

Greenhouse Gases

Soils affect many of the processes that can mitigate or exacerbate global change. Many NIFA activities relate to the potential for soil to serve as a sink for greenhouse gases.

Carbon and nitrogen cycles

The most important greenhouse gases are carbon dioxide (CO₂), nitrous oxide (N₂O), and methane (CH₄). While these gases have many non-agricultural sources, soil organisms and soil conditions play a major role in the consumption and production of these gases. Judicious management of soils can have a tremendous potential for helping to control or reduce these gases.

Soil microorganisms control many of the processes that transform organic carbon into the greenhouse gas carbon dioxide. At the same time, soils supply support, water, and nutrients necessary for plants to grow and fix carbon dioxide in organic form. Soils can also be either a source (chemical reduction) or sink (oxidation) for methane, another carbon-containing greenhouse gas, depending on soil conditions, such as wetness, microbial community, crop productivity, and soil chemical and physical properties.

Many nutrients, including nitrogen, are recycled into usable forms by soil microorganisms and/or are stored and held against loss to ground and surface water by soil particles. Atmospheric nitrogen is fixed in organic form through free-living soil organisms and by symbiotic associations of soil microorganisms and plants. Organic nitrogen can then be mineralized to ammonia and oxidized to nitrate (both usable by plants) by soil microorganisms. They can be transformed to nitrogen gas and/or the greenhouse gas nitrous oxide by other microorganisms. The balance of these processes and potential of soils to exacerbate or mitigate greenhouse gas concentrations in the atmosphere depends on physical, chemical, and microbiological properties of soils, as well as climatic conditions, soil and crop management practices, vegetation, and atmospheric composition.

NIFA supports research, education, and extension activities in all of these areas through competitive and non-competitive grants and through collaboration with our land-grant partners and in interagency cooperation and planning.

Ecosystems

Soils and soil organisms form an integral part of natural and managed ecosystems that can be altered by climate change and can affect the concentrations of greenhouse gases through respiration, sequestration, and photosynthesis. The various components of ecosystems all interact to determine the overall response of the system to changing climate and atmospheric composition, as well as the feedback to the atmosphere to mitigate or exacerbate potential future climate change. Each type of ecosystem in each different region, soil type, and type and level of management may react differently to changing conditions.

NIFA supports research, education, and extension activities aimed at understanding and eventually being able to predict and manage these effects through competitive and non-competitive grants and through collaboration with our land-grant partners and interagency cooperation and planning.