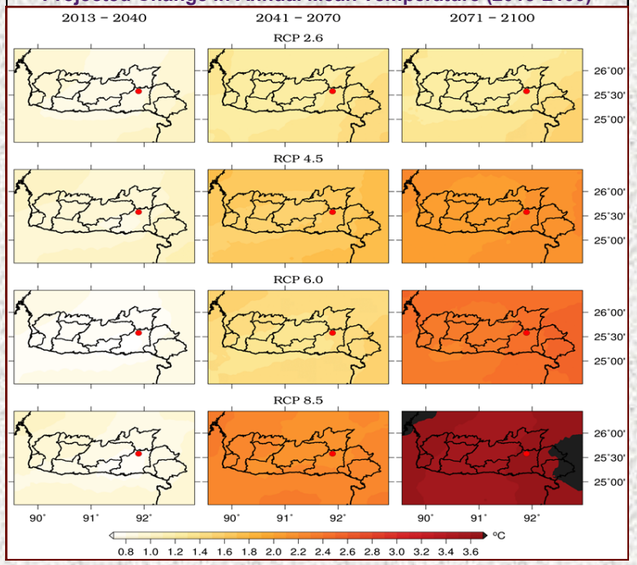
PROJECTED PERIOD ANALYSIS (2013-2100)

Projected Temperature:

- The State is anticipated to face **an increase in temperature** under all scenarios for all projected time periods.
- The increments in the long term under mild and extreme scenario are limited to 2.2°C and more than 3.5°C respectively.

Scenarios	Time Period		
	Near Term (2013-2040)	Mid Term (2041-2070)	Long Term (2071-2100)
RCP 2.6	0-1.5°C		
RCP 4.5	0.9-1.7°C		1.3-2.2°C
RCP 6.0	0.7-0.8°C	1.4-2.5°C	
RCP 8.5	0.7-0.9°C	1.4-2.2°C	>3.5°C

Projected Change in Annual Mean Temperature (2013-2100)

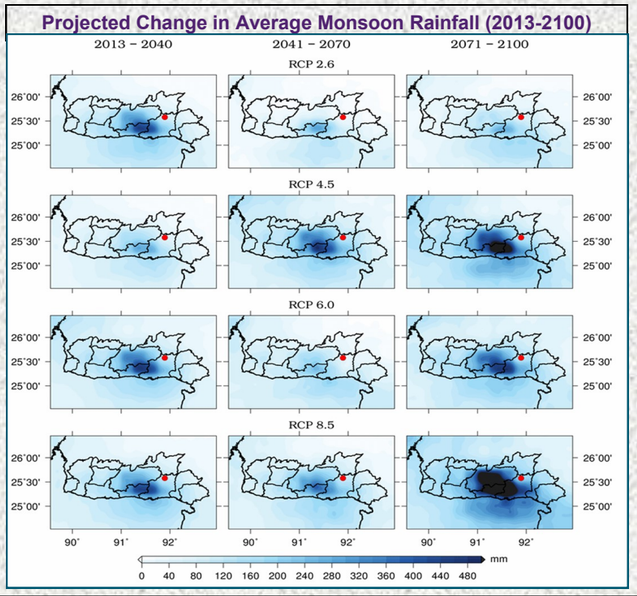


Projected Precipitation:

- An **increase in rainfall is projected** to be about **3-7%** in the near term, **3-6%** in the mid-term and **5-13%** in the long term under various scenarios.
- The **central region**, which already receives very high precipitation, is projected to face even higher rise.

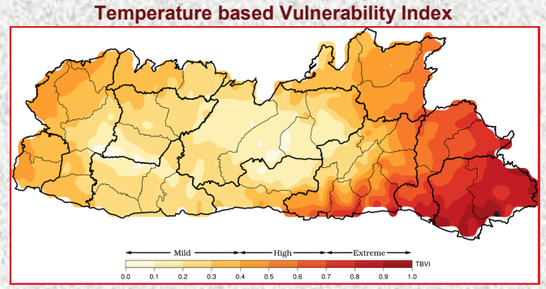
Scenarios	Time Period		
	Near Term (2013-2040)	Mid Term (2041-2070)	Long Term (2071-2100)
RCP 2.6	40-300 mm	30-180 mm	78-180 mm
RCP 4.5	50-160 mm	80-190 mm	95-350 mm
RCP 6.0	92-287 mm	45-178 mm	120-270 mm
RCP 8.5	100-269 mm	86-212 mm	181-420 mm

Projected Change in Average Monsoon Rainfall (2013-2100)

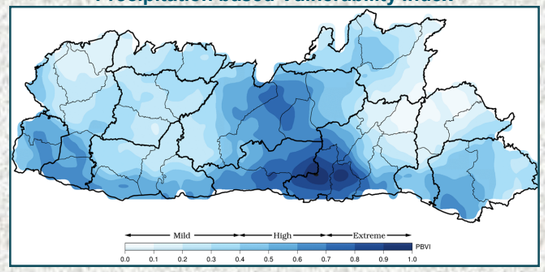


CLIMATE VULNERABILITY HOT-SPOTS

Temperature based Vulnerability Index



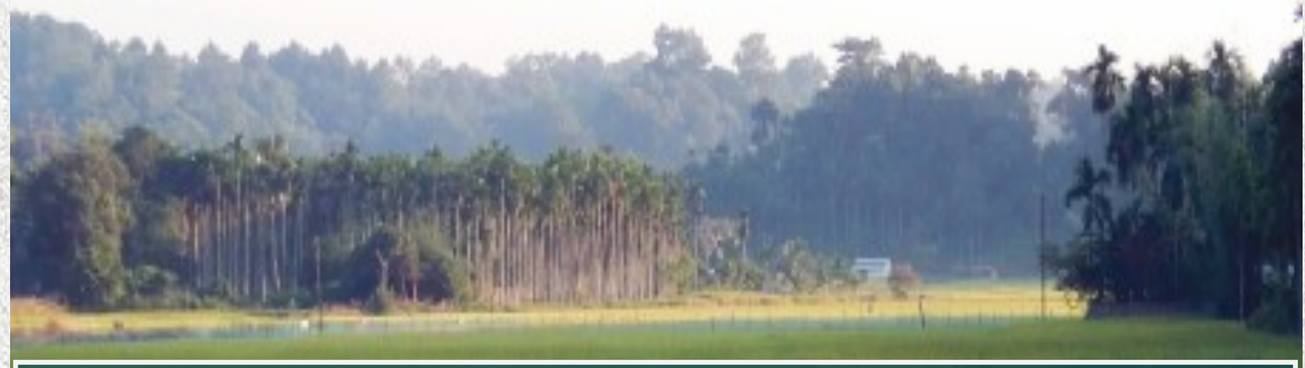
Precipitation based Vulnerability Index



- Two indices, **Temperature based Vulnerability Index** and **Precipitation based Vulnerability index,** were developed based on the observed mean, projected changes in climate and projected frequencies of extreme events in order to identify the regions that are vulnerable to climate change hazards.
- **Climate vulnerability hot-spots** are those regions which **are more susceptible to** changes in climate. **Based on severity of the vulnerability** index, the indices were categorized as **mild** (0 to 0.4), **high** (0.4 to 0.7), and **extreme** (0.7 to 1).
- **Temperature Vulnerability Hot-spots:** East Jaintia Hill, West Jaintia Hills, and some parts of East Khasi Hills & Ri-Bhoi are at high risk of temperature based hazards.
- **Precipitation Vulnerability Hot-spots:** South West Khasi Hills, West Khasi Hills, some parts of East Khasi Hills, South West Garo Hills & West Garo Hills are at high risk of precipitation based hazards.

Meghalaya Climate Change Centre, Meghalaya Basin Development Authority, Nongrim Hills, Shillong
Email : cccmegh@gmail.com

सत्यमेव जयते



Identification of Climate Vulnerability Hot-spots in Meghalaya using High Resolution Climate Projections

MEGHALAYA CLIMATE CHANGE CENTRE

IBDLP MEGHALAYA

Department of Science &Technology
Ministry of Science & Technology
Government of India

NMSHE NATIONAL MISSION FOR SUSTAINING THE HIMALAYAN ECOSYSTEM

OBJECTIVE

- **U**nderstanding the impacts of observed climate variability on hydrologic variables (rainfall, air temperature, and evapotranspiration) in Meghalaya
- **E**valuating changes in observed climate and extreme events (droughts, floods, and heat waves) in Meghalaya for the period of 1981-2012 using the high-resolution datasets
- **P**roviding an assessment on the future changes using high resolution dynamically and statistically downscaled projections from the CMIP5 and CORDEX-south Asia regional climate models
- **P**roviding observed and projected future climate gridded data at high resolution (~5-10 km) for each district in Meghalaya, that can be used for vulnerability assessment and policy making

DATA USED

OBSERVED (1981-2012):

- For temperature, data from Sheffield et al. (2006) at 0.25 degree resolution was re-gridded to 0.05 degree resolution.
- For precipitation, Climate Hazards Group Infra-Red Precipitation with Station (CHIRPS) data at 0.05 degree resolution rescaled using IMD and APHRODITE precipitation to 0.25 degree resolution.

PROJECTIONS (2013-2100):

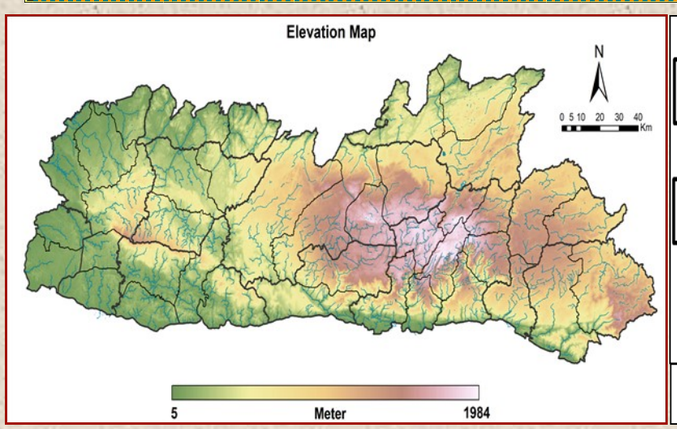
- Projected climate data were obtained from Coupled Model Intercomparison Project 5 (CMIP5). Out of the 40 CMIP models, 5 best model were selected (viz. CCSM4, GFDL-ESM2M, NorESM1-M, NorESM1-ME & MIROC5).
- The final resolution after applying bias correction for all the products was 0.05 degree resolution.

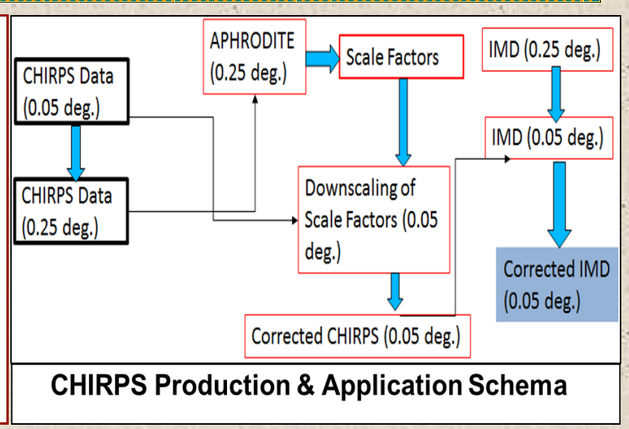
Climate Change Projections

- Future projections of **both rainfall and temperature** for different time period under four representative concentration pathways (RCP 2.6, RCP 4.5, RCP 6.0, RCP 8.5) scenarios were considered.
- The **time period of evaluation** was divided into near term (2013-2040), mid term (2041-2070), and long term (2071-2100).
- All the projected changes are relative to the **baseline climate data** (1981-2012).

Projection Challenges

- **Reliability** of climate models
- **Uncertainty** (climate models, climate scenarios, and impact models)
- **Observations** (spatial & temporal resolution)
- **Downscaling** & **Bias correction** (Statistical vs. Dynamical)





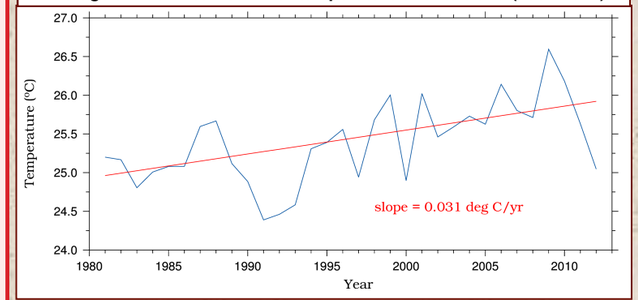
CHIRPS Production & Application Schema

OBSERVED PERIOD ANALYSIS (1981-2012)

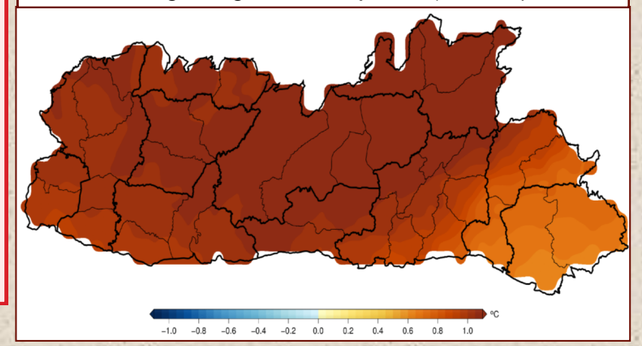
Observed Temperature:

- The State has experienced a **steady increase in the average temperature** during the past three decades (1981-2012) which clearly indicates that climate change is a reality and is happening now.
- The rate of annual temperature increment being **0.031 °C per year** poses a serious challenge.
- In the years 1991 and 1992 a drop in temperature below normal was observed, but for rest of the observation period, temperature increased consistently up to 1°C between 1981 and 2012.
- The **rate of increase** in temperature **varied spatially** with the South-eastern part having experienced a slower rate as compared to the rest of the State.

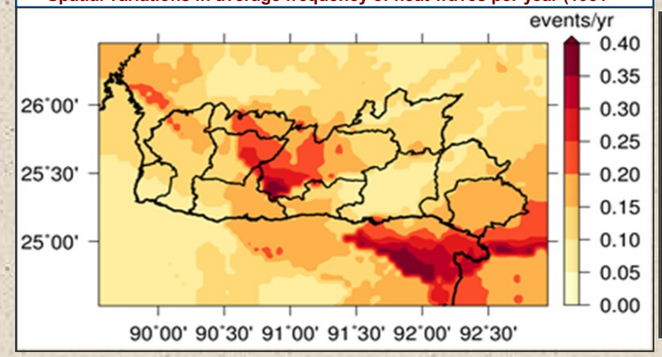
Average annual mean summer temperature and its trend (1981-2012)



Average change in mean temperature (1981-2012)



Spatial variations in average frequency of heat waves per year (1981 –



Extreme Temperature Events:

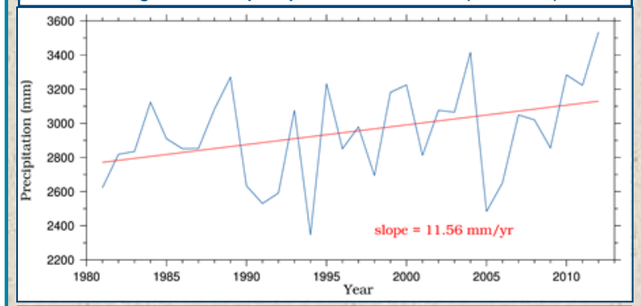
The number of hot days and nights dropped between the period 1990-1994, while cold days and nights increased. However, 1995 onwards, **the number of hot days and nights has an increasing trend** while that of cold days and nights has a declining trend.

This trend signifies a consistent warming of the region.

Observed Precipitation:

- The State received an **annual average rainfall of 4085 mm** of which **72%** occurs during June-September.
- The average annual rainfall has an **increasing trend** of **11.56 mm per year**.
- There is a **high spatial variability** in rainfall as central part of the State received **4000-8000 mm** while rest of the State experienced relatively moderate rainfall.
- Though there is a **steady change in precipitation levels**, the districts of West Khasi Hills, South West Khasi Hills & East Khasi Hills **shows very high precipitation levels as well as higher rise in intensities**.

Average monsoon precipitation and its trend (1981-2012)



Average monsoon precipitation