Nitrous Oxide Emissions Estimated with the Carbon Tracker-Lagrange North American Regional Inversion Framework

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North American nitrous oxide (N_2O) emissions of 1.5 ± 0.2 Tg N/yr over 2008-2013 are estimated using the Carbon Tracker-Lagrange (CTL) regional inversion framework. The estimated N_2O emissions are largely consistent with the Emission Database for Global Atmospheric Research (EDGAR) global inventory and with the results of global atmospheric inversions. Emissions are strongest from the Midwestern corn/soybean belt, which accounts for about 25% of the total North American N_2O source. The emissions are maximum in late spring/early summer, consistent with a nitrogen fertilizer-driven source, but also show a late winter spike consistent with freeze-thaw effects. Interannual variability in emissions across the primary months of fertilizer application is positively correlated to mean soil moisture and precipitation. The estimated N_2O flux from the Midwestern corn/soybean belt and the more northerly U.S./Canadian wheat belt corresponds to 3.8-4.6% and 1.4-3.5%, respectively, of total synthetic + organic N fertilizer applied to those regions.

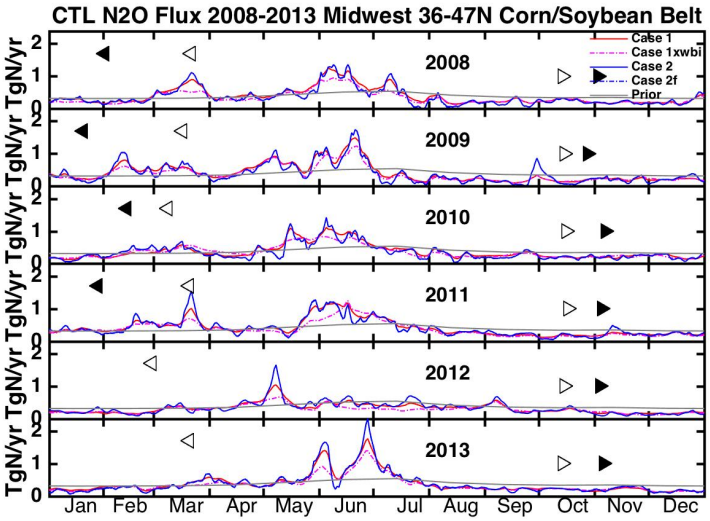

Figure 1. Posterior N_2O flux integrated over the Midwestern corn/soybean belt (36° to 47°N, 102° to 80°W, in grids where 5% or more of land area was planted in corn and/or soybean). Cases 1 (red) and 2 (blue) are defined based on different model-data mismatch and prior flux uncertainty covariance parameters and use a best guess prior derived from *Saikawa et al.* [2014], while Case 2f (blue dash) uses a flat prior. The magenta dashed line shows Case 1xwbi, in which N_2O data from West Branch, Iowa were omitted from the inversion. Left and right facing triangles show the approximate day when soil temperature climbs above 0°C and drops below 10°C (50°F), respectively. Solid and open triangles reflect mean soil temperature integrated over the southern (36° to 41.5°N) and northern (41.5° to 46°N) half, respectively, of the Midwestern Corn/Soybean belt. In 2012 and 2013, no 0°C crossing symbol is plotted for the southern half of the belt because the mean soil temperature remained above freezing.