

Building Heat Resilience in India's Growing Urbanscapes–National Heat + Insights Explorer (BHRIGU–NHIE+)

User Manual

Center for Study of Science, Technology and Policy (CSTEP)

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Edited and designed by CSTEP

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1. Introduction

1.1. About BHRIGU

India's urbanscapes are increasingly vulnerable to heat stress, driven by rapid urbanisation, changing land-use patterns, and evolving climatic conditions. Understanding these patterns requires looking beyond air temperature alone, considering both surface conditions and human thermal exposure, while accounting for atmospheric, land surface, and environmental factors that shape heat stress across diverse urban environments. It also requires understanding where heat overlaps with other climate hazards and how these hazards intersect with the places and populations exposed to them.

Building Heat Resilience in India's Growing Urbanscapes–National Heat+ Insights Explorer (BHRIGU–NHIE+) is an interactive web-based platform that brings together nationally consistent heat assessment datasets covering the period 2002–2025, along with information on other climate hazards and supporting thematic datasets, to enable the exploration and understanding of heat patterns across India. The platform integrates multiple heat indices that represent surface thermal behavior, human thermal discomfort, and overall heat hazard. In addition to these heat indices, the portal offers information on other climate hazards, including floods, drought, and extreme rainfall, enabling users to explore where different hazards occur together and understand their spatial combinations. It also includes demographic, infrastructure, land-use, and urban thematic datasets to provide context for understanding exposure in different places. The heat datasets are presented at a 1 km × 1 km spatial resolution, enabling detailed analysis across more than 5,000 functional urban areas in India, ranging from dense urban centres to peri-urban and transitional zones.

Designed for governments, researchers, planners, practitioners, decisionmakers, and other stakeholders, BHRIGU–NHIE+ provides a common evidence base for understanding heat patterns, identifying heat-vulnerable areas, and exploring the spatial overlap of different climate hazards. This enables evidence-based planning and decision-making to inform policy development and climate adaptation across local, regional, and national scales.

1.2. Browser requirements

BHRIGU–NHIE+ works on the following browsers:

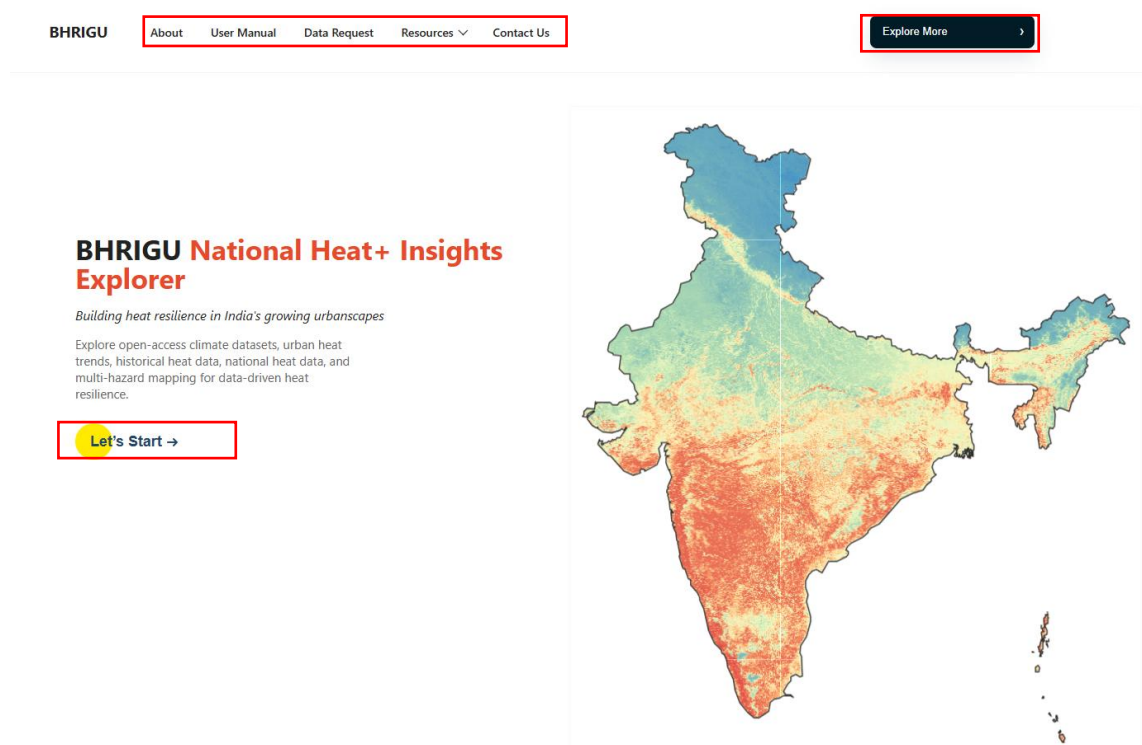
- Google Chrome
- Mozilla Firefox
- Microsoft Edge
- Safari
- Opera

2. BHRIGU–NHIE+ Access and Navigation

2.1. Landing page

Users can access the BHRIGU–NHIE+ portal at <https://bhrigu.cstep.in/>. The following menu options are visible on the landing page:

- **About:** Gives a brief overview of the tool.
- **User Manual:** Leads to the user manual.
- **Data Request:** Allows users to request datasets.
- **Resources:** Shows a dropdown of related reports, tools, and reference materials.
- **Contact Us:** Lists contact information for any queries.
- **Explore more/ Let's Start:** Leads to the Registration / Log In page.



2.2. Creating an account

2.2.1. Register / Sign up

1. Choose 'Explore more' or 'Let's start' to register.
2. Click 'Create an account' to proceed to the registration screen.
3. Fill out the required details and enter a password. Note: The password is case-sensitive.
4. Re-enter the password to confirm.
5. Click the 'Register' button.

NHRD Login

National Heat Risk Dashboard

Email

Password

 [Show](#)

Login

New user? [Create an account](#)

[← Back to Home](#)

BHRIGU Create Account

Register to access National Heat Risk Explorer.

Full name

Email

Password

 [Show](#)

Password must include:

- At least 8 characters
- One uppercase letter
- One lowercase letter
- One number
- One special character

Confirm password

 [Show](#)

Register

[Back to login](#)

BHRIGU Login

Access National Heat Risk Explorer with your registered account.

Registration successful. You can log in now.

Email

Password

 [Show](#)

Login

[Forgot password?](#)

New user? [Create an account](#)

2.2.2. Log in

Once you have registered, you can log in to the dashboard by entering your email address and password and clicking on the 'Login' button.

2.2.3. Forgot password

1. If you have forgotten your password or want to change it, click 'Forgot Password'.

BHRIGU

Login

Access National Heat Risk Explorer with your registered account

Email

Password

Show

Login

Forgot password?

New user? [Create an account](#)

BHRIGU

Forgot Password

Enter your registered email address and we will send a password reset link.

If an account with that email exists, a reset link has been sent.

Email

xx@cstep.in

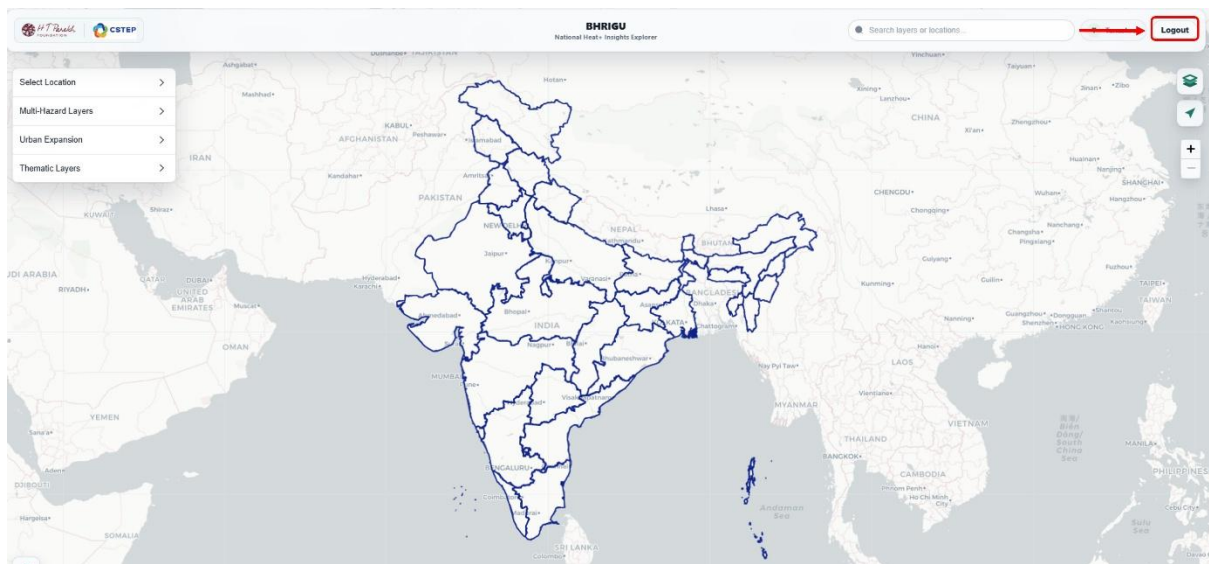
Send Reset Link

[Back to login](#)

2. Type the email address and click 'Send Reset Link'. You will get the message 'Password reset link sent to your email'.
3. Go to your inbox, open the email, and click 'Reset password'.

2.2.4. Log out

To log out, click the 'Logout' icon in the top-right corner of the page.



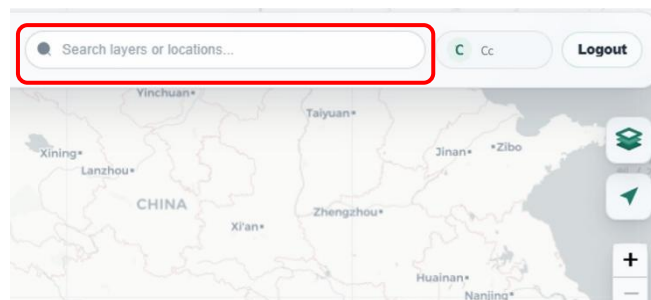
3. Exploring the Features of BHRIGU–NHIE+

3.1. Layers and filters

Through the 'Layers & Filters' panel, users can customise map views by selecting locations, specific hazard layers, urban expansion and thematic layers to generate insights that are unique to each location and enhance spatial understanding.

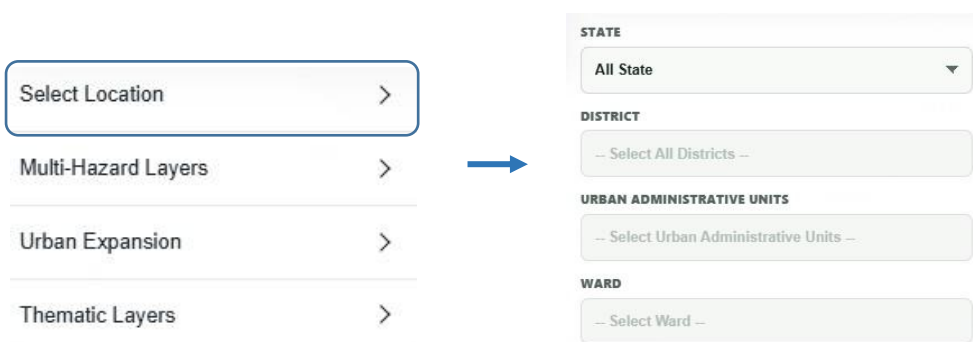


There is a search layers or locations option at the top right corner, where users can directly type the name of the required layer or place for quick access.



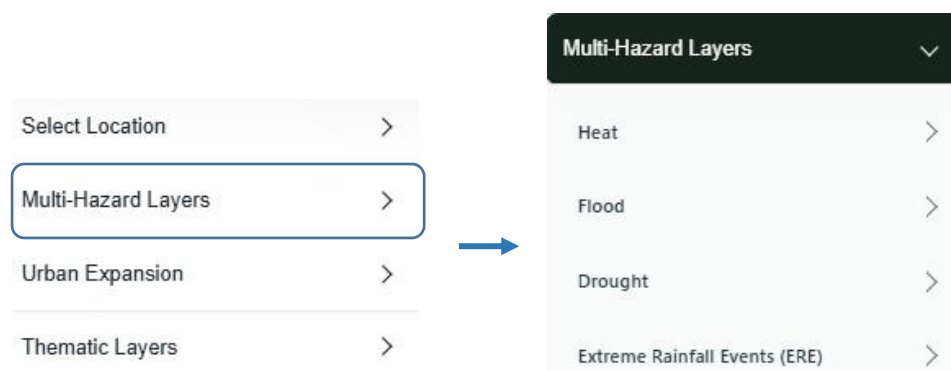
3.2. Select location

The 'Select Location' feature allows users to narrow the dashboard view to specific geographic areas. Users can begin by selecting a 'State', followed by the corresponding 'District', 'Urban Administrative Units, and 'Ward', enabling detailed exploration of location-specific data, multi-hazards, urban expansion and thematic landscapes.



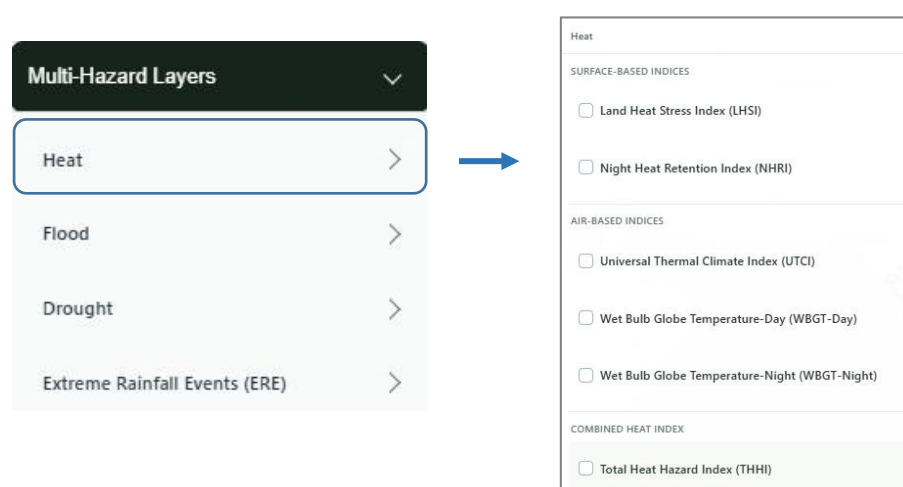
3.3. Multi-Hazard layers

After selecting the location, users can visualise and explore multi-hazard layers: heat, flood, drought and rainfall through the Multi-Hazard Layers option.



3.3.1. Heat

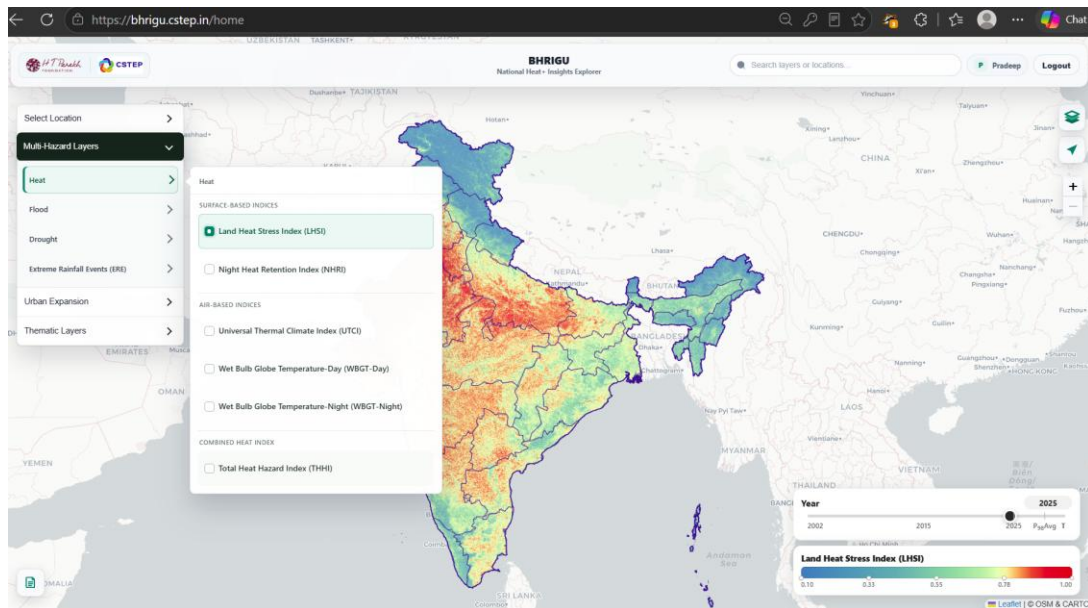
BHRIGU–NHIE+ considers three types of heat indices, namely, surface-based indices, air-based indices, and their combined heat index. Users can see the definition of each index by hovering over the titles and select one hazard layer at a time.



3.3.1.1. Surface-based indices

These represent land surface conditions that contribute to heat stress and heat retention within urban and natural environments and include two indicators: Land Heat Stress Index (LHSI) and Night Heat Retention Index (NHRI).

Land Heat Stress Index (LHSI): Represents daytime surface heat stress and the tendency of different land surfaces to absorb, store, and retain heat.

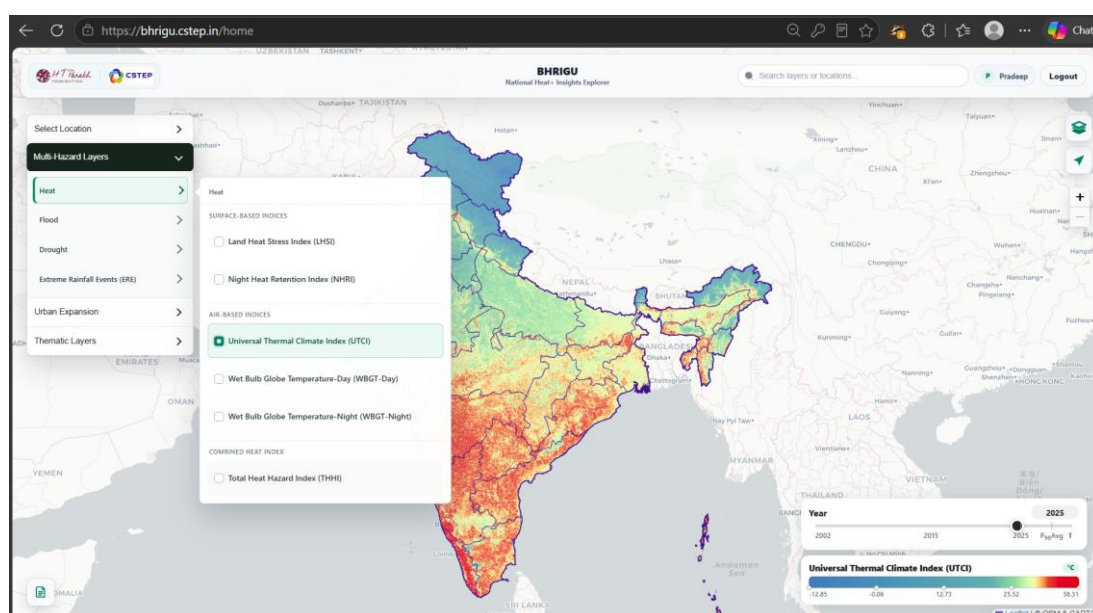


Night Heat Retention Index (NHR): Represents the persistence of stored heat at night and the effectiveness of nocturnal cooling.

3.3.1.2. Air-based indices

These represent atmospheric heat conditions and thermal stress experienced within the urban and surrounding environments and include three indicators: Universal Thermal Climate Index (UTCI), Wet Bulb Globe Temperature (WBGT)-Day, and Wet Bulb Globe Temperature (WBGT)-Night.

Universal Thermal Climate Index (UTCI): Represents physiological heat stress experienced by people under combined thermal and radiative conditions.



Wet Bulb Globe Temperature (WBGT) - Day: Represents daytime thermal stress experienced by people under combined heat and humidity conditions.

Wet Bulb Globe Temperature (WBGT) - Night: Represents persistent night-time thermal stress under warm and humid conditions that can limit physiological recovery.

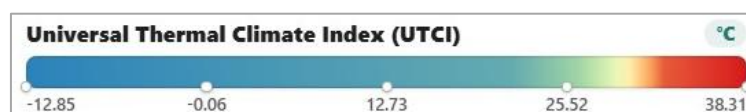
3.3.1.3. Combined heat index

This includes a composite heat hazard index built from the surface- and air-based indices.

Total Heat Hazard Index (THHI): Represents overall heat stress by combining surface thermal behaviour and human thermal discomfort.

3.3.1.4. Index scale (Heat)

This function enables users to interpret and compare the intensity of heat indices across regions. The colour gradient represents varying levels of intensity, with cooler colours such as blue indicating lower heat indices and warmer colours such as red indicating higher heat indices. The markers along the scale indicate the associated specific index value ranges, and the unit of the index is given in the top-right corner of the scale.



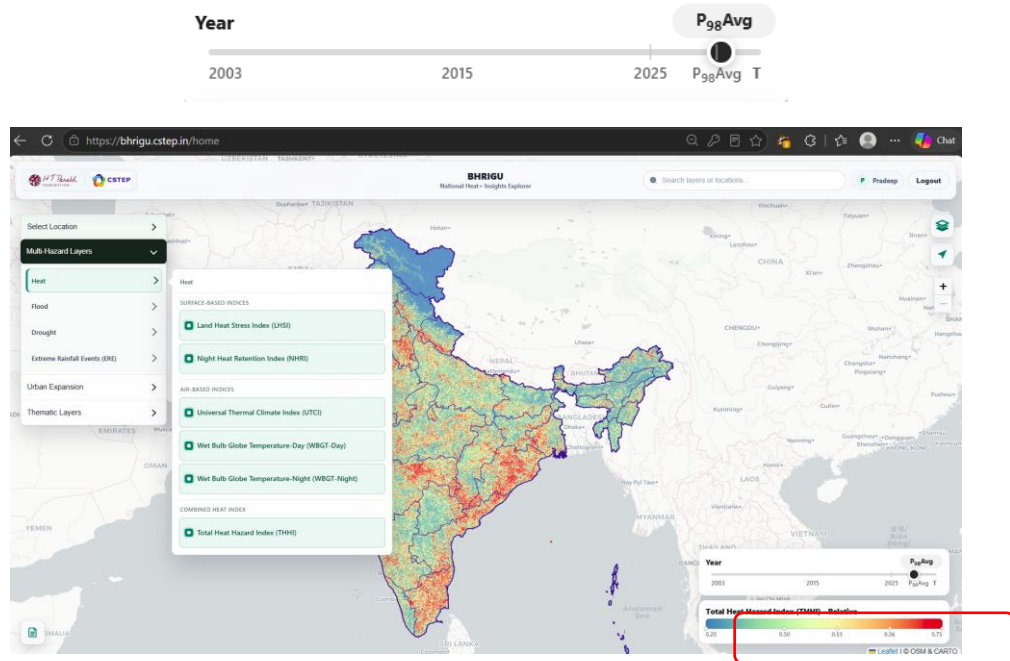
3.3.1.5. Year selector (Heat)

This function enables users to visualise and compare the selected indices across different years (2002–2025). By moving the slider along the timeline scale, users can explore changes in indices over time. To the right of the scale, there is an option to view the average and trend across pixels.



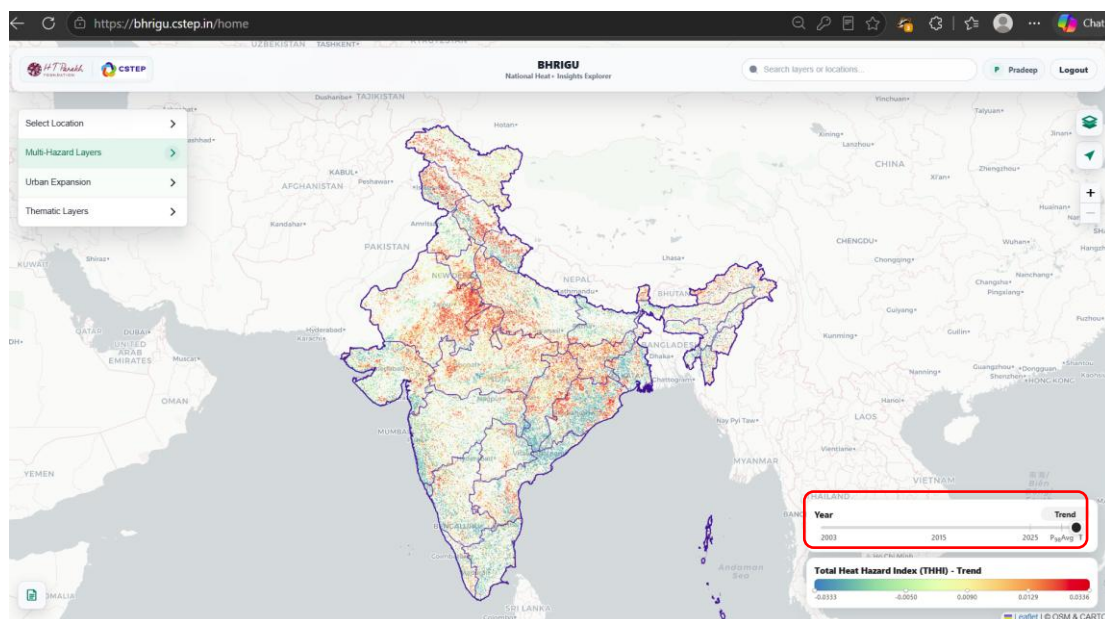
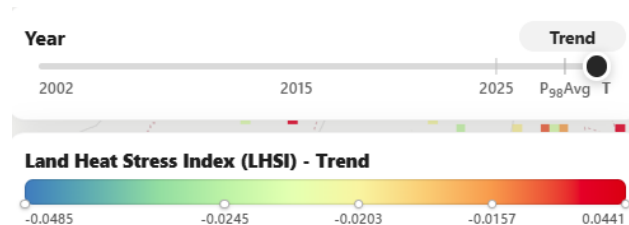
3.3.1.6. Average Percentile-98 (P₉₈ Avg)

By moving the selection point to “P₉₈ Avg”, users can visualise the average 98th percentile value of the selected heat index over the period ‘2002–2025’. This feature made available across all the heat indices.



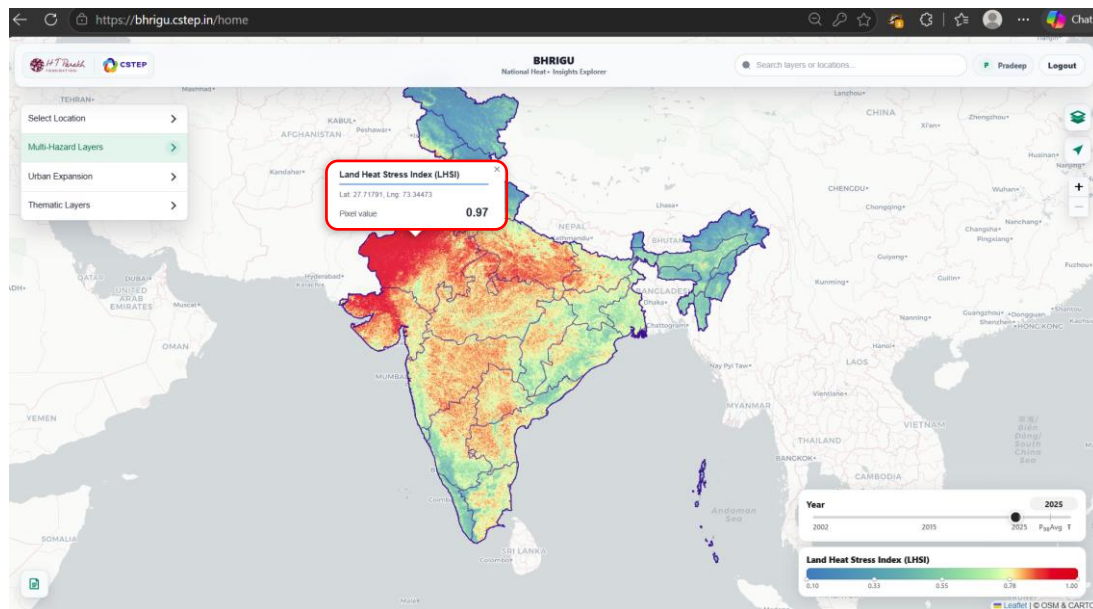
3.3.1.7. Trend (T)

By moving the selection point to “T”, users can visualise the trend value in the selected heat index over the period ‘2002–2025’ computed using Sen’s slope estimator. Positive value indicates an increasing trend in the heat stress, while negative values depict a decreasing trend. This feature made available across all the heat indices.



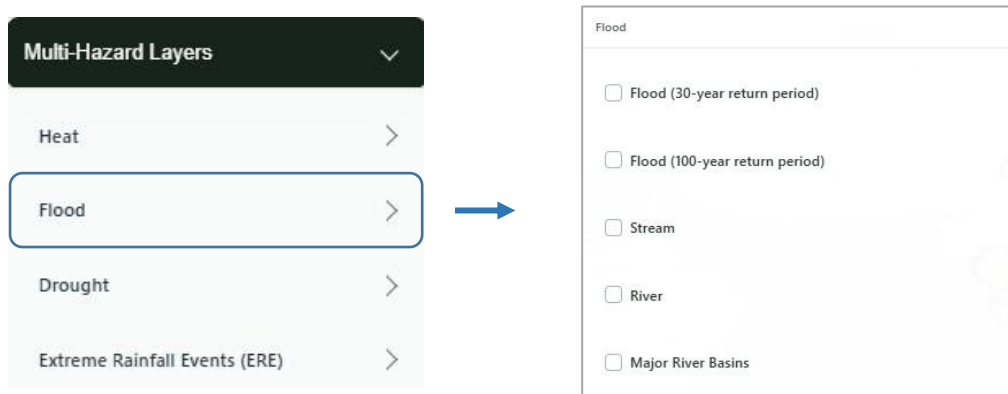
3.3.1.8. Pop-up

By clicking on any location across India, users can view the absolute value of the selected heat index at the that location. This feature is available across all layers in the NHIE+.



3.3.2 Flood

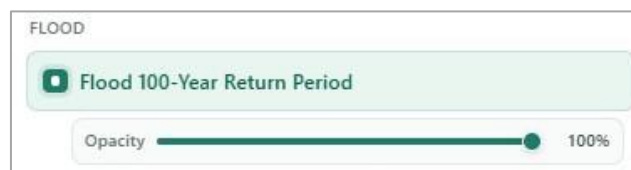
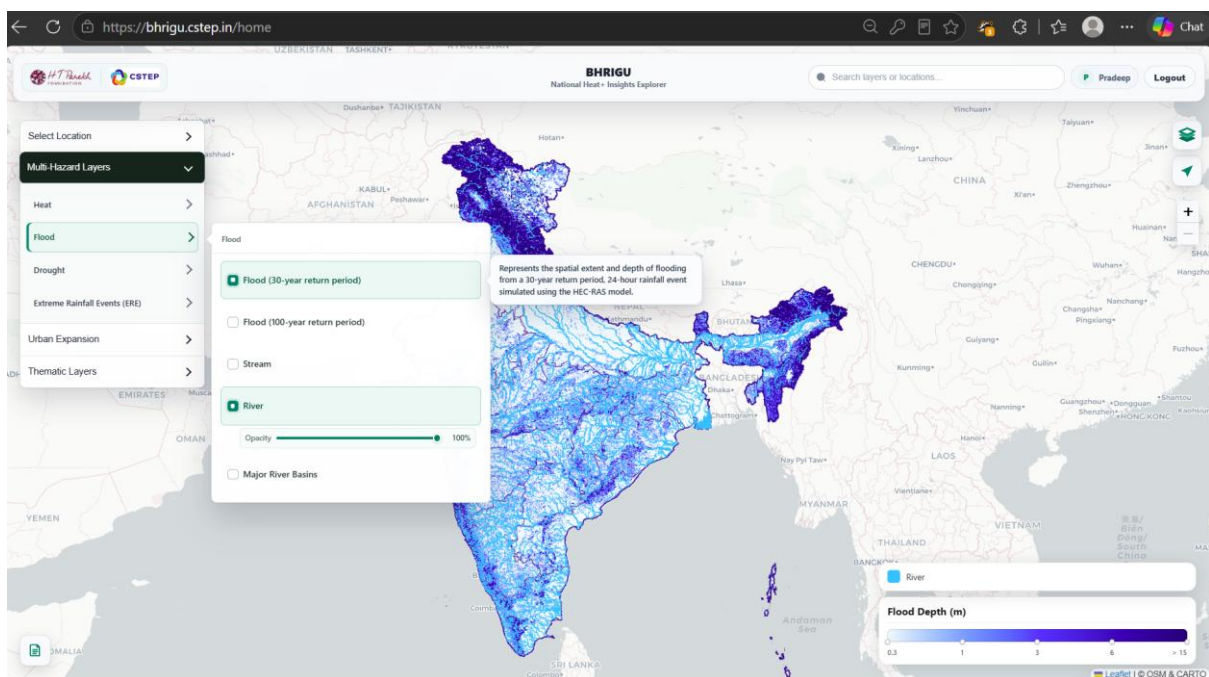
BHRIGU–NHIE+ provides five flood and hydrological layers, including 30-year and 100-year flood return periods, streams, river networks, and major river basins. Users can view the details of each layer by hovering over the layer titles, and multiple layers can be overlaid and viewed simultaneously.



- Flood (30-Year Return Period):*** Represents the spatial extent and depth of flooding simulated using the Hydrologic Engineering Center's River Analysis System (HEC-RAS) model for a 30-year return period, 24-hour-duration rainfall event. This information can support applications such as flood risk assessment, potential inundation zones, agriculture land protection and planning flood-resilient infrastructure.

- **Flood (100-Year Return Period):** Represents the spatial extent and depth of flooding simulated using the HEC-RAS model for a 100-year return period, 24-hour-duration rainfall event. This information can support applications such as informing long-term flood mitigation and disaster preparedness strategies.
- **Stream:** Represents the stream network rendered through the fast flood grid layer.
- **Major River Basins:** Represents land area drained by a river and all its tributaries, where water from precipitation converges and flows toward a single outlet such as a river mouth.

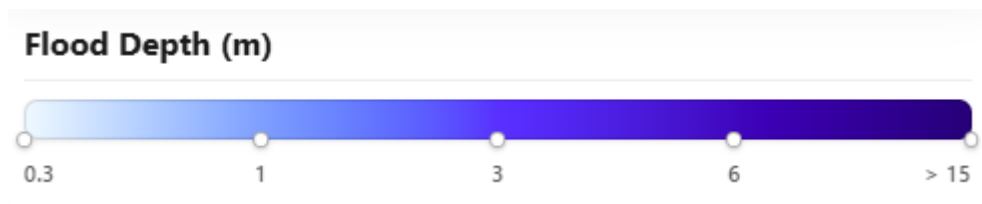
Users can also adjust the layer's opacity by dragging the opacity slider left or right to decrease or increase the layer's transparency.



3.2.2.1 Flood depth legend

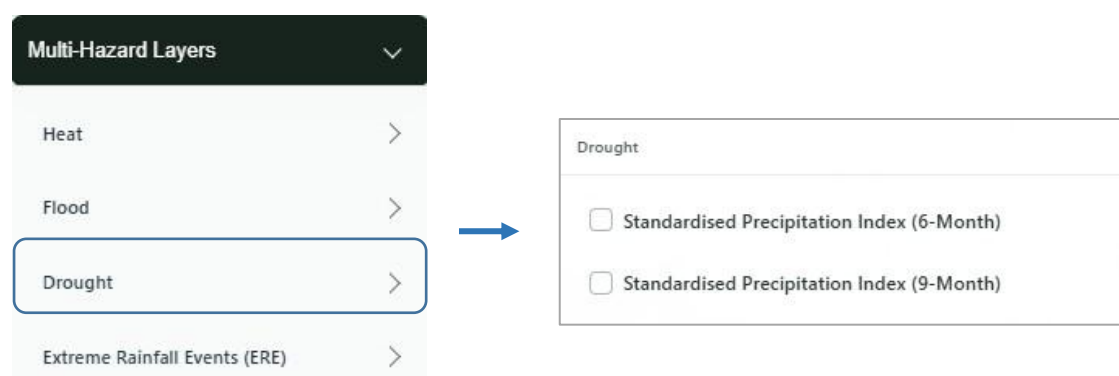
The legend indicates the range of flood depth (in metres) represented by each colour on the map for the 30-year and 100-year return period layers. Users can refer to the legend to interpret the flood depth at a given location by matching the colour displayed on the map with its corresponding depth range, from 0.3 m to >15 m.



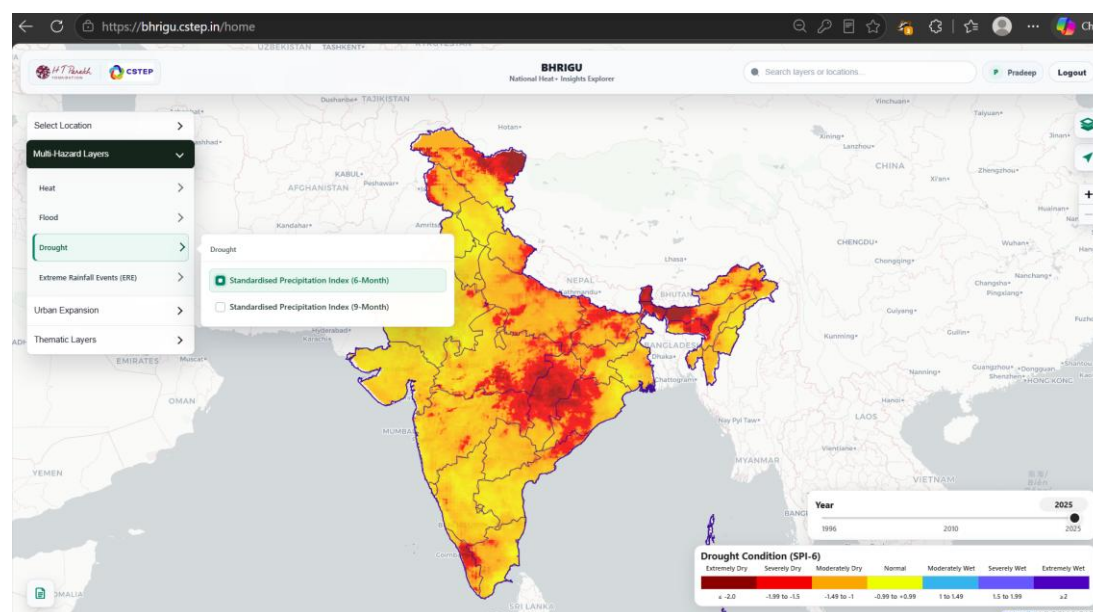


3.3.3 Drought

BHRIGU–NHIE+ provides two drought indicators, Standardized Precipitation Index (6-Month) and Standardized Precipitation Index (9-Month), which represent drought conditions over different time scales. Users can view the details of each indicator by hovering over the layer titles and select one layer at a time.



Standardized Precipitation Index (SPI) - 6-Month: Represents spatial distribution and intensity of dry and wet conditions based on precipitation anomalies accumulated over 6-month (January-June). This information can support applications such as agriculture drought assessment.



Standardized Precipitation Index - 9-Month): Represents spatial distribution and intensity of dry and wet conditions based on precipitation anomalies accumulated over 9-month (January-September). This information can support applications such as assessing prolonged meteorological drought, informing reservoir management and regional drought preparedness.

3.3.3.1 Year selector (Drought)

This function enables users to visualise and compare the selected SPI indicator across different years (1996–2025). By moving the slider along the timeline scale, users can explore changes in the SPI over time.



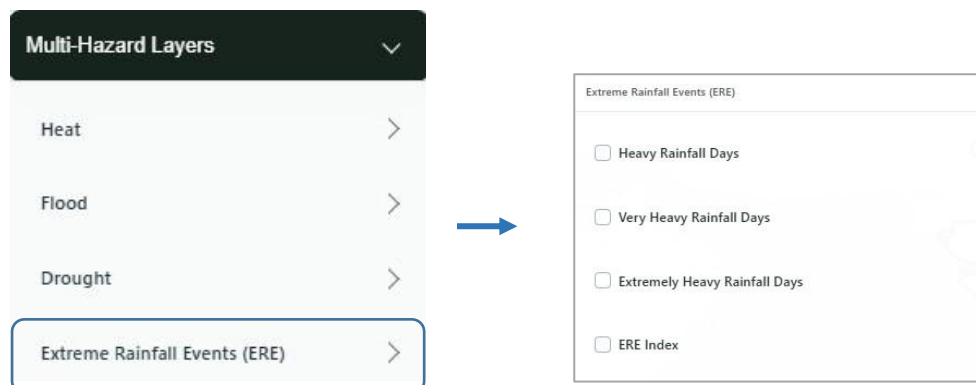
3.3.3.2 SPI Scale

This function helps users interpret drought conditions by matching the colour displayed on the map with the corresponding SPI value on the scale. It ranges from extremely dry to extremely wet conditions. Dark red indicates extremely dry conditions, yellow represents near-normal conditions, and dark blue indicates extremely wet conditions.



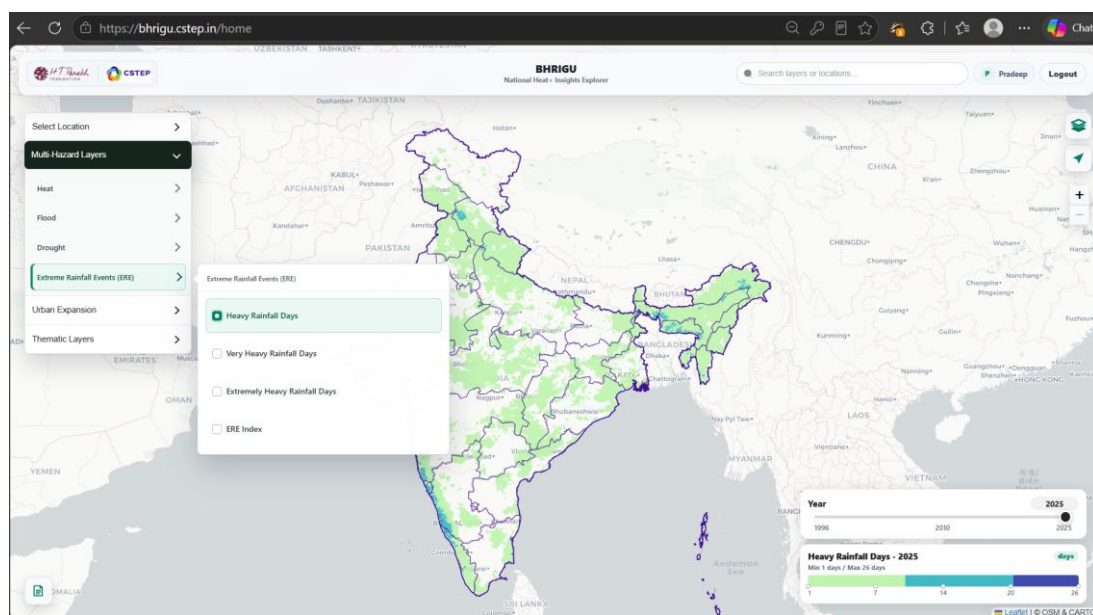
3.3.4 Extreme Rainfall Events (ERE)

BHRIGU–NHIE+ provides four rainfall indicators, namely Heavy Rainfall Days, Very Heavy Rainfall Days, Extremely Heavy Rainfall Days, and the Extreme Rainfall Event (ERE) Index. Users can view the definition of each indicator by hovering over the titles and select one rainfall layer at a time.



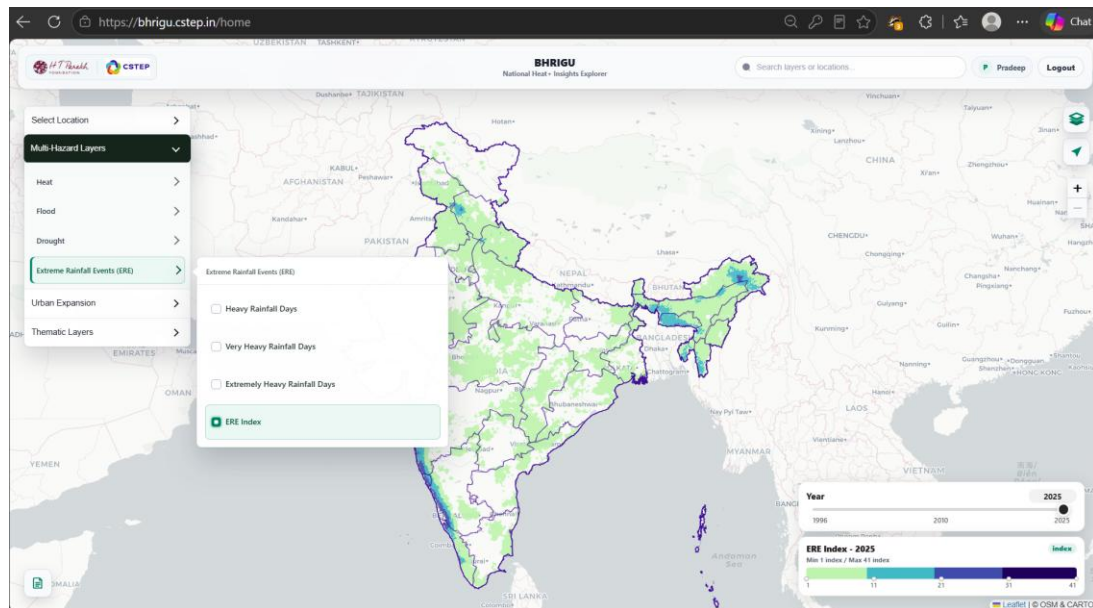
Heavy Rainfall Days: Represents spatial distribution and frequency of annual extreme rainfall days, with daily rainfall between 64 to 204 mm using CHIRPS data. This information can support applications such as agriculture drainage management, waterlogging risk assessment.

Very Heavy Rainfall Days: Represents spatial distribution and frequency of annual extreme rainfall days, with daily rainfall between 115 to 204 mm using CHIRPS data. This information can support applications such as landslide risk assessment in mountain regions, drainage infrastructure planning in urban areas.



Extremely Heavy Rainfall Days: Represents spatial distribution and frequency of annual extreme rainfall days, with daily rainfall of >204 mm, derived from CHIRPS data. This information can support applications such as flash flood risk assessment and disaster preparedness.

ERE Index: Represents combined spatial intensity and frequency of extreme rainfall occurrence using heavy, very heavy and extremely rainfall days into a single index. This information can support applications such as regional climate risk assessment and prioritisation of areas for climate adaptation planning.



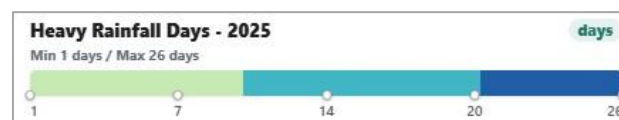
3.3.4.1 Year selector (ERE)

This function enables users to visualise and compare the number of rainfall events of the selected intensity across different years (1996–2025). By moving the slider along the timeline, users can explore changes in the number of days over time.



3.3.4.2 Rainfall Days scale

Using this scale, users can identify the number of days with the selected rainfall intensity in the selected year. Reading the scale from left to right shows the minimum to maximum number of rainfall days, with each range represented by a corresponding colour on the map.

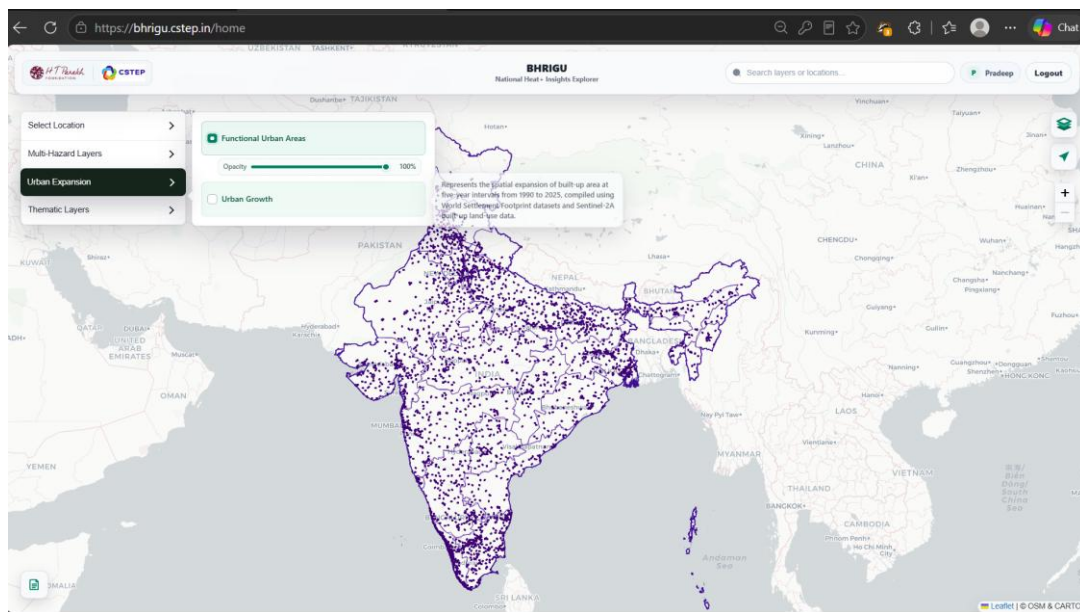


3.4 Urban Expansion

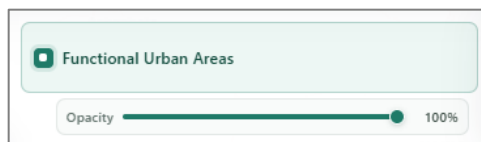
BHRIGU–NHIE+ enables users to visualise and explore urban expansion alongside the multi hazard layers to understand patterns of urban extent and growth. The section includes layers such as Functional Urban Areas and Urban Growth which users can overlay and explore together.



Functional Urban Areas: Represents a city and its community zone, covering areas that are functionally and economically connected to the city based on factors such as night-time lights, built up lands and administrative boundaries.

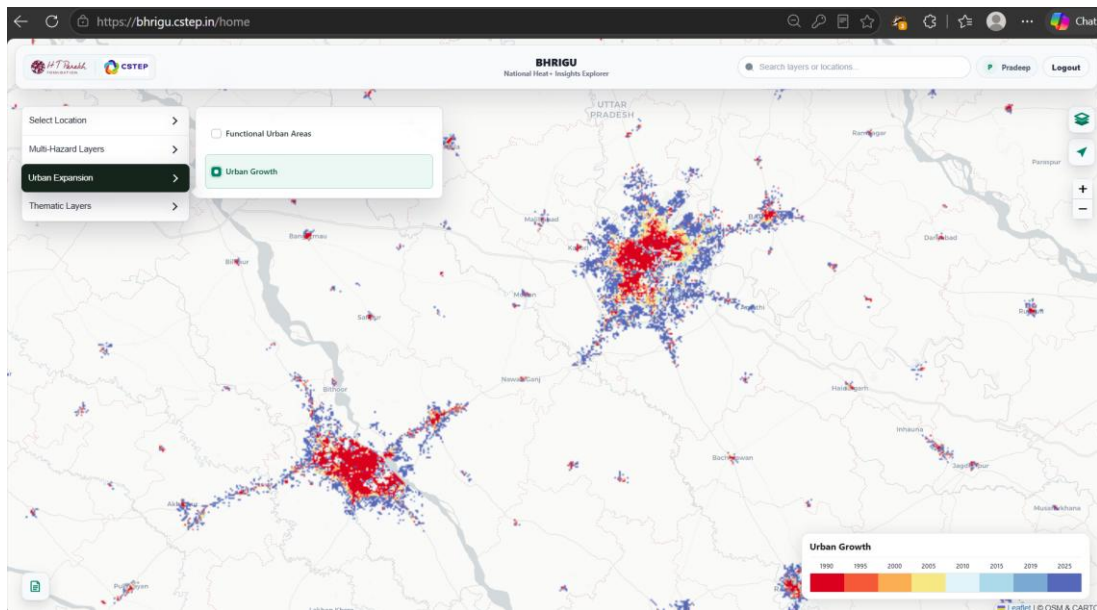


Users can also adjust the layer's opacity by dragging the opacity slider left or right to decrease or increase the layer's transparency.



3.4.2 Urban Growth

Urban Growth: Represents the spatial expansion of built-up area at an interval of 5 years (1990-1925).



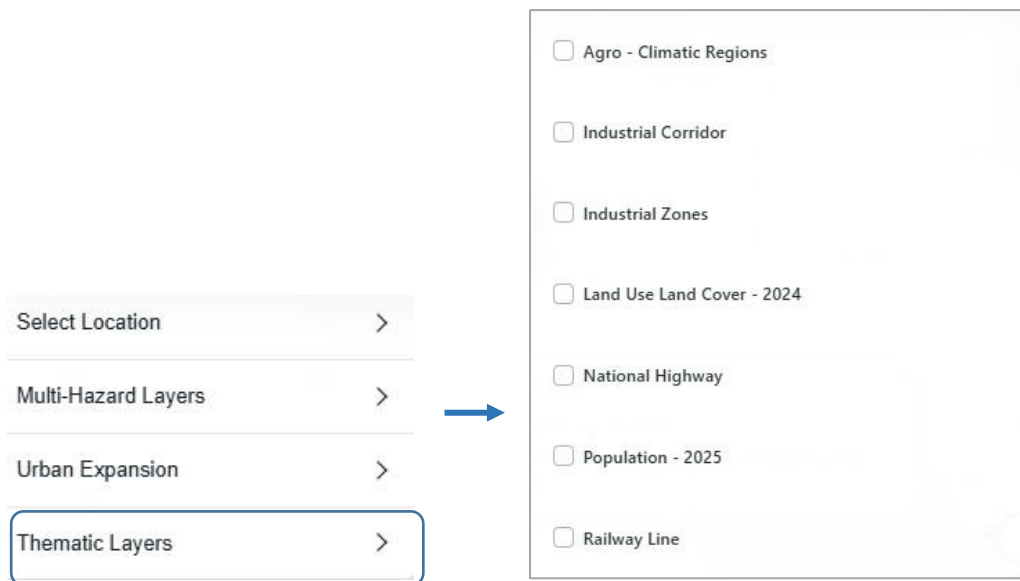
3.4.2.1 Urban Growth Legend

This function helps users visualise the urban growth over time from 1990 to 2025. The dark red on the extreme left indicates the earliest period (1990), yellow represents the middle period (around 2005–2010), and the dark blue on the extreme right indicates the latest period (2025).



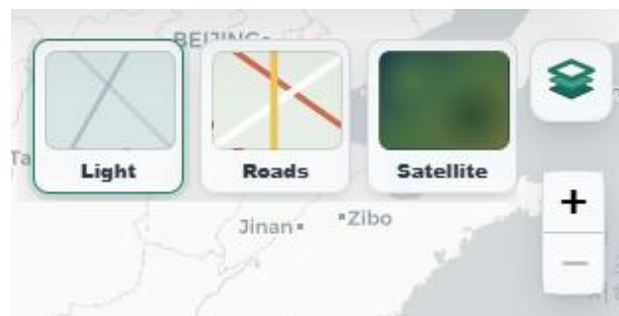
3.5 Thematic layers

BHRIGU–NHIE+ enables users to visualise and explore human and natural landscape features alongside the hazard layers to enhance spatial understanding. The section includes multiple layers such as agro-climatic regions, industrial corridor, industrial zones, land use land cover - 2024, national highway, population - 2025, and railway line.



3.5.2 Basemap layers

Users can view the geographical regions in different base layers. When users click the layer icon in the top-right corner of the dashboard, it displays three types of layers: Light, Roads, and Satellite. Additionally, users can change the map's spatial extent using the plus and minus icons below the map layers icon.



Users can click the desired layer to display the regions on it.



4. Visualising the Layers: A Sample Walkthrough

4.1. Location

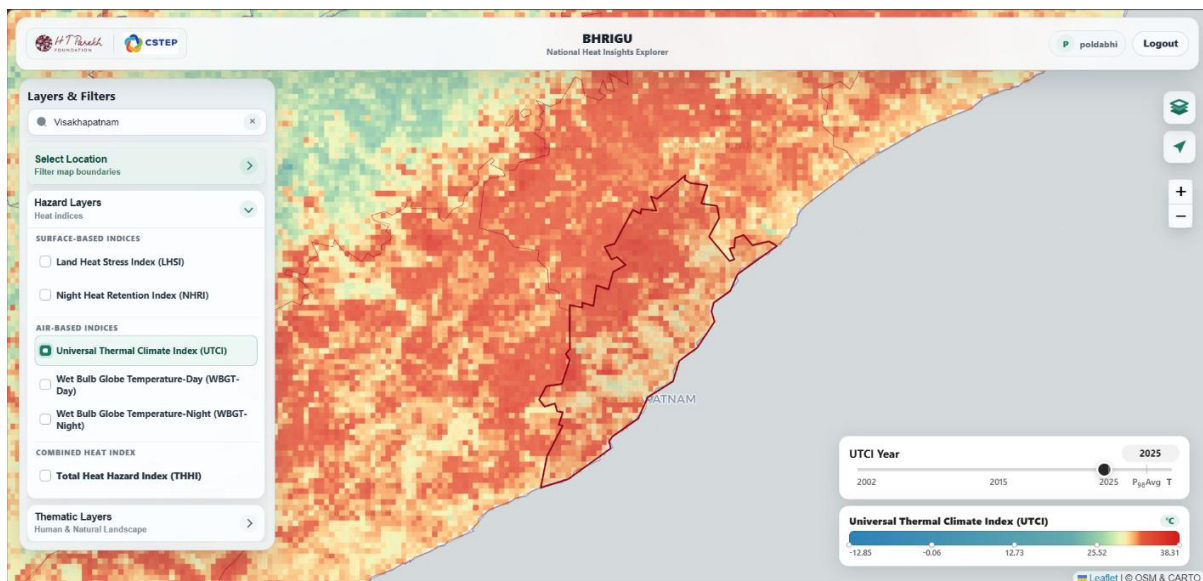
Select a state, followed by a district, city, and ward. The images below use Andhra Pradesh as an example, with the district Visakhapatnam, city Gajuwaka, and ward 66 selected.



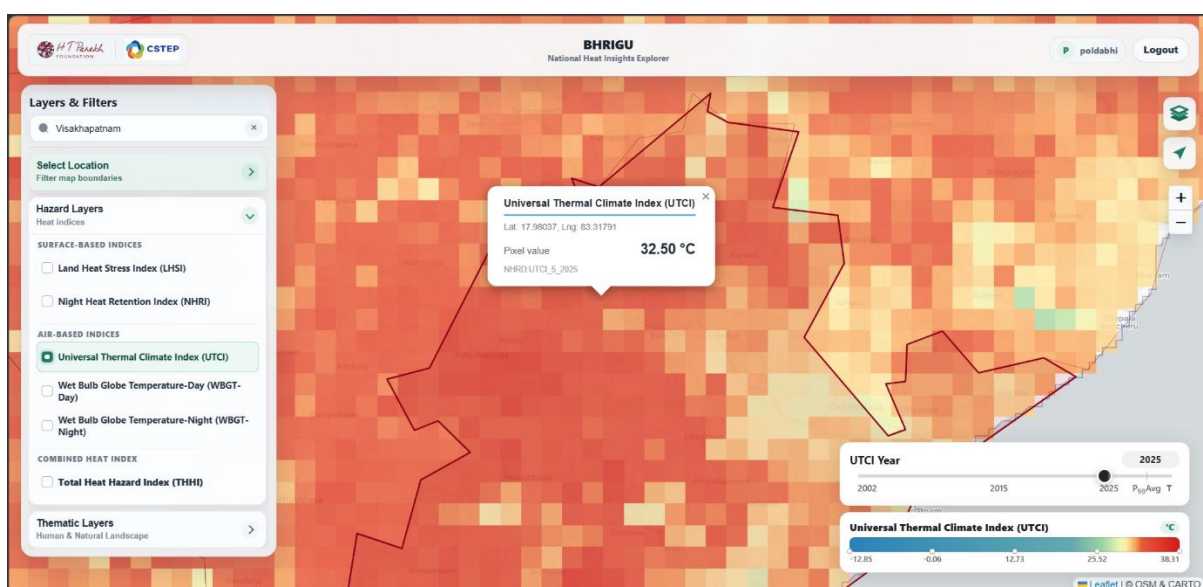
4.1.1. Hazard layer

After selecting the location, choose the required heat index and year. In the image below, the 'UTCI' index has been selected for the year '2018' for Visakhapatnam.

The index scale and year selector are present in the bottom-right corner.

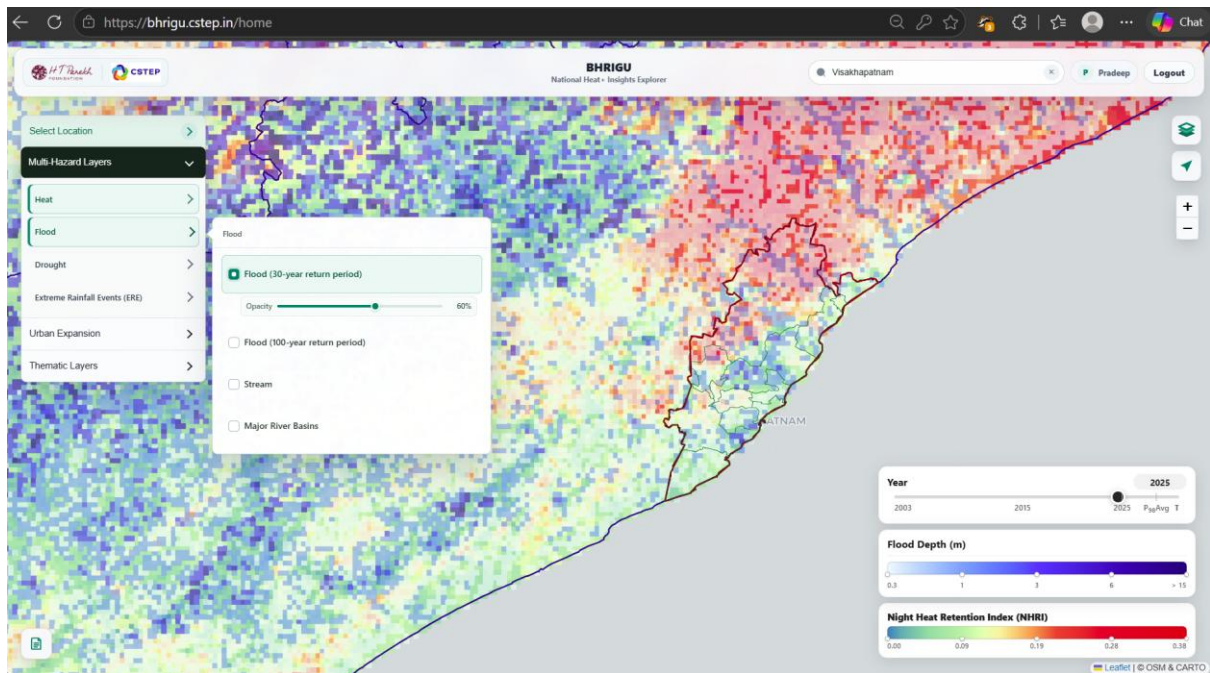


Users can also view pixel-level index details by clicking on a specific pixel on the map. A pop-up box displays the selected index name, the corresponding year, the latitude and longitude coordinates, and the pixel-level index value.



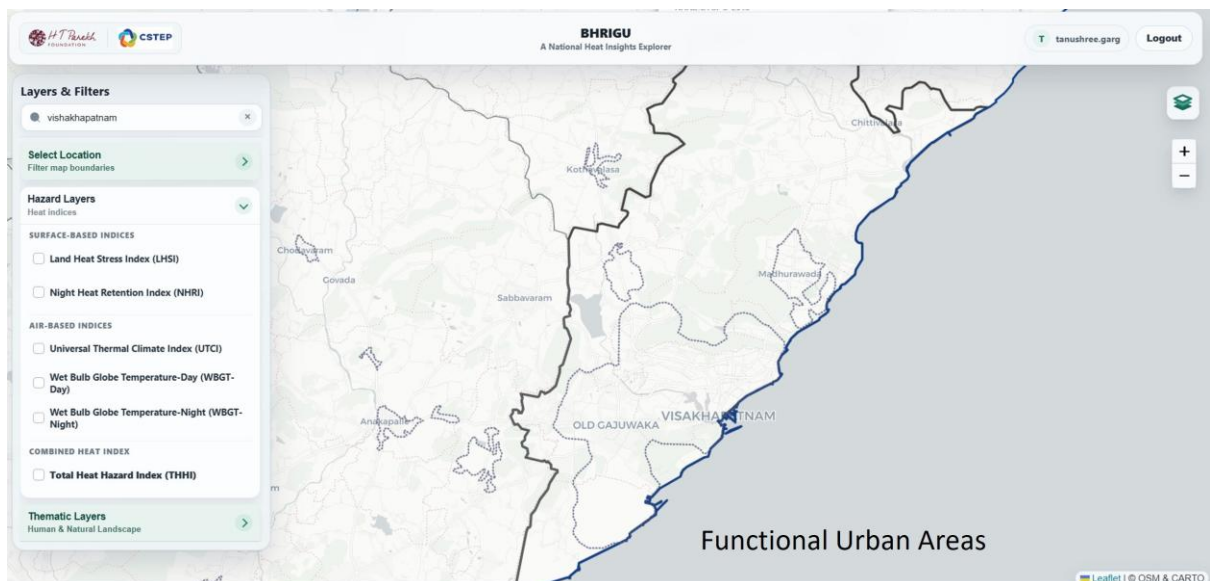
4.1.2. Visual comparison of the flood and heat layers

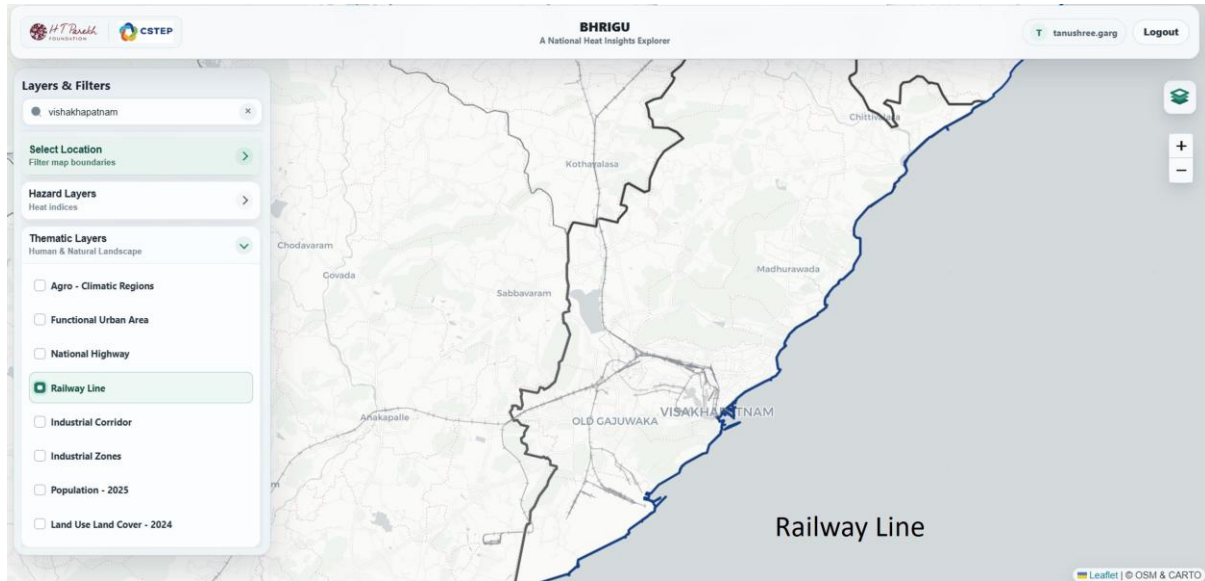
The application allows users to overlay the flood layer on other hazard layers, including heat indices, using the opacity adjustment feature. This enables users to visually compare the spatial distribution of flood and heat hazards and identify areas where multiple hazards overlap.



4.1.3. Thematic layers

The following screenshots show how to select the thematic layers 'Functional Urban Areas' and 'National Highway' for Visakhapatnam.







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