As of 25 November, 2019, in the COMET-Farm tool build version #2.3, the COMET team at CSU implemented a number of changes addressing issues with simulating soil nitrous oxide, and propagating the uncertainty of different nitrous oxide subsource categories into a single, combined uncertainty prediction for nitrous oxide. This document is intended to explain the changes, and describe upcoming changes in the tool.

Direct soil nitrous oxide for mineral soils: We ceased implementing the practice-scaled emission factor rate adjustments for no-tillage and for enhanced efficiency products (slow-release fertilizers and nitrification inhibitors) in the soil nitrous oxide model. These are described in Eve, et al. (2014) *Quantifying Greenhouse Gas Fluxes in Agriculture and Forestry: Methods for Entity-Scale Inventory*, page 3-62, equation 3-9. After extensive analysis and consultation with the method's authors, we determined that these factors could only be applied under conditions that strictly limited the scenario modeling flexibility designed into the COMET-Farm tool. Users may still assess how converting from intensive tillage to no tillage affects nitrous oxide emissions in the COMET-Planner tool.

In addition to this change, The COMET-Farm tool is shifting to using the IPCC recommendations for a background N2O-N emissions of 1 kg N2O-N per hectare, in lieu of calculating the net contribution of nitrogen from organic matter mineralization. For an explanation, see page 11-10, footnote 7, from De Klein *et al. (2006)* Chapter 11: N_2O Emissions from Managed Soils, and CO_2 Emissions from Lime and Urea Application, in 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

These changes address issues wherein certain use cases within the tool led to double-counting and under-counting of emissions. For example, in the case where users were applying an organic matter addition such as manure or compost in combination with growing a cover crop, the direct soil N2O prediction double-counted the contributions of organic matter and cover crops. In addition to this, we discovered through internal analysis that the DayCent model, as configured in the version currently used in the tool, could not provide an external variable to the COMET Tool to predict the N contributions from a combination of soil organic matter mineralization, manure/compost decomposition, and cover crop decomposition.

Indirect soil nitrous oxide for mineral soils: The emission factors used within the indirect mineral soil N_2O model included a number of uncertainty distributions described as "uniform", with upper and lower bounds that were not uniformly distributed about the mean. For example, the emission factor "Fraction of synthetic nitrogen that volatilizes as NH_3 and NO_x" is listed with an estimated value of 0.1, with a lower bound of 0.03 and an upper range of 0.3 (0.1 +0.2/-0.07) (Eve, et al. 2014, page 3-72, table 3-11). We discovered through extensive analysis that when implemented as a uniform distribution as part of a Monte Carlo method to propagate uncertainty, the net effect of this probability density function is to increase the overall nitrous oxide prediction for the scenarios. After consulting with the original authors of this method, the USDA Climate Change Program Office (CCPO), and program officers in the Natural Resources Conservation Service (NRCS), we've received the recommendations for corrected techniques to utilize when implementing the probability density functions described in the methods document, consistent with the methods used in the U.S. National Greenhouse Gas Inventory.

The net effect of this change is that the combined prediction of N_2O provided by the tool for the baseline and conservation scenarios is lower, though the effect on the difference between the baseline and conservation scenarios will vary.

Future Changes: After extensive analysis and coordination with the NRCS and the USDA CCPO, the CSU team is preparing to implement the DayCent model for all future direct and indirect soil N_2O emissions predictions for mineral soils. CSU intends to implement this change before the end of the calendar year 2019. Doing so will better align soil N2O predictions with the U.S. National Inventory, while allowing a more dynamic integration of combined agricultural practices (e.g. combining changes in organic matter additions, cover crops, shifts in crop rotations, and changes in fertilizer applications) in the predictions of their effects on N_2O from mineral soils.