide when and how much to irrigate and

- how healthy is the crop and predicted yield during the season.

Apps can use WaPOR data in combination with user's inputs and other data sources
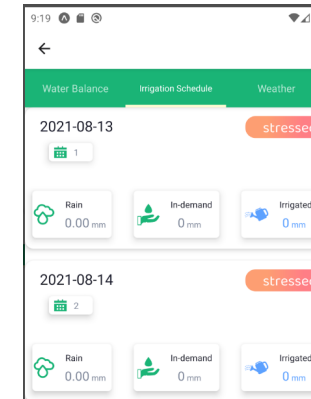
Capacity development (online and on-site)

New online open course started on 15 June

Visit WaPOR website to find out more and register

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

WaPOR concepts and validation

An OpenCourseWare from IHE Delft and the FAO

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WaPOR open data access

- Methodology documents, manuals, quality assessments;

- Codes and algorithms:
https://www.fao.org/aquastat/py-wapor/index.html
https://bitbucket.org/cioapps/wapor-et-look

- Data and metadata available through:

  o WaPOR portal wapor.apps.fao.org and FAO geospatial platform

  o ReST API for easier integration in ICT applications

  o Open geospatial standards (wms, wcs, CO GeoTiff)

Food and Agriculture Organization of the United Nations

USING REMOTE SENSING IN SUPPORT OF SOLUTIONS TO REDUCE AGRICULTURAL WATER PRODUCTIVITY GAPS
DATABASE METHODOLOGY: LEVEL 1 DATA

Bitbucket

python

| CONTINENTAL (250m) | NATIONAL (100m) | SUB-NATIONAL (30m) | ☑ Water Productivity ☑ Water ☑ Land ☑ Climate ☑ Ancillary |

Gross Biomass Water Productivity
The annual Gross Biomass Water Productivity expresses the quantity of output (above ground biomass production) in relation to the total volume of water consumed in the year (actual evapotranspiration).
WATER PRODUCTIVITY

Net Biomass Water Productivity
The annual Net Biomass Water Productivity expresses the quantity of output (above ground biomass production) in relation to the volume of water beneficially consumed (by canopy transpiration) in the year, and thus net of soil evaporation.
WATER PRODUCTIVITY

Actual EvapoTranspiration and Interception (Annual)
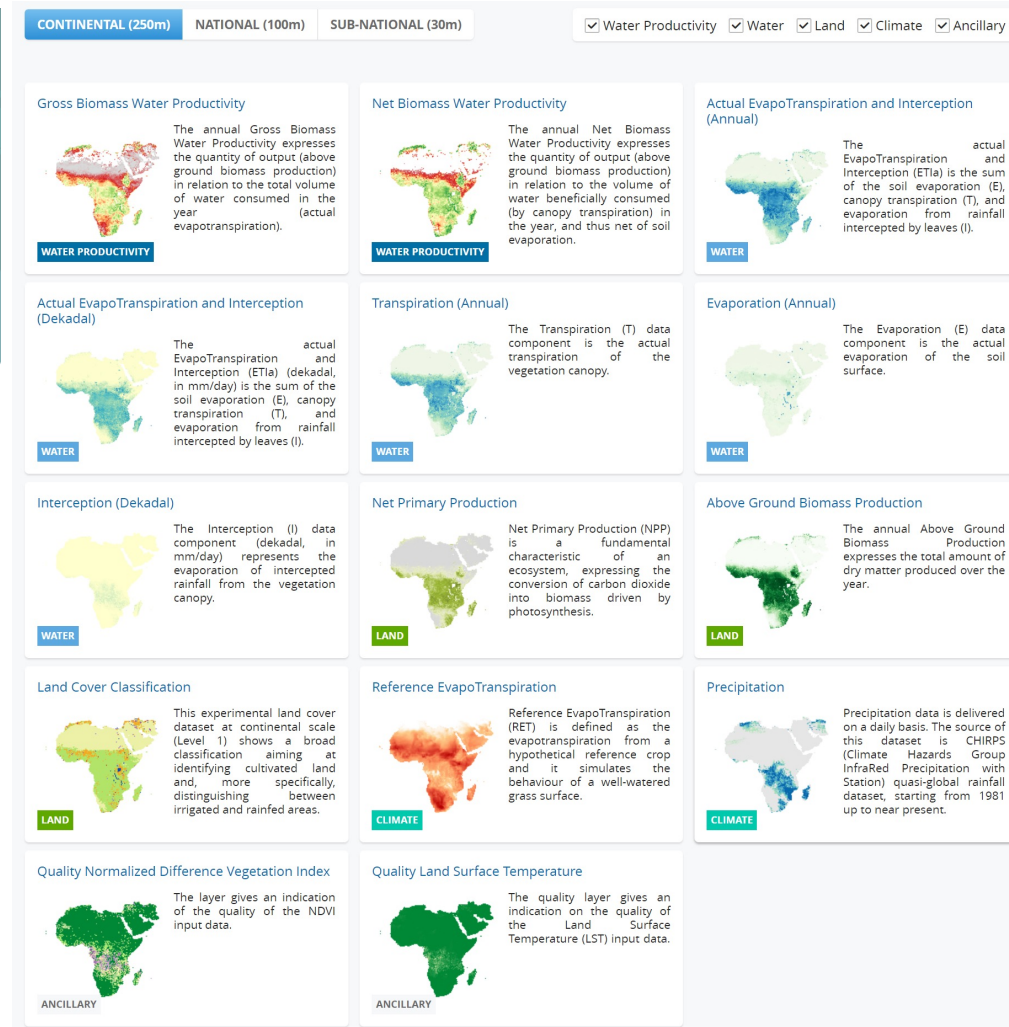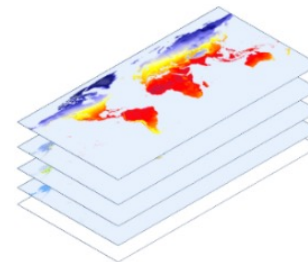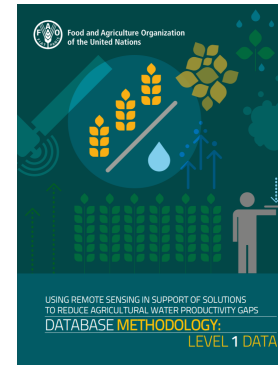The actual EvapoTranspiration and Interception (ETIa) is the sum of the soil evaporation (E), canopy transpiration (T), and evaporation from rainfall intercepted by leaves (I).
WATER

Actual EvapoTranspiration and Interception (Dekadal)
The actual EvapoTranspiration and Interception (ETIa) (dekadal, in mm/day) is the sum of the soil evaporation (E), canopy transpiration (T), and evaporation from rainfall intercepted by leaves (I).
WATER

Transpiration (Annual)
The Transpiration (T) data component is the actual transpiration of the vegetation canopy.
WATER

Evaporation (Annual)
The Evaporation (E) data component is the actual evaporation of the soil surface.
WATER

Interception (Dekadal)
The Interception (I) data component (dekadal, in mm/day) represents the evaporation of intercepted rainfall from the vegetation canopy.
WATER

Net Primary Production
Net Primary Production (NPP) is a fundamental characteristic of an ecosystem, expressing the conversion of carbon dioxide into biomass driven by photosynthesis.
LAND

Above Ground Biomass Production
The annual Above Ground Biomass Production expresses the total amount of dry matter produced over the year.
LAND

Land Cover Classification
This experimental land cover dataset at continental scale (Level 1) shows a broad classification aiming at identifying cultivated land and, more specifically, distinguishing between irrigated and rainfed areas.
LAND

Reference EvapoTranspiration
Reference EvapoTranspiration (RET) is defined as the evapotranspiration from a hypothetical reference crop and it simulates the behaviour of a well-watered grass surface.
CLIMATE

Precipitation
Precipitation data is delivered on a daily basis. The source of this dataset is CHIRPS (Climate Hazards Group InfraRed Precipitation with Station) quasi-global rainfall dataset, starting from 1981 up to near present.
CLIMATE

Quality Normalized Difference Vegetation Index
The layer gives an indication of the quality of the NDVI input data.
ANCILLARY

Quality Land Surface Temperature
The quality layer gives an indication on the quality of the Land Surface Temperature (LST) input data.
ANCILLARY

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Annual average soil moisture (2022)

WaPOR (300 m)

SMAP > 9 km

WaPOR RSM is a ***beta*** product

Join us :
- Comparison, validation, quality assessments
- Open data policy: publicly available data, algorithms, calculation scripts, quality of input data
- Testing applications for irrigation scheduling, drought and climate impact assessment

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Thank you!

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www.fao.org/in-action/remote-sensing-for-water-productivity