Title: Should Terrestrial Biosphere Models Remove Triose Phosphate Utilization Limitation from Their Representation of Photosynthesis?

Alistair Rogers[1], Dushan P. Kumarathunge[2], Danica L. Lombardozzi[3], Shawn P. Serbin[1] Belinda E. Medlyn[4], Anthony Walker[5]

[1]Environmental and Climate Sciences Department, Brookhaven National Laboratory, Upton, NY [2]Plant Physiology Division, Coconut Research Institute of Sri Lanka, Lunuwila, Sri Lanka [3]Climate and Global Dynamics Division, National Center for Atmospheric Research, Boulder, CO [4]Hawkesbury Institute for the Environment, Western Sydney University, Penrith, Australia [5]Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN

Contact: (arogers@bnl.gov)

Project Lead Principle Investigator (PI): Jeff Chambers (LBNL) & Stan Wullschleger (ORNL)

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Project Abstract: Triose phosphates are the principal product of photosynthesis. They are utilized within the chloroplast for starch synthesis or translocated to the cytosol where they fuel sucrose synthesis. However, the limitation of photosynthesis by the triose phosphate utilization (TPU) rate can occur when the capacity for sucrose and starch synthesis are not sufficient to maintain a phosphate pool size that is capable of meeting the demand for ATP synthesis and the subsequent use of that ATP by the Calvin-Benson cycle. The Farquhar, von Caemmerer & Berry (FvCB) model of photosynthesis is at the heart of many terrestrial biosphere models (TBMs) that seek to understand the global carbon cycle and project the response of the terrestrial biosphere to global change. Several TBMs include representation of the TPU limited rate of photosynthesis as a potential limitation of photosynthesis. However, representation of TPU limitation in TBMs is currently based on an arbitrary relationship with the maximum carboxylation capacity. Furthermore, recent work has (1) demonstrated the sensitivity of TBM output to model representation of TPU, (2) revealed potential artifacts within some TBMs that exaggerate the impact of including formulations of TPU limitation, (3) showed that when measured under growth conditions TPU limitation rarely limits photosynthesis, even at low temperature. Collectively, these advances, suggest that current model formulations of TPU limitation should be removed from TBMs until we have an improved understanding and model representation of this process.