Climate Change Information - User Manual

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Table of Contents

About
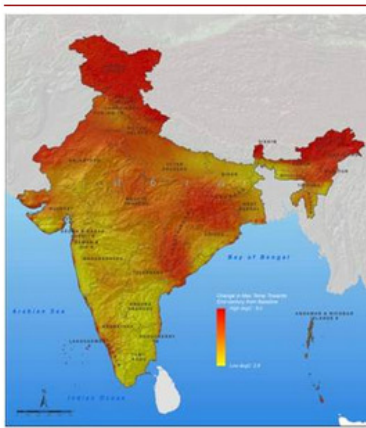
The "**climatevulnerability.in**" Portal is a one-stop window to climate related information focussing on climate change. This web based climate information tool provides access to country data (India) related to climate change. One can query, map, compare, chart and summarize key climate and climate-related information.
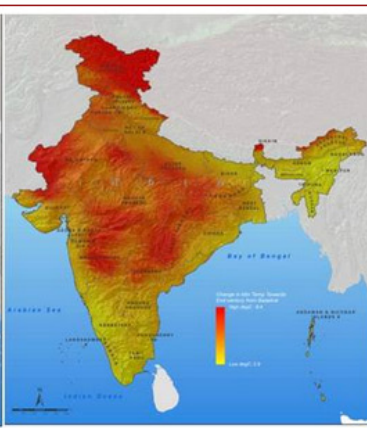
Climate Change profiles at State, District and Sub district level provide quick information including mean, trend, change and extreme climate indices. Climate profiles are intended for practitioners to identify key climate related vulnerabilities and risks and further assist them to better integrate climate resilience in development planning and operations.
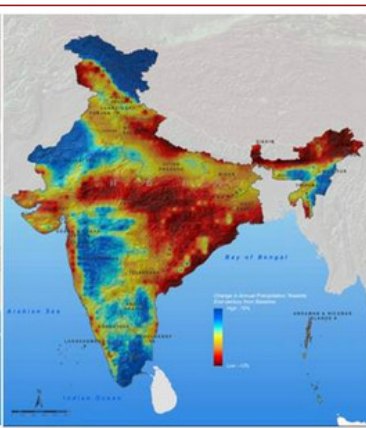
Data, analysis and conversion to information/knowledge has been contributed in-house by INRM Consultants and supported in part by The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) in India.

Main Features

Main features of the website include;

- User friendly Web Based climate information for visual comparison of climate variables through graphs and maps
- Information and analysis derived from gridded rainfall, maximum and minimum temperature data.
- Historical climate information based on IMD gridded data.
- Projected climate information based on multiple regional climate model outputs for 2 IPCC AR5 climate scenarios (RCPs; Representative Concentration Pathways).

- Covers 29 states and 7 Union Territories of India.
- Statistics include Historical: Mean, Trend, and Projected: Mean, Trend, Delta (change from baseline).
- Climate Extreme indices: 10 Precipitation indices and 16 Temperature indices.

Data Source

Historical: The high resolution (0.25°x0.25° latitude and longitude) daily gridded rainfall dataset for precipitation grids provided by Indian Meteorological Department (IMD) for the States of India for a period of 63 years (1951–2013) for precipitation, and 1.0°x1.0° latitude and longitude daily gridded temperature datasets for temperature grids, spanning over 63 years (1951-2013) for maximum and minimum temperature (Rajeevan et al. 2006[1]) has been used to calculate the variability and trend in precipitation and temperature respectively.

Projections/Climate Extreme: The CORDEX South Asia modelled data on precipitation, maximum temperature, minimum temperature and another 26 climate extremes indices have been analyzed for the States of India for baseline, BL (1981-2010), near term, NT (2011 – 2040), mid-century, MC (2021-2050), mid-term, MT (2041 – 2070) and end-century, EC (2071-2100). Climate change projections and trend analysis for the climate variables have been carried out for the States of India.

Grid-resolutions for the climate projections are 0.5°x0.5°. Climate data from the three Regional Climate Models (RCM) of REMO (from MPI), RCA4 (from SMHI) and CCAM (from CSIRO) for IPCC AR5 climate scenarios of

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[1] Rajeevan, M., Bhate, J., Kale, J. D. and Lal, B., 2006, High resolution daily gridded rainfall data for the Indian region: Analysis of break and active monsoon spells", Curr. Sci., 91, 3, 296-306.

RCP4.5 (moderate emission scenario) and RCP8.5 (a scenario of comparatively high greenhouse gas emissions) have been used. 10 Global Circulation Models (GCMs) belonging to three Regional Climate Models (RCMs) have been used. 1 GCM of REMO, 6 GCMs of SMHI and 3 GCMs of CSIRO is used. The Multi Model Ensemble (MME) shows the average of the 10 General circulation Models (GCMs) for both IPCC AR5 RCP4.5 and RCP8.5 scenarios. The bias corrected data of the models is shown as mean, trend and delta.

Getting Started

Registration and login credentials are required to access *"climatevulnerability.in"* website.

Registration

For first time user, to register, please create a username and password. The information gathered from the registration process is not distributed to other organizations and is only used to determine trends in data usage.

email Verification

After registration user will receive the "Confirm Registration" link in their email, one should click on link to enable the User.

After successful registration user can login to have access to the content.

Update User Profile

After successful registration and first time login, user is asked to update profile. Please fill in the profile form to update your account.

User Interface

Login screen is shown in Figure 1.
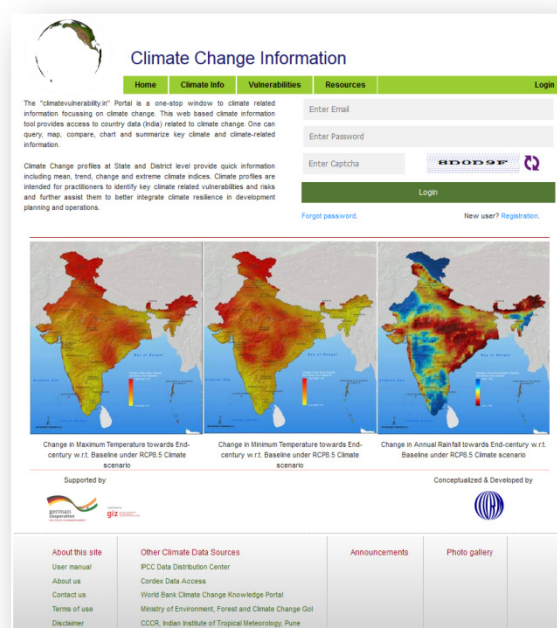
Figure 1: Login Screen

Main Menu
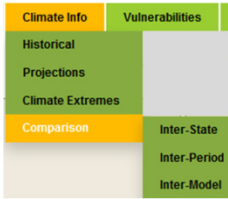
Menu bar displayed on the Top is shown in Figure 2.

Figure 2: Main Menu

Functions under each item on the main menu bar are shown below;

Button	Function
Home	Navigates to Main Home page.
Climate Info	Climate Information Tab consisting of:

Button	Function
	• Historical Mean and Trend. • Projected Mean and Trend for multiple models using 2 IPCC climate scenarios. • Comparison: any two (states, scenarios, periods); 4 periods comparison;11 model comparison.
Vulnerabilities	Climate Change vulnerability for 4 GIZ partner states.
Resources	Meant for other related knowledge products.
Logout	Log out of the site.

Window Panels

After successful login screen as shown in Figure 3 will appear.
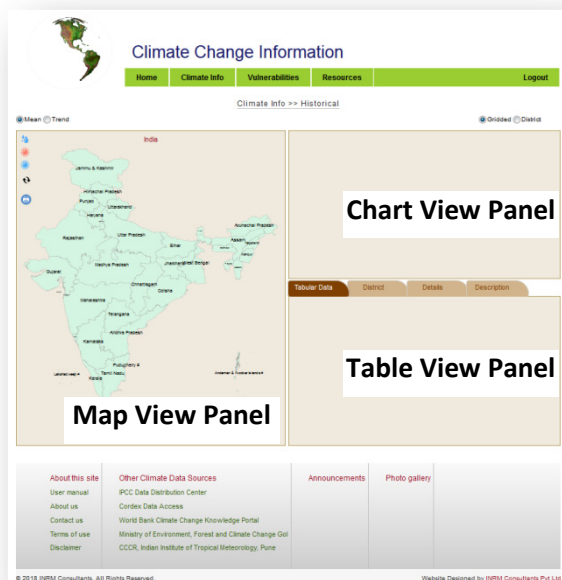
Figure 3: Climate Info >> Historical Screen

Page is divided into 3 panels, (1) Map View Panel (2) Chart View Panel and (3) Table View Panel.

Radio Buttons

Radio buttons are displayed on the top of Map View is shown in Figure 4

Figure 4: Radio Buttons Climate Info >> Historical Screen

Mean: Gives the average of a climate variable for the given time period for a grid/district.

Trend: Gives the trend of a climate variable for the given time period for a grid/district.

Gridded: Displays climate variable information at grid resolution (25 km for IMD rainfall, 100 km for IMD temperature, 50 km for all projected climate variables).

District: Displays aggregated climate variable information at district level.

Map View Panel

Map view panel on the left side of the page allows user with State selection by clicking on the desired State. To select another state use reset button (⟲).

Zoom in-out: Mouse wheel can be used to zoom in and out the displayed state map. Zoom in can also be done by double clicking left mouse button.

Pan: Left mouse click and drag to pan.

Title Text: Top of the selected map displays the complete information on the selected climate parameter with state name.

Legend Bar: Legend bar which is a color gradient with an associated quantitative scale of the climate variable is displayed at the bottom right part of the map view panel.

Tool tip: On mouse over on the state map the title attribute is displayed in a little box at the bottom left part of the Map View Panel.

Map View Panel Tool Buttons

Buttons displayed on the left side of Map View panel have the following function when the mouse pointer hovers on the button.

Button	Function activated on mouse pointer over button
💧	Precipitation related Data *Annual, Monthly and Seasonal*
☀	Maximum Temperature related Data *Annual, Monthly and Seasonal*
☀	Minimum Temperature related Data *Annual, Monthly and Seasonal*
🔄	Reset to select State
🖨	Download Image

Chart View Panel

Top right part of the page has the Chart View Panel to display values of the selected climate variable in chart form. Tool tip containing value is displayed on mouse over action on the chart.

Table View Panel

Bottom right part of the page has a tabbed control Panel to display Table, district codes, details and description on the selected climate variable.

Step by Step - Menu: ClimateInfo>>Historical

Click on the India map to select any State to view historical mean or trend of any climate variable of precipitation, maximum or minimum temperature.

Example:

Figure 5 shows an example of query result for "Mean (Trend)" Annual maximum temperature for Madhya Pradesh at "Grid" resolution, with chart and tabular data.
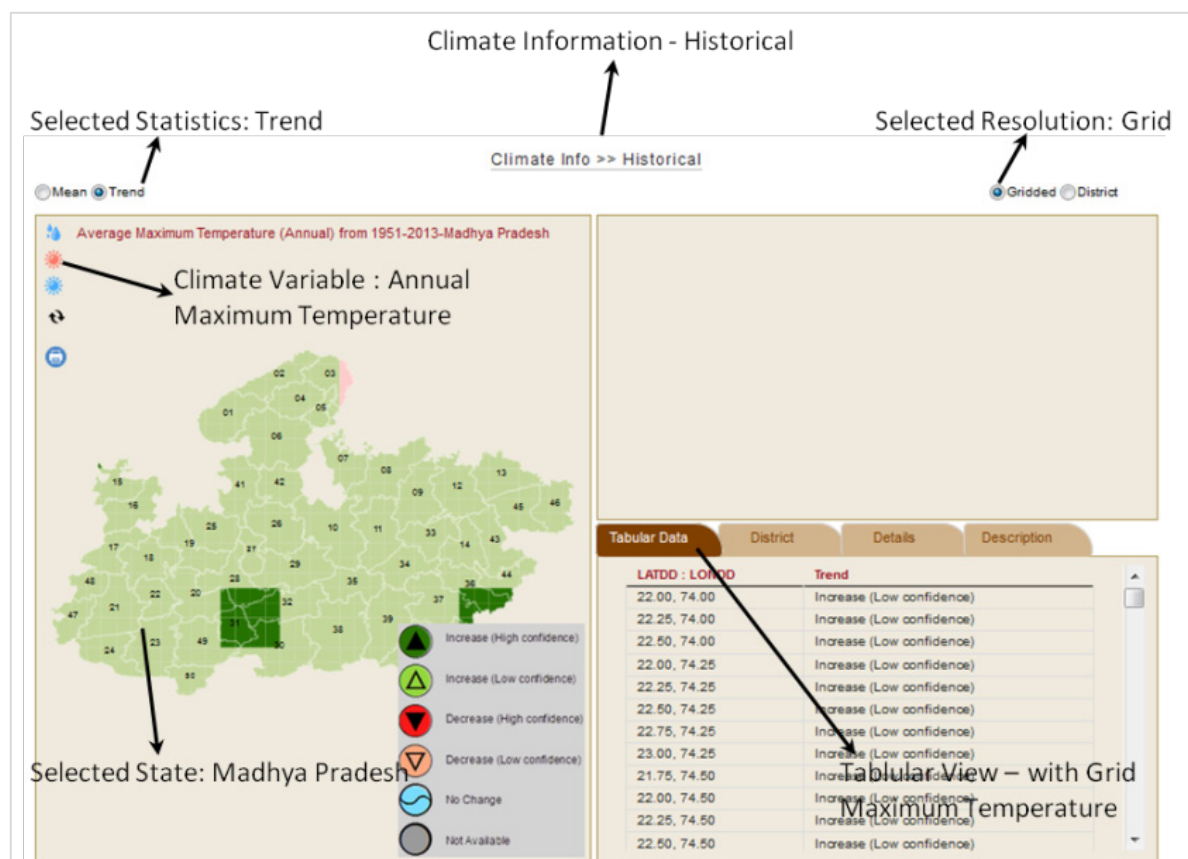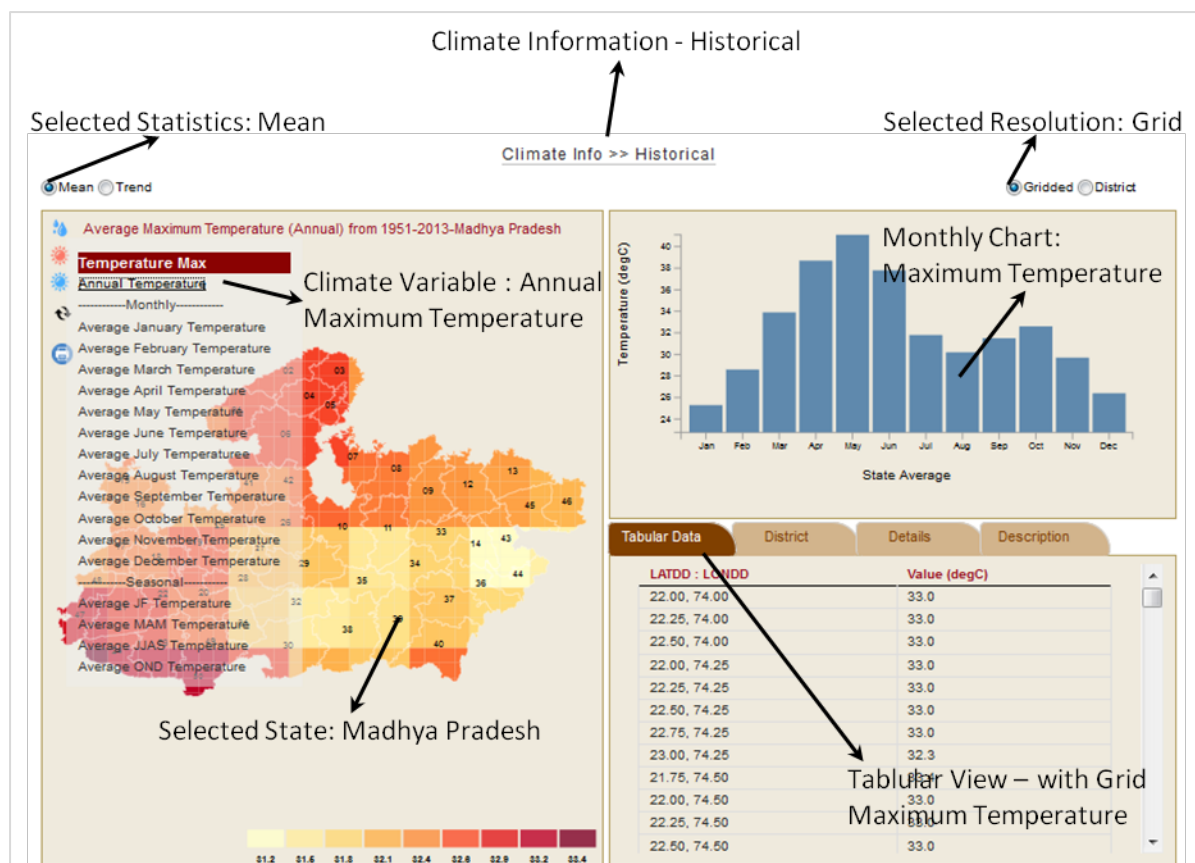
Figure 5: Example of Query: Climate Info >> Historical Screen (Mean and Trend) - Gridded

Figure 6 shows example of query result for "Mean (Trend)" Annual maximum temperature for Madhya Pradesh at "District" resolution, with chart and tabular data.
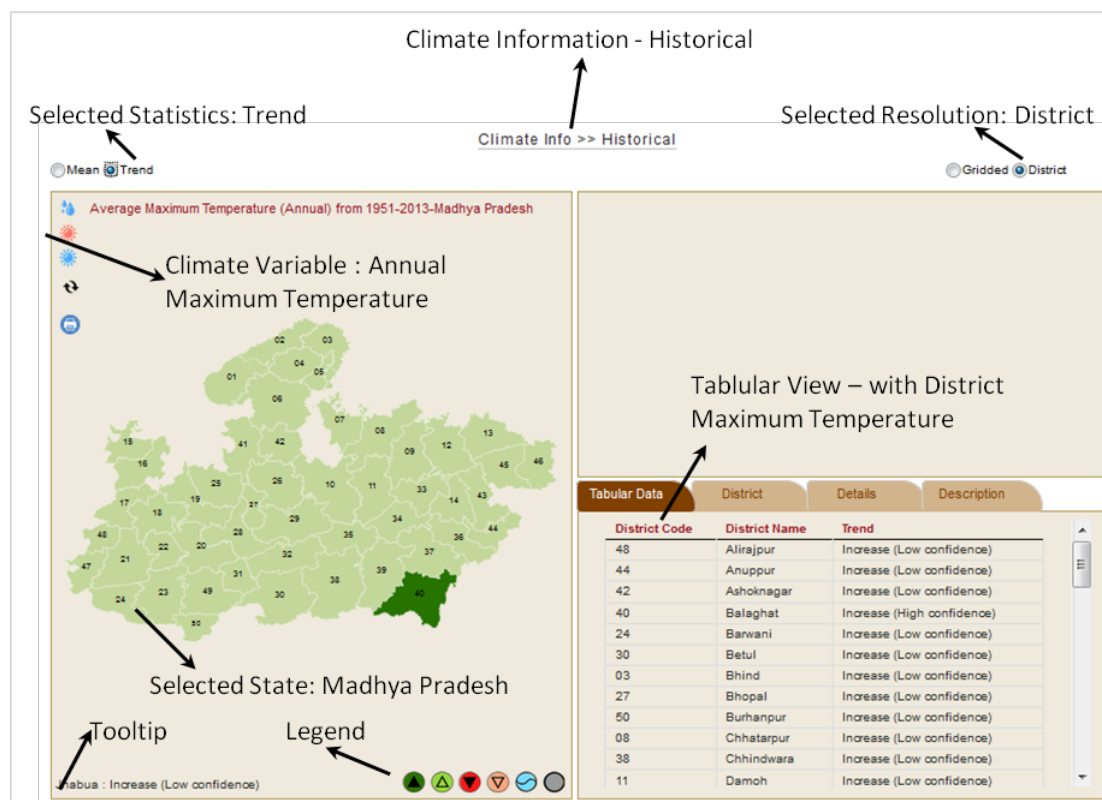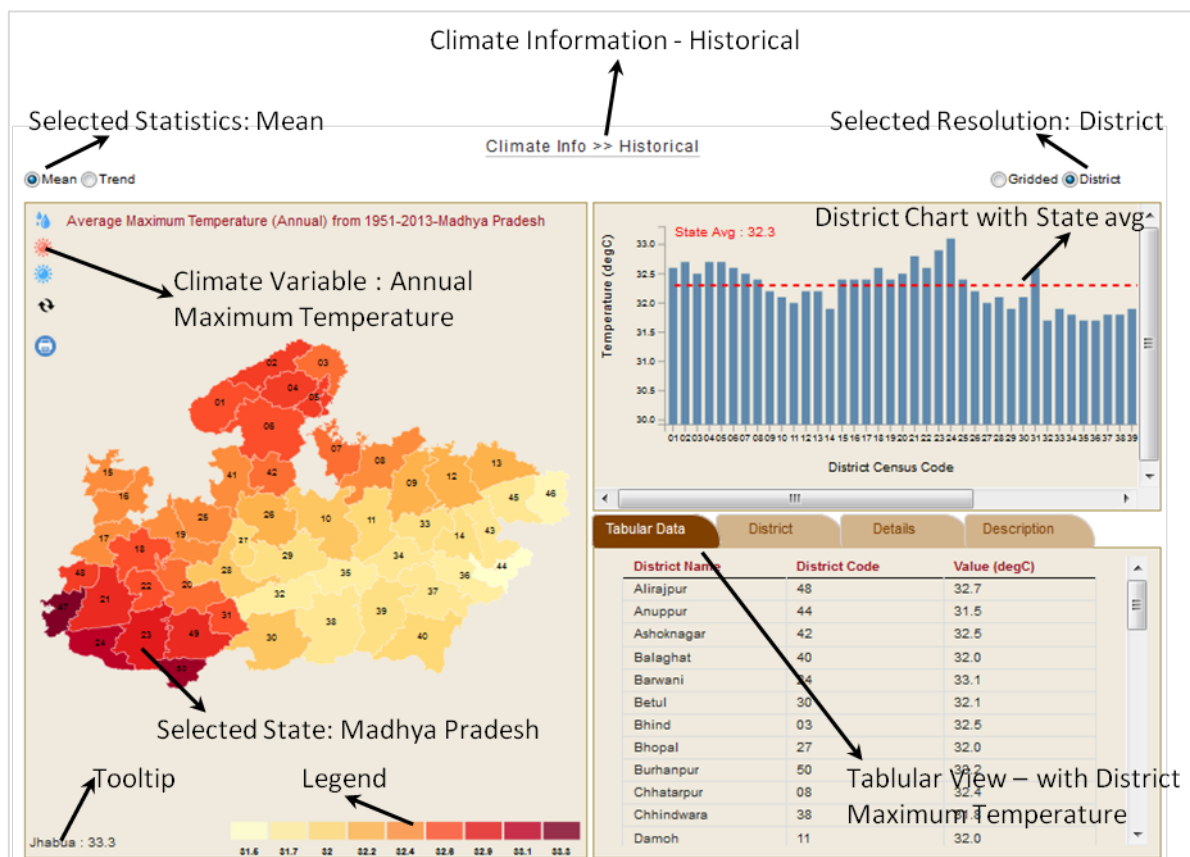
Figure 6: Example of Query: Climate Info >> Historical Screen (Mean and Trend) - District

Step by Step - Menu: ClimateInfo>>Projections

Click on the India map to select any State to view projected mean, trend or change of any climate variable of precipitation, maximum or minimum temperature.

These climate variables can be viewed for

- 10 regional climate models and 1 multimodel ensemble mean (MME - Multi Model Ensemble).
- 2 IPCC AR5 climate scenarios
  - Low emission - RCP4.5
  - High Emission - RCP8.5
- 5 time periods
  - Baseline (1981-2010)
  - Near Term (2011-2040)
  - Mid-Century (2021-2050)
  - Mid-Term (2041-2070)
  - End-Century/Long-Term (2071-2100)
- 3 Statistics
  - Mean
  - Trend
  - Delta (Change from baseline, in ^{0}C for temperature and in % for precipitation)
- Resolution: Grid resolution. District resolution is available additionally for MME.

Figure 7 shows the available choice under Climate Info>>Projections.
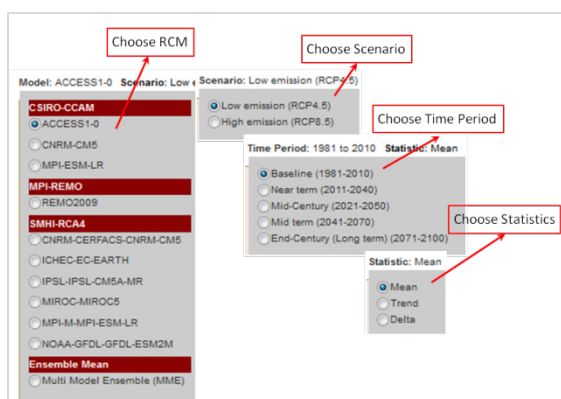
Figure 7: Selection Choice Query: Climate Info >> Projections

Step by Step - Menu: ClimateInfo>>Climate Extremes

Click on the India map to select any State to view projected mean, trend or change of any climate extreme indices of precipitation, or temperature.

Select the blue rain symbol to get data for 9 Precipitation Indices and Yellow sun symbol to get 16 Temperature Indices (Figure 8).
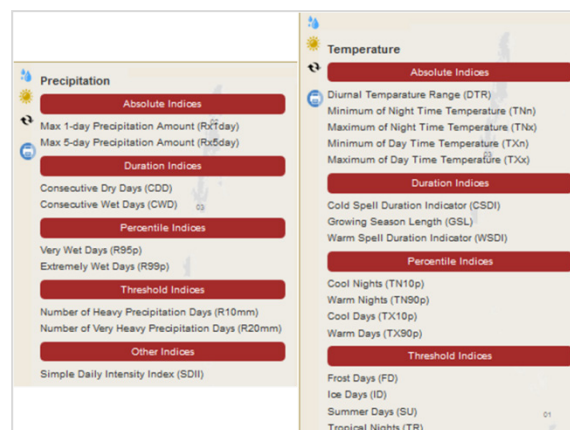
Figure 8: Climate extreme indices: Climate Info >> Climate Extremes

These climate extreme indices can be viewed for;

- 10 regional climate models and 1 multimodel ensemble mean (MME - Multi Model Ensemble).
- 2 IPCC AR5 climate scenarios
  - Low emission - RCP4.5
  - High Emission - RCP8.5
- 5 time periods
  - Baseline (1981-2010)
  - Near Term (2011-2040)
  - Mid-Century (2021-2050)
  - Mid-Term (2041-2070)
  - End-Century/Long-Term (2071-2100)
- 3 Statistics
  - Mean
  - Trend
  - Delta (Change from baseline)
- Resolution: Only at Grid resolution. Only for MME District resolution is available.

Step by Step - Menu: ClimateInfo>> Comparison

Figure 9 shows possible inter comparison which can be viewed using ClimateInfo>> Comparison menu.
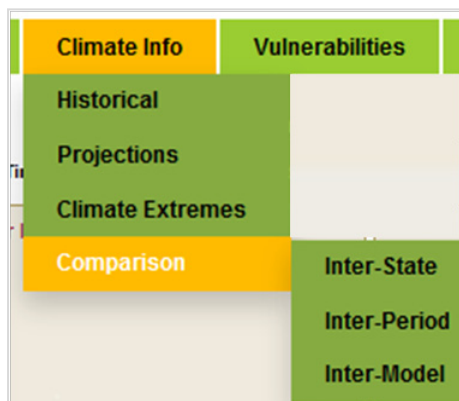
Figure 9: Comparison sub menu: Climate Info >> Comparison

- Comparison between two states/models/ scenarios/time periods and any two combination of these can be viewed under ClimateInfo>> Comparison>>Inter-State menu.
- Comparison for any state for 4 time period can be viewed under ClimateInfo>> Comparison>>Inter-Period menu.
- Comparison for any state for all 11 models can be viewed under ClimateInfo>> Comparison>>Inter-Model menu.

Figures, Figure 10, Figure 11 and Figure 12 shows these comparisons.
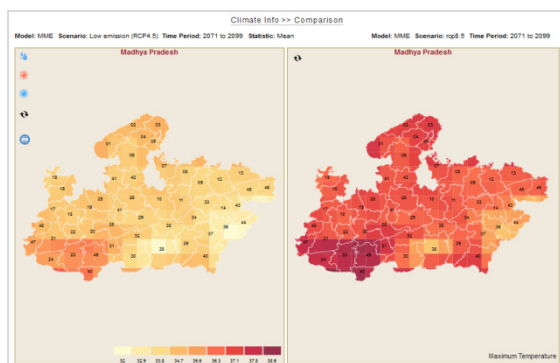
Figure 10: Comparison sub menu: Climate Info >> Comparison>>Inter-State

Figure 10 shows comparison of maximum temperature for Madhya Pradesh towards End-Century for Low and High emission scenarios.
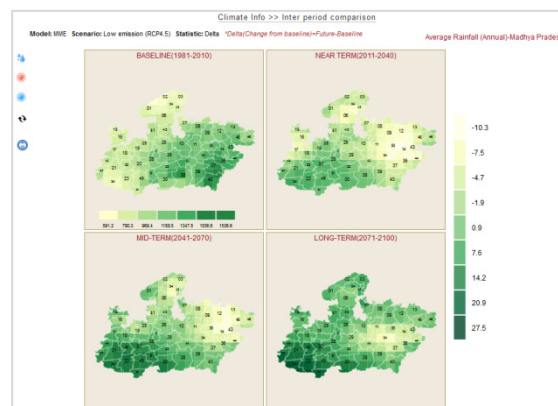
Figure 11: Comparison sub menu: Climate Info >> Comparison>>Inter-Period (Delta)

Figure 11 shows comparison of annual precipitation for Madhya Pradesh for 4 time periods under Low emission scenario.

For "Delta" statistics, the Baseline panel shows the actual value of the climate variable and other 3 time period shows change from baseline.
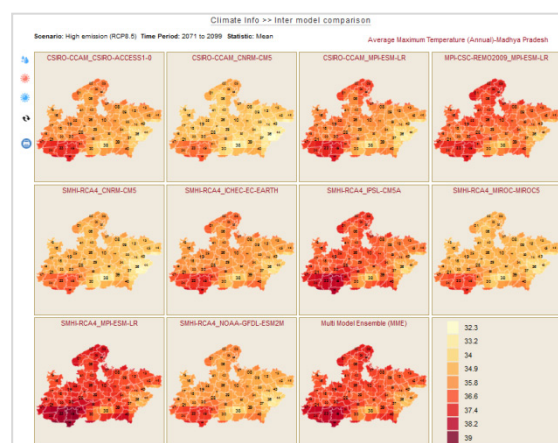
Figure 12: Comparison sub menu: Climate Info >> Comparison>>Inter-Models

Figure 12 shows comparison of all climate models for maximum temperature in Madhya Pradesh towards End-Century under Low emission scenario.

Step by Step - Menu: Vulnerabilities

The project titled 'Climate Change Adaptation in Rural Areas of India Phase –II (CCA RAI-II)' is being implemented under the bilateral cooperation of MoEFCC and GIZ. Under this project vulnerability assessment for water resources to climate change has been conducted by INRM Consultants for the GIZ partner states namely, Himachal Pradesh, Punjab Tamil Nadu, and Telangana.

Outputs of the assessment are made available in this portal. Map view on the left panel shows the composite vulnerability index. Illustration of importance of individual vulnerability indicators contributing to Composite Vulnerability Index is shown on the right panel.

Description for the abbreviated indicator is shown as "Tooltip" when mouse cursor is pointed at the marker.

Outputs from ClimateInfo>> Vulnerabilities menu is shown in Figure 13 and Figure 14.

- Left panel has Map View and Right panel has Chart View.
- Maps can be viewed for 2 scenarios, 3 time periods, 4 states and their districts.
    - Scenarios: Low emission (RCP4.5) and High emission (RCP8.5).
    - Time Periods: Baseline (1981-2010), Mid-Century (2021-2050) and End-Century (2071-2100).
    - States: Himachal Pradesh, Punjab Tamil Nadu, and Telangana.
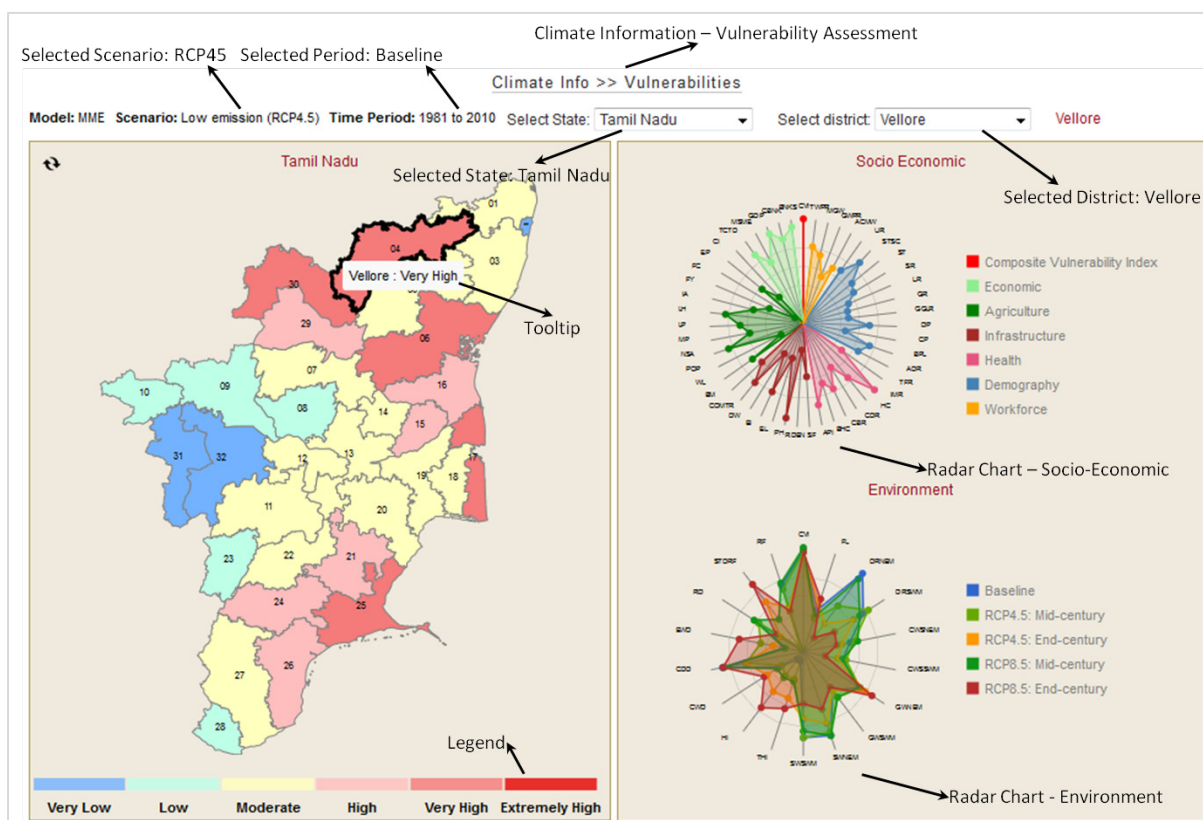
Figure 13: Vulnerabilities sub menu: Climate Info >> Vulnerabilities

Figure 14: Vulnerabilities: Illustration of complex multi-dimensional interrelations between Indicators

Appendix

Statistics

Mean: In statistics, the mean is the mathematical average of a set of numbers. The average is calculated by adding up two or more scores and dividing the total by the number of scores.

Delta: shows change in maximum and minimum temperature (°C) while for rainfall it shows percentage change in rainfall (%), towards future periods with respect to baseline for grids and districts of States of India under IPCC AR5 RCP4.5 and RCP8.5 scenarios. For temperature change is calculated as (Future-Baseline) and for precipitation change is calculated as (100* (Future-Baseline)/Baseline).

Trend: Trend tests are run at 5% level of significance to indicate the presence of statistical significant trends over the period of years. Increasing trend is denoted by "Increase" while decreasing trend is denoted by "Decreasing" for the state. Only those areas are considered as statistically significant whose confidence level is greater than or equal to 95%. A statistically significant trend is denoted by "High confidence" and statistically non significant trend is denoted by "Low confidence". The annual value of the climate extremes indices have been used for the trend analysis. Statistical confidence increases with the number of data points available.

Climate Extreme Indices

Table 1 : List of Climate Extreme Indices

Index	Descriptive Name	Units	Classification of indices	Definitions
			Precipitation indices	
CDD	Consecutive Dry Days	days	Duration Indices	Maximum number of consecutive days with RR<1mm
CWD	Consecutive Wet Days	days	Duration Indices	Maximum number of consecutive days with RR>=1mm
R10mm	Number of heavy precipitation days	days	Threshold Indices	Annual count of days when PRCP>=10mm
R20mm	Number of very heavy precipitation days	days	Threshold Indices	Annual count of days when PRCP>=20mm
R95p	Very wet day precipitation	mm	Percentile Indices	Annual total PRCP when RR>95th percentile
R99p	Extremely wet day precipitation	mm	Percentile Indices	Annual total PRCP when RR>99th percentile
RX1day	Max 1-day precipitation	mm	Absolute Indices	Monthly maximum 1-day precipitation
RX5day	Max 5-day precipitation	mm	Absolute Indices	Monthly maximum consecutive 5-day precipitation
SDII	Simple Daily	mm/day	Other Indices	Annual total precipitation divided by the number of

	Intensity Index			wet days (defined as PRCP>=1.0mm) in the year
Temperature indices				
DTR	Diurnal Temperature Range	°C	Absolute indices	Monthly mean difference between TX and TN
CSDI	Cold Spell Duration Indicator	days	Duration Indices	Annual count of days with at least 6 consecutive days when TN<10th percentile
*FD	Frost Days	days	Threshold Indices	Annual count when TN(daily minimum)<0ºC
*GSL	Growing Season Length	days	Duration Indices	Annual (1st Jan to 31st Dec in NH, 1st July to 30th June in SH) count between first span of at least 6 days with TG>5ºC and first span after July 1 (January 1 in SH) of 6 days with TG<5ºC
* ID	Ice Days	days	Threshold Indices	Annual count when TX(daily maximum)<0ºC
SU	Hot Days	days	Threshold Indices	Annual count when TX(daily maximum)>25ºC
TN10p	Cool nights	% days	Percentile indices	Percentage of days when TN<10th percentile
TN90p	Warm nights	% days	Percentile indices	Percentage of days when TN>90th percentile
TNn	Minimum of Night time Temperature	°C	Absolute indices	Monthly minimum value of daily minimum temp
TNx	Maximum of Night time Temperature	°C	Absolute indices	Monthly maximum value of daily minimum temp
TR	Tropical Nights	days	Threshold Indices	Annual count when TN(daily minimum)>20ºC
TX10p	Cool days	% days	Percentile indices	Percentage of days when TX<10th percentile
TX90p	Warm days	% days	Percentile indices	Percentage of days when TX>90th percentile
TXn	Minimum of Day time Temperature	°C	Absolute indices	Monthly minimum value of daily maximum temp
TXx	Maximum of Day time Temperature	°C	Absolute indices	Monthly maximum value of daily maximum temp
WSDI	Warm Spell Duration Indicator	days	Duration Indices	Annual count of days with at least 6 consecutive days when TX>90th percentile

The details of the CORDEX Models used are given in Table 2.

Table 2 : List of CORDEX Models

Asia CORDEX RCMs	RCM	GCM Boundary Condition	Institute	Scenario	Resolution	Daily time period
CSIRO-CCAM						
ACCESS1-0_CSIRO-CCAM-1391M	CCAM	CSIRO-ACCESS1-0	CSIRO	RCP45,RCP85	0.5X0.5	1970-2099
CNRM-CM5_CSIRO-CCAM-1391M	CCAM	CNRM-CM5	CSIRO	RCP45,RCP85	0.5X0.5	1970-2099
MPI-ESM-LR_CSIRO-CCAM-1391M	CCAM	MPI-ESM-LR	CSIRO	RCP45,RCP85	0.5X0.5	1970-2099
SMHI-RCA4						
CNRM-CERFACS-CNRM-CM5_SMHI-RCA4	RCA4	CNRM-CM5	SMHI	RCP45,RCP85	0.5X0.5	1951-2100
NOAA-GFDL-GFDL-ESM2M_SMHI-RCA4	RCA4	NOAA-GFDL-ESM2M	SMHI	RCP45,RCP85	0.5X0.5	1951-2100
ICHEC-EC-EARTH_SMHI-RCA4	RCA4	ICHEC-EC-EARTH	SMHI	RCP45,RCP85	0.5X0.5	1951-2100
IPSL-CM5A-MR_SMHI-RCA4	RCA4	IPSL-CM5A	SMHI	RCP45,RCP85	0.5X0.5	1951-2100
MIROC-MIROC5_SMHI-RCA4	RCA4	MIROC-MIROC5	SMHI	RCP45,RCP85	0.5X0.5	1951-2100
MPI-M-MPI-ESM-LR_SMHI-RCA4	RCA4	MPI-ESM-LR	SMHI	RCP45,RCP85	0.5X0.5	1951-2100
MPI-REMO2009						
MPI-M-MPI-ESM-LR_MPI-CSC-REMO2009	REMO2009	MPI-ESM-LR	MPI-CSC	RCP45,RCP85	0.5X0.5	1961-2100
MME - Multi -model Ensemble Mean						
Mean of above 10 models				RCP45,RCP85	0.5X0.5	1961-2100

Multi-dimensional Interrelations of Vulnerability Indicators					
Socio-Economic					
Economic	BNKS	% of households availing banking services, 2011	**Health**	HC	No of health centres/ lakh population, 2015
	CBNK	Total no of all scheduled Commercial Banks/ Lakhs Pop, 2015-16		API	Annual Parasite Index, 2010
	GDP	GDP per capita (Rs. '000), 2013-14		BHC	No of beds/lakh of population, 2013-14
	MSME	MSME units per lakh population, 2014-15		CBR	Total Crude Birth Rate (CBR), 2012
	TCTD	Credit Deposit Ratio, 2015-16		CDR	Total Crude Death Rate (CDR), 2012
Agriculture	CI	Cropping Intensity(%), 2013-14		IMR	Total Infant Mortality Rate (IMR), 2008
	FC	Fertilizer consumption (kg/ha) 2013-14		TFR	Total Fertility Rate, 2001
	FY	Total Foodgrains_Yield (kg/ha) 2012-13	**Demography**	CP	% of child population in the age group 0-6, 2011
	IA	% of net irrigated area to net sown area, 2013-14		DP	Districtwise Population Density per sq. km., 2011
	LH	Percentage of land holdings area below 1 hectare (2010-2011)		GR	Decadal growth rate of population, 2011
	LP	Total Number of Livestock per 1000 households, 2012		LR	Literacy rate 2011 (pop>6 years), 2011
	MP	Milk production per capita availability gms/day, 2013-14		SR	Sex Ratio, 2011
	EP	Egg Production per capita, 2013-14		ST	Student/teacher ratio 2014-15
	WL	Total wasteland As a % of the District Geographical Area, 2013-14		UR	% of urban population, 2011
	NSA	Net Area Sown As a % of the District Geographical Area, 2013-14		ADR	Age Dependency ratio, 2011
	POP	Total Number of Poultry per 1000 households, 2012		BPL	% of population BPL, 2007-08
Infrastructure	BM	% of households still dependent on biomass as fuel for cooking, 2011		GGLR	Gender gap in Literacy rate (MLR-FLR), 2011
	DW	% of Tot households with access to improved source of drinking water, 2011		STSC	% of SC and ST population, 2011
	EI	Total Number of Schools/lakh population, 2015-14	**Workforce**	ACMW	% of main agriculture to total main workers, 2011
	EL	% of Households having electricity as main source of lighting, 2011		GWPR	Gap in work participation rate (M-F), 2011
	PH	% of households having Permanent houses, 2011		MGW	% of Marginal workers to total workers, 2011
	SF	% of households having latrine facility within the premises, 2011		TWPR	Total work participation rate %, 2011
	COMTR	% of Households with access to modes of communication/transport, 2011			
	RDEN	Total Length of Roads Per.100 sq. kms, 2013-14			

Environment (with Climate Change Projection)					
Health/ Extreme Climate	**RF**	Average annual rainfall	**Water Resources**	**SWSWM**	Surface Water availability in South West Monsoon season
	STDRF	Standard deviation in annual rainfall		**SWNEM**	Surface Water availability in North East Monsoon season
	RD	No. of Rainy Days		**GWSWM**	Ground Water availability in South West Monsoon season
	EWD	R99p/extremely wet days		**GWNEM**	Ground Water availability in North East Monsoon season
	CDD	Consecutive dry days		**CWSSWM**	Crop water Stress(ET/PET) in South West Monsoon season
	CWD	Consecutive wet days		**CWSNEM**	Crop water Stress(ET/PET) in North East Monsoon season
	HI	Heat Index		**DR**	Frequency of Drought
	THI	Temperature Humidity Index		**FL**	Flood Discharge (1-2% probable flow)
CVI Composite Vulnerability Index					