Interactions between Asian air pollution and monsoon system: South Asia (ROSES-2014 AMAP)

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1. INTRODUCTION

Asia’s rapid economic growth over the past several decades has brought a remarkable increase in air pollution levels in South Asia. High concentrations of aerosols (also known as particulate matter or PM) from pollution sources pose major health hazards to this highly populated region. How do pollution and dust aerosols interact with the monsoon circulation and rainfall via scattering and absorbing solar radiation, changing the atmospheric heating rates, and modifying the cloud properties? This study investigates the worsening air quality problem in South Asia by focusing on the interactions between pollution and South Asian monsoon, not merely focusing on the increase of pollutant emissions.

2. OBJECTIVES

Specifically, this work assessed the impact of aerosol-cloud-radiation (ACR) interactions on Indian regional PM2.5 using the NASA Unified Weather Research and Forecasting modeling system (NU-WRF).

3. METHODS

- We conducted a series of regional model experiments using NU-WRF regional model with coupled aerosol-chemistry-radiation-microphysics processes over South Asia (5km) for winter (January), pre-monsoon (April), and monsoon seasons (July) in 2010.

4. RESULTS

- Overall, NU-WRF can capture the spatial distribution in all seasons except for in January, high in northern India and low in other region.
- Kanpur: low bias in Jan and Apr and high bias in July.
- Lahore and Pokhara: low bias in all months

5. CONCLUSIONS

- In northern India where heavy pollutions are found, the ACR interaction profoundly reduces planetary boundary layer (PBLH) in Jan. and Apr. (up to ~111.3 m, ~13% of reference run), while slightly enhances PBLH (0.9 m; 0.3%) in July.
- The result of PM2.5_DRY are consistent with that of PBLH. In northern India, the PM2.5_DRY is enhanced in Jan. and Apr. (about 3 ug m^-3, 4% of the reference run), but slightly reduced in Jul. (about 0.6 ug m^-3, 2%).
- The effect of AR is to reduce PBLH and enhance PM2.5 in northern India, opposite to those of AC. AR is the dominant factor of the overall ACR in Jan. and Apr., while AC dominates in Jul. The similar results are found in central India but in different degree.
- Altogether through the ACR interaction, aerosol can affect the PBLH structure and the local/regional weather pattern including wind, which can subsequently impact PM2.5 and thus air quality.

REFERENCES


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