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

Overview of RICCAR and the integrated assessment methodological framework

Climate Watch workshop for Arab countries in West Asia, 27-29 May 2013
Amman, Jordan

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

The Regional Initiative aims to provide a ***common platform*** *for addressing and responding 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 adaptation at the regional level.***

RICCAR UN-LAS Regional Mandates

Mandates

- **Arab Ministerial Declaration on Climate Change (Dec 2007)** - adopted by the LAS Council of Arab Ministers Responsible for the Environment (CAMRE).
- **ESCWA 25th Ministerial Session Resolution on Climate Change (May 2008)** - called for the preparation of an assessment of socio-economic vulnerability caused by climate change impacts on water resources (Sana'a).
- **Arab Summit for Economic and Social Development (Jan 2009)** - accepted the preparation of project to assess impacts of climate change on water.
- **Arab Ministerial Water Council (AMWC) (July 2010)** - approved the IWRM project brief submitted by LAS & ACSAD called "Assessment of Climate Change Impacts on Available Water Resources in the Arab Region" based on UN-LAS Regional Initiative concept note prepared by ESCWA to support Arab Water Security Strategy.

UN-LAS Coordination Mechanisms for RICCAR

Coordination Mechanisms

- **UN-LAS 9th Sectoral Meeting focused on Climate Change (June 2009) -** called for UN-LAS joint action on vulnerability studies to assess climate change impacts on water, land, drought, desertification, biodiversity, health and agriculture.
- **Regional Initiative Core Group (Oct 2009)** – UN-LAS core partners established group following 1st expert group meeting (Oct 2009); Annual EGMs.
- **Regional Coordination Mechanism/ Thematic Working Group on Climate Change (Nov 2010) -** Initiative adopted & reported on as a joint UN-LAS inter-agency initiative by UNEP.
- **AMWC: Ministerial Council, Executive Bureau, and Technical Scientific & Advisory Committee (June 2011, Jan 2012, June 2012, Jan 2013)** – Receives updates on RICCAR by ACSAD+ESCWA.
- **Permanent Committee for Meteorology & Climate and Climate Change Sub-Committee (January 2012, March 2012)** – Endorsement of RICCAR; follow-up via Permanent Representatives.

RICCAR
Expert Group Meetings (annual)

Vulnerability Assessment Working Group

Regional Knowledge Hub Working Group

Mapping Inter-Agency Support

Arab Permanent Sub-Committee for Meteorology

Arab Ministerial Water Council
Climate Change Impact on Water Resources Project

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

SIDA-Funded Project: Assessment of the Impact of Climate Change on Water Resources and Socio-Economic Vulnerability in the Arab Region
including
Data Rescue, RCM, RHM, Extreme Events & Regional Knowledge Hub
LAS, ESCWA, ACSAD, SMHI, WMO, UNISDR

UNU Info Hub

UNESCO RCM

UNEP CC Networks + National UNFCCC Support

GIZ Project: Adaptation to Climate Change in the Water Sector in the MENA Region
Including Vulnerability Tools & Knowledge Hub with LAS, ESCWA, ACSAD (adelphi)

Establishment of Regional Early Warning System

Preparation of National UNFCCC Communications & CC Strategies

Support to Met Offices

Implementation Framework – الهيكل التنفيذي للمشروع

حصر المعلومات الأساسية المتاحة وإدارتها
Baseline Review & Knowledge Management

Integrated Assessment(تقييم متكامل)

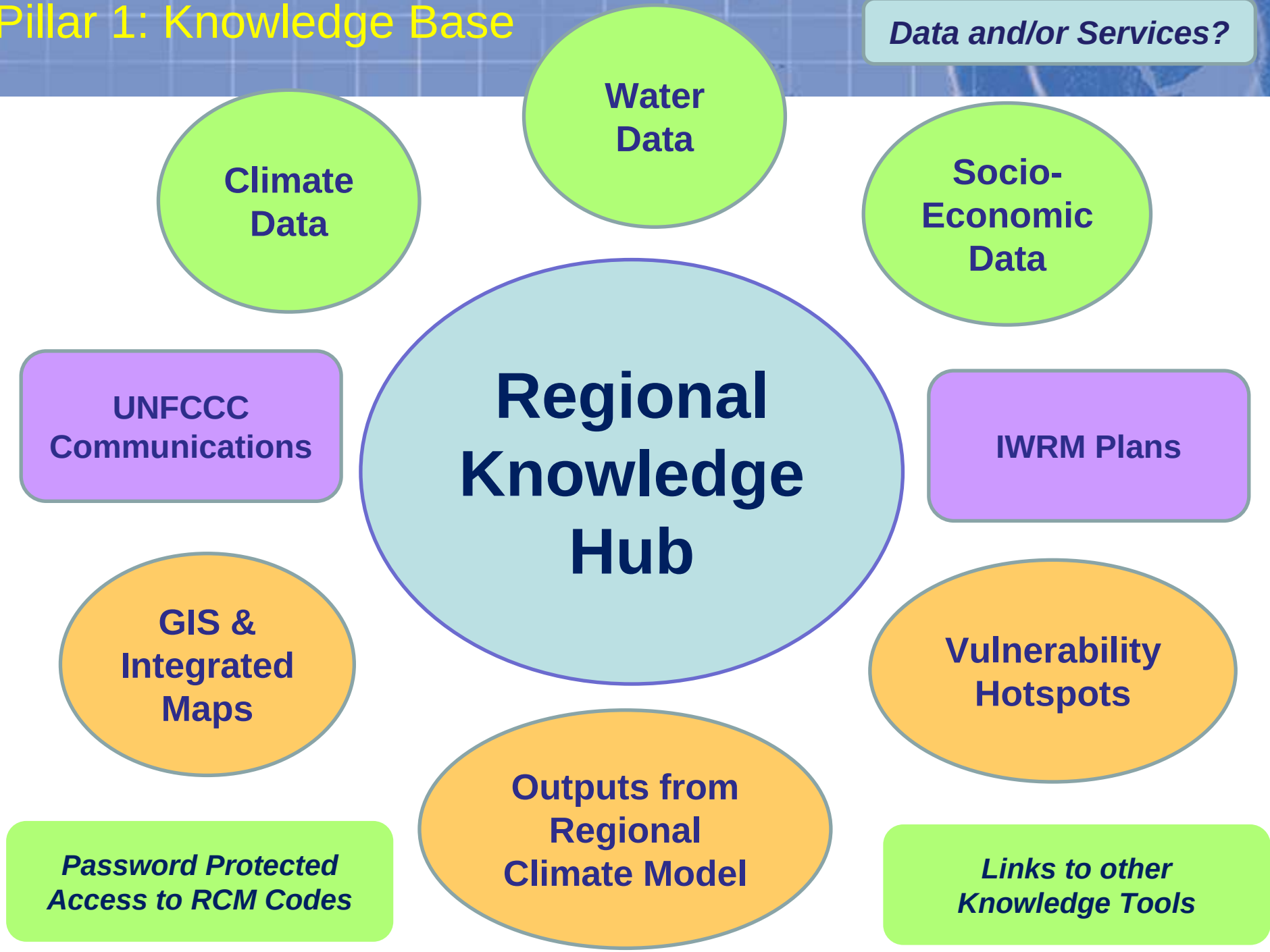
تقييم تأثير التغير المناخي
Climate Change Impact Assessment

تقييم قابلية التأثر من التغير المناخي
Climate Change Vulnerability Assessment

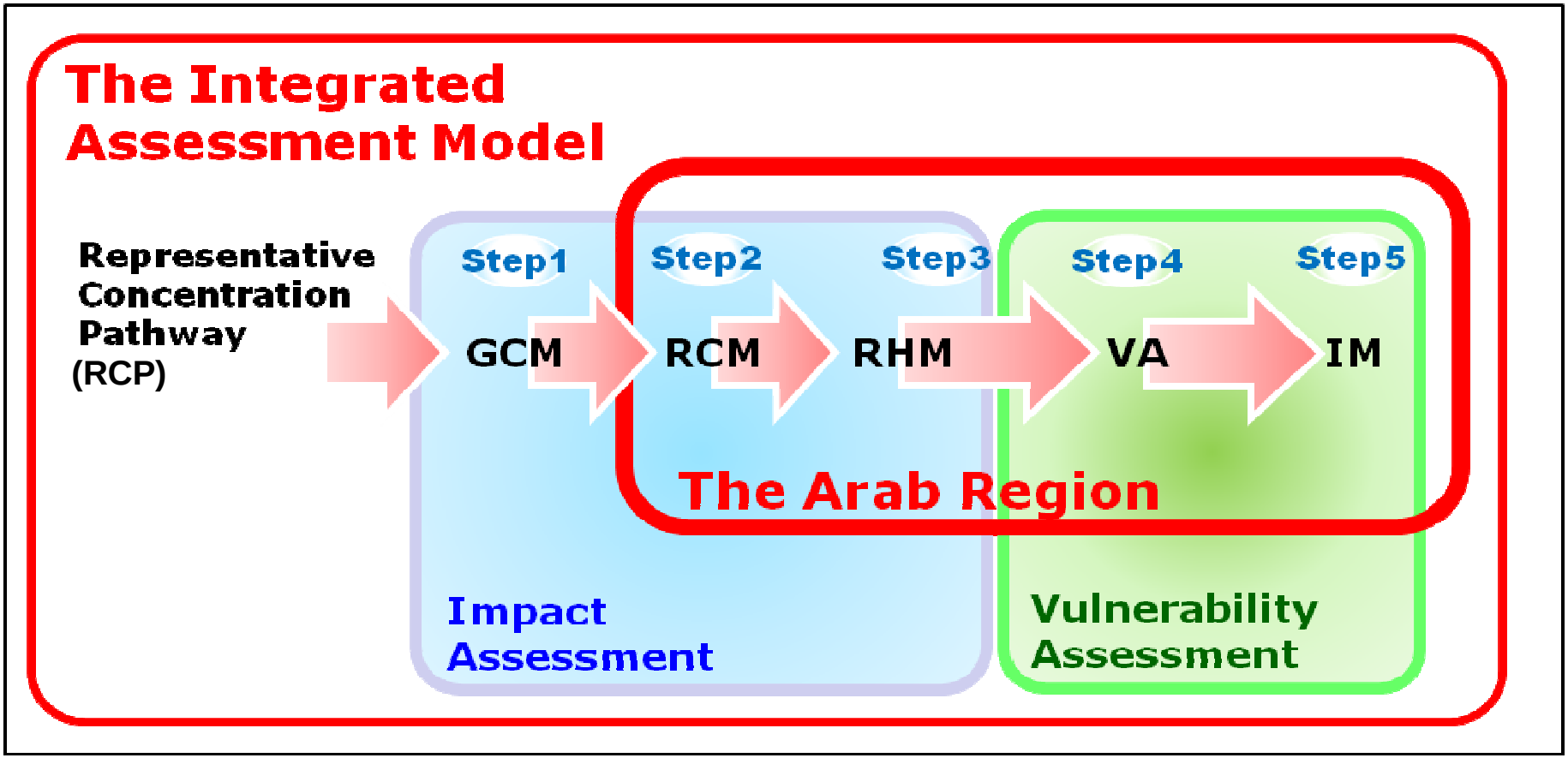
بناء القدرات
Capacity Building & Institutional Strengthening
***for Water Ministries, Meteorological Offices, Arab Research* Centers**

رفع الوعي
Awareness Raising & Information Dissemination

Pillar 1: Knowledge Base

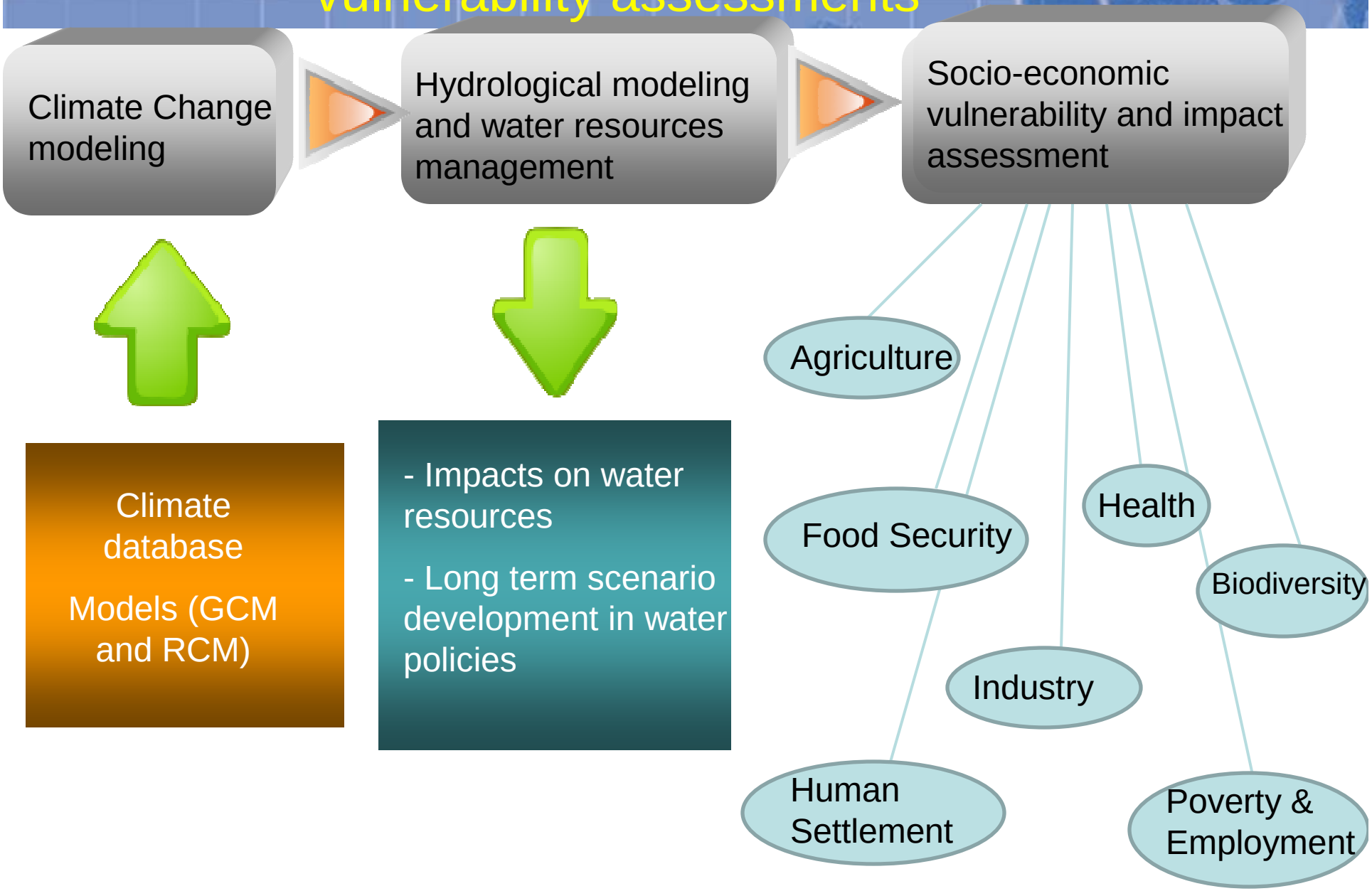


Pillar 2: Integrated Assessment
Methodological Framework



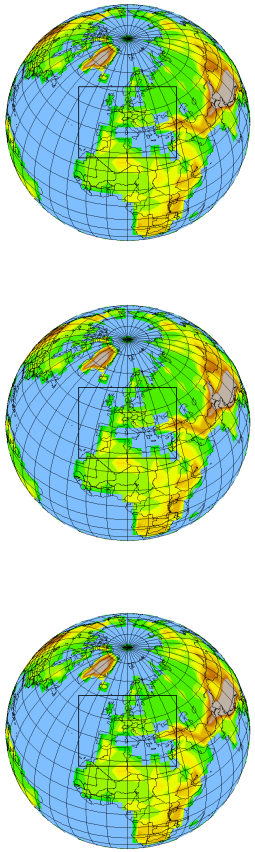
Step 1: Global Climate Modeling using General Circulation Model
Step 2: Regional Climate Modeling
Step 3: Regional Hydrological Modeling
Step 4: Vulnerability Assessment
Step 5: Integrated Mapping

Integrated model-based approach for impact and vulnerability assessments



Impact Assessment Component

Different GCMs



for the Same RCP

General Circulation Model GCM)

GCM

RCP

GCMs at 300 km x 300 km

Ensemble Average used to reduce uncertainty at level of RCMs & RHMs

Ensembles compare findings of different RCMs & RHMs applied for same RCP & Domain

Regional Climate Model (RCM)

50km x 50km

25km x 25km

Regional Hydrological Model (RHM)

Calibration

Calibration

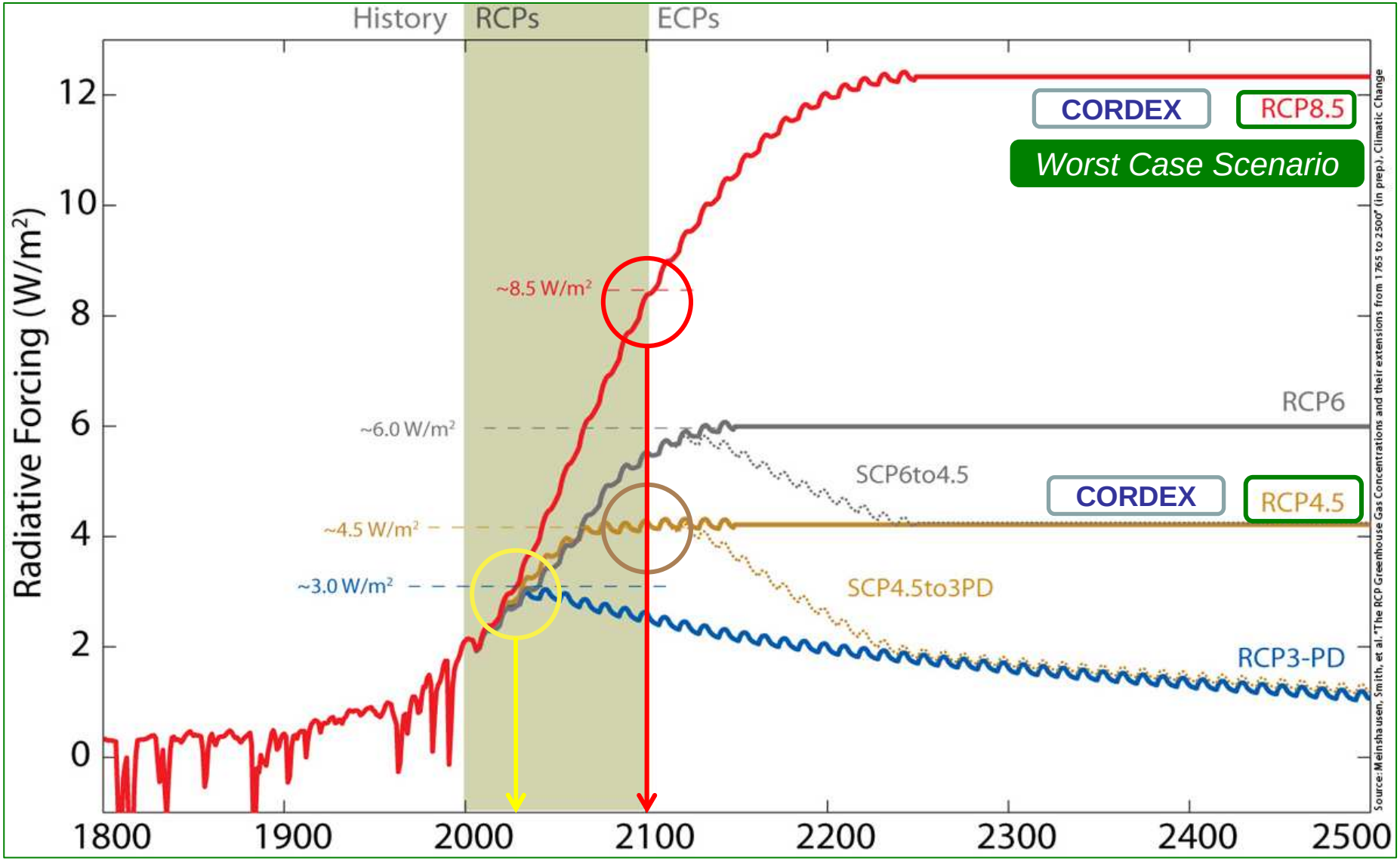
Calibration

Calibration

Calibration

Extreme Events now also included

Representative Concentration Pathways (RCPs)
New basis for Climate Modeling & IPCC Projections for AR5

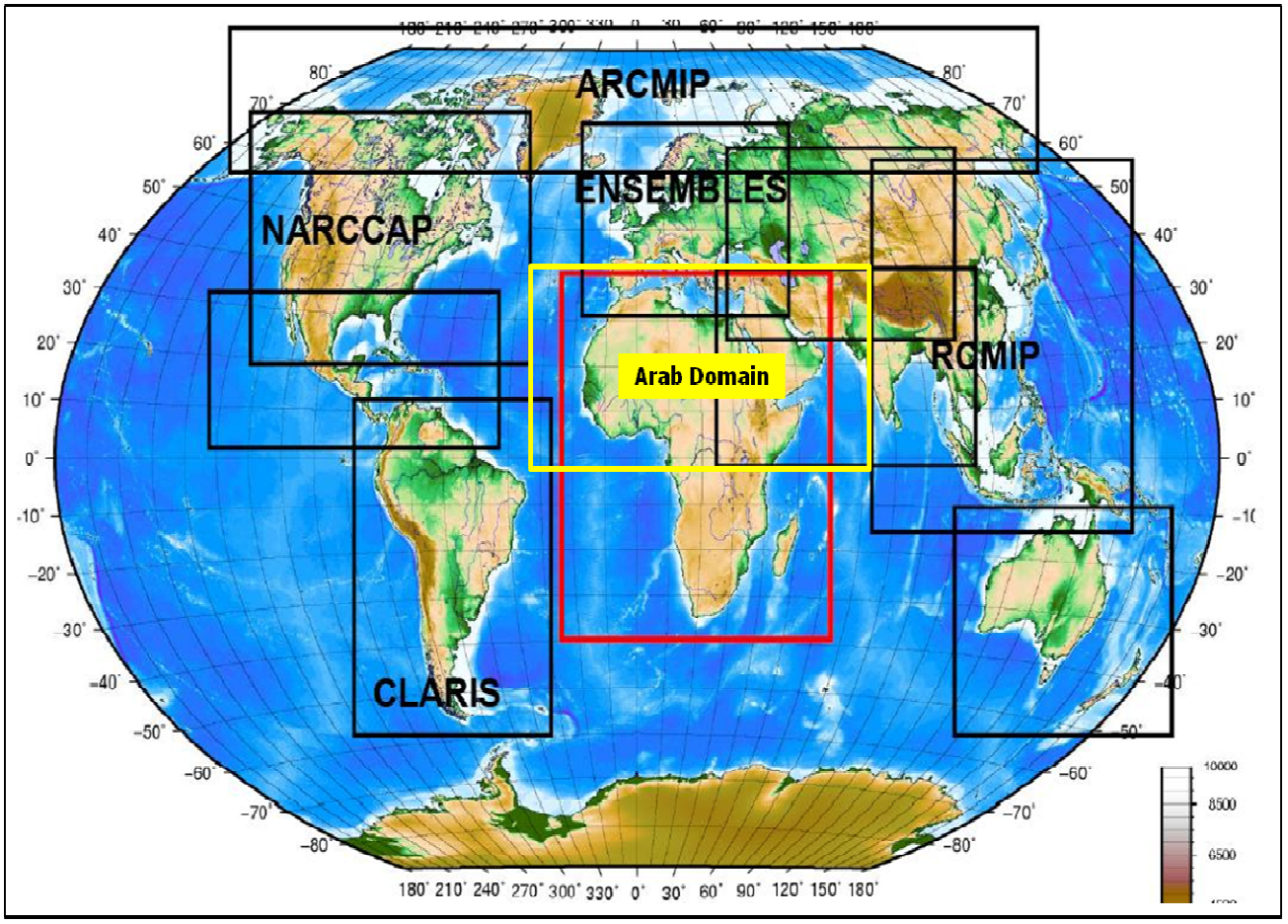


Graph adapted from: Meinshausen et al.,2010

Regional Climate Modeling:
Establishing an Arab/MENA-CORDEX Domain

CORDEX: COordinated Regional climate Downscaling EXperiment

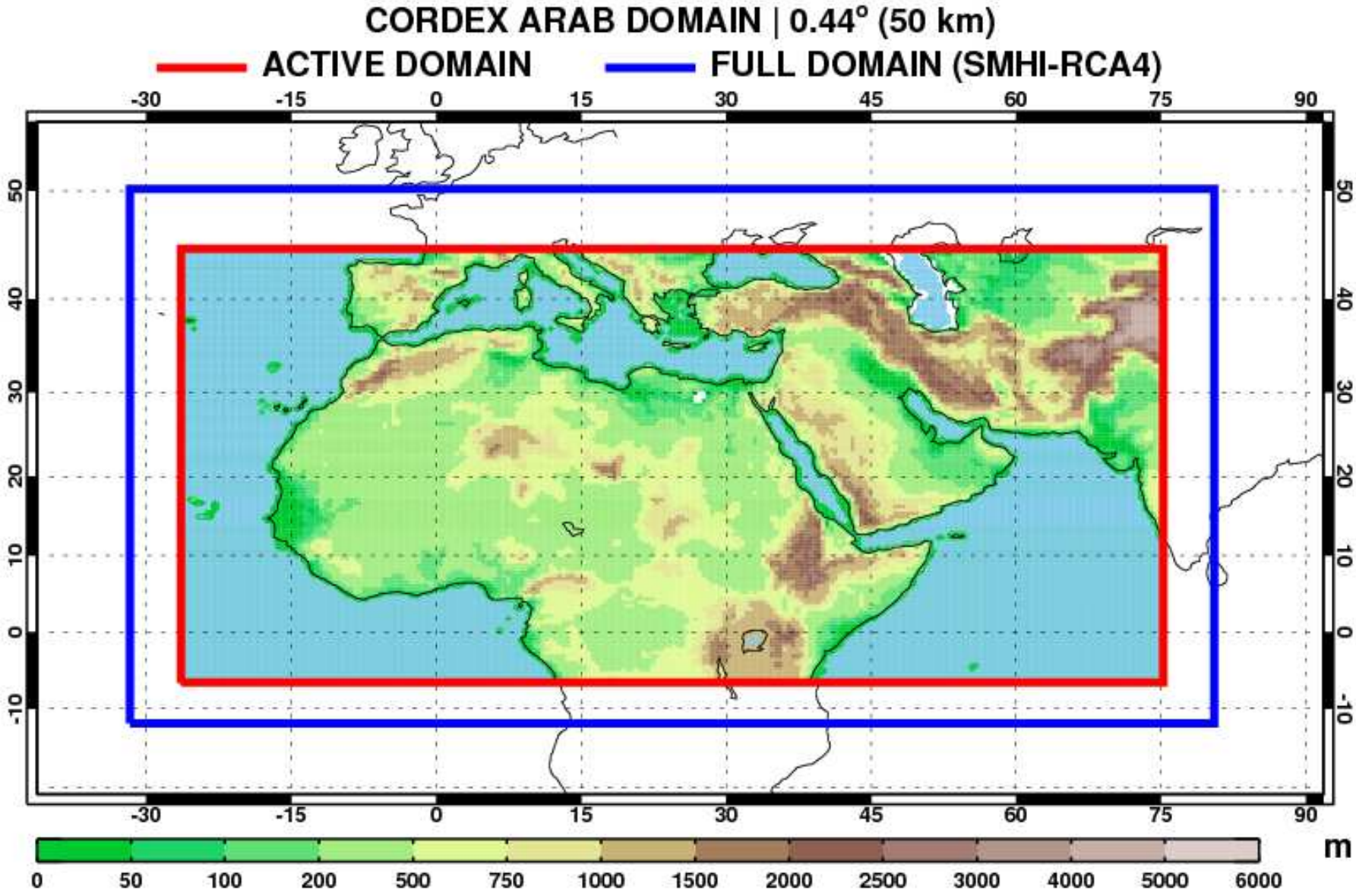
- Arab/MENA-COREX Domain sets the **limiting boundary conditions** for regional climate modeling
- Domain approved by CORDEX in June 2012.
- SMHI conducted Sensitivity Analysis & set up Domain in consultation with ACSAD, UNESCO, KAU, KAUST, ESCWA
- Domain covers headwaters of Nile & Indian Ocean effects
- Comoros to be covered in own map.



** Arab Domain shown here only for illustrative & comparative purposes; domain is larger*

Illustration adapted from Giorgi et al., 2009, p.178, as drawn from collective CORDEX effort displayed at: http://www.meteo.unican.es/en/projects/CORDEX.

Arab/MENA-CORDEX Domain



Regional Hydrological Modeling (RHM)

General Circulation Model (GCM)
(300 km x 300 km):

Over Land and Ocean: Air temperature and pressure, Wind speed and direction, humidity (specific, relative), Precipitation (rain & snow), number of sunny / cloudy days, river discharge / runoff, soil moisture, Earth Radiation Budget, Ozone, Aerosols.

Ocean: Salinity, Sea level, Sea ice, Currents, Ocean Layering,

Terrestrials: River discharge / Surface Runoff, Snow cover, Glaciers and ice caps, Permafrost, Soil moisture, Vegetation

Regional Climate Model (RCM)
(50km x 50km or 25km x 25km)

Over Land and Ocean: Air temperature and pressure, Wind speed and direction, humidity (specific, relative), Precipitation (rain & snow), river discharge / runoff, soil moisture, number of sunny / cloudy days, Aerosols

@ Terrestrials: River discharge / Surface Runoff, Snow cover, Soil moisture, Vegetation

RHM Incorporates:
- RCM Outputs
- Elevation Data (DEM)
- Land Parameters
- Hydrological data on surface water
- Hydrological data on groundwater

Regional Hydrological Model (RHM)

Hydrologic Stations: Air Temperature and pressure at Surface, Surface Evapotranspiration, Precipitation (rain & snow)

Surface: Runoff, Flow (into/out of), Snow amount, snow Melt, Soil Moisture Content

Groundwater: Flow in & out of grid-cell.

Calibration

Basin-Centered Hydrological Model (BHM)

Groundwater: water table, Change in Groundwater Level, Groundwater Infiltration Rate, aquifer safe yield, Seawater Intrusion, Salinization

Surface: soil moisture, runoff, Crop Water Demand, Agricultural Productivity

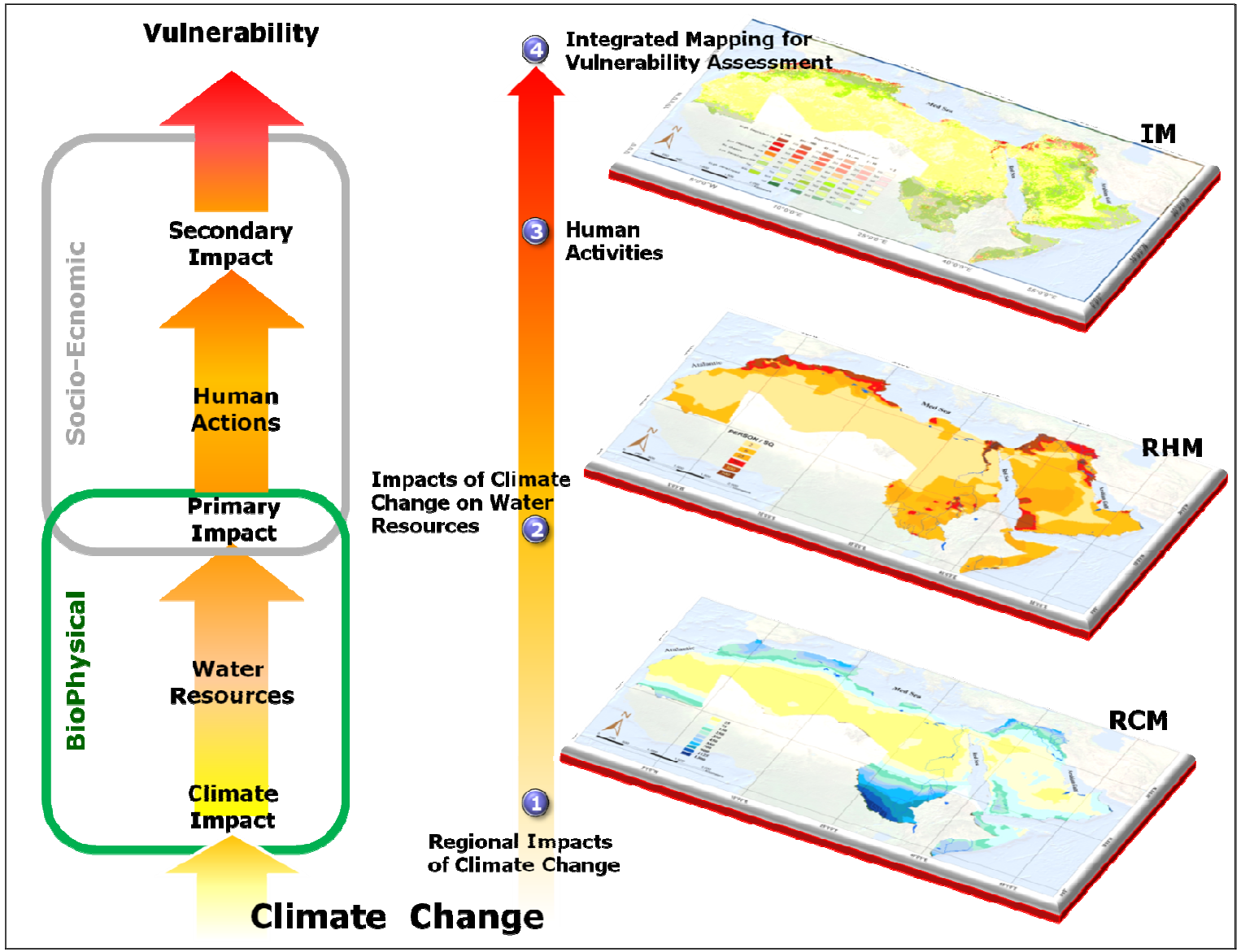
Two Options:
RCM to Regional HM
or
RCM to Basin HM

Arab-CORDEX Ensemble Matrix

RCM (Institute)	GCM (resolution)	Historical (1950-2005)	RCP8.5 (2006-2100)	RCP4.5 (2006-2100)
RCA4 (SMHI)	EC-Earth (50km)	✓	✓	✓
RCA4 (SMHI)	EC-Earth (25km)	✓	✓	
RCA4 (SMHI)	CNRM (50km)	✓	✓	(✓)
RCA4 (SMHI)	HadGEM (50km)	(✓)	(✓)	(✓)
RCA4 (SMHI)	GFDL-ESM (50km)	✓	✓	(✓)
RCA4 (SMHI)	TBD (25km)	✓	✓	
n/a (KAUST)	GFDL-ESM-1 (25km)	✓	✓ (2050)	✓ (2050)
RegCM4 (KAU)	TDB (50km)	✓	✓	✓
Remo (CSC)	MPI-ESM (50km)	✓		✓

✓: running, completed, or planned
(✓): may be run if possible
Source: SMHI presentation, 'Establishing an Arab Domain within CORDEX & Pursuing an Ensemble Approach' presented at EGM4 held in July 2012 in Beirut

Vulnerability Assessment



Need to incorporate Extreme Events

Flooding

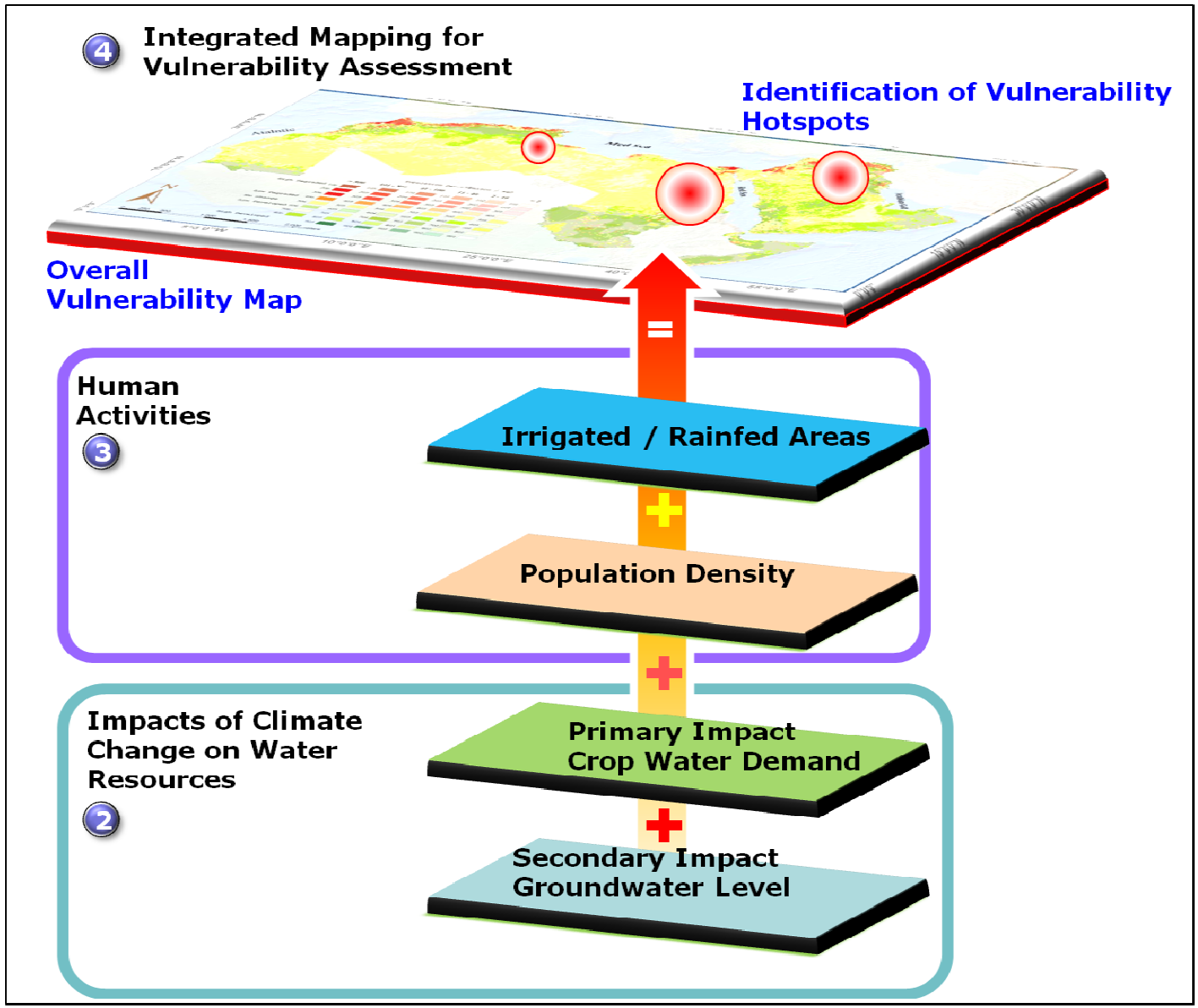
- Coastal flooding
- Wadi flooding
- Urban flooding/ stormwater drainage

Drought

- Regional/sub-regional
- Cyclical
- Duration
- Displacement

Tropical Cyclone Gonu: Oman (2007)
Credit: H.M. Fritz et al. / Estuarine, Coastal and Shelf Science 86 (2010) 102–106

Integrated Mapping



Pillar 3:
Capacity Building & Institutional Strengthening

Regional Workshops / EGMs	Participants	Lead	Date
Workshop on Projection/Prediction and Extreme Events Indices in the Arab Region	Arab Met Offices	WMO	13-16 March 2012 Casablanca
Regional Workshop on Applications and Analysis of Regional Climate Models	Arab Water Ministries (technical staff)	SMHI, ACSAD	2-4 July 2012 Beirut
Expert Group Meeting 4 on the Regional Initiative	RICCAR Partners & Arab Water Ministries	ESCWA, UNEP, LAS	5-6 July 2012 Beirut
National Workshops for Disaster Losses Inventories (Tunisia, Morocco, Yemen, Jordan)	Inter-ministerial (planning, interior, environment, sectors)	UNISDR	September 2012 – April 2013
Regional Workshop on linking Regional Climate Models to Regional Hydrological Models	Arab Water Ministries (technical Staff)	SMIH, ACSAD, ESCWA	26-28 June 2013
Expert Group Meeting on the Preliminary Findings of the Regional Climate Models covering the Arab Domain (Expert Group Meeting 5)	Arab Water Ministries (senior staff)	SMHI, ACSAD, ESCWA,	October 2013*

** Date to be confirmed*

Regional Workshop on Climate Prediction/Projection and Extreme Events Indices in the Arab Region

- The workshop was hosted by the Direction de la Météorologie Nationale (DMN) in Casablanca 13-16 March 2012.
- It aimed to Enhance Climate Data Collection and Processing Capability and the Dissemination of Derived Global Climate Change Information, along with Climate Prediction/Projection aspects for the Arab Region.
- The workshop was attended by experts from Met. Offices from 17 Arab countries.
- The training was lead by a team of experts from USA, Spain, Australia, KSA and Sweden in addition to experts from ESCWA, ACSAD, SMHI and WMO.
- Data was analyzed for one station in each country and climate induces were derived using WMO software.

Follow up actions – Climate Data Rescue Project for Jordan

- Climate data rescue project was initiated in coordination with the Jordan Meteorological Department and is currently being implemented by ESCWA, WMO and an international consultant.
- The project started in mid May 2013 and will continue for two months.
- A training workshop on the tools and methodologies for data rescue will be held in Amman during 11-13 June 2013 on the Climate Data Rescue process with the participation of meteorological experts from Jordan and Palestine.

Publication of a paper on long term Climate trends in the International Journal of Climatology

International Journal of Climatology

Changes in extreme temperature and precipitation in the Arab region: long-term trends and variability related to ENSO and NAO

Journal:	*International Journal of Climatology*
Manuscript ID:	JOC-12-0334.R1
Wiley - Manuscript type:	Research Article
Date Submitted by the Author:	12-Mar-2013
Complete List of Authors:	Donat, Markus; Climate Change Research Centre, University of New South Wales Peterson, Thomas; National Climatic Data Center, Brunet, M King, Andrew; University of New South Wales, Climate Change Research Centre Almazroui, Mansour; King Abdulaziz University, Meteorology Kolli, Rupa Kumar; World Meteorological Organization, World Climate Applications & CLIPS Division Boucherf, Djamel; National Climatologocal Office Algeria, Al-Mulla, Anwar Nour, Abdourahman Aly, Ahmed Nada, Tamer Semawi, Muhammad Mfddi; Jordan Meteorological Department, Al Dashti, Hasan Salhab, Tarek El Fadli, Khalid Muftah, Mohamed Dah Eida, Sidaty BADI, wafae; National meteorological service, National center for Meteorological Research Driouech, Fatima El Rhaz, Khalid Abubaker, Mohammed Ghulam, Ayman Sanhouri Erayah, Amani Ben Mansour, Maher Alabdouli, Waleed Al Dhanhani, Jemie Salem Al Shekaili, Majed Naser; National Center for Meteorology and Seismology,
Keywords:	climate extremes, climate change, observations, temperature, precipitation, ENSO, NAO

(wileyonlinelibrary.com) DOI: 10.1002/joc.3707 (2013)

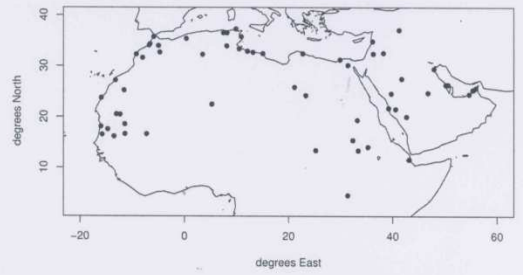


Figure 1: Locations of all stations from which at least 30 years of homogeneous data were available to be included in this study.
127x79mm (300 x 300 DPI)

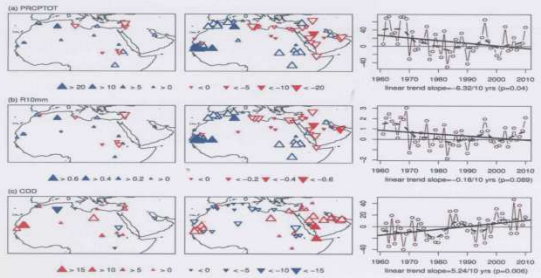
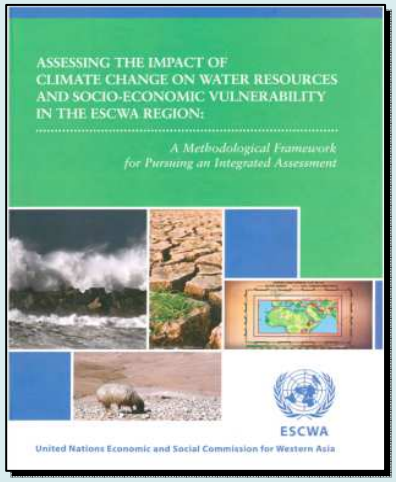


Figure 5: As Figure 2, but for precipitation indices total annual precipitation on wet days (PRCPTOT, unit: mm/10years), heavy precipitation days (R10mm, unit: days/10years) and consecutive dry days (CDD, unit: days/10years). Upward pointing triangles show increasing trends, downward pointing triangles represent decreasing trends. Significant changes ($p \leq 0.05$) are indicated by filled symbols. Red colour coding indicates drying trends, blue indicates trends towards wetter conditions.
209x157mm (300 x 300 DPI)

Pillar 4:
Awareness Raising & Information Dissemination

Objectives	Activities Completed	Activities in Progress
✓ Raise public awareness on climate change phenomenon and encourage the participation of local civil society to face it. ✓ Provide tools to present simplified key messages to targeted stakeholders on the findings.	✓ **Brochure** ✓ **Website** www.escwa.un.org/RICCAR ✓ **Integrated Assessment Methodological Guidance Document** Doc#: E/ESCWA/SDPD/2011/1  	❑ **Regional Knowledge Hub** ❑ **National Disaster Inventories** (in 5 Arab countries) ❑ **Technical Materials** ❑ **Policy Briefs** ❑ **Integrated Mapping Tools** ❑ **Study on "Regional Cooperation for Climate Change Adaptation" (ESCWA, UNEP, LAS)** ➢ ***English/Arabic language accessibility*** *on final outputs*

Regional Initiative
Implementation Partners

Partners

ESCWA

UNEP

WMO

ACSAD

LAS

SMHI

UNESCO
United Nations
Educational, Scientific and
Cultural Organization

Cairo Office

UNITED NATIONS
UNIVERSITY

UNU-INWEH

ISDR
United Nations
International Strategy for Disaster Reduction

giz Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

Donors

Sida SWEDISH INTERNATIONAL DEVELOPMENT
COOPERATION AGENCY

Federal Ministry
for Economic Cooperation
and Development

National Research Institutes *(under formalization)*

* National Water Research Institute / *Ministry of Water Resources and Irrigation (Egypt)*
* Center of Excellence for Climate Change Research / *King Abdulaziz University (KSA)*
**KAUST (KSA)*
**Climate Services Center (CSC) – to be confirmed*

Thank you!

Additional information on the Regional Initiative is available at:

www.escwa.un.org/RICCAR