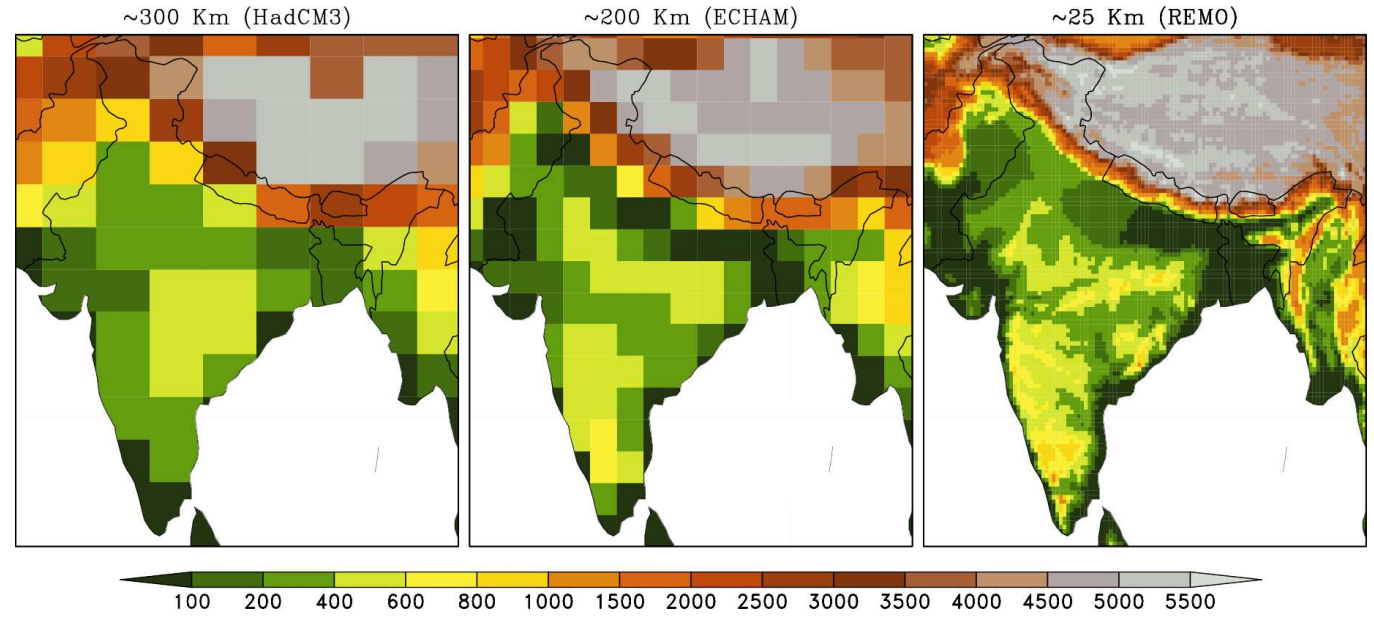
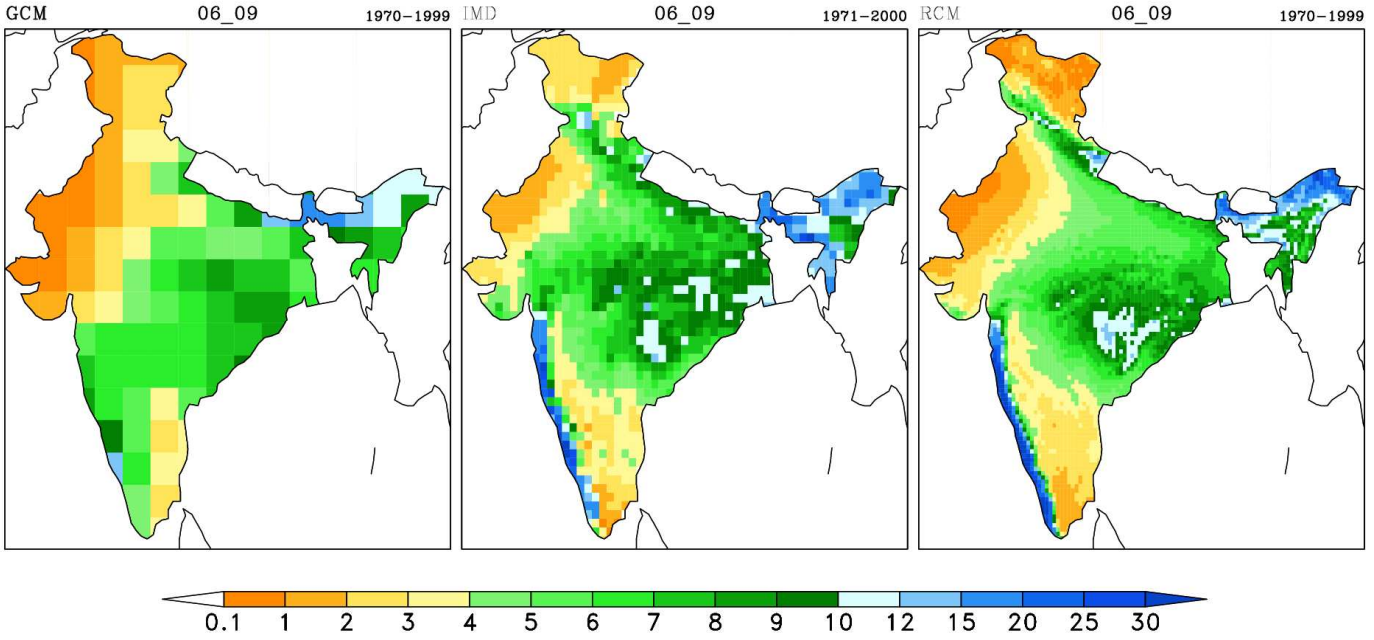
Simulation of the regional climate model REMO over CORDEX West-Asia

Pankaj Kumar, Daniela Jacob

- Max Planck Institute for Meteorology, Hamburg, Germany
- Climate Service Center, Hamburg, Germany



Orography



More realistic monsoon precipitation pattern in RCM

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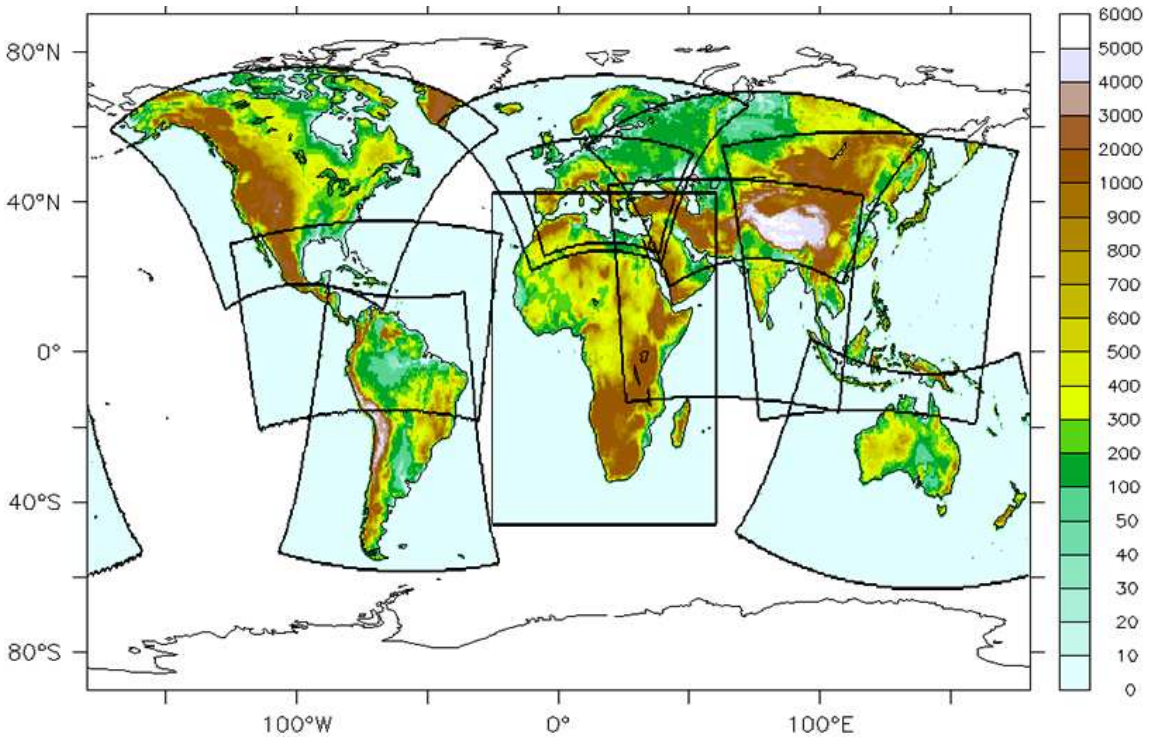
COordinated Regional climate Downscaling EXperiment



- 12 domains with a resolution of 0.44°x0.44° (approx. 50x50km²)
- Focus on Africa (mandatory domain)
- High resolution simulations with 0.11°x0.11° (approx. 12x12km²) for Europe (by some participating institutions)

Orography of CORDEX model domains in [m] (except for the Arctic and Antarctica)

WCRP World Climate Research Programme

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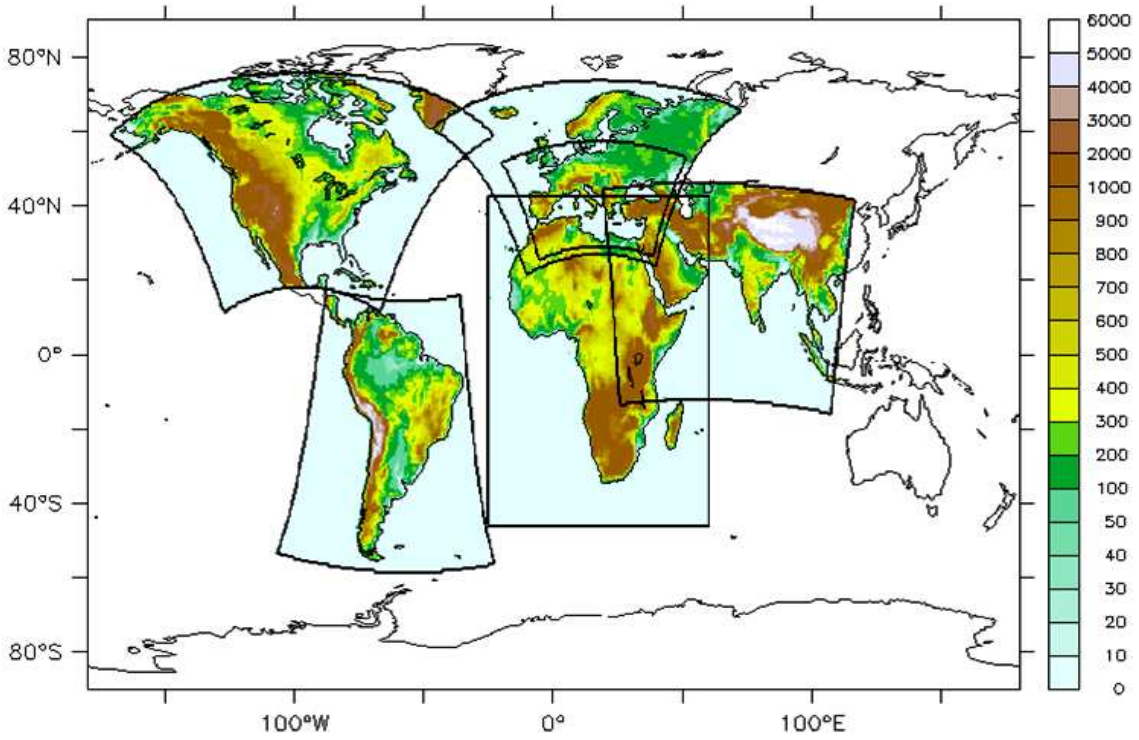
Model Setup with REMO



Orography of REMO model domains in [m]

- Using the hydrostatic version of the regional climate model REMO (Jacob 2001,2009)
- ERA-Interim boundary data (1989-2008)
- 6 domains with a resolution of 0.44°x0.44° (approx. 50x50km²)

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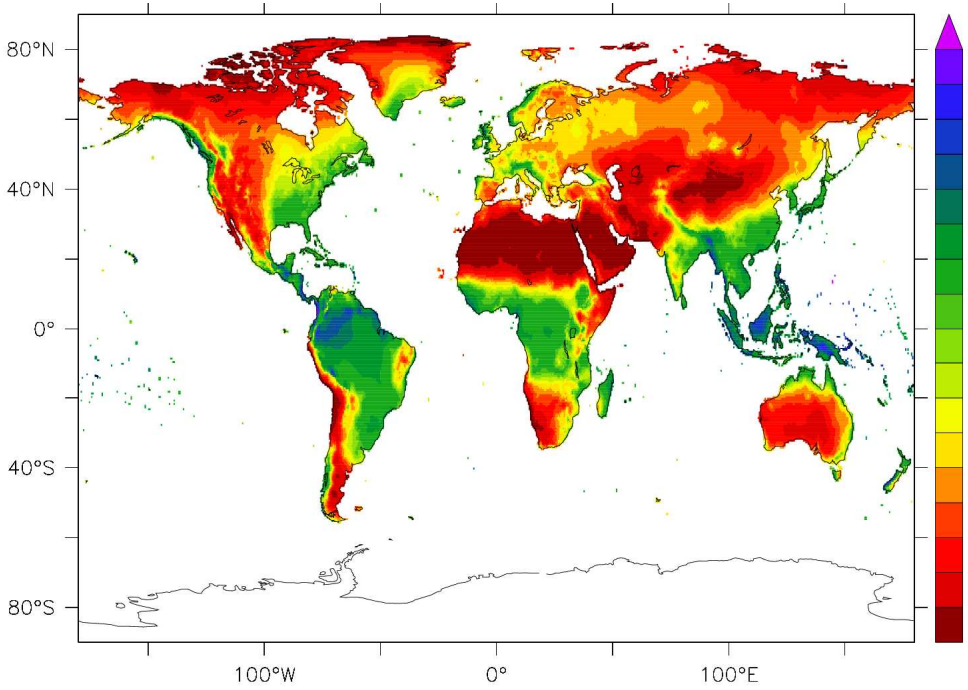
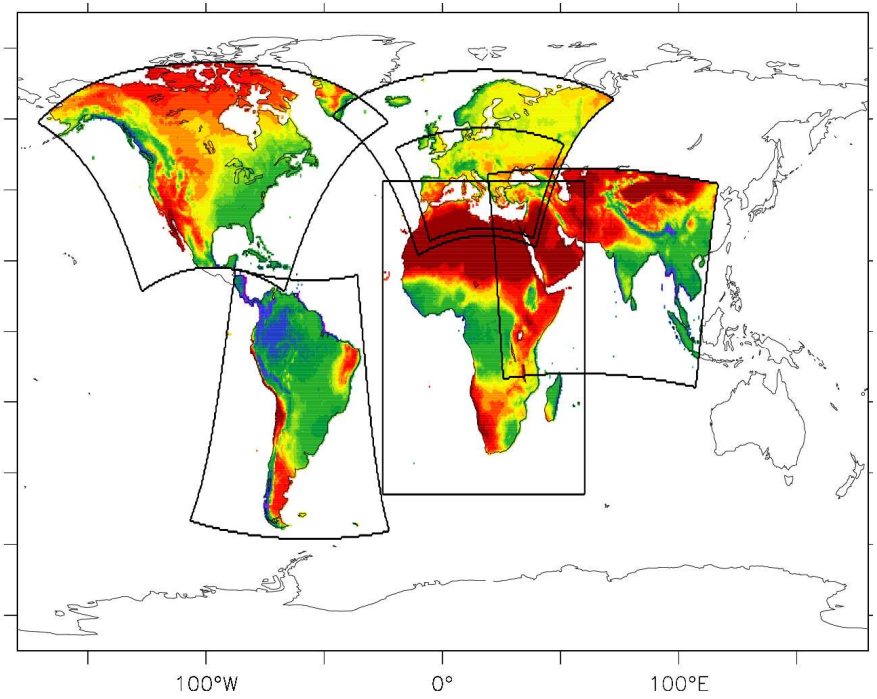
Evaluation of Annual Mean Precipitation

CRU 3.0



REMO



Annual mean precipitation [mm/month], 1989-2006

CRU TS3.0 (Mitchell and Jones, 2005)

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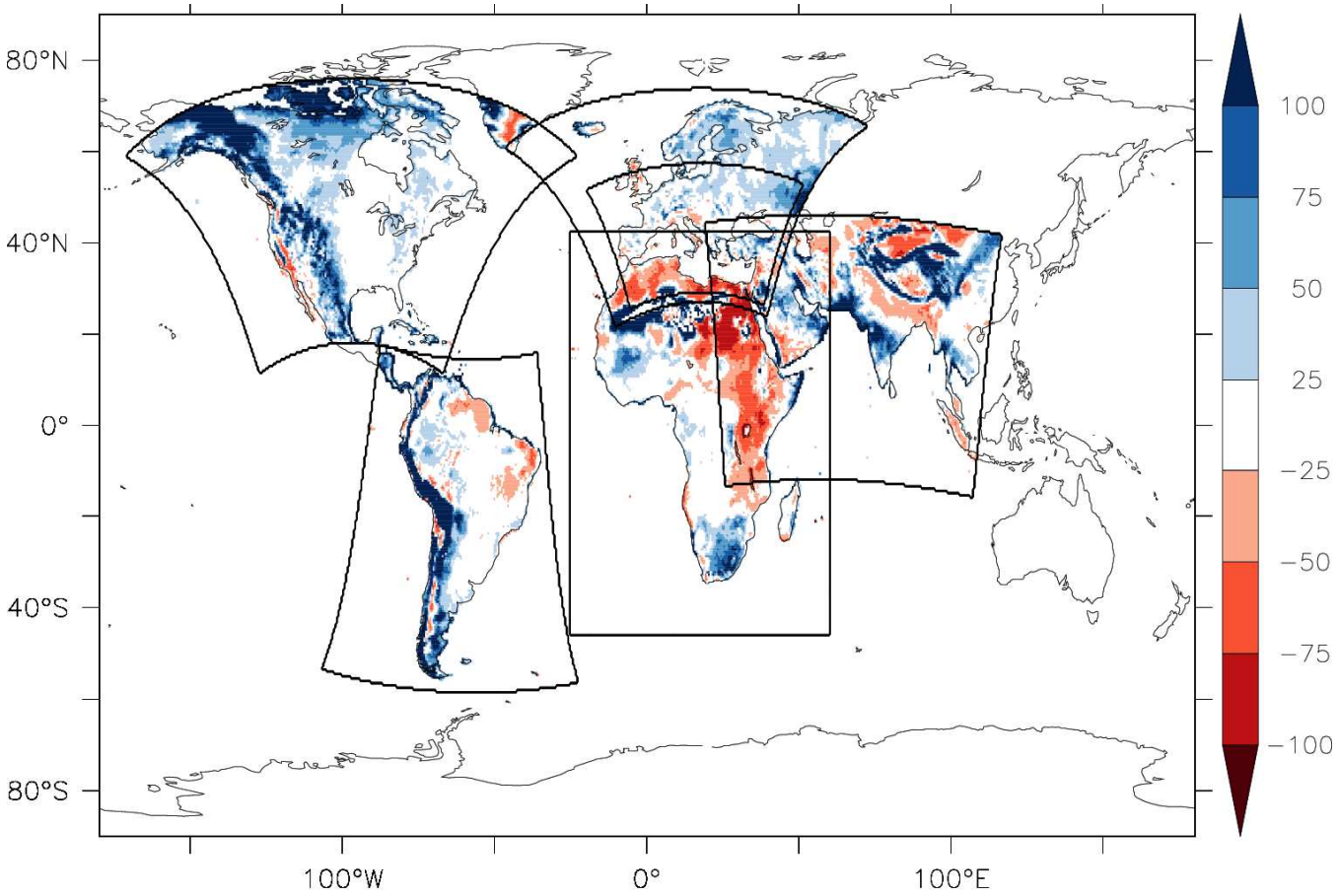
Evaluation of Annual Mean Precipitation



Annual mean relative difference of precipitation [%]: REMO -CRU, 1989-2006

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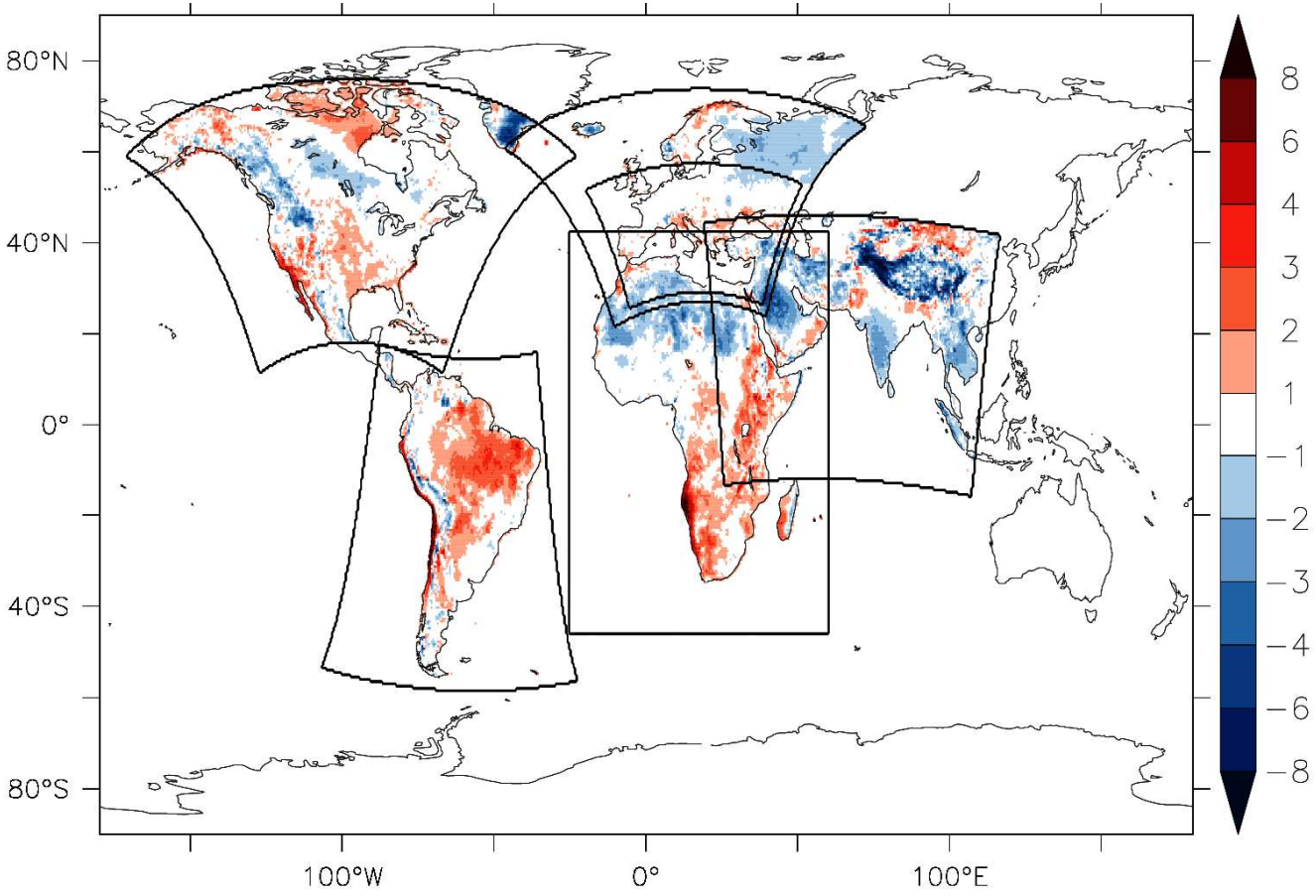
Evaluation of Annual Mean Temperature



Annual mean difference of temperature [K]: REMO-CRU,

1989-2006

- Positive bias in areas of upwelling ocean currents

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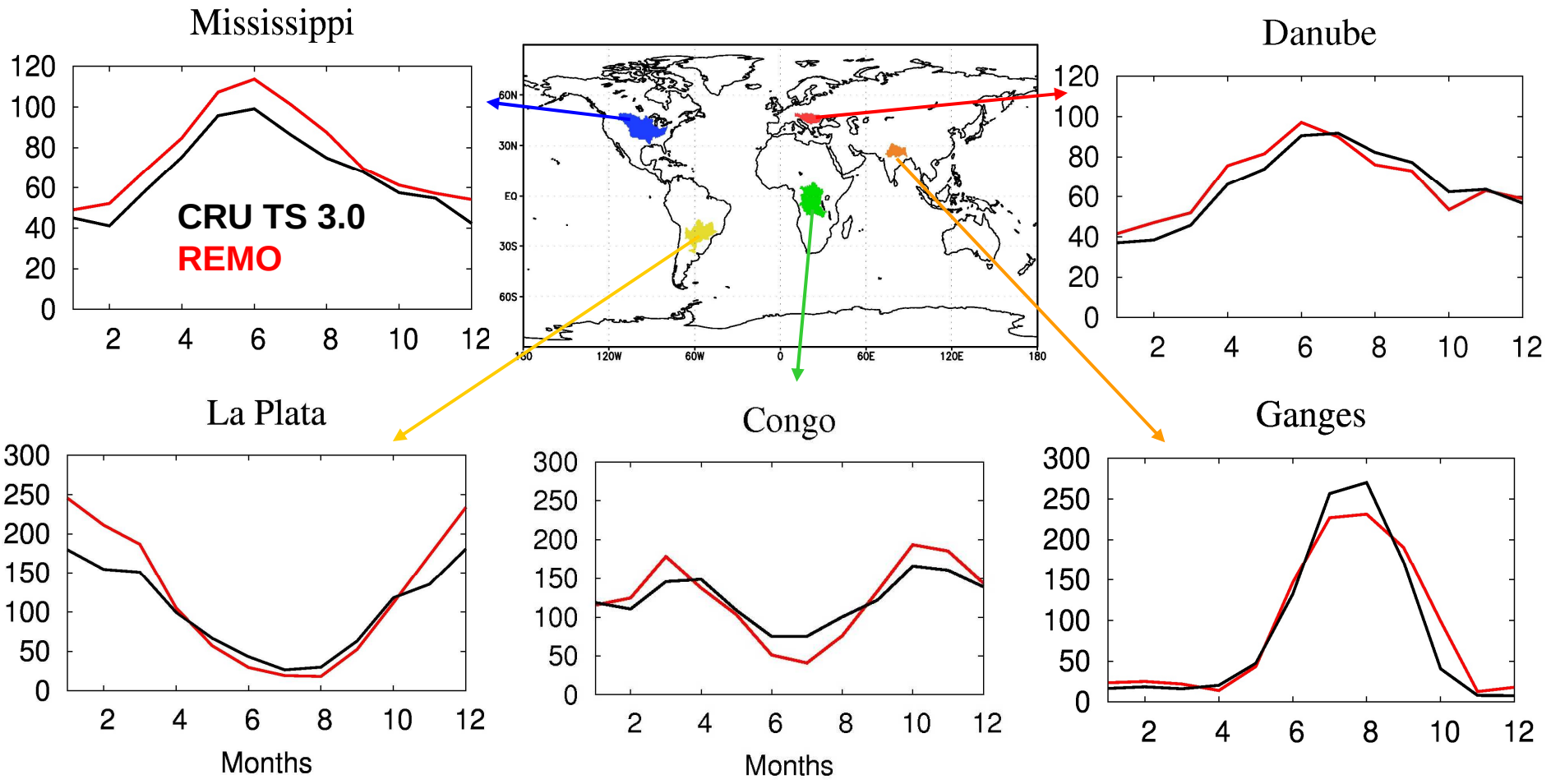
Annual Cycle of Precipitation

Annual cycle of precipitation for different catchments in [mm/month]



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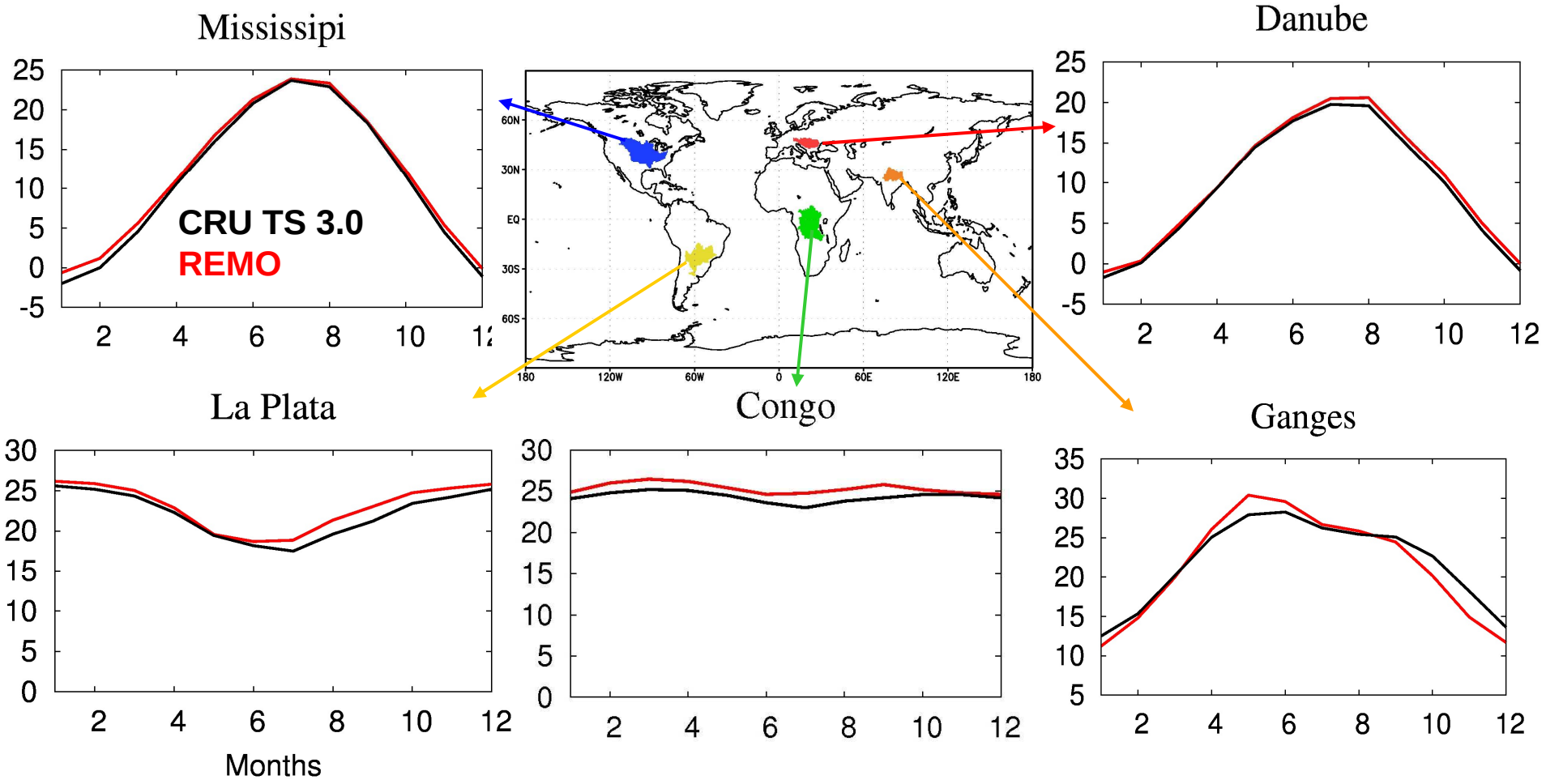
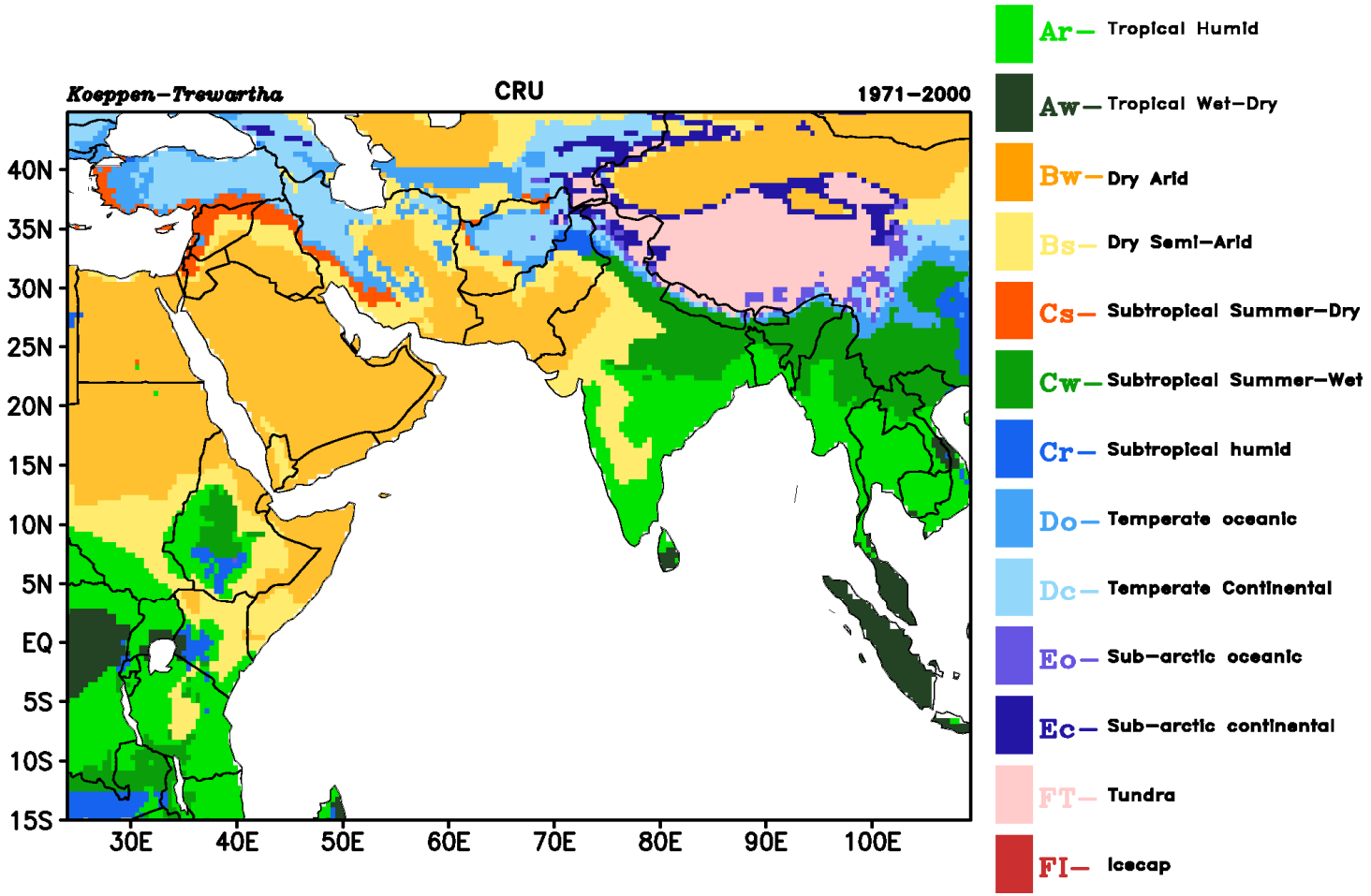
Annual Cycle of Temperature

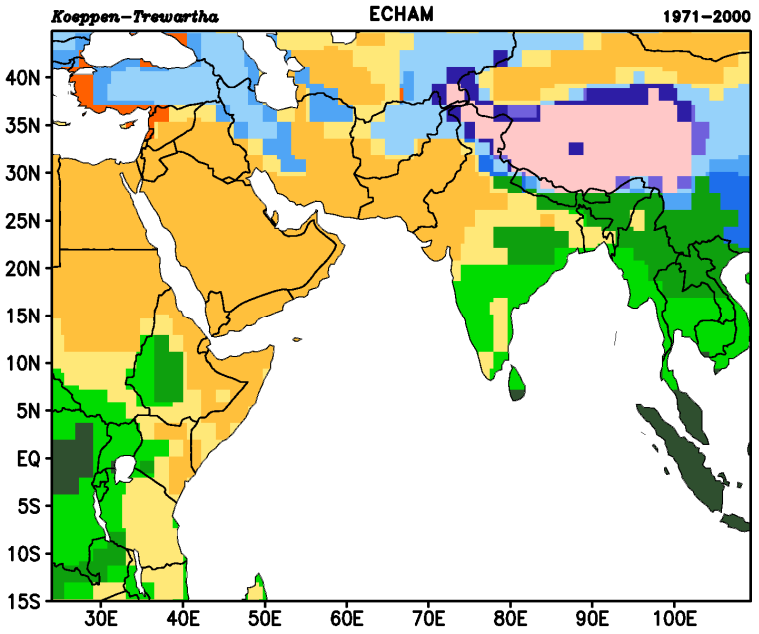
Annual cycle of temperature for different catchments in [℃]

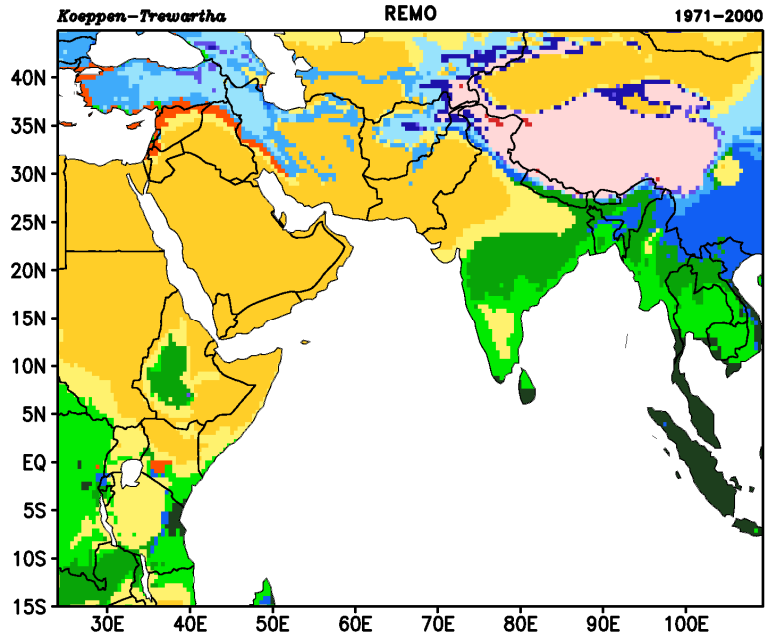


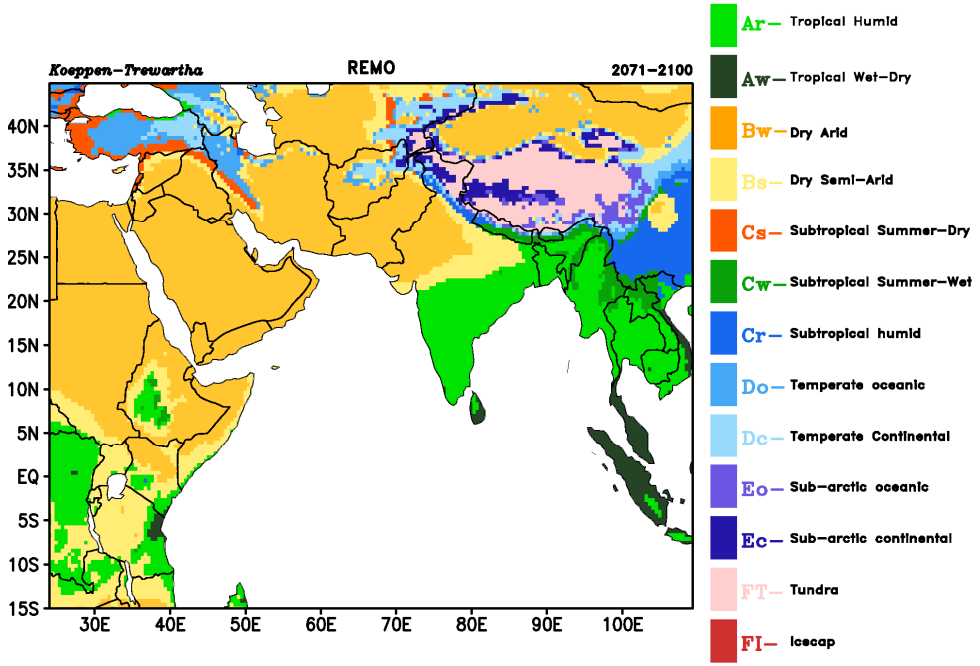
Köppen-Trewartha Climate Type



Based on monthly mean values of temperature and precipitation from CRU







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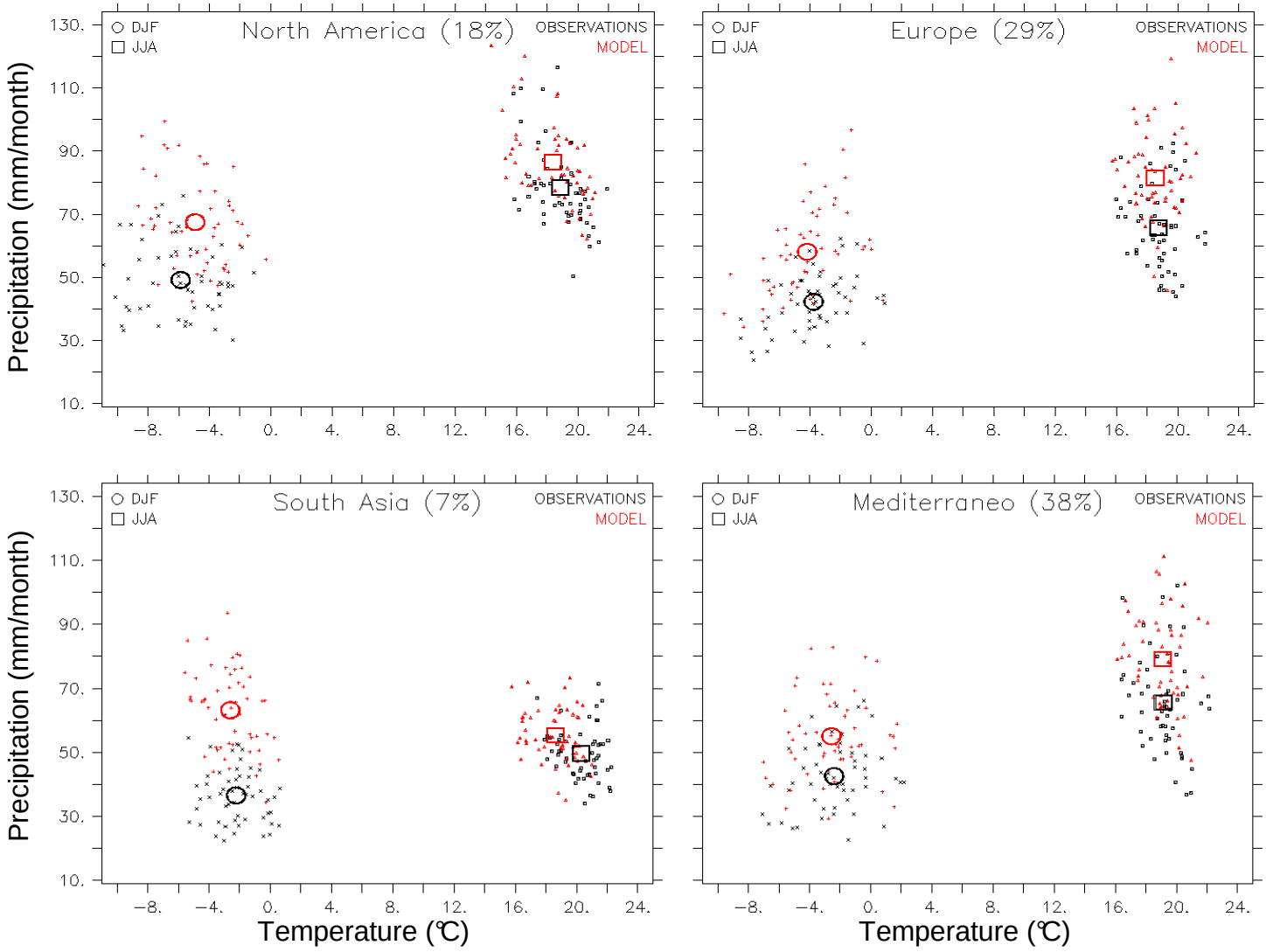
Temperature and Precipitation (Dc – Temperate continental)



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Finished and Proposed REMO CORDEX West-Asia simulations

Forcing	Scenario	Period	Comment
ERA_Int	Baseline	1979-2008	Finished
ECHAM5MPI-OM	20c3m	1971-2000	Finished
	A1B	2021-2050 & 2071-2100	Finished
ECHAM6_LR	Historical	1950-2005	Finished
	RCP2.6	2006-2100	Finished
	RCP4.5	,,	Finished
	RCP8.5	,,	Finished
HadCM3/?	Same as ECHAM6_LR	,,	Proposed

PS: RCM CCLM form Gothe Uni. Frankfurt, Germany will also conduct CORDEX WA at-least one simulation one.

Conclusions and Outlook

- REMO is able to simulate the mean annual climatic features in all domains, however some biases still remain
- Seasonal cycles are well captured for major river basins
- In depth analysis of main biases, e.g., by inter-comparison with other models and using other observational datasets
- Precipitation future prediction over AM region suggest an increase in precipitation in summer and winter
- Temperature rise in winter is more over Himalayan region whereas in summer more over land
- REMO SA CORDEX simulation with IPCC AR5 models in progress

Point of Discussion-1

- CORDEX SA/WA mailing list like EU-CORDEX list
- Data output ….
- What format data people wish to submit e.g. Core - mon/season, daliy(Tier-1), 3-hr'ly(Tier-2)
- Data format--Netcdf4 format
- Quality check, before go to public (Hydrologist, impact scientists, journalists, politicians, ….) to avoid any conflict like IPCC AR4
- Representative Concentrations Pathways (RCPs) how many!
- Clear simulation Technical Info

Point of Discussion-2

- Which Obs. Data!
- Time line (who will contribute what and when!)
- Put all result at the same grid , if not may lose high resolution quality (e.g. WRF λ-coordinate)
- Bias correction, not physically consistent but may be useful for impact people, If BC is agreed what method, who will take a lead!
- Paper contribution by all participating institute and at least one lead paper from each contributing group
  - Topics- indices, snow cover, glacier, monsoon pattern, cyclones, extreme cases

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Article

Assessing the Transferability of the Regional Climate Model REMO to Different COordinated Regional Climate Downscaling EXperiment (CORDEX) Regions

Daniela Jacob [1,2,*], Alberto Elizalde [2], Andreas Haensler [1], Stefan Hagemann [2], Pankaj Kumar [2], Ralf Podzun [2,†], Diana Rechid [2], Armelle Reca Remedio [2], Fahad Saeed [1], Kevin Sieck [2], Claas Teichmann [2] and Christof Wilhelm [2]

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† This author is deceased on 7 September 2011.

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Abstract: The transferability of the regional climate model REMO with a standard setup over different regions of the world has been evaluated. The study is based on the idea that the modeling parameters and parameterizations in a regional climate model should be robust to adequately simulate the major climatic characteristic of different regions around the globe. If a model is not able to do that, there might be a chance of an “overtuning” to the “home-region”, which means that the model physics are tuned in a way that it might cover some more fundamental errors, e.g., in the dynamics. All simulations carried out

Very High Resolution Climate Change Information over India

- Current Climate Change Information of India GCM/RCM
  - GCM
  - RCM
- Multi-model very high-resolution Climate change information for India

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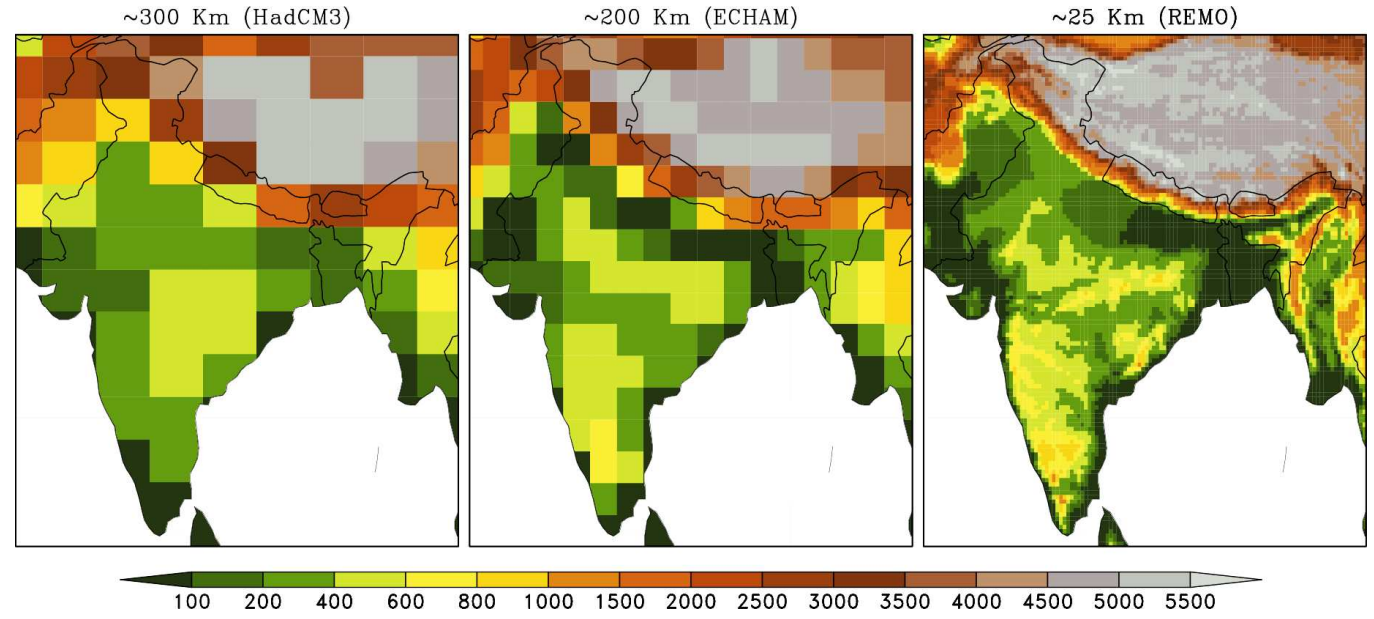
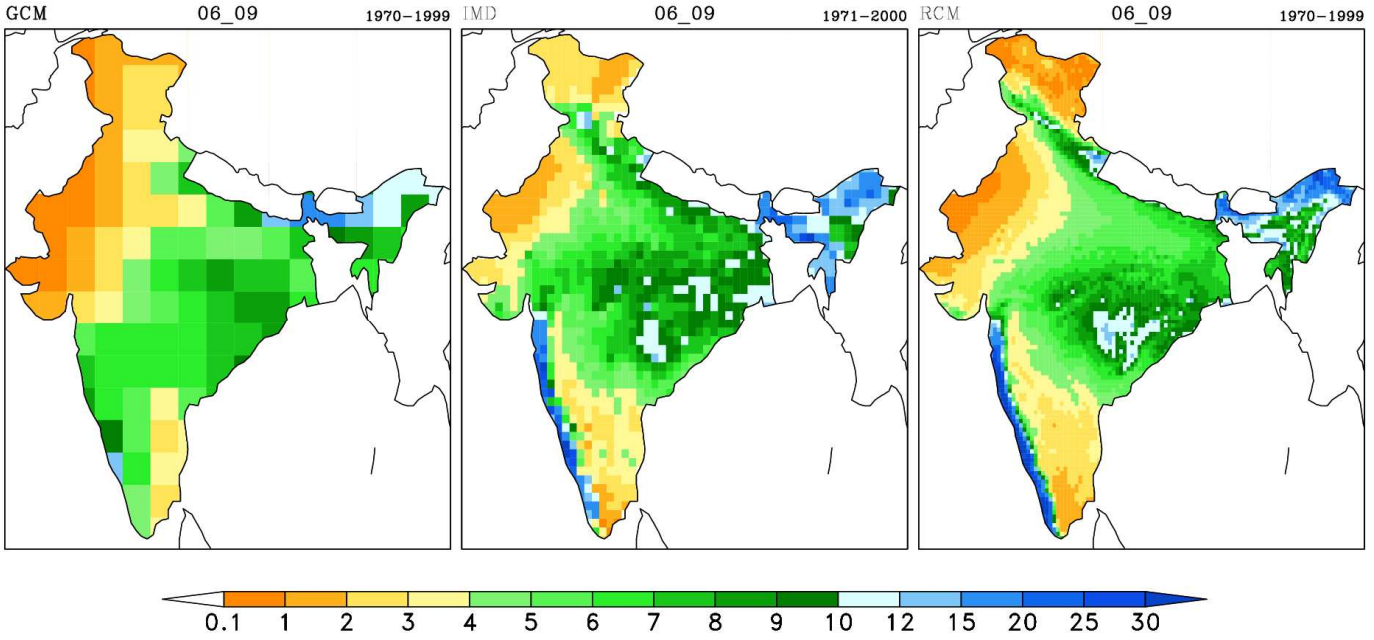


Orography



More realistic monsoon precipitation pattern in RCM

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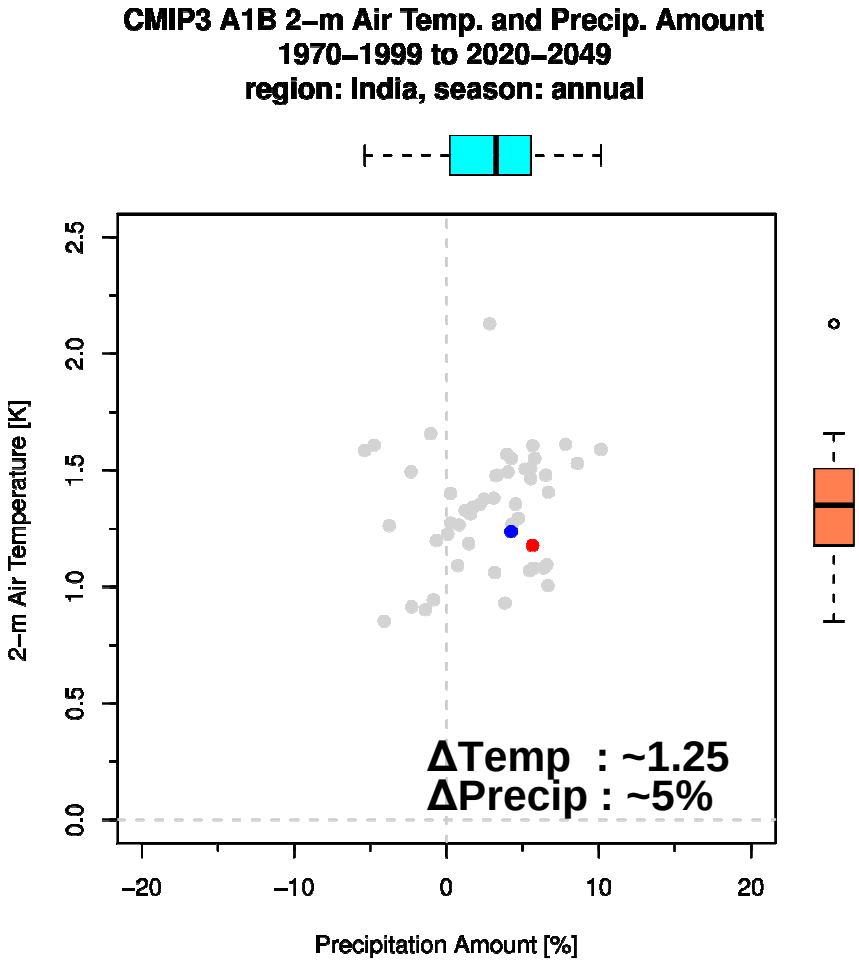
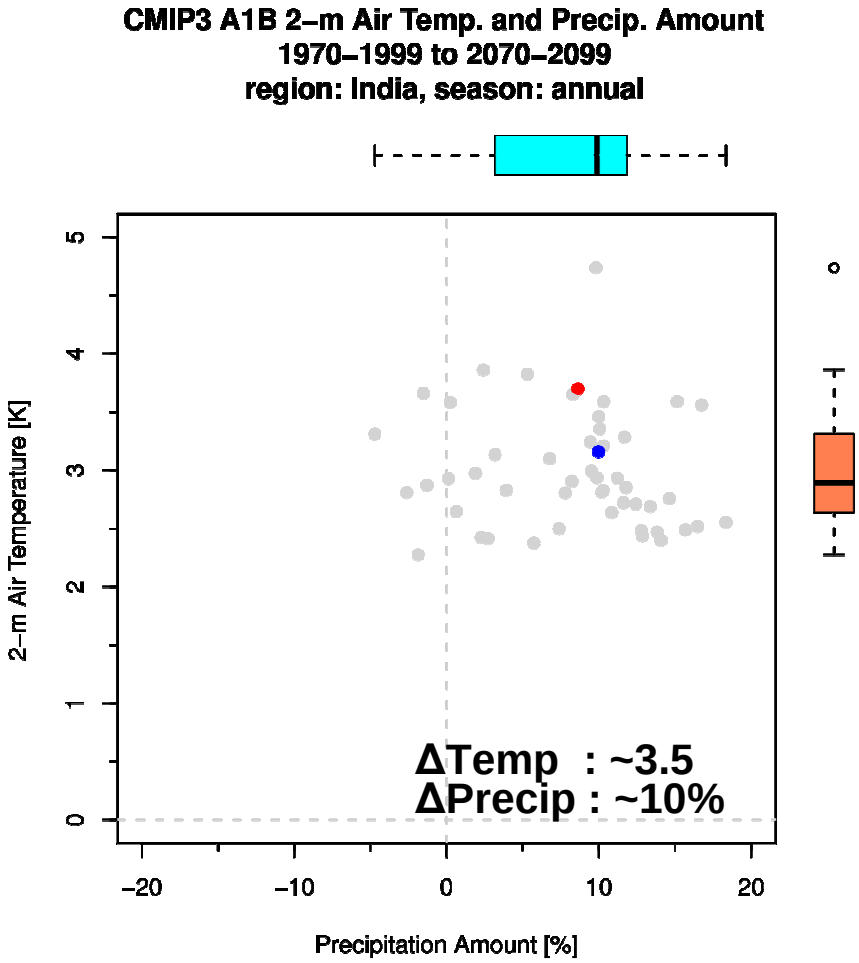
GCM Projection for South Asia





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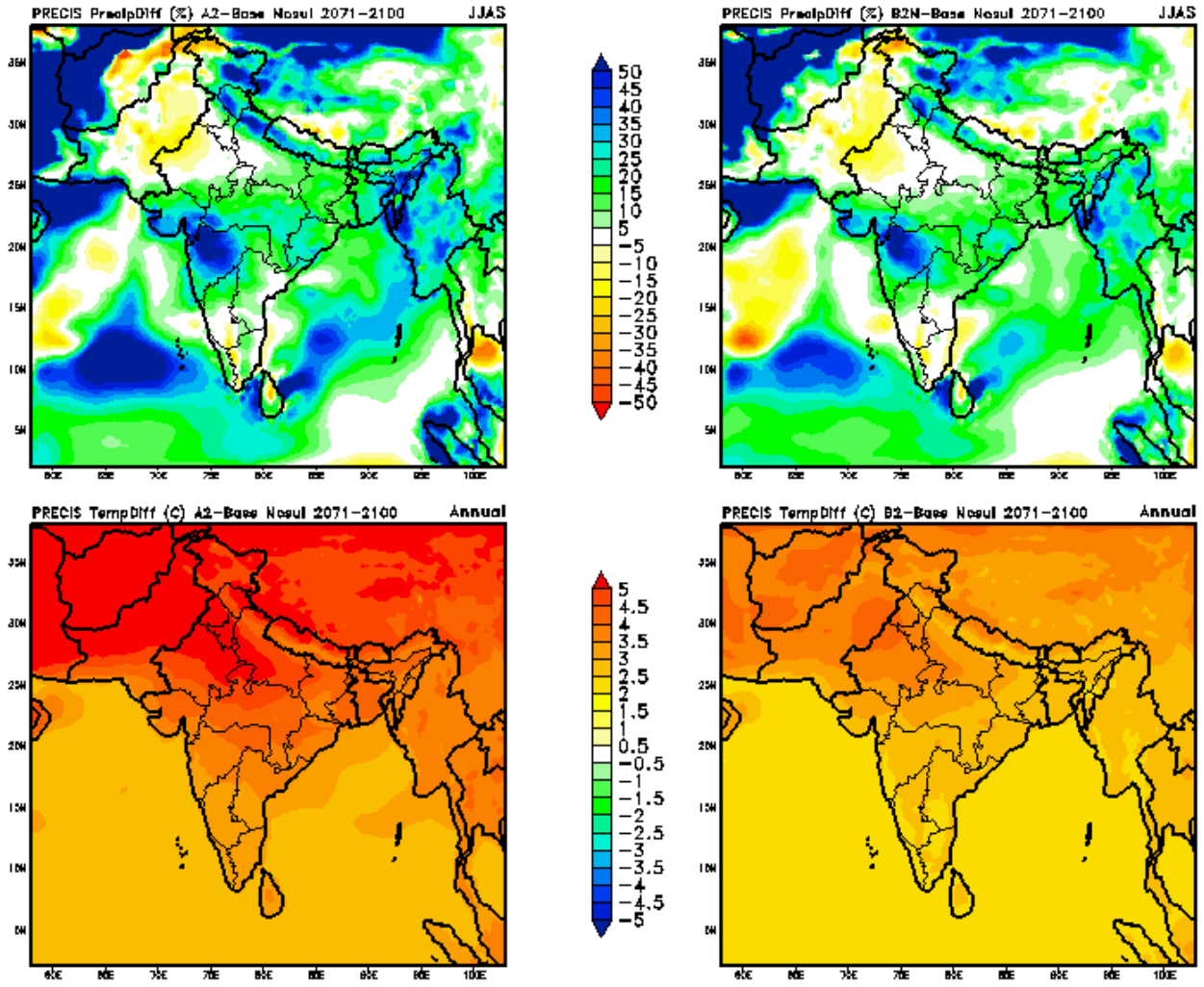
RCM Simulation available for India



RCM-PRECIS
~55Km
A2 and B2
1960-1990 vs. 2071-2100

Rupa Kumar et al. 2006, Current Science

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HighNoon RCM Simulations for India

Regional Models (RCMs)

REMO : Max Planck Inst. for Meteorology, Germany

HadRM3 : UK Met Office

Resolution : 0.22x0.22 deg (~25Km)

Domain : 60.125E - 100.125E & 4.125N - 40.125N

Period : 1960-2100

Forcing : ERA-I, ECHAM5/MPI OM and HadCM3

Simulation : 4

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Very-high resolution RCMs ensemble annual mean projections

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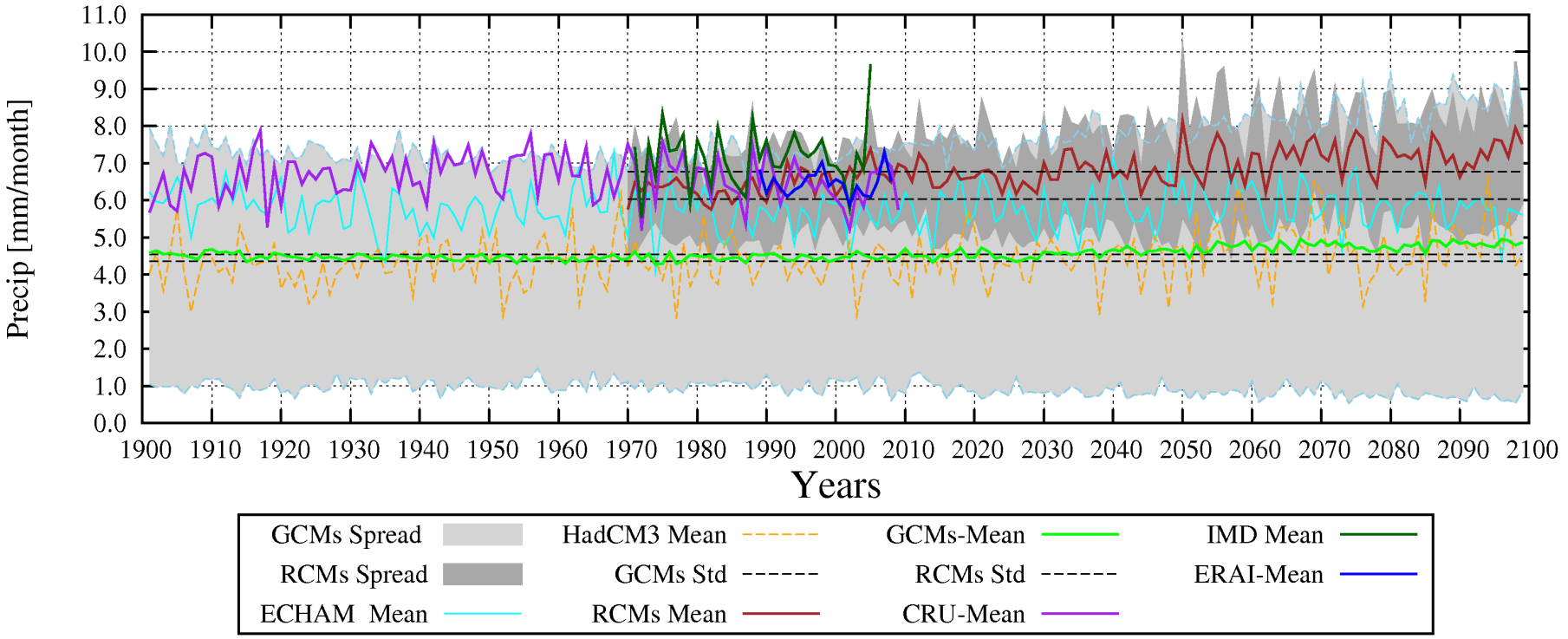
Precipitation over India



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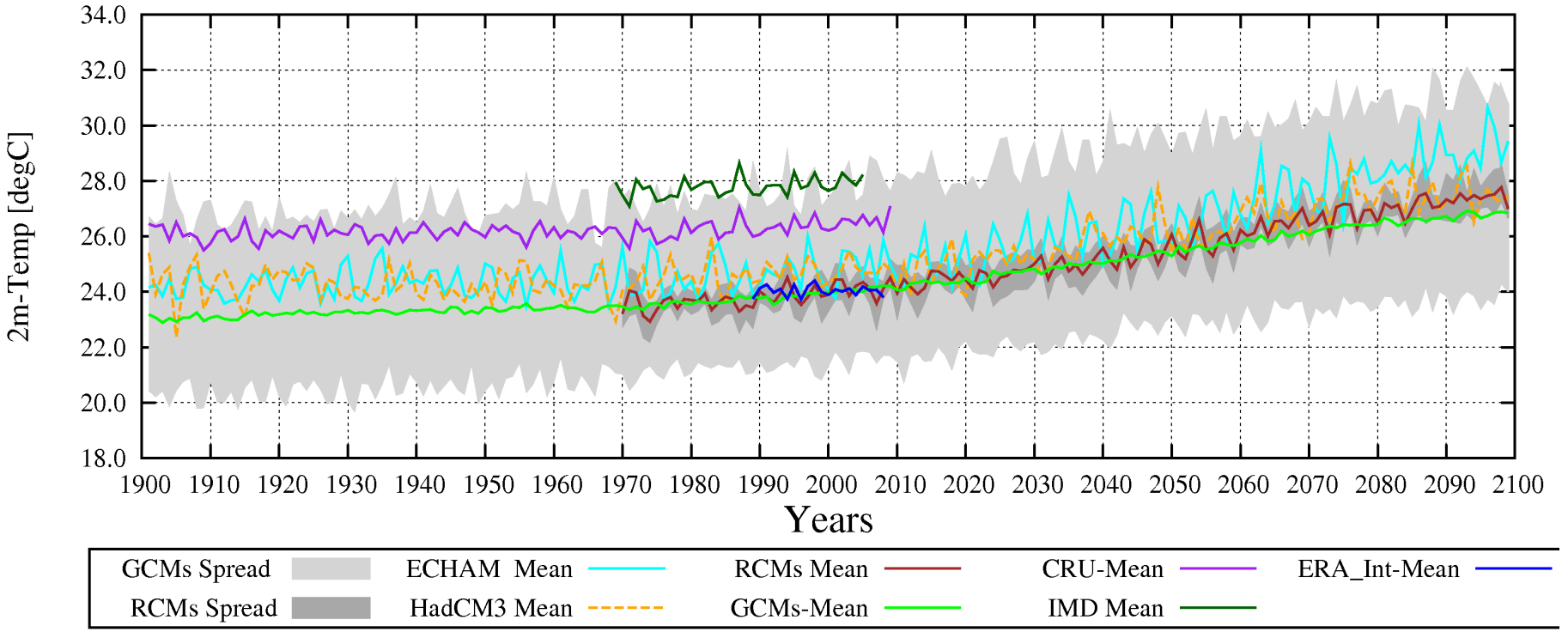
2m Temperature over India



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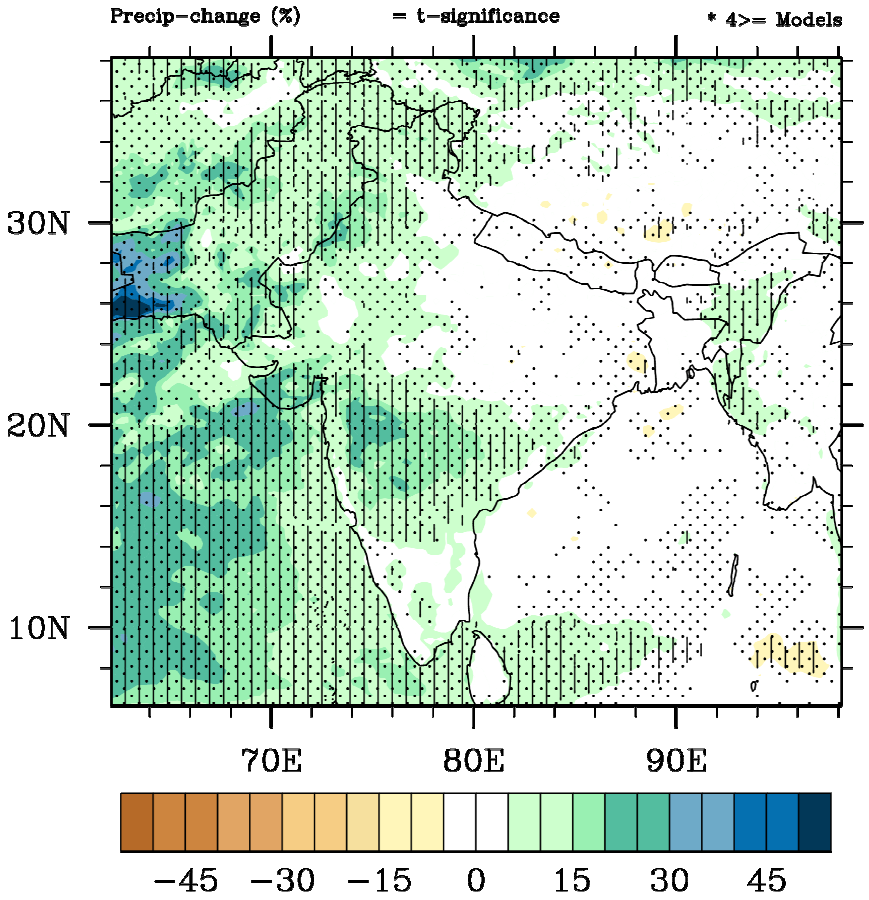
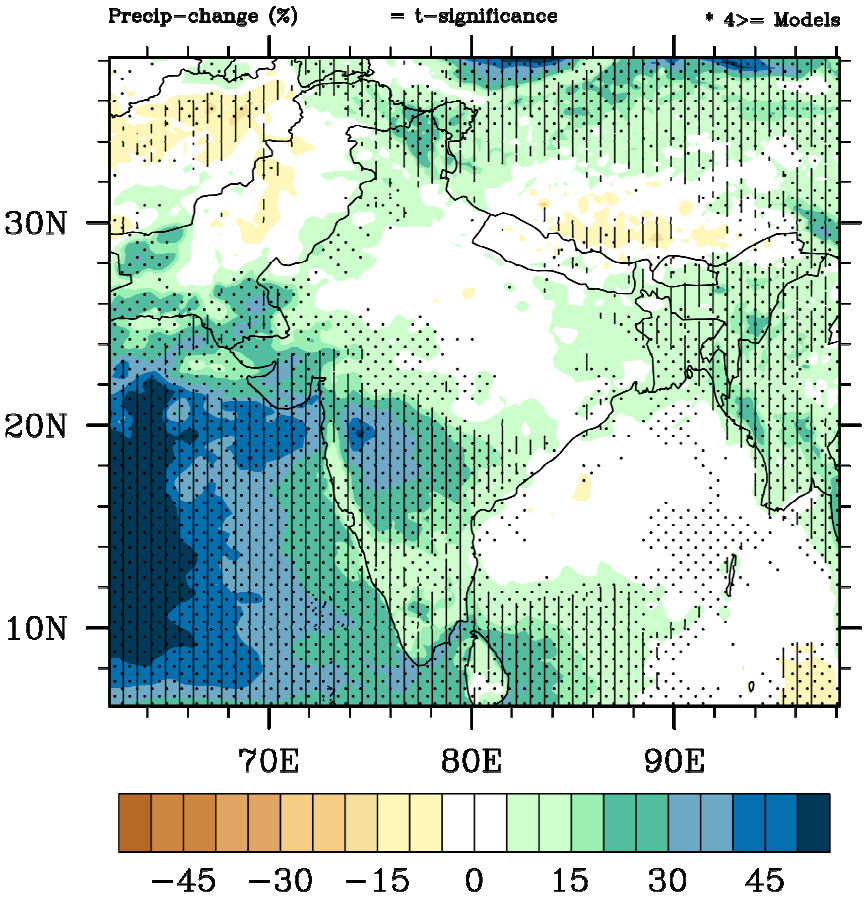
Precipitation change

1970-1999 vs. 2021-2050



1970-1999 vs. 2070-2099



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Summary

- **The most detailed high resolution (~25Km) climate information available for the region.**
  - **The first complete high resolution climate simulation data set from 1960 to 2100.**
- **Both GCM and RCM showed schematic cold bias over India.**
  - **The ensemble-mean warming evident at the end of 2050 is 1-2 ℃, whereas it is 3-5 ℃ at the end of century.**
- **RCMs were able to simulate the monsoon inter-annual variability quite well.**
  - **The projected pattern of the precipitation change shows spatial variability.**
  - **Future precipitation extremes are likely to increase.**

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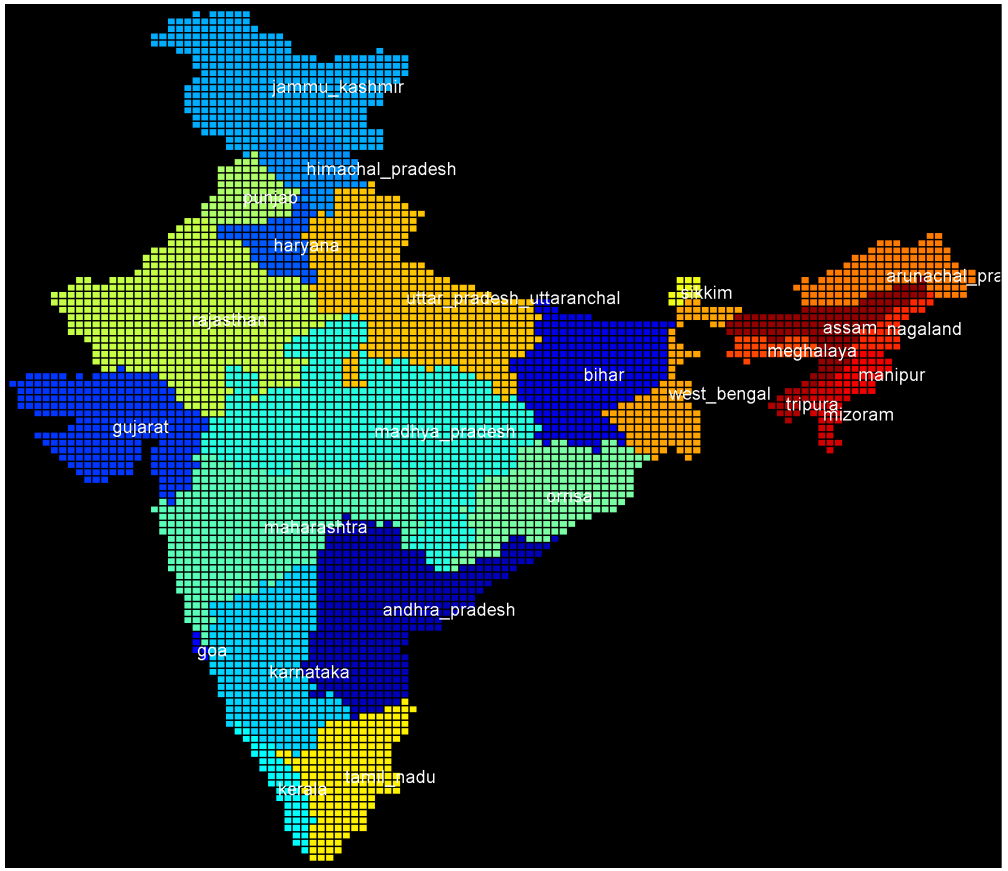
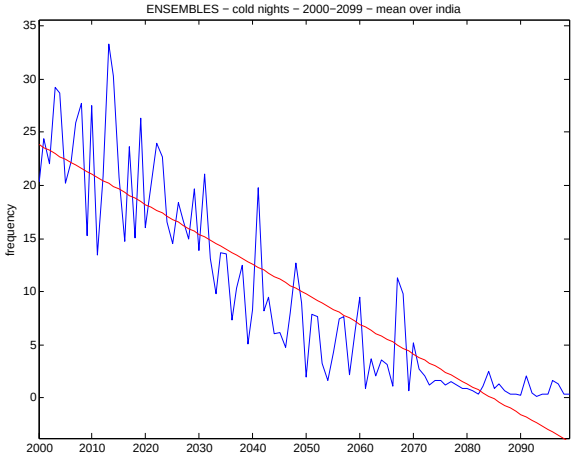
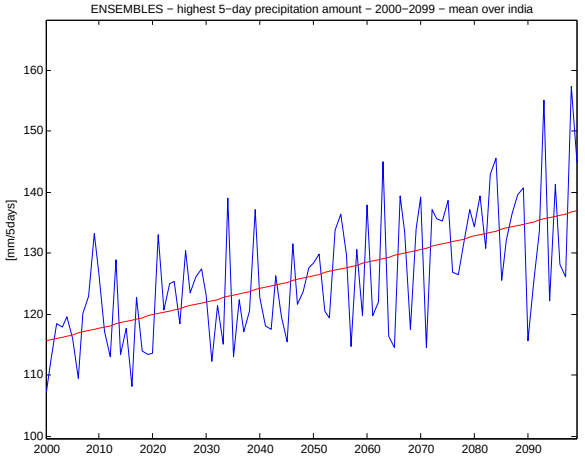
Regional Tailored Climate Information





Cold nights



Yearly 5-day mean max precip.

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Point of Discussion-1

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- Data output ….
- What format data people wish to submit e.g. Core - mon/season, daliy(Tier-1), 3-hr'ly(Tier-2)
- Data format--Netcdf4 format
- Quality check, before go to public (Hydrologist, impact scientists, journalists, politicians, ….) to avoid any conflict like IPCC AR4
- Representative Concentrations Pathways (RCPs) how many!
- Clear simulation Technical Info

Point of Discussion-2

- Which Obs. Data!
- Time line (who will contribute what and when!)
- IITM may be regional hub for hosting CORDEX SA/WA data
- Put all result at the same grid , if not may lose high resolution quality (e.g. WRF λ-coordinate)
- Bias correction, not physically consistent but may be useful for impact people, If BC is agreed what method, who will take a lead!
- Paper contribution by all participating institute and at least one lead paper from each contributing group
- Topics- indices, snow cover, glacier, monsoon pattern, cyclones, extreme cases

Thank you for attention!!

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