

## National Institute of Advanced Studies (NIAS)

NIAS Blog  
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### **When the Sea Turns Hot: The Unseen Heat Risk Along Karnataka's Coast**

*How new climate science (CMIP6) is revealing dangers policymakers can no longer ignore*

#### **The question**

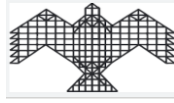
India has experienced increasingly frequent, intense, and prolonged extreme heat events in recent years, with climate change intensifying seasonal patterns. Recent heatwaves have set temperature records and arrived earlier in the season, such as the record-breaking conditions of 2024 and the early heat alerts issued in April 2025. Contributing factors include climate change, urbanisation, which creates "heat islands" in major cities, and climatic patterns such as El Niño.

This extreme heat poses significant risks to public health, exacerbating illnesses like heatstroke and causing higher mortality rates, and also severely impacts sectors such as agriculture, productivity, and infrastructure. Despite ongoing efforts with heat action plans and early warning systems, the escalating threat of extreme heat raises a critical question: is incremental progress sufficient, or does the situation demand a more aggressive, data-driven approach to implement truly transformative and resilient adaptation strategies?

#### **The issue**

A recent study of the Council on Energy, Environment and Water (CEEW) 2025 informs heat risk across 734 districts of India using 35 indicators spanning hazard, exposure, and vulnerability. Going beyond just daytime temperatures, it includes nighttime heat and relative humidity, offering a clearer picture of how climate change has altered the frequency, intensity, and duration of heat hazard from 1982 to 2022. Using high-resolution Indian Monsoon Data Assimilation and Analysis (IMDAA) climate data (12 km), satellite imagery, and the latest socio-economic and health datasets (NFHS 2019–21, Census 2011), the study identifies areas most at risk from this growing 'invisible disaster' in the coming years (Figure 1).

For decades, Karnataka's coastline — from Karwar to Mangaluru — symbolised climatic stability. In the public mind, the sea breeze, lush greenery, and monsoon rains were natural shields against the heat waves that battered inland India. Even meteorological data seemed to agree: maximum daytime temperatures rarely crossed 36 °C, and the coast was labelled "moderate."



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Yet, beneath this apparent comfort lies a growing danger that the thermometer cannot see. The Coupled Model Intercomparison Project Phase 6 (CMIP6) — the world’s most advanced set of climate simulations — has exposed the myth of coastal immunity. Coastal Karnataka is not cooler — it is quietly hotter in ways we do not measure.

Humidity, trapped night-time warmth, and stagnating sea breezes are turning this once-safe stretch into one of India’s most physiologically stressful heat zones. This form of heat does not burn; it exhausts. It is invisible, cumulative, and intensifying rapidly.

### How Extreme Heat is Impacting India

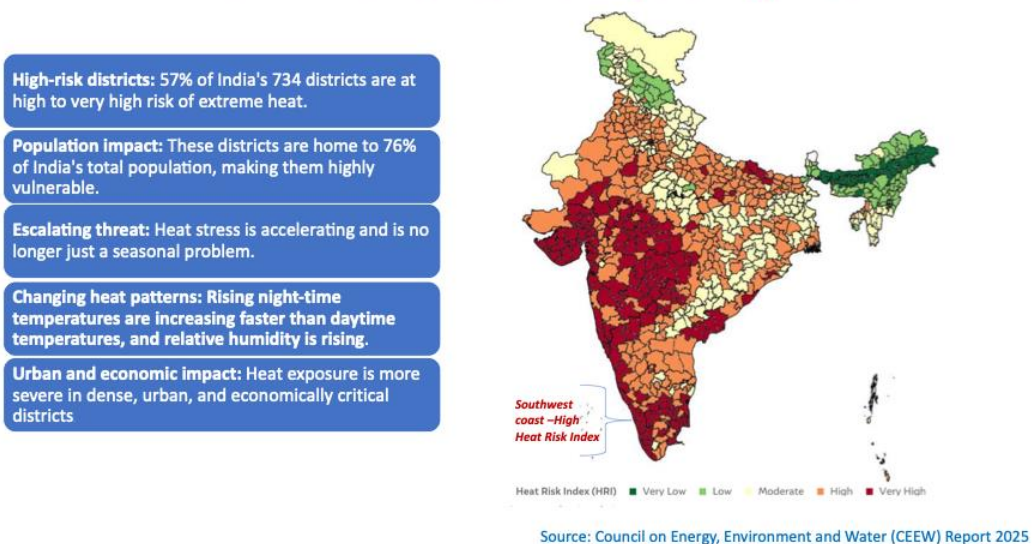


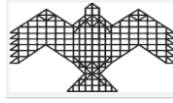
Figure 1. Heat Risk Index of districts in India – based on CMIP 6 model (Source: CEEW 2025)

### Findings

#### *What CMIP6 Science Reveals*

CMIP6 integrates multiple global models to project changes in temperature, humidity, radiation, and atmospheric circulation under different emission pathways (SSP scenarios). When applied to India’s west coast, it paints an unsettling picture.

Building on the CMIP 6 model, the CEEW “How Heat is Impacting India 2025” report has revealed the hidden vulnerabilities of coastal Karnataka. Udupi and Mangalore are identified as high heat-risk zones, where humidity raises perceived temperature by 3–5°C and 70% of districts experience warmer nights (Figure 2). The implications are stark: for informal workers, fisherfolk, street vendors, and construction labourers, heat is life-threatening, not seasonal discomfort.



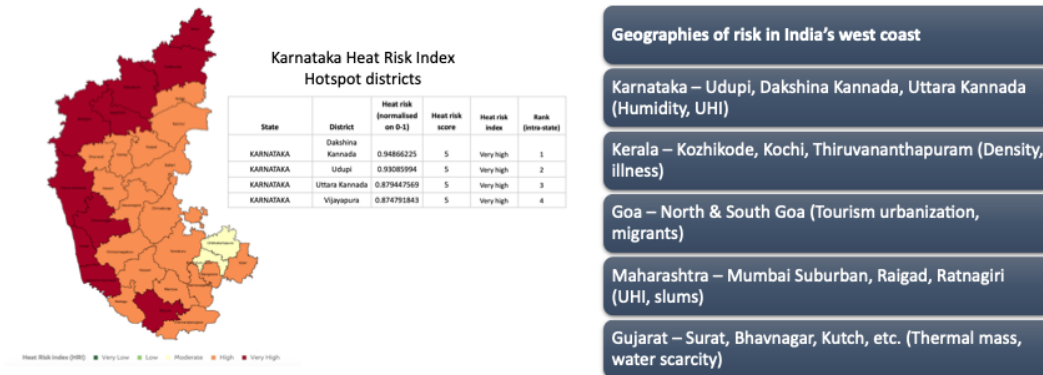
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## Coastal vulnerabilities

Humidity increases perceived temperature by 3–5°C

70% districts: ≥5 extra warm nights

Humidity increases perceived temperature by 3–5°C



Source: Council on Energy, Environment and Water (CEEW) Report 2025

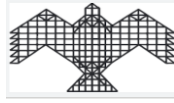
Figure 2. Heat Risk Index – Hotspot coastal districts of Karnataka (Source: CEEW 2025)

### Key Scientific Findings

- 1. Rising Humid-Heat Days:** Under a moderate pathway (SSP2-4.5), the number of days with Heat Index  $\geq 32$  °C may rise from  $\sim 20$  days/year today to 40–50 days by 2050. Under high emissions (SSP5-8.5), that number could reach 70–80 days/year by 2100.
- 2. Hotter Nights, Weaker Relief:** Night-time minimum temperatures are increasing faster than daytime highs. The frequency of “very warm nights” could triple, leaving no recovery time for human bodies.
- 3. Compound Heat Extremes:** Consecutive hot-day + hot-night events may rise by 30–40 %, magnifying health impacts.
- 4. Sea-Breeze Variability:** CMIP6 shows that under stagnant wind conditions, the coastal breeze may weaken, causing heat to build locally rather than disperse.

### The Invisible Heat Mechanism

There is a difference between apparent temperature (felt) and dry bulb temperature, which is invisible heat (Figure 3). Dry bulb temperature incorporates humidity and is a better indicator of heat-related health risks. There is a process of coastal heat feedback loop that results from rising temperature leading to trapped urban heat and finally high humidity and weak night



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cooling (Figure 4). An early warning system for heat-related illness needs to consider dry bulb temperature to be effective.

On the same day that inland Mysuru records 40 °C and dry discomfort, coastal Mangaluru might record 34 °C with 80 % humidity — yet the “felt” temperature exceeds 45 °C. This Heat Index reflects how humidity limits the body’s ability to cool through sweat evaporation.

At night, high moisture acts like a blanket, trapping heat near the surface. The human body never truly cools down, especially in poorly ventilated housing or fishing villages. The result: fatigue, sleep disruption, and slow erosion of health and productivity.

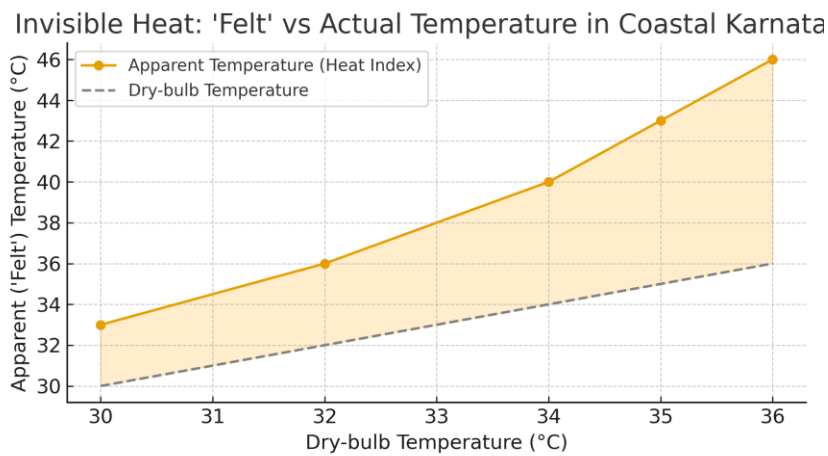


Figure 3. Heat Index vis-à-vis dry-bulb temperature representing invisible heat.

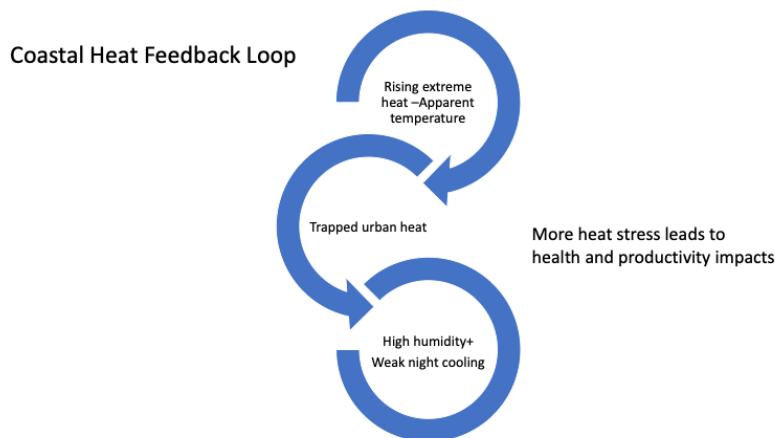
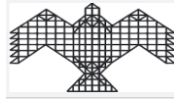


Figure 4. Heat Risk Index – Hotspot coastal districts of Karnataka (Source: CEEW 2025)



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### *From Climate Data to Human Impact*

1. **Public Health:** Hospitals report rising heat-related dehydration, hypertension, and cardiac stress, especially among outdoor workers and the elderly.
2. **Labour Productivity:** Occupational models linked to CMIP6 data project 30–40 % productivity losses in peak humid months. Fisherfolk, dock workers, construction labourers, and informal vendors bear the brunt.
3. **Energy & Infrastructure:** As night-time cooling demand rises, electricity consumption spikes. Local grids face stress, and poorer households struggle with higher bills or limited access.
4. **Urban Heat & Inequality:** Urban expansion in Mangaluru, Udupi, and Karwar traps heat between concrete walls. Informal settlements — often tin-roofed and unventilated — experience the highest indoor temperatures.

### CMIP6 Projection Snapshot — Coastal Karnataka

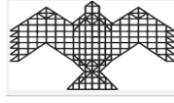
Timeframe	Scenario	Humid-Heat Days (HI $\geq 32^\circ\text{C}$ )	Key Implication
2000–2020	Historical	~20 days/year	Sporadic discomfort
2041–2070	SSP2- 4.5	~40–50 days/year	Health systems under strain
2071–2100	SSP5- 8.5	~70–80 days/year	Chronic heat stress; economic losses

Despite these trends, formal heat-wave alerts still rely on air temperature alone. This underestimates coastal risk where the Heat Index, not the thermometer, determines danger. Policymakers cannot manage what they cannot measure.

### **The interventions**

Data correlating the heat index directly to specific health ailments is essential for creating more effective early warning systems that move beyond generic discomfort alerts. While the heat index already accounts for temperature and humidity, precise epidemiological data linking various heat index levels to different illness types—such as renal, cardiovascular, or heat stroke cases—is lacking.

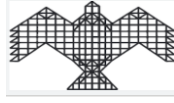
### *Turning Science into Action*



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1. Collect detailed information to allow health officials to establish more accurate, location-specific alert thresholds and prioritize targeted interventions for vulnerable populations, ultimately enabling more proactive, life-saving public health responses.
2. Modernise Early Warning Systems: Integrate Heat Index and Wet-Bulb Globe Temperature (WBGT) into alerts, covering hot nights and compound heat events.
3. Plan Cities for Thermal Comfort: Add ventilation corridors, reflective roofs, and tree cover in city plans. Prioritise heat-resilient housing in fishing communities.
4. Protect Workers & Livelihoods: Mandate heat-safe work schedules, rest breaks, and hydration zones, with mobile alerts linked to Heat Index thresholds.
5. Use CMIP6 Data for Local Planning: Downscale CMIP6 data for district-level heat mapping, integrating findings into DDMPs and Heat Action Plans.
6. Invest in Cooling Infrastructure: Promote community cooling centres, shaded public spaces, and passive cooling technologies.

The coast that once cooled Karnataka is warning it now. CMIP6 models have made the invisible visible — revealing how humidity, night-time heat, and urbanisation converge to create a silent public-health emergency. Policymakers must now view the coast not as geography but as a frontline of adaptation. If acted upon today, this science can help build resilience; if ignored, comfort will turn into crisis.



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