Consultative Meeting on the Environmental Dimension of the Sustainable Development Agenda:
"Solutions and Action for SDGs implementation amid the triple planetary crisis"

The Use of Satellite Imageries for the Assessment of Climate Associated Risks

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UN House- Beirut; 2 March 2023,

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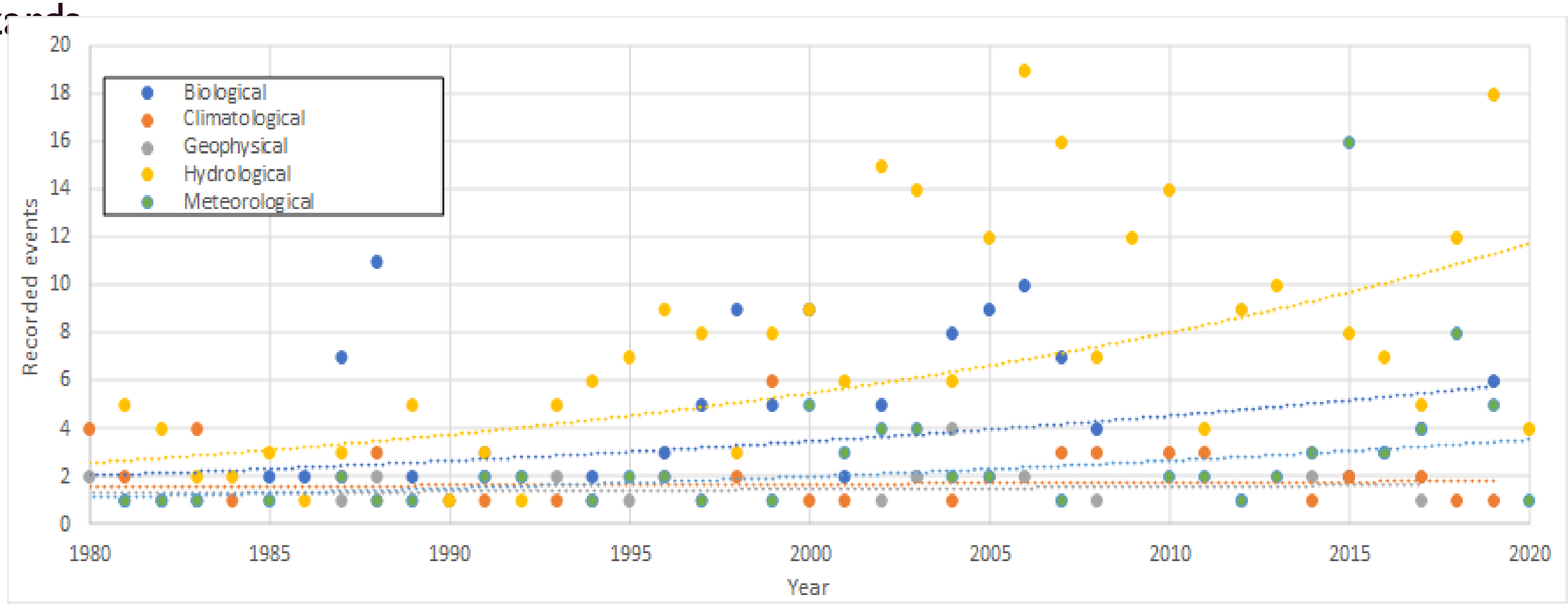
PREVAILING HAZARDS

The Arab Region is prone to natural haz...

- Floods
- Landslides
- Earthquakes
- Tsunamis
- Sand and dust storms
- Droughts
- Wildfires
- Tropical cyclones
- Volcanic Eruption



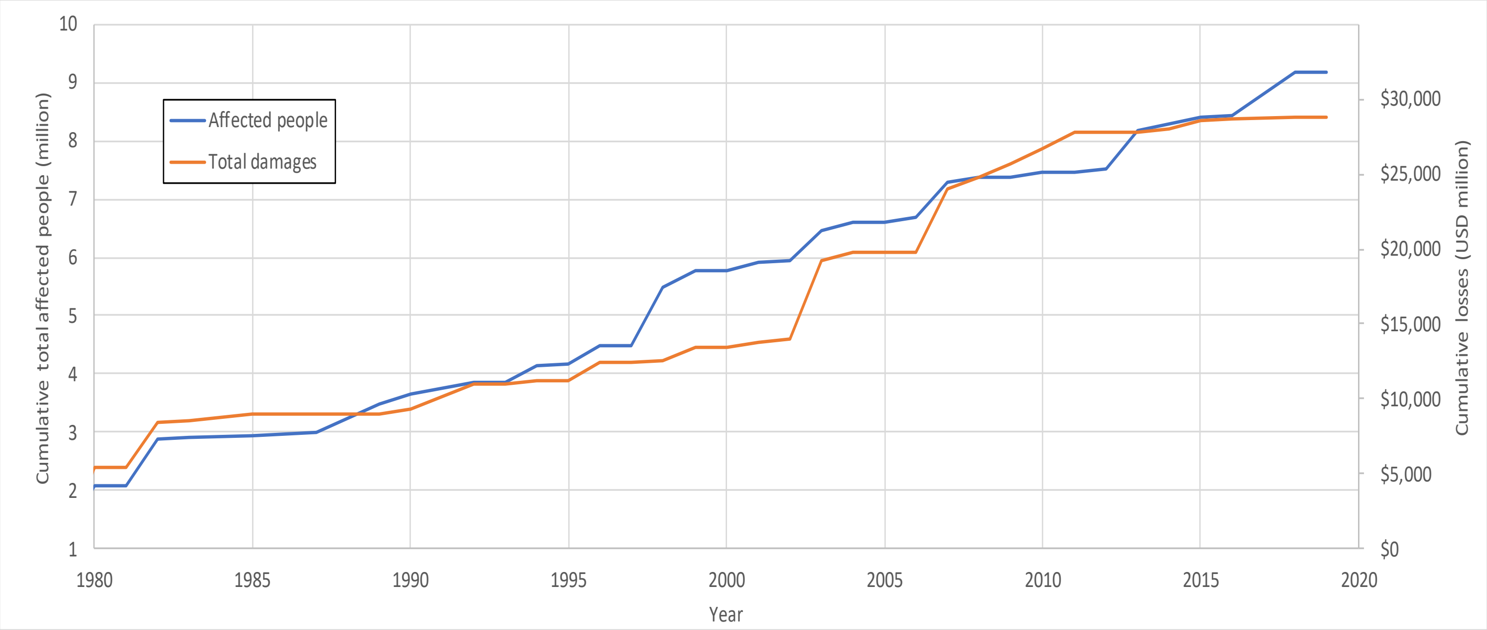
Number of disasters by type and year in the Arab Region between 1980 and 2020. Source: EMDAT database

RISK TRENDS

- Exposure and vulnerability have considerably increased in the region (Poorly Planned, Rapid Urbanization and Population Growth)

Increasing losses

- Drought has the largest cumulative impact in terms of deaths, affected people and economic losses



Regional cumulative total damages and affected people, 1980 - 2020. Current USD. Source: EMDAT database

- **Monitoring weather patterns:** Satellites can provide continuous monitoring of weather patterns, such as the movement and intensity of storms and the development of drought conditions. This information can be used to identify areas at risk of **flooding, landslides**, or other climate-related hazards.

- **Tracking changes in land use**: Satellites can also be used to track changes in land use, such as deforestation or urbanization, which can contribute to climate change and increase the risk of natural disasters.

- **Identifying vulnerable populations:** Satellite imagery can be used to identify populations that are particularly vulnerable to climate risks, such as those living in low-lying areas or areas prone to drought. This information can be used to target interventions and improve disaster preparedness.

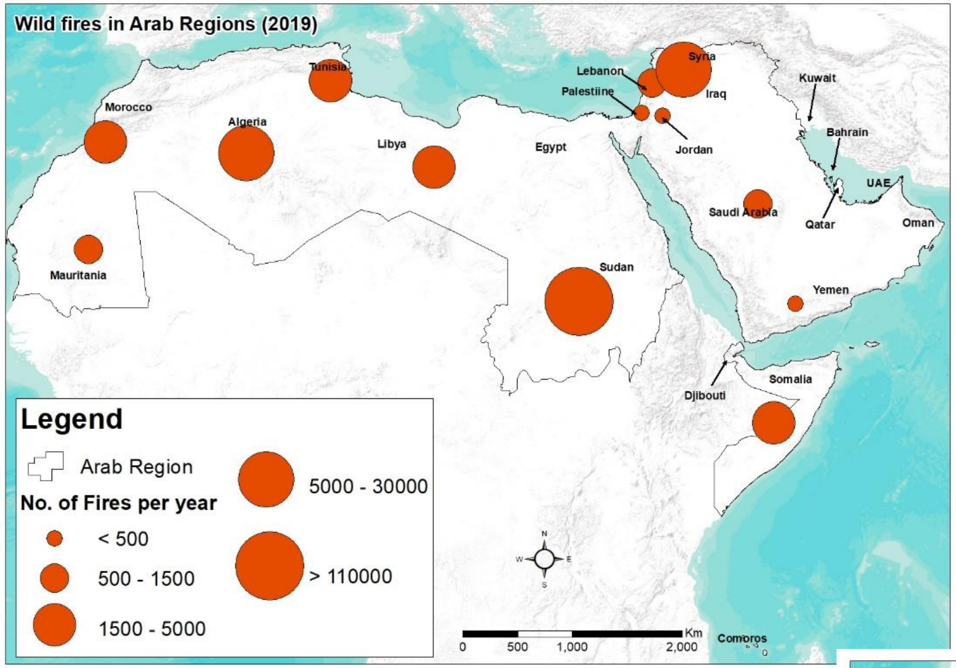
- **Identification of water resources:** Satellite imagery can be used to identify and monitor water resources such as rivers, lakes, and aquifers. This information is critical for managing water resources and addressing risks such as droughts and floods.

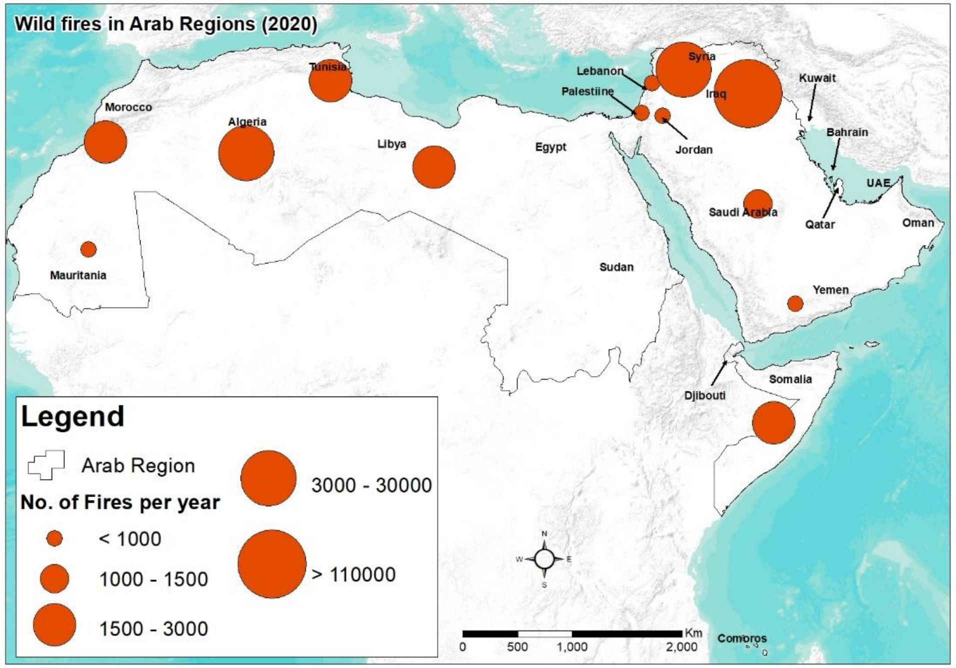
- **Assessing damage after disasters:** Following a climate-related disaster, satellite imagery can be used to assess the extent of the damage and prioritize response efforts. For example, satellite imagery can be used to identify areas where roads are blocked or where infrastructure has been damaged, allowing relief organizations to target their efforts more effectively.

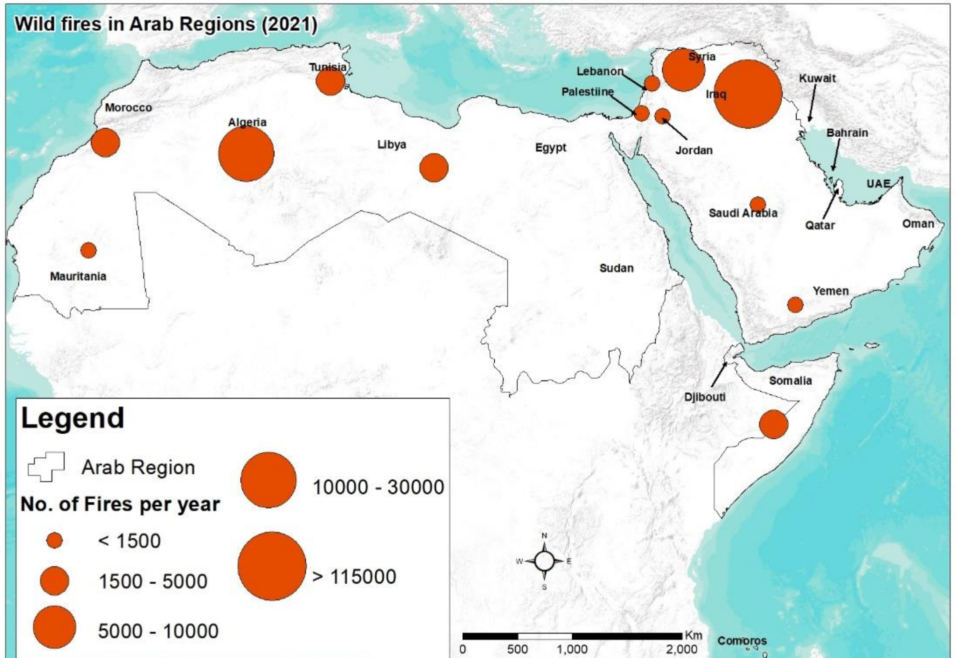
- **Assessment of sea level rise:** Satellite imagery can be used to monitor changes in sea level and coastal erosion. This information is critical for assessing the risks associated with sea level rise and developing strategies to adapt to these changes

- **Assessment of vegetation health:** Satellite imagery can be used to monitor the health and productivity of vegetation, which is an important indicator of climate change impacts. Changes in vegetation health can signal droughts, heatwaves, and other risks associated with climate change.

Wild Fires in the Arab Region



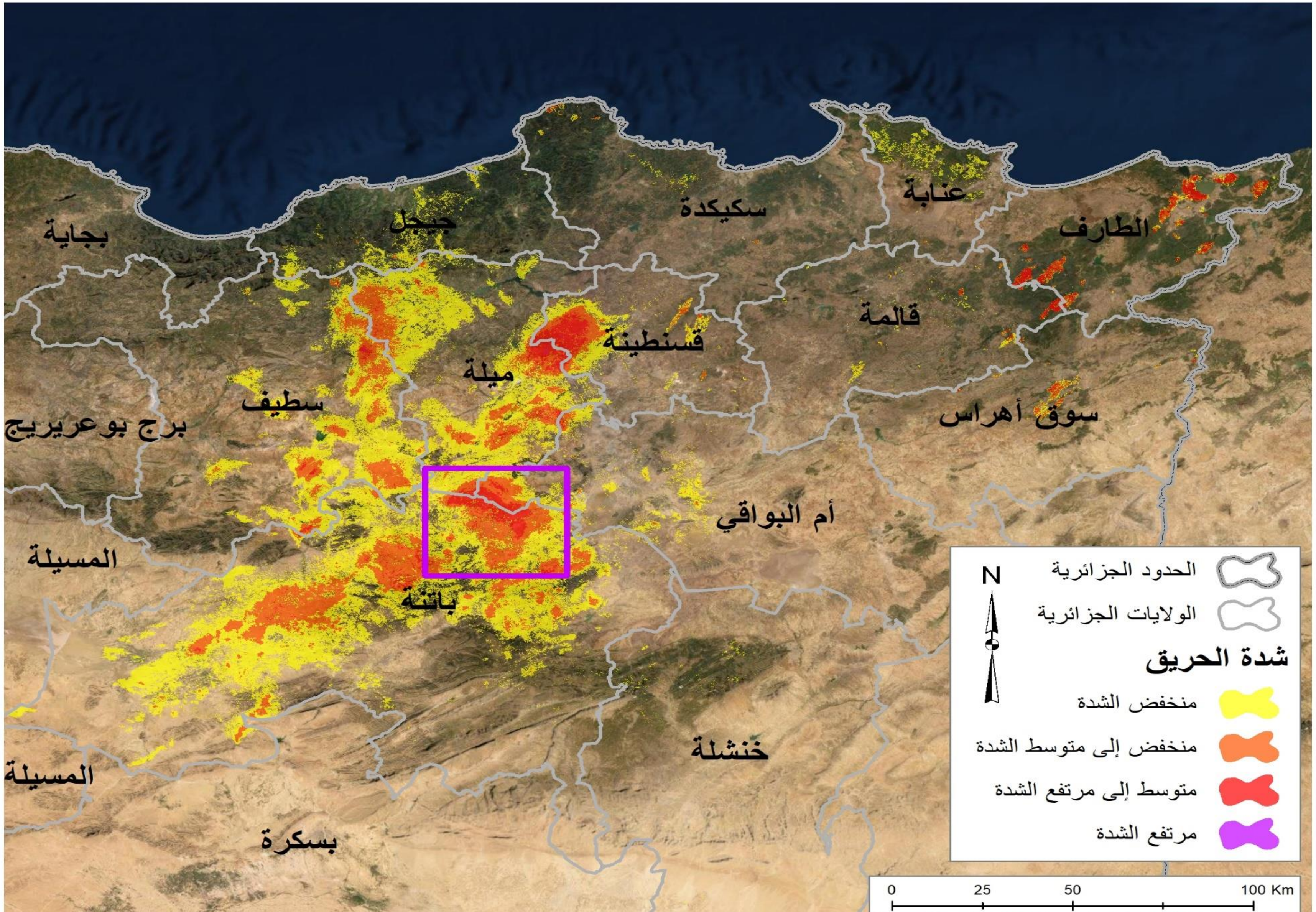


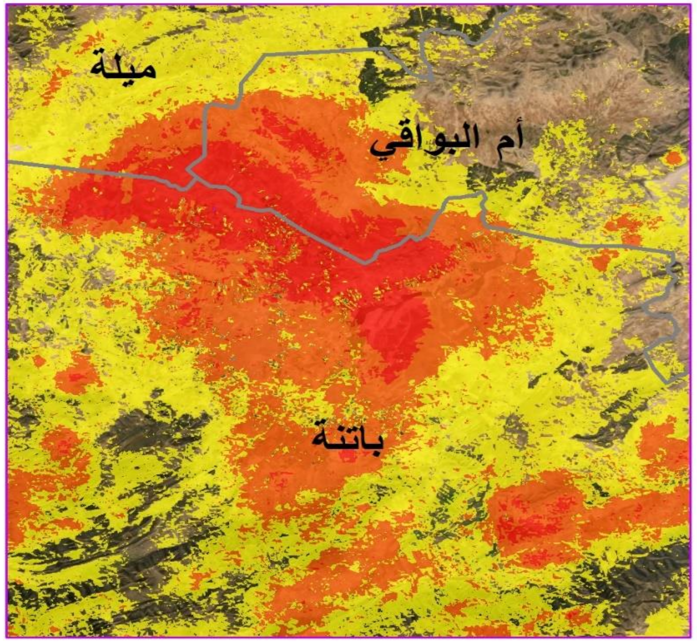


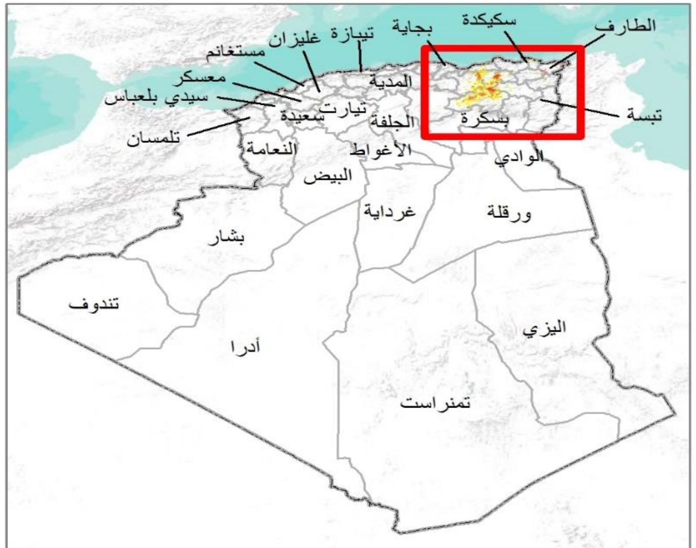
AR-STAG
Arab Science & Technology Advisory Group
SENDAI FRAMEWORK
FOR DISASTER RISK REDUCTION 2015-2030

شدة حرائق الغابات التي اندلعت في شمال شرق الجزائر

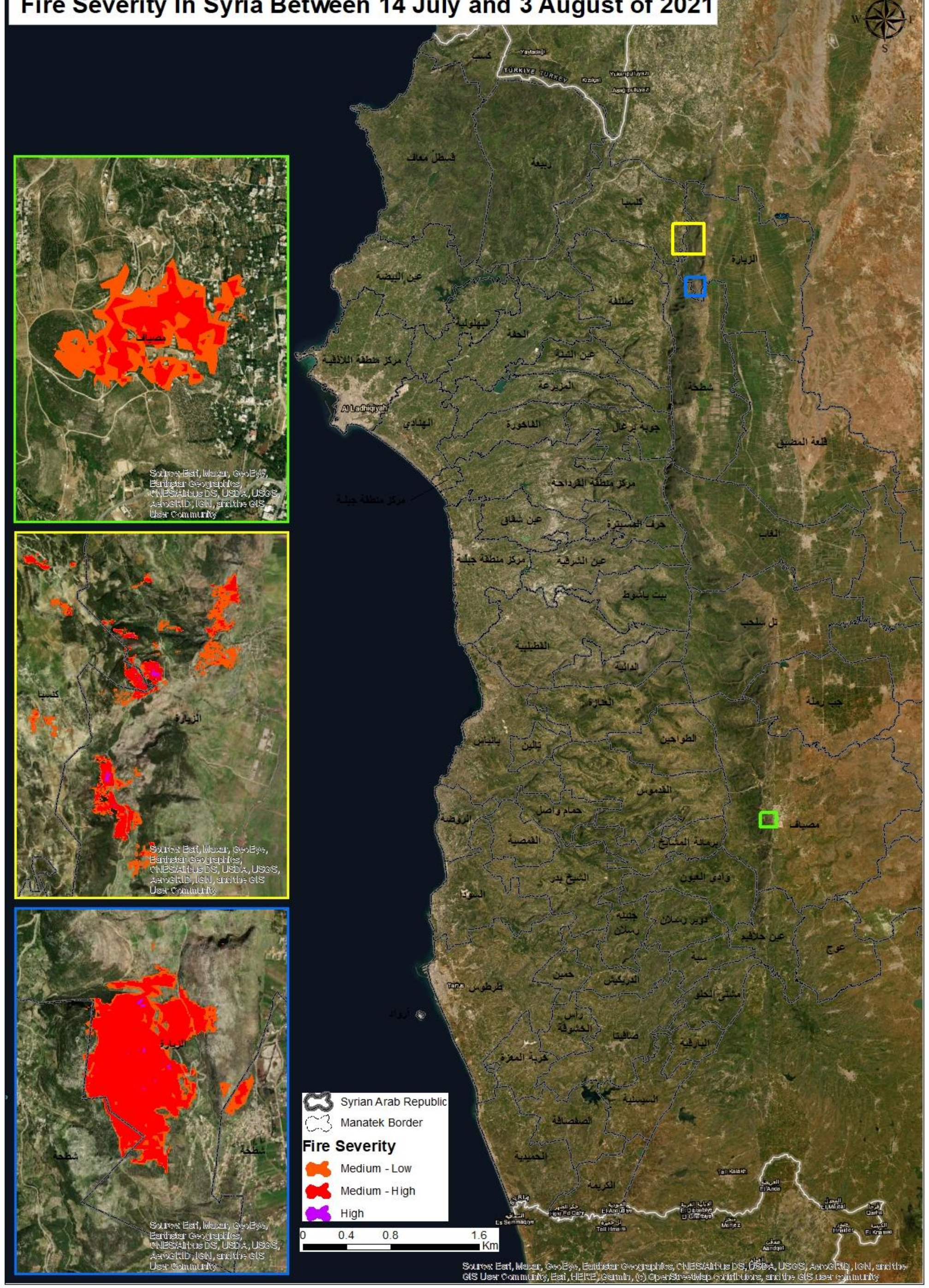
17 و 18 أغسطس 2022

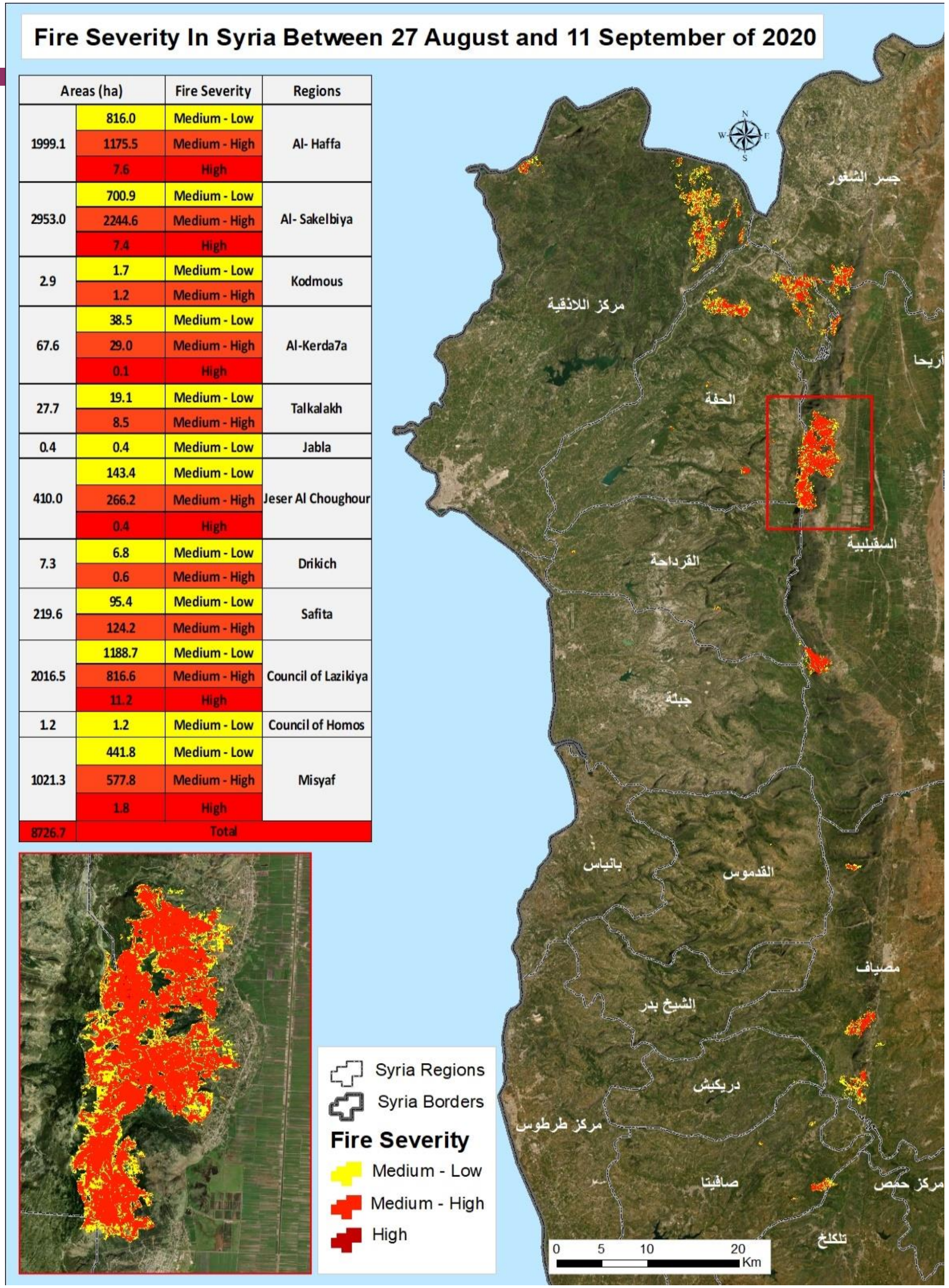






Syria - DNBR

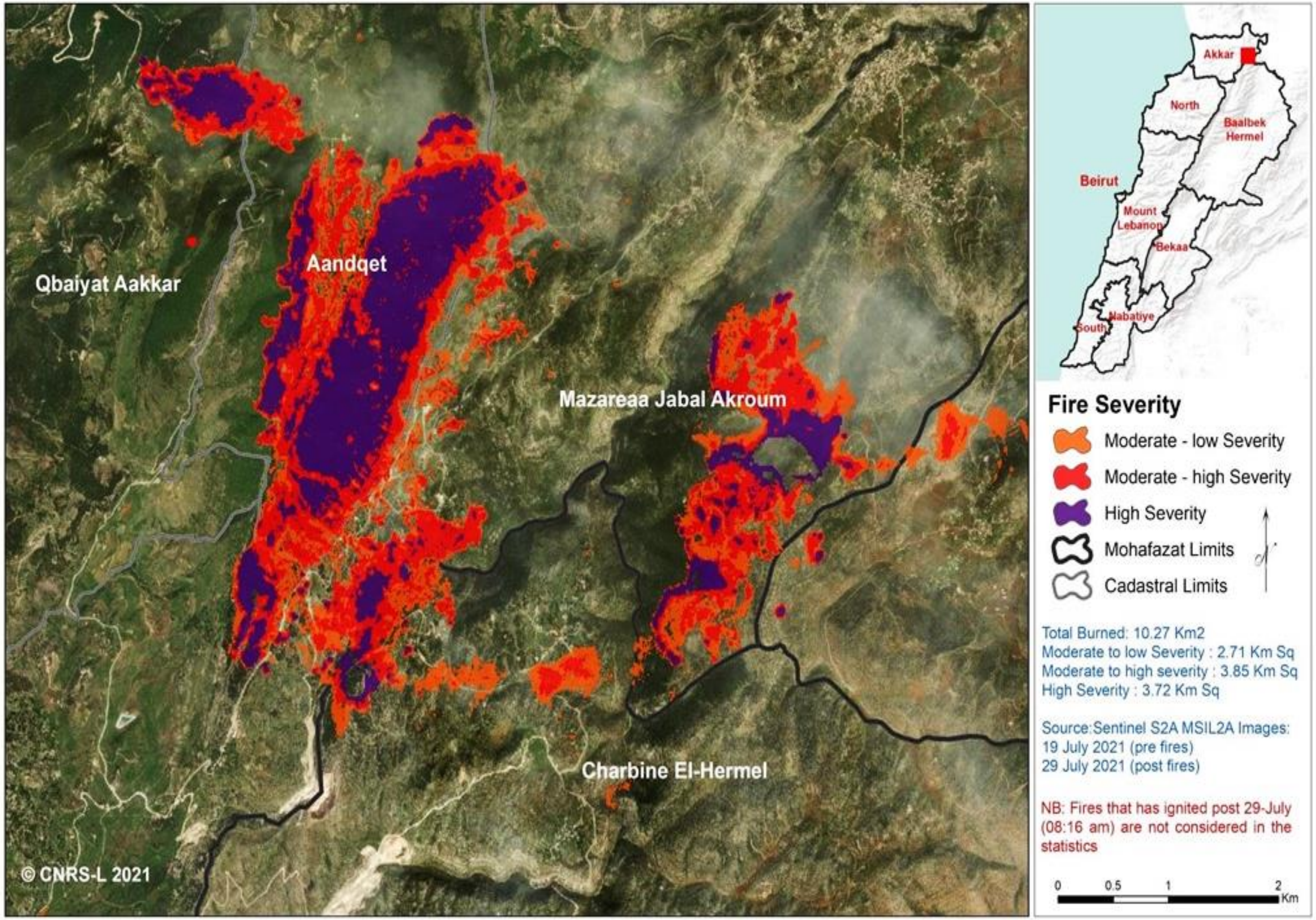




Areas (ha)		Fire Severity	Regions
1999.1	816.0	Medium - Low	Al- Haffa
	1175.5	Medium - High	
	7.6	High	
2953.0	700.9	Medium - Low	Al- Sakelbiya
	2244.6	Medium - High	
	7.4	High	
2.9	1.7	Medium - Low	Kodmous
	1.2	Medium - High	
67.6	38.5	Medium - Low	Al-Kerda7a
	29.0	Medium - High	
	0.1	High	
27.7	19.1	Medium - Low	Talkalakh
	8.5	Medium - High	
0.4	0.4	Medium - Low	Jabla
410.0	143.4	Medium - Low	Jeser Al Choughour
	266.2	Medium - High	
	0.4	High	
7.3	6.8	Medium - Low	Drikich
	0.6	Medium - High	
219.6	95.4	Medium - Low	Safita
	124.2	Medium - High	
2016.5	1188.7	Medium - Low	Council of Lazikiya
	816.6	Medium - High	
	11.2	High	
1.2	1.2	Medium - Low	Council of Homos
1021.3	441.8	Medium - Low	Misyaf
	577.8	Medium - High	
	1.8	High	
8726.7	Total		

Fire Burn Severity for July Fires in Aakar

مخطط شدة الحـــرائق الـــتي إتـــدلعت فـــي عكـار (تمـوز 2021)



Downscale Examples

Aakar Lebanon - DNBR

- Severity of Fires in **Aakar – Lebanon in 2021**

The total number of burned areas was approximately equal to **10.27 Km2**

Those results were obtained using the images available from Sentinel-2 between **19 July (pre-fires) and 29 July (post-fires).**

Fire Burn Severity for July Fires in Aakar

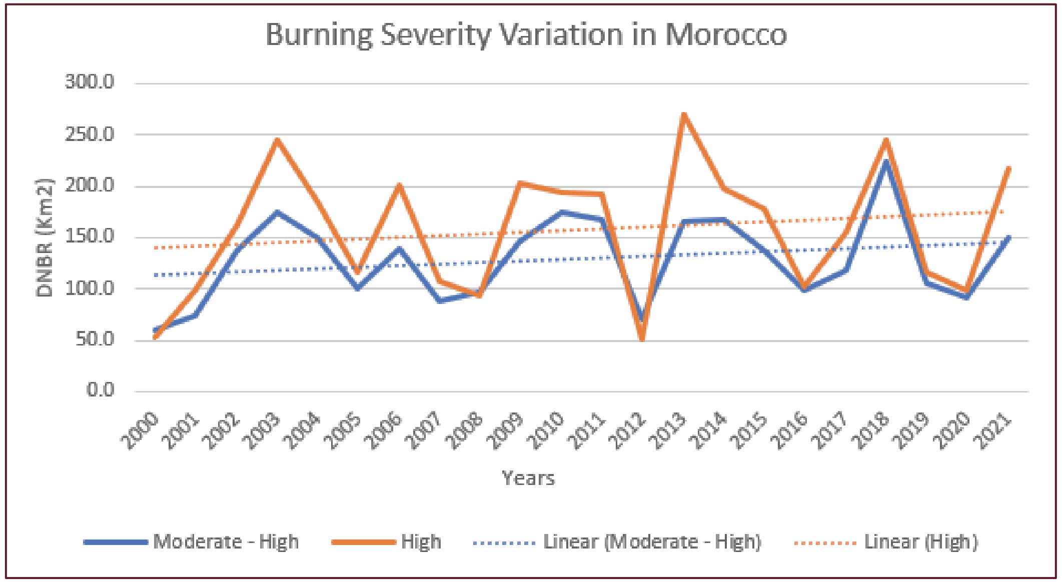
مخطط شدة الحـــرائق الـــتي إتـــدلعت فـي عكار (تمـوز 2021)

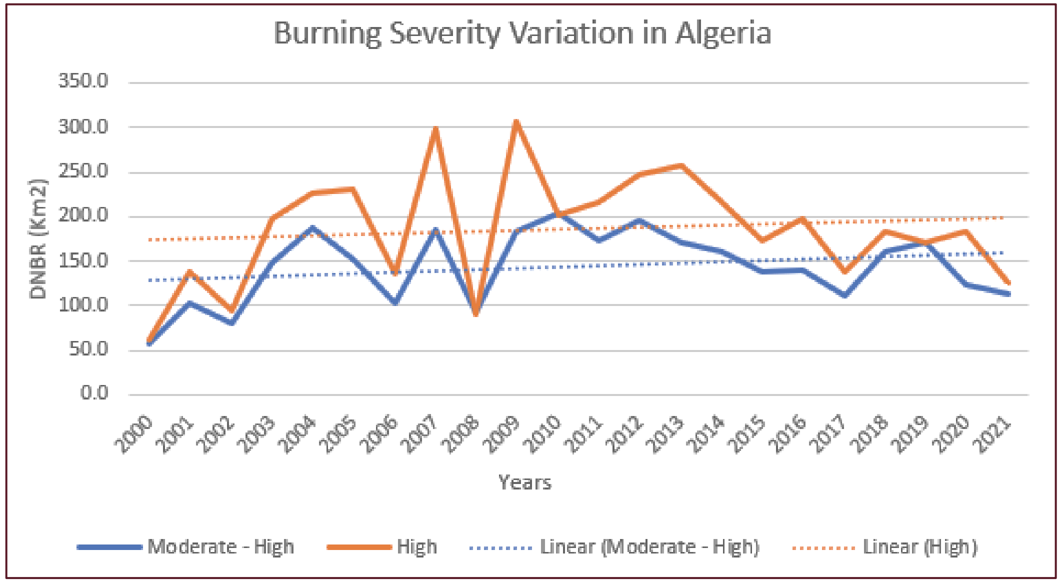
Village	Fire Severity	Area (ha)	Area (Km²)
Akroum	Moderate - Low Severity	147.9	1.48
	Moderate - High Severity	173.9	1.74
	High Severity	89.3	0.89
Aandqet	Moderate - Low Severity	61.6	0.62
	Moderate - High Severity	162.6	1.63
	High Severity	238.2	2.38
Daoura	Moderate - Low Severity	8.3	0.08
	Moderate - High Severity	7.9	0.08
	High Severity	10.1	0.10
Qbaiyat Aakar	Moderate - Low Severity	5.3	0.05
	Moderate - High Severity	15.8	0.16
	High Severity	25.9	0.26
Hermel Charbine	Moderate - Low Severity	47.6	0.48
	Moderate - High Severity	23.7	0.24
	High Severity	8.8	0.09
	Total	1026.9	10.27

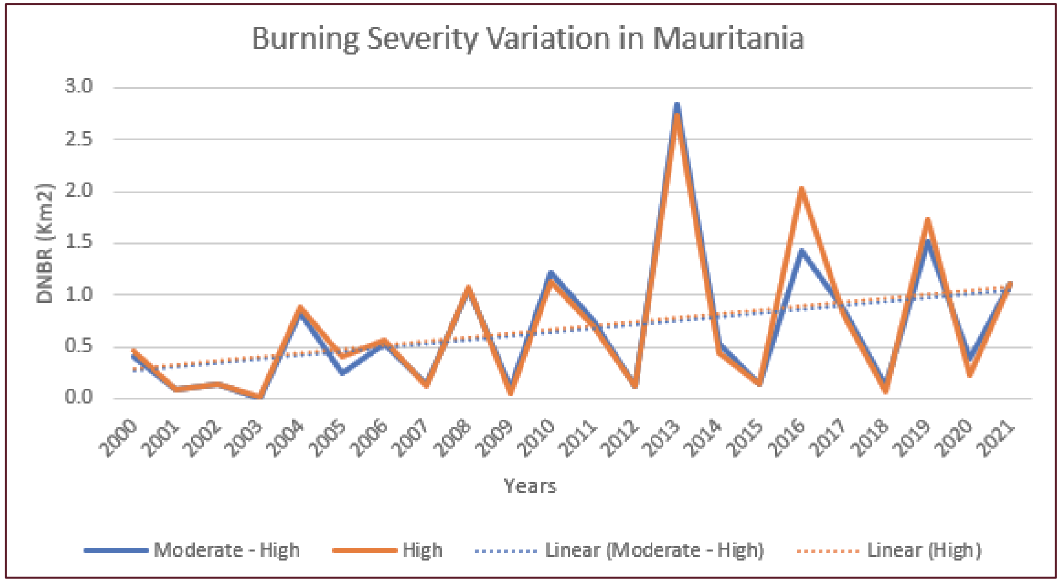
Note: Fires that has ignited post 29-July (08:16 am) are not considered in the statistics

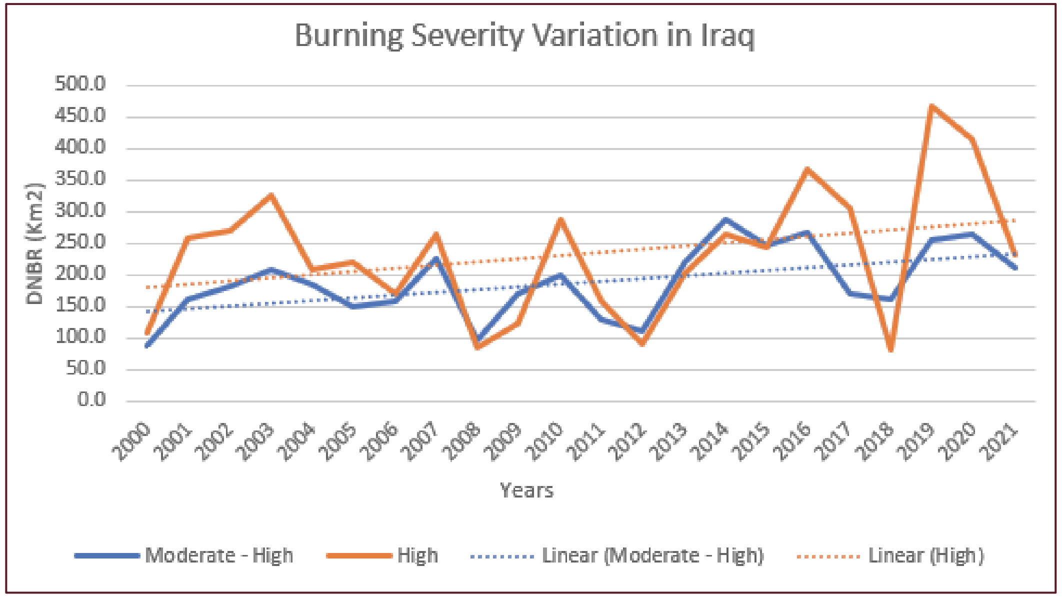
Burning Severity Index (DNBR)

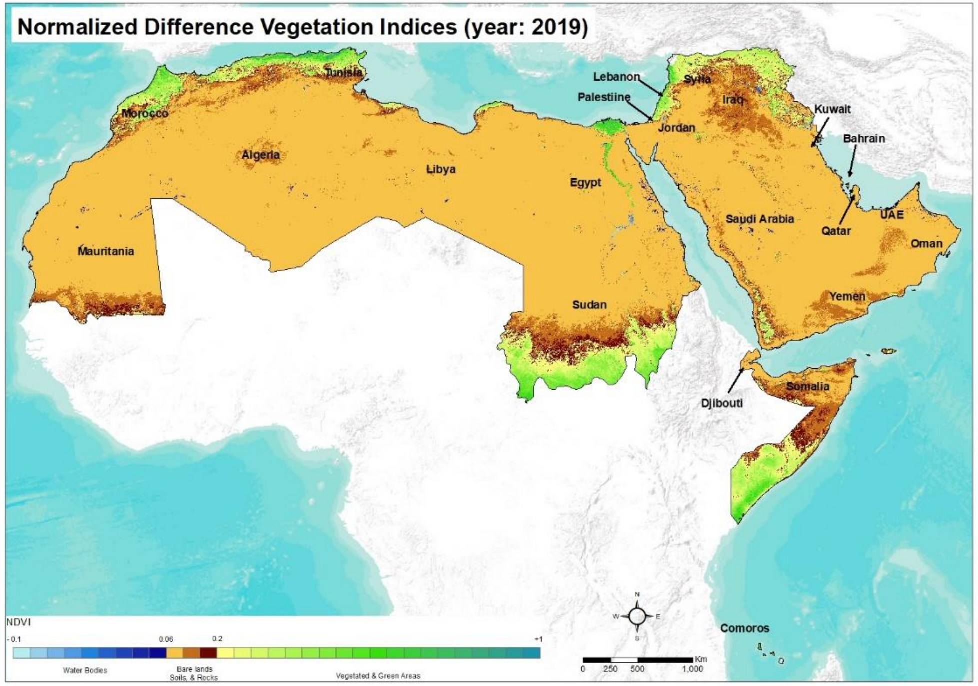
Ascending Trend

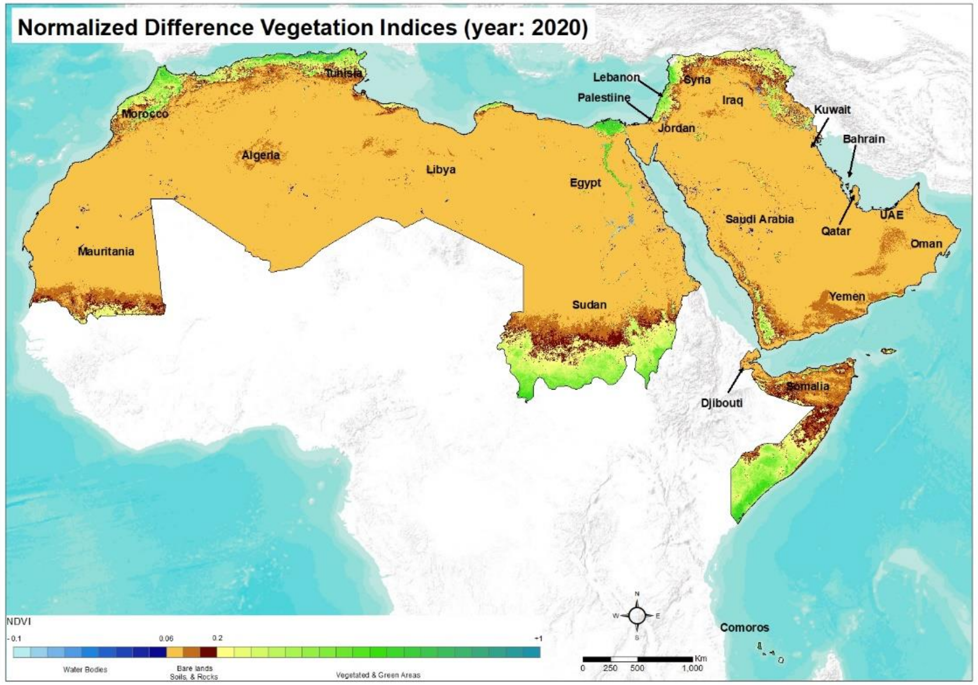









Normalized Difference Vegetation Indices (year: 2019)
Tunisia
Morocco
Algeria
Libya
Egypt
Lebanon
Palestiine
Syria
Iraq
Jordan
Kuwait
Bahrain
Qatar
UAE
Saudi Arabia
Oman
Yemen
Mauritania
Sudan
Somalia
Djibouti
Comoros
NDVI
- 0.1
0.06
0.2
+1
Water Bodies
Bare lands Soils, & Rocks
Vegetated & Green Areas
0 250 500 1,000 Km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Egypt
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Palestiine
Syria
Iraq
Jordan
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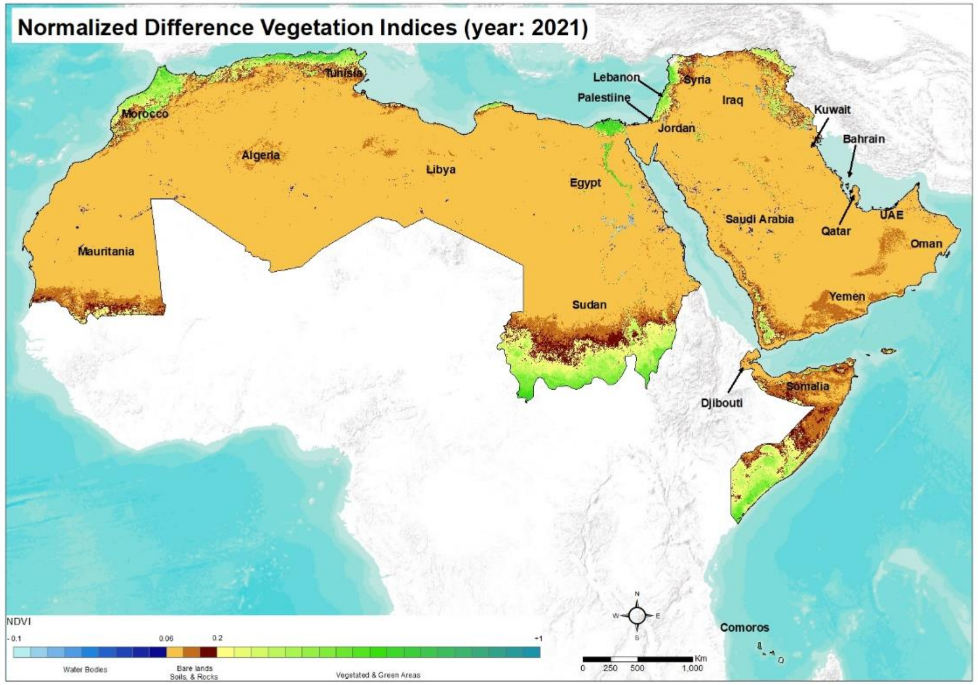
Normalized Difference Vegetation Indices (year: 2021)
Tunisia
Morocco
Algeria
Libya
Egypt
Lebanon
Palestiine
Syria
Iraq
Jordan
Kuwait
Bahrain
Qatar
UAE
Saudi Arabia
Oman
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0.2
+1
Water Bodies
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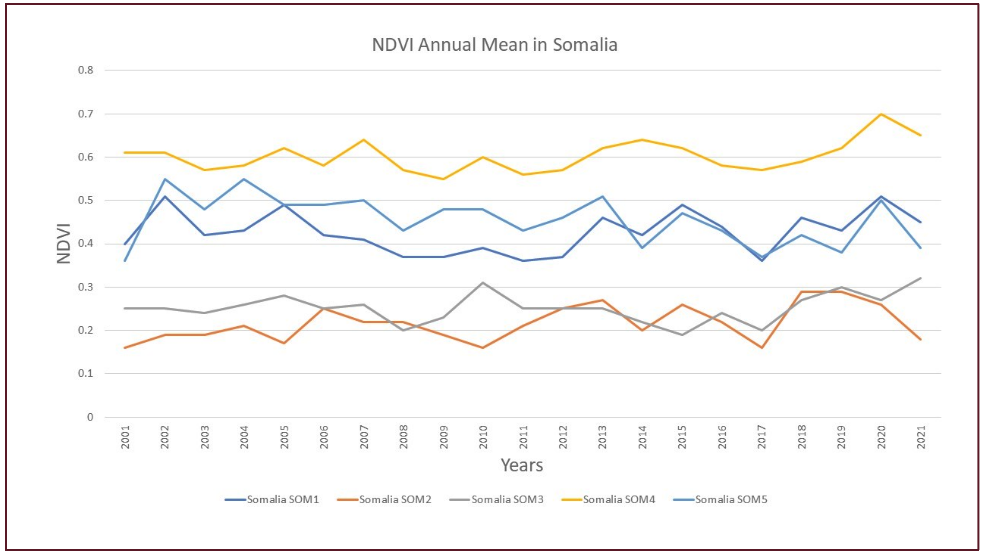
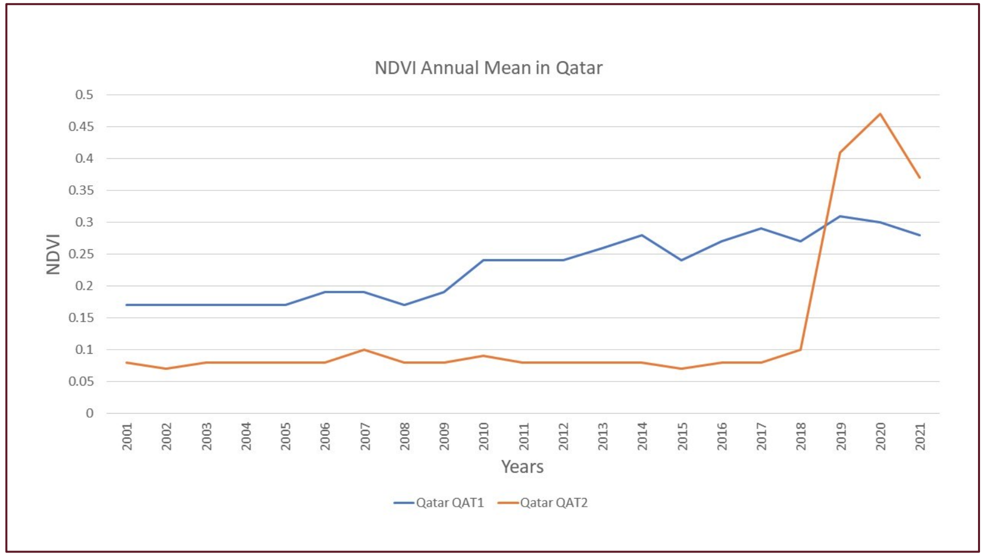
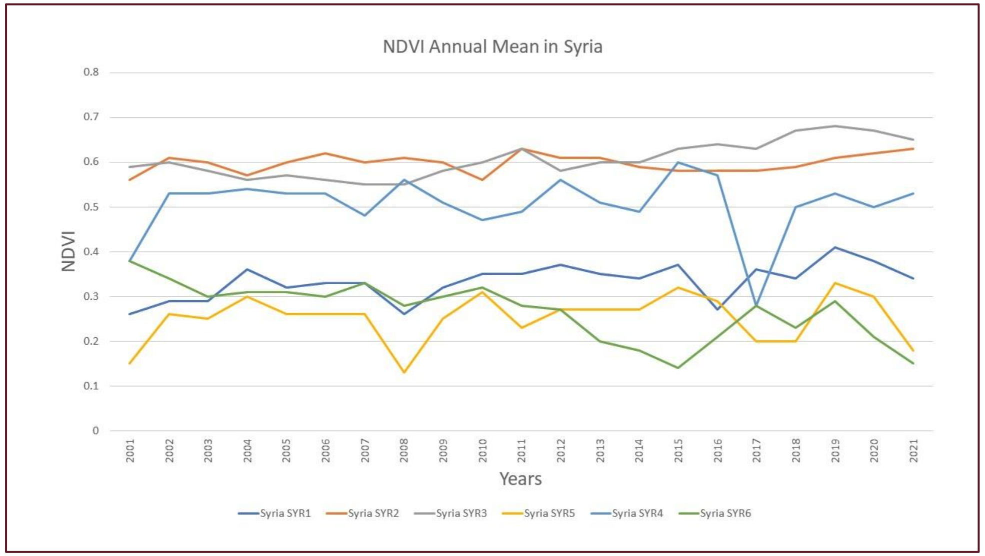
Vegetated & Green Areas
0 250 500 1,000 Km

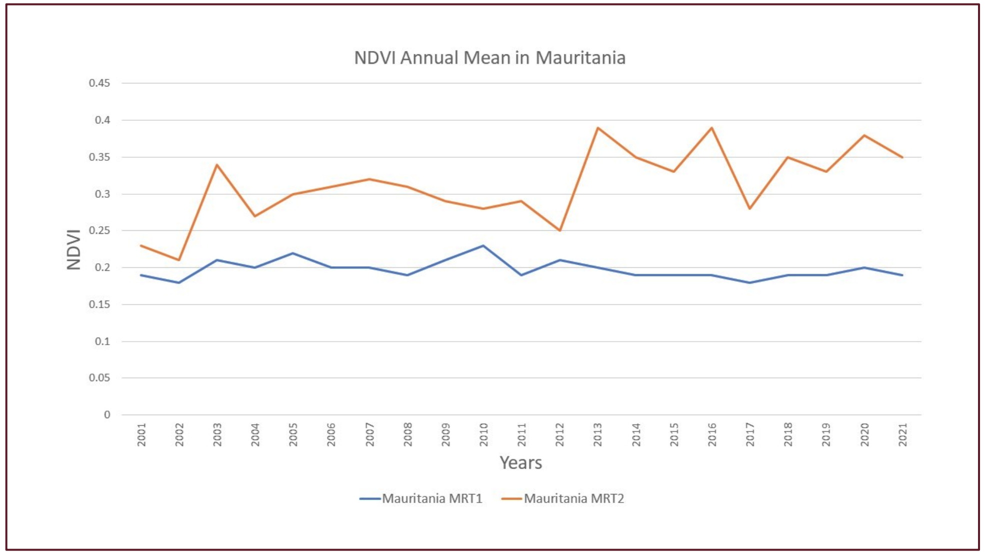
Normalized Difference Vegetation Index (NDVI)

Descending Trends



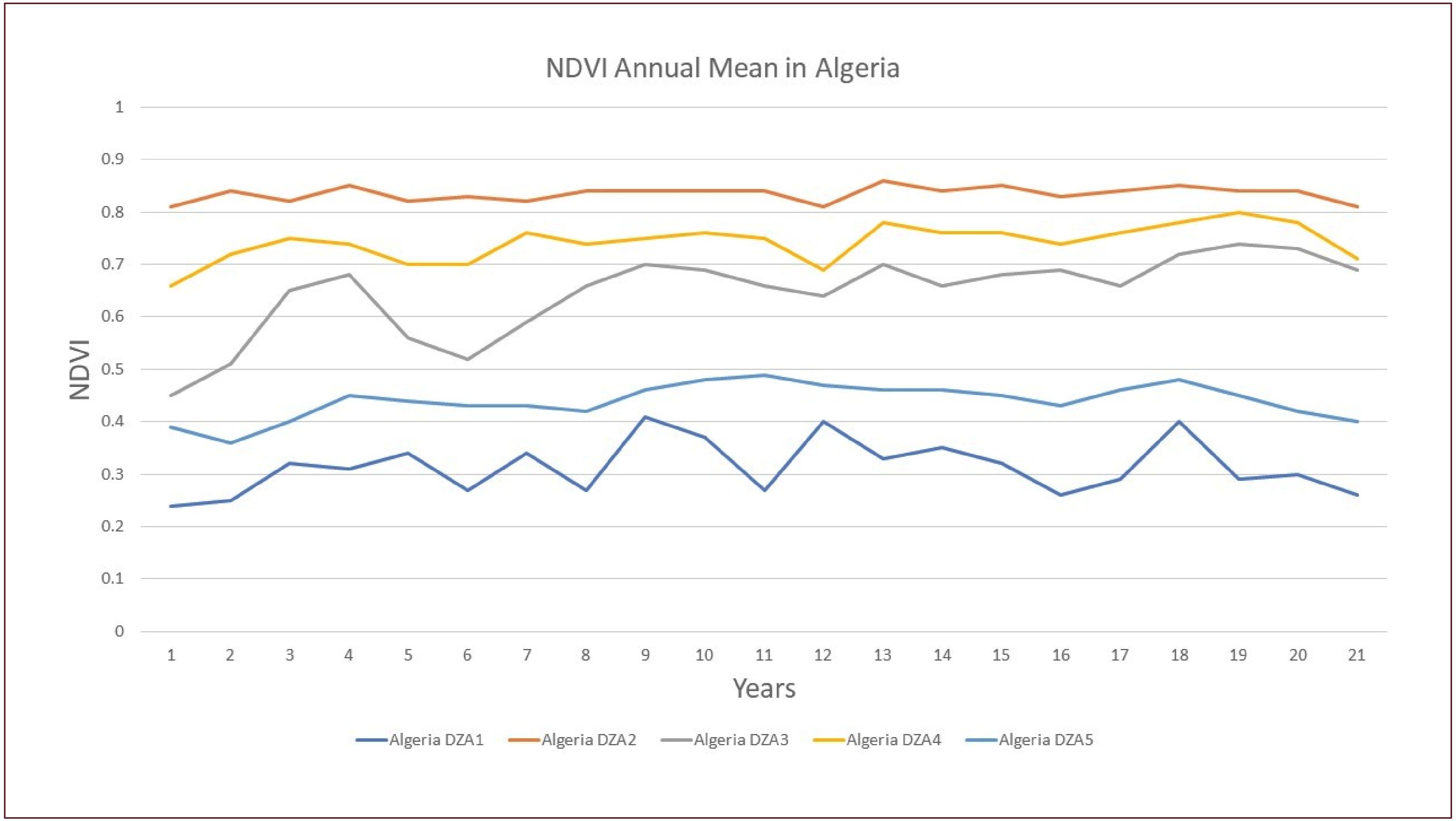




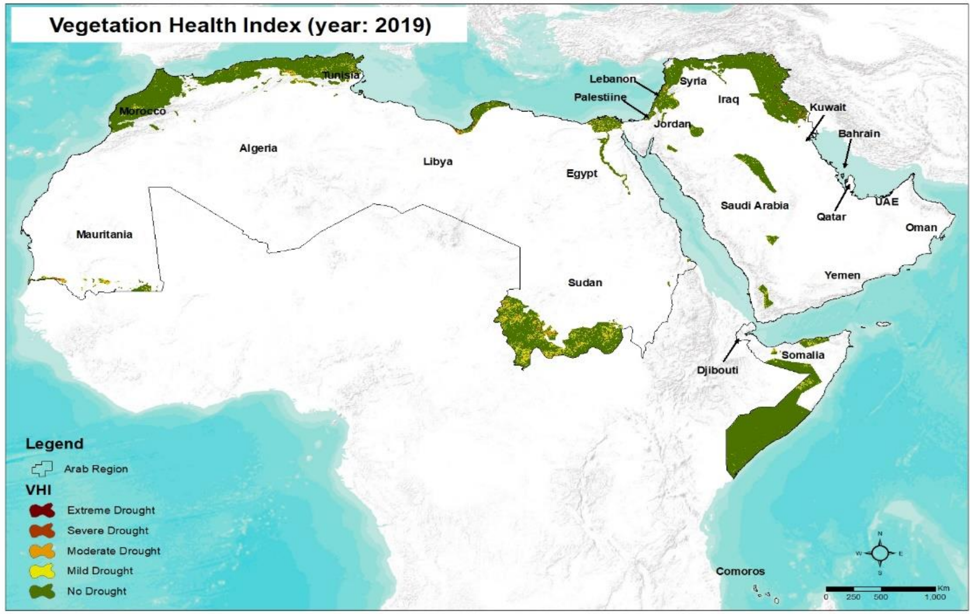


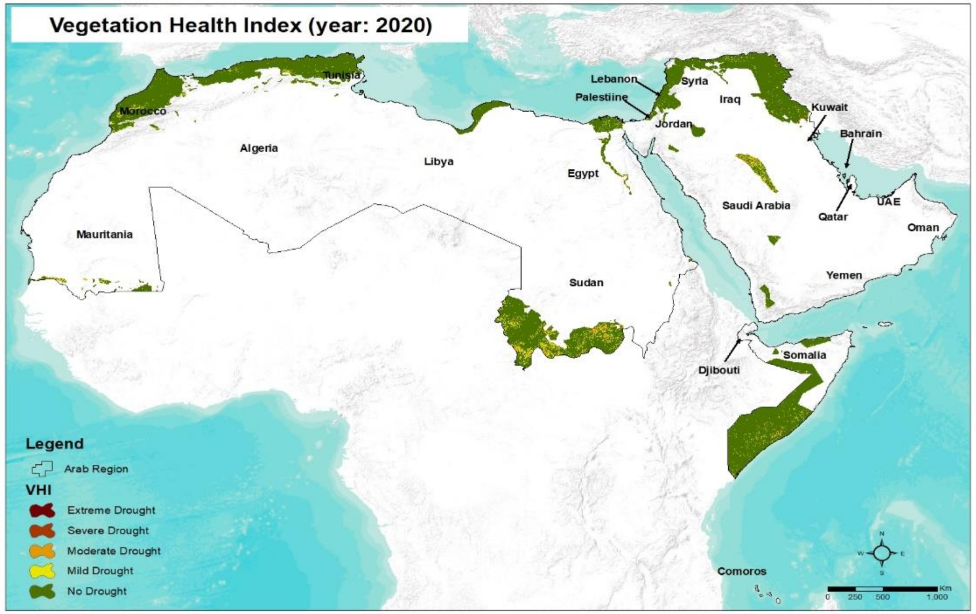
Normalized Difference Vegetation Index (NDVI)

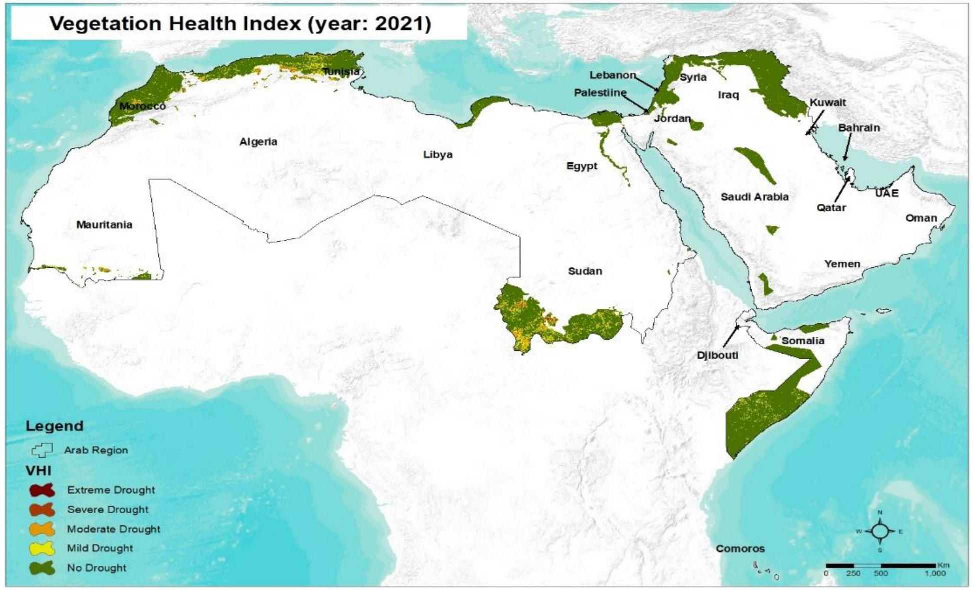
NDVI in Algeria is approximatively stable till 2018, after this date we can notice a decline in the forest and cropland samples taken due to the several fires that have occurred recently



Vegetation Health Index (VHI)







Soil Salinization Index

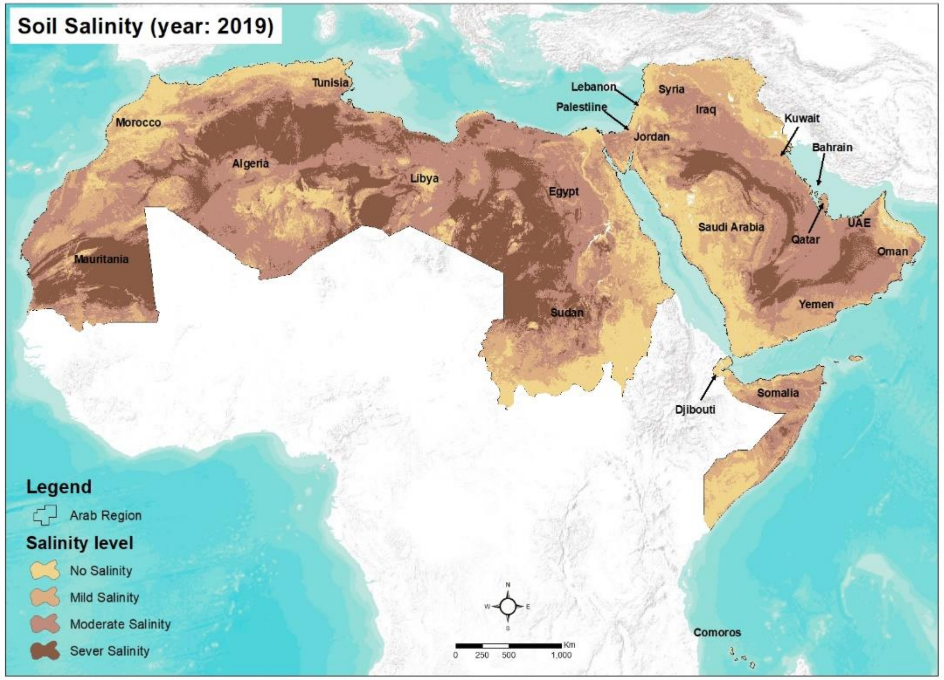
- The salinity index visualizes the amount of salt present in soils. Soil salinization is one of the most common land degradation processes, especially in arid and semi-arid regions, where precipitation exceeds evaporation.

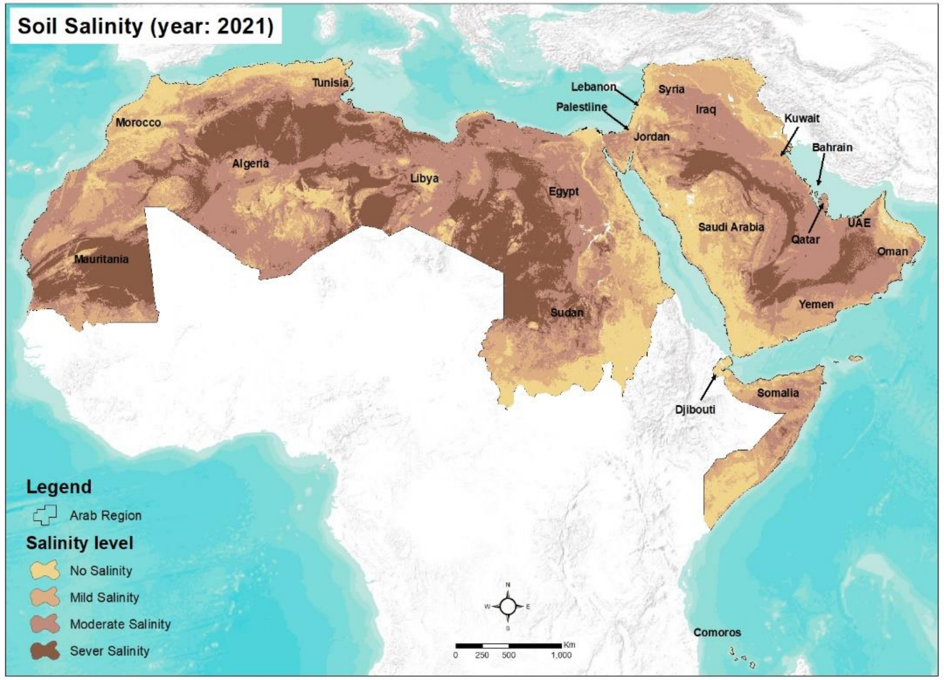
- **Formula: Salinity = ((Red*NIR)/ (Green))**

- ***Iraq, North-Est of Syria, Sudan Saudi Arabia, United Arab Emirates, Kuwait, Bahrain, Mauritania, Center of Algeria and Egypt*** are countries characterized by high salinity

- ***South-East of Sudan, Lebanon, Syria, Palestine, North of Tunisia*** shows no to mild salinity.

Through all the time series presented we can recognize an increase in the soil salinity in several countries


Soil Salinity (year: 2019)
Tunisia
Morocco
Algeria
Libya
Egypt
Lebanon
Palestine
Syria
Iraq
Jordan
Kuwait
Bahrain
Saudi Arabia
Qatar
UAE
Oman
Yemen
Mauritania
Sudan
Djibouti
Somalia
Comoros
Legend
Arab Region
Salinity level
No Salinity
Mild Salinity
Moderate Salinity
Sever Salinity
0 250 500 1,000 Km


Soil Salinity (year: 2021)
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Libya
Egypt
Lebanon
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Syria
Iraq
Jordan
Kuwait
Bahrain
Saudi Arabia
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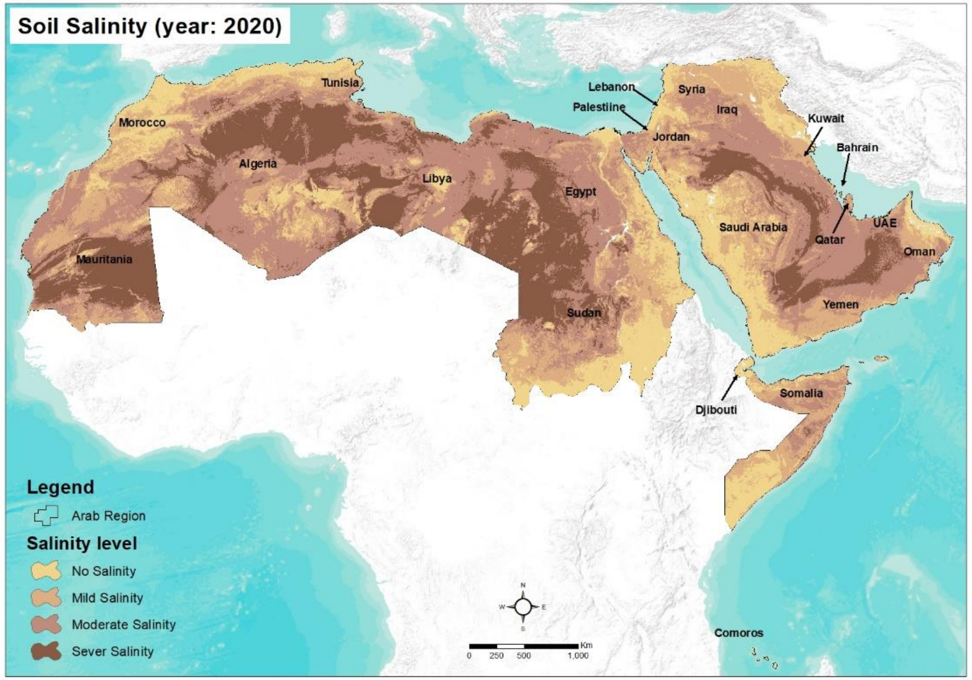
Soil Salinity (year: 2020)
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Oman
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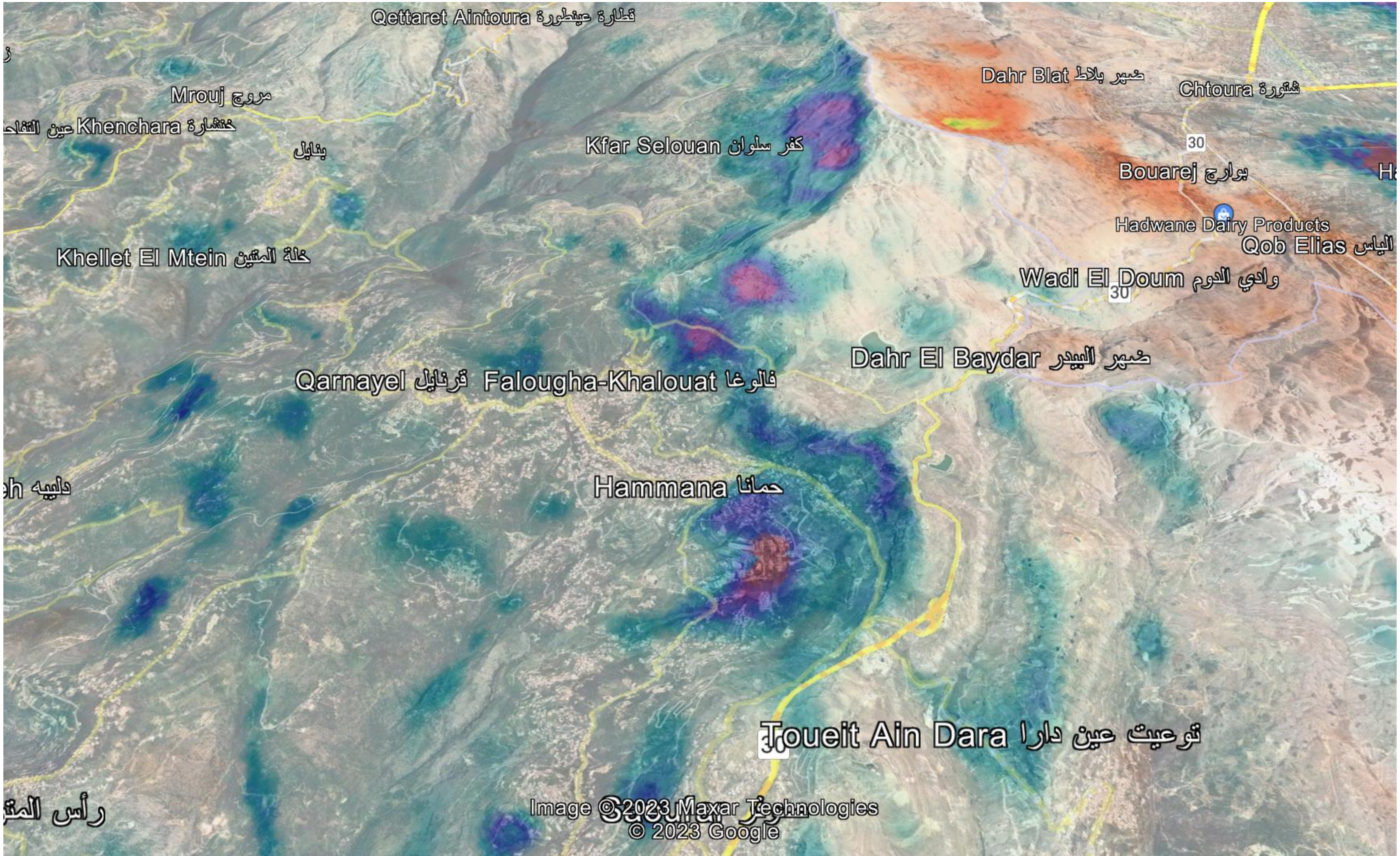
Lnaslides Monitoring



Early warning early action and international governance

National societies can support their government with international commitments in the Paris Agreement

Especially with Adaptation

- Each country must communicate **Nationally Determined Contributions** (NDCs)
- NDCs reviewed/updated every 5 years (from 2023)
- NAPs (National Adaptation Plans) are only 'required' for Least Developed Countries (LDCs) although most countries have something similar

Early warning early action and international governance

EWEA is reflected in Target G of the United Nations’ Sendai Framework for Disaster Risk Reduction:

“Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to people by 2030”.

Early warning early

- EWEA is part of prepared … nal Disaster Management Strategy
- Usually, national disaster … al Hydro-meteorological Services (… s – are mandated to lead and other engage
- However, the relevant Sta … C, etc…) can be positioned to partner … unity level EWEA initiatives and to advocate for community participation.

EWEA aims to reach ‘the last mile’ by reaching:

- All people (including the most vulnerable)
- In all communities (including the most remote)

GLOBAL TRENDS

3,751
Natural hazards
recorded by EM-DAT
over the last **10 years**

84%

are weather related hazards

Floods 40.5%, storms 26.7%, other weather related 16.9%

2bn
Estimated **number of people**
affected by natural hazards
over the last **10 years**

95%

of people are affected by weather related hazards

Floods 36.7%, storms 17%, other weather related 41.8%

US$1,658bn
Estimated **cost of damages**
in 141 countries
over the last **10 years**

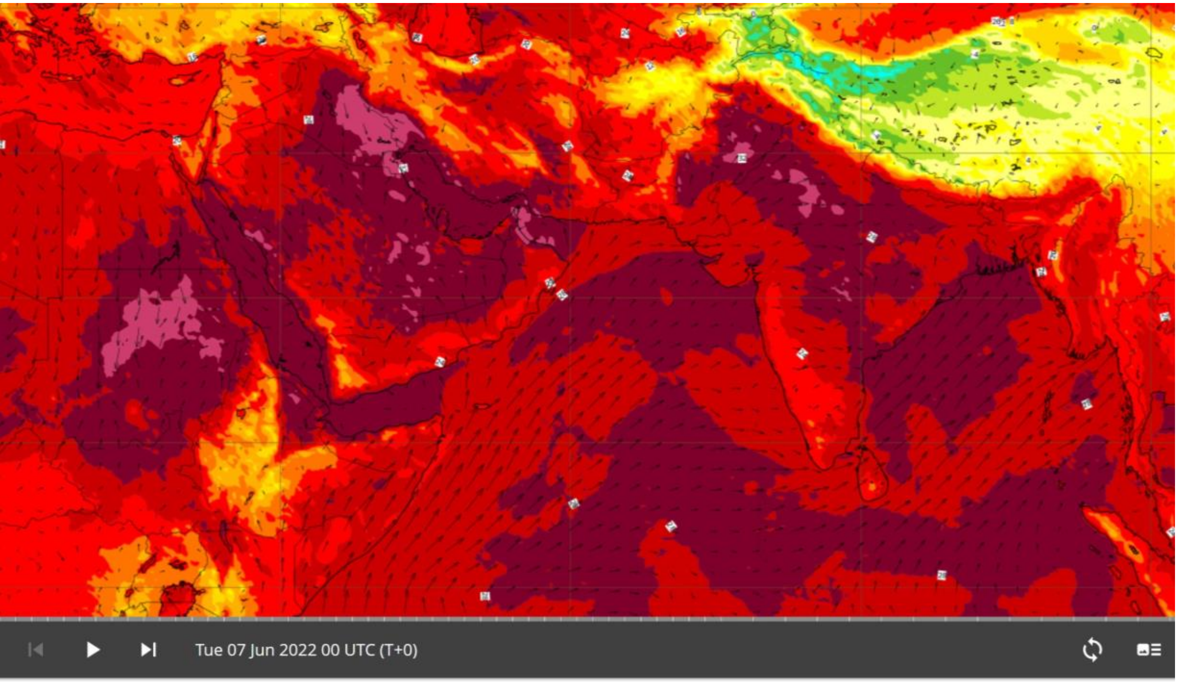
73%

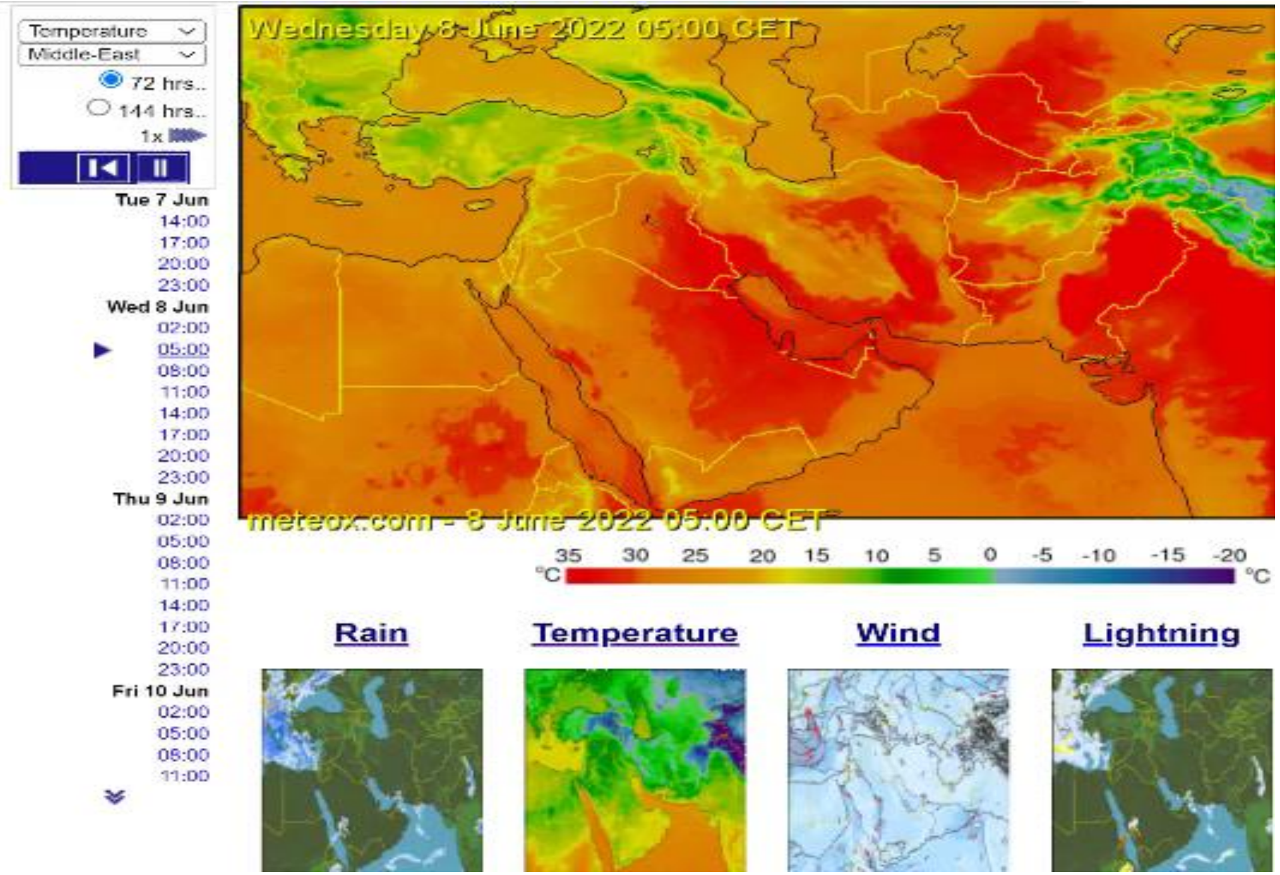
of costs are due to weather related hazards

Storms 41.7%, floods 21.9%, other weather related 9%

Weather Satellites are an important observational tool for all scales of EWS forecasting operations. Satellite data, having a global view, complements land-based systems such as radiosondes, weather radars, and surface observing systems.

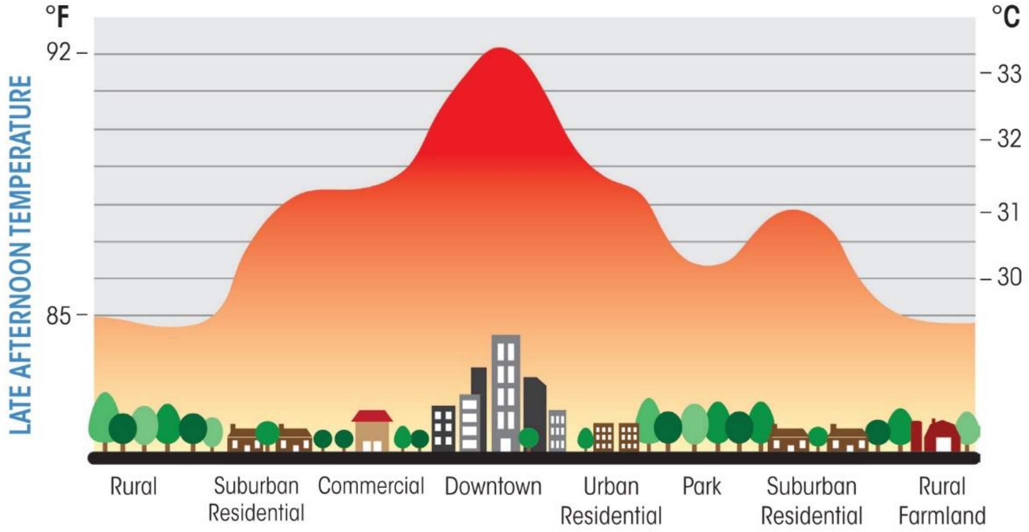
SOURCES OF HYDRO-METEOROLOGICAL DATA

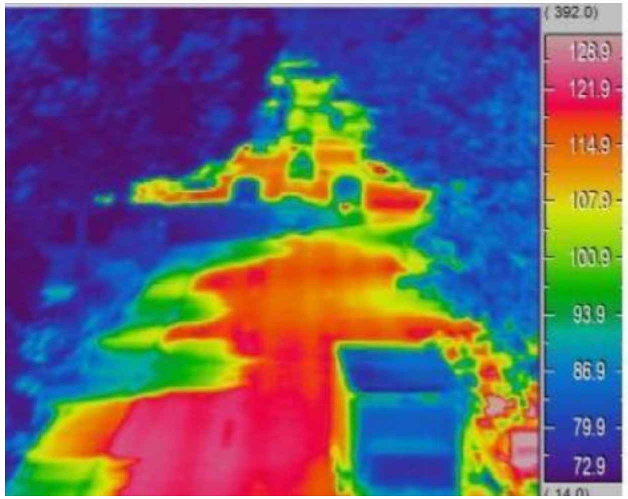


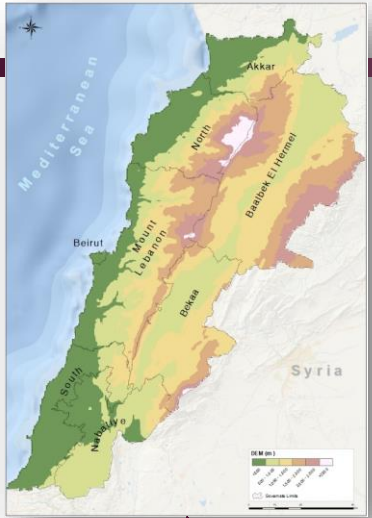


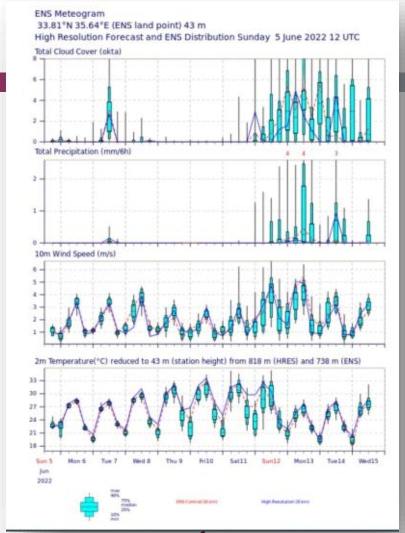
Urban Heat Island (UHI)

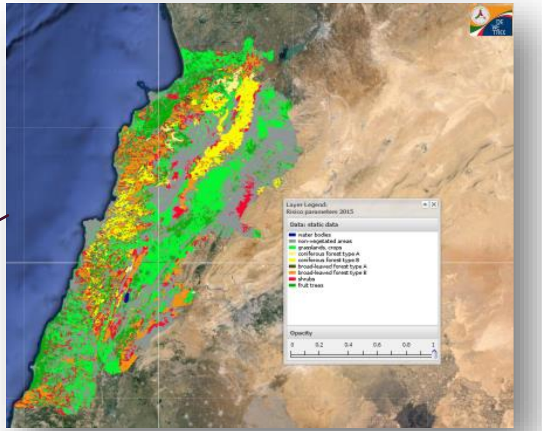
- ❖ Heat islands are urbanized areas that experience higher temperatures than outlying areas.
- ❖ Structures such as buildings, roads, and other infrastructure absorb and re-emit the sun’s heat more than natural landscapes such as forests and water bodies.
- ❖ Urban areas, where these structures are highly concentrated and greenery is limited, become “islands” of higher temperatures relative to outlying areas.
- ❖ This difference in temperature is usually more easily detected at night than in the day, when there is a greater difference in temperature.
- ❖ The main cause of UHIs is the composition of the land surfaces. Increasingly, large areas are being covered by asphalt and tarmac, and buildings are being constructed that absorb sunlight then radiate heat, thus heightening the overall temperature of the area.



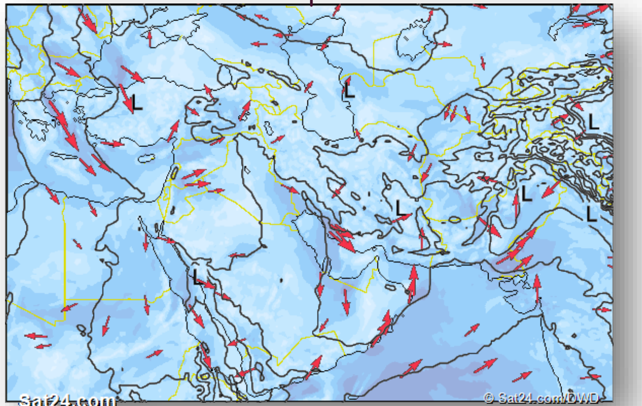


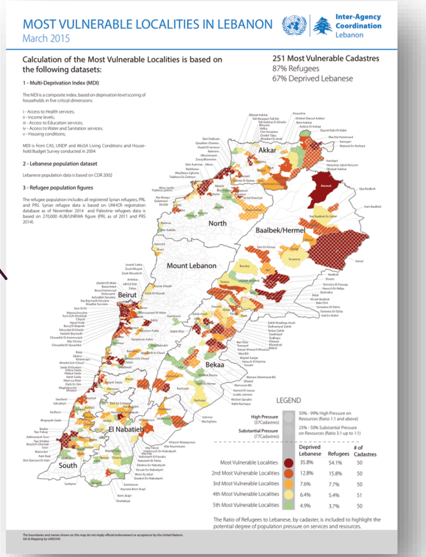




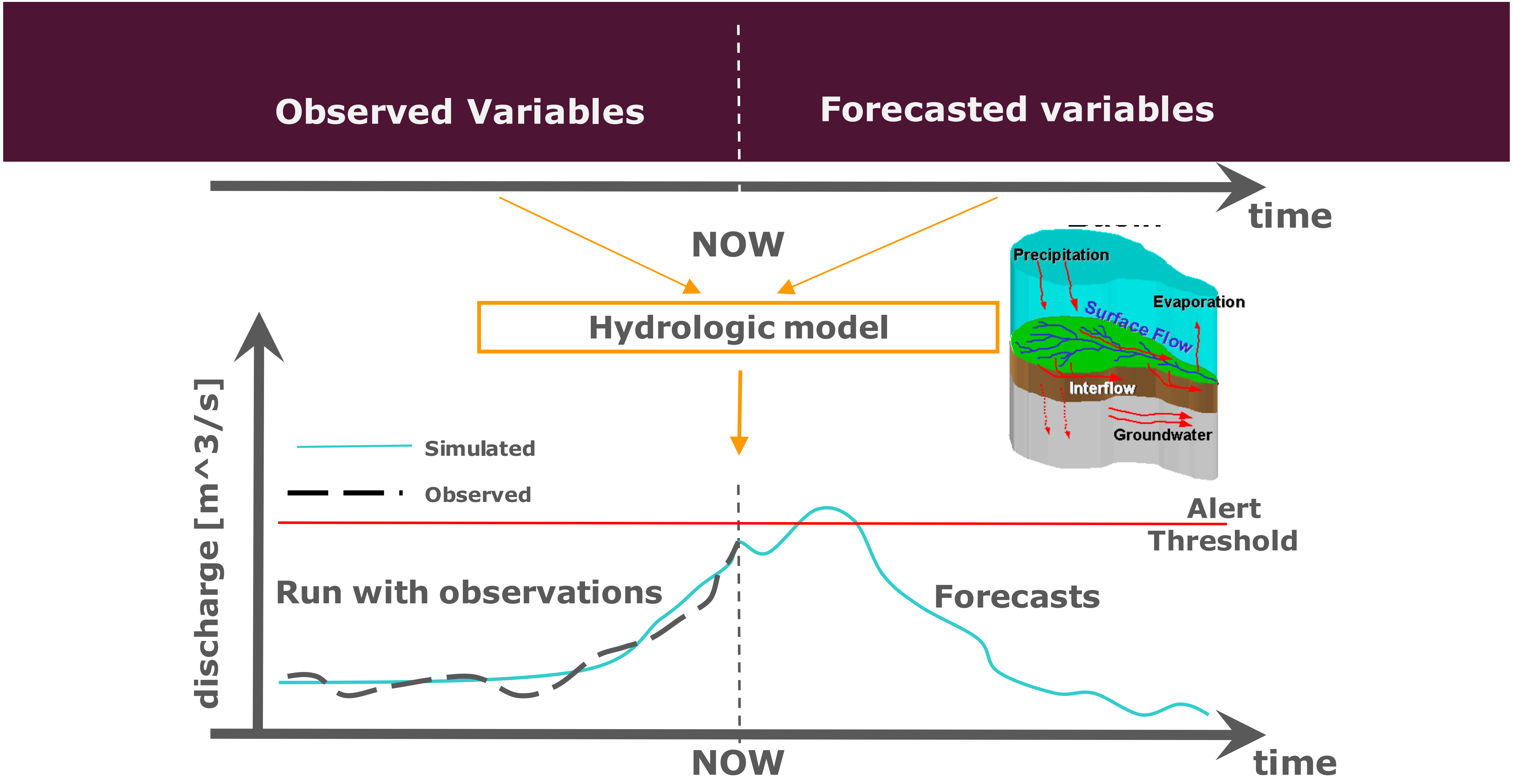


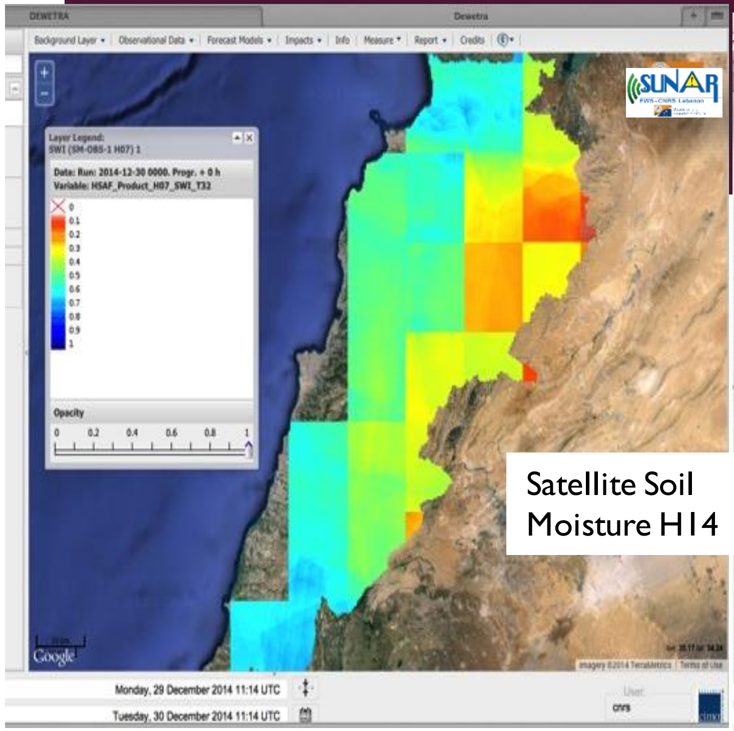
SuNAR for HEWS



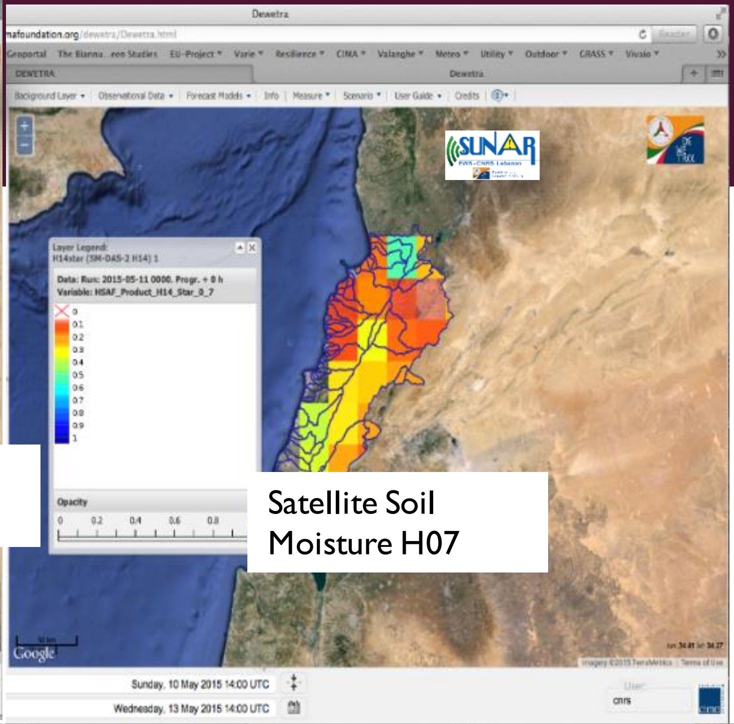


Flood forecasts

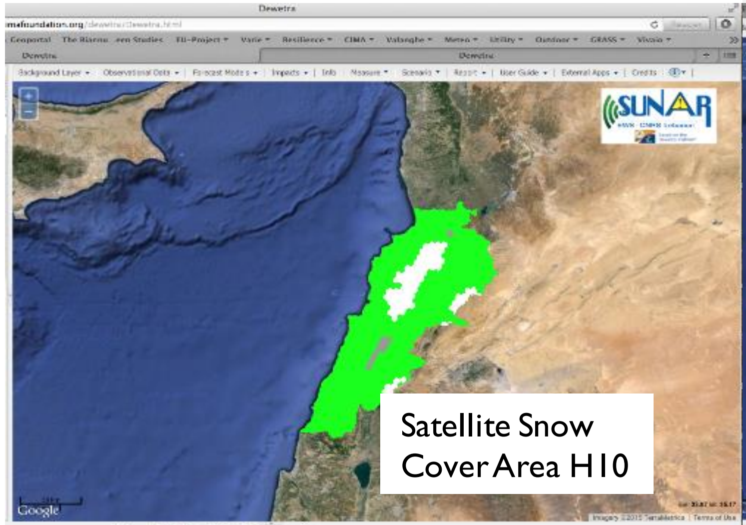




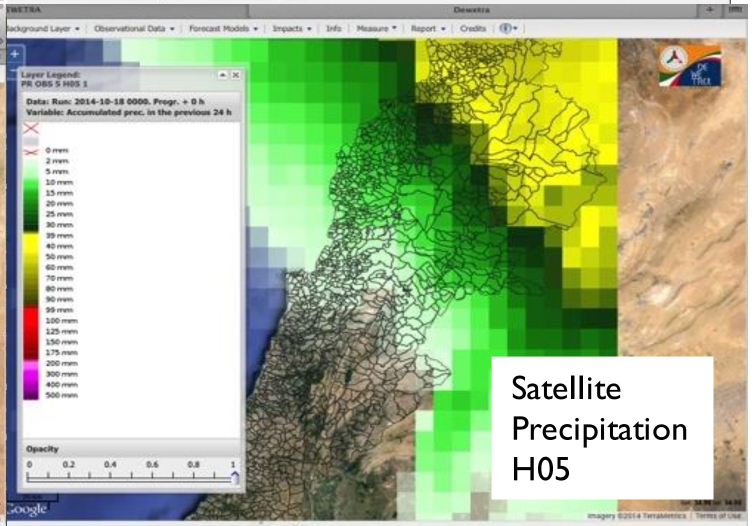
Satellite Soil Moisture H14



Satellite Soil Moisture H07

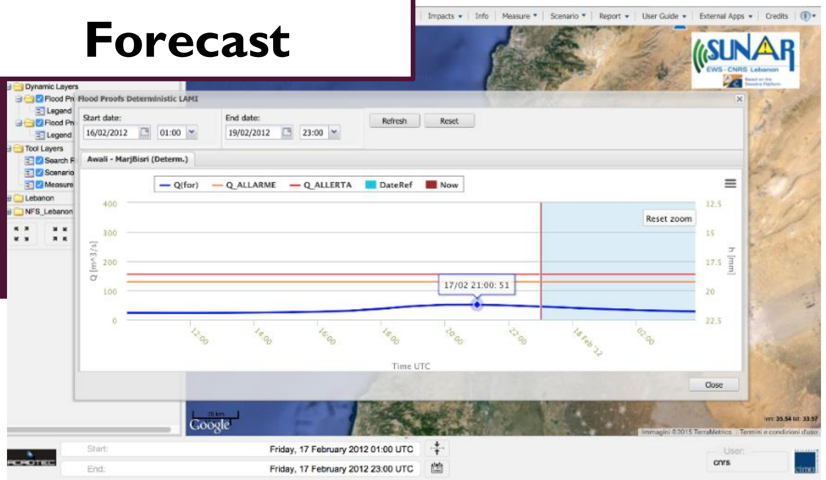


Satellite Snow Cover Area H10

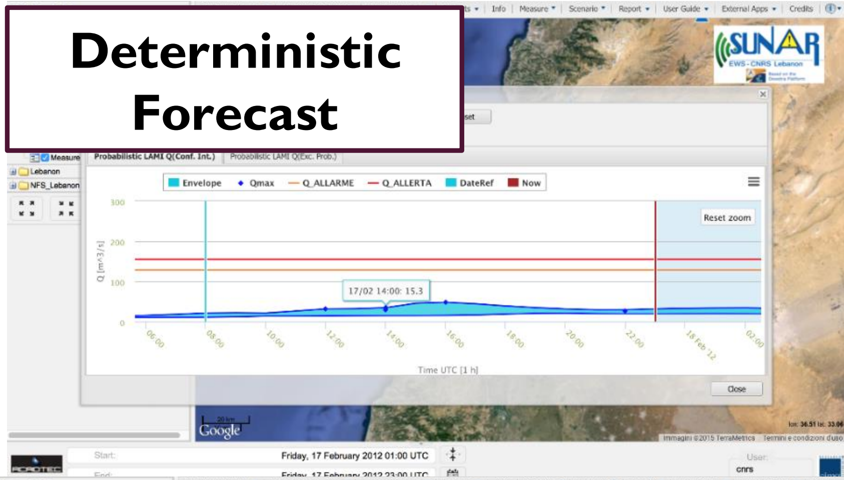


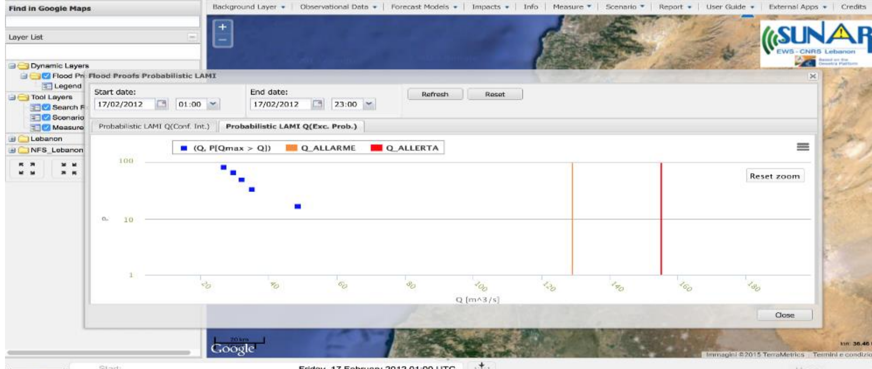
Satellite Precipitation H05

Probabilistic Forecast



Deterministic Forecast





Dynamic risk assessment (data and methods)

METEO FORECASTED DATA

The system receives daily the outputs of a meteorological ***Limited Area Model*** (LAM), namely *COSMO ME* comprising a set of data discretized in time steps of 3 hours, over a time horizon of 72 hours

t_k (h) air temperature [K]

r_k (h) dew point temperature [K]

p_k (h) cumulate rainfall ($t_h - t_{h-1}$) [m]

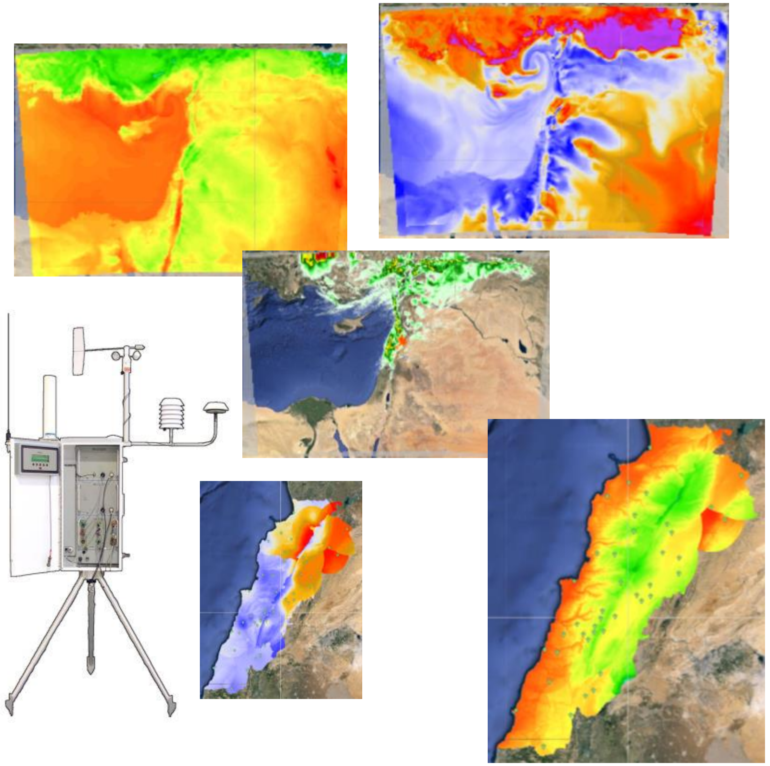
w_k (h) wind speed [m s^{-1}]

h_k (h) wind direction [rad]

METEO OBSERVED DATA

Each new run of the system is fed by fresh data obtained from the available meteorological observations.

Information relevant to cumulate rainfall, RH and temperature observed by about 40 meteo stations is interpolated to obtain the fields defining the initial state of each run.

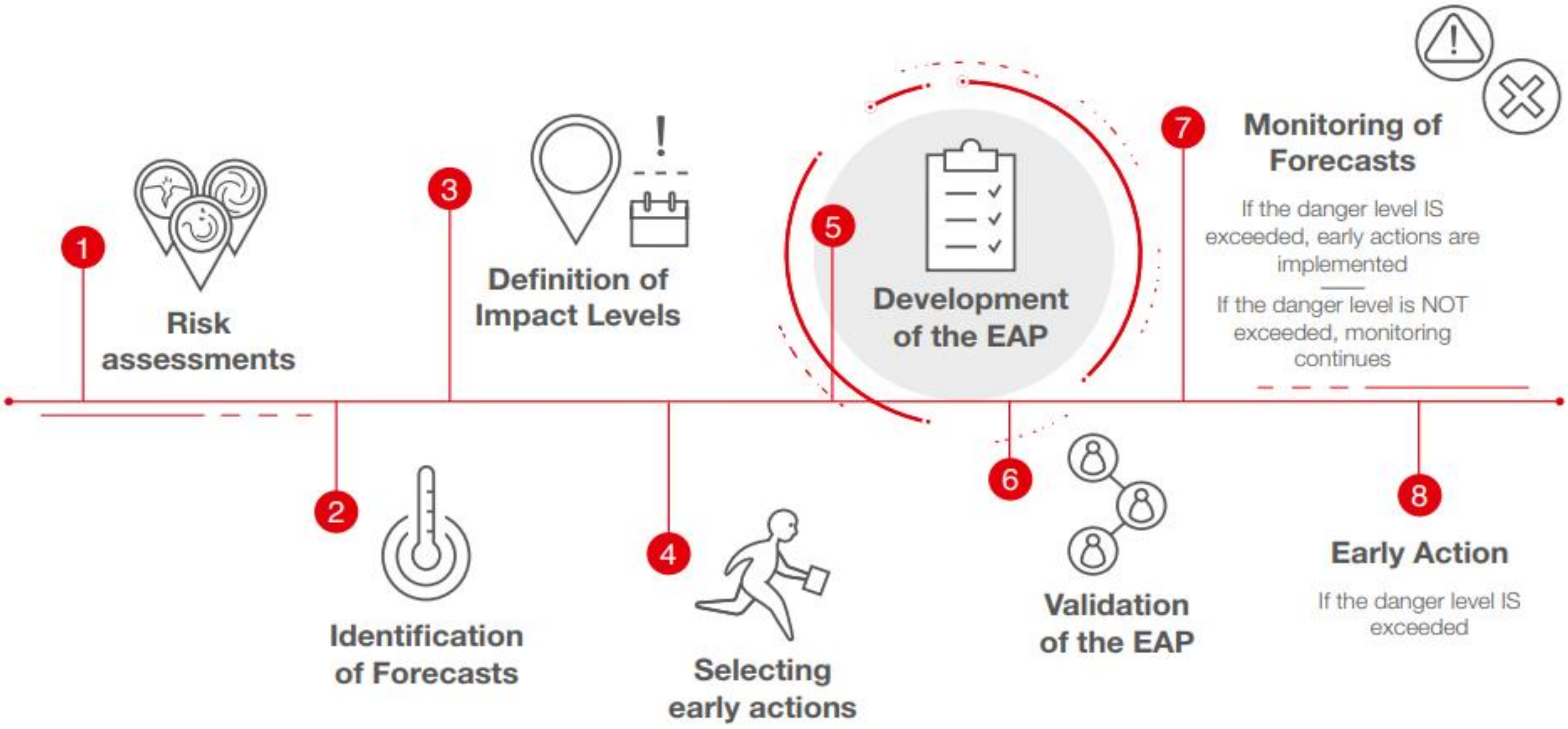


Forecast based financing ?

Early Actions are all the activities that can take place before a potential disaster in order to ***prevent and/ or mitigate*** a disaster and /or to ***prepare for effective response***

Forecast based Financing takes advantage of the window period between the issuance of an alert and the occurrence of the anticipated event

Steps of FBF



1
Risk assessments
2
Identification of Forecasts
3
Definition of Impact Levels
4
Selecting early actions
5
Development of the EAP
6
Validation of the EAP
7
Monitoring of Forecasts
If the danger level IS exceeded, early actions are implemented
If the danger level is NOT exceeded, monitoring continues
8
Early Action
If the danger level IS exceeded

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الخاتمة

ستحدد تحليلات النتائج **مواقع التدخل الموصى بها** بمعلومات مفصلة

ستساهم هذه النتائج **بدراسة كيفية** **المحلية** على مواجهة الحرائق

زيادة قدرات المجتمعات

ستساهم **بالحدّ والتقليص من هذه الحرائق** اضافة الى **زيادة الوعي المجتمعي**