Research BRIEFS

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.

Sensitivity of Carbonaceous Aerosol Properties to the Implementation of a Dynamic Aging Parameterization in the Regional Climate Model RegCM

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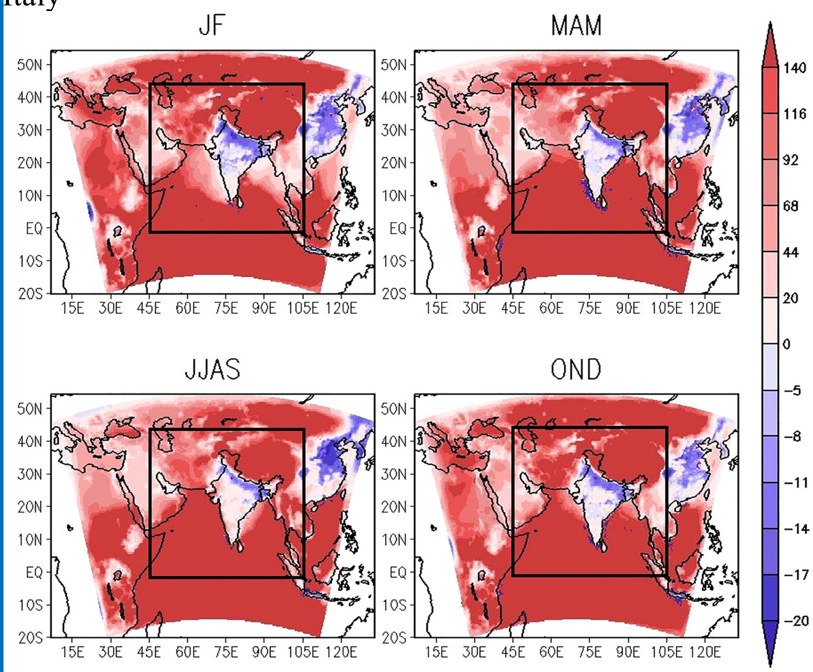

Seasonal variation of aging timescale anomaly (in h) of carbonaceous aerosols at 1,000 hPa w.r.t the fixed aging timescale of 27.6 h (1.15 days). The upper level of the color scale bar has been capped at 140 h (i.e., the aging time scale is [27.6 + 140] h = 167.6 h or 7 days), and the lower limit has been capped at −20 h (i.e., the aging time scale is (27.6−20) h = 7.6 h).

Key highlights:

- Hydrophobic black carbon (BC) is converted to hydrophilic BC in <10 h in the polluted Indo-Gangetic Plain as opposed to default 27.6 h in RegCM
- BC concentration increases in the dry season due to the dynamic aging, but reduces in the wet season due to an efficient washout
- Surface dimming increases due to the implementation of the dynamic aging scheme

Summary of your Research:

To understand the impacts of aerosols on air quality and climate, the models need to have a better representation of aerosol processes. One such example is the representation of soot, emitted from fossil-fuel and biomass burning. Many climate models consider soot to be hydrophobic and keep its optical properties constant. However, in reality, this is not true. In this work, we implement the transformation of soot properties in the atmosphere in a regional climate model, RegCM. We found that the soot is converted to hygroscopic in only <10 h in the polluted regions of India relative to a fixed 27.6 h. We discuss the implication of incorporation of such transformation in terms of the changes in aerosol loading, mass concentration, and radiative forcing over the Indian Subcontinent.

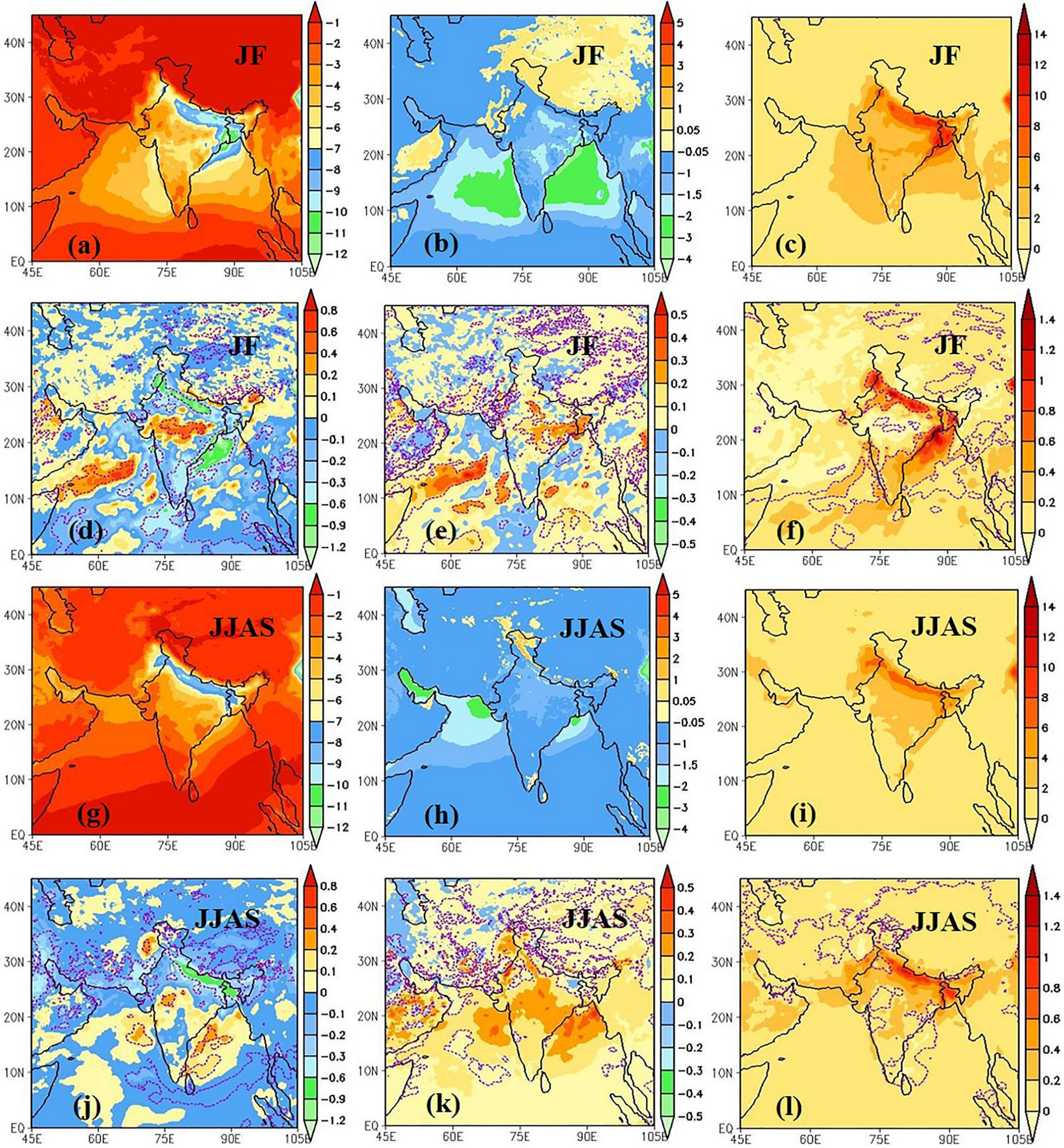

Figure: Mean surface shortwave radiative forcing (W m−2) in Expt_dyn and corresponding changes w.r.t Expt_fix for winter (a and d) and monsoon (g and j), mean top of the atmosphere aerosol shortwave forcing (W m−2) in Expt_dyn and corresponding changes w.r.t Expt_fix for winter (b and e) and monsoon (h and k) and mean atmospheric heating (W m−2) in Expt_dyn and corresponding changes w.r.t Expt_fix for winter (c and f) and monsoon (i and l).

Take away/conclusion :

The implementation of the new aging scheme converts the hydrophobic BC to the hydrophilic BC over polluted regions several hours faster (e.g., smaller than 10 h in the IGB) than the default value of 27.5 h used in the standard version of the model. Conversely, this conversion is slower by several hours than the default value in less polluted regions

The atmospheric heating increases by more than 1.2 W m−2 in the polluted IGB primarily due to a larger dimming when the dynamic aging scheme is implemented, while TOA forcing remains more or less unchanged

A regionally specific inventory might provide a more detailed description of local emissions and improve the overall agreement of simulated and observed BC and OC concentrations

Research Article citation

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