Regional Climate Projections and Applications for Sand and Dust Storms Analysis

Enhancing Understanding and Expanding Inter-regional and Regional Cooperation on Sand and Dust Storms

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Marlene Tomaszkiewicz
Regional Advisor for GIS for Climate Change Analysis
Arab Centre for Climate Change Policies, ESCWA
Arab Domain Regional Climate Modelling
Mean change in temperature

**RCP 4.5**

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

**RCP 8.5**

- **1986-2005**
- **2046-2065**
- **2081-2100**
Drivers of Sand and Dust Storms

Land Degradation
- Unsustainable land and water use
- Vegetation decline
- Land use changes

Desertification
- Greater aridity
- Drier soils
- Water diversion

Climate Change
- Higher air temperature
- Less precipitation
- Stronger winds
Seasonal drought frequency

Reference period
1986-2005

Mid-century
2046-2065

End-century
2081-2100

Tomaszkiewicz / Atmosphere (2021) 12(7), 856
Focus on Mashreq Domain

- Afghanistan (partial)
- Armenia
- Azerbaijan
- Bahrain
- Bulgaria (partial)
- Cyprus
- Djibouti
- Egypt (partial)
- Eritrea
- Ethiopia
- Georgia
- Greece (partial)
- Iran
- Iraq
- Jordan
- Kazakhstan (partial)
- Kenya (partial)
- Kuwait
- Lebanon
- Moldova
- Oman
- Pakistan (partial)
- Palestine
- Qatar
- Romania (partial)
- Russia
- Saudi Arabia
- Somalia (partial)
- South Sudan (partial)
- Sudan (partial)
- Syria
- Turkey
- Uganda (partial)
- United Arab Emirates
- Uzbekistan (partial)
- Yemen
SDS Frequency from meteorological stations (2000-2013)

New Mashreq Domain Climate Modelling Outputs

- 10 km grid spatial scale
- Multiple climate parameters suitable for SDS analysis (and other studies)
- Bias-corrected temperature and precipitation
- 1961 – 2070
- SSP5-8.5 climate scenario
- 6 downscaled climate models
## Climate Models used for Mashreq Domain (based on CMIP6)

### Global Climate Models

<table>
<thead>
<tr>
<th>Model</th>
<th>Institute</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMCC-CM2-SR5</td>
<td>Euro-Mediterranean Centre on Climate Change</td>
<td>Cherchi et al. 2018</td>
</tr>
<tr>
<td>CNRM-ESM2-1</td>
<td>National Center for Meteorological Research, France</td>
<td>Séférian et al. 2019</td>
</tr>
<tr>
<td>EC-Earth3-Veg</td>
<td>European Consortium</td>
<td>Wyser et al. 2020</td>
</tr>
<tr>
<td>MPI-ESM1-2-LR</td>
<td>Max Planck Institute for Meteorology, Germany</td>
<td>Mauritsen et al. 2019</td>
</tr>
<tr>
<td>MRI-ESM2-0</td>
<td>Meteorological Research Institute, Japan</td>
<td>Yukimoto et al. 2019</td>
</tr>
<tr>
<td>NorESM2-MM</td>
<td>Norwegian Meteorological Institute</td>
<td>Tjiputra et al. 2020</td>
</tr>
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### Regional Climate Model

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</thead>
<tbody>
<tr>
<td>HCLIM-ALADIN</td>
<td>Swedish Meteorological and Hydrological Institute</td>
<td>Belušić et al., 2020</td>
</tr>
</tbody>
</table>
Mean change in annual temperature compared to the baseline period

Baseline
1995 – 2014

Near-term
2021 – 2040

Mid-term
2041 – 2060

Temperature (°C)

Change in temperature (°C)

Change in temperature (°C)
Mean change in daily maximum wind speed compared to the baseline period

Baseline
1995 – 2014

Near-term
2021 – 2040

Mid-term
2041 – 2060

Daily maximum wind speed (m/s)

Change in daily maximum wind speed (m/s)

(Not bias-corrected)
### Results for selected subdomains

<table>
<thead>
<tr>
<th>Sub-domain</th>
<th>Temperature (°C)</th>
<th>Daily max wind speed (m/s)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>21.2</td>
<td>0.9</td>
</tr>
<tr>
<td>2</td>
<td>21.7</td>
<td>0.9</td>
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<tr>
<td>3</td>
<td>24.9</td>
<td>0.9</td>
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<td>4</td>
<td>19.8</td>
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<td>5</td>
<td>27.8</td>
<td>1.0</td>
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<tr>
<td>6</td>
<td>28.5</td>
<td>0.8</td>
</tr>
<tr>
<td>7</td>
<td>24.7</td>
<td>0.6</td>
</tr>
</tbody>
</table>
Next steps

- Seasonal forecasting conducted twice a year by the for Arab Climate Outlook Forum
  - Intergovernmental process launched under the Council of Ministers responsible for Meteorology and Climate under the League of Arab States
- Seasonal climate modelling outputs under RICCAR
- Evaluate national SDS trends and frequency analysis to identify proxy parameters and link to regional and inter-regional trends
- Remote sensing analysis to study historical events and link to climate modelling outputs
Thank you!

Discussion - Questions

Marlene Tomaszkiewicz
tomaszkiewiczm@un.org

www.riccar.org
www.unescwa.org/acccp