

# GLASS activities in 2002

## 1 Rhône-AGG

The Rhone-AGGregation (Rhone-AGG) experiment was successfully completed this year. This experiment was an intermediate step leading up to the next phase of the Global Soil Wetness Project (GSWP) (Phase 2), for which there will be a broader investigation of the aggregation between global scales (GSWP-1) and the river scales. An overview of the results obtained during this experiment are currently being published<sup>1</sup>. The abstract of the paper is provided below.

*This project makes use of the Rhone modeling system, which was developed in recent years by the French research community in order to study the continental water cycle on a regional scale. The system is comprised of gridded atmospheric data (8 km resolution) derived from 60 Météo-France weather network sites and total daily precipitation data from over 1500 gauges throughout the Rhone basin in southeastern France, a LSS interface using a detailed vegetation database, and a distributed hydrological model.*

*The main goals of this study are to investigate how a variety of LSSs simulate the water balance for several annual cycles compared to data from a dense observation network consisting of daily discharge from over 145 gauges and daily snowdepth from 24 sites, and to examine the impact of changing the spatial scale on the simulations. 15 LSSs submitted 20 simulations to the project. The overall evapotranspiration, runoff and monthly change in water storage were similarly simulated by the LSSs, however the differing partitioning among the aforementioned fluxes resulted in very different river discharges and soil moisture equilibrium states. Sub-grid runoff was especially important for discharge at the daily time scale, and for smaller scale basins. It was also found that snow schemes which use a more complex explicit treatment of the snowpack produced results which best compared with the observations.*

*A series of scaling experiments was performed by the LSSs for which the spatial resolution of the computational grid was decreased to that consistent with large-scale atmospheric models. The impact of upscaling on the domain-averaged hydrological components was similar among most LSSs, with increased evaporation of water intercepted by the canopy and a decrease in surface runoff representing both the most significant and consistent inter-LSS responses. It was also found that the snow water equivalent was significantly degraded by upscaling in all LSSs but one which explicitly modeled elevation effects on the atmospheric forcing.*

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<sup>1</sup>The Rhone-Aggregation Land Surface Scheme Inter-comparison Project: An Overview (2002) A. Boone, F. Habets, J. Noilhan, D. Clark, P. Dirmeyer, S. Fox, Y. Gusev, I. Haddeland, R. Koster, D. Lohmann, S. Mahanama, K. Mitchell, O. Nasonova, G.-Y. Niu, A. Pitman, J. Polcher, A. B. Shmakin, K. Tanaka, B. Van Den Hurk, S. Verant, D. Verseghy, And P. Viterbo, submitted to Journal of Climate

## 2 PILPS-C1

The PILPS-C1 (Project for Inter-comparison of Land Surface Parameterisation Schemes) experiment, which will evaluate the ability of land-surface models to simulate the carbon fluxes at the local scale and in a off-line environment, started during the summer of 2002. This experiment is coordinated by Nicolas Viovy at IPSL.

The recent evolution of land-surface models both for the study of carbon cycle or climate have lead to an improvement of the coupling between biophysical and bio-geochemical processes. At the same time, since the middle of the 1990's several sites have been instrumented to continuously measuring both net  $CO_2$  flux and energy fluxes (latent and sensible). Thus we are able now to go further in our understanding of coupling between the  $CO_2$  and the water cycle by comparing simulated  $CO_2$  and energy fluxes with in situ data.

The experiment is being carried out over the Loobos site. This site belongs to the "Euroflux" program network. The vegetation cover is a scots pine (*Pinus sylvestris*) forest located in the center Netherlands . The soil is sandy and the climate is cool with a mean annual temperature of 10°C and an annual precipitation around 800mm. The forest was planted on sand dunes in the beginning of the 20th century and is now almost 100 years old. In addition to the precise observation of meteorological forcing and fluxes for the years 1997 and 1998, a set of atmospheric conditions for the entire 20th century have been reconstructed. Thus the models can be started at the time the forest was planted and thus solving the problem of initializing the carbon reservoirs.

From the 13 groups which have expressed their intention to participate 6 have already submitted their results. Since in many groups the addition of the carbon cycle to land-surface models is very recent or in progress, the GLASS panel proposed to extend the deadline for performing simulations. It is expected that a workshop will be organized by Nicolas Viovy in Paris in spring 2003 and thus a suitable new deadline would be a few weeks before the workshop.

## 3 GSWP-2

The Global Soil Wetness Project 2 (GSWP-2)<sup>2</sup>, coordinated by Paul Dirmeyer and Taikan Oki has been approved during the last GLASS panel meeting. It will start in early 2003 and first results should be available by the end of the year. Its goals are to:

- Produce state-of-the-art global data sets of surface fluxes, of soil wetness and related hydrologic quantities.
- Develop and test large-scale validation, calibration, and assimilation techniques over land.
- Provide a large-scale validation and quality check of the ISLSCP data sets.
- Compare LSSs, and conduct sensitivity studies of specific parameterizations which should aid future model development.

GSWP-2 is closely linked to the ISLSCP Initiative II data effort, and LSS simulations in GSWP-2 will encompass the same core ten-year period as ISLSCP Initiative II (1986-1995).

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<sup>2</sup>The science and implementation plan is available at : <http://www.iges.org/gswp/>

There are five basic categories of participants in GSWP-2: the operational centers, the land-surface modelers, validators of the model output, those involved in remote sensing applications, and other users of the model output. An Inter-Comparison Center will collect results from participating models, perform consistency checks and basic comparisons.

A major product of GSWP2 will be a multi-model land surface analysis for the ISLSCP II period. This will be a land surface analog to the atmospheric reanalyses, and will include estimates of uncertainties based on inter-model spread. The science plan also includes in situ validation with data from field campaigns, observational networks and long-term monitoring sites. Modeling sensitivity studies will involve re-integrating the LSSs over part or all of the global, 10-year domain to test the response of the models to changes in meteorological data (including choice of reanalysis products, impacts of bias correction, sensitivity to the range in observational estimates, and impacts of rain- gauge under-catch) and surface parameters. Comparisons to land models of simple and intermediate complexity will also be conducted.

## 4 GLACÉ

In order to assess our knowledge on the role surface moisture and temperature states play in the evolution of weather and the generation of precipitation, the GLASS panel is sponsoring the experiment proposed by Randy Koster. GLACÉ will build on the experimental design used in Koster et al (2002)<sup>3</sup> and expand it by a third ensemble of simulation and ensuring the participation of more models.

The experiment is based on 3 ensembles of 16 members for the period June August 1994. In the first ensemble the natural variability of the full coupled system is explored. In one of these simulations, all surface state variables are written in a file. In this way the surface history of the simulation is saved. In a second ensemble the surface is forced to evolve along a given path and thus hindering the surface from responding to the atmospheric variability. This is achieved by replacing at each time step the surface variables with the values read from the history file produced previously. An intermediate ensemble is also proposed in which only the evolution of the slow components of the surface is forced.

This experiment is simple enough to allow a large number of groups to perform it. Comparing the results of all models will allow us to determine how strongly the land/atmosphere coupling differ between models and in which regions this uncertainty is the largest. A more detailed analysis of the extreme models will allow us to identify the processes which are key in this spread.

This experiment is co-sponsored by the CLIVAR WGSIP panel.

## 5 PILPS San-Pedro

The GLASS panel proposes to conduct the first local/off-line inter-comparison of land-surface model in a semi-arid climate over the San-Pedro catchment. The PILPS-San Pedro experiment will be coordinated by Luis Bastidas at the Utah State University and should start in the second part of 2003.

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<sup>3</sup>Koster, R.D., Dirmeyer, P.A., Hahmann, A.N., Ijpehaar, R., Tyahla, L., Cox, P. and Suarez, M.J. (2002) Comparing the degree of land-atmosphere interaction in four atmospheric general circulation models. *J. Hydromet.*, **3**, 363-375

The availability of 4+ years of data at two sites and data from a location with similar vegetation coverage but hundreds of kilometers apart provide an exciting opportunity for cross-validation of the model results and for comparison of different models. The three different vegetation types existing at the data sites also provide a quick look on the diversity of environments in arid lands and will allow to establish whether or not further distinction is required to better represent the water, energy, and  $CO_2$  exchanges taking place over such areas.

The experiment will start as a standard PILPS experimentation but after these “naive simulations” the participants will be asked to optimize the parameters of their models and re-run the experiments. The optimization can be made with the methods proposed by Bastidas et al (1999)<sup>4</sup> or by other means if available to the participants.

The availability of data from 3 sites will allow to test the transferability of the optimized parameters. The comparison will show if the “optimal” performance of the models obtained with the parameter estimation is compatible with the generality required for the large scale application of these land-surface models.

## 6 The local coupled action

Are the results of the offline surface model evaluations in the context of PILPS or GSWP affected by the lack of land surface-atmosphere feedback? Is the use of offline land surface models in Land Data Assimilation Systems (LDAS) making optimal use of the assimilated data? These are questions that are addressed in the local coupled action of the GLASS panel.

GLASS initiated a workshop held in De Bilt (The Netherlands) on 19 and 20 April 2002, aiming at identifying an experimental strategy to address the importance of land - atmosphere interaction in surface model calibration and data assimilation. The workshop was cosponsored by GEWEX and the Netherlands Royal Meteorological Institute (KNMI).

The results of this workshop are presented in the GEWEX News of May 2002. The GLASS panel tasked Paul Houser and Luis Bastidas to initiate the implementation of the first and simplest experiment proposed during the workshop. This would be an inter-comparison of existing land-surface models coupled to their single column atmospheric model at a site. It is hoped that this first step will encourage the community to go further and consider doing more standardized, and thus more work intensive, experiments later on.

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<sup>4</sup>Bastidas, L. A., H.V. Gupta, S. Sorooshian, W.J. Shuttleworth and Z.L. Analysis of a Land Surface Scheme using Multi-Criteria Met Geophysical Research, Vol. 104, No D16, p. 19,481-19,490, 1999.