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 $1.5 \pm 0.2$ 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 ($36^\circ$ to $47^\circ$N, $102^\circ$ to $80^\circ$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 ($36^\circ$ to $41.5^\circ$N) and northern ($41.5^\circ$ to $46^\circ$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.