United States Environmental Protection Agency
Office of Research and Development
Washington, DC 20460

EPA /600/F-05/004
April 2005

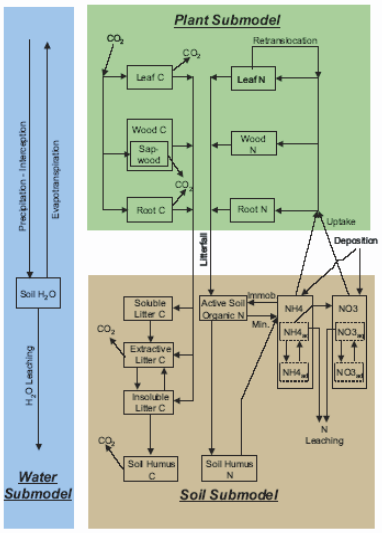
TERRESTRIAL ECOSYSTEM STUDIES AT THE WESTERN ECOLOGY DIVISION

A Series of Models for Management of Water, Nutrients, and Chemicals at Watershed Scales

Increasing pressures from urbanization, farming practices, and continued industrialization have put many of the country's watersheds at risk from nutrient run-off or toxic chemicals. Our research increases our understanding of how to assess, improve, and restore the integrity and sustainability of ecosystems.

Ecosystem Models

We are using a series of models to improve risk predictions for streams and watersheds, including understanding effects to wildlife and their habitats. These models each represent a part of the system. They are then linked together to represent processes of the entire watershed. They include plant community models (e.g., FORCLIM for forests), surface hydrology models (e.g., TOPMODEL), biogeochemistry models (e.g., GEM), and spatially explicit wildlife population models (e.g., PATCH).



General Ecosystem Model (GEM)

By linking these models, we will replace weaknesses inherent to each class of models with the strengths of the others. For example, the strength of FORCLIM (a forest community model) is in the way it predicts changes in plant species as a result of natural or human-induced stress (such as fire or timber harvest). It uses highly simplified approaches for simulating changes in the availability of resources that limit the growth of trees, such as carbon and nitrogen. GEM (a **G**eneral **E**cosystem **M**odel), on the other hand, takes a more realistic approach to predicting the availability, uptake, and redistribution of carbon and nitrogen within the watershed. This increases the accuracy of the information used by FORCLIM, making the whole prediction of forest changes much more accurate. Similarly, another model under development is a sophisticated description of movement of water through surface soils within the watershed, another important input to plant community models. Once we can describe changes in the plant community, we will then be able to predict what might happen to the wildlife that live in these forests. We will use a model called PATCH that is under development by another research project at WED.

A Forested Watershed

Water Quality

The models we are using in this research were designed originally to describe potential changes to terrestrial systems. However, they also give us information about the seasonality, chemical composition, and amount of water and nutrients (or toxics) that will be discharged to streams, rivers, and lakes within the watersheds. The surface water hydrology model, for example, will show us the movement of rain and snowmelt through soils and into water bodies. We will then be able to predict the severity of floods and droughts. Some pollutants will move along with the water gradient, and so we will also predict the amount of discharges and stream water quality. This applies to nutrients (such as nitrogen) as well, as the General Ecosystem Model (GEM) explicitly quantifies how these will move through the soils and into streams and rivers.

Our models are particularly well-suited to predicting pollution of streams and rivers, a major problem currently facing the agency.

For more information, contact:

Robert B. McKane
Project Leader

mckane.bob@epa.gov
(541)754-4631

Western Ecology Division, NHEERL, US EPA
200 SW 35th Street
Corvallis, OR 97333
http://www.epa.gov/wed/