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Interactive comment on "Assessment of Regional Aerosol Radiative Effects under SWAAMI Campaign – PART 2: Clear-sky Direct Shortwave Radiative Forcing using Multi-year Assimilated Data" *by* Harshavardhana Sunil Pathak et al.

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South West Asian Aerosols Monsoon Interactions (SWAAMI) a co-ordinated field campaign jointly undertaken by the scientists from India and the United Kingdom , have already brought out the Part -1 observations and as a sequel to this , the current paper is Part-2 of SWAAMI campaign results. The contributors have systematically generated a gridded 10X 10 by incorporating the large network of In-situ observations on AOD and SSA and ensured the whole gridded data is seamlessly assimilated well using the 3-D var operations. At domain level, region level and sub region level data integrity is well

represented using the 2009-2013 years data sets. The study estimated direct shortwave aerosol radiative forcing (ARF) over the Indian region using the above gridded data. Further compared the top-of-the-atmosphere (TOA) radiances estimated using the assimilated data with the radiance values measured by Clouds and Earth's Radiant Energy System (CERES) instrument. The regional heterogeneity and responses in terms of ARF, TOA radiances were evaluated using the assimilated gridded data, which otherwise constrains the domain level evaluations.

The study used the aerosol phase function of AOD and SSA were based on OPAC and the Satellite derived AOD are adopted from MODIS; Terra/Aqua and MISR, where as SSA is from OMI on board AQUA satellite, a monthly mean of SSA at 500 nm.

The ARF is computed using the SBDART and the inputs for surface reflectance were adopted from MODIS derived L-3 products, vertical heterogeneity of Ozone and water vapour is taken from OMI and MODIS for the respective periods appropriately. The other atmospheric gases vertical heterogeneity the SBDART based model out puts as available for tropical environment are employed.

The results were evaluated for ARF using the assimilated gridded data based ARF and Satellite data based ARF and the Differences were over the domain and sub region were evaluated.The results were presented using the Winter season data of January 2009 and for Summer data of May 2009 were presented.

The winter (January) assimilated datasets show stronger surface cooling and higher atmospheric warming than those yielded from the satellite retrieved data, except over IGP region (fig 2a and b).It is clearly seen that satellite derived TOA has not shown any warming where as Assimilated data showed at few regions warming as it apparent the assimilated data is pronouncing the TOA to a tune of 2-5 Wm2 . Where as surface forcing in assimilated data relatedly across domain is lower and Satellite only derived surface forcing appear over estimating.(fig 3a, b , and C). Contrastingly the atmospheric forcing is in assimilated data pronounced in IGP region where in satellite

derived data it is low.(fig;4a-c)

The summer months data of May 2009 for AS ARF TOA is strikingly higher in IGP region and SR ARF TOA relatively low.(fig 5 a and b). Where as for surface forcing in AS ARF srf it as expected the IGP region is cooler than the SR ARF srf. (fig 6a and b). Similarly the Atmospheric ARF in AS ARF atom is significantly higher in IGP and where as it is underestimated in SR ARF atm.(fig 7 a-b).

The key evaluation is by using the collocated regridded Radiance values of CERES satellite TOA as reference since it has three Onboard sensors, covering Short wave, Infra Red and total wave length regions. This data is evaluated with the above (AS; SR) data products and the whisker plots have clearly shown error bars are well with in permissible limits.

Heating rates were also calculated considering the pressure levels of 1000 hpa to 700 hpa of potentially 3KM altitude.HR were calculated for both winter (jan) and Summer periods (May) for 2009 and clearly projected HR is higher all along IGP region and Western part of india.(fig 9 a-d).

Overall the investigation of SWAAMI Par-2 and data sets employed appear very demonstrative and intriguing. The scientific paper is certainly a quality investigation deserves appearing the ACP.

However very minor suggestion is to provide a X, Y plot from 2009-2013 for five years along with error bars; though whisker plots are given. This will be made year wise clarity. A minor hunch is that the Tropic of Cancer above region is distinctive over all.The extended application of Assimilated data and gridded data may put In use for NCP models as it deserves. Typo issues at : 4.3: line 15 (2009); 4.1 : line 19 (used)

I strongly recommend the paper for appearing in ACP.

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