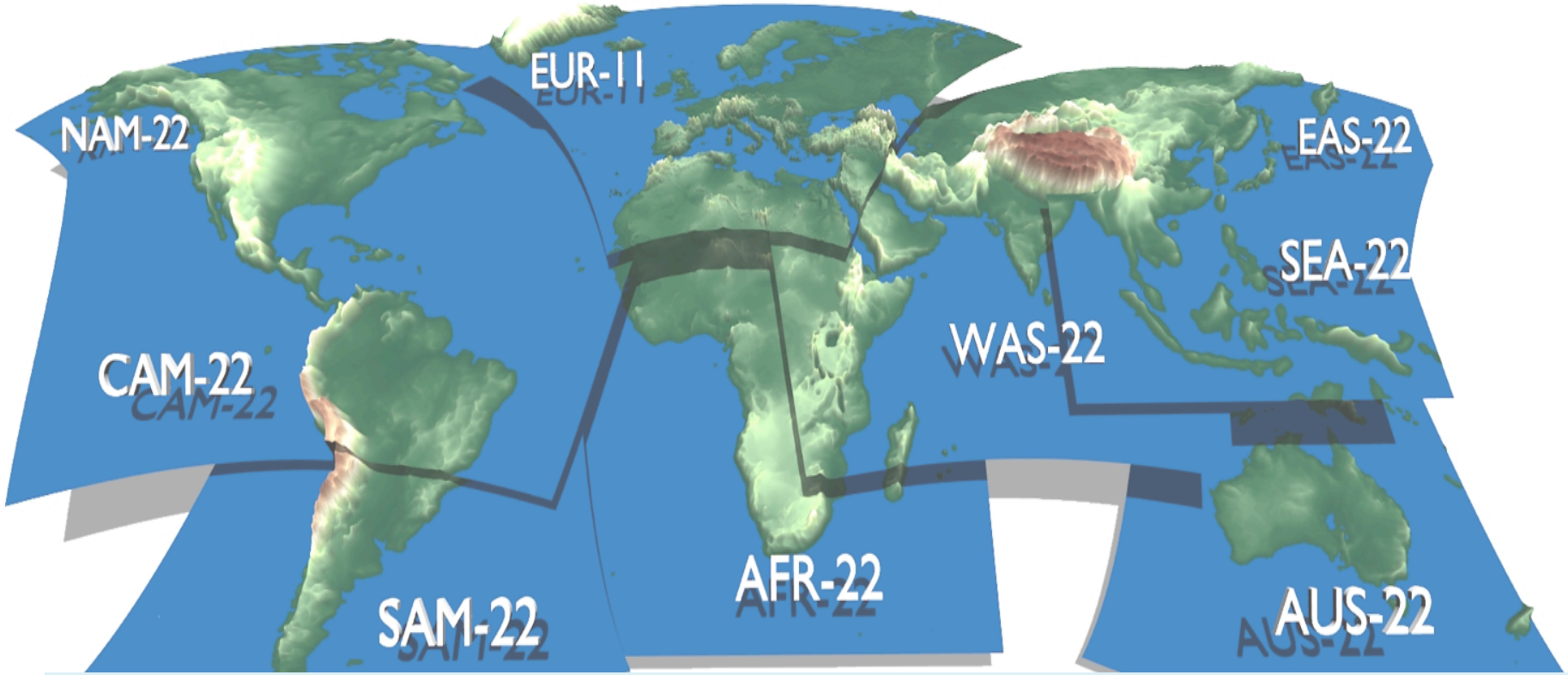
Overview of the RegCM CORDEX-CORE simulations and the IPCC Atlas



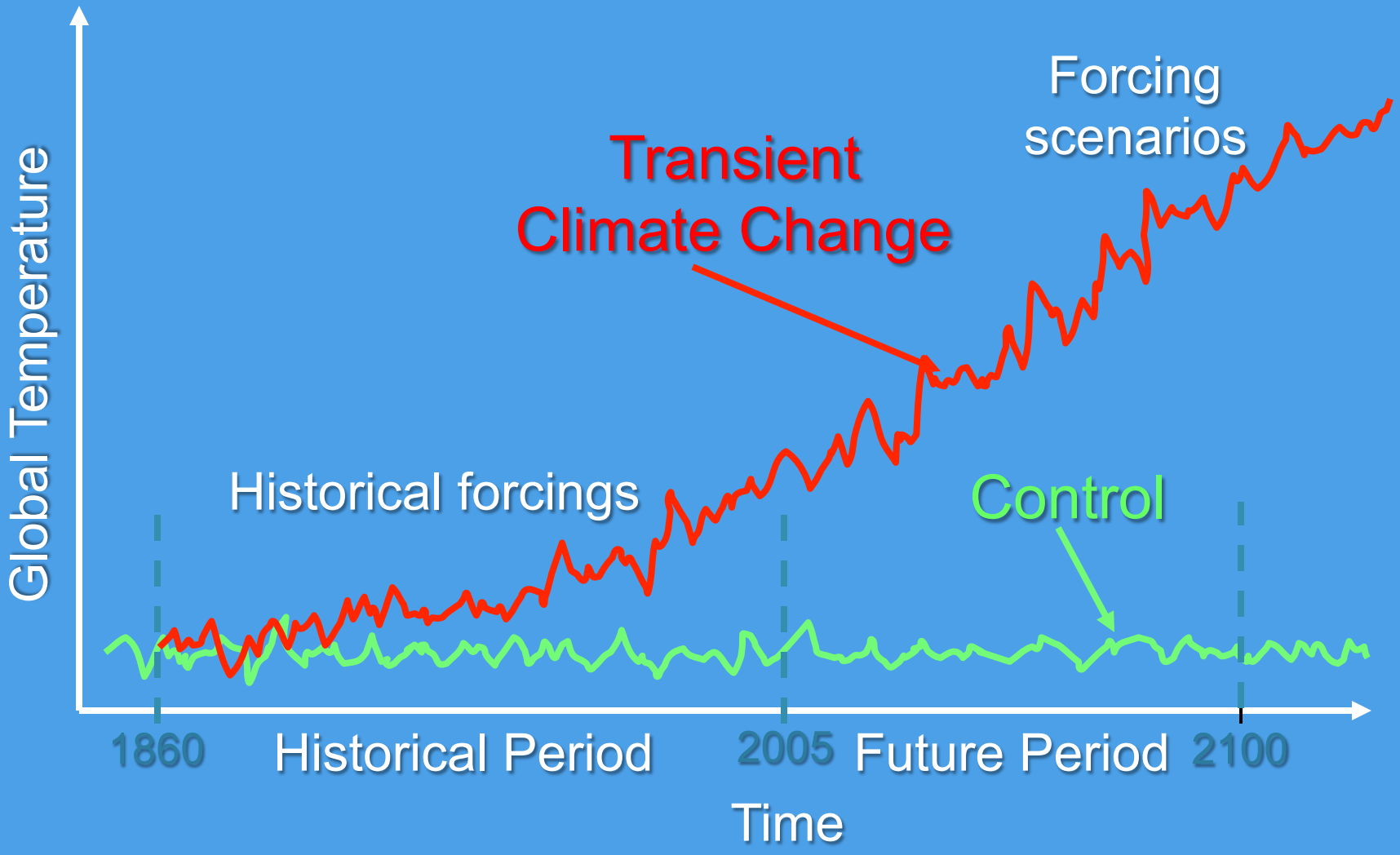
Erika Coppola, and ....

the ICTP Atlas team: Filippo Giorgi, Francesca Raffaele, Taleena Rae Sines, Abraham Torres, Graziano Giuliani, Adriano Fantini, James Ciarlo, Sushant Das, Fabio di Sante, Emanuela Pichelli, Russel Glazer

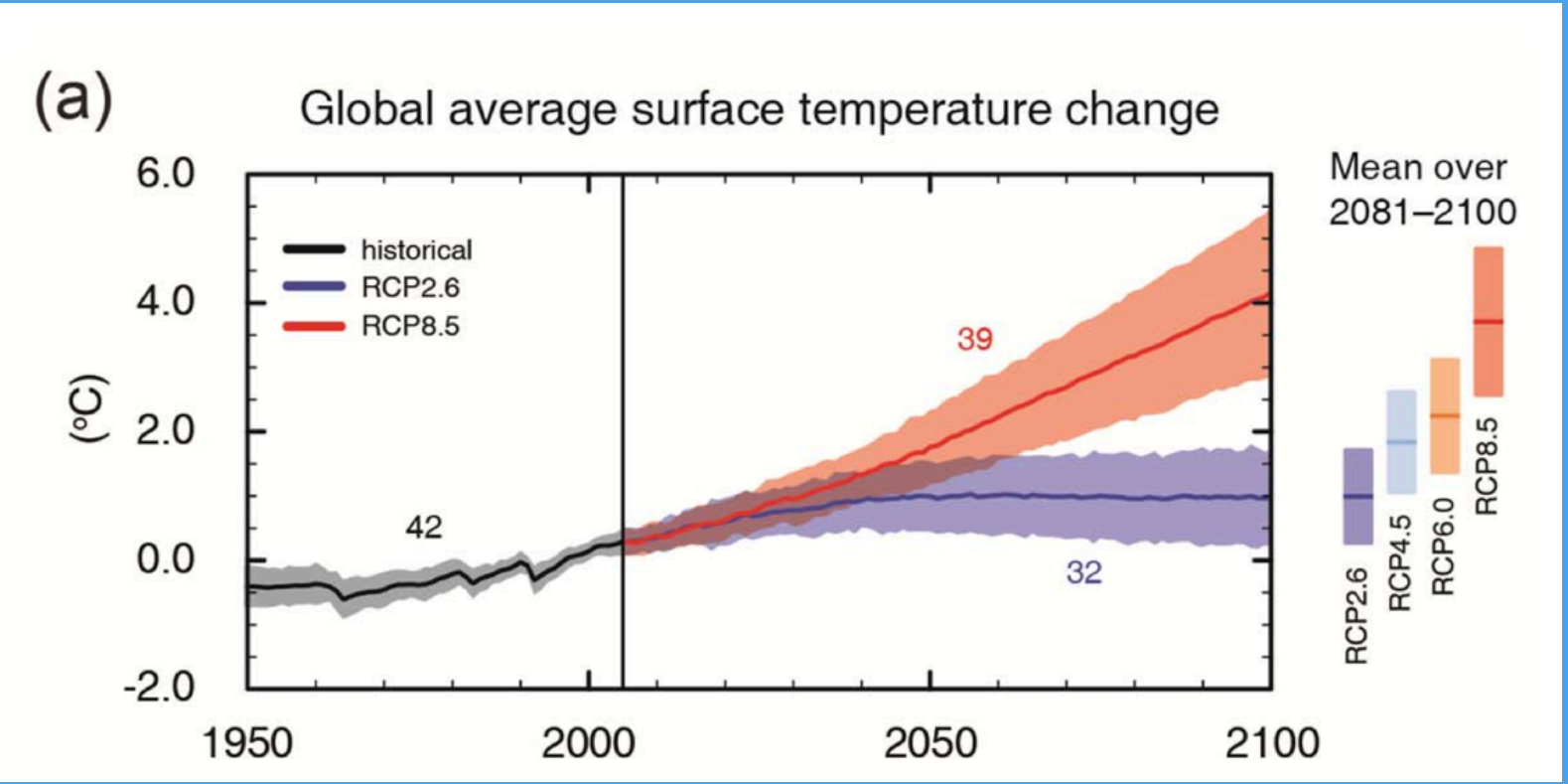
The Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy

The Abdus Salam International Centre for Theoretical Physics

Transient Climate Change "Projection" (using a GCM as boundary condition)



IPCC – 2013: Global temperature change projections for the 21st century

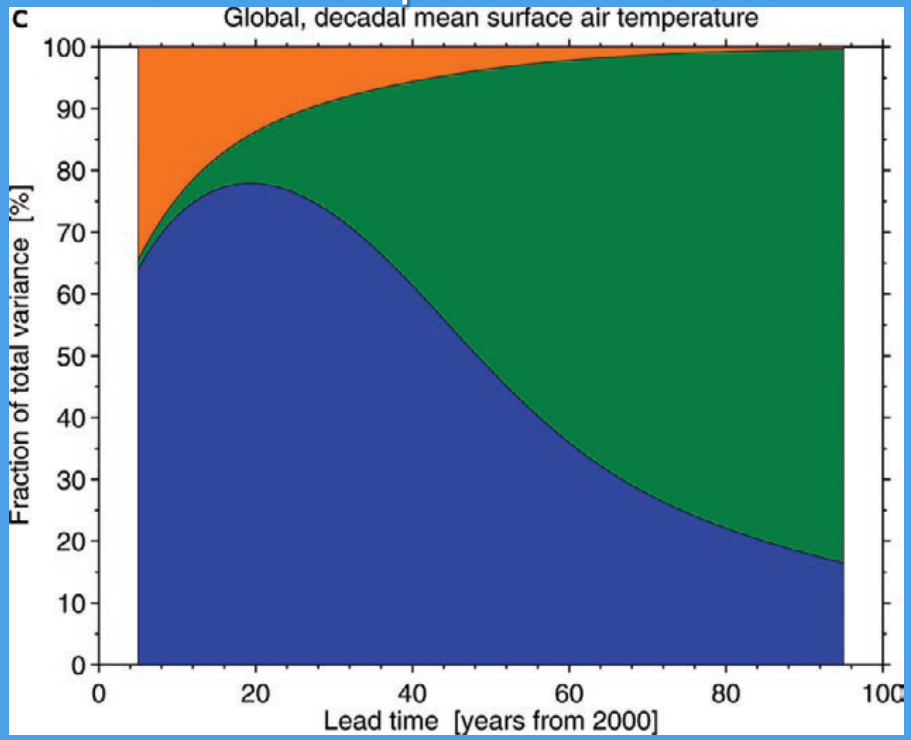


Fraction of uncertainty explained by different sources as a function of lead time

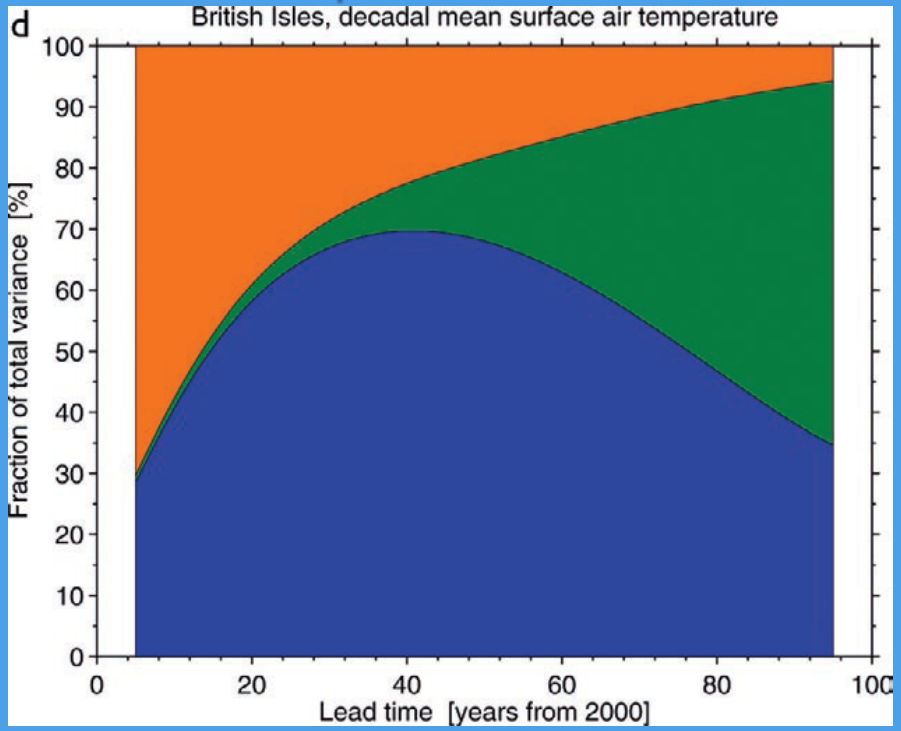
Internal variability
Scenario uncertainty
Model configuration uncertainty

Hawkins and Sutton 2009

Decadal temperature - Global



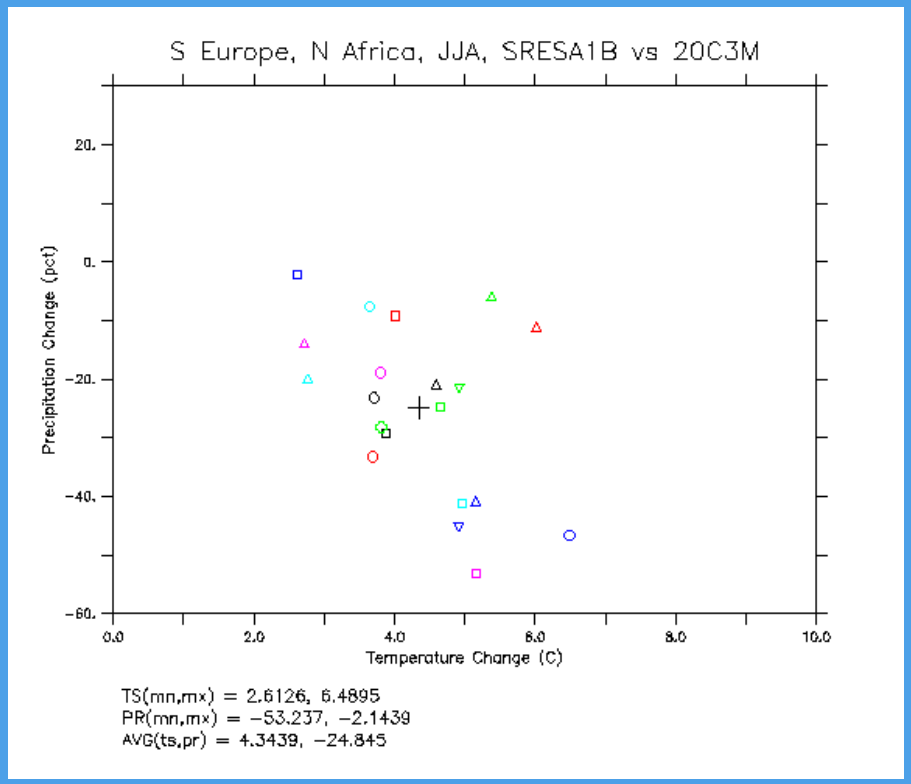
Decadal temperature – British Isles



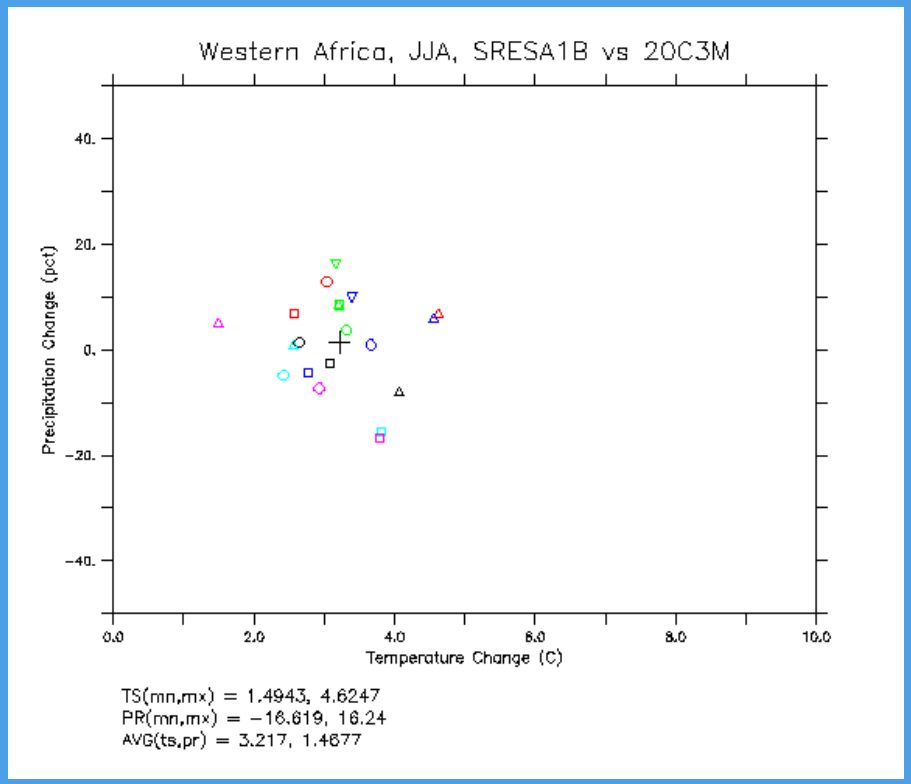
Model configuration uncertainty at the regional scale (AOGCMs)

Regional precipitation vs. temperature change

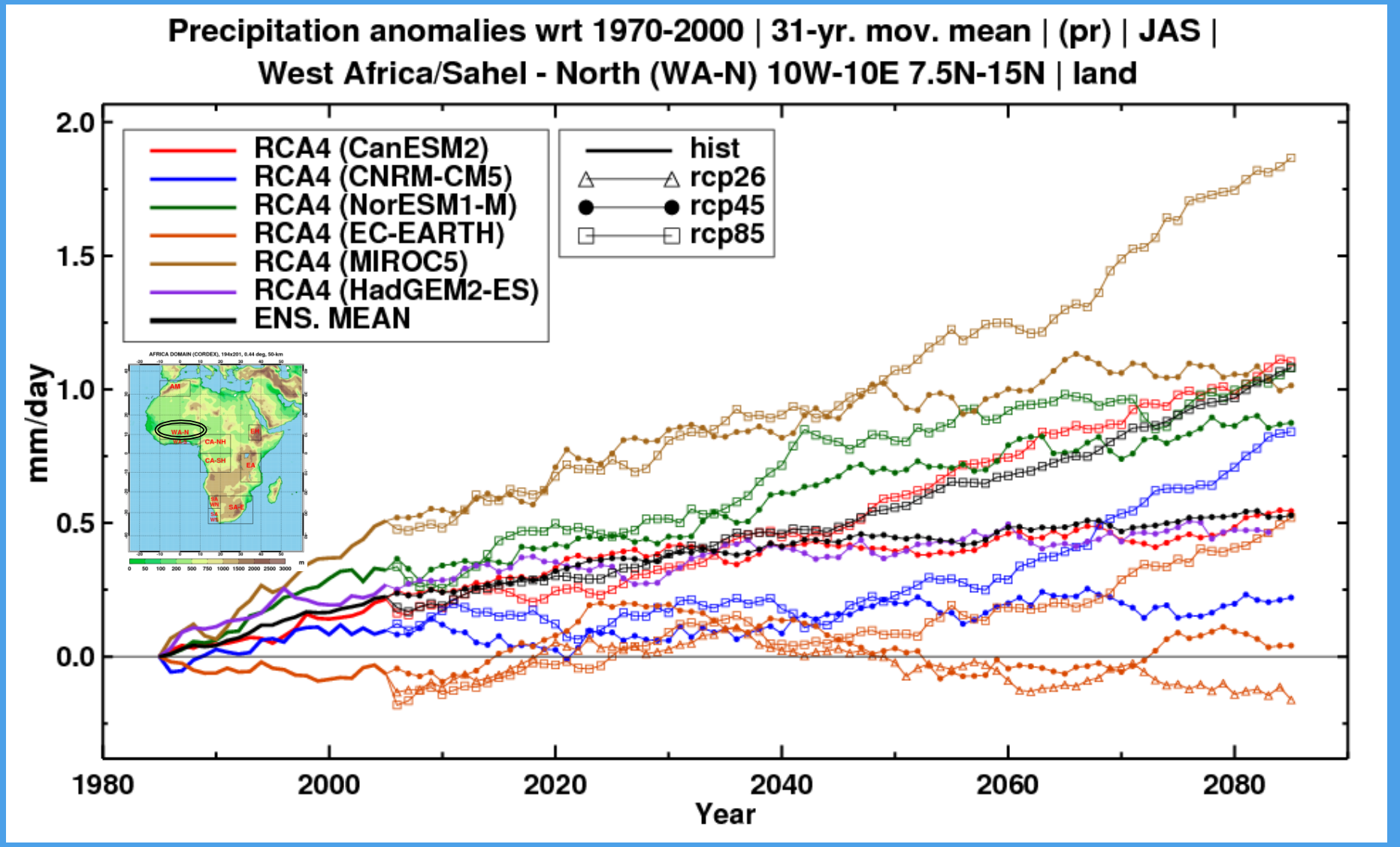
Mediterranean warm season



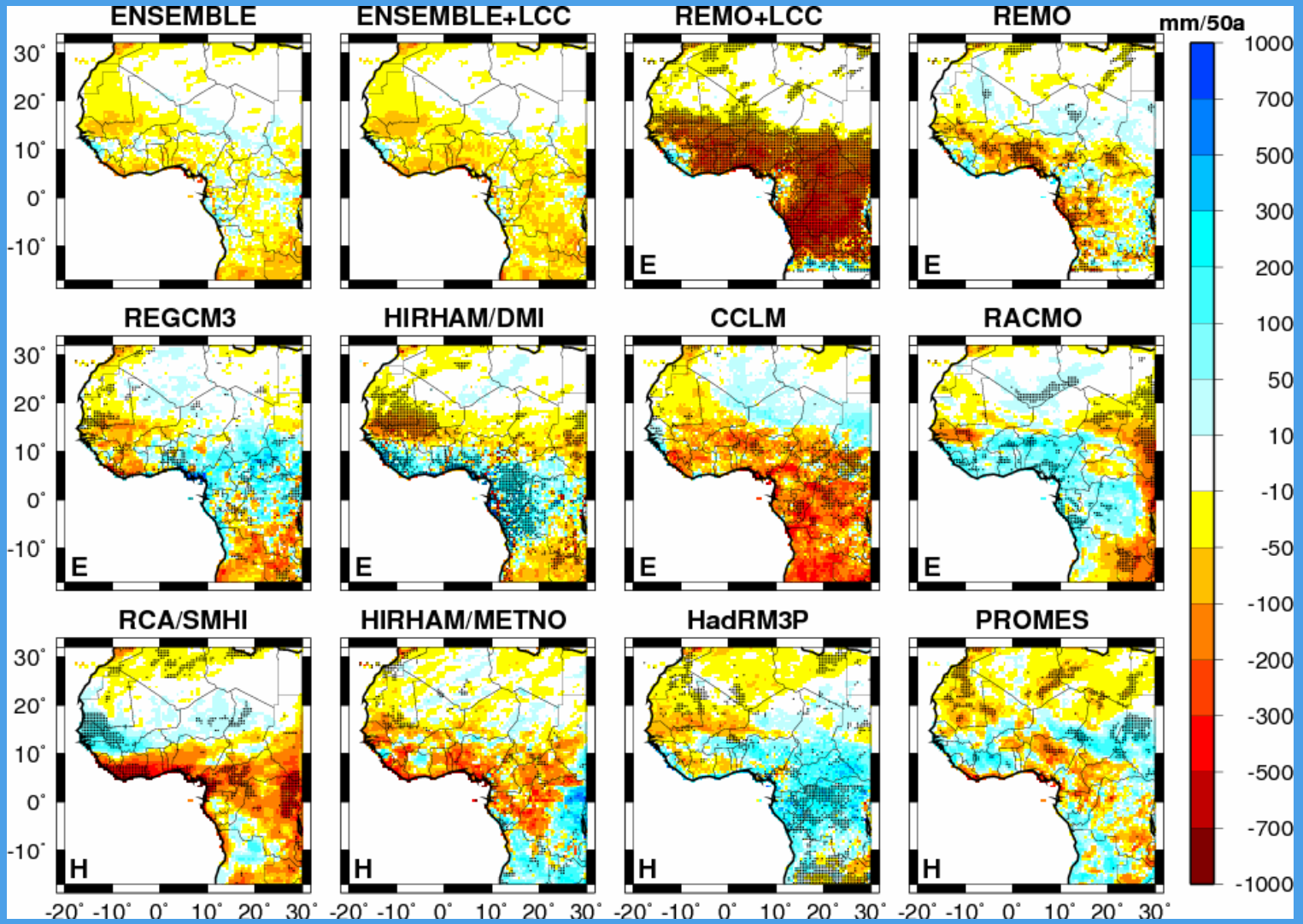
West Africa monsoon season



Trends on a regional scale



Precipitation trend 1990-2050

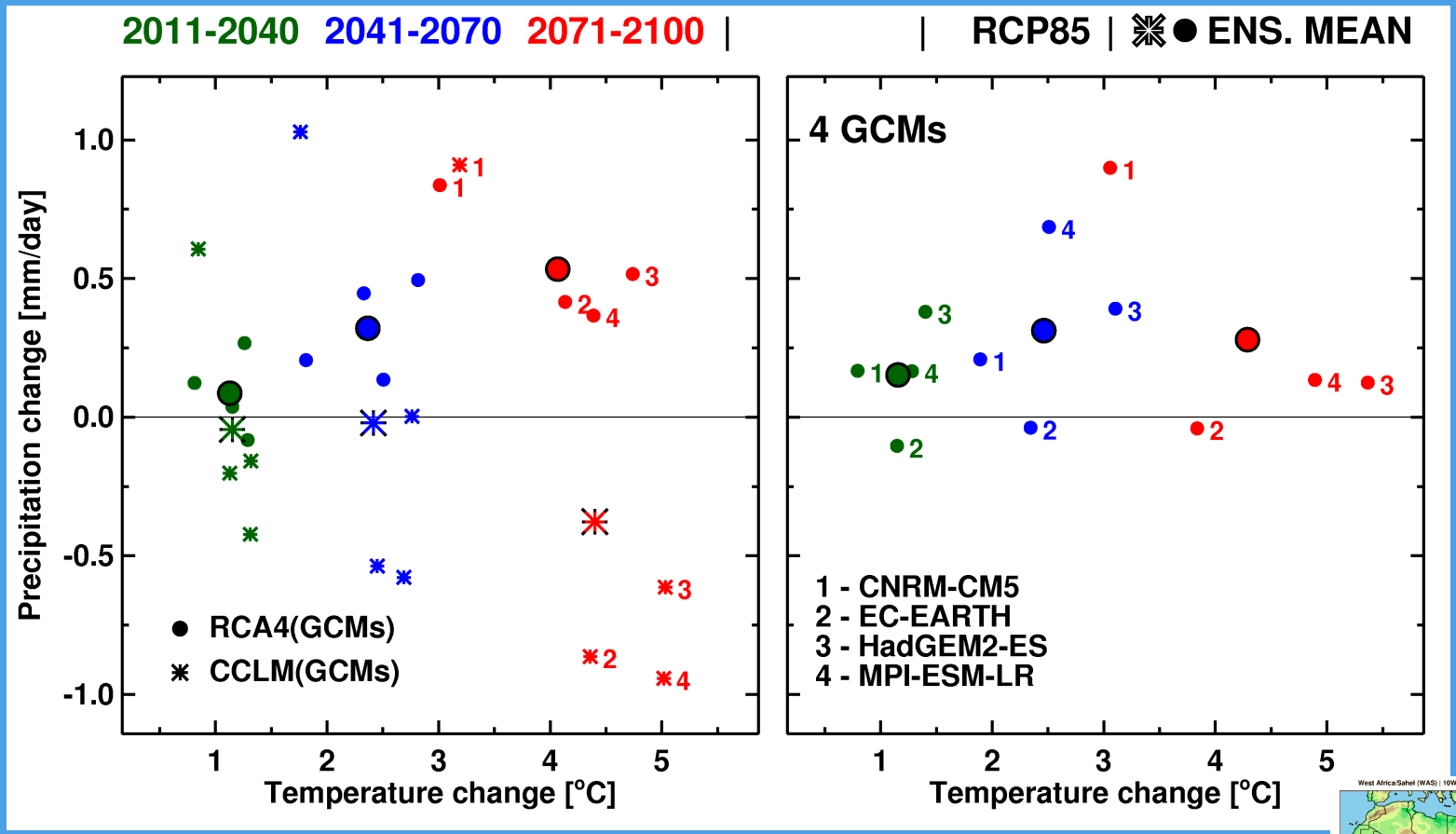


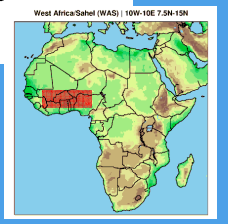
ECHAM5 LBC

HadCM3 LBC

West Africa: climate projections (JAS)

4 GCMs, RCA4 (4 GCMs) and CCLM (4 GCMs)





GCMs: a small increase in rainfall (ensemble average)

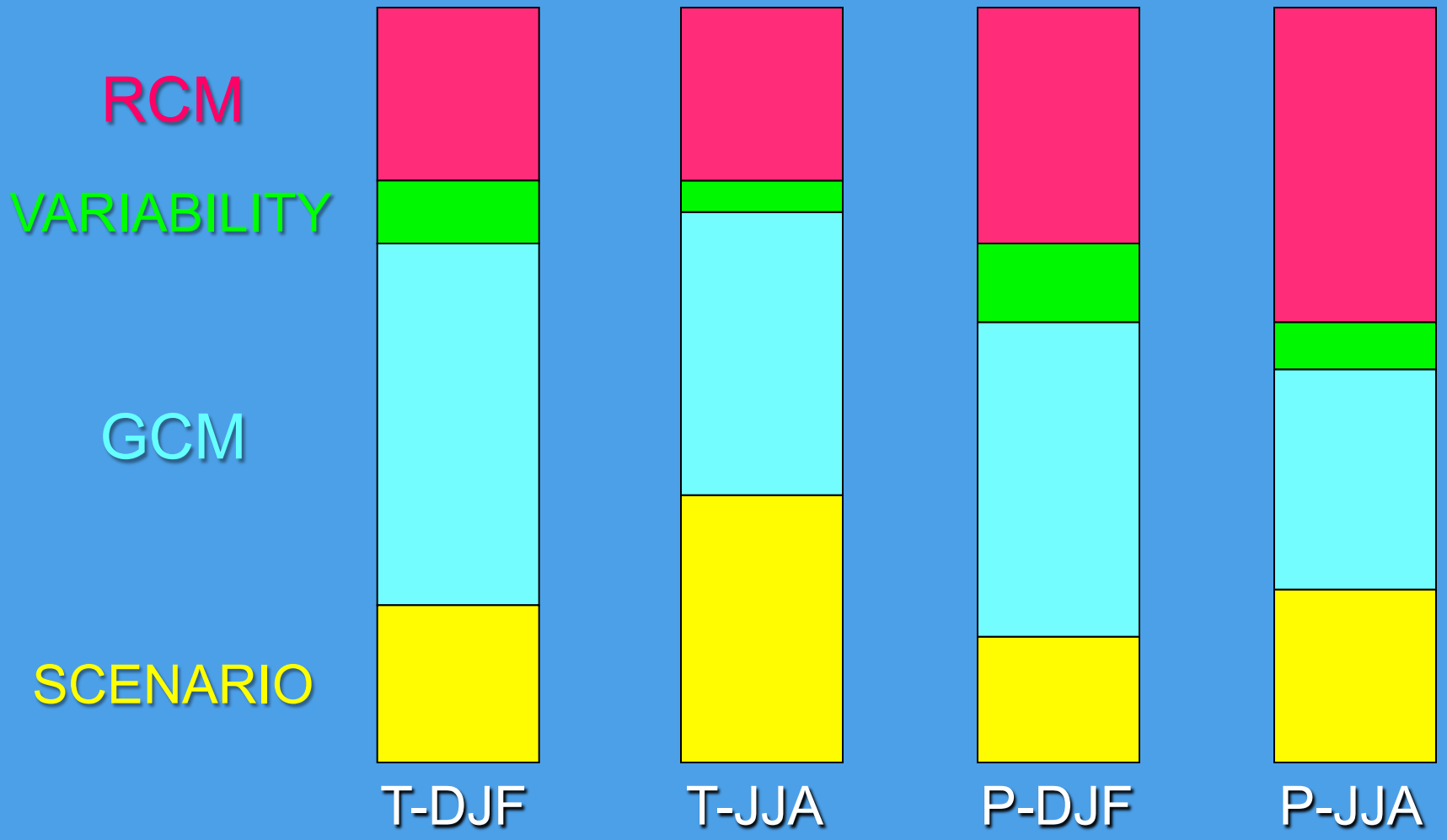
RCA4: an increase in rainfall for all members

CCLM4: a decrease (3 of 4)

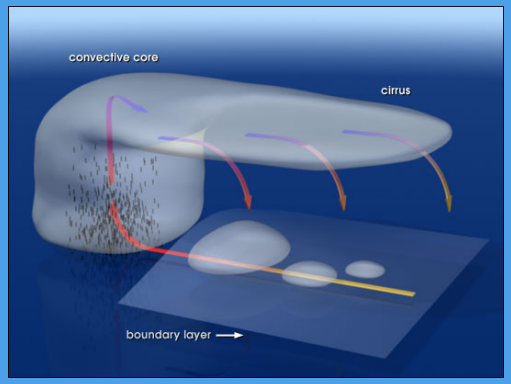
Courtesy of G. Nikulin

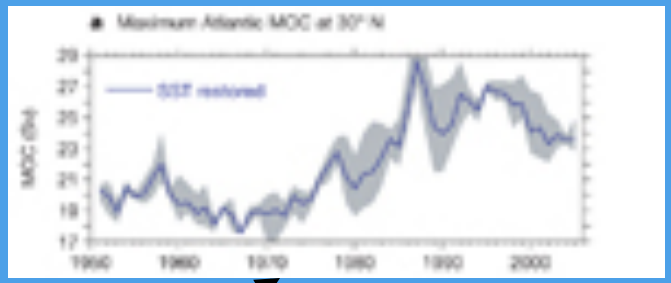
Sources of uncertainty in the simulation of temperature and precipitation change (2071-2100 minus 1961-1990) by the ensemble of PRUDENCE simulations (whole Europe)

(Note: the scenario range is about half of the full IPCC range, the GCM range does not cover the full IPCC range) (Adapted from Deque et al. 2006)



Large ensembles are needed to explore the uncertainty space

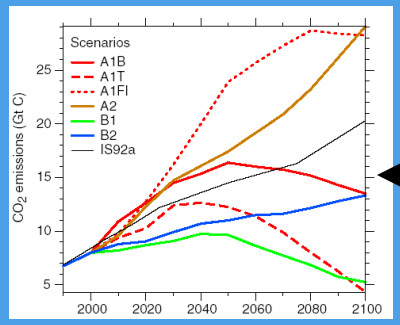




Internal Variability

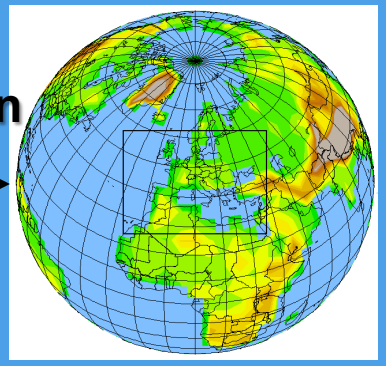
RCD Configuration

GCM Configuration



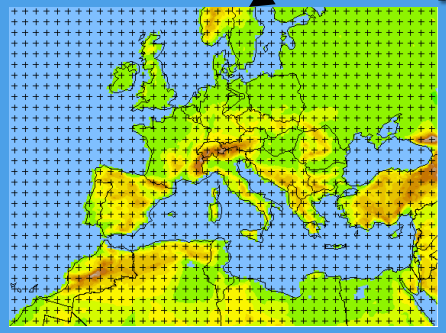
Forcing Scenario

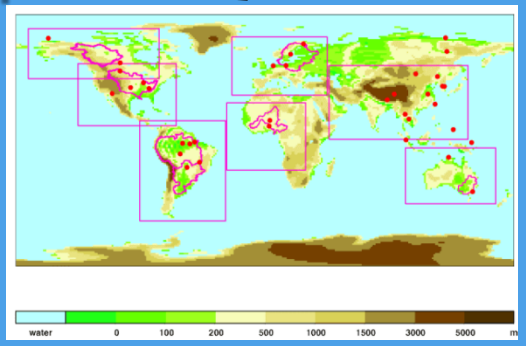
Experiment (i,j,k …)



RCD Approach

Geographic Region





Giorgi et al. EOS 2008

CORDEX Vision and Goals

The CORDEX vision is to advance and coordinate the science and application of regional climate downscaling through global partnerships

- To better understand relevant regional/local climate phenomena, their variability and changes through downscaling
- To evaluate and improve regional climate downscaling models and techniques (RCM, ESD, VAR-AGCM, HIR-AGCM)
- To produce large coordinated sets of regional downscaled projections worldwide
- To foster communication and knowledge exchange with users of regional climate information

CORDEX – Some history

- Initial discussions across the downscaling community (mostly RCM) - Toulouse 2009
- Establishment by the WCRP of the Task Force on Regional Climate Downscaling, TFRCD (2010)
- Design of Phase I CORDEX framework (Giorgi et al. 2009; Jones et al. 2011) and first CORDEX Conference (Trieste 2011)
- Establishment by the WCRP of the Science Advisory Team, SAT (2012)
- Second Pan-CORDEX conference ICRC-CORDEX 2013, Brussels, November 2013.
- Establishment by WCRP of the Working Group on Regional Climate, WGRC (2013).
- Third Pan-CORDEX conference ICRC-CORDEX 2016, Stockholm, May 2016
- Fourth Pan-CORDEX conference ICRC-CORDEX 2019, Beijing, October 2019

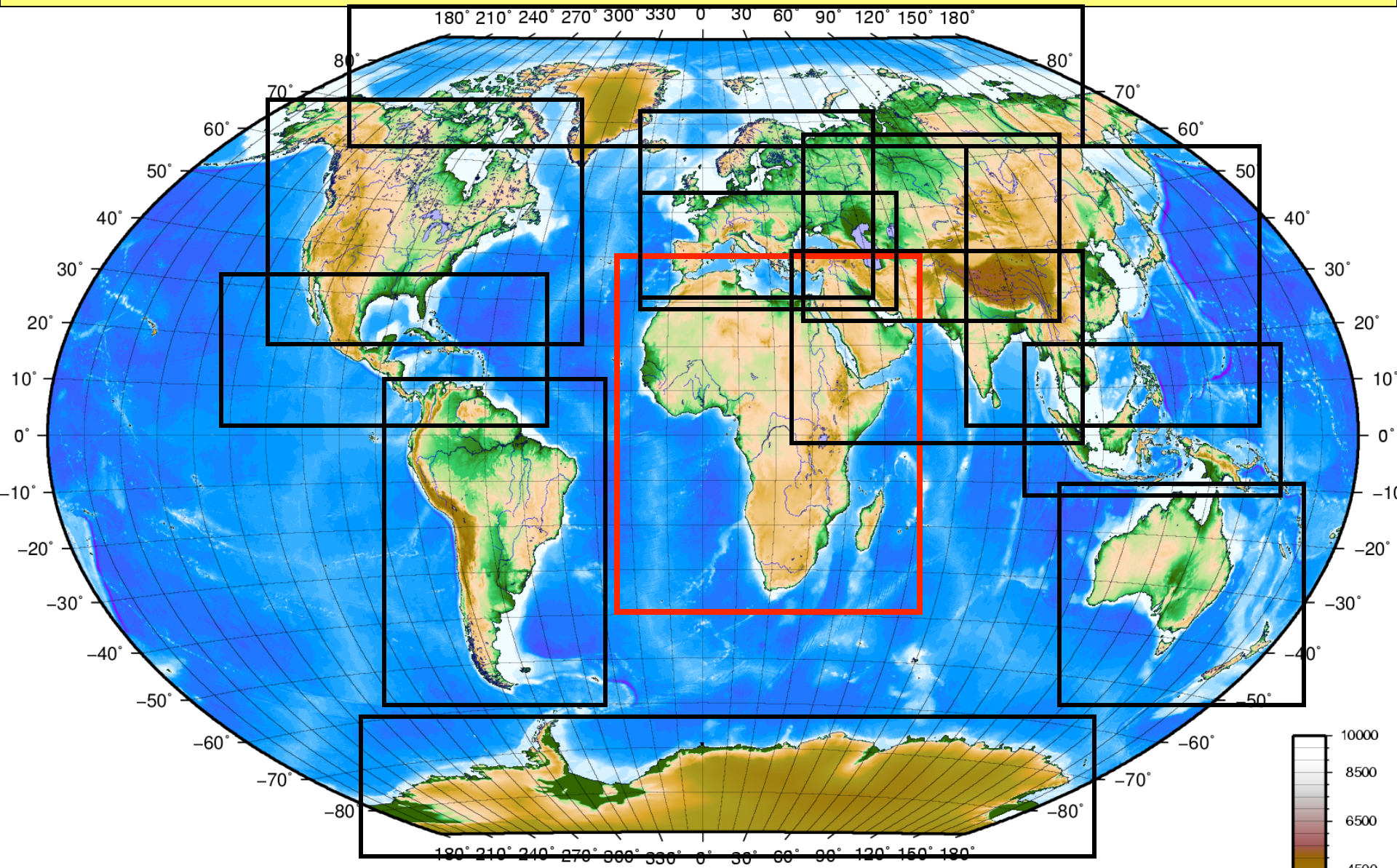
CORDEX Management

- CORDEX Science advisory team (SAT), 12 members

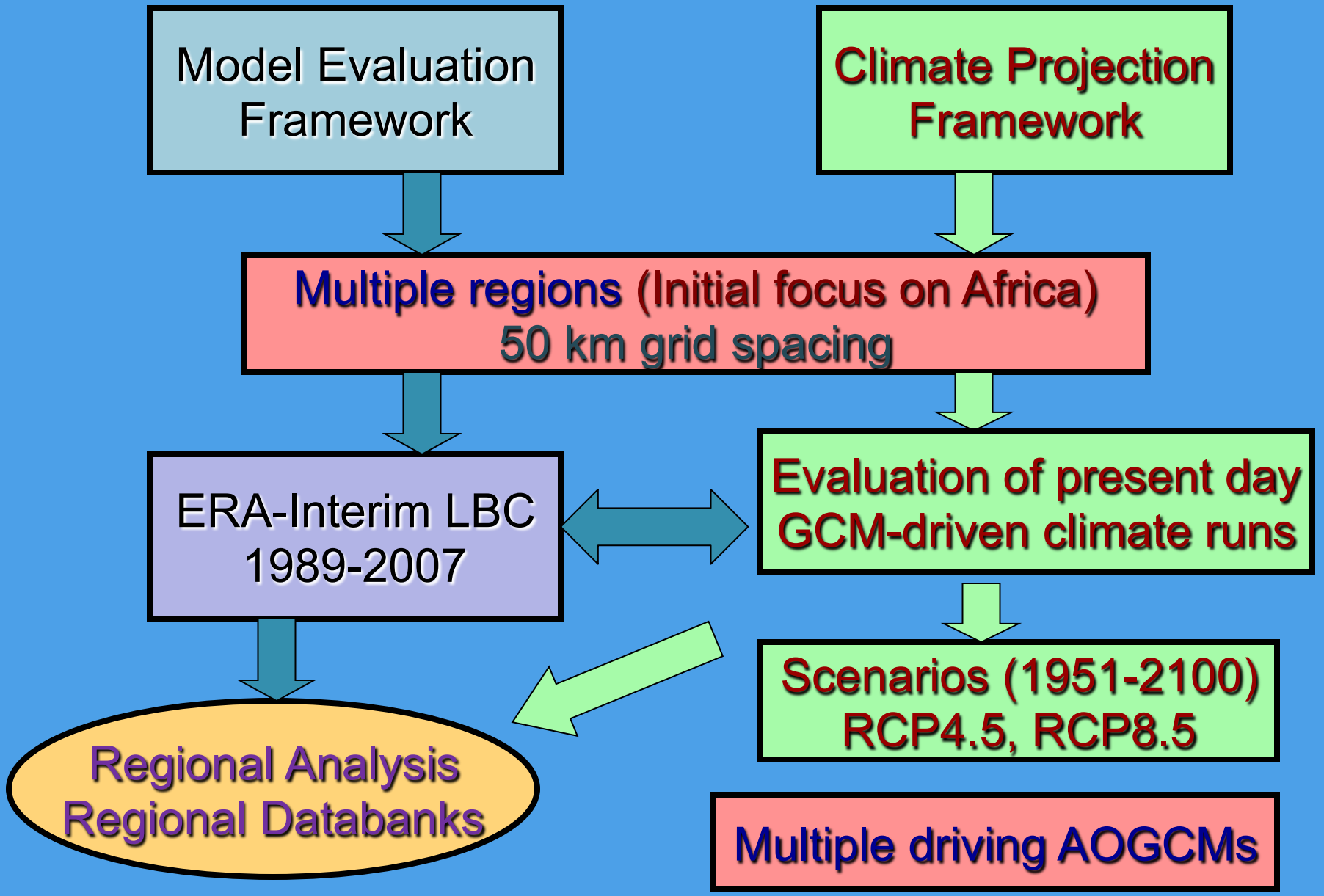
SAT-2 meeting
SMHI (Sweden)
25-27 Feb., 2015

- International Project Office for CORDEX (IPOC) hosted at SMHI since January 2015 (I. lake Head).
- CORDEX archiving coordinated by IS-ENES
- Regional points of contact (POCs), 2-3 per region

CORDEX domains



CORDEX Phase I experiment protocol



nsembles of projections are available for most domains, howeve with a large heterogeneity in the ensemble size, e.g. >30 over Europe, ~0 over Australasia

CORDEX-S. ASIA

CORDEX-South Asia Multi Models Output

Historical (1950 – 2005) | Evaluation Run (1989 - 2008) | RCP 4.5

Variable name (Monthly and Daily)	SMHI-RCA4	IITM-RegCM4-GFDL	IITM-RegCM4-LMDZ	COSMO-CLM	IITM-LMDZ
Institute's / Data Providers	Rossby Centre, SMHI	CCCR-IITM, Pune	CCCR-IITM, Pune	Goethe Inst - Univ. of Frankfurt	CCCR-IITM, Pune
Rainfall (pr)	✓	✓	✓	✓	✓
Surface Air Temperature (tas)	✓	✓	✓	✓	✓
Surface Air Temp. Maximum (tasmax)	✓	✓	✓	--	✓
Surface Air Temp. Minimum (tasmin)	✓	✓	✓	--	✓
Sea-level Pressure (psl)	✓	✓	✓	--	✓
Surface Specific Humidity (huss)	✓	✓	✓	--	✓
Surface Zonal Wind (uas)	✓	✓	✓	--	✓
Surface Meridonial Wind (vas)	✓	✓	✓	--	✓
Downward Shortwave Radiation (rsds)	--	✓	✓	--	--

To download the data please click here

Regridding script example, click here to download | script

CORDEX-AFRICA

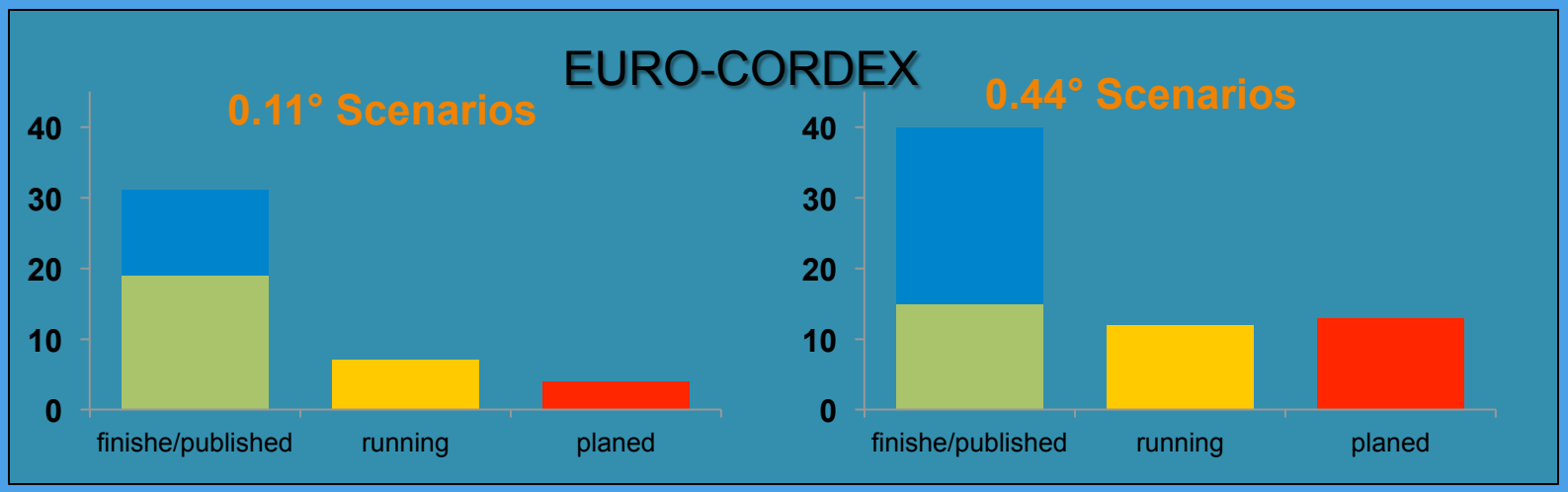
RCP4.5

	BCCR-greenWRF	CCCma-CanRCM4	CLMcom-CCLM4-8	CNRM-ALADIN	CSC-REMO	DMI-HIRHAM5	ICTP-RegCM4	KNMI-RACMO2.2	MOHC-GA3RCM	SMHI-RCA4	UCLM-PROMES	ULL-WRF311	UCAN-WRF34	UQAM-CRCM	sum
CanESM2		■								■				■	3
CNRM-CM5			■	■						■					3
NorESM1-M	■									■					1
EC-EARTH (r1)							■			■					1
EC-EARTH (r3)					■					■					1
EC-EARTH (r12)			■		■					■					3
HadGEM2-ES			■			■			■	■					3
MIROC5										■					1
MPI-ESM-LR			■		■					■				■	4
GFDL-ESM2M										■					1
HADCM3															
sum		1	4	1	2	1	1	1		8				2	21

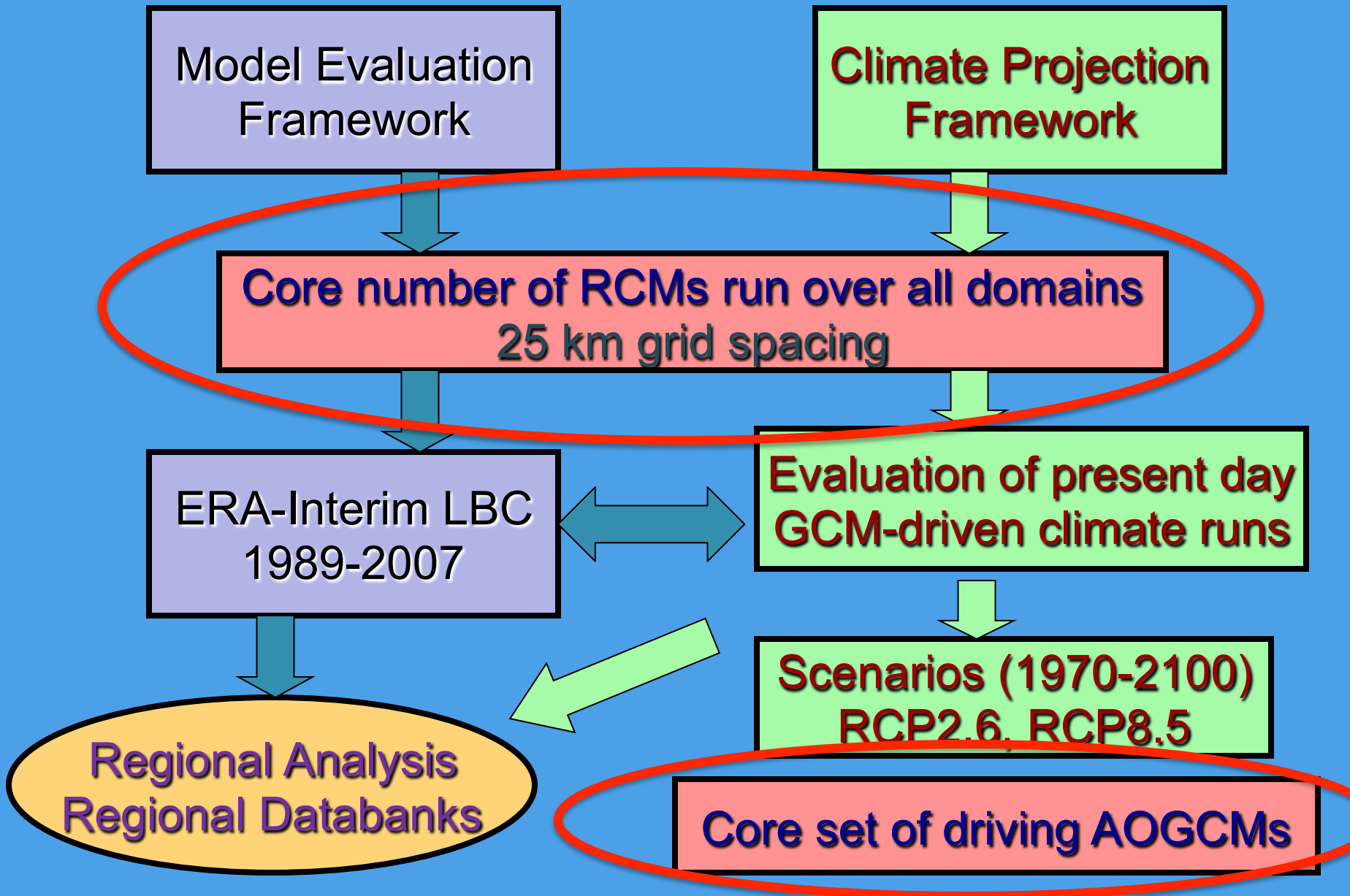
RCP8.5

	BCCR-greenWRF	CCCma-CanRCM4	CLMcom-CCLM4-8	CNRM-ALADIN	CSC-REMO	DMI-HIRHAM5	ICTP-RegCM4	KNMI-RACMO2.2	MOHC-GA3RCM	SMHI-RCA4	UCLM-PROMES	ULL-WRF311	UCAN-WRF34	UQAM-CRCM	sum
CanESM2		■								■					2
CNRM-CM5			■	■						■					3
NorESM1-M	■									■					1
EC-EARTH (r1)								■							1
EC-EARTH (r3)					■										1
EC-EARTH (r12)			■		■					■					3
HadGEM2-ES			■			■			■	■					3
MIROC5										■					1
MPI-ESM-LR			■		■					■					4
GFDL-ESM2M										■					1
HADCM3											■				
sum		1	4	1	2	1	2	1		8					19

EURO-CORDEX



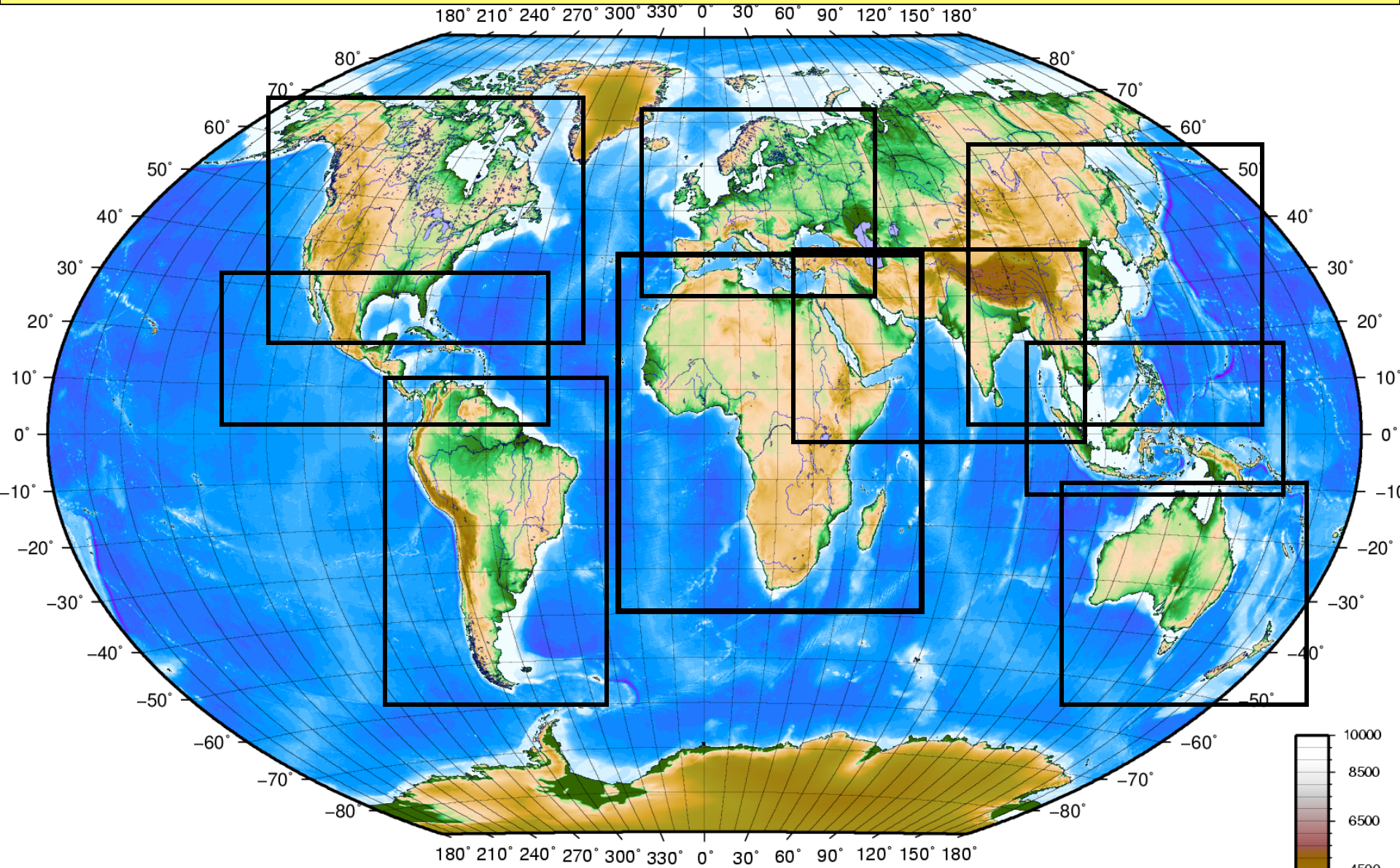
CORDEX-CORE experiment protocol



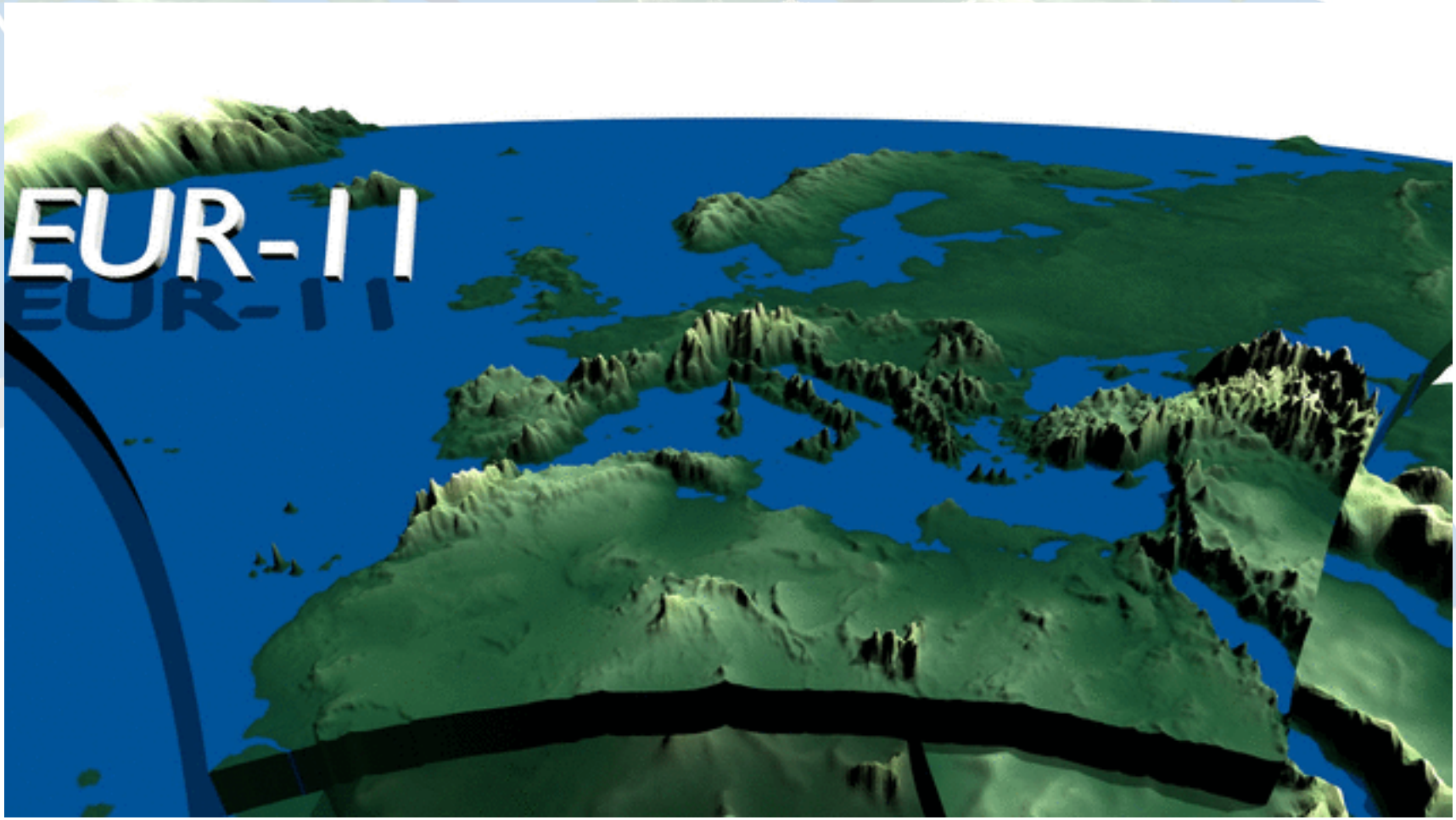
Current status of CORDEX-CORE

- Two RCMs participating
  - RegCM4 (ICTP-RegCNET)
  - REMO (GERICS)
- Two scenarios: RCP8.5, RCP2.6
- Three CMIP5 GCMs are being downscaled
  - HadGEM (MIROC for SAS)
  - MPI
  - NorESM (GFDL for CAM)
- Ten CORDEX domains: EUR, AFR, SAS, EAS, SEA, AUS, NAM, CAM, SAM, CAS (GERICS only)
- Some other models may join (CLM) for individual domains.

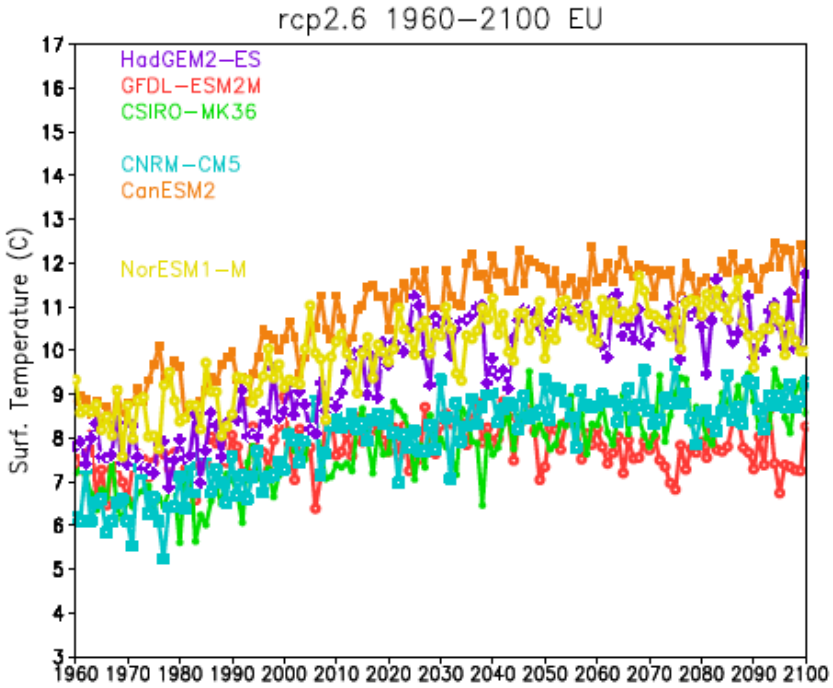
RegCM4 CORDEX-CORE domains

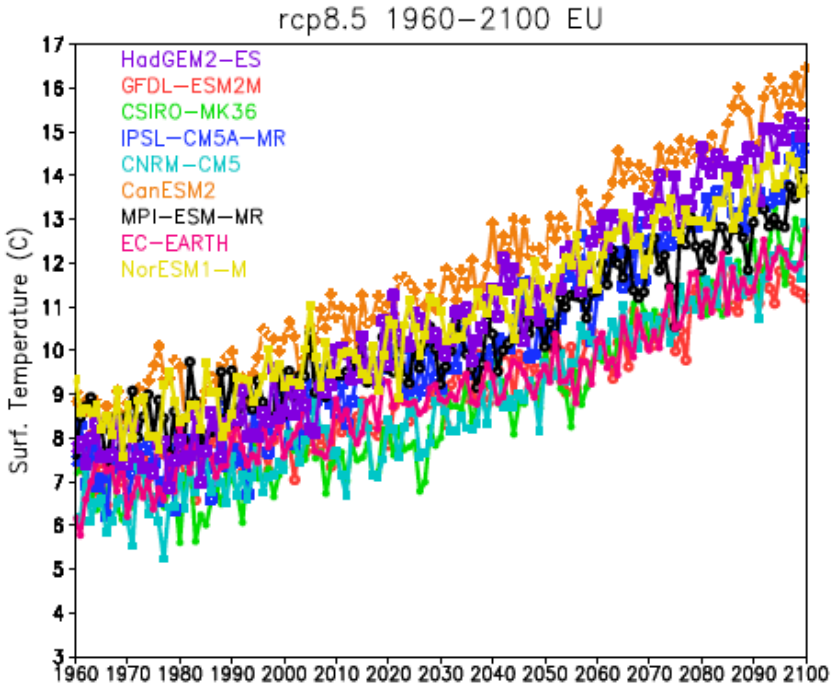


RegCM4 CORDEX-CORE domains



RegCM CORDEX-atlas simulations settings





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RegCM CORDEX-atlas simulations status

Domains			ERA-Int	MPI-ESM		HadGEM		NORESM		GFDL		MIROC	
				rcp26	rcp85	rcp26	rcp85	rcp26	rcp85	rcp26	rcp8.5	rcp26	rcp8.5
1 Europe	RegCM	yes	D	r	r	D	D						
2 Africa	RegCM	yes	r	r	r	r	r	r	r				
3 Central America	RegCM	yes	D	D	D	D	D			D	D		
4 South America	RegCM	yes	D	D	D	D	D	D	D				
5 Southeast Asia	RegCM	yes	r	r	r	r	r	r	r				
6 South Asia	RegCM	yes	D	r	r			D	D			D	D
7 East Asia	RegCM	yes	D	D	D	D	D	D	D				
8 Australasia	RegCM	yes	D	D	D	D	D	D	D				
9 North America	RegCM	yes	D	D	D	D	D			D	D		

p/shaded	planned simulation
r	running
D	Done
P	Published

Different model version

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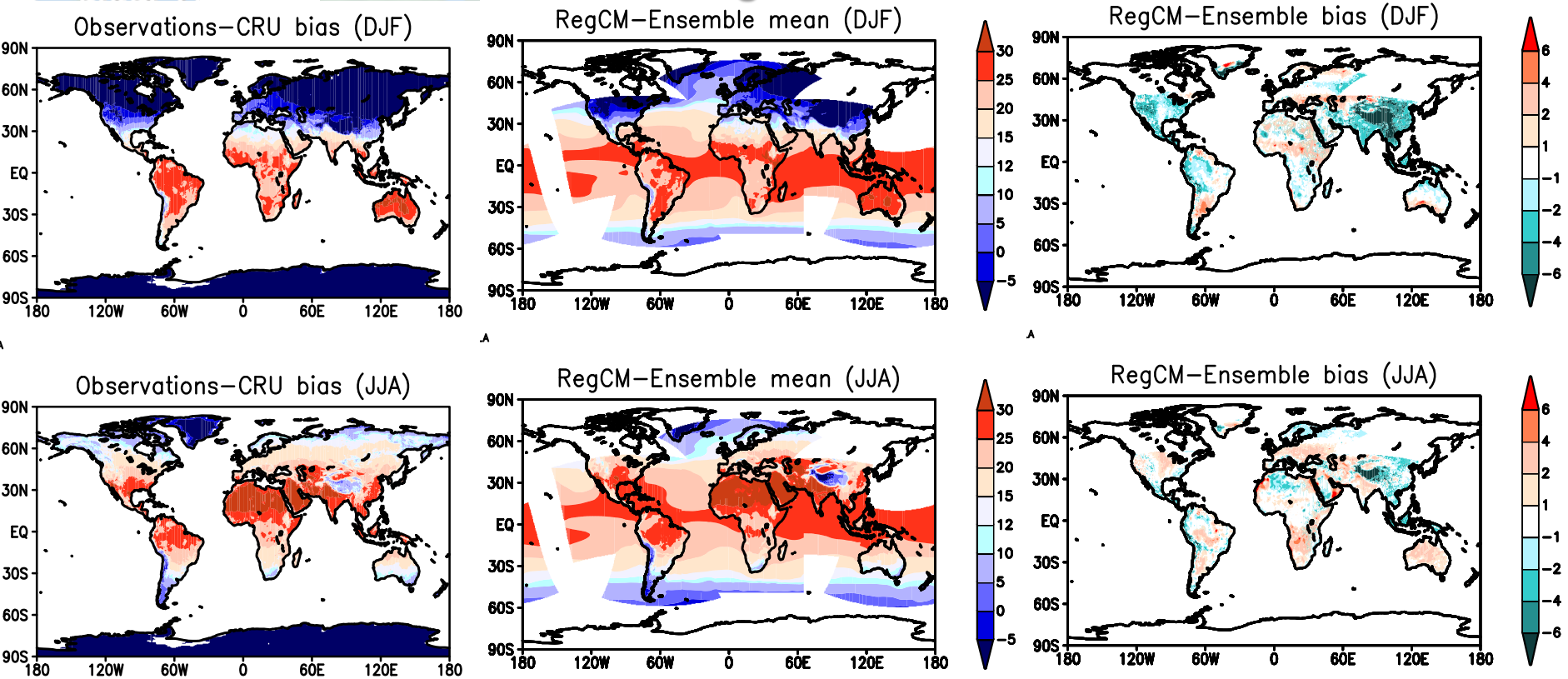
RegCM CORDEX-atlas simulations validation

Temperature

OBS | **RegCM** | **Bias**



Bias are comparable with previous CREMA ensemble (Coppola et al 2014)

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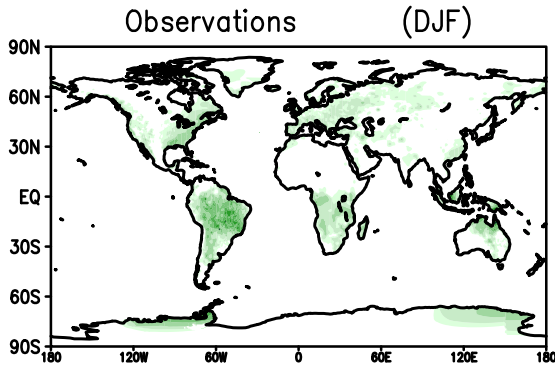
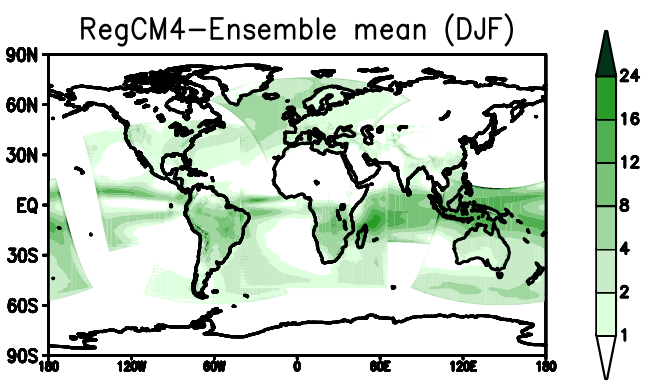
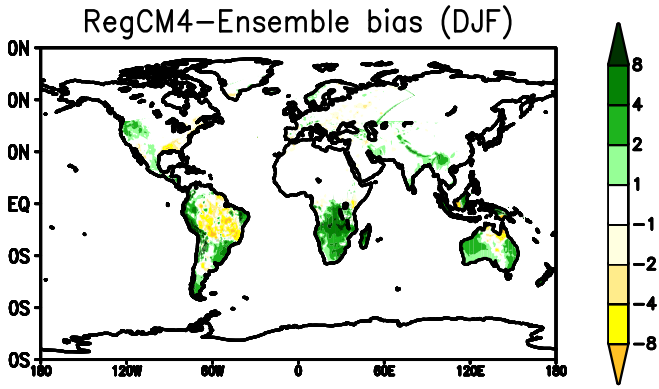
RegCM CORDEX-atlas simulations validation

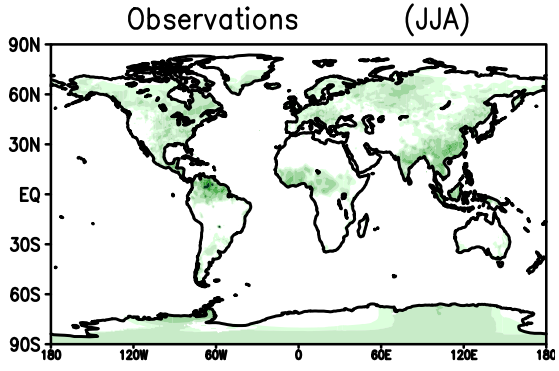
Precipitation

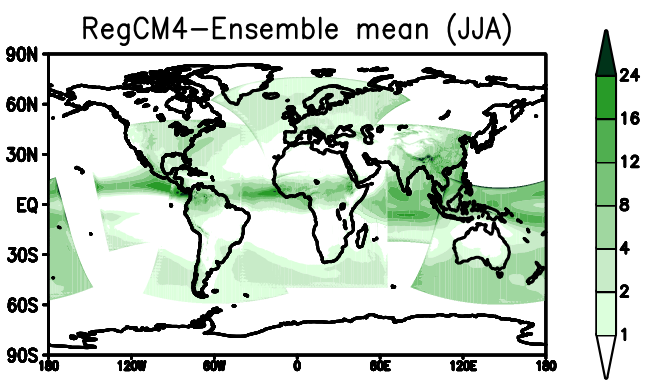
OBS | **RegCM** | **Bias**

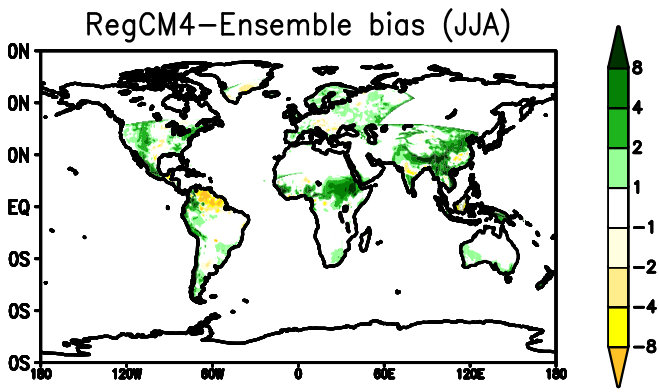










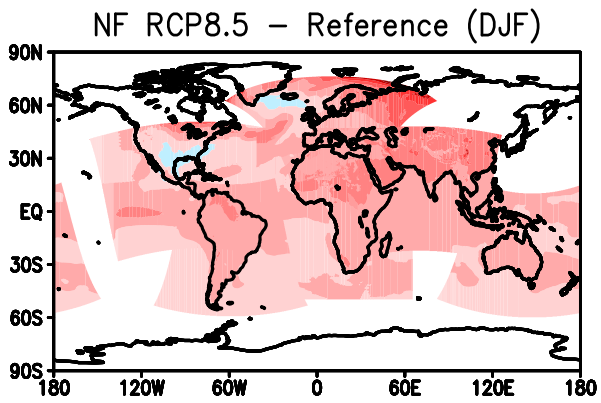


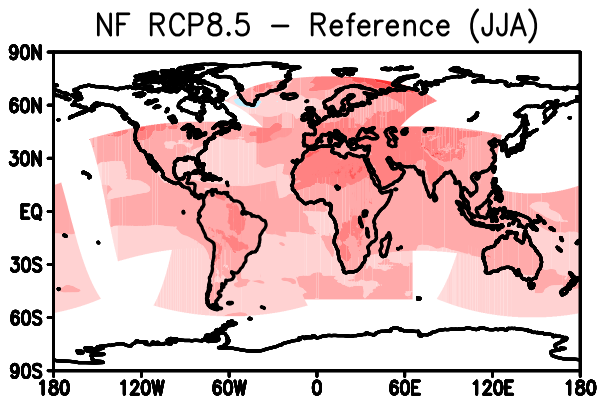
Bias are comparable with previous CREMA ensemble (Coppola et al 2014)

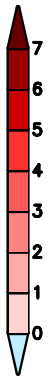
RegCM CORDEX-atlas climate change

Temperature change mid century

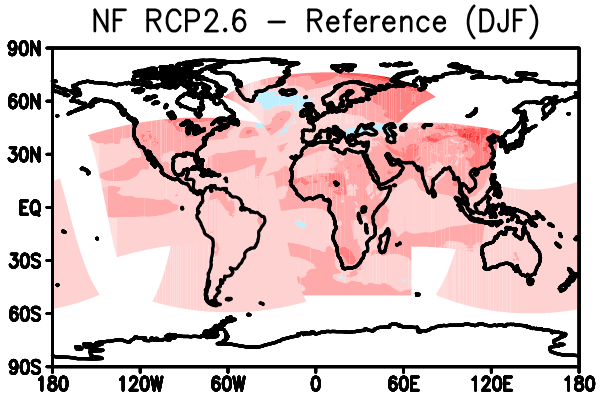
(1975-2005)-(2030-2060)

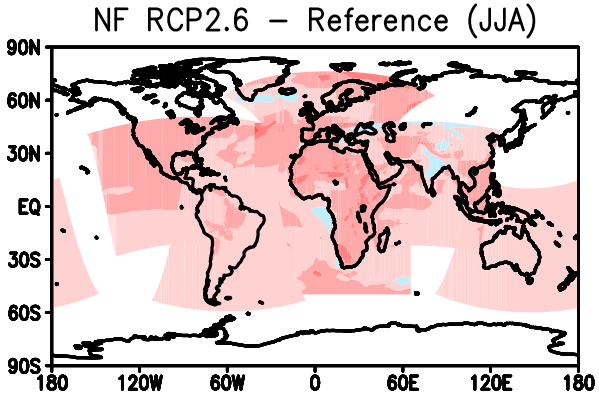


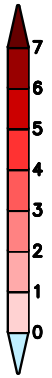




RCP 8.5







RCP 2.6

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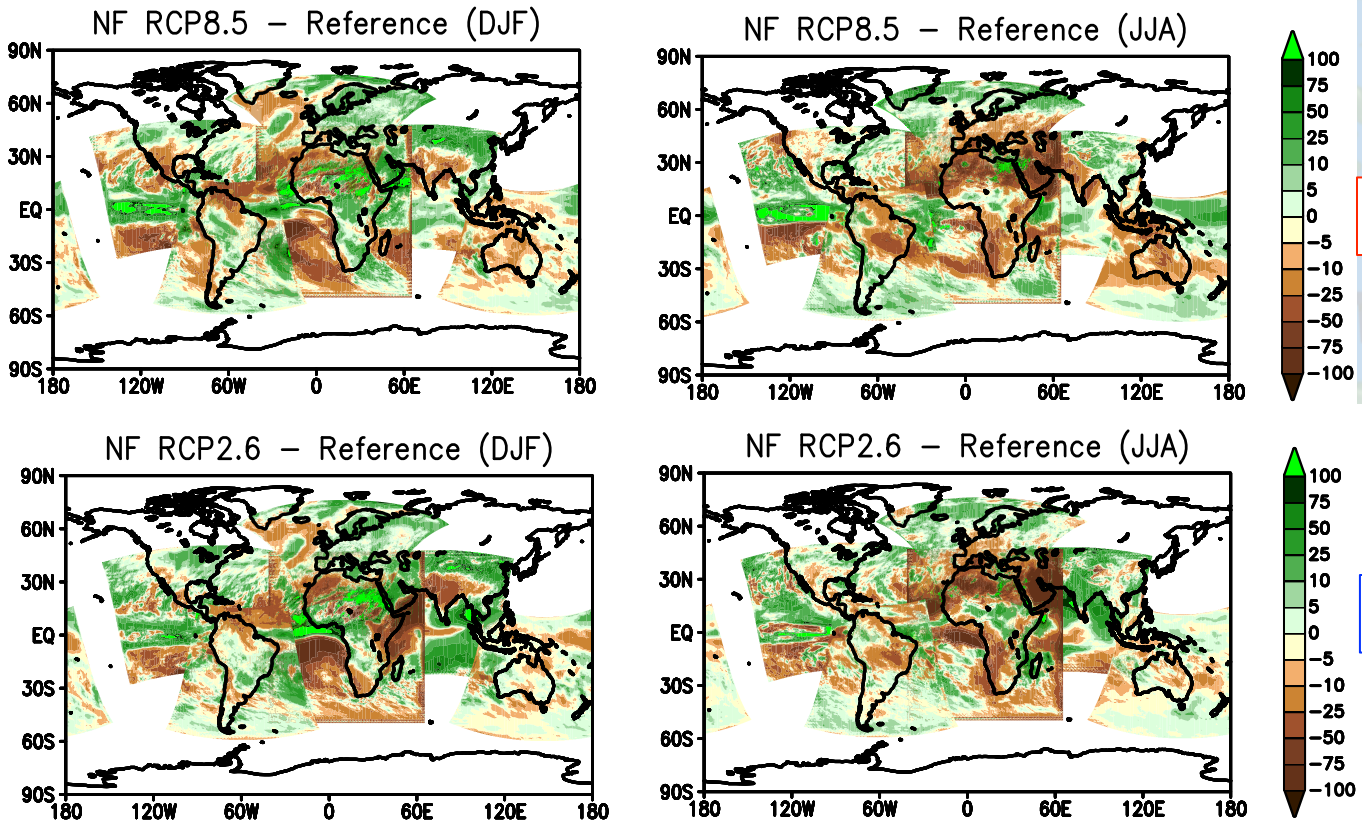
RegCM CORDEX-atlas climate change

Precipitation change mid century

(1975-2005)-(2030-2060)



RCP 8.5

RCP 2.6

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IPCC AR6 – Enhanced Focus on regional climate

Working Group 1:
'Regional Chapters'

- **Chapter 10: Linking global to regional climate change**
- Chapter 11: Weather and climate extreme events in a changing climate
- **Chapter 12: Climate change information for regional impact and for risk assessment**
- **Chapter Atlas:**

Chapter 10:
Linking global to regional climate change
Executive Summary
• Regional phenomena, drivers, feedbacks and teleconnections
• Regional scale observations and reanalyses
• Interplay between internal variability and forced change at the regional scale, including attribution
• Evaluation of model improvements, methods, including downscaling and bias adjustment and regional specificities
• Confidence in regional climate information, including quantification of uncertainties
• Scale specific methodologies e.g. urban, mountains, coastal, catchments, small islands
• Approaches to synthesizing information from multiple lines of evidence
Frequently Asked Questions

IPCC AR6 – Enhanced Focus on regional climate

CH11:
Weather and climate extreme events in a changing climate
Executive Summary
• Extreme types, encompassing weather and climate timescales and compound events (including droughts, tropical cyclones)
• Observations for extremes and their limitations, including paleo
• Mechanisms, drivers and feedbacks leading to extremes
• Ability of models to simulate extremes and related processes
• Attribution of changes in extremes and extreme events
• Assessment of projected changes of extremes and potential surprises
• Case studies across timescales
Frequently Asked Questions

IPCC AR6 – Enhanced Focus on regional climate & hazard

➢ **CH 12:**

Climate change information for regional impact and for risk assessment

Executive Summary

• Framing: physical climate system and hazards

• Region-specific integration of information, including confidence

• Information (quantitative and qualitative) on changing hazards: present day, near term and long term

• Region-specific methodologies

• Relationship between changing hazards, global mean temperature change, scenarios and emissions

Frequently Asked Questions

Aim of the new Chapter:

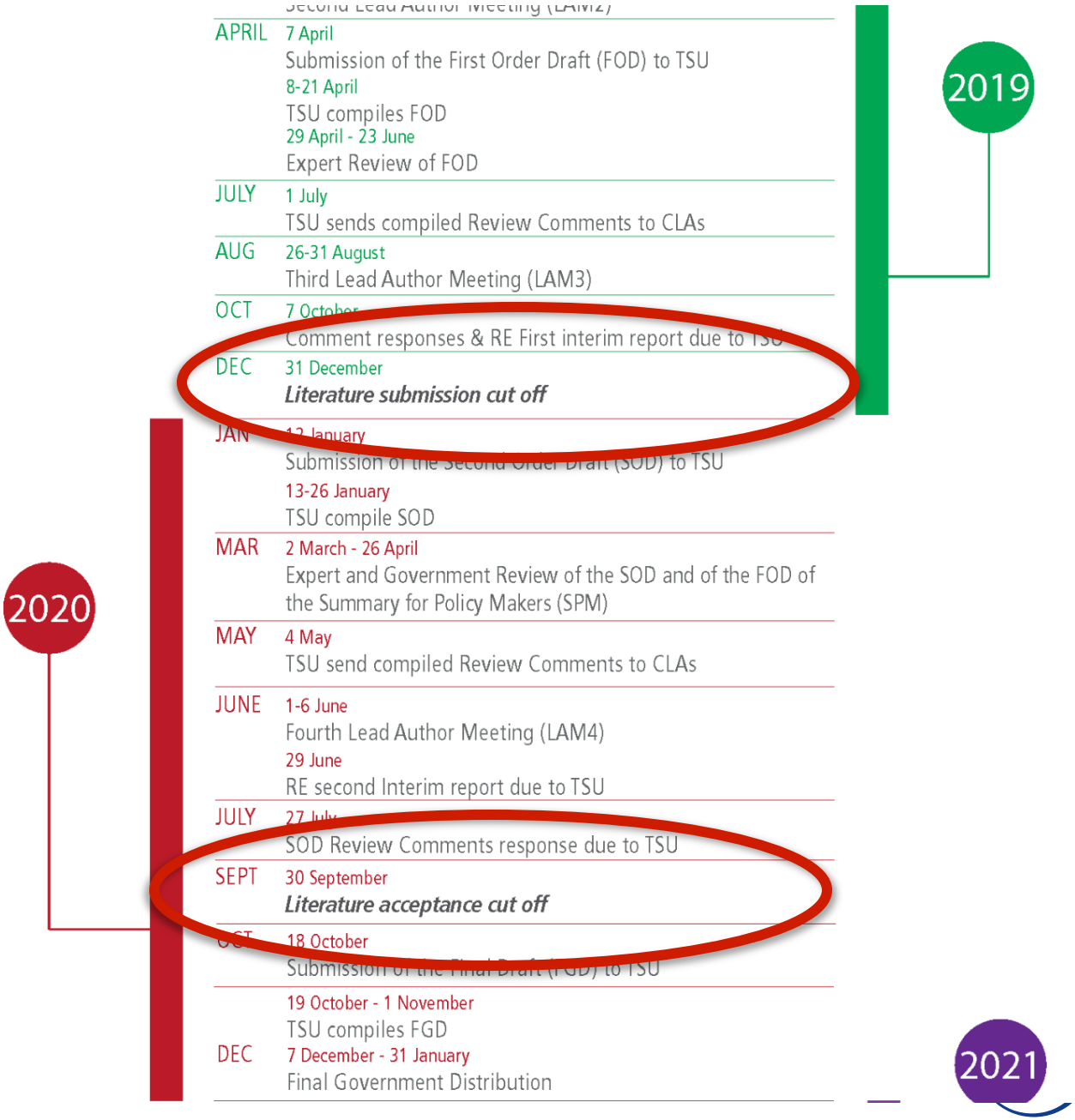
- 'Handshake' synthesizes the science of WG1 for use in WG2

- Risk = hazard x vulnerability x exposure
- Impact = a specific realization of a risk

- A climate value becomes a climate hazard when it connects to exposure and/or vulnerability
- Hazards can change in their magnitude, frequency, duration, timing, and/or spatial extent -- *changes can be beneficial or detrimental*

- Maps essential climate variables → hazards, hazards → sectors, and hazards → regions
- Connects to 'Reasons for Concern' framework

WGI AR6 IPCC paper deadlines



RegCM CORDEX-atlas data access

- Data are CMOR-ized and all possible CORDEX variables will be available.
- The first available will be : T, Tmax, tmin, pr, hus, mrro (all daily)
- Distributed on the ESGF archive (CINECA node, Bologna Italy)
- ESGF node will be opened possibly by this week for some domains (SA, AUS, EU)
- Data policy will be: if you are going to publish a paper using the new RegCM-CORDEX-Core simulations, offer authoship to ICTP people, if ICTP is not involved

WGI AR6 IPCC how to be a reviewer

Sign as a reviewer of the WGI FOD

https://apps.ipcc.ch/comments/ar6wg1/fod/register.php

The Abdus Salam International Centre for Theoretical Physics