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ORNL's Terrestrial Ecosystem Science – Scientific Focus Area (TES SFA): A 2018 Overview

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Project: ORNL Terrestrial Ecosystem Science SFA

Project Website: <http://tes-sfa.ornl.gov/> and <http://mnspruce.ornl.gov/>

Understanding responses of ecosystem carbon (C) cycles to climatic and atmospheric change is the aim of the Terrestrial Ecosystem Science Scientific Focus Area (TES SFA). Our vision is to:

Improve integrative understanding of terrestrial ecosystem processes to advance Earth System predictions through experiment-model-observation synergy.

The TES SFA is guided by the vision that sensitivities, uncertainties and recognized weaknesses of Earth System Model (ESM) predictions inform observations, laboratory and field experiments and the development of ecosystem process modeling. In turn, predictive understanding and findings from the field and laboratory, and improved process modeling are incorporated (with the associated uncertainties) into ESMs as explicitly and expeditiously as possible. Overarching science questions are:

1. How will atmospheric and environmental change affect the structure and functioning of terrestrial ecosystems at scales from local to global and from decadal to centuries?
2. How will fossil fuel emissions and terrestrial ecosystem processes, mechanisms, interactions and feedbacks control the magnitude and rate of change of atmospheric CO₂ and other greenhouse gases?
3. What are the climate-induced shifts in terrestrial hydrologic and ecosystem processes that inform assessment of climate change impacts on ecosystem services and society?

The ongoing science includes large manipulations, C-Cycle observations, database compilation, and process studies integrated and iterated with modeling activities. The centerpiece of our climate change manipulations is the SPRUCE experiment testing multiple levels of warming at ambient and elevated CO₂ on the C feedbacks from a black spruce–*Sphagnum* ecosystem. New SPRUCE results in 2018 include a comprehensive analysis of the C cycle and root production in peatlands, a full evaluation of *Sphagnum* gross primary production, a new publication on the negative response of lichens to warming environments, publications regarding the improvement of peatland ecosystems models, and a number of collaborator publications on bog biogeochemistry. The Fine Root Ecology Database (FRED) has begun to generate published commentaries, and Version 2.0 will be released early in 2018. Work at the Missouri Ozark eddy flux site has advanced our understanding of temperate forest responses to drought and data that were collected from ORNL-designed instrumentation on solar-induced chlorophyll fluorescence used to evaluate OCO-2 advanced photosynthesis observation from space. The TES SFA aims to integrate experimental and observational studies with model building, parameter estimation, and evaluation to yield reliable model projections from site to global scales. New modeling results in 2018 include new methods to estimate model parameter sensitivities and calibration with observations.