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The Magic of Water [1]

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Global soil wetness project is generating improved soil wetness data.

"If there is magic on this planet, it is contained in water," wrote the anthropologist Loren Eisely. He must have been thinking particularly of the alchemy of water on land, through which particular magic, according to some accounts, even the species is supposed to have achieved flesh and blood. It's not a bad idea, considering our rudimentary understanding of the power of soil moisture to influence regional and global climate, and what we know about the circular relationship water in the soil has to that in the atmosphere, given a little vegetation and sunshine.

Soil moisture is one of the components of land-surface evapotranspiration, and is a required parameter for evaporation calculations. Its critical role in the process has been made evident by many studies finding that evaporation and precipitation decrease over time in areas where forest canopy has been reduced. Such overgrowth preserves soil moisture; removing it allows for increased surface albedo as well as a rise in surface temperatures. When the intimacy between soils and vegetation types is disturbed altering soil moisture levels, original plant species cannot always be reestablished under the altered conditions. Winter precipitation is also held in soils, humidifying the atmosphere over summer months.

Scientists (indeed, even ordinary citizens) have known for many years that soil moisture levels and dependent systems have profound effects on climate. The conundrum for climate modelers is that total soil moisture storage cannot be directly measured. While point measurements of soil moisture are taken around the world, it is not possible to measure how much mud there is at any one time on the planet, know its depth or relative dryness. Yet, a realistic initialization of the soil moisture field is required for climate simulations.

This soil moisture data gap prompted members of the Global Energy and Water Cycle Experiment (GEWEX) International Satellite Land-Surface Climatology Project (ISLSCP) and the GEWEX Numerical Experimentation Panel (G-NEP) to establish a pilot program in 1994 for generating global soil wetness fields, as well as snow cover, surface-atmosphere fluxes and runoff, for use in initializing global circulation models.

"There are few adequate data sets for initializing soil wetness in climate models," says director of the Global Soil Wetness Project (GSWP), Paul Dirmeyer, a research scientist at the Center for Ocean-Land-Atmosphere Studies (COLA). "In climate studies, it's very important to have soil wetness, especially in the summertime for the midlatitudes and just about anytime for the tropics and subtropics.

"The idea behind GSWP is to use the highest quality data available to drive the best, state-of-the-art land surface models available in order to get -- maybe not perfect data -- but the best soil wetness data that has been produced to date."

Land surface modelers involved in GSWP will use the same input data sets, identical soil and vegetation maps, to run their various models. Accordingly, the group selected ISLSCP Initiative I data distributed by the Goddard Space Flight Center DAAC for its global coverage spanning 1987 through 1988, one degree gridded resolution, and for the wealth of geophysical parameters contained in the collection. Output data from all the models will supplement and improve upon some of the Initiative I data, and be at the same global, one-degree resolution.

But besides the advantage of deriving consistent output, "The project is a feasibility study for production of land surface data with models, and to see how well different models compare globally. Most models are rather similar," Dirmeyer says, "but none are perfect." Model intercomparison thus allows for error detection and model refinement, he says.

Data produced by the Global Soil Wetness Project will be validated against regional, site-specific data by project participants at the Center for Climate System Research, University of Tokyo and Japan Meteorological Agency.

Afterwards, the new soil wetness data will be tested in a host of model sensitivity studies focusing on the 1987 and 1988 northern summer seasons, to examine whether these presumably more realistic soil moisture estimations in fact yield improved simulations of that summer season climate. Since extreme rainfall was measured in the midlatitude and monsoon regions in both 1987 and 1988, a large variability in soil moisture and in land-atmosphere evaporation feedback would be expected. But, Dirmeyer reminds, the current project is only a pilot study. No official versions of global soil moisture data will be released by GSWP.

"We need data over a longer time period, better quality data at higher resolution," Dirmeyer explains. ISLSCP Initiative II will be available in 1997. The second ISLSCP data collection will cover 1986 through 1995 and will be offered at a resolution of 0.5 degrees latitude and longitude. In 1998, based on its exhaustive initial study with Initiative I data, GSWP will begin to quantify global soil moisture for Initiative II.

FIFE is currently one of the most extensive studies on soil moisture and surface hydrology, Viterbo says. "We continue to use FIFE data in order to test modifications in our parameterization schemes, and we will certainly use it a lot in connection to the results of the European Centre for Medium-range Weather Forecasts Reanalysis Project."

"If there is magic on this planet, it is contained in water. . . . Its substance reaches everywhere; it touches the past and prepares the future; it moves under the poles and wanders thinly in the heights of air. It can assume forms of exquisite perfection in a snowflake, or strip the living to a single shining bone cast up by the sea."

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