BIOME-BGC: MODELING EFFECTS OF DISTURBANCE AND CLIMATE (THORNTON ET AL. 2002)

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Biome-BGC: Modeling Effects of Disturbance and Climate (Thornton et al. 2002)

Summary:

This archived model product contains the directions, executables, and procedures for running Biome-BGC, Version 4.1.1, to recreate the results of:

> Thornton, P. E., B. E. Law, H. L. Gholz, K. L. Clark, E. Falge, D. S. Ellsworth, A. H. Goldstein, R. K. Monson, D. Hollinger, M. Falk, J. Chen, and J. P. Sparks. 2002. Modeling and measuring the effects of disturbance history and climate on carbon and water budgets in evergreen needleleaf forests. Agricultural and Forest Meteorology 113:185-222.

Abstract:

The effects of disturbance history, climate, and changes in atmospheric carbon dioxide (CO2) concentration and nitrogen deposition (Ndep) on carbon and water fluxes in seven North American evergreen forests are assessed using a coupled water, carbon, nitrogen model, canopy-scale flux observations, and descriptions of the vegetation type, management practices, and disturbance histories at each site. The effects of interannual climate variability, disturbance history, and vegetation ecophysiology on carbon and water fluxes and storage are integrated by the ecosystem process model Biome-BGC, with results compared to site biometric analyses and eddy covariance observations aggregated by month and year. The model produced good estimates of between-site variation in leaf area index, with mixed performance for between- and within-site variation in evapotranspiration. There is a model bias toward smaller annual carbon sinks at five sites, with a seasonal model bias toward smaller warm-season sink strength at all sites.

Data Citation:

Cite this model product as follows:

Thornton, P. E. 2005. Biome-BGC: Modeling Effects of Disturbance and Climate (Thornton et al. 2002). ORNL DAAC, Oak Ridge, Tennessee, USA. http://dx.doi.org/10.3334/ORNLDAAC/806.

References:

Thornton, P.E., Law, B.E., Gholz, H.L., Clark, K.L., Falge, E., Ellsworth, D.S., Goldstein, A.H., Monson, R.K., Hollinger, D., Falk, M., Chen, J. and Sparks, J.P., 2002. Modeling and measuring the effects of disturbance history and climate on carbon and water budgets in evergreen needleleaf forests. Agricultural and Forest Meteorology 113:185-222.

Model Product Description:

The directions for installing and running Biome-BGC, Version 4.1.1, using the executables and procedures archived in BIOME-BGC_fluxnet2.zip are provided in the companion file thornton_2002_msarch_readme.pdf.

Additional model information is provided in Thornton et al., 2002.

The Biome-BGC model was used to simulate fluxes and storage of water, carbon, and nitrogen at each measurement site. The Biome-BGC (version 4.1.1) was designed explicitly for the purpose of studying the influences of climate, disturbance and management history, atmospheric chemistry, and plant ecophysiological characteristics on the terrestrial components of the carbon, nitrogen and water cycles.

Daily surface weather data are the fundamental drivers for Biome-BGC. Given a record of daily weather, a description of the site vegetation ecophysiology, and some simple site physical characteristics, the model estimates the daily fluxes of carbon, nitrogen, and water between the atmosphere, plant state variables, and litter and soil state variables. LAI is predicted as a function of the amount of leaf carbon, one of multiple vegetation state variables that are updated every day according to the estimated fluxes. The vegetation type, as defined by a set of ecophysiological characteristics, is assigned by the user and does not change over time. The state of the assigned vegetation type is fully prognostic: the model simulates changes in

structure over time as interacting functions of disturbance history, the meteorological drivers, and the constant ecophysiological characteristics of the vegetation type.

The analysis consisted of model initialization followed by a series of simulations designed to replicate as closely as possible the known disturbance history of each site. The results of the site-specific disturbance history simulations were compared with recent eddy covariance and biometric measurements at the sites. The timing and magnitude of fluxes during recovery from disturbance were related to environmental factors, disturbance history, and the timing of disturbance with respect to historical changes in CO2 and Ndep.

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