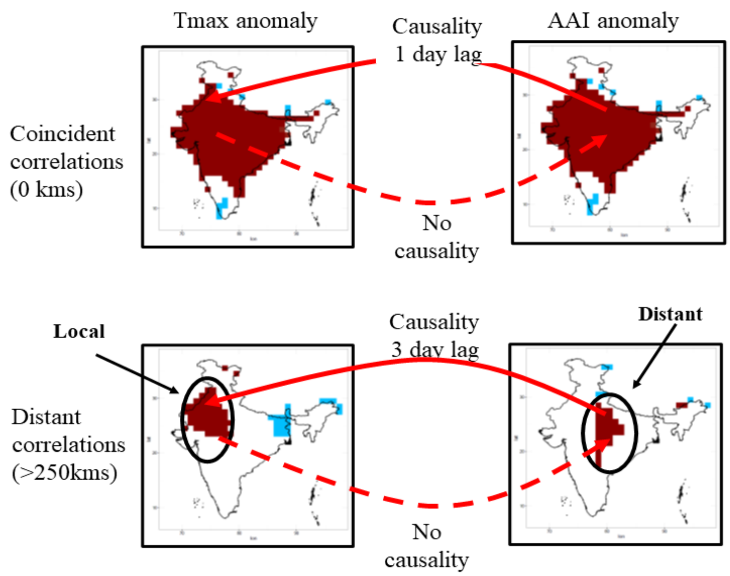
NCAP-COALESCE
CarbOnaceous AerosoL Emissions, Source apportionment & ClimatE impacts
Understanding scientific complexities related to carbonaceous aerosols focussing on issues underlying their origin and fate, and their role as drivers of regional climate change over India.

Research BRIEFS

Local and remote co-variability of absorbing aerosols and temperature maxima over India.

Prashant Dave, Mani Bhushan, Chandra Venkataraman



- Tmax cluster (Local region) matches with Ratnam et al. (2016) box used for studying heat waves.
- Using cluster average, causality of upto 3-days was found from AAI anomaly (Non-local region) to Tmax anomaly (Local region)
- If causality exits at multiple lags, lag with maximum lagged correlation was selected for the analysis.
- **Non-local aerosols** play role in affecting distant temperature.
- Plays prominent role in effecting extreme heat events.

Key highlights:

- Temperature maxima in northwest India correlate with absorbing aerosol abundance.
- Absorbing aerosols enhance local and non-local temperature maxima.
- The is a causal link between absorbing aerosols loading and temperature maxima enhancement.
- The effect lasts over a period of 1–11 days.
- Absorbing aerosols exacerbates the exacerbate conditions.

Summary:

The goal of the work was to understand the relationship between absorbing aerosols and summer time maximum temperature and temperature extremes in north-west India. Previous modelling studies infer that positive trend in extreme temperature in India are masked significantly by cooling due to blocking of sunlight blocking or due to increased evapotranspiration resulting from extensive irrigation (Purnadurga et al., 2018). In the current study, statistical tools were applied to long term (1979–2013) satellite and ground based observations, to evaluate the relationship of absorbing aerosols and temperature maxima in north-west India. Here, we found that regional absorbing aerosols in the north-west (AAI-NW) and central-India (AAI-CI) show co-variability with Tmax in north-west India, implying both local and non-local heating effects of absorbing aerosols. The non-local effect of AAI-CI on Tmax-NW showed co-variability with a lag of 1–8 days. The effects persisted on seasonal and heat-wave event scales, becoming stronger on heatwave days. Causal effects of AAI-NW on Tmax-NW were identified with a lag of 1–11 days, across multiple years, thereby implying absorbing aerosol influence heatwave events.

While absorbing aerosols exerting a purely local effect could lead either to surface cooling or heating, based on altitude of aerosol layers, this work suggests that cumulative non-local and local effects, bear a causal relationship to temperature enhancement in the Indian northwest.

Given the recent increase in intensity and frequency of northwest India heatwave events (Rohini et al., 2016) along with increasing trends in anthropogenic emissions over India (Ohara et al., 2007), the current findings have significant implications for action on adaptation and mitigation measures concerning heatwave events. Moreover, findings necessitate a coordinate climate and air-quality action on regional scales.

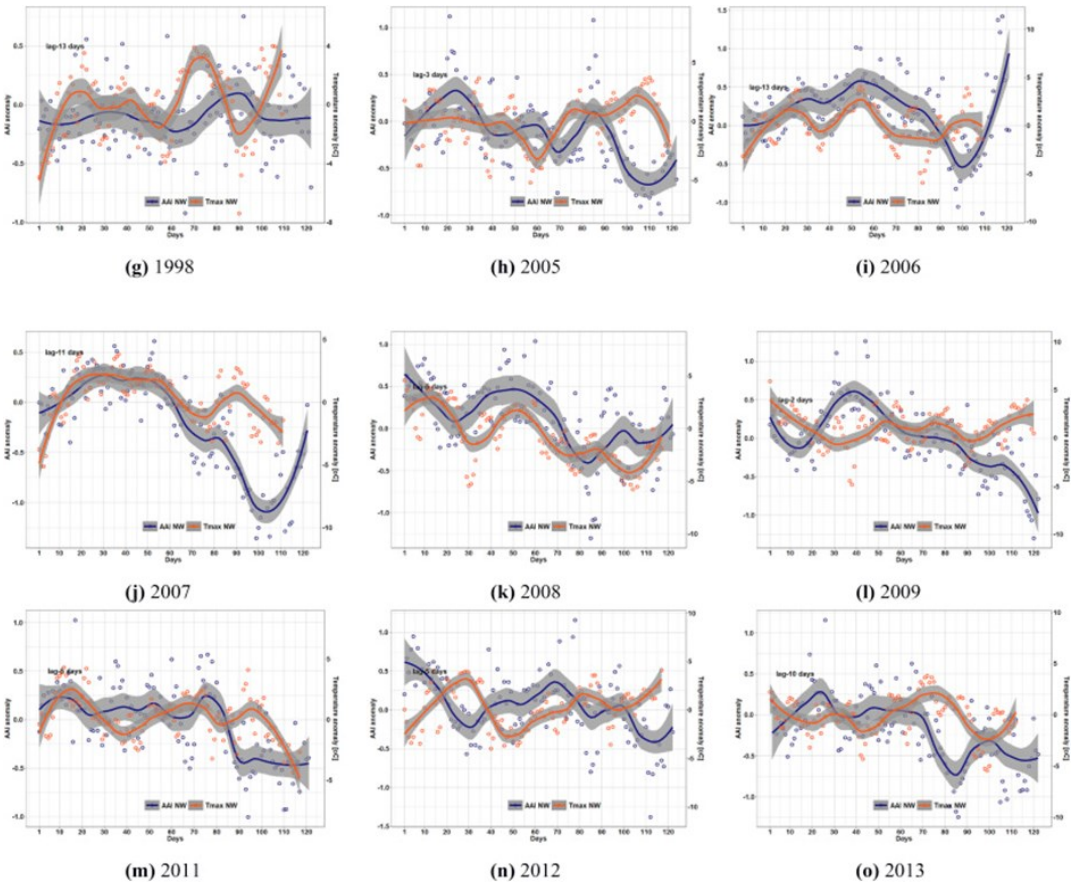


Figure 1. Spatially averaged temporal plot of AAI-NW (red color) and Tmax-NW (blue color) for years with causality from AAI-NW to Tmax-NW. The Tmax-NW values are shifted as per the lag identified using causality analysis. The smoothed curves are generated using loess method with span of 0.75 and the grey region depicts 95% confidence interval.

Major findings :

- Regional absorbing aerosols in the north-west (AAI-NW) and central-India (AAI-CI) showed co-variability with Tmax in north-west India.
- The non-local effect of AAI-CI on Tmax-NW showed co-variability with a lag of 1–8 days.
- Causal effects of AAI-NW on Tmax-NW were identified with a lag of 1–11 days, across multiple years, thereby implying absorbing aerosol influence heatwave events.
- The effects persisted on seasonal and heatwave event scales, becoming stronger on heatwave days.

Research Article

Citation

Absorbing aerosols induced local and remote variability of Temperature maxima: An observation based study. P. Dave, M. Bhushan, C. Venkataraman, 223, 11237, Atmospheric Environment, 2020

Link:https://doi.org/10.1016/j.atmosenv.2019.117237

Contact

Prof. Chandra Venkataraman

National Co-ordinator

(NCAP-COALESCE Project)
Interdisciplinary Programme in Climate Studies

Indian Institute of Technology, Bombay Powai, Mumbai-400076, India

Phone: 91-22-2576-5141

https://ncapcoalesce.iitb.ac.in/

Consortium partners in the NCAP-COALESCE network