

**Supplementary material for**  
**Towards an improved representation of carbonaceous aerosols over the**  
**Indian monsoon region in a regional climate model, RegCM4**

Sudipta Ghosh<sup>1</sup>, \*Sagnik Dey<sup>1,2</sup>, Sushant Das<sup>3</sup>, Nicole Riemer<sup>4</sup>, Graziano Giuliani<sup>3</sup>, Dilip Ganguly<sup>1</sup>, Chandra Venkatraman<sup>5</sup>, Filippo Giorgi<sup>3</sup>, Sachchida Nand Tripathi<sup>6</sup>, S. Ramachandran<sup>7</sup>, T.A. Rajesh<sup>7</sup>, Harish Gadhavi<sup>7</sup>, Atul Kumar Srivastava<sup>8</sup>

<sup>1</sup>Centre for Atmospheric Sciences, Indian Institute of Technology Delhi, India

<sup>2</sup>Centre of Excellence for Research on Clean Air, Indian Institute of Technology Delhi, India

<sup>3</sup>Earth System Physics Section, ICTP, Trieste, Italy

<sup>4</sup>Department of Atmospheric Sciences, University of Illinois at Urbana-Champaign, IL, USA

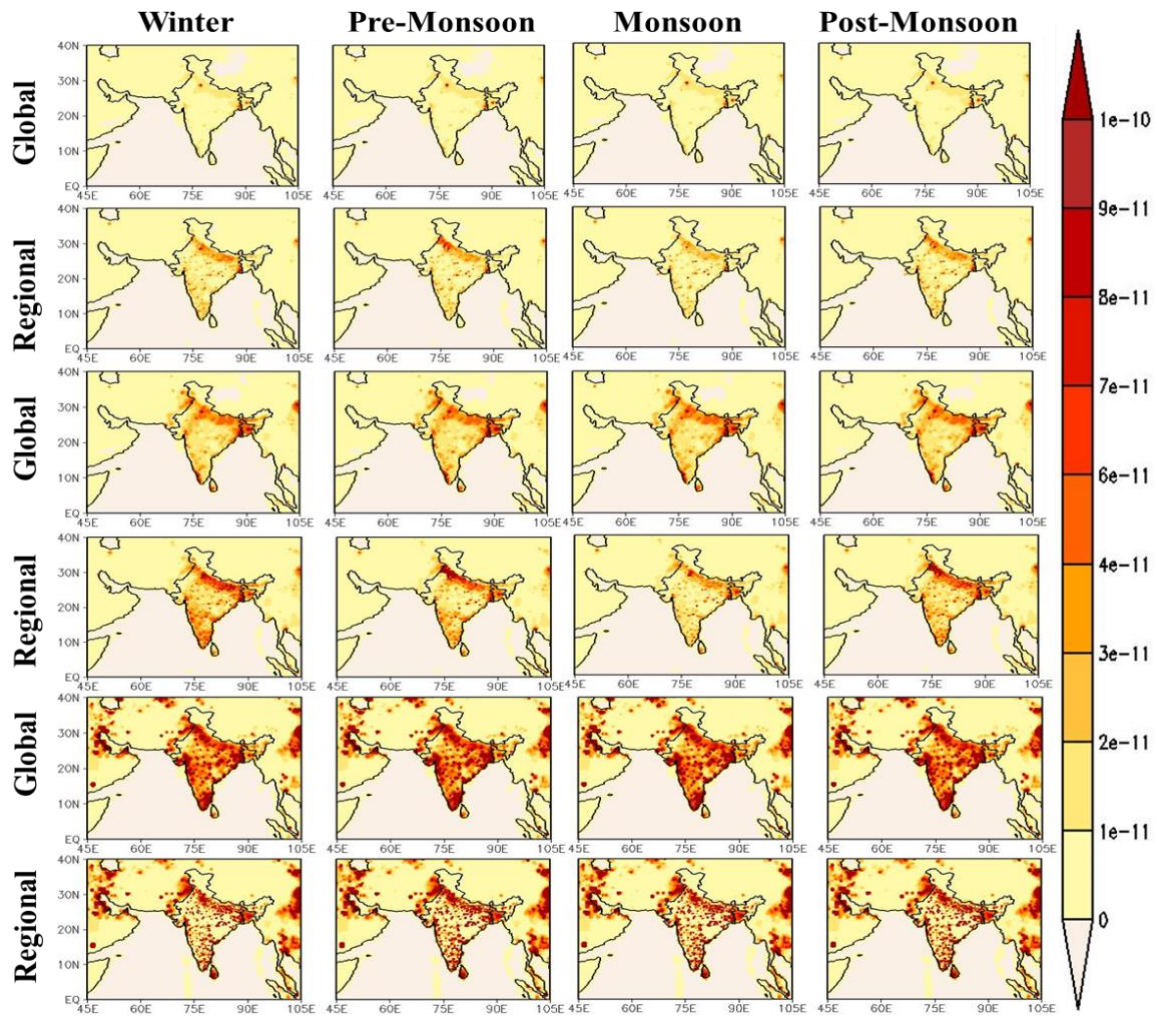
<sup>5</sup>Department of Chemical Engineering, Indian Institute of Technology Bombay, India

<sup>6</sup>Department of Civil Engineering, Indian Institute of Technology Kanpur, India

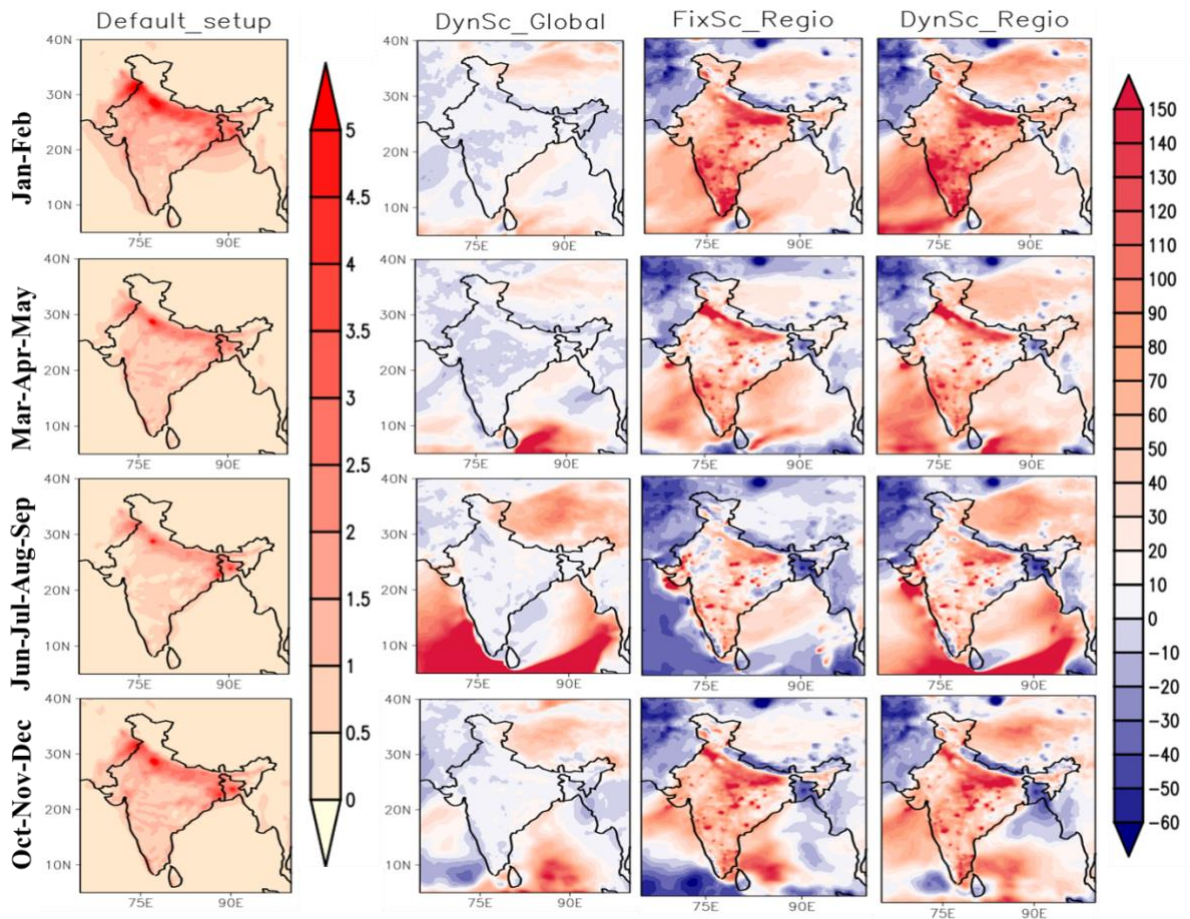
<sup>7</sup>Space and Atmospheric Sciences Division, Physical Research Laboratory, Ahmedabad, India

<sup>8</sup>Indian Institute of Tropical Meteorology, New Delhi, India

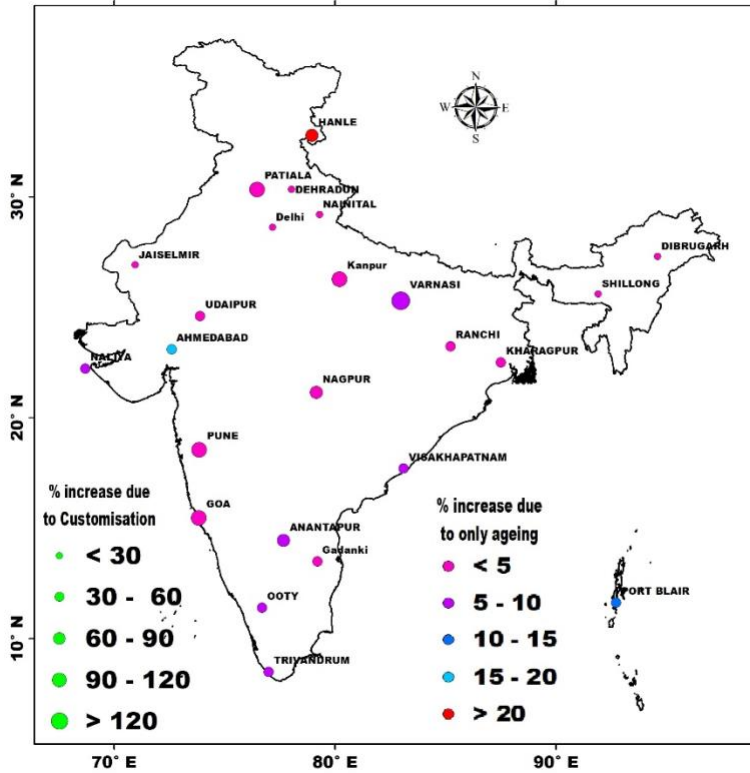
\*Correspondence: [sagnik@cas.iitd.ac.in](mailto:sagnik@cas.iitd.ac.in)



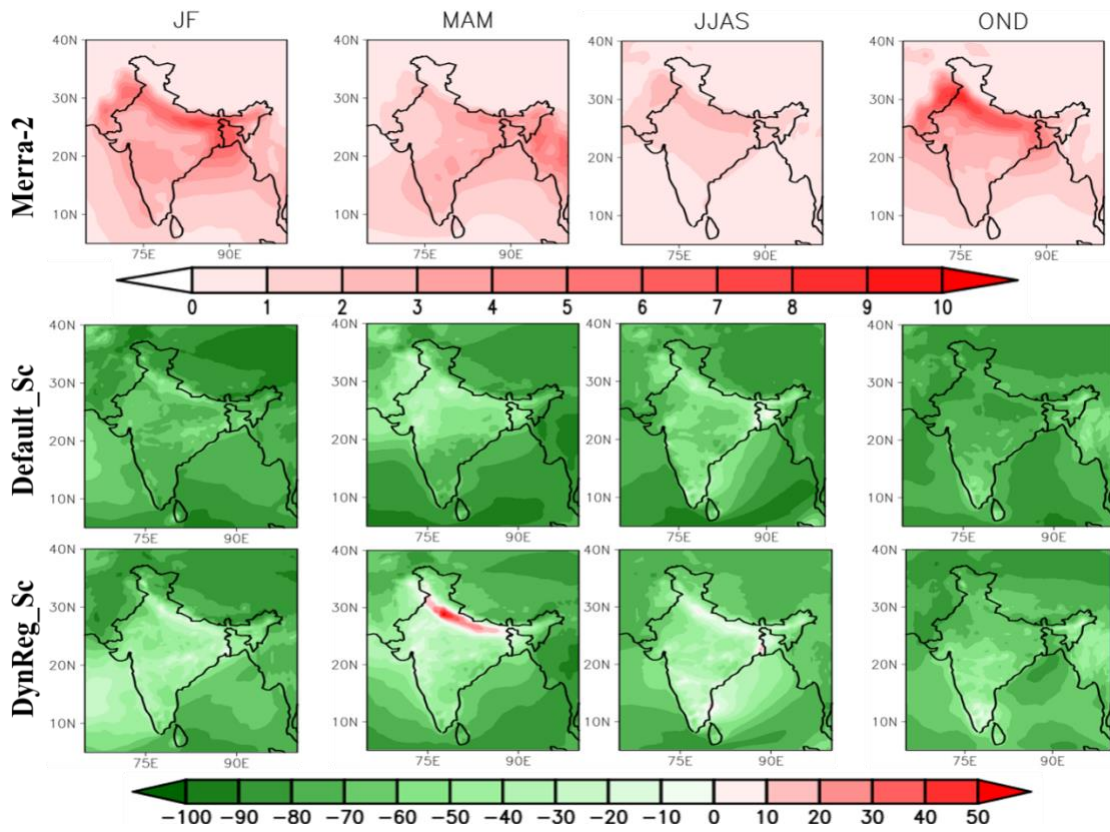
**Figure S1.** Seasonal variation of the global and regional emission inventories in  $\text{kg m}^{-2} \text{s}^{-1}$  for BC (1<sup>st</sup> and 2<sup>nd</sup> rows), OC (3<sup>rd</sup> and 4<sup>th</sup> rows) and SO<sub>2</sub> (5<sup>th</sup> and 6<sup>th</sup> rows) used in the simulation.



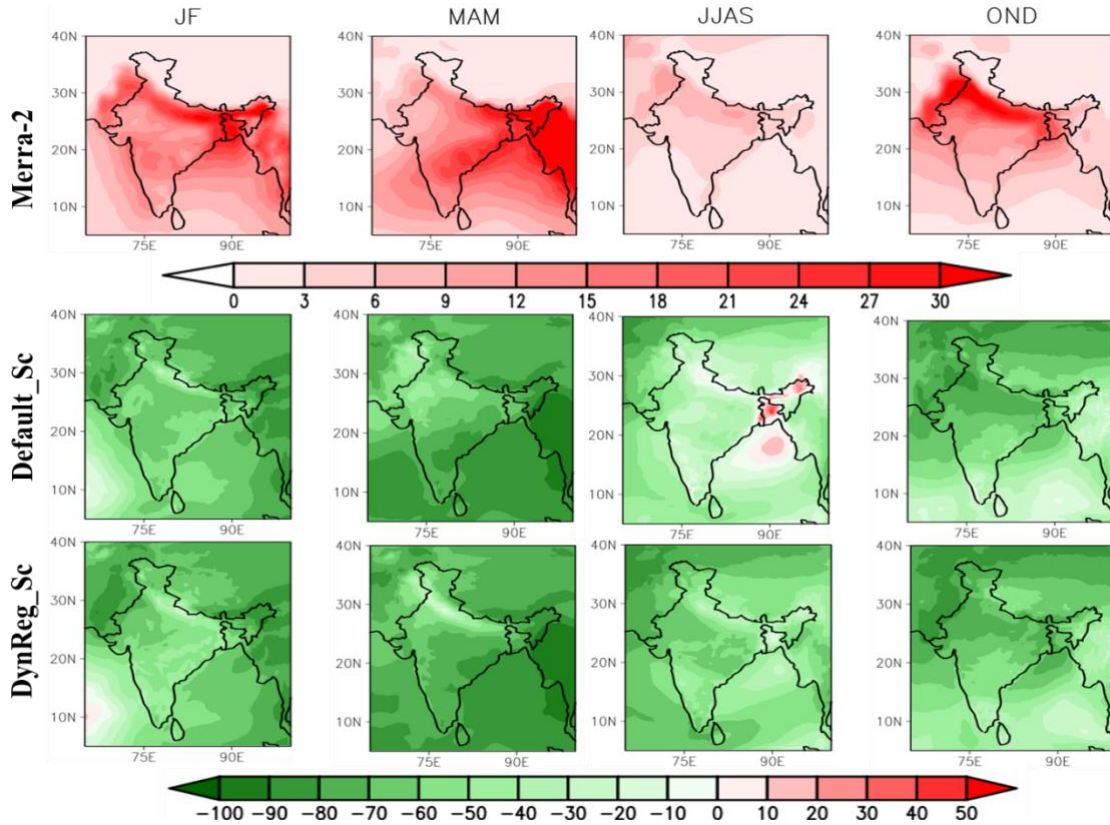
**Figure S2.** Spatial patterns of mean seasonal surface BC concentration ( $\mu\text{g}/\text{m}^3$ ) over India (1<sup>st</sup> column) using the default set-up and percentage differences in the (2<sup>nd</sup> and 3<sup>rd</sup> columns) modified and (4<sup>th</sup> column customized configurations relative to the default set-up.



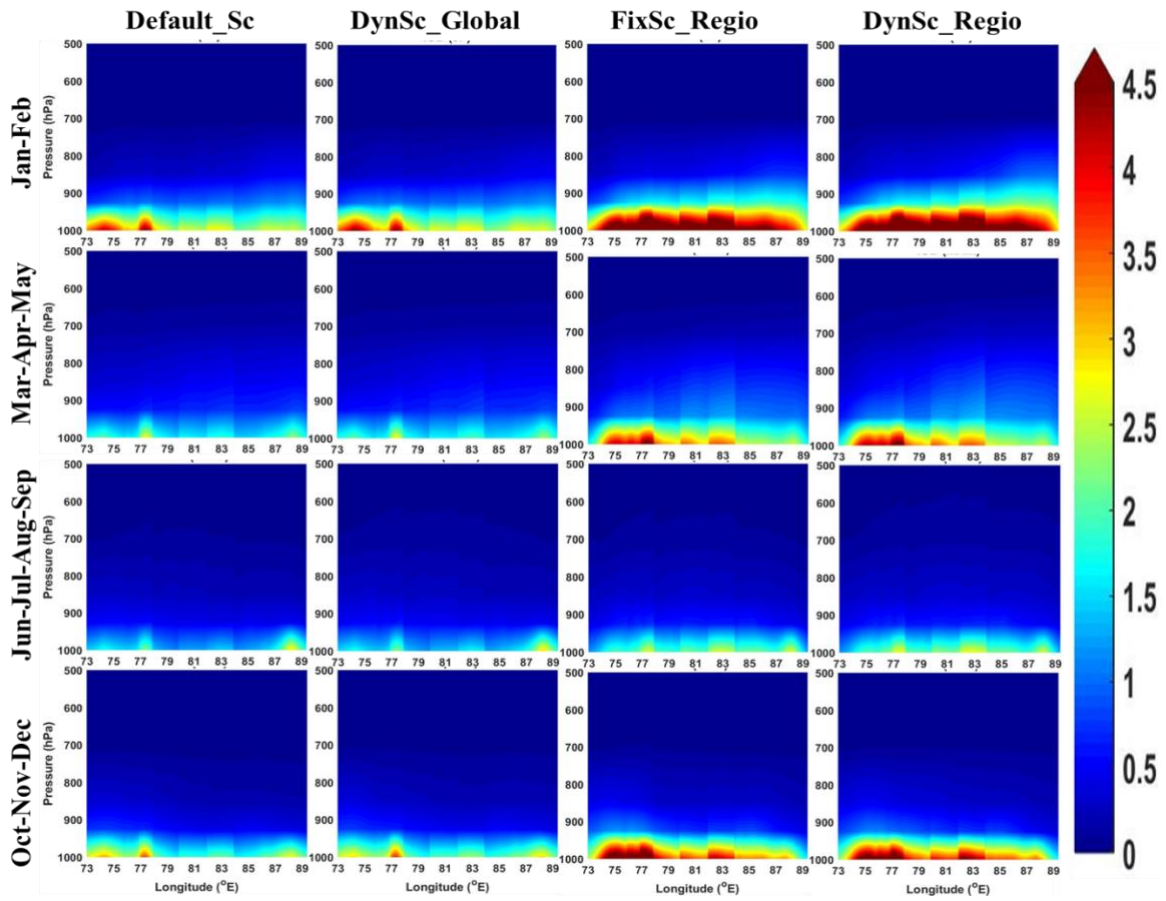
**Figure S3.** Locations of the 24 cities where BC concentrations were measured during the study period and used to evaluate the customized model performance. The colour of the circles indicates the percentage increase in BC concentrations due to the implementation of the dynamic scheme and the size of the circles indicate the percentage increase in BC concentrations due to the combined impact of ageing scheme and regional inventory in the customized model.



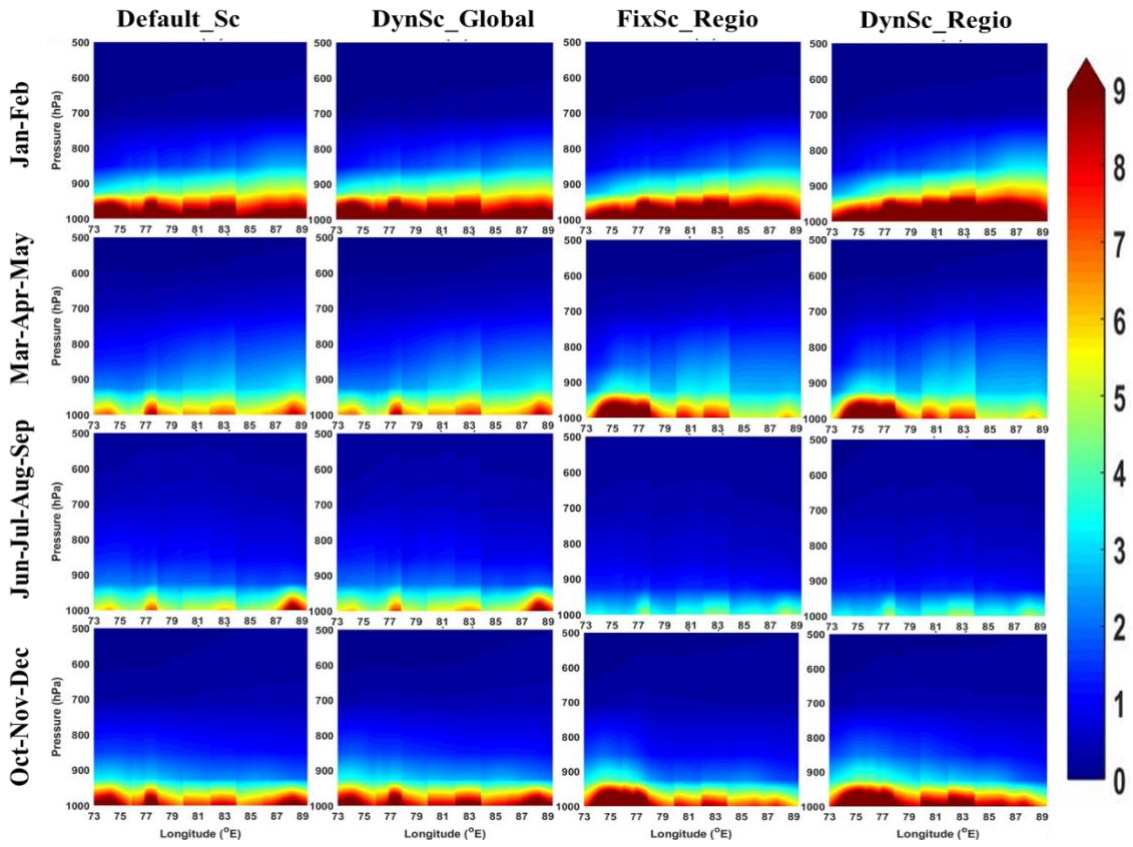
**Figure S4.** Top panel - MERRA-2 BC burden (mg/m<sup>2</sup>). Middle and bottom panels - Percentage difference of BC columnar burden simulated by the model w.r.t MERRA-2 BC burden (mg/m<sup>2</sup>)



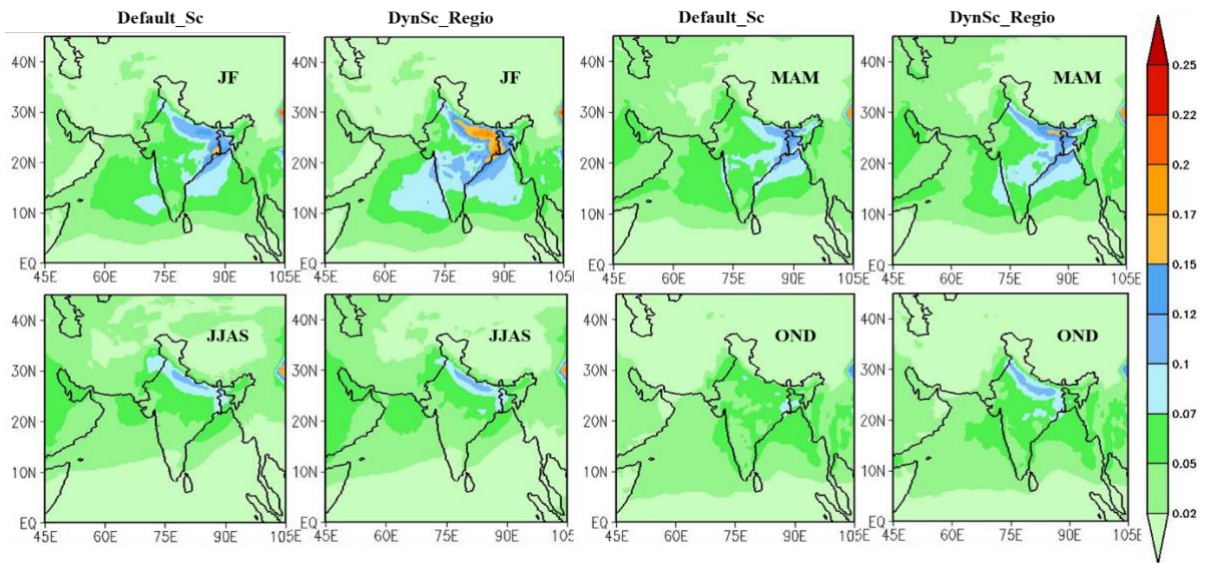
**Figure S5.** Top panel - MERRA-2 OC burden (mg/m<sup>2</sup>). Middle and bottom panels - Percentage difference of OC columnar burden simulated by the model w.r.t MERRA-2 OC burden (mg/m<sup>2</sup>).



**Figure S6.** Seasonal variation of vertically distributed mass concentration ( $\mu\text{g}/\text{m}^3$ ) of BC over the highly polluted Indo-Gangetic Plain

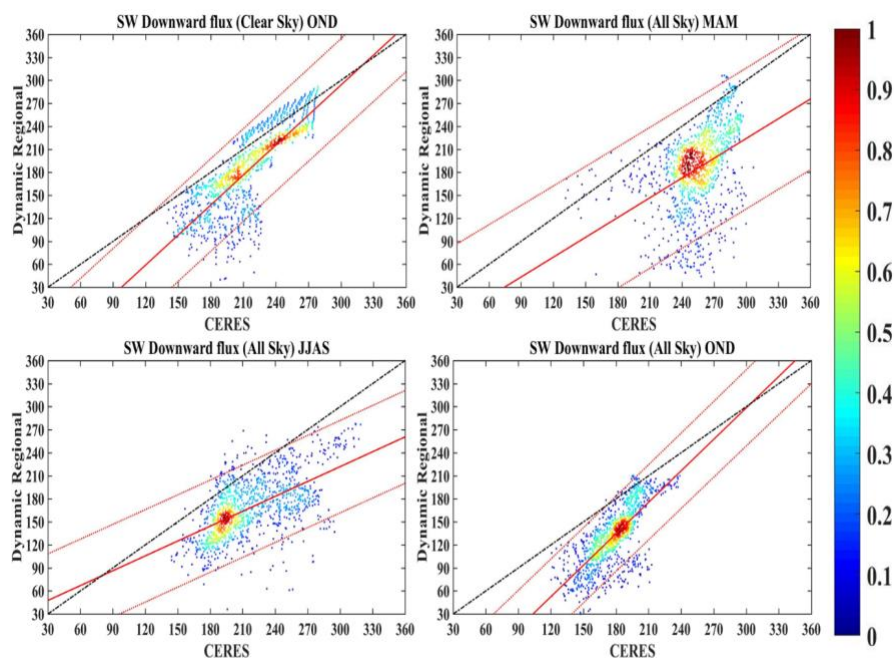


**Figure S7.** Seasonal variation of vertically distributed mass concentration ( $\mu\text{g}/\text{m}^3$ ) of OC over the highly polluted Indo-Gangetic Plain

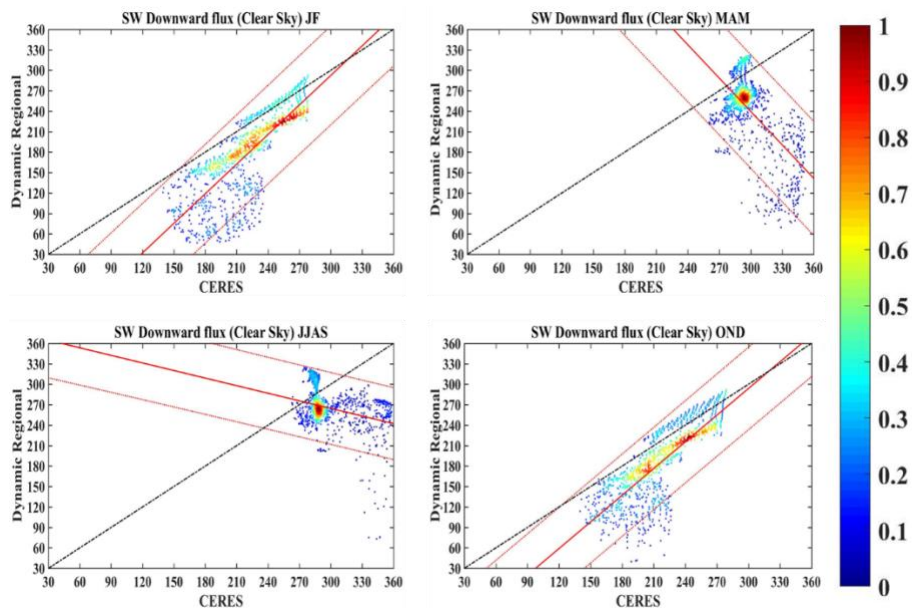


**Figure S8:** Seasonal variation of anthropogenic AOD simulated by default and augmented model set-up.





**Figure S9:** Evaluation between model derived surface downward shortwave flux and CERES surface shortwave flux ( $\text{W}/\text{m}^2$ ) for all-sky conditions for the year 2010. Black line represents 1:1 line and solid red line is the curve fitting line along with red dotted predicted bounds.



**Figure S10:** Evaluation between model derived surface downward shortwave flux and CERES surface shortwave flux ( $\text{W}/\text{m}^2$ ) for all-sky conditions for the year 2010. Black line represents 1:1 line and solid red line is the curve fitting line along with red dotted predicted bounds.