World Meteorological Organization

Working together in weather, climate and water

Downscaling Activities in Developing Countries

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Climate Prediction and Adaptation Branch

Climate and Water Department

WMO

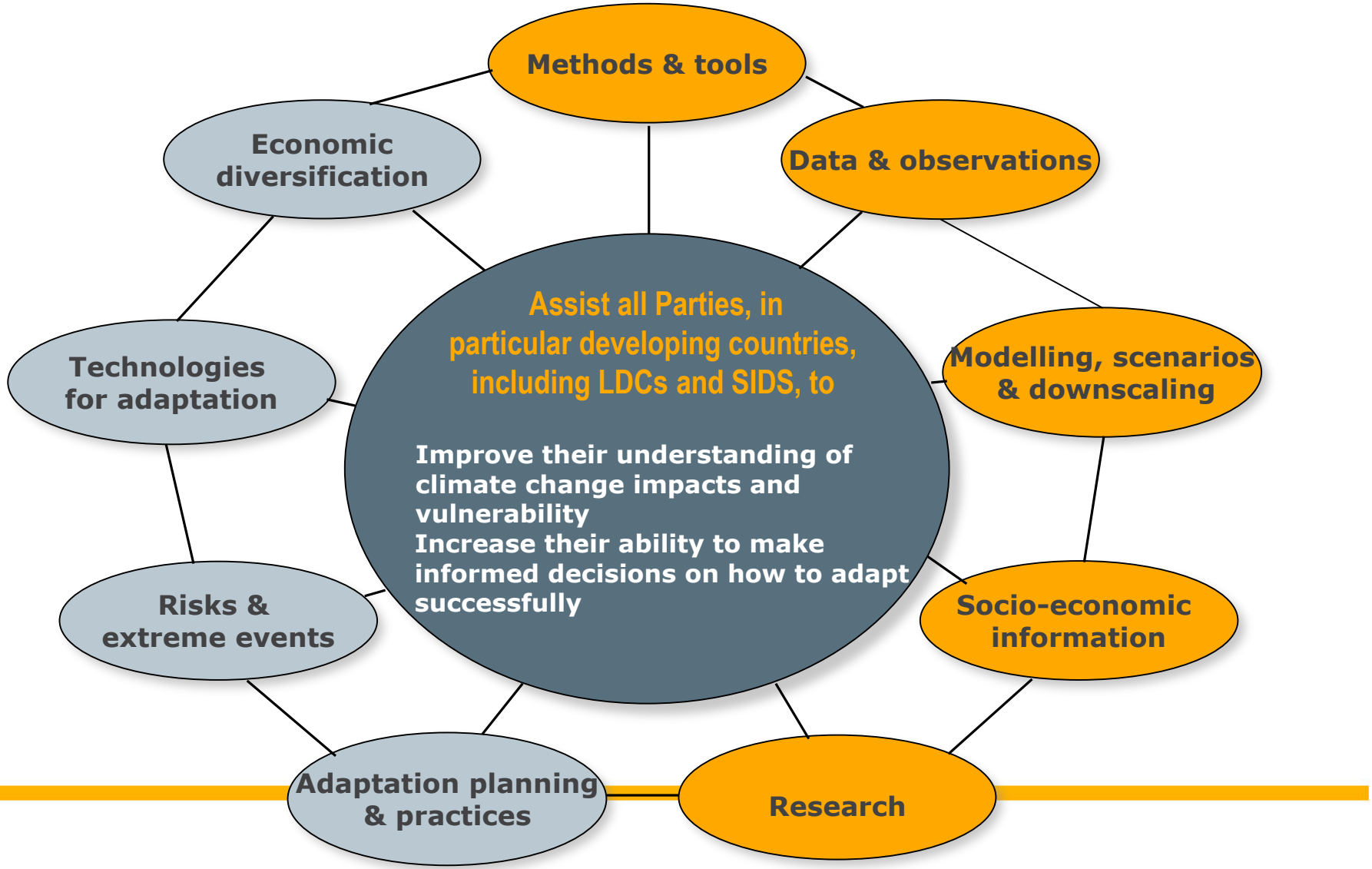
UNFCCC Efforts to enhance work on vulnerability and adaptation issues

- As part of the national communications - support for Impact, Vulnerability and Adaptation assessment
- Under the Buenos Aires Programme of work on adaptation and Response measures (2004) - Further implementation of actions including on data and modelling, vulnerability and adaptation assessment and implementation
- Under the NAPA process - Addressing special needs of LDCs
- Nairobi Work Programme (adopted at COP 12 in Nairobi in 2006) – science and technical advice on adaptation:
- Enhanced Action on adaptation under the Bali action Plan (2007)

Nairobi Work Programme (NWP)

- 5-year programme under the SBSTA (Nov 2006)
- Expected outcomes:
  - Enhanced capacity and knowledge to further understand Vulnerability & adaptation
  - Enhanced development, dissemination and use of knowledge from practical adaptation activities
  - Improved information and advice to COP and subsidiary bodies
  - Enhanced cooperation among Parties, relevant organizations, business, civil society, and decision makers
  - Enhanced integration of actions to adapt to climate change with sustainable development
- Recognizes that regional centres and networks undertaking work relevant to climate change play an important role in enhancing adaptation.

NWP Objectives and areas of work



Downscaling: Need of the Hour

- Developments in climate modelling and understanding of the physical processes of the climate system over the years have led to a considerable increase in confidence in projecting future climate change on continental and larger scales.
- However, it is widely recognized that the spatial and temporal resolution associated with outputs from climate model experiments carried out so far has been insufficient.
- This is especially so for Small Island Developing States (SIDS), because some of the small islands are treated as ocean area in the models.
- This, coupled with issues related to model uncertainties, has placed constraints on the development of regional and subregional climate scenarios to support policy-relevant impact and vulnerability assessments.

UNFCCC/SBSTA Recent Initiatives

- UNFCCC organized a workshop on climate modelling, scenarios and downscaling on 7 June 2008 during the twenty-eighth sessions of the subsidiary bodies in Bonn, Germany.
- The workshop was attended by over 100 representatives from Parties and relevant intergovernmental and non-governmental organizations, United Nations agencies and constituted bodies, as well as by individual experts and practitioners.
- The discussions at the workshop were organized in two parts:
  - Development of regional and subregional climate scenarios and ways to improve access to, and application of, climate model outputs.
  - Analysis of availability and applicability of climate model outputs and downscaled data for policymakers.

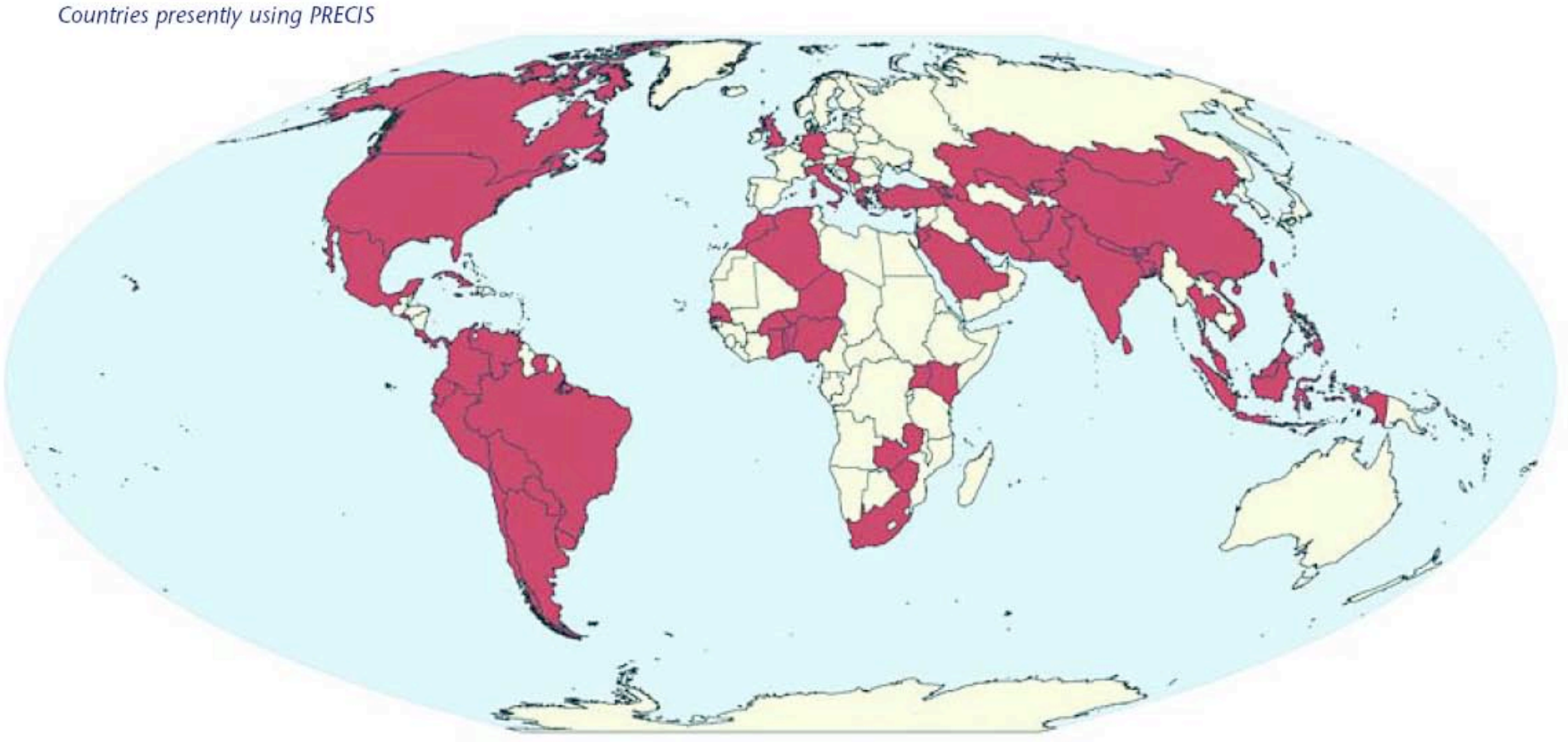
Worldwide efforts in Downscaling

- Participants provided information on a number of efforts that are being undertaken to construct regional and subregional scenarios.
- While the number of regional projections that are now available for many parts of the world is increasing, many of them are still in the exploratory phase.
- The quality of regionalized model projections at present is often considered to be inadequate for providing the specific and detailed information needed for adaptation planning, and that therefore regional models are having to be used in collaboration with global models.
- Challenges remain to improve climate projections on regional and subregional scales for adaptation purposes.
- At the same time, as global models provide the range of possible future climates as well as necessary inputs (e.g. boundary conditions) for all the regional and subregional climate simulations, participants reiterated the importance of further enhancement and refinement of global models to improving climate information in support of adaptation strategies.

PRECIS Programme

- Detailed climate scenarios using the UKCIP02 methodology for the main developing country regions
- Detailed simulation of the recent climate (last 50 years) for many developing country regions
- Basic capacity building and technology transfer enabling mitigation and adaptation activities via:
  - scientific and technical support for applying PRECIS to scenario development and climate research
  - ad hoc advice on using scenarios in impacts assessments, developing collaborations and research proposals

PRECIS worldwide

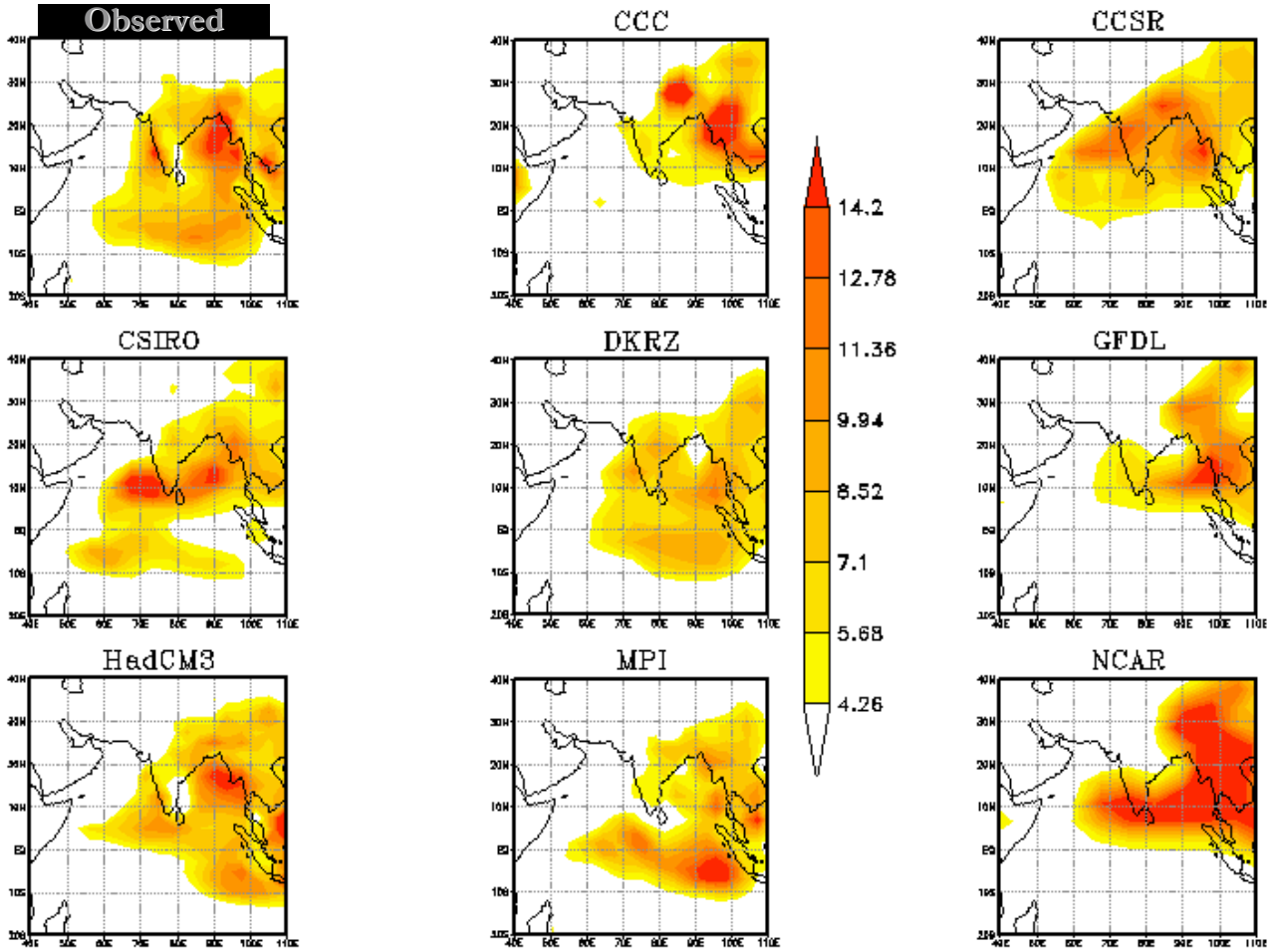


PRECIS Coverage

- PRECIS user network and data centres PRECIS has over 190 users from more than 60 countries worldwide.
- Users obtain PRECIS via participation in regional workshops. PRECIS is usually applied collaboratively over a region.
- Southern and central Africa, South America, the Caribbean and Central America, the Middle East and most of Asia (as well as Europe and North America) have been covered.
- In many regions PRECIS data are readily available from participating institutes. For example, an internet-based data acquisition and analysis system has been developed by the Cuban Meteorological Institute (INSMET). This system provides both climate data and visualisation facilities from PRECIS experiments run over the Caribbean/Central American region.

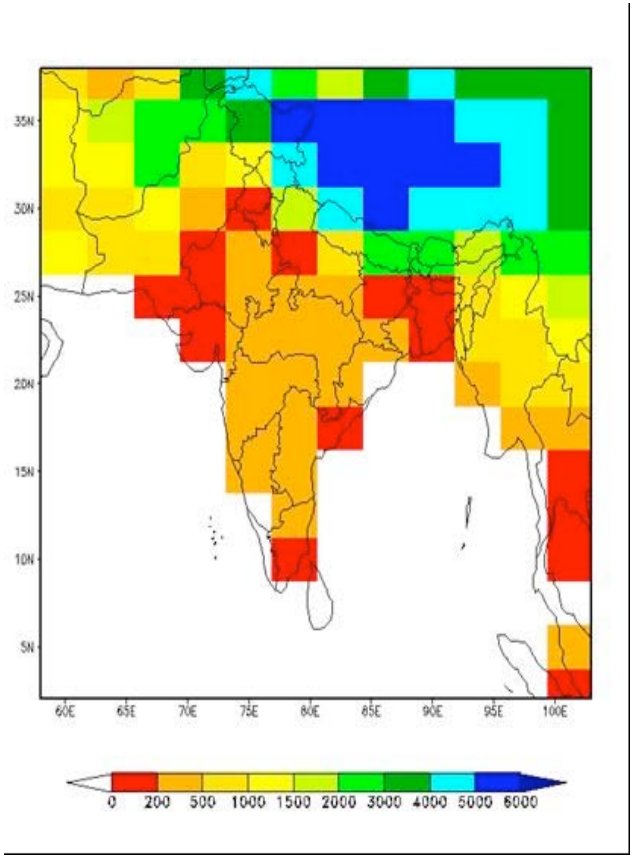
Global models provide inadequate and even inaccurate information on regional scales, more strikingly in the case of the Indian summer monsoon variability patterns.

Summer Monsoon Rainfall (mm/day) Simulation by AOGCMs

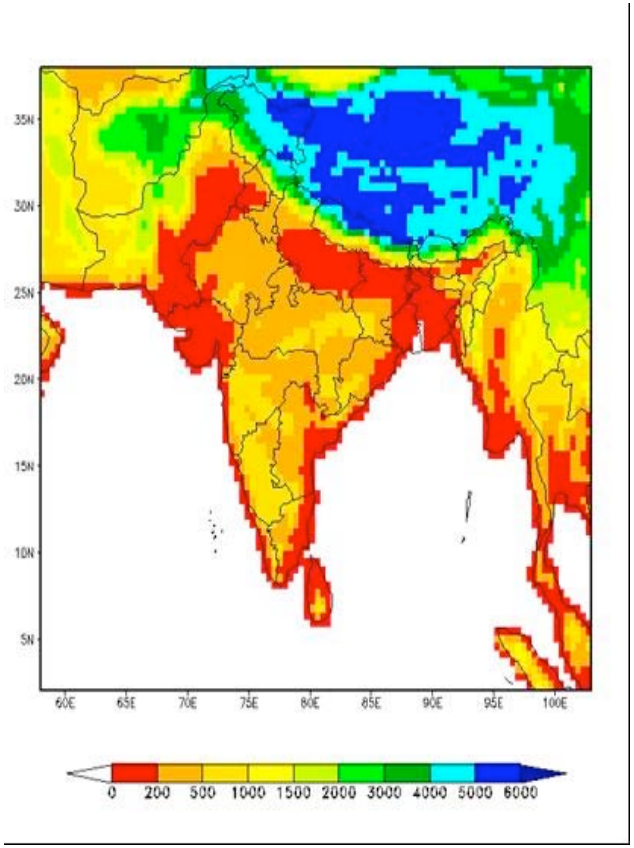


Model Orography

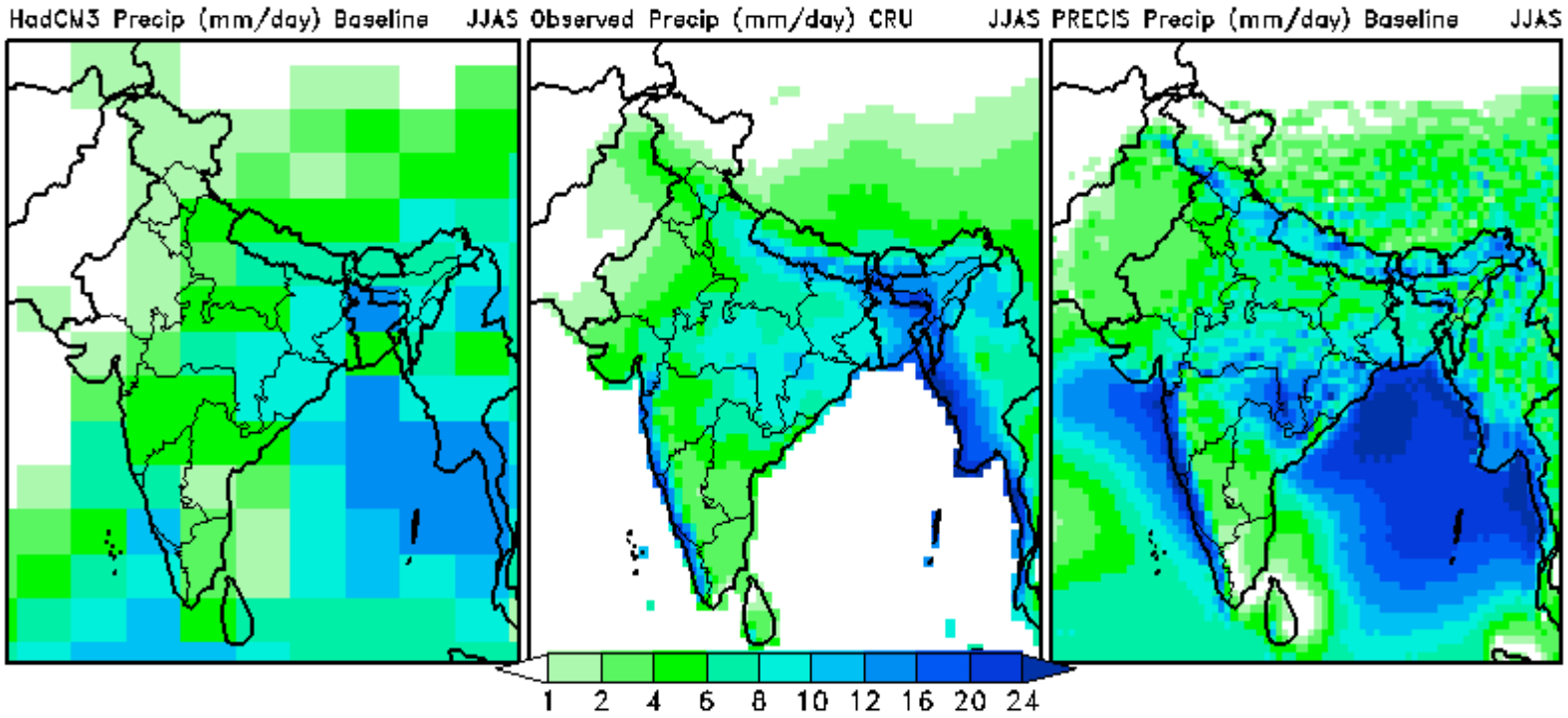
Global Model



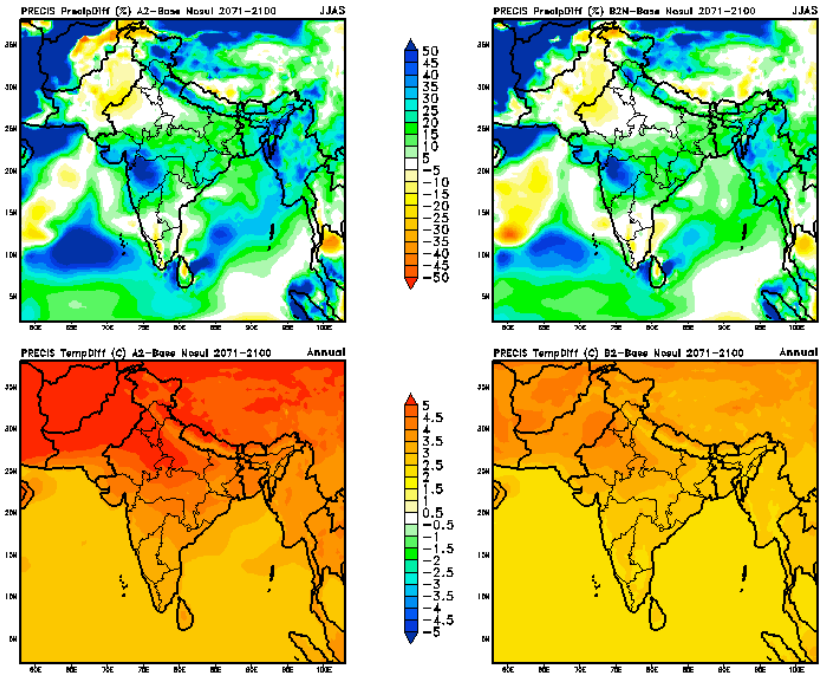
Regional Model (PRECIS)



PRECIS captures important regional information on summer monsoon rainfall.



Climate Change Scenarios for India

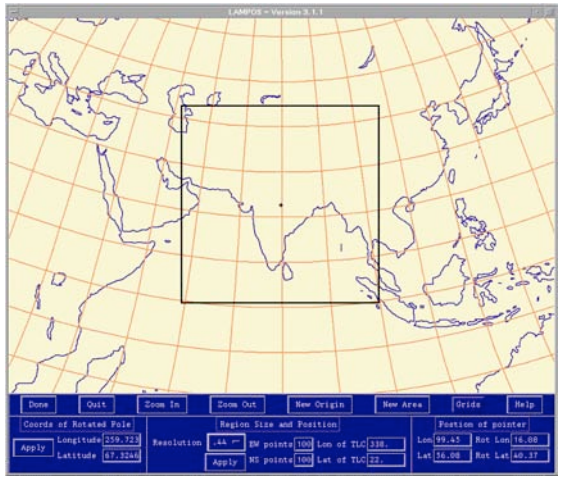


- Climate change scenarios developed using Hadley Centre Regional Climate Models.
- Model simulations performed for the current period (1961-90), A2 (high emissions) and B2 (low emissions) scenarios for the future period (2071-2100).
- Temperatures projected to increase by as much as 3° to 4°C towards the end of 21st century.
- Large-scale increase in monsoon rainfall (10 to 30%), but substantial spatial differences.

PRECIS Runs at IITM

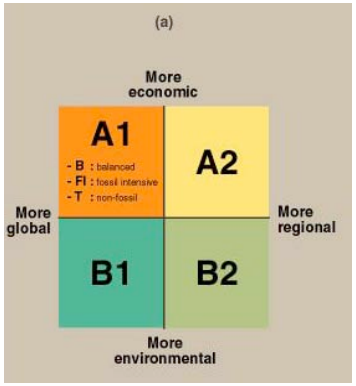
(Resolution: 50km)

Evaluation experiment using LBCs derived from ERA-15 (1979-93)



LBCs from Hadley Centre Models

- *Baseline (1961-90) – 3 members*
- *A2 scenario (2071-2100) -3 members*
- *B2 scenario (2071-2100)*
- *3 Members of QUMP (1951-2100) – A1b*



LBCs from ECHAM

- *Baseline 1961-1990*
- *A2 scenario :1991-2100*
- *B2 scenario : 1991-2100*

Climate change research in India

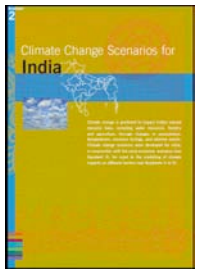
WMO

Natcom india
Ministry of Environment & Forests
Govt.of India
GEF/UNFCCC

MoEF
Govt. of India

INDO-UK
defra
Department for Environment Food and Rural Affairs

WINROCK INTERNATIONAL INDIA
ERM Int. India



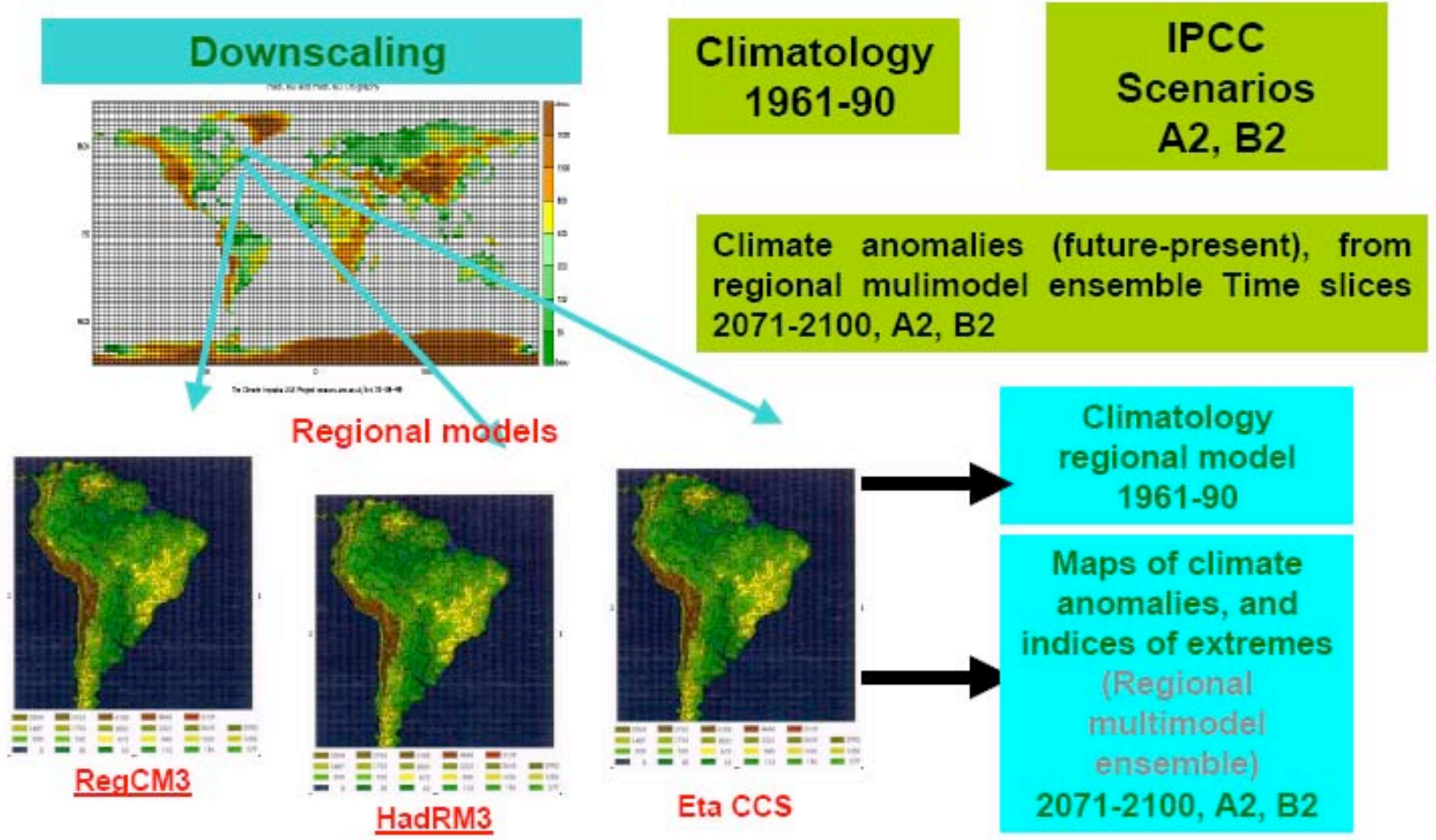
Climate Change Scenario Development
I.I.T.M, Pune

- Agriculture — IARI, Delhi
- Ecology & Forests — IISc, Bangalore
- Water — IIT, Delhi
- Energy — TERI, Delhi
- Industry & Transportation — IIM, Ahmedabad
- Sea Level — NIO, Goa

Key Benefits

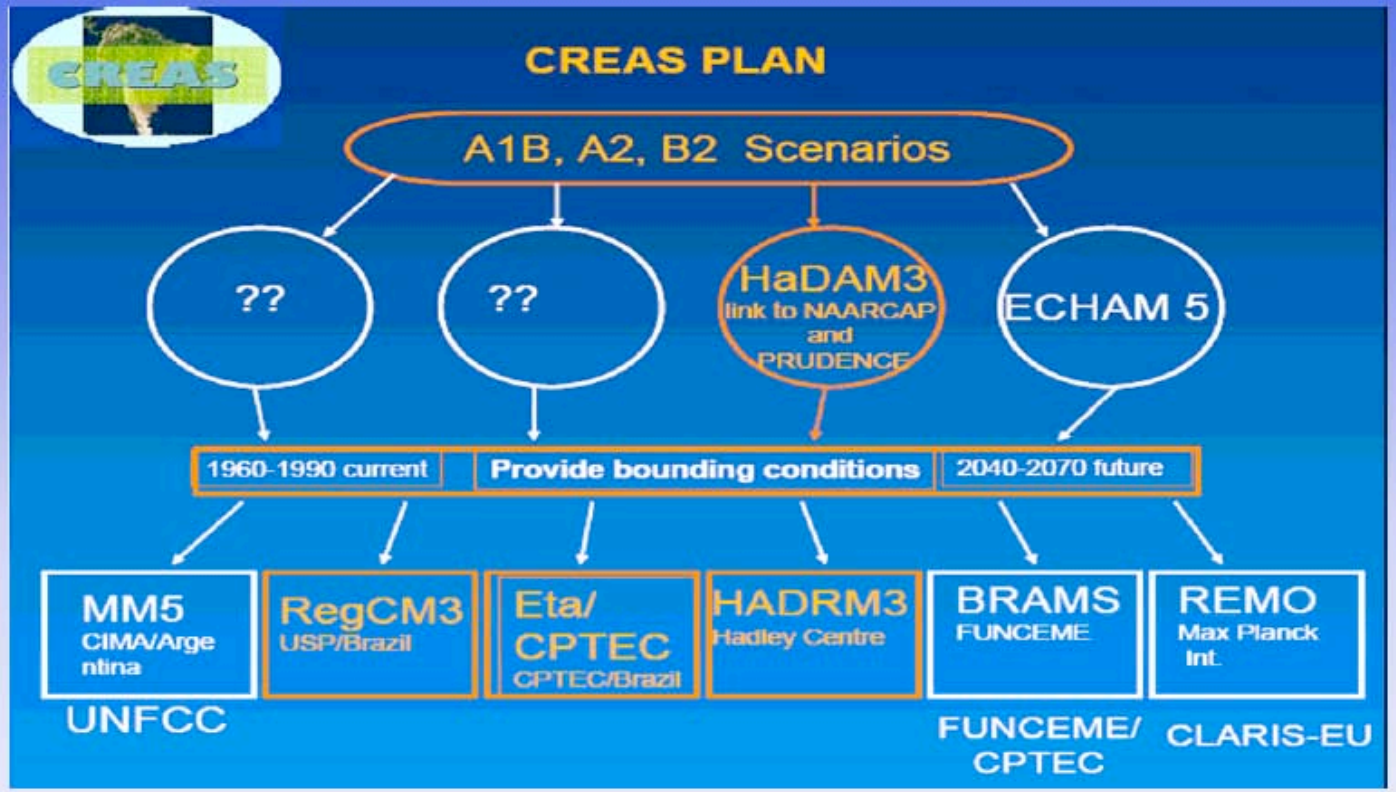
- Establishment of a framework for multi-disciplinary research in climate change impacts.
- Successful application of state-of-art modelling tools and capacity building.
- Comprehensive picture of impacts of climate change, reported in National Communication to the UNFCCC.
- A large database on scenarios and impacts, that can feed more detailed studies for many years to come, and underpin future adaptation strategies.
- Interactions between Indian and UK researchers to share their experiences and perspectives in the area.
- Networking of South Asian countries in climate change assessments.

Regional Climate Change Scenarios in South America (CREAS)



Dynamic Dowscaling of GCM in Argentina and Brazil

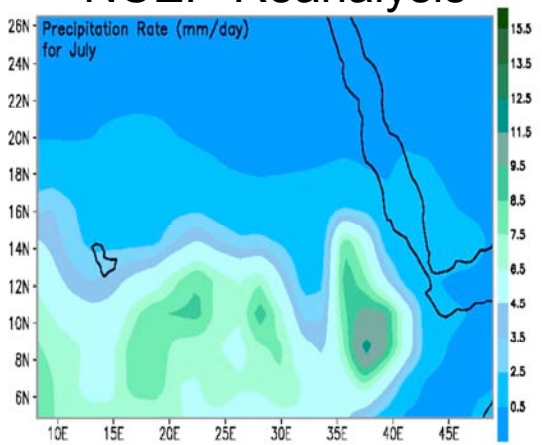
Regional Climate Change Scenarios for South America (CREAS)



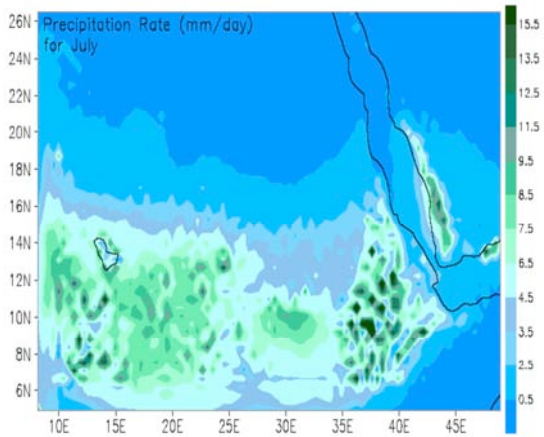
Similar efforts in Chile, Colombia, Costa Rica, Mexico, Perú, etc.

Precipitation estimates over Eastern Africa

NCEP-Reanalysis



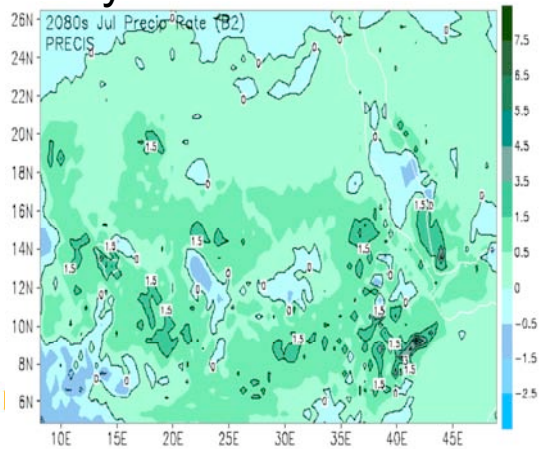
PRECIS



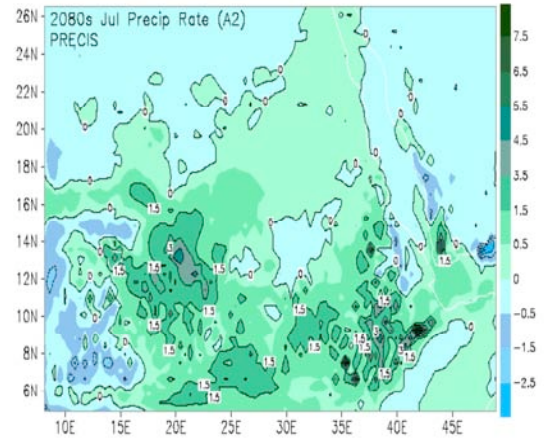
Current climate (1961-1990)

Captures the regional rainfall pattern along the East African steep topography and Red Sea area

July rainfall 2080 -B2



July rainfall 2080 -A2



Future projections: 2080s

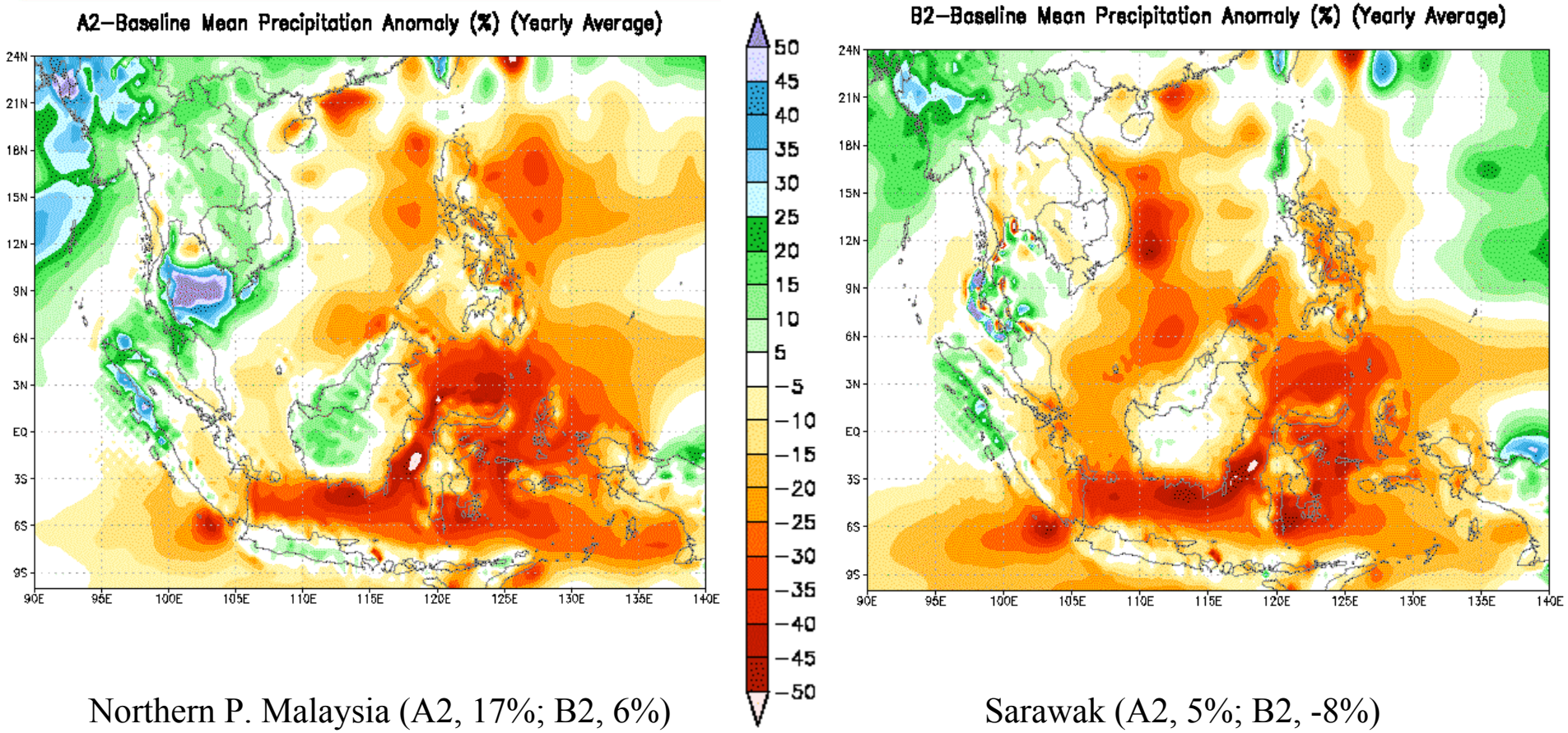
ncreased rainfall (1.5mm/day) over the domain for both A2 & B2

ore areas in A2 would experience higher rainfall increases

Mean Annual Precip Anomaly

Precip deficit over maritime SEA

-12%



Northern P. Malaysia (A2, 17%; B2, 6%)

Southern P. Malaysia (A2, -3%; B2, -20%)

Sarawak (A2, 5%; B2, -8%)

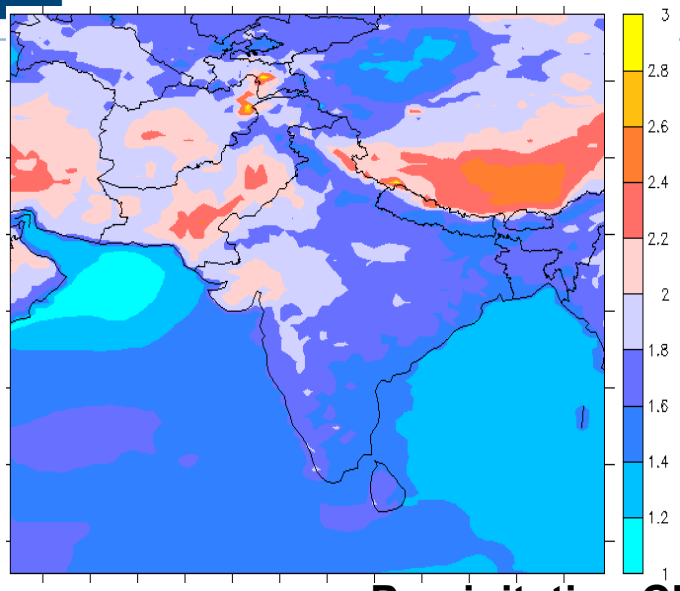
Sabah (A2, -15%; B2, -18%)

Results for Climate Change

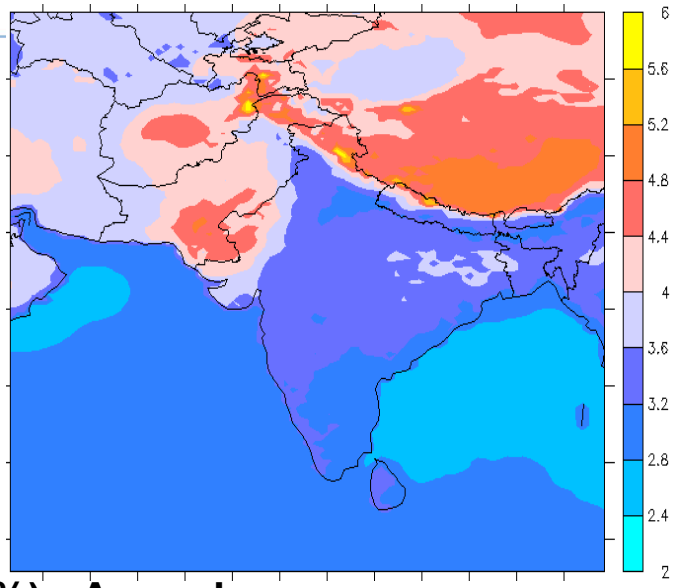
F1 =2040-2049
F2 =2071-2080

Temperature Change (°C) - Annual

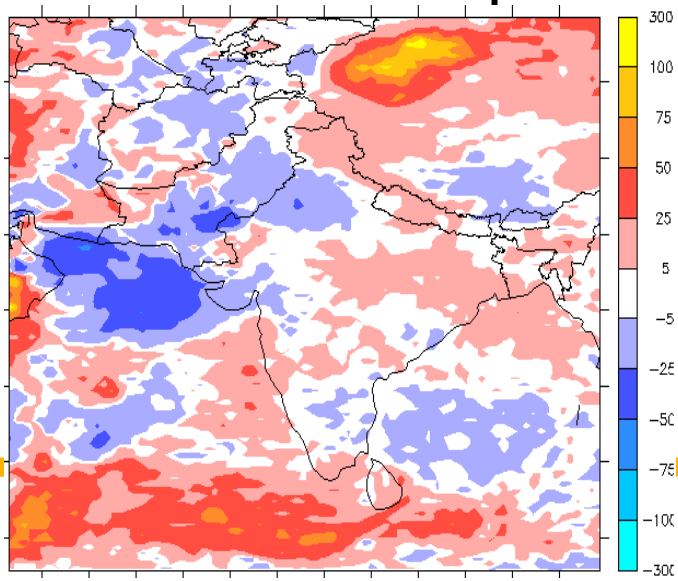
F1-BASE

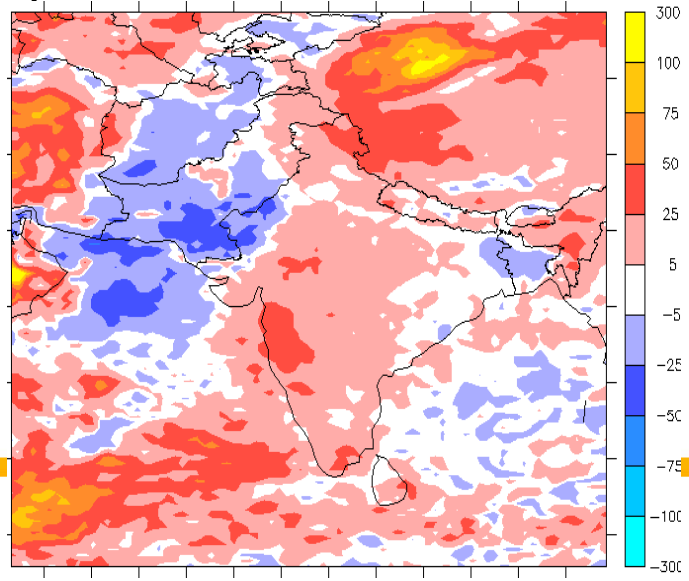


F2-BASE



Precipitation Change (%) - Annual



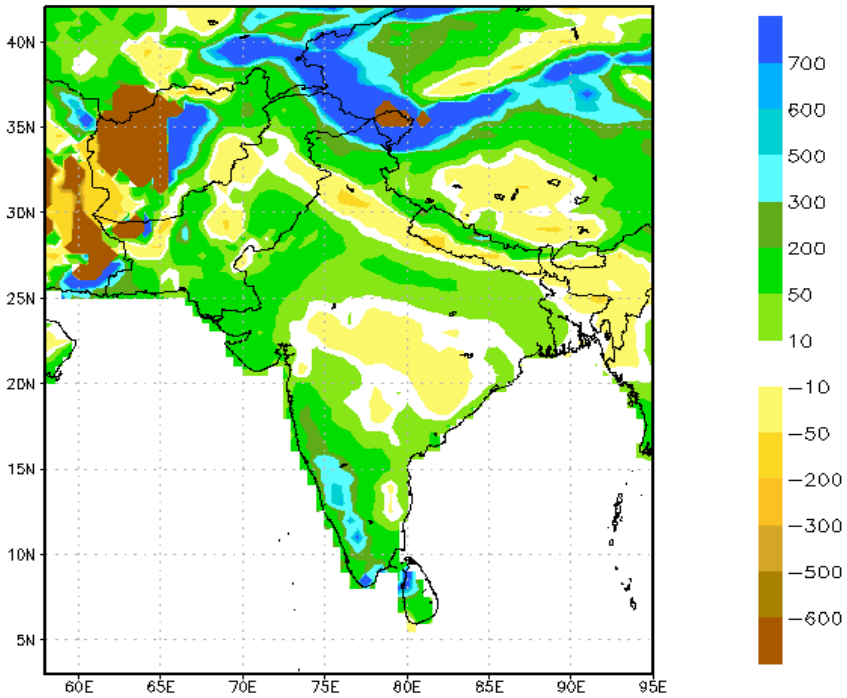


PRECIS vs RegCM3 Biases (ERA40-CRU)

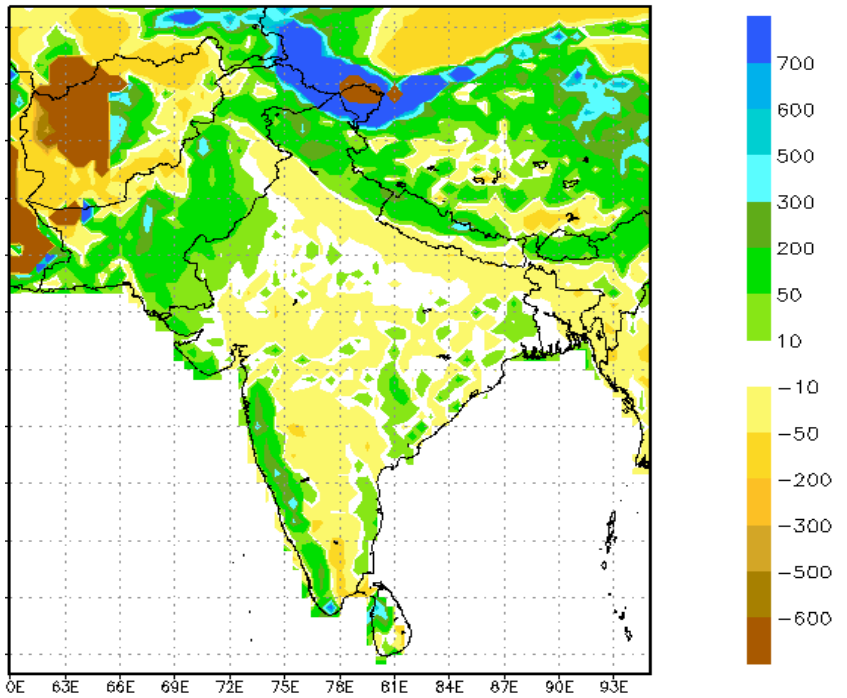
Summer only

Precipitation (%)
(1961-1990)

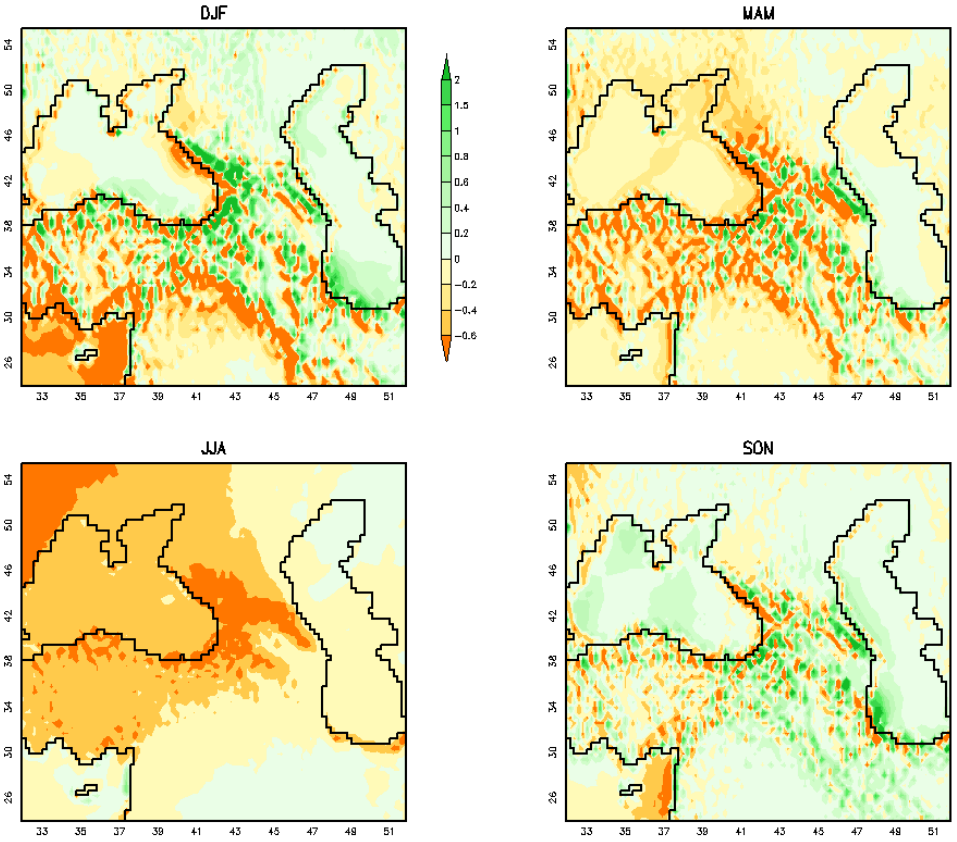
RegCM3 (ERA40)

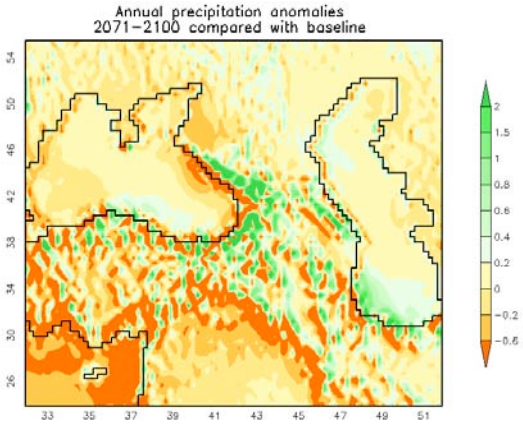


PRECIS (ERA40)



Analysis of results
Precipitation





During spring and summer months over whole Caucasus region, Turkey, Black Sea precipitation amount shall reduce by about **0.5 - 0.6 mm/day**. In JJA the reduction of precipitation will be more. So it may be consistent to suppose that drought intensity and frequency in summer will increase accordingly. But in autumn and winter increase of precipitation is predicted by model, in some parts, particularly in some coastal areas of Caspian Sea and Black Sea it's positive anomaly reaches **1.5-2 mm/day**. Over the Caspian Sea region the precipitation obtained will increase by 0.2-0.6 mm/day during all the seasons. Model predicts overall reduction of annual precipitation.

Some common aspects

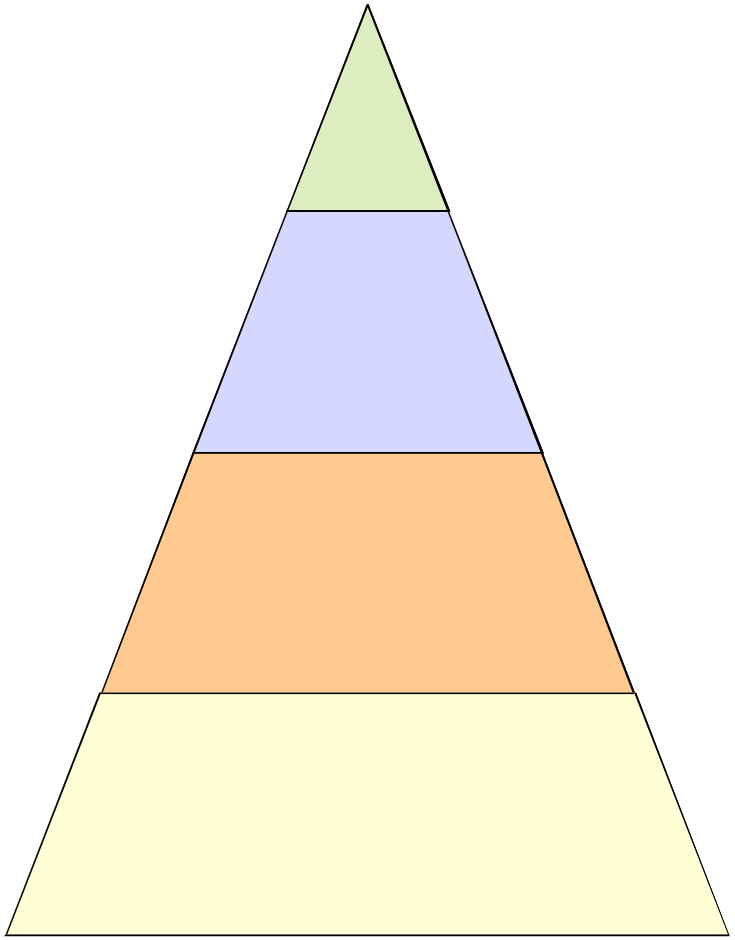
- Generally only few downscaled data exist for a limited number of GCMs and scenarios.
- Most popular route to generating downscaled data is to use Regional Climate Models for 1-2 scenarios and potentially 1-2 GCMs, which is not ideal for assessing risks –usually restricted to a few specialised centres of expertise
- Limited attempts at statistical downscaling but often constrained by lack of adequate expertise on the techniques and their application
- Lack of adequate understanding on how to correctly interpret/use downscaled data, particularly in the user sectors.
- Correctly using the downscaled data in applications and further impact (e.g. crop and hydrological) modelling, requires constant interaction and discussions (beyond workshop environments) between the producers of the downscaled climate change data and the impact modellers.

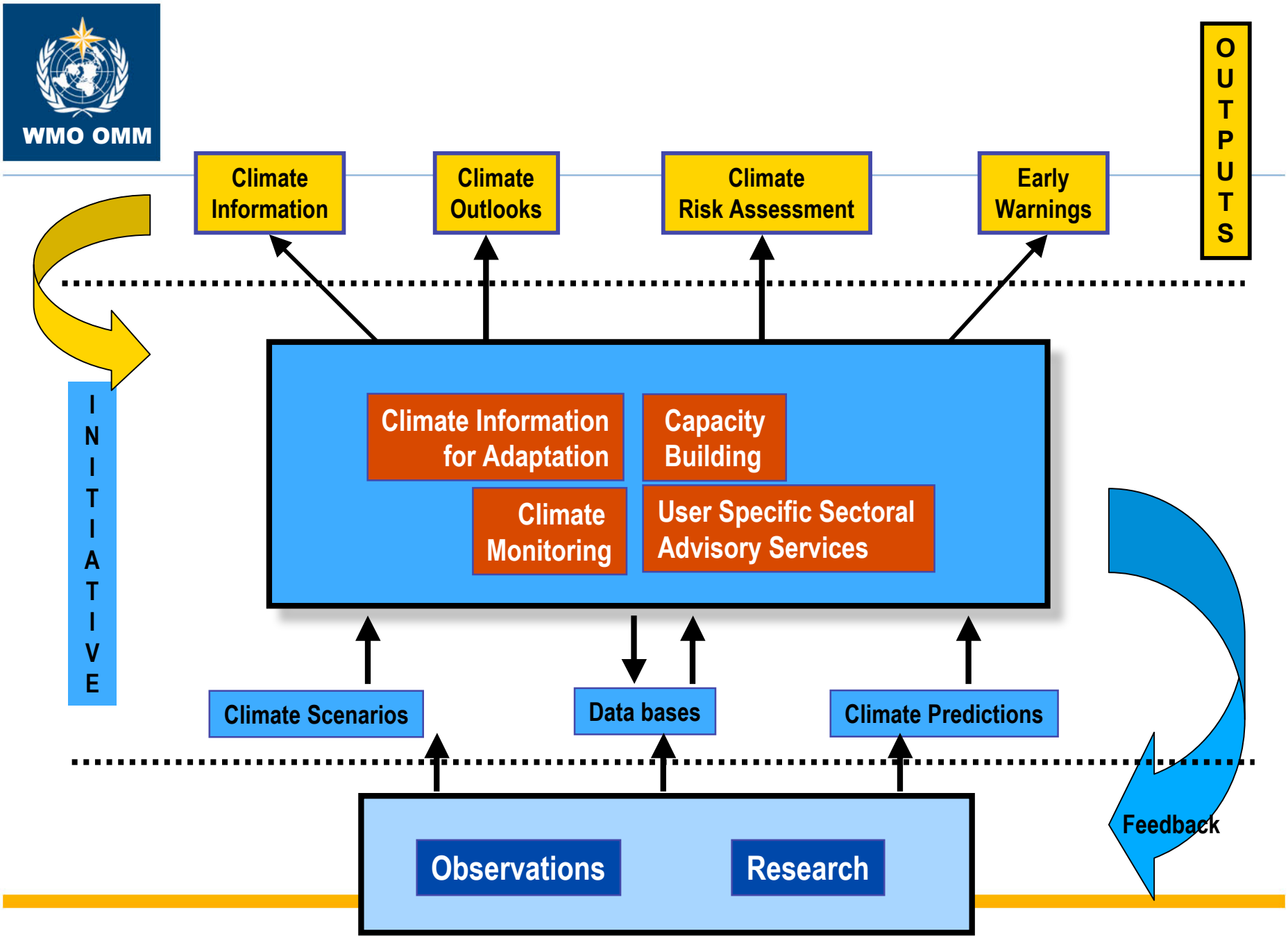
WMO Initiative to Support Climate Change Adaptation

- Endorsed by WMO Executive Council in June 2008.
- Mission: To facilitate provision of user oriented climate information, products, advisories and services to support national and regional climate risk assessment, climate adaptation planning and implementation practices for sustainable development

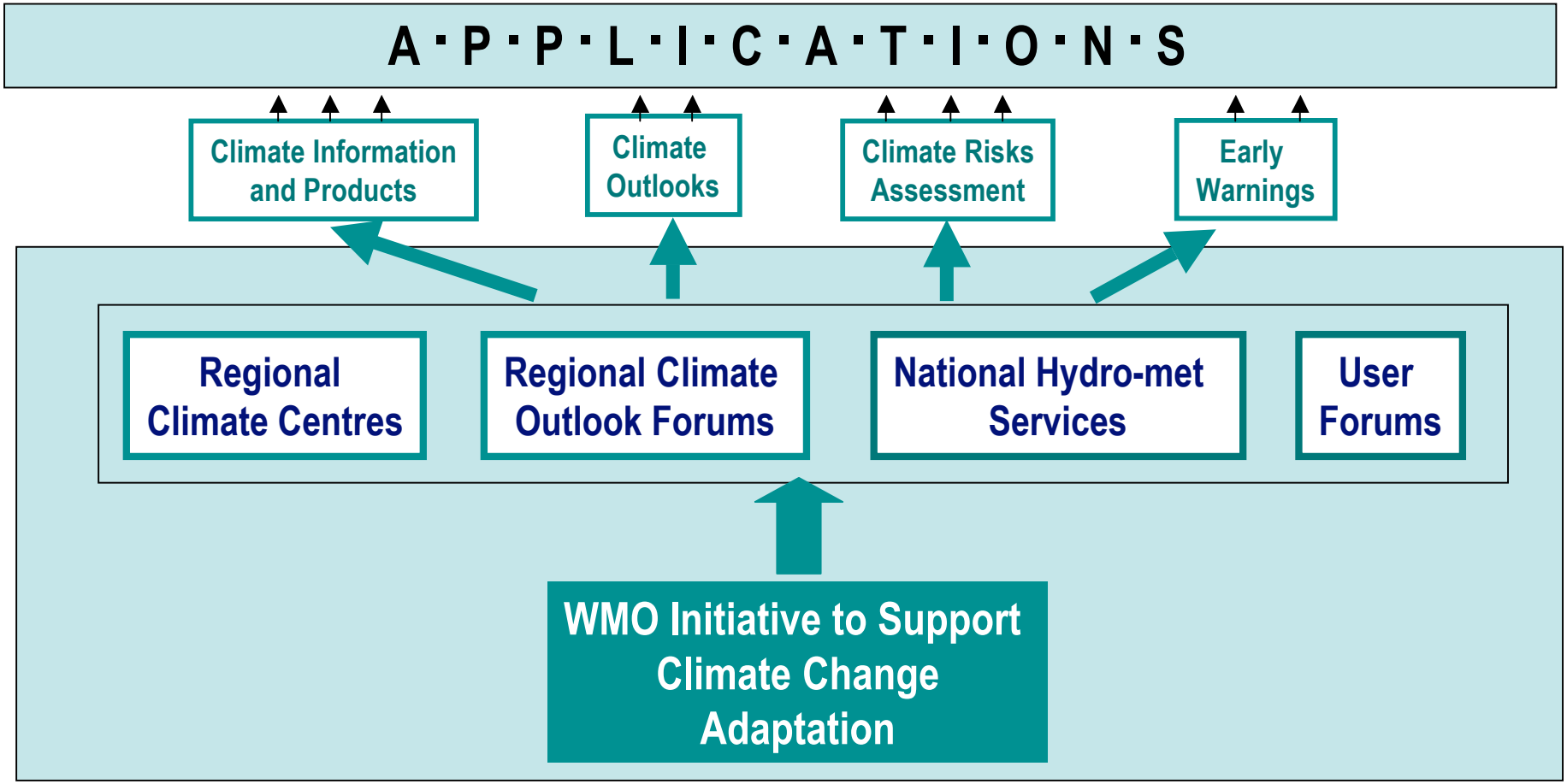
Objectives

- Facilitate use of climate information for mainstreaming climate risks in decision making
- Make available data and information for developing adaptation strategies and integrating them in national development agenda
- Enhance the national capacities in provision of user-oriented climate information
- Help develop regional capacities
- Support the scientific foundation for climate adaptation strategies

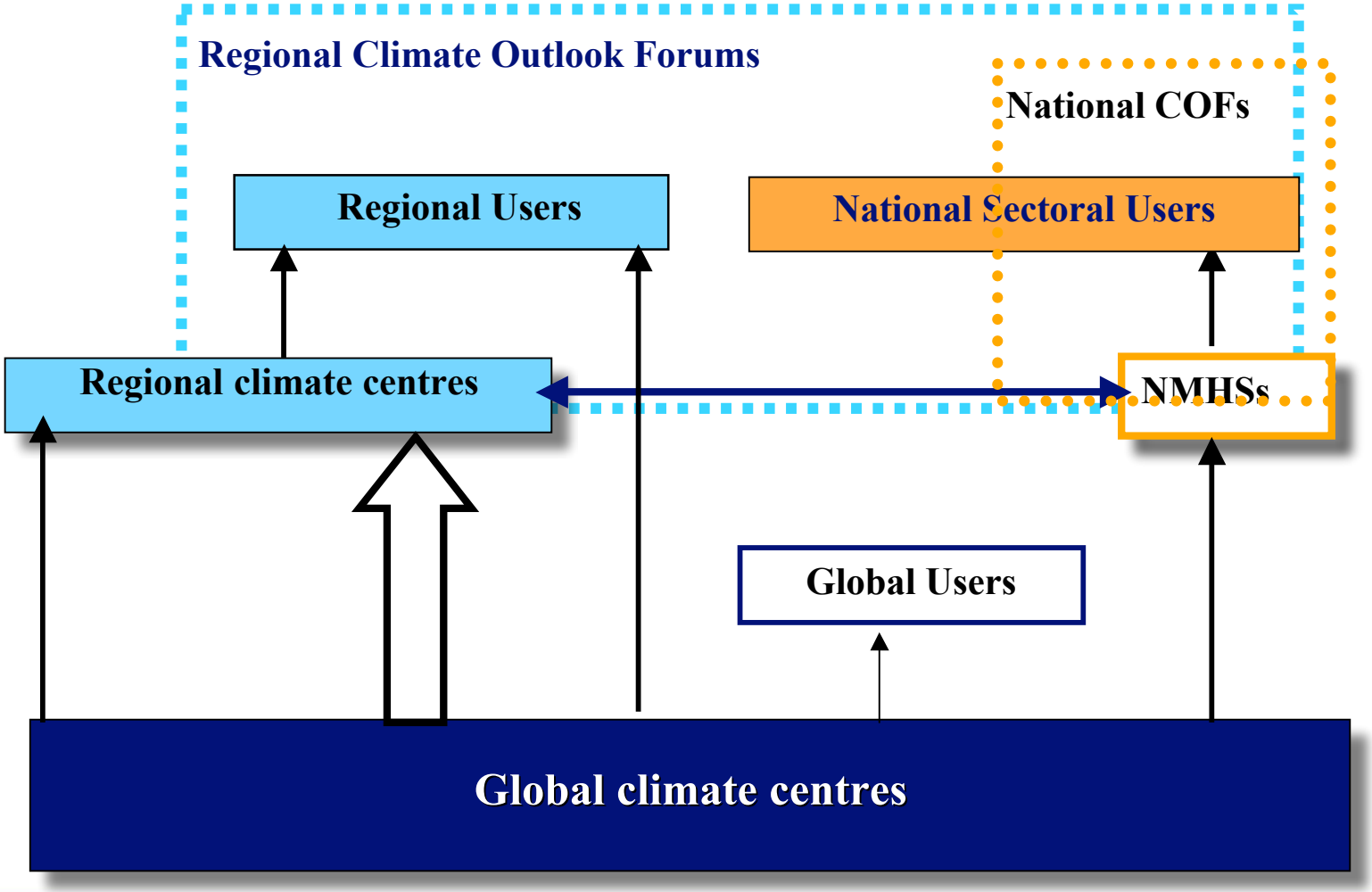



WMO OMM
OUTPUTS
Climate Information
Climate Outlooks
Climate Risk Assessment
Early Warnings
INITIATIVE
Climate Information for Adaptation
Capacity Building
Climate Monitoring
User Specific Sectoral Advisory Services
Climate Scenarios
Data bases
Climate Predictions
Observations
Research
Feedback

WMO OMM


A·P·P·L·I·C·A·T·I·O·N·S
Climate Information and Products
Climate Outlooks
Climate Risks Assessment
Early Warnings
Regional Climate Centres
Regional Climate Outlook Forums
National Hydro-met Services
User Forums
WMO Initiative to Support Climate Change Adaptation

Network for Climate Information (NCI): Coordinated System for development and delivery of climate information to users



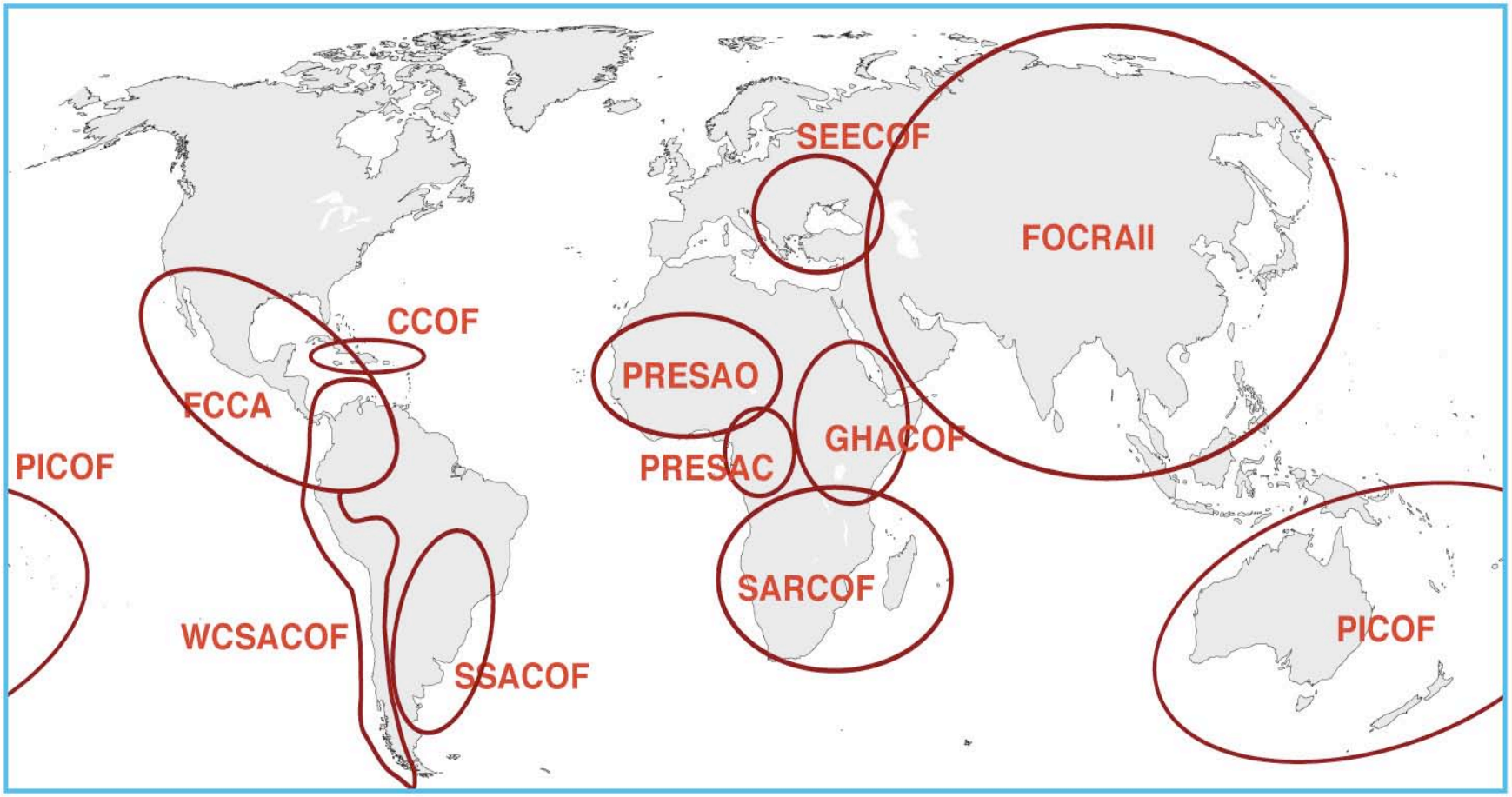
Climate Change and RCOFs (1/2)

- RCOFs worldwide have been set up so far with the main focus on seasonal prediction.
- However, the same RCOF mechanisms can be effectively expanded to cater to the needs of developing and disseminating regional climate change information products.
- Such initiatives are already being taken up by some RCOFs (e.g., Greater Horn of Africa)
- Regional assessments of observed and projected climate change, including the development of downscaled climate change scenario products for impact assessments, can be included in the product portfolio of RCOFs

Climate Change and RCOFs (2/2)

- RCOFs have been recognized to have potential contributions to the UNFCCC/SBSTA Nairobi Work Programme (NWP) on Adaptation to Climate Change
- CLIPS/RCOFs have been included in the UNFCCC Compendium of Methods and Tools in support of climate adaptation
- RCOFs form a core component of WMO Action Pledge to the NWP on climate information, products and services for adaptation

Existing RCOFs worldwide



(http://www.wmo.int/pages/prog/wcp/wcasp/clips/outlooks/climate_forecasts.html

RCOFs

- A COF is inclusive – all available information is reviewed, in open discussion.
- Common elements are highlighted, leading to greater confidence in those aspects.
- Users evaluate/discuss multiple sources of information (sometimes divergent), learn to use probabilistic outputs and understand their uncertainty.
- COFs provide a regular platform for interdisciplinary interaction, particularly ahead of a crucial season.
- UNFCCC recognizes COFs as an effective tool for adaptation.

SEECOF and Climate Change

- Moving towards a future consensus on regional climate change over SEE
- Individual results vary, but some common signals are apparent:
  - Warming
  - Increase in the frequency of extreme climate events
  - Drier climate in summer

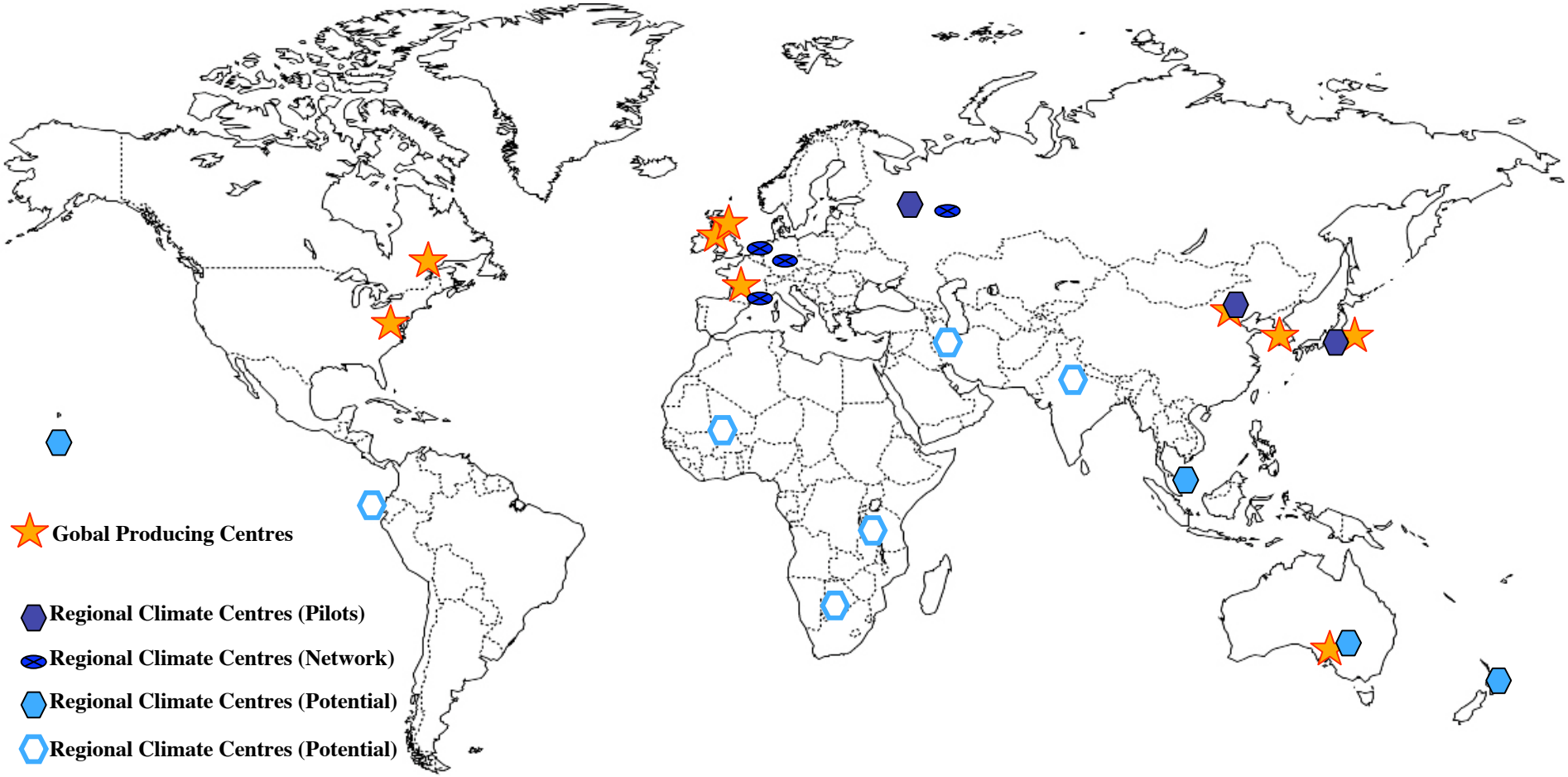
SEECOF and Climate Change

- SEECOF noted that several attempts have been made to develop regional climate change scenarios for SEE, but that there is considerable diversity in approaches.
- SEECOF processes can play a crucial role in promoting a collaborative and complementary approach, thereby facilitating consensus and consistency in generating climate change information in support of climate adaptation.
- SEECOF promotes regional ownership of climate knowledgebase, and supports region-driven climate change actions.

Regional Climate Centres (RCCs)

- RCCs will be Centres of Excellence, designated by CBS and CCl, to perform regional-scale climate functions, including:
  - Operational LRF and Climate Monitoring
  - Coordination between RCCs, GPCs and NMHSs in the region
  - Data services
  - Climate Applications
  - Training and capacity building
  - Research and Development
- RCCs will be complementary to and supportive of NMHSs, who will deliver all Warnings and national-scale products
- Establishment of RCCs will be initiated by Regional Associations, based on regional needs and priorities

Global Network for Climate Information



Observations in Support of the Design of Effective Adaptation Strategies

- Reliable and detailed (temporally & spatially) regional climate information, including current and future assessments of climate variability and change, is essential in the design of effective adaptation strategies and depends on:
  - availability of good quality climate observations with sufficient spatial coverage over long periods
  - adequacy of models to depict current and future regional climate
  - thorough understanding and appreciation of the uncertainties and constraints associated with the use of both data and regional and global models
- Joint WCRP/WMO-ICPAC project supported by the World Bank addresses these issues

A Pilot Project: Climate Observations and Regional Modeling in Support of Climate Risk Management and Sustainable Development

- For: Representatives of meteorological services in the Greater Horn of Africa
- Principal Partners: WCRP, WMO, ICPAC
- Other Partners: Hadley Centre, NCDC
- With funding from: World Bank
- Objectives of 3-workshop programme:
  - Ensure attention given by countries in Eastern Africa to observation and data needs
  - Demonstrate the use and value of regional models
  - Provide advice on model limitations
  - Improve regional capabilities for using data records and model projections for adaptation planning
- An initial planning workshop in the second quarter of 2009 will develop a detailed implementation plan

CCI Efforts to support Downscaling

- WMO Commmission for Climatology (CCI) Expert Team on Research Needs charged with the development of guidance on downscaling, which can benefit developing countries.
- Best practices documents within the WMO framework have special relevance to operational aspects, particularly seasonal forecasting, but have common elements with climate change.
- Links with WCRP initiatives on regional modelling and downscaling essential to avoid overlapping and ensure synergy
- Guidelines on best practices in downscaling to be expedited before the next CCI session in January 2010; CCI will greatly benefit from interactions with the WCRP community.

World Climate Conference-3

Better climate information for a better future

WCC · 3

Geneva, Switzerland

31 August–4 September 2009

World Meteorological Organization
Weather • Climate • Water

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Canada

Die Bundesregierung

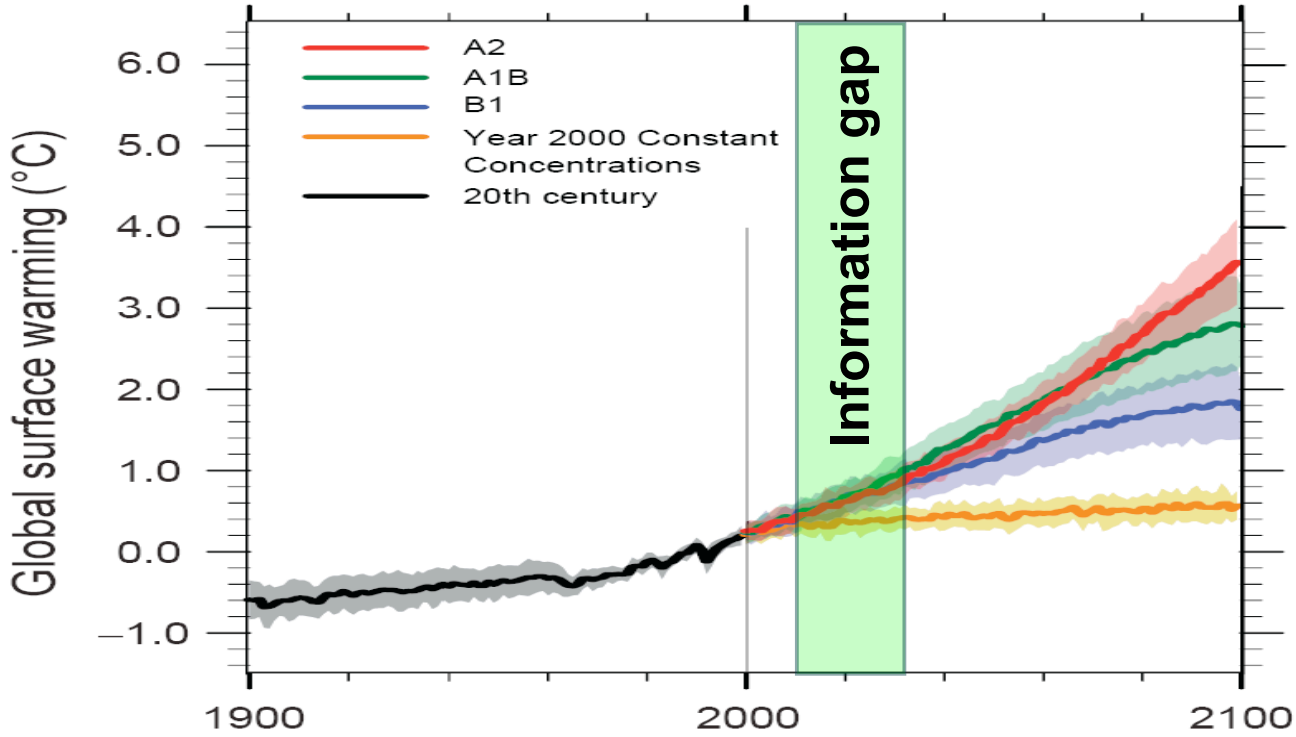
EUROPEAN COMMUNITY

GOBIERNO DE ESPAÑA

The Climate Challenge

- Climate risks affect all nations and has been a concern for humanity over generations!
- Seasonal to decadal prediction is one of the highest priorities to address the changing climate & reduce the impacts of future climate change as well.
- The public, climate dependent sectors and policymakers need robust and credible scientific and technical information in implementing climate services (disaster warning, climate risk management & adaptation).
- Adaptation and risk management should be one of the highest priorities under the UNFCCC and other international agreements.
- The WCC-3 will establish a framework for the provision and application of climate services at the global, regional, national and local levels.

Focus on the next 1-30 years



The IPCC process provides useful information for the time post 2050. But there is a conspicuous information gap to support management of regional and shorter term climate risks.

Expectations for WCC-3

- The WCC-3 is expected to provide direction to the world community to address the risks associated with climate such as droughts, floods, heat waves, famine and disease outbreaks, among others, as a step towards disaster risk reduction and adaptation to climate change through improved climate prediction science and information services together with their integration into decision-making.
- Conference will:
  - Set the stage for nations and organizations to identify the needs of end users who can benefit from improved climate predictions and information services
  - Address the state of knowledge and the capacity to mobilize climate science globally to advance seasonal to decadal predictions.
  - Negotiate the principles and discuss the global infrastructure and mechanisms to share new advances in science and information for the benefit of end users.

Thank You.

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