Economic and Social Commission for Western Asia

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

RICCAR Climate Modelling Updates: Mashreq Domain

ArabCOF – June 2021

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Shared Prosperity Dignified Life

Marlene Tomaszkiewicz
Regional Advisor for Climate Change Analysis and GIS

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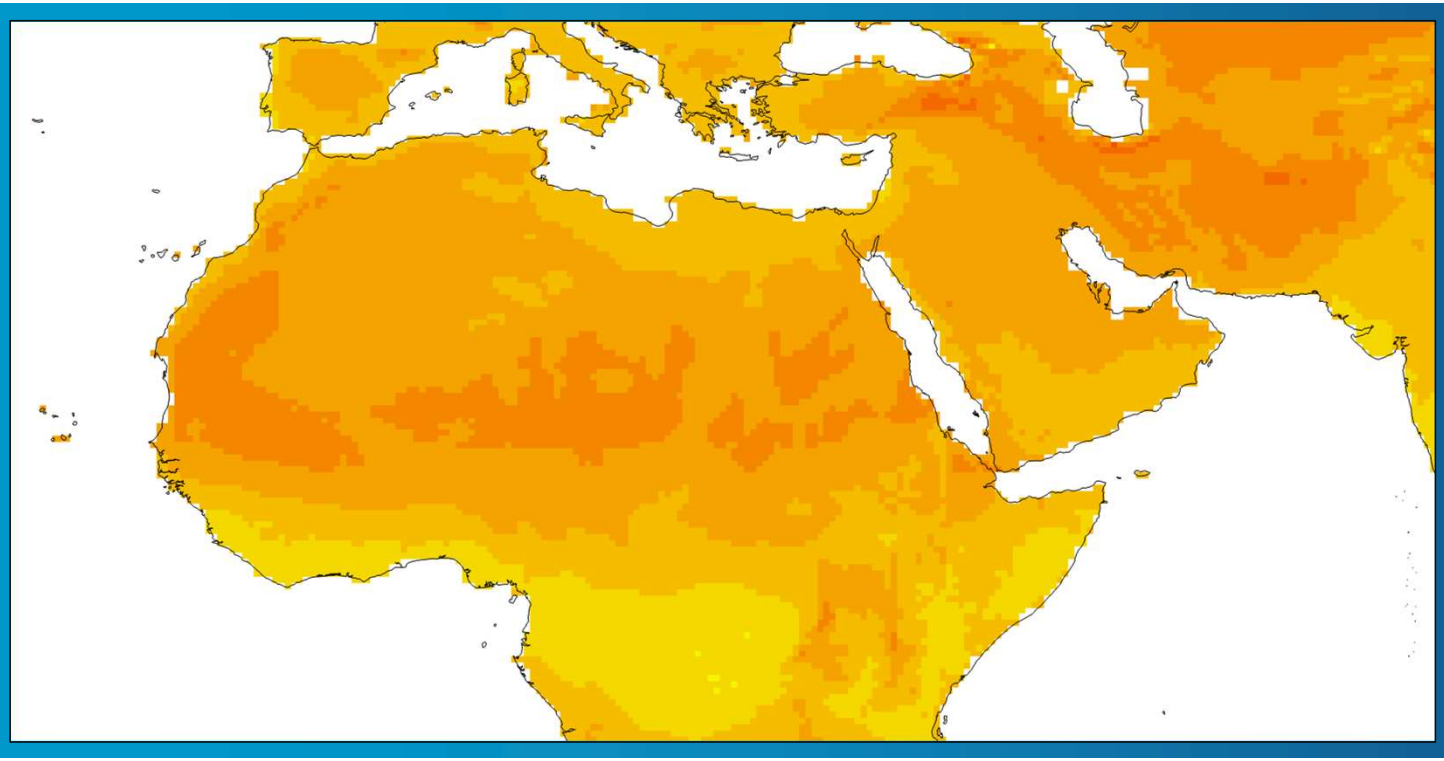

Original RICCAR Domain
50 km grid

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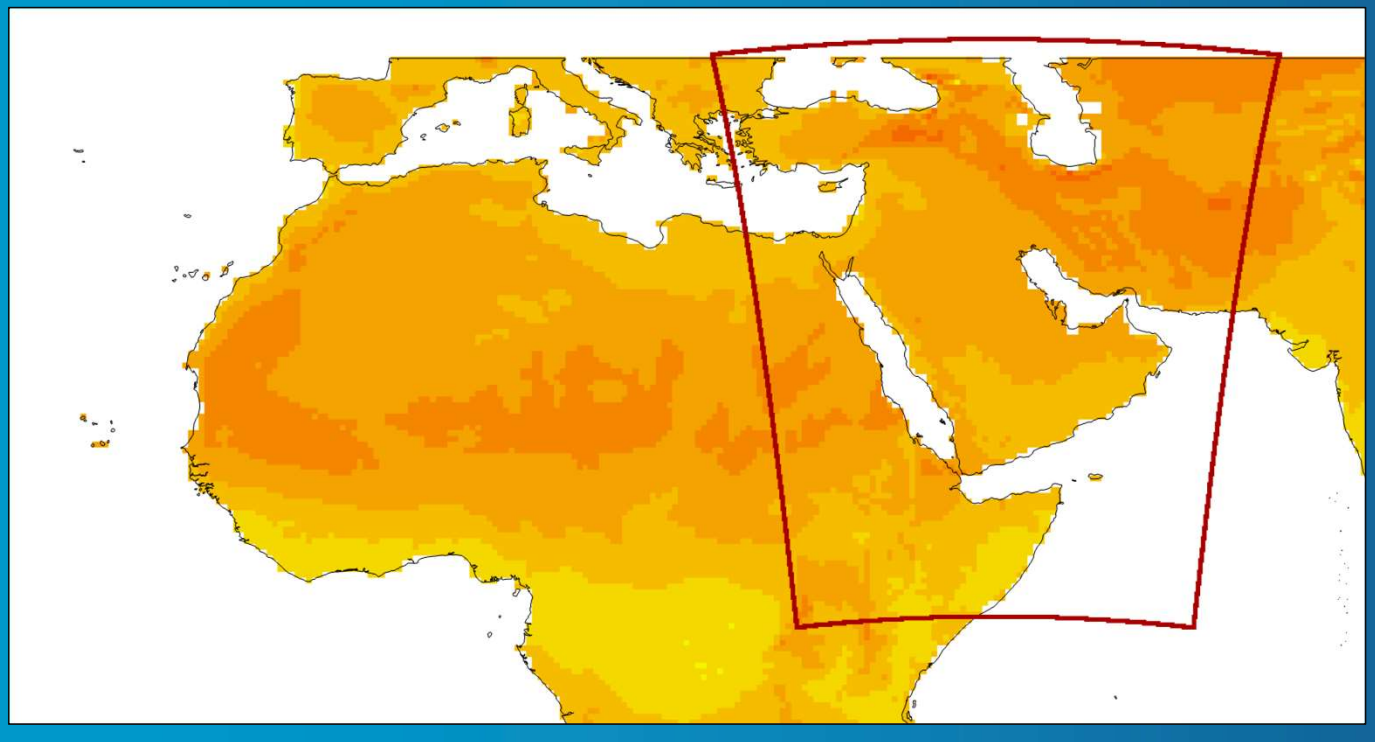

New Mashreq Domain boundary

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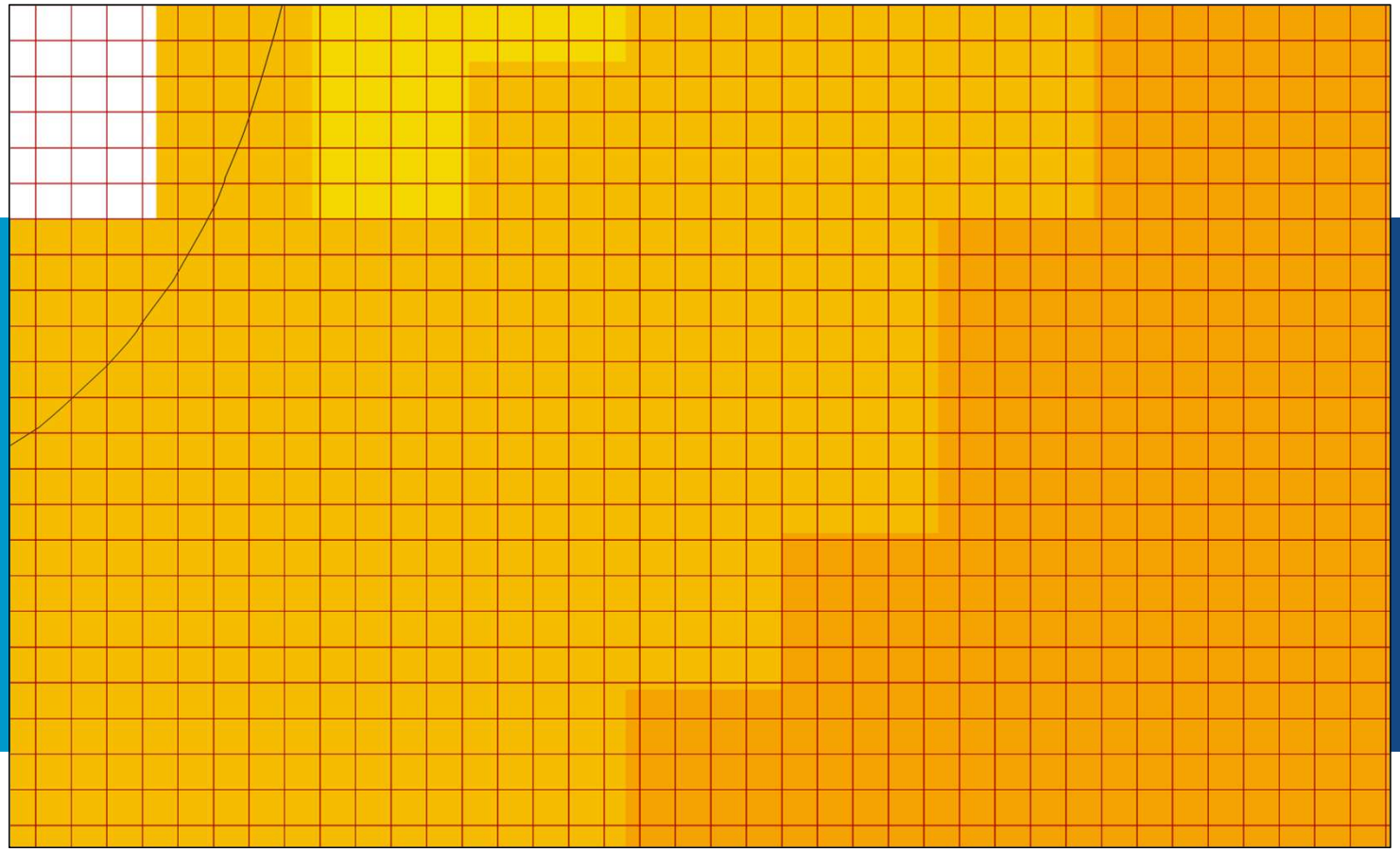
Compare 50 km grid to Mashreq Domain 10 km grid



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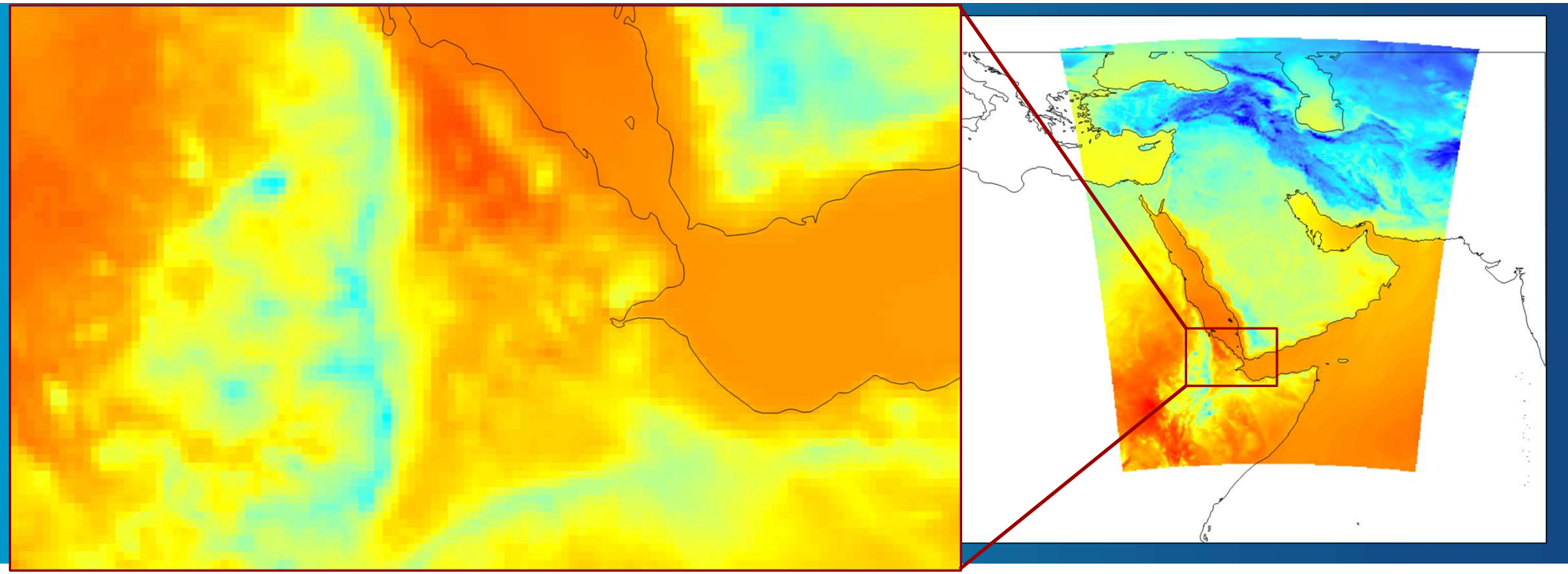

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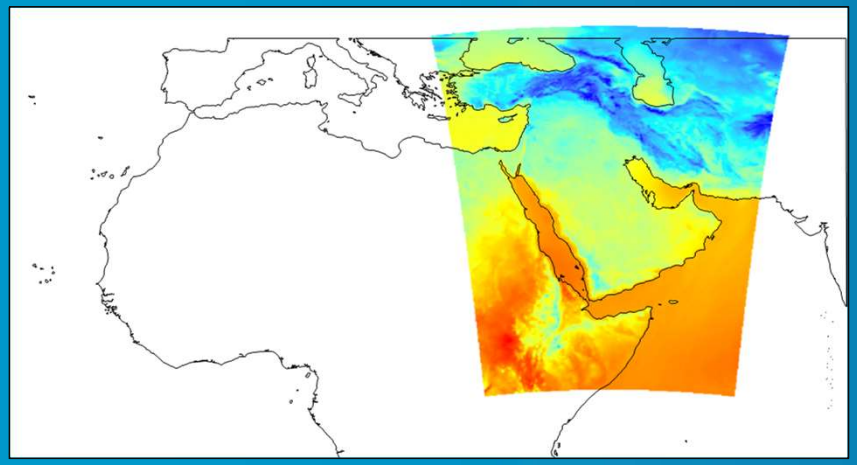


To be bias-corrected

Parameter	Long Name
evspsbl	Evaporation
hurs	Near-surface relative humidity
pr	Precipitation
ps	Surface air pressure
rsds	Surface downwelling shortwave radiation
sfcWind	Near-surface wind speed
sfcWindmax	Daily maximum near-surface wind speed
sund	Duration of sunshine
tas	Near-surface air temperature
tasmax	Daily maximum near-surface air temperature
tasmin	Daily minimum near-surface air temperature
uas	Eastward near-surface wind
vas	Northward near-surface wind
wsgsmax	Daily maximum near-surface wind speed of gust

Mashreq Domain
Regional Climate Modelling
Outputs are based on
6 downscaled
CMIP6 GCMs

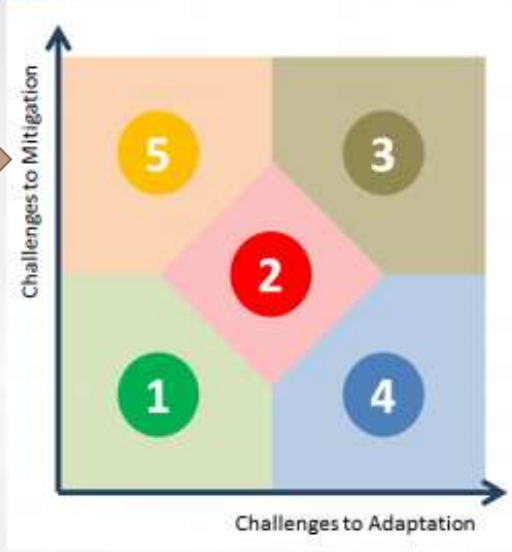
GCM	Institute	Ref
CMCC-CM2-SR5	Euro-Mediterranean Centre on Climate Change (Italy)	Cherchi et al. (2019)
CNRM-ESM2-1	National Centre for Meteorological Research and Centre Européen de Recherche et de Formation Avancée en Calcul Scientifique (France)	Séférian et al. (2019)
EC-Earth3-Veg	European Consortium	Wyser et al. (2020)
MPI-ESM1-2-LR	Max Planck Institute for Meteorology (Germany)	Mauritsen et al.. (2019)
MRI-ESM2-0	Meteorological Research Institute (Japan)	Yukimoto et al. (2019)
NorESM2-MM	Norwegian Earth System Model	Tjiputra et al. (2020)

RCM	Institute	Ref
HCLIM-ALADIN	Swedish Meterological and Hydrological Insitute	Belušić et al. (2020)

- Based on CMIP6 scenarios (SSPs)
  - Mashreq outputs only consider SSP5-8.5
- Historical period 1961-2014
- Future scenarios 2015-2070

Shared Socioeconomic Pathways (SSPs)

- SSPs are the basis of the new scenarios
  - Narrative storylines
  - Quantitative scenarios (demographics, economics, technology)
  - Other socioeconomic indicators
- Represent a range of future development pathways, defined around
  - Challenges to adaptation
  - Challenges to mitigation



http://www.globalchange.umd.edu/data/gtsp/workshops/2013/Day2/Waldhoff_RCP_SSP_2013-10-02.pdf

SSP Narratives

SSP5: Conventional Development

- Rapid economic development
- Stabilizing population
- Consumerism
- High fossil fuel dependency
- Eradication of extreme poverty and universal access to education and basic services
- Highly engineered infrastructure and ecosystems

SSP1: Sustainability

- Good progress towards sustainable development
- Stabilizing population
- Decreasing income inequality
- Early MDG achievement
- Low resource intensity and fossil fuel dependency
- Strong int'l governance and local institutions
- Well managed urbanization
- Environmentalism

SSP2: Middle of the Road

- Current trends continue
- Moderate population growth
- Slowly converging incomes between industrialized and developing countries
- Delayed MDG achievement
- Reductions in resource and energy intensity at historic rates
- Environmental degradation

SSP3: Fragmentation

- Rapid population growth
- Slow economic growth
- Failing to achieve MDG
- High resource intensity and fossil fuel dependency
- Low investments in technology development and education
- Unplanned settlements
- Weak int'l governance and local institutions

SSP4: Inequality

- Increasing inequality within and across countries
- Effective governance controlled by a small number of rich global elites
- Most of populations with limited access to higher education and basic services
- Energy tech R&D made by global energy corporations
- Low social cohesion

Adapted from the meeting report of the *Workshop on The Nature and Use of New Socioeconomic Pathways for Climate Change Research* https://www.isp.ucar.edu/sites/default/files/Boulder%20Workshop%20Report_0_0.pdf

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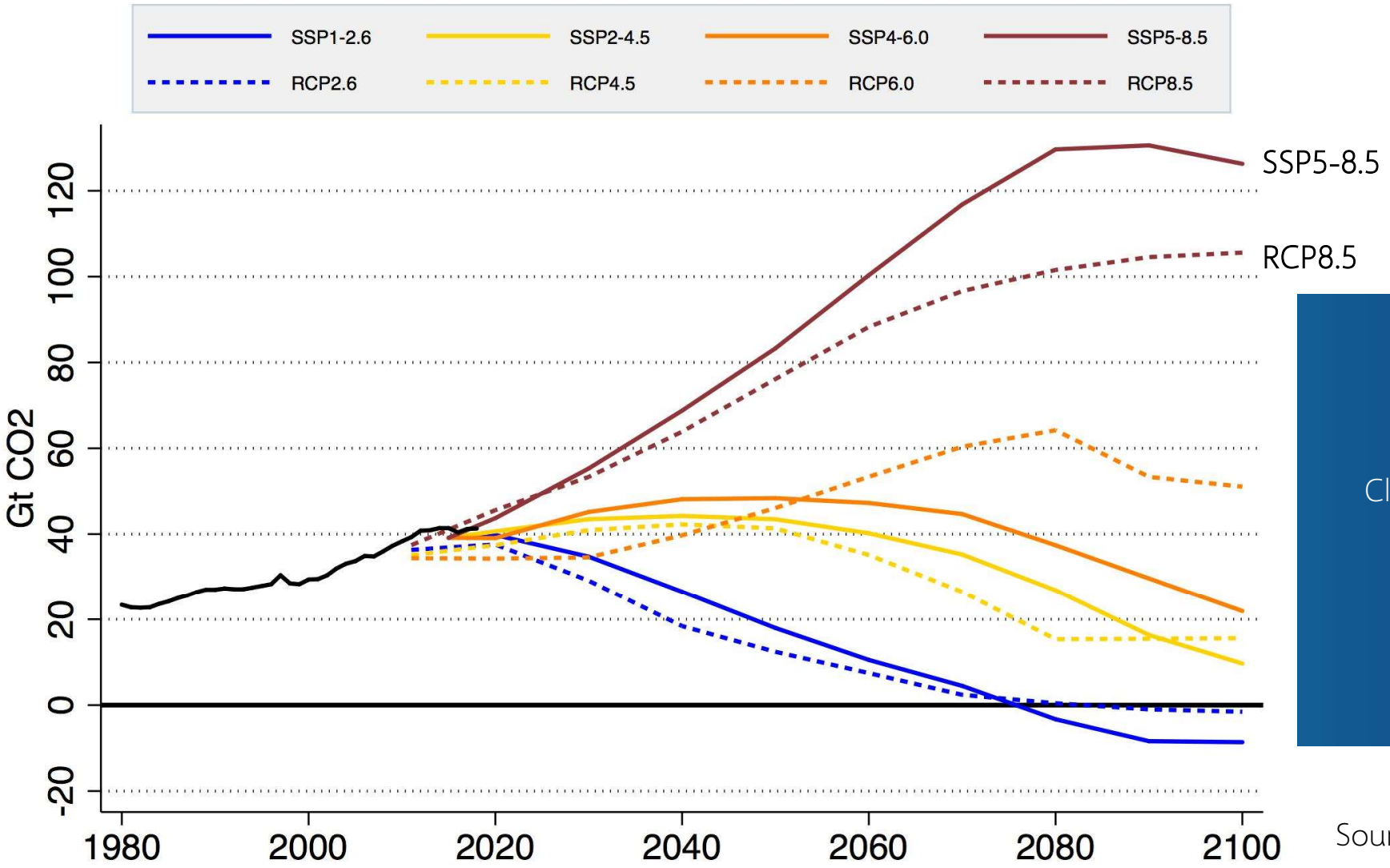
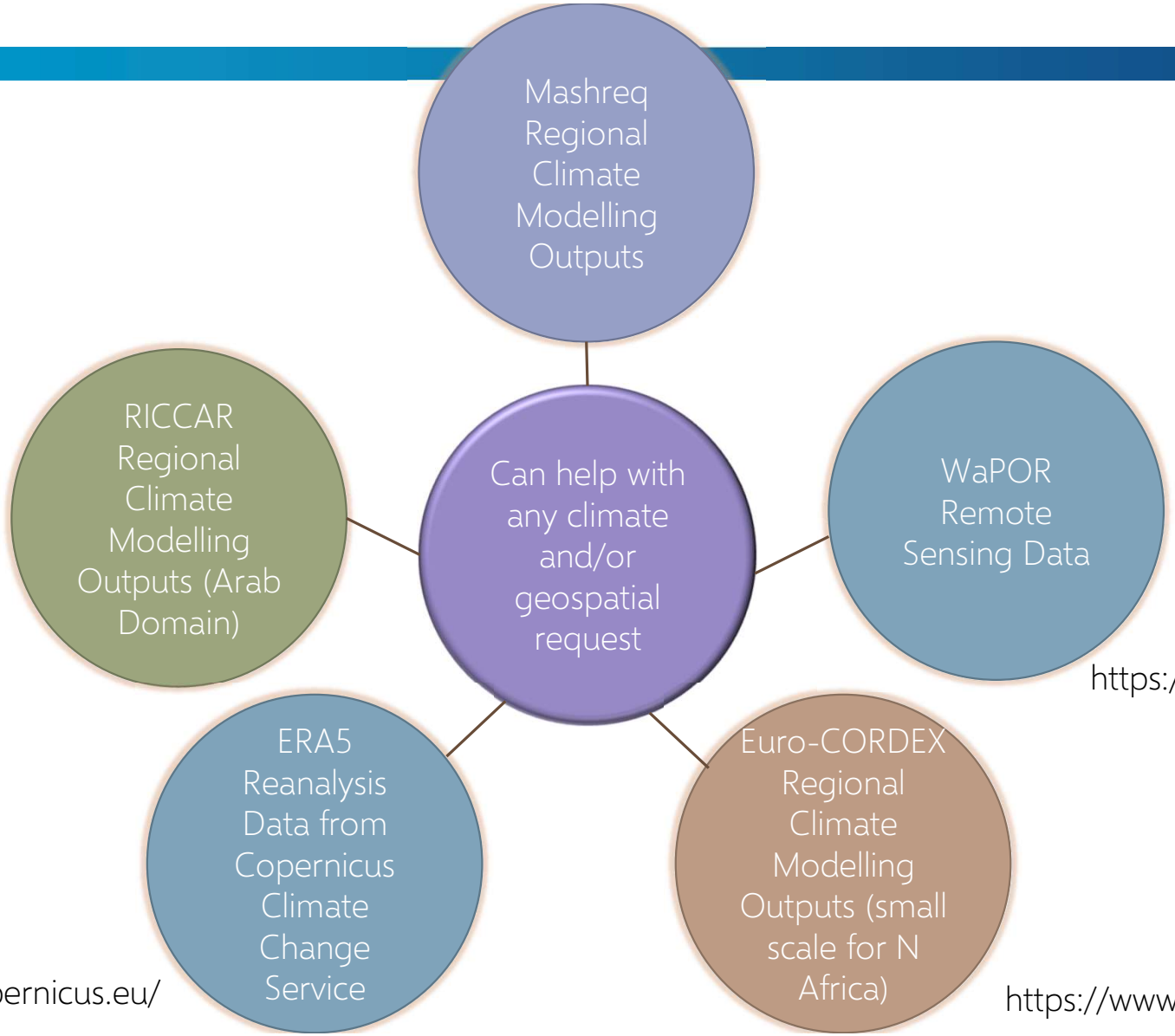


CMIP6
Climate Scenarios

Source: Carbon Brief


Mashreq Regional Climate Modelling Outputs
RICCAR Regional Climate Modelling Outputs (Arab Domain)
Can help with any climate and/or geospatial request
WaPOR Remote Sensing Data
https://wapor.apps.fao.org/
ERA5 Reanalysis Data from Copernicus Climate Change Service
https://climate.copernicus.eu/
Euro-CORDEX Regional Climate Modelling Outputs (small scale for N Africa)
https://www.euro-cordex.net/

atmosphere

MDPI

Article

Future Seasonal Drought Conditions over the CORDEX-MENA/Arab Domain

Marlene A. Tomaszkiewicz

United Nations Economic and Social Commission for Western Asia, Beirut, Lebanon; tomaszkiewicz@un.org

Abstract: Seasonal drought is often overlooked because its impacts are less devasting than meteorological or hydrological drought. Nevertheless, short-term drought can have significant impacts on soil moisture content, agricultural crop yield, and sand and dust storms. Using data obtained from bias-corrected regional climate modelling (RCM) outputs, future seasonal drought is investigated over the water-scarce Arab domain using SPI-3. The climate modelling outputs include three downscaled mainframe GCMs downscaled using a single RCM for two climate scenarios: RCP4.5 and RCP8.5. Results across the region exhibit spatial and temporal variability. For example, Rift Valley, in the eastern sub-Sahara, projects less frequent and less severe drought, particularly during the winter (DJF) months. Conversely, the Morocco Highlands and adjacent Mediterranean coast signals a dramatic increase in drought by end-century during winter (DJF) and spring (MAM). Moderate increase in drought indicated in the greater Mashreq in spring (MAM) can be linked to sand and dust storm risk. Thirdly, autumn drought (SON) is linked to increased forest fire risk in the Levant. Projected increases in drought frequency and severity call for adaptation measures to reduce impacts.

Keywords: drought; climate change; Arab domain

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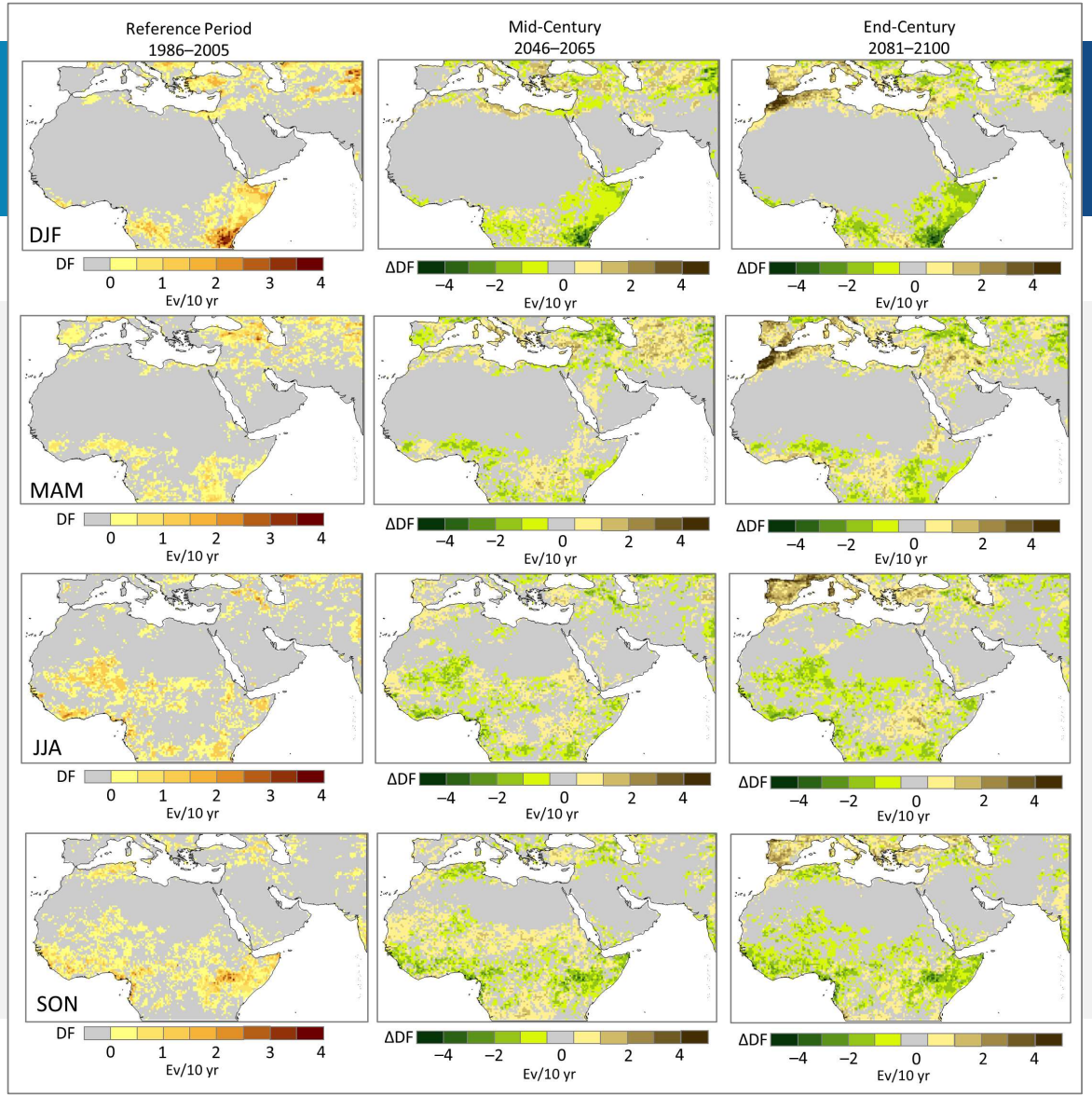
1. Introduction

The Middle East and North Africa, also known as the Arab region, is perpetually faced with multiple complex issues that arguably possess one common denominator: drought. Water scarcity is most obviously connected to drought, impacting agriculture and food security [1–4], ecosystems [5,6], drinking water demand [7], and energy sustainability [1]. Drought also perpetuates other climate-related extreme events such as floods [8], forest fires [9], desertification [6], and sand and dust storms [10–12]. Lastly, geopolitical challenges in the region have been interlinked to drought including migration [13,14], conflict [1,14–16], and vulnerable population groups [1,4,17].

Drought is not a new phenomenon in the region. Geological evidence has revealed drought recurrence as early as the Aceramic Neolithic period [18,19]. Several atmospheric circulation patterns influence precipitation patterns, most notably North Atlantic Oscillation (NAO) and El Niño–Southern Oscillation (ENSO), which have partially triggered the most extreme disasters in the region [17,20,21]. Drought was blamed for devasting famine in Sudan during the 1980s and 1990s [4], the near collapse of the camel husbandry economy in Jordan during the mid-20th century [22], and a severe decline wheat and barley production during 2007–2010 in the Tigris-Euphrates Basin [14]. Thus, the question is not whether drought is a recurring problem. Rather, it is whether drought frequency and severity are increasing due to climate change and the potential impacts upon differing sectors.

Often overlooked due to smaller scale, short-term or seasonal drought can be crucial to detect reduction in soil moisture content and is a risk factor for climate-related extreme events. Over the last 75 years, a study conducted by Spinoni et al. [23] detected over 420



tomaszkiewiczm@un.org
www.riccar.org