Response to Reviews of manuscript entitled "Wintertime direct radiative effects due to black carbon (BC) over Indo-Gangetic Plain as modelled with new BC emission inventories in CHIMERE (ACP-2020-511)"

We thank the Editor for their valuable comments, suggestions, and corrections. Specific changes made in response to the comments are described below.

Response to Editor's comments

One remaining technical yet important issue is regarding running WRF-Chem with 0.1° ×0.1° degree resolution. I double checked and found that indeed it is an option for WRF and as explained in your last response, WPS is converting the projection to km for each grid cell. But I am wondering how this dx and dy matrices are passed into the Chem module (e.g., the emission matrix is km-based, and the matrices of dx and dy are needed there)? Could you please point out the coding in the chem module that makes such simulation compatible? As there seems to be quite few studies have performed degree-based simulation with WRF-Chem, at least I haven't found any after spending some effort searching the literature, it would be very important if this issue can be clarified. Also it would be very helpful if the authors could provide some references to previous studies which also made such configurations in WRF-Chem simulations.

Response: In our study, we have used the WRF-CHIMERE modelling system.

For CHIMERE: We thank the Reviewer for this question. But please note that we are not using WRF-CHEM, but another modelling system, WRF and CHIMERE. As already in the manuscript, WRF can run with a grid defined either in lon-lat or meters. In this study, CHIMERE (Mailler et al., 2017) is used in offline mode. CHIMERE reads the WRF hourly meteorological fields and interpolates these meteorological fields if the CHIMERE grid is different. The interpolation is a bilinear interpolation, ensuring mass conservation for variables needing it. CHIMERE also reads anthropogenic emissions fields. The user can use the CHIMERE dedicated program (called EMISURF, see Menut et al. (2012)) or make its own program and create a file on the CHIMERE grid directly. Please see pages 105-106 in the CHIMERE user guide (`https://www.lmd.polytechnique.fr/chimere/docs/CHIMEREdoc2017.pdf`) for the user's pre-compiled emissions preparation.

The above details for CHIMERE simulation are now also included in the manuscript (refer to Section 2.1.1).

For WRF-CHEM: The domain definition (either km or longitude-latitude projection) is given in the control file "namelist.input" that governs the WRF or WRF-CHEM simulations. The user has to prepare the emissions in a netcdf format, suggested being compatible in format with emissions such as EDGAR_HTAP emissions database. For the WRF or WRF-CHEM setup, the WRF Preprocessing System (WPS) internally converts grid resolution corresponding to longitude-latitude projection in the degrees to meters required for model processing. The netcdf emission files created above is processed through an emissions control file to generate emissions in a model format usable by the simulation. Please see pages 12 and 26 in the WRF-CHEM user guide (`https://ruc.noaa.gov/wrf/wrf-chem/Users_guide.pdf`) for the emissions generation and use.

References

Mailler, S., Menut, L., Khvorostyanov, D., Valari, M., Couvidat, F., Siour, G., Turquety, S., Briant, R., Tuccella, P., Bessagnet, B., et al.: CHIMERE-2017: from urban to hemispheric chemistry-transport modeling, Geoscientific Model Development, 10, 2397–2423, https://doi.org/https://doi.org/10.5194/gmd-10-2397-2017, 2017.

Menut, L., Goussebaile, A., Bessagnet, B., Khvorostiyanov, D., and Ung, A.: Impact of realistic hourly emissions profiles on air pollutants concentrations modelled with CHIMERE, Atmos. Environ., 49, 233–244, https://doi.org/10.1016/j.atmosenv.2011.11.057, 2012.