



Climate Change – Relevance to Goa

(Presentation for creating basic awareness as a part of preparation of Goa State Action Plan on Climate Change - SAPCC)





Terminology

Adaptation: Adjustment in natural or human systems in response to actual or expected climatic changes or their impacts, so as to reduce harm or exploit beneficial opportunities

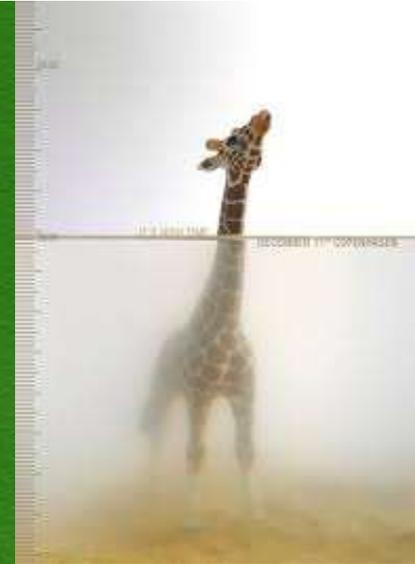
Vulnerability: The degree to which a human or natural system is susceptible to, or unable to cope with, adverse effects of climate change. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.

Climate variability: Variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual weather events. Examples of climate variability include extended droughts, floods, and conditions that result from periodic El Niño and La Niña events.

Mitigation: Within a climate change context, mitigation is a human intervention to actively reduce the production of greenhouse gas emissions (reducing energy consumption in transport, construction, at home, at work etc.), or to remove the gases from the atmosphere (sequestration)

Climate change: Any change in weather averaged over time due to natural variability or because of human activity.

Hazard Mitigation: Sustained action taken to reduce or eliminate long-term risk to life and property from a hazard event. Considered as one of four phases of emergency management, together with preparedness, response, and recovery.



What Is Climate Change?

Climate change refers to change in Earth's climate. Change in Earth's usual temperature. Or it could be a change in where rain and snow usually fall on Earth. Climate change is a change in the usual weather found in a place. Weather can change in just a few hours. **Climate takes hundreds or even millions of years to change.**

<https://www.nasa.gov/audience/forstudents/k-4/stories/nasa-knows/what-is-climate-change-k4.html>



Climate Change refers to a change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods.

(Source - IPCC)



Recent observations indicate that the impacts of climate change on the oceans **will exceed the projections** of the Intergovernmental Panel on Climate Change (IPCC) in its Fourth Assessment Report of 2007.

Key climate indicators

Sea-level rise,

Global ocean temperature,

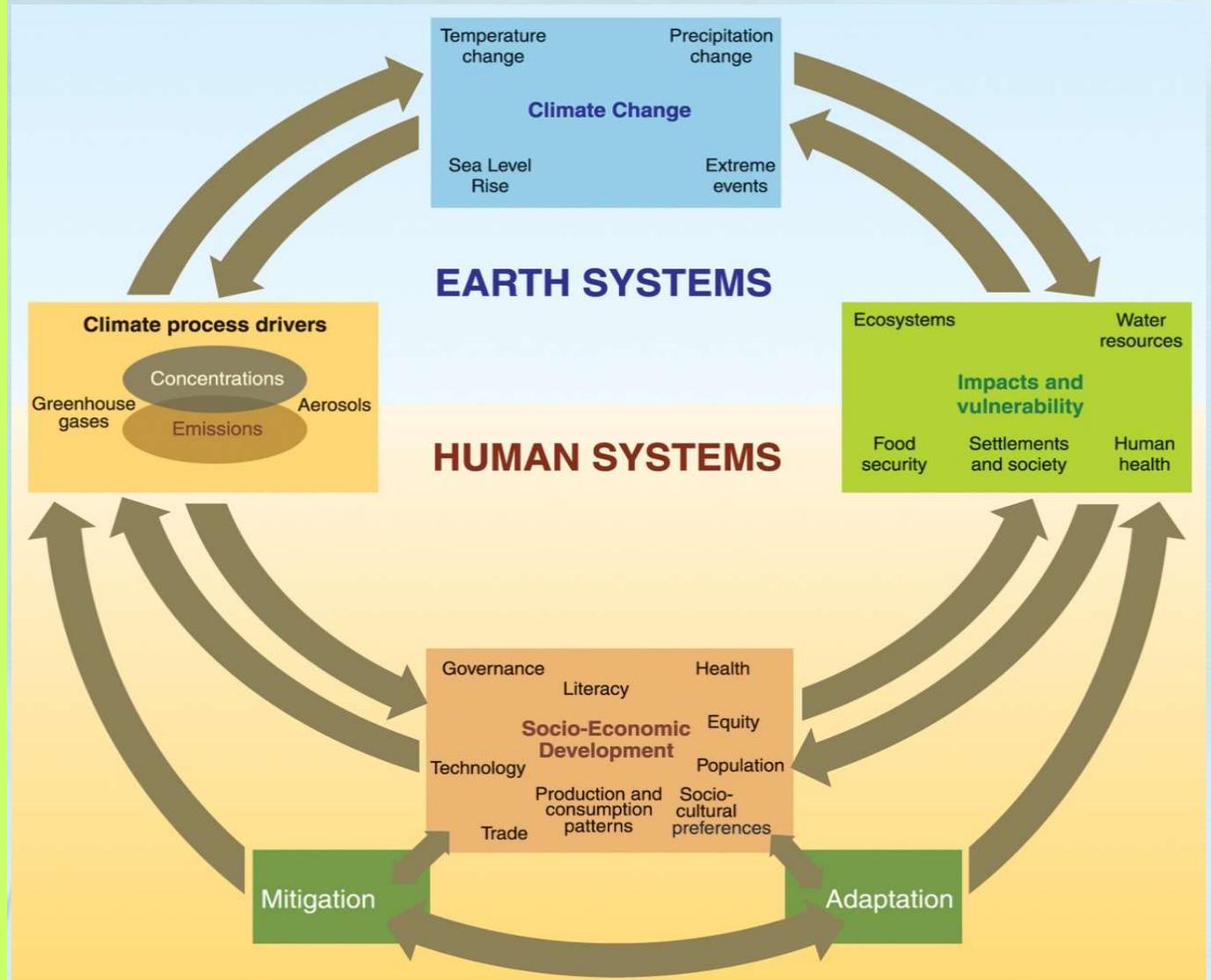
Arctic sea ice extent and

Ocean acidification,

Greenhouse gas emissions,

Adverse trends in climate will likely accelerate,

Increasing risk of abrupt or irreversible climatic shifts



Source : <http://www.oceansatlas.org/subtopic/en/c/315/>

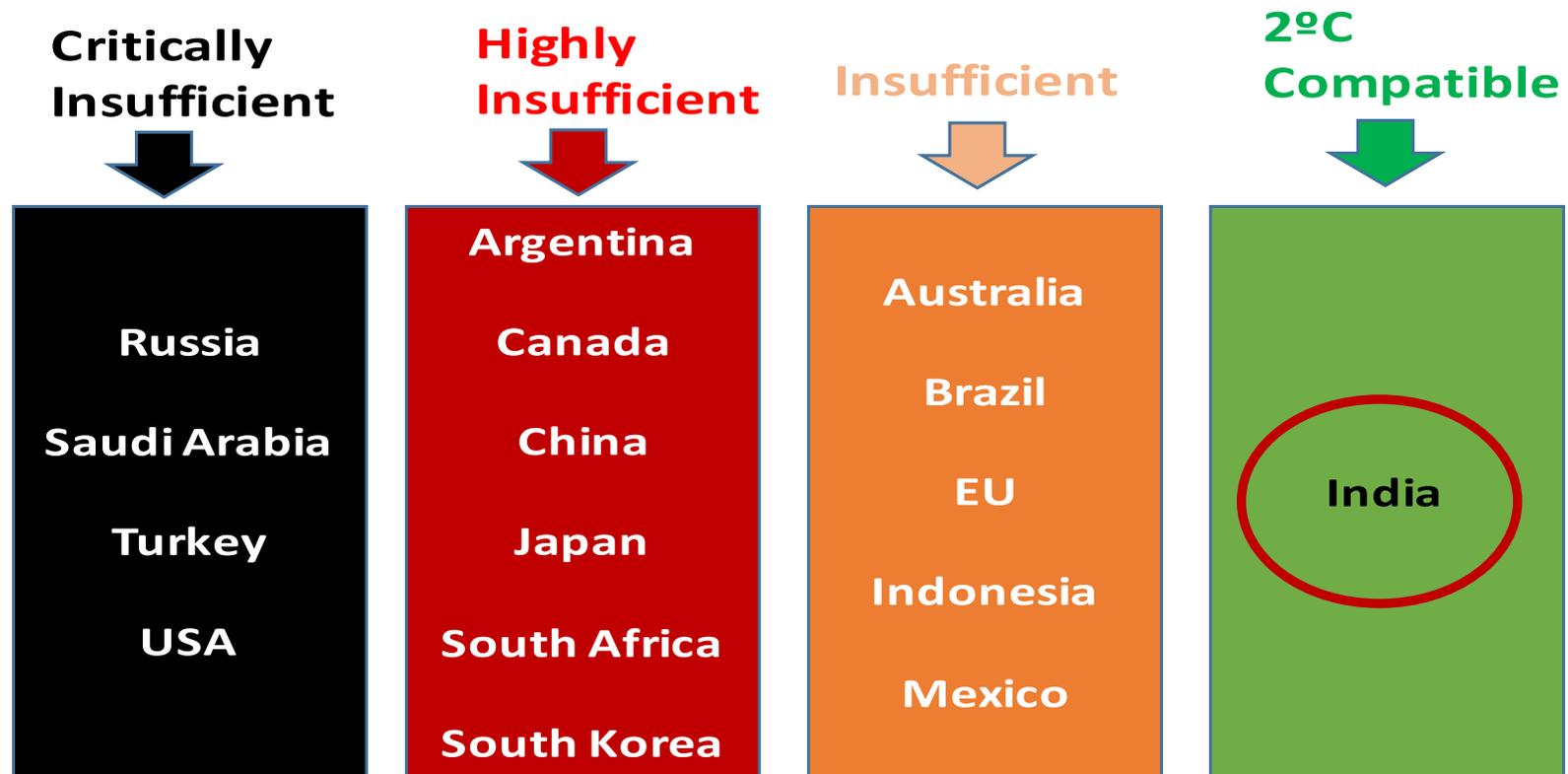
Impacts – Just Imagine

1. Sea level rise - Sea Surface Temperature Change, Ocean acidification
2. Increased Frequency of Extreme Weather Events
3. Precipitation Changes
4. Coral Reefs, Coastal Wetlands and Ecosystems – 30% already lost
5. Capture Fisheries - Destructive fishing practices (e.g., bottom trawling, dynamite fishing, beach seining)
6. Mariculture, Unsustainable tourism, Increasing human settlements, fresh water depletion, etc

Uplands, Western Ghats, Ecosystems, Agriculture, Food Security and Ultimately Socio- Economic Aspects of Nations – States – Global Communities

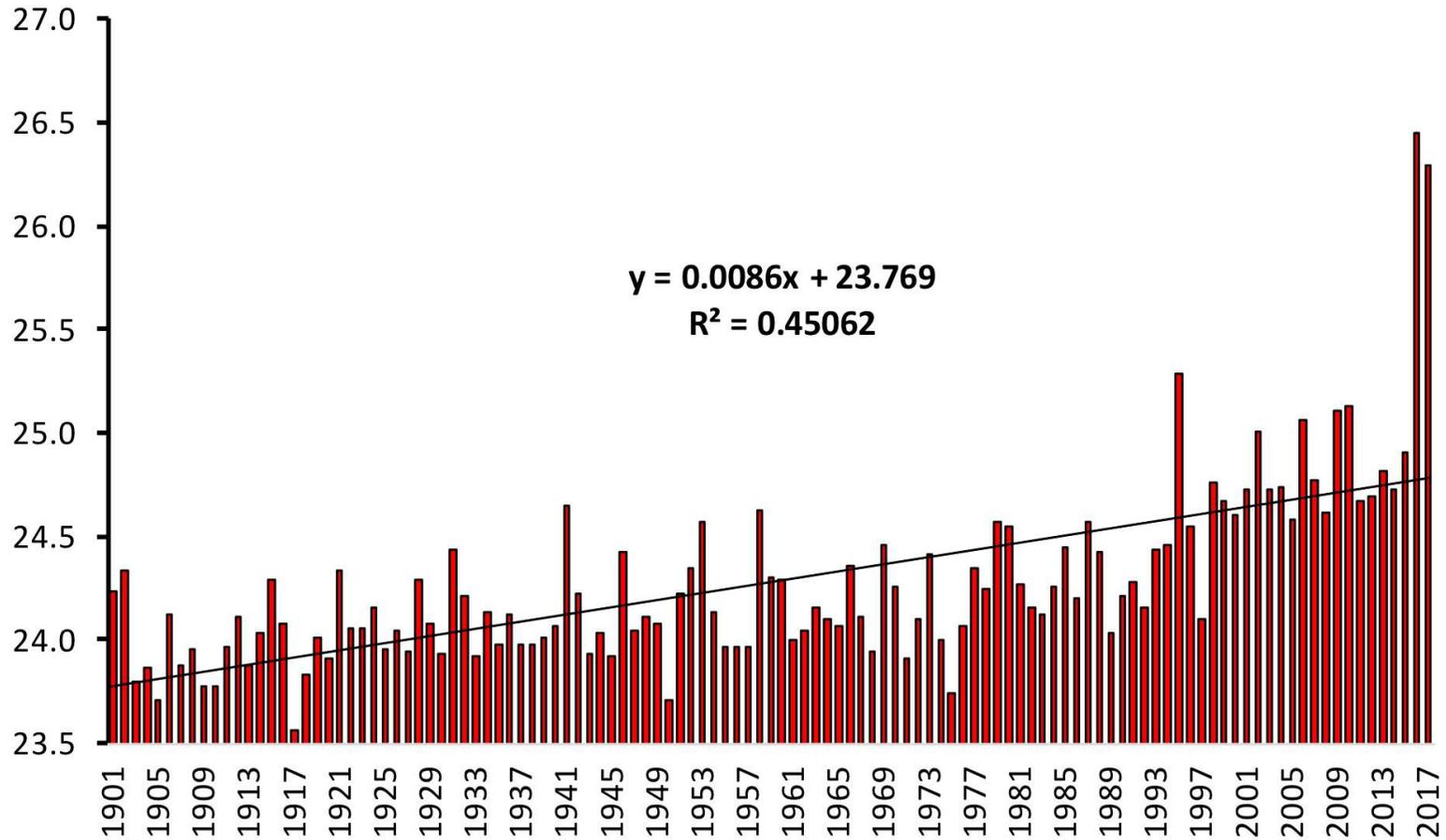
Goa - Low-lying coastal areas, deltas and countries—many of which are small island developing states—and less developed countries are especially vulnerable to climate change impacts. Each has social, economic and physical vulnerabilities that combine to increase likely impacts even further.

India's Climate Action Rating



Requirement for Increasing emission reduction ambition for a 2°C compliant world

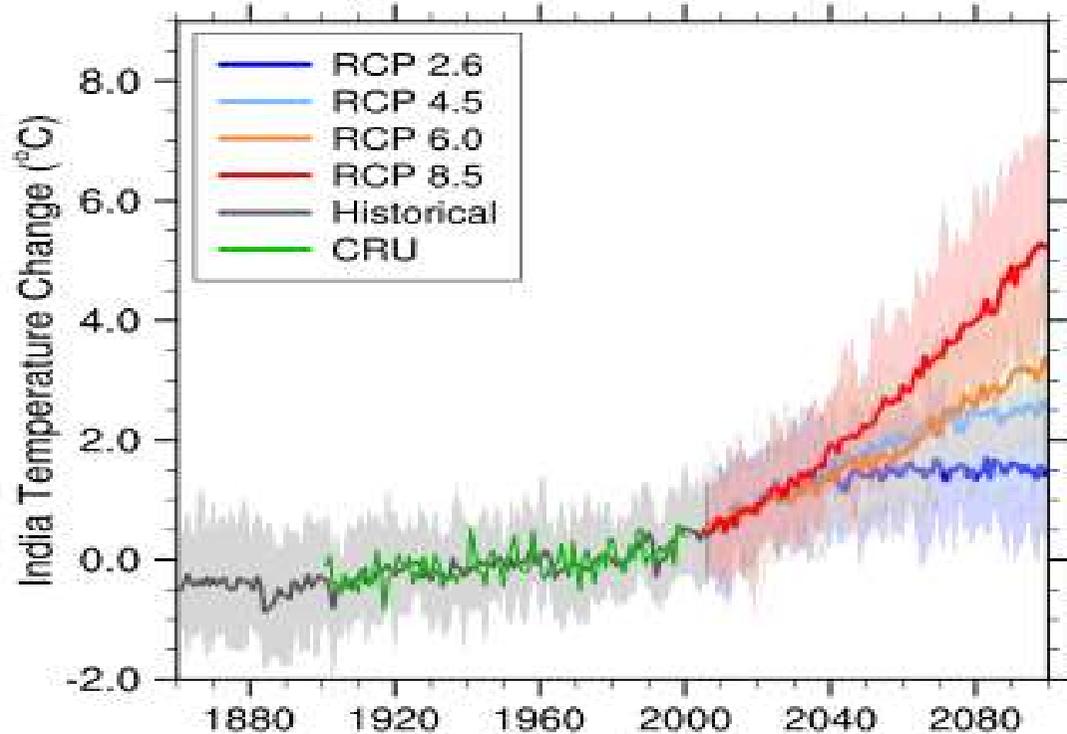
How Climate is Changing in India?



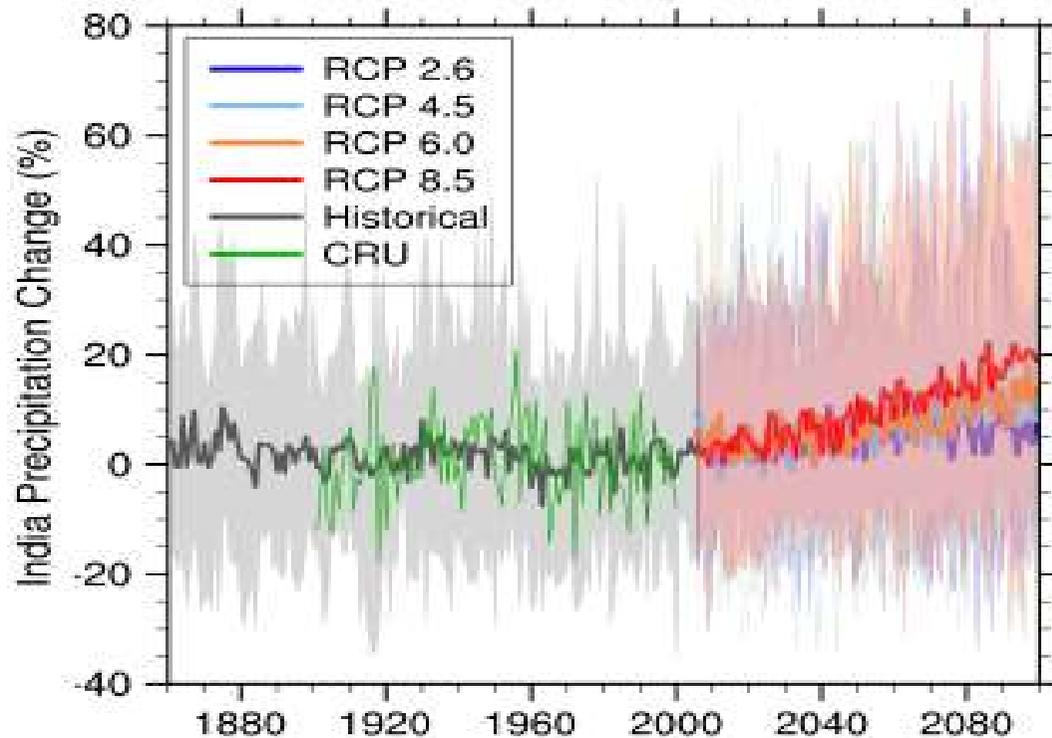
Based on IMD data, taken from Chaturvedi and Bhatt (in Publication)

Climate Change Projections for India

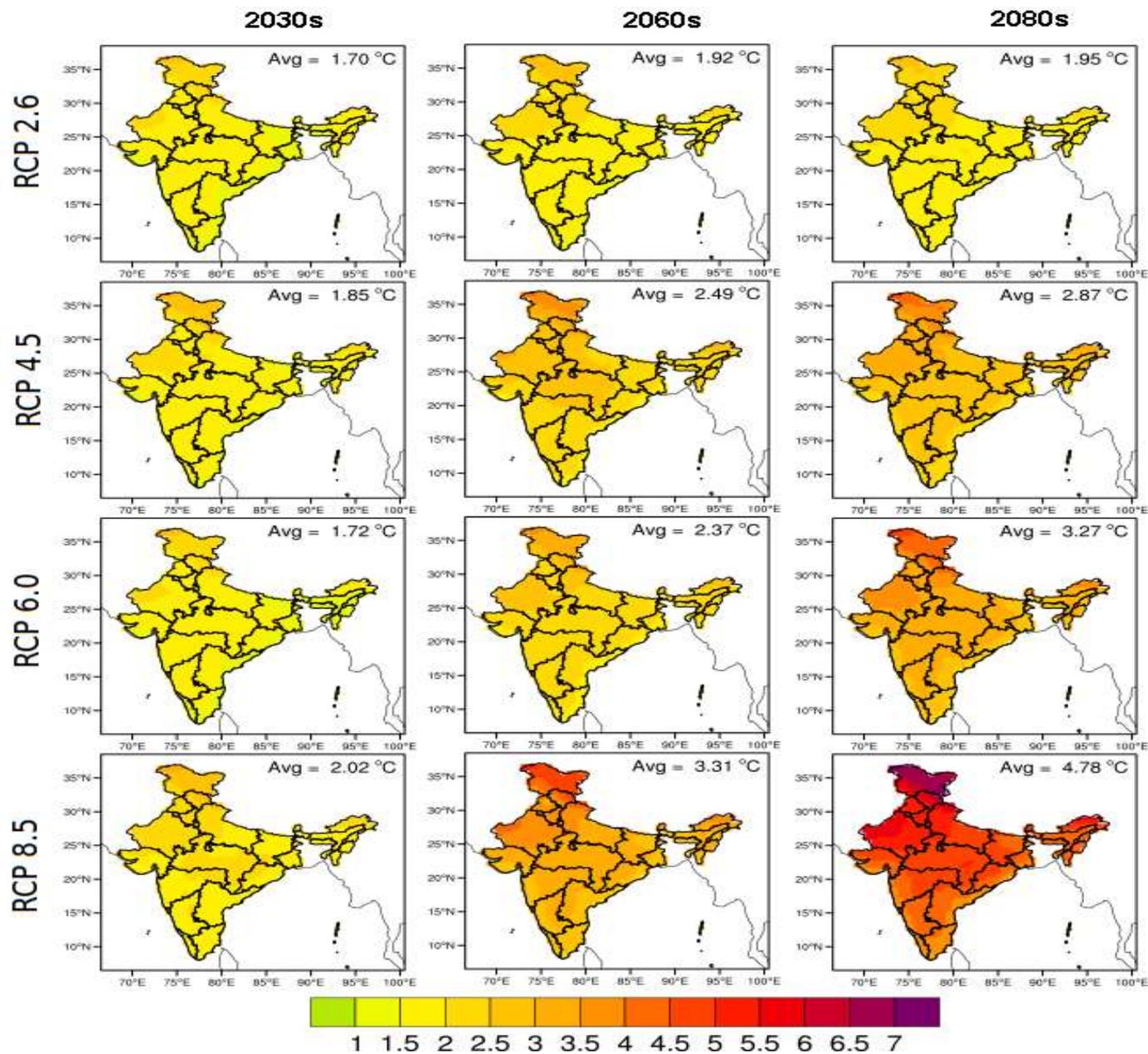
Temperature Change since 1861



Precipitation Change since 1861

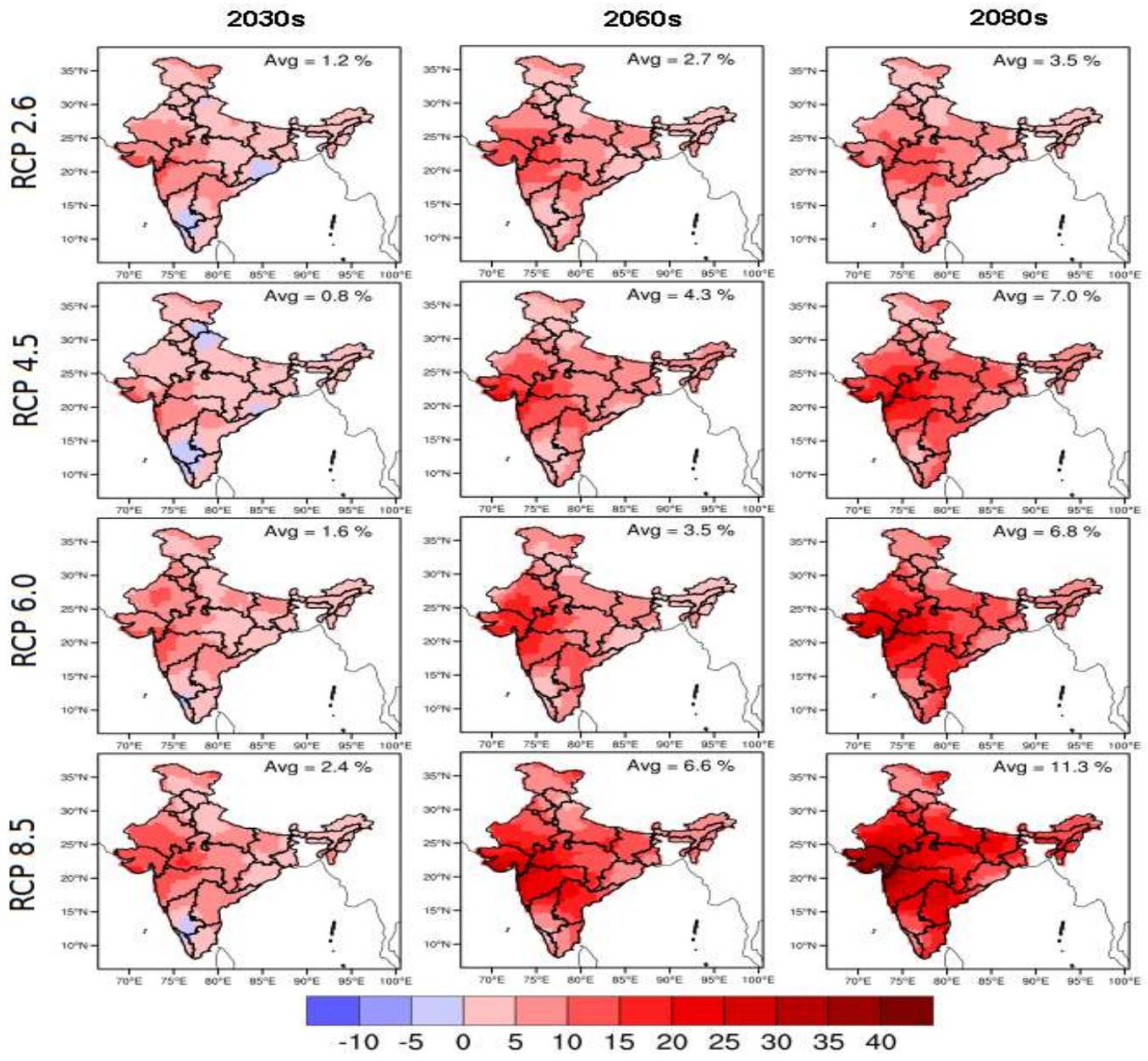


Based on *Chaturvedi RK (2012)*; Cited 175 times



**Mean temperature change (°C)
projections relative to the pre-
industrial period over India**

Chaturvedi et al., 2012



**Mean precipitation change
(%) relative to the pre-
industrial period**

Chaturvedi et al., 2012



Circumstances & Challenges

- **Human Development Index: 0.64; Global rank of 130**
- **Large Number of People yet to access proper Housing, Drinking Water and Electricity**
- **India's priority: Poverty Eradication & Sustainable Growth with Limited and Stressed Natural Resources**
- **Only 5.7% Share in Global Annual Emissions with 1.6 tons per capita CO2 Emissions**
- **India – 6th most vulnerable nation to climate change**





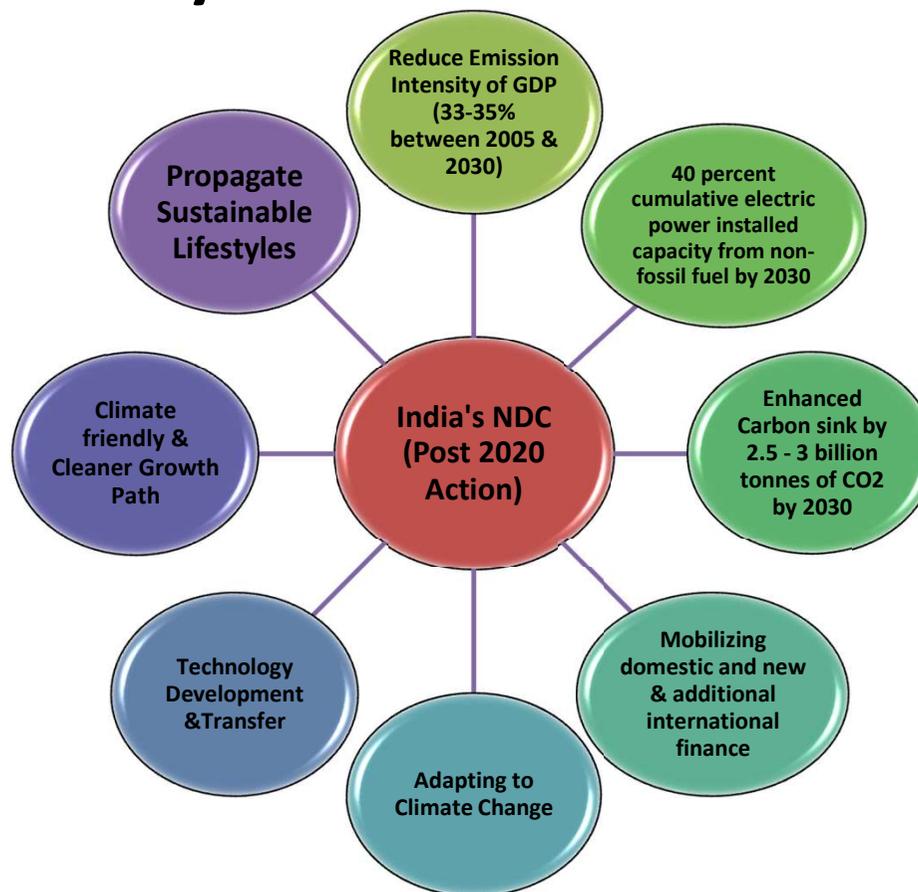
India's Action on Climate Change

- National Action Plan on Climate Change (8 Missions)
- 33 States and UTs have SAPCCs following a common framework
- Dedicated climate change institutions/ cells at States/UTs
- Climate Change Action Plan (CCAP) research, capacity building and demonstration pilots
- National Adaptation Fund interventions
- Research and pilot projects at States/UTs
- SAPCC revision based on evolving scientific evidences, enhanced understanding, and NDC's Targets





Nationally Determined Contributions

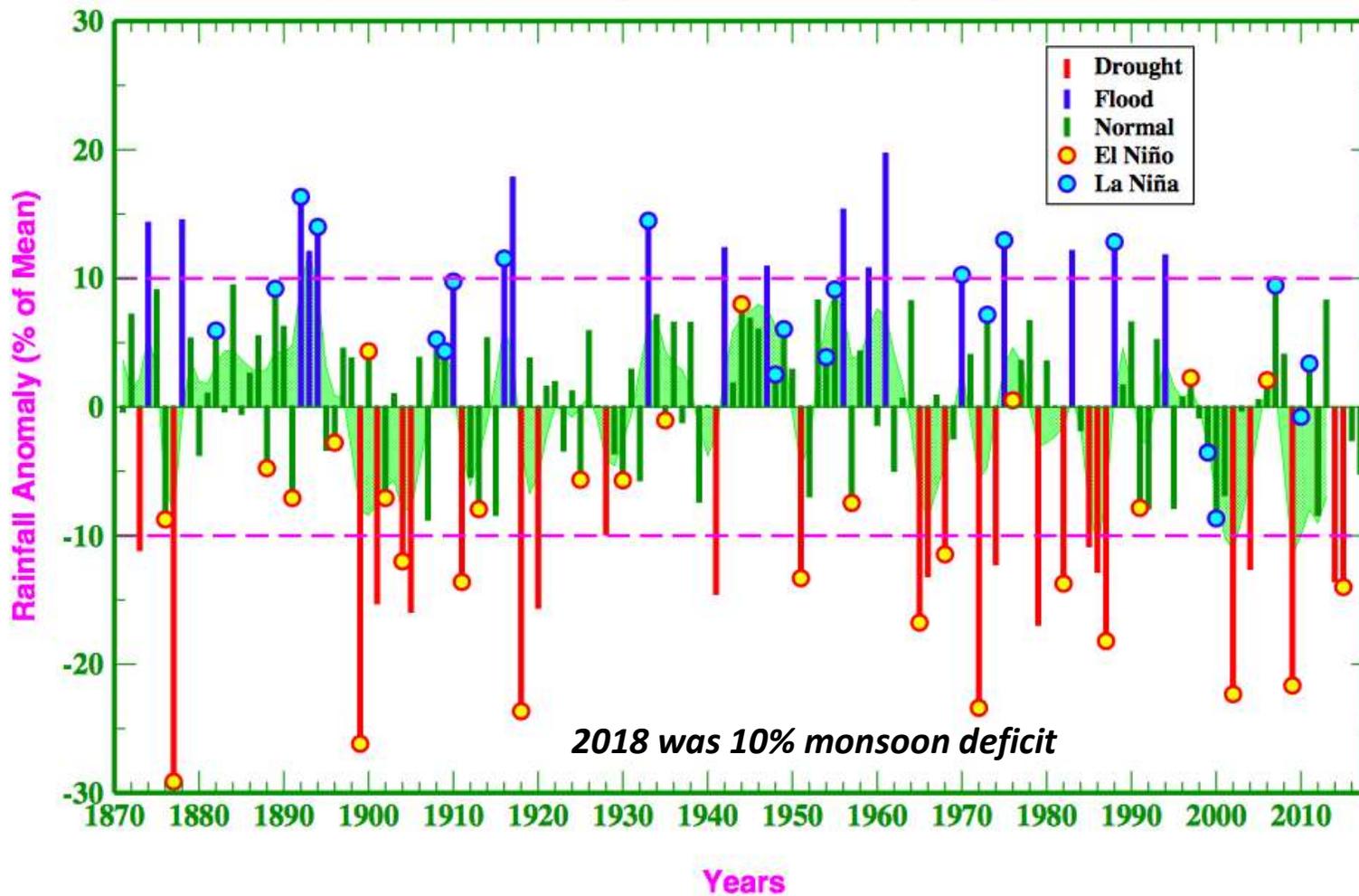




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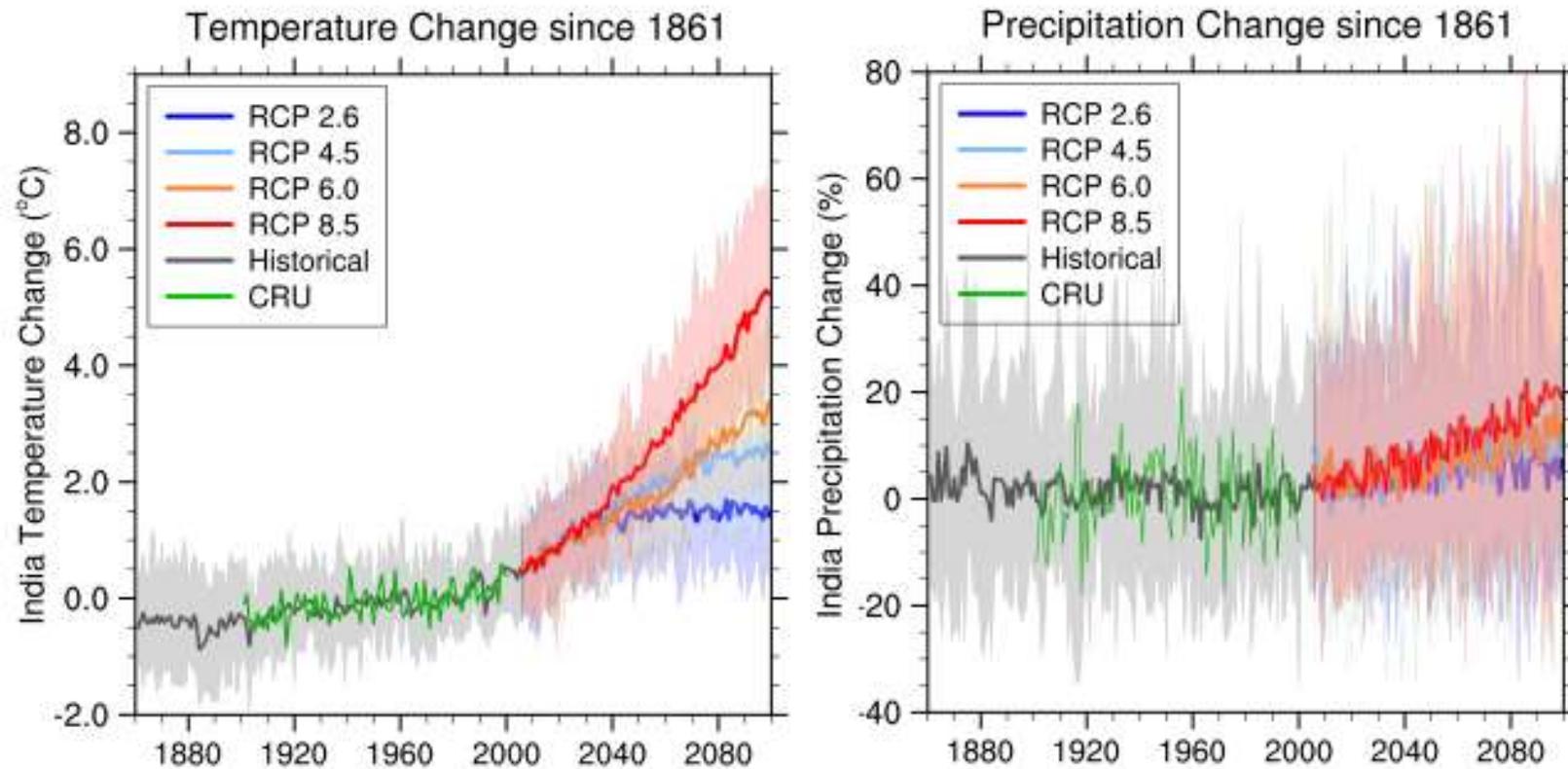
All-India Summer Monsoon Rainfall, 1871-2017

(Based on IITM Homogeneous Indian Monthly Rainfall Data Set)





Climate Change Projections for India



Baseline = 1961-1990

Based on Chaturvedi RK (2012); Cited 180 times



National Action Plan on Climate Change

- **Protection** - of the poor and vulnerable sections of society through what is termed as an inclusive development strategy,
- **Achieving national growth** - through a qualitative change and economic direction that enhances ecological sustainability,
- **Demand side management**- Devising efficient and cost – effective strategies for end use
- **Better technology** - that looks into aspects of mitigation or adaptation,
- **Market mechanism** - that rewards sustainable development,
- **Inclusivity**- that invites linkups with civil society and local government institutions.



National Action Plan on Climate Change



National Solar Mission

National Mission for Enhanced Energy Efficiency

National Mission on Sustainable Habitat

National Water Mission

National Mission for Sustaining the Himalayan Ecosystem

National Mission for a Green India

National Mission for Sustainable Agriculture

National Mission on Strategic Knowledge for Climate Change



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Government Initiatives to combat climate change



International Solar Alliances

FAME Scheme – National mission on E-mobility

Atal Mission for Rejuvenation & Urban Transformation (AMRUT) – for Smart Cities

Pradhan Mantri Ujjwala Yojana – for access to clean cooking fuel

UJALA scheme - for embracing energy efficient LED bulbs

Swachh Bharat Mission





How is climate changing in Goa?



Goa

- ❑ 3,702 square kilometres (1,430 square miles) overlooking the Arabian Sea
- ❑ Climate is Tropical
- ❑ Hot – Long & Sunny season
- ❑ Rains- Late may to Early October





State level annual and seasonal mean temperature trends based upon 282 surface meteorological stations for 1951-2010. Increasing (+) and decreasing (-) trends significant at 95% level of significance are shown in bold and marked with '*' sign.

State	Mean Temperature Trends in °C per year				
	Annual	Winter	Summer	Monsoon	Post monsoon
Andaman & Nicobar	+0.01*	+0.01*	+0.01*	+0.01*	+0.01*
Andhra Pradesh	+0.01*	+0.01*	+0.01*	+0.01*	+0.01*
Arunachal Pradesh	+0.01*	+0.02*	+0.01	+0.01	+0.02*
Assam	+0.01*	+0.01*	No trend	+0.01*	+0.02*
Bihar	+0.01*	No trend	No trend	+0.01*	+0.02*
Chhattisgarh	No trend	No trend	-0.01	No trend	+0.01
Delhi	+0.01*	+0.01	+0.01*	+0.01	+0.02*
Goa	+0.02*	+0.02*	+0.02*	+0.02*	+0.03*
Gujarat	+0.01*	+0.02*	+0.01	+0.01*	+0.02*
Haryana	No trend	-0.01	No trend	-0.01*	+0.01
Himachal Pradesh	+0.02*	+0.02*	+0.01	+0.03*	+0.02*
Jammu & Kashmir	-0.01	No trend	-0.02	-0.02*	-0.02*
Jharkhand	+0.01*	+0.01	No trend	No trend	+0.02*
Karnataka	+0.01*	+0.01	No trend	+0.01*	+0.01*
Kerala	+0.01*	+0.01*	+0.01*	+0.01*	+0.01*
Lakshadweep	+0.01*	+0.02*	+0.02*	+0.01*	+0.01*
Madhya Pradesh	+0.01*	No trend	No trend	No trend	+0.03*
Maharashtra	+0.01*	No trend	+0.01	+0.01	+0.01*
Manipur	+0.03*	+0.04*	+0.02*	+0.02*	+0.03*
Meghalaya	No trend	+0.01*	No trend	No trend	+0.02*
Mizoram	+0.01*	+0.02*	No trend	+0.02*	+0.02*
Orissa	No trend	No trend	-0.01	-0.01*	+0.01
Punjab	-0.01*	-0.02*	No trend	-0.01*	No trend
Rajasthan	+0.01*	+0.01*	+0.02*	+0.01	+0.02*
Sikkim	+0.05*	+0.05*	+0.05*	+0.05*	+0.04*
Tamil Nadu	+0.02*	+0.03*	+0.03*	+0.02*	+0.02*
Tripura	+0.01*	+0.01*	-0.01*	+0.01*	+0.03*
Uttar Pradesh	No trend	No trend	-0.01	No trend	+0.01*
Uttarakhand	-0.01	+0.01	-0.02	-0.02*	+0.01
West Bengal	No trend	No trend	-0.01*	+0.01*	+0.01*

Source: IMD, 2013





State level annual and seasonal rainfall trends based upon 1451 rainfall stations for 1951-2010. Increasing (+) and decreasing (-) trends significant at 95% level of significance are shown in bold and marked with '**' sign.

State	Rainfall trends in mm per year				
	Annual	Winter	Summer	Monsoon	Post monsoon
Andaman & Nicobar	-7.77*	-2.70*	-0.51	-2.93	-1.35
Andhra Pradesh	+1.31	+0.29	+0.35	-0.14	+0.46
Arunachal Pradesh	-3.63	-0.10	No trend	-2.30	-0.83
Assam	-2.96	0.08	-0.56	-2.19	-0.75
Bihar	+1.41	-0.06	+0.59*	+1.11	+0.11
Chhattisgarh	-2.03	+0.02	+0.04	-2.38	+0.06
Delhi	-0.51	+0.16	+0.40*	-0.32	-0.20
Goa	-3.82	No trend	-0.31	-2.61	+0.04
Gujarat	+1.41	No trend	-0.03	+1.27	-0.02
Haryana	+0.45	+0.07	+0.39*	-0.01	-0.23*
Himachal Pradesh	-3.26	-0.18	+0.31	-2.85	-0.21
Jammu & Kashmir	+2.13	+1.88*	-1.07	-0.16	-0.37
Jharkhand	+0.84	-0.13	+0.43	+0.44	+0.03
Karnataka	-0.05	+0.10	-0.41	+0.61	+0.14
Kerala	-1.43	-0.40	-1.15	-2.42	+1.68
Lakshadweep	+3.22	-0.33	-0.44	+1.73	+0.83
Madhya Pradesh	-1.81	-0.06	No trend	-1.74	+0.03
Maharashtra	-0.71	+0.04	-0.15	-0.29	-0.05
Manipur	+1.94	+0.10	+1.63	-0.89	+0.11
Meghalaya	14.68	+0.52*	+2.25	+9.27	+2.04
Mizoram	+0.33	-0.31	+2.80	+7.71	-6.19
Nagaland	-1.86	+0.05	+0.43	-1.69	+0.12
Orissa	+0.69	+0.06	+0.65*	-0.23	-0.83
Punjab	-2.41	+0.09	+0.22	-1.49	-0.13
Rajasthan	+0.04	+0.02	+0.17*	-0.09	-0.04
Sikkim	-3.12	-0.12	-0.83	-1.36	-0.11
Tamil Nadu	+0.80	-0.16	-0.47	-1.35*	+1.49
Tripura	+0.77	+0.11	+1.73	-1.11	-0.55
Uttar Pradesh	-4.42*	-0.22	+0.02	-3.52*	-0.33
Uttarakhand	-1.07	-0.01	+0.86	-1.45	-0.63
West Bengal	+3.63*	+0.16	+1.34*	+1.45	+0.19



Source: IMD, 2013



Reasons for preparation of SAPCC

- Not substantive information and plan available to deal the challenges of climate change specific to Goa
- To address the past and future vulnerabilities of various sectors
- Inclusion of scientific theory and methodologies in climate change
- Gender mainstreaming in climate change
- Understand availability of climate finance and funds & draw plans/programs to utilize them





Key Sectors of Goa

- **Agriculture**
- **Forestry**
- **Fisheries, Coastal & Marine Conservation**
- **Energy and Sustainable Development**
- **Education and Capacity Building**
- **Land use**
- **Mining**
- **Biodiversity**
- **Health**
- **Industry**
- **Waste Management**
- **Tourism**
- **Urbanization**
- **Water and Sanitation**





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Climate Finance

Climate funding can be obtained from a variety of sources, each with its own unique characteristics of documentation needs, approval procedures and eligibility criteria:

Public sources

Domestic (e.g. internal national budgets of the country-NAFCC)

Bilateral (e.g. existing development aid/financing, dedicated bilateral funds for adaptation)

Multilateral (e.g. GCF, AF, GEF, etc.)

State level – Co-financing of existing funds with Departments

Private Sources

Domestic (e.g. local banks and businesses, private citizens)

International (e.g. International private banks, FDI, Pension Funds, NGOs etc.)





NDC & SDG



Nationally Determined Contribution (NDC) has already been developed in India with major focus on availability of climate finance sources within the country viz. NAFCC and others. Green bond is one of the low hanging potential finance available for the adaptation / mitigation activities. Goa state has already ahead in RE & CE therefore Green Bond can be suitable fund for assuring Green Goa Mission.

As far as Sustainable Development Goals (SDGs) are concerned Goa has already achieved 64% of its goal as per the performance indicator of the states in India





SDG link with SAPCC

SDG 3- Good health and well-being	Health Management & Quality of life
SDG 6- Clean water & sanitation	Integrated water Management & Water action plan as per the State Water Policy
SDG-7 Affordable clean energy	Efficient Energy- through Renewable energy
SDG-11 Sustainable cities and communities	Smart cities
SDG-13 Climate Action	VA, Adaptation and Mitigation
SDG-14 Life below water	Coastal zone management & restoration





Agenda of SAPCC



- Assessing observed climate change and developing climate scenario for future
 - ✓ Based on Past Data / Future projections (more details available in the next slide)

- Identifying Vulnerability/ Assessment
 - ✓ Vulnerable sectors in Goa
 - ✓ Agriculture, Tourism, Water, Coast & Institution

- Approach for Adaptation / Mitigation
 - ✓ Best adaptation options / mitigation action plan





Agenda of SAPCC

- Policy framework
 - ✓ Aligned with NAPCC objective
 - ✓ Aligned with SDGs
 - ✓ IPCC SR 1.5

- Institutional Arrangement
 - ✓ Capacity building
 - ✓ Coordination among institutions
 - ✓ Dovetail of Funds by the line department

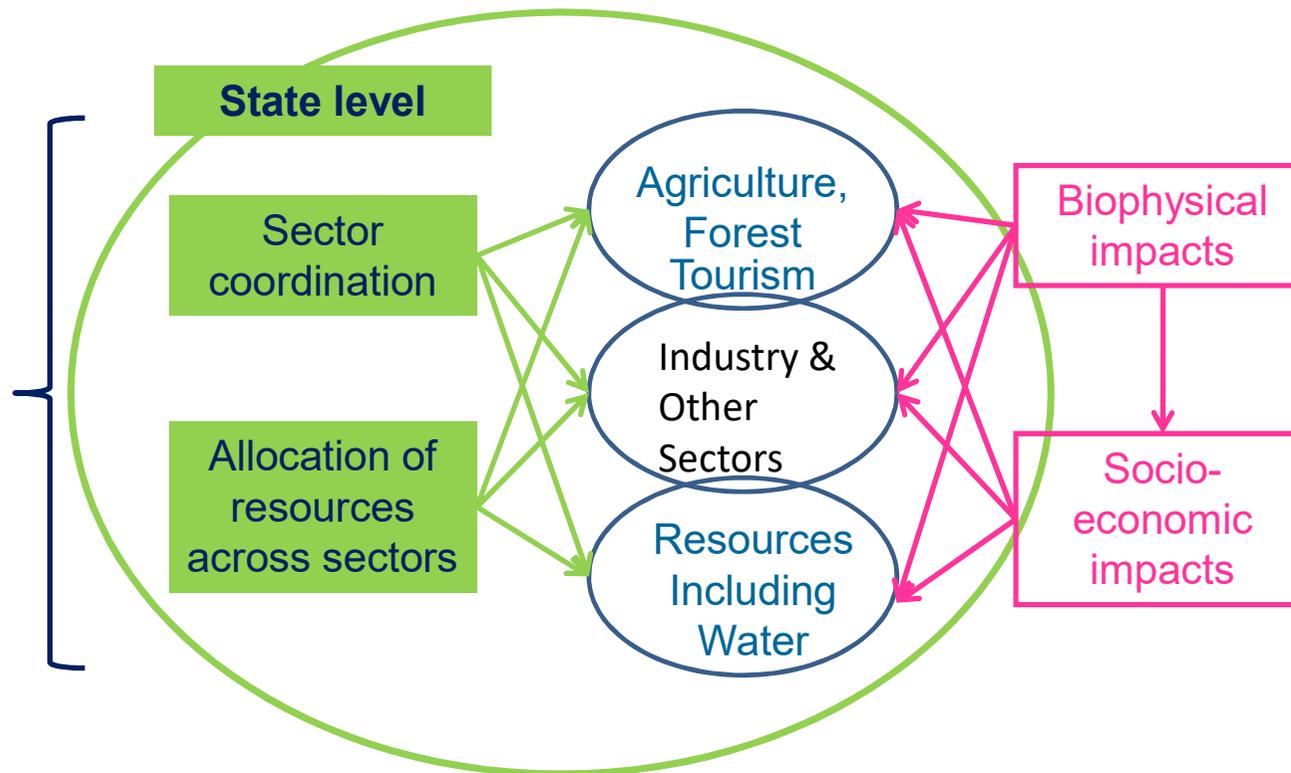




Strategic planning for Climate Change at Goa



Results are,
-More integrated
-Effective
-Efficient
-Sustainable responses





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Climate Change Strategic planning levels



State level

- ✓ Over all guiding policy frame work covering all
- ✓ State and National legislation / regulation
- ✓ Exercise of some key functions
- ✓ Management of National relations

Sector level

- ✓ Operationalization and implementation of national / state policies
- ✓ Sector – Specific legislation/regulation
- ✓ Own initiatives, development of capacities & good practices
- ✓ Trans boundary cooperation on climate – relevant issues





Climate Change at lower levels of Governance



Best levels for observing / understanding development and climate change impacts

Vulnerability and adaptive capacity are context-specific

Local levels

Most adaptation options require local implementation

Potential for piloting / pioneering initiatives





Summary



- ❖ Climate Smart Approach
- ❖ Climate Resilient planning
- ❖ Energy efficient and Management
- ❖ Eco Tourism
- ❖ Knowledge management & capacity building
- ❖ Coastal zone Management
- ❖ Restoration of livelihoods
- ❖ Reduction of Vulnerabilities
- ❖ Institutional Arrangements



Please send your inputs, suggestions, learnings, real experiences in this regard and how you would like to contribute to Goa State in dealing with climate change

For more details

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Thank you....