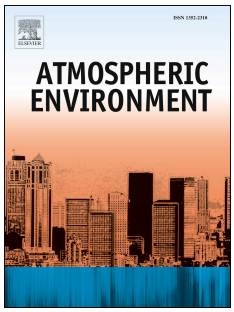
Accepted Manuscript



Constraining the uncertainty in emissions over India with a regional air quality model evaluation

Alexandra Karambelas, Tracey Holloway, Gregor Kiesewetter, Chris Heyes

PII: S1352-2310(17)30813-0

DOI: 10.1016/j.atmosenv.2017.11.052

Reference: AEA 15709

To appear in: *Atmospheric Environment*

Received Date: 10 July 2017

Revised Date: 17 November 2017

Accepted Date: 27 November 2017

Please cite this article as: Karambelas, A., Holloway, T., Kiesewetter, G., Heyes, C., Constraining the uncertainty in emissions over India with a regional air quality model evaluation, *Atmospheric Environment* (2017), doi: 10.1016/j.atmosenv.2017.11.052.

Constraining the uncertainty in emissions over India with a regional air quality model evaluation

Alexandra Karambelas[1,*], Tracey Holloway[1,2], Gregor Kiesewetter[3], Chris Heyes[3]

[1] Nelson Institute Center for Sustainability and the Global Environment, University of Wisconsin—Madison, 1710 University Avenue, Madison, WI, USA
[2] Department of Atmospheric and Oceanic Sciences, University of Wisconsin—Madison, 1225 West Dayton Street, Madison, WI, USA
[3] Air Pollution and Greenhouse Gases, International Institute for Applied Systems Analysis, Schloßplatz 1, 2361 Laxenburg, Austria

* *Corresponding author present address*: The Earth Institute, Columbia University, 2910 Broadway, New York, NY, USA

E-mail addresses: ak4040@columbia.edu (A. Karambelas); taholloway@wisc.edu (T. Holloway); kiesewet@iiasa.ac.at (G. Kiesewetter) heyes@iiasa.ac.at (C. Heyes)

Abstract

To evaluate uncertainty in the spatial distribution of air emissions over India, we compare satellite and surface observations with simulations from the U.S. Environmental Protection Agency (EPA) Community Multi-Scale Air Quality (CMAQ) model. Seasonally representative simulations were completed for January, April, July, and October 2010 at 36km x 36km using anthropogenic emissions from the Greenhouse Gas-Air Pollution Interaction and Synergies (GAINS) model following version 5a of the Evaluating the Climate and Air Quality Impacts of Short-Lived Pollutants project (ECLIPSE v5a). We use both tropospheric columns from the Ozone Monitoring Instrument (OMI) and surface observations from the Central Pollution Control Board (CPCB) to closely examine modeled nitrogen dioxide (NO_2) biases in urban and rural regions across India. Spatial average evaluation with satellite retrievals indicate a low bias in the modeled tropospheric column (-63.3%), which reflects broad low-biases in majority non-urban regions (-70.1% in rural areas) across the sub-continent to slightly lesser low biases reflected in semi-urban areas (-44.7%), with the threshold between semi-urban and rural defined as 400 people per km^2. In contrast, modeled surface NO_2 concentrations exhibit a slight high bias of +15.6% when compared to surface CPCB observations predominantly located in urban areas. Conversely, in examining extremely population dense urban regions with more than 5000 people per km^2 (dense-urban), we find model overestimates in both the column (+57.8) and at the surface (+131.2%) compared to observations. Based on these results, we find that existing emission fields for India may overestimate urban emissions in densely populated regions and underestimate rural emissions. However, if we rely on model evaluation with predominantly urban surface observations from the CPCB, comparisons reflect model high biases, contradictory to the knowledge gained using satellite observations. Satellites thus serve as an important emissions and model evaluation