Peter Thornton

Seminar Title:

Putting ecosystem science in Earth system models

Summary:

As we grow our knowledge of ecosystems through observation and experimentation, models can help us organize what we learn into a self-consistent and predictive understanding of Earth system interactions. Some of the most pressing questions facing humanity require an integrated scientific consideration of processes operating across scales from molecules to the entire Earth, and from seconds to centuries. Earth system modeling is one approach to answering questions about the future of life and its co-evolution with physical systems, synthesizing process knowledge for the atmosphere, oceans, ice, land, ecosystems spanning all these domains, and human systems operating within them.

Constraints imposed by computation and by the availability of data force Earth system models to operate at a relatively coarse spatial resolution, usually many times larger than the scales of ecosystem observation and experimentation. Constraints imposed by fundamental process understanding also restrict the level of ecosystem detail that can be included in global-scale models. An important challenge, then, is to migrate our best current understanding of ecosystem processes into these constrained frameworks, while retaining enough mechanistic detail to result in improved prediction skill for the fully coupled Earth system model.

This presentation will examine the problem of improving Earth system prediction from the perspective of adding new mechanistic understanding of ecosystem processes. The difficulties of spatial scale and process resolution, and some solutions, are addressed through examples including the representation of coupled carbon and nutrient dynamics, prediction in the extreme environment of the Arctic tundra, and resolving the interface between land and ocean in coastal wetlands.

Biography:

Dr. Thornton is a Corporate Fellow in the Environmental Sciences Division at Oak Ridge National Laboratory (ORNL). He studies biogeochemistry of land, coastal, and aquatic ecosystems, and incorporates that knowledge into global-scale models to improve predictions of future climate. His research spans spatial scales from plots to the global Earth system. He is the Director for ORNL's Climate Change Science Institute (CCSI), which brings together researchers from across the Lab with shared interests and expertise in climate change science, impacts, and solutions.