N_2O emissions Estimated with the Carbon Tracker Lagrange North American Regional Inversion Framework

C. Nevison[1], A.E. Andrews[2], K. Thoning[2], E. Dlugokencky[2], C. Sweeney[3,2] and E. Saikawa[4]

[1]Institute of Arctic and Alpine Research (INSTAAR), University of Colorado, Boulder, CO 80309; 303-492-7924, E-mail: Cynthia.Nevison@colorado.edu
[2]NOAA Earth System Research Laboratory, Global Monitoring Division (GMD), Boulder, CO 80305
[3]Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, Boulder, CO 80309
[4]Emory University, Atlanta, GA 30322

The Carbon Tracker Lagrange (CTL) regional inversion framework is used to estimate North American nitrous oxide (N_2O) emissions of ~ 1.4 ± 0.4 Tg N/yr in 2012. The CTL framework is a Bayesian method based on footprints from the Stochastic Time-Inverted Lagrangian Transport (STILT) model applied to atmospheric N_2O data from the ESRL/GMD Global Greenhouse Gas Reference Network, including surface, aircraft and tall tower platforms. Nearly half of the North American emissions (including Central America and Canada) are estimated to come from the Midwestern U.S. agricultural belt, and are strongest in spring and early summer, consistent with a synthetic nitrogen (N) fertilizer-driven source. While earlier regional atmospheric inversion studies have suggested that global inventories such as Emission Database for Global Atmospheric Research (EDGAR) may be underestimating U.S. anthropogenic N_2O emissions by a factor of 3 or more, our results, integrated over a full calendar year, are generally consistent with those inventories and with global inverse model results and budget constraints. The CTL inversion results are sensitive to the prescribed boundary condition or background value of N_2O, which is estimated based on a new Empirical Back-Ground (EBG) product derived from STILT back trajectories applied to ESRL/GMD data. Analysis of the N_2O EBG products suggests a significant, seasonally-varying influence on surface N_2O data due to the stratospheric influx of N_2O-depleted air.

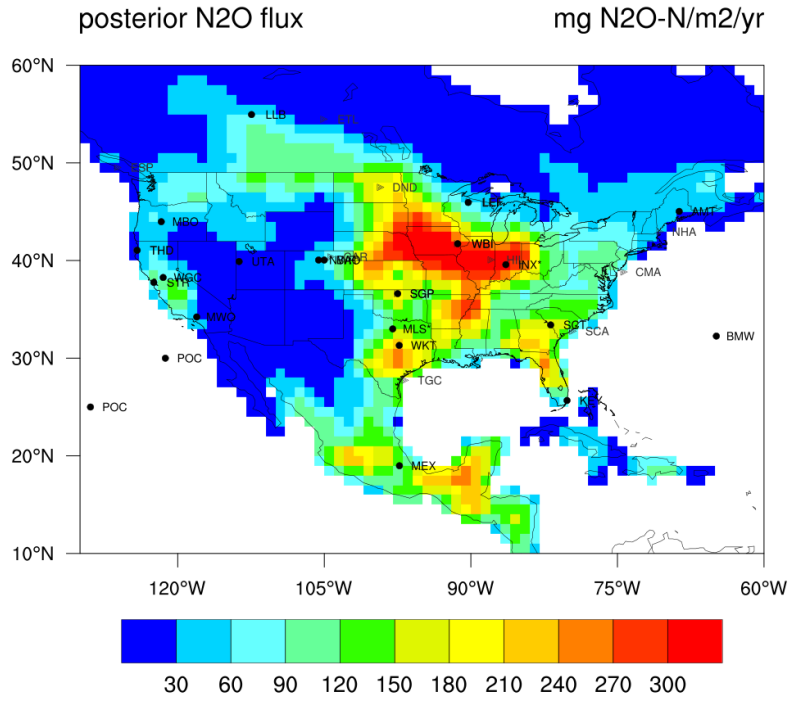

Figure 1. Posterior annual mean N_2O emissions for 2012 estimated with the CTL regional inversion framework. The locations of ESRL/GMD surface and aircraft data used in the inversion are superimposed as black circles and grey triangles, respectively. Mobile surface sites are indicated with asterisks.