Long term projection of climate extreme indices associated with sand and dust storms in the Arab Region

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Sustainable Development Policies Division
UN-ESCWA
• The frequency of the sand and dust storms (SDS) has been increasing during the last decade due to climatic changes.

• The main reasons of the SDS is the significantly increased warming of the soil and drastic decrease in the annual rate of rainfall in addition to environmental changes.

• It is important to consider various climate parameters and phenomena related to extreme temperatures, wind, soil moisture, drought and desertification.

• Long term projections of rainfall and temperature climate indices using the Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-economic Vulnerability in the Arab Region (RICCAR) can assist in identifying driving factors for SDS.
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

- United Nations Environment (UN Environment)
- World Meteorological Organization (WMO)
- Arab Centre for Geosciences and Natural Resources Engineering (ACSAAD)
- LAS (France)
- SMHI (Sweden)
- UNESCO (United Nations Educational, Scientific and Cultural Organization)
- UNU-INWEH (United Nations University - Institute for Water, Environment and Health)
- United Nations Office for Disaster Risk Reduction (UNISDR)
- Egypt Office

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
IPCC regional domains

SREX: Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation
The CORDEX-Mena/Arab Domain

Regional “Domain” (RCM)

Size determined by Arab water resources & climate processes

A specific region of the globe to be investigated in more detail with *Regional Climate Models* (RCMs)
Arab Domain

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

Active Domain

Full Domain (SMHI-RCA4)
• An “ensemble” means that we reproduce results many times using variations in how we go about it

• For climate modelling, different GCMs are coupled to RCMs to produce a range of results based on the same emissions

**Global Climate Models (GCMs)**

**Regional Climate Models (RCMs)**
# RCM Simulations Used

## RCM Ensemble Matrix

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8 future climate simulations analysed
Future Projections - Temperature

**RCA4: 3-member ensemble**

**RCP 4.5**

- 1986-2005
- 2046-2065
- 2081-2100

**RCP 8.5**

- 1986-2005
- 2046-2065
- 2081-2100

Mean annual temperature change
Future Projections - Precipitation RCP 4.5

**RCA4: 3-member ensemble**

**April-September:**
- **1986-2005**
- **2046-2065**
- **2081-2100**

**October-March:**
- **1986-2005**
- **2046-2065**
- **2081-2100**

*Precipitation*

RCA4: 3-member ensemble
Future Projections - Precipitation (Prec) RCP 8.5

Precipitation
RCA4: 3-member ensemble
## Extreme TEMPERATURE Indices

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>SU</td>
<td><strong>Number of summer days</strong>: Annual count of days when, daily maximum temperature &gt; 25°C</td>
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<tr>
<td>SU35</td>
<td><strong>Number of hot days</strong>: Annual count of days when, daily maximum temperature &gt; 35°C {defined for application in RICCAR}</td>
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<tr>
<td>SU40</td>
<td><strong>Number of very hot days</strong>: Annual count of days when, daily maximum temperature &gt; 40°C {defined for application in RICCAR}</td>
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<tr>
<td>TR</td>
<td><strong>Number of tropical nights</strong>: Annual count of days when, daily minimum temperature &gt; 20°C.</td>
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## Extreme PRECIPITATION Indices

<table>
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<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>CDD</td>
<td><strong>Maximum length of dry spell</strong>: maximum number of consecutive days with, daily precipitation &lt; 1mm</td>
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<tr>
<td>CWD</td>
<td><strong>Maximum length of wet spell</strong>: maximum number of consecutive days with, daily precipitation ≥ 1mm</td>
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<tr>
<td>R10</td>
<td><strong>Annual count of 10mm precipitation days</strong>: when, daily precipitation ≥ 20mm</td>
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<tr>
<td>R20</td>
<td><strong>Annual count of 20mm precipitation days</strong>: when, daily precipitation ≥ 20mm</td>
</tr>
<tr>
<td>SDII</td>
<td><strong>Simple precipitation intensity index</strong>: defined as, total precipitation amount ÷ number of wet days</td>
</tr>
</tbody>
</table>
Temperature – “Summer” days (>25°C)
Temperature – “Hot” days (>35°C)
Dry Periods – # Consecutive Dry Days

RCP 4.5

Number of days/year

1986-2005
2046-2065
2081-2100

Number of days/year

RCP 8.5

Number of days/year

1986-2005
2046-2065
2081-2100

Number of days/year
Intense Rainfall – R10 mm

RCP 4.5

Number of days/year

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RCP 8.5

Number of days/year

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Intense Rainfall – R20 mm

**RCP 4.5**

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**RCP 8.5**

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Intense Rainfall – SDII

RCP 4.5

- 1986-2005
- 2046-2065
- 2081-2100

RCP 8.5

- 1986-2005
- 2046-2065
- 2081-2100
Analysis of climate change impacts on shared water resources can benefit from regional and basin-level assessments.

Location of Subdomains for analysis including shared river basins
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
Moroccan Highlands 9W 1W 30N 35N

<table>
<thead>
<tr>
<th>Year</th>
<th>RCP 8.5</th>
<th>RCP 4.5</th>
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% Change in mean annual river discharge

HYPE: Change in Discharge mean [%]

<table>
<thead>
<tr>
<th>Year</th>
<th>RCP 4.5</th>
<th>RCP 8.5</th>
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Precipitation Intensity - SDII
• Mean annual temperature change over the entire Arab domain is projected to
  – 1.6 °C at mid-century, 1.9 °C by end-of-century for RCP 4.5
  – 2.2 °C at mid-century, 4.0 °C by end-of-century for RCP 8.5
    (with variations over different regions)

• A number of regions show larger temperature increase during summer than during winter
  – large increases for “hot” days (>35°C) and “very hot” days (>40°C)
  – much more severe for RCP 8.5 than for RCP 4.5

• Precipitation changes vary considerably over the region – many areas show decreases
  – more severe for RCP 8.5 than for RCP 4.5
  – length of dry periods mostly increasing in both RCPs
Publication Series Launched

Other outputs under preparation:

- Executive Summary (70 pgs)
- RICCAR “Shapshop” of findings
- Arabic Translation of Main Report & Executive Summary
- Technical Report: VA Application on Lebanese Agricultural Sector
- Training Materials
Linking Climate Science to Policy, Adaptive Strategy and Mitigation

Science → Impact and Vulnerability Assessment → RICCAR

Policy → Climate Change Adaptation

Adaptation in Agriculture, Health, Human Settlement, Biodiversity and Economic Development (IWRM)

Negotiations (Paris Agreement) → Adaptation-Mitigation Co-benefit
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. Environment module by UNEP/ROWA;
2. Agriculture module by ACSAD/GIZ;
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
Conclusions

• RICCAR sets a baseline for climate impact assessment in the Arab Region

• RICCAR outputs can be used for advancing the study and planning efforts to combat sand and dust storms over longer time periods.

• The transboundary nature of SDS requires collective analysis and action to combat their severe impacts on human health and socio-economic activities.

• There is thus an utmost need to improve understanding of these extreme events within the context of climate change and efforts to achieve sustainable development.
Thank You

www.unescwa.org/climate-change-water-resources-arab-region-riccar

www.riccar.org