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Ecophysiological Parameters for Pacific Northwest Trees

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Abstract

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We developed a species- and location-specific database of published ecophysiological variables typically used as input parameters for biogeochemical models of coniferous and deciduous forested ecosystems in the Western United States. Parameters are based on the requirements of Biome-BGC, a widely used biogeochemical model that was originally parameterized for the forests of the Pacific Northwest. Several other ecosystem models, including Century 5, Daycent, TEM, and PnET, also use some of the inputs described here. This database provides a compendium of ecophysiological data for the Pacific Northwest that will provide easily accessible information for particular tree species, parameters, and ecosystems for application to simulation modeling.

Keywords: Ecological modeling, ecophysiology, Pacific Northwest forests.

Summary

Ecosystem models use input parameters including physiology, biochemistry, structure, and allocation to describe processes and fluxes such as productivity, nitrogen cycling, and water relations. Many ecosystem models useful for investigating these interactions are grounded in ecophysiological relationships originally measured in the laboratory or field, typically at scales ranging from the leaf to the plot level. These lab- or field-based measurements serve as both parameterization and validation data sets for ecosystem models and therefore play a crucial role in current and future model development and implementation.

Ecophysiological parameters for biogeochemical models have been measured for Pacific Northwest tree species on a variety of sites with multiple age classes. However, locating these parameter values in the literature can be difficult and time consuming especially when multiple species or community types are included in a model. Furthermore, these values may have been measured by using different methods or recorded in different units.

We developed a summary of critical ecophysiological values for biogeochemical model parameters through a search of the scientific literature and expert opinion. Parameters are based on the requirements of Biome-BGC, a widely used biogeochemical model that was originally parameterized for the forests of the Pacific Northwest. Having this information in an easily accessible database will make future modeling efforts with Biome-BGC and other models more efficient and consistent.

Introduction

Recent efforts to model rapid changes in global climate and atmospheric biochemistry require a detailed understanding of how biochemistry, biophysics, and plant responses interact across local, regional, and global scales (Waring 1993). Although some of these interactions can be measured at local scales, empirical estimates of these processes at regional and global scales are not yet tenable. Simulation modeling provides an essential tool for exploring these complex interactions at larger spatial scales (Running 1994). Ecosystem models use input parameters including physiology, biochemistry, structure, and allocation to describe processes and fluxes such as productivity, nitrogen cycling, and water relations. Many ecosystem models useful for investigating these interactions are grounded in ecophysiological relationships originally measured in the laboratory or field, typically at scales ranging from the leaf to the plot level. These lab- or field-based measurements serve as both parameterization and validation data sets for ecosystem models and therefore play a crucial role in current and future model development and implementation.

Ecophysiological relationships of forest ecosystems, especially in the Pacific Northwest of North America, have been studied extensively. Many critical ecophysiological parameters for biogeochemical models have been measured for individual species on a variety of sites with various age classes present. However, locating these parameter values in the literature can be difficult and time consuming, especially when multiple species or community types are included in a model run (Running 1994). Although data exist for many species, these values are difficult to locate and standardize for several reasons: (1) data were printed in older publications (pre-1980) that are not catalogued in online databases; (2) data were published in obscure journals or gray literature; (3) data collection methods and units differ substantially for some parameters, making standardization difficult. Despite these difficulties, it is critical that important parameter values and all references for these parameter values be provided for any model-based study (Aber 1997, White et al. 2000).

In biome-based ecosystem models, commonly measured ecophysiological variables taken from a large number of observations of many communities and locations are typically averaged across broad vegetation classes (e.g., evergreen needleleaf, broadleaf deciduous, etc.) to generate default parameterization values (Neilson 1995, White et al. 2000). These default values may include data collected from low-elevation to subalpine locations, mesic to xeric sites, and recently disturbed to old-growth forests. Thus, the average or default values include a high degree of variability even within these broad vegetation types. New parameterization data sets may be required to apply existing models to new locations, to parameterize

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Appendix A: Instructions

Microsoft Access[®] Users

One search form, built into the database, allows users to search for all data by species, parameter, and location, then allows users to view and print the parameter values and citations to a file. This file can be printed as text or downloaded to other applications (Microsoft Excel[®]). The data also can be accessed as a series of text files that can be used with a variety of applications. Advanced Microsoft Access[®] users may wish to forgo the search form and create their own queries on the database by using Microsoft Access[®] query tools.

Text or Other Database Users

Seven comma-delimited text files also have been included on the CD-ROM attached to this publication to allow researchers who are using software other than Microsoft Access[®] to use the database. These files are entitled:

- Parameters.txt—includes a list of parameters and definitions
- Parameter-Location.txt—links parameters with locations
- Parameter-Species.txt—links parameters with species
- ParameterValues.txt—includes parameter values, species, site, and reference information (this is the critical table)
- References.txt—includes the list of references for the parameter values
- Species.txt—defines the species, scientific name, four-letter acronym, and common name for all species included
- Location.txt—defines the abbreviation for place names used in ParameterValues

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