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

RICCAR Overview

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Workshop on Climate Change Adaptation in the Economic Development Sector
Using Integrated Water Resources Management (IWRM) Tools

Amman, 25-27 May 2016

CAMRE – December 2007

Arab Ministerial Declaration on Climate Change
CAMRE
2007

Council of Arab Ministers Responsible for the Environment (CAMRE)
under League of Arab States

- Issued first inter-governmental Arab Statement on Climate Change in December 2007,

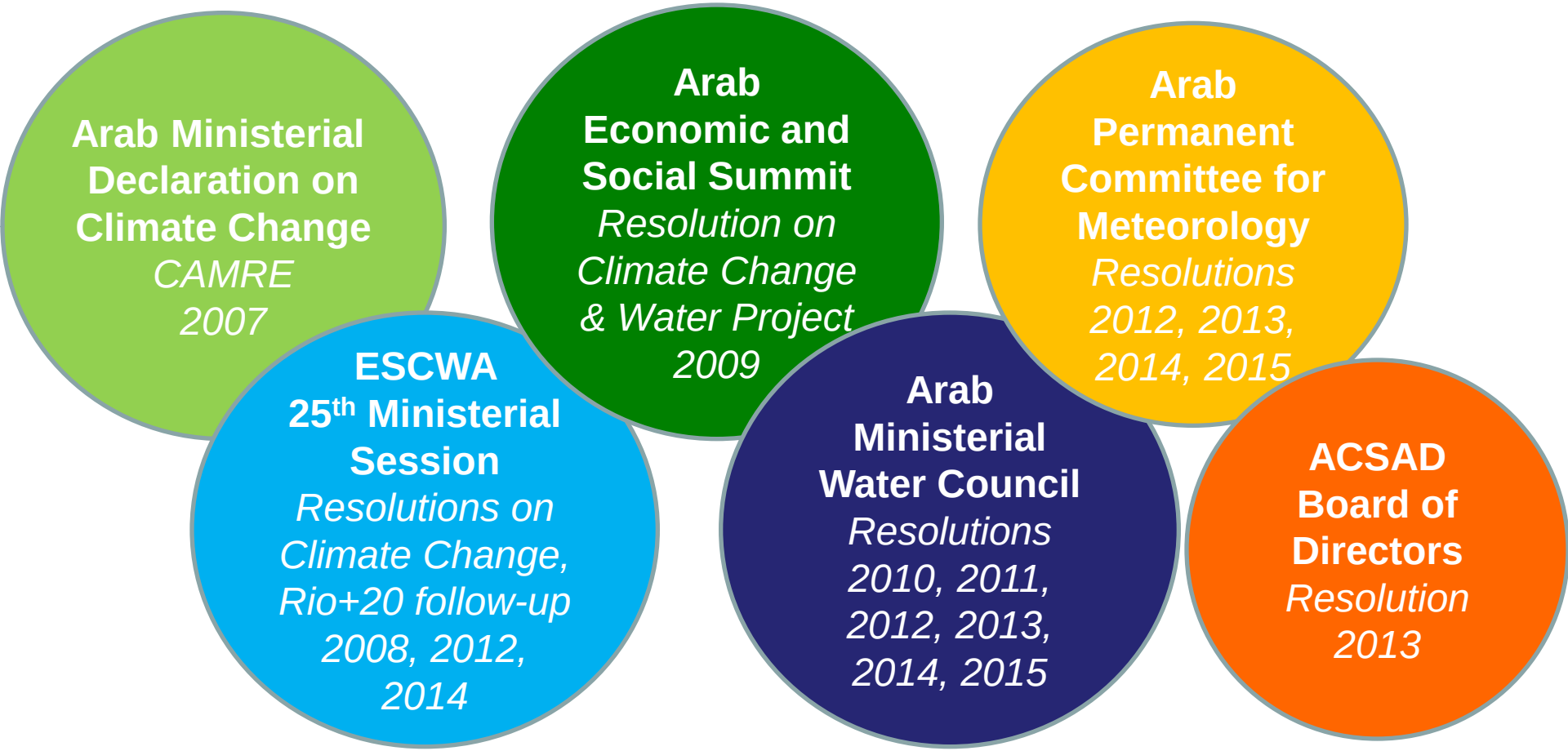
Declaration (excerpts):

- *Constitutes the base for future action and reflects the Arab position in dealing with climate change issues,*

- ***- Adaptation to …climate change** shall be fully consistent with the economic and social development …. It shall be implemented through the **development and dissemination of methodologies and tools that assess the impacts of climate change and their extent;** as well as through improving planning for adaptation, along with its measures and procedures, in addition to its integration in sustainable development policies; besides understanding, **developing and disseminating measures, methodologies and tools that achieve economic diversity with the aim of increasing the elasticity of economic sectors vulnerable to climate change.***

- ***Establish studies and research centers for climate change** in the regions of developing countries, including the Arab region. These centers should be concerned with **examining impacts and challenges facing the citizens and peoples of the developing countries as a result of climatic change.***

Inter-Governmental Mandates calling for & supporting Climate Change Assessment in the Arab Region



Environment	Foreign Affairs & Planning	Water	Met	Agriculture

RICCAR Objective

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.

Assessment | **Adaptation** | **Mitigation** | **Negotiations**

RICCAR Partnerships

Implementing Partners

ESCWA

UNEP

WMO

THE LEAGUE OF ARAB STATES
THE ARAB CENTER FOR THE STUDIES OF ARID ZONES AND DRY LANDS
ACSAD 1968
ACSAD

LAS

SMHI

UNESCO
United Nations
Educational, Scientific and
Cultural Organization

Cairo Office

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

UNISDR
The United Nations Office for Disaster Risk Reduction

UNITED NATIONS UNIVERSITY
UNU-INWEH

FAO
FIAT PANIS

Donors

SWEDEN
SWEDISH INTERNATIONAL DEVELOPMENT COOPERATION AGENCY

german cooperation
DEUTSCHE ZUSAMMENARBEIT

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*

RICCAR supported & implemented through Regional Cooperative Arrangements & Mechanisms

UN-LAS Coordination Mechanism

UN-LAS Sectoral Meeting on Climate Change

2009

Arab Summit approved IWRM Project on Climate Change

LAS/ACSAD - 2009

UN Regional Coordination Mechanism (RCM) Thematic Working Group on Climate Change

Chaired by UNEP/ROWA - 2010

RICCAR Formulation & Implementation with Partners

Annual EGMs

2009, 2010, 2011, 2012, 2013, 2014

Technical Workshops

2011, 2012, 2013, 2014

VA & RKH Working Groups

2013, 2014

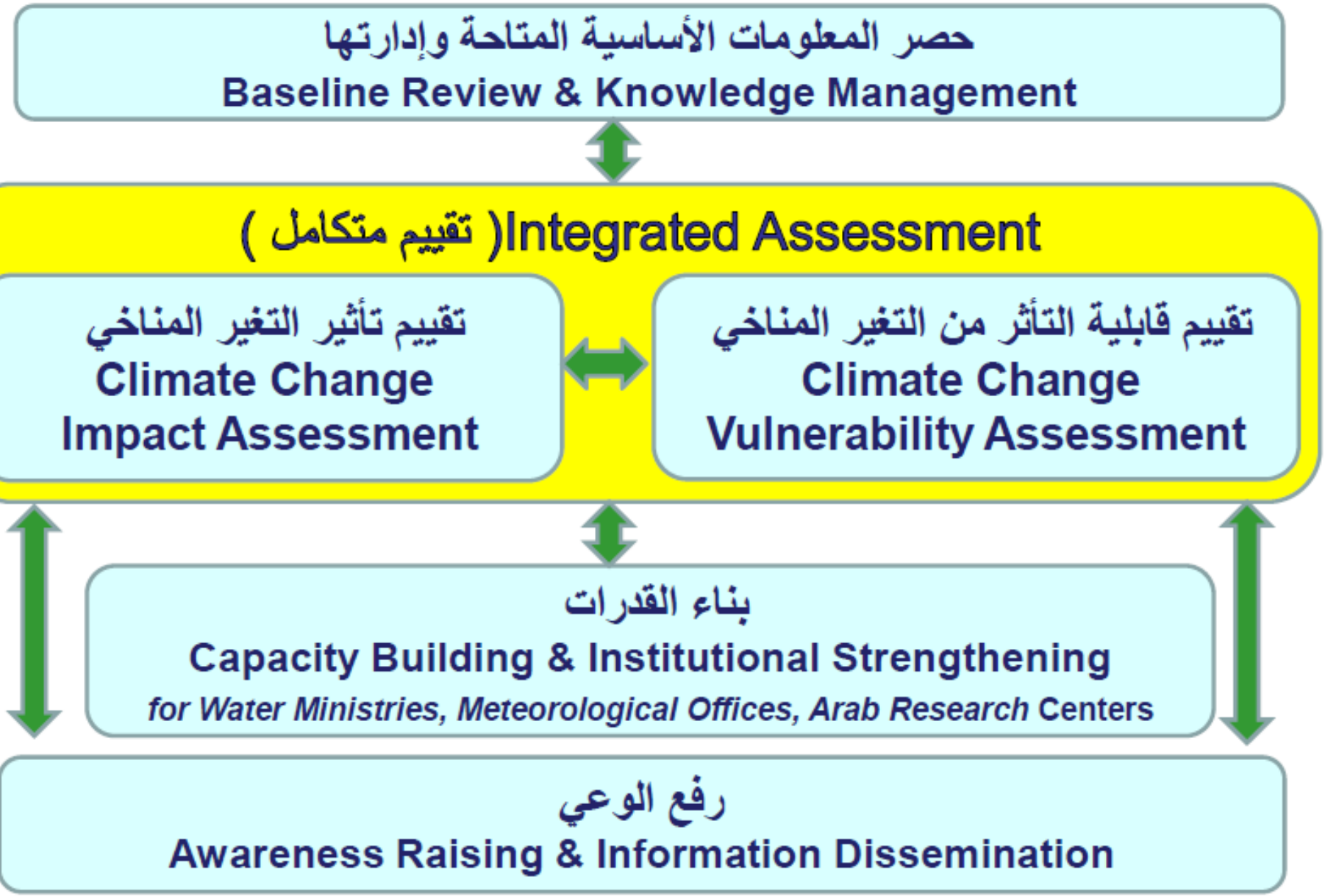
RCM Ensemble Task Force & CORDEX

2011, 2012, 2013, 2014, 2016

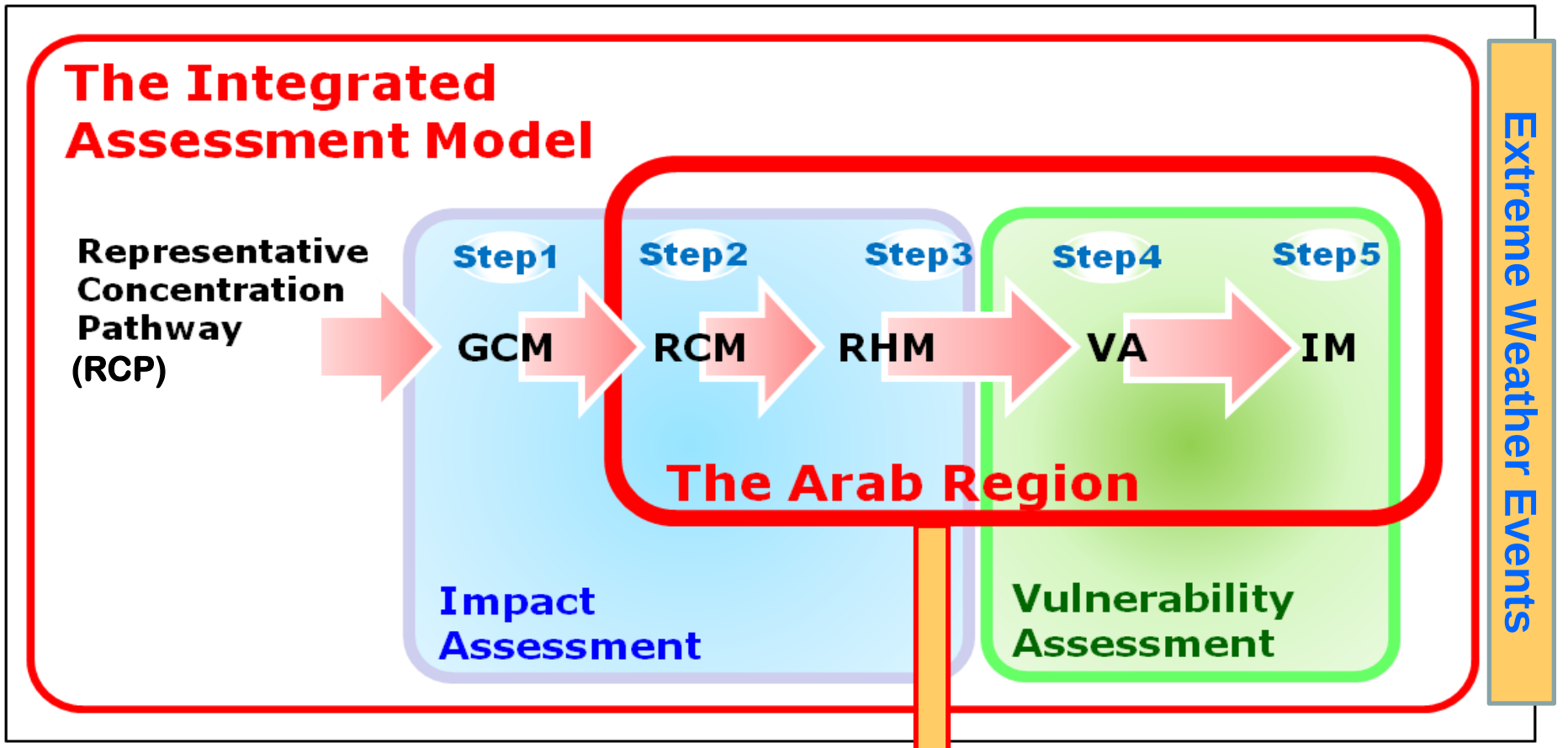
VA Task Force Meetings (sensitivity, AC)

2014, 2015

Implementation Pillars



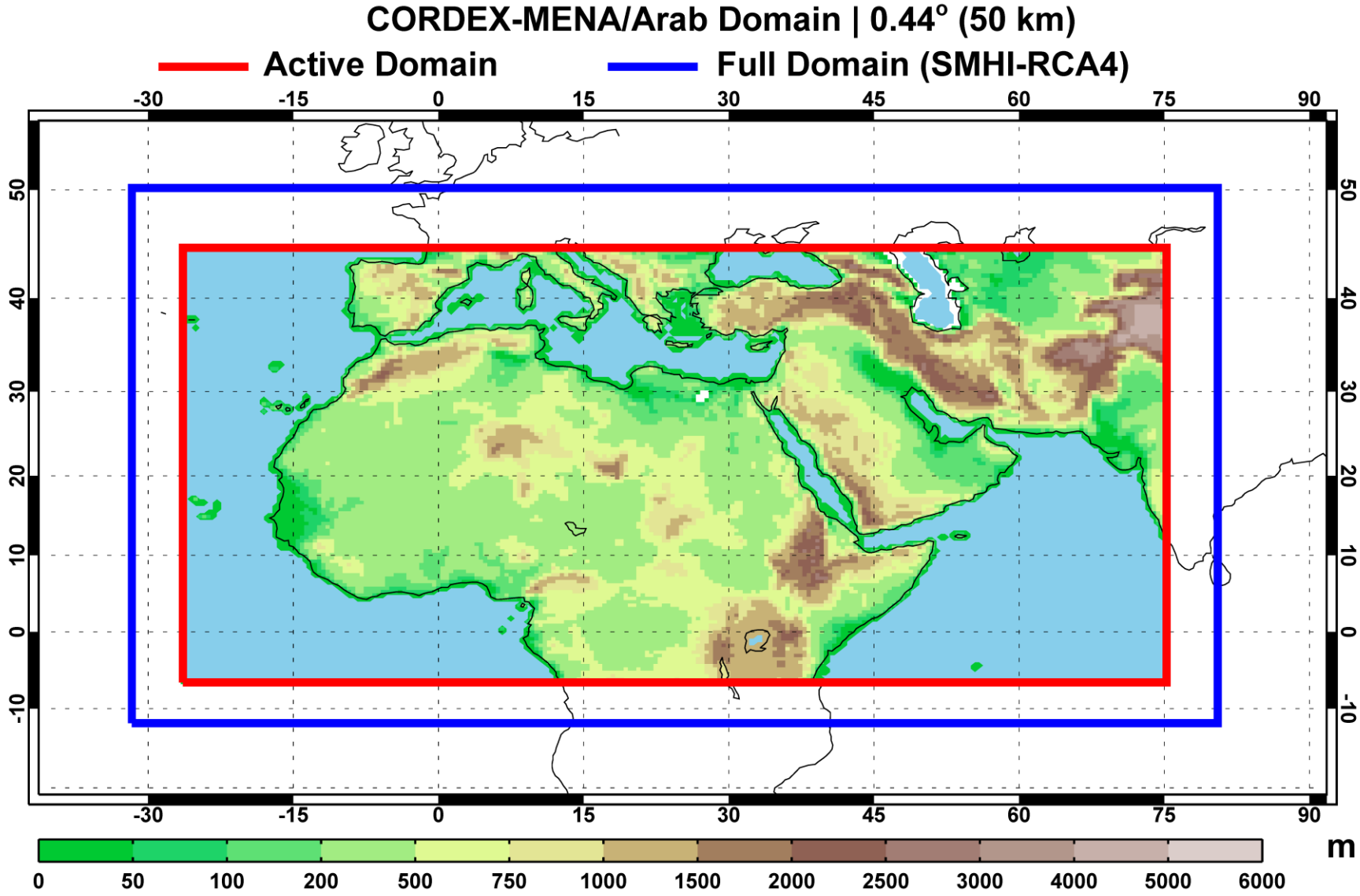
Integrated Assessment
Methodological Framework



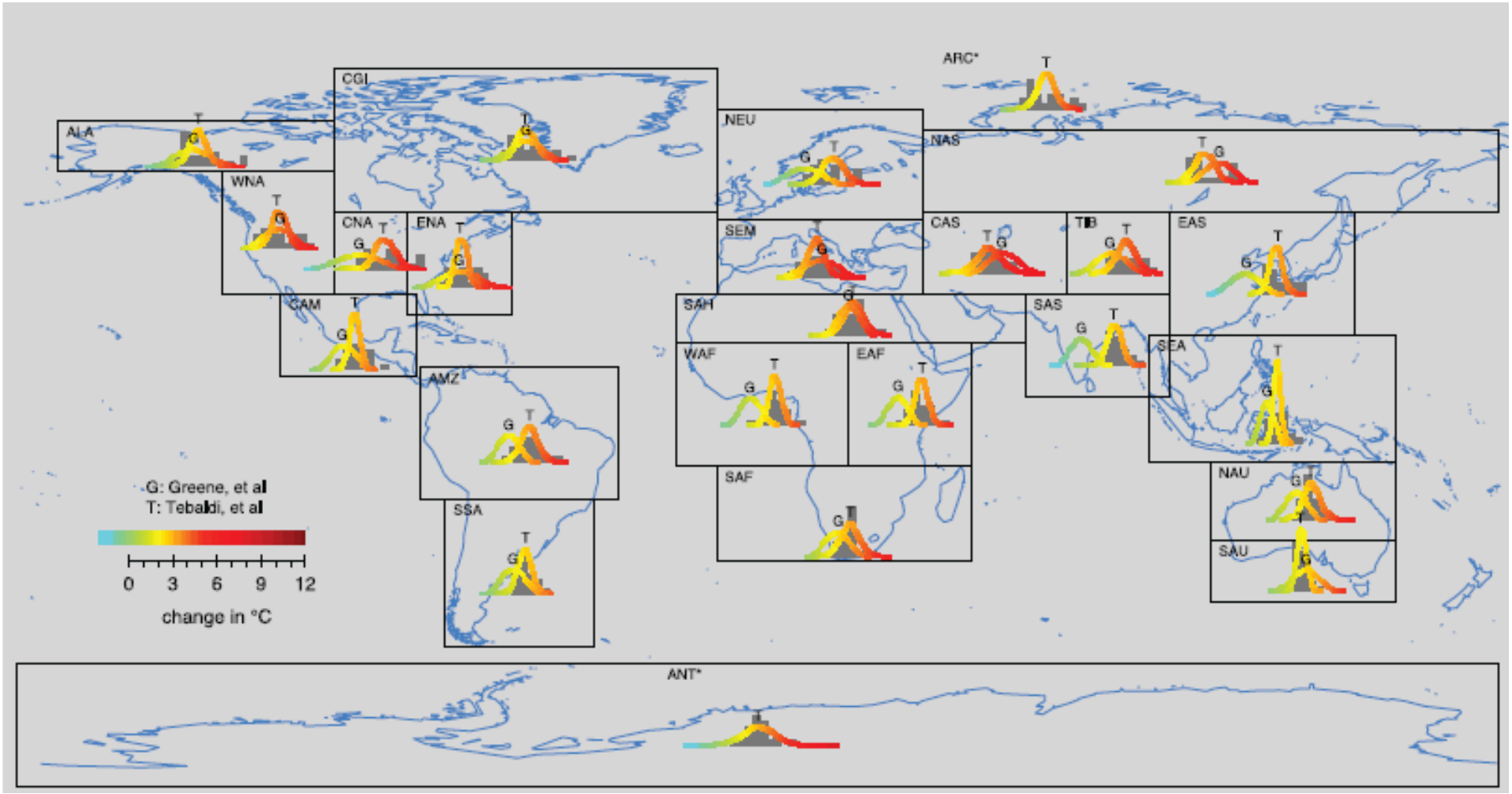
Step 1: Global Climate Model Selection
Step 2: Regional Climate Modeling
Step 3: Regional Hydrological Modeling
Step 4: Vulnerability Assessment
Step 5: Integrated Mapping

→ **Water, Agriculture, Health Impact Assessments**

Regional Climate Modeling over the Arab Domain



Inter-Governmental Panel on Climate Change: Areas considered for regional averages in IPCC AR4



From R.K Kolli, WMO
RICCAR EGM #2 (Beirut, 2010)

Inter-Governmental Panel on Climate Change: Areas considered for regional averages in IPCC AR5 (2013)

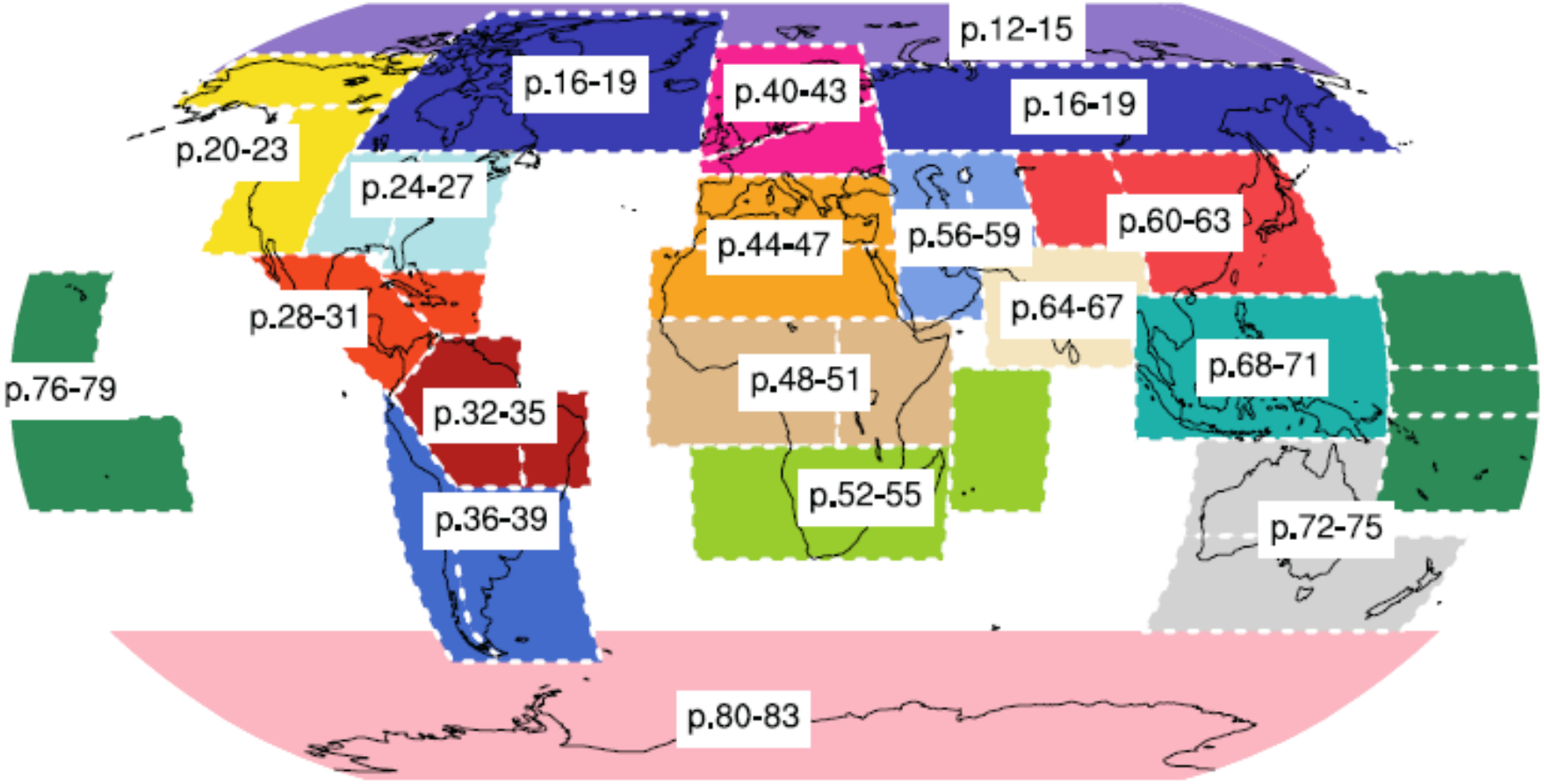
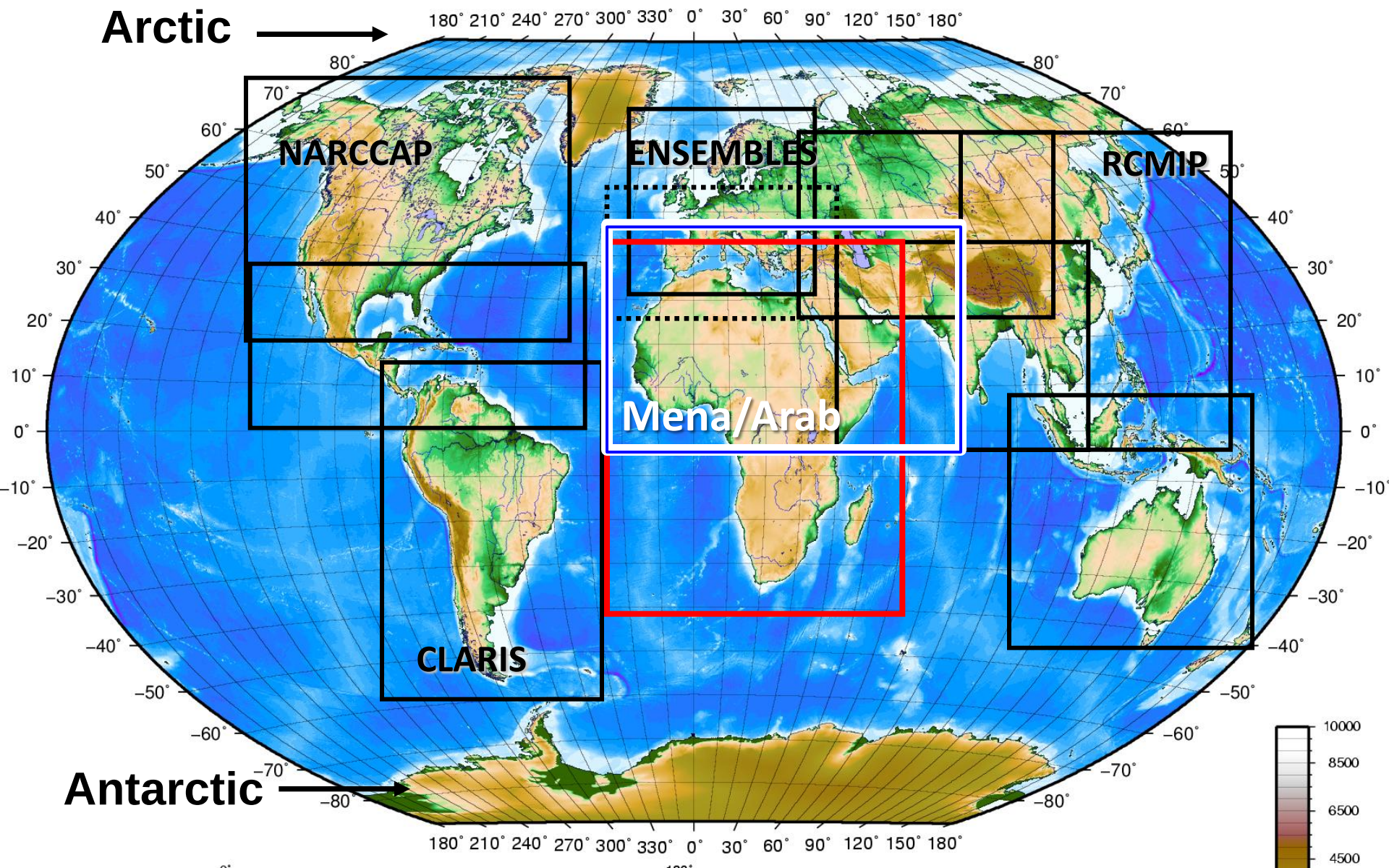


Figure AI.3: Overview of the SREX, ocean and polar regions used.

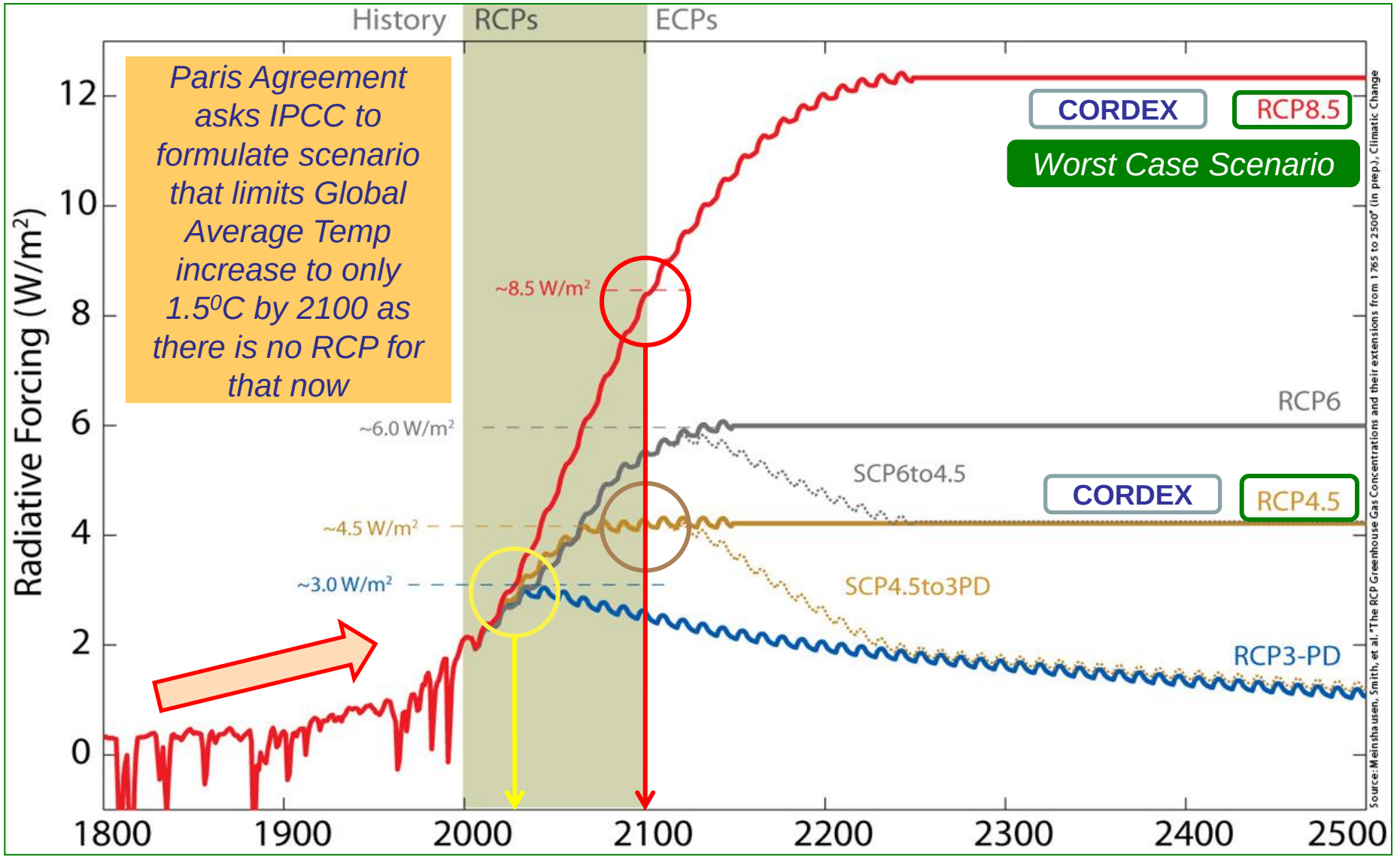
IPCC WG1 Assessment Report 5 - Annex I
DRAFT – 30 September 2013

CORDEX Domains



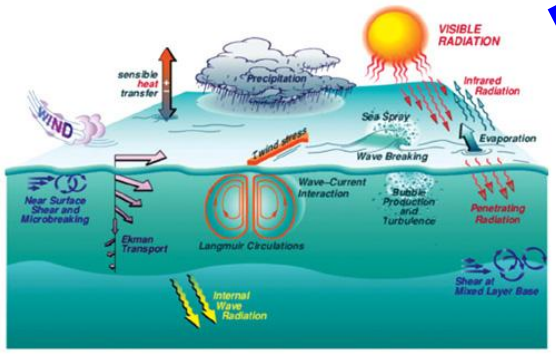
Representative Concentration Pathways (RCPs)

As first represented in IPCC AR5 Projections



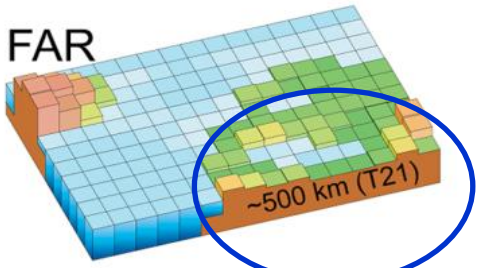
Graph adapted from: Meinshausen et al.,2010

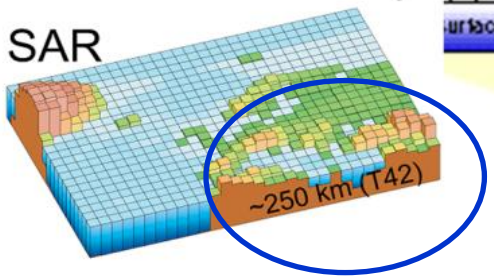
Computing Climate Variables per Grid Box

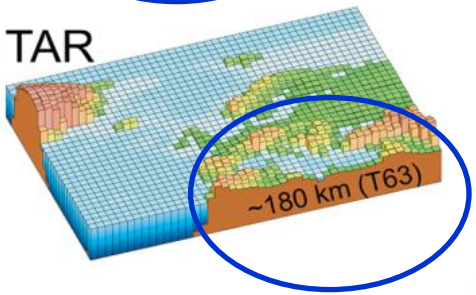


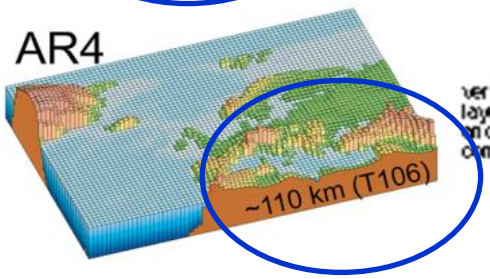
REF: http://stratus.astr.ucl.ac.be/textbook/chapter3_node8.html
http://www.nesl.ucar.edu/LAR/2007/strategic-priorities/sp2/index.php

Computing Climate Variables:
Scale Improving Over Time



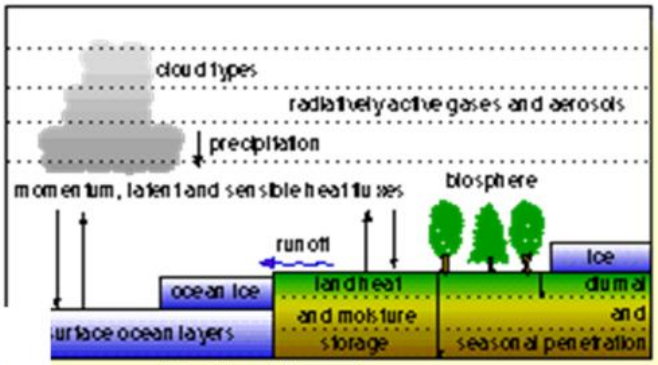






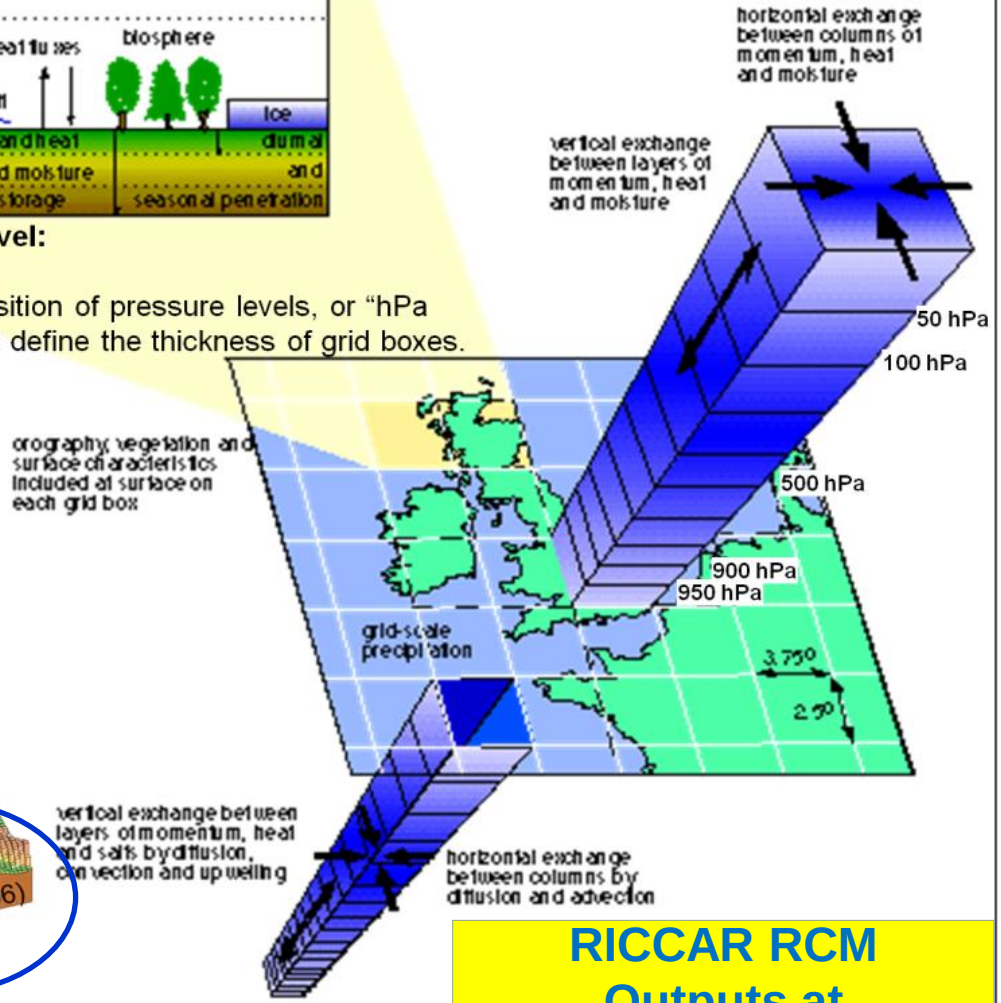
Horizontal Grid:

Evolution of horizontal resolution over the course of the Various IPCC reports



Vertical Level:

Relative position of pressure levels, or "hPa Levels" that define the thickness of grid boxes.



RICCAR RCM Outputs at 50x50 km & 25x25 km

IPCC, 2007; Met Office, 2011

Essential Climate Variables generated per Grid Box

Table 1. LIST OF ESSENTIAL CLIMATE VARIABLES[1]

Domain	Sub-domain	GCOS Essential Climate Variables	
Atmospheric (over land, sea and ice)	Surface[a]	• Air temperature • Wind speed and direction • Water vapour	• Pressure • Surface radiation budget
	Upper-air (up to the stratopause)	• Temperature • Wind speed and direction • Water vapour	• Cloud properties • Earth radiation budget (including solar irradiance)
	Composition	• Carbon dioxide • Methane and other long-lived greenhouse gases: nitrous oxide (N_2O), chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF_6), perfluorocarbons (PFCs)	• Ozone and aerosols, supported by their precursors, in particular nitrogen dioxide (NO_2), sulphur dioxide (SO_2), formaldehyde (HCHO), carbon monoxide (CO)
Oceanic	Surface[b]	• Sea-surface temperature • Sea-surface salinity • Sea level • Sea state • Sea ice	• Surface current • Ocean colour • Carbon dioxide partial pressure • Ocean acidity • Phytoplankton
	Sub-surface	• Temperature • Salinity • Ocean current • Nutrients	• Carbon dioxide partial pressure • Ocean acidity • Oxygen • Tracers
Terrestrial	Surface[b]	• River discharge • Water use • Lakes • Snow cover • Glaciers and ice caps • Ice sheets • Permafrost • Albedo	• Land cover (including vegetation type) • Fraction of absorbed photosynthetically active radiation (FAPAR) • Leaf area index (LAI) • Above-ground biomass • Fire disturbance
	Sub-surface	• Groundwater	• Soil carbon • Soil moisture

Notes: [a] Including measurements at standardized, but globally varying heights in close proximity to the surface.
[b] Including measurements within the surface mixed layer, usually within the upper 15 m.

UPPER GRID BOXES

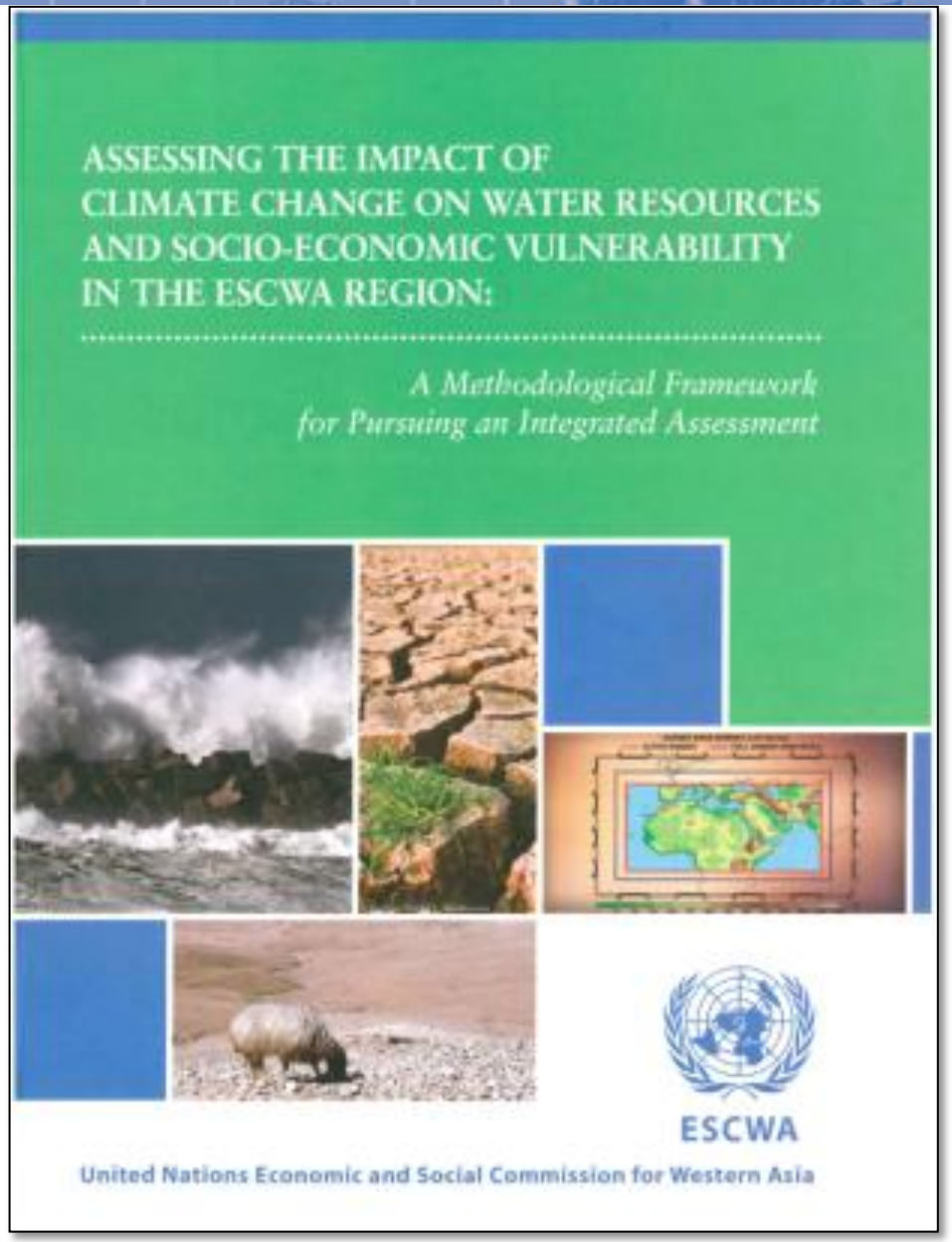
OCEAN GRID BOXES

LAND GRID BOXES

RCMs generate no Oceanic Variables

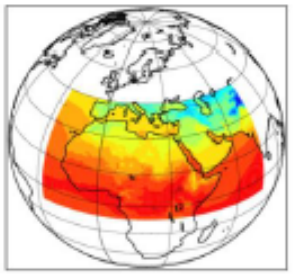
GCOF,2012

More information available at



CORDEX-MENA/Arab Ensemble Matrix

RCM (Institute)	GCM	Historical 1950-2005	RCP2.6 2006-2100	RCP4.5 2006-2100	RCP8.5 2006-2100
RCA4 (SMHI)	EC-Earth 50km	✔	✔	✔	✔
RCA4 (SMHI)	EC-Earth 25km	✔			✔
RCA4 (SMHI)	CNRM 50km	✔		✔	✔
RCA4 (SMHI)	GFDL-ESM 50km	✔		✔	✔
RCA4 (SMHI)	GFDL-ESM 25km	✔			✔
na (Kaust)	GFDL-ESM-1 25km	✔			✔
na (Kaust)	GFDL-ESM-2 25km	✔			✔
Rem (CSC)	EM 50km	✔			✔
RegCM4 (Kau)	HadGEM2 50km	✔			✔
RegCM4 (Kau)	MPI-ESM	✔		✔	✔
RegCM4 (Kau)	GFDL-ESM 50km	✔		✔	✔



Currently have 13 regional climate projections completed

9 are available for CORDEX download

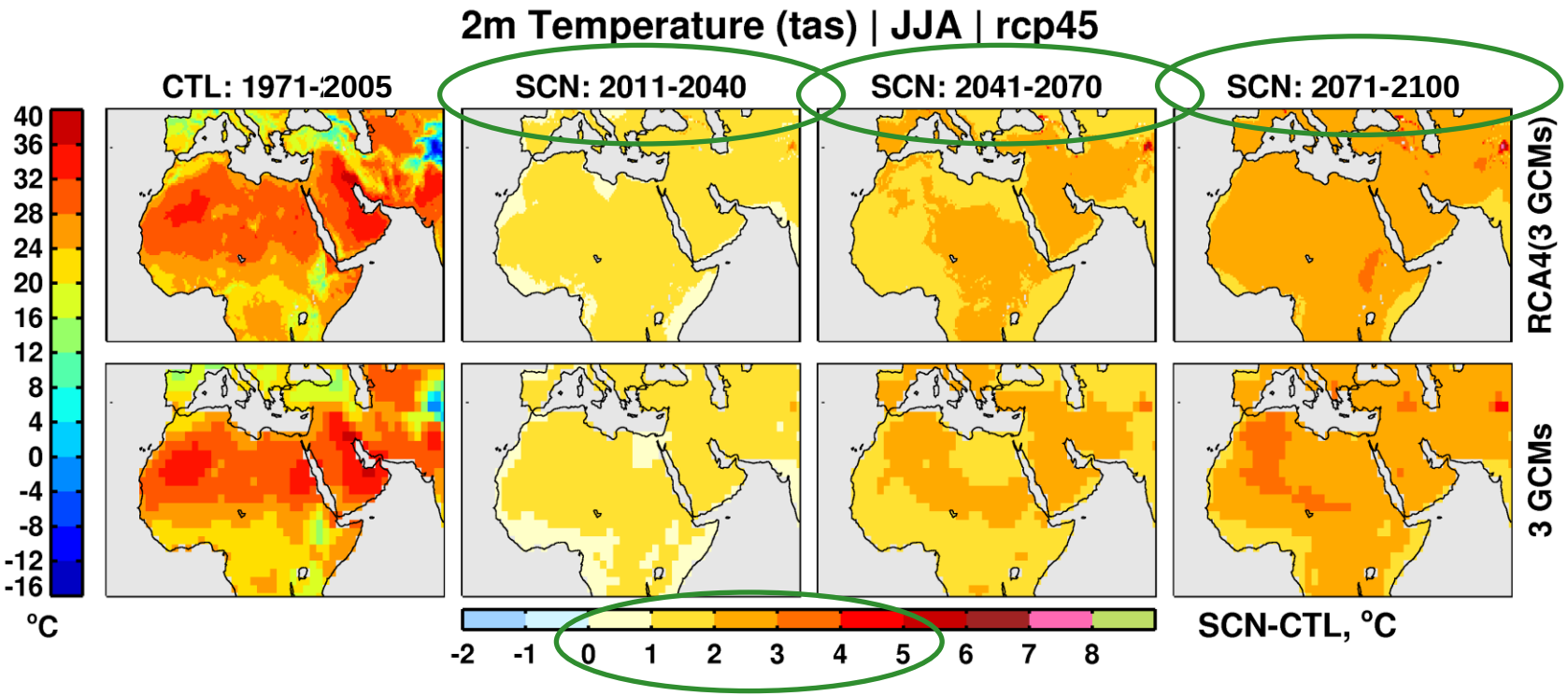
✔ Completed ✔ Running ✔ Planned

Source: P. Graham, SMHI, RICCAR EGM 6 (Cairo, Dec 2014)

Projected changes in temperature: RCP4.5

global - GCMs and regional – RCA4(GCMs) ensembles

SUMMER



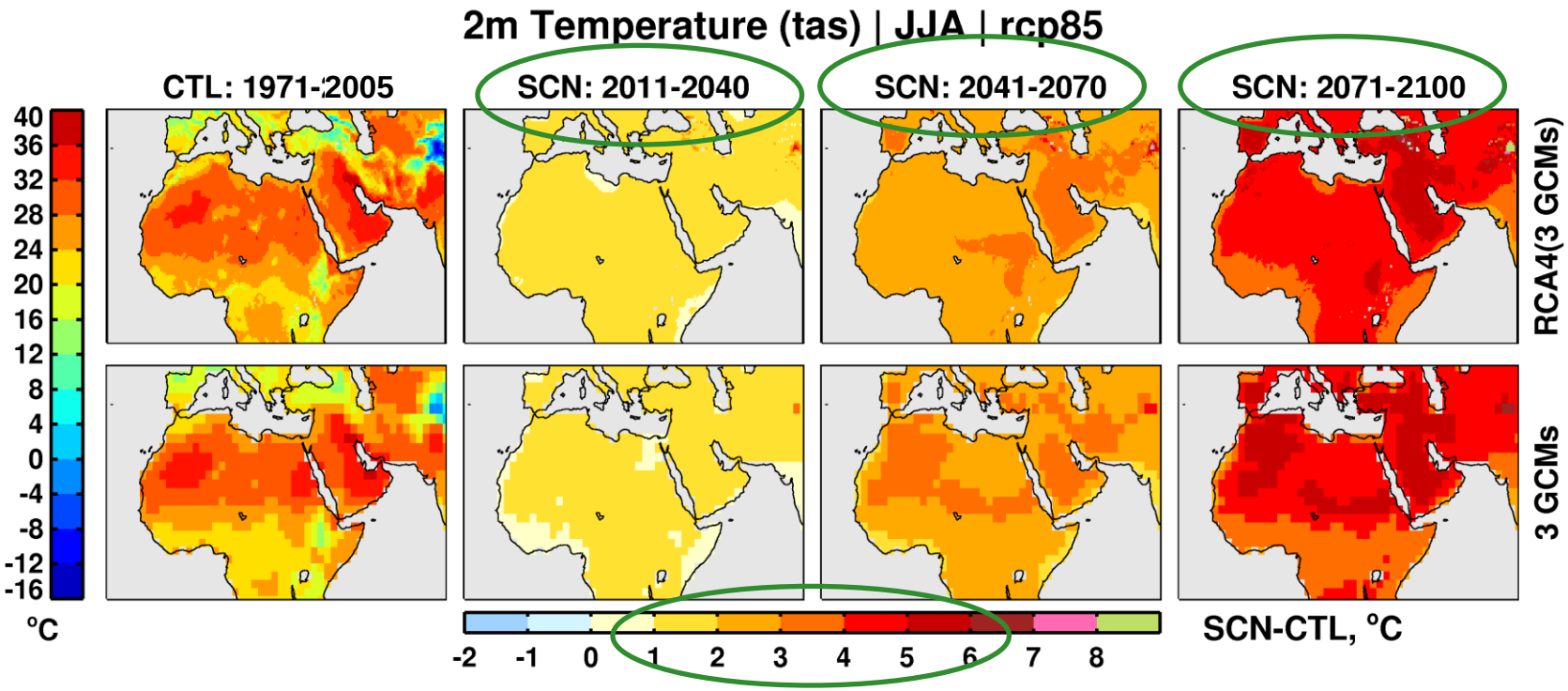
- similar patterns in both global and regional ensembles
- some differences on regional scale

Source: G.Nikulin (SMHI), RICCAR EGM-5, 11 Dec 2013

Projected changes in temperature: RCP8.5

global - GCMs and regional – RCA4(GCMs) ensembles

SUMMER



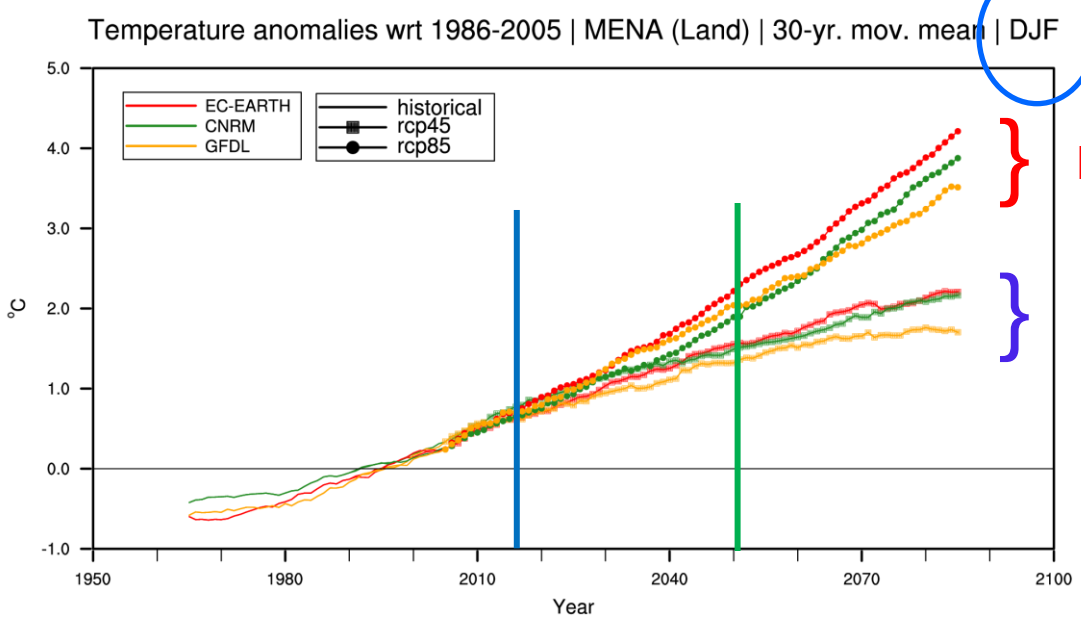
- in coming decades both RCP4.5 and RCP8.5 are similar
- larger warming from 2041 on for RCP8.5 than for RCP4.5

➢ Average global temperature has already risen by 1°C since pre-industrial times.
➢ INDCs submitted pre-Paris Agreement puts the world on a 3-4°C pathway

Source: G.Nikulin (SMHI), RICCAR EGM-5, 11 Dec 2013

RICCAR

Temperature Over Time: Climate Shifts

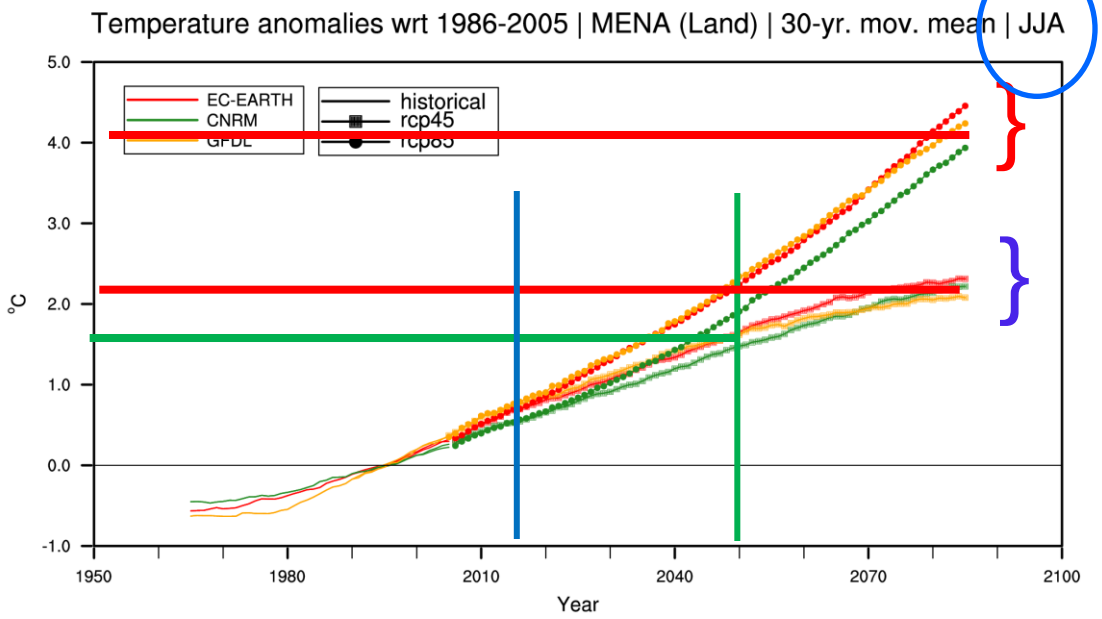


Winter

RCP **8.5**

RCP **4.5**

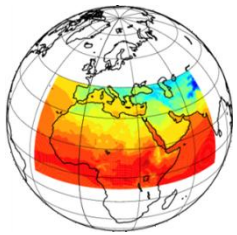
Draft Findings for sake of illustration



Summer

RCP **8.5**

RCP **4.5**



RICCAR

RICCAR Results

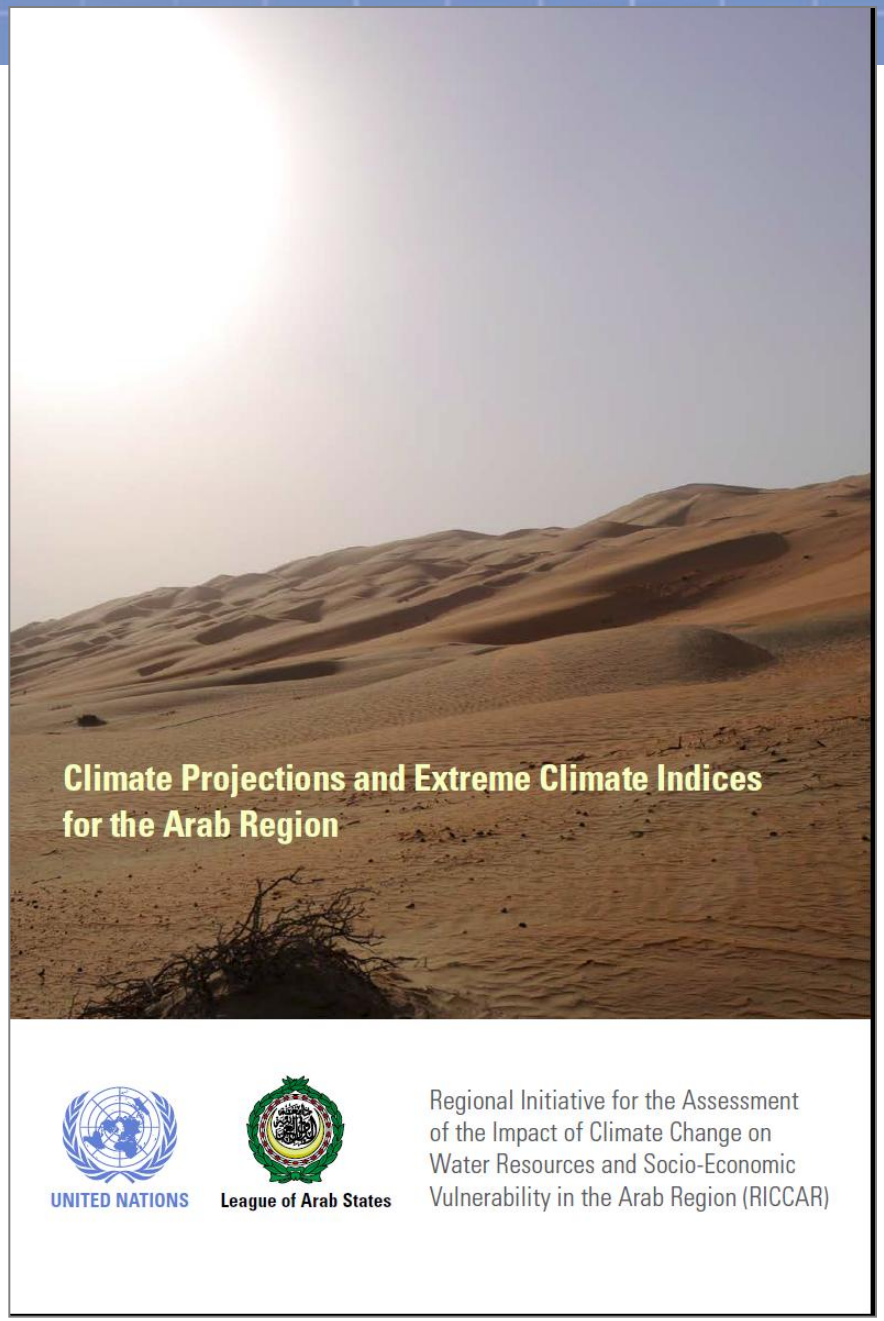
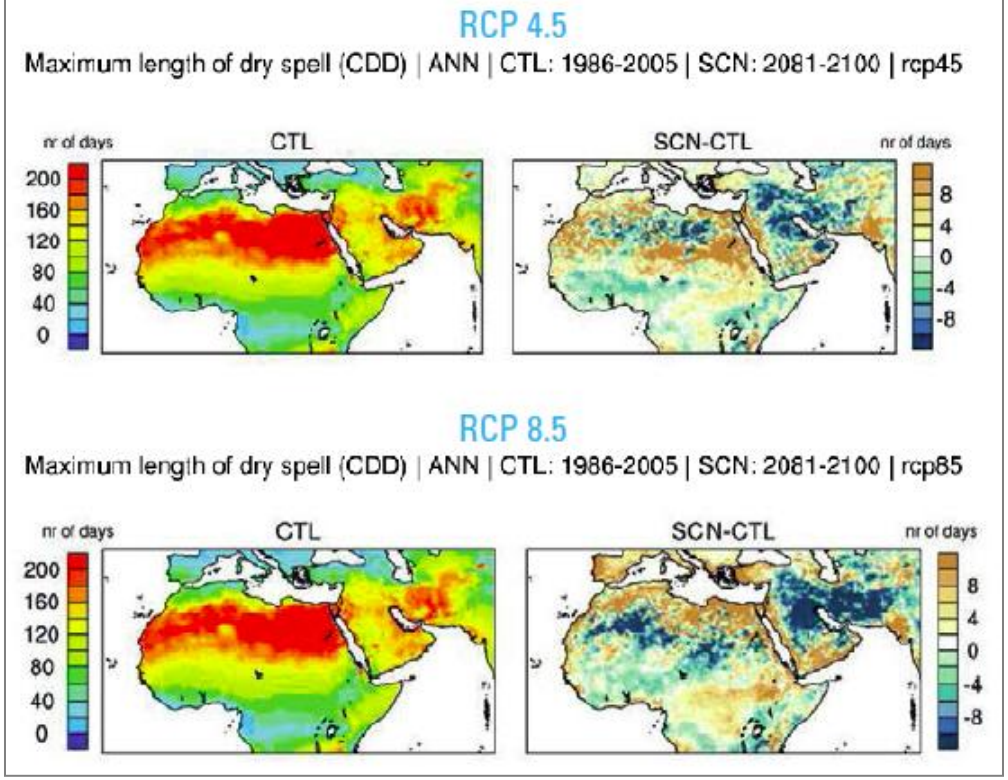


Figure 10. Change in the Maximum Length of Dry Spell (CDD) for the time period 2081-2100 from the baseline period 1986-2005 for RCP 4.5 and RCP 8.5.



Issued November 2015

Climate Change Indices: Global to Regional

Table 1. Climate Change Indices

Indices	Code	Definition
Changes in Temperature Indices		
Cold spell duration index	CSDI	Annual number of days with at least 6 consecutive days when Tmin < 10th percentile
Summer days with Tmax > 35°C	SU35	Annual number of days when Tmax > 35°C
Summer days with Tmax > 40°C	SU40	Annual number of days when Tmax > 40°C
Tropical nights	TR	Annual number of days when Tmin > 20°C
Changes in Precipitation Indices		
Maximum length of dry spell	CDD	Maximum annual number of consecutive dry days (i.e. when precipitation < 1.0 mm)
Heavy precipitation days	R10mm	Annual number of days when precipitation ≥ 10 mm)
Very heavy precipitation days	R20mm	Annual number of days when precipitation ≥ 20 mm)

SU35 & SU40 were added to better reflect regional specificities associated with warmer temperatures in the Arab region, as the global indicator for summer days adopted by WMO/ETCCDI was limited to measuring the number of summer days (SU) when the daily maximum temperature (TX) exceeds 25°C. More water needed during these higher temperature periods for health & cooling.

Source: RICCAR, Climate Projections and Extreme Climate Indices for the Arab Region (2015)

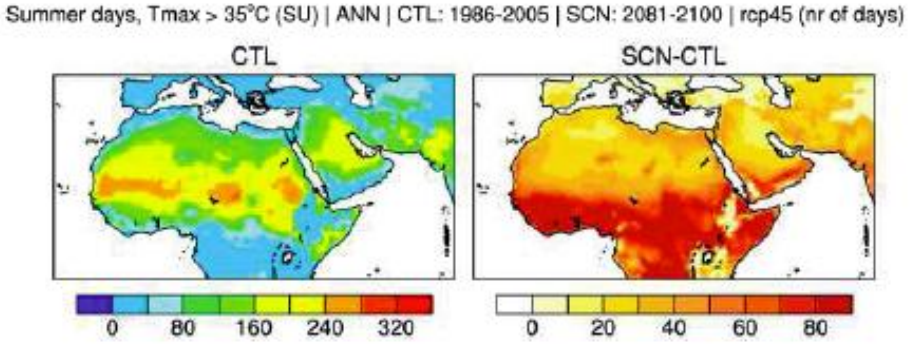
Number of days with TX over SU35°C

Number of days with TX over SU40°C

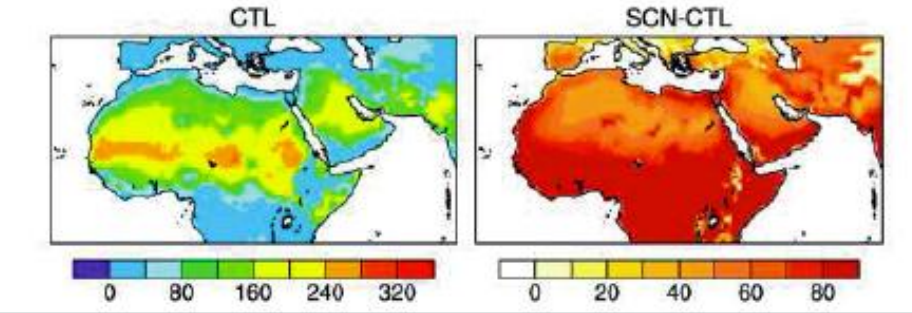
Changes in Extreme Temperature

Figure 7. Change in the Summer Days with Tmax> 35°C (SU35) for the time period 2081-2100 from the baseline period 1986-2005 for RCP 4.5 and RCP 8.5.

RCP 4.5



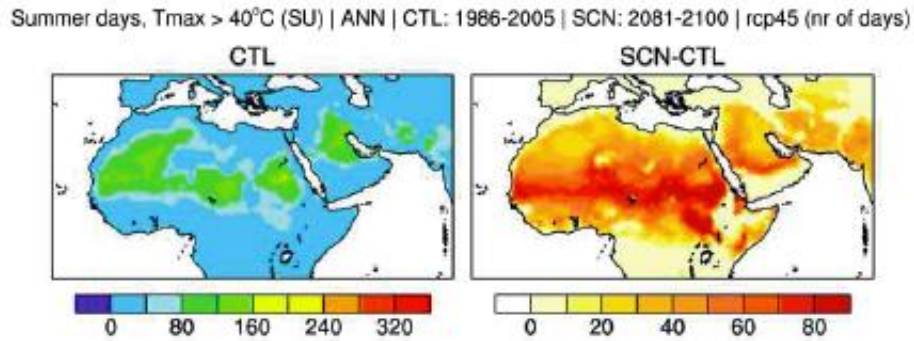
RCP 8.5



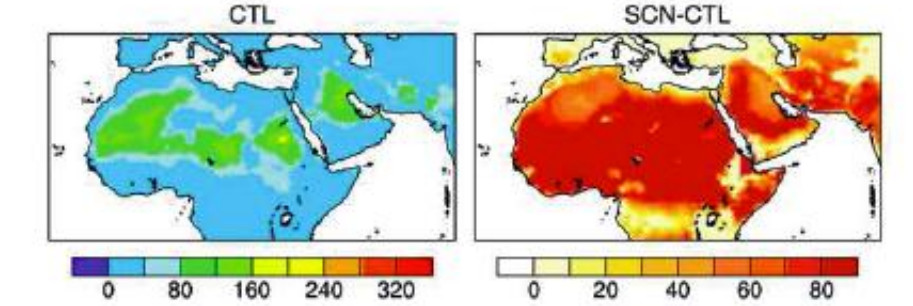
Changes in Extreme Temperature

Figure 8. Change in the Summer Days with Tmax> 40°C (SU40) for the time period 2081-2100 from the baseline period 1986-2005 for RCP 4.5 and RCP 8.5.

RCP 4.5



RCP 8.5



Source: RICCAR, Climate Projections and Extreme Climate Indices for the Arab Region (2015)

Change in Number of days with more than 10 mm of rainfall

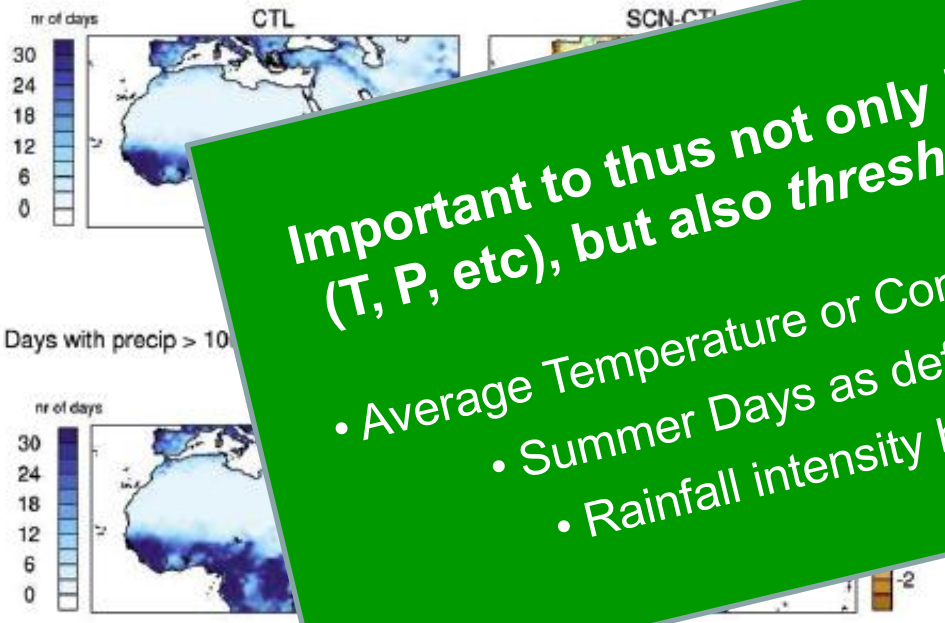
Change in Number of days with more than 20 mm of rainfall

Changes in Extreme Precipitation

Figure 11. Change in Heavy Precipitation Days (R10mm) for the time period 2081-2100 from the baseline period 1986-2005 for RCP 4.5 and RCP 8.5.

RCP 4.5

Days with precip > 10mm (R10mm) | ANN | CTL: 1986-2005 | SCN: 2081-2100 | rcp45



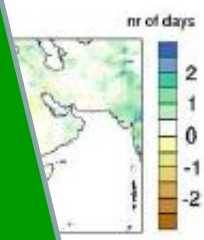
Days with precip > 10

The figures show decreasin ..., indicating a projected overall reduction in rainy days with intensity greater than 10 mm for the Arab region.

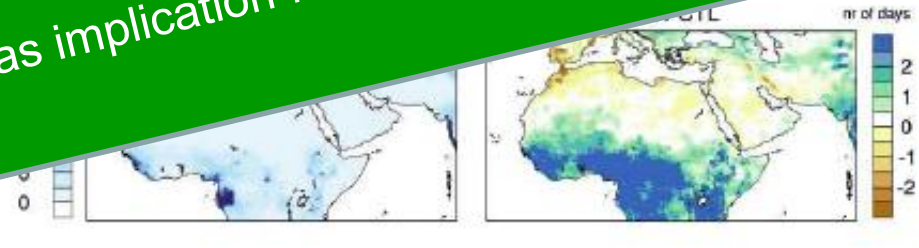
Changes in Extreme Precipitation

Figure 12. Change in Very Heavy Precipitation Days (R20mm) for the time period 2081-2100 from the baseline period 1986-2005 for RCP 4.5 and RCP 8.5.

...2081-2100 | rcp45



...0 | rcp85



The results are similar to the R10mm showing decreasing trends and an overall reduction in rainy days with an intensity greater than 20 mm for the Arab region.

Important to thus not only look at climate parameters (T, P, etc), but also *thresholds* used for the analysis:

- Average Temperature or Consecutive Peak Temperature Days
- Summer Days as defined as 25°C, 35°C or 40°C
- Rainfall intensity has implication for flooding

Source: RICCAR, Climate Projections and Extreme Climate Idices for the Arab Region (2015)

Earth System Grid Federation: CORDEX MNA Results

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ESGF@LiU in cooperation with SMHI

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The Earth System Grid Federation (ESGF) maintains a global system of federated data centers that allow access to the largest archive of climate data world-wide. The ESGF datanode at the National Supercomputer Centre, Linköping, is Sweden's first datanode in the ESGF framework. It is a joint activity of NSC and the Swedish Meteorological and Hydrological Institute (SMHI). NSC is an independent organization within Linköping University (LiU), and is funded by the Swedish Research Council via SNIC (Swedish National Infrastructure for Computing).

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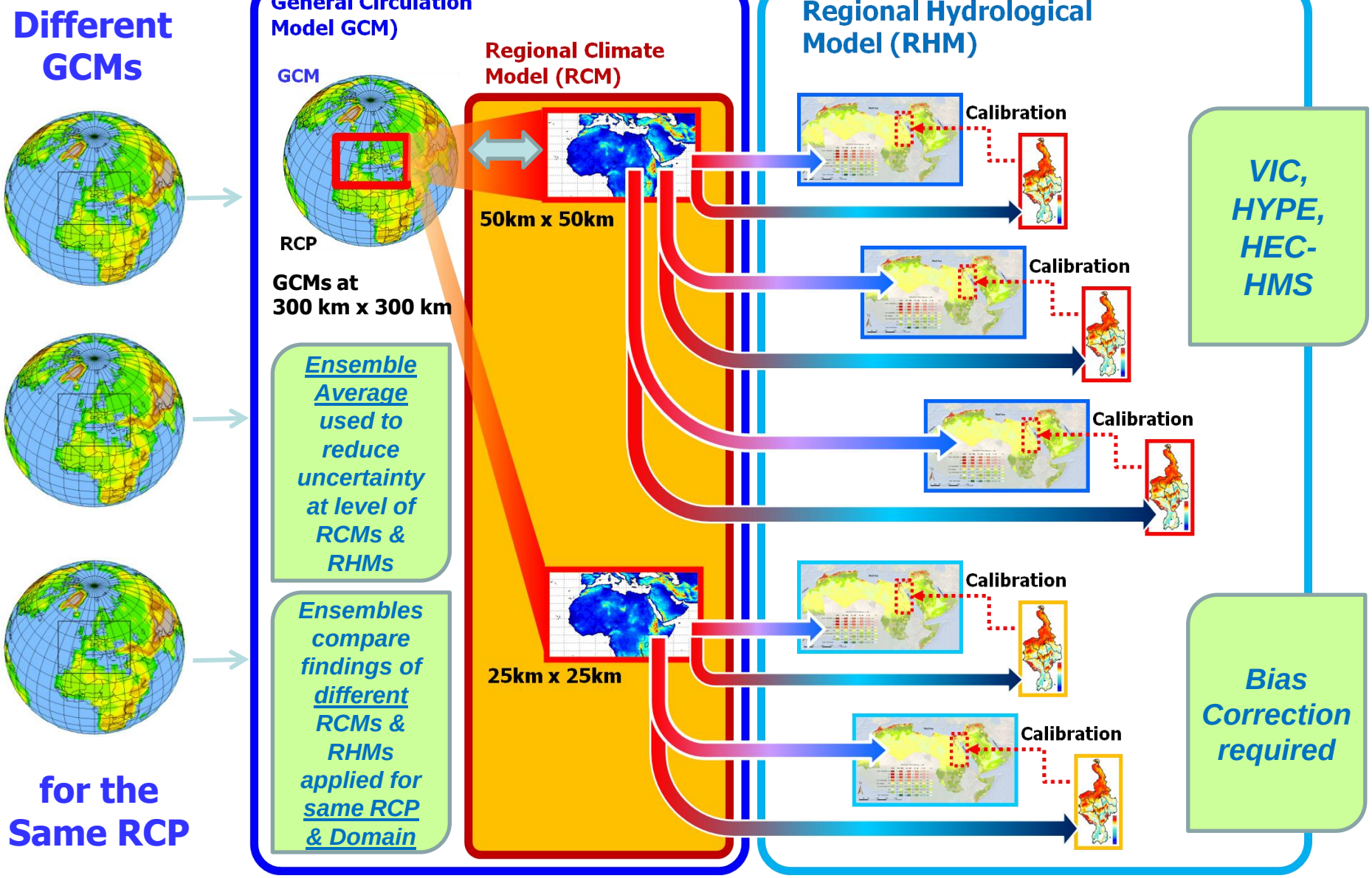
Regional Climate and Hydrological Modeling for Climate Change Impact Assessment in Arab Region



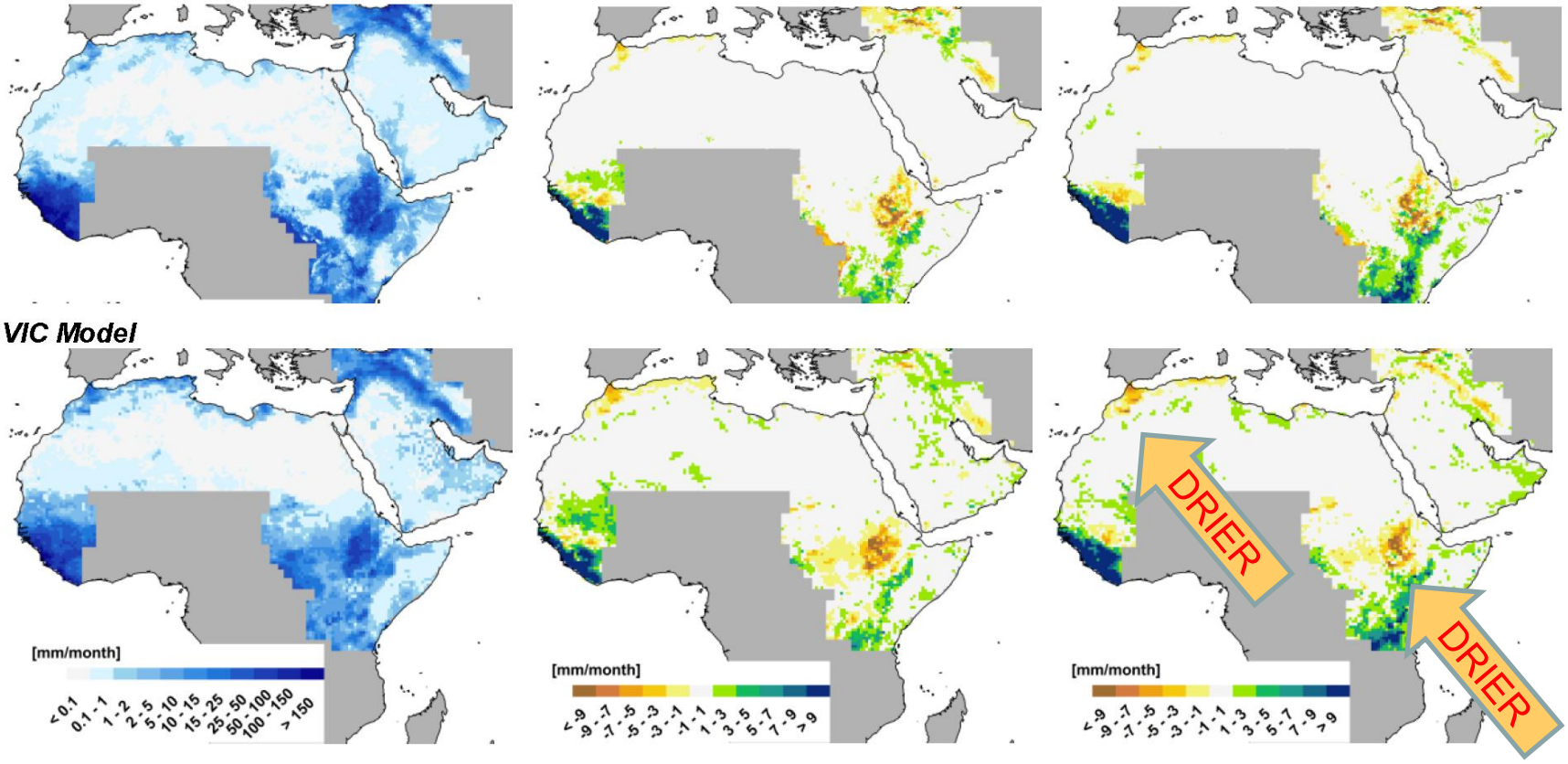
Future Hydrological Projections

Runoff – Summer – RCP 4.5

Apr-Sep: 1986-2005 2046-2065 2081-2100

HYPE Model

VIC Model



Hydro Models: 3-member ensemble

Preliminary findings

Source: P. Graham (SMHI),
RICCAR Scoping Meeting for the Establishment of an ArabCOF, 15 October 2014

RICCAR

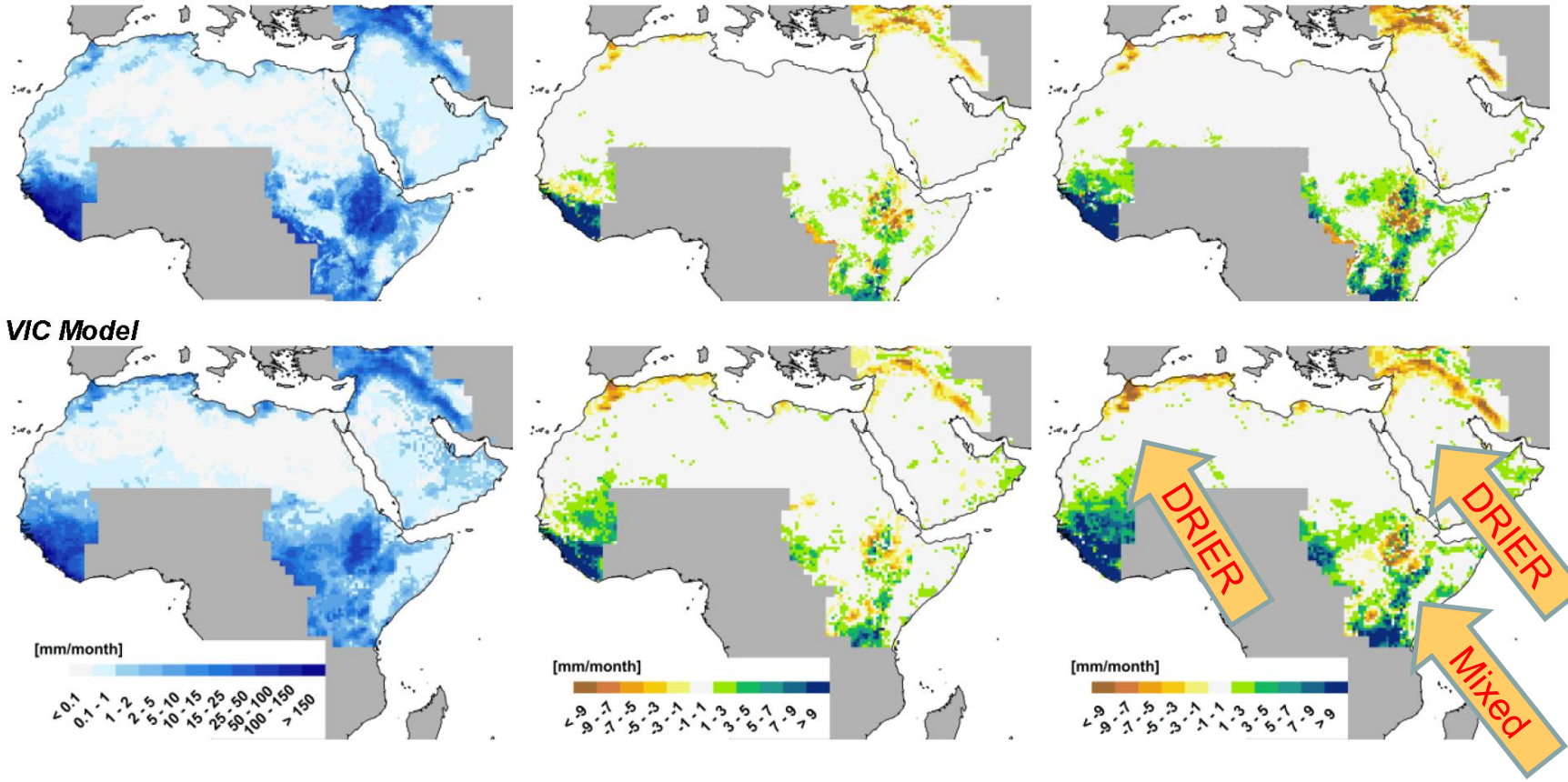
Future Hydrological Projections

Runoff – Summer – RCP 8.5

Apr-Sep: 1986-2005 2046-2065 2081-2100

HYPE Model

VIC Model



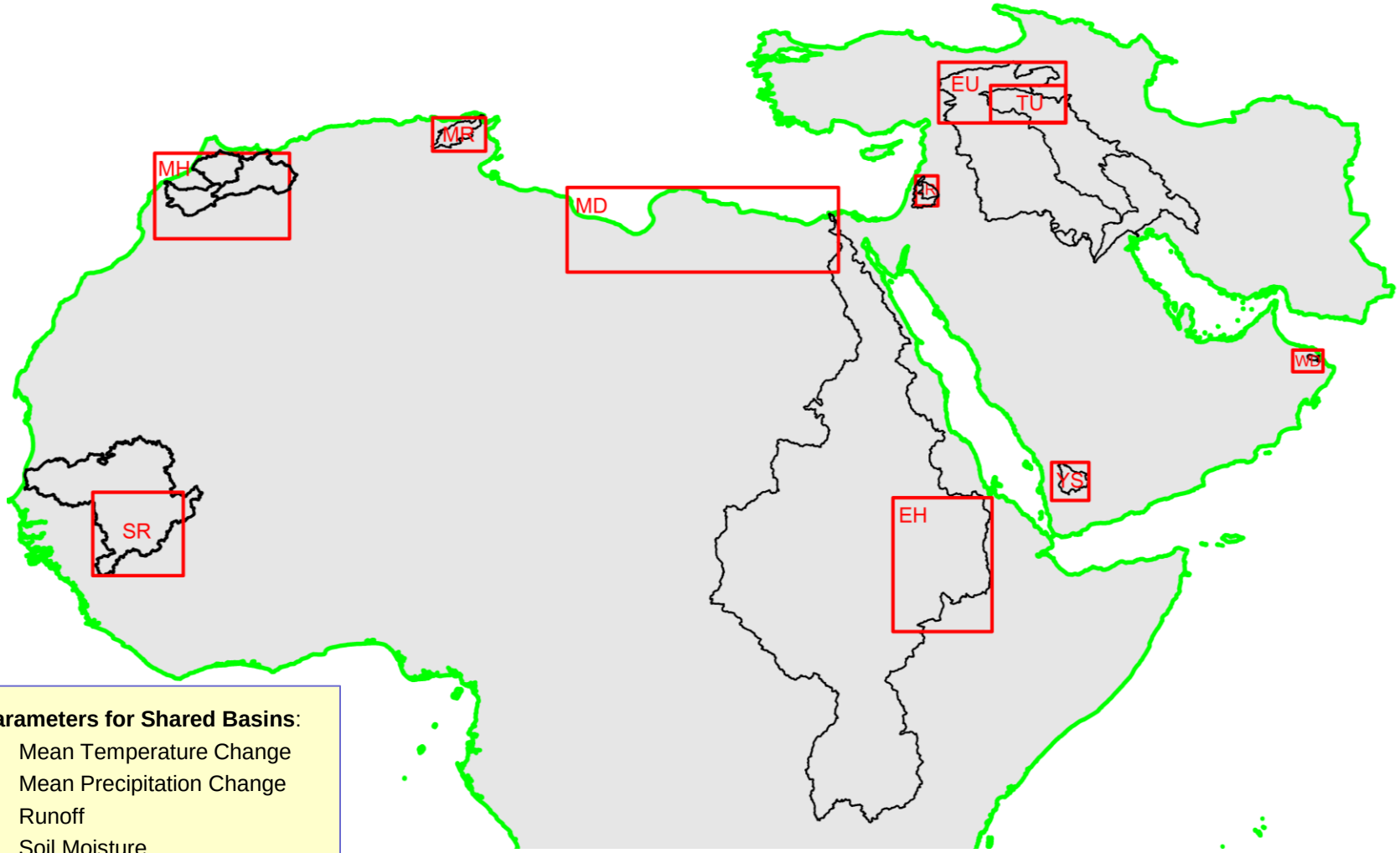
Hydro Models: 3-member ensemble

Preliminary findings

Source: P. Graham (SMHI),
RICCAR Scoping Meeting for the Establishment of an ArabCOF, 15 October 2014

RICCAR

RCM projections used to generate hydrological modeling projections for Arab Region, Sub-regions & Shared Water Basins



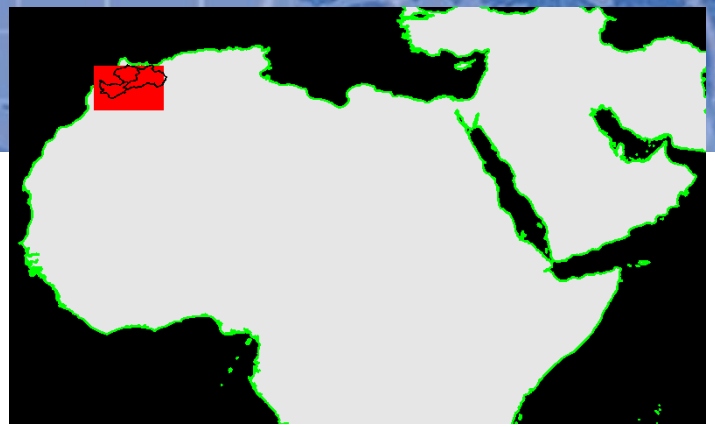
Parameters for Shared Basins:

- Mean Temperature Change
- Mean Precipitation Change
- Runoff
- Soil Moisture
- Evapotranspiration
- Groundwater interaction with surface water

Source: P. Graham (SMHI), based on AWMC & Sida Partners Consultations, RICCAR Scoping Meeting for the Establishment of an ArabCOF, 15 Oct 2014

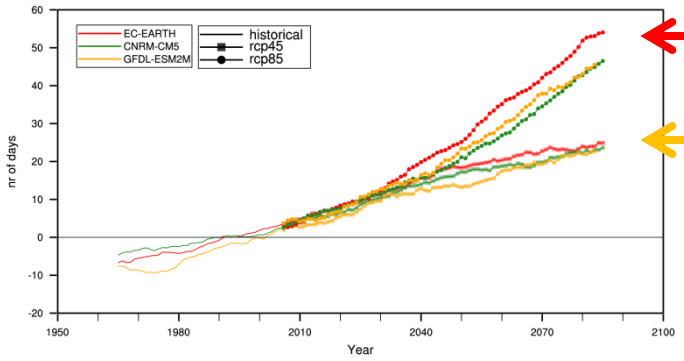
RICCAR

Moroccan Highlands (Atlas)



Temperature

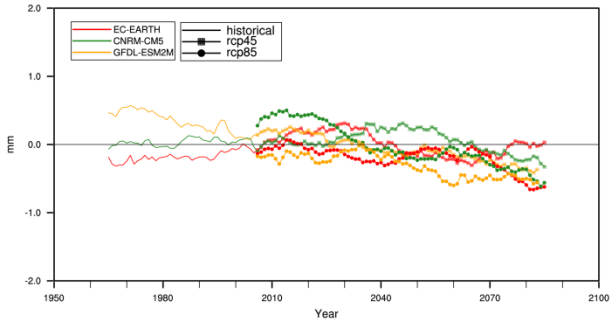
Change in number of days > 35ºC



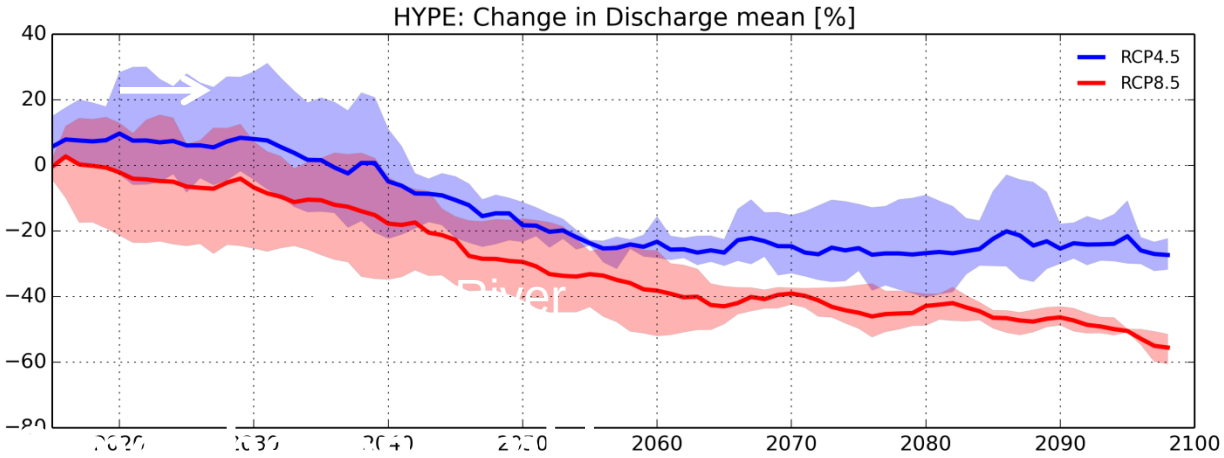
RCP 8.5

RCP 4.5

Precipitation Intensity - SDII



% Change in mean annual river discharge



RCP 4.5

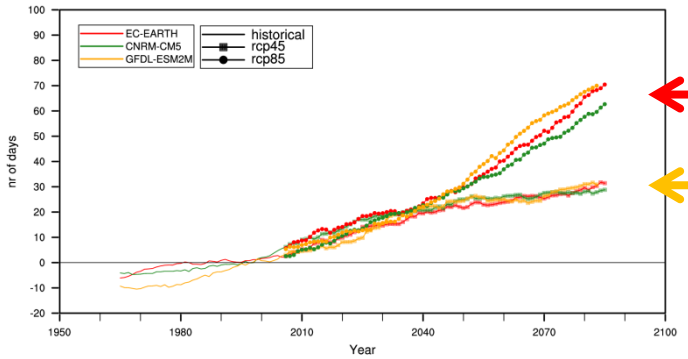
RCP 8.5

From P. Graham, SMHI PPT to RICCAR Event at WWW 2016 (Stockholm)

Jordan River

Temperature

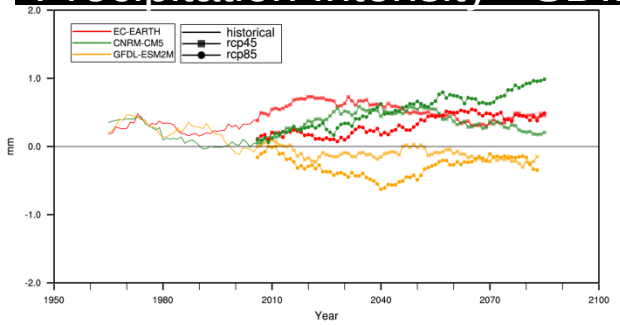
Change in number of days > 35ºC



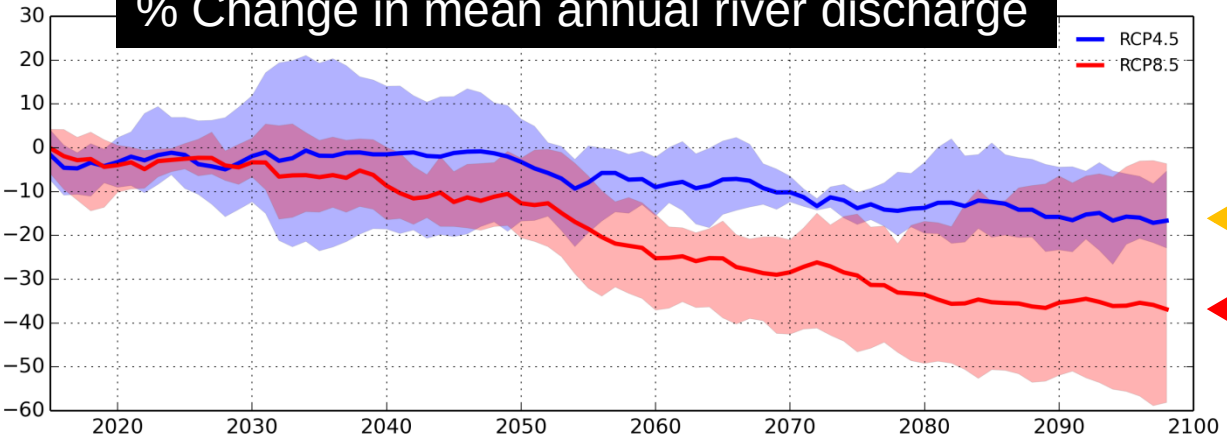
RCP 8.5

RCP 4.5

Precipitation Intensity - SDII



% Change in mean annual river discharge



RCP 4.5

RCP 8.5

Source: P. Graham (SMHI), RICCAR Seminar, Stockholm, 25 August 2015

12 Nominated Hydrological Focal Points

Country	Focal Point	Title	Ministry
1-Iraq	Mr. Jaafar Zamel	Head of Environmental Policy Dept	Ministry of Water Resources
	Mr. Abdul Jabar Khalaf Fench	Expert, National Center for the Management of Water Resources	
2-Jordan	Ms. Rania Abdul Khaleq	Director, Finance & Int'l Cooperation	Ministry of Water and Irrigation
3-Djibouti	Mr. Ismail Elmi Habane	Technical Advisor to the Minister in charge of Marine Resources	Ministry of Agriculture, Water, Livestock, Fisheries
4-Qatar	Mr. Saad Abdullah El Hatmi		Ministry of Environment
5-Libya	Mr. Mahdi ElMejrebi	Director General	Public Water Authority
6-Oman	Mr. Ali Ben Mohsen Ben Jawad Lwatia	Hydrological	Ministry of Regional Municipalities and Water Resources
7-Palestine	Ms. Salam Abouhantash	Head, Water Harvesting Section	Palestinian Water Authority
8-Mauritania	Mr. Mohamed Abdellahi Ould Taleb	Technical Advisor responsible for Hydrology	Ministry of Hydrology and Sanitation
9-Morocco	Mr. Hasan Bargheit	Head of Surface Water Establishment, Water Research & Planning Directorate	Ministry of Energy, Minerals, Water and Environment
10-Saudi Arabia	Mr. Yaser Bin Mashfar El Asmari	Hydrologist	Ministry of Water
11-Sudan	Mr. Ammar Abdelrahman	Water Resources Engineer	Ministry of Water
	Ms. Widad Saadalla	Executive Secretary	
12-Yemen	Mr. Abdulkhaleq Alwan	IWRM Principal Advisor, Water Planning & Policies, Director NWRA-SB	Ministry of Water and Environment

Attending meetings:
Egypt
Lebanon
Tunisia

Impact Assessments

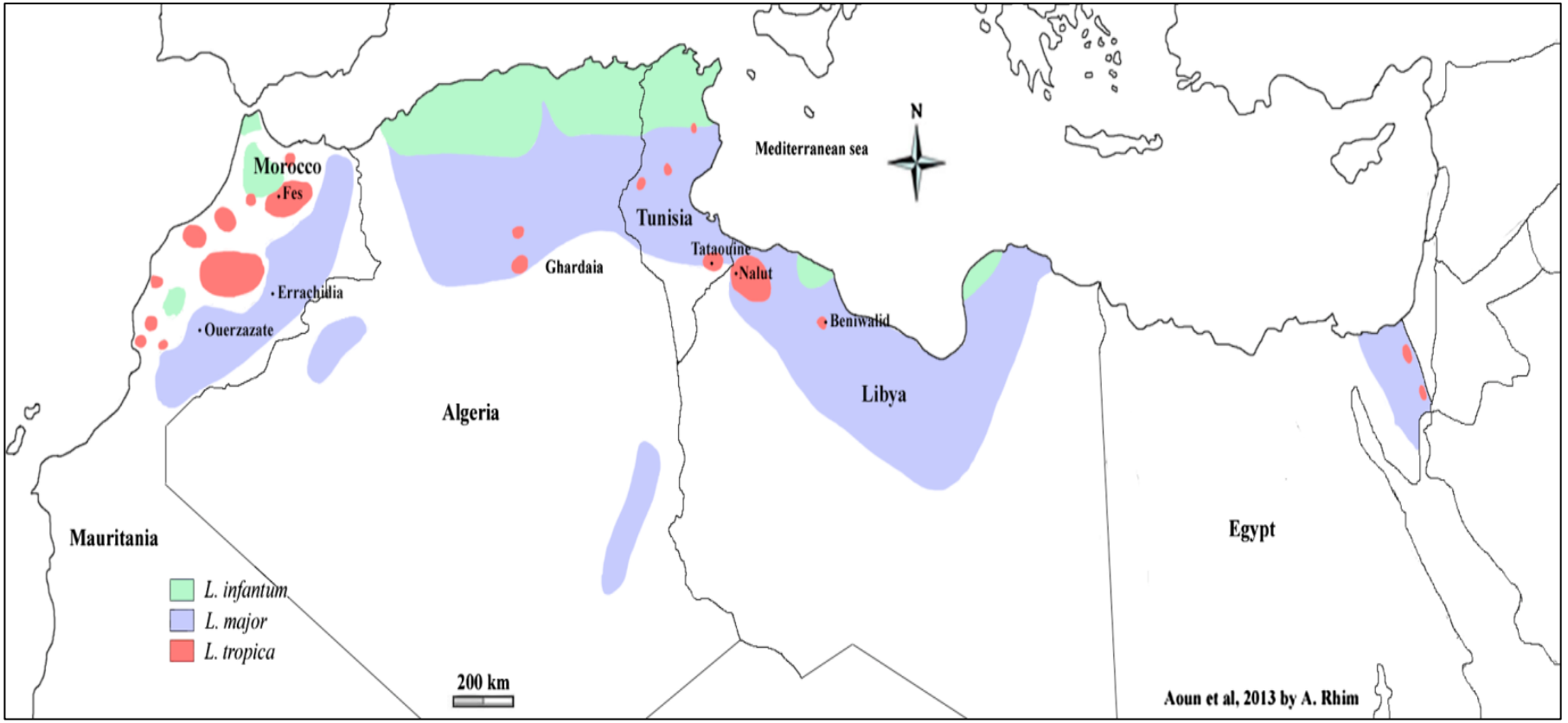
Agriculture

- FAO, ACSAD, GIZ/ACCWaM
- Forests
- In-land Fisheries
- Selected Crops
  - Irrigated
  - Rainfed
  - Mixed
- Selected Hot Spots

Health

- UNU/INWEH under Sida Project in consultation with WHO on Neglected Tropical Diseases (NTCs) looking at:
- Disease Vectors
- Rodent-Borne Infectious Diseases
- North Africa

Geographical distribution of cutaneous leishmaniasis cases due to *L. infantum, L. major* & *L. tropica* in North

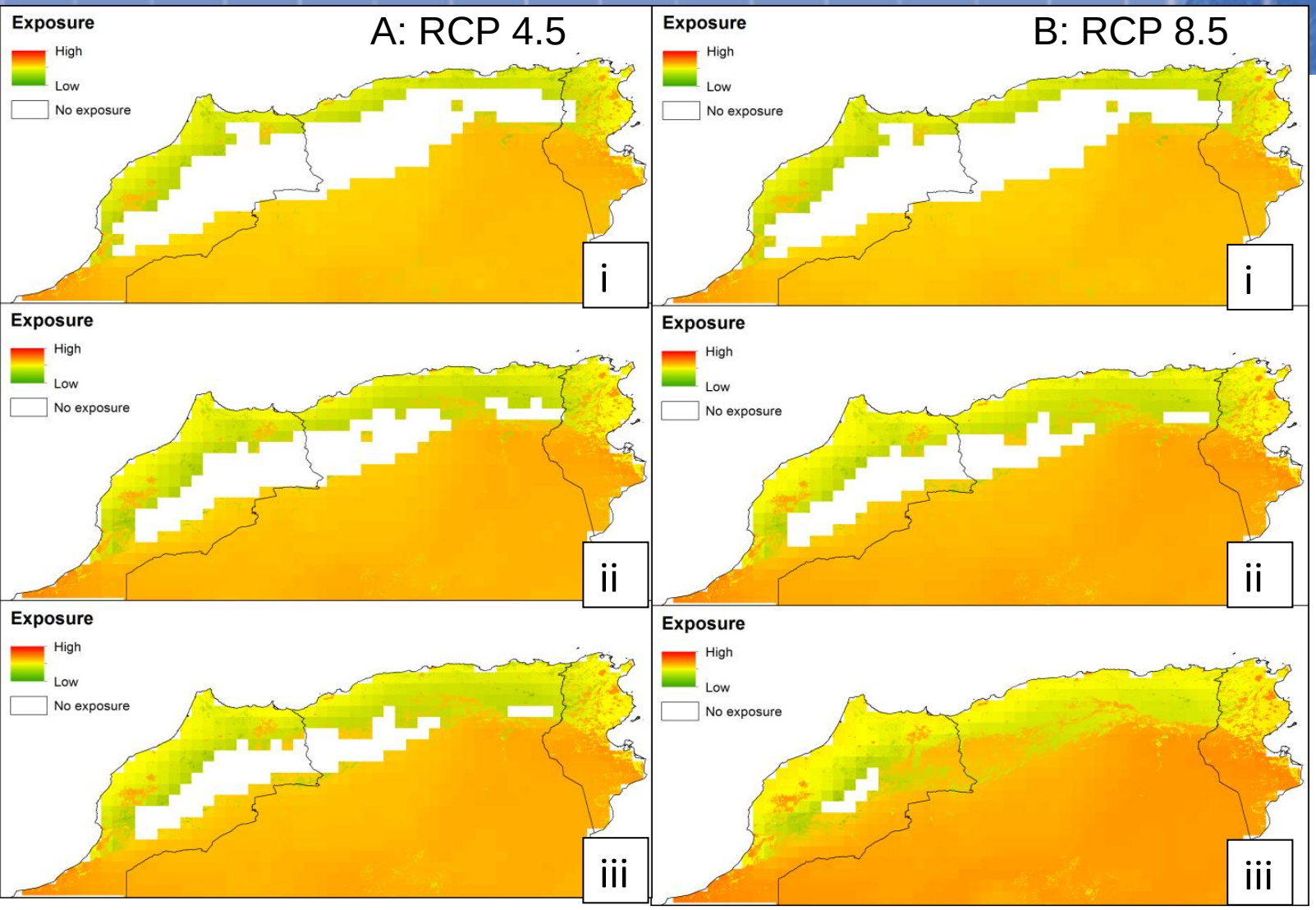


Source: Aoun and Bouratbine, 2014, as cited by UNU-INWEH in "Climate change impacts on health in the Arab region: A case study on neglected tropical disease" RICCAR, UNU-INWEH draft report 7 Dec 2015

L.major causes zoonotic cutaneous leishmaniasis and is the dominant form in North Africa, *causing 90% of cases*.

L. tropica largely occurs in Morocco, while only sporadic cases of *L.infantum* are reported.

Applying WADI in RICCAR: Leishmaniasis: Fall



Historical (1986-2005)

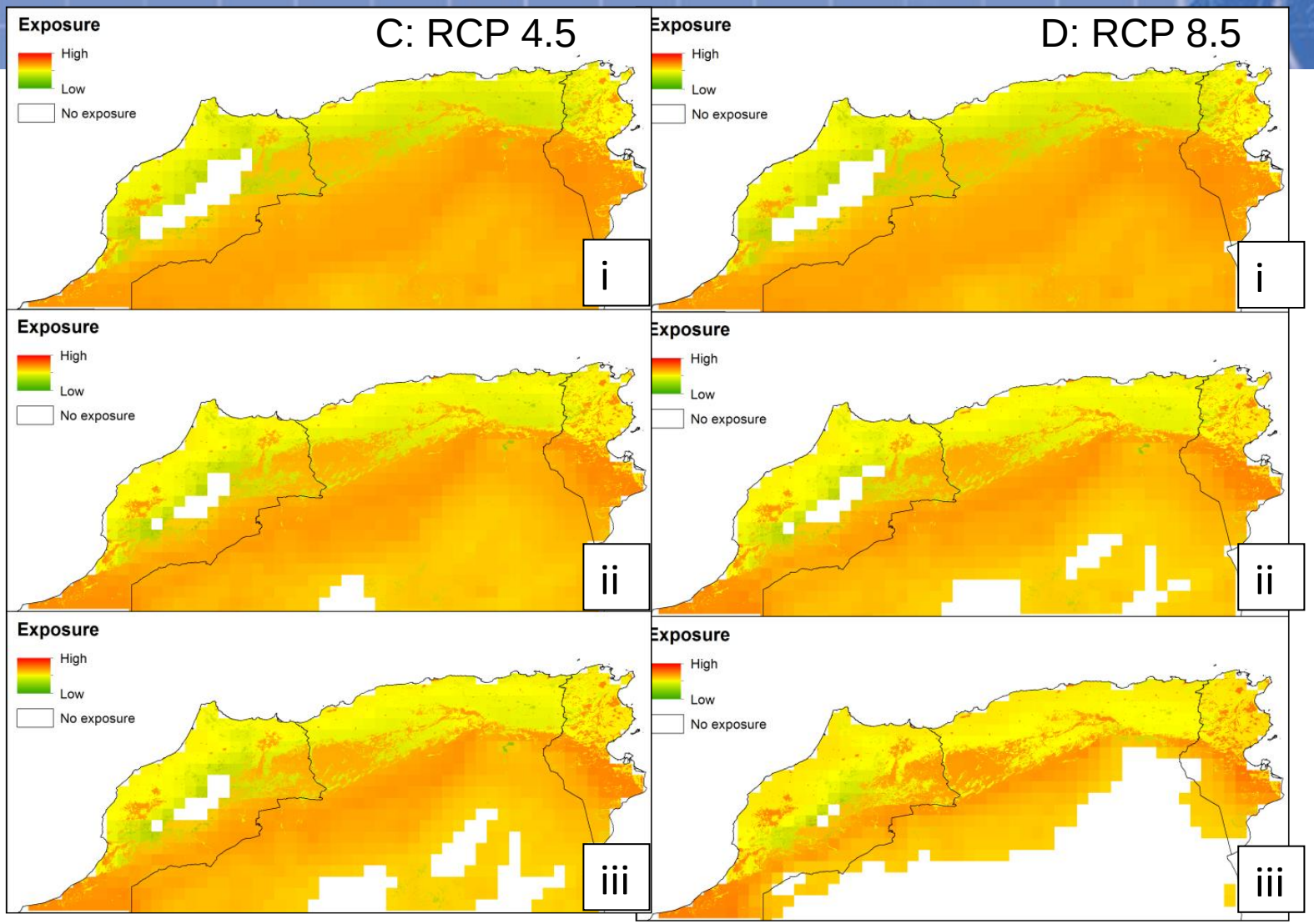
Mid-century (2046-2065)

End century (2081-2100)

Column A: Fall (October) ZCL exposure 1) Historical ii) RCP 4.5 2046-2065 iii) RCP 4.5 2081-2100;
Column B: Fall (October) ZCL exposure 1) Historical ii) RCP 8.5 2046-2065 iii) RCP 8.5 2081-2100

UNU-INWEH "Climate change impacts on health in the Arab region: A case study on neglected tropical disease" RICCAR, draft report 7 Dec 2015

Applying WADI in RICCAR: Leishmaniasis: Summer



Column C: Summer (June) ZCL exposure 1)Historical ii)RCP 4.5 2046-2065 iii)RCP 4.5 2081-2100;
Column D: Summer (June) ZCL exposure 1)Historical ii)RCP 8.5 2046-2065 iii)RCP 8.5 2081-2100

UNU-INWEH "Climate change impacts on health in the Arab region: A case study on neglected tropical disease" RICCAR, draft report 7 Dec 2015

Agriculture Case Studies by ACSAD-FAO-GIZ/ACCWaM

Three case studies to assess impact of climate change on crop yield (due to T, P, CO_2 in atmosphere, etc.)

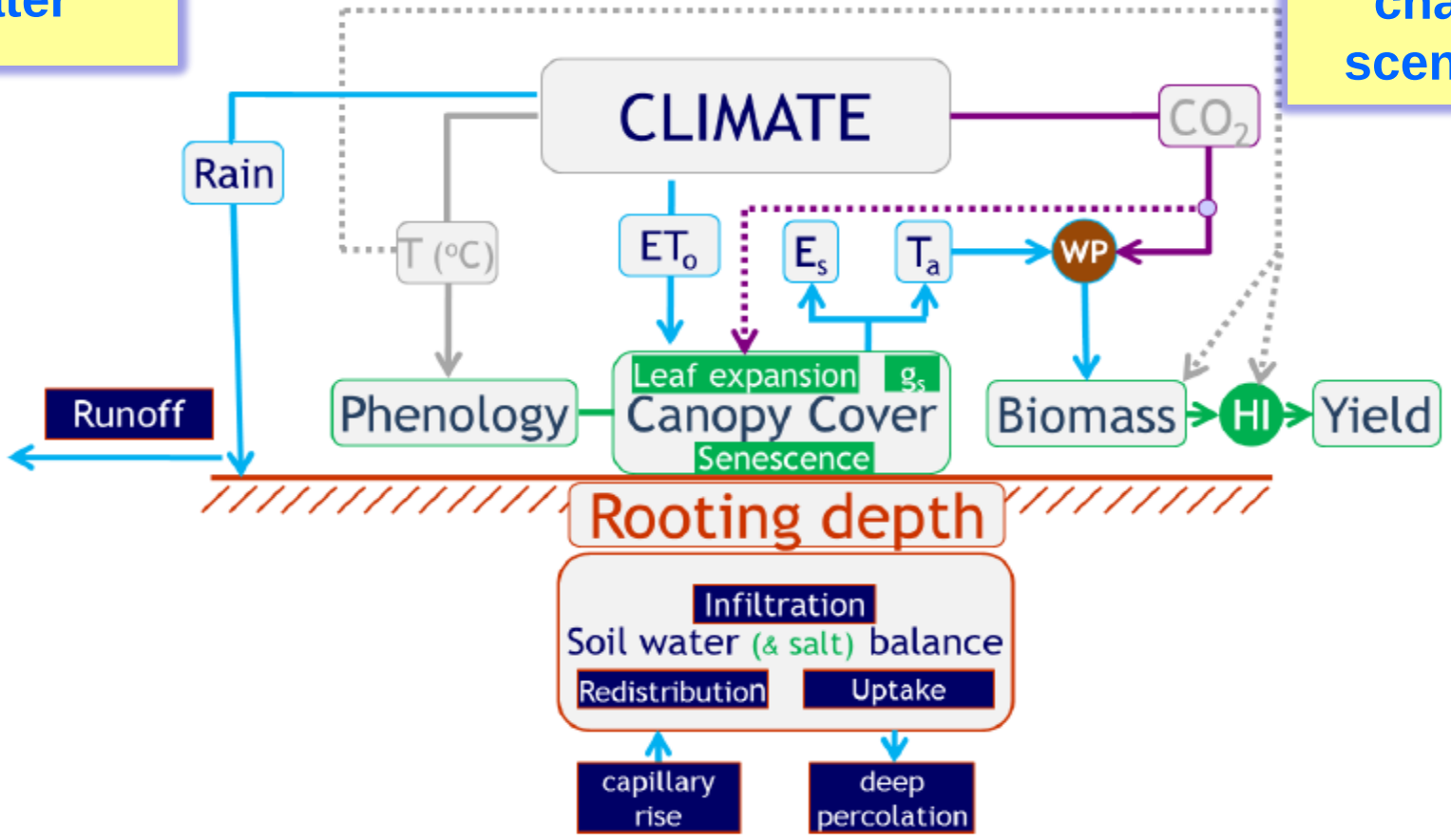
1. Egypt: North Delta
   *Irrigated agriculture zone
2. Jordan: Karak Governorate
   *Rainfed agriculture
3. Lebanon: Orontes watershed
   *Mixed agriculture

From Mr. Ihab Jnad, ACSAD, Green Sectors Studies Workshop (Beirut, 19 March 2016)

AquaCrop model

AquaCrop model simulate yield **response to water**

AquaCrop predict yield under **climate change scenarios**

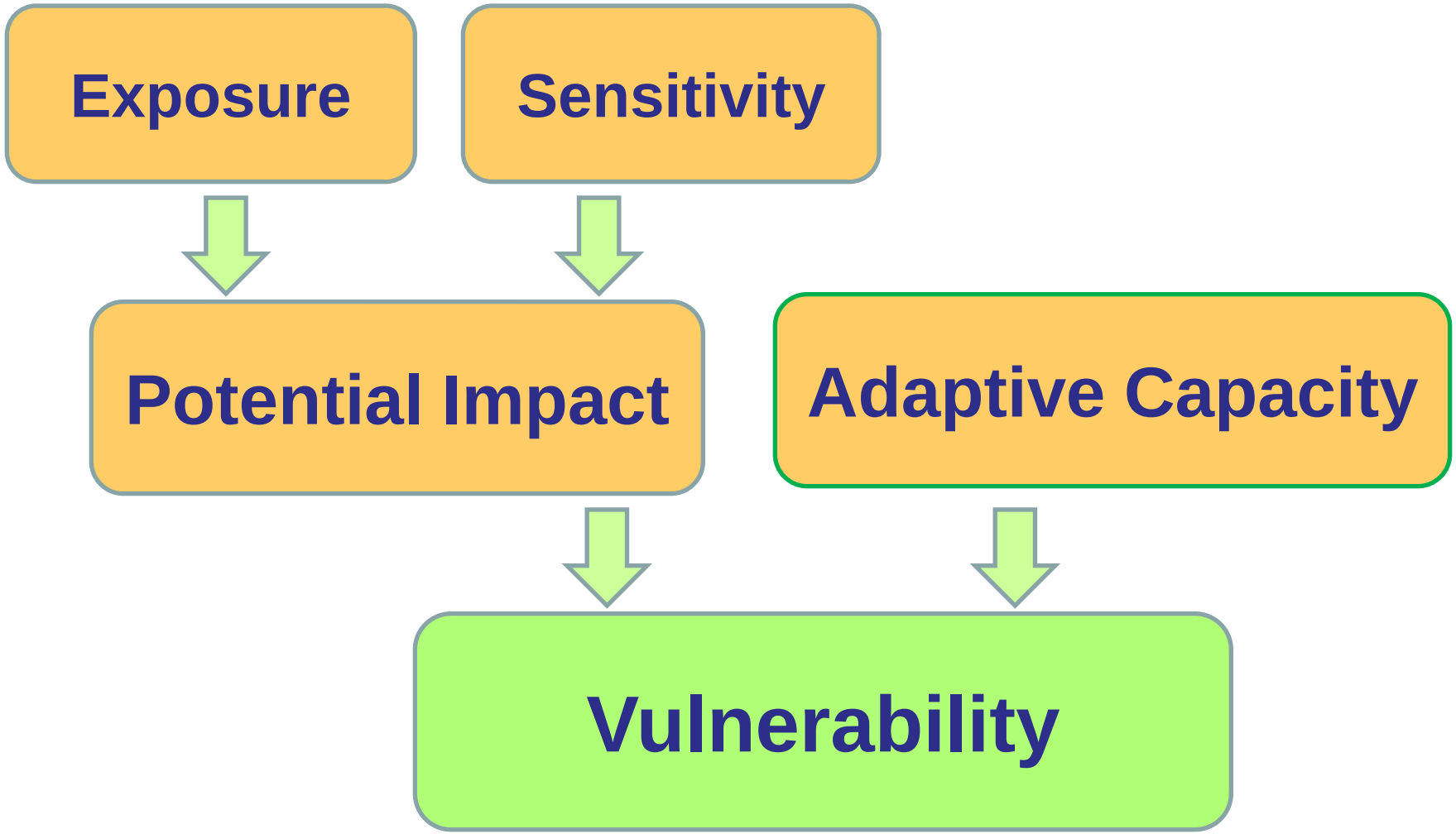


Developed by FAO

Dirk RAES, Pasquale STEDUTO, Theodore C. HSIAO, and Elias FERERES

From Mr. Ihab Jnad, ACSAD, Green Sectors Studies Workshop (Beirut, 19 March 2016)

Vulnerability Assessment Framework



IPCC AR4 approach to vulnerability assessment

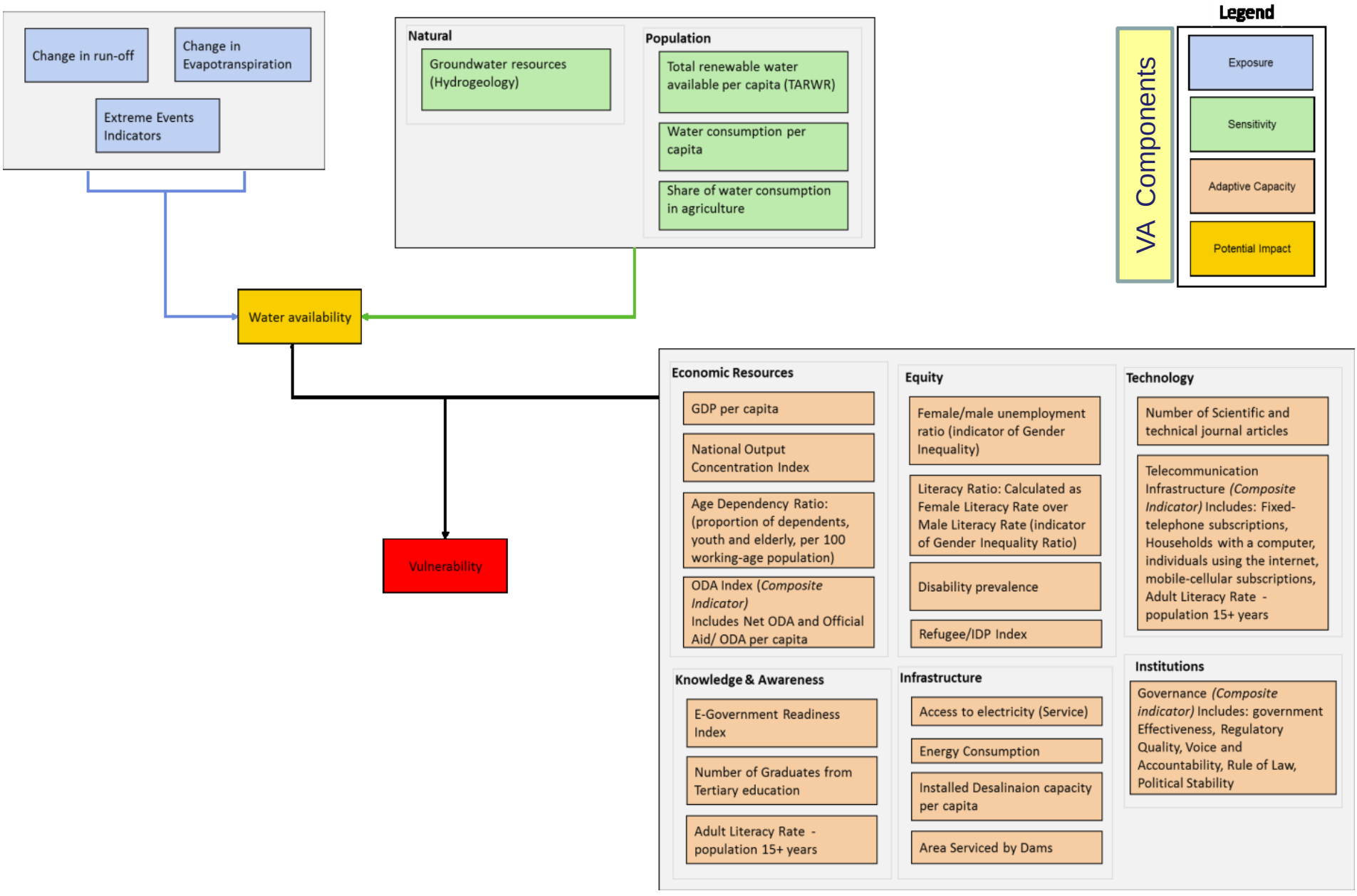
RICCAR VA Sectors

Work supported by GIZ/ACCWaM Contribution to RICCAR, with ACSAD & ESCWA

	Impacts	Sub-Vulnerability
 Water	Change in water availability	V0
 Biodiversity & Ecosystems	Change in area covered by forests	V1
	Change in area of wetlands	V2
 Agriculture	Change of water available for crops	V3
	Change of rangeland for livestock	V4
 Infrastructure & Human Settlements	Damage from inland flooding	V5
	(Damage from coastal flooding)	(V6)
 People	Change of water available for drinking	V7
	Change in health due to heat stress	V8
	Change of employment rate in the agricultural sector	V9

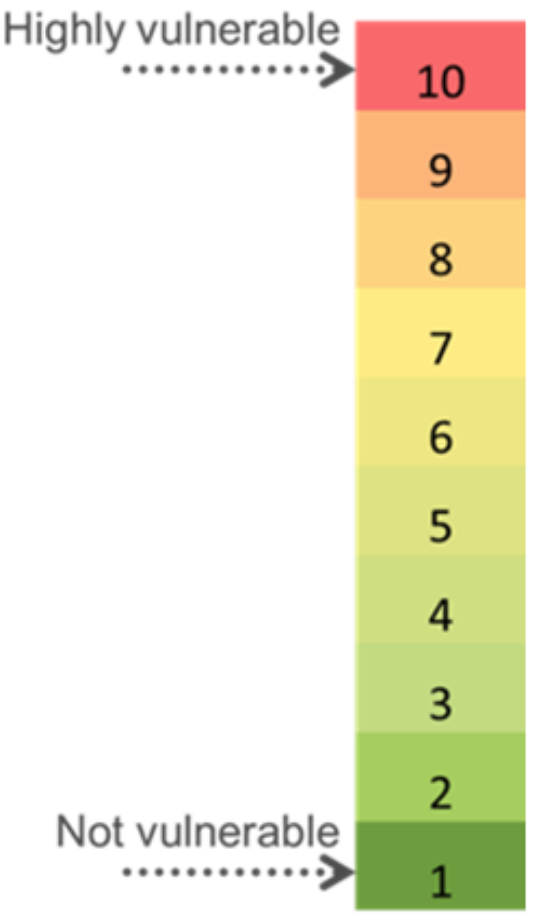
Based on: VA Training Manual

Sample VA Impact Chain for Water Availability

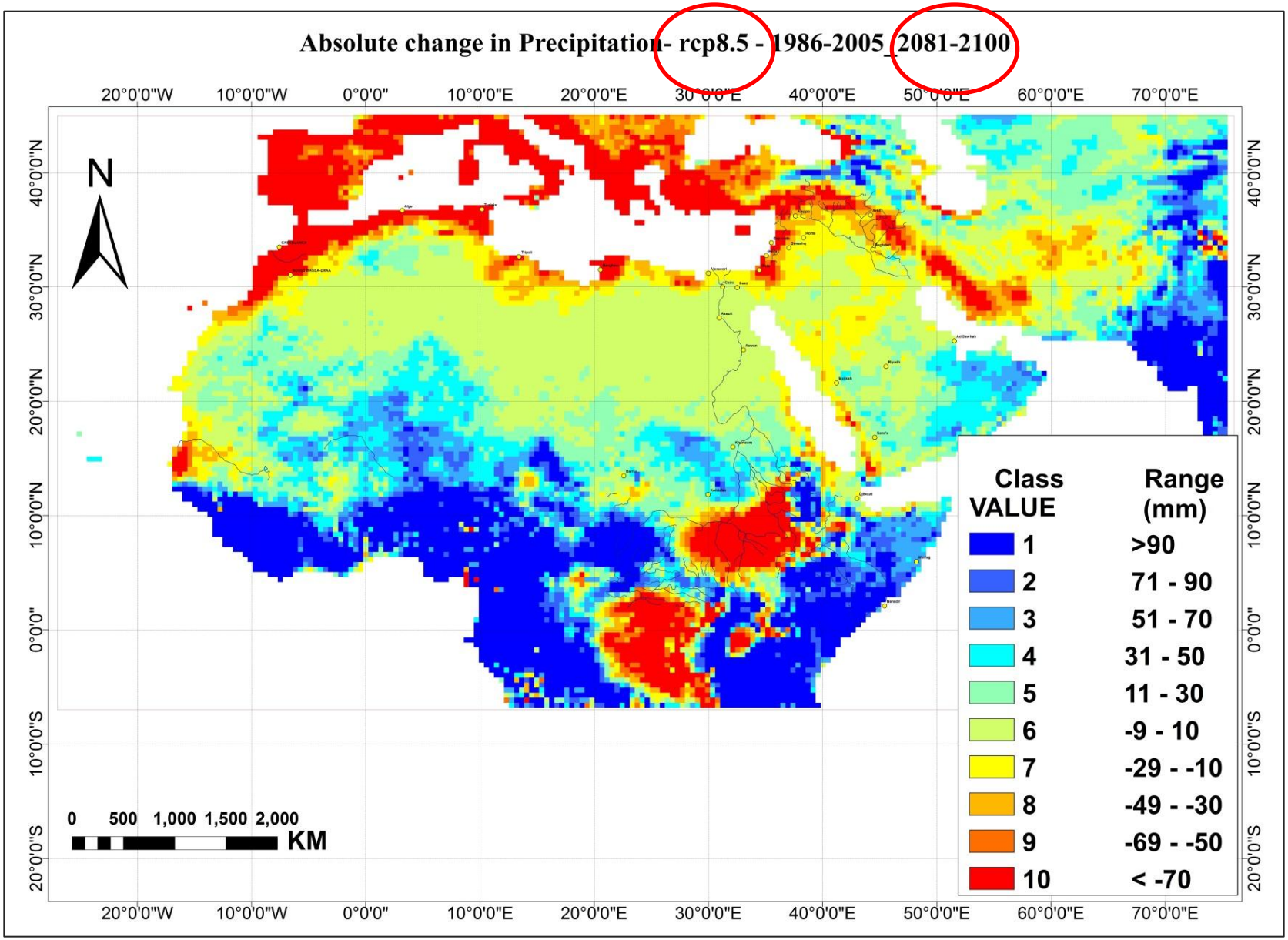


Normalisation and Evaluation of Data for GIS aggregation and visualization

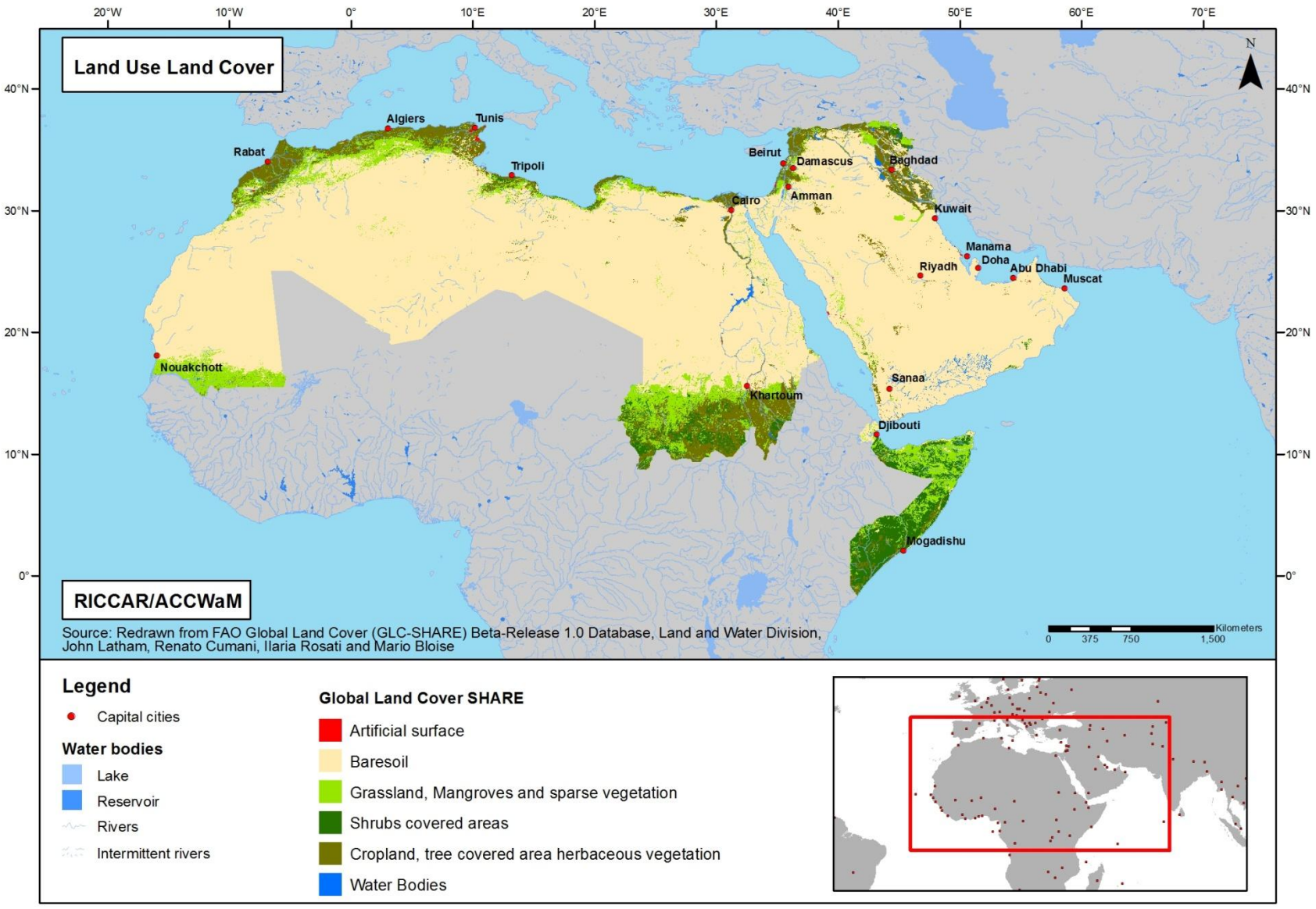
- In order to aggregate these datasets into the course of the vulnerability assessment, the data first need to be transformed into a unit-less score on a common scale. This process is called **normalisation**



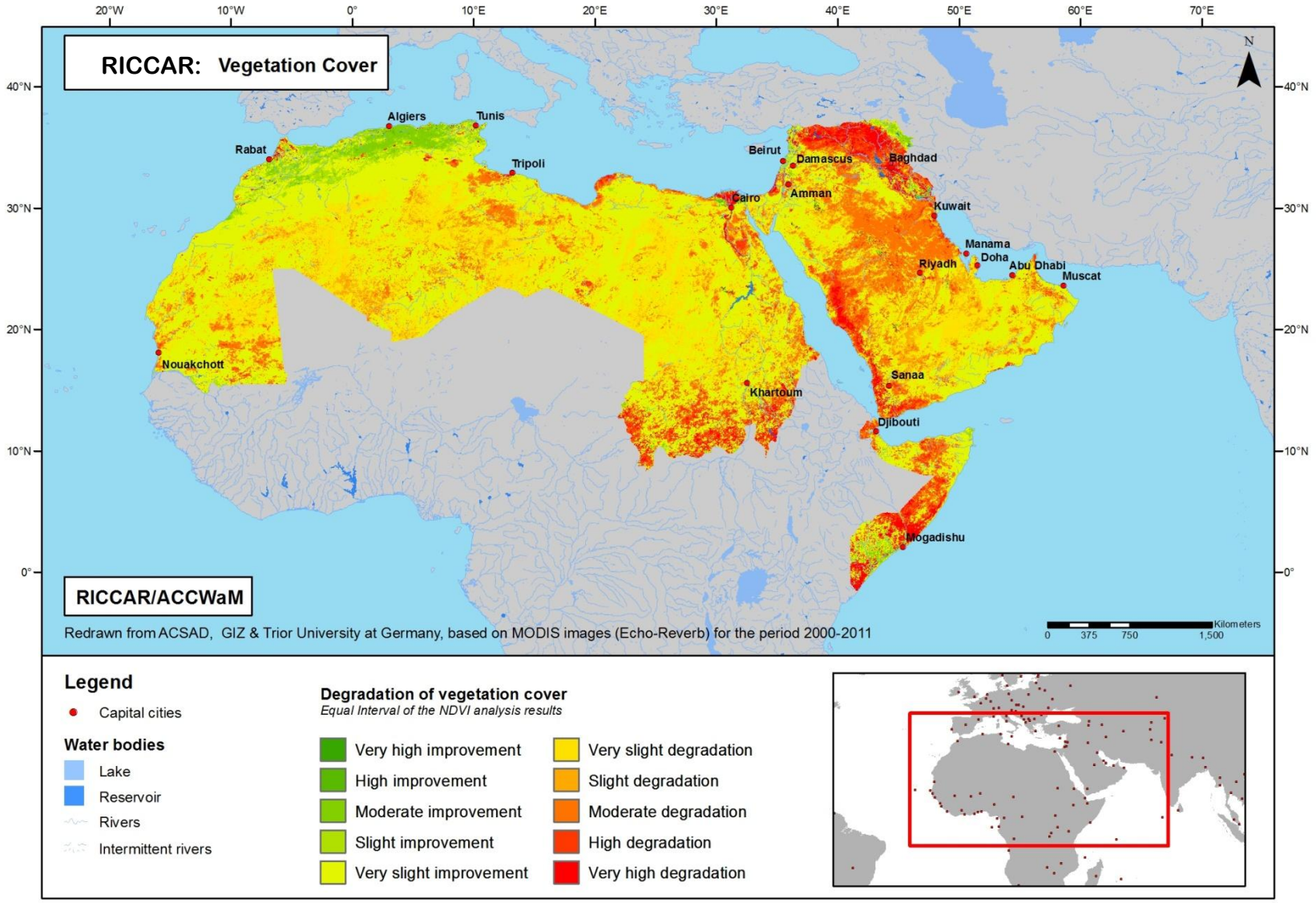
Change in Precipitation: Normalized Map



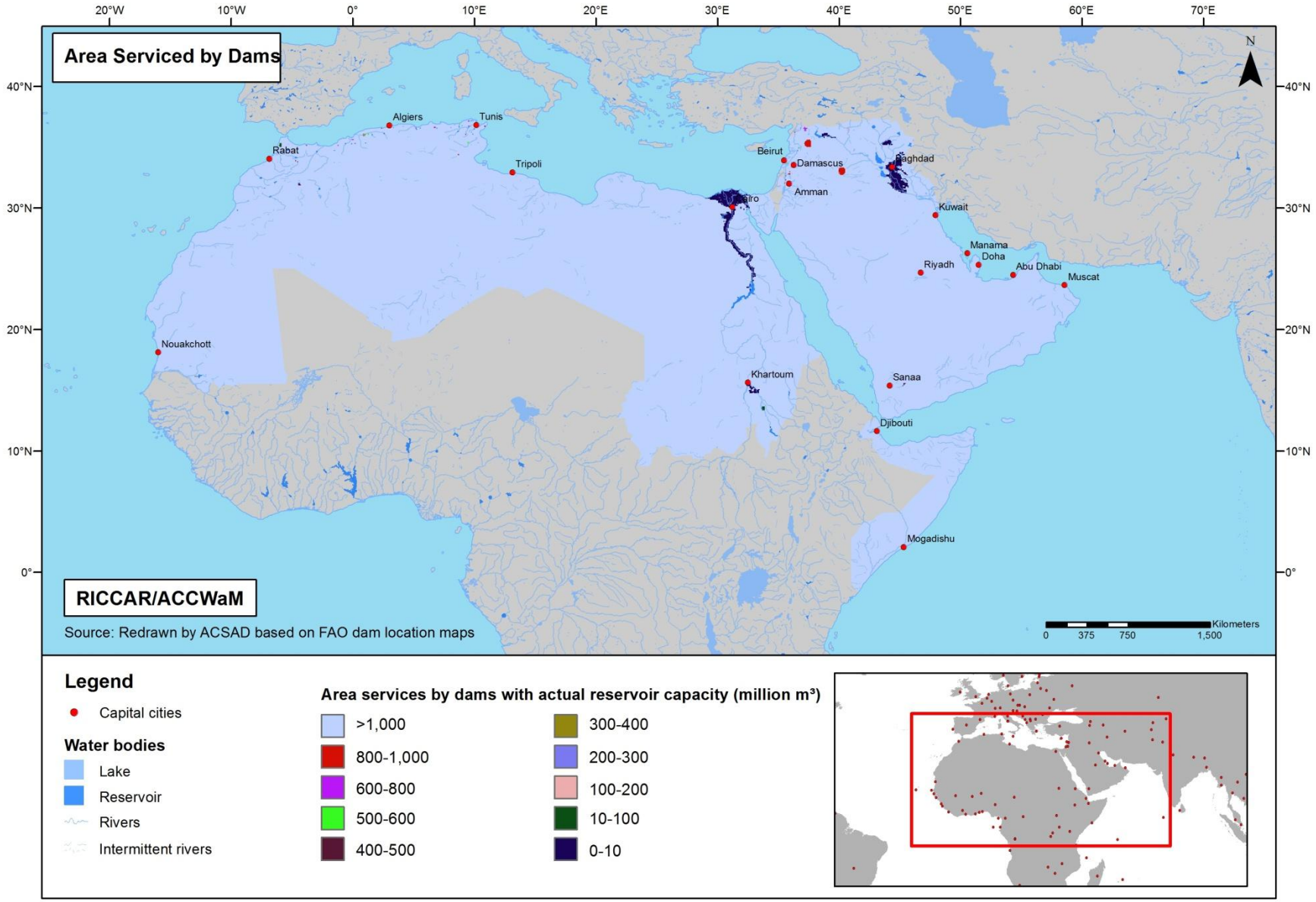
Land Use and Land Cover



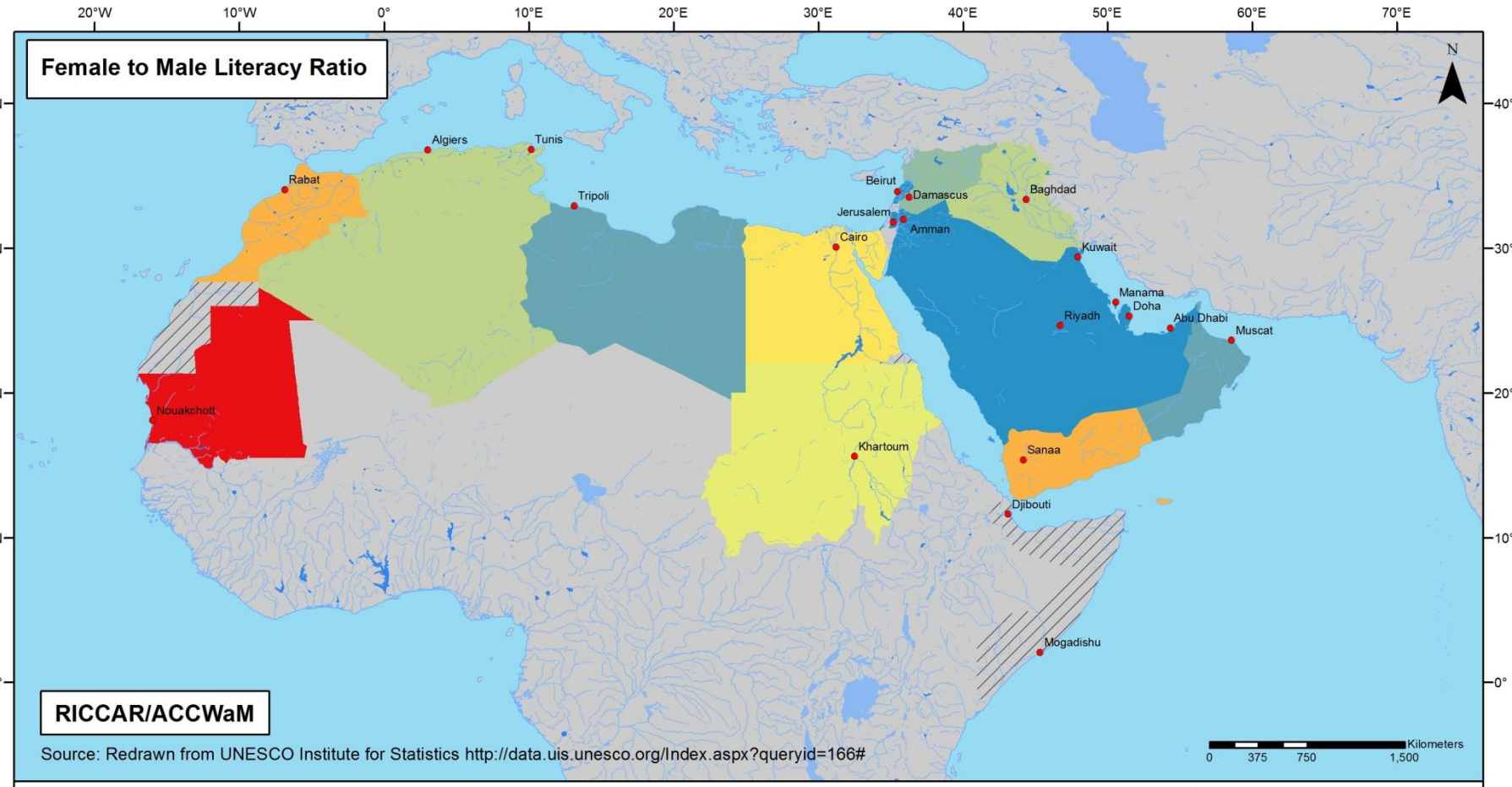
Change in Vegetation Cover (2000-2011)



Areas serviced by Dams



Prepared by ACSAD



Legend

- Capital cities

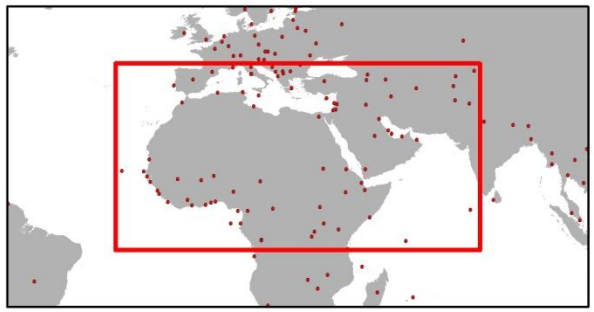
Water bodies

- Lake
- Reservoir
- Rivers
- Intermittent rivers
- No Data

Female/Male Adult literacy ratio (% of population 15+ years)

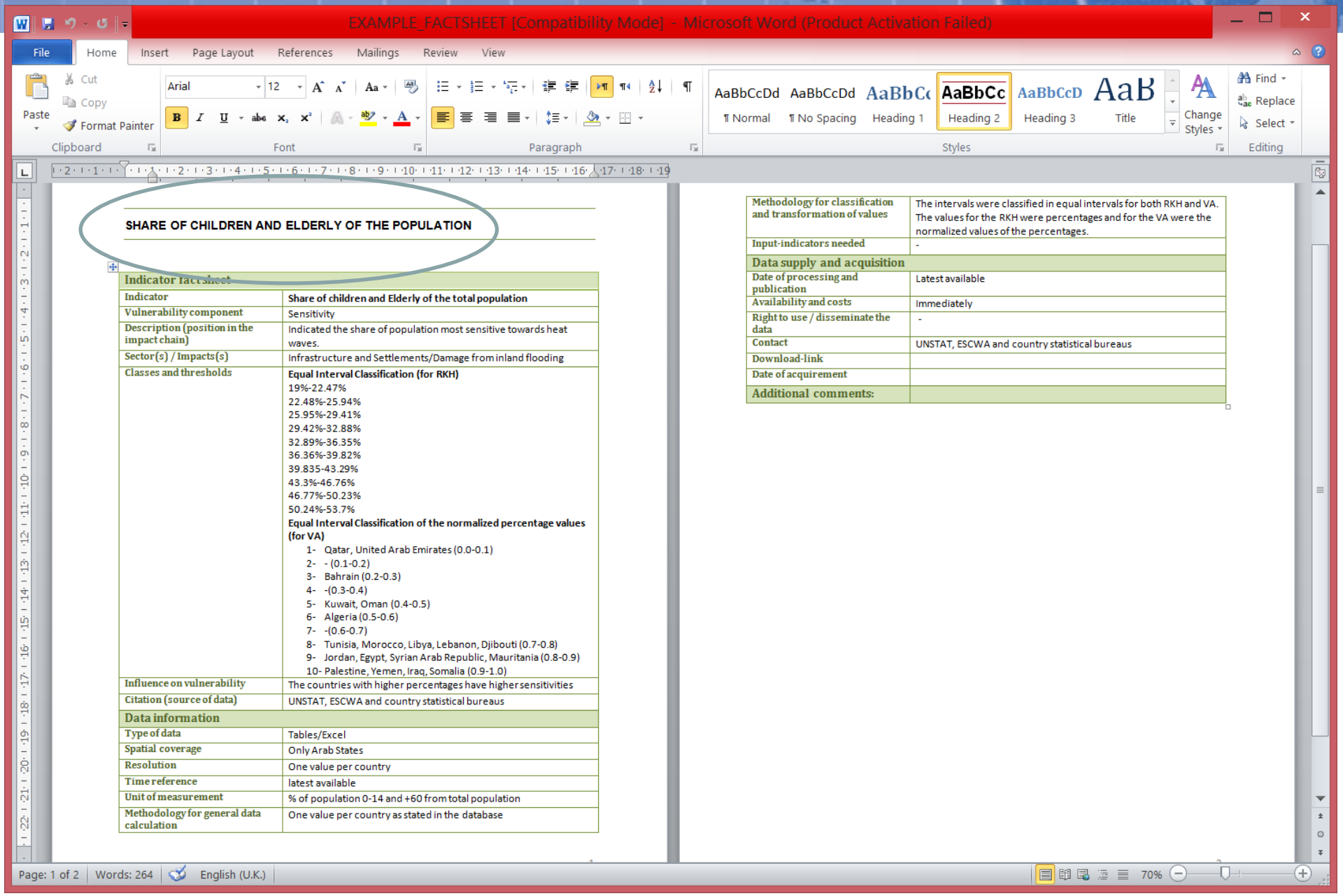
Ratio; Female Adult literacy ratio, population 15+ years (%); Male Adult literacy ratio, population 15+ years (%)

52.10 - 56.62	74.71 - 79.22
56.63 - 61.14	79.23 - 83.74
61.15 - 65.66	83.75 - 88.26
65.67 - 70.18	88.27 - 92.78
70.19 - 74.70	92.79 - 97.30



Prepared by ESCWA

VA Indicator Fact Sheets



SHARE OF CHILDREN AND ELDERLY OF THE POPULATION

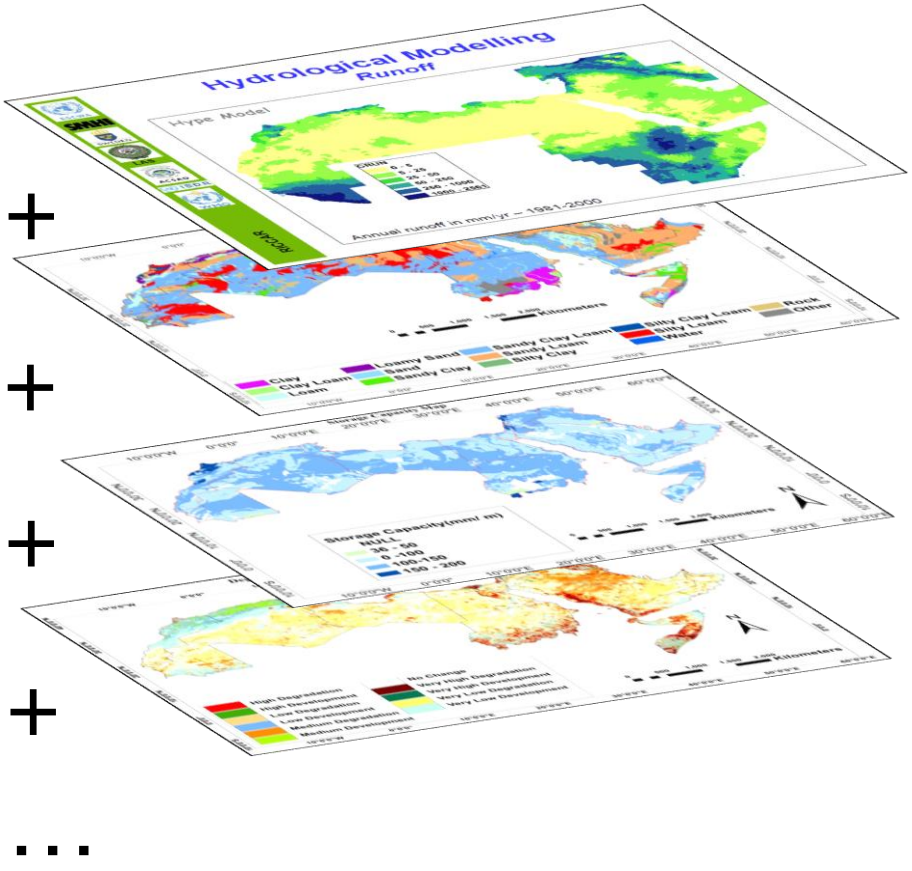
Indicator fact sheet	
Indicator	**Share of children and Elderly of the total population**
Vulnerability component	Sensitivity
Description (position in the impact chain)	Indicated the share of population most sensitive towards heat waves.
Sector(s) / Impacts(s)	Infrastructure and Settlements/Damage from inland flooding
Classes and thresholds	**Equal Interval Classification (for RKH)** 19%-22.47% 22.48%-25.94% 25.95%-29.41% 29.42%-32.88% 32.89%-36.35% 36.36%-39.82% 39.835-43.29% 43.3%-46.76% 46.77%-50.23% 50.24%-53.7% **Equal Interval Classification of the normalized percentage values (for VA)** 1- Qatar, United Arab Emirates (0.0-0.1) 2- - (0.1-0.2) 3- Bahrain (0.2-0.3) 4- -(0.3-0.4) 5- Kuwait, Oman (0.4-0.5) 6- Algeria (0.5-0.6) 7- -(0.6-0.7) 8- Tunisia, Morocco, Libya, Lebanon, Djibouti (0.7-0.8) 9- Jordan, Egypt, Syrian Arab Republic, Mauritania (0.8-0.9) 10- Palestine, Yemen, Iraq, Somalia (0.9-1.0)
Influence on vulnerability	The countries with higher percentages have higher sensitivities
Citation (source of data)	UNSTAT, ESCWA and country statistical bureaus
Data information	
Type of data	Tables/Excel
Spatial coverage	Only Arab States
Resolution	One value per country
Time reference	latest available
Unit of measurement	% of population 0-14 and +60 from total population
Methodology for general data calculation	One value per country as stated in the database
Methodology for classification and transformation of values	The intervals were classified in equal intervals for both RKH and VA. The values for the RKH were percentages and for the VA were the normalized values of the percentages.
Input-indicators needed	-
Data supply and acquisition	
Date of processing and publication	Latest available
Availability and costs	Immediately
Right to use / disseminate the data	-
Contact	UNSTAT, ESCWA and country statistical bureaus
Download-link	
Date of acquirement	
Additional comments:	

Vulnerability Assessment Outputs

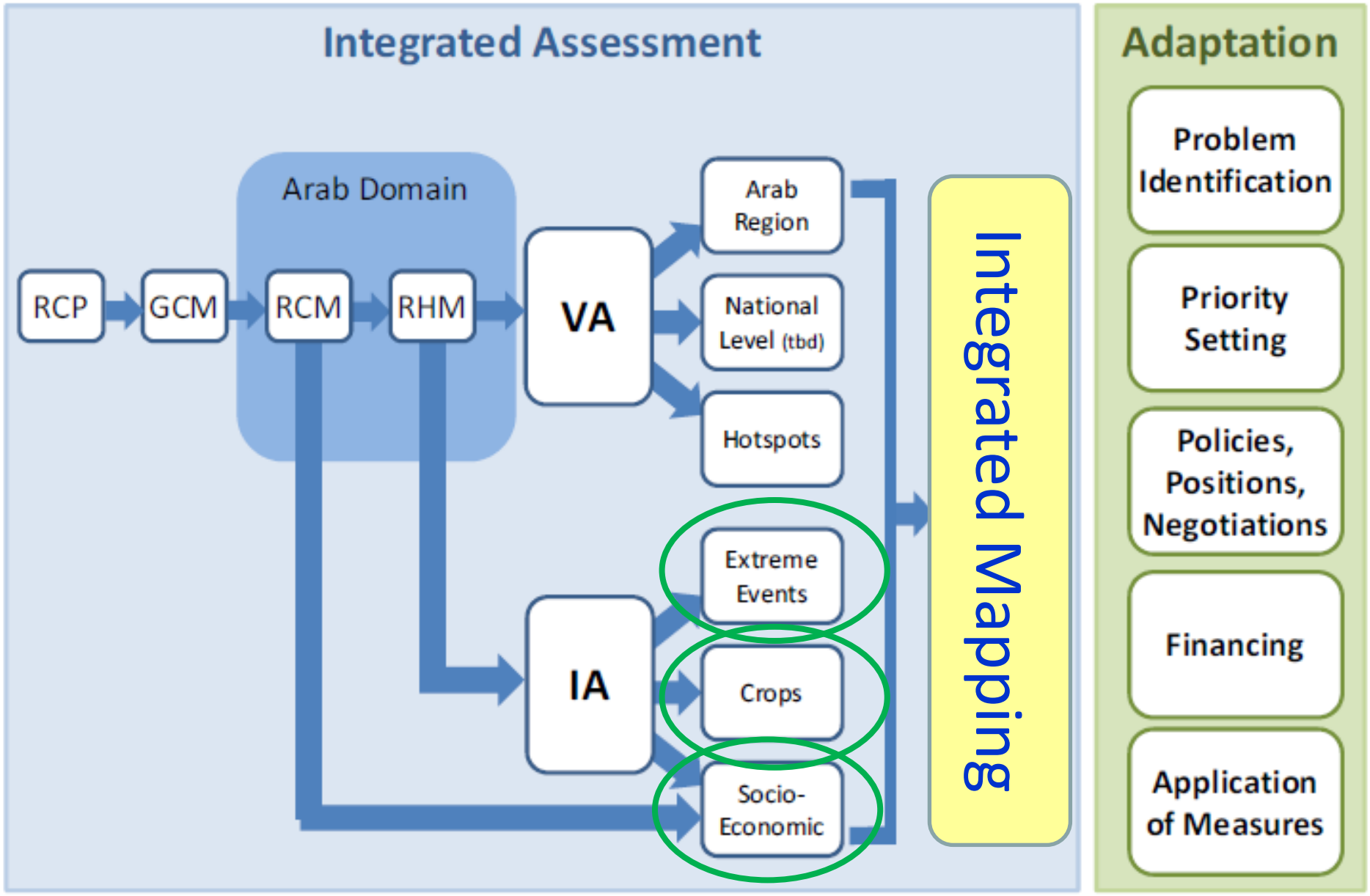
Preparation of a Vulnerability Index:

- **Per Sector**
  - Contains all indicators identified to assess a given sectors
  - Attribution of weights for each indicator dependent on impact chains and expert judgment
  - As sector level, aggregated by component: Exposure, Sensitivity, Adaptive Capacity

- **Overall Vulnerability**
  - Aggregates vulnerability of each sector to generate an Overall VA
  - Supports identification of VA Hotspots



Slide graphics: adelphi
Source of maps: ACSAD, SMHI

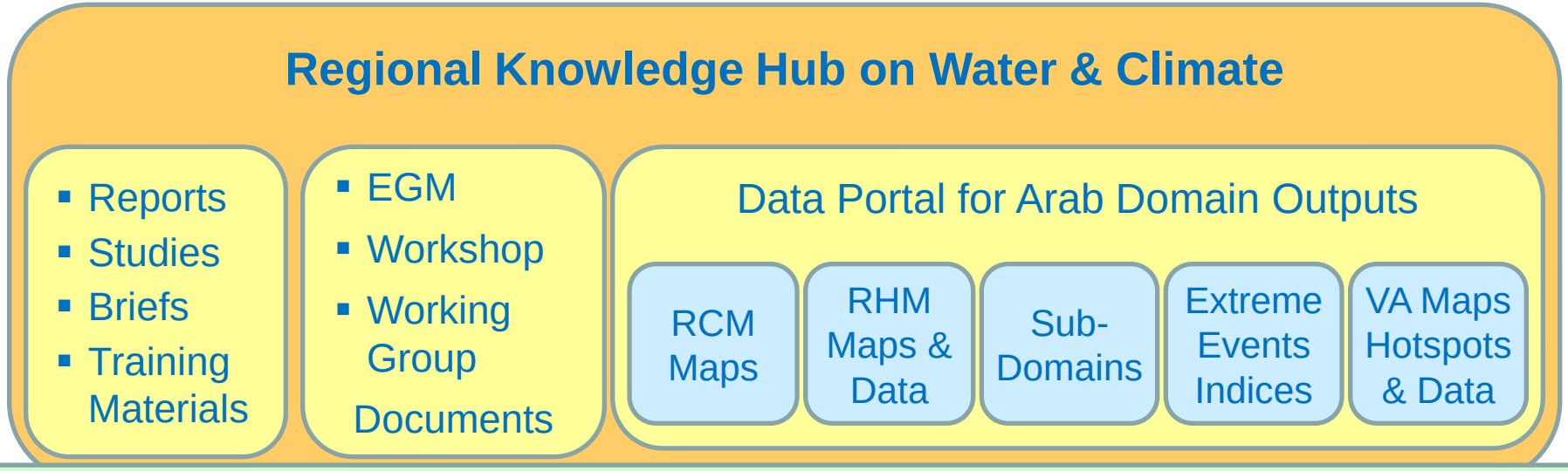


RCP: Representative Concentration Pathway; **GCM:** Global Climate Model; **RCM:** Regional Climate Model; **RHM:** Regional Hydrological Model; **VA:** Vulnerability Assessment; **IA:** Impact Assessment; **IM:** Integrated Mapping

Regional Knowledge Hub

Governance

- ACSAD-ESCWA Coordinating Secretariat (Doha,2014)
- FAO identified to provide IT Platform via FENIX
- ➢ RKH Consultative Meeting: ESCWA, ACSAD, FAO, GIZ (Beirut, 19-20 April 2015); Contracting planned in 2016



Additional Technical & Training Materials to be provided from ACCWaM & UNDA Climate Change Adaptation using IWRM Tools Capacity Building Project, which draw on RICCAR Outputs

RICCAR Regional Knowledge Hub

Arab Ministerial Water Council (AMWC)

Regional Knowledge Hub

RKH Advisors

ACSAD-ESCWA Coordinating Secretariat

FAO/FENIX IT Platform

Regional Knowledge Hub Network

- Sub-Regional Nodes
- Thematic Nodes
- Water & Climate Node

Arab Climate Outlook Forum

under preparation

Purpose

- Regular **seasonal forecast** products for the Arab region.
- Regional assessments of **climate extremes** based on national inputs.
- Climate/climate change **monitoring and assessment**
- Regional assessment of **climate change scenarios** and their implications.
- Improved and accurate **climate data** and enhanced monitoring capacity.
- Provision of regional climate information to help responding to **user needs** (hydrology, agriculture, health, etc.).
- Regular **capacity development** efforts and promotion of common approaches for climate services by Arab countries
- Better user awareness and sustainable platform for **user interface**.

Governance

- **Approved** by Arab Permanent Committee for Meteorology (Jeddah, 25-30 March 2015)
- **UAE** offered to host ArabCOF, with budgetary review currently underway with LAS Technical Secretariat and ESCWA.

Capacity Building & Institutional Strengthening

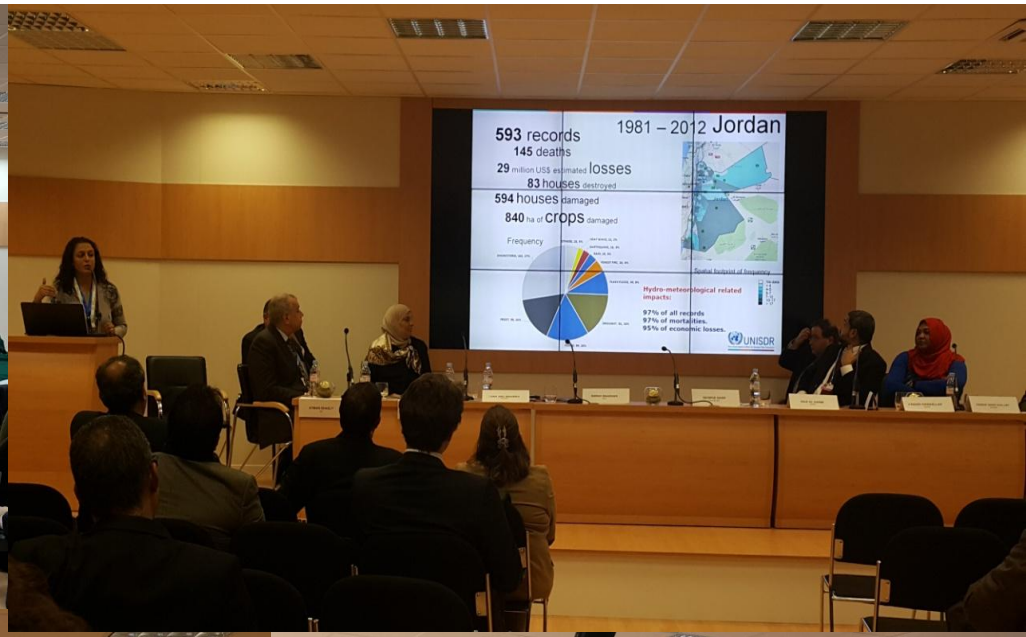
Workshops

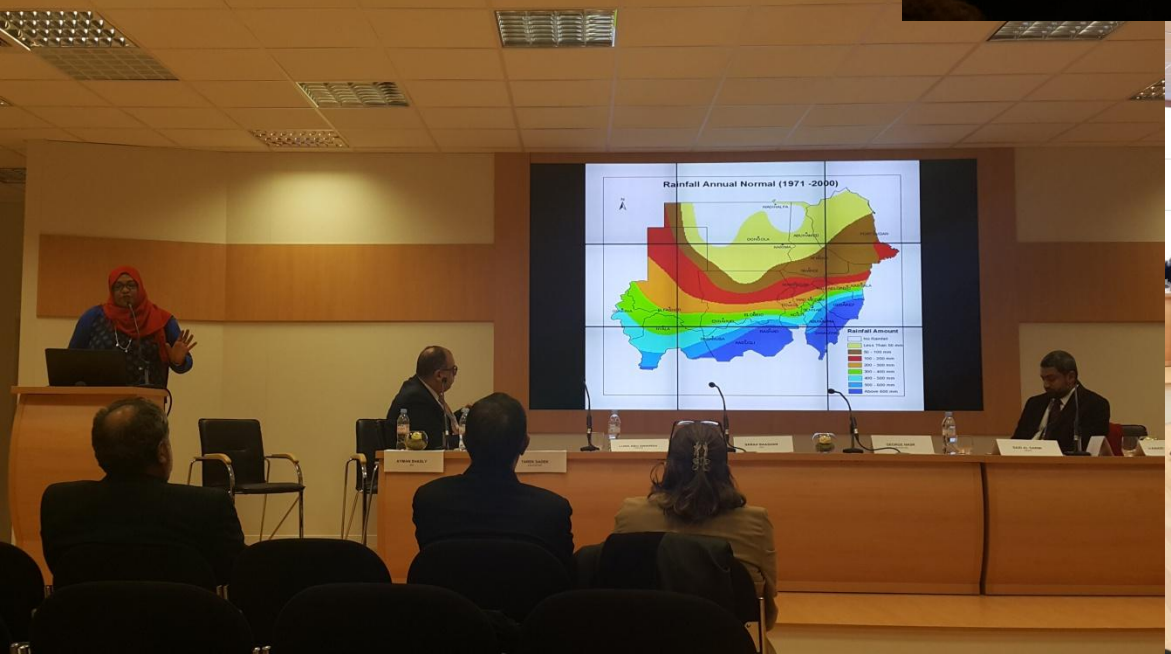
Projection/ Prediction and **Extreme Events Indices**	Arab Met Offices	March 2012 Casablanca
Applications & Analysis of **Regional Climate Models**	Water Ministries	July 2012 Beirut
National Workshops for **Disaster Losses Inventories** (Tunisia, Morocco, Yemen, Jordan, Palestine)	Inter-ministerial	September 2012-April 2014
Climate Data Rescue Sub-regional Workshop (Palestine, Jordan, KSA, Yemen)	Met Services	June 2013 Amman
Linking Regional Climate Models to **Hydrological Models**	Arab Water Ministries`	June 2013 Beirut
Technical Workshop on the **Vulnerability Assessment** Methodology Application	Research Centers	May 2014 Beirut
Scoping Meeting for Establishing an **Arab Climate Outlook Forum (ArabCOF)**	Met Services	Oct 2014, Amman
Moving from Impact Assessment to Socio-Economic Vulnerability Assessment	Water & Agriculture Ministries	June 2015 Beirut

Expert Group Meetings

EGM 1: Launching	Water, Environ	2009 Beirut
EGM 2: Arab Domain	Water Environ	2010 Beirut
EGM 3: RCMs	Water Environ	2011 Beirut
EGM 4: Climate Ensemble & Working Groups	Water Ministries Environ Agencies	2012 Beirut
EGM 5: Preliminary RCM Findings for Arab Domain & VA Methodology	Water Ministries	2013 Amman
EGM 6: Review of RCM & RHM Findings & VA Sectors	Water, Ag & Envion Ministries	2014 Cairo
EGM Peer Reviews	*Experts, Gov't*	*2016*

COP-21 RICCAR Side Event at GCC Pavillion





Arab Climate Change Assessment Report

I. Introduction

II. Data, Databases and Baseline Information

III. Regional Climate Modelling Findings for Arab Region

IV. Hydrological Findings for Major Shared Basins

- A. Nile Basin
- B. Tigris and Euphrates Rivers
- C. Medjerda River Basin
- D. Jordan River Basin
- E. Senegal River Basin

V. Extreme Events Case Studies

- A. Wadi Diqah (Oman)
- B. Medjerda (Tunisia/Algeria)
- C. Nahr Al-Kabir (Lebanon/Syria)

VI. Impact Assessment Studies

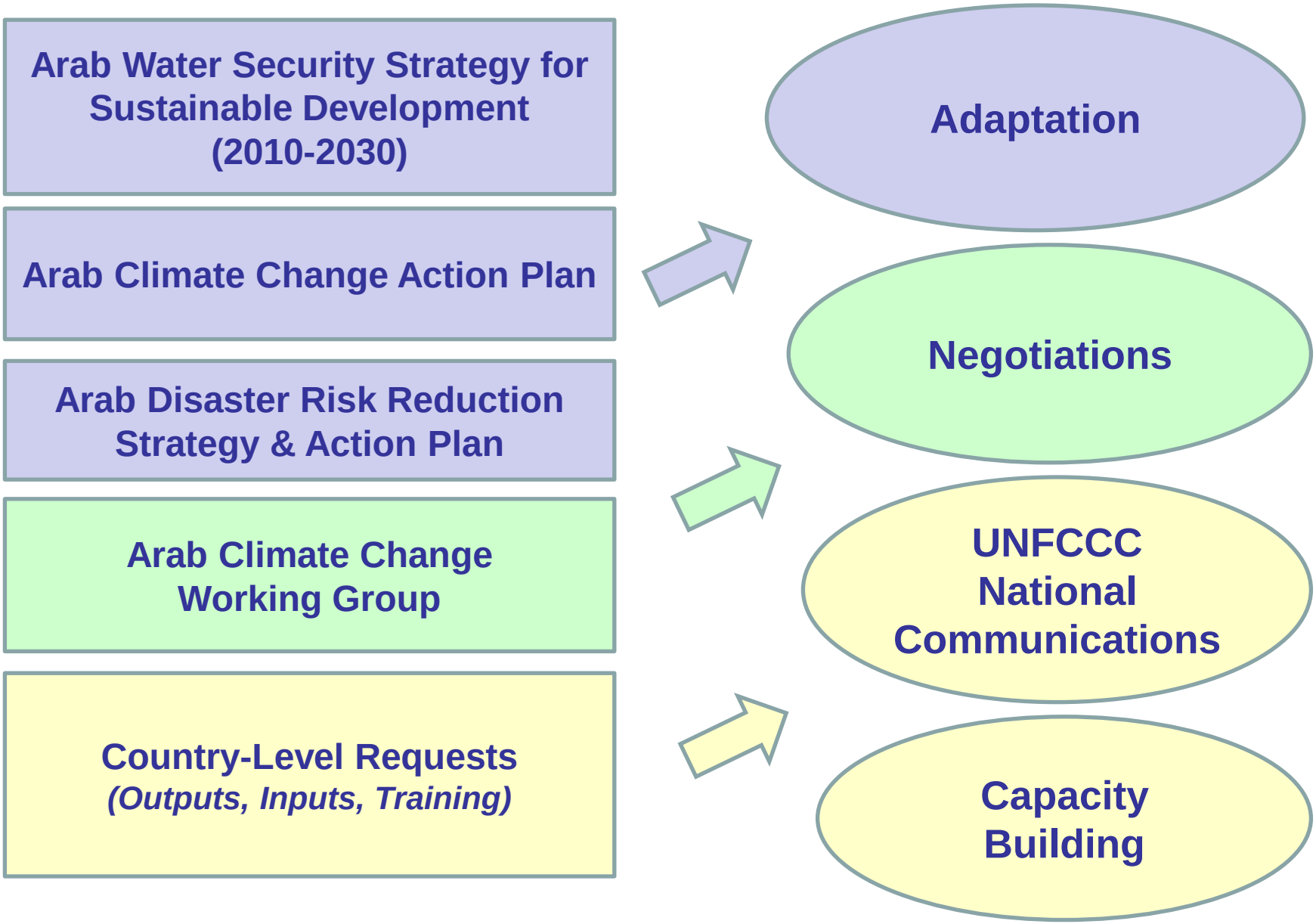
- A. Agriculture (rainfed, irriated, mixed)
- B. Human Health

VII. Vulnerability Assessment

- A. Water
- B. Agriculture
- C. Biodiversity & Ecosystems
- D. Infrastructure & Human Settlements
- E. People

VIII. Conclusion

RICCAR Assessment Outputs for informing Action



Thank you!

Implementing Partners

www.escwa.un.org/RICCAR

ESCWA

UNEP

WMO

ACSAD

LAS

SMHI

United Nations Educational, Scientific and Cultural Organization

Cairo Office

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

UNISDR
The United Nations Office for Disaster Risk Reduction

UNITED NATIONS UNIVERSITY
UNU-INWEH

FAO

Donors

SWEDEN
SWEDISH INTERNATIONAL DEVELOPMENT COOPERATION AGENCY

german cooperation
DEUTSCHE ZUSAMMENARBEIT

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*