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

Evaluating cloud properties over India: COALESCE intercomparison of regional climate models and sensitivity to aerosol feedback effects

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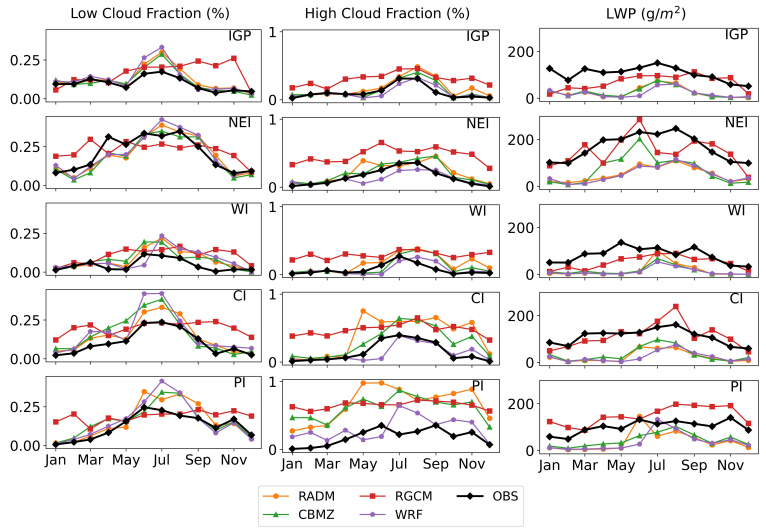

Figure 1: Temporal variations of monthly satellite observation vs. simulated low-level cloud fraction (%), high-level cloud fraction (%), and liquid water path (g/m2; LWP) averaged over five regions (IGP, NEI, WI, CI, PI)

Key highlights:

- Regional chemistry transport models over India adequately simulate the seasonal and spatial variability of clouds.
- Simulated cloud fraction (bias<30%), cloud radiative effects (bias<11%) with greater accuracy than cloud condensate mass (bias~-60%)
- Aerosol feedback effects increase the cloud mediated cooling through a microphysical pathways.

Summary of your Research:

Clouds in the atmosphere play a crucial role in regulating the surface temperature and energy balances of the earth's system. The numerical modelling of clouds has difficulty in accurate prediction and interaction with pollution particles which act as a substrate for cloud formation. In this work, numerical models with a different set of governing equations are used to understand the cloud predictability problem. The numerical models sufficiently predicted cloud-induced cooling of the earth system, frequency of cloud occurence, and amount of clouds over India. Quantifying the model performance revealed deficiencies in aerosol abundance predicted by the models, problems with the

model physics and the representation of the interactions between the clouds and pollution particles. To address the interactions between pollution and clouds, additional simulations were analyzed which showed suppressed cloud occurrence leading to increased warming through a radiation pathway. The pollution particle's ability to act as the substrate for cloud formation revealed more cloud occurrences in the presence of pollution which could lead to cooling. Here we find that a complete representation of the above-described interaction processes between pollution and clouds will lead to better cloud prediction and a better insight into cloud-mediated cooling in the future climate.

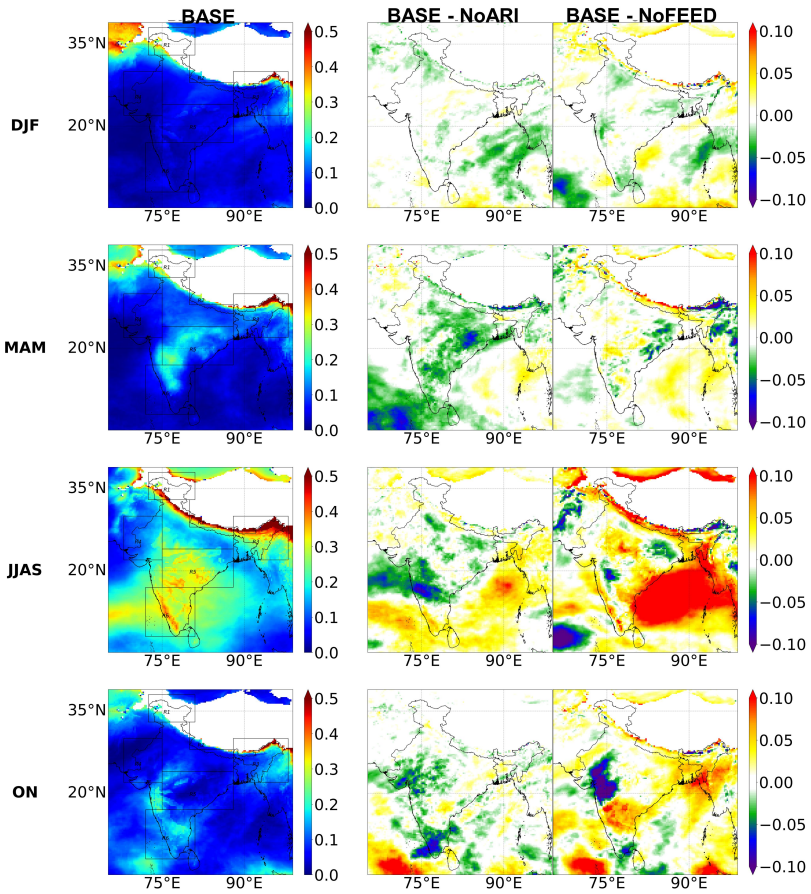

Figure: Aerosol feedback effects on low-level cloud fraction. Low-level CF is shown for all four seasons (DJF, MAM, JJAS and ON) for seasonal average (left panels), aerosol radiative feedbacks (ARI; middle panels; calculated as the difference betwen BASE and NoARI experiments), and aerosol total feedback effects (ARI+ACI; calculated as the difference between BASE and NoFEED experiments)

Take away/conclusion :

A comprehensive operational evaluation of the clouds, moisture and radiation is performed on the three regional climate models. Regional chemistry transport models over India adequately simulate the seasonal and spatial variability of clouds. Simulated cloud fraction (bias<30%), cloud radiative effects (bias<11%) with greater accuracy than cloud condensate mass (bias~-60%). Sensitivity simulations show a radiative mediated warming and aerosol-cloud interaction mediated cooling.

Research Article citation

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