DROUGHTS European (EDO) and Global (GDO) Drought Observatories

Drought Team- Paulo Barbosa

On-demand mapping

Rapid Risk and Recovery Mapping Mapping Early warning and monitoring

Floods

Droughts



Fires

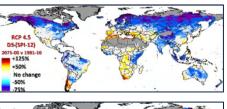


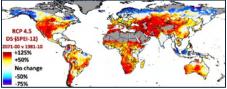
Management

Gllobal Drought Observatory - Introduction

- <u>Why</u>? Droughts are ...
 - Increasing in frequency and severity in many parts of the world, likely to aggravate in the future.
 - A global hazard with significant economic, societal and environmental impacts (e.g. 9 billion Euros/year in EU+UK¹).
- <u>What</u>?
 - Early warning, monitoring and forecasting of droughts and their likely impacts, based on satellite data, hydrometeorological modelling and in-situ observations.
 - Based on a conceptual model of drought risk
- For Whom?
 - European Emergency Response Coordination Centre (ERCC)
 - Global Disaster Alert and Coordination System (GDACS)
 - International aid organizations, UNCCD

1 Naumann, G., Cammalleri, C., Mentaschi, L. et al. Increased economic drought impacts in Europe with anthropogenic warming. Nat. Clim. Chang. (2021). https://doi.org/10.1038/s41558-021-01044-3









Europea



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Slow onset, "creeping" phenomenon

Energy

Production

- Affects all compartments of the hydrological cycle (rainfall, soil moisture, groundwater, reservoirs, river flows)
- Impacts are non-structural, spread over large areas and long time periods (direct and indirect), affect many people, and depend on the <u>exposure</u> and the <u>societal and environmental vulnerability</u>





Agriculture

Public Water

Supply



Waterborne Transport

Terrestrial & Freshwater Ecosystems



Forestry/

Wildfires



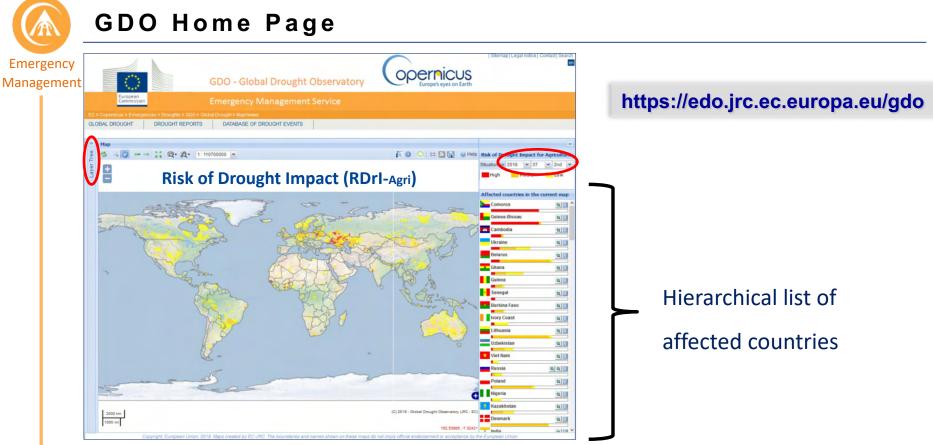
Tourism



Human Health







The risk of drought impact is evaluated based on the drought hazard, exposure and the vulnerability.

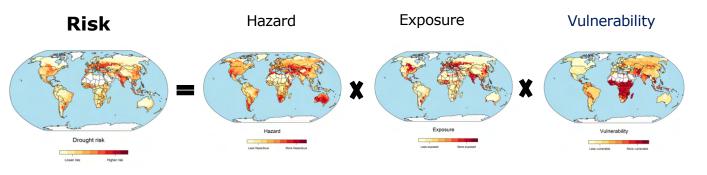
Updated every 10 days





Drought Risk Concept

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Risk or Likelihood of drought impact

Probability of a drought event with a certain severity.

Risk is sector specific!

<u>Amount</u> of population, livelihoods, assets, resources, services potentially affected. Susceptibility to suffer adverse effects

Sensitivity

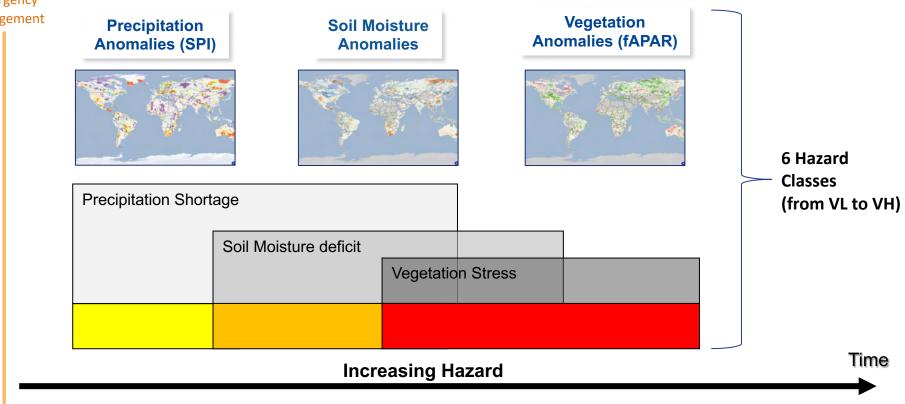
Coping Capacity





Hazard - Indicators & Conceptual Framework

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European





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Population:

Agriculture:

- Number of persons per grid, 2015, 1 km; Global Human Settlements Layer (GHSL), JRC (<u>https://ghsl.jrc.ec.europa.eu/</u>)
- Global Agricultural Lands, 2000, 10 km; Ramankutty *et al.* 2008, FAO Aquastat
- Gridded Livestock of the World, 2010, 10 km; Gilbert et al. 2018

Water Stress:

 Baseline Water Stress, 2010, sub-basin; WRI Aqueduct (total freshwater withdrawal₂₀₁₀/total renewable water resources₁₉₅₀₋₂₀₁₀)

Carrão et al., 2016, Glob. Env. Change 39, 108–124 Naumann et al., 2014, HESS 18, 1591-1604 Gilbert et al., 2018, Sci. Data 5, 180227 Ramankutty et al. 2008, Global Biogeochemical Cycles 22, GB1003





Vulnerability Indicators

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Social Factor:

Level of well-being of individuals and communities

Economic Factor:

Economic status of individuals, communities and nations

Infrastructural Factor:

Infrastructures needed to support the production of goods and sustainability of livelihoods

$$dv_i = \frac{Soc_i + Econ_i + Infr_i}{3}$$

- Rural population (% of total population), 2018; World Bank
- Refugee population (% of total population), 2018; World Bank
- Improved water source (% of rural population), 2018; World Bank
- Life expectancy at birth (years), 2018; World Bank
- Population ages 15-64 (% of total population), 2018; World Bank
- Literacy rate (% of people aged 15 and above), 2018; World Bank
- Government Effectiveness, 2013; WGI
- Disaster Prevention & Preparedness (US\$/Year/capita), 2014; OECD

Proxy Indicators at Country Level

- Agriculture (% of GDP), 2018; World Bank
- Poverty headcount ratio at \$1.90 a day (PPP) (% of total population), 2018; World Bank
- GDP per capita (current US\$), 2018; World Bank
- Energy Consumption per Capita (kg of oil equivalent/capita), 2018; World Bank

Proxy Indicators at Subnational Level

- Agricultural irrigated land (% of total agricultural land), 2014, 10km; FAO
- Percent of retained renewable water, 2010, catchment; FAO
- Global map of Accessibility (travel time to major cities), 2015, 10km; JRC

Carrão et al., 2016, Glob. Env. Change 39, 108–124 Naumann et al., 2014, HESS 18, 1591-1604





Risk Assessment

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Hazard

AZARD CLASS	CDI VALUE
0 Null	0
VL Very Low	from 1 to 2
L Low	3
M Medium	from 4 to 6
H High	from 7 to 8
VH Very High	from 9 to 10

Combinations of

- SPI-1
- SPI-3
- **SMAnomaly** •
- **fAPAR**Anomaly •



COLOR	ID	NAME	MINVAL.	MAXVAL
	α	Exceptionally Low	0	0
	XI.	Extremely Low	0	.0001
	VI.	Very Low	.0001	.001591861
	L	Low	.001591861	.01321501
	н	Medium	.01321501	.04884863
v	н	High	.04884863	.129725
	VH	Very High	.129725	.3147335
	хн	Extremely High	.3147335	1
	сн	Exceptionally High	1	1

Definition/optimization of thresholds

RISK_MATRIX ExpVul VH 0 -0 -0 -0 💌 0 w 💌 w 💌 w 💌 w 💌 w 💌 VL. • w 💌 w 💌 0 • w 💌 w 💌 Α 💌 L w w 💌 w 💌 A 💌 M Α 💌 w 💌 w 💌 w 💌 A 💌 A 💌 ε . w 💌 w 💌 A 💌 E 💌 VF A . Ε. VH: Very High - 0: Null - W: Warning - A: Alert - E: Emerger Very Low - L: Low

Risk Matrix

Weighting and Aggregation





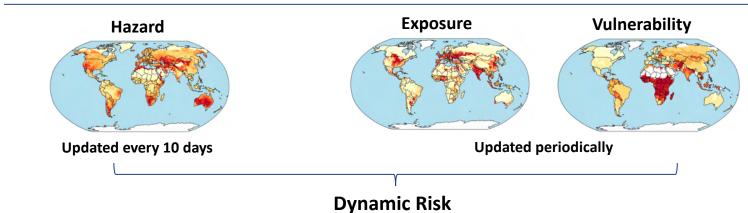


Carrão et al., 2016, Glob. Env. Change 39, 108–124 Naumann et al., 2014, HESS 18, 1591-1604



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Risk Assessment



Note: Drought risk is not an absolute measure of actual economic loss or damage, but a relative statistic suitable for ranking regions and prioritize actions.

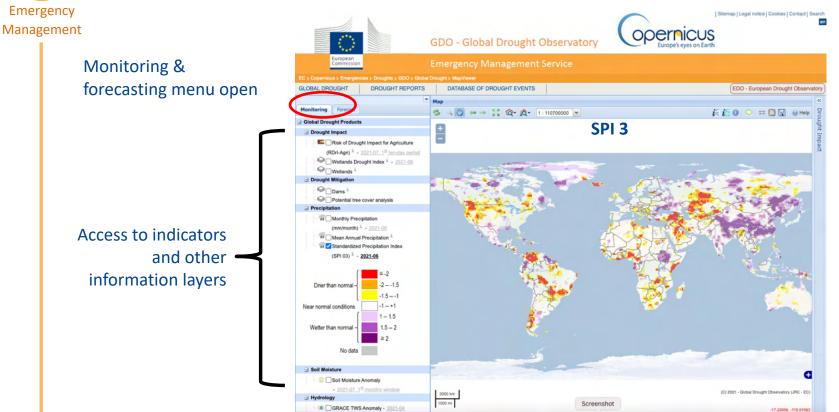
Note: While the methodology is scale-independent, the results are scale dependent (local data & relative ranking!)

Updated every 10 days





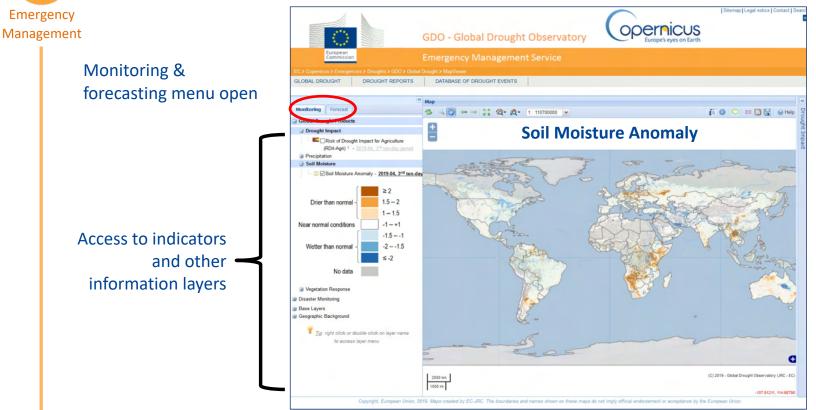
GDO Indicator Menu- Standardized Precipitation Index







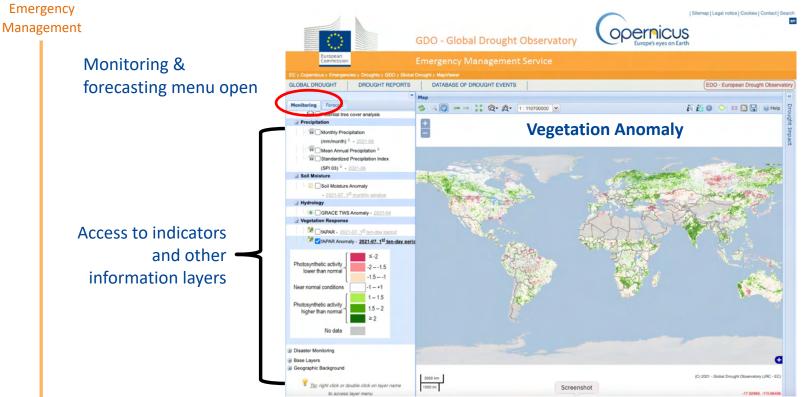
GDO Indicator Menu- Soil Moisture Anomaly







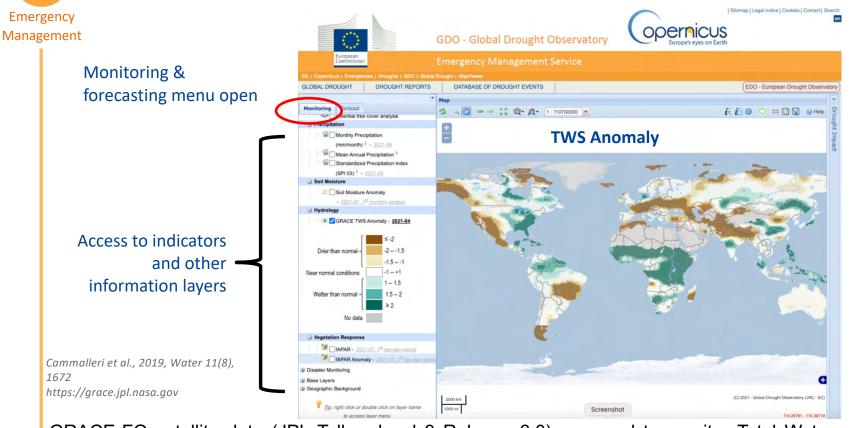
GDO Indicator Menu- Vegetation Anomaly







GDO Indicator Menu- Total Water Storage Anomaly



GRACE-FO satellite data (JPL Tellus, level 3 Release 6.0) are used to monitor Total Water Storage (TWS), as proxy of long-term (groundwater) drought.

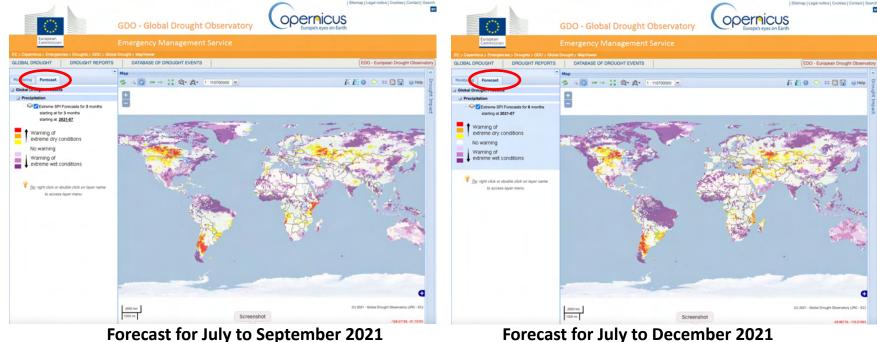
European

GDO Early Warning of Extreme Wet/Dry Conditions

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- 1-month to 6-months lead time (i.e. SPI1, SPI3 and SPI6)
- Derived from Seasonal S5 model of ECMWF





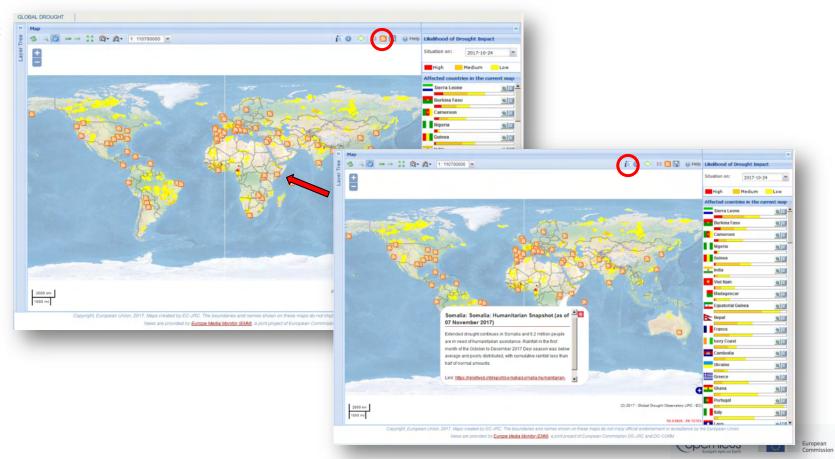
Warning levels increase with the intensity (median) and the coherency (spread) of the ensemble forecast





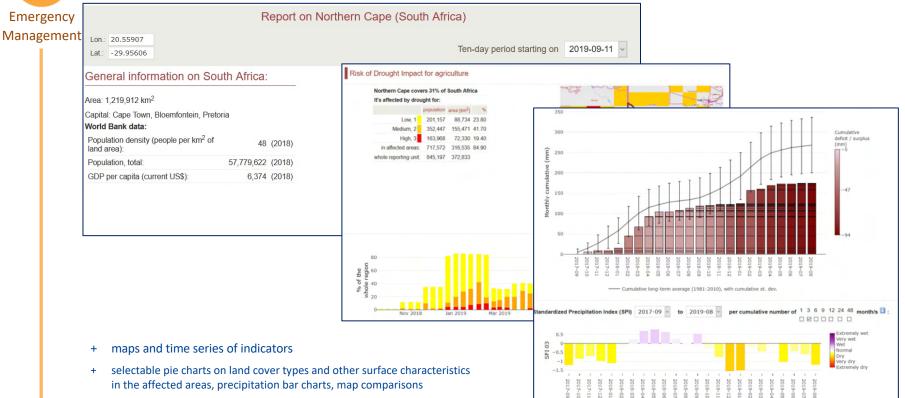
Geo-located News

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Automatic Report Generation



+ download of data and ad-hoc draft reports

 \rightarrow Targets the ERCC duty officers and the ERCC Analytical Team





Analytical Reports and Outreach

Emergency Management

BC Global	t in India – December : Grought Generators (600) :	ID18 of ENCE Analytical Ison	1012/2014 GP	ernous	
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		subject to	period	Executive summary A drought is unliding over the Greater Form of Africa, specifically tienya, southers Somalia	
		Global Dec	Risk of	Uganda and southern Uthiopia. Despite cumulated precipitation not being lower than th disastic normal in the last year over most locations, the last trinsenter was slightly drive that sound, triggering concerns for the incoming meeths.	
			account it the aprice	· indeed, the precipitation forecasts for the next few months are very negative and robust	
			For mid-h women Se	and April is particular, which is a key month for yearly-water balance, hence supporting th growing concerns for fixed security and the release of early summing. • Benjuits must exports focusing on the other coantries of the Hors of Abrics, Ugandia show	
				the worst combination of drought indicators among all countries involved, so there chance that the drought impacts are going underreported there. Nonetheless, the 3-month	
			* temps (Dente	outlook suggests a late recovery, followed by wetter conditions over the 5-months outlook	
			Global Dec	Geographical context Must of the Youn of Milos has a hot and dry climate, particularly in the northern and water parts and the lealands, with sparse regulation, while pencipitations are concentrated modify the mountainous areas. Next population preshy depends on the seasonal rainfalls from April 1	
			1000	June and from September to December. Droughts are common.	
				The population in the Horn is networkly subsectible, due to powerty and political instability, with \$1 million people severely free insecure? A real amount of inhabitants is highly dependent a substance agriculture, thus enhancing the risks related to a failed harvest. The heavy related	
				They are an a substantial strength to a free of all to get	UNCCD
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GDACS

Global Disaster Alert and Coordination System www.gdacs.org







Analytical Reports

Emergency 2019 Management

- Southern Angola (10-2019)
- South-East Australia (10-2019)
- Central America (09-2019)
- Southern Africa (08-2019)
- Europe (08-2019)
- Mainland South-East Asia (07-2019)
- **Sudan** (06-2019)
- South Sudan (06-2019)
- India (06-2019)
- Greater Horn of Africa (04-2019)
- Southern Africa (03-2019)
- Central America & Caribbean (03-2019)
- Southern Africa (01-2019)

2020/2021

- Europe (09-2020)
- Mainland_Southeast_Asia (08-2020)
- Mozambique_and_neighbours (07-2020)
- Europe (06-2020)
- Great_Chaco_and_Paraguay_basin (04-2020)
- Mainland_Southeast_Asia (03-2020)
- Zimbabwe_Zambia_Mozambique (02-2020)
- Brazil (06-2021)
- Iran_Afghanistan_Turkmenistan_Uzbekistan_
 Pakistan (05-2021)
- Syria_Iraq (04-2021)
- Angola (03-2021)
- Turkey (02-2021)
- Madagascar (01-2021)



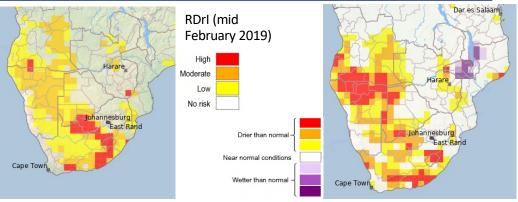


Case Southern Africa, 2018-2019

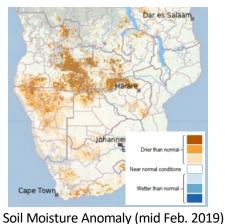
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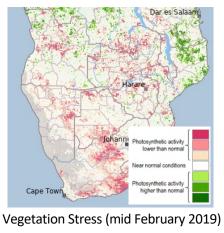
Event features and context

- Multiyear drought
- High precipitation seasonality
- Low-income subsistence agriculture
- Political economic instability
- Chronic malnutrition
- Heavy reliance on hydropower



SPI-9 (June 2018 to February 2019)





Impacts

- Delayed sowing, reduced yields and livestock famine
- Widespread food insecurity, worsening of chronic malnutrition
- Local conflicts amongst communities for water access (and with wildlife too)
- Rise of grain and animal feed prices
- Depleted reservoirs, intermittent water supply
- Lack of clean water (risk of diseases)



GDO reports at: https://edo.jrc.ec.europa.eu/gdo/php/index.php?id=2050



Emergency

- Management Higher resolution meteorological data
 - Exposure and vulnerability data of high quality and spatial resolution
 - Selection and weighting of vulnerability indicators (better understand the drivers of vulnerability)
 - Availability of standardized Impact data (Inclusion of an impact database)
 - Adding additional sectors (e.g., public water supply, energy production)
 - Link to (sub-)continental systems (e.g., US Drought Monitor, South Asian Drought Monitor)
 - Transfer regionally adapted systems (e.g. ICPAC)
 - Integration with other natural hazards (multi-hazard alert systems) and analysis of systemic risks
 - Based on past trends and future projections analyze adaptation options





Thank You!

https://edo.jrc.ec.europa.eu/gdo

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> European Commission Joint Research Centre http://jrc.ec.europa.eu/

