Simulation of the Arab World Climate using Global and Regional Climate Models

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http://ceccr.kau.edu.sa
We are HERE for finding a path for assessing climate change impacts.

Assessing Climate Change Impacts on Water Resources and Socio-Economic Development in the Arab Region

Irrespective to Regions and Sectors, Climate Models are the tools for Assessing Climate Change Impacts

The GCMs and RCMs are tools to generate the past-climate as well as the climate-projection

Why focus in the Arab Region?

Less Research Results/Less facilities are available
Moisture Transport (source: NASA)

IPCC Future

Chance of Heavy precipitation Events

Chance of increase Water scarcity

Moisture Transport (source: NASA)

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Climate Modelling
Short Range/Seasonal Forecast
Impact Studies (extreme analysis, agriculture, water resources)

Infrastructures
Professionals
HPC
MSc and PhD Programs

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Center of Excellence for Climate Change Research (CECCR)

King Abdulaziz University

Vice President for Higher Studies and Research

CECCR

Sci. Consultancy Council

Global Data

Data Base

Administration Board

Local Observations

Long Range

Numerical Models

Short Range

Applications

Web Applications

Consultations

Agriculture

Water Resources

Env. Risks

Extreme Phenomena

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Rainfall is projected to increase (decrease) in the Southern (Northern) region of KSA during 2061-2070 compared to 2021-2030.
Temperature is projected to increase more during 2061-2070 compared to 2021-2030.
As it is GCM, we can extend data analysis for the entire Arab World

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Annual mean precipitation (CECCR-SNU Global Climate Model)

Observation

TRMM

CMAP

25KM

CGCM

300KM

35KM

AGCM

300KM

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6 July 2011 Lebanon
CORDEX (COordinated Regional climate Downscaling Experiment) is a program for dynamical downscaling to produce regional climate change scenarios globally. International efforts are behind it for its success for the impact and adaptation studies.
A number of experiments are performed on this domain (15-75E & 0-45N)
Arab Domain

RegCM4.1 simulation at CECCR

Run Specifications

Forcing: ERA-int
Period: 1989-2009
Resol: 50 km

Current Domain
(Run tested for RegCM4)

[10S-55N; 25W-75E]
[Center: 22.5N; 25E]

55N
10S
25W
75E
RCM simulated Rainfall Climatology (Arab Domain)

RegCM4.1 1998-2009

CRU 1998-2009

TRMM 1998-2009

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RCM simulated Temperature Climatology

RegCM4.1 Tmean 1998-2009

CRU Tmean 1998-2009
WRF run using NCEP reanalysis (1°×1 °) data for the entire globe, Arab Domain and Mashrek domain (Arabian Peninsula Domain)
## Necessity of HPC (e.g. Arab Domain)

<table>
<thead>
<tr>
<th>Number of CPU</th>
<th>Required Time</th>
<th>Run-length</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-Processor</td>
<td>6.4 day</td>
<td>1-Year simulation – 50km-resolution (25W-75E &amp; 10S-55N)</td>
</tr>
<tr>
<td>8-Processor</td>
<td>2.92 day</td>
<td></td>
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<tr>
<td>12-Processor</td>
<td>1.46 day</td>
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<tr>
<td>24-Processor</td>
<td>1.2 day</td>
<td></td>
</tr>
<tr>
<td>66-Processor</td>
<td>0.28 day (6.72hr)</td>
<td></td>
</tr>
</tbody>
</table>

KAU is aiming in 2012 to have **10,000 core processors**

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Sustainable Development needs the balance between-

- Social (e.g. health/food/water)
- Economic (e.g. energy/tourism/migration) and
- Environment (e.g. infrastructure/ecosystems/marine)
Building climate database at the CECCR using Climate Models are applicable in different sectors in the region:

- Ecology
- Forestry
- Fisheries
- Food & Disaster
- Health
- Agriculture
- Infrastructure
- Biodiversity
- Water Management

Many More!
Concluding Remarks

- In general, GCM/RCM produces well the climatology for Arab domain. However, bias is evident in a particular region. Therefore, more work is needed with coordinating different working groups interested for this Arab domain.

- Carry out Dynamical Downscaling with RegCM4, WRF, PRECIS as well as improving high resolution GCM simulations.

- CECCR has now developed required knowledge, high computing facilities and personnel for studying climate and climate change of the region.

- CECCR is ready to play a role in the region as a regional climate center, based on its available climate data-base and skilled-professionals, to accomplish local and regional tasks related to climate projection studies.