Recent Increase in Winter Hazy Days over Central India and the Arabian Sea

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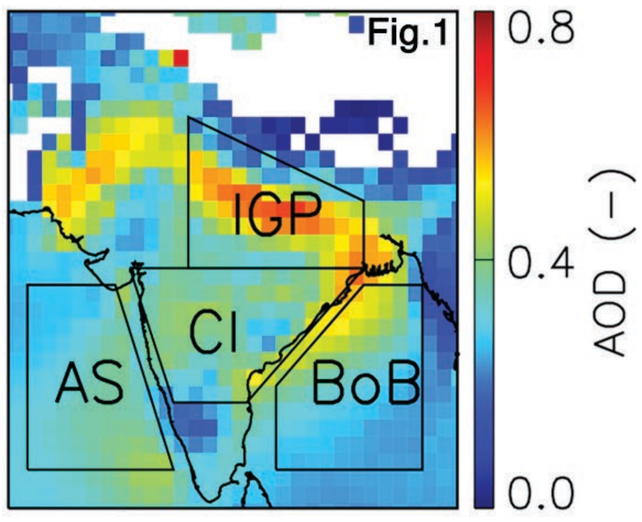
Introduction

• The Indian subcontinent is greatly vulnerable to air pollution, especially during winter.

• Recent studies showed the increasing trend in aerosol loading over India [*e.g. Babu et al., 2013; Srivastava, 2017*], particularly for Indo-Gangetic Plain (IGP), which can reduce radiation reaching to the surface by about 25%, thereby decreasing crop yield[*Burney & Ramanathan, 2014*].

• Here, we estimate the trend in number of hazy days (i.e. days with high aerosol loading) and aerosols radiation feedback on surface-atmosphere system, using 15 years (2003-2013) of satellite data.

Methodology



• The study region bounded by 7°-38°N and 66°-94°E, which is divided into four sub-regions viz., Indo-Gangetic Plain, Central India, Arabian Sea and Bay of Bengal (Fig.1.)

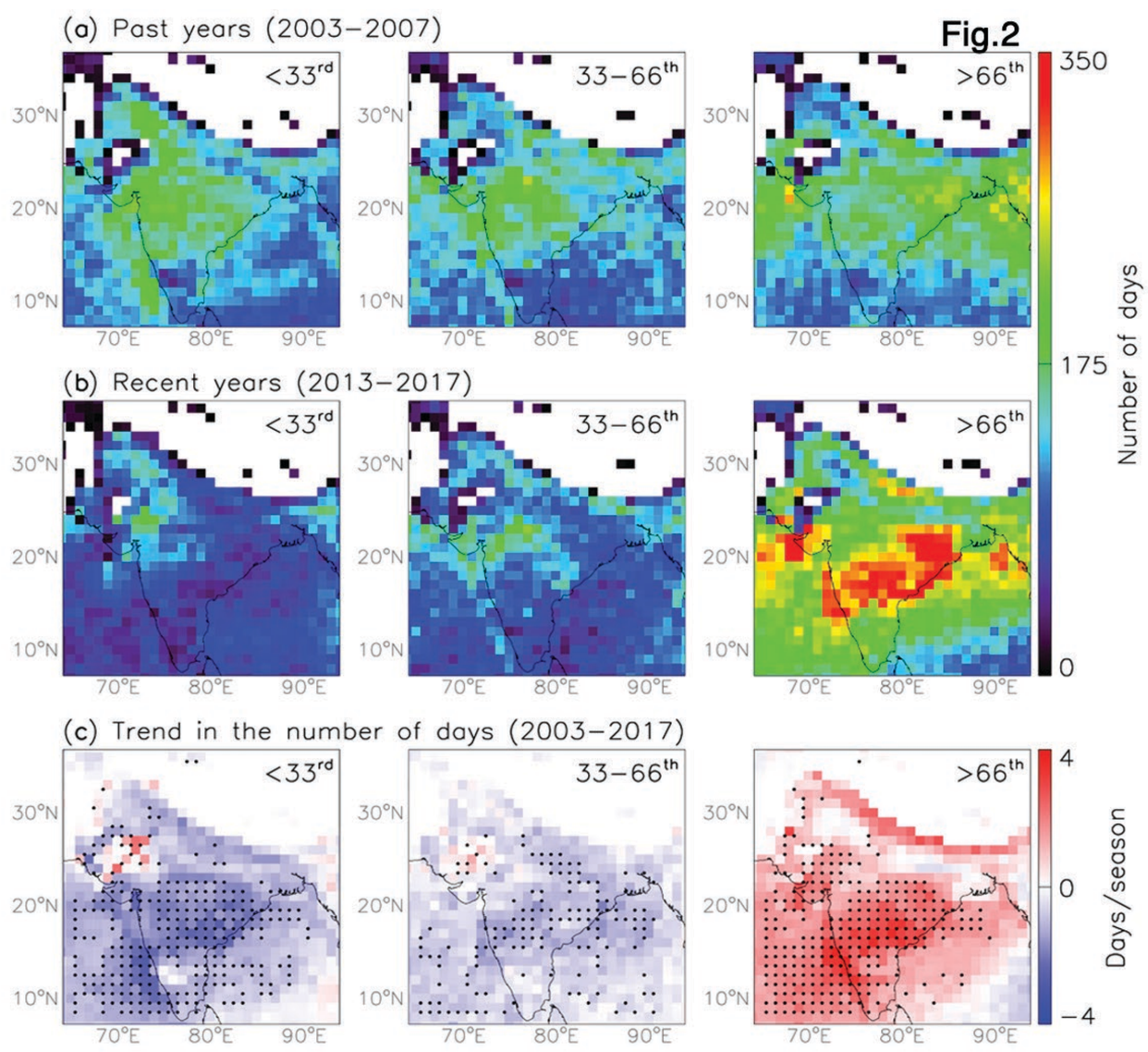
• Satellite and model reanalysis data are used at daily resolution for the dry winter season (Nov.-Feb.)

• The study period is split into the past (2003-07) and the recent (2013-17) years.

Trend in the Number of Hazy days

• AOD observations are split into three regimes; low (AOD <33rd percentile value of AOD), medium (33-66th) and high (>66th) based on the year 2003. Then, the number of days falling in each of these regimes, for the past and the recent years, are counted and plotted in Fig.2(a-b).

• Fig. 2(c) shows the trend in the number of days for each aerosol regime.



• The number of days with high aerosol loading is increasing at a higher rate over Central India than other regions.

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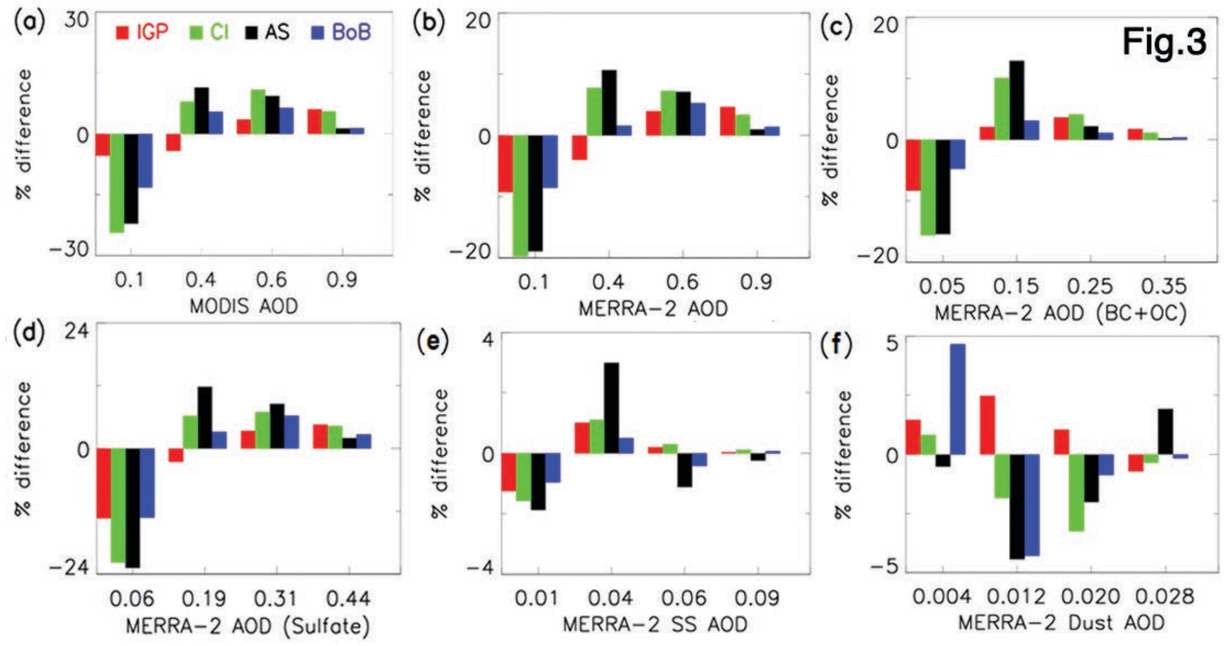
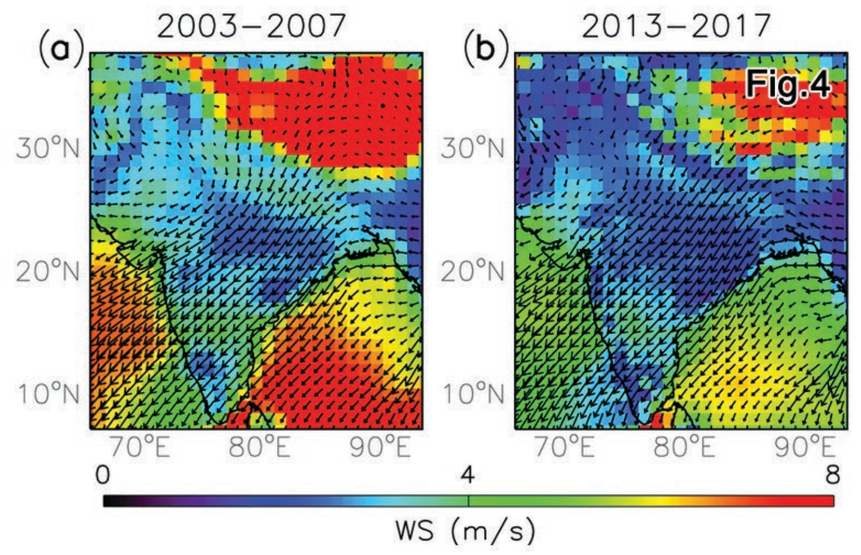


• The intensity-frequency variability for MODIS AOD and MERRA-2 composite AOD are comparable and shows a decreasing frequency of low aerosol loading (AOD bin of 0.1) and an increasing frequency of medium to high aerosol loading (AOD bin >0.4).

• Anthropogenic aerosols like BC+OC and sulfate shows similar pattern.

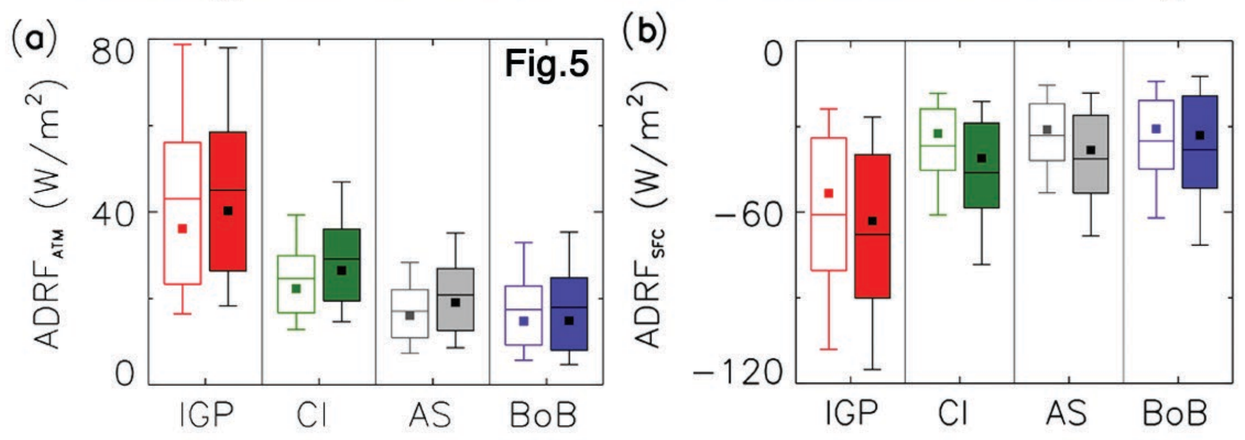
• The changes in intensity-frequency is higher over CI than IGP and also, the AS has greater difference than the BoB.

• The contribution of transported/natural aerosols is negligible.



• The predominately northeasterly flow during the winter season leads to higher aerosol loading over the AS than the BoB (Fig.4).

Change in Aerosol Direct Radiative Forcing



• Aerosol-induced atmospheric warming (4.50 W/m^2) and surface cooling (-9.44 W/m^2) is highest over CI as compared to other study regions in the recent years.

Conclusions

• High aerosol loading is observed over IGP than other regions, but he aerosol buildup rate over Central India has escalated greatly in the recent years

• Overall, aerosol loading over India and adjoining Seas is increasing and the number of hazy days is increasing at the rate of about 2 days/season over India, with a higher rate over CI (~2.6 days/season) than over IGP (~1.7 days/season).

• Aerosols exert about two-fold higher atmospheric warming over Central than over IGP, and about seven times higher over the Arabian Sea than the Bay of Bengal.

References:
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Srivastava, R, *J. Climatol.*, **37**, 2017.
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