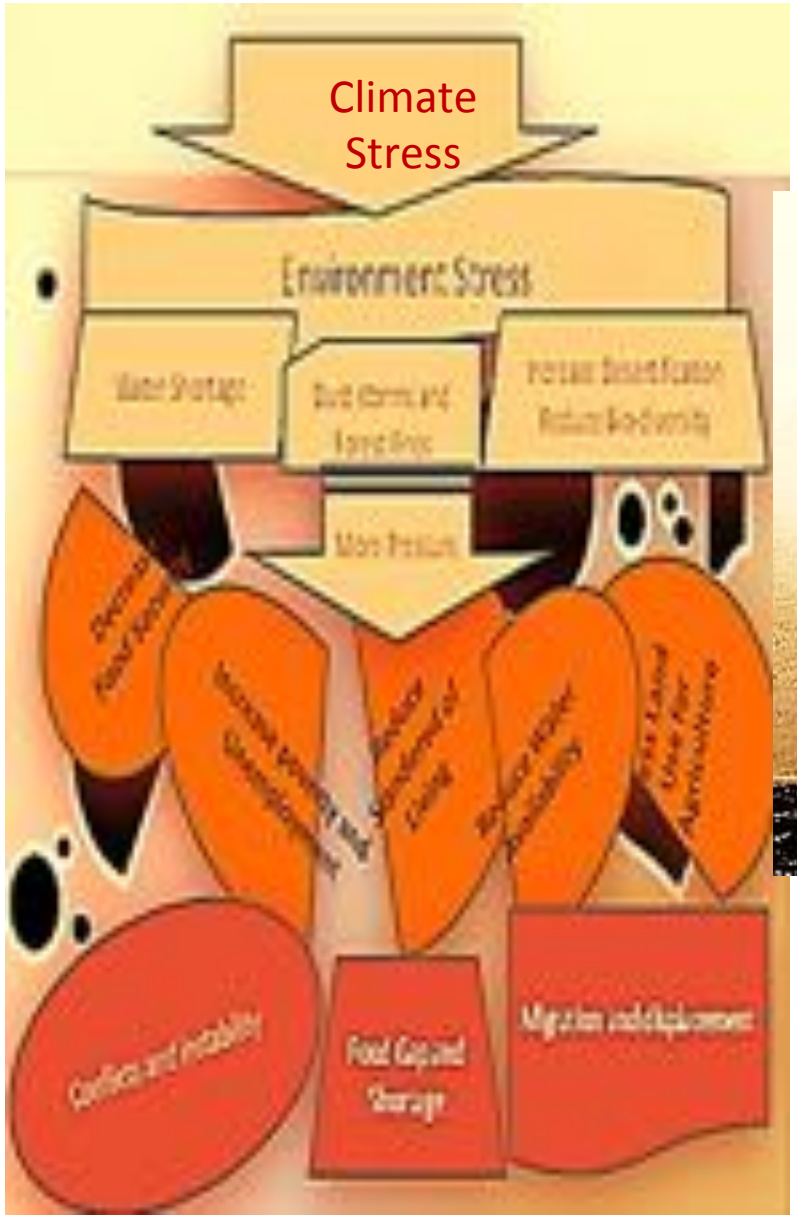


Mapping and Modeling Agriculture Drought Hazard

Prof. Wadid ERIAN

Prof. of Soil Science Cairo University
LAS Programme Coordinator

- **LAS Climate Risk Nexus Initiative "LAS CRNI"** The League of Arab States Geographical Information Room – Hosted by Arab Water Council
- LAS AGIR – Hosted by AWC

Scoping Meeting on Assessing Drought Risk and the Agricultural Sector in the UNISDR led Global Risk Model
Historic Hotel Boulderado, in Boulder, Colorado, USA, between the 7th and 9th of February, 2017

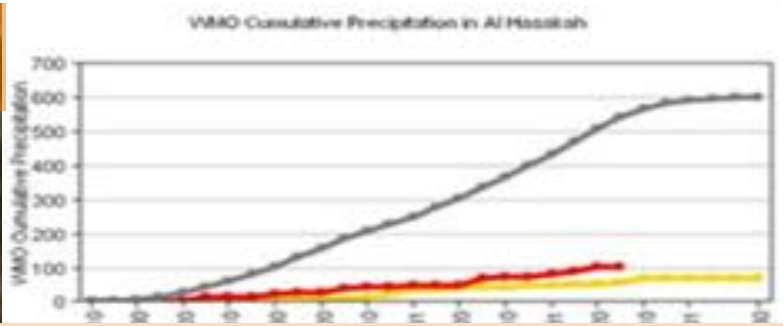
What is Drought?

A period of abnormally dry weather long enough to cause a serious hydrological imbalance.

Drought is a relative term
shortage of precipitation
related to particular activity

Storage changes in soil moisture and groundwater are also affected by increases in actual evapotranspiration in addition to reductions in precipitation.

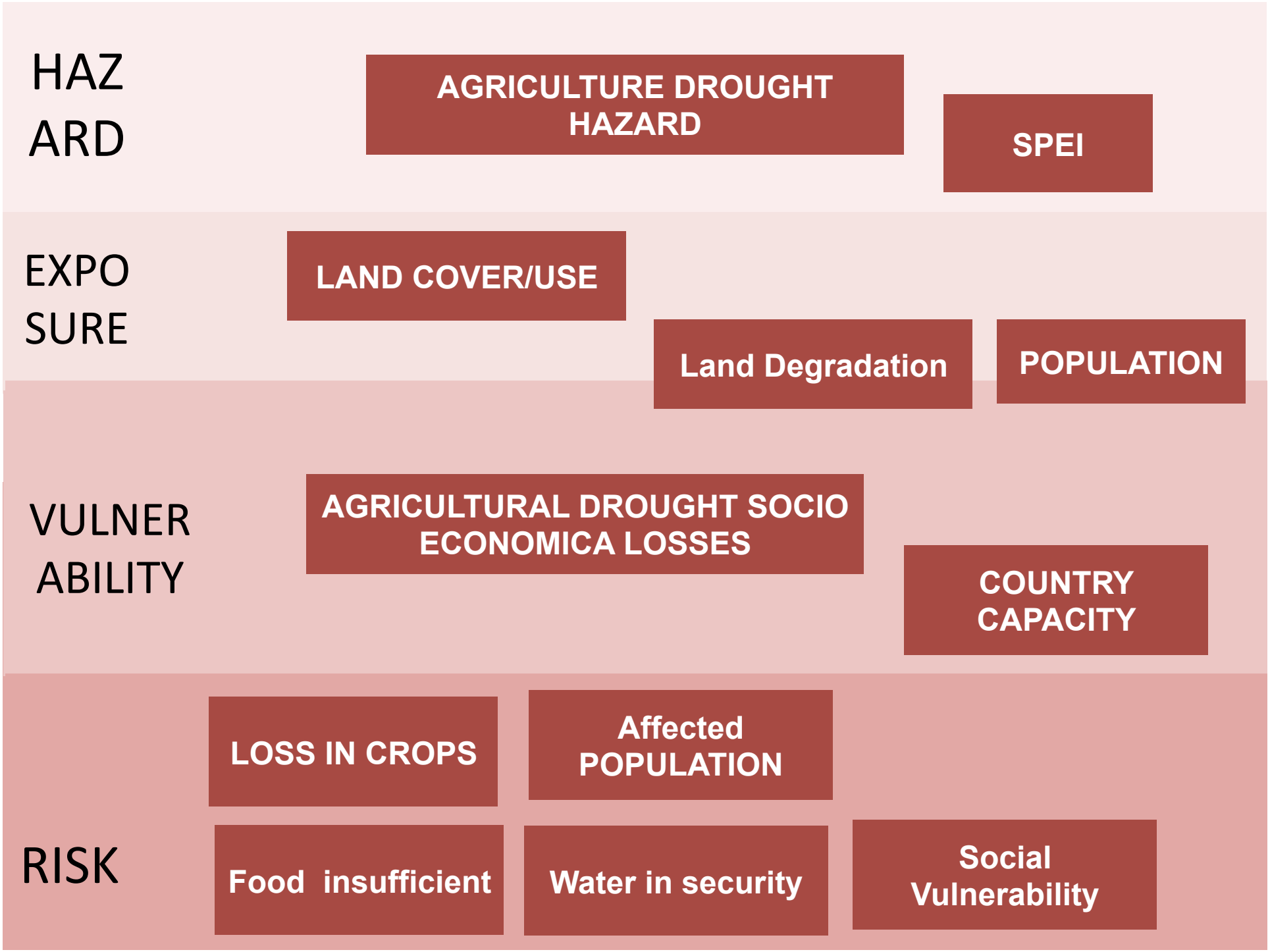
A MEGADROUGHT
is drought, lasting much longer than normal, usually a decade or more.

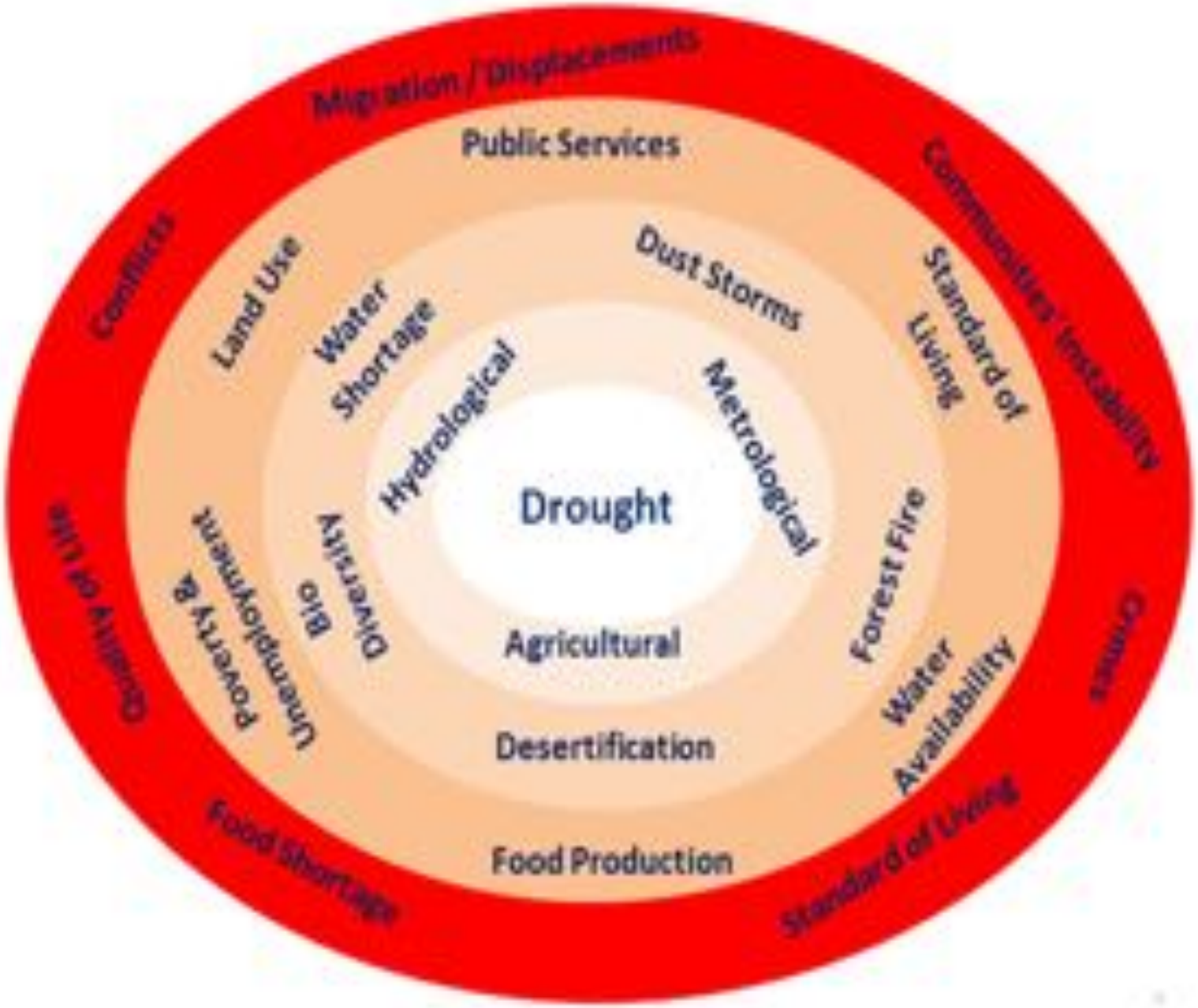


Precipitation deficit is defined as a METEOROLOGICAL DROUGHT.

during the growing season affects yield - SOIL MOISTURE DROUGHT, or AGRICULTURAL DROUGHT,

during the runoff season affects water supplies – HYDROLOGICAL DROUGHT.


HAZ
ARD
AGRICULTURE DROUGHT HAZARD
SPEI
EXPO
SURE
LAND COVER/USE
Land Degradation
POPULATION
VULNER
ABILITY
AGRICULTURAL DROUGHT SOCIO ECONOMICA LOSSES
COUNTRY CAPACITY
RISK
LOSS IN CROPS
Affected POPULATION
Food insufficient
Water in security
Social Vulnerability



Framework for building Drought Risk, Water, Food, and Socio-economy Nexus, after Erian et al (2014)

Modeling and Mapping Related MULTI-HAZARDS

- Land Degradation
- Drought
- Floods
- Flash Floods
- Forest Fires
- Dust Storms
- Water erosion/ mud flow
- Sand erosion/ encroachment

Define single, compound and Multi-hazards Hot spots areas

Mapping and Modeling Affected Areas by Drought

Mean Temperature 5 km

Precipitation 5km

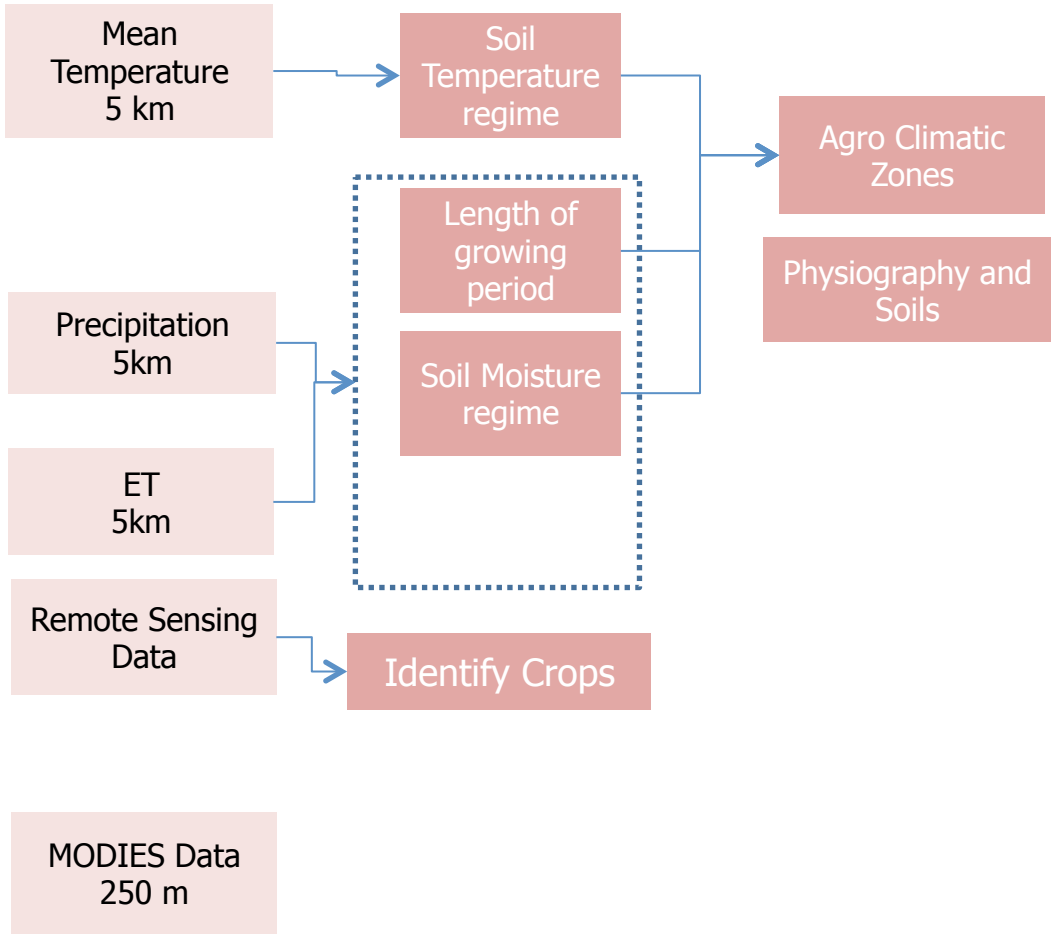
ET 5km

Remote Sensing Data

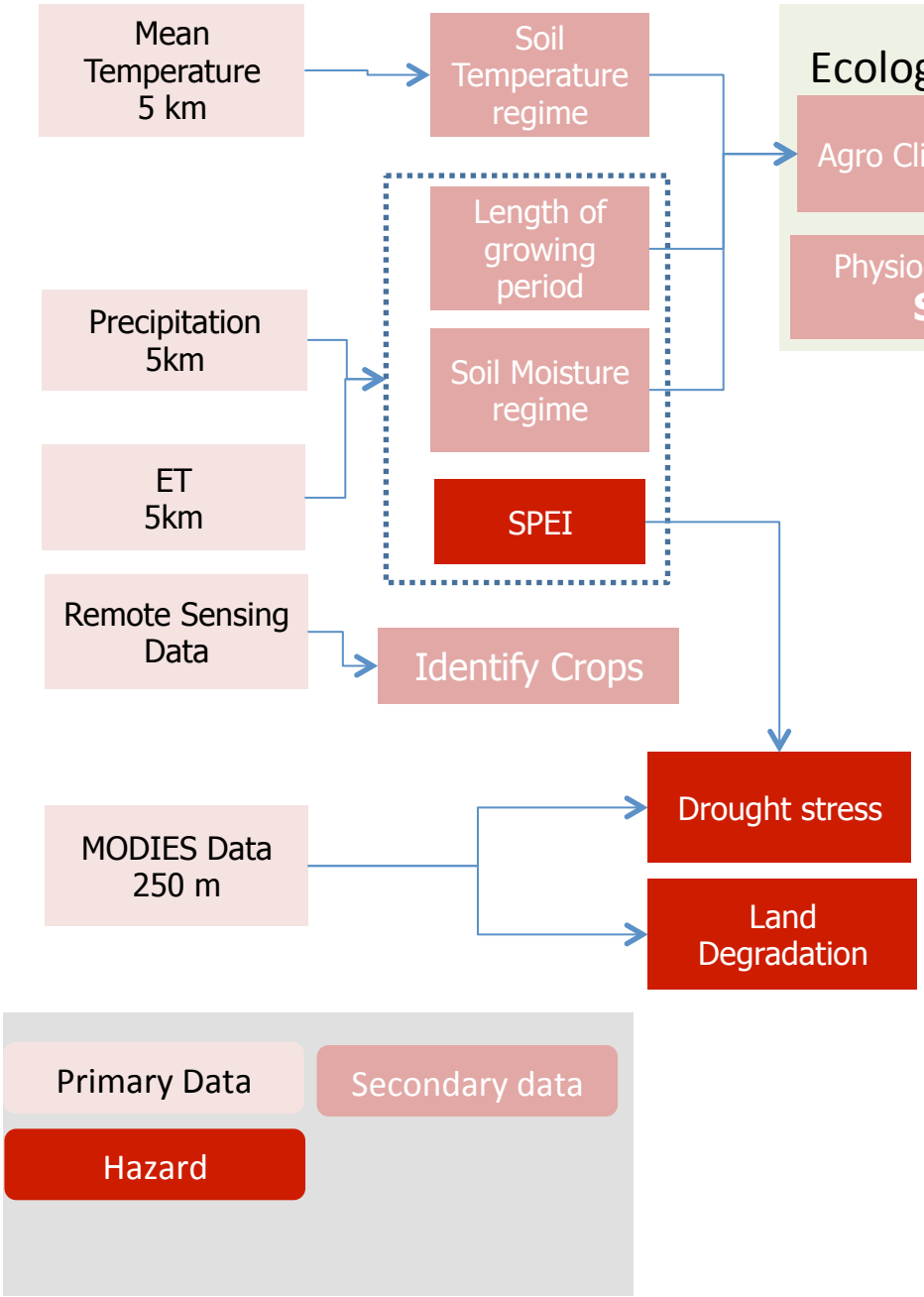
MODIES Data 250 m

Primary Data

Mapping and Modeling Affected Areas by Drought

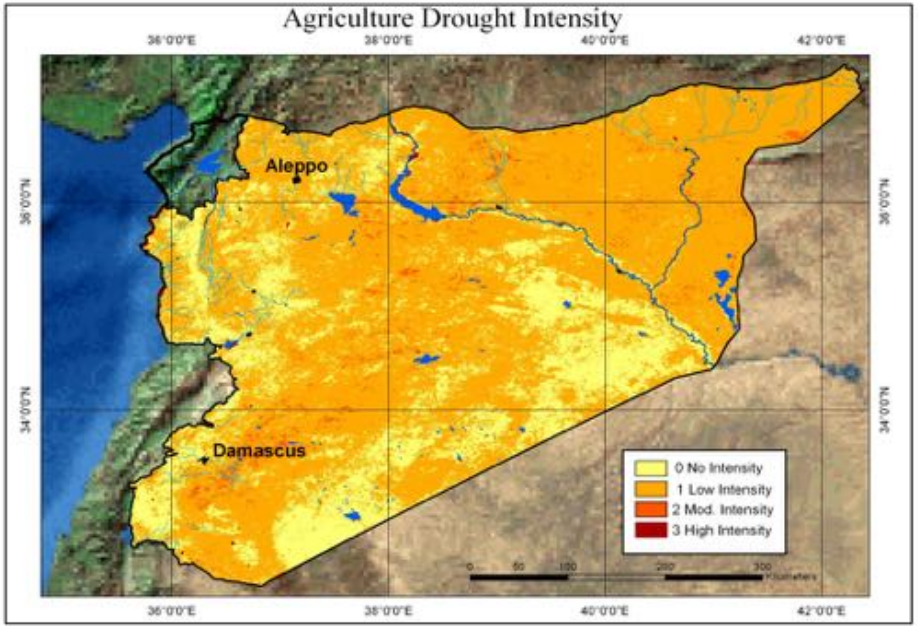


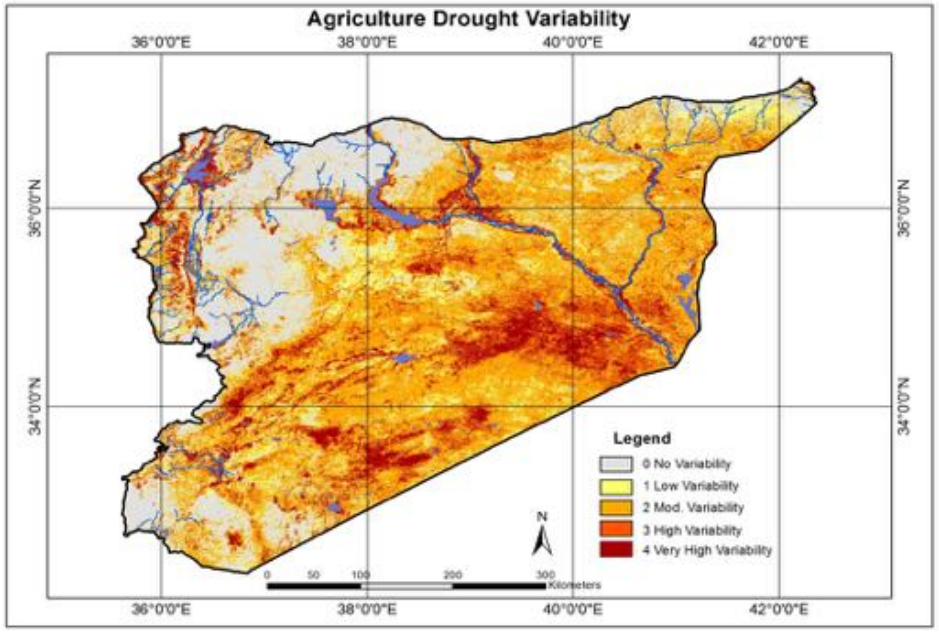
Mapping and Modeling Affected Areas by Drought

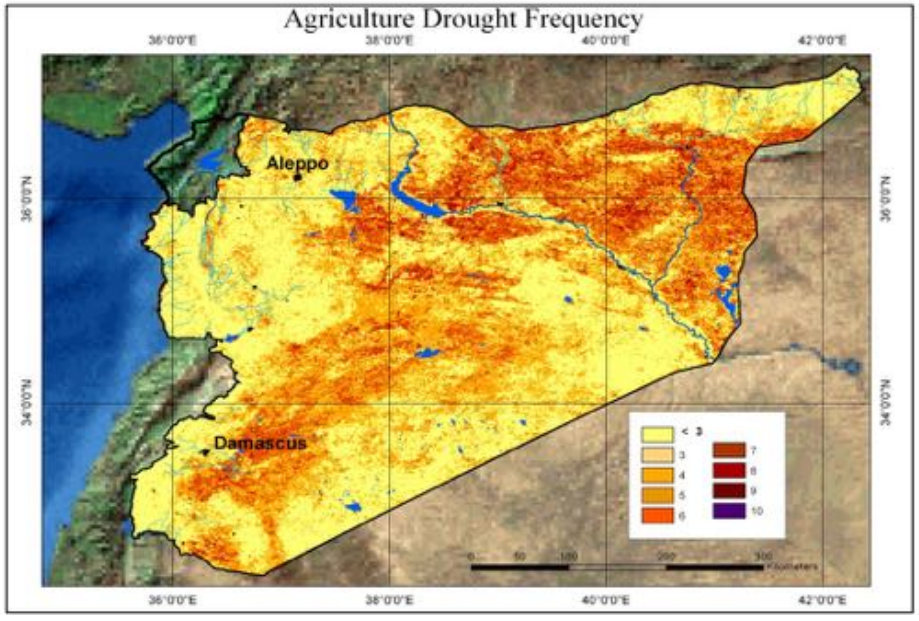


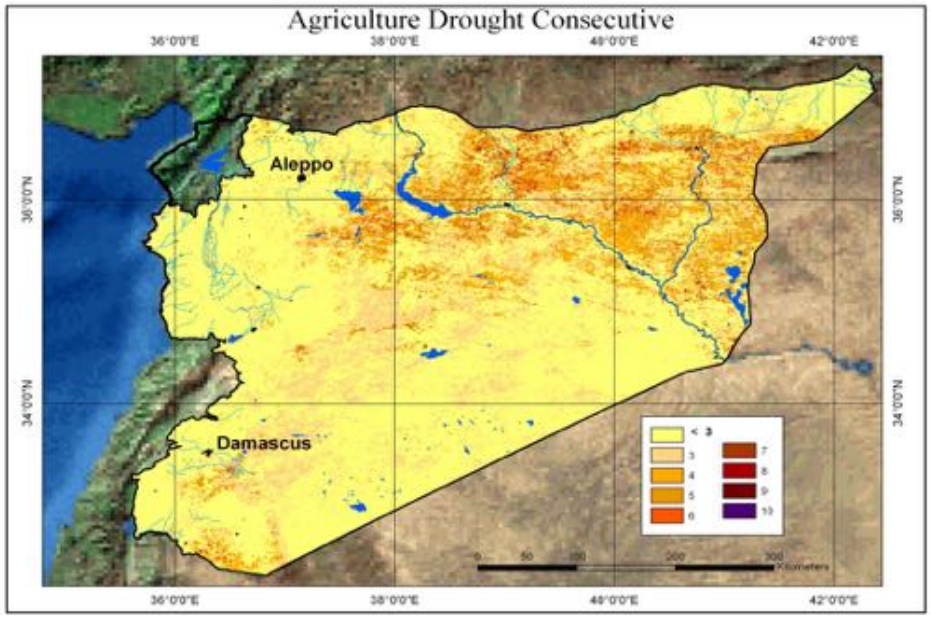
Modeling and Mapping Related HAZARDS

- ❑ Drought
- ❑ Land Degradation
- ❑ Floods
- ❑ Flash Floods
- ❑ Forest Fires
- ❑ Dust Storms
- ❑ Water erosion/ mud flow
- ❑ Sand erosion/ encroachment
- ❑ Define single, compound and Multi-hazards Hot spots areas

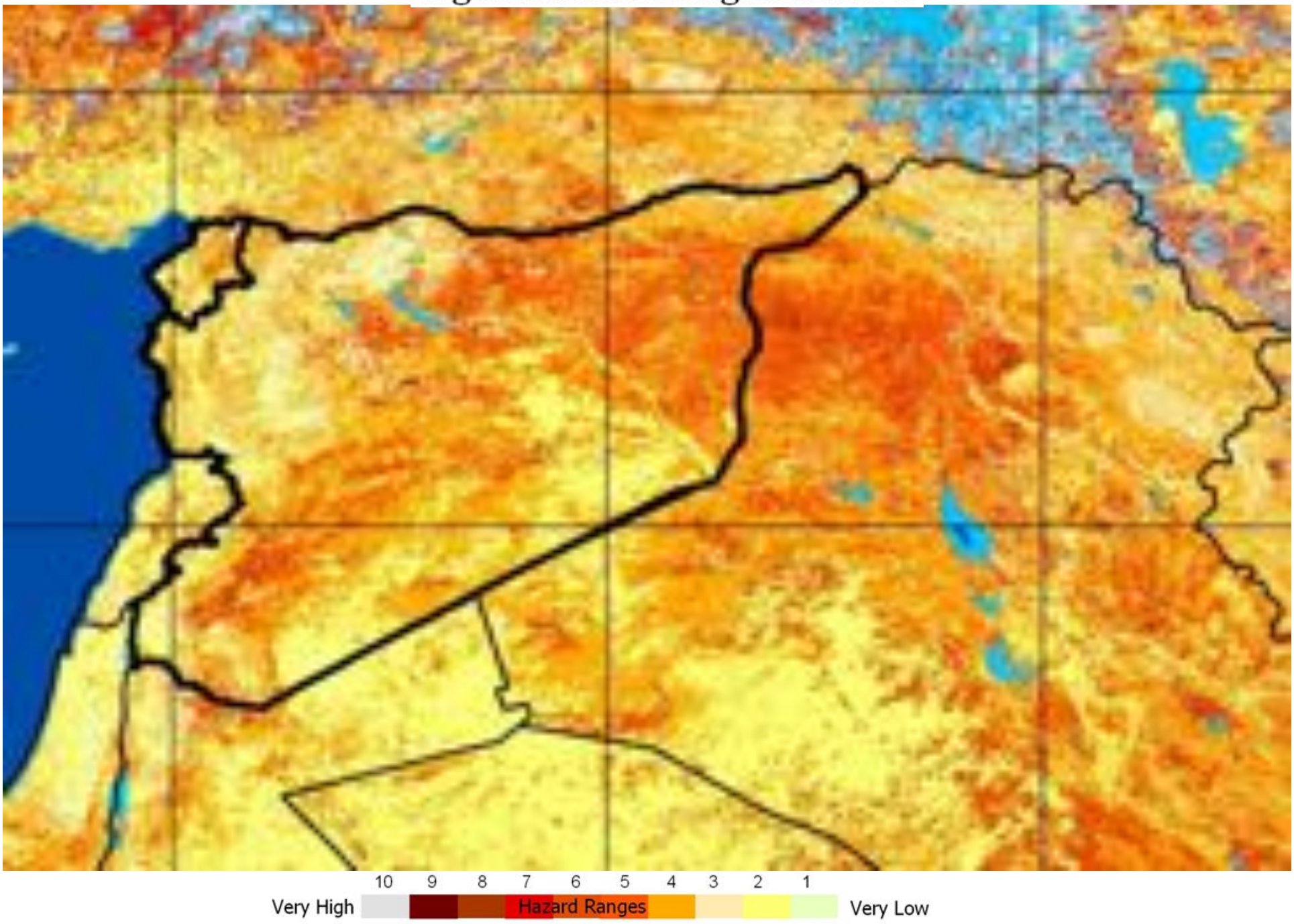

Agriculture Drought Intensity
36°0'0"E
38°0'0"E
40°0'0"E
42°0'0"E
36°0'0"N
34°0'0"N
Aleppo
Damascus
0 No Intensity
1 Low Intensity
2 Mod. Intensity
3 High Intensity
0 50 100 200 300
Kilometers

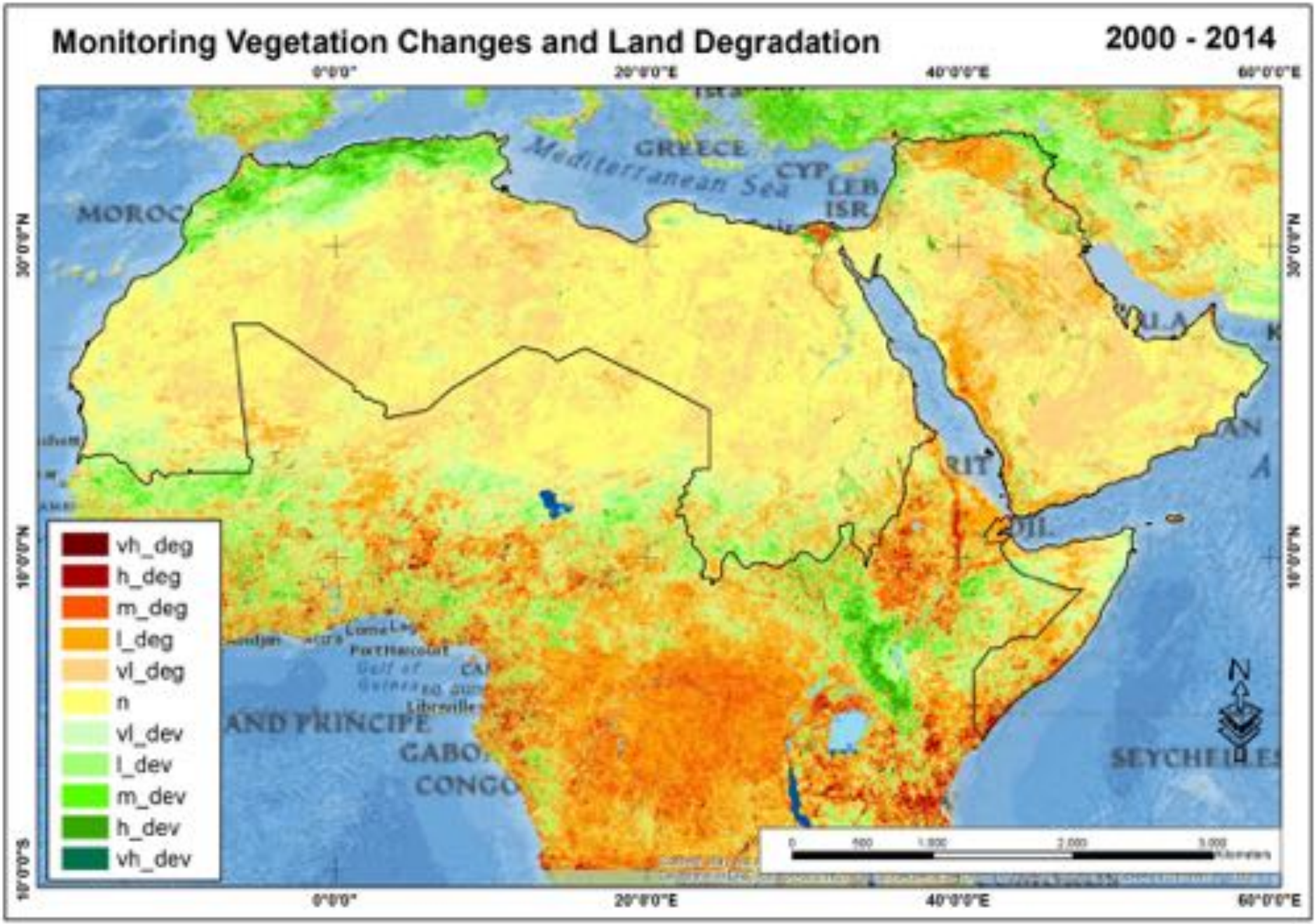

Agriculture Drought Variability
36°0'0"E
38°0'0"E
40°0'0"E
42°0'0"E
36°0'0"N
34°0'0"N
Legend
0 No Variability
1 Low Variability
2 Mod. Variability
3 High Variability
4 Very High Variability
N
0 50 100 200 300
Kilometers


Agriculture Drought Frequency
36°0'0"E
38°0'0"E
40°0'0"E
42°0'0"E
36°0'0"N
34°0'0"N
Aleppo
Damascus
< 3
3
4
5
6
7
8
9
10
0 50 100 200 300
Kilometers


Agriculture Drought Consecutive
36°0'0"E
38°0'0"E
40°0'0"E
42°0'0"E
36°0'0"N
34°0'0"N
Aleppo
Damascus
< 3
3
4
5
6
7
8
9
0 50 100 200 300
Kilometers

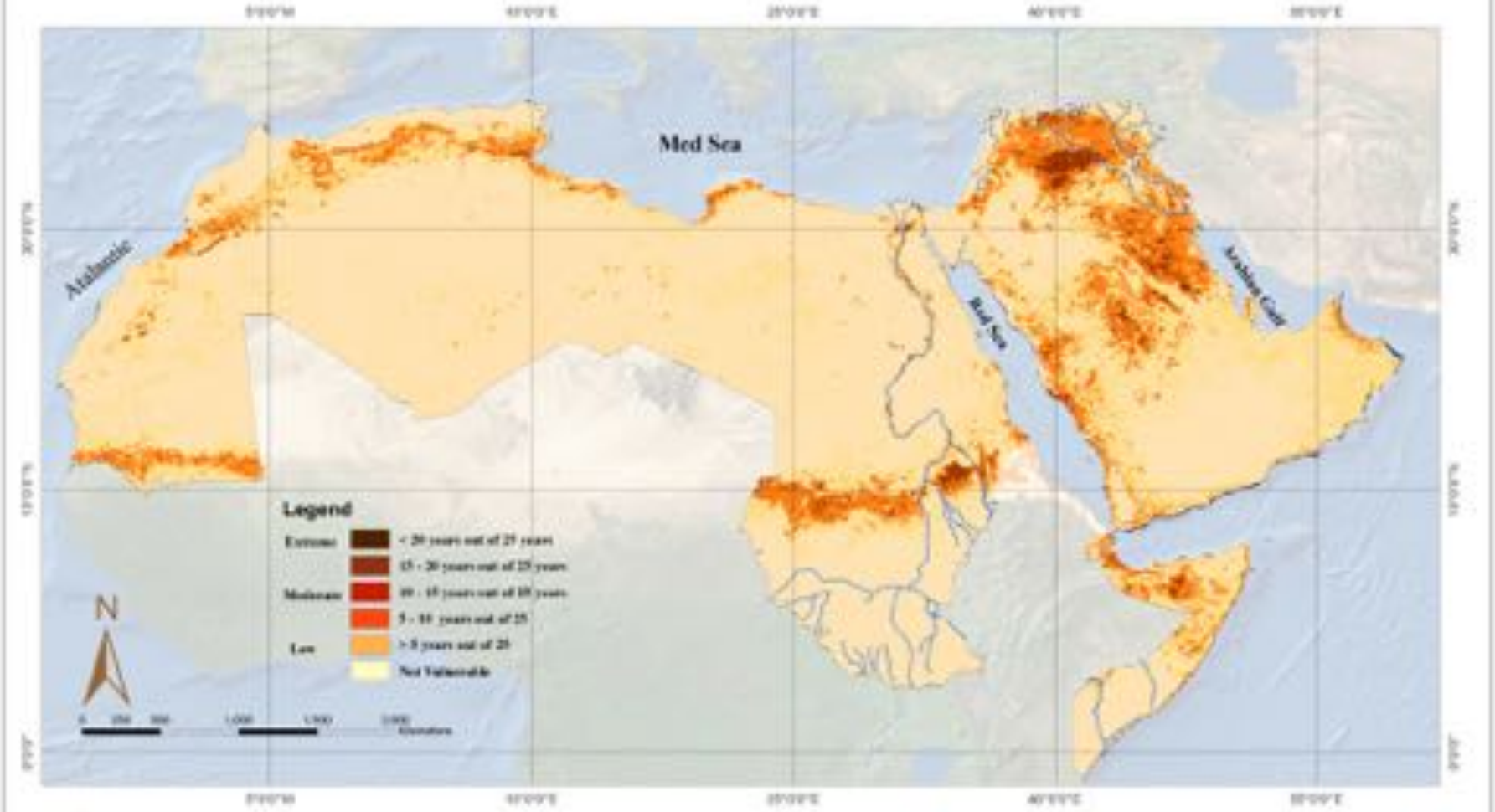
Agriculture Drought Hazard



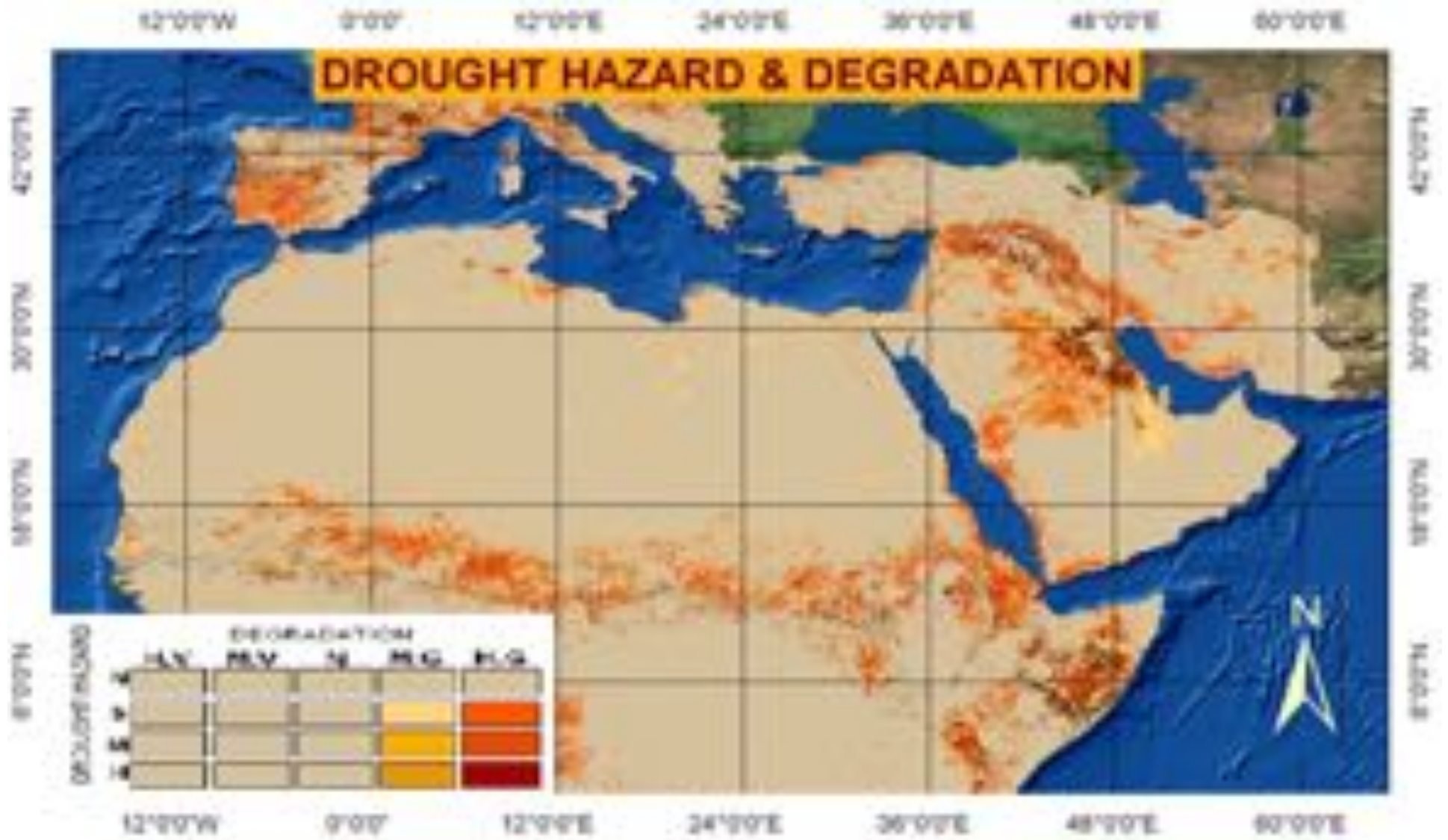

Monitoring Vegetation Changes and Land Degradation
2000 - 2014
0°0'0"
20°0'0"E
40°0'0"E
60°0'0"E
30°0'0"N
10°0'0"N
10°0'0"S
Mediterranean Sea
GREECE
CYP
LEB
ISR
MOROC
AND PRINCIPE
GABO
CONGO
SEYCHELLES
vh_deg
h_deg
m_deg
l_deg
vl_deg
n
vl_dev
l_dev
m_dev
h_dev
vh_dev
N

Freqeuncy of vegetation Cover Decrease over Years

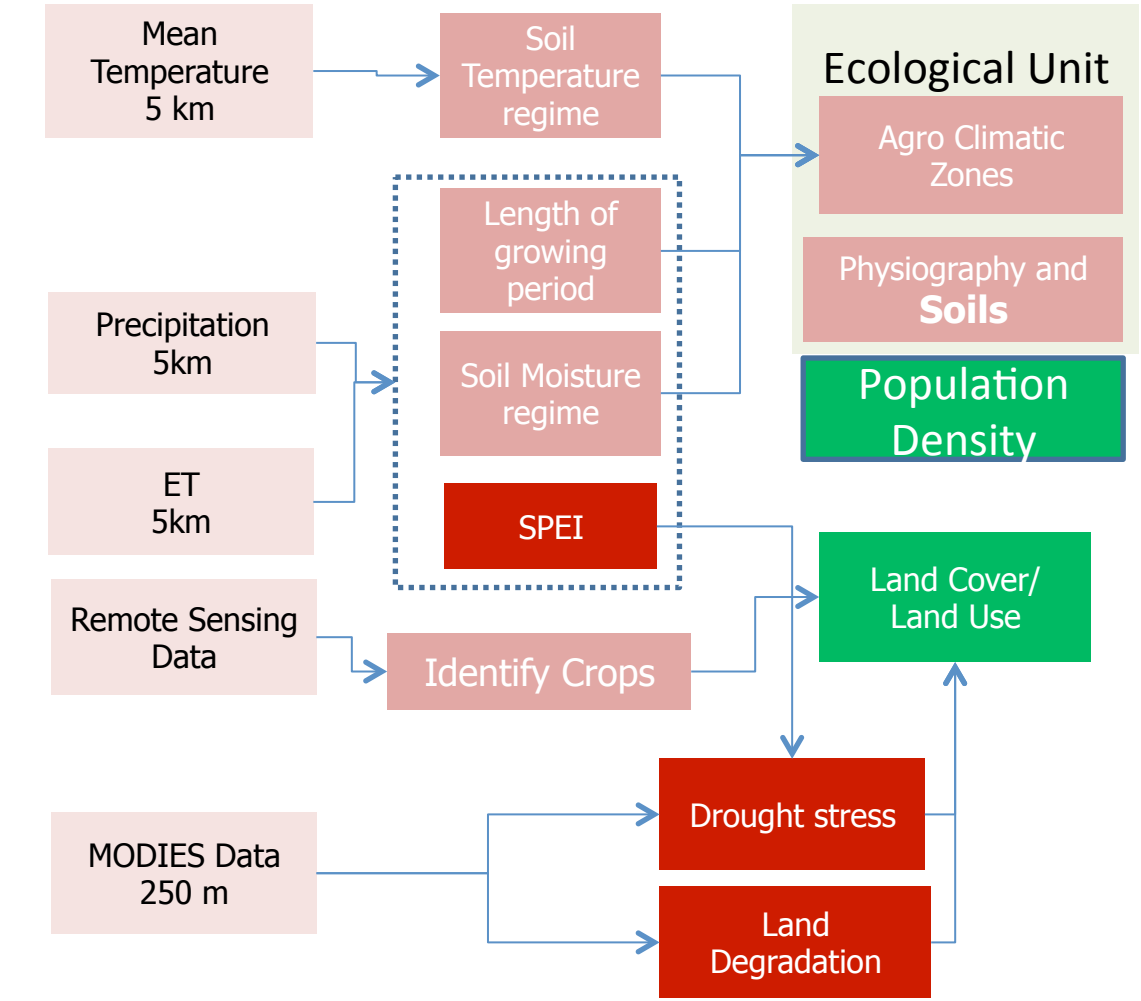
1982 - 2006



GIMMS IMAGES 8KM


DROUGHT HAZARD & DEGRADATION
12°0'0"W
0°0'0"
12°0'0"E
24°0'0"E
36°0'0"E
48°0'0"E
60°0'0"E
42°0'0"N
30°0'0"N
18°0'0"N
6°0'0"N
N

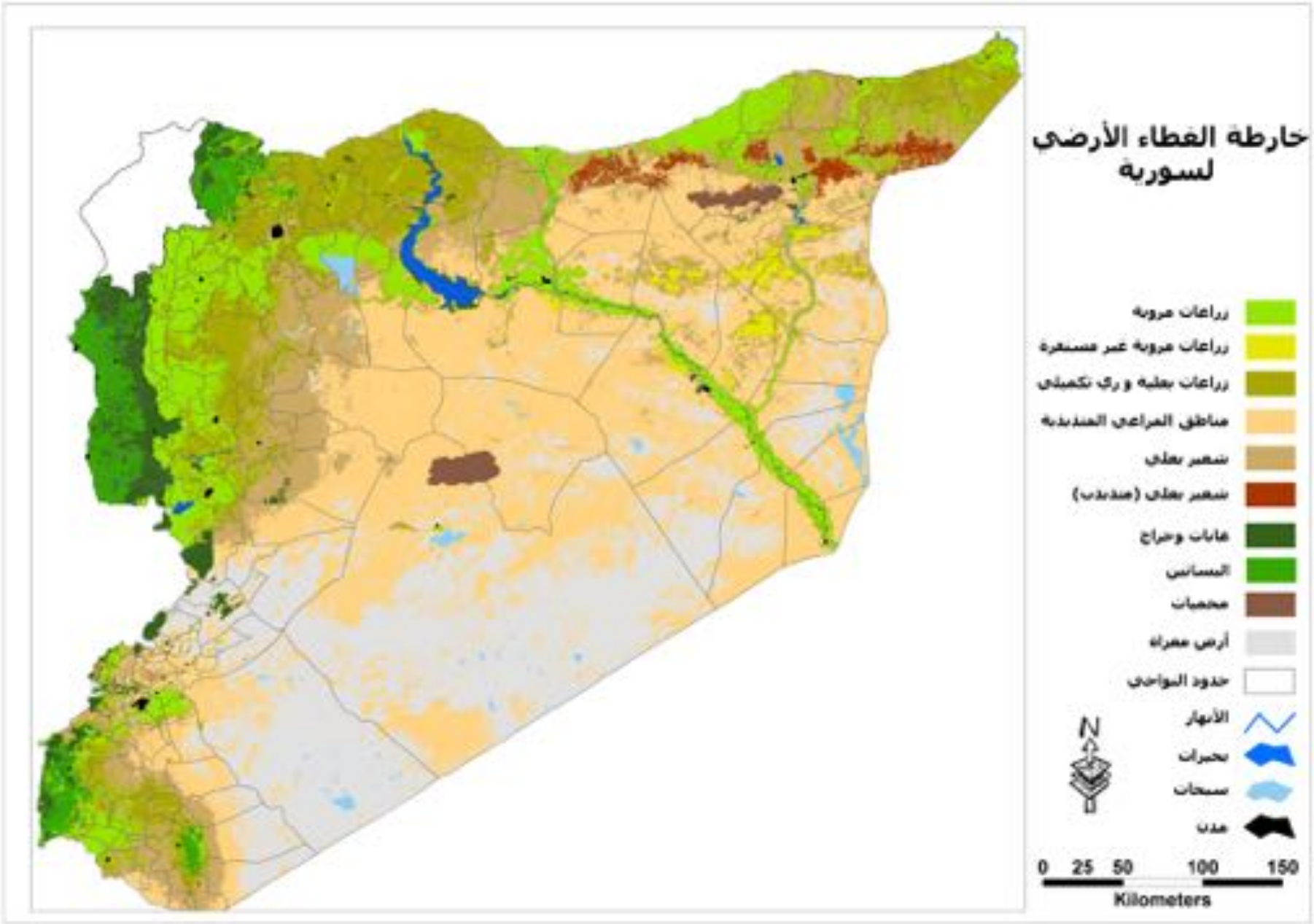
Mapping and Modeling Affected Areas by Drought

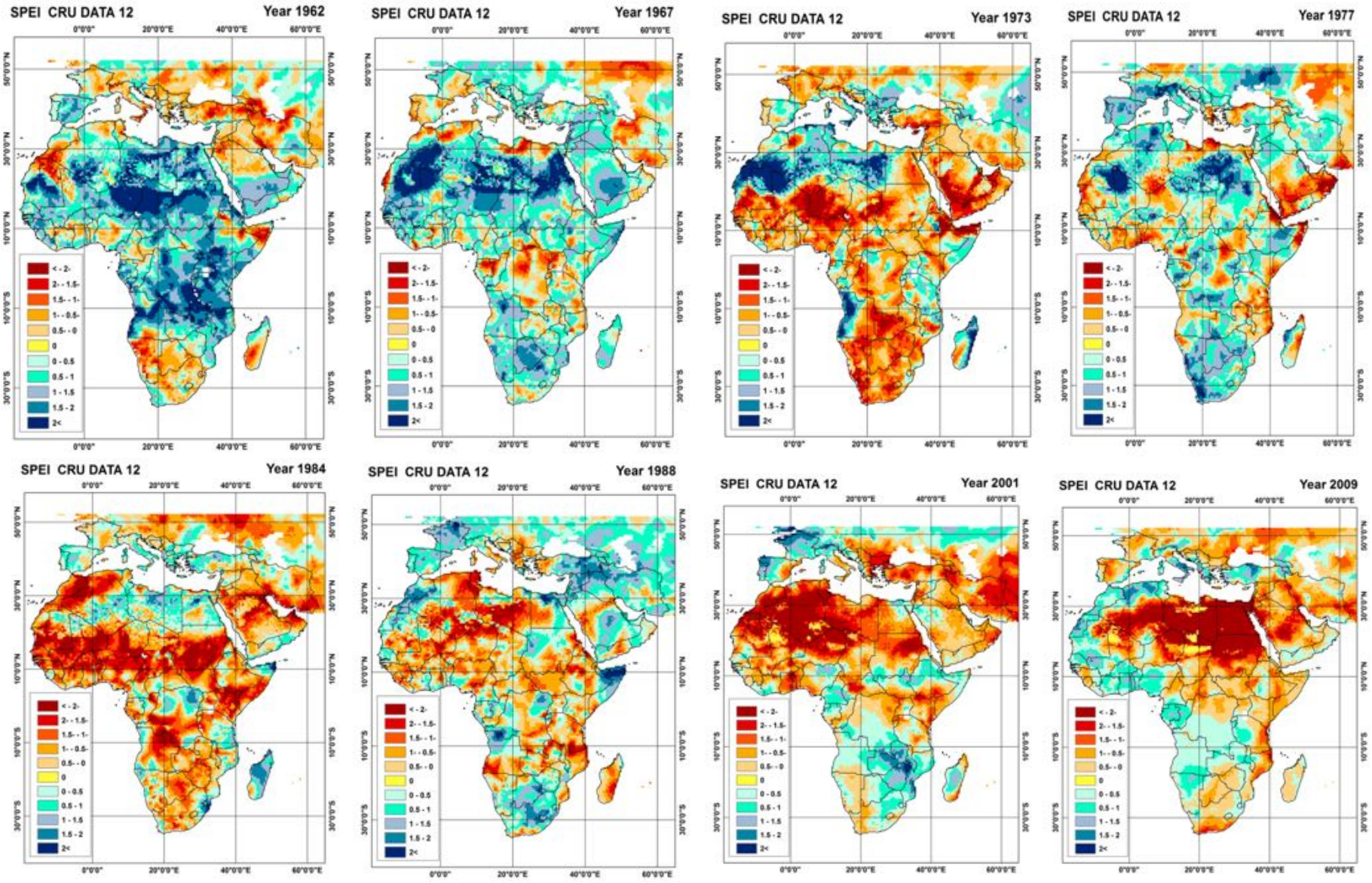


LAND COVER

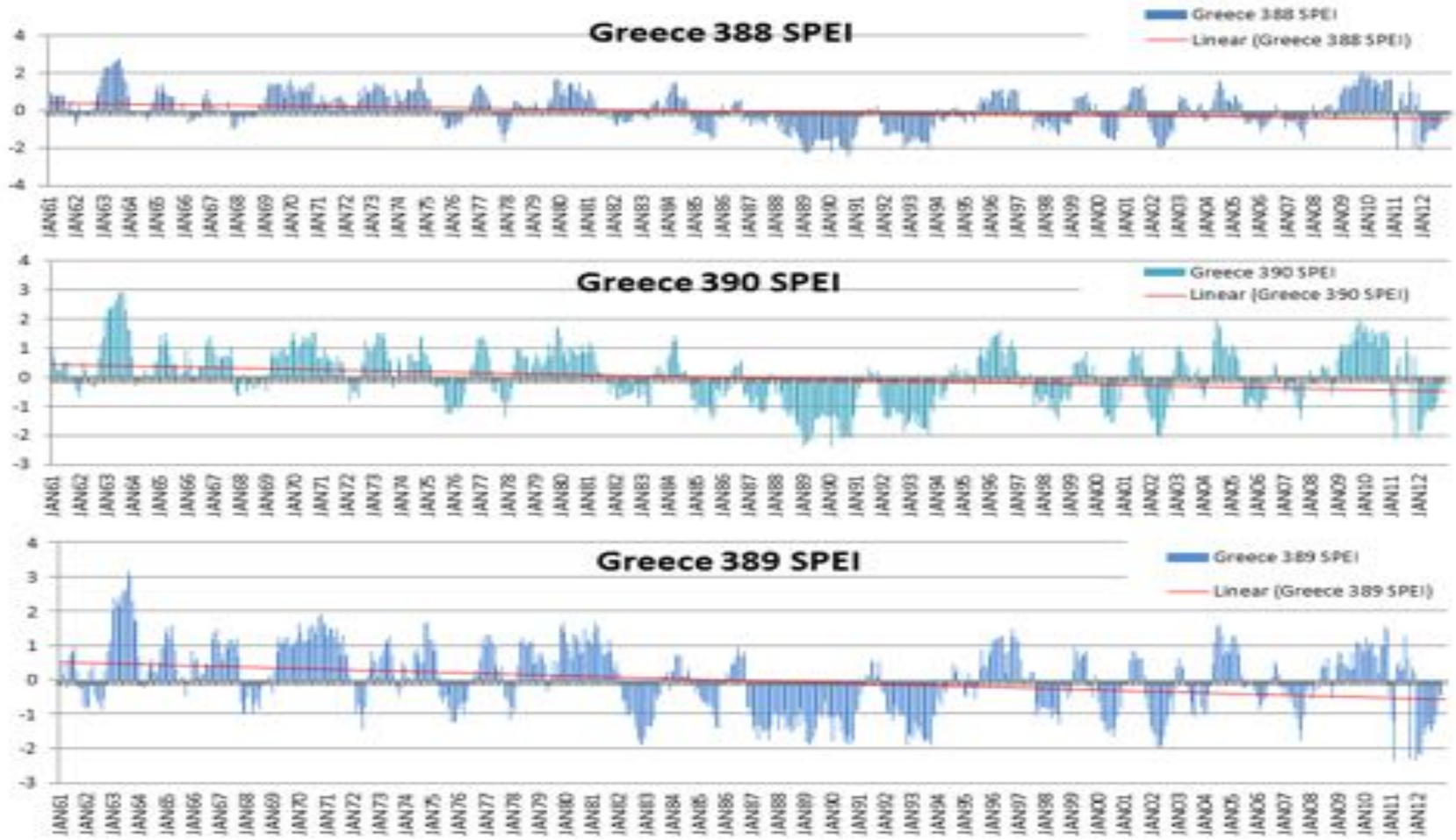
- ❑ Building Land scape
- ❑ (geomorphic unit)
- ❑ Lithology map
- ❑ Soils data bank
- ❑ ground water data base
- ❑ Hydrological basins database
- ❑ Ecological Units (geomorphic with geomorphology terms, agro-climatic zones and soils)
- ❑ Total vegetation cover
- ❑ Open natural Rangelands
- ❑ Shrubs
- ❑ Seasonal herbaceous
- ❑ Permanent herbaceous
- ❑ Rangelands
- ❑ Rainfed
- ❑ Irrigated agriculture (surface water)
- ❑ Irrigated agriculture (ground water)
- ❑ Irrigated agriculture (Brackish water)
- ❑ Forests
- ❑ Water bodies/bonds
- ❑ Oasis database
- ❑ Urban Areas
- ❑ Cities
- ❑ villages

Land Cover/ Land Use

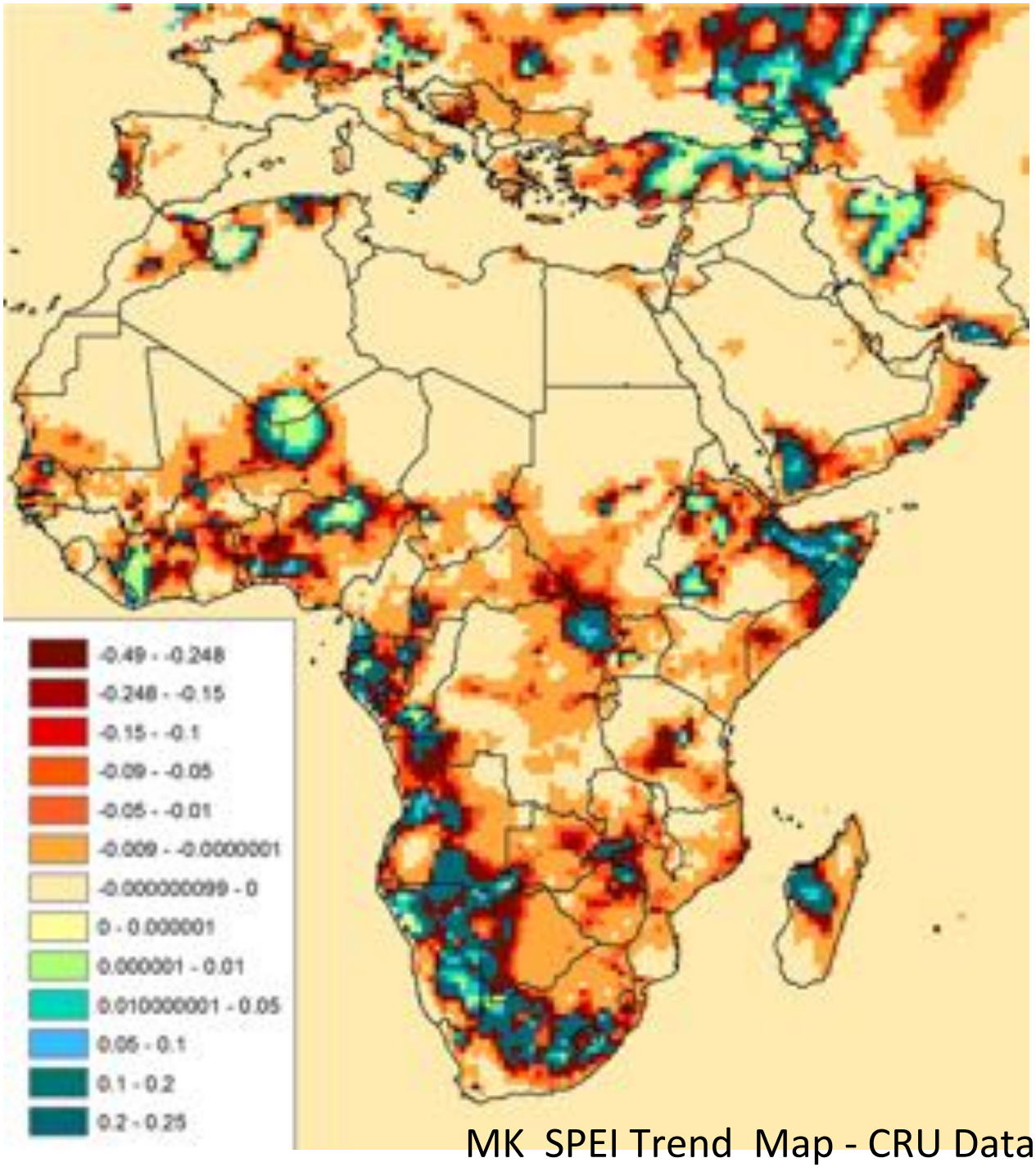




SPEI as average for some selected the Year (s) - CRU 12months

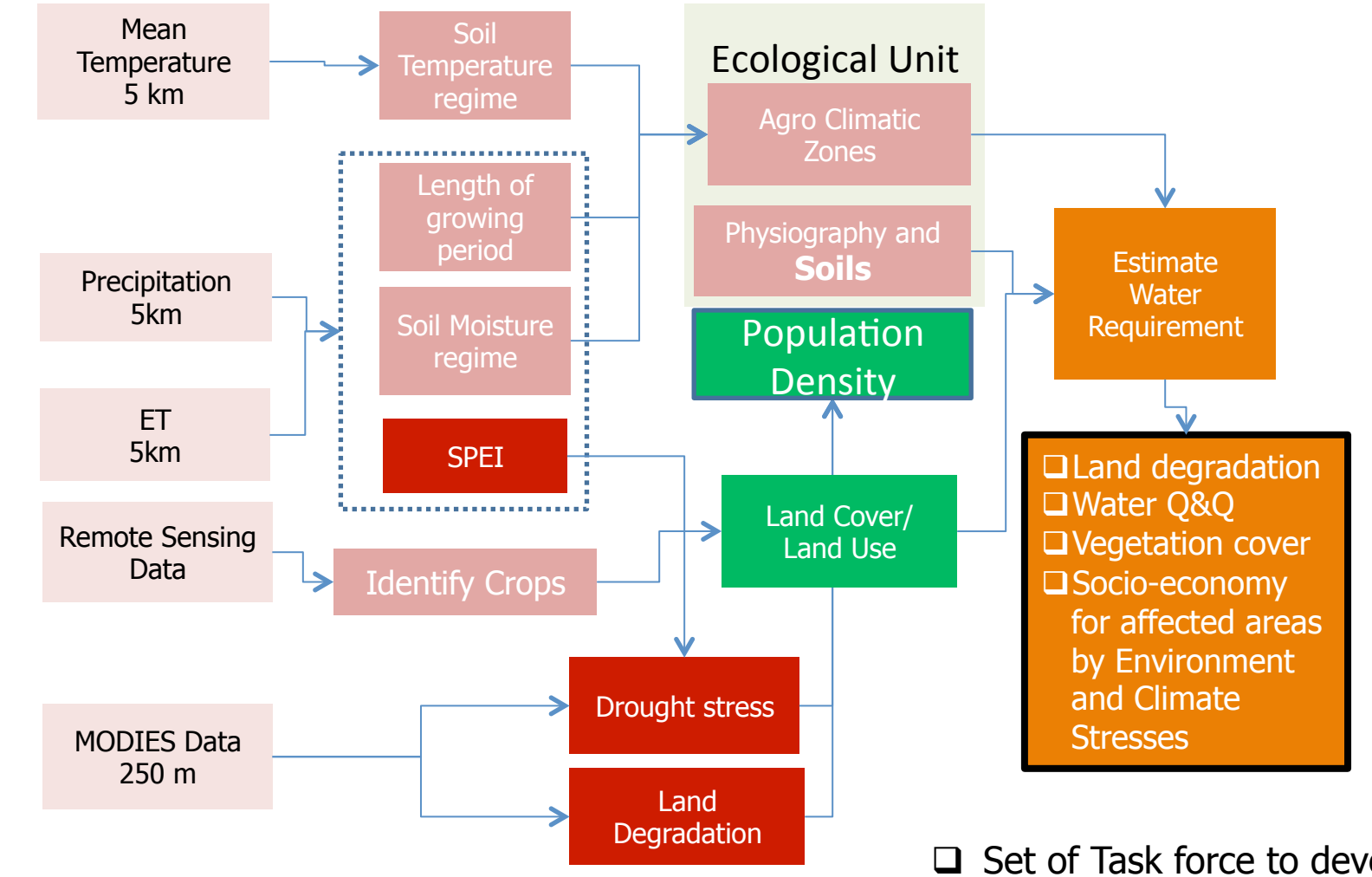


SPEI Value	Drought Classes
>=2.00	Extreme Wet
1.50 – 1.99	Severe Wet
1.00 – 1.49	Moderate Wet
0. 1 – 0.99	Slight Wet
0.0 – 0.1 to 0.0 – - 0.1	Normal
-0. 1 – - 0.99	Slight Drought
'-1.49 - -1.00	Moderate Drought
'-1.99 - -1.50	Severe Drought
<= -2.00	Extreme Drought



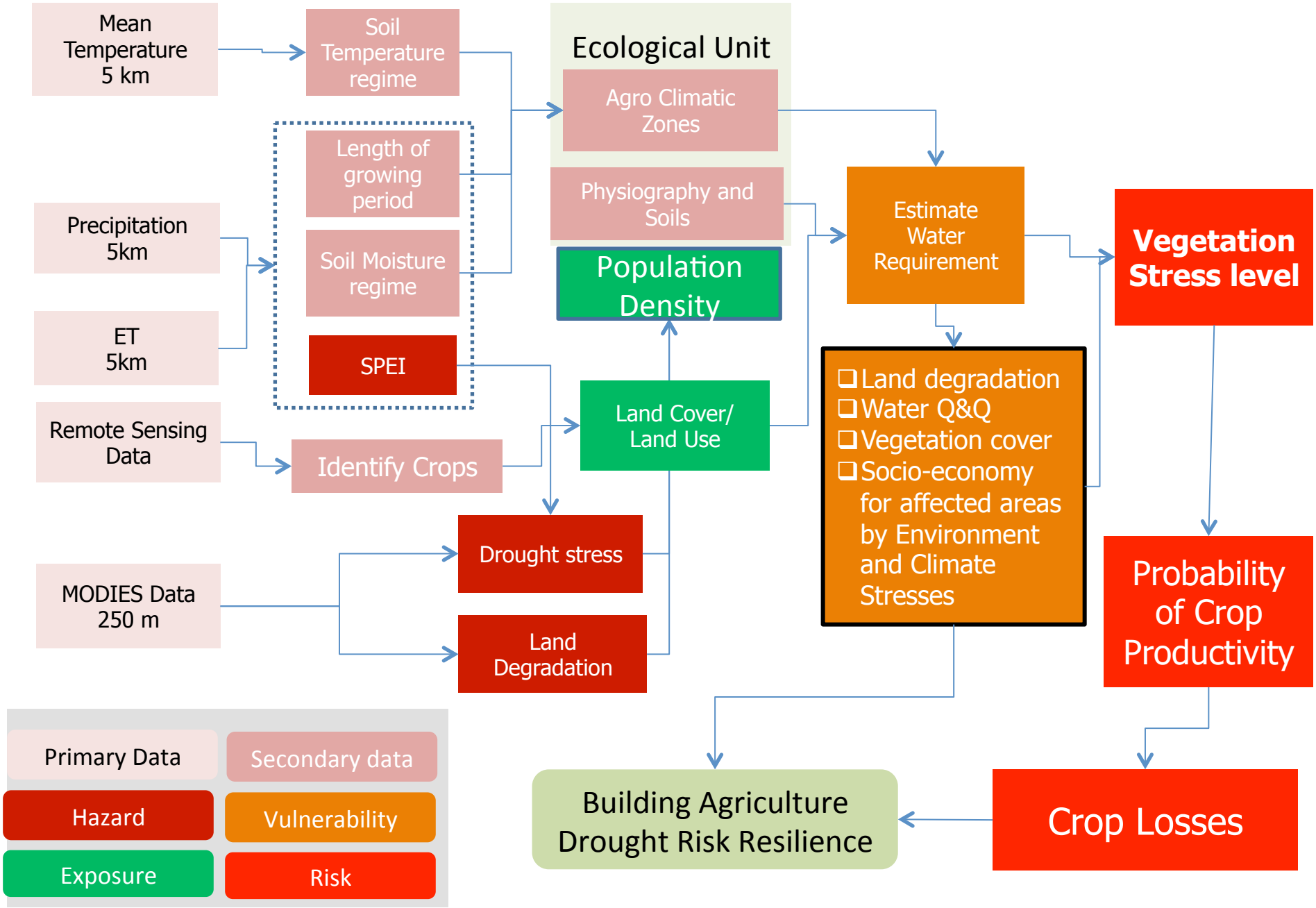
MK SPEI Trend Map - CRU Data , 12 Months

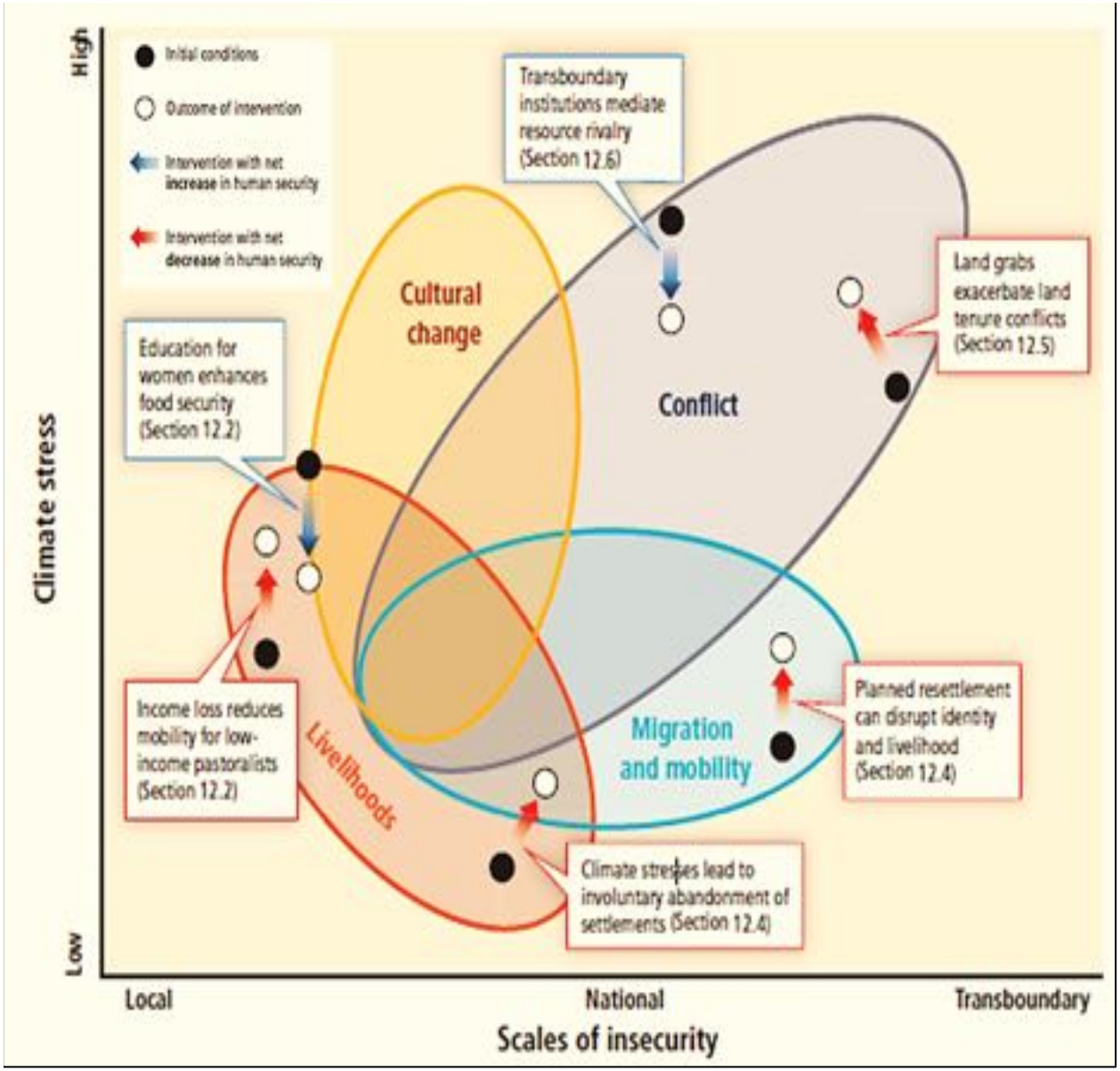
Mapping and Modeling Affected Areas by Drought



- Set of Task force to develop Social Vulnerability indicators
- Set a task force to develop the Model for Mapping SOCIO-ECONOMIC status

Mapping and Modeling Affected Areas by Drought



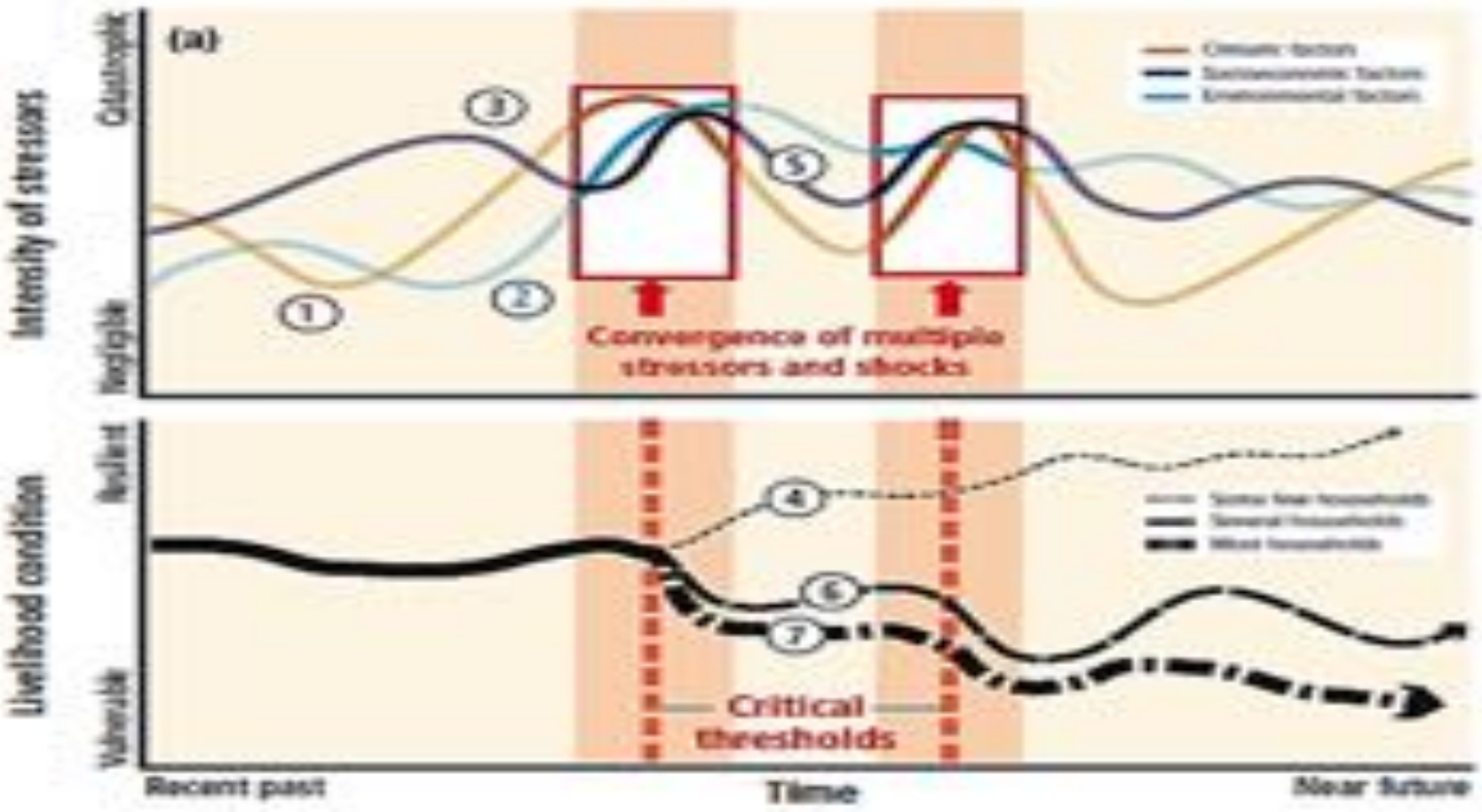


Agriculture Production is likely to be affected by Agriculture drought hazard, Land degradation and combined phenomena's .

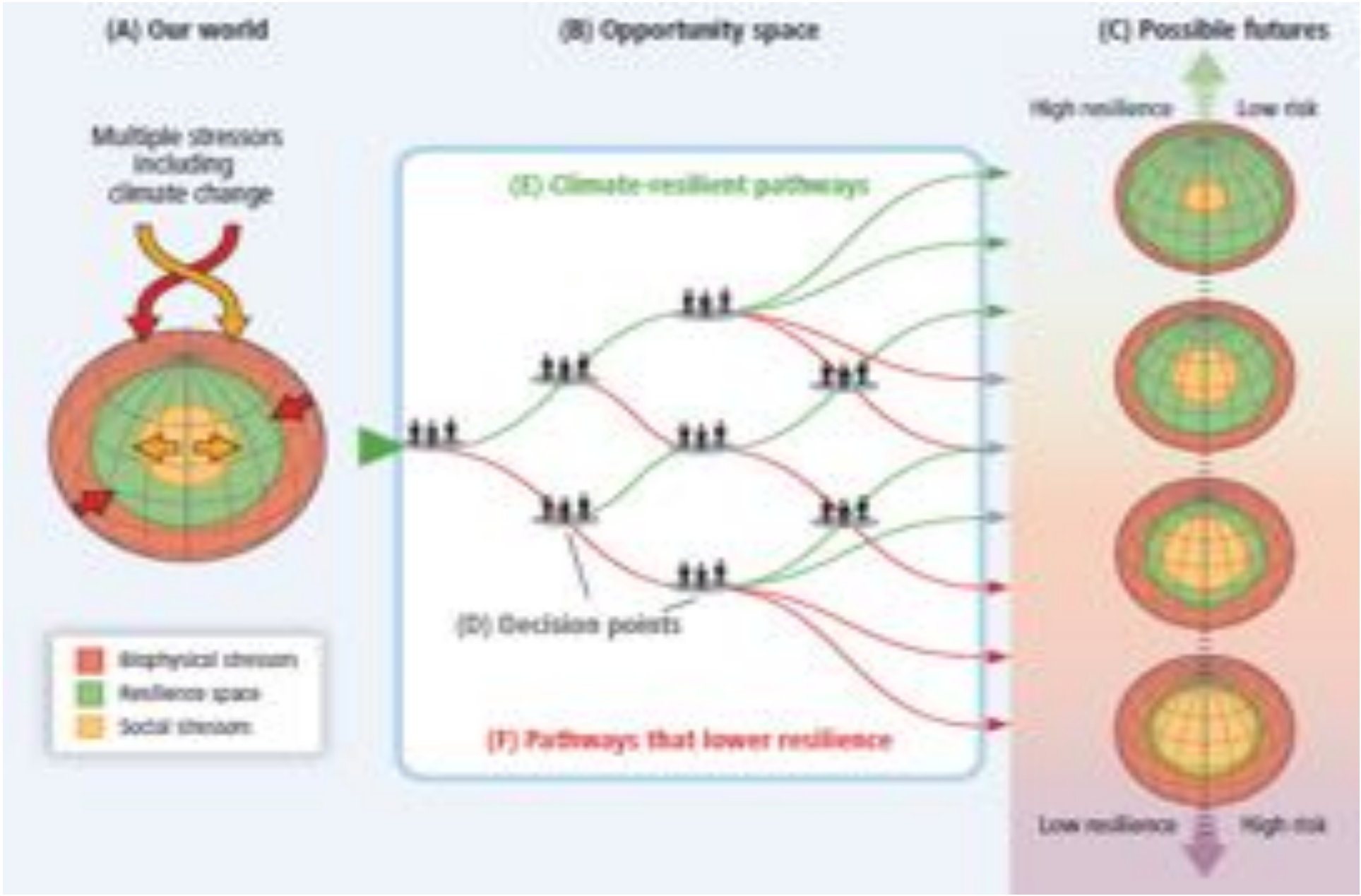
Increase in
Environmental stresses
Social Vulnerability
Are likely increasing
FOOD INSECURITY
And lead to
Migration, and Displacement,
Conflicts and instability

There for Changes in Landscape of food security due to increased hazards, Exposure and Vulnerability in National and Community levels
Could be one of the major challenges that affect Arab Region Stability .

Synthesis of evidence on the impacts of climate change on elements of human security and the interactions between livelihoods, conflict, culture, and migration. Interventions and policies indicated by difference between initial conditions (solid black) and outcome of intervention (white circles). Some interventions (blue arrows) show net increase human security while others (red arrows) lead to net decrease in human security. IPCC 2014

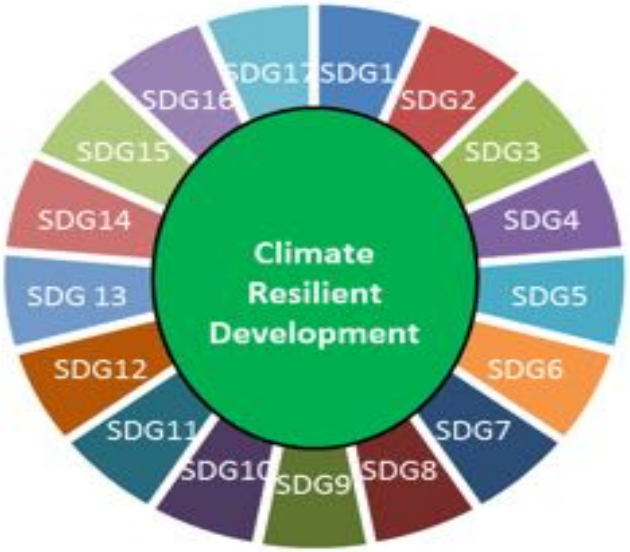


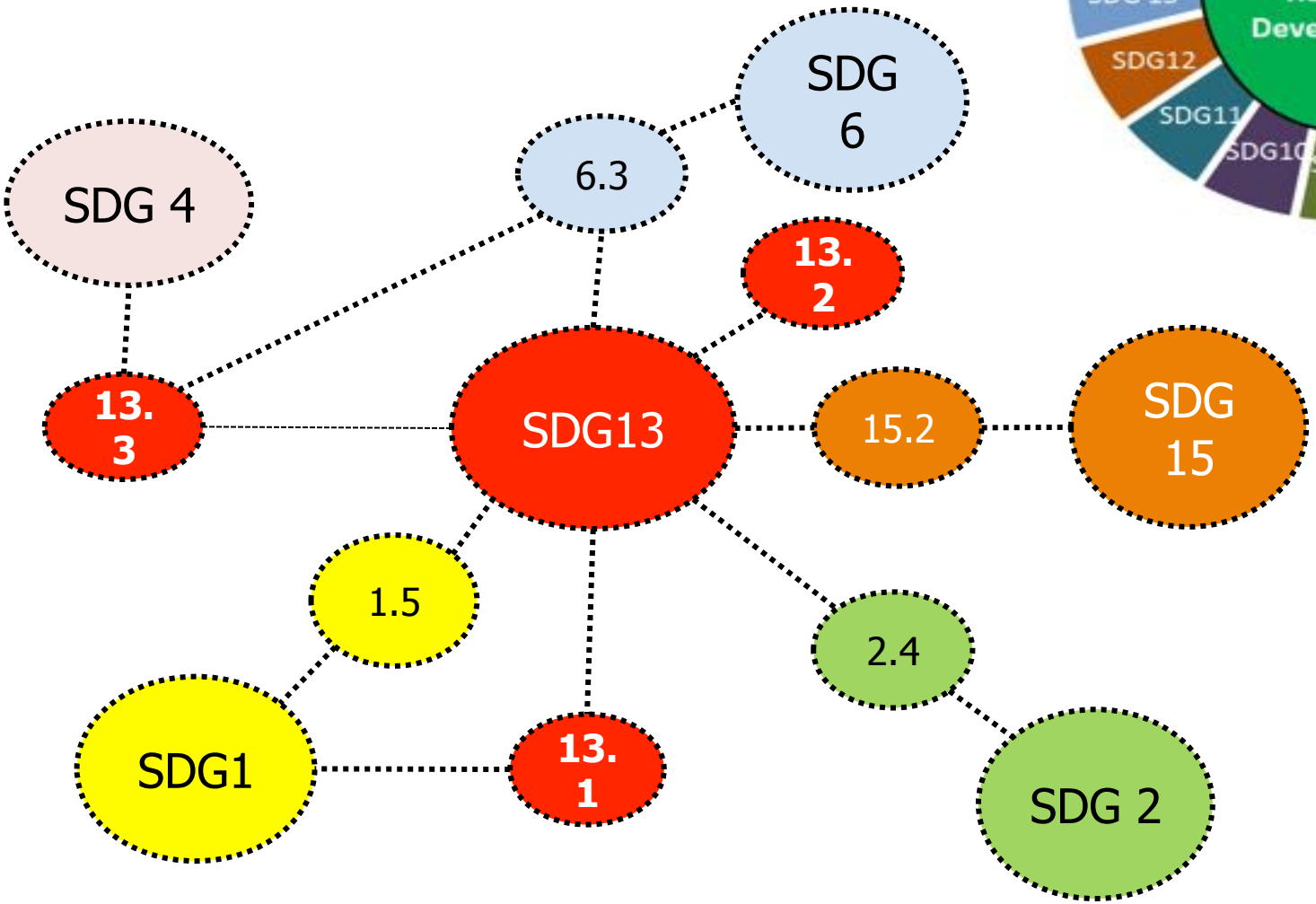
Describe livelihood dynamics under simultaneous climatic, environmental, and socioeconomic stressors, shocks, and policy responses – leading to differential livelihood trajectories over time. The red boxes indicate specific critical moments when stressors converge, threatening livelihoods and well-being. IPCC 2014



Opportunity space and climate-resilient pathways, IPCC 2014

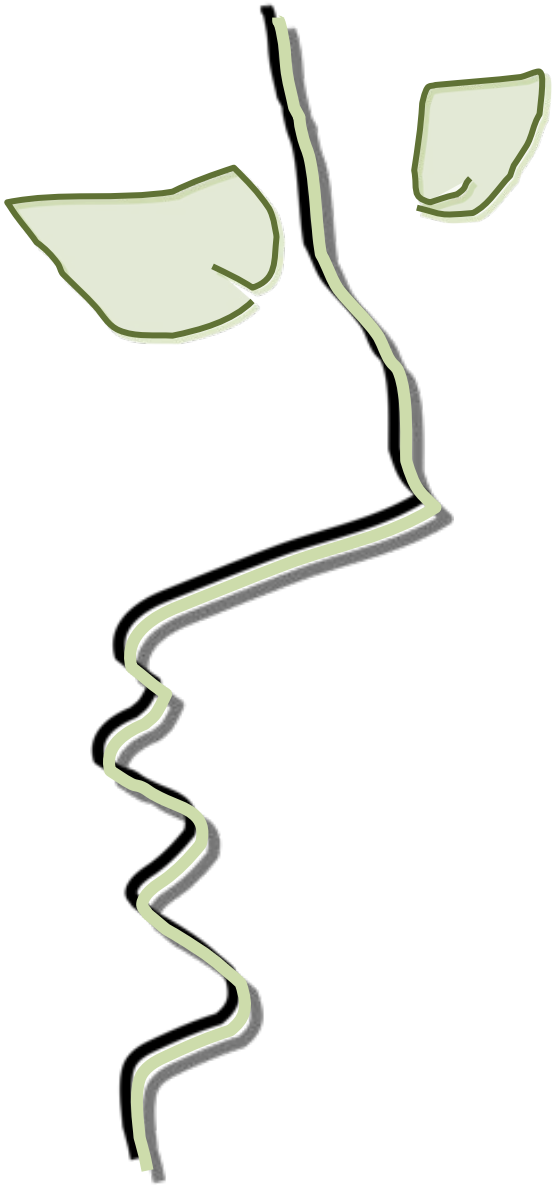
SDG-Climate Risk





SDG-Climate (Hydro-metrological Hazards) Risk-Resilience Nexus

- ❑ Develop 2030 scenarios on Climate and drought risks (Regional/National) for:
  - poverty,
  - social vulnerability and
  - instability in the region;
- ❑ Policy response options to reduce vulnerabilities in emerging climate risk hotspots
- ❑ Capacity development on risk literacy, systems-based understanding of multi-dimensional hazards and vulnerabilities, and ways to better manage risk through use of science and data
- ❑ Piloting of innovative technologies that enhance early warning to detect social vulnerabilities to climate and disaster risks
- ❑ Pilot community-based technologies that help build resilience to climate change while also bringing co-benefits for multiple SDGs
- ❑ Improved indicator systems that track climate and disaster trends under SDG 13 and related risks to other SDGs and social vulnerability
- ❑ Policy options to de-risk scaled-up finance on ways that benefit climate action and development dividends across all SDGs



Thank you

wadiderian@gmail.com