EGU21-9109
https://doi.org/10.5194/egusphere-egu21-9109
EGU General Assembly 2021

Accounting for Non-detects in Satellite Retrievals: Application Using CrIS Ammonia Observations

Evan White[1,2], Mark Shephard[2], Karen Cady-Periera[3], Shailesh Kharol[2], Enrico Dammers[4], Evan Chow[1,2], Dave Tobin[5], Greg Quinn[5], Jason O'Brien[2], and Jesse Bash[6]

[1]University of Waterloo, Waterloo, Ontario N2L 3G1, Canada
[2]Environment and Climate Change Canada, Toronto, Ontario M3H 5T4, Canada
[3]Atmospheric and Environmental Research(AER), Lexington, Massachusetts, USA
[4]Netherlands Organisation for Applied Scientific Research (TNO), Utrecht, The Netherlands
[5]Space Science and Engineering Center, University of Wisconsin-Madison, USA
[6]U.S. EPA National Exposure Research Laboratory, USA

For measurements from any instrument there is a minimum detection limit below which the sensor cannot measure (i.e., non-detects). Measurements of trace gases from satellite instruments can also suffer from a significant number of non-detects, especially for species with very low atmospheric concentrations and that have a very weak or absent signals (signal-to-noise<1) in the spectral region used to detect the species (e.g., ammonia). For ammonia, these non-signal conditions generally occur when thick clouds obscure the ammonia signal, or atmospheric conditions generates too weak of a radiometric signal to detect (e.g., very low concentrations). Presented is a robust approach to explicitly identify and account for cloud-free satellite observations that are below the detection limit of the sensor (which occur principally in non-source regions) for the Cross-Track Infrared Sounder (CrIS) Fast Physical Retrieval (CFPR) ammonia (NH_3) product. This approach uses the newly developed CrIS Ammonia Cloud Detection Algorithm (CACDA) to compute a cloud flag based on the CrIS IMG (CIMG) product . The CIMG product uses coincident Visible Infrared Imaging Radiometer Suite (VIIRS) brightness temperatures and cloud fractions mapped onto CrIS Field of Views (FOV). This cloud flag is used to separate CrIS FOVs without signal due to clouds from FOVs that are below the detection limit due to the atmospheric state (referred to as non-detects). Survival data is generated from in-situ surface observations from non-emission source regions to produce ammonia concentration values under CrIS non-detect conditions. Accounting for these non-detects can be significant in reducing bias of averaged values (i.e., Level 3 products) in regions or conditions with low concentration amounts (e.g. wintertime, non-agriculture regions, etc.), with little impact on concentrations in emission regions. This presentation will provide examples and evaluations of the CACDA and the inclusion of non-detects in the CFPR generated ammonia product. This will include comparisons of annual and seasonal averages of surface level ammonia concentrations with and without survival data to demonstrate the reduction in bias.