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.*

# Assessment of the impact of atmospheric aerosols and meteorological data assimilation on simulation of the weather over India during summer 2015

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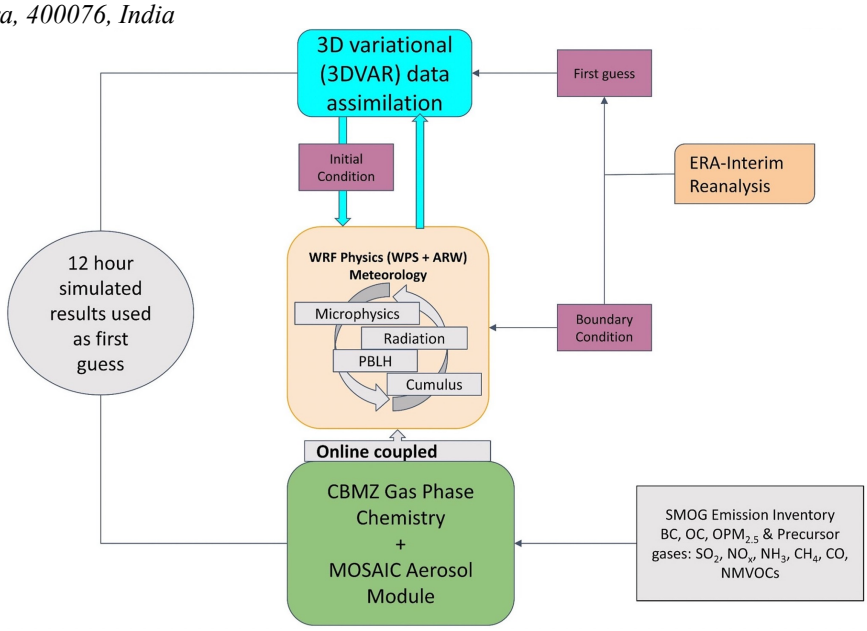


## *Key highlights:*

- 3DVARDA helped improve WRFChem simulated radiation and meteorology over India
- WRFChem/WRFChem DA captured aerosol-radiation-meteorology interactions over India
- These interactions were more intense over high-aerosol loading regions like the IGP
- Inclusion of aerosols in WRF caused greater disagreements with observed meteorology

## *Summary of your Research:*

The Weather Research and Forecasting Model - Chemistry (WRF-Chem) was used to assess the effects of aerosols on radiation and meteorology at the surface. Three sets of simulations including WRFChem without meteorological data assimilation (WRFChemCntrl), WRFChem with meteorological data assimilation (WRFChemDA) and WRF only with meteorological data assimilation (WRFDA) were performed over the south Asian domain for the summer season (March–May) of 2015. Regional reanalysis using 12 hourly cyclic 3-dimensional variational meteorological data assimilations (3DVAR-DA) techniques, a unique effort over the Indian region was developed.

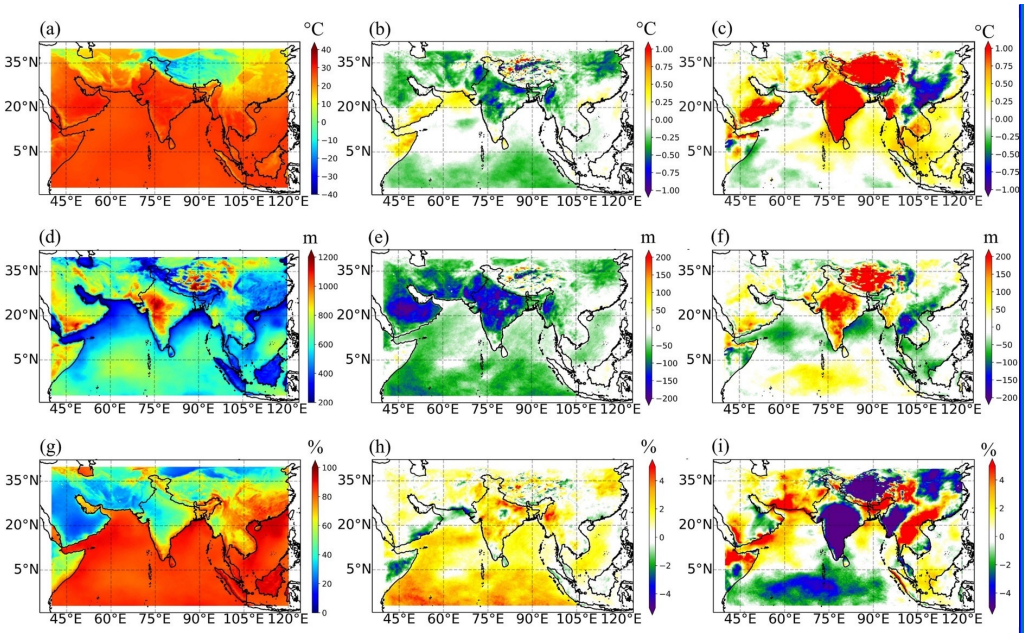


Figure: Seasonal mean SWDNB (W/m²) at the surface from (a) WRFChemDA simulations and difference of SWDNB between two simulations i.e. (b) WRFChemDA - WRFDA and (c) WRFChemDA - WRFChemCntrl. LWUPB (W/m²) at the surface from (d) WRFChemDA simulation and the difference of LWUPB between two simulations i.e. (e) WRFChemDA - WRFDA and (f) WRFChemDA – WRFChemCntrl. Similarly, RH2 (%) from (g) WRFChemDA and the difference between two simulations i.e. (h) WRFChemDA - WRFDA and (i) WRFChemDA – WRFChemCntrl.

Results from all the simulations were evaluated over India, including 5-sub regions, against the gridded observations available over the study domain. The model was able to reproduce incoming shortwave radiation at the surface (SWDNB), outgoing longwave radiation at the surface (LWUPB), 2-m temperature (T2), planetary boundary layer height (PBLH), 2-m relative humidity (RH2) and aerosol optical depth (AOD) reasonably well over the Indian landmass. Model output parameters between WRFDA and WRFChemDA simulations suggested that because of the effects of aerosols, reductions in SWDNB (~10–60 W/m²), LWUPB (~5–20 W/m²), T2 (~0.10–0.60 °C) and PBLH (~50–125 m) were observed over the Indian domain.

***Take away/conclusion :***

- 3DVAR meteorological data assimilation when implemented in WRFChemCntrl helped improve model simulated results
- The inclusion of aerosols in WRF simulations improved the prediction of surface radiation (SWDNB and LWUPB) but degraded predictions of T2, PBLH and RH2 over India
- Sensitivity simulations altering the input aerosol information to the model and utilizing different chemical mechanisms are required to understand better the performance of the model for meteorological variables
- Inclusion of meteorological DA in WRFChemCntrl simulations (i.e. WRFChemDA) improves model simulated radiation and meteorological variables for a given set-up over most of India

Research Article citation

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