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

RICCAR Overview

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Chief, Water Resources Section, Sustainable Development Policies Division
United Nations Economic and Social Commission for Western Asia (ESCWA)
Beirut, Lebanon

Workshop on Developing the Capacities of the Human Settlements Sector for Climate Change Adaptation Using Integrated Water Resources Management (IWRM) Tools
Amman, 22-24 May 2016
Council of Arab Ministers Responsible for the Environment (CAMRE) under League of Arab States

- Issued first inter-governmental Arab Statement on Climate Change in December 2007,

**Declaration (excerpts):**

- Constitutes the base for future action and reflects the Arab position in dealing with climate change issues,

- **Adaptation to ...climate change** shall be fully consistent with the economic and social development .... It shall be implemented through the development and dissemination of methodologies and tools that assess the impacts of climate change and their extent; as well as through improving planning for adaptation, along with its measures and procedures, in addition to its integration in sustainable development policies; besides understanding, developing and disseminating measures, methodologies and tools that achieve economic diversity with the aim of increasing the elasticity of economic sectors vulnerable to climate change.

- Establish studies and research centers for climate change in the regions of developing countries, including the Arab region. These centers should be concerned with examining impacts and challenges facing the citizens and peoples of the developing countries as a result of climatic change.
Inter-Governmental Mandates calling for & supporting Climate Change **Assessment** in the Arab Region

- **Arab Ministerial Declaration on Climate Change**
  - CAMRE 2007

- **ESCWA 25th Ministerial Session**

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

- **Arab Permanent Committee for Meteorology Resolutions**

- **Arab Ministerial Water Council Resolutions**

- **ACSAD Board of Directors Resolution**
  - 2013

**Environment** | **Foreign Affairs & Planning** | **Water** | **Met** | **Agriculture**
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.

RICCAR aims to provide a common platform for assessing, addressing and informing response to climate change impacts on freshwater resources in the Arab region by serving as the basis for dialogue, priority setting and policy formulation on climate change at the regional level.
RICCAR Partnerships

Implementing Partners

- ESCWA
- UNEP
- WMO
- ACSAD
- LAS
- SMHI
- UNESCO
- Cairo Office
- gIZ
- UNU-INWEH

Donors

- Sweden

Collaborating Research Institutes

- 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 2.0 (CS2.0) - Germany
RICCAR supported & implemented through Regional Cooperative Arrangements & Mechanisms

UN-LAS Coordination Mechanism

- UN-LAS Sectoral Meeting on Climate Change 2009
- Arab Summit approved IWRM Project on Climate Change LAS/ACSAD - 2009
- UN Regional Coordination Mechanism (RCM) Thematic Working Group on Climate Change Chaired by UNEP/ROWA - 2010

RICCAR Formulation & Implementation with Partners

- VA & RKH Working Groups 2013, 2014
- VA Task Force Meetings (sensitivity, AC) 2014, 2015
Implementation Pillars

1. Baseline Review & Knowledge Management
2. Integrated Assessment
   - Climate Change Impact Assessment
   - Climate Change Vulnerability Assessment
3. Capacity Building & Institutional Strengthening for Water Ministries, Meteorological Offices, Arab Research Centers
4. Awareness Raising & Information Dissemination
The Integrated Assessment Model

1. Global Climate Model Selection (GCM)
2. Regional Climate Modeling (RCM)
3. Regional Hydrological Modeling (RHM)
4. Vulnerability Assessment (VA)
5. Integrated Mapping (IM)

Impact Assessments:
- Water, Agriculture, Health
- Extreme Weather Events
Regional Climate Modeling over the Arab Domain

CORDEX-MENA/Arab Domain | 0.44° (50 km)

- **Active Domain**
- **Full Domain (SMHI-RCA4)**
Inter-Governmental Panel on Climate Change:
Areas considered for regional averages in IPCC AR4

From R.K Kolli, WMO
RICCAR EGM #2 (Beirut, 2010)
Figure A1.3: Overview of the SREX, ocean and polar regions used.
Representative Concentration Pathways (RCPs)
As first represented in IPCC AR5 Projections

Paris Agreement asks IPCC to formulate scenario that limits Global Average Temp increase to only 1.5°C by 2100 as there is no RCP for that now.

Graph adapted from: Meinshausen et al., 2010
Computing Climate Variables per Grid Box

REF: http://stratus.astr.ucl.ac.be/textbook/chapter3_node8.html
Computing Climate Variables: Scale Improving Over Time

Relative position of pressure levels, or “hPa Levels” that define the thickness of grid boxes.

Horizontal Grid:
Evolution of horizontal resolution over the course of the Various IPCC reports

FAR
~500 km (T21)

SAR
~250 km (T42)

TAR
~180 km (T63)

AR4
~110 km (T106)

RICCAR RCM Outputs at 50x50 km & 25x25 km

IPCC, 2007; Met Office, 2011
### Table 1. LIST OF ESSENTIAL CLIMATE VARIABLES

<table>
<thead>
<tr>
<th>Domain</th>
<th>Sub-domain</th>
<th>GCOS Essential Climate Variables</th>
</tr>
</thead>
</table>
| Atmospheric (over land, sea and ice) | Surface<sup>a</sup> | • Air temperature  
  • Wind speed and direction  
  • Water vapour  
  • Pressure  
  • Surface radiation budget |
| Upper-air (up to the stratopause) | Temperature  
  Wind speed and direction  
  Water vapour  
  Cloud properties  
  Earth radiation budget (including solar irradiance) |
| Composition | Carbon dioxide  
  Methane and other long-lived greenhouse gases: nitrous oxide (N<sub>2</sub>O), chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF<sub>6</sub>), perfluorocarbons (PFCs)  
  Ozone and aerosols, supported by their precursors, in particular nitrogen dioxide (NO<sub>2</sub>), sulphur dioxide (SO<sub>2</sub>), formaldehyde (HCHO), carbon monoxide (CO) |
| Oceanic | Surface<sup>b</sup> | Sea-surface temperature  
  Sea-surface salinity  
  Sea level  
  Sea state  
  Sea ice  
  Surface current  
  Ocean colour  
  Carbon dioxide partial pressure  
  Ocean acidity  
  Phytoplankton |
| | Sub-surface | Temperature  
  Salinity  
  Ocean current  
  Nutrients  
  Carbon dioxide partial pressure  
  Ocean acidity  
  Oxygen  
  Tracers |
| Terrestrial | Surface<sup>b</sup> | River discharge  
  Water use  
  Lakes  
  Snow cover  
  Glaciers and ice caps  
  Ice sheets  
  Permafrost  
  Albedo  
  Land cover (including vegetation type)  
  Fraction of absorbed photosynthetically active radiation (FAPAR)  
  Leaf area index (LAI)  
  Above-ground biomass  
  Fire disturbance |
| | Sub-surface | Groundwater  
  Soil carbon  
  Soil moisture |

Notes:  
<sup>a</sup> Including measurements at standardized, but globally varying heights in close proximity to the surface.  
<sup>b</sup> Including measurements within the surface mixed layer, usually within the upper 15 m.
<table>
<thead>
<tr>
<th>RCM (Institute)</th>
<th>GCM</th>
<th>Historical 1950-2005</th>
<th>RCP2.6 2006-2100</th>
<th>RCP4.5 2006-2100</th>
<th>RCP8.5 2006-2100</th>
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<tr>
<td>RCA4 (SMHI)</td>
<td>EC-Earth</td>
<td>✓</td>
<td>✓</td>
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<tr>
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<td>EC-Earth</td>
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<td>✓</td>
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<tr>
<td>RCA4 (SMHI)</td>
<td>CNRM</td>
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<tr>
<td>RCA4 (SMHI)</td>
<td>GFDL-ESM</td>
<td>✓</td>
<td>✓</td>
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<td>GFDL-ESM-1</td>
<td>✓</td>
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<tr>
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<td>GFDL-ESM-1</td>
<td>✓</td>
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</tr>
</tbody>
</table>

Currently have 13 regional climate projections completed
9 are available for CORDEX download

Source: P. Graham, SMHI, RICCAR EGM 6 (Cairo, Dec 2014)
Projected changes in temperature: RCP4.5

- similar patterns in both global and regional ensembles
- some differences on regional scale

Source: G. Nikulin (SMHI), RICCAR EGM-5, 11 Dec 2013
Projected changes in temperature: RCP8.5

global - GCMs and regional – RCA4(GCMs) ensembles SUMMER

- in coming decades both RCP4.5 and RCP8.5 are similar
- larger warming from 2041 on for RCP8.5 than for RCP4.5

Average global temperature has already risen by 1°C since pre-industrial times.
INDCs submitted pre-Paris Agreement puts the world on a 3-4°C pathway

Source: G.Nikulin (SMHI), RICCAR EGM-5, 11 Dec 2013
Figure 10. Change in the Maximum Length of Dry Spell (CDD) for the time period 2081-2100 from the baseline period 1986-2005 for RCP 4.5 and RCP 8.5.

**RCP 4.5**
Maximum length of dry spell (CDD) | ANN | CTL: 1986-2005 | SCN: 2081-2100 | rcp45

**RCP 8.5**
Maximum length of dry spell (CDD) | ANN | CTL: 1986-2005 | SCN: 2081-2100 | rcp85

Issued November 2015
SU35 & SU40 were added to better reflect regional specificities associated with warmer temperatures in the Arab region, as the global indicator for summer days adopted by WMO/ETCCDI was limited to measuring the number of summer days (SU) when the daily maximum temperature (TX) exceeds 25°C. More water needed during these higher temperature periods for health & cooling.

Source: RICCAR, Climate Projections and Extreme Climate Indices for the Arab Region (2015)

<table>
<thead>
<tr>
<th>Indices</th>
<th>Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changes in Temperature Indices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cold spell duration index</td>
<td>CSDI</td>
<td>Annual number of days with at least 6 consecutive days when Tmin &lt; 10th percentile</td>
</tr>
<tr>
<td>Summer days with Tmax &gt; 35°C</td>
<td>SU35</td>
<td>Annual number of days when Tmax &gt; 35°C</td>
</tr>
<tr>
<td>Summer days with Tmax &gt; 40°C</td>
<td>SU40</td>
<td>Annual number of days when Tmax &gt; 40°C</td>
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<tr>
<td>Tropical nights</td>
<td>TR</td>
<td>Annual number of days when Tmin &gt; 20°C</td>
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<tr>
<td>Changes in Precipitation Indices</td>
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<td></td>
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<tr>
<td>Maximum length of dry spell</td>
<td>CDD</td>
<td>Maximum annual number of consecutive dry days (i.e. when precipitation &lt; 1.0 mm)</td>
</tr>
<tr>
<td>Heavy precipitation days</td>
<td>R10mm</td>
<td>Annual number of days when precipitation ≥ 10 mm)</td>
</tr>
<tr>
<td>Very heavy precipitation days</td>
<td>R20mm</td>
<td>Annual number of days when precipitation ≥ 20 mm)</td>
</tr>
</tbody>
</table>
Number of days with TX over SU35°C

Number of days with TX over SU40°C

Source: RICCAR, Climate Projections and Extreme Climate Indices for the Arab Region (2015)
Change in Number of days with more than 10 mm of rainfall

Change in Number of days with more than 20 mm of rainfall

Important to thus not only look at climate parameters (T, P, etc.), but also thresholds used for the analysis:

• Average Temperature or Consecutive Peak Temperature Days
• Summer Days as defined as 25°C, 35°C or 40°C
• Rainfall intensity has implication for flooding

Source: RICCAR, Climate Projections and Extreme Climate Idices for the Arab Region (2015)
ESGF@LiU in cooperation with SMHI

Welcome to the ESGF Node @ LiU

The Earth System Grid Federation (ESGF) maintains a global system of federated data centers that allow access to the largest archive of climate data worldwide. The ESGF datanode at the National Supercomputer Centre, Linköping, is Sweden’s first datanode in the ESGF framework. It is a joint activity of NSC and the Swedish Meteorological and Hydrological Institute (SMHI). NSC is an independent organization within Linköping University (LIU), and is funded by the Swedish Research Council via SNIC (Swedish National Infrastructure for Computing).

https://esg-dn1.nsc.liu.se

Last Update: April 13, 2016, 10:55 a.m. by Admin User
Regional Climate and Hydrological Modeling for Climate Change Impact Assessment in Arab Region

Different GCMs

Ensemble Average used to reduce uncertainty at level of RCMs & RHMs

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

Bias Correction required

VIC, HYPE, HEC-HMS
Future Hydrological Projections

Runoff – Summer – **RCP 4.5**

**Hydro Models:** 3-member ensemble

*Preliminary findings*

Source: P. Graham (SMHI),
RICCAR Scoping Meeting for the Establishment of an ArabCOF, 15 October 2014
Future Hydrological Projections

Runoff – Summer – RCP 8.5

Hydro Models: 3-member ensemble

Preliminary findings

Source: P. Graham (SMHI), RICCAR Scoping Meeting for the Establishment of an ArabCOF, 15 October 2014
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
Moroccan Highlands (Atlas)

Temperature

Change in number of days > 35°C

% Change in mean annual river discharge

From P. Graham, SMHI PPT to RICCAR Event at WWW 2016 (Stockholm)
# 12 Nominated Hydrological Focal Points

<table>
<thead>
<tr>
<th>Country</th>
<th>Focal Point</th>
<th>Title</th>
<th>Ministry</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-Iraq</td>
<td>Mr. Jaafar Zamel</td>
<td>Head of Environmental Policy Dept</td>
<td>Ministry of Water Resources</td>
</tr>
<tr>
<td></td>
<td>Mr. Abdul Jabar Khalaf Fench</td>
<td>Expert, National Center for the Management of Water Resources</td>
<td></td>
</tr>
<tr>
<td>2-Jordan</td>
<td>Ms. Rania Abdul Khaleq</td>
<td>Director, Finance &amp; Int’l Cooperation</td>
<td>Ministry of Water and Irrigation</td>
</tr>
<tr>
<td>3-Djibouti</td>
<td>Mr. Ismail Elmi Habane</td>
<td>Technical Advisor to the Minister in charge of Marine Resources</td>
<td>Ministry of Agriculture, Water, Livestock, Fisheries</td>
</tr>
<tr>
<td>4-Qatar</td>
<td>Mr. Saad Abdullah El Hatmi</td>
<td></td>
<td>Ministry of Environment</td>
</tr>
<tr>
<td>5-Libya</td>
<td>Mr. Mahdi ElMejrebi</td>
<td>Director General</td>
<td>Public Water Authority</td>
</tr>
<tr>
<td>6-Oman</td>
<td>Mr. Ali Ben Mohsen Ben Jawad Lwatia</td>
<td>Hydrological</td>
<td>Ministry of Regional Municipalities and Water Resources</td>
</tr>
<tr>
<td>7-Palestine</td>
<td>Ms. Salam Abouhantash</td>
<td>Head, Water Harvesting Section</td>
<td>Palestinian Water Authority</td>
</tr>
<tr>
<td>8-Mauritania</td>
<td>Mr. Mohamed Abdellahi Ould Taleb</td>
<td>Technical Advisor responsible for Hydrology</td>
<td>Ministry of Hydrology and Sanitation</td>
</tr>
<tr>
<td>10-Saudi Arabia</td>
<td>Mr. Yaser Bin Mashfar El Asmari</td>
<td>Hydrologist</td>
<td>Ministry of Water and Electricity</td>
</tr>
<tr>
<td>11-Sudan</td>
<td>Mr. Ammar Abdelrahman</td>
<td>Water Resources Engineer</td>
<td>Ministry of Water &amp; Electricity</td>
</tr>
<tr>
<td></td>
<td>Ms. Widad Saadalla</td>
<td>Executive Secretary</td>
<td></td>
</tr>
<tr>
<td>12-Yemen</td>
<td>Mr. Abdulkhaleq Alwan</td>
<td>IWRM Principal Advisor, Water Planning &amp; Policies, Director NWRA-SB</td>
<td>Ministry of Water and Environment</td>
</tr>
</tbody>
</table>

**Attending meetings:** Egypt, Lebanon, Tunisia
Impact Assessments

**Agriculture**
- FAO, ACSAD, GIZ/ACCWaM
- Forests
- In-land Fisheries
- Selected Crops
  - Irrigated
  - Rainfed
  - Mixed
- Selected Hot Spots

**Health**
- UNU/INWEH under Sida Project in consultation with WHO on Neglected Tropical Diseases (NTCs) looking at:
  - Disease Vectors
  - Rodent-Borne Infectious Diseases
  - North Africa
L. major causes zoonotic cutaneous leishmaniasis and is the dominant form in North Africa, causing 90% of cases. L. tropica largely occurs in Morocco, while only sporadic cases of L. infantum are reported.
Applying WADI in RICCAR: Leishmaniasis: Fall

Column A: Fall (October) ZCL exposure 1) Historical ii) RCP 4.5 2046-2065 iii) RCP 4.5 2081-2100;
Column B: Fall (October) ZCL exposure 1) Historical ii) RCP 8.5 2046-2065 iii) RCP 8.5 2081-2100

UNU-INWEH “Climate change impacts on health in the Arab region: A case study on neglected tropical disease”
RICCAR, draft report 7 Dec 2015
Applying WADI in RICCAR: Leishmaniasis: Summer

Column C: Summer (June) ZCL exposure
1) Historical
2) RCP 4.5 2046-2065
3) RCP 4.5 2081-2100

Column D: Summer (June) ZCL exposure
1) Historical
2) RCP 8.5 2046-2065
3) RCP 8.5 2081-2100

UNU-INWEH “Climate change impacts on health in the Arab region: A case study on neglected tropical disease”
RICCAR, draft report 7 Dec 2015
Three case studies to assess impact of climate change on crop yield (due to T, P, CO₂ in atmosphere, etc.)

1. Egypt: North Delta
   *Irrigated agriculture zone

2. Jordan: Karak Governorate
   *Rainfed agriculture

3. Lebanon: Orontes watershed
   *Mixed agriculture

From Mr. Ihab Jnad, ACSAD, Green Sectors Studies Workshop (Beirut, 19 March 2016)
AquaCrop model

simulate yield response to water

AquaCrop predict yield under climate change scenarios

Developed by FAO

Dirk RAES, Pasquale STEDUTO, Theodore C. HSIAO, and Elias FERERES

From Mr. Ihab Jnad, ACSAD, Green Sectors Studies Workshop (Beirut, 19 March 2016)
Vulnerability Assessment Framework

Exposure

Sensitivity

Potential Impact

Adaptive Capacity

Vulnerability

IPCC AR4 approach to vulnerability assessment
### Impacts

<table>
<thead>
<tr>
<th>Sector</th>
<th>Impact</th>
<th>Sub-Vulnerability</th>
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<tbody>
<tr>
<td>Water</td>
<td>Change in water availability</td>
<td>V0</td>
</tr>
<tr>
<td>Biodiversity &amp; Ecosystems</td>
<td>Change in area covered by forests</td>
<td>V1</td>
</tr>
<tr>
<td></td>
<td>Change in area of wetlands</td>
<td>V2</td>
</tr>
<tr>
<td>Agriculture</td>
<td>Change of water available for crops</td>
<td>V3</td>
</tr>
<tr>
<td></td>
<td>Change of rangeland for livestock</td>
<td>V4</td>
</tr>
<tr>
<td>Infrastructure &amp; Human Settlements</td>
<td>Damage from inland flooding</td>
<td>V5</td>
</tr>
<tr>
<td></td>
<td>(Damage from coastal flooding)</td>
<td>(V6)</td>
</tr>
<tr>
<td>People</td>
<td>Change of water available for drinking</td>
<td>V7</td>
</tr>
<tr>
<td></td>
<td>Change in health due to heat stress</td>
<td>V8</td>
</tr>
<tr>
<td></td>
<td>Change of employment rate in the agricultural sector</td>
<td>V9</td>
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</table>

Based on: VA Training Manual
Note that Exposure indicators are selected from 1 climate scenario per VA, depending on whether assessing baseline conditions, the absolute change from baseline to 2046-2065 or 2081-2100 for RCP 4.5, or the absolute change from baseline to 2046-2065 or 2081-2100 for RCP 8.5.
Over 300 Sector Questionnaires
Completed by Regional Experts
and vetted to support indicator weighting scheme.
Impact Chain for Water Sector, Potential Impact 0: Change in Water Availability

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

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

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

Population (0.34)
- Population density (0.21)
- Total renewable water available per capita (0.21)
- Water consumption per capita (0.21)

Share of water consumption in agriculture (0.21)
- Refugee population (0.16)

Natural (0.34)
- Land use/land cover (0.27)
- Soil type - Storage capacity (0.25)
- Degradation of vegetation cover (0.26)
- Wetlands (0.22)

Man-made (0.32)
- Urban extent (0.47)
- Area served by dams (0.53)

Knowledge & Awareness (0.17)
- E-Government Readiness Index (0.33)
- Number of graduates from tertiary education (0.32)
- Adult literacy rate - population 15+ years (0.35)

Technology (0.17)
- Number of scientific and technical journal articles (0.46)
- Information and communication technologies index (0.54)

Infrastructure (0.17)
- Water and Sanitation (0.52)
  - Area serviced by dams (0.17)
  - Installed desalination capacity per capita (0.17)
  - Fossil groundwater (0.17)
- Environment (0.48)
  - Environment performance index (1.0)

Institutions (0.17)
- Governance index (0.54)
- Existence of DRR committees (0.46)

Economic Resources (0.18)
- GDP per capita (0.36)
- ODA index (0.30)
- Food imports as percentage of merchandise exports (0.34)

Equity (0.14)
- Literacy ratio (0.51)
- Migrants/refugees index (0.49)

Legend
- Exposure
- Sensitivity
- Adaptive Capacity
- Potential Impact
- Sub-Sector Vulnerability

Draft
Normalisation and Evaluation of Data

- In order to aggregate these datasets into the course of the vulnerability assessment, the data first need to be transformed into a unit-less score on a common scale. This process is called **normalisation**.
Change in Precipitation: Normalized Map

Absolute change in Precipitation - rcp8.5 - 1986-2005, 2081-2100

Class VALUE Range (mm)
1 >90
2 71 - 90
3 51 - 70
4 31 - 50
5 11 - 30
6 -9 - 10
7 -29 - -10
8 -49 - -30
9 -69 - -50
10 < -70
Change in Vegetation Cover (2000-2011)

RICCAR: Vegetation Cover

Legend
- Capital cities

Water bodies
- Lake
- Reservoir
- Rivers
- Intermittent rivers

Degradation of vegetation cover
Equal Interval of the NDVI analysis results
- Very high improvement
- High improvement
- Moderate improvement
- Slight improvement
- Very slight improvement
- Very slight degradation
- Slight degradation
- Moderate degradation
- High degradation
- Very high degradation

RICCAR/ACCWaM
Redrawn from ACSAD, GIZ & Trier University at Germany, based on MODIS images (Echo-Reverb) for the period 2000-2011
Female to Male Literacy Ratio


Legend
- Capital cities
- Water bodies
  - Lake
  - Reservoir
  - Rivers
  - Intermittent rivers
- No Data

Female/Male Adult literacy ratio (% of population 15+ years)
Ratio: Female Adult literacy ratio, population 15+ years (%);
Male Adult literacy ratio, population 15+ years (%)

- 52.10 - 56.62
- 56.63 - 61.14
- 61.15 - 65.66
- 65.67 - 70.18
- 70.19 - 74.70
- 74.71 - 79.22
- 79.23 - 83.74
- 83.75 - 88.26
- 88.27 - 92.78
- 92.79 - 97.30

Prepared by ESCWA
SHARE OF CHILDREN AND ELDERLY OF THE POPULATION

Indicator Fact Sheet

Indicator: Share of children and Elderly of the total population

Vulnerability component: Sensitivity

Description (position in the impact chain): Indicated the share of population most sensitive towards heat waves.

Sectors / Impacts: Infrastructure and Settlements/Damage from inland flooding

Classes and thresholds:

- Equal Interval Classification (for RKH):
  - 10%-12.47%
  - 22.56%-25.34%
  - 25.95%-28.63%
  - 29.42%-32.88%
  - 32.89%-36.35%
  - 36.56%-39.82%
  - 39.83%-43.29%
  - 43.35%-46.76%
  - 46.77%-50.13%
  - 50.24%-53.74%

Equal Interval Classification of the normalised percentage values (for VA):

1. Qatar, United Arab Emirates (0.0-0.1)
   2. Bahrain (0.1-0.2)
   3. Kuwait, Oman (0.2-0.3)
   4. (0.3-0.4)
   5. (0.4-0.5)
   6. Algeria (0.5-0.6)
   7. (0.6-0.7)
   8. Tunisia, Morocco, Libya, Lebanon, Djibouti (0.7-0.8)
   9. Jordan, Egypt, Syrian Arab Republic, Mauritania (0.8-0.9)
   10. Palestine, Yemen, Iraq, Somalia (0.9-1.0)

Influence on vulnerability:
The countries with higher percentages have higher sensitivities.

Criterion (source of data):
UNSTAT, ESCWA and country statistical bureaus

Data information:

Type of data: Tables/Excel

Spatial coverage: Only Arab States

Resolution: One value per country

Time reference: Latest available

Unit of measurement: % of population 0-14 and 65+ from total population

Methodology for general data calculation:
One value per country as stated in the database
Preparation of a Vulnerability Index:

- **Per Sector**
  - Contains all indicators identified to assess a given sector
  - Attribution of weights for each indicator dependent on impact chains and expert judgment
  - As sector level, aggregated by component: Exposure, Sensitivity, Adaptive Capacity

- **Overall Vulnerability**
  - Aggregates vulnerability of each sector to generate an Overall VA
  - Supports identification of VA Hotspots

Slide graphics: adelphi
Source of maps: ACSAD, SMHI
Regional Knowledge Hub

Governance

- ACSAD-ESCWA Coordinating Secretariat (Doha, 2014)
- FAO identified to provide IT Platform via FENIX

RKH Consultative Meeting: ESCWA, ACSAD, FAO, GIZ (Beirut, 19-20 April 2015); Contracting planned in 2016

Regional Knowledge Hub on Water & Climate

- Reports
- Studies
- Briefs
- Training Materials
- EGM
- Workshop
- Working Group Documents

Data Portal for Arab Domain Outputs

- RCM Maps
- RHM Maps & Data
- Sub-Domains
- Extreme Events Indices
- VA Maps Hotspots & Data

Additional Technical & Training Materials to be provided from ACCWaM & UNDA Climate Change Adaptation using IWRM Tools Capacity Building Project, which draw on RICCAR Outputs
Purpose

- Regular seasonal forecast products for the Arab region.
- Regional assessments of climate extremes based on national inputs.
- Climate/climate change monitoring and assessment
- Regional assessment of climate change scenarios and their implications.
- Improved and accurate climate data and enhanced monitoring capacity.
- Provision of regional climate information to help responding to user needs (hydrology, agriculture, health, etc.).
- Regular capacity development efforts and promotion of common approaches for climate services by Arab countries
- Better user awareness and sustainable platform for user interface.

Governance

- Approved by Arab Permanent Committee for Meteorology (Jeddah, 25-30 March 2015)
- UAE offered to host ArabCOF, with budgetary review currently underway with LAS Technical Secretariat and ESCWA.
<table>
<thead>
<tr>
<th>Workshops</th>
<th>Location</th>
<th>Date/Duration</th>
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<tbody>
<tr>
<td>Capacity Building &amp; Institutional Strengthening Workshops</td>
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<tr>
<td><strong>Projection/ Prediction and Extreme Events Indices</strong></td>
<td>Arab Met Offices</td>
<td>March 2012 Casablanca</td>
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<tr>
<td><strong>Applications &amp; Analysis of Regional Climate Models</strong></td>
<td>Water Ministries</td>
<td>July 2012 Beirut</td>
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<tr>
<td><strong>National Workshops for Disaster Losses Inventories</strong> (Tunisia, Morocco, Yemen, Jordan, Palestine)</td>
<td>Inter-ministerial</td>
<td>September 2012-April 2014</td>
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<td><strong>Climate Data Rescue</strong></td>
<td>Met Services</td>
<td>June 2013 Amman</td>
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<tr>
<td><strong>Linking Regional Climate Models to Hydrological Models</strong></td>
<td>Arab Water Ministries</td>
<td>June 2013 Beirut</td>
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<tr>
<td><strong>Technical Workshop on the Vulnerability Assessment Methodology Application</strong></td>
<td>Research Centers</td>
<td>May 2014 Beirut</td>
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<tr>
<td><strong>Scoping Meeting for Establishing an Arab Climate Outlook Forum (ArabCOF)</strong></td>
<td>Met Services</td>
<td>Oct 2014, Amman</td>
</tr>
<tr>
<td><strong>Moving from Impact Assessment to Socio-Economic Vulnerability Assessment</strong></td>
<td>Water &amp; Agriculture Ministries</td>
<td>June 2015 Beirut</td>
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<tr>
<th>Expert Group Meetings</th>
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<td><strong>EGM 1:</strong> Launching Water, Environ</td>
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<td>2009 Beirut</td>
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<td><strong>EGM 2:</strong> Arab Domain Water Environ</td>
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<td>2010 Beirut</td>
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<td><strong>EGM 3:</strong> RCMs Water Environ Agencies</td>
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<td>2011 Beirut</td>
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<td><strong>EGM 4:</strong> Climate Ensemble &amp; Working Groups Water Ministries Environ</td>
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<td>2012 Beirut</td>
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<td><strong>EGM 5:</strong> Preliminary RCM Findings for Arab Domain &amp; VA Methodology</td>
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<td>2013 Amman</td>
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<td><strong>EGM 6:</strong> Review of RCM &amp; RHM Findings &amp; VA Sectors Water, Ag &amp; Environ Ministries</td>
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<td>2014 Cairo</td>
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<tr>
<td><strong>EGM Peer Reviews Experts, Gov’t</strong></td>
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<td>2016</td>
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</table>
# Arab Climate Change Assessment Report

## I. Introduction

## II. Data, Databases and Baseline Information

## III. Regional Climate Modelling Findings for Arab Region

## IV. Hydrological Findings for Major Shared Basins

- A. Nile Basin
- B. Tigris and Euphrates Rivers
- C. Medjerda River Basin
- D. Jordan River Basin
- E. Senegal River Basin

## V. Extreme Events Case Studies

- A. Wadi Diqah (Oman)
- B. Medjerda (Tunisia/Algeria)
- C. Nahr Al-Kabir (Lebanon/Syria)

## VI. Impact Assessment Studies

- A. Agriculture (rainfed, irrigated, mixed)
- B. Human Health

## VII. Vulnerability Assessment

- A. Water
- B. Agriculture
- C. Biodiversity & Ecosystems
- D. Infrastructure & Human Settlements
- E. People

## VIII. Conclusion
Assessment for informing Action


Arab Climate Change Action Plan

Arab Disaster Risk Reduction Strategy & Action Plan

Arab Climate Change Working Group

Country-Level Requests (Outputs, Inputs, Training)

Adaptation

Negotiations

UNFCCC National Communications

Capacity Building
Thank you!

**Implementing Partners**

- ESCWA
- UNEP
- WMO
- ACSAD
- LAS
- SMHI
- UNESCO
- UNISDR
- Cairo Office
- giz
- UNU-INWEH

**Donors**

- SWEDEN
- Swedish International Development Cooperation Agency

**Collaborating Research Institutes**

- Center of Excellence for Climate Change Research/ King Abdullah University (CECCR/KAU) - KSA
- King Abdullah University of Science and Technology (KAUST) - KSA
- Climate Services Center 2.0 (CS2.0) - Germany