Cloud-based Geospatial Tools for Water and Agriculture Analyses

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FAO-RNE

Food and Agriculture Organization of the United Nations

Presentation Outline

Regional Initiative on Water Scarcity

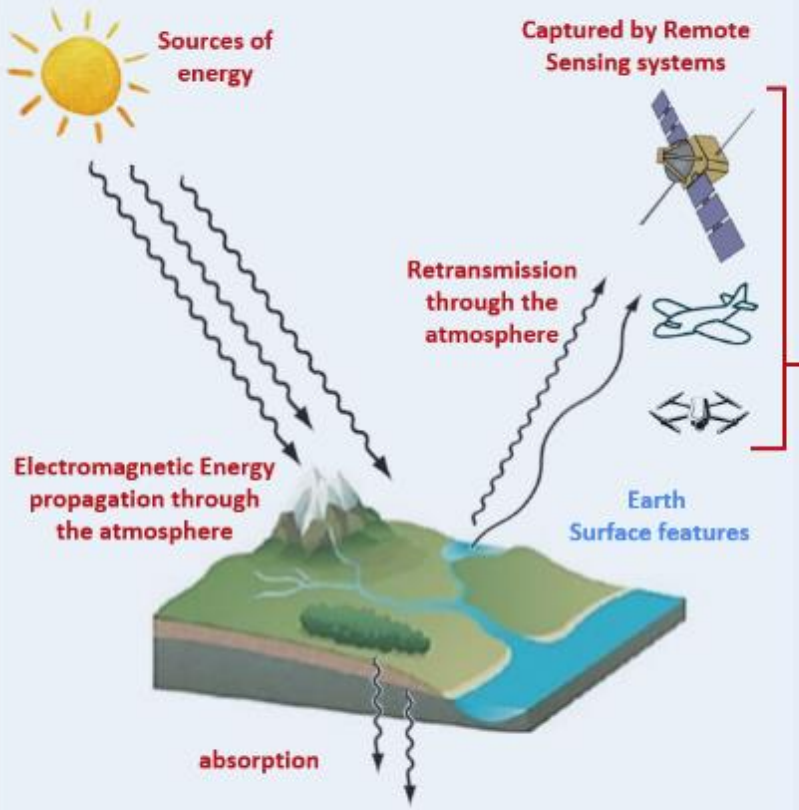
- **Geospatial Technology…The Big Picture**
- **Applications**
  - Precipitation Trends and Deviation from Long-Term Average
  - Surface Water Change
  - Irrigation Areas Water Consumption
  - Agricultural Production Change
  - Vegetation Cover Change
  - Forest Fires Burn Severity
- **Earth Observation and Geospatial Information for SDGs**

→ **Live Demo – Using Cloud Computing / Big Data for Vegetation Monitoring**

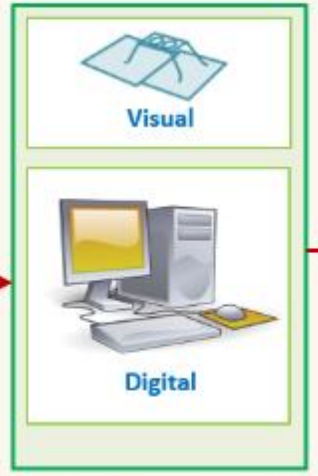
The Big Picture … Integration of Geospatial Technologies

- **Geospatial Technologies** is a term used to describe tools contributing to the **Collection, Processing, Visualization and Analysis** of **data associated with location (Geospatial Data)**

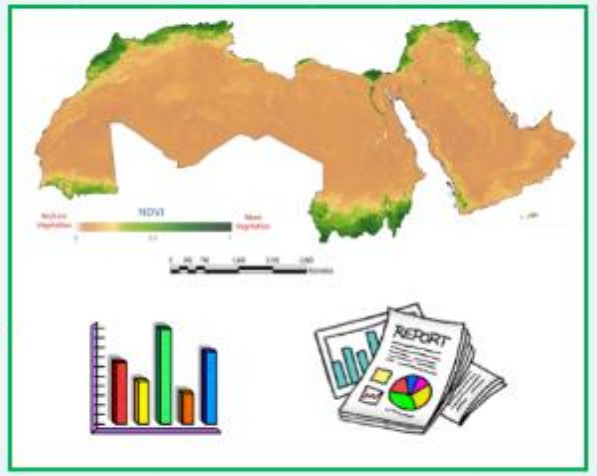
Remote Sensing



Global Positioning System



Geographic Information Systems



Data Acquisition → **Processing | Interpretation** → **Analysis | Dissemination**

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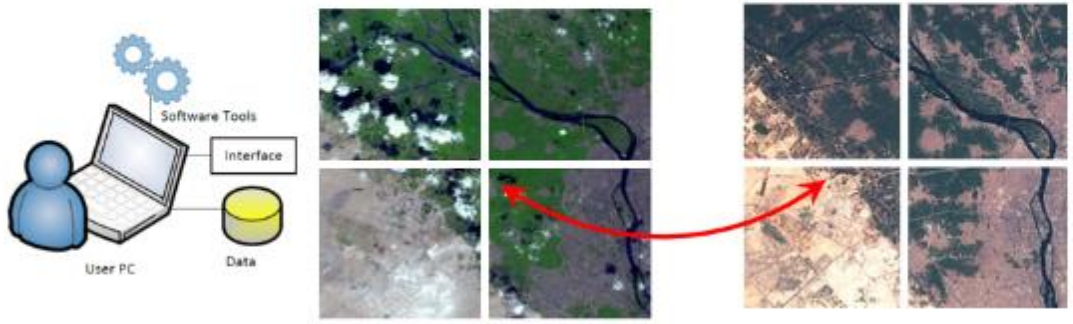
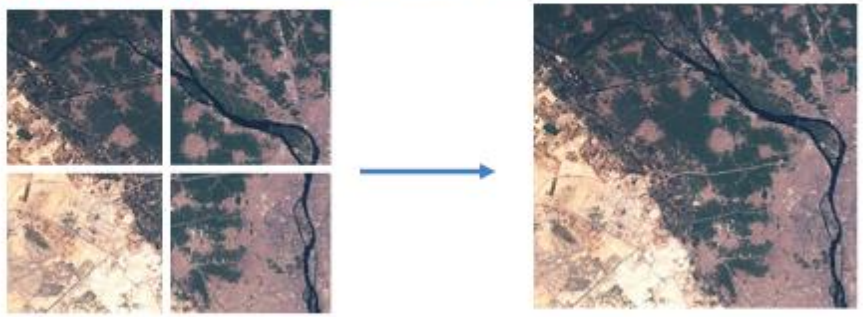
Cloud Computing…Reshaping Geospatial Big Data Analyses

Traditional Workflow

- An expert discovers all the cloud-free imagery available for the region of interest and period under analysis.



- Downloading data from the servers…Storage Space
- Pre-processing images (correcting the data for atmospheric and geometric effects.
- Mosaicking if several images present.

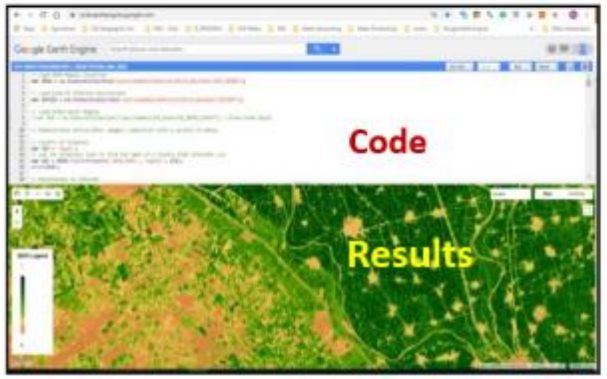


- Performing the Analysis……Computational Power

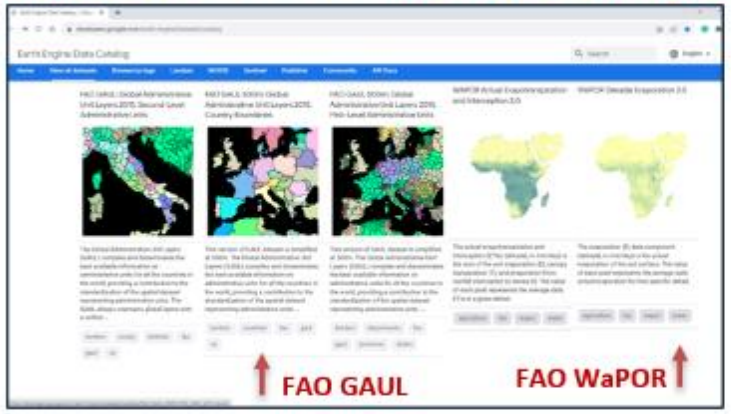
Cloud Computing and Big Data Paradigm

- Moving large Data Storage and Computational Power (Processing) towards cloud solutions

Google Earth Engine Platform Provides:



- Access to most free RS Data Catalogues



- Analysis Functionalities
- Google Infrastructure Computational Power

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FAO Geospatial Platforms

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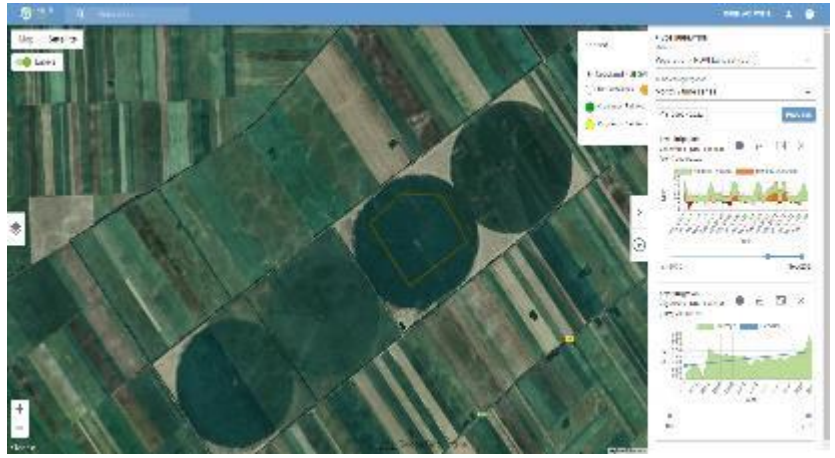
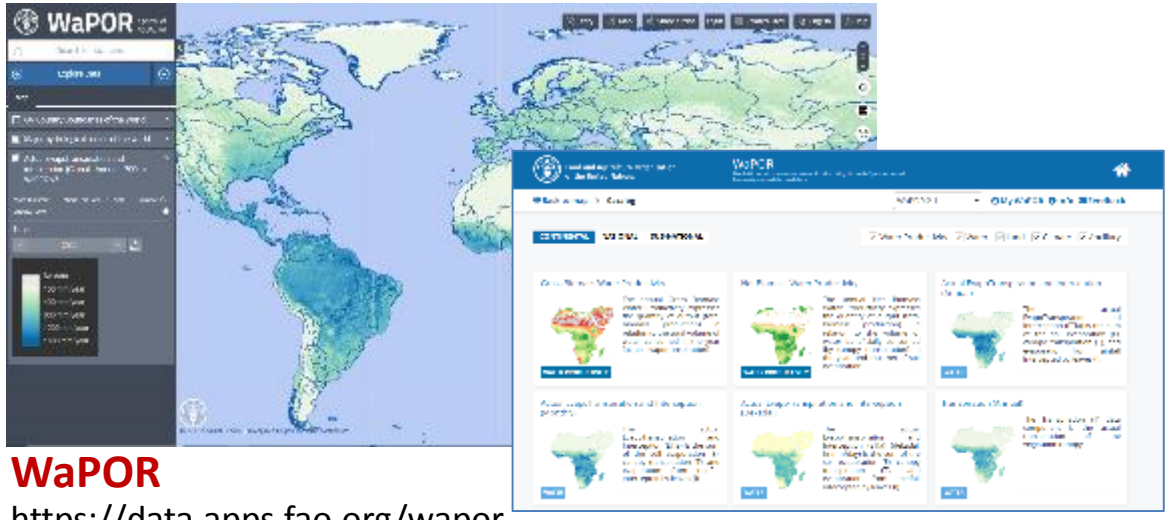
GEE Serves as the back-end to FAO Geospatial Platforms → FAO WaPOR | SEPAL | Earth Map | FAO Agro-Informatics Platform



Earth Map - https://earthmap.org



WaPOR
https://data.apps.fao.org/wapor

SEPAL - System for Earth Observation Data Access, Processing and Analysis for Land Monitoring (https://sepal.io)

FAO Agro-Informatics Platform - https://data.apps.fao.org/

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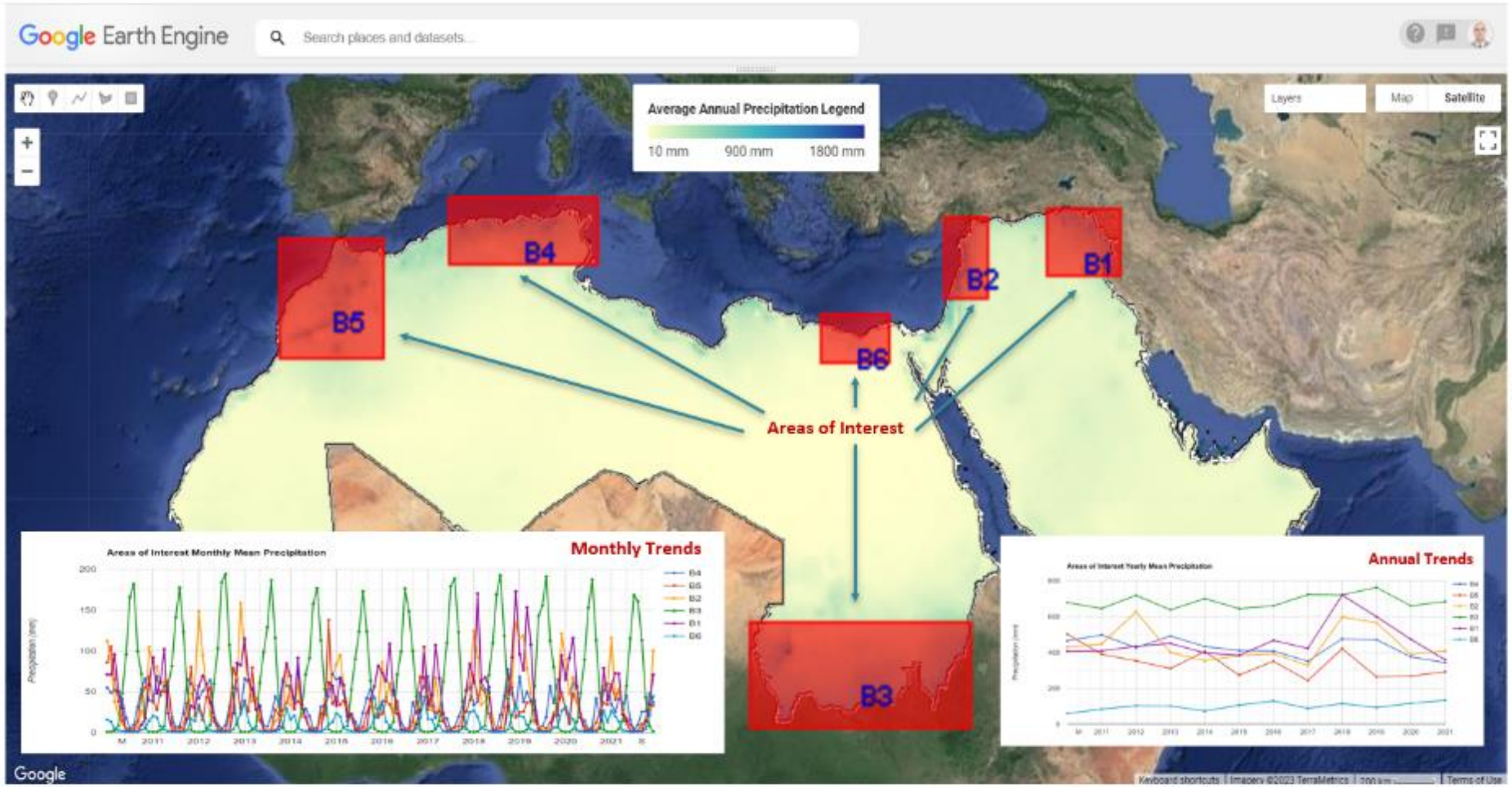
Applications for Water & Agriculture Sectors

Geospatial Tech. for Water – Agriculture Applications

Precipitation – Long-Term Average and Trends




```
Number of Chirps Rainfall Images retrieved
▾ ImageCollection UCSB-CHG/CHIRPS/PENTAD (864 elements)
    type: ImageCollection
    id: UCSB-CHG/CHIRPS/PENTAD
    version: 1697234385823072
    bands: []
  ▾ features: List (864 elements)
      ▸ 0: Image UCSB-CHG/CHIRPS/PENTAD/20211226 (1 band)
      ▸ 1: Image UCSB-CHG/CHIRPS/PENTAD/20211221 (1 band)
      ▸ 2: Image UCSB-CHG/CHIRPS/PENTAD/20211216 (1 band)
      ▸ 3: Image UCSB-CHG/CHIRPS/PENTAD/20211211 (1 band)
      ▸ 4: Image UCSB-CHG/CHIRPS/PENTAD/20211206 (1 band)
      ▸ 5: Image UCSB-CHG/CHIRPS/PENTAD/20211201 (1 band)
      ▸ 6: Image UCSB-CHG/CHIRPS/PENTAD/20211126 (1 band)
      ▸ 7: Image UCSB-CHG/CHIRPS/PENTAD/20211121 (1 band)
      ▸ 8: Image UCSB-CHG/CHIRPS/PENTAD/20211116 (1 band)
      ▸ 9: Image UCSB-CHG/CHIRPS/PENTAD/20211111 (1 band)
      ▸ 10: Image UCSB-CHG/CHIRPS/PENTAD/20211106 (1 band)
      ▸ 11: Image UCSB-CHG/CHIRPS/PENTAD/20211101 (1 band)
```

1 Calendar month = 6 pentads (Images)

Number of Images Processed:
6 pentads * 12 months *12 Years = 864 Images

Region: NENA Region **Dataset:** CHIRPS **Years:** 2010 - 2021

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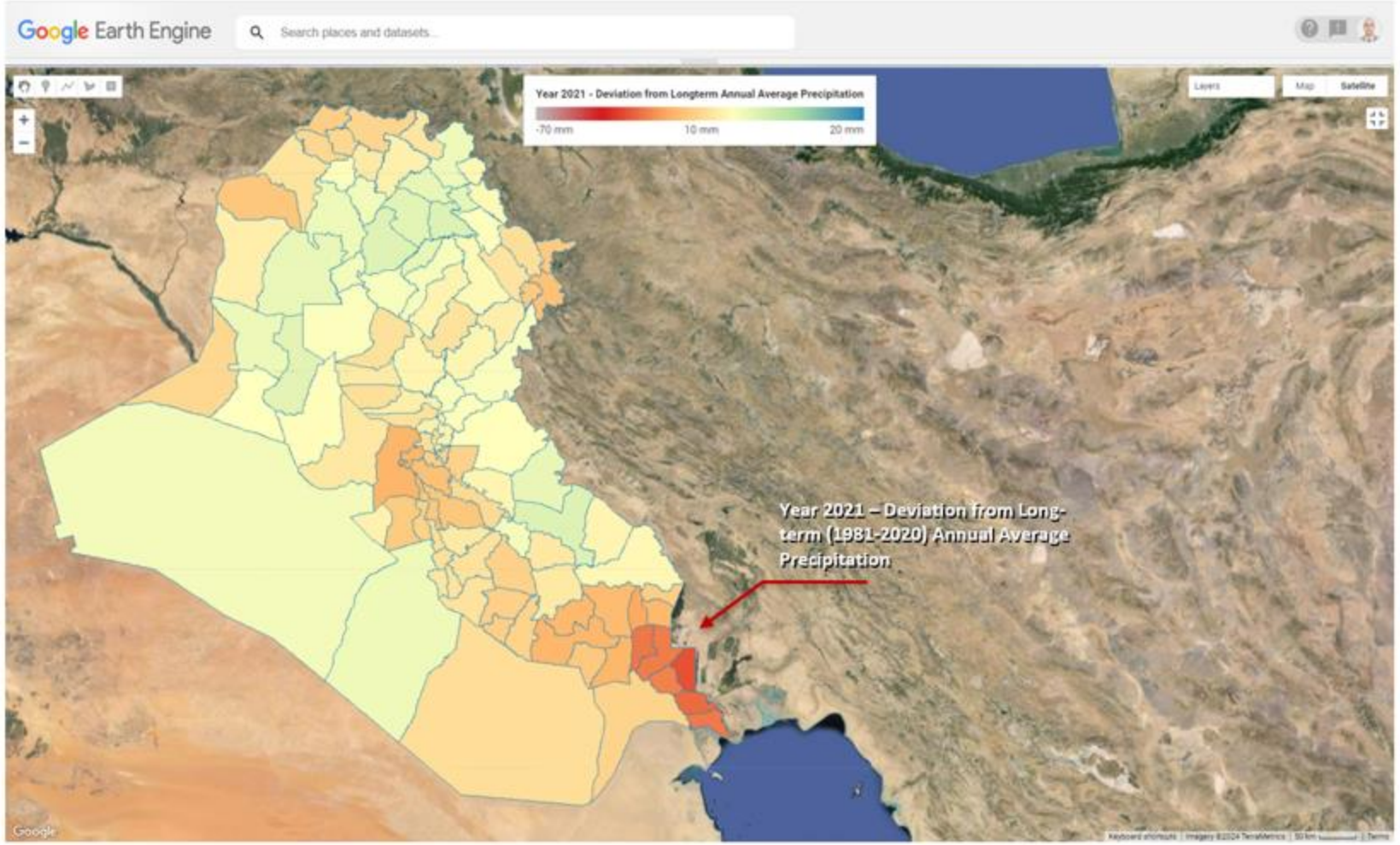
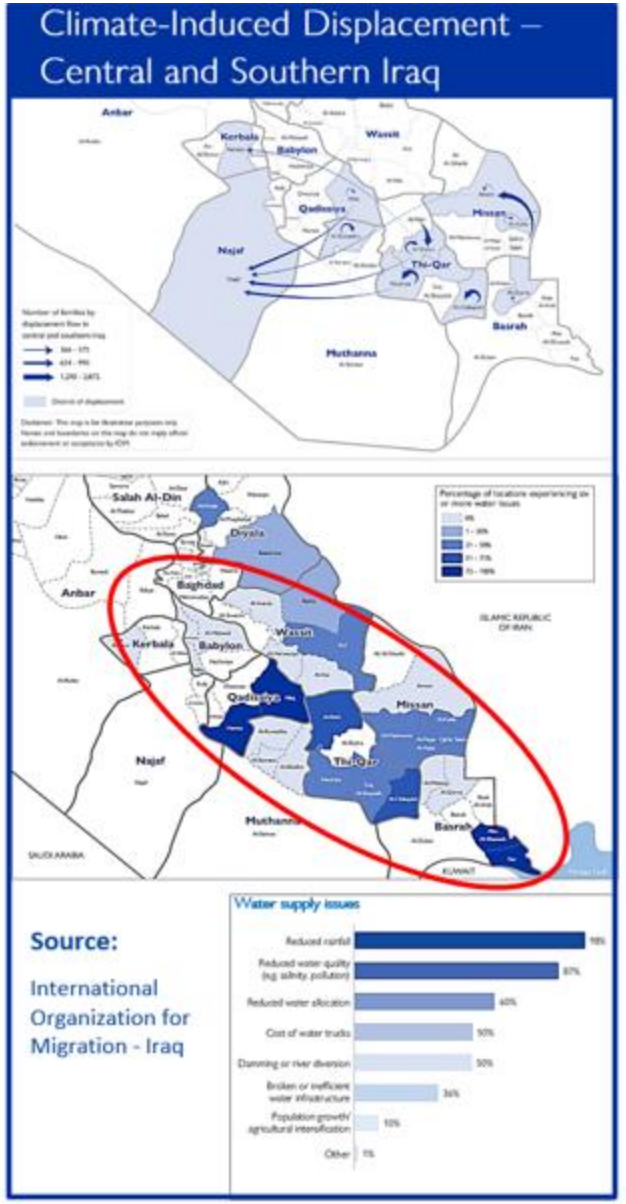
Precipitation – Deviation from Long-term Average





Country: Iraq Dataset: CHIRPS Reference Period: 1981 – 2020 Target year: 2021

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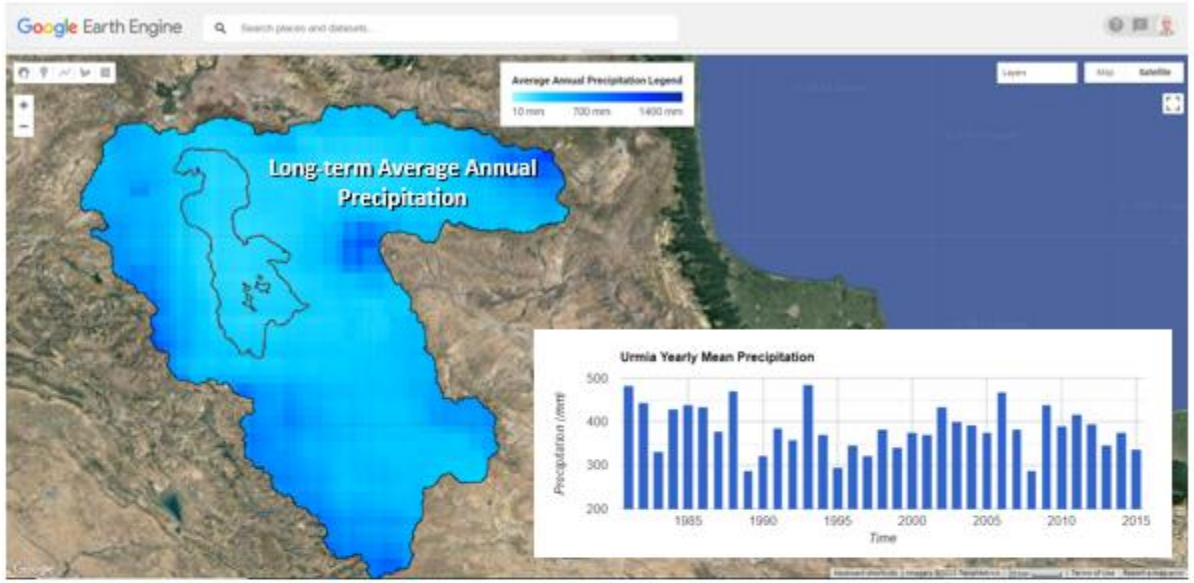
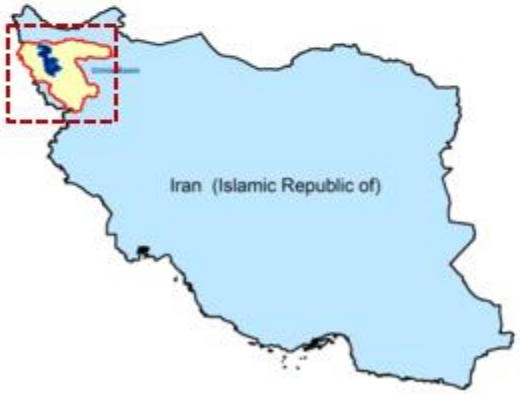
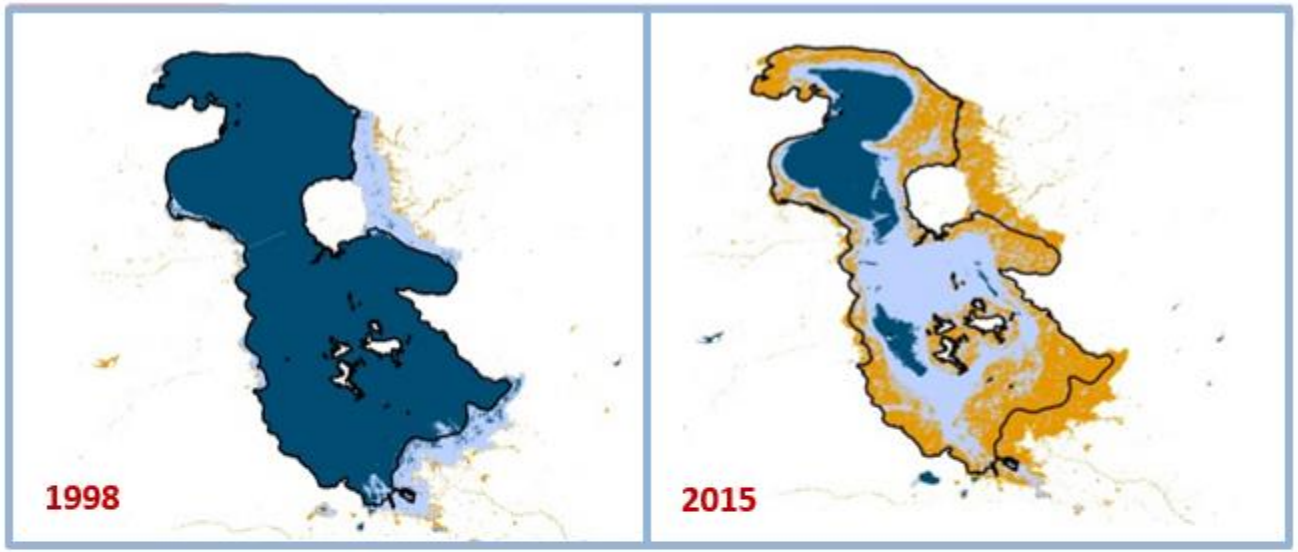
Monitoring Surface Water Change



- Region: Urmia Basin
- Country: Iran
- Dataset: CHIRPS
- Years: 1981 - 2015





- Region: Urmia Lake
- Country: Iran
- Dataset: JRC Global Surface Water Mapping Layers (V1.4) Layers
- Years: 1984 - 2022

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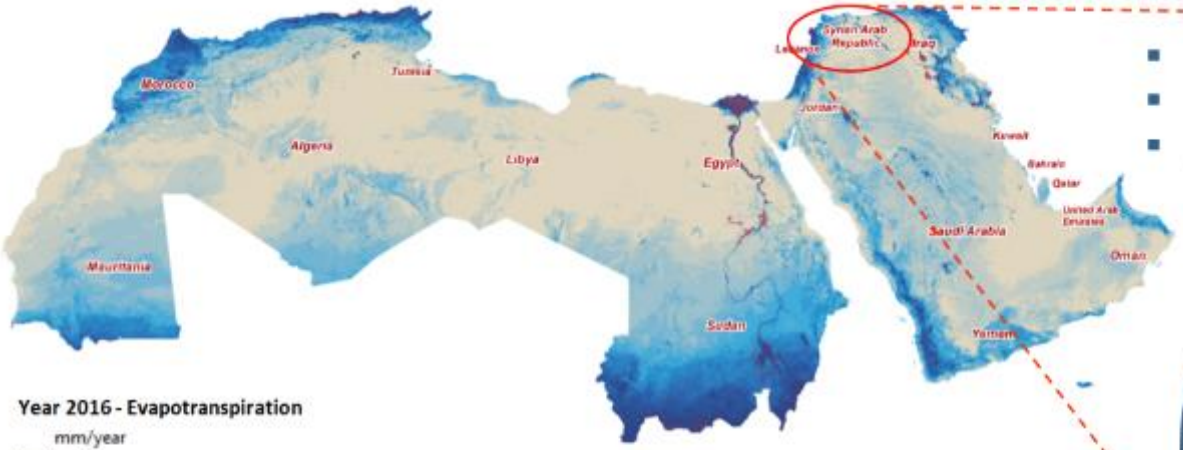
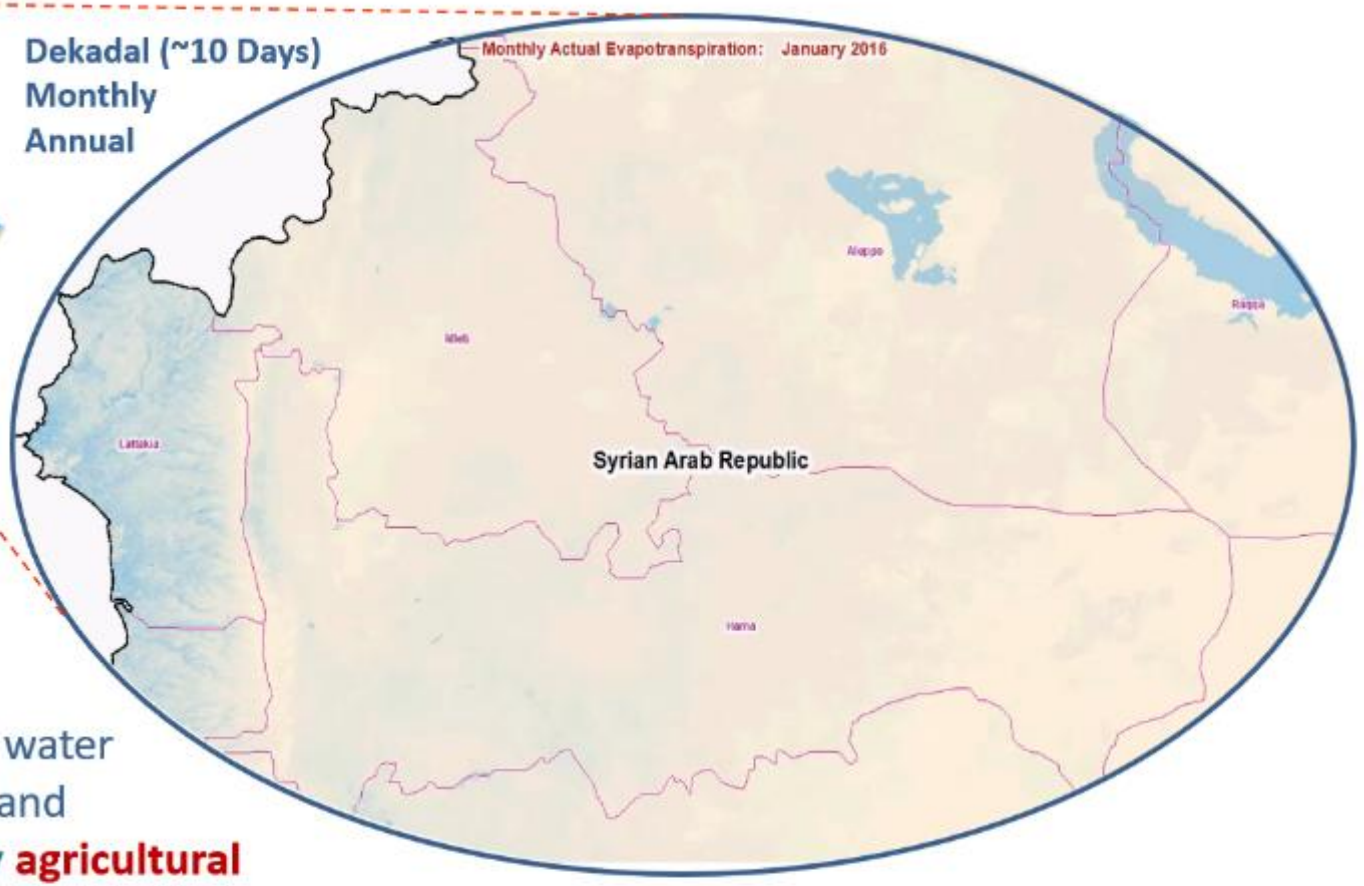
Monitoring Water Consumption



- Dekadal (~10 Days)
- Monthly
- Annual



Year 2016 - Evapotranspiration

mm/year

0 - 22
23 - 52
53 - 88
89 - 134
135 - 194
195 - 265
266 - 341
342 - 423
424 - 517
518 - 621
622 - 734
735 - 859
860 - 999
1,000 - 1,166
1,167 - 1,357
1,358 - 1,576
1.577 - 1.909

Annual Actual Evapotranspiration (Year 2016)

Spatial Resolution: **250m** - Temporal Resolution: **Annual**

Datasets Source: **FAO Water Productivity Open Access Portal (WAPOR)**

Actual Evapotranspiration (ET) is the amount of water released into the air through **Soil Evaporation (E)** and **Plant Transpiration (T).** It can be used to quantify **agricultural water consumption**

Amount of **Water Consumed (mm)** through **Evapotranspiration** over a year

Low: 0 mm — High: 22 mm

Monthly Actual Evapotranspiration (Year 2016)

Spatial Resolution: **100m** - Temporal Resolution: **Monthly**

Precipitation | Surface Water Change | Water Consumption | Biomass Production | Crop Mapping | Vegetation Cover Change | Fire Burn Severity

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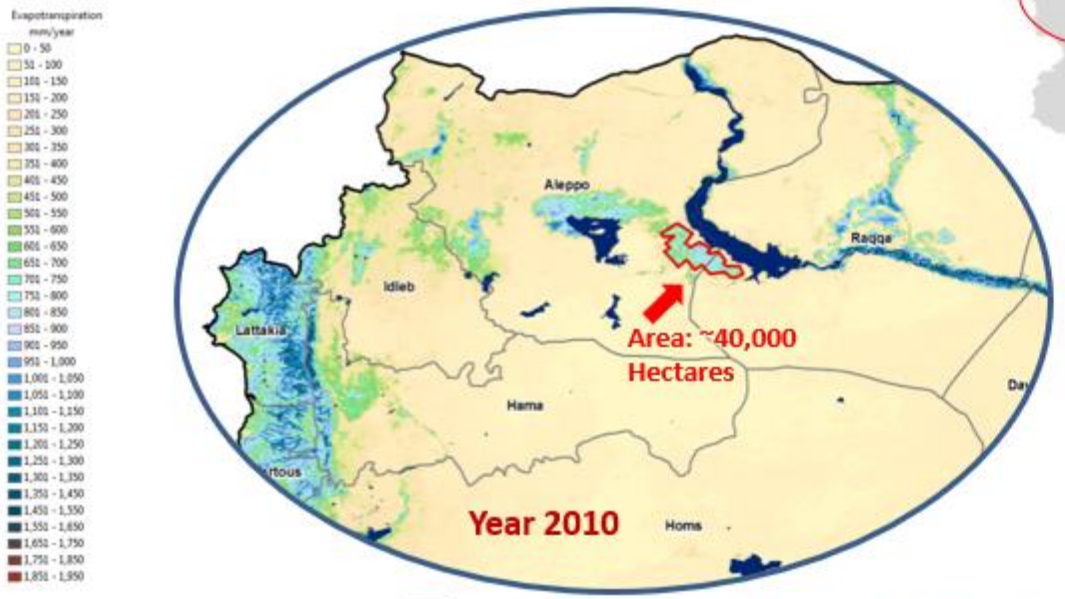
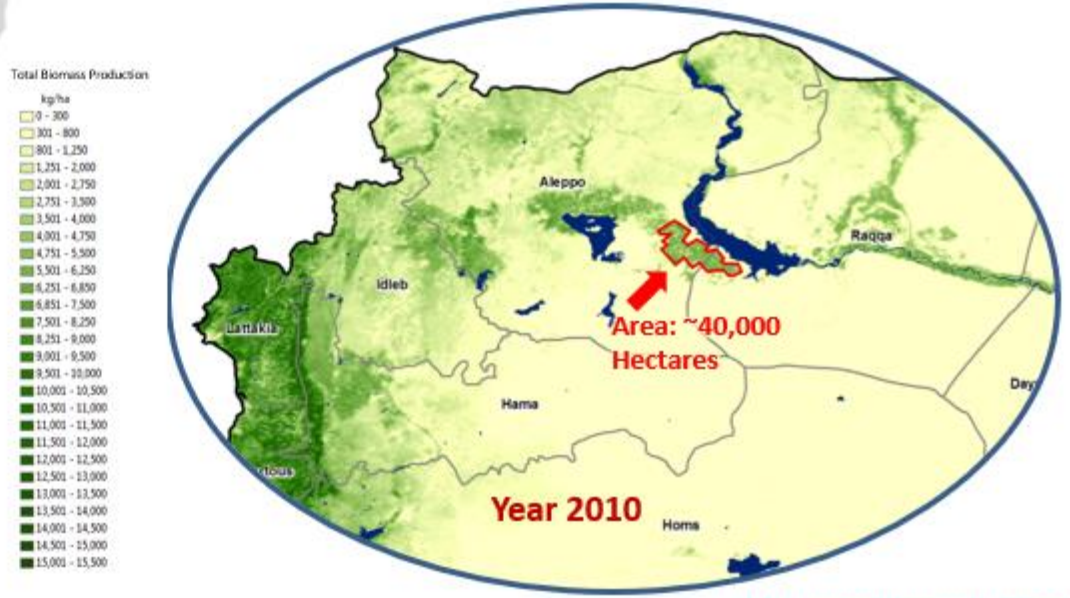
Water Consumption (Evapotranspiration)



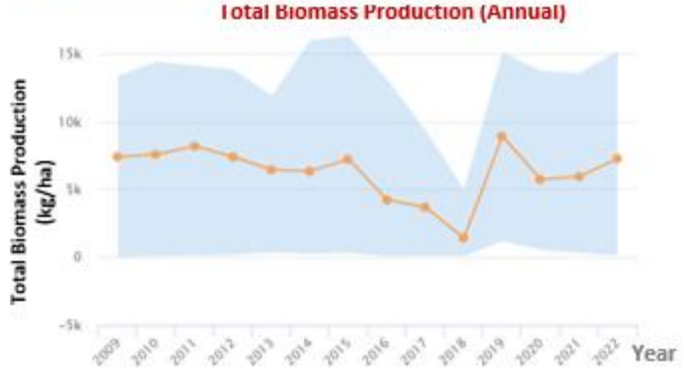
Total Biomass Production



1

- Region: Aleppo-Raqqa
- Country: Syria
- Dataset: ET - FAO WaPOR
- Years: 2009 - 2022

- Region: Aleppo-Raqqa
- Country: Syria
- Dataset: TBP - FAO WaPOR
- Years: 2009 - 2022



Precipitation | Surface Water Change | Water Consumption | Biomass Production | Crop Mapping | Vegetation Cover Change | Fire Burn Severity

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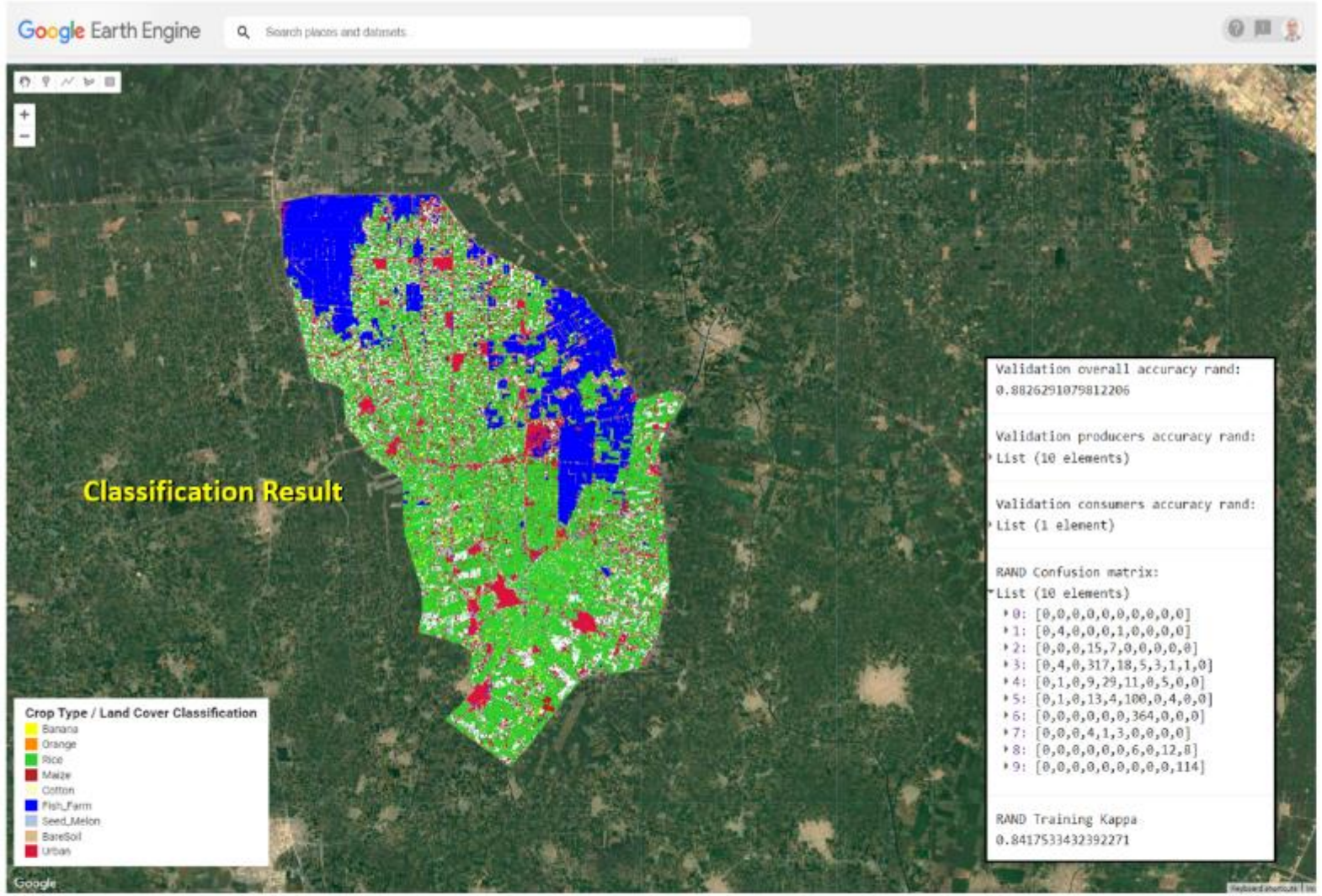
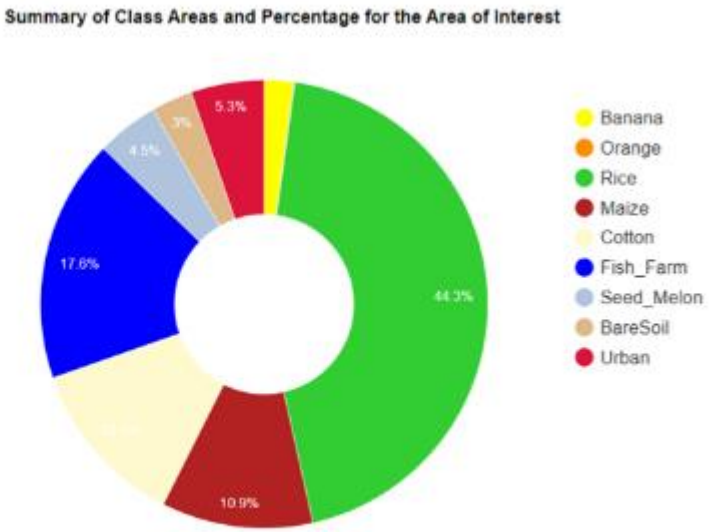
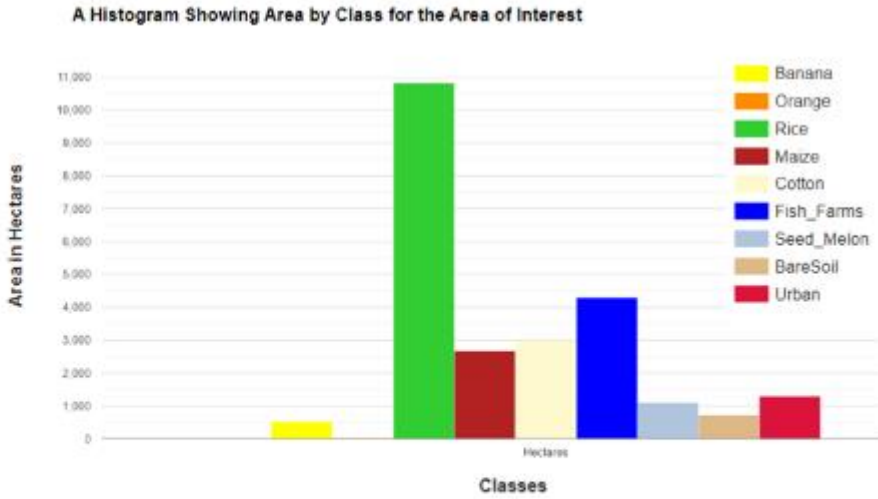
Crop Mapping







Country: Egypt **Governorate:** Kafr El-Sheikh **Dataset:** Sentinel-2 **Year:** Summer 2019

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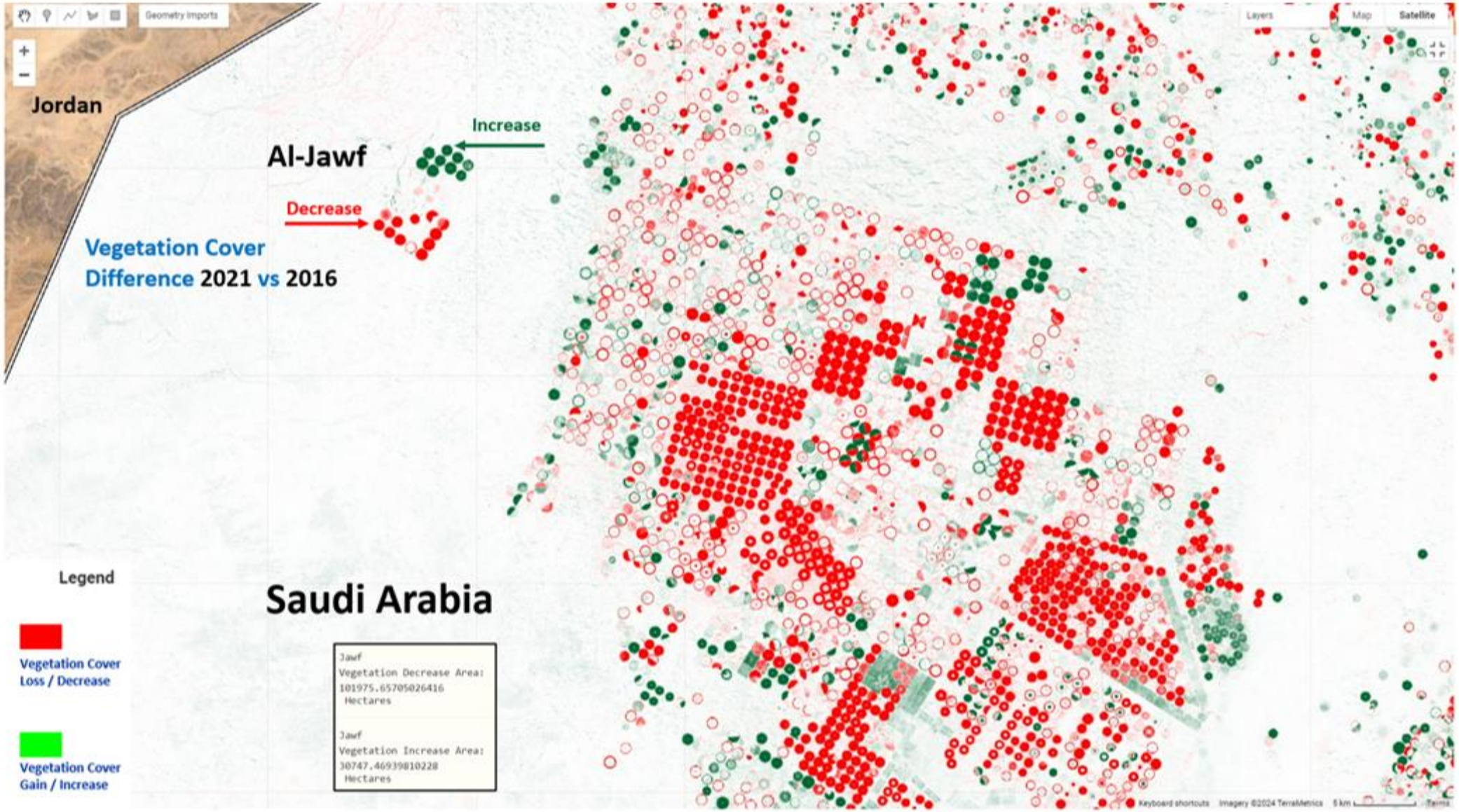
Vegetation Cover Change

- Country: Saudi Arabia
- Region: Al-Jawf
- Dataset: Sentinel-2
- Year: 2016 vs 2021



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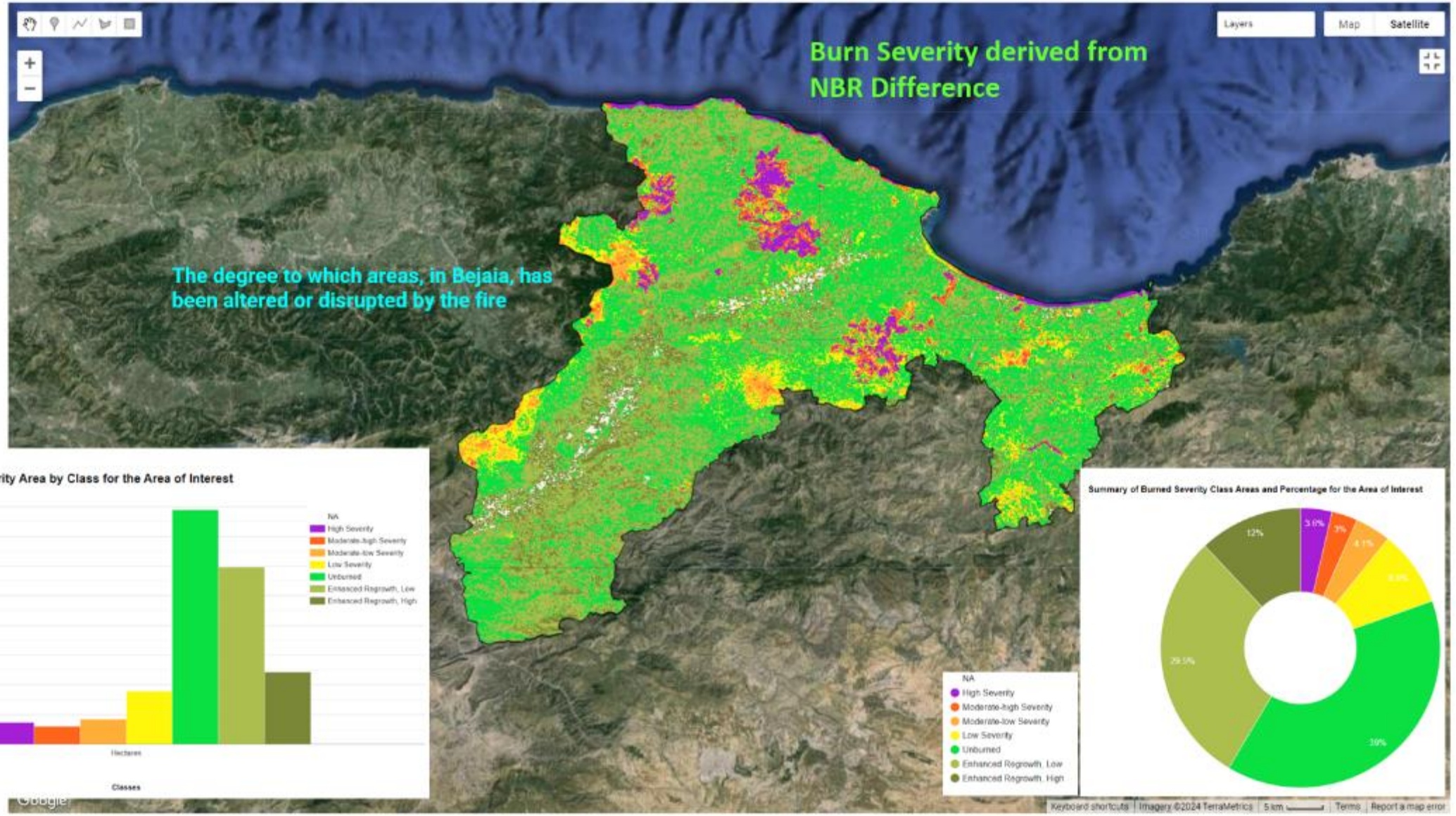
Vegetation Fire Burn Severity

- Country: Algeria
- Region: Bejaia
- Dataset: Sentinel-2
- Year: 2021



Precipitation | Surface Water Change | Water Consumption | Biomass Production | Crop Mapping | Vegetation Cover Change | Fire Burn Severity

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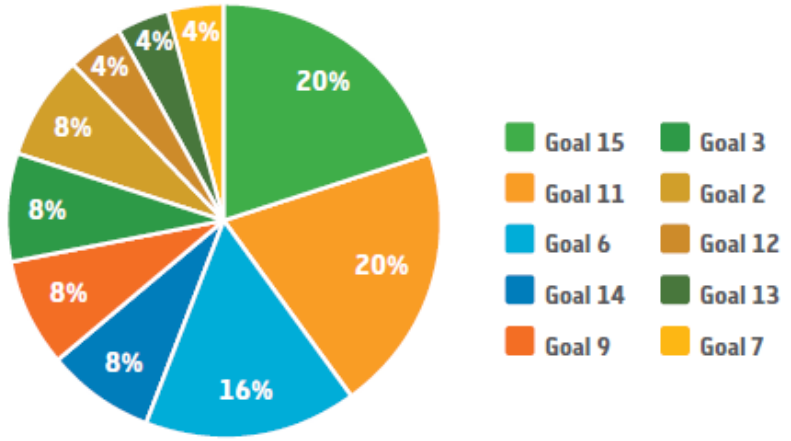
Earth observation and Geospatial Linkages to SDGs

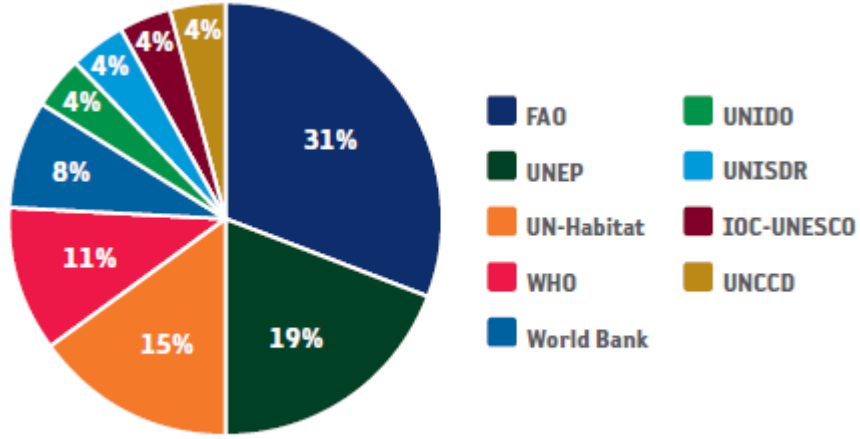
Regional Initiative on Water Scarcity

Target (Contribute to progress on the Target, not necessarily the Indicator)	Goal	Indicator (Direct measure or indirect support to the Indicator)
1.4 1.5	1 No poverty	1.4.2
2.3 2.4 2.c	2 Zero hunger	2.4.1
3.3 3.4 3.9 3.d	3 Good health and well-being	3.9.1
	4 Quality education	
5.a	5 Gender equality	5.a.1
6.1 6.3 6.4 6.5 6.6 6.a 6.b	6 Clean water and sanitation	6.3.1 6.3.2 6.4.2 6.5.1 6.6.1
7.2 7.3 7.a 7.b	7 Affordable and clean energy	7.1.1
8.4	8 Decent work and economic growth	
9.1 9.4 9.5 9.a	9 Industry, Innovation and infrastructure	9.1.1 9.4.1
10.6 10.7 10.a	10 Reduced inequalities	
11.1 11.3 11.4 11.5 11.6 11.7 11.b 11.c	11 Sustainable cities and communities	11.1.1 11.2.1 11.3.1 11.6.2 11.7.1
12.2 12.4 12.8 12.a 12.b	12 Responsible consumption and production	12.a.1
13.1 13.2 13.3 13.b	13 Climate action	13.1.1
14.1 14.2 14.3 14.4 14.6 14.7 14.a	14 Life below water	14.3.1 14.4.1 14.5.1
15.1 15.2 15.3 15.4 15.5 15.7 15.8 15.9	15 Life on land	15.1.1 15.2.1 15.3.1 15.4.1 15.4.2
16.8	16 Peace, justice and strong institutions	
17.2 17.3 17.6 17.7 17.8 17.9 17.16 17.17 17.18	17 Partnerships for the goals	17.6.1 17.18.1

The most likely Targets and Indicators that Earth observations can contribute as a direct measure or as indirect support. (Source: EO4SDG)



An approximate visual assessment of which Goals are supported by EO (Source: ESA, 2018)



An approximate distribution of the Custodian Agencies for the Indicators supported by EO (Source: ESA, 2018)

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Regional Initiative on Water Scarcity

Thank You