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Greenhouse Gases in Farm and Forest Soils

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Soils throughout the world are large repositories of organic carbon. It is estimated that the topmost one meter of global soil contains between 3-4 times as much carbon as the entire planetary atmosphere. Soil respiration is the absorption or emission of gases from the soil owing primarily to the action of microbes living within the soil. Soil microbes feed upon decomposing soil biomass and depending on several factors may emit or absorb greenhouse gases such as carbon dioxide, methane, isoprene, and others. The rise of organic, sustainable farming may have a large impact on the worldwide respiration of greenhouse gases from the farmland soils.

The harvesting of trees for forest products may not be explicitly a form of agriculture, but it exhibits many similar gas respiration properties. Their soil, along with farmland worldwide, are a major source of greenhouse gas respiration worldwide. Studies of forest soils includes pristine soils, and soils of forests burned by wildfires, logged forests, and mechanically thinned forests.

We have used a portable, battery powered quadrupole mass spectrometer to measure the relative concentrations of greenhouse gases CO2, CH4, and isoprene, along with water vapor concentrations in the soils of land practicing sustainable organic farming and in the soils of a large ponderosa pine forest. Soils measured in this study show a reasonably strong correlation between greenhouse gas concentrations and soil water vapor content. In this study, soil CO2 concentration generally rises as water vapor content increases while CH4 concentration increases as water vapor in the soil decreases. This is observed most strongly in the tilled soils, pristine forest soils and recovering burned and logged forest soils. This result is likely the result of CH4 oxidation decreasing as soil water content decreases. An exception to this trend for methane was observed in the organic fruit orchards. Higher relative CH4 levels were measured along with high levels of soil isoprene. Here, isoprene producing bacteria are likely dominant, resulting in the higher CH4.

Biography

Dr. Porter received his Ph.D. in physics from Arizona State University in 1988. In 1988, he became a Professor at Northern Arizona University in Flagstaff, AZ. In 22 years at NAU, Dr. Porter served as a faculty member, Department Chair, and Director of the Growing Biotechnology Initiative at NAU. He has published over 90 scientific papers in peer-reviewed journals and holds 10 U.S. and international patents related to his work in the area of chemical and biological microsensors. Other research interests include low energy ion scattering, interaction of biomolecules with layered silicates, and nano-structured materials for the storage of electrical energy. Dr. Porter served as the Dean of the College of Sciences at University of Nevada Las Vegas from 2010 until 2016 and is now w Professor in the Department of Physics and Astronomy. Dr. Porter is also a veteran of the U.S. Air Force and Air National Guard

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