



**UN-LAS**

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

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RICCAR Coordinator*

*Beirut Water Week, 21 February 2013*

# **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 to inform 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 25<sup>th</sup> 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.

- 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

1. **Requests the (ESCWA) Secretariat to prepare an assessment of the vulnerability to climate change of economic and social development in the region, with particular emphasis on fresh water resources;**

2. *Encourages member countries to*

- 1- Build a **regional integrated database** electronically connected with international and global databases in an interactive manner in order to continuously update it and connect it with GIS to be able to follow-up the development in climatic trends in the Arab region;
- 2- **Application of regional climate models** in the Arab countries to improve its performance and accuracy;
- 3- **Assess impact of climate change on several sectors including biodiversity, agriculture, food security, land use, forestry, water resources, population and human settlements, and social economics, specifically on agricultural production, drought, decertification and on sustainable development** in general;

# UN-LAS Coordination Mechanisms for RICCAR

## Coordination Mechanisms

- **UN-LAS 9<sup>th</sup> 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.
- **RICCAR Expert Group Meetings (started Oct 2009)** - UN-LAS core group established following 1<sup>st</sup> EGM; Annual EGMs convened since.
- **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)

*Involves Arab Water & Environment Ministries,  
RICCAR Partners, Regional Research Centers*

### Vulnerability Assessment Working Group

*15 members*

*Arab Governments,  
UN, LAS/Arab Orgs,  
Expert Institutions*

### Regional Knowledge Hub Working Group

*10 members*

*Arab Governments,  
UN, LAS/Arab Orgs,  
Expert Institutions*

# 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)*

*Support to*  
*Met Offices*

**Establishment of**  
**Regional Early**  
**Warning System**

**Preparation of**  
**National UNFCCC**  
**Communications &**  
**CC Strategies**



# الهيكل التنفيذي للمشروع – Implementation Framework

حصر المعلومات الأساسية المتاحة وإدارتها  
Baseline Review & Knowledge Management

Integrated Assessment (تقييم متكامل)

تقييم تأثير التغير المناخي  
Climate Change  
Impact Assessment

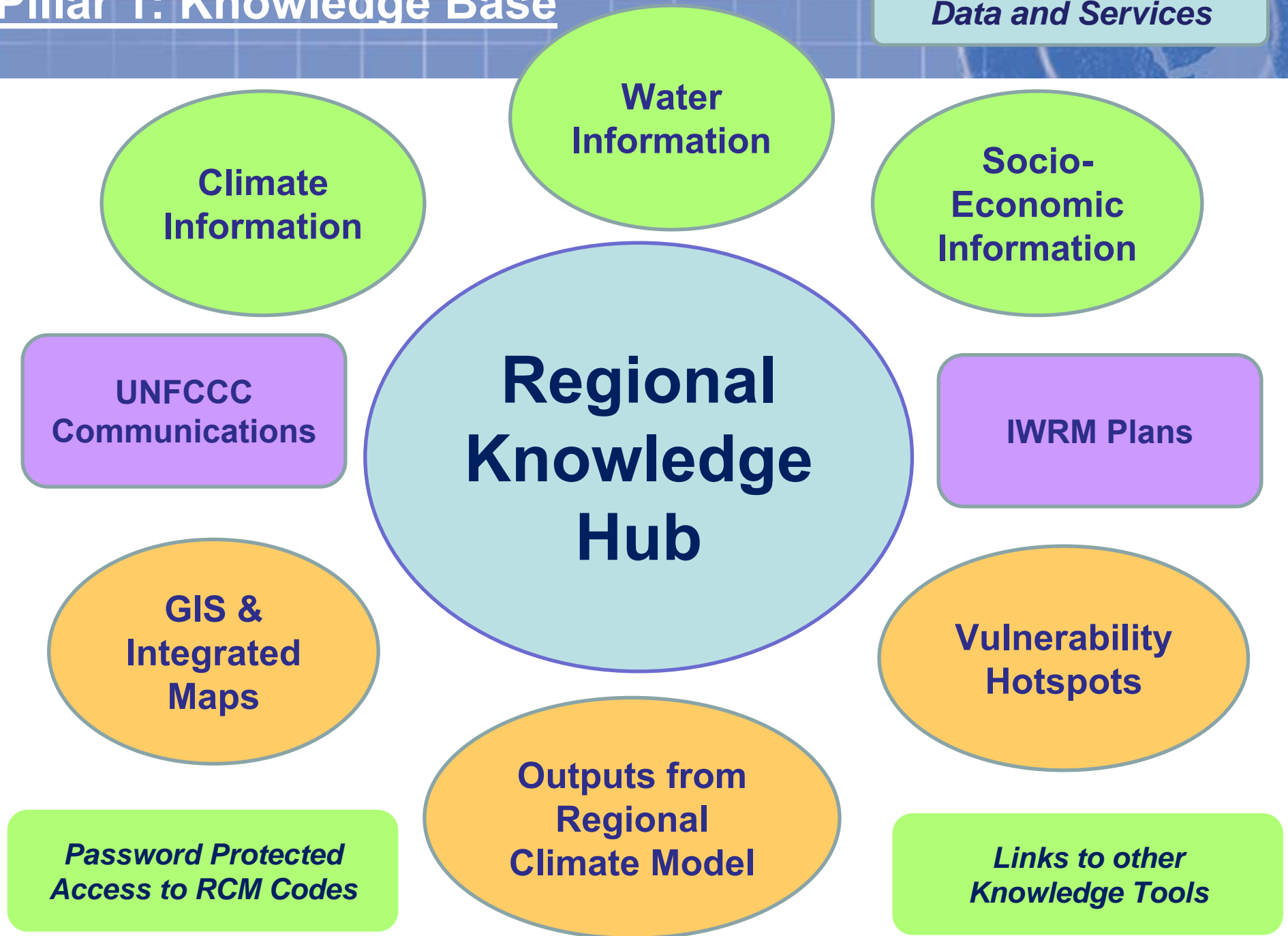
تقييم قابلية التأثر من التغير المناخي  
Climate Change  
Vulnerability Assessment

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

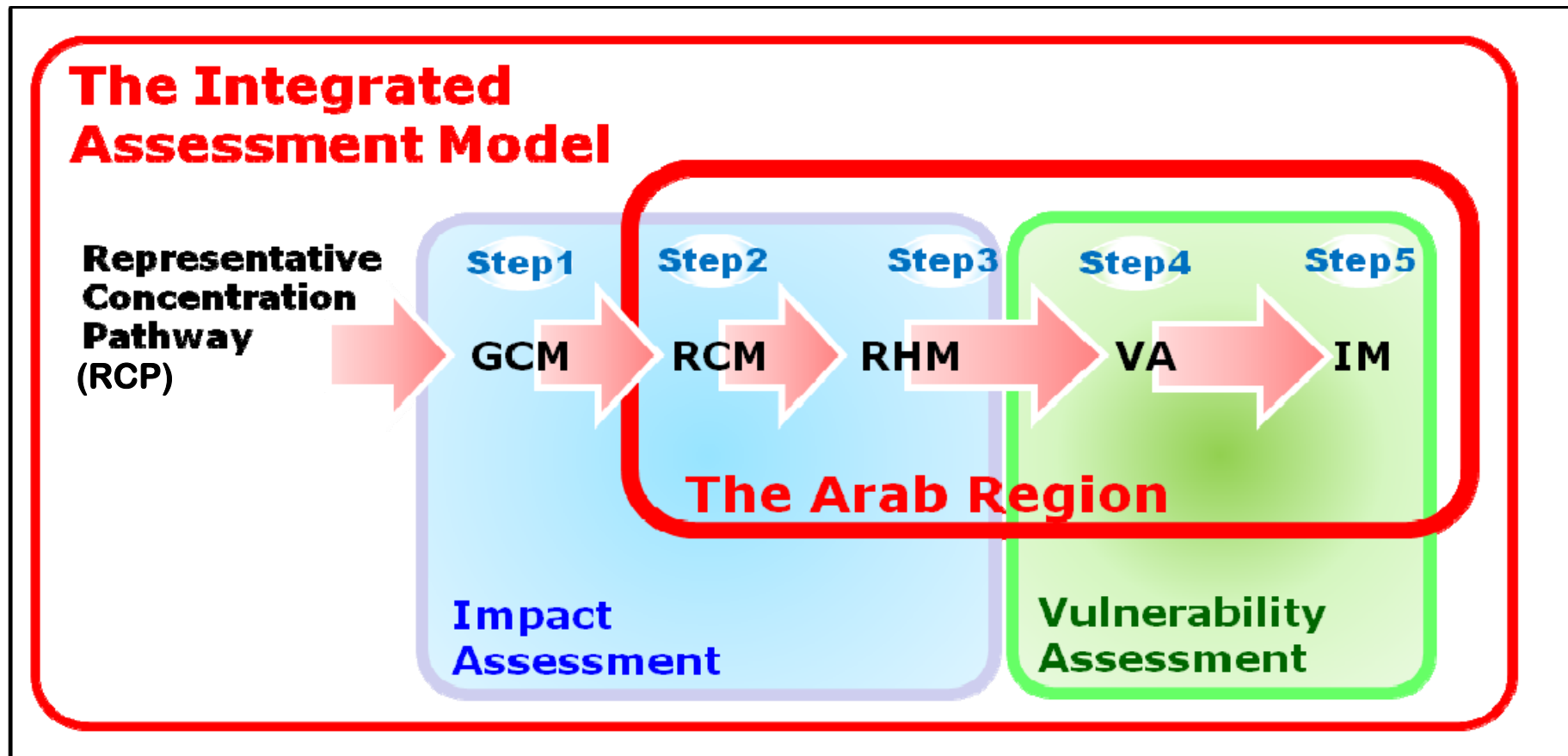
رفع الوعي  
Awareness Raising & Information Dissemination

# Pillar 1: Knowledge Base

*Data and Services*



## 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

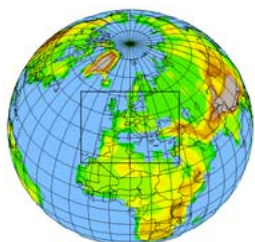
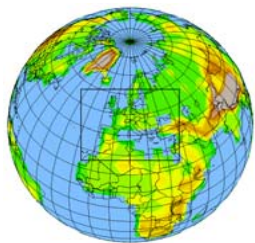
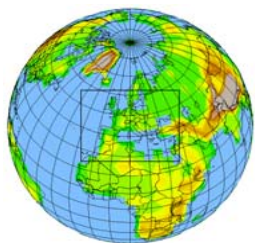
**Step 4:** Vulnerability Assessment

**Step 5:** Integrated Mapping



# Impact Assessment Component

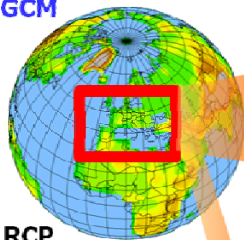
Different GCMs



for the Same RCP

**General Circulation Model (GCM)**

GCM



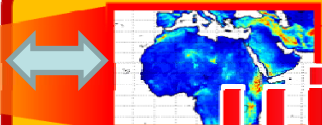
RCP

GCMs at 300 km x 300 km

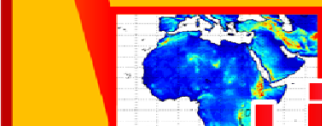
Ensemble Average used to reduce uncertainty at level of RCMs & RHMs

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

**Regional Climate Model (RCM)**

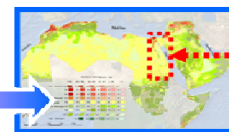


50km x 50km

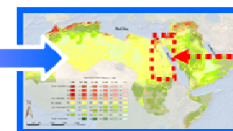
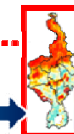


25km x 25km

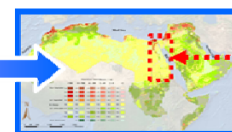
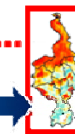
**Regional Hydrological Model (RHM)**



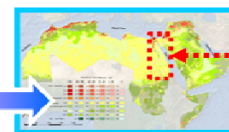
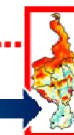
Calibration



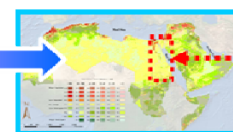
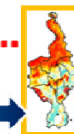
Calibration



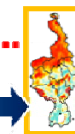
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Calibration



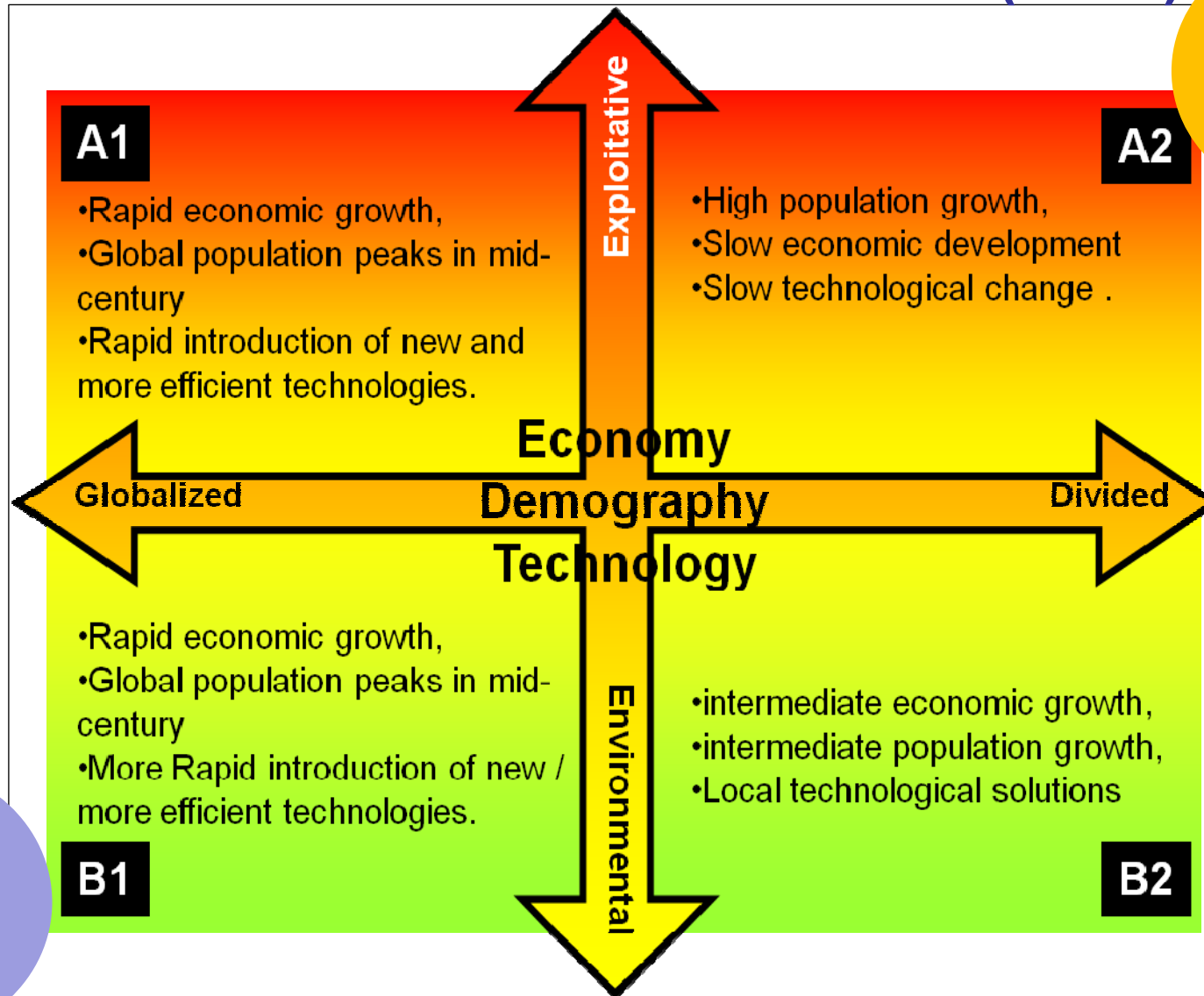
Calibration



Extreme Events now also included

# Special Report on Emission Scenarios (SRES)

## SRES Scenarios used in IPCC AR4 (2007)



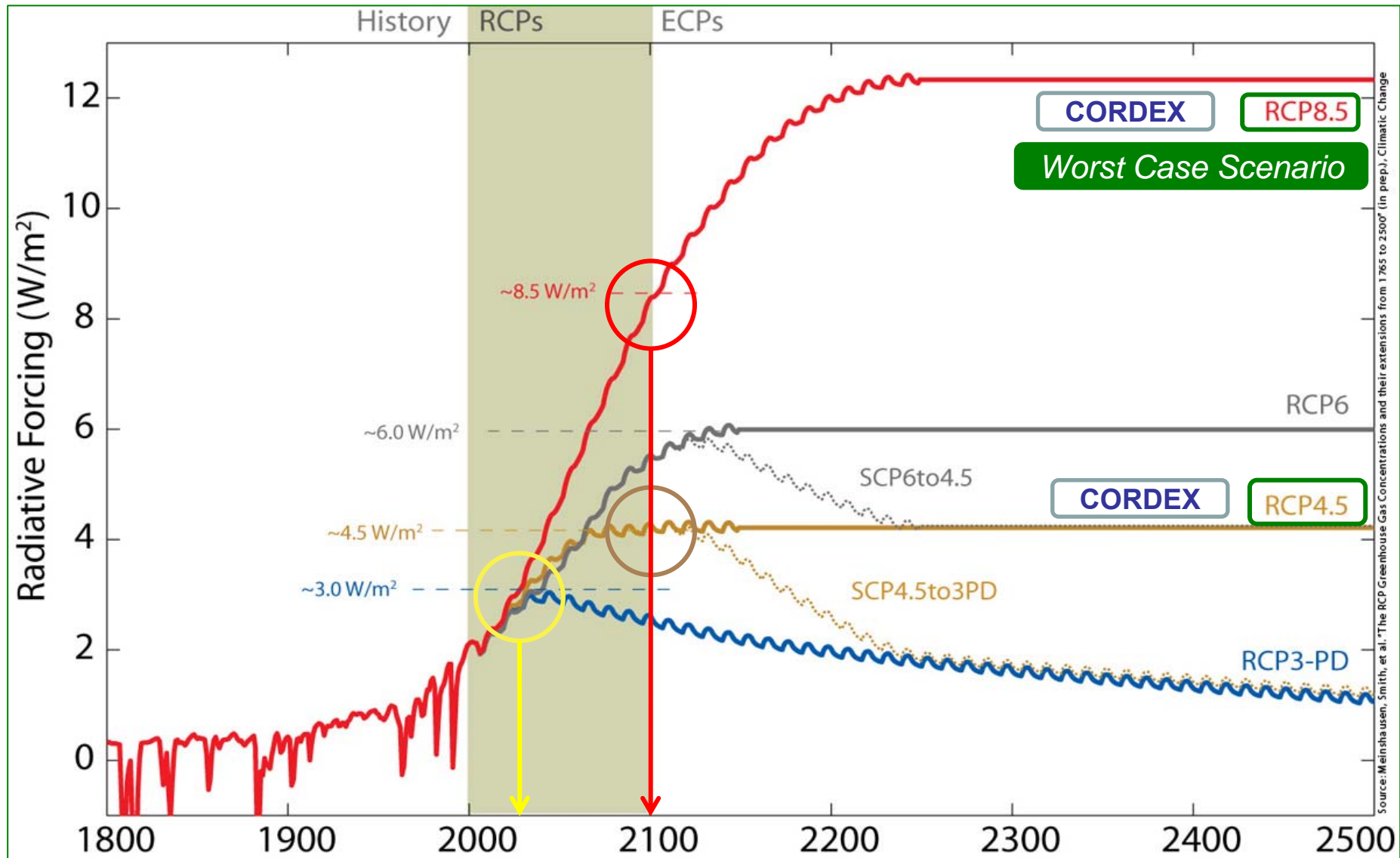
Average  
3.4C  
Temp  
increase  
Scenario

Average  
1.8 C  
Temp  
increase  
Scenario

Source:  
ESCWA,  
2009

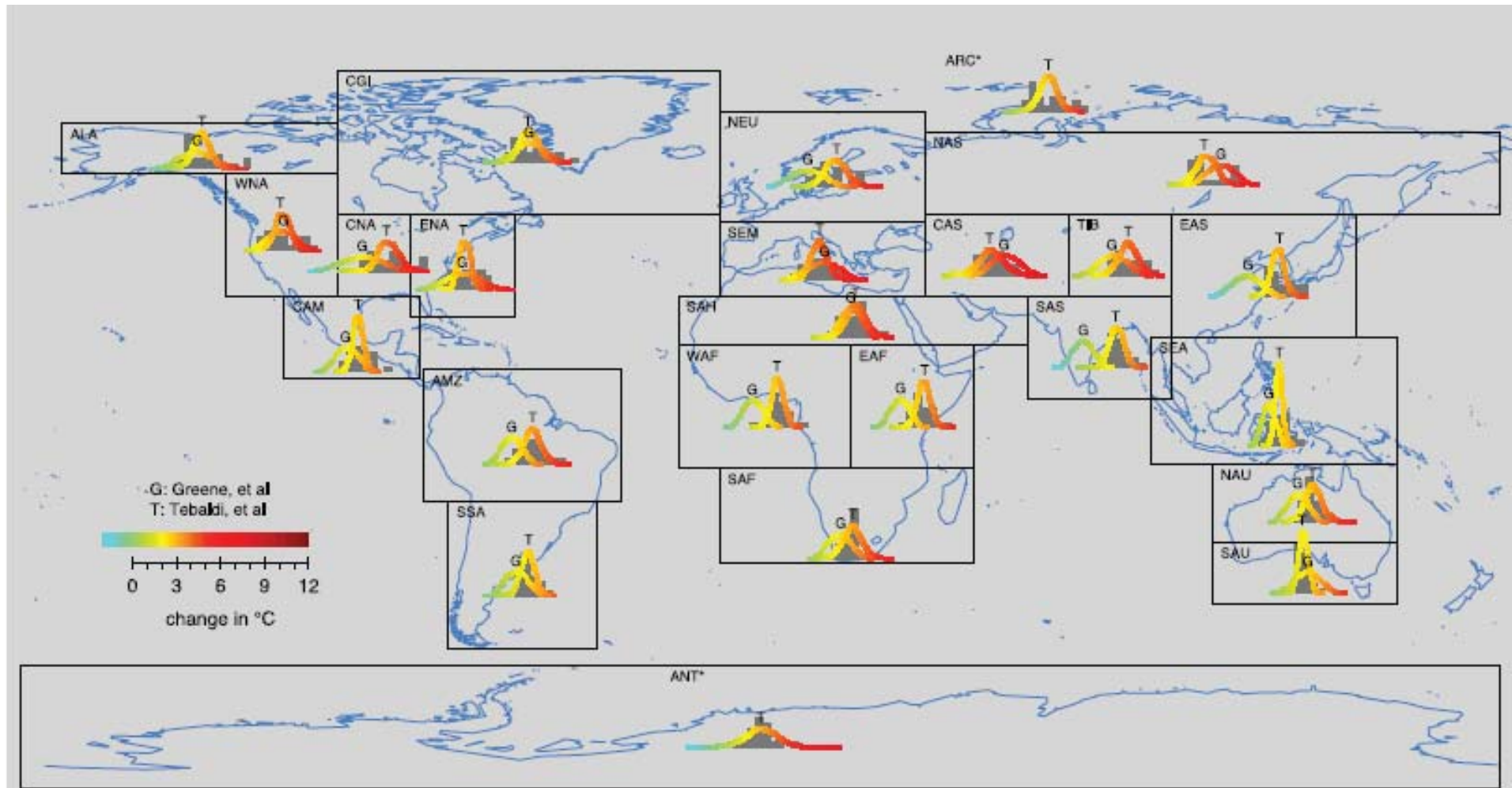
# Representative Concentration Pathways (RCPs)

## New basis for Climate Modeling & IPCC Projections for AR5



Graph adapted from: Meinshausen et al., 2010

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



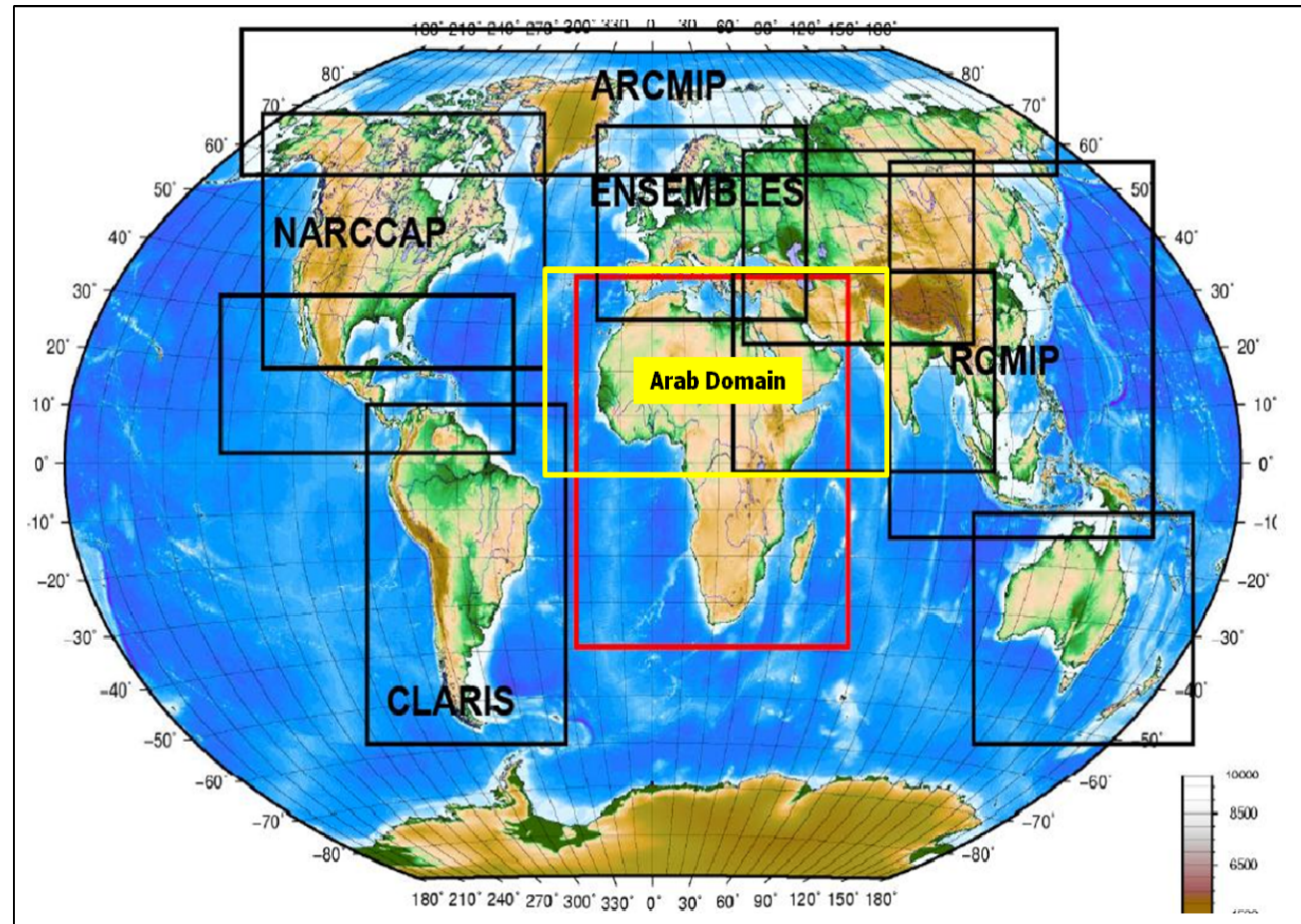
From R.K Kolli, WMO  
RICCAR EGM #2 (Beirut, 2010)



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

## CORDEX: COordinated Regional climate Downscaling EXperiment

- Arab/MENA-CORDEX 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.



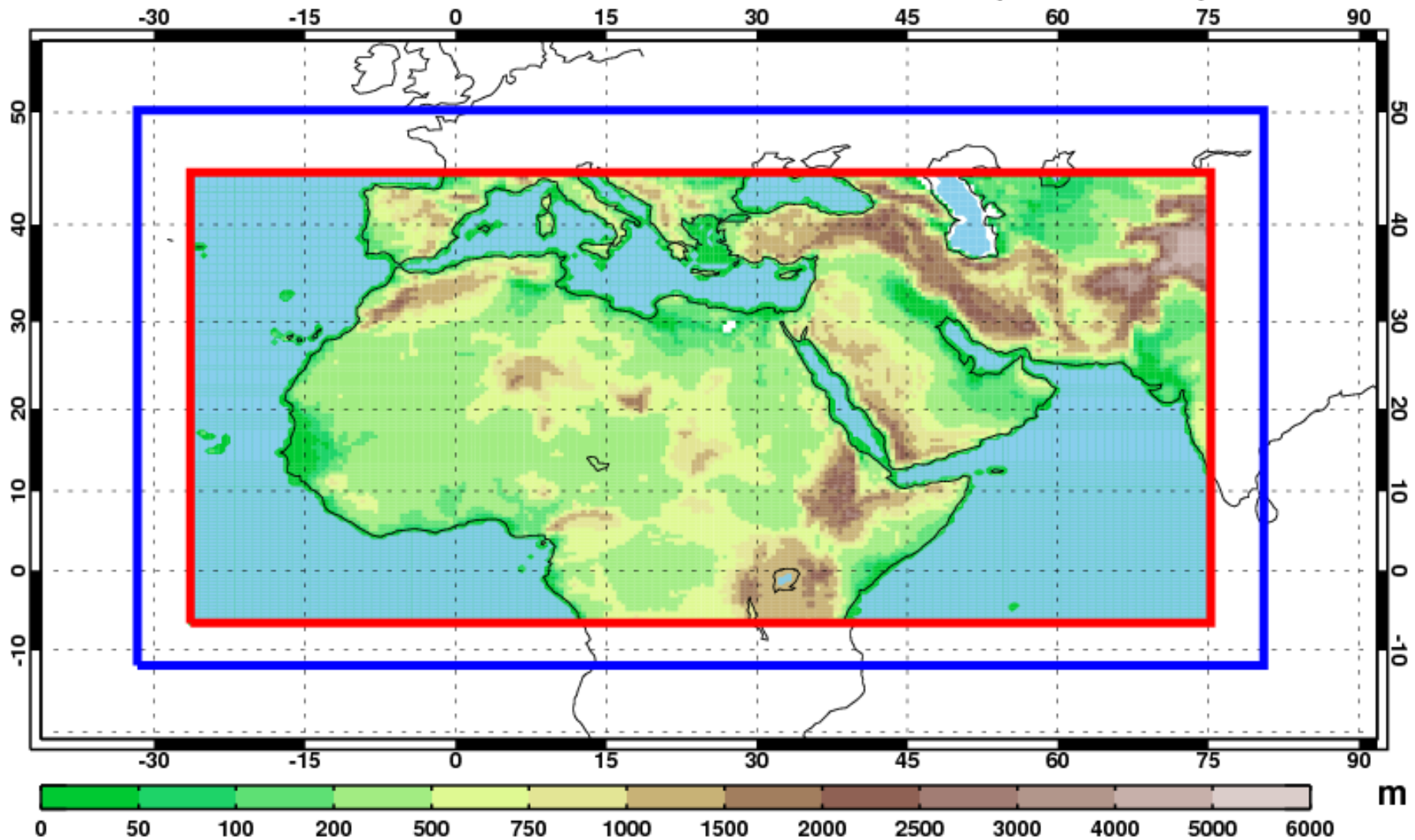
*\* Arab Domain shown here only for illustrative & comparative purposes; domain is larger*

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

CORDEX ARAB DOMAIN | 0.44° (50 km)

— ACTIVE DOMAIN      — FULL DOMAIN (SMHI-RCA4)





# 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**

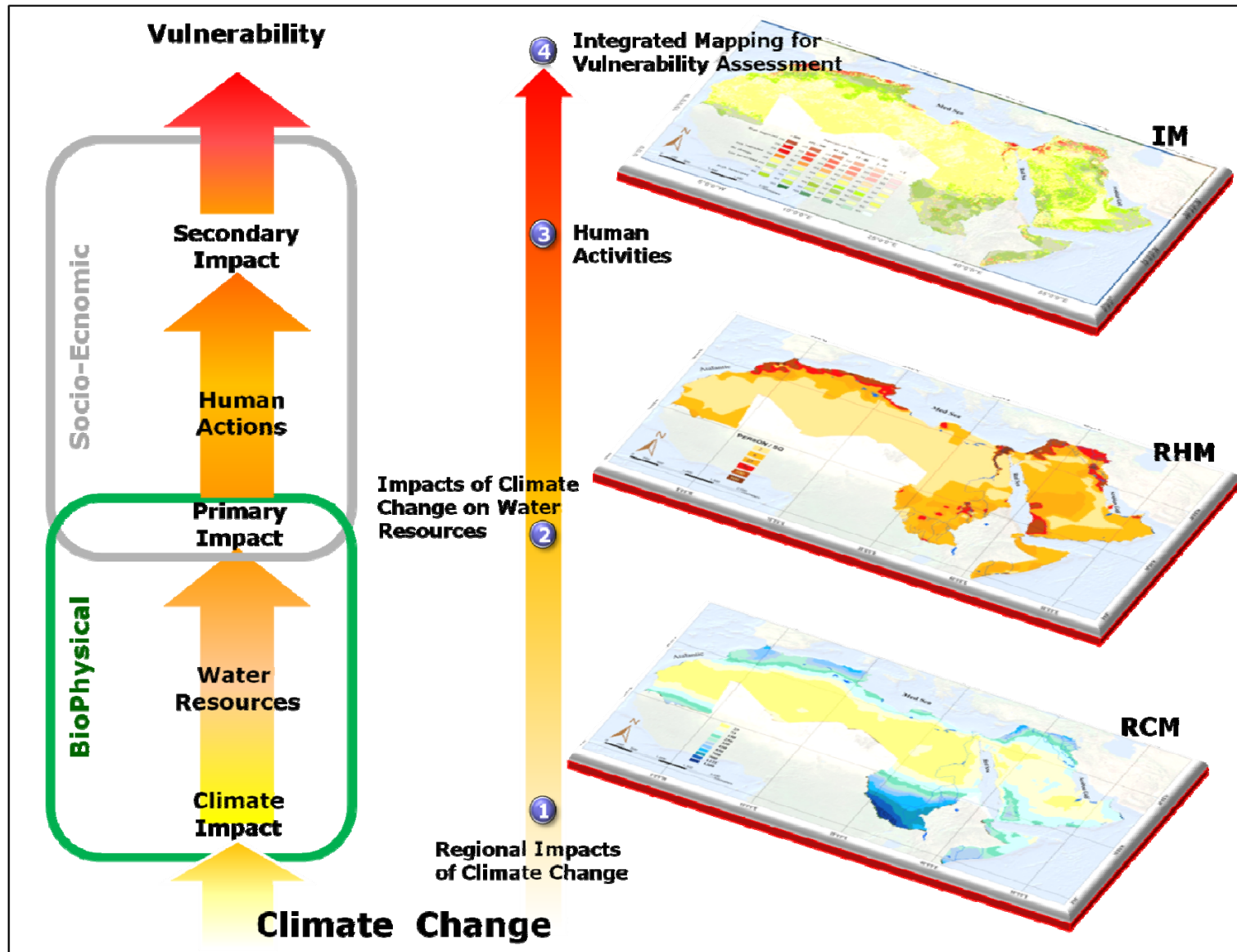
## Basin-Centered Hydrological Model (BHM)

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

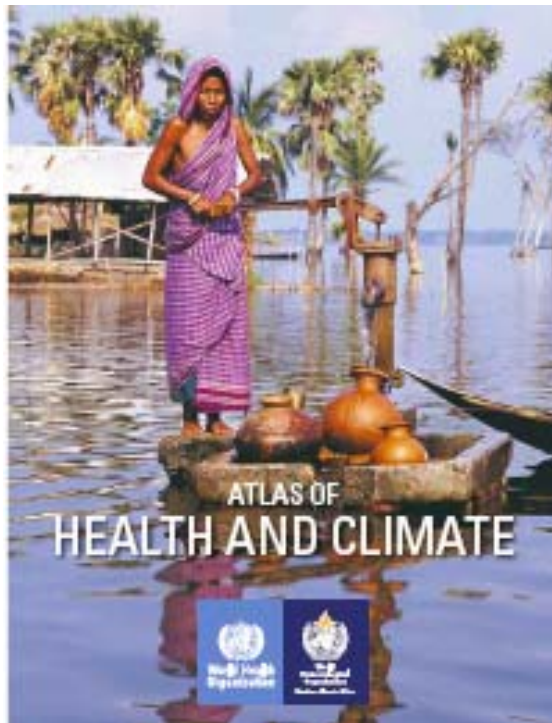
**Surface:** soil moisture, runoff, Crop Water Demand, Agricultural Productivity

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

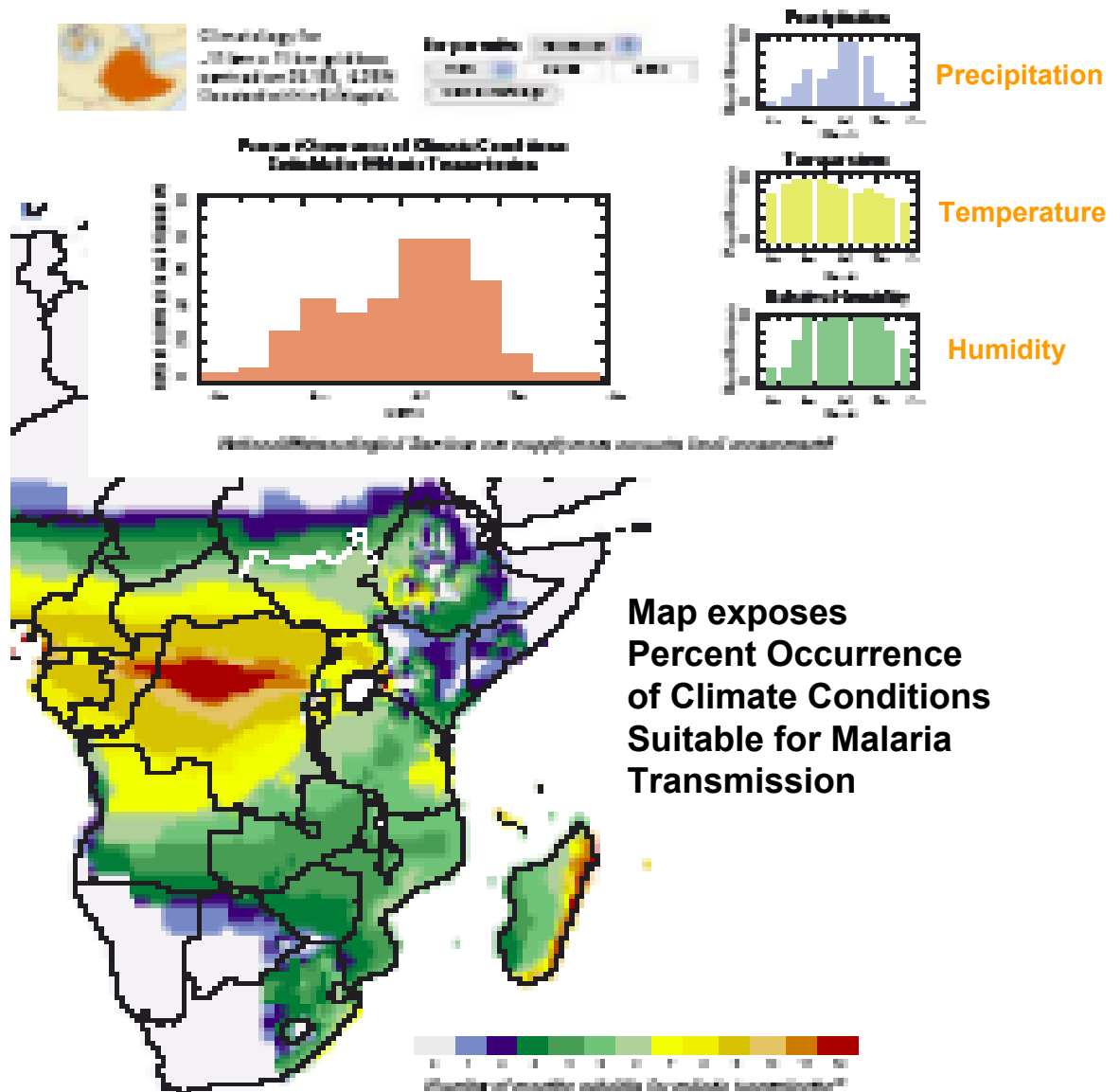
# Vulnerability Assessment



# Example: Health Sector



- Climate implications for Health/Diseases
- Projected CC impact on health indicators
- Health implications for socio-economics & VA



# Need to incorporate Extreme Events

## Floods

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



**Tropical Cyclone Gonu:  
Oman (2007)**

Photo Credit: H.M. Fritz et al. /  
*Estuarine, Coastal and Shelf Science*  
86 (2010) 102–106

## Drought

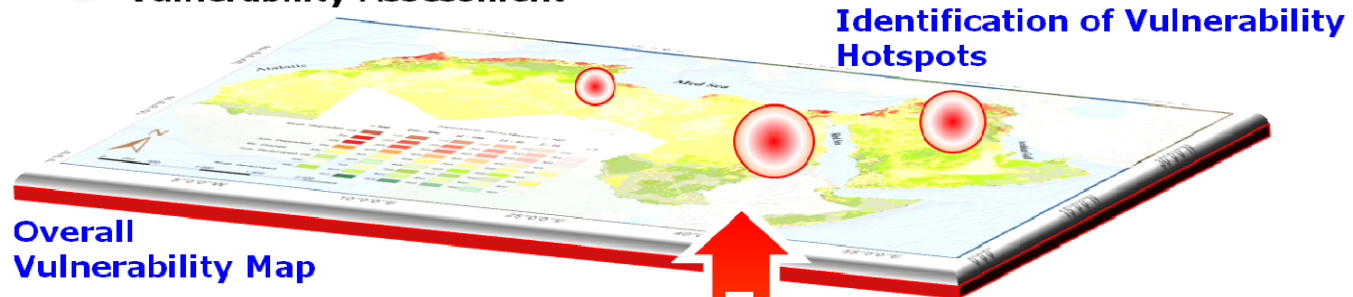
- Regional/sub-regional
- Cyclical
- Duration
- Displacement

Climate  
Change  
v/s Human  
Action or  
Inaction

- *“In Ar Raqqah (Syria), many displaced farmers talk about wells running dry, and turning polluted.*
- *“My uncle’s well used to be 70 meters deep, now it’s 130 meters and now the water became salty, so we closed it down,” said Khalaf Ayed Tajim, a stocky sheep herder and farmer who heads a local collective for displaced northerners. He left his native village 60 miles from here when half of his herd died off and his fields dried up, and now lives in a concrete bunker with his 17 children, two wives, and his mother.*” – “The Earth is Parched where Syrian Farms Thrived”, NYT, 13 Oct 2010

# Integrated Mapping

## 4 Integrated Mapping for Vulnerability Assessment



### Human Activities

3

Irrigated / Rainfed Areas

+

Population Density

+

### Impacts of Climate Change on Water Resources

2

Primary Impact  
Crop Water Demand

+

Secondary Impact  
Groundwater Level



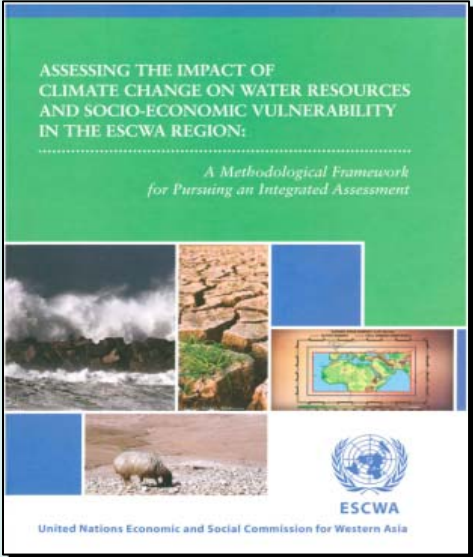
## Pillar 3: Capacity Building & Institutional Strengthening

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

*\* Date to be confirmed*



# Pillar 4: Awareness Raising & Information Dissemination

| Objectives   | Activities Completed  | Activities in Progress  |
|--|---|---|
| <ul style="list-style-type: none"> <li>✓ Raise public awareness on climate change phenomenon and encourage the participation of local civil society to face it.</li> <br/> <li>✓ Provide tools to present simplified key messages to targeted stakeholders on the findings.</li> </ul> | <ul style="list-style-type: none"> <li>✓ Brochure</li> <li>✓ Website<br/><a href="http://www.escwa.un.org/RICCAR">www.escwa.un.org/RICCAR</a></li> <br/> <li>✓ Integrated Assessment Methodological Guidance Document<br/><a href="#">Doc#: E/ESCWA/SDPD/2011/1</a></li> </ul> <div style="text-align: center; margin-top: 10px;">  </div> | <ul style="list-style-type: none"> <li><input type="checkbox"/> <b>Regional Knowledge Hub</b></li> <li><input type="checkbox"/> National Disaster Inventories (in 5 Arab countries)</li> <li><input type="checkbox"/> Technical Materials</li> <li><input type="checkbox"/> Policy Briefs</li> <li><input type="checkbox"/> Integrated Mapping Tools</li> <li><input type="checkbox"/> Study on “Regional Cooperation for Climate Change Adaptation” (ESCWA, UNEP, LAS)</li> <br/> <li>➤ <i>English/Arabic language accessibility on final outputs</i></li> </ul> |

# RICCAR Partners

## Implementation Partners



Cairo Office



United Nations  
International Strategy for Disaster Reduction



## Donors



## National Research Institutes *(under formalization)*

- National Water Research Center / *Ministry of Water Resources and Irrigation (Egypt)*
- Center of Excellence for Climate Change Research at *King Abdulaziz University (KSA)*
- *KAUST (KSA)*
- *Climate Services Center (CSC) - Germany*



***Thank you!***

*Additional information is available at:*

**[www.escwa.un.org/RICCAR](http://www.escwa.un.org/RICCAR)**