Atmospheric Environment 269 (2022) 118839

Contents lists available at ScienceDirect

Atmospheric Environment

journal homepage: www.elsevier.com/locate/atmosenv

Influence of emission inventory resolution on the modeled spatio-temporal distribution of air pollutants in Buenos Aires, Argentina, using WRF-Chem

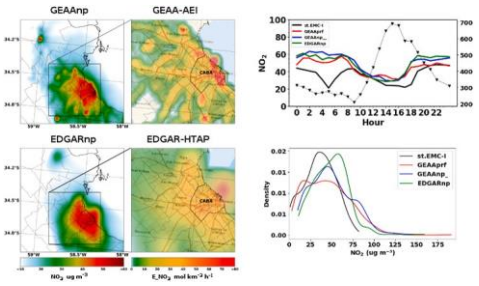
Ana I. López-Noreña [a,b,c], Lucas Berná [b], M. Florencia Tames [a,b], Emmanuel N. Millán [a,c], S. Enrique Puliafito [a,b], Rafael P. Fernandez [a,b,c,d,*]

[a] National Scientific and Technical Research Council (CONICET), Argentina
[b] Atmospheric and Environmental Studies Group (GEAA), National Technological University (UTN-FR Mendoza), Mendoza, 5501, Argentina
[c] School of Natural Sciences, National University of Cuyo (FCEN-UNCuyo), Mendoza, 5501, Argentina
[d] Institute for Interdisciplinary Science, (ICB-CONICET/UNCUYO), Mendoza, 5501, Argentina

HIGHLIGHTS

- First high-resolution WRF-Chem air quality modeling study over Buenos Aires.
- High-resolution emission inventory for Argentina is compared with global inventory.
- Introducing hourly cycles of emissions improves the agreement with observations.
- Usefulness of atmospheric modeling as a tool for the design of air quality networks.

GRAPHICAL ABSTRACT



ARTICLE INFO

Keywords:
WRF-Chem
High resolution emissions inventory
South America air quality modeling
GEAA-AEI
EDGAR-HTAP
TROPOMI

ABSTRACT

The temporal and spatial resolution of the emission inventory included into an air quality model plays a key role in the appropriate representation of air pollution events and background atmospheric chemistry. Here, we use the Weather Research and Forecasting coupled with Chemistry (WRF-Chem v4.0) model to perform high-resolution air quality simulations over the city of Buenos Aires, Argentina, with two different anthropogenic emissions datasets: the High-resolution Emissions Inventory of Argentina (GEAA-AEI) and the Emissions Database for Global Atmospheric Research - Hemispheric Transport of Air Pollution (EDGAR-HTAP). A local optimized configuration considering 3 nested domains with a horizontal grid size of 20 × 20 km, 4 × 4 km, and 1.3 × 1.3 km and the MOZART chemical scheme was used. The model performance for NO_2, PM_{10}, $PM_{2.5}$, and O_3 concentrations was validated against measurements from the existing air quality monitoring stations in the Buenos Aires Metropolitan Area (AMBA) during austral fall 2018. Our results show that the daytime concentrations of air pollutants are influenced by the shape and shift of the hourly emissions profile, especially for NO_2 where the reduction in nighttime emissions decreased the mean model bias by ~50%. PM_{10} and $PM_{2.5}$ generally satisfied the model performance criteria, but underestimation tended to occur in the GEAA-AEI simulations and overestimation for the EDGAR-HTAP case. Comparison with TROPOMI-derived tropospheric NO_2 columns showed a high positive correlation ($r > 0.75$) and a positive bias. We found large discrepancies between the spatial distribution patterns of the simulations within the innermost high-resolution domain centered on AMBA,

* Corresponding author. Institute for Interdisciplinary Science (ICB-CONICET/UNCUYO). Padre Jorge Contreras, 1300, Mendoza, CP: M5502JMA, Argentina.
E-mail address: rpfernandez@mendoza-conicet.gob.ar (R.P. Fernandez).

https://doi.org/10.1016/j.atmosenv.2021.118839
Received 4 January 2021; Received in revised form 12 October 2021; Accepted 6 November 2021
Available online 11 November 2021

mostly in suburban areas where no observations are available. We propose additional monitoring sites to address such differences and determine the size and shape of the main pollutant plume. We conclude that high-resolution air quality modeling is important within underdeveloped or developing South American cities that lack continuous air quality measurements, as it represents a powerful tool in supporting the design of governmental monitoring networks and air pollution mitigation policies.

https://doi.org/10.1016/j.atmosenv.2021.118839