Published on *EOSDIS - Earth Data Website* (http://earthdata.nasa.gov)

Transcending Boundaries [1]

by Annette Varani
Published in 1995

This is the land. We have our inheritance. -T.S. Eliot

Role of net primary productivity in larger models is investigated.

The graceful transubstantiations of carbon as it cycles from atmosphere to green plants, and the consequent release of energy to the biosphere, while having mystical aspects, can hardly remain an article of faith. Tracking net primary productivity (NPP) helps us know the condition of the Earth's land surface and have better appreciation for ecosystem processes. modeling and monitoring NPP allows humankind to be in closer communion with the planet, providing the knowledge to temper land use and practices, and influence resource policy making toward greater food security.

For these reasons global terrestrial vegetation is one of the most-modeled ecological systems. However, because they are inconsistently characterized, vegetation models which provide NPP are often difficult to couple with other Earth systems models, hindering the development of large-scale biogeochemical models that could help in understanding global interactions and in forming predictions. The inconsistencies between model results prompted a team of scientists to assess and coordinate modeling activities under the International Geosphere-Biosphere Program (IGBP).

The Global Analysis Interpretation and modeling task force (GAIM) is the integrative element of the IGBP, says its director, Dork Sahagian. "Our main goal is to promote the development of integrated prognostic biogeochemical models of the Earth system. To do this, we try to make sure that the appropriate modeling communities are in touch with each other for larger scale integration.

"There are many independent ways to model the Earth," Sahagian says. "Within each global model are subsystem models. GAIM is trying to develop a suite of consistent sets of subsystem models which can be coupled into several different but equally valid Earth system models. But each subsystem model must be compatible with the next so that each provides the next with the boundary conditions and fluxes it needs.

"We are beginning to understand and model various Earth subsystems, such as terrestrial ecosystems, marine systems, the atmosphere, and coastal zones. But the connections between them are not well understood," he says.

"In a global system, the boundary conditions of each Earth subsystem become the boundary conditions of the next. For instance, the boundary between land and ocean is the coast. The characteristics of fluxes, such as rivers, that cross that boundary need to be matched between the two models. In order to match boundary conditions you also need to match the processes and parameters in the adjoining models.

"A big problem we have is comparing models of net primary productivity where parameterizations are very different. Some models use Normalized Difference Vegetation Index (NDVI) and photosynthetically active radiation (PAR), while others use leaf area index (LAI), temperature, and other parameters. Parameter mismatches can create problems when coupling models.

"In the case of NPP, we've had two workshops trying to compare model results, and the comparison has been difficult because of the problem of not matching apples to apples. It's one thing when the parameterizations are different, but even worse when the input data sets are different. Then, not only can you not match processes, you can't even match initial conditions."

With these issues in mind, researchers involved in an NPP model intercomparison project under GAIM rely

extensively on NDVI data from the International Satellite Land Surface Climatology Project (ISLSCP) Initiative I data collection, available from the Goddard DAAC.

Usually, global NPP models are either statistical comparisons (for example, relating annual precipitation and temperature to NPP), descriptions of macroscopic processes occurring within ecosystems, or descriptions of processes underlying plant growth, such as photosynthesis and respiration, and their interrelation with environmental conditions like soil type and climate. Historically, there has been a paucity of global data containing the variables needed to parameterize and validate primary production models.

"There's always a lack of good data," Sahagian says. "It's a big problem because you're looking at a changing system for which we have data mostly for the present. We don't have data for the past, of course we have nothing for the future, so the problem arises in using present data to characterize a changing system, knowing that the system may not be in equilibrium with the data we're observing."

The ISLSCP Initiative I data collection resulted in response to recommendations emerging from a 1992 workshop attended by modelers, algorithm developers and field experiment scientists considering just such data needs as Sahagian describes.

"ISLSCP is not really one-stop shopping" Sahagian concedes, "but it's not bad." Initiative I contains 23 data sets drawn from 1987 through 1988 satellite data, ground data and model output, mapped (with one exception) to a 1-degree square grid.

For the NPP Model Intercomparison Project, ISLSCP data are used primarily as input to models, Sahagian says, which are then validated against ground-based, site specific data. "And that's another big problem," he says.

"We're trying to develop some method for scaling so that we can integrate local fine-scale data into global models which are mostly based on ISLSCP-style data of lower resolution." The issue of scaling was addressed at the April 1996 IGBP conference in Germany.

"Certainly, GAIM is in its infancy," Sahagian says. "Some of the subsystem models are coming along -- they're not completely mature, but developing, and beginning to provide some answers. The linkages between the subsystem models are still in planning stages and that's what GAIM has been charged to develop."

Besides envisioning the development of a prognostic biogeochemical model integrating all subsystem models that could then be coupled with physical climate models, Sahagian sees the addition of a third element in the form of the International Human Dimensions Program.

"If we can begin to predict changes in socioeconomic development within and between various regions, and thereby predict land use and emissions changes, we could fix another variable in the global carbon cycle. But that's in the future," he says. For now, GAIM is focused on clarifying the key scientific issues, such as data needs and consistent model parameterization, scaling, and validation, that confront modelers.

Reference(s)

Sellers, P. J., B. W. Meeson, F. G. Hall, G. Asrar, R. E. Murphy, R. A. Schiffer, F. P. Bretherton, R. E. Dickinson, R. G. Elligson, C. B. Field, K. F. Huemmrich, C. O. Justice, J. M. Melack, N. T. Roulet, D. S. Schimel, and P. D. Try. 1995. Remote sensing of the land surface for studies of global change: Models - algorithms - experiments. Remote Sensing of Environment. 51(3):3-27.

Source URL: http://earthdata.nasa.gov/featured-stories/featured-research/transcending-boundaries

Links:
[1] http://earthdata.nasa.gov/featured-stories/featured-research/transcending-boundaries