



Impact of Climate Change on the Arab Region: Moving from Assessment to Adaptation in Key Sectors

Economic And Social Commission For Western Asia



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ESCWA

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Climate Change Assessment - RICCAR

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

To assess the impact of climate change on freshwater resources in the Arab Region through a consultative and integrated regional initiative that seeks to identify the socio-economic and environmental vulnerability caused by climate change impacts on water resources based on regional specificities.

Assessment

Adaptation

Mitigation

Negotiations

RICCAR Partnerships

Implementing Partners



Cairo Office



United Nations
Educational, Scientific and
Cultural Organization



UNITED NATIONS
UNIVERSITY

UNU-INWEH



Donors



SWEDISH INTERNATIONAL DEVELOPMENT
COOPERATION AGENCY

Research Institutes supporting Climate Ensemble

- Center of Excellence for Climate Change Research/ King Abdulaziz University (CECCR/KAU) - KSA
- King Abdullah University of Science and Technology (KAUST) - KSA
- Climate Services Center (CSC) - Germany

Science – Policy Interface

Climate Change modeling

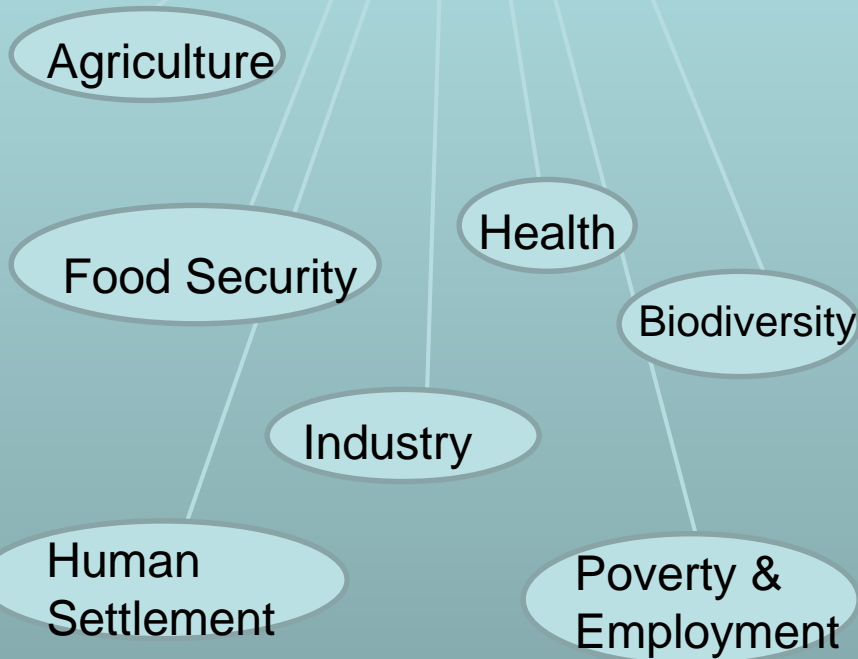
Hydrological modeling and water resources management

Socio-economic vulnerability and impact assessment



Climate database
Models (GCM and RCM)

- Impacts on water resources
- Long term scenario development in water policies



RICAAR

Climate Change adaptation

UNDA Project (IVRM)

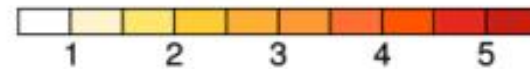
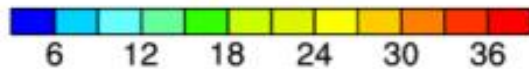
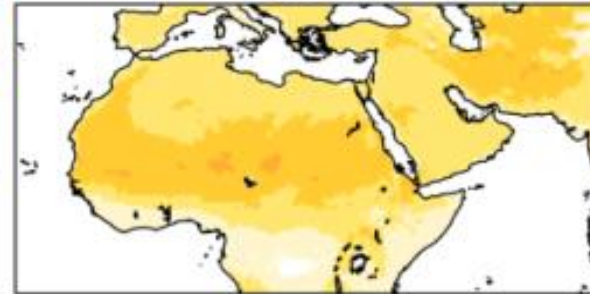
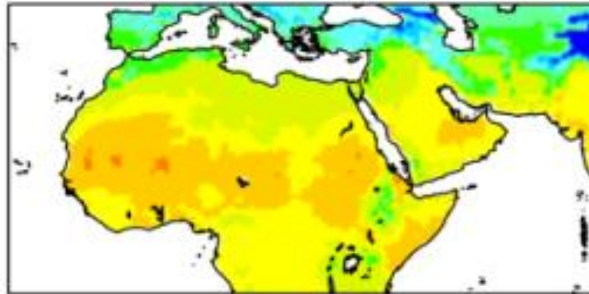


Changes in temperature for time period 2081-2100 from the baseline 1986-2005 (End-Century)

Temperature (°C) | Annual | CTL: 1986-2005 | SCN: 2081-2100 | rcp45

CTL

SCN-CTL

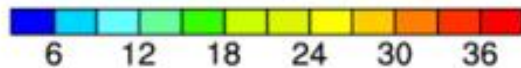
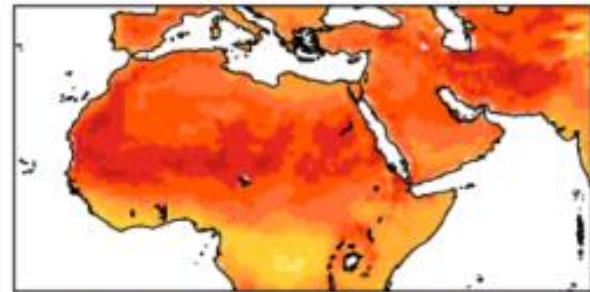
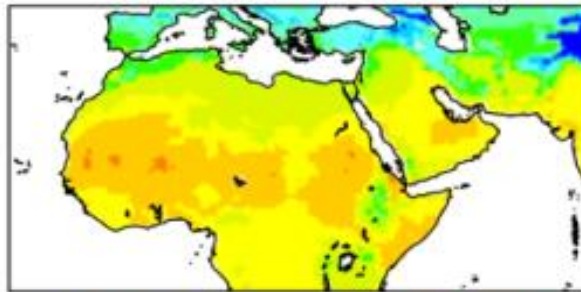


RCP 4.5

Temperature (°C) | Annual | CTL: 1986-2005 | SCN: 2081-2100 | rcp85

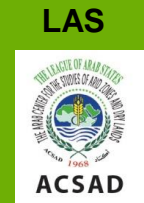
CTL

SCN-CTL



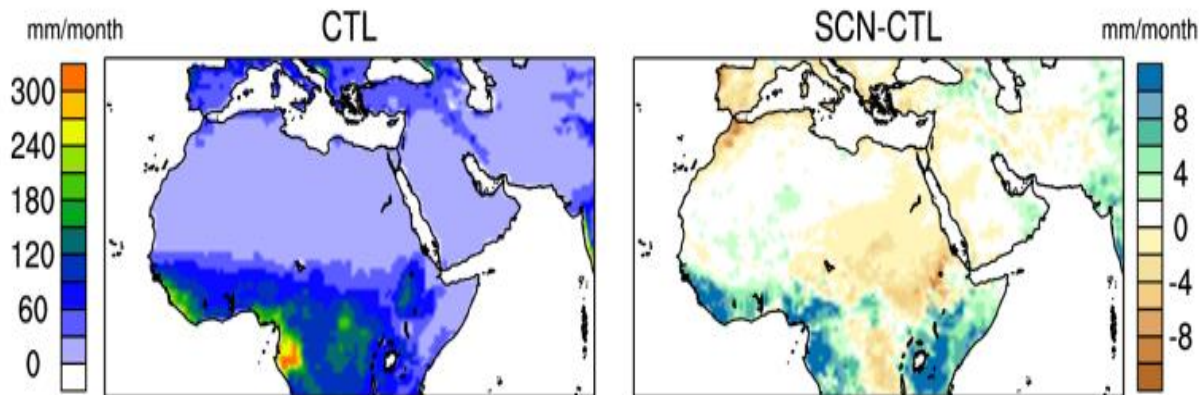
RCP 8.5

- The general change of temperature towards shows an increase between 1 to 3°C in RCP 4.5 and from 2 to 5°C with RCP 8.5.
- The areas showing higher increase are in the Sahara area in North Africa and East Africa, including Morocco and Mauritania.
- The increasing temperature signals along the westerns shores of Yemen and Saudi Arabia under RCP 8.5 are also stronger than under RCP 4.5 in comparison with the rest of the Arabian peninsula.



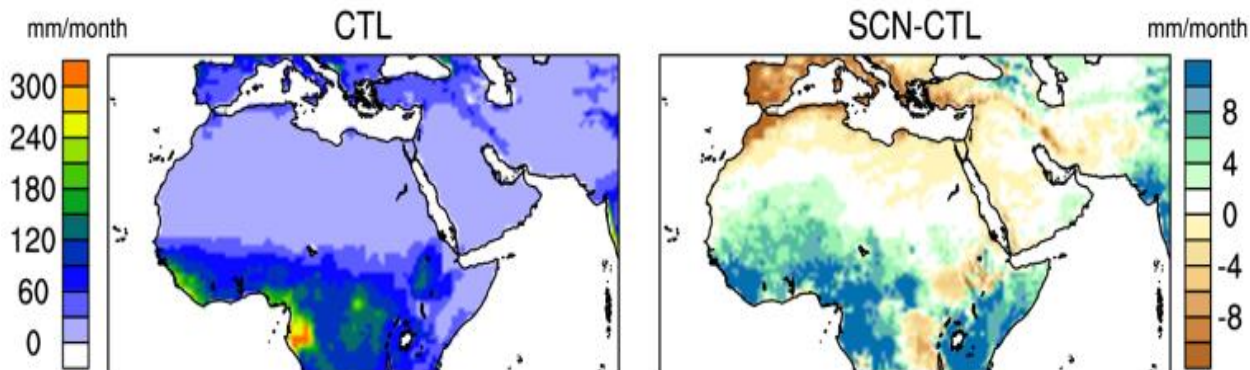
Changes in precipitation for time period 2081-2100 from the baseline 1986-2005 (End-Century)

Precipitation | Annual | CTL: 1986-2005 | SCN: 2081-2100 | rcp45



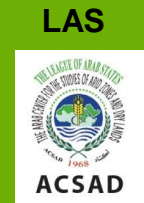
RCP 4.5

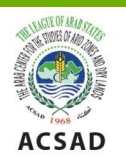
Precipitation | Annual | CTL: 1986-2005 | SCN: 2081-2100 | rcp85



RCP 8.5

- Both scenarios show a reduction of the average monthly precipitation reaching 8-10 mm in the coastal areas of the domain, mainly around the Atlas Mountains in the West and upper Euphrates and Tigris river basins in the East.





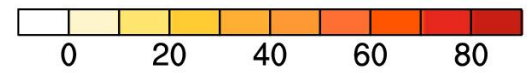
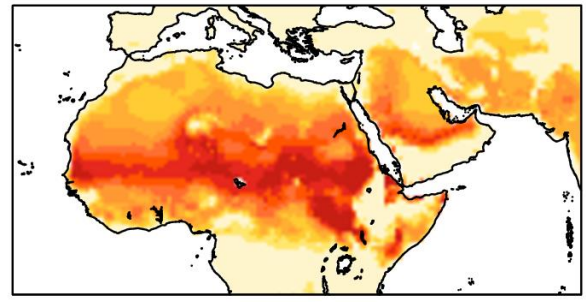
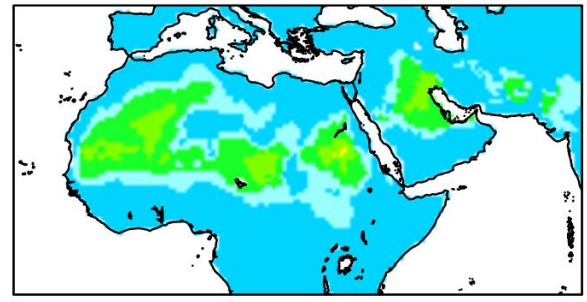
Extreme Climate Indices

Changes in Temperature Indices – Summer Days >40

Summer days, Tmax > 40°C (SU) | ANN | CTL: 1986-2005 | SCN: 2081-2100 | rcp45 (nr of days)

CTL

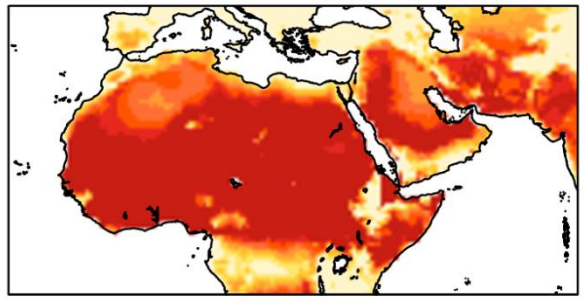
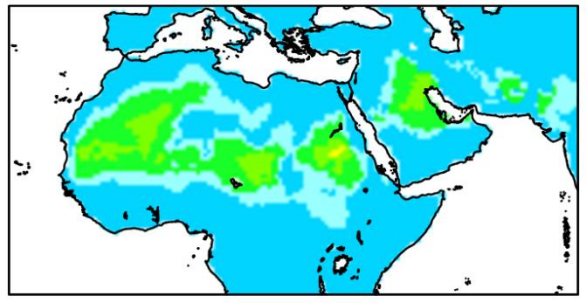
SCN-CTL



Summer days, Tmax > 40°C (SU) | ANN | CTL: 1986-2005 | SCN: 2081-2100 | rcp85 (nr of days)

CTL

SCN-CTL



• Changes in the Summer days with Tmax > 40°C (i.e. annual number of days when Tmax >40°C) for the period 2081-2100 for RCP 4.5 and RCP 8.5 compared to the baseline period 1986-2005 for the ensemble of the three projections.

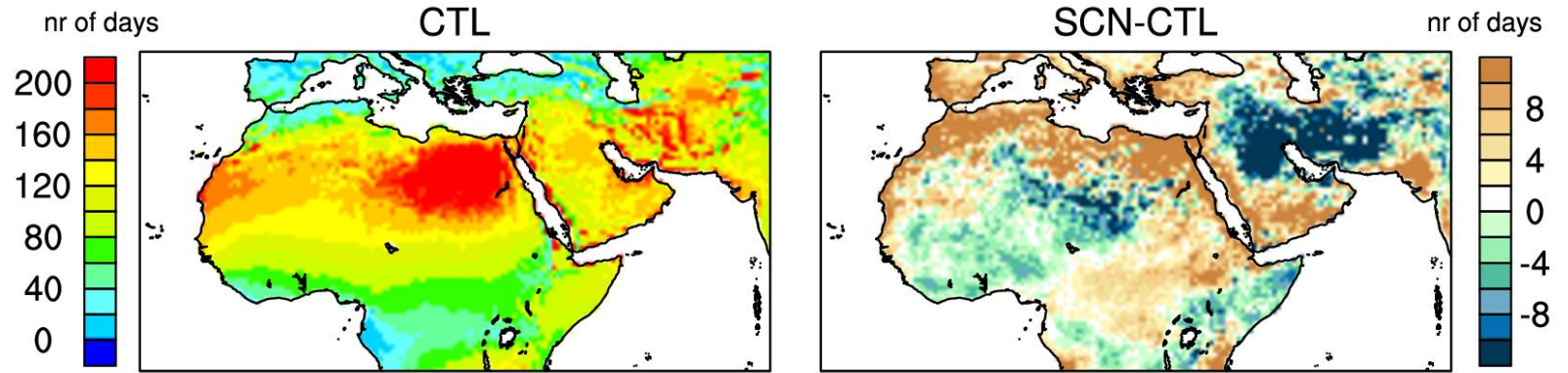
• The results show strong warming in the Sahara and Central Peninsula Areas for RCP8.5. The increase in the extreme temperature on the coastal areas would be lower than the central parts of the region for both scenarios.



Extreme Climate Indices

Changes in Precipitation Indices- Maximum Length of Dry Spell (days)

Maximum length of dry spell (CDD) | ANN | CTL: 1986-2005 | SCN: 2081-2100 | rcp85



- Changes in the maximum length of dry spell of ensembles of three projections for RCP8.5 for the period 2081 – 2100 compared to the base period 1986-2005.
- The projections show trends towards drier condition with an increase in number of days specifically Mediterranean and western and Southern parts of the Arabian Peninsula by the end of the century. This indicates that the dry season (summer) is extending in length especially in these areas.



Future Hydrological Projections

Runoff – Summer – RCP 8.5

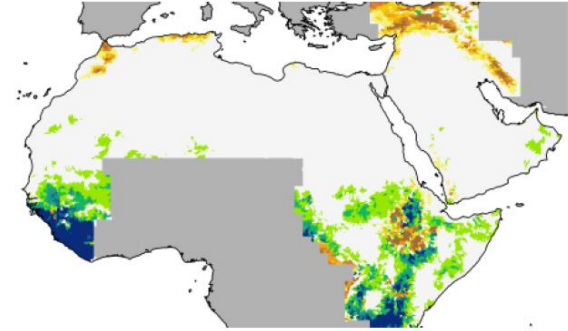
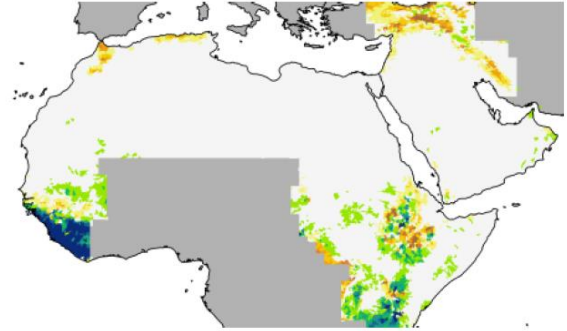
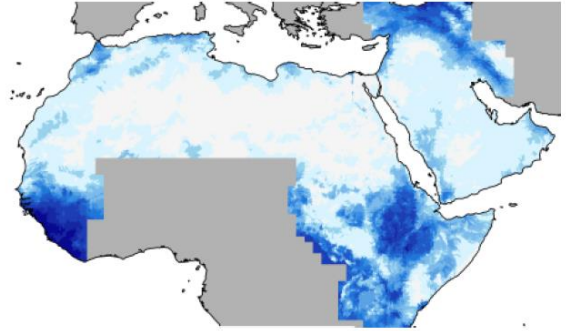


Apr-Sep: 1986-2005

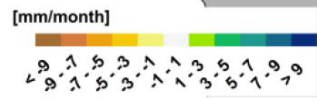
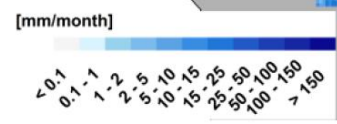
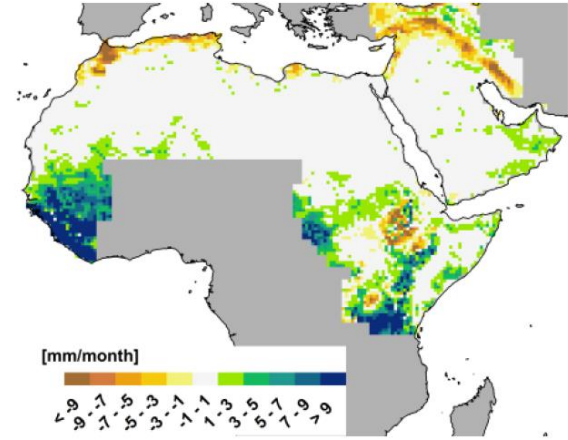
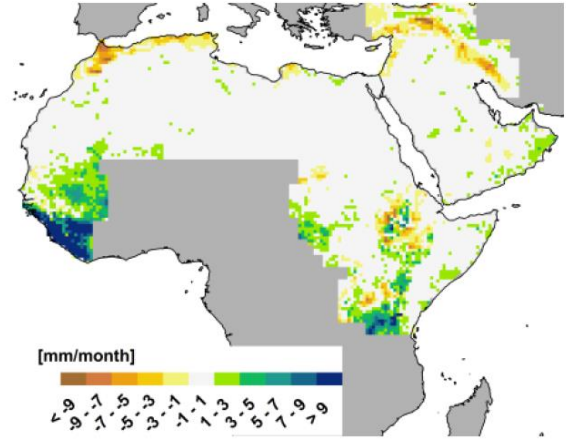
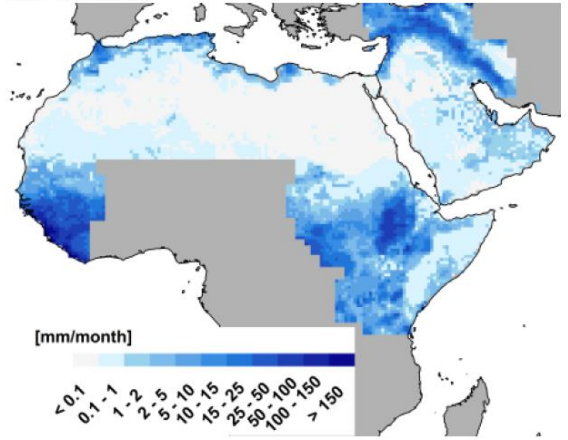
2046-2065

2081-2100

HYPE Model

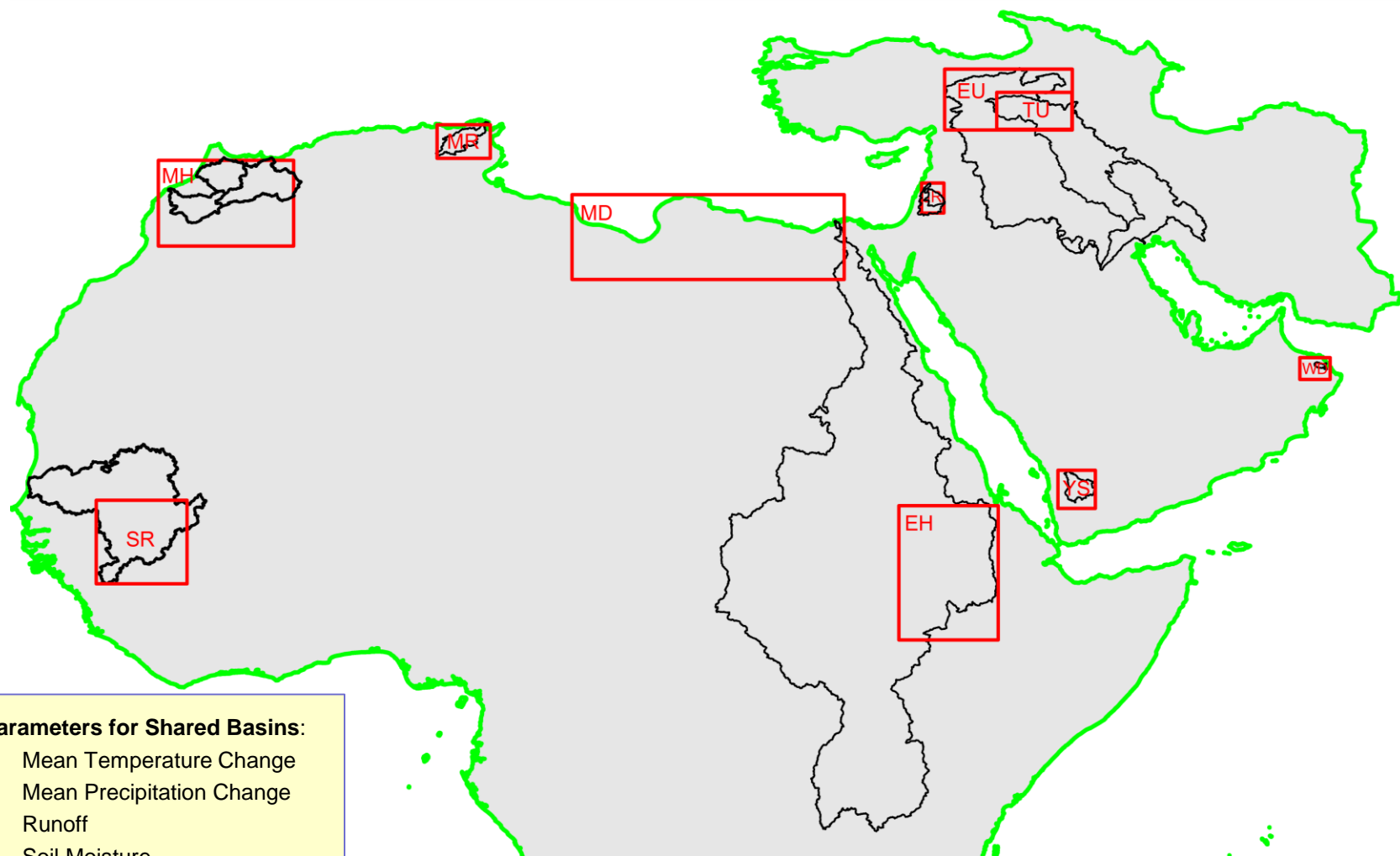


VIC Model



Hydro Models: 3-member ensemble
Preliminary findings

RCM projections used to generate hydrological modeling projections for Arab Region, Sub-regions & Shared Water Basins



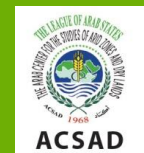
Parameters for Shared Basins:

- Mean Temperature Change
- Mean Precipitation Change
- Runoff
- Soil Moisture
- Evapotranspiration
- Groundwater interaction with surface water

Source: P. Graham (SMHI), based on AWMC & Sida Partners Consultations, RICCAR Scoping Meeting for the Establishment of an ArabCOF, 15 Oct 2014



LAS



ACSAD



WMO

RICCAR

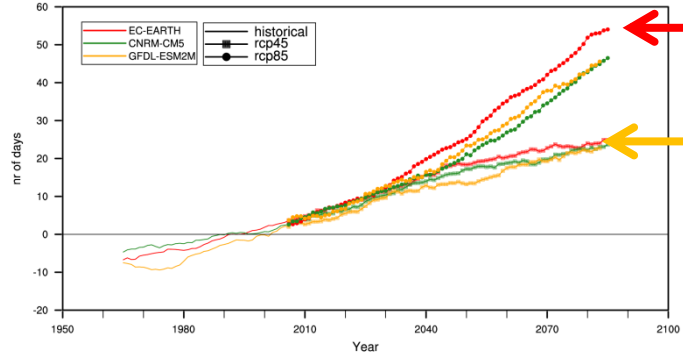


Moroccan Highlands

Temperature

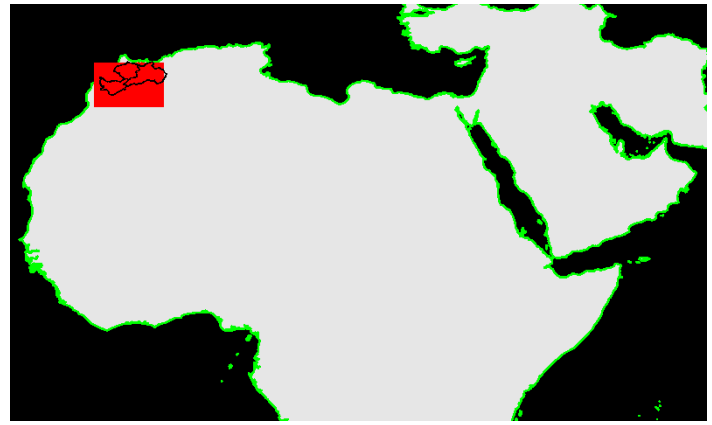
Change in number of days > 35°C

Summer days, Tmax > 35°C (SU35) anom. wrt 1986-2005 | 30-yr. mov. mean | ANN
Morrocan Highlands 9W 1W 30N 35N

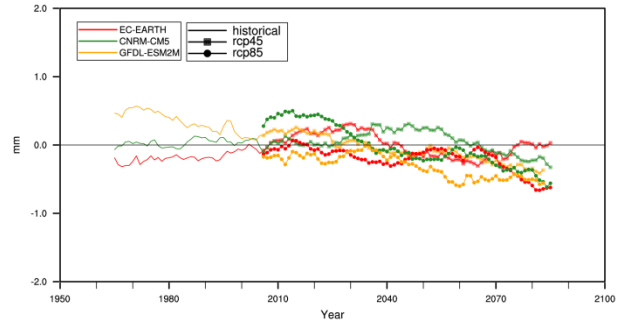


RCP 8.5

RCP 4.5

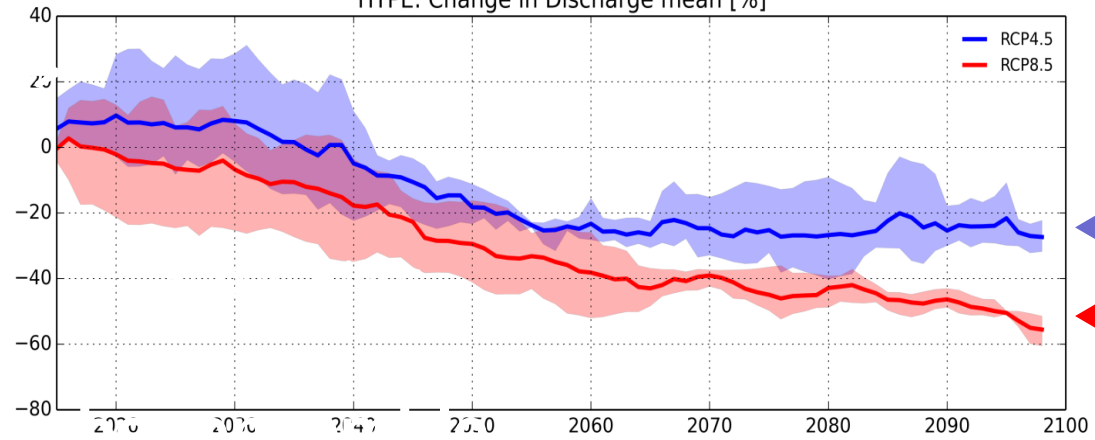


Precipitation Intensity - SDII



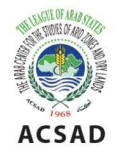
% Change in mean annual river discharge

HYPE: Change in Discharge mean [%]



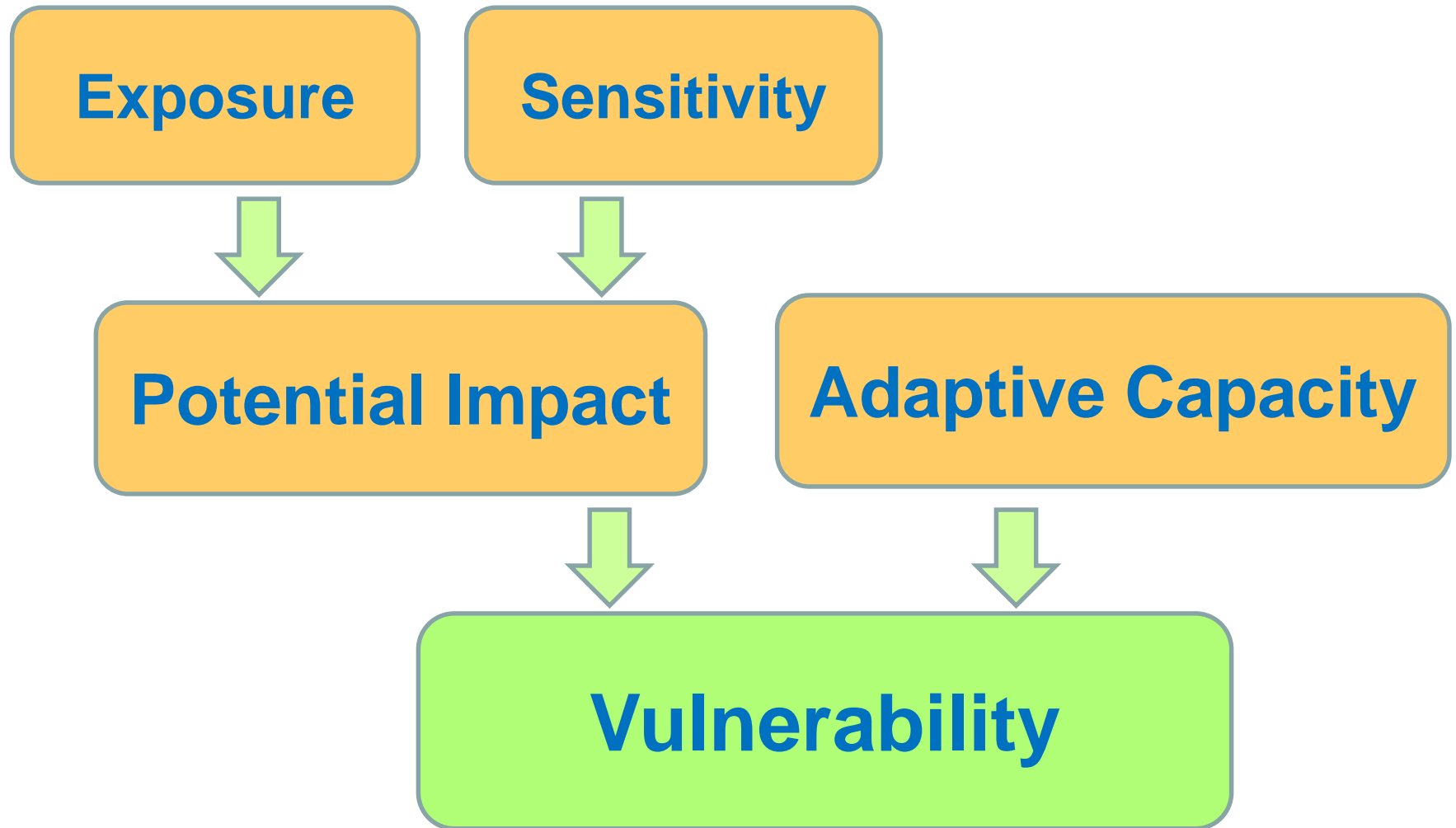
RCP 4.5

RCP 8.5








RICCAR

Vulnerability Assessment Framework

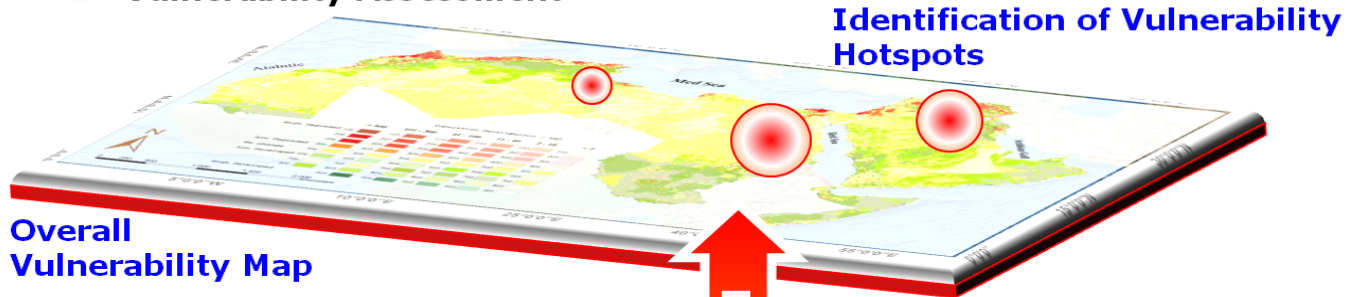


Sector & Impacts Selected for Arab Region VA

Sectors	Impacts
 Water	<p>Change in water availability</p>
 Biodiversity & Ecosystems	<p>Change in area covered by forests</p> <p>Change in area of wetlands/marshes</p>
 Agriculture	<p>Change of water available for crops</p> <p>Change of rangeland for livestock</p>
 Infrastructure & Human Settlements	<p>Change in inland flooding area</p> <p>Change in coastal flooding area</p>
 People	<p>Change of water available for drinking</p> <p>Change in health due to heat stress</p> <p>Change of employment rate in the agricultural sector</p>

RICCAR Integrated Vulnerability Mapping Methodology

4 Integrated Mapping for Vulnerability Assessment



Human Factor

3

Adaptive Capacity

+

Population Density

Potential Climate Change Impact

2

Sensitivity

+

Exposure

With Weighting & Indicator Classification Schemes

Over 200 indicators vetted through a consultative process. 62 Indicators selected

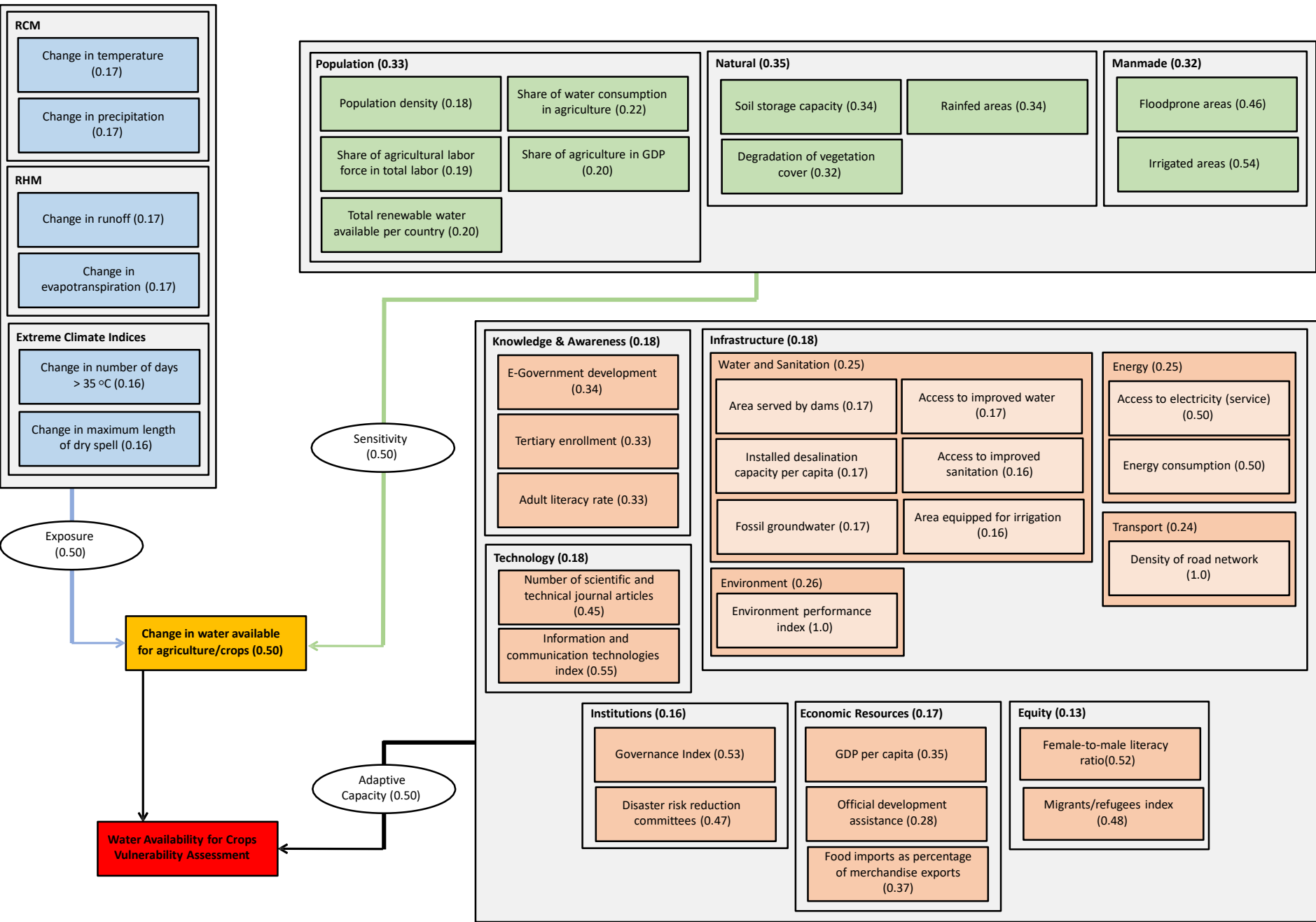


Regional Initiative for the Assessment of the Impact of Climate Change on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR)

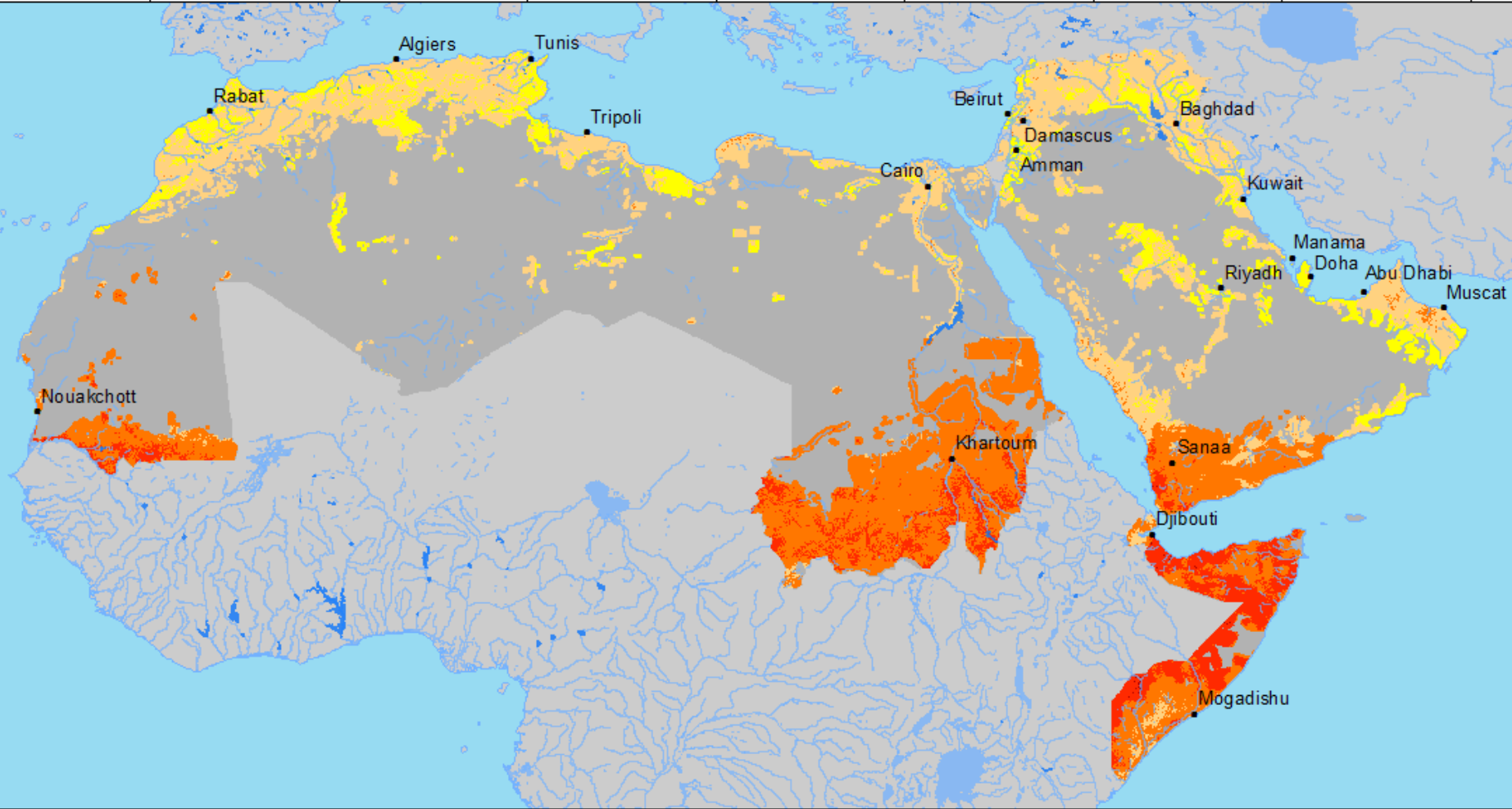
Adaptation to Climate Change in the Water Sector in the MENA Region (ACCWiM) project

Training Manual on the Integrated Vulnerability Assessment Methodology

Impact Chain and Weights for Agriculture Sector - Change in water available for agriculture/crops



CC Vulnerability of Agriculture Sector by 2100 for RCP 4.5



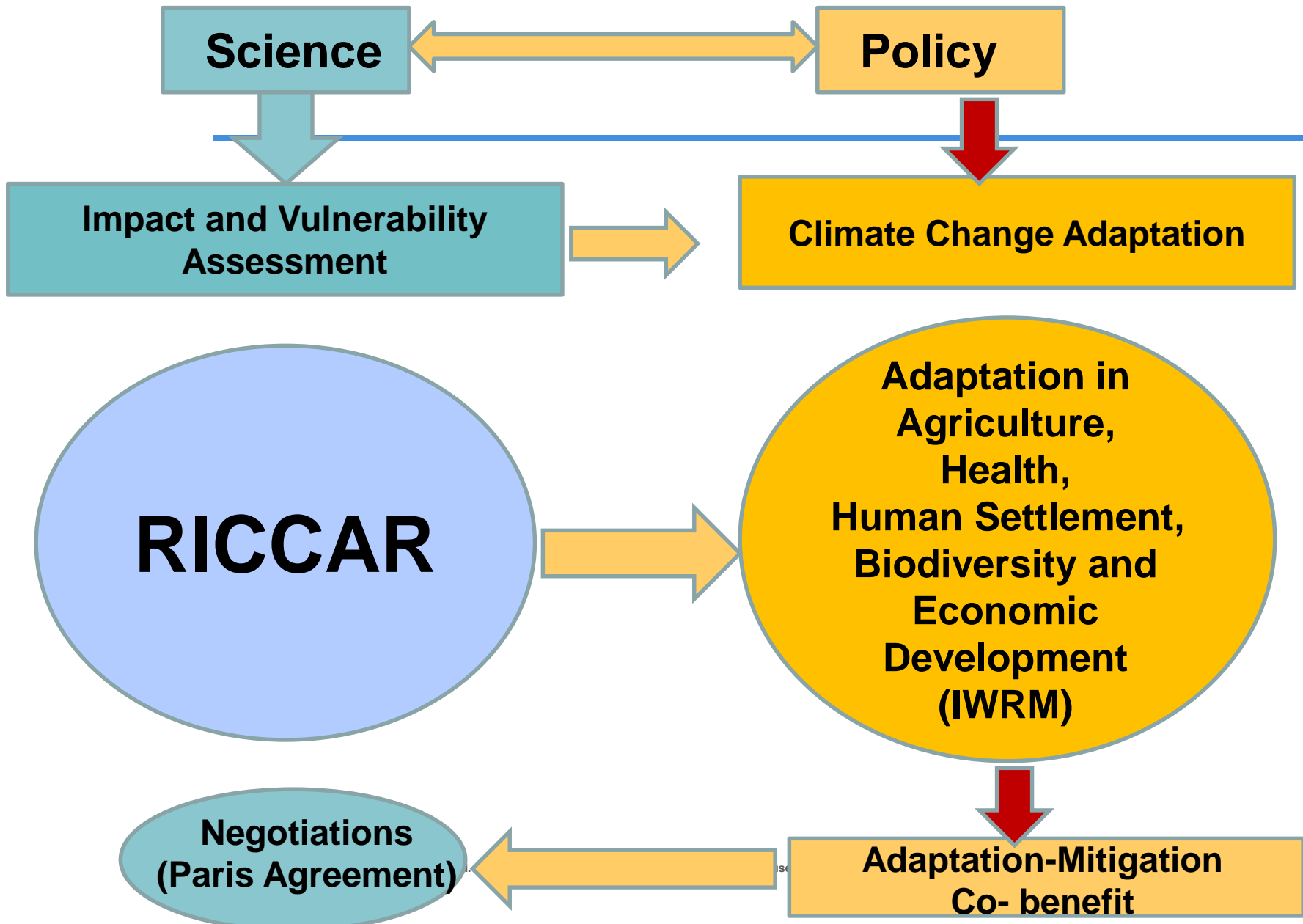
Legend

- Lakes
- Reservoirs
- Rivers
- Intermittent rivers

- Major cities
- Study area not relevant to sector



Linking Climate Science to Policy, Adaptive Strategy and Mitigation



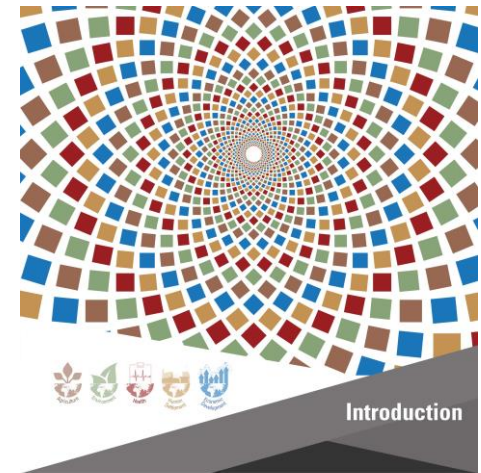
Climate Change Adaptation

United Nations Development Account Project on Developing the Capacities of the Arab Countries for Climate Change Adaptation by Applying Integrated Water Resources Management Tools

Five sector modules were developed by the following leading organizations (in coordination with ESCWA):

1. Agriculture module by ACSAD/GIZ;
2. Environment module by UNEP/ROWA;
3. Health module by WHO;
4. Human settlements (water supply and sanitation) by ACWUA;
5. Economic module by ESCWA as well as an introductory chapter for the manual.

Five workshops were held with stakeholders from each sector to review respective modules



Climate Change Adaptation

Example: Human Settlements Module (I)

1- Introduction

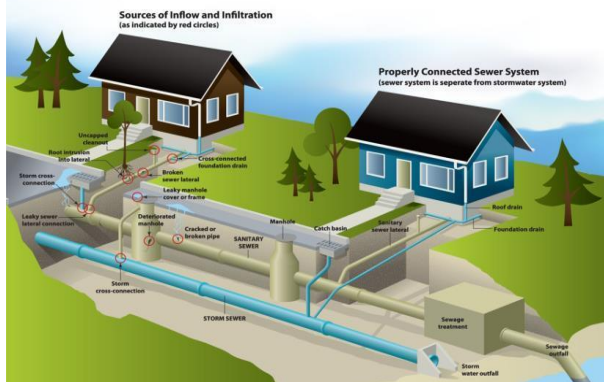
- Objectives
- Targeted stakeholders

2- Framing Sectoral Problems

- Resource challenge
- Intermittent supply
- Enhancing water efficiency at the city level
- Management of storm and wastewater infrastructures

3- Vulnerability and impacts assessment

- Drainage networks performance under various climate scenarios
- Impacts on drainage network design



Climate Change Adaptation

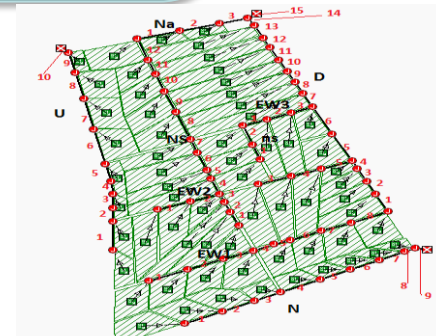
Example: Human Settlements Module (II)

4- Adaptation measures and implementation

- Water harvesting
- Water demand management
- Reuse of grey water
- Treatment technologies for grey water recycling
- Water footprints tool
- Cutting on the Non-revenue water
- Wastewater reuse and recycle
- Water Tariffs

5- Areas for action

- Best practices
- Governance
- Social factors
- Economic factors
- Cost of water adaptation measures



THANK YOU

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