National Center for Atmospheric Research

Climate and Global Dynamics • Terrestrial Sciences Section

NCAR

Gordon Bonan, Senior Scientist
P.O. Box 3000 • Boulder, CO 80307-3000
Tel: 303.497.1613 • email: bonan@ucar.edu
Web: http://www.cgd.ucar.edu/staff/bonan

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Dear Award Committee:

It is with great pleasure that I write a letter in support of Nick Smith's nomination for an ESA Early Career Fellow. I have known Nick for several years and have collaborated with him while he was a graduate student and post-doc on several projects related to photosynthesis and how to represent this important process in Earth system models. Nick has subsequently established a vibrant research program as an assistant professor at Texas Tech. I continue to collaborate with him in various capacities. Nick is well-qualified for this award. He is a plant physiologist, ecosystem ecologist, and global modeler of the biosphere. His research combines observations, theory, and macroscale models of the Earth system to understand ecosystem responses to global change and biosphere-atmosphere interactions.

Our understanding of global change ecology has expanded from a disciplinary view that emphasizes the impacts of climate change on ecosystems to one in which ecosystem functions significantly feed back to influence climate change. Accordingly, global climate models have expanded beyond their atmospheric physics roots to include terrestrial ecosystems, biogeochemical cycles, vegetation dynamics, and land-use change. Ecological forcings and feedbacks are now recognized as important for climate change simulation, and our models have become models of the entire Earth system. The theoretical basis for these models, their development and verification, and experimentation with these models requires a new generation of scientists versed in biological sciences, atmospheric sciences, and other Earth sciences. Nick is one of these multidisciplinary scientists.

Nick is an expert in the physiology of photosynthesis and respiration. He has a strong theoretical understanding of these processes gained by extensive field and laboratory data collection. A primary focus of Nick's research has been to study temperature acclimation. He is a recognized leader in the physiology of acclimation and has authored several manuscripts that have studied acclimation from an experimental and modeling basis. Nick has an excellent grasp of how to incorporate temperature acclimation in models. He has collaborated with me on projects to incorporate temperature acclimation in the Community Land Model, the terrestrial component of our Earth system model. The initial research focused on the carbon cycle consequences of temperature acclimation. Nick followed up the project with additional simulations in which he analyzed the climate consequences of changes in stomatal conductance resulting from temperature acclimation. That manuscript significantly adds to the body of literature regarding stomatal conductance and its role in climate. Nick also has had several other manuscripts on the consequences of temperature acclimation on land carbon uptake in Earth system models. Nick subsequently collaborated with me to understand the role of triose phosphate utilization (TPU) in photosynthesis. Limitation of photosynthetic carbon uptake by TPU is poorly known, and is even more poorly represented in models. Nick brought his physiological expertise to the problem in a co-authored modeling study in which we reviewed the evidence for TPU limitation and examined the consequences this has on the global carbon cycle. More recently, Nick's research has moved to consider optimality theory as a means to understand photosynthesis in a changing environment. His

contributions in this area provide an innovative way to incorporate advanced physiological theory into our Earth system models.

Nick uses multi-scale, complex data streams in combination with macroscale models to answer novel questions about biosphere-atmosphere interactions and the role of terrestrial ecosystems in creating planetary sustainability. He collects his own data as needed, using in situ observations or manipulative experiments as appropriate. He also works with plant trait databases spanning species and sites from around the globe to develop physiological theories of plant functioning and to test the generality of his theories in multiple environments. In this way, his research contributes to an understanding of ecological processes from individual sites to global scales. Such research requires an expert in ecological measurements and models, who can readily converse with both the observational and modeling communities, and who can work with diverse data from leaf-scale photosynthetic measurements, to ecosystem-scale measurements of carbon and nitrogen, to globally gridded output of Earth system models encompassing tens of thousands of model grid cells and hundreds of years of simulation. Nick is well-versed in all of these areas.

Nick is an innovative and productive early career scientist. He has a prodigious publication record. His research is at the forefront of linking physiological processes with large-scale geophysical models of climate and examining the consequences of these processes for climate and Earth system functioning. He has a firm grasp of theory, observations, and models – their theoretical foundations, their strengths and weaknesses, and how to appropriately use models and observations to test hypotheses of the coupled biosphere-atmosphere system. He is a rare individual who can combine field and laboratory experiments with Earth system models. As more ecology is added to our Earth system models, and as ecological processes are being recognized as fundamental to climate science, we need more ecologists who can successfully bridge the two fields of science. I have no doubt that Nick will continue to have a highly successful career as a well-respected and influential researcher and that he will continue to make significant contributions to the science.

Sincerely,

Fellow, Ecological Society of America, American Geophysical Union, American Meteorological Society