Response to comments of the anonymous Referee #2, "RC2"

Comment 1*: This paper designs an integrated tool, ISAT v2.0, to configure nested model grid, downscale regional grided inventory, spatially allocate provincial/city-level inventory, and finally generate model-ready emission data. These are often the tedious and error-prone tasks that one has to do before running a WRF-AQM simulation, and ISAT v2.0 is designed to streamline this process with a clear and user-friendly workflow. In this sense, the modeling tool described in this paper definitely has its value and, if well implemented, can be very helpful to users. However, there are some tools that can accomplish similar tasks. Compared to those existing tools, I am not convinced that this new tool, as described in the current form, represents "substantial new concepts, ideas, or methods" (GMD criteria on scientific significance) in geoscientific modeling. A clear presentation of scientific novelty and contributions is required to meet the GMD standard.*

Author's Response:

We appreciate the reviewer's insights. We agree with the reviewer that there are several public available platforms that can be used for processing emission inventory (e.g., Sparse Matrix Operator Kernel Emissions (SMOKE) developed by US EPA). However, these similar tools mainly focus on a single step in the WRF-AQM pre-processing. As described in introduction, "SMOKE, a Linux-platform supported and widely used tool in AQM, requires a predefined spatial surrogate from other geoprocessing tools, such as ArcGIS, **and cannot define parameters for nested domains in WRF-AQM** (Baek and Seppanen, 2021). The WRF Domain Wizard (https://esrl.noaa.gov/gsd/wrfportal/DomainWizard.html) allows the user to configure nested domains by **manually delimiting research areas.** However, **without the shapefile of the target area, obtaining precise domains is challenging, which requires several trials and expert experience to obtain suitable nested domains in AQMs**". Lacking an integrated and easy-to-use workflow, these are often the tedious and error-prone tasks that one has to do before running a WRF-AQM simulation, as you mentioned. This study integrates the steps in WRF-AQM preprocessing and conduct new algorithms in the ISAT v2.0. Benefit from

integrated and easy-to-use workflow, the old version of ISAT has helped users to completed their research.

To clarify our scientific novelty and contributions to the modeling community, we rephrased the description of innovation and supplied related literature on ISAT's applications.

(1) Three references adopt ISAT had been supplied. Please see "Previous studies achieved reliable simulations result using this approach (H. Wang et al., 2021; K. Wang et al., 2022, 2021a, 2021b; Liu et al., 2023; Li, 2021; Tan, 2022)" on **Line 235**.

Li, Y. 2021. Study on Ozone Formation Sensitivity in the Pearl River Delta based on Satellite Remote Sensing and Air qualify Model. Master's Thesis, South China University of Technology.

Liu S., Liu, K., Wang, K., et al. 2023. Fossil-Fuel and Food Systems Equally Dominate Anthropogenic Methane Emissions in China. Environmental Science & Technology. 2023, 57, 6, 2495–2505. https://doi.org/10.1021/acs.est.2c07933

Tan, X. 2022.Construction of CMAQ Pollution Source Inventory Based on ISAT Model. Master's Thesis, Jilin University.

(2) Clarify the innovation of "Prepgrid" model in "2.1 Nested domain configuration in "Prepgrid"". In this module, we conduct a shapefile-based algorithm on nested domain configuration. And user can obtain parameters of nested domain including projection parameters, grid position and extent based on shapefiles in each domain. Please see "In practice, we usually obtain the extent of the study area based on its shapefile. Compared with manual configuration, using shapefile can provide consistent and accurate nested domain between WRF, AQM and emission inventory." on **Line 87**.

(3) Previous emission processing tool, such as SMOKE, allocate local emission inventory based on processed spatial surrogate by ArcGIS and cannot downscaled regional emission inventory. In ISAT, we integrated and simply these steps in "Mapinv" and "Downscale" without external tools such as ArcGIS. And sub-grid nearest method was conduct in

"Downscale", which obtained downscale emission inventory user-friendly and easy-to-use. Please see "This module can downscale regional emission inventories user-friendly and easy-to-use based on default or user-defined proxy without external tools such as ArcGIS." on **Line 136**.

(4) SMOKE model applied Source Classification Code (SCC), GSCNV, GSPRO, GSPRODESC, GSPRO_COMBO, GSREF, and GSTAG files to produce model-ready emission inventory in CMAQ. ISAT adopted a simpler and user-friendly source classification and speciation method, and allows users to modify chemical mechanism in different AQM according to their needs. We supplied the innovation of prepmodel module. Please see "Users can easily add or delete sources in model-ready emission inventory by their needs in "Prepmodel"." on **Line 154**.

***Comment 2**: The authors present "sub-grid nearest" method as an innovation. This is not a new idea either. In section 3.2, the "sub-grid nearest" method is compared with the nearest method and the intersect method. The accuracy of the method is shown with R2, but the claimed computing efficiency of the "sub-grid nearest" method is not discussed.*

Author's Response:

Thanks for your comment. Traditional nearest method ignored the differences of resolution between regional emission inventory and targe domain in WRF-AQM. Conducting sub-grid ratio, sub-grid nearest method can optimize the results on nearest method and obtain more accurate results. Meanwhile, we supplied the discussion of computing efficiency. Pleases see "Compared with ArcGIS, SMOKE and other tools, using "Dowanscale" module reduces the timeliness from hours to minutes." on **Line 195**. And "For example, the running time of "downscaled" module increased from 2 minutes to 10 minutes with the sub-grid ratio increased from 3 to 9 in this case." on **Line 204**.