O-25

Session 7) 40th anniversary of N_2O isotopomer research

Combining different methodological approaches for estimating N_2O processes and N_2O reduction

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Global changes caused by anthropogenic activities are altering the cycling of nitrogen (N) in terrestrial ecosystems. For example, droughts of increasing in frequency and severity can stimulate large emission pulses of nitrous oxide (N_2O; a powerful greenhouse gas) when dry soils wet up, but the mechanisms governing the N losses are not fully resolved. Further, more frequent wildfires can favor the colonization of novel pyrophilous or "fire-loving" fungi with the capacity to produce N_2O, yet N_2O isotopic ranges have been characterized in few fungal species, making generalizations difficult. To better understand how global changes are altering the N cycle, we studied drylands in southern California that can experience >6 months without rain and used a culture collection of pyrophilous fungi isolated from wildfire-burned soils to characterize their $\delta^{15}N_2O$bulk, $\delta N_2{}^{18}O^{bulk}$, and $\delta^{15}N_2O^{SP}$ values. Despite the hot and dry conditions known to hinder denitrification, isotope tracers and natural abundance isotopologues of N_2O indicated NO_3^- was reduced within 15 minutes of wetting dry desert soils and that N_2O reduction to N_2 occurred. In contrast to NO_3^-, ^{15}N-NH_4^+ was not found in N_2O, suggesting nitrification cannot account for the N_2O produced in these predominantly aerobic systems. In post-fire environments, we found that while N_2O isotope values for *Neurospora discreta* and *Fusarium tricinctum* closely matched literature values when grown with NO_2^-, *Aspergillus fumigatus*, *Coniochaeta hoffmannii*, *Holtermaniella festucosa*, and *R. columbienses* did not. Further, *Fusarium* sp. $\delta^{15}N_2O^{bulk}$ and $\delta N_2{}^{18}O^{bulk}$ values fell outside literature-derived values when grown with NO_3^-. Overall, we find that despite the hot and dry conditions known to make denitrification thermodynamically unfavorable in many drylands, denitrifiers can endure through hot and dry summers and are key to producing the surprisingly large N_2O emissions when dry desert soils wet up. Further, we find that novel pyrophilous fungi present a unique opportunity to further characterize the isotopic composition of N_2O produced by fungal denitrification, allowing us to better characterize sources of N_2O from ecosystems impacted by global changes.