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Government of Nepal
Ministry of Irrigation
Department of Irrigation

Projected future climate for Western Nepal

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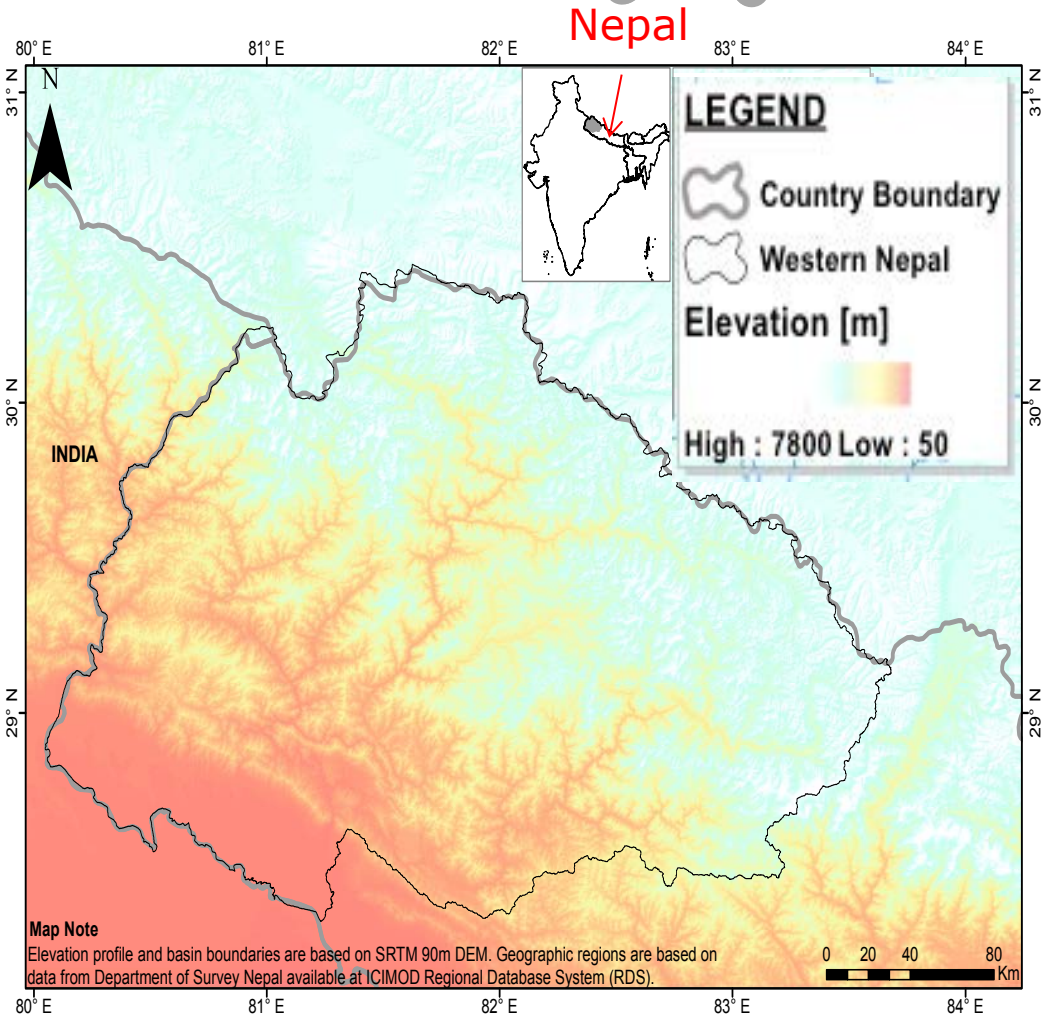
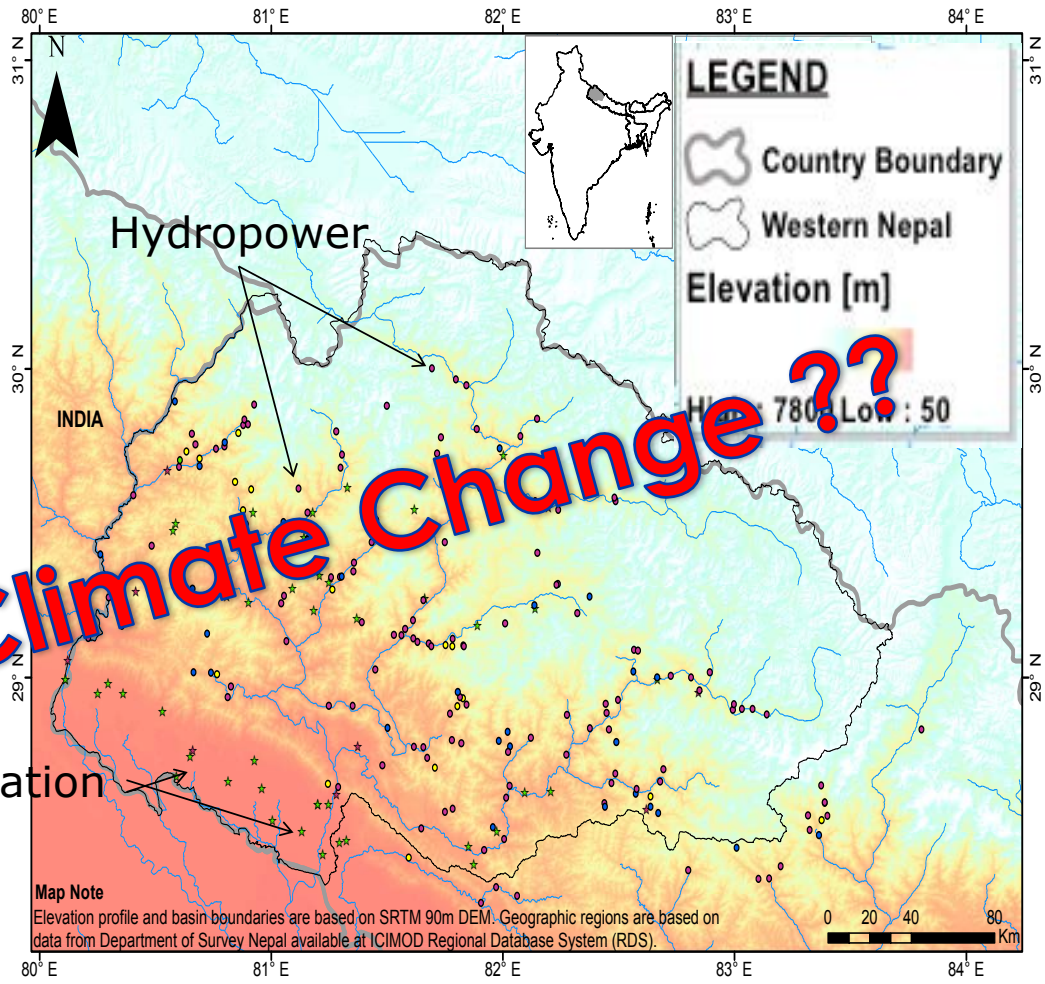
Western Nepal

- Headwater of the Ganga basin
- Remote communities vulnerable to climate change
- Steep terrain with rich biodiversity



Western Nepal

- Headwater of the Ganga basin
- Remote communities vulnerable to climate change
- Steep terrain with rich biodiversity
- Planned hydropower and irrigation projects



Climate Projections

- Regional Climate Model (RCM)s are key for future projections
- Application of RCM at local scale is difficult:
  - Many to choose from
  - Limited skill and resources to handle/process RCMs
- Prior assessments provide limited help:
  - Address regional scales over long time-frames
  - Assess climate parameters separately
  - Consider different ensembles

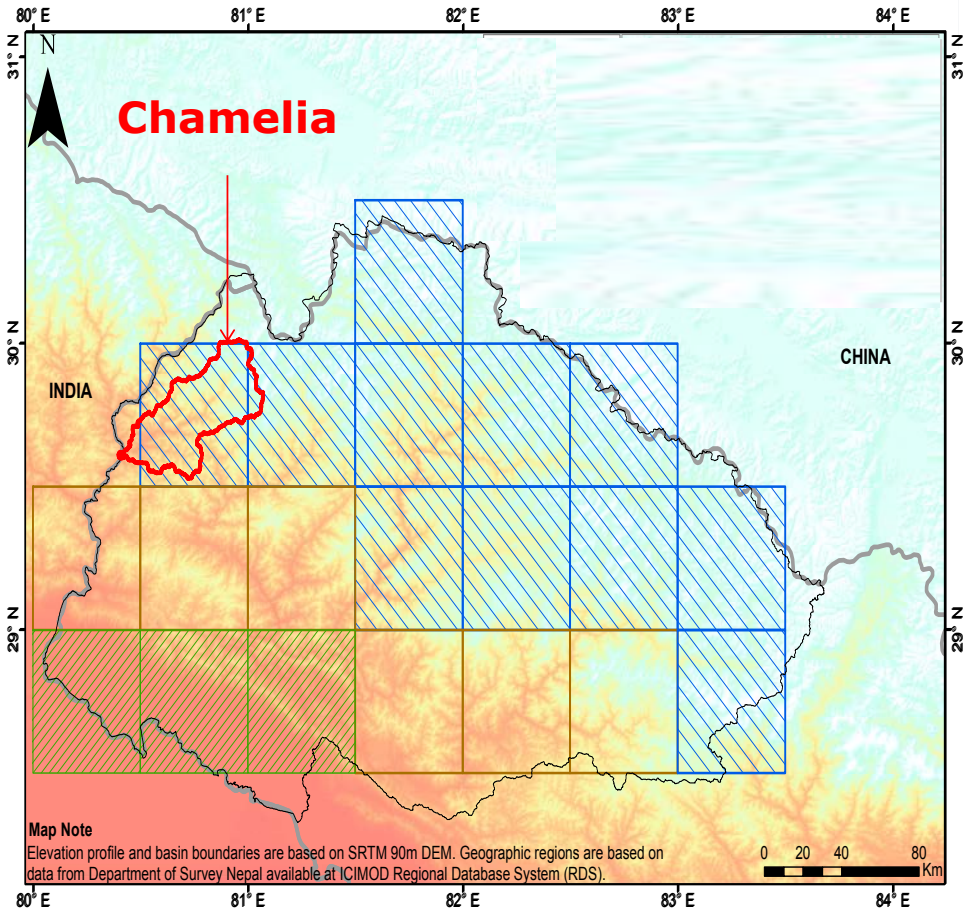
Objectives

- Develop a single framework to assess projections across
  - all available RCMs
  - multiple parameters (precipitation, min/max temperature)
- Work at finer spatial and temporal scales

Develop SIMPLE visual climate future matrices as tools for RCM selection

Methods

- Spatial disaggregation:
  - Mountain, hill, terai
- Temporal disaggregation:
  - Three 25 yr timeframes
  - Near, Mid and Far
- 19 CORDEX-SA* products:
  - 6 RCMs and 14 GCMs
  - 2 RCPs in each RCM
- **Example:** Climate impact assessment in Chamelia



*CORDEX-SA: CoOrdinated Regional Downscaling Experiment – South Asia

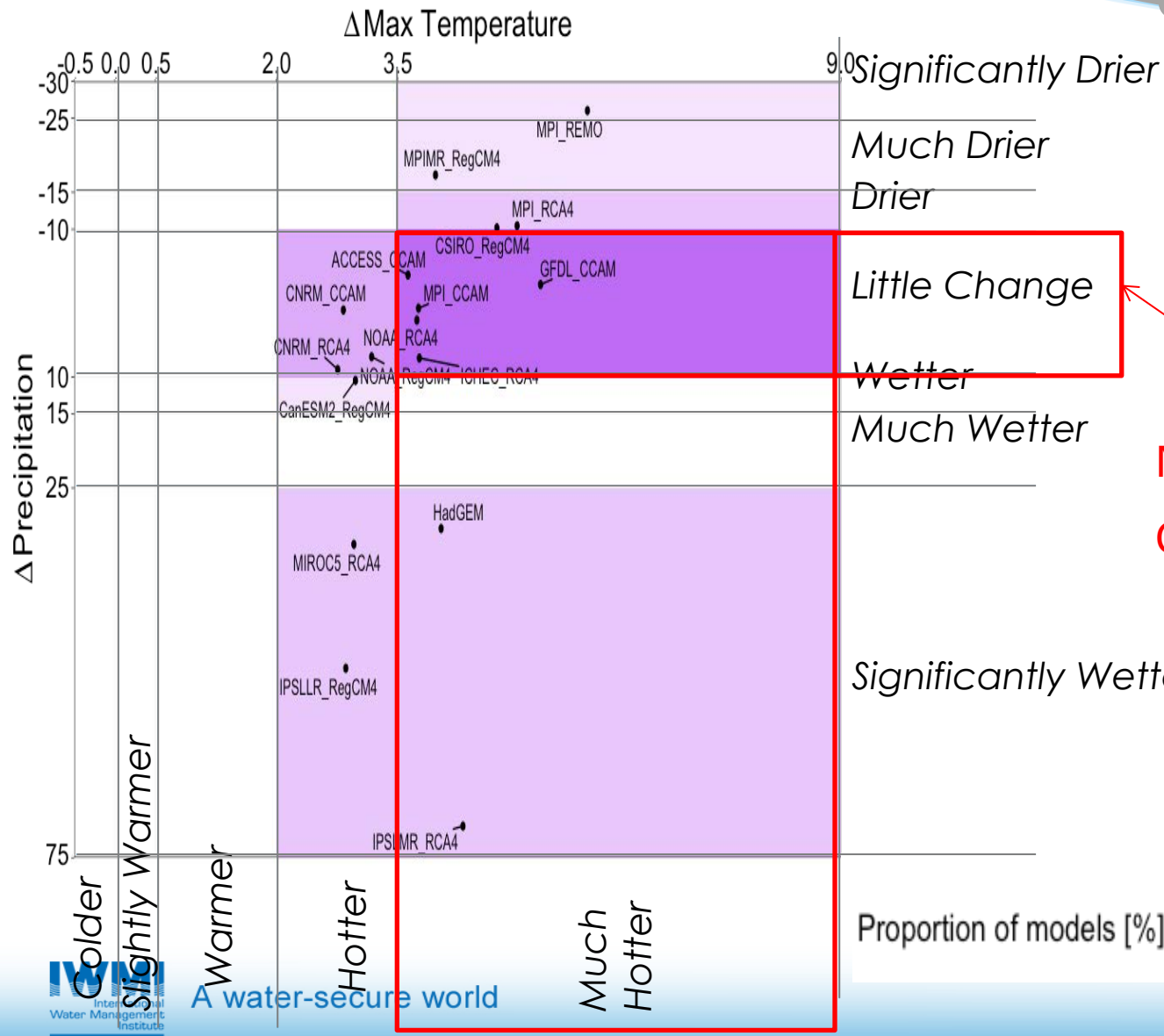
Climate Futures (CF) Framework

- From CSIRO Clarke et al., (2011); Whetton et al. (2012)

1. Plot annual average changes across parameters
   - Max temperature and total precipitation
   - For each RCM,

     Change: Δ = [historical – future time-frame]
2. Classify Δ into qualitative categories
3. Identify RCMs that fall into climate future of interest

CF Framework



Significantly Drier

Much Drier

Drier

Little Change

Wetter

Much Wetter

Significantly Wetter

- Each box in the matrix = a Climate Future (CF)

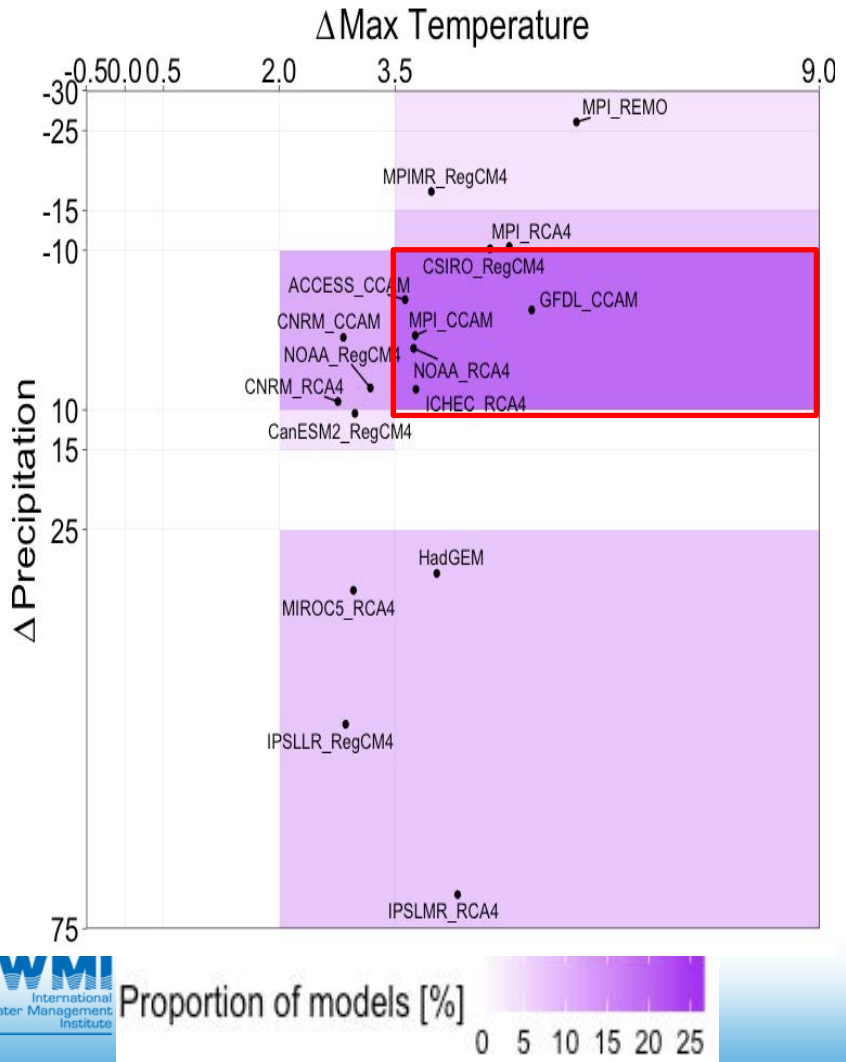
MAXIMUM CONSENSUS CF

Proportion of models [%]
0 5 10 15 20 25

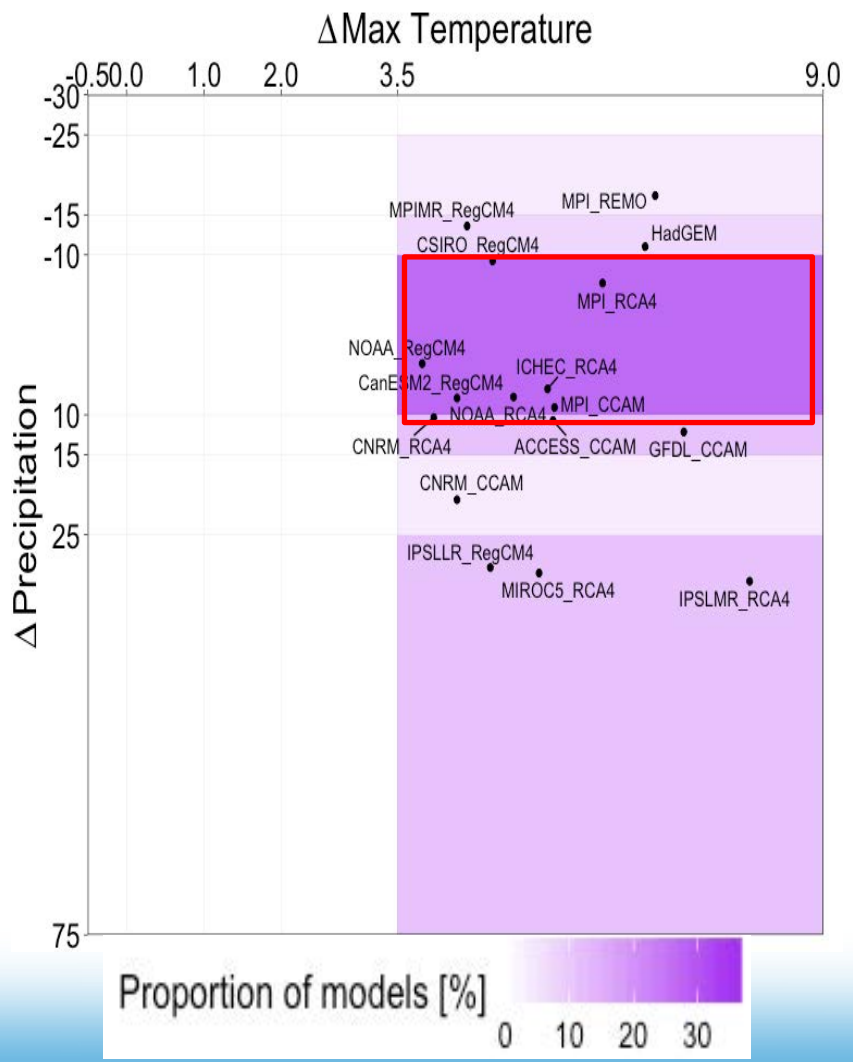
CF for Western Nepal

under RCP 8.5, far future [2070-2095]

TERAI



MOUNTAIN



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Selected CF for RCP 8.5

TERAI

RCP 8.5 Case	Far Future: 2071-2095 CF description	# Models
Low Risk	Wetter and Warmer	No model
Consensus	Little change in rain and Much Hotter	5
High Risk	Significantly Drier and Much Hotter	1

Selected CF for RCP 8.5

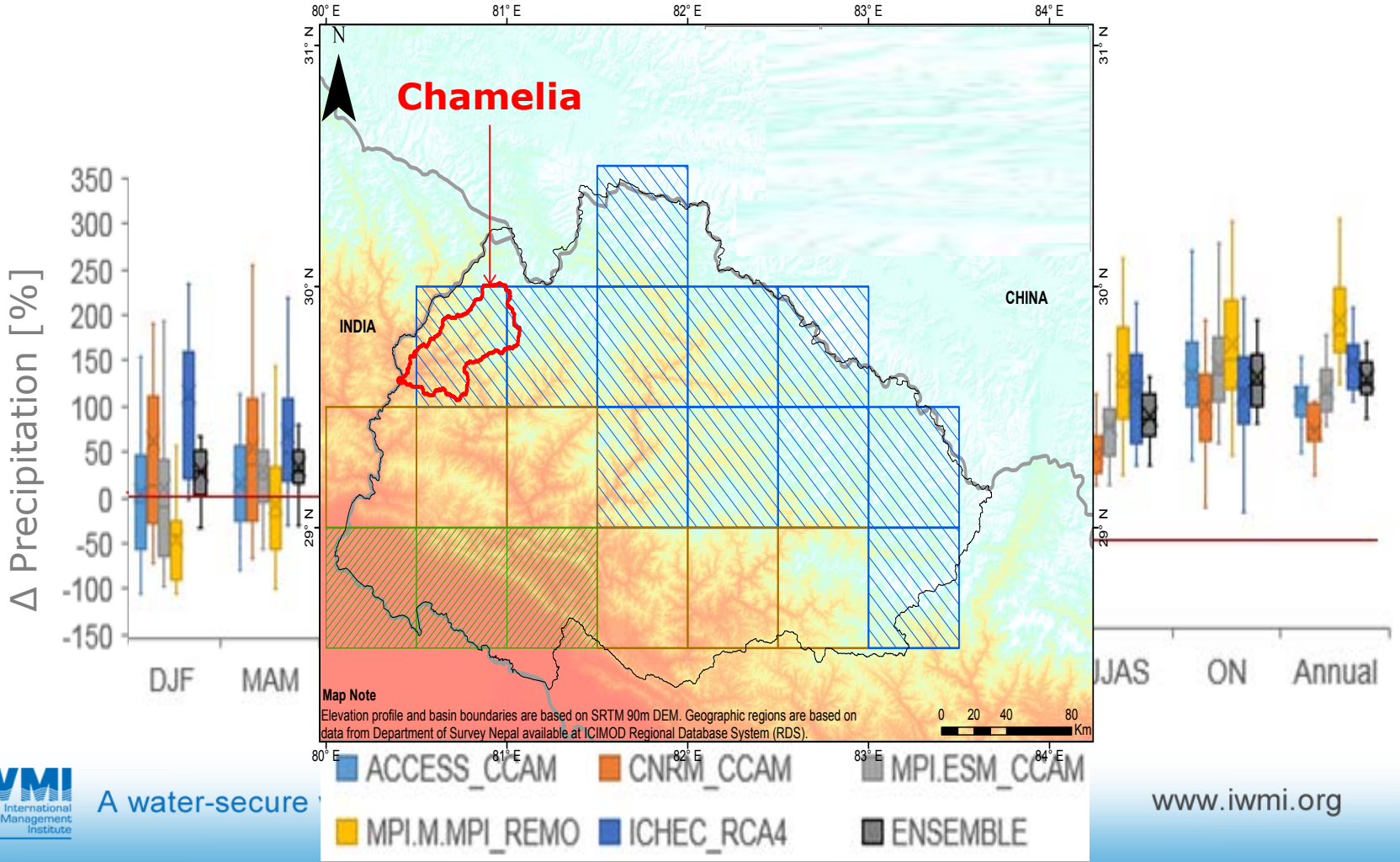
MOUNTAINS

RCP 8.5	Case	Near Future: 2021-2045		Mid Future: 2046-2070		Far Future: 2071-2095	
		CF description	# Models	CF description	# Models	CF description	# Models
	Low Risk	Wetter and Warmer	1	Wetter and Warmer	No model	Wetter and Warmer	No model
	Consensus	Little change in rain and Warmer	10	Little change in rain and Hotter	8	Little change in rain and Much Hotter	7
	High Risk	Much Drier and Hotter	No model	Much Drier and Hotter	No model	Much Drier and Much Hotter	1

Chamelia Climate Assessment

under RCP 8.5, far future [2070-2095]

- Hydrological modeling with RCM bias corrected using **quantile mapping**



Conclusions

- Trends noticed:
  - Δtemperature increases consistently
  - Δprecipitation is less variable in mountains than in terai
  - ΔT and P correlate best between hills and terai
- Visualized range of predictions help narrow the list of RCMs
  - 18 CFs matrices for 3 regions x 2 RCPs x 3 time-frames
  - Hydrological modelling for Chamelia basin
- Further processing of selected RCMs is needed prior to application

Future Work

- Improve visualization to represent range in each RCM
- Analyze seasonal or monthly change
  - Annual analyses may average out seasonal changes and extremes
- Expand database to include GCMs in same framework

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CGIAR RESEARCH PROGRAM ON Water, Land and Ecosystems

LED BY: IWMI International Water Management Institute

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ADB

NDF Nordic Development Fund

CIF CLIMATE INVESTMENT FUNDS

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Precipitation and Temperature Classes

Δ Precipitation Classes		Δ Temperature Classes	
Description	**Range**	**Description**	**Range**
Significantly Drier	**Δ**pr < -25%	Colder	**Δ**t < 0°C
Much Drier	-25% ≤ **Δ**pr < -15%	Slightly Warmer	0 ≤ **Δ**t < 0.5 °C
Drier	-15% ≤ **Δ**pr < -10%	Warmer	0.5 °C ≤ **Δ**t < 2.0 °C
Little change	-10% ≤ **Δ**pr < 10%	Hotter	2.0 °C ≤ **Δ**t < 3.5 °C
Wetter	10% ≤ **Δ**pr < 15%	Much Hotter	**Δ**t ≥ 3.5 °C
Much Wetter	15% ≤ **Δ**pr < 25%		
Significantly Wetter	**Δ**pr ≥ 25%		

Considered RCMs from CORDEX-SA

	CORDEX South Asia RCM	Driving GCM	RCM Description	Contributing RCM Modeling Center
1	CSIRO-CCAM-1391M	ACCESS1.0	Conformal Cubical Atmospheric Model - CCAM (McGregor and Dix, 2001)	Commonwealth Scientific and Industrial Research Organisation (CSIRO), Marine and Atmospheric Research, Melbourne, Australia
2	CSIRO-CCAM-1391M	CNRM-CM5		
3	CSIRO-CCAM-1391M	GFDL-CM3		
4	CSIRO-CCAM-1391M	MPI-ESM-LR		
5	CSIRO-CCAM-1391M	NorESM-M		
6	HadGEM3-RA	HadGEM2-AO	HadGEM3 Regional Atmospheric model	Met Office Hadley Centre (MOHC), UK
7	IITM-RegCM4	CCCma-CanESM2	The Abdus Salam International Centre for Theoretical Physics (ICTP) Regional Climatic Model version 4 (RegCM4; Giorgi et al., 2012)	Centre for Climate Change Research (CCCR), Indian Institute of Tropical Meteorology (IITM), India
8	IITM-RegCM4	CNRM-CM5		
9	IITM-RegCM4	CSIRO-Mk3.6		
10	IITM-RegCM4	IPSL-CM5A-LR		
11	IITM-RegCM4	MPI-ESM-MR		
12	IITM-RegCM4	NOAA-GFDL-GFDL-ESM2M		
13	MPI-CSC-REMO2009	MPI-ESM-LR	MPI Regional model 2009 (REMO2009; Teichmann et al., 2013)	Climate Service Center (CSC), Germany
14	SMHI-RCA4	CNRM-CM5	Rossby Centre regional atmospheric model version 4 (RCA4; Samuelsson et al., 2011) 011)	Rosssy Centre, Swedish Meteorological and Hydrological Institute (SMHI), Sweden
15	SMHI-RCA4	ICHEC-EC-EARTH		
16	SMHI-RCA4	IPSL-CM5A-MR		
17	SMHI-RCA4	MIROC-MIROC5		
18	SMHI-RCA4	MPI-ESM-LR		
19	SMHI-RCA4	NOAA-GFDL-GFDL-ESM2M		