



# Regional Initiative for the Assessment of Climate Change Impacts on Water Resources & Socio-Economic Vulnerability in the Arab Region (RICCAR)

*Overview for Workshop on Environmental Statistics and Information for Sustainable Development in the Arab Region  
Beirut, 15 November 2018*



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UN Economic and Social Commission for Western Asia

# Intergovernmental mandates calling for Climate Change Assessment in the Arab Region have existed for only just over a decade

First  
Arab Ministerial  
Declaration on  
Climate Change  
*CAMRE*  
2007

Arab  
Economic and  
Social Summit  
*Resolution on  
Climate Change  
& Water Project*  
2009

Arab Permanent  
Committee for  
Meteorology  
*Resolutions*  
2012, 2013, 2014,  
2015, 2016,  
2017

Arab  
Ministerial  
Council of for  
Meteorology &  
Climate  
2018

ESCWA  
25<sup>th</sup> Ministerial  
Session  
*Resolutions on  
Climate Change,  
Rio+20 follow-up*  
2008, 2012,  
2014

Arab  
Ministerial  
Water Council  
*Resolutions*  
2010, 2011,  
2012, 2013,  
2014, 2015,  
2016, 2017

ACSAD Board  
of Directors  
*Resolution*  
2013

ESCWA  
30<sup>th</sup> Ministerial  
Session  
*Resolution setup  
Center for Arab  
Climate Change  
Policies*  
2018

Environment

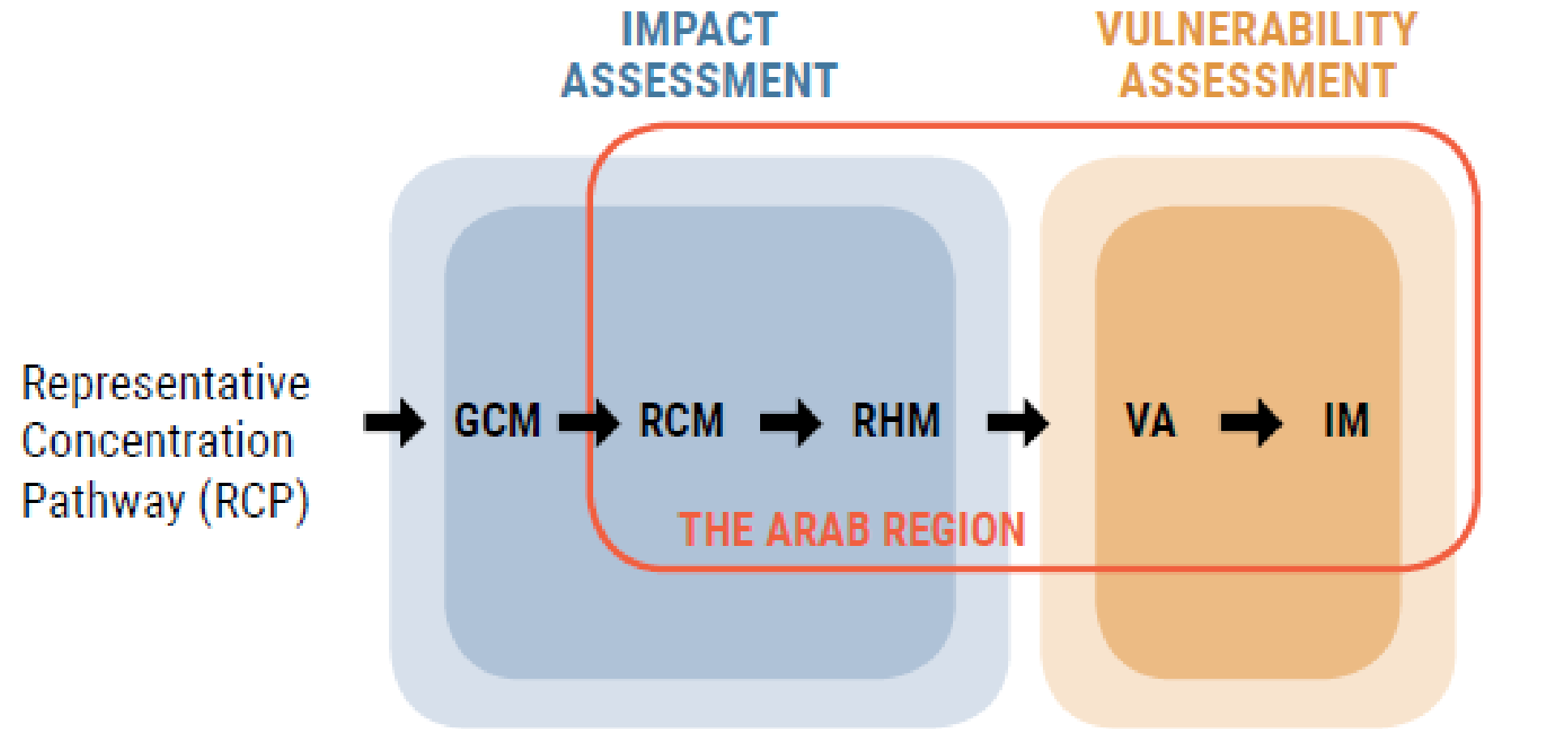
Foreign Affairs &  
Planning

Water

Meteorology

Agriculture &  
Food Security

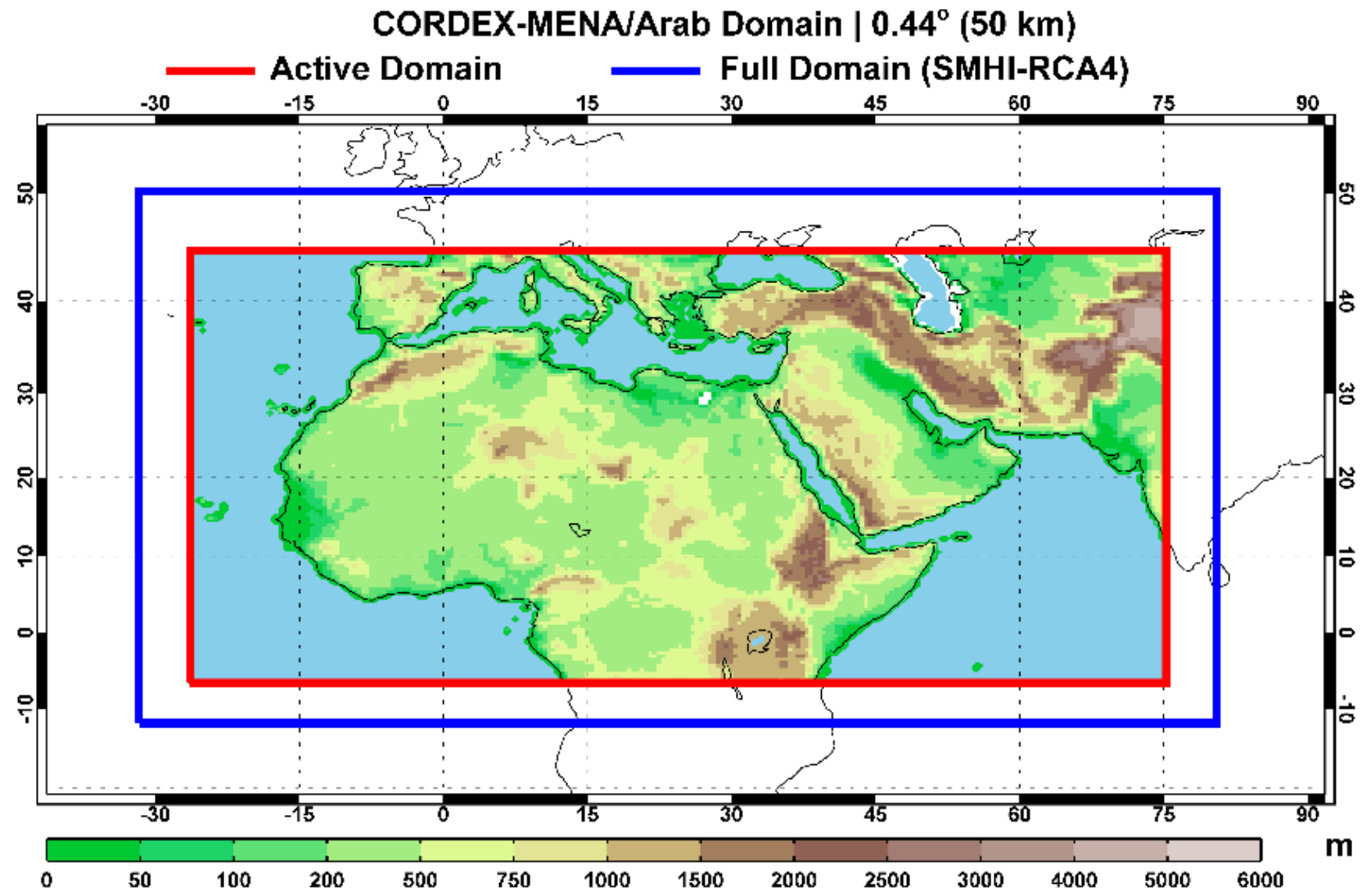
# Integrated Assessment for Arab Region



GCM: Global Climate Modelling  
RCM: Regional Climate Modelling  
RHM: Regional Hydrological Modeling

VA: Vulnerability Assessment  
IM: Integrated Mapping

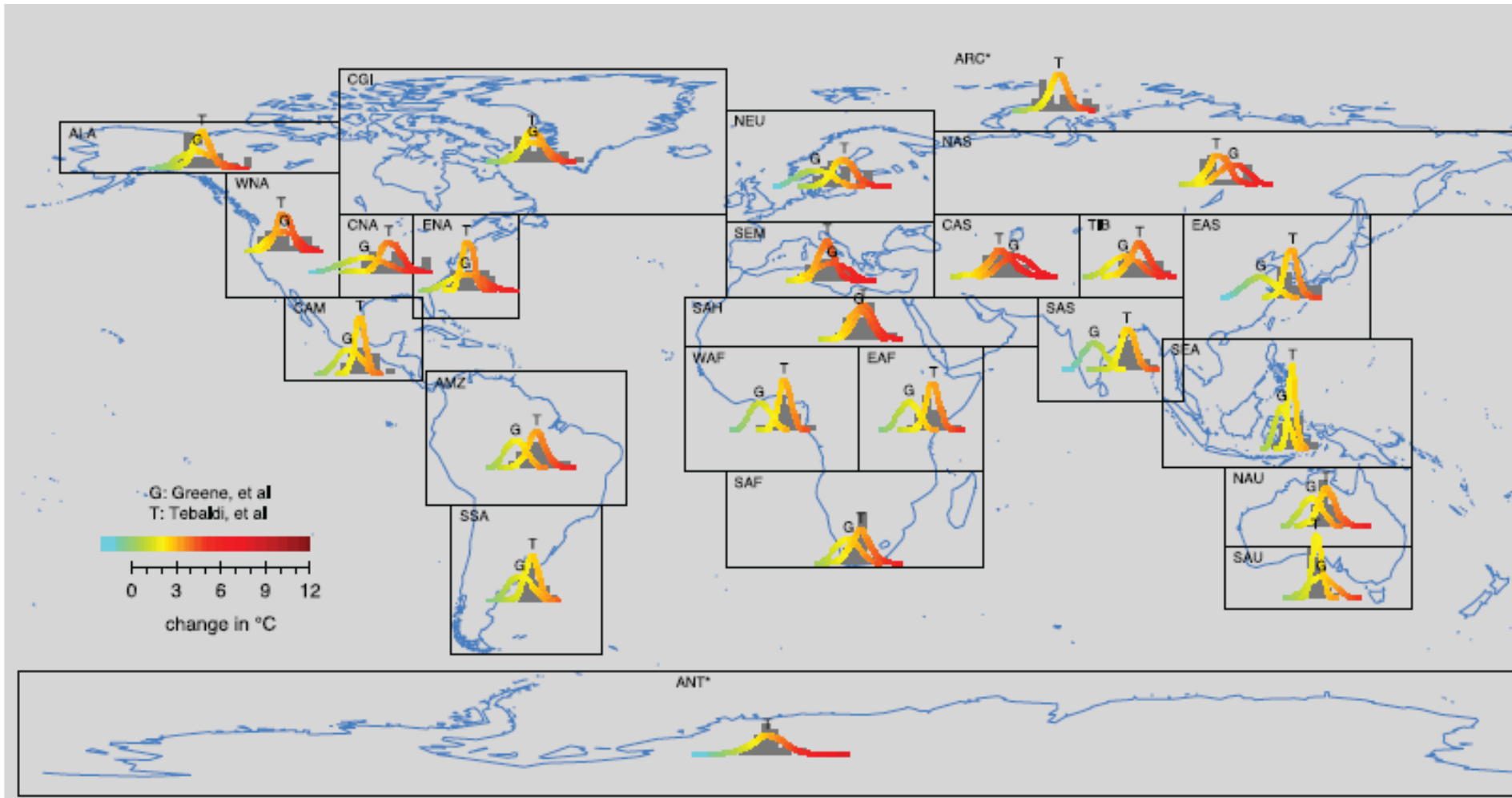
# Arab Domain



Coordinated Regional Climate Downscaling Experiment  
<http://www.cordex.org/domains/cordexregion-mena-cordex/>

Set in  
2011

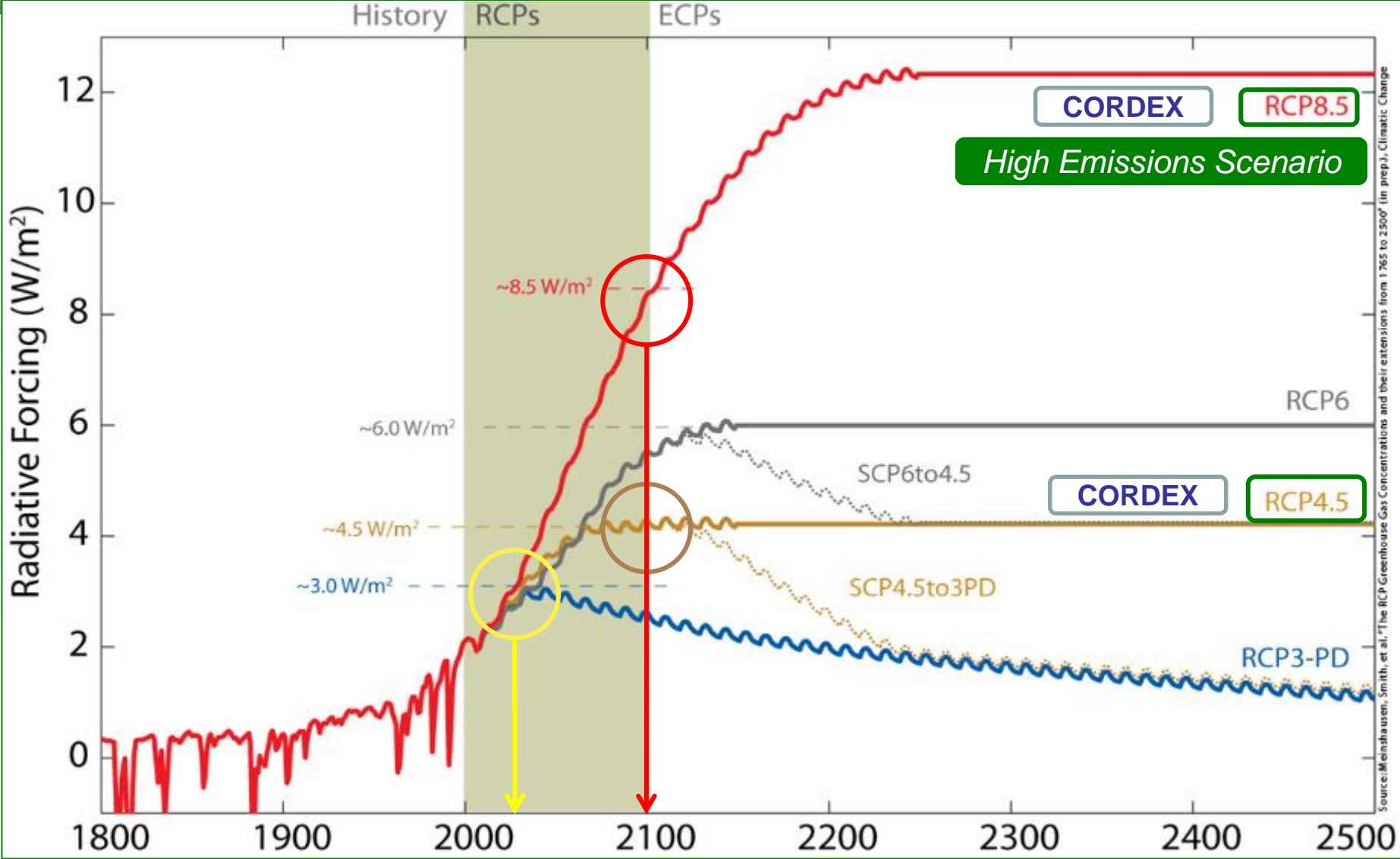
# IPCC regional domains



From R.K Kolli, WMO  
RICCAR EGM #2 (Beirut, 2010)

# Representative Concentration Pathways (RCPs)

As first represented in IPCC AR5 Projections

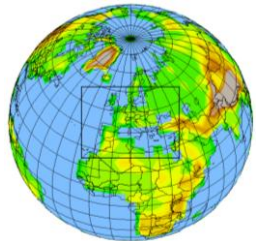
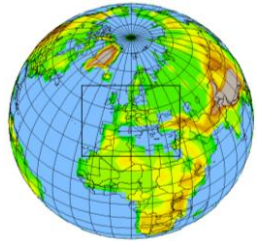
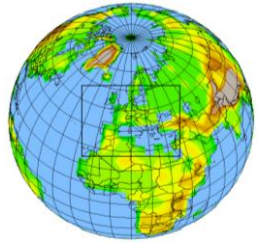


These RCPs do not represent a 1.5° C temperature increase scenario, which IPCC has modelled through a new set of socio-economic projections

Graph adapted from: Meinshausen et al., 2010

# Regional Climate Modeling & Hydrological Modeling

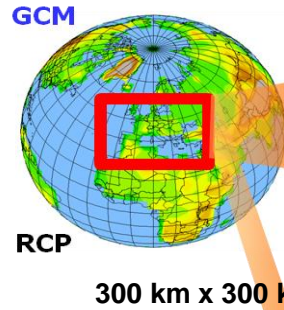
## Different Global Climate Models



## Same

## Representative Concentration Pathway (RCP)

### General Circulation Model GCM



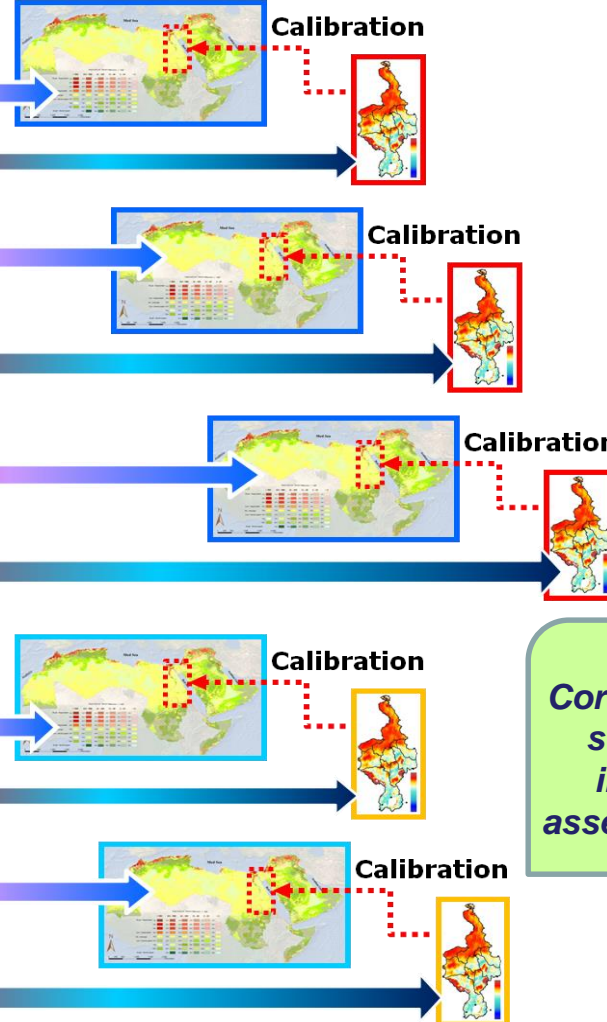
*Ensembles used to reduce uncertainty at level of RCMs & RHMs*

*Ensembles aggregate findings of different RCMs & RHMs applied for same RCP & Domain*

### Regional Climate Model (RCM)



### Regional Hydrological Model (RHM)



*Bias-Corrected to support impact assessments*

Extreme climate indices

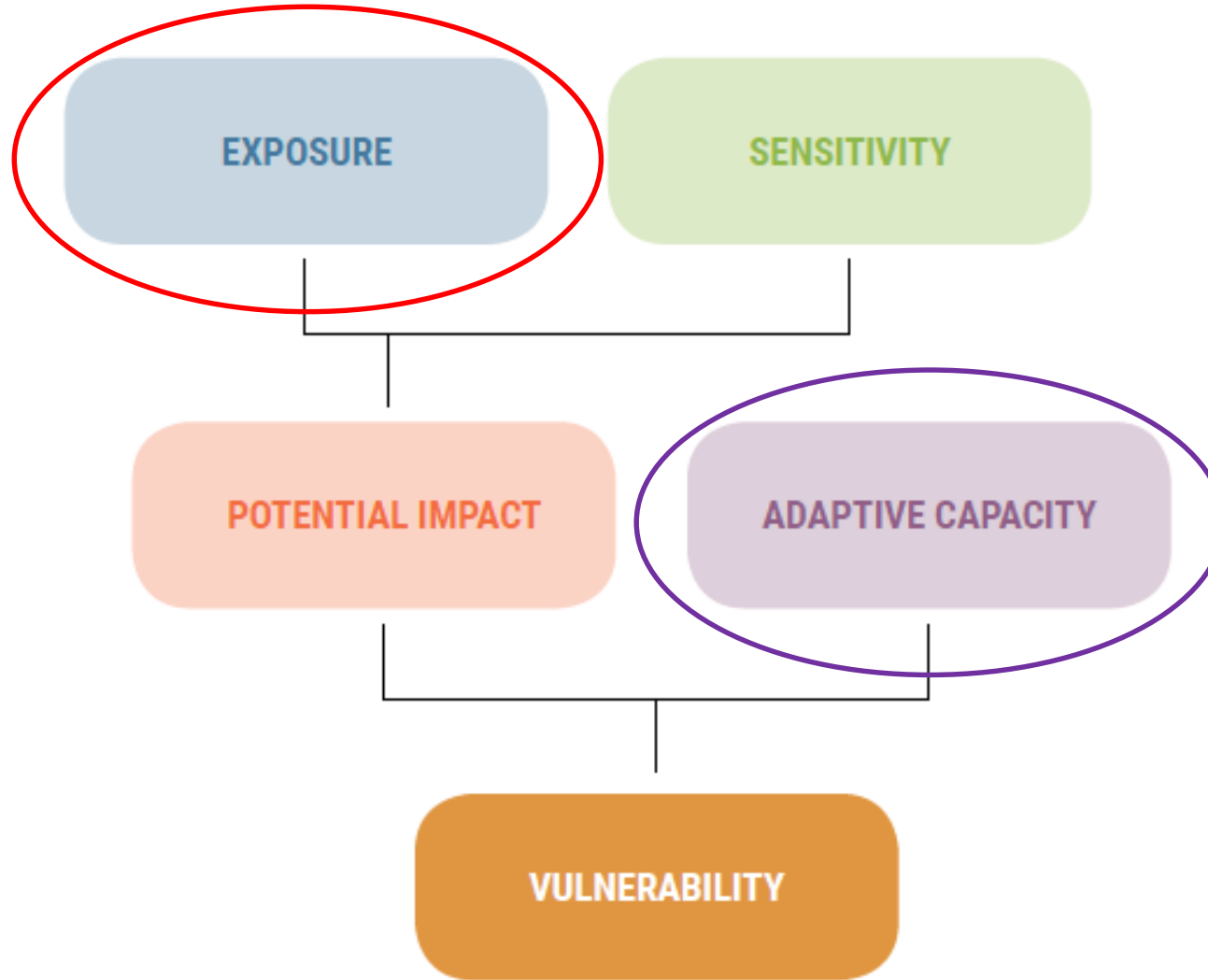
# Extreme Events Indices: For Past & Future Projections

Extreme temperature indices		Extreme precipitation indices	
Index	Full name	Index	Full name
SU	Number of summer days	CDD	Maximum length of dry spell
SU35	Number of hot days	CWD	Maximum length of wet spell
SU40	Number of very hot days	R10	Annual count of 10 mm precipitation days
TR	Number of tropical nights	R20	Annual count of 20 mm precipitation days
		SDII	Simple precipitation intensity index

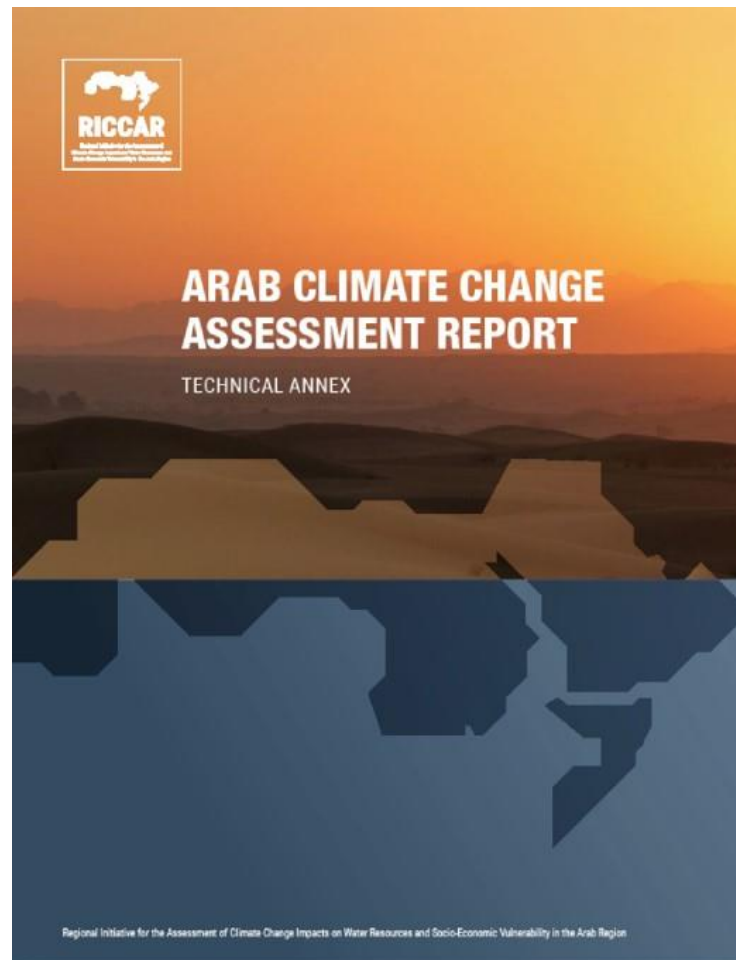
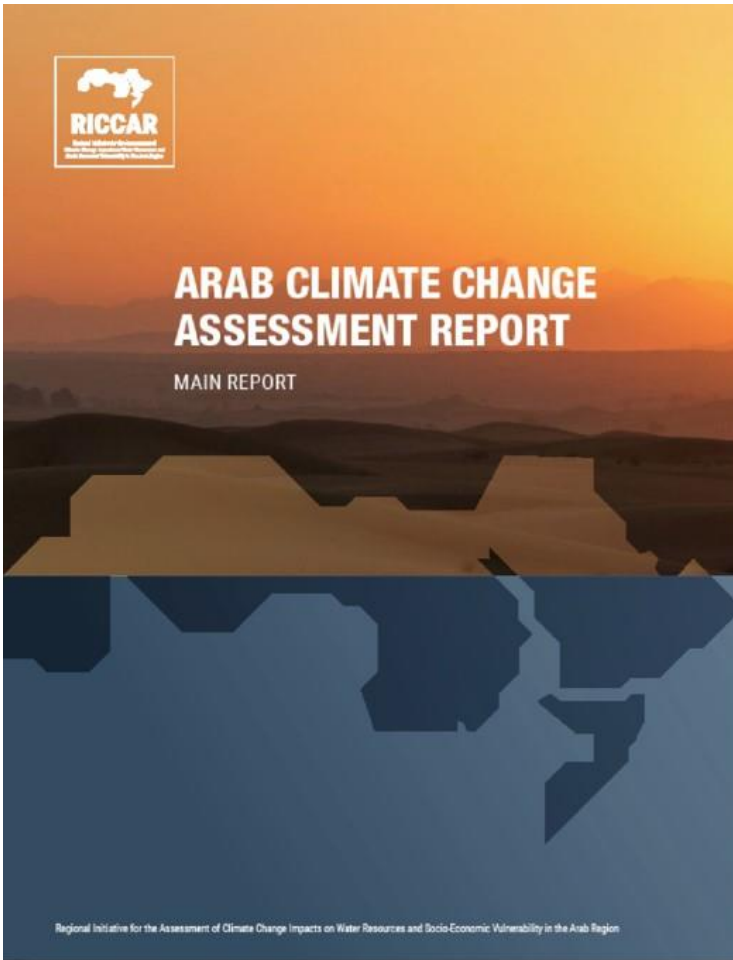
*In presenting data and analysis, need to consider appropriateness of providing data in terms of changes in **value** or changes in **percentage**, and choice of **units** (e.g., +1 mm/month of precipitation may be significant change when viewed as a percentage change in water scarce Arab Region)*



# Vulnerability Assessment

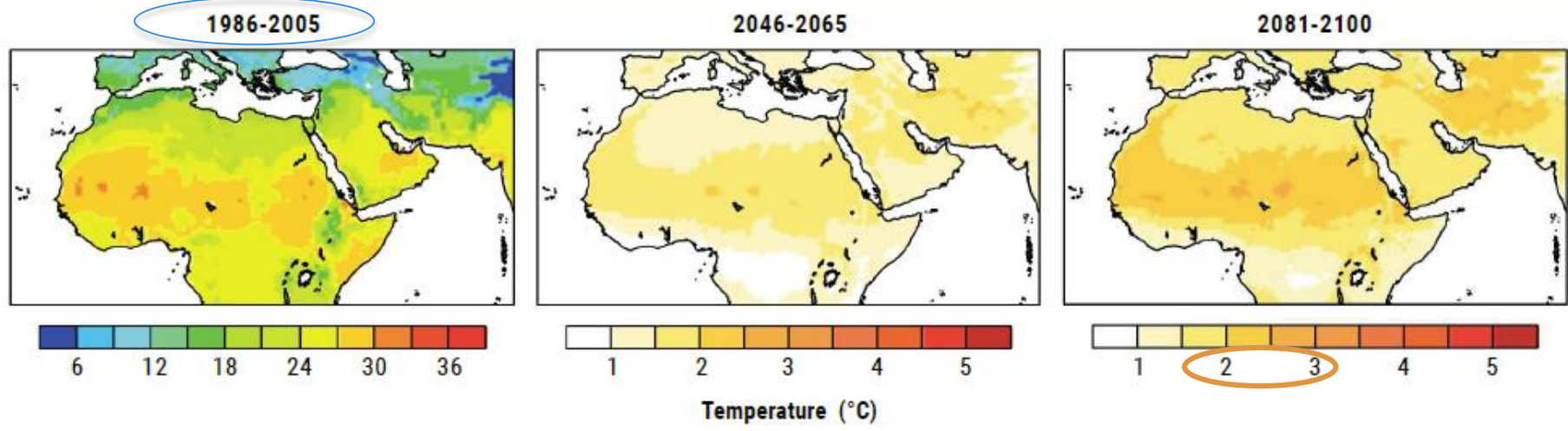


# Report Launched September 2017

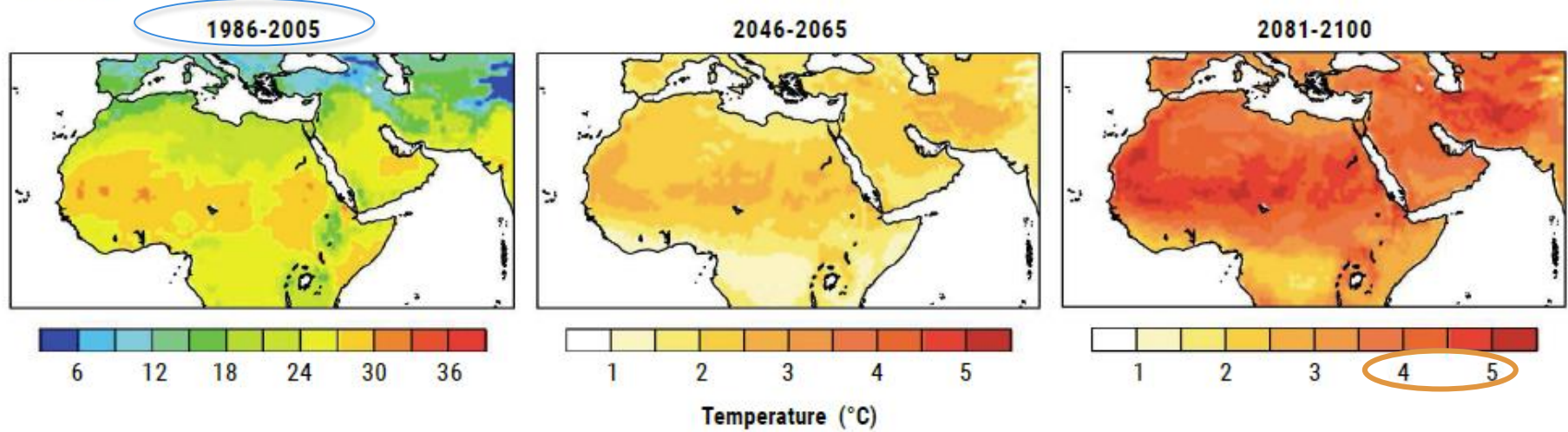


# Temperature in the Arab region is increasing and is expected to continue to increase until the end of the

## RCP 4.5



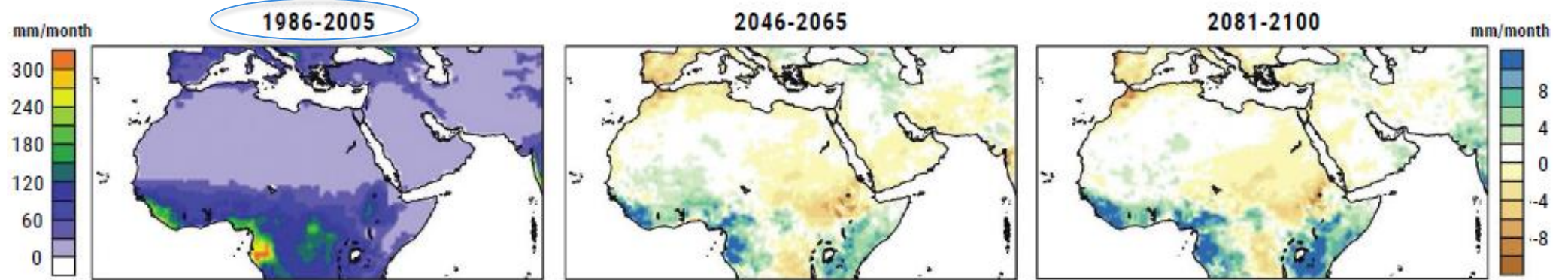
## RCP 8.5



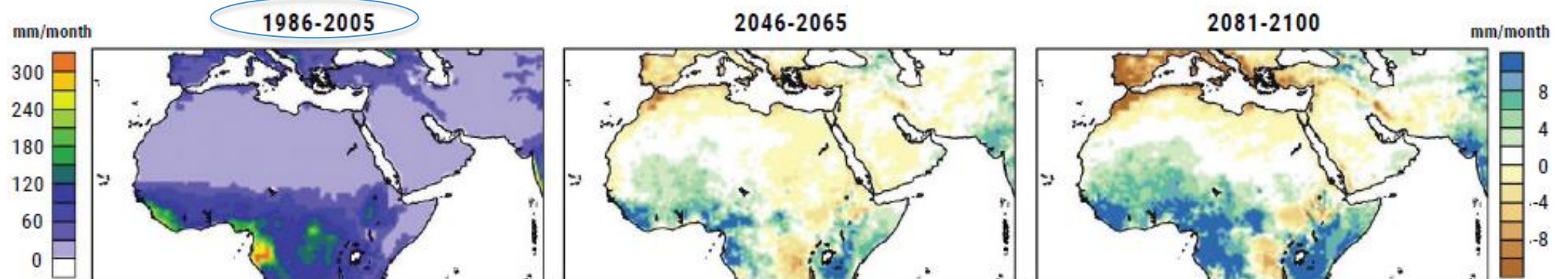
Reference period (1986-2005) based on Reanalysis Datasets drawn from and validated against Observed Datasets

# Precipitation trends are largely decreasing across, although limited areas projected to exhibit an increase in the intensity & volume of precipitation

## RCP 4.5



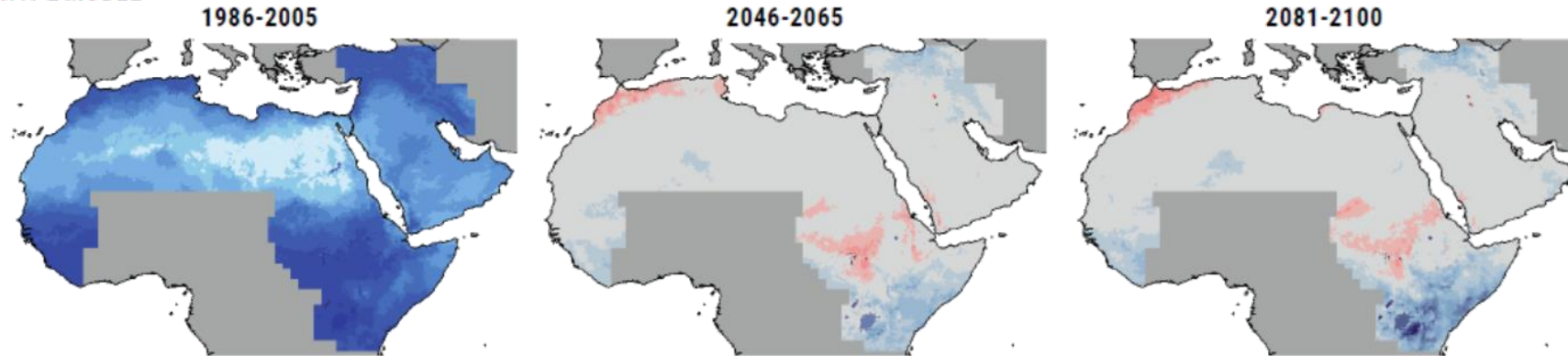
## RCP 8.5



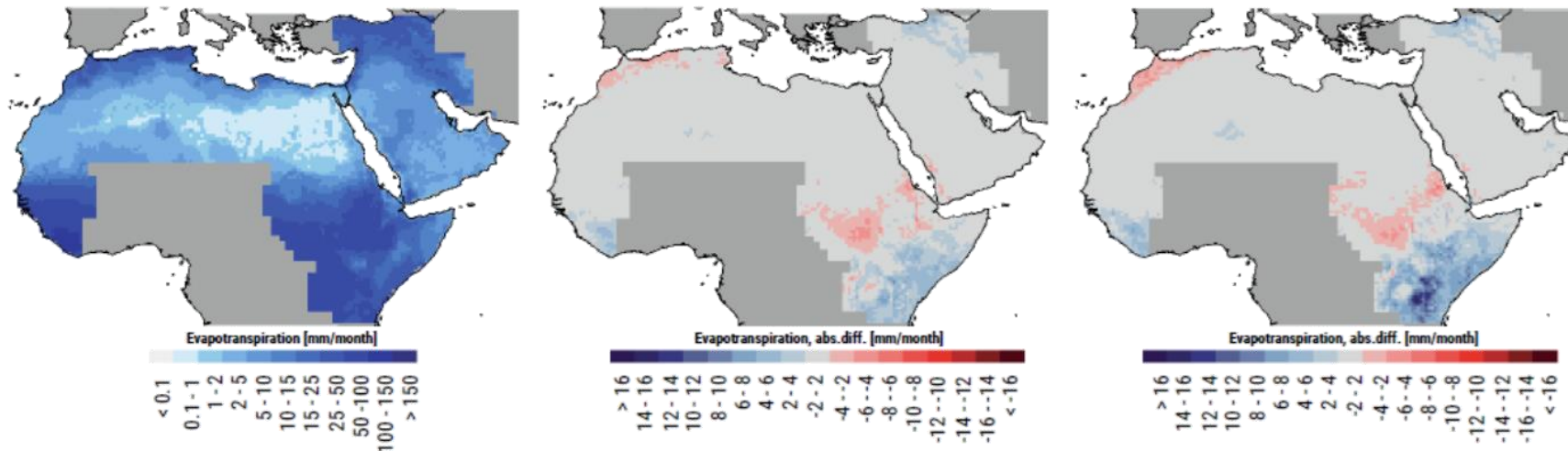
# Mean change in annual evapotranspiration

RCP 4.5

HYPE MODEL



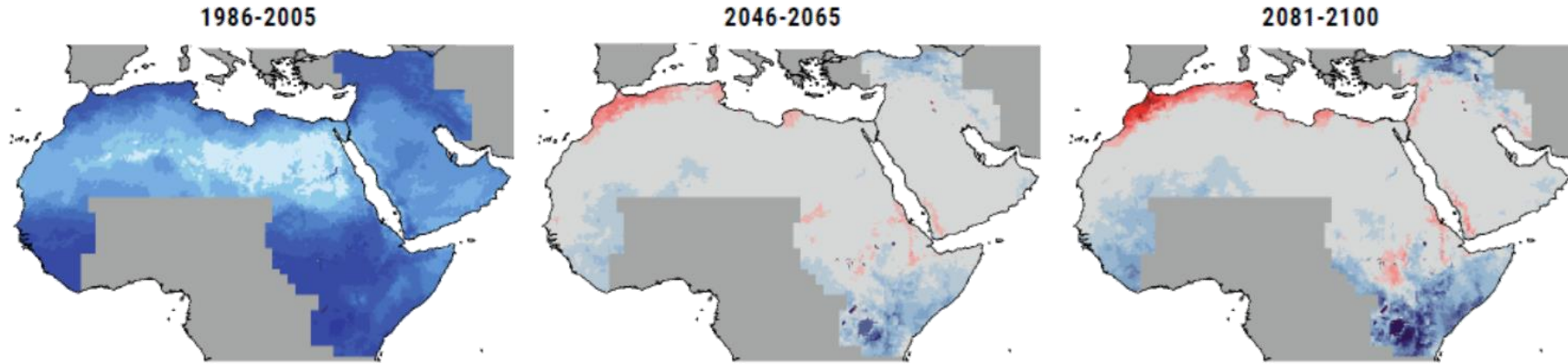
VIC MODEL



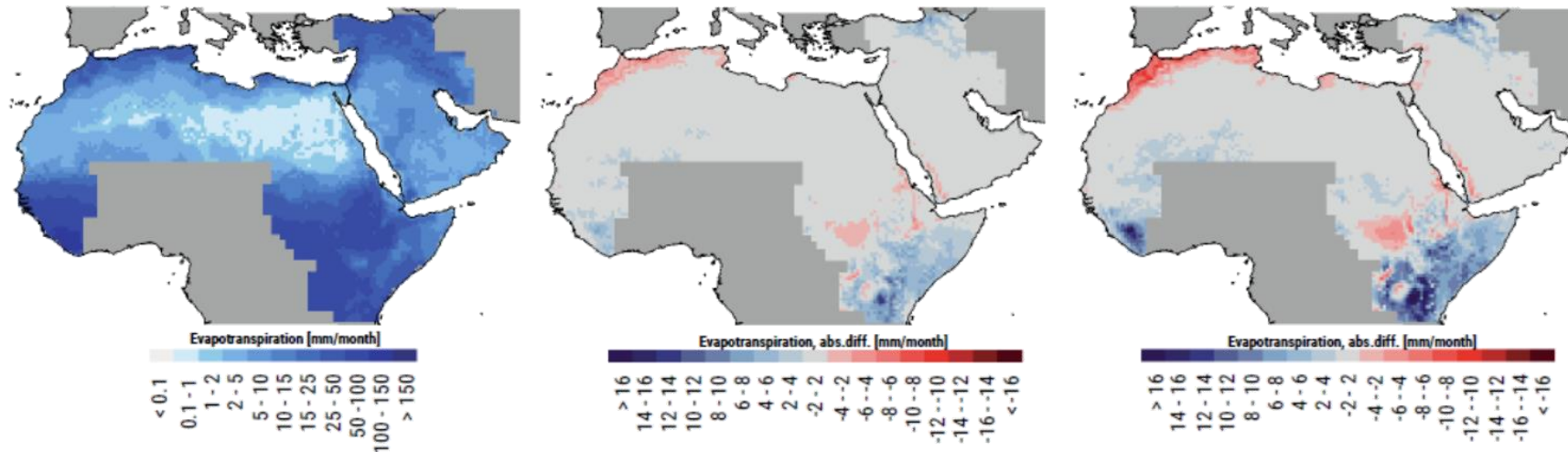
# Mean change in annual evapotranspiration

RCP 8.5

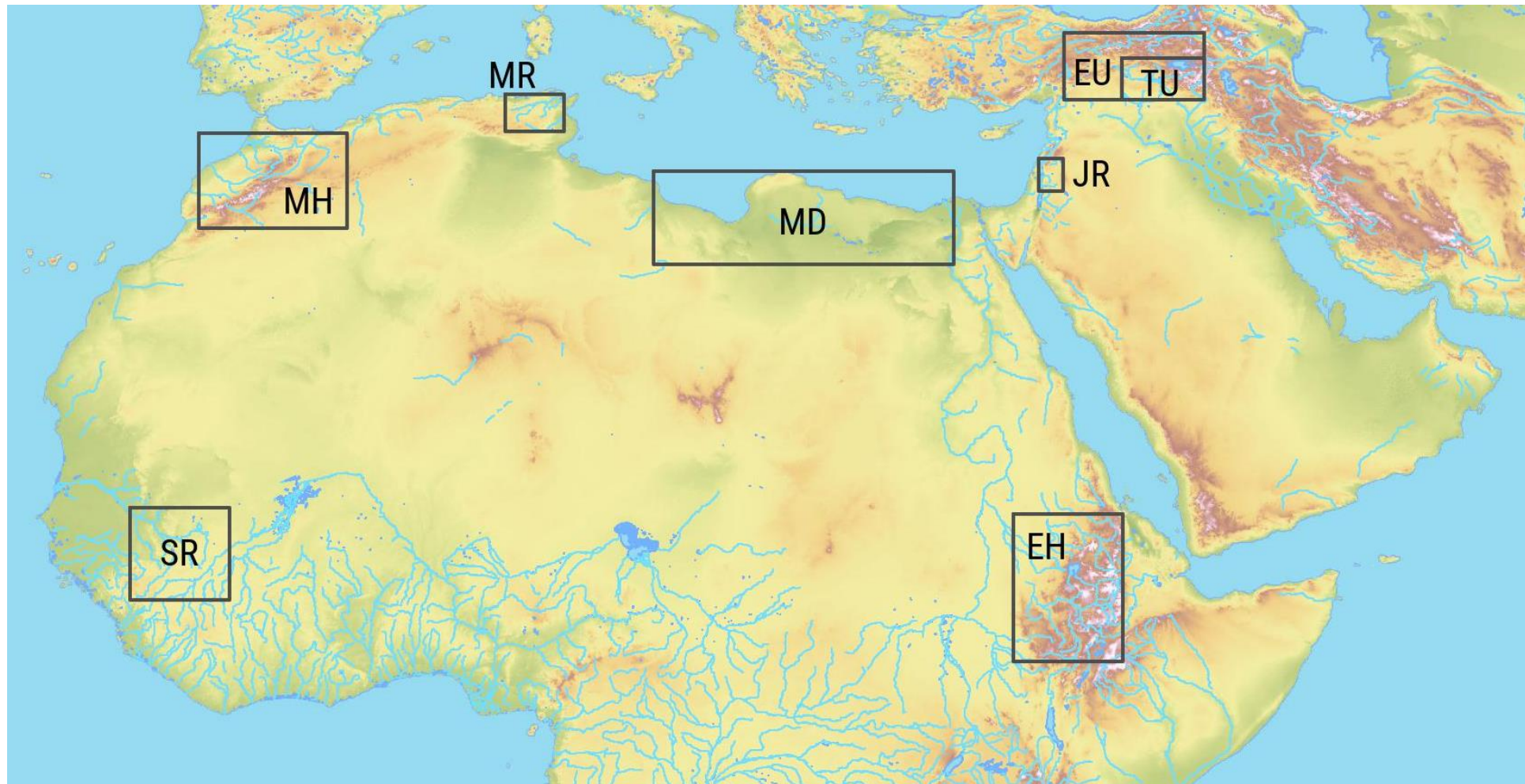
HYPE MODEL



VIC MODEL



# Subdomains for hydrological analysis



# Mean change in runoff and evapotranspiration

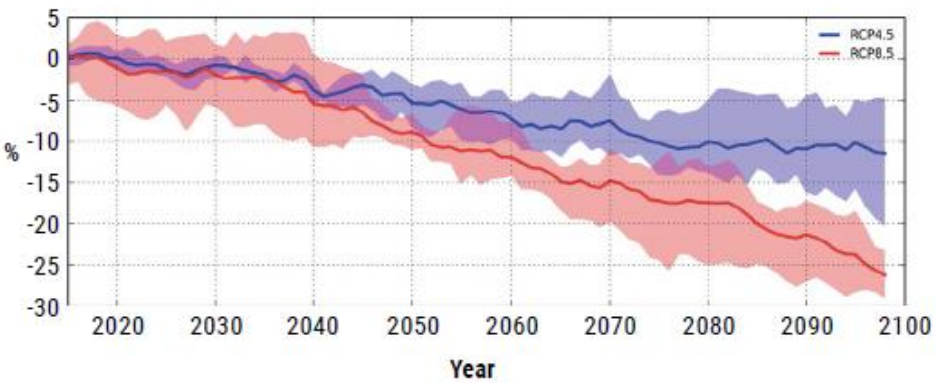
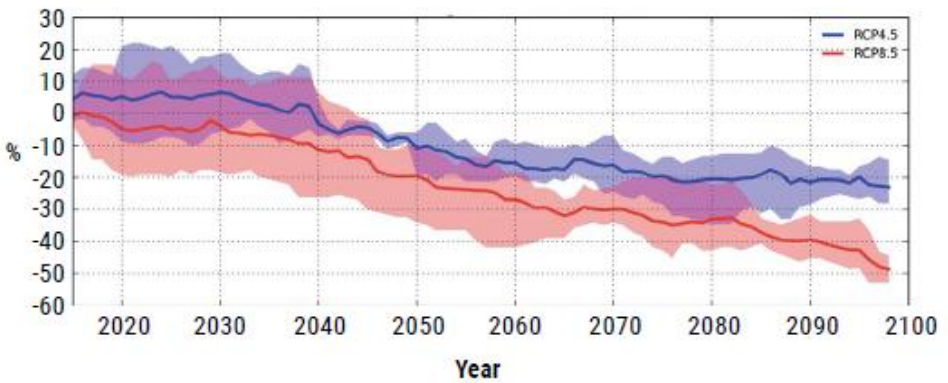
## Moroccan Highlands (MH)

**RUNOFF**

**EVAPOTRANSPIRATION**

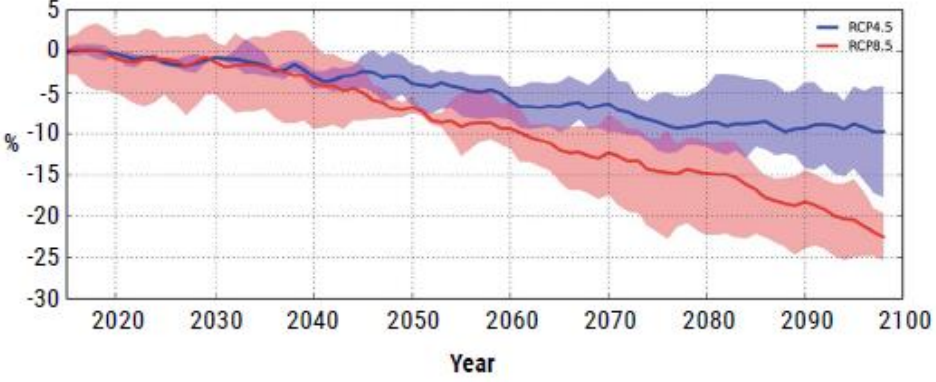
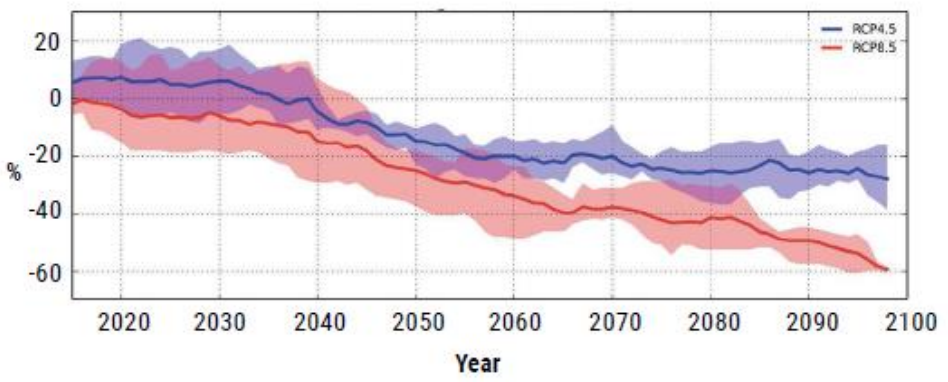
**HYPE MODEL**

**HYPE MODEL**



**VIC MODEL**






**VIC MODEL**

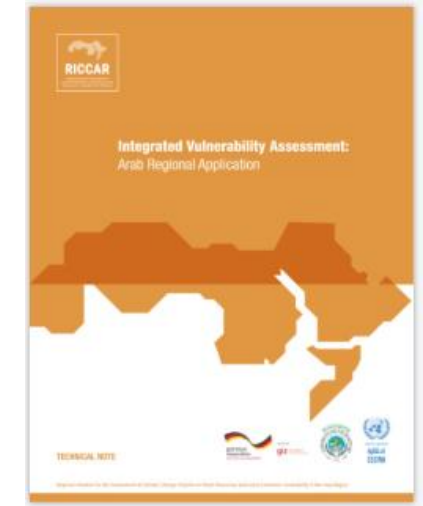


— RCP4.5  
— RCP8.5

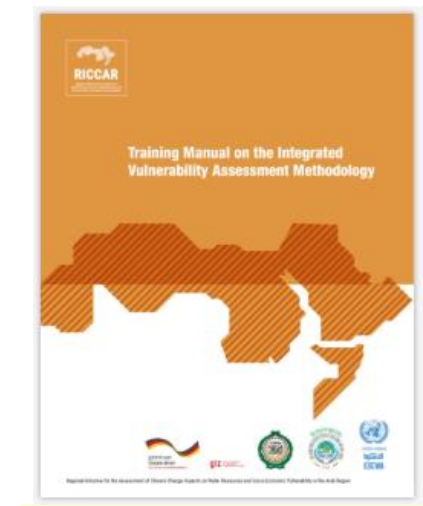


# Vulnerability Assessment

SECTORS	SUBSECTORS
 <b>Water</b>	Water availability
 <b>Biodiversity and Ecosystems</b>	Area covered by forests Area covered by wetlands
 <b>Agriculture</b>	Water available for crops Water available for livestock
 <b>Infrastructure and Human Settlements</b>	Inland flooding area
 <b>People</b>	Water available for drinking Health conditions due to heat stress Employment rate for the agricultural sector



**VA Methodological Note**



**VA Training Manual**

**6**  
Exposure  
indicators

**EXPOSURE (0.50)**

**RCM**

- Change in temperature (0.17)
- Change in precipitation (0.17)

**EXTREME EVENTS INDICES**

- Change in maximum length of dry spell (0.16)
- Change in maximum length of wet spell (0.16)

**RHM**

- Change in runoff (0.17)
- Change in evapotranspiration (0.17)

**SENSITIVITY (0.50)**

**POPULATION (0.50)**

- Population density (0.14)
- Total renewable water available per capita (0.50)
- Water consumption per capita (0.13)
- Share of water consumption in agriculture (0.13)
- Refugee population (0.10)

**NATURAL (0.26)**

- Land use/land cover (0.27)
- Soil storage capacity (0.25)
- Degradation of vegetation cover (0.26)
- Wetlands (0.22)

**MANMADE (0.24)**

- Urban extent (0.47)
- Areas served by dams (0.53)

**11**  
Sensitivity  
indicators

**POTENTIAL IMPACT**  
(0.50)



**VULNERABILITY ASSESSMENT**



**ADAPTIVE CAPACITY (0.50)**

**KNOWLEDGE & AWARENESS (0.10)**

- E-Government development (0.33)
- Tertiary enrollment (0.32)
- Adult literacy rate (0.35)

**TECHNOLOGY (0.10)**

- Number of scientific and technical journal articles (0.46)
- Information and communication technologies index (0.54)

**INSTITUTIONS (0.10)**

- Governance index (0.54)
- Disaster risk reduction committees (0.46)

**INFRASTRUCTURE (0.50)**

**WATER & SANITATION (0.50)**

- Areas served by dams (0.17)
- Installed desalination capacity per capita (0.17)
- Fossil groundwater (0.17)
- Access to improved water (0.17)
- Access to improved sanitation (0.16)
- Area equipped for irrigation (0.16)

**ENVIRONMENT (0.50)**

- Environment performance index (1.0)

**ECONOMIC RESOURCES (0.11)**

- GDP per capita (0.36)
- ODA (0.30)
- Food imports as % of merchandise exports (0.34)

**EQUITY (0.09)**

- Female-to-male literacy ratio (0.51)
- Migrants/refugees index (0.49)

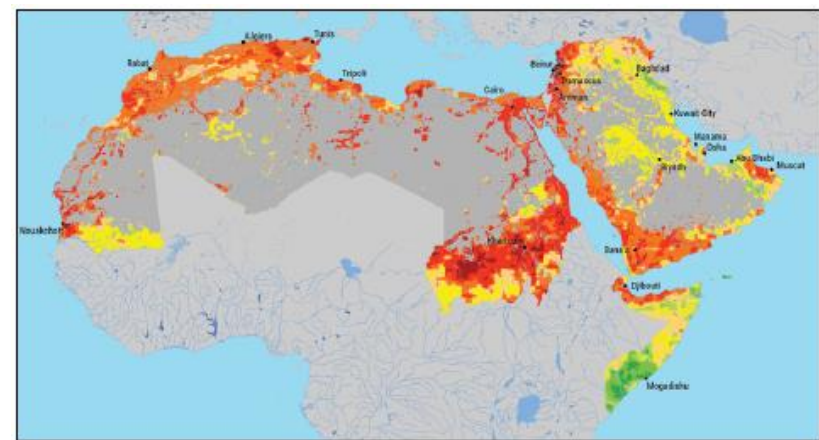
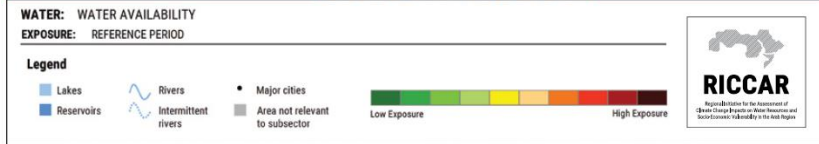
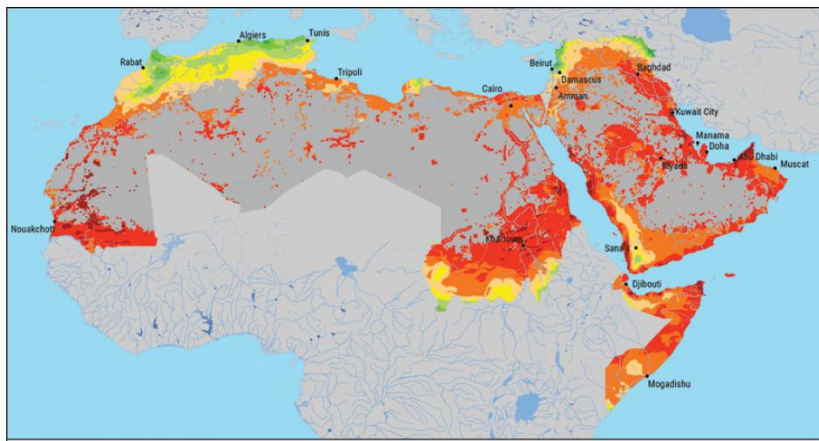
**19**  
Adaptive  
Capacity  
indicators



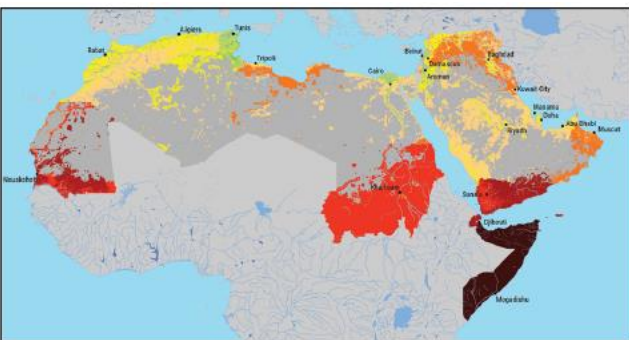
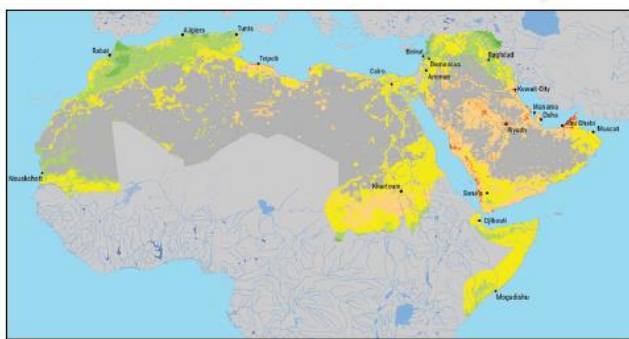
**Impact chain:**  
**Water Availability**

# Water Availability Vulnerability

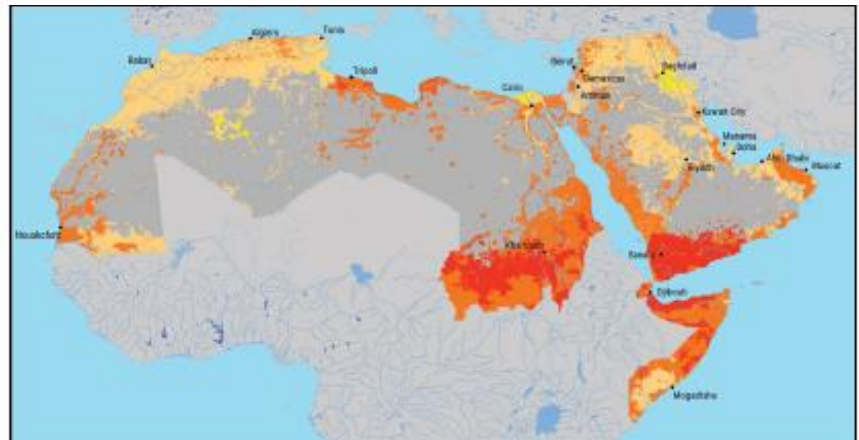
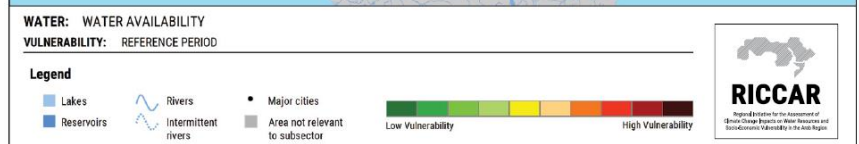
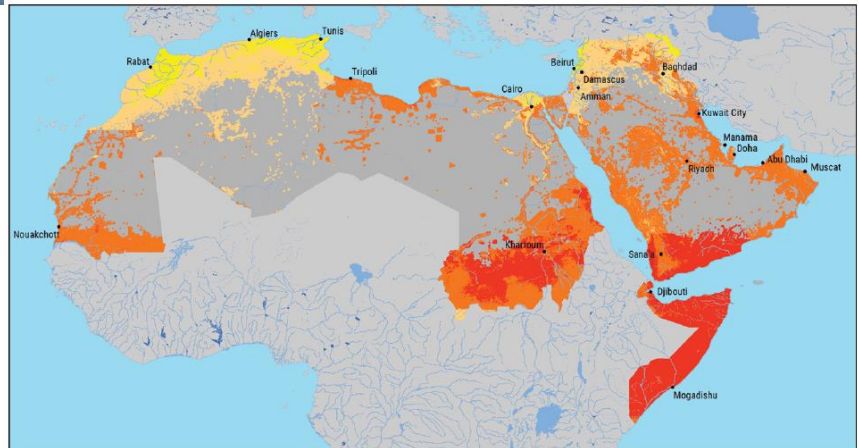
(Reference Period to RCP 8.5 end century projection)



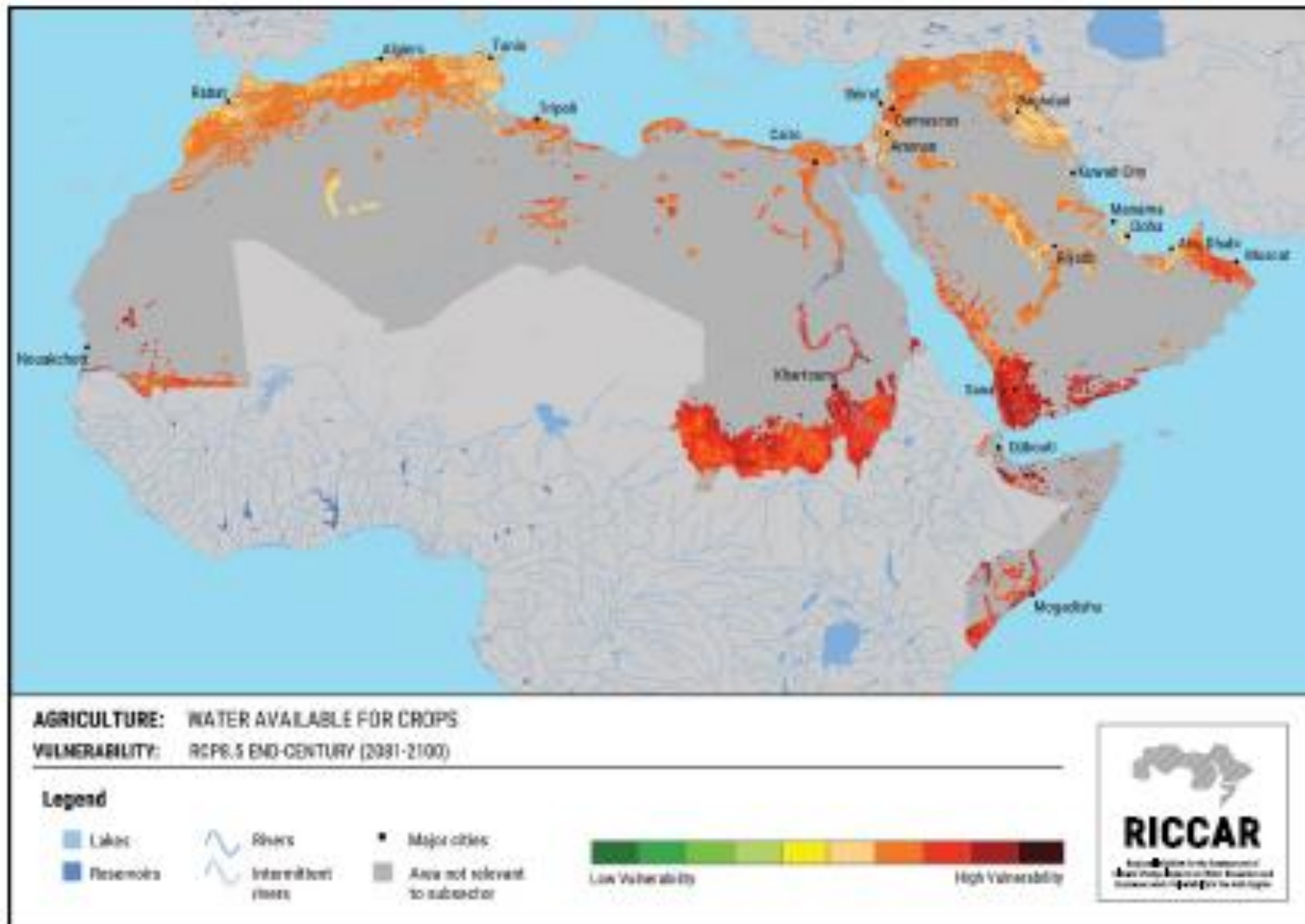
Reference Period →



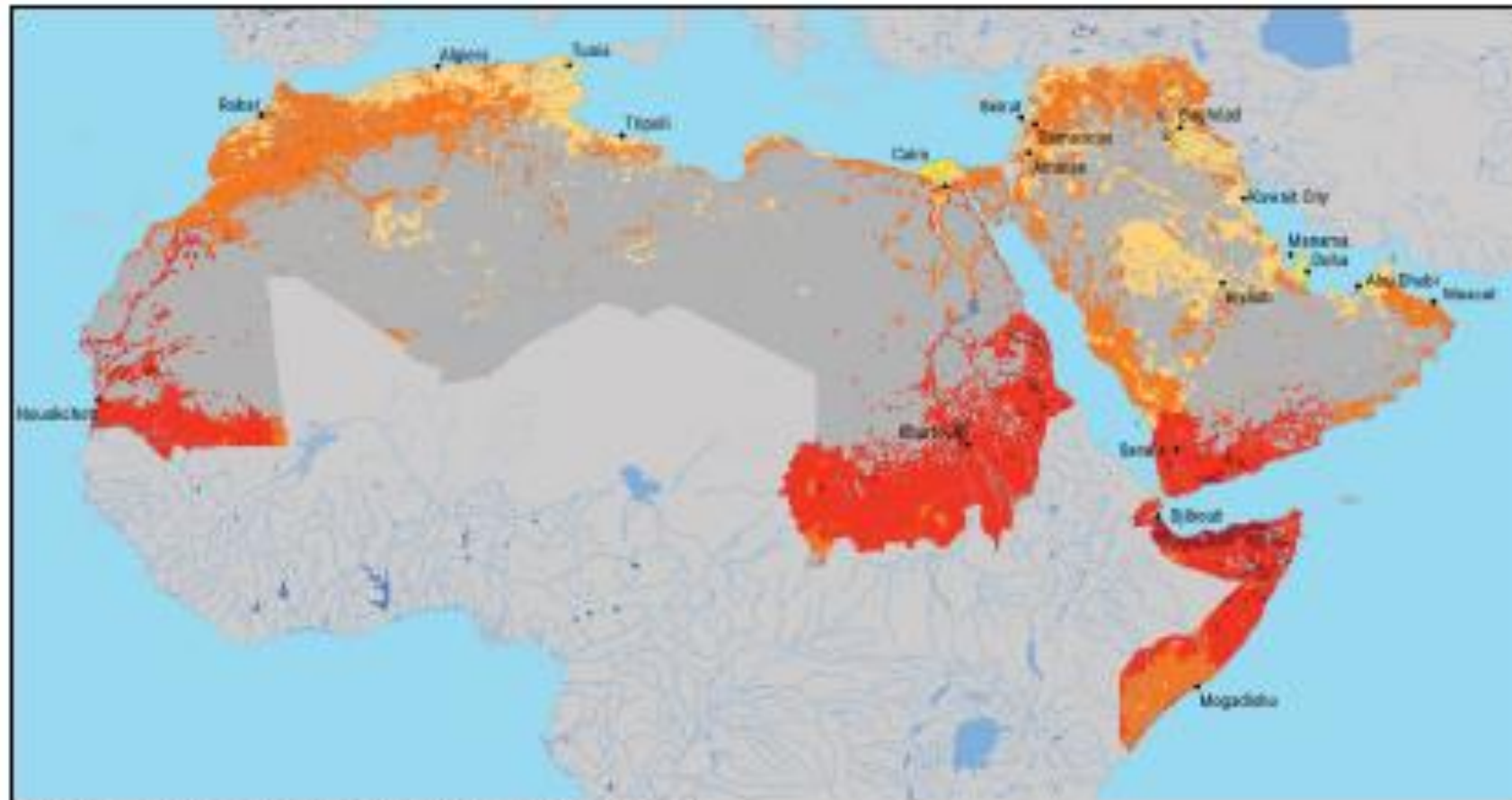
← RCP 8.5 end century



# Water Availability for Crops (RCP 8.5)



# Employment in the Agricultural Sector (RCP 8.5)



PEOPLE: EMPLOYMENT RATE FOR THE AGRICULTURAL SECTOR

VULNERABILITY: RCP8.5 END-CENTURY (2081-2100)

**Legend**



Lakes



Rivers



Major cities



Reservoirs



Intermittent rivers



Area not relevant to subsector





# Welcome to the **RICCAR REGIONAL KNOWLEDGE HUB**

[www.riccar.org](http://www.riccar.org)



REGIONAL INITIATIVE FOR THE ASSESSMENT OF CLIMATE CHANGE IMPACTS ON WATER RESOURCES AND SOCIO-ECONOMIC VULNERABILITY IN THE ARAB REGION



Partners



Overview



Meetings & Events



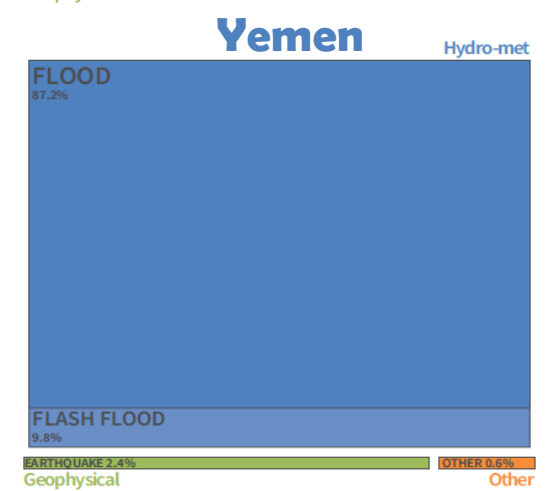
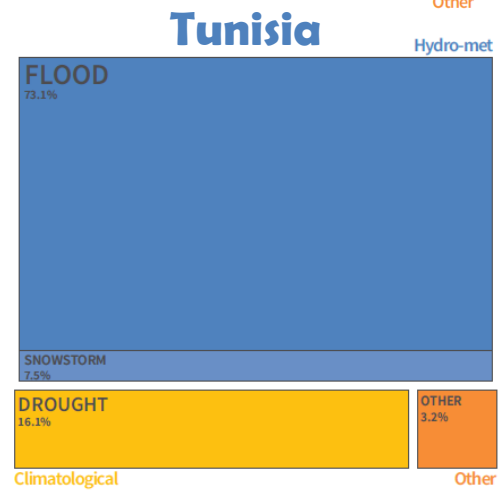
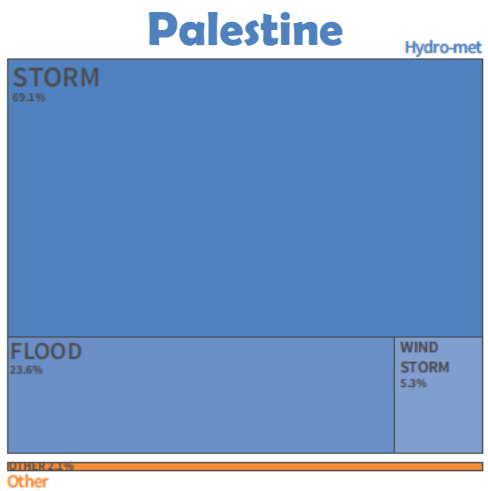
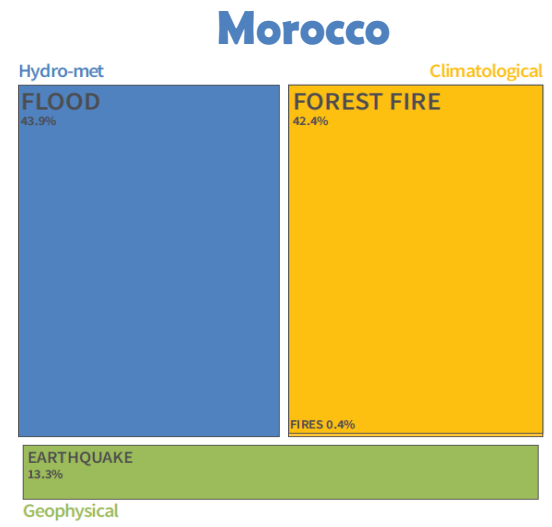
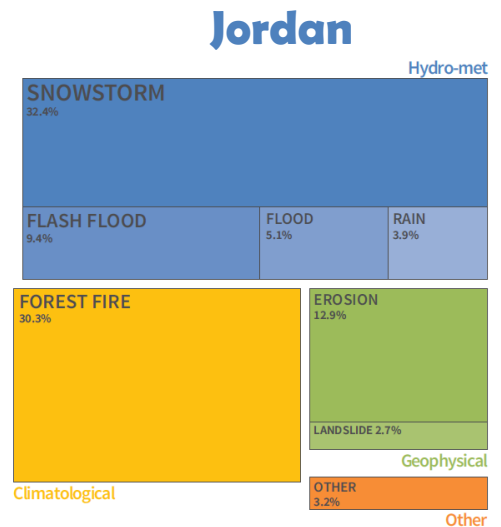
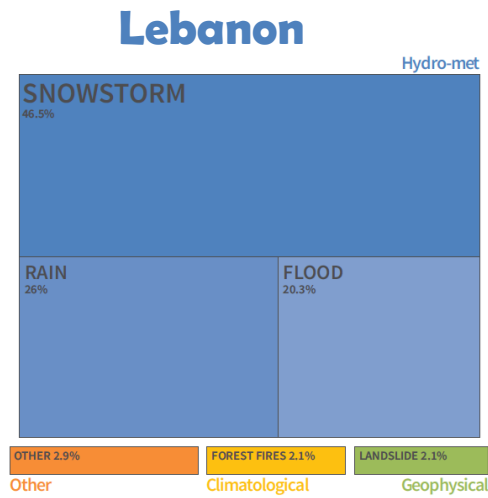
Data Portal

## KNOWLEDGE RESOURCES





# Economic Loss: Breakdown by Hazard type



Hazards which cause Economic losses can be quite different from those responsible for the highest levels of mortality. For example, in Morocco forest fires cause 42% of economic losses, but only 9% of disaster-related deaths

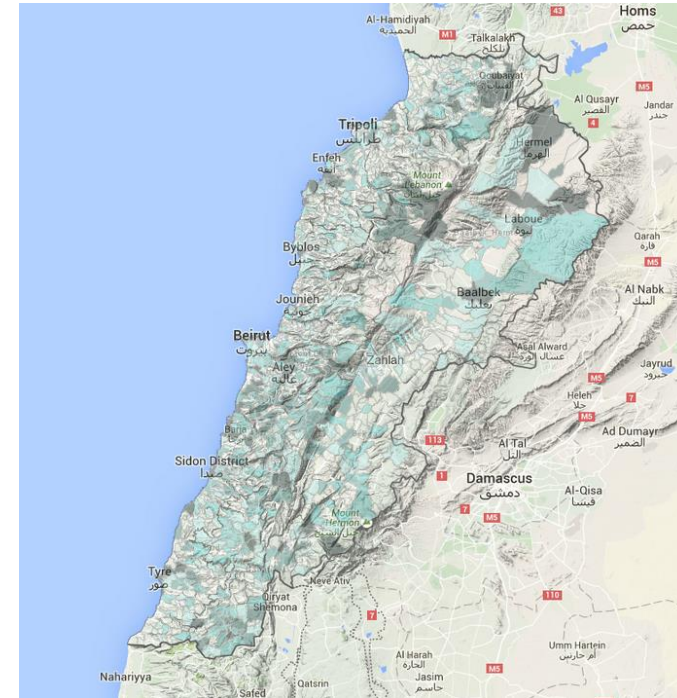




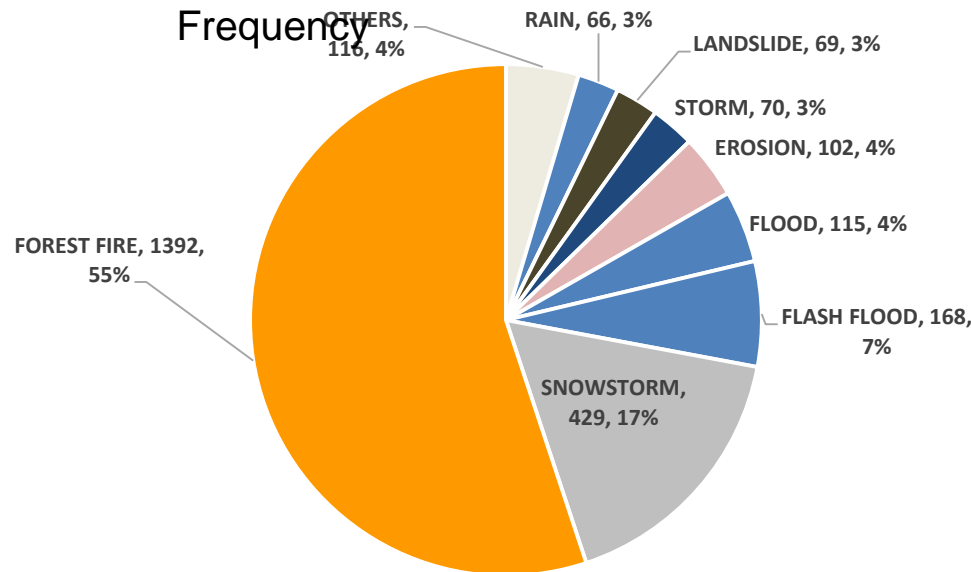
1980 – 2011

# Lebanon

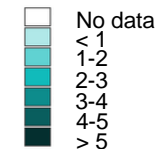
**2527 records**  
**156 deaths**  
**48 million US\$ estimated losses**  
**181 houses destroyed**  
**1366 houses damaged**  
**17700 ha of crops damaged**



Spatial footprint of frequency



**Hydro-meteorological related impacts:**

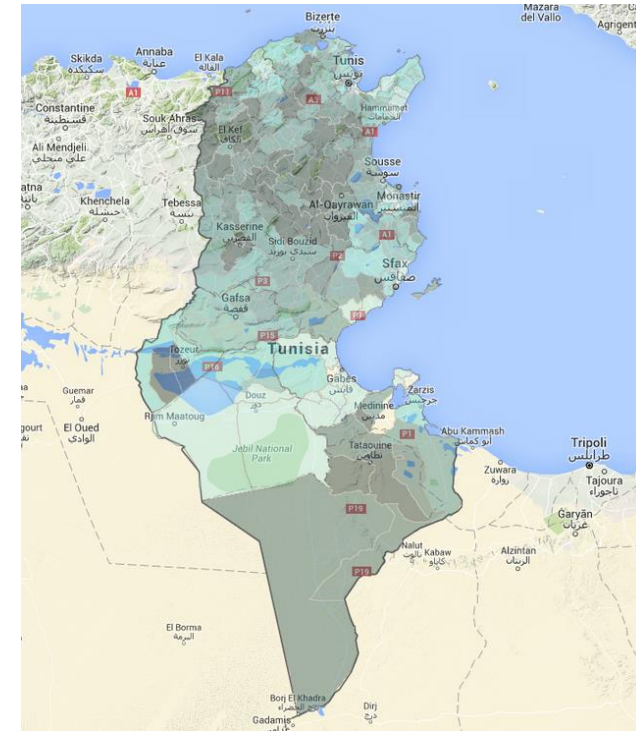


**75% of all records**  
**100% of mortalities.**  
**86% of economic losses.**

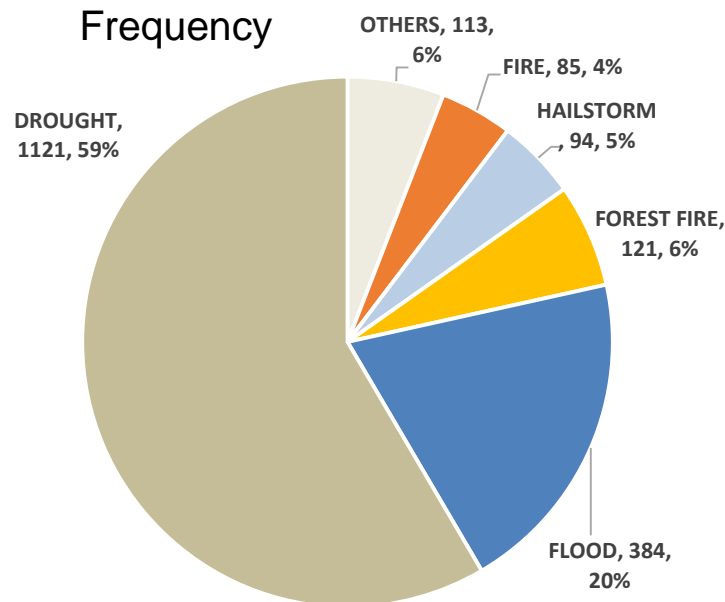


# 1982 – 2013 Tunisia

**1918 records**  
**330 deaths**  
**684 million US\$ estimated losses**  
**17821 houses destroyed**  
**24728 houses damaged**  
**837000 ha of crops damaged**

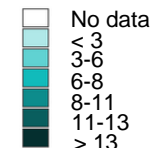


Spatial footprint of frequency



## Hydro-meteorological related impacts:

**99% of all records**  
**100% of mortalities!**  
**98% of economic losses.**





# Thank you

[www.riccar.org](http://www.riccar.org)

