(51-240329-B) **SMAP Soil Moisture Variations Are Linked to Midwestern N_2O Emission Pulses in a Regional Inversion Framework**

C. Nevison[1], A. Andrews[2], L. Hu[2], and X. Lan[3,2]

[1]Institute of Arctic and Alpine Research (INSTAAR), University of Colorado, Boulder, CO 80309; 303-551-3330, E-mail: cynthia.nevison@colorado.edu
[2]NOAA Global Monitoring Laboratory (GML), Boulder, CO 80305
[3]Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, Boulder, CO 80309

Atmospheric nitrous oxide (N_2O) is well mixed and near background levels at many sites in the NOAA Global Greenhouse Gas Reference Network (GGGRN). However, large excursions above background are observed episodically in late winter through early summer at some Midwestern sites. These excursions help drive strong spatiotemporal features in the CarbonTracker-Lagrange (CT-L) regional inversion, leading to a pattern of dual seasonal maxima in the inferred N_2O flux from the U.S. corn/soybean belt. The first maximum occurs in February or March and is linked to freeze/thaw dynamics. The second, broader maximum occurs during the crop growing season, typically beginning around the time of corn planting and associated nitrogen fertilizer application and reaching its peak in early June.

In this poster, large excursion events in NOAA GGGRN N_2O data are compared to remotely sensed soil moisture and soil freeze/thaw status data from the Soil Moisture Active Passive (SMAP) satellite for the overlapping period 2015-2021. Weighted average SMAP values are estimated over the influence footprint of each atmospheric N_2O observation with a > 6 ppb excursion above background. Large N_2O excursion events in late winter are linked to decreases in frozen soil, often with concurrent increases in soil moisture. Large N_2O excursions during the growing season are linked to large changes in soil moisture, from dry to wet for most events (Figure 1), but also from very wet to drier in one third of events (Figure 2). Due to the complexity of the soil moisture-N_2O relationship and the high spatiotemporal variability of soil moisture, the posterior N_2O flux from the CT-L inversion is not significantly correlated to mean soil moisture over the Midwest as a whole. However, CT-L estimates that the N_2O flux over Iowa was ~10% lower than normal in 2017 and 2021, years with unusually low June soil moisture, while the N_2O flux was 10% higher than normal in 2019, a year in which spring flooding created very wet soil conditions and delayed corn planting for several weeks.

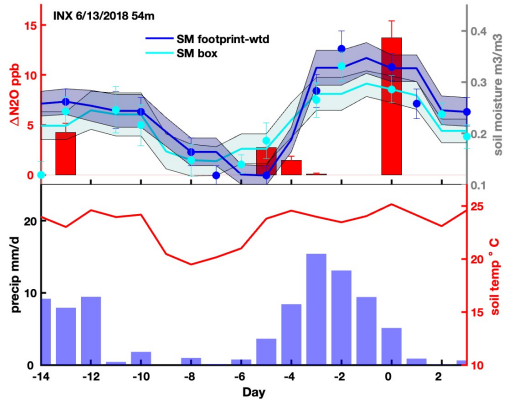

Figure 1. Top panel: SMAP soil moisture compared to a 15 ppb excursion event in atmospheric N_2O observed in Indiana (INX) on 6/13/2018 (day zero on the X axis). Soil moisture is averaged alternatively over the influence footprint of the N2O event and over a 2x2 degree box centered around INX. Bottom panel shows the corresponding soil temperature and daily precipitation from the North American Regional Reanalysis (NARR) averaged over the 2x2 degree surrounding INX.

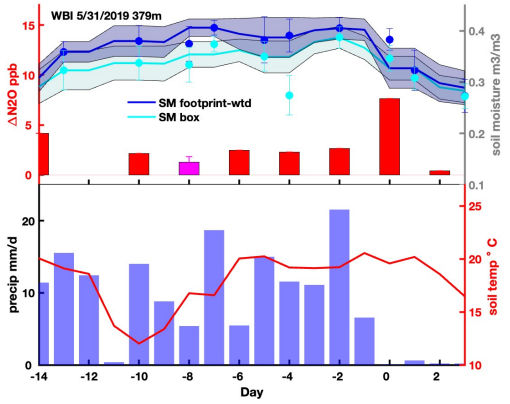

Figure 2. Same as Figure 1 but for a 7.5 ppb excursion event in atmospheric N_2O observed at West Branch Iowa (WBI) on 5/31/2019 (day zero on the X axis).