INTRODUCTION

The Center for Climate Modeling focusses on addressing the knowledge gaps in climate change science and develops a better understanding of climate variability at various spatial and temporal scales in an effort to effectively link climate science to policy research. With its unique integrated focus, TERI's Center for Climate Modeling in this context seeks to build its climate modeling skills to effectively use it for better understanding of the regional changes and their links to policy. The information generated would serve the purpose for impact and vulnerability and adaptation assessments. The group's activity spectrum ranges from the use of state-of-the-art global and regional climate models, such as CCSM 3.0[1], CESM 1.0[2], GFS[3] and Met Office Unified Model (GCMs) and PRECIS[4], WRF[5], NorESM[6] and COAWST[7] (regional coupled) (GCMs), to linking these regional climate projections to various Impact Assessment Models, such as ADCIRC (for storm surge and coastal circulation), SWAT (for water resources), DSSAT (for agriculture), IBIS (for forestry), DIVA (for coastal zones) and MIKE (for storms).

RESEARCH

- Relation between Sea-Ice loss and Indian Summer Monsoon.
- Improving the understanding of climate processes and its linkages at regional scales, especially under the growing extreme climate events.
- Development of Flood Warning System for studying the potential impact of flooding and identification of flood prone areas in north eastern India.

SERVICES

- Climate projections at regional scale under AR4/5 scenarios.
- Climate Risk assessment specific to various sectors.
- Cyclone detection and Hazard Risk Mapping
- Sea level rise and its impact upon coastal inundation
- Multi-hazard risk mapping and Integrated Impact Assessment
- Outreach and Training

POLICY LINKAGES

- State Action plans on climate
- State/ district level climate vulnerability plans
- Industry level risk assessment plans
- City level flood management plans
- Near real time flood forecasting for cities
- Climate Tool for decision makers
- Training: research schools and workshops for stakeholders and policy makers

[1] CCSM- Community Climate System Model by National Centre for Atmospheric Research (NCAR)
[2] CESM- Community Earth System Model by National Centre for Atmospheric Research (NCAR)
[3] GFS- Global Forecast System
[4] PRECIS- Providing Regional Climate for Impact Studies by UK Met Office
[5] WRF- Weather Research and Forecasting by NCAR
[6] NorESM- Norway Earth System Model
[7] COAWST- Coupled-Ocean-Atmosphere-Wave-Sediment Transport Modelling System
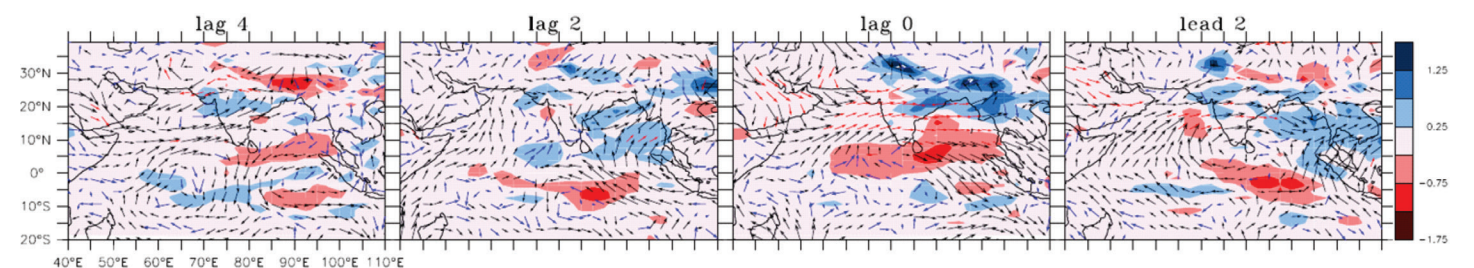
SKILLS AND EXPERTISE:

- **Global Climate Model Analysis**: TERI's Climate Modeling team aims to build capacity in Climate System Models and Earth System Models with the objective to assess and address existing uncertainties by providing the bias corrected data for better results and reliable projections.
- **Quantitative impact assessment of severe climate change or Extreme Events**: The team assessed precipitation and temperature extremes over India through various indices. This projected extreme events over the spatial and temporal scales.
- **High Resolution regional climate projections for different scenarios**: To simulate the climate at local scales TERI in collaboration with UK Met Office has developed in house capacity to project climate change scenarios over Indian region at high spatial resolution.
- **Multi-hazard risk mapping**: The validated high resolution climate modeling inputs are further tailored to feed into Impact Assessment Models. This produces risk and vulnerability assessment maps.
- **Hydro-dynamical Modeling and Storm Surge modeling**: TERI's climate modeling group has ported regional climate model outputs to a two-dimensional depth averaged hydro-dynamical model (ADCIRC) which provides the maximum probable surge height due to high intensity storms in future with respect to baseline.
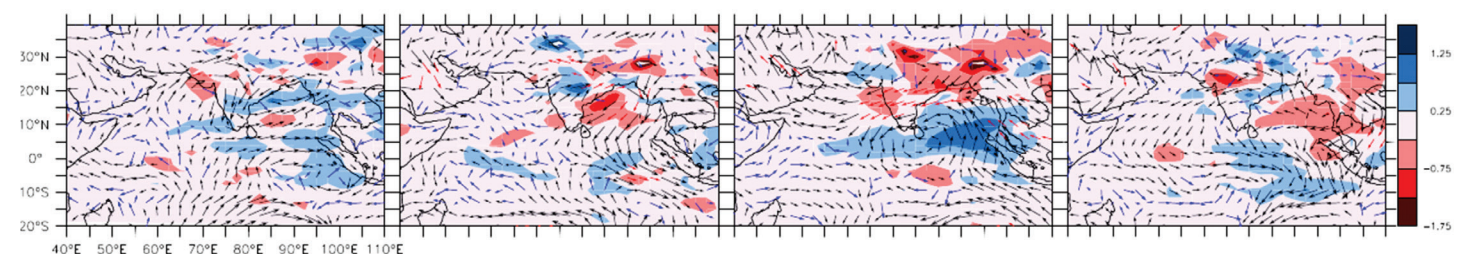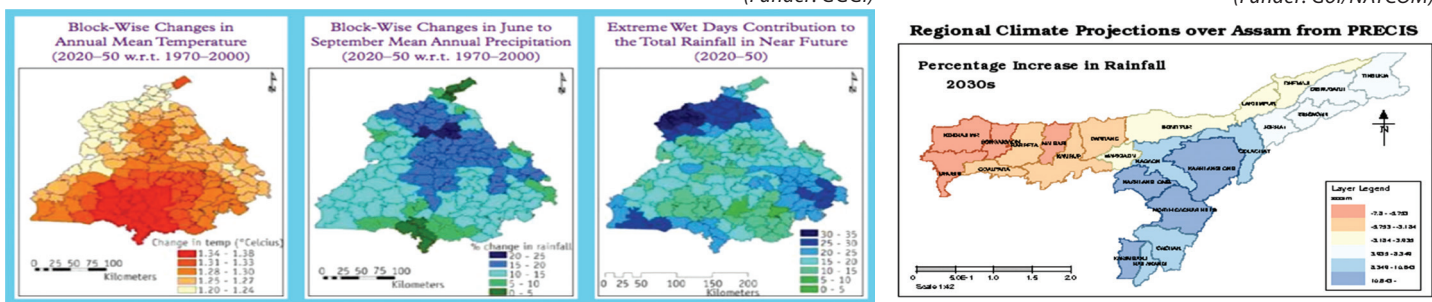
MAJOR ACTIVITIES:

- Global and regional simulations of past, present and future climate using the climate system models and regional dynamical downscaling tools.
- Scenario generation and understanding the spatial-temporal scales of climate variability using the models.
- Understanding the climate variability and monsoon dynamics depicted in the models and qualitative estimation of bias or uncertainty produced by the models.
- Tailoring of climate model outputs in order to link them with the region or location specific Impact Assessment Models.
- Extreme climate event analysis and determination of climate extremes to assist better decision making.
- Tailor made climate outputs for user specific needs – transport sector, water sector, health sector, coastal infrastructure like Ports etc., Oil & Gas sector and Energy sector.

SUCCESSFUL FINDINGS:

ACTIVE AND BREAK PHASES OF RAINFALL:

Intra-seasonal variability in the ISM is studied to establish a tele-connection between ISM and the variations in Global winds.

Assessment of Dry and Wet phases within ISM are crucial for forecasting droughts and floods respectively.

(Funder: MoES)

REGIONAL CLIMATE PROJECTIONS:

(Funder: GGGI)

(Funder: GoI/NATCOM)

Block-Wise Changes in Annual Mean Temperature (2020–50 w.r.t. 1970–2000)

Block-Wise Changes in June to September Mean Annual Precipitation (2020–50 w.r.t. 1970–2000)

Extreme Wet Days Contribution to the Total Rainfall in Near Future (2020–50)

Regional Climate Projections over Assam from PRECIS

Percentage Increase in Rainfall 2030s
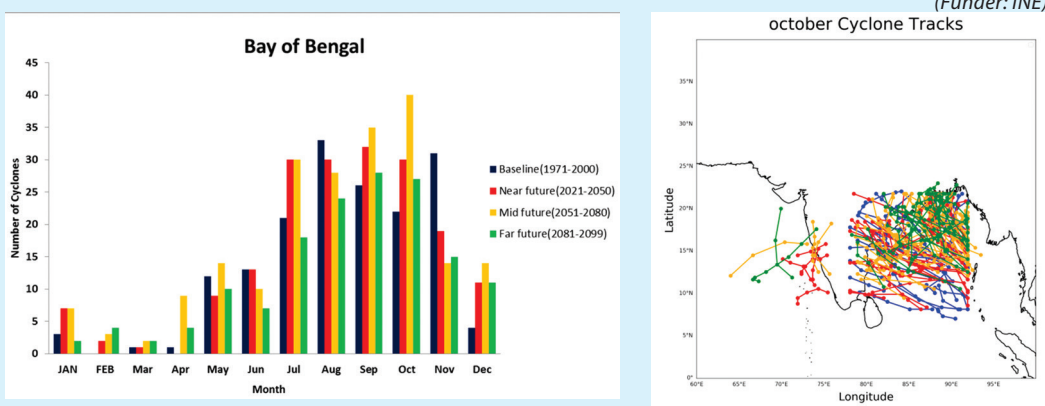
Regional Climate Models are used to provide high resolution climatic (Temperature and Precipitation) projections. For Punjab(left) and for Assam(right)

HYDRO-DYNAMICAL AND STORM SURGE MODELING

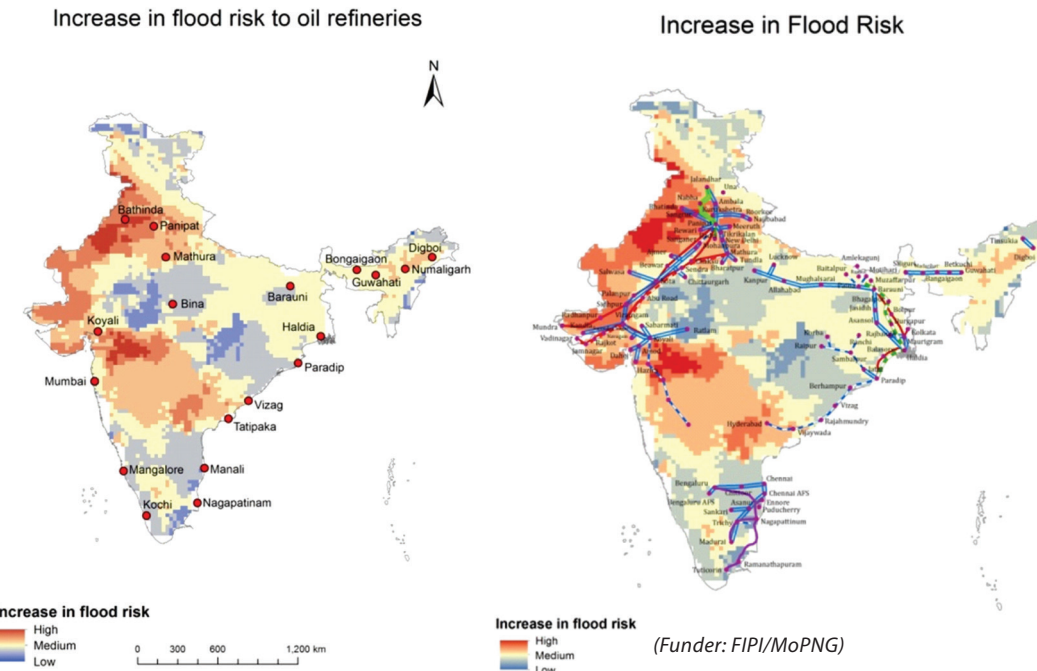*(Funder: INE)*

Bay of Bengal

october Cyclone Tracks

Tropical cyclone annual cycle over Bay of Bengal (BoB) during base line and future periods

Tracks of cyclones from PRECIS RCM for baseline (blue line), Near future(red line), Mid future(orange line) and Far future (Green line)

OIL AND GAS REFINERIES: FLOOD RISK MAP

Increase in flood risk to oil refineries

Increase in Flood Risk

(Funder: FIPI/MoPNG)

Mapping the flood risks around oil and gas refineries at the pan-India level

CONTACT

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INFRASTRUCTURE:

- Centre for Climate Modeling's expertise may be assessed from the infrastructure capacity and the projects that are undergoing and have been undertaken in the past few years.
- The climate modelling infrastructure consists of High Performance Computing (HPC) facility with total peak performance of 12 TerraFLOPS.
- It has 308 cores of new generation Intel Xeon processors with in total 1408 GB RAM. The HPC setup has over 210 TB of storage.
- Apart from the HPC setup, there are three dedicated high end servers to perform the regional climate model and impact model simulate with 1TB hard disk and 8GB RAM and quad core performance.
- Separate data storage file servers to restore the climate modelling outputs are a part of this division. The climate modelling simulations have provided inputs to many projects which require assessing climate change impacts and coastal vulnerability over eastern sectors, North Indian region and coastal states in India.

CLIMATE MODELING ACTIVITIES AT TERI
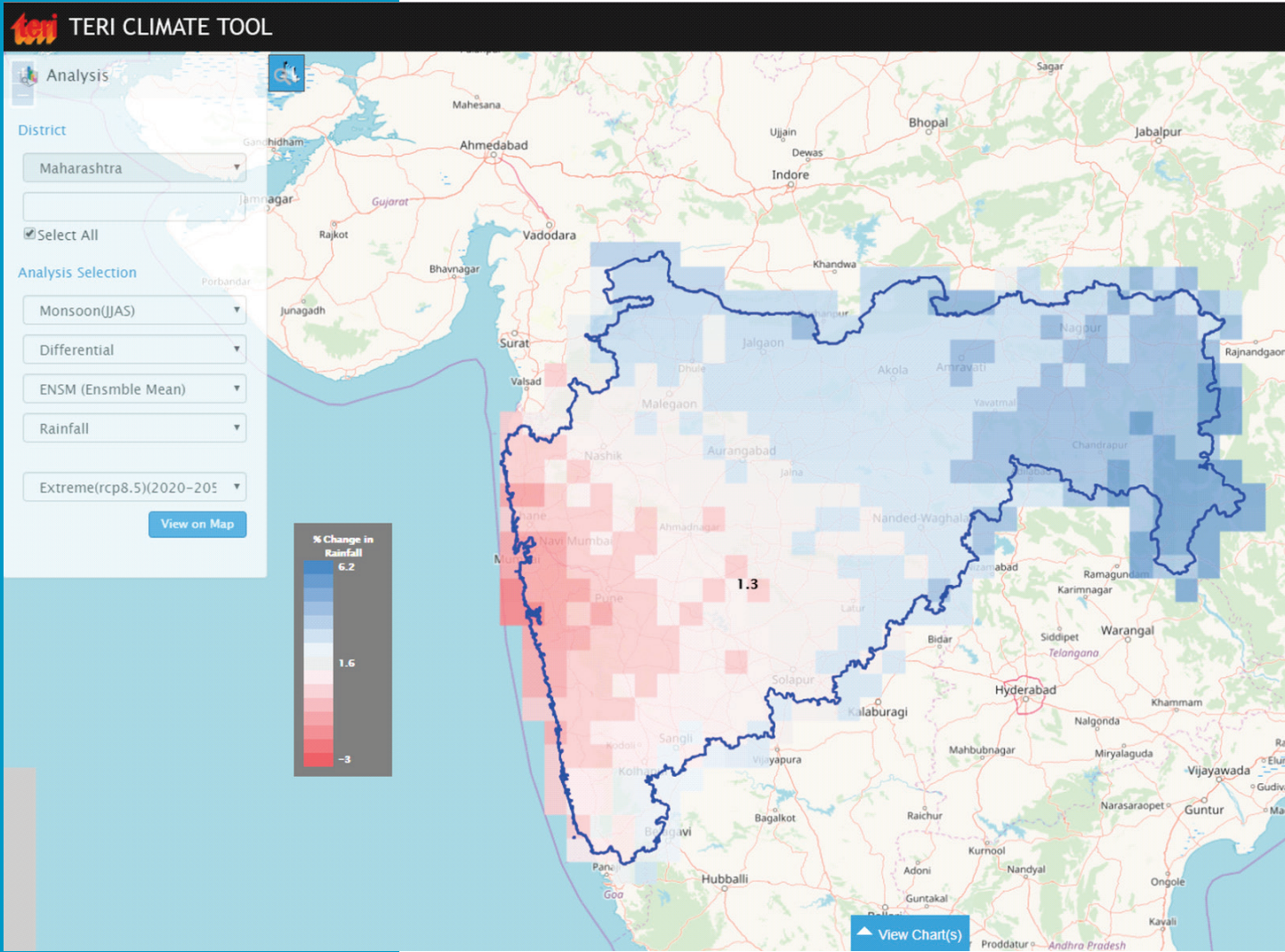
TERI CLIMATE TOOL

TERI Climate Tool: An interactive regional climate information portal

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