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### Assessment of Thunderstorms and Hailstorms Events in Jharkhand, India: Merging Ground Observations with WRF-ARW Simulations

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### Introduction

- Jharkhand is one of the Eastern Indian states that faces the wrath of premonsoon thunderstorms known as the "Kaal Baisakhis" or the Nor'westers.
- These extreme events are frequent in the months of March to May.
  Extreme thunder and hailstorm events in Eastern India, present challenges, and wide range of societal implications.



## Objectives

 Two extreme events a thunderstorm and a hailstorm in were simulated using the regional WRF-ARW model and ground observations.

### **Materials & Methods**



#### Fig 2: Case #1 Hailstorm Event in AOI



#### Fig 1: Area of Interest

- WRF-ARW version 3.9 was utilized for the simulation.
- Ground observation collected at micrometeorological tower at BIT Mesra, Ranchi, India.

## **Results and Discussion**

- Wind Circulation & Temperature:
- Both cases (Hailstorm in May 2009 and Thunderstorm in May 2010) depicted the WRF model accurately represented wind circulation patterns.
- Near-surface temperatures simulated by the model before and after the storm events in both cases were consistent with observational data.
   Heat Fluxes & Geopotential Heights:
   In both cases, sensible and latent heat fluxes decreased considerably poststorm, corroborating with observational data.



Fig 4: Case #1 Hailstorm Event Simulation

# **Results and Discussion**

- Geopotential heights also decreased before the onset of storms and increased afterward, aligning with observational insights.
- Turbulent Kinetic Energy (TKE) & Planetary Boundary Layer (PBL) Height:
- Both cases showed maximum variations in TKE and PBL height around the storm events, with the PBL



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Fig 5: Case #2 Thunderstorm Event Simulation

## Conclusion

- The model accurately portrayed most surface parameters, planetary boundary layer and geopotential height, except TKE values in the 2nd case.
- Further research is needed, integrating ground station observations with satellite and model data.
- WRF-ARW is a viable regional climate model for studying extreme events in

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height dipping to indicate stormy conditions. The model value for TKE in the 2<sup>nd</sup> case was considerably lower than the observed value.

#### > Consistency Across Parameters:

 Sensible heat, latent heat, and potential temperature depicted similar values in simulations across all days in the 2<sup>nd</sup> case, indicating the model's general reliability.

Eastern India.

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