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Future Projection of Temperature & Humidex indices over Coastal District of Odisha

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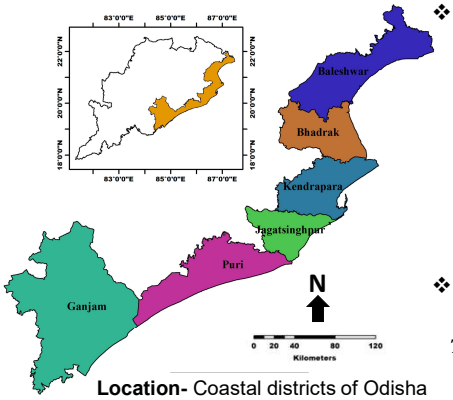
Introduction and Objective

- Climate change is a global challenge, with rising temperatures affecting ecosystems, weather patterns, and human livelihoods.
- Regional climate models (RCMs) offer vital localized projections for adaptation and mitigation.
- Coastal Odisha, highly vulnerable to extreme weather, faces significant future warming.
- This study assesses spatial and temporal variations in temperature and heat stress indices, providing key insights for climate resilience.

Data and Study Area

- **Dataset:** CORDEX South Asia Regional Climate Model (RCM)
- **Period:** Historical (1951–2005) & Future (2006–2100)
- **Scenarios:** RCP 4.5 & RCP 8.5
- **Variables Used:**
  - Near-Surface Air Temperature(**tas**)
  - Daily Maximum Temperature(**Tasmax**)
  - 2m Mean Relative Humidity (**hurs**)
- **Data Source:** Earth System Grid Federation (ESGF)



Location- Coastal districts of Odisha

Methodology

❖ **Temperature:**

- Temperature data for each blocks of coastal district were extracted.
- Interannual variations and temperature anomalies, and spatial distribution maps for the years 2020, 2050, and 2100 were generated.
- The annual mean temperature and anomaly trends are analyzed.
- Future temperature extremes and their implications for Odisha's coastal climate were assesed.

❖ **Humidex stress-index (HIS):**

$$HX = T_a + \frac{5}{9}(\rho - 10); \quad \rho = 6.112 \times 10^{7.5 \times T_a/(237.7+T_a)} \times \frac{RH}{100}$$

$T_a = Air\ temperature, \quad \rho = vapour\ pressure\ of\ water(hpa)$

- No of days of a year crossed the threshold value, were assessed based on HSI.

Results and Discussion

❖ Projected warming by 2100- **RCP4.5:** $+1.76$℃ , **RCP8.5:** $+4.1$℃

❖ **Puri**: Highiest temp. increase **Balasore**: Least affected

❖ **Western inland regions (Ganjam & Balasore):** Lower temperatures than coastal areas

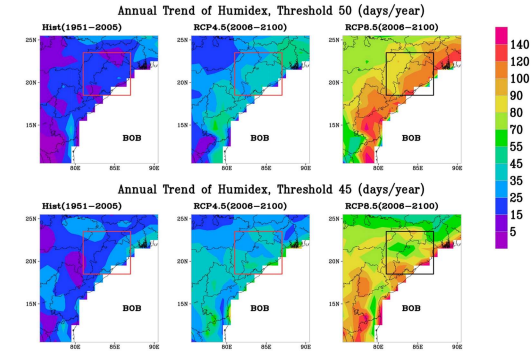
❖ Peak deviations of Temp. Anomaly: 2074 (RCP 4.5), 2098 (RCP 8.5)

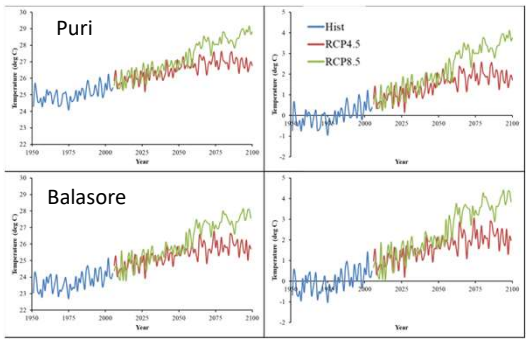
❖ **Extreme Heat Days:**

•**Historical:** More moderate heat days (**TH40**) in coastal regions, but fewer extreme heat days (**TH50**) than inland areas

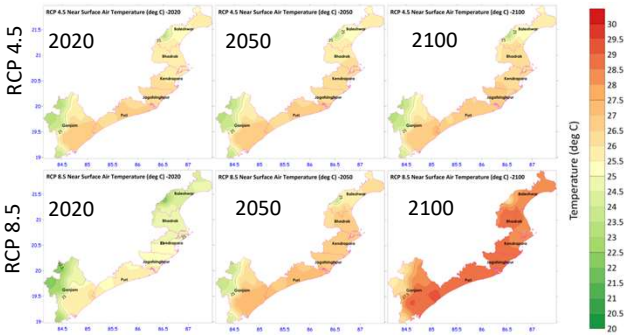
•**Future Projections:** Coastal regions show a **stronger increase** in extreme heat days (**TH45 & TH50**) than inland areas

•**RCP 8.5:** Significant rise in heat stress, increasing risks to **human health, agriculture, and climate adaptation efforts**





Variation of surface air temperature (left) and its anomaly (right)



Spatial distribution of temperature (deg C) across the coastal districts of Odisha under RCP 4.5(upper) and RCP 8.5(lower)

Temperature Ranges

District	RCP 4.5			RCP 8.5		
	2020	2050	2100	2020	2050	2100
Balasore	23.0-25.9	23.2-25.9	23.1-26.2	21.9-24.7	23.4-26.5	25.8-28.5
Bhadrak	25.7-25.9	25.8-26.0	25.9-26.2	24.5-24.9	26.2-26.6	28.4-28.5
Kendrapada	25.9-26.3	26.1-26.4	26.3-26.6	24.9-25.4	26.6-26.9	28.4-28.7
Jagatsinghpur	26.0-26.3	26.3-26.4	26.5-26.6	25.3-25.4	26.7-26.9	28.5-28.7
Puri	26.2-26.6	26.1-26.8	26.4-26.9	25.1-25.9	26.7-27.1	28.5-28.9
Ganjam	23.4-26.8	23.6-26.8	23.6-27.0	22.4-26.0	23.8-27.4	26.0-29.0

Conclusion

This study highlights increasing temperature and heat stress in Odisha's coastal districts, with greater vulnerability under RCP 8.5. Rising temperature and humidity levels will intensify risks to health, agriculture, and infrastructure, emphasizing the need for climate-resilient policies, heat warning systems, and adaptation strategies.

References

- Krishnan, R., Sanjay, J., Gnanaseelan, C., Mujumdar, M., Kulkarni, A., & Chakraborty, S. (2020). *Assessment of Climate Change over the Indian Region: A Report of the Ministry of Earth Sciences (MOES), Government of India*. Springer Nature.
- Diaconescu, E., Sankare, H., Chow, K., Murdock, T.Q. and Cannon, A.J., 2023. A short note on the use of daily climate data to calculate Humidex heat-stress indices. *International Journal of Climatology*, *43*(2), pp.837-849.
- NASA Earth Observatory. *Global Temperature Trends.* Retrieved from https://earthobservatory.nasa.gov/world-of-change/global-temperatures
- Kumar, T. S., Mahendra, R. S., Nayak, S., Radhakrishnan, K., & Sahu, K. C. (2010). Coastal vulnerability assessment for Orissa State, east coast of India. *Journal of Coastal Research, 26*(3), 523-534.