Climate Change modeling over the Arab Domain: Empowering today’s and tomorrow’s water and agriculture decision-makers

Adla Khalaf, PhD
Remote Sensing Scientist
International Center for Biosaline Agriculture
Aim

• Introduce MAWRED Project

• Regional Outputs

• Introduce Climate Change Downscaling over the Arab Domain
Modeling And Mapping Water Resources for Development (MAWRED)
MAWRED project: March 2009 – June 2015

• USAID Grant in partnership with NASA’s Goddard Space Flight Center
• Regional modeling
• Targeted countries: Yemen, Iraq, Jordan, Palestine and Tunisia
• Stakeholders: Ministries of agriculture and water, decision makers, scientific researchers, professionals
Mission

Develop new data sets that will be used directly by ministries and other decision-makers including:

i. Irrigation areas
ii. Crop type mapping
iii. Estimates of yield for key crops
iv. Water mapping and modeling
v. Regular data on groundwater and surface water
vi. Soil moisture
vii. Irrigation water use
viii. Evapotranspiration
ix. Climate variability modeling – current and long-term climate change data
x. Drought (in next extension)
Data Dissemination

Data will be provided to the ministries directly as well as made available through a knowledge hub based at ICBA.
Results of MAWRED
Results of MAWRED project

1- Develop Hydrological and Crop production models calibrated and adapted for MENA region
Results of MAWRED project

2- Drought monitoring (2008) through remote sensing data and modeling techniques

59 killed & 35000 families left homeless

Drought has pushed 2-3 million to extreme poverty by affecting food security (UN)
Results of MAWRED: SPI of October 2014

Persistent drought over Syria and Yemen

SPI: 1981-2014 (CHIRPS v1.8)

SPI 201410 run=12

SIP: 1981-2014 (CHIRPS v1.8)

SPI 201410 run=6

SPI 201410 run=12

35N
30N
25N
25E 30E 35E 40E

35N
30N
25N
25E 30E 35E 40E

35N
30N
25N
25E 30E 35E 40E

35N
30N
25N
25E 30E 35E 40E
Results of MAWRED project

3- Mapping Regional Scale

250 m spatial resolution
Climate Change Downscaling
IPCC report – ICBA filling an important gap

- ICBA unique in region working on climate change modeling of impacts on agriculture and water
- Create platform to share data and knowledge in MENA
GCMs rainfall projections present high uncertainty
GCMs assessment
Tool: NASA-JPL RCMES

GCMs: CCSM4, CESM1-BGC, GFDL-ESM, bcc-csm-1-m, CNRM-CM5, MIROC5

14 sub-regions for atmospheric variables

R07: UAE
General Circulation Model (GCM) coarse resolution

Mean Annual Total Rainfall for 1981-2005 (mm)

TRMM Annual Total Precipitation 1998-2005

GCM Rainfall climatology in Lebanon

Observed Rainfall climatology in Lebanon
Dynamical downscaling at ICBA

ICBA tuned regional climate model: WRF
GCM: MIROC5 identified as best for MENA

Model domains setup

<table>
<thead>
<tr>
<th>DOMAIN</th>
<th>RESOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>MENA</td>
<td>45 km</td>
</tr>
<tr>
<td>TUNISIA / WB-GAZA</td>
<td>9 km</td>
</tr>
<tr>
<td>YEMEN</td>
<td>15 km</td>
</tr>
</tbody>
</table>

(2026 – 2045) Projected
(2081 – 2100)
MIROC5 raw rainfall climatology Vs “Satellite Observations”

CHIRPS Annual Total Precipitation 1998-2005

Global data

MIROC5 Annual Total Precipitation 1998-2005

ICBA downscaled data
Future changes 2071-2100 vs 1976-2005

rcp4.5

rcp8.5
Results of MAWRED: CDD for MENA (maximum number of consecutive dry days with Precipitation <1 mm)

Historical (1971-2000)

rcp8.5 (2021-2050)

rcp8.5 (2071-2100)
Results of MAWRED: CDD for Tunisia

Historical (1971-2000)

rcp8.5 (2021-2050)

rcp8.5 (2071-2100)
Results of MAWRED: CDD for Egypt

Partnership with Oxford University: Event attribution

http://www.climateprediction.net

- The world’s largest climate modelling facility
Thank you