



PROGRAMME OF THE
EUROPEAN UNION

Copernicus
Europe's eyes on Earth



European
Commission

Drought Monitoring & Forecasting

Methodologies and Systems
From Awareness to Cure

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Joint Research Centre – European Commission



COPERNICUS
EMERGENCY
MANAGEMENT
SERVICE



ClimSA

INTRA-ACP CLIMATE SERVICES AND RELATED APPLICATIONS PROGRAMME



An initiative of the Organisation of African, Caribbean
and Pacific States funded by the European Union



Coverage

- Methodologies for Drought Monitoring & Forecasting
 - Field
 - Models
 - Space
 - Statistics
- Importance of Drought
 - Impacts
 - Climate change
- Observing Drought in Africa
 - ICPAC
 - ACMAD
- Curing the landscape
 - Agricultural methodology crisis
 - Importance of Forest



Methodologies for Drought Monitoring & Forecasting

- Rain
- Temperature
- Soil
- Vegetation



- *Weather Stations*
- *Models, filling gaps, understanding relations*
- *Satellite, complement measurements, impacts*
- *Long term*

Probability of Temperature and Rainfall extremes

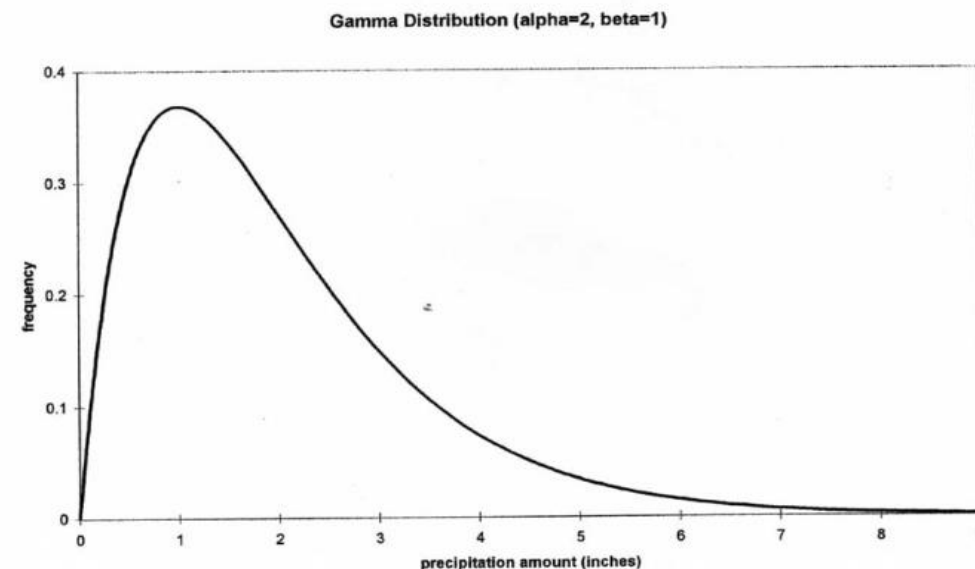
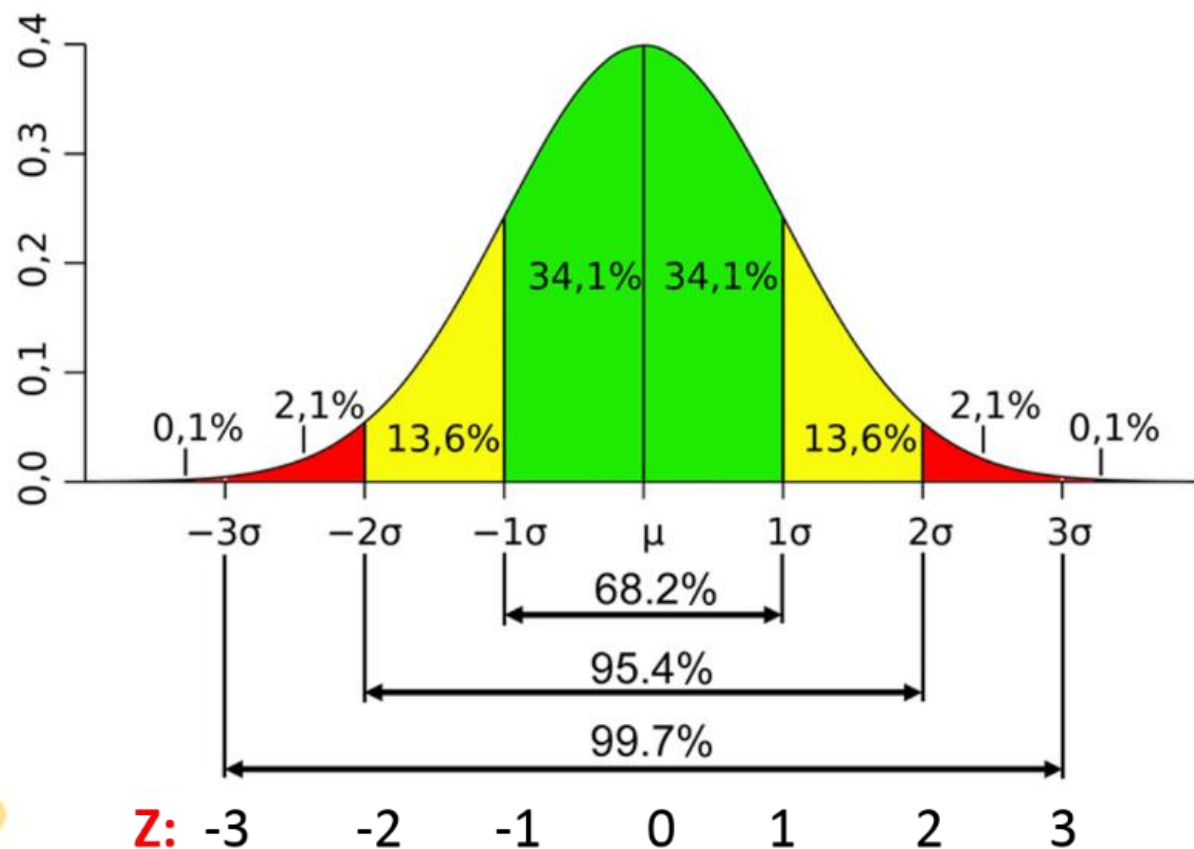
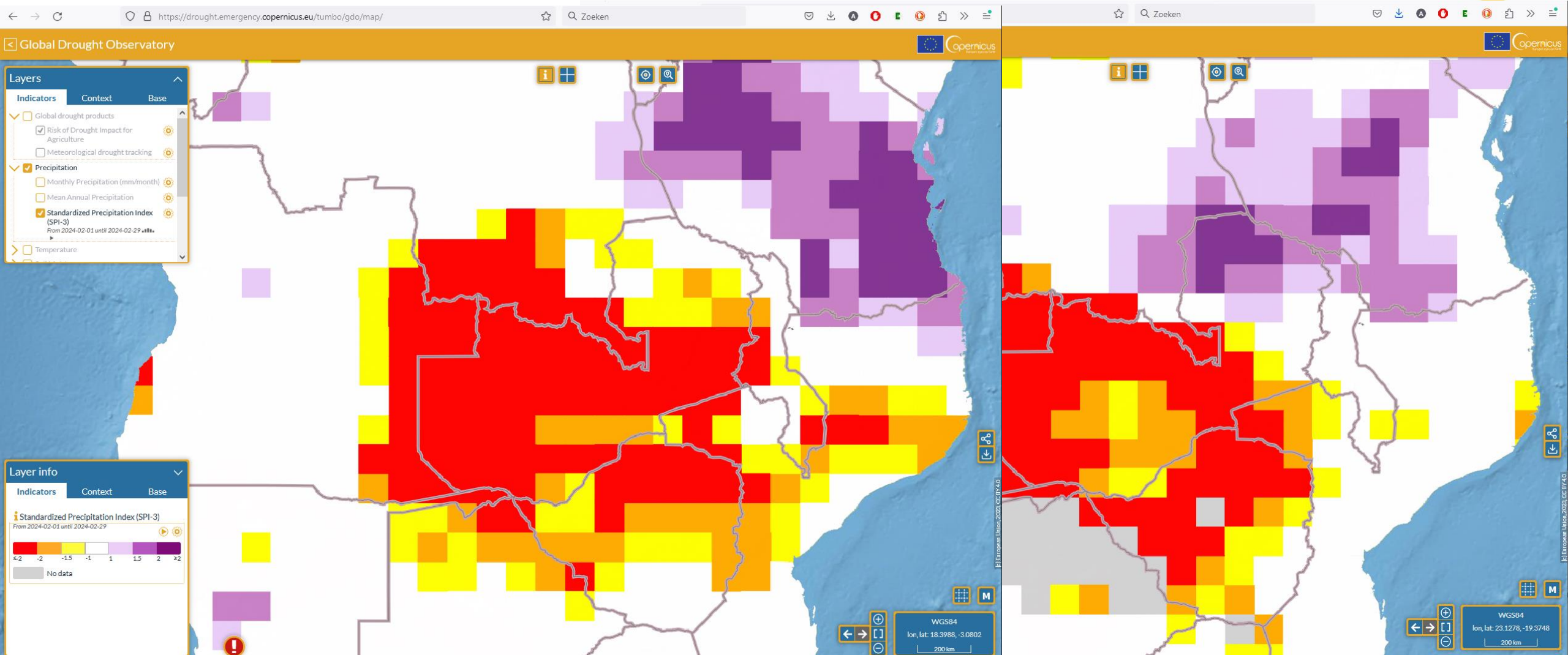
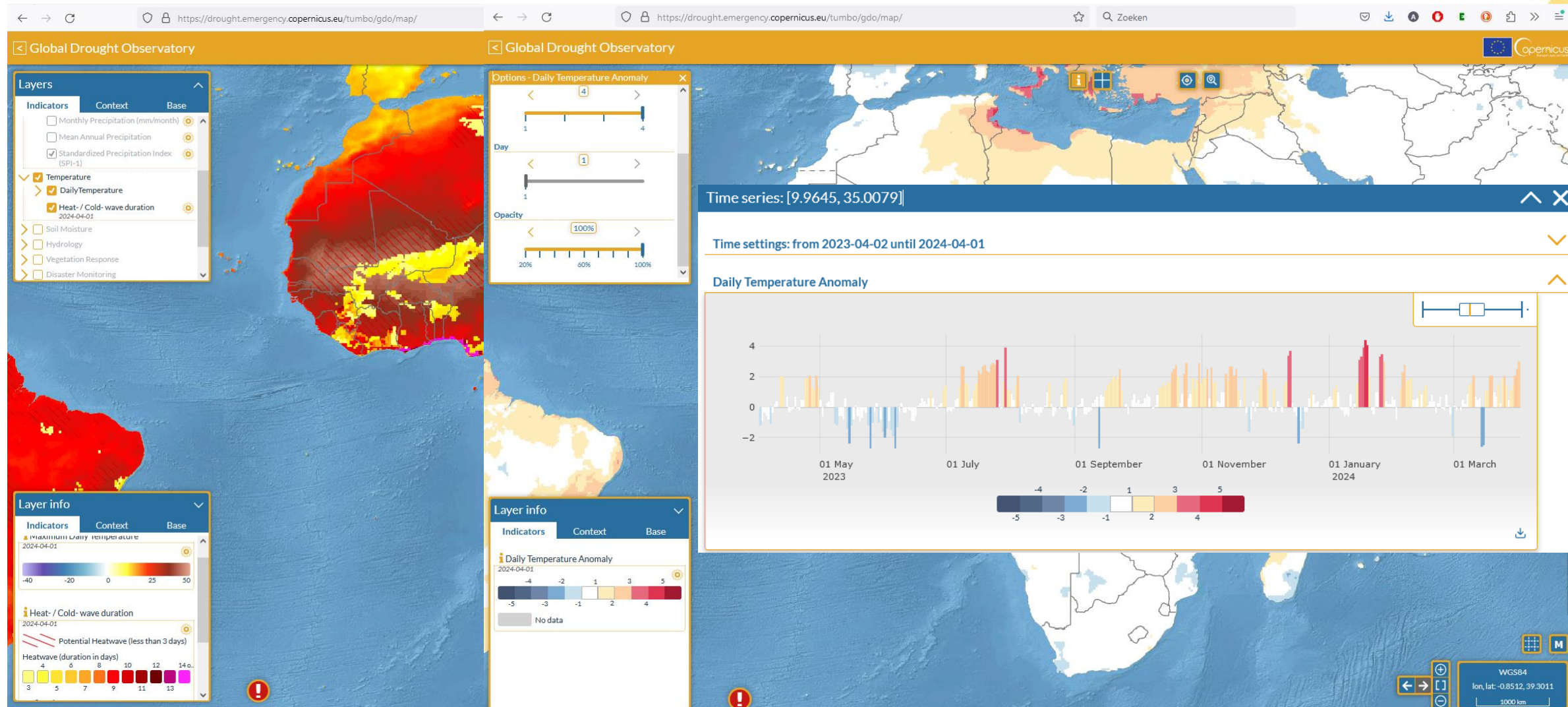


Fig. 3.1 Gamma frequency distribution with parameters alpha=2 and beta=1.

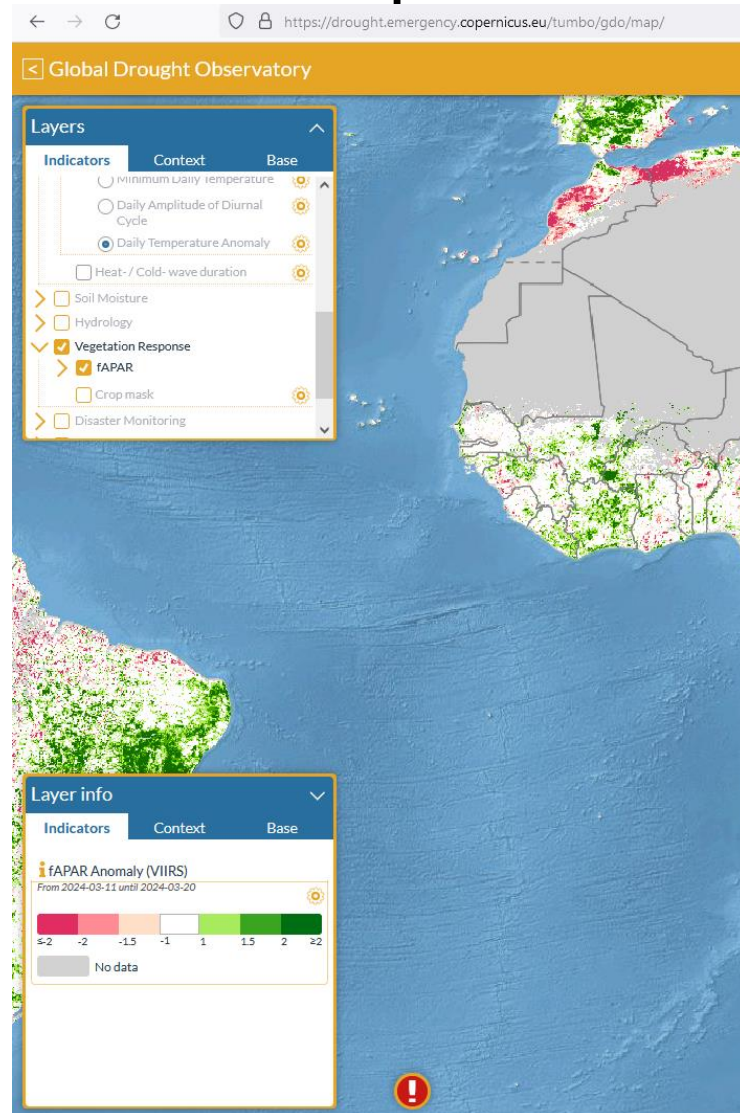
Rainfall in southern central Africa for March, monthly accumulated



Temperature Anomalies



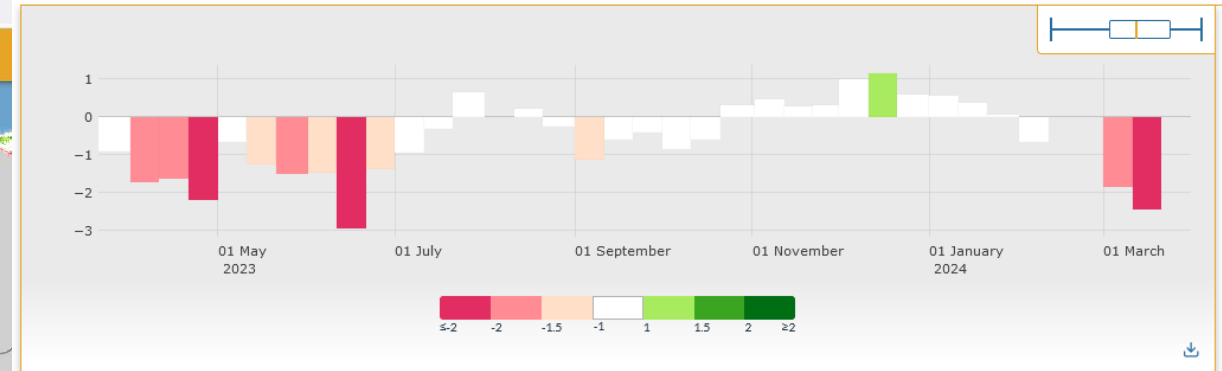
Vegetation Impacts



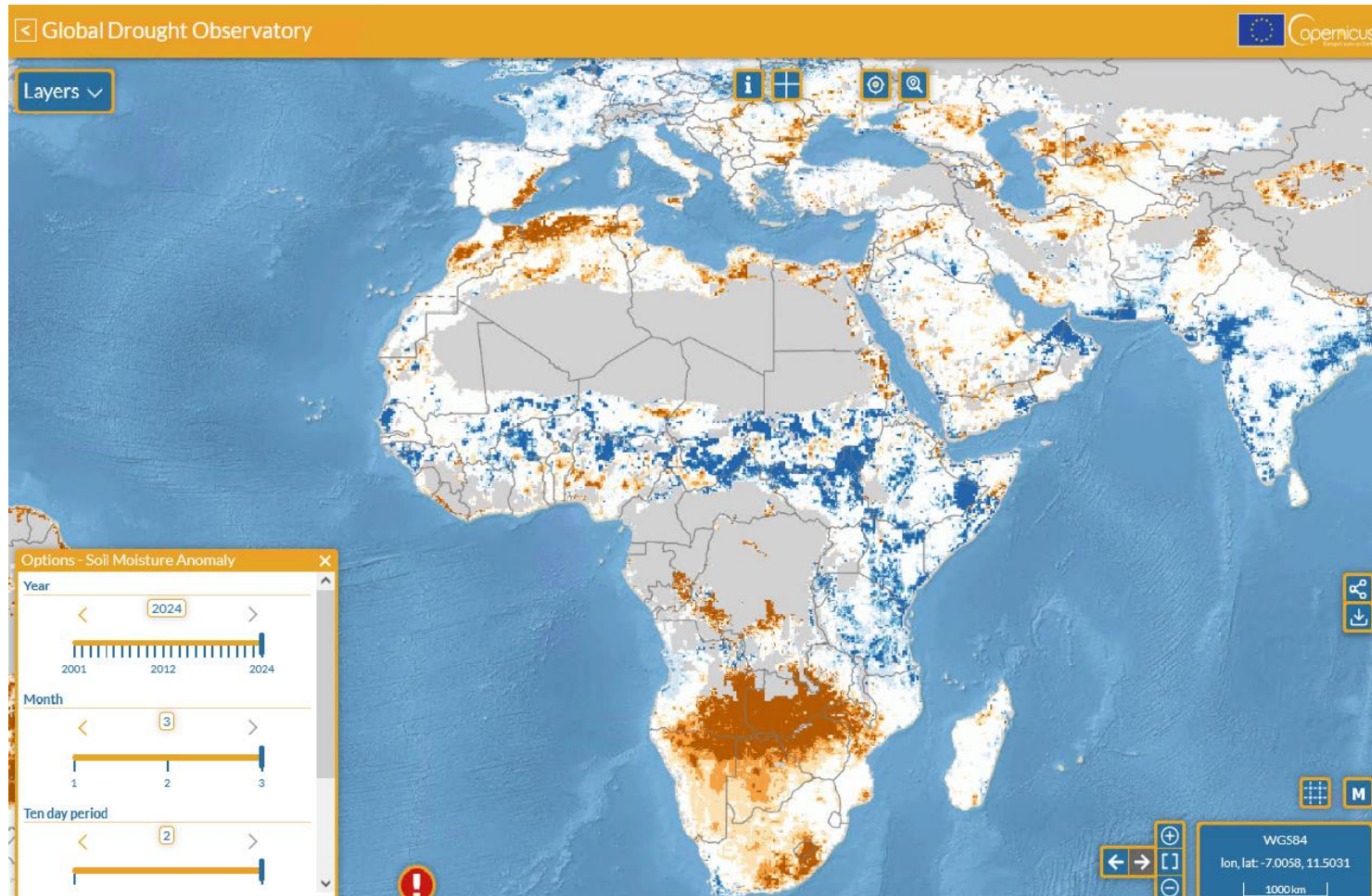
Time series: [7.2399, 9.4962]

Time settings: from 2023-03-21 until 2024-03-20

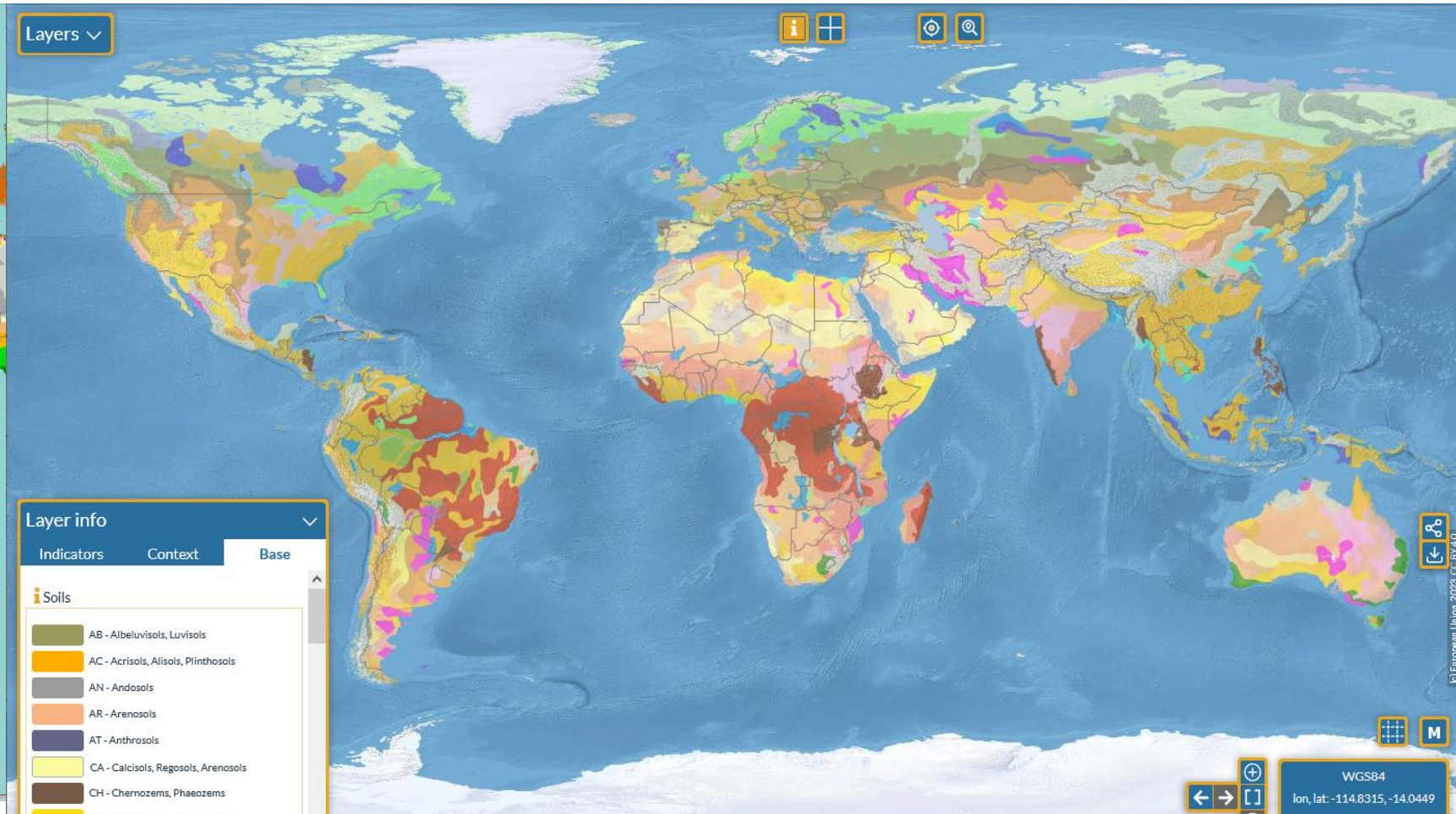
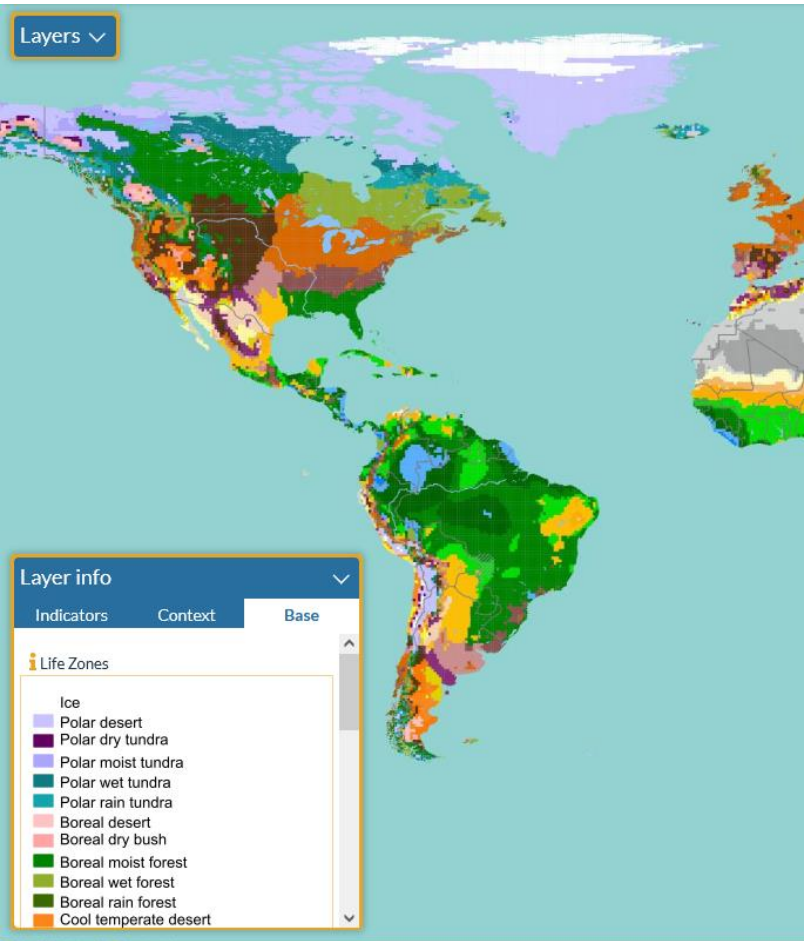
fAPAR Anomaly (VIIRS)



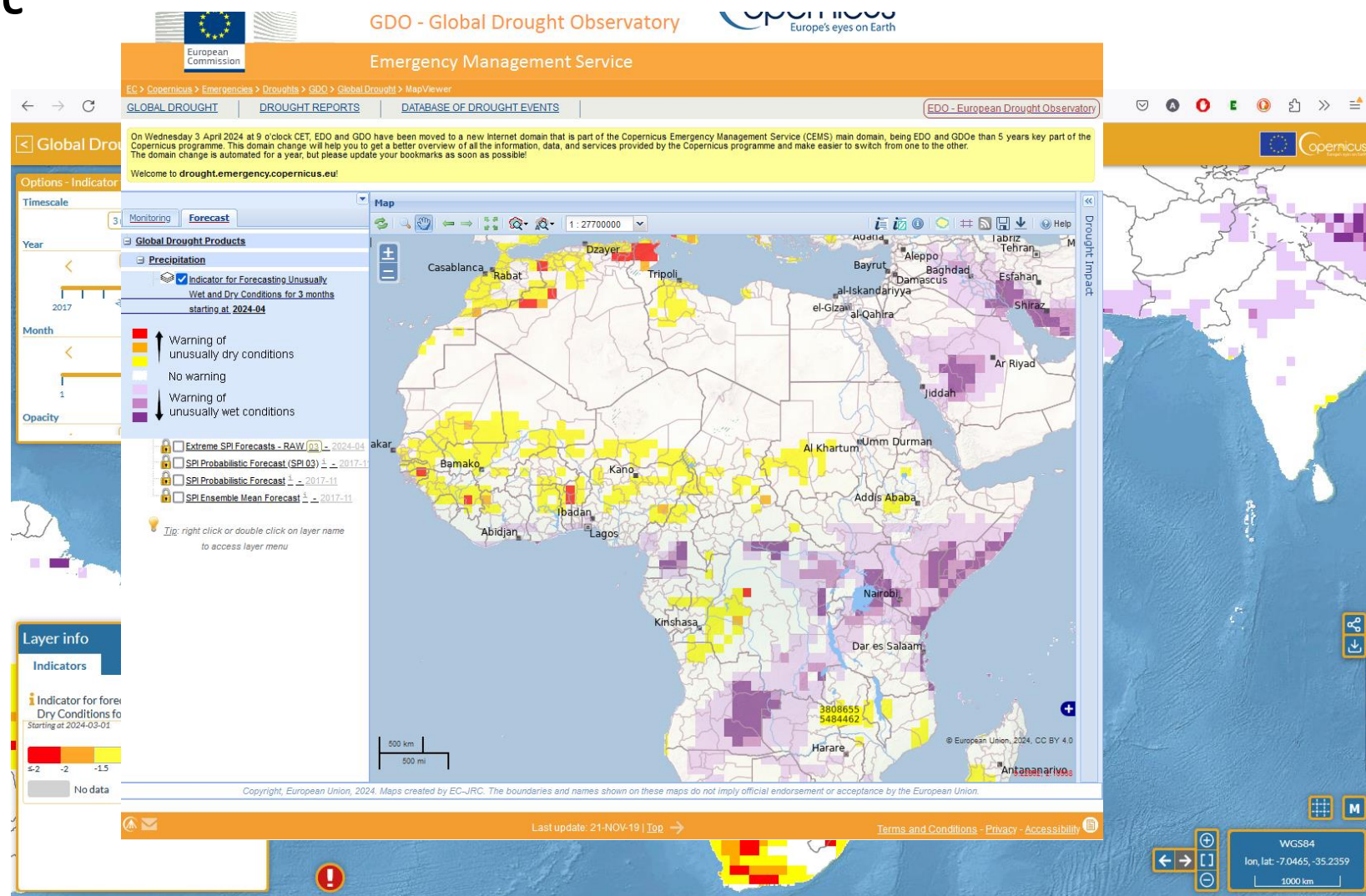
Impact on agriculture, Soil moisture



Basis, life-zones, world-soils



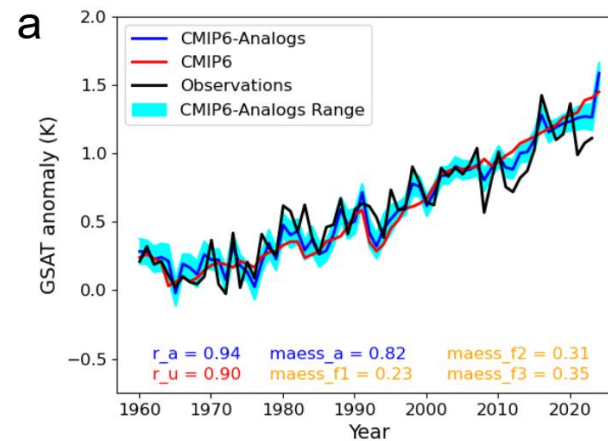
Forecast



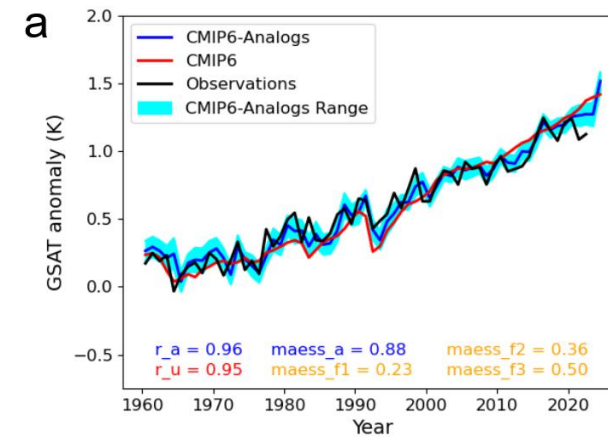
Seasonal to inter-annual (3 months – 5 years) drought forecasting developments

- Prediction based on climate analogues from the CMIP6 multi-model ensemble.
- Improved skill for both surface air temperature and precipitation as compared to the CMIP6 projections.

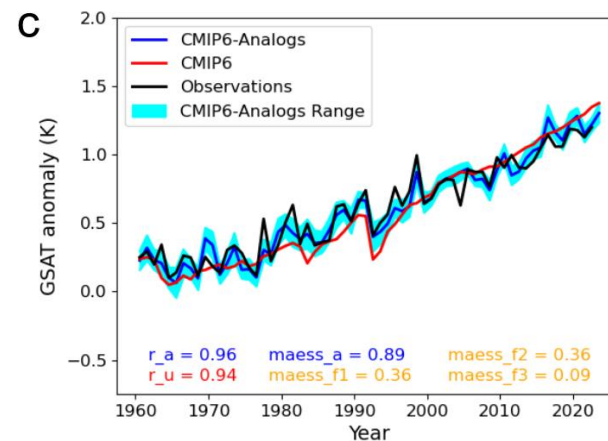
December-January
global temperature
predictions



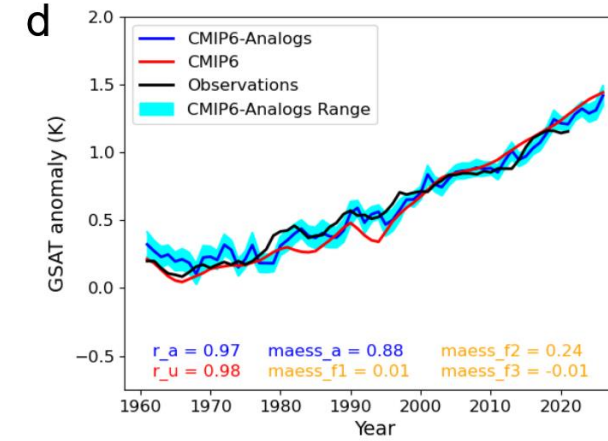
Annual
global temperature
predictions



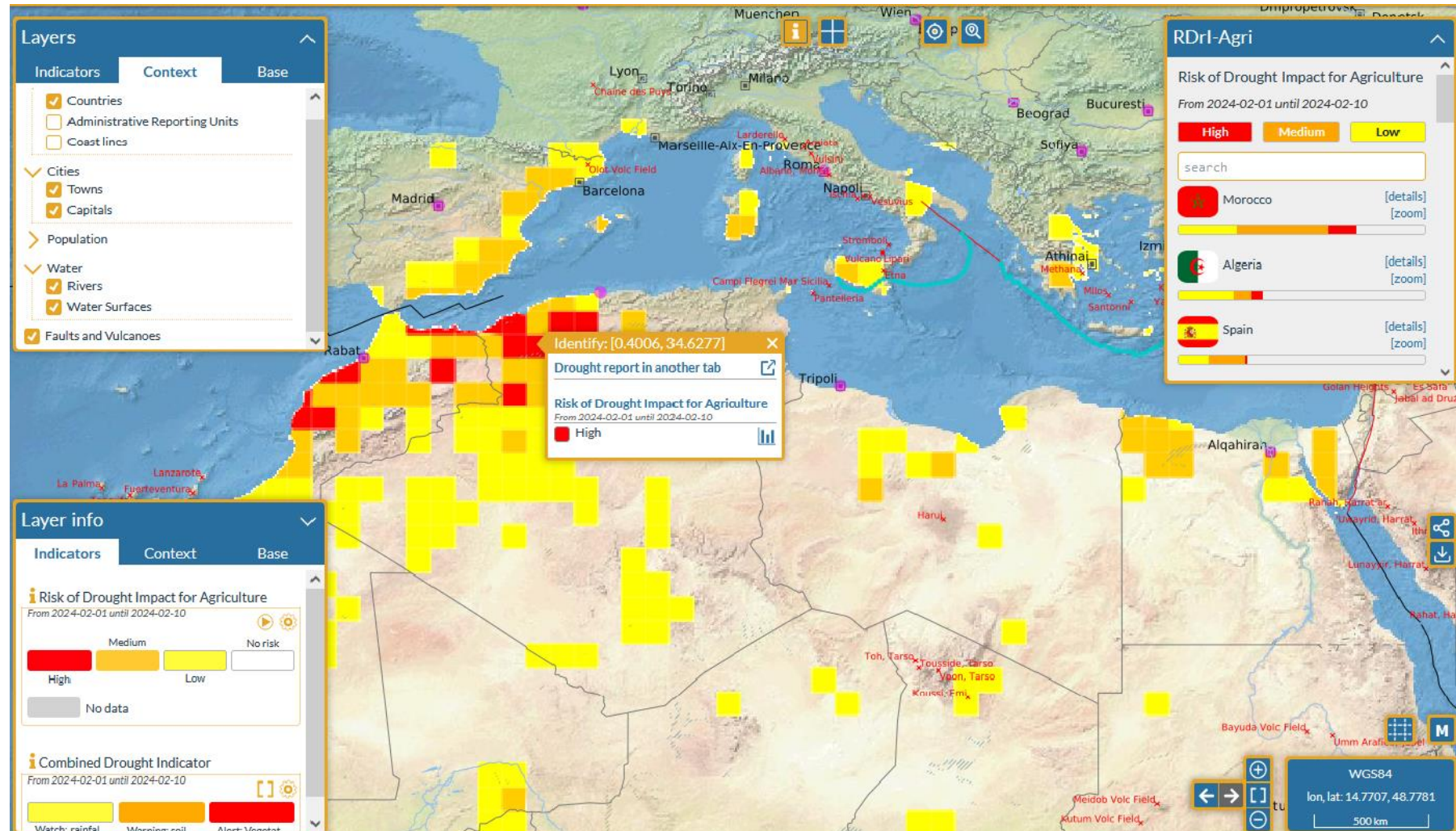
June-August
global temperature
predictions



4-Year
global temperature
predictions

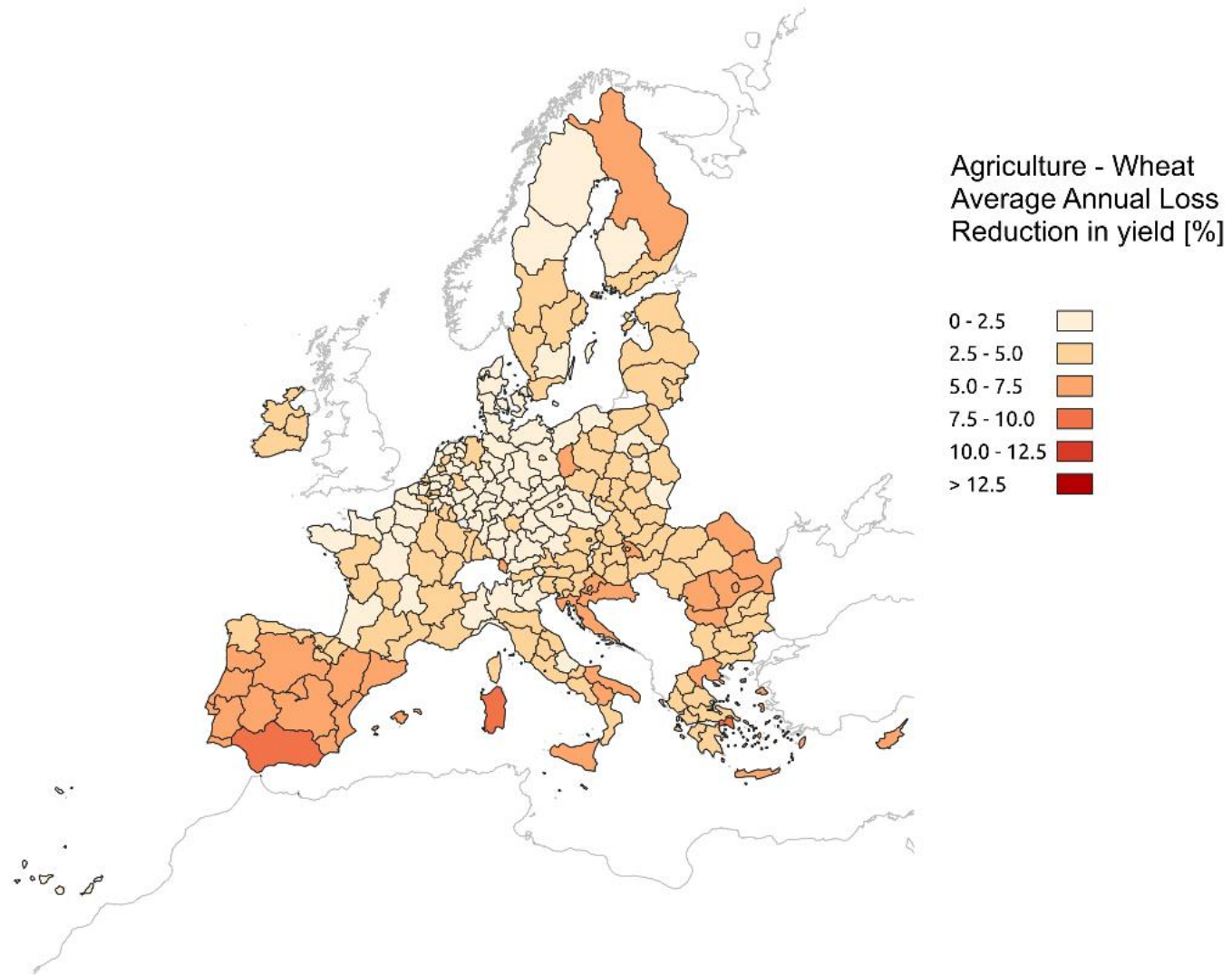


Combined Indices



Impacts

Europe 5 % in 2022
Brazil 8 % in 2022



Koppen climatic zones and FAO land classifications in affected areas

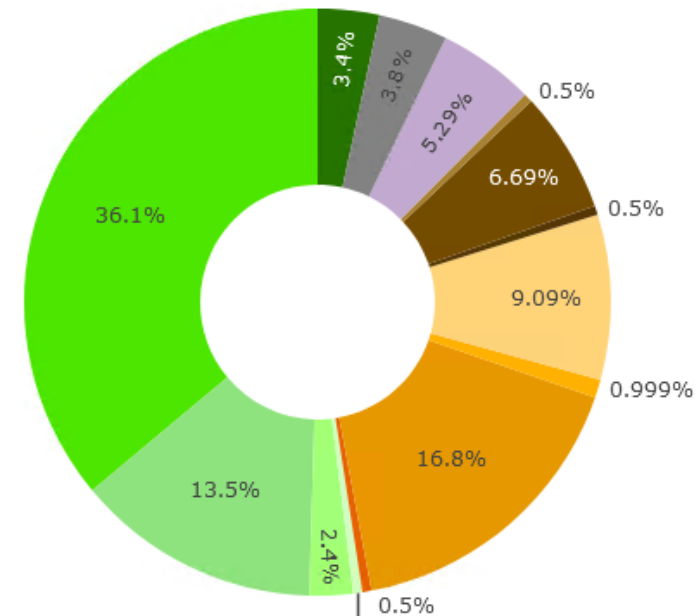
Koppen climate zone

Cwa - Temperate/Dry Winter/Hot Summer	9,922.00km ² (54.3%)
BSh - Arid/Steppe/Hot	8,341.50km ² (45.7%)

Land use ○ ■ High ○ ■ Medium ○ ■ Low

FAO Land classification - Land use

	area (km ²)
1 Forestry - no use / not managed (Natural)	614,637 (3.4%)
2 Forestry - Protected areas	6,585,398 (36.1%)
4 Forestry - Pastoralism moderate or higher	2,458,549 (13.5%)
5 Forestry - Pastoralism moderate or higher with scattered plantations	439,027 (2.4%)
6 Forestry - Scattered plantations	87,805 (0.5%)
7 Herbaceous - no use / not managed (Natural)	87,805 (0.5%)
8 Herbaceous - Protected areas	3,073,186 (16.8%)
9 Herbaceous - Extensive pastoralism	175,611 (1.0%)
10 Herbaceous - Mod. Intensive pastoralism	1,668,301 (9.1%)
13 Rainfed Agriculture (Subsistence / commercial)	87,805 (0.5%)
14 Agro-pastoralism Mod. Intensive	1,229,274 (6.7%)
16 Agro-pastoralism mod. intensive or higher with Large scale irrigation	87,805 (0.5%)
18 Agriculture - Protected areas	965,858 (5.3%)
19 Urban areas	702,443 (3.8%)

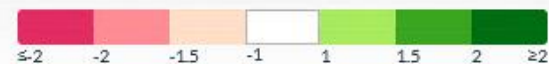


Jul 2022

Jan 2023

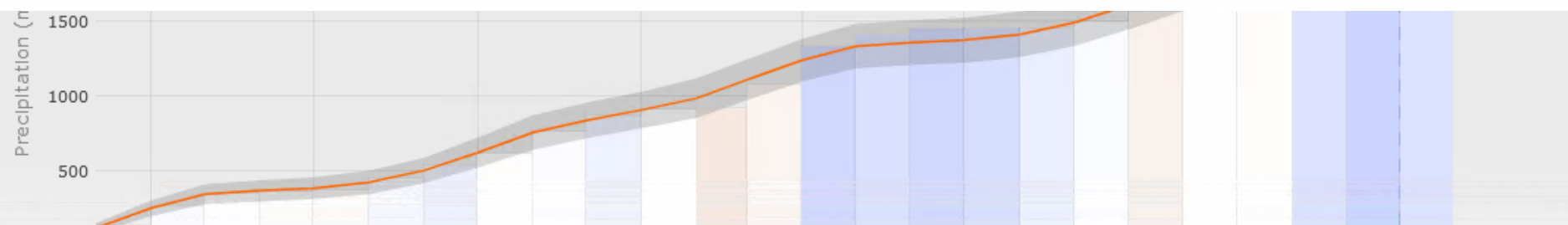
Jul 2023

Jan 2024



Precipitation (mm)

1500
1000
500



Covering the World



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INTRA-ACP CLIMATE SERVICES AND RELATED APPLICATIONS PROGRAMME

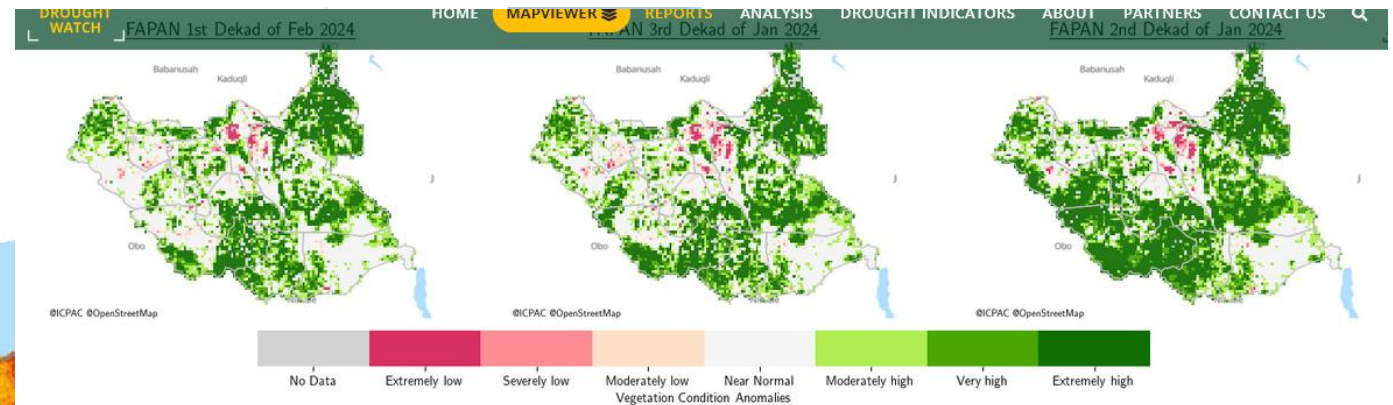
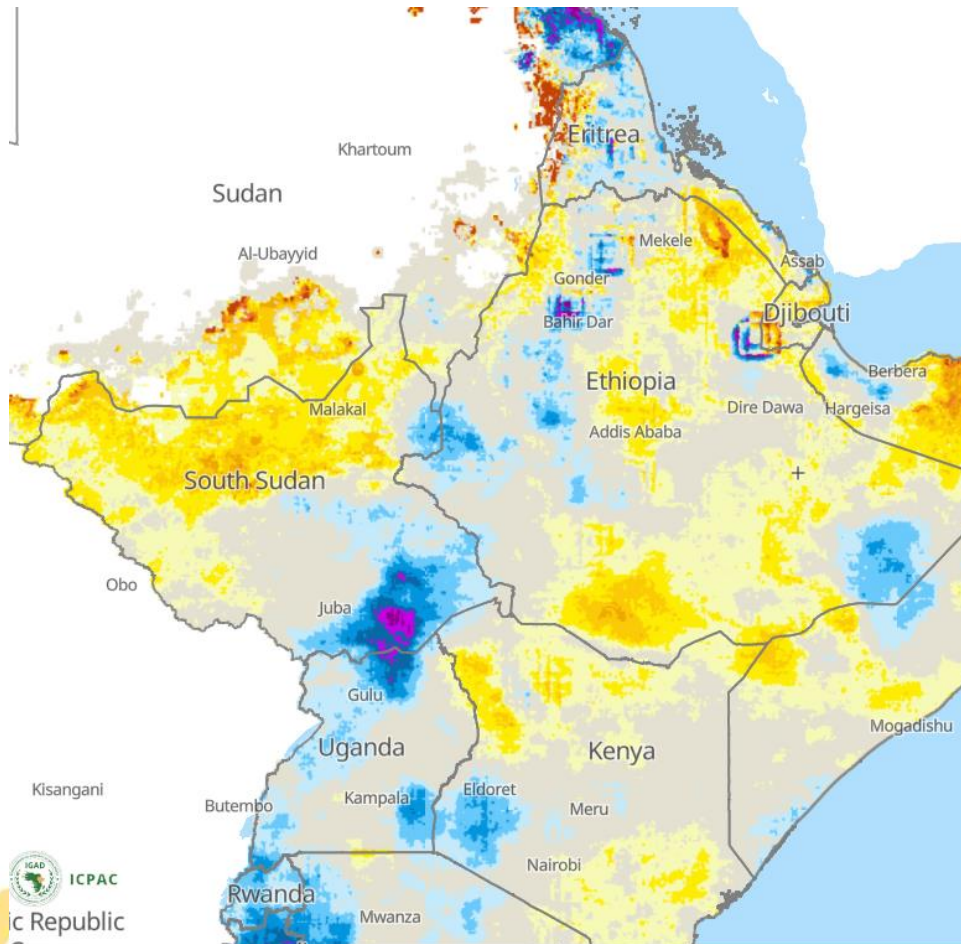


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- 2018 South and Central American Drought Observatory, CIIFEN
- 2021 East African Drought watch, ICPAC
- 2023 African Drought Monitor and Advisory, ACMAD

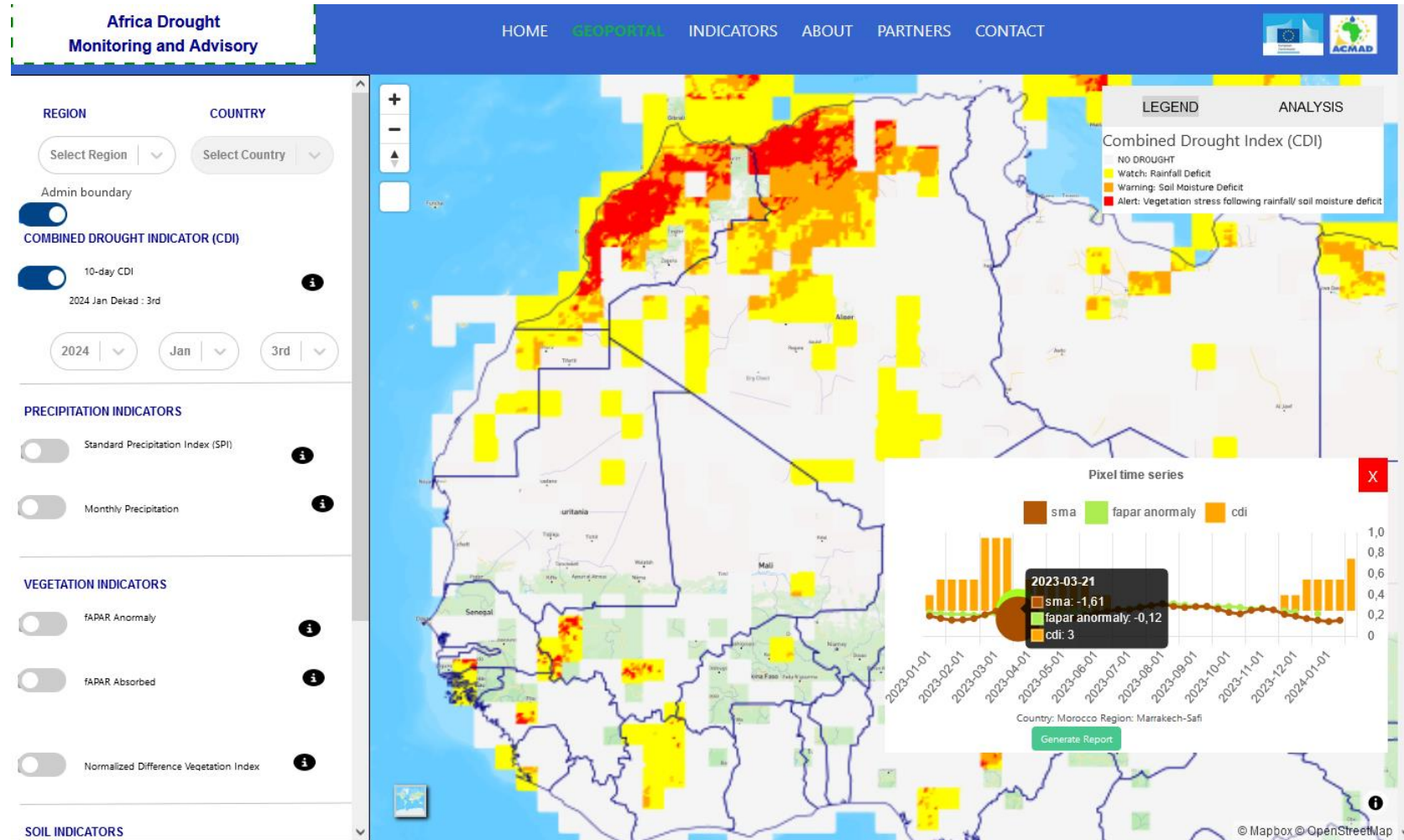
East African Drought watch



A timeseries graph showing evolution of Vegetation Condition Anomaly for the monitoring period between 3rd Dekad of February 2022 and 1st Dekad of February 2024. The graph shows how Vegetation Condition Anomaly changes over time. By comparing the bar heights for different categories at each time step, one can identify relative differences between visualized categories.



African Drought Advisory



Landscape resilient to drought

- **Agricultural slowdown**

- Lighter machines
- Restoring micro relief & meanders
- Mixed Cropping systems
- Less animals, better cured animals
- Permaculture

- **Reversed Urbanization**

- High rise buildings on infrastructure nodes
- Urbanize where resources are available, abandon **dangerous** places
- Green living neighborhoods, accept maintenance for **trees**
- Never burn during temperature inversion, **stockpile** fuel



Our Agricultural Landscape, drought vulnerability diagnosis

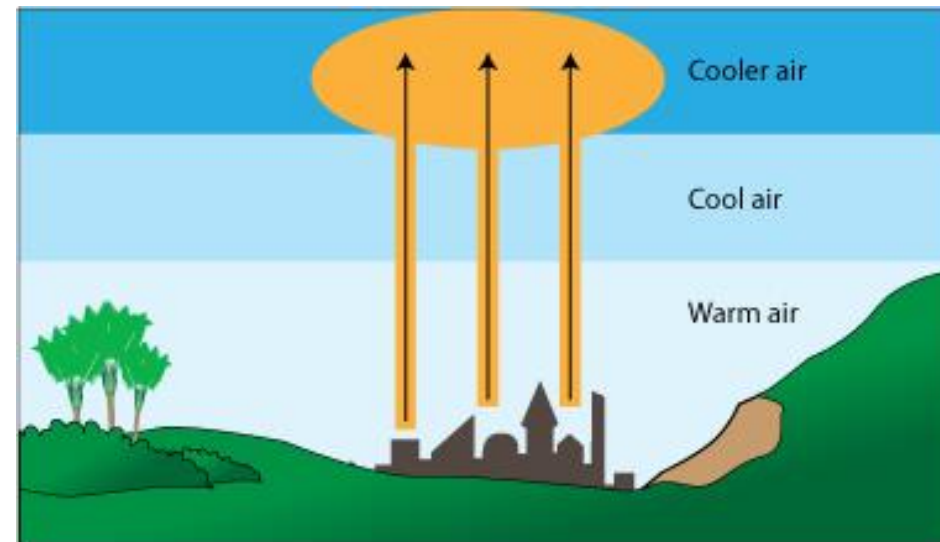
Driver	Risk to Manage
Mechanization	Compaction & Equalization
Pesticide & Fertilizer dependency	Organic matter content loss
Water reservoirs & Irrigation	Pricing, Leakages, Evapotranspiration, Salinization
Monocultures	Diseases, Increased failure risk
Fodder	Protein loss, animal & farmer suffering, pandemics
Crops with Limited Rooting depth	Quick drought impact



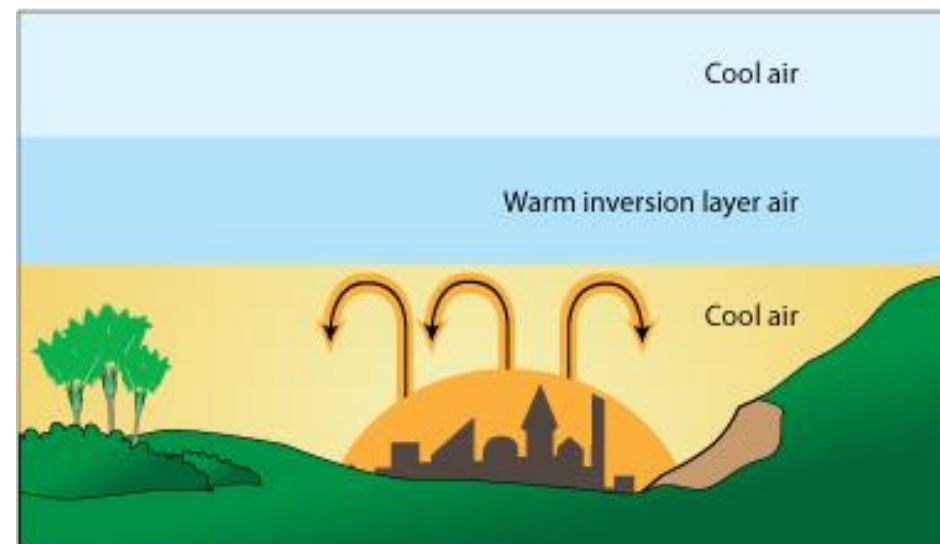
Accelerated Urbanization

Driver	Result
Soil sealing	No ground water recharge, quick flooding, subsiding
Dependency on transported water/ desalinization	Cost & Energy usage, ecosystem impact
Limited green areas , urban Heat island	Excess impact of heatwaves
High pressure system leading to Air pollution	Low quality of life, ecosystem impact





Normal pattern



Thermal inversion



STAY CONNECTED

EVENTS, ONLINE, and MAP VIEWERS



@CopernicusEMS



drought.emergency.copernicus.eu

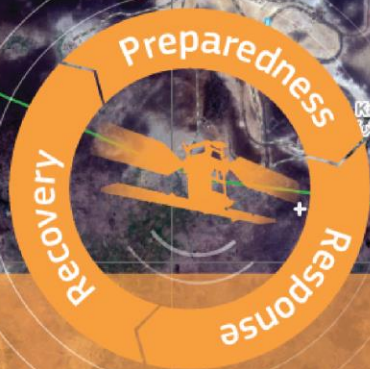
<https://droughtwatch.icpac.net>



activations.emergency.copernicus.eu

<https://ado.acmad.org>

alfred.de-jager@ec.europa.eu



**Rapid
Mapping**



**Risk & Recovery
Mapping**



Floods



Fires



Droughts



Population



**Built-up
areas**



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Early Warnings for All, Bonn