RHESSys - Introduction and Overview

The Regional HydroEcological Simulation System, RHESSys, is a spatial data processing and simulation system designed to estimate the spatial patterns of forest productivity, as well as water and carbon budgets of terrestrial ecosystems. The computer system takes as input information describing the characteristics of the forest canopy, soils, topography and meteorology of an area and estimates the net energy, water and carbon exchange between the landscape and the atmosphere. The set of computer outputs includes forest productivity for the distribution of forest stands, the runoff and streamflow from watersheds, and the effectiveness of the landscape as an absorber of atmospheric carbon dioxide.

The system has been jointly developed by research teams at the University of Toronto, led by Professor Larry Band, the University of Montana, led by Professor Steve Running and at NASA/Ames Research Center, led by Dave Peterson and was initially designed to operate in western coniferous forests. The set of computer models have been expanded to include different forest biomes. One of the major foci of the research groups has been to develop the capability to flexibly represent ecosystem processes over the scale range of single stands to regional extents. The system has been adapted to the ecosystems of Ontario by adding specific modules to account for the range of terrestrial biomes and terrain conditions common to the province.

An important feature of RHESSys is the distributed approach to ecosystem process computations which allows the spatial interactions of ecological and hydrological processes to be represented at the landscape level. This gives RHESSys the ability to estimate ecological limitations based on local water limitations as well as waterlogging and nutrient limitations, both of which are common in Ontario. In addition, the rang of ecological and hydrological variables that can be estimated in an integrated manner promotes a multi-resource evaluation of landscape ecological systems as well as the effects of harvesting patterns and other forms of disturbance. The model can be used to estimate spatial patterns of ecosystem processes across a range of scales, which can be compared and combined with measured landscape characteristics using a combination of sampling approaches ranging from FEC and FRI information, to stream runoff production and other hydrological and ecological observations. The carbon and biomass budget predictions can be translated into forest productivity by computing or specifying carbon allocation patterns and converting accumulated biomass to stemwood volume.

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