



Geospatial Tools for Climate Risks in Jordan: Progress and Actions Needed

Prof. Jawad Al-Bakri

jbakri@ju.edu.jo

Department of Land, Water and Environment

School of Agriculture



The University of Jordan

Contents

1. Introduction: Climate Risks in Jordan.
2. Need for geospatial data
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4. Actions needed.

1. Introduction

1. Climate Risks in Jordan are high. Increased air temperature, decrease in rainfall, increase in heat waves and drought.
2. Reflections: water and food insecurity accelerated by degraded soil health

Journal of Geophysical Research: Atmospheres

RESEARCH ARTICLE
10.1002/2015JD023929

Spatiotemporal drought variability in the Mediterranean over the last 900 years

Benjamin I. Cook^{1,2}, Kevin J. Anchukaitis^{3,4,5}, Ramzi Touchan⁴, David M. Meko⁴, and Edward R. Cook⁵

Key Points:

- There is large multidecadal drought variability across the Mediterranean over the last 900 years
- Droughts tend to be zonally symmetric, but there is strong north-south antiphasing in eastern basin
- There is an 89%/98% likelihood that the recent Levant drought is the worst of the last 900/500 years

Correspondence to:
B. I. Cook,
benjamin.i.cook@nasa.gov

Citation:
Cook, B. I., K. J. Anchukaitis, R. Touchan,

¹NASA Goddard Institute for Space Studies, New York, New York, USA, ²Ocean and Climate Physics, Lamont-Doherty Earth Observatory, Palisades, New York, USA, ³School of Geography and Development, University of Arizona, Tucson, Arizona, USA, ⁴Laboratory of Tree-Ring Research, University of Arizona, Tucson, Arizona, USA, ⁵Tree Ring Laboratory, Lamont-Doherty Earth Observatory, Palisades, New York, USA

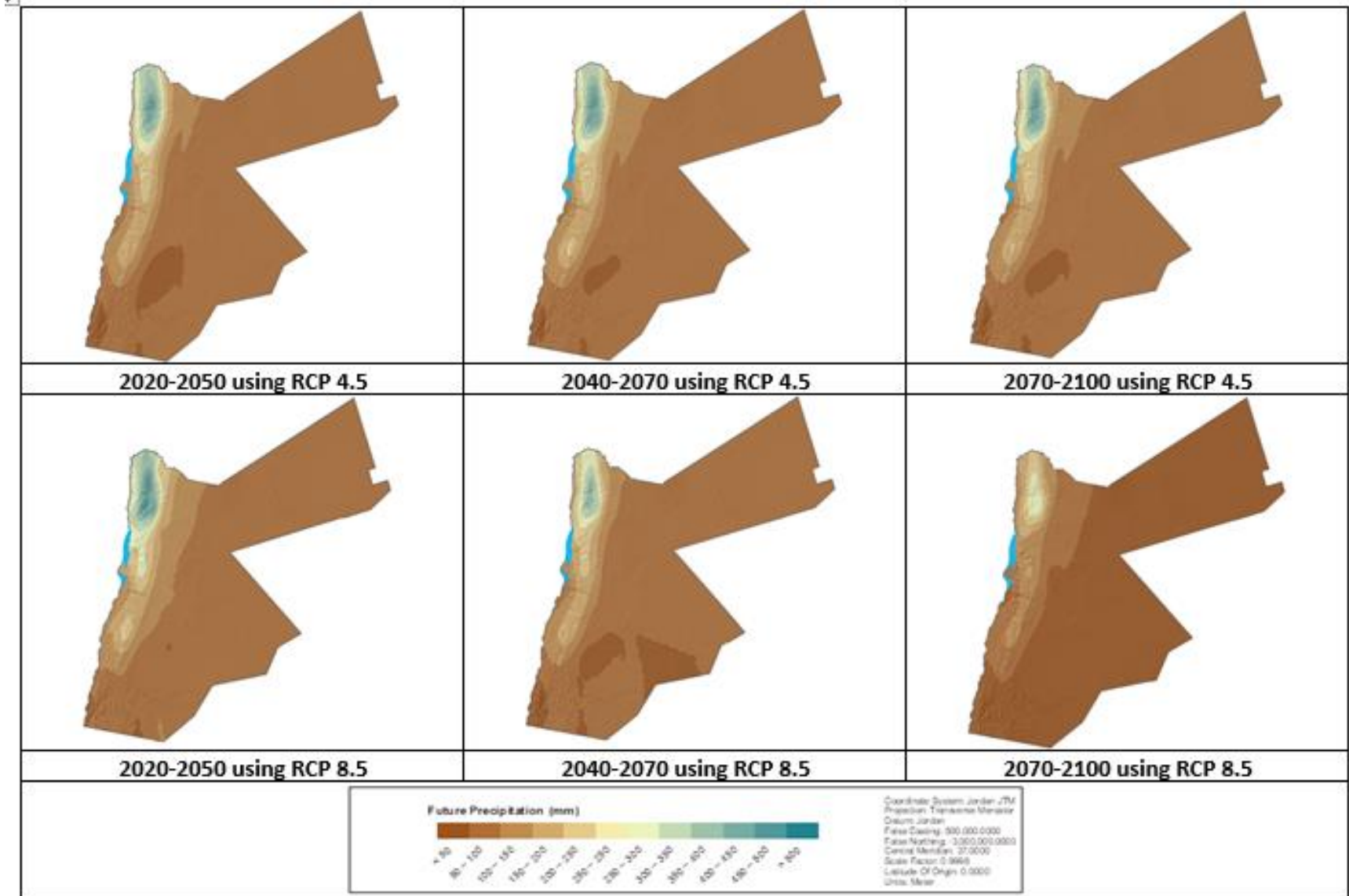
Abstract Recent Mediterranean droughts have highlighted concerns that climate change may be contributing to observed drying trends, but natural climate variability in the region is still poorly understood. We analyze 900 years (1100–2012) of Mediterranean drought variability in the Old World Drought Atlas (OWDA), a spatiotemporal tree ring reconstruction of the June–July–August self-calibrating Palmer Drought Severity Index. In the Mediterranean, the OWDA is highly correlated with spring precipitation (April–June), the North Atlantic Oscillation (January–April), the Scandinavian Pattern (January–March), and the East Atlantic Pattern (April–June). Drought variability displays significant



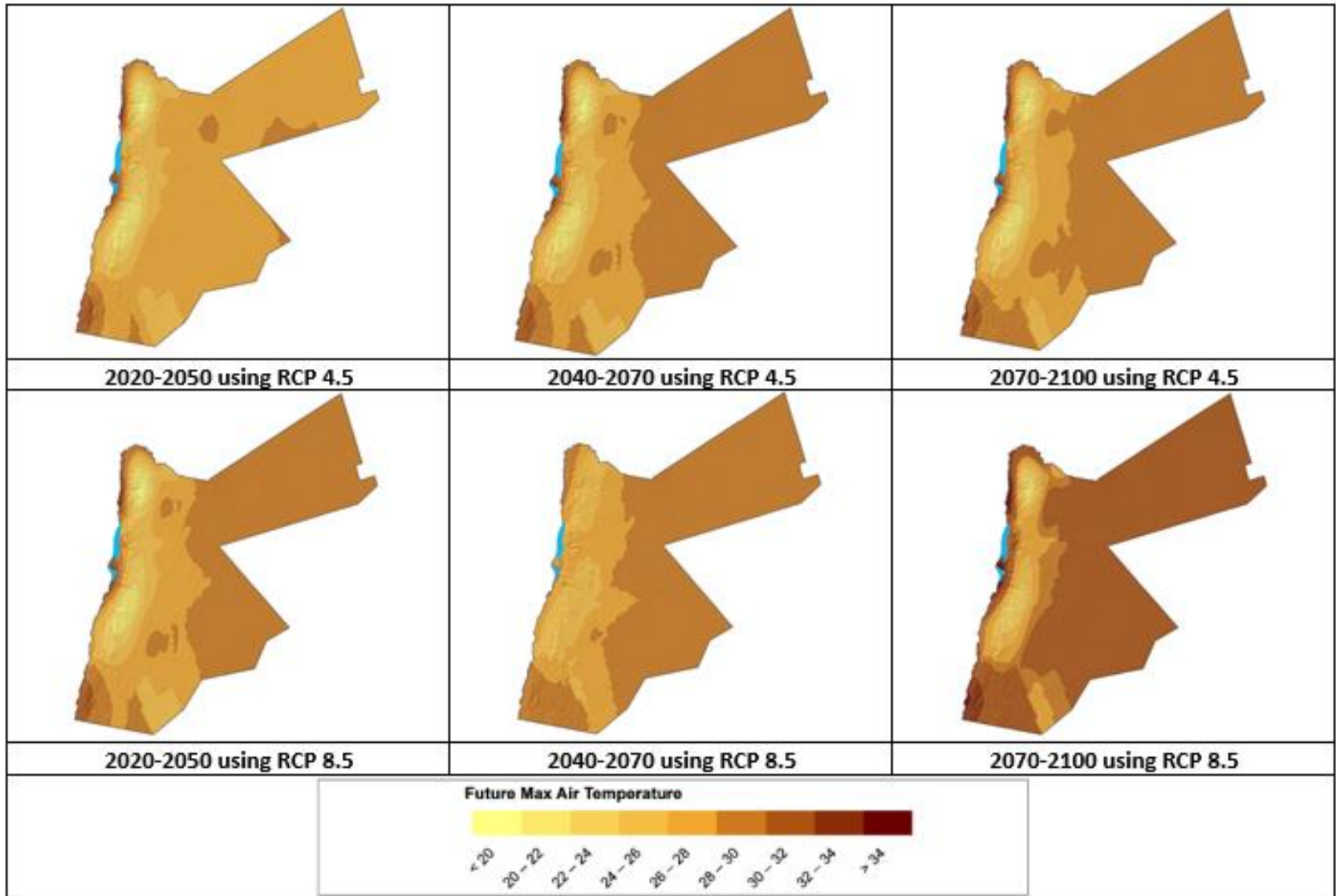
1998-2012 is the driest period during the last 900 years

Climate Projections: Precipitation

Precipitation decrease by 15.8 to 47.0% by 2100



Climate Projections: Air Temp. ↑↑↑

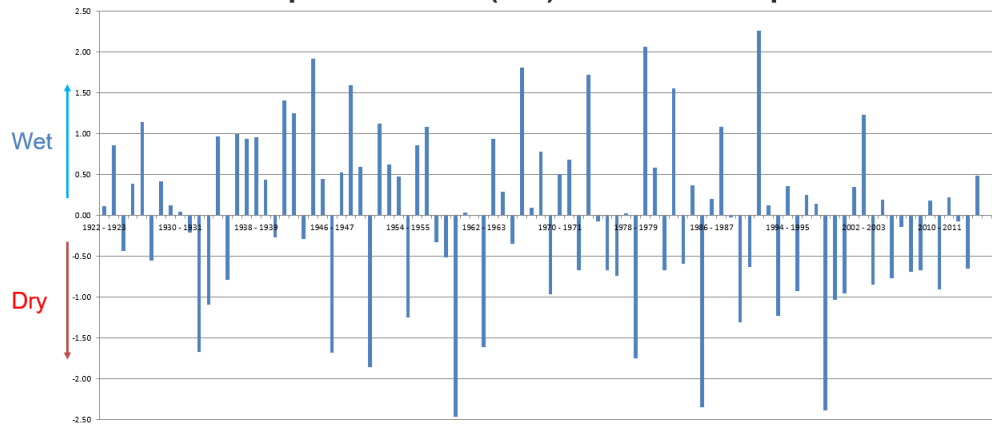


Tmin increase by +1.2 to 2.7 °C by 2070.

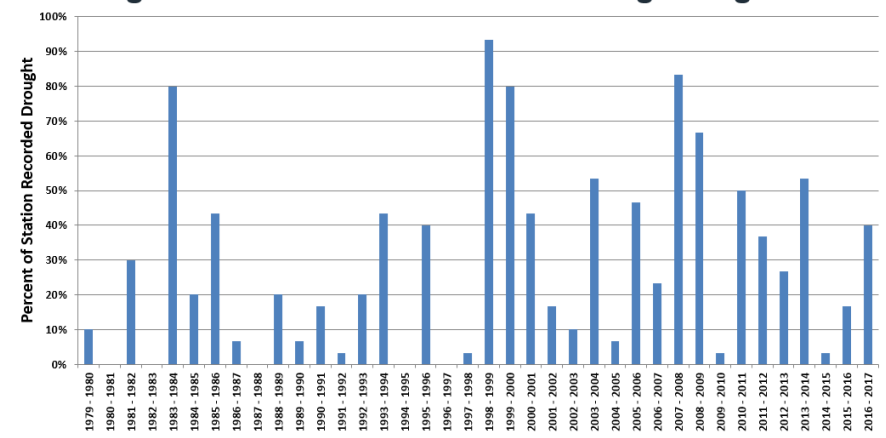
Tmax increase by +1.1 to 3.1 °C by 2070

How does it look in Jordan

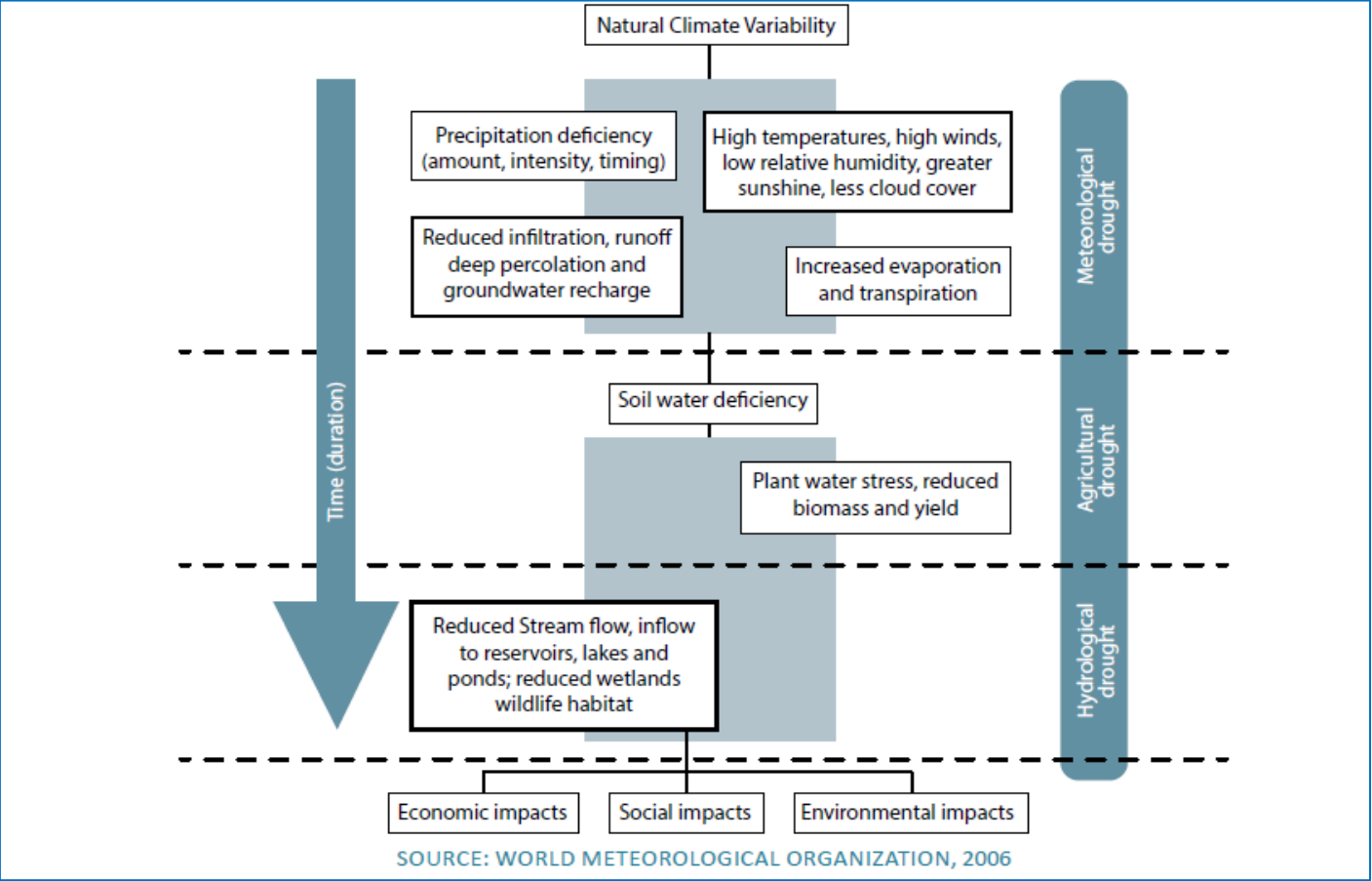
Standard Precipitation Index (SPI) for Amman Airport 1922-2017



Drought in Jordan: % stations recording drought



Risks arising from drought



Need for geospatial data

- Access to the latest data and information on climate hazards and vulnerable people is important for actions and response.

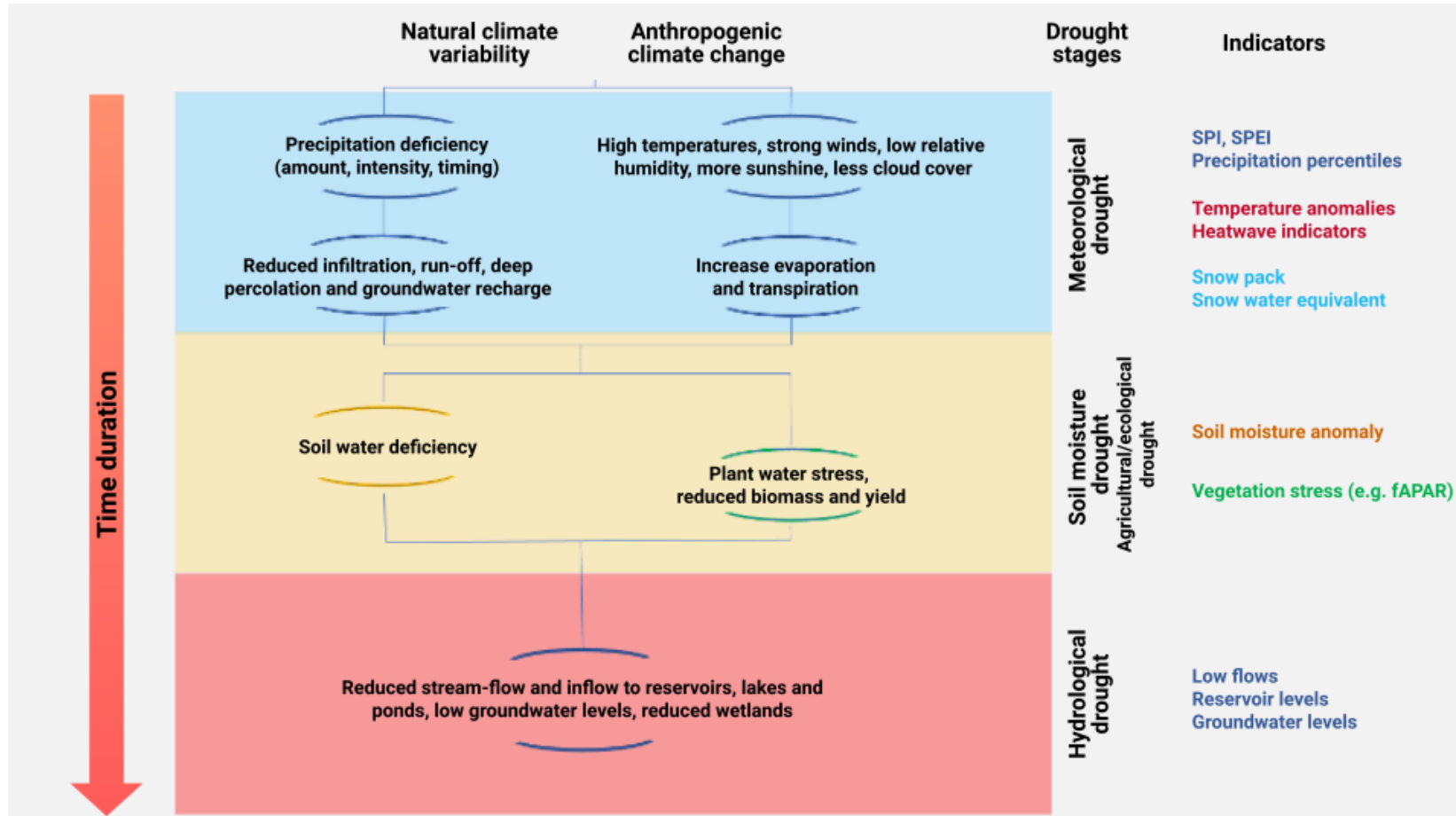
Barriers

- Poor access to ground data with good spatial distribution.
- Time and cost needed for data processing.

Solutions:

- Open-source data (EOS), platforms with functional dashboard.
- (Examples presented: PRISM, WaPOR and SIS)

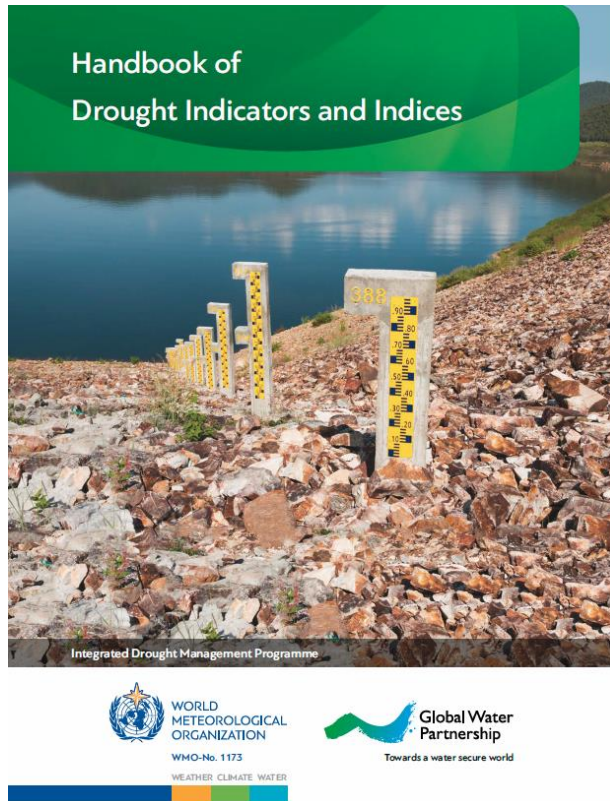
Remember: different risks and different sectors means different indicators



Source:
 UNDRR, 2021. Special Report on Drought 2021, Global Assessment Report on Disaster Risk Reduction.

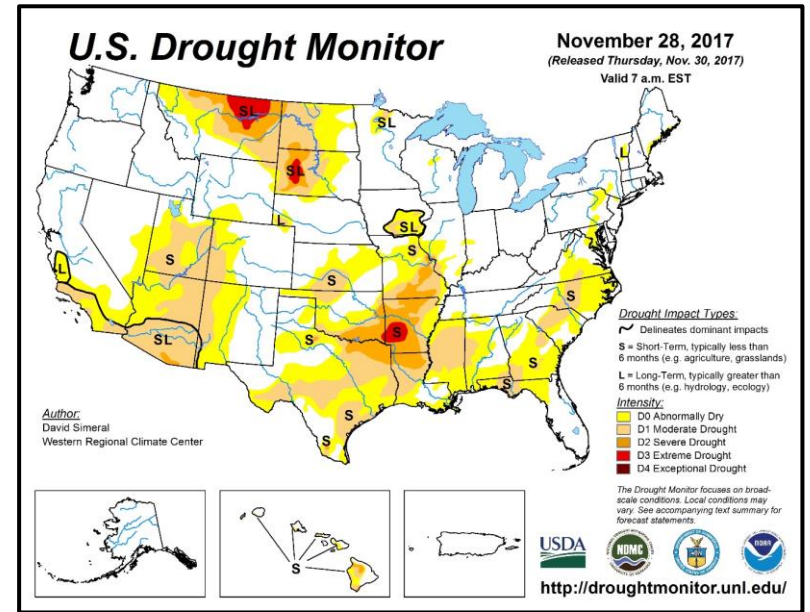
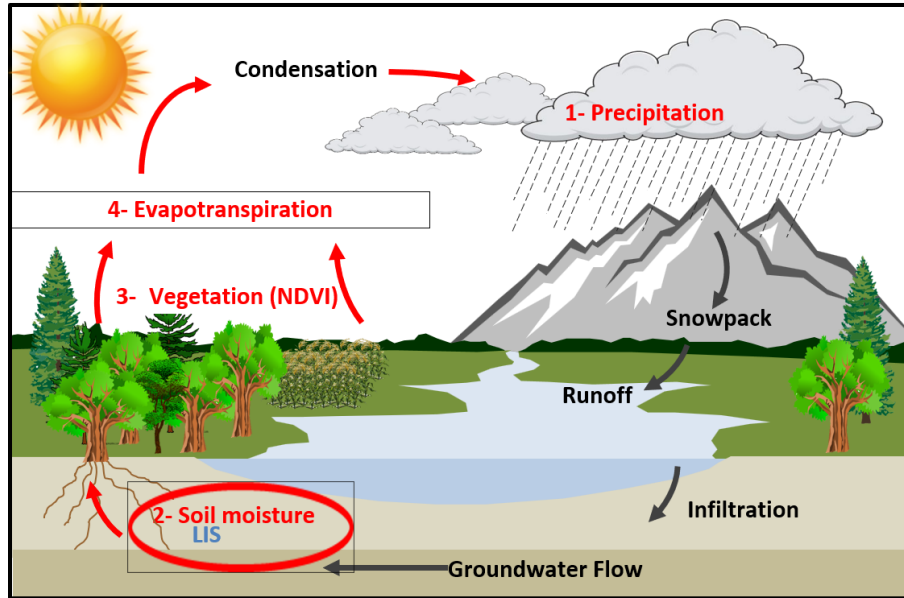
3. Examples on dashboards for drought, water and soils.

3.1. Drought



- **Availability of Data**, historical, present and future
- **Real-Time**, or even forecasted
- **Scale**, temporal and spatial scales
- **Representation** for different types of droughts
- **Accuracy**, for regional and local scales
- **Cost**, no software requirement, minimum user effort

Combined Drought Index (CDI)





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Article | [Open access](#) | Published: 05 March 2024

Development of a composite drought indicator for operational drought monitoring in the MENA region

[Karim Bergaoui](#) , [Makram Belhaj Fraj](#), [Stephen Fragaszy](#) , [Ali Ghanim](#), [Omar Hamadin](#), [Emad Al-Karablieh](#), [Jawad Al-Bakri](#), [Mona Fakhri](#), [Abbas Fayad](#), [Fadi Comair](#), [Mohamed Yesssef](#), [Hayat Ben Mansour](#), [Haythem Belgrissi](#), [Kristi Arsenault](#), [Christa Peters-Lidard](#), [Sujay Kumar](#), [Abheera Hazra](#), [Wanshu Nie](#), [Michael Hayes](#), [Mark Svoboda](#) & [Rachael McDonnell](#)

[Scientific Reports](#) 14, Article number: 5414 (2024) | [Cite this article](#)



Risk analysis efforts PRISM-Platform for Realtime Impact and Situation Monitoring

OBJECTIVES



Reduce barriers to access information on climate hazards



Facilitate rapid risk and impact analysis by combining hazard, vulnerability and exposure information in a single system



Augment satellite data with information from the field from ground sensors and mobile devices

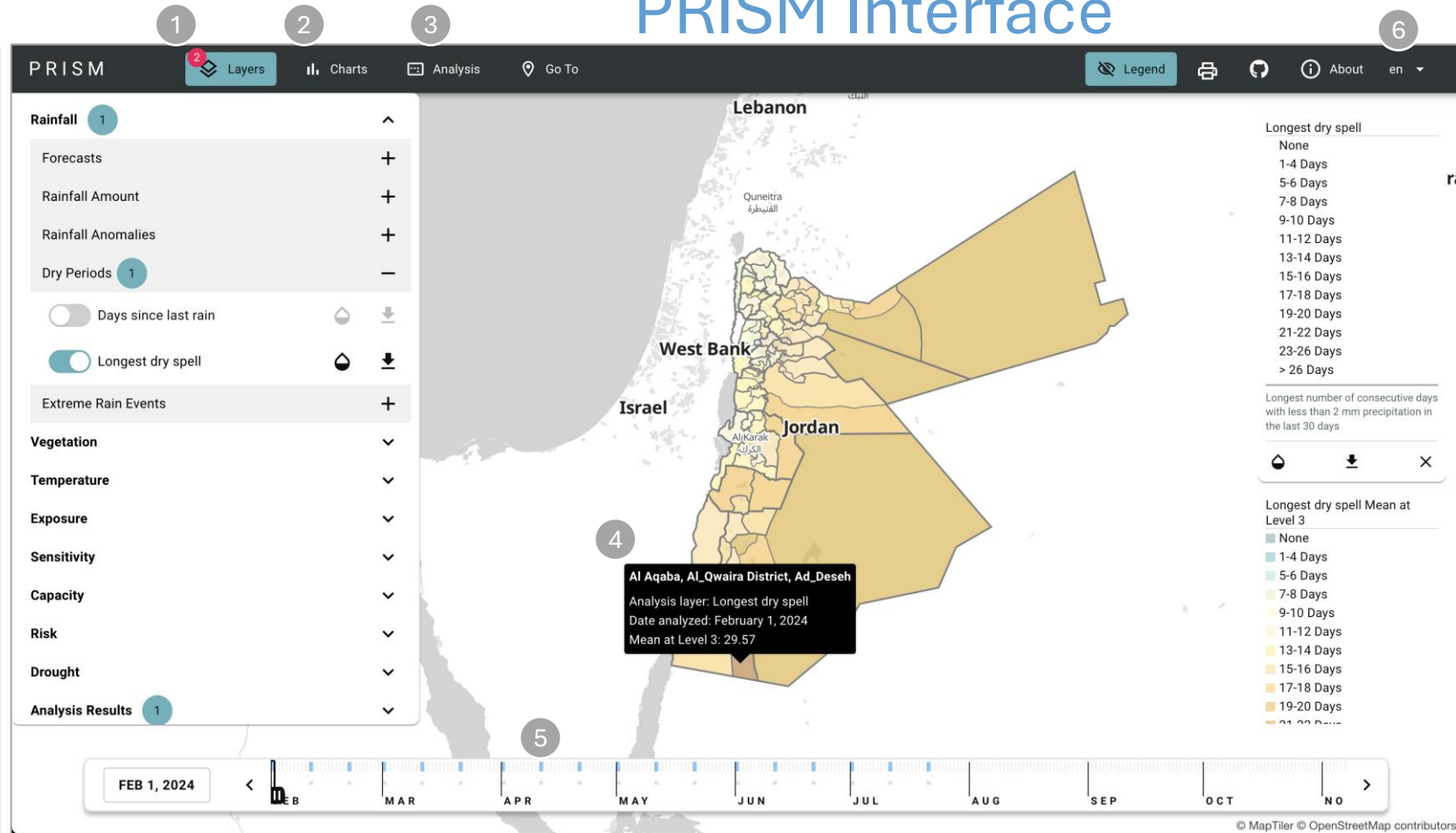


Enable national and local ownership through easy to configure technology

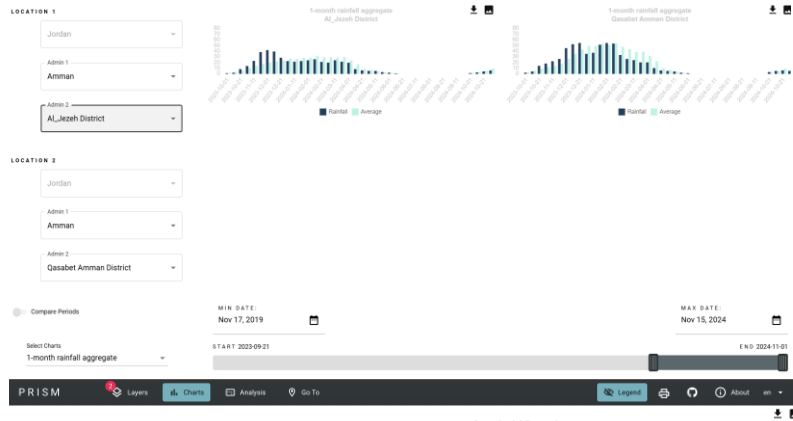
PRISM Interface

Key Features

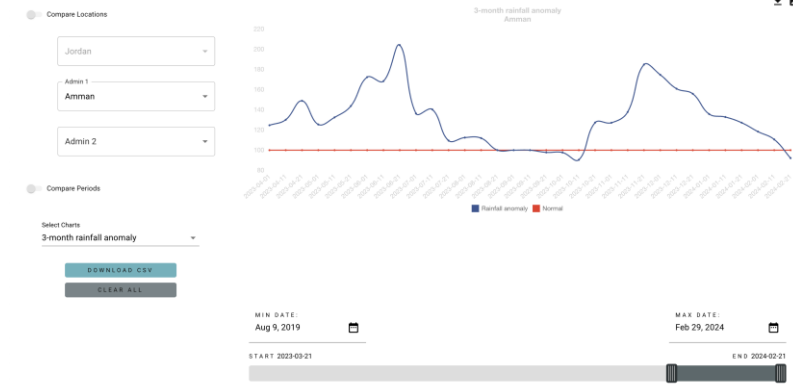
1. Data layers are configured with government and key stakeholders
2. Charting feature shows trends of selected indicators over time
3. Users can perform spatial analysis that combines hazards, vulnerability, and exposure
4. Detailed data at the administrative level is available for each hazard, vulnerability and exposure layer
5. A timeline-based navigation allows users to view climate hazards over time
6. The user-interface can be translated into local languages



Comparison between locations and times



Trend Analysis



RAINFALL AMOUNT

- 10-day rainfall estimate (mm) 📊
- 1-month rainfall aggregate 📊
- 3-month rainfall aggregate (mm) 📊
- 6-month rainfall aggregate (mm) 📊
- 9-month rainfall aggregate (mm) 📊
- 1-year rainfall aggregate (mm) 📊

RAINFALL ANOMALIES

- 10-day rainfall anomaly 📊
- Monthly rainfall anomaly 📊
- 3-month rainfall anomaly 📊
- 6-month rainfall anomaly 📊
- 9-month rainfall anomaly 📊
- 1-year rainfall anomaly 📊
- SPI - 1-month 📊
- SPI - 3-month 📊
- SPI - 6-month 📊
- SPI - 9-month 📊
- SPI - 1-year 📊

EXTREME RAIN EVENTS

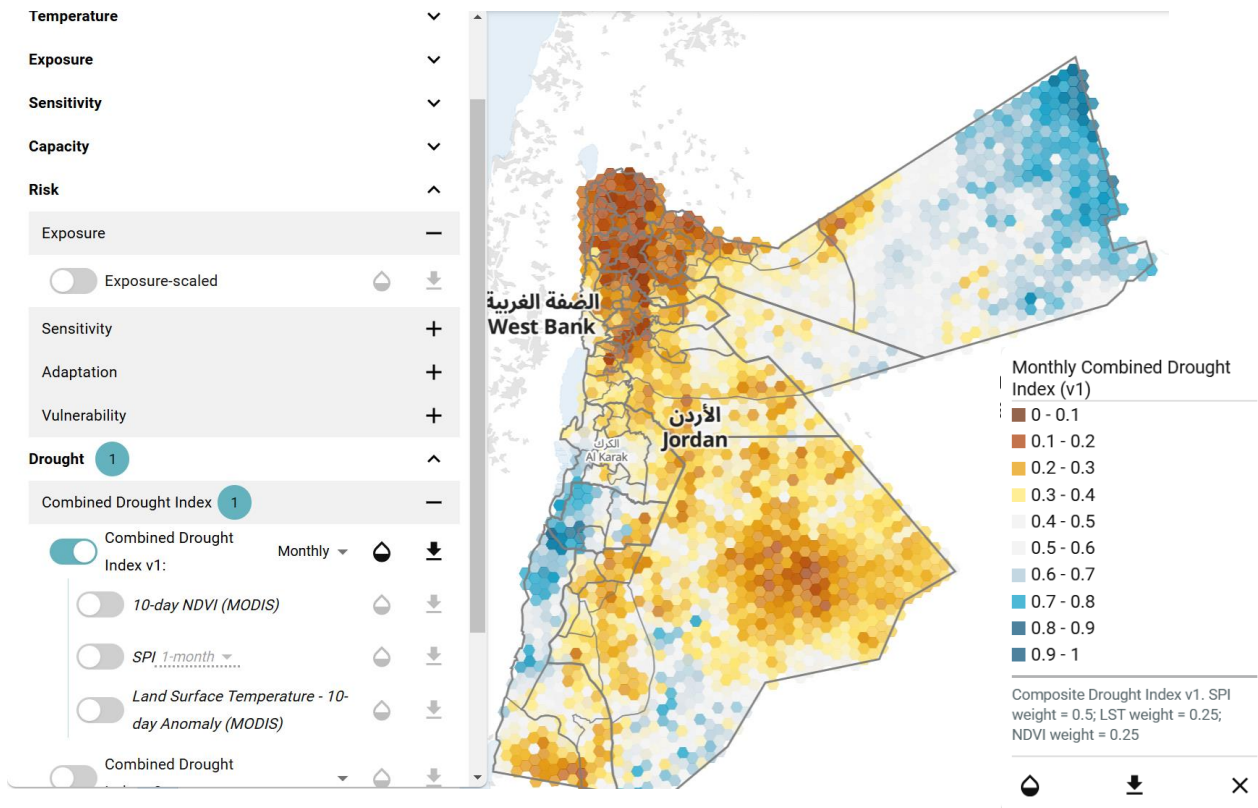
- Number of days with heavy rainfall in the last 30 days 📊
- Number of days with intense rainfall in the last 30 days 📊
- Number of days with extreme rainfall in the last 30 days 📊
- Longest consecutive heavy rainfall days 📊
- Longest consecutive intense rainfall days 📊
- Longest consecutive extreme rainfall days 📊

VEGETATION CONDITIONS

- 10-day NDVI (MODIS) 📊
- 10-day NDVI anomaly (MODIS) 📊

LAND SURFACE TEMPERATURE

- Daytime Land Surface Temperature - 10-day (MODIS) 📊
- Nighttime Land Surface Temperature - 10-day (MODIS) 📊
- Land Surface Temperature - 10-day Anomaly (MODIS) 📊
- Land Surface Temperature - 10-day Amplitude (MODIS) 📊



Supports different languages

PRISM الطبقات المخططات

- هطول الأمطار ✓
- الغطاء النباتي ✓
- درجة الحرارة ✓
- التعرض ✓
- الحساسية ✓
- السعة ✓
- مخاطرة ^
- التعرض -
- مقياس التعرض
- الحساسية +
- التكيف +
- وهن +
- الجفاف 1 ✓

PRISM: Dashboard for climate risk and impact analysis

PRISM الطيفات المسطحات التحليل اذهب إلى عنوان تفسيري حوّل عربي

هطول الأمطار
الغطاء النباتي
درجة الحرارة
التعرض
الحساسية
السعة
مخاطرة 1
التعرض 1
مقياس التعرض
الحساسية
التكيف
وهن
الجفاف
مؤشر الجفاف المشترك

Consolidate and integrate data on vulnerability with hazard to provide risk maps

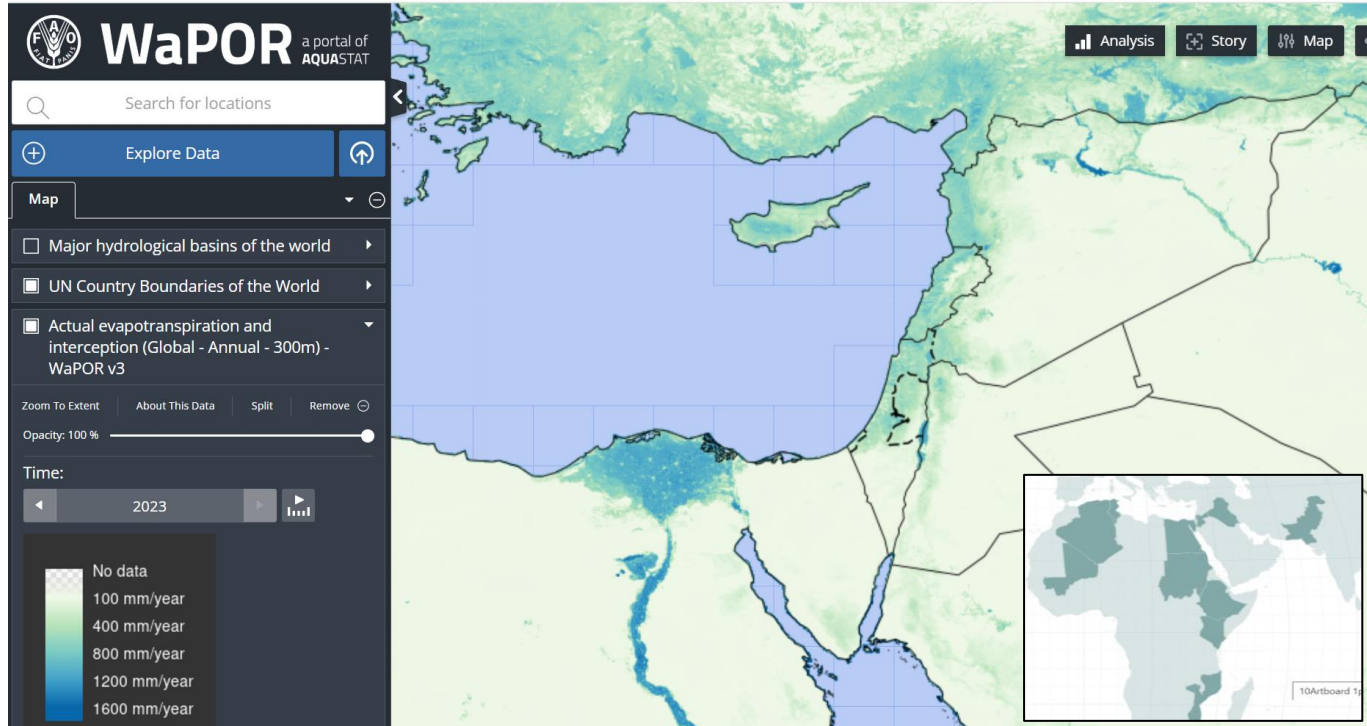
Translatable user interface for local languages

مقياس التعرض
تعرض منخفض
تعرض معتدل
تعرض مرتفع
تعرض شديد
الزراعة والديورغرافيا

Lebanon
الأردن
Jordan

Hazard
Exposure
Vulnerability
Risk / Impact

Example 2- WATER Productivity through Open-access of Remotely sensed derived data



WaPOR OBJECTIVES

- Monitoring water productivity,
- Identifying gaps and propose solutions,
- Contributing to a sustainable increase of agricultural production and food security.

<https://data.apps.fao.org/>

Data

- Rainfall
- ET
- Biomass
- Water Productivity
- Soil Moisture
- Spatial:
 - 250, 100 and 30 m
- Temporal:
 - 10 days, monthly, annual
- Access:
 - FAO
 - Google Earth Map
 - QGIS

The image shows a screenshot of the WaPOR v3 web application interface. The interface is divided into several sections:

- Left Panel (Dark Theme):** Contains the WaPOR logo, a search bar for locations, and a list of data layers. The selected layer is "Actual evapotranspiration and interception (Global - Annual - 300m) - WaPOR v3". Below the layer list, there are controls for "Zoom To Extent", "About This Data", "Split", and "Remove". A "Time" slider is set to 2023. A legend for the selected layer shows a color scale from "No data" (white) to "1600 mm/year" (dark blue).
- Top Panel (Blue Theme):** Contains navigation tabs for "WaPOR v3", "WaPOR v2", "Tools", "Base Layers", "External Datasource", "AQUAMAPS", "Hand-in-Hand", and "My Data".
- Center Panel (Light Theme):** A search bar "Search the catalogue" is at the top. Below it, a tree view shows the hierarchy: "Global" > "National" > "Sub-National" > "Jafr-Shoubak". Under "Jafr-Shoubak", several datasets are listed, including "Actual evapotranspiration and interception (Shoubak and Jafr, Jordan - Annual - 20m) - WaPOR v3" and "Evaporation (Shoubak and Jafr, Jordan - Annual - 20m)".
- Right Panel (Light Theme):** Displays the metadata for the selected dataset. It includes a "National" header, a "Description" section, a "Organization" section (FAO Water Productivity Open-access portal (WaPOR)), a logo, a "Metadata Link" (<https://data.apps.fao.org/catalog/dataset/wapor-v-3-national>), and a "Remote Config Group URL" (<https://storage.googleapis.com/fao-maps-catalog-mirror/ckan/terriajs/6529d22f-3780-4062-966d-729993>).



The PRIMA programme is supported under Horizon 2020, the European Union's Framework Programme for Research and Innovation.



Example 3: Soil and land information platform in the MR

- Most of the MR countries have old soil maps and surveys
- Using different classification systems and nomenclature that is not easy to understand for a non-specialist
- Different analysis methods
- Scales and details vary

soils4med

Advice and Outreach Committee

JRC (Joint Research Center) of the European Commission

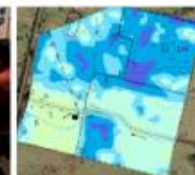
FAO-GSP – Global Soil Partnership

ISRIC – World Soil Information

Conscious Planet – Save Soil



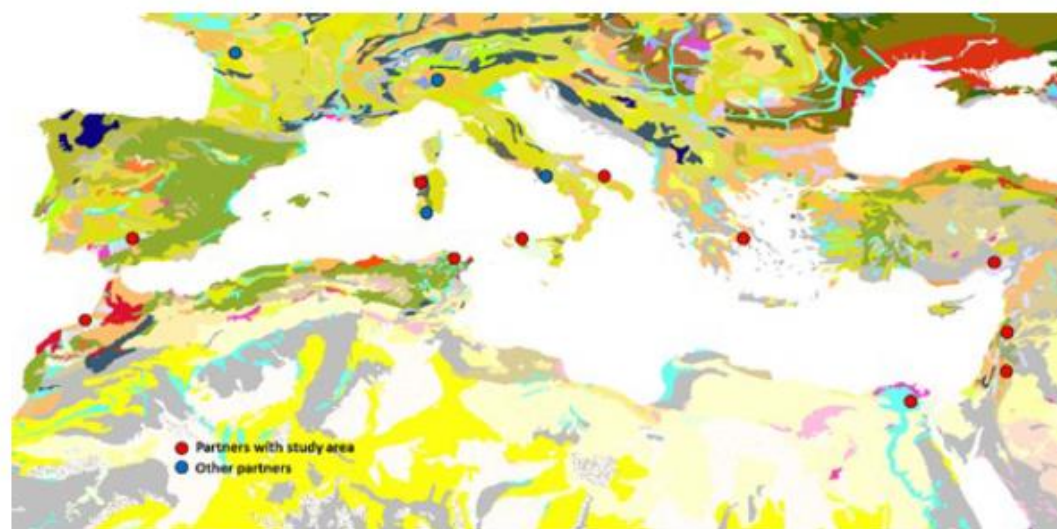
Standardized monitoring protocols and soil information systems



Contacts

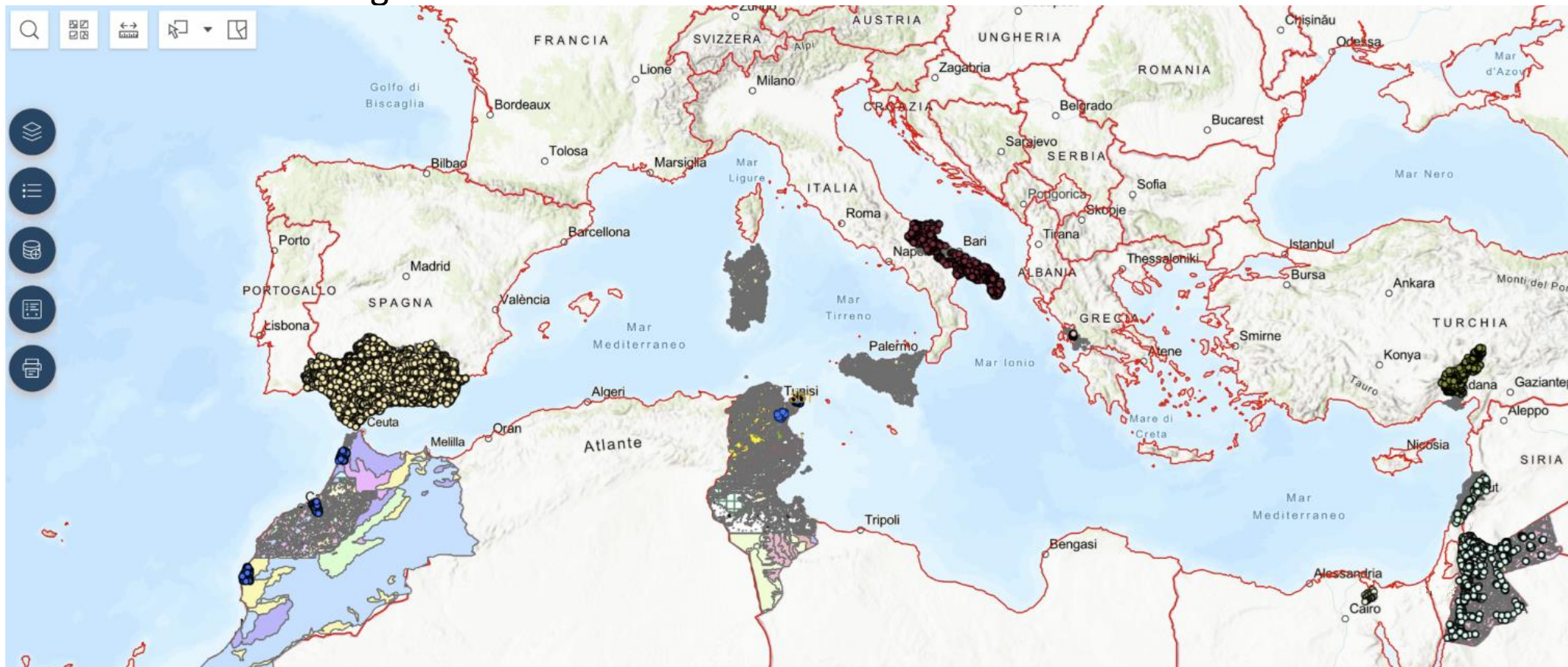
SOILS4MED Project at UNISS:
smsl@uniss.it, clzucca@uniss.it

Viale Italia 39, 07100 Sassari, Italy



Objectives and activities

- Collect soil data and maps and standardize classification systems.
- Updating soil data and developing soil health indicators (SHI).
- Create an updated SIS database and Living Labs (LL) to disseminate data and knowledge



Next steps

- An enhanced version of the PRISM platform.
- Launch of the Mediterranean Soils Platform (2026)
- Activate and improve water management platforms
- Establishing a climate change platform within the executive program of the economic modernization vision.



المبادرة	2023	2024	2025	الجهة المسؤولة
حماية التنوع الحيوي والموائل الطبيعية والحفاظ عليها	إنشاء منصة بحثية وطنية حول التغير المناخي والنفايات والنقل والطاقة والتنوع الحيوي			وزارة التعليم العالي والبحث العلمي

أهداف التنمية المستدامة



يكن المرأة أثر غير مباشر

Actions and opportunities (What is next)

Research and Academia (MENA and MR)

- Assessment of data and impacts (Accuracy, integration...etc.)
- Regional networking at Mediterranean level for exchange of ground data, results, methods, development of dashboards...
- Improvement of data and EOS data processing (AI, ML, PY scripts..etc.)
- Integration of climate risks in educational curricula (Climate change, green skills, disaster risk reduction, water accounting, WEFE nexus...etc.)
- ??

Examples on research

Earth Systems and Environment (2021) 5:561–573
<https://doi.org/10.1007/s41748-021-00245-2>

ORIGINAL ARTICLE

Evaluation of Remotely Sensed Precipitation Estimates from the NASA POWER Project for Drought Detection Over Jordan

Muhammad Rasool Al-Kilani¹ · Michel Rahbeh¹ · Jawad Al-Bakri¹ · Tsegaye Tadesse² · Cody Knutson²

Received: 22 February 2021 / Revised: 1 July 2021 / Accepted: 2 July 2021 / Published online: 12 July 2021
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Earth Systems and Environment (2021) 5:751–766
<https://doi.org/10.1007/s41748-021-00238-1>

ORIGINAL ARTICLE

Assessment of Climate Changes and Their Impact on Barley Yield in Mediterranean Environment Using NEX-GDDP Downscaled GCMs and DSSAT

Jawad Al-Bakri¹ · Ibrahim Farhan² · Mohammed Al-Qinna³ · Emad Al-Karablieh¹ · Karim Bergouli⁴ · Rachael McDonnell⁵

Environ Monit Assess (2024) 196:879
<https://doi.org/10.1007/s10661-024-13061-8>

RESEARCH

Assessment of meteorological drought impacts on rainfed agriculture using remote sensing–derived biomass productivity

Muhammad Rasool Al-Kilani¹ · Jawad Al-Bakri¹ · Michel Rahbeh¹ · Qasem Abdelal¹ · Seleshi Yalew¹ · Marloes Mul¹





ELSEVIER

Science of The Total Environment

Volume 952, 20 November 2024, 176010



The heat-mortality association in Jordan: Effect modification by greenness, population density and urbanization level

L. Luque-García^{a,b,c}, S. Bataineh^d, J. Al-Bakri^e, F.A. Abdulla^d, W.K. Al-Delaimy^f  

Actions (What is next)

Institutional and decision making

- Mainstreaming of risks in planning of affected sectors
- Capacity building in MENA countries
- Guidelines for assessment of impacts (post disaster)
- Plans for recovery and adaptation at sectoral levels (Water, agriculture, environment, health)



Thank you for listening

