GLASS : activities in 2001

Jan Polcher, Laura Bowling, Bart Nijssen, Nicolas Viovy,
Aaron Boone, Luis Bastidas, Randy Koster

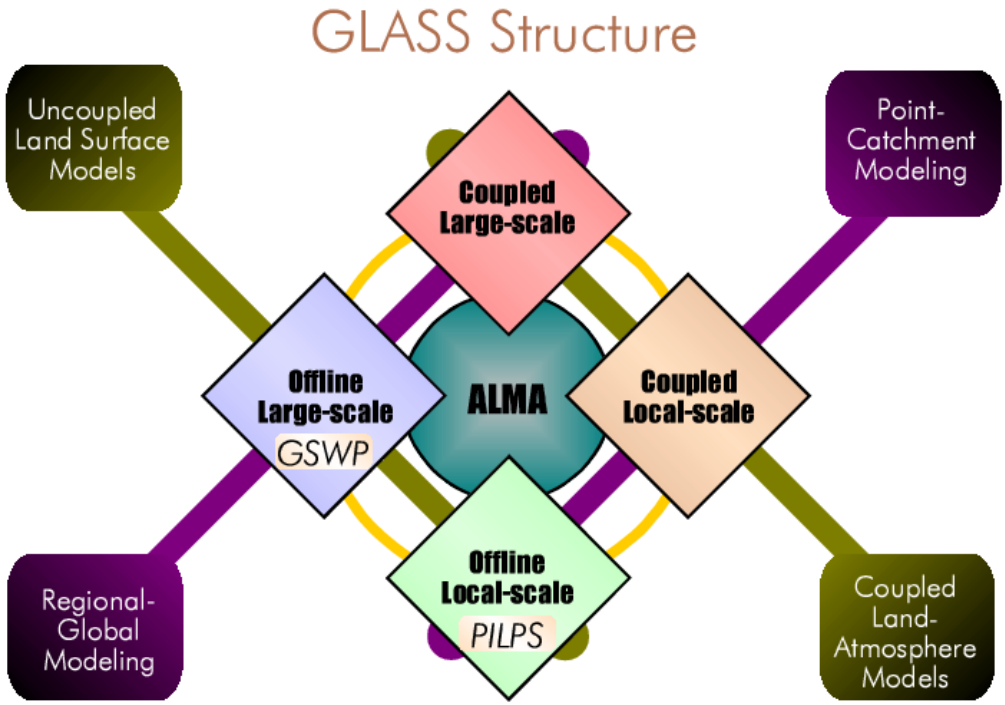
WGNE/GMPP, October 2001

- Short description of the structure of the GLASS project.
- New results from PILPS-2e and the planed PILPS-C1 experiment.
- Rhône-AGG is under-way and prepares future global/off-line experiments.
- New evidence has highlighted the need for a new approach to forcing land-surface models (LSMs) outside of atmospheric models.
- Two experimental designed for the global/coupled action have been tested.

Next GLASS science panel meeting is set for 7th to 9th November 2001.

1. Organization and management

GLASS will coordinate LSM inter-comparisons from local to global scales and from off-line forcing to fully coupled.

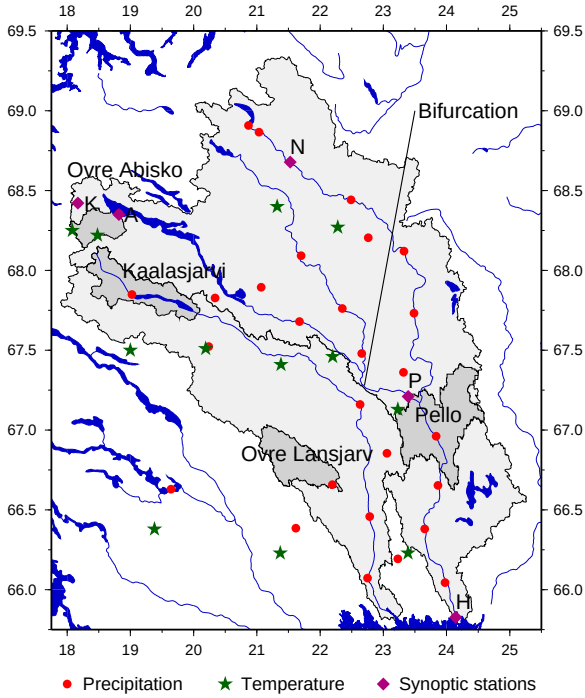


2. Local-scale/Off-line action

Coordination : Ann Henderson-Sellers, Andy Pitman

2.1. PILPS-2e : *L.C. Bowling, B. Nijssen, D.P. Lettenmaier*

This experiment aimed at evaluating the ability of land-surface models to simulate the surface hydrology in northern latitude.

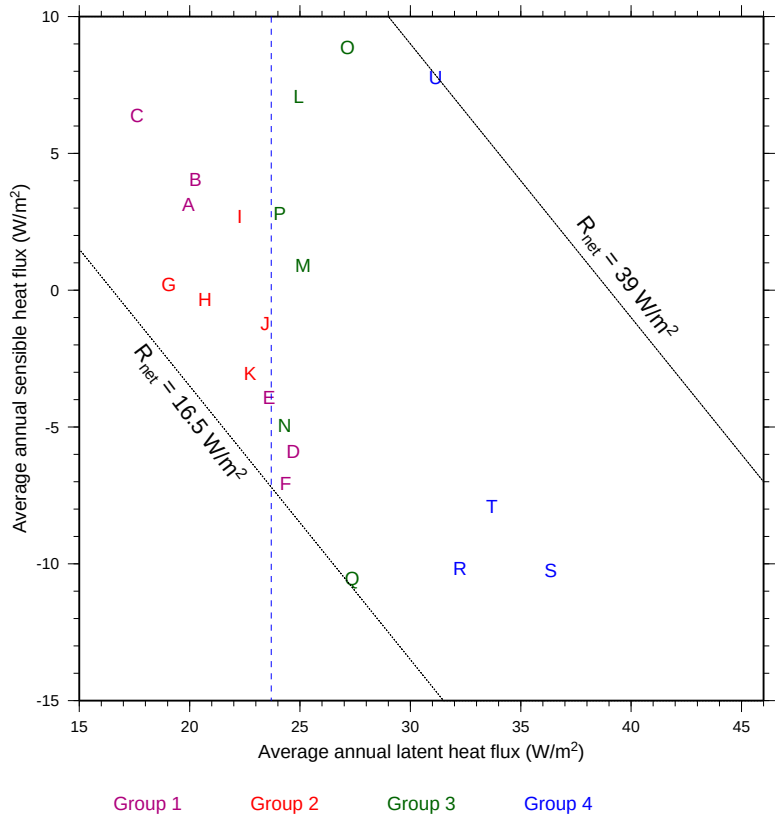


The following processes are evaluated:

- Snow regime : Are ablation or sublimation the main uncertainties ?
- Turbulent fluxes in cold climates : Can we reliably validate surface fluxes in an off-line environment ?
- Frozen soil and surface storage : Is the representation of these processes needed for simulating runoff in these latitude ?

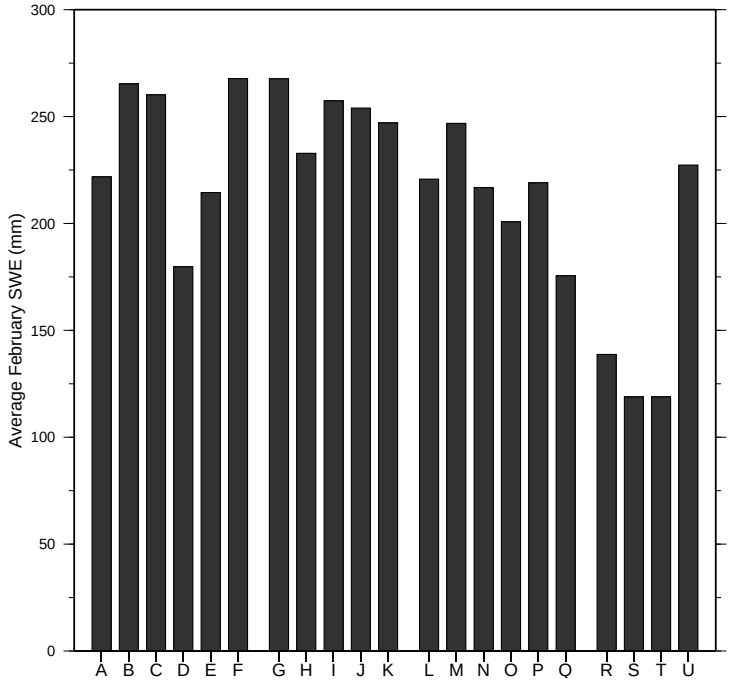
21 models have taken part in the PILPS-2e experiment.

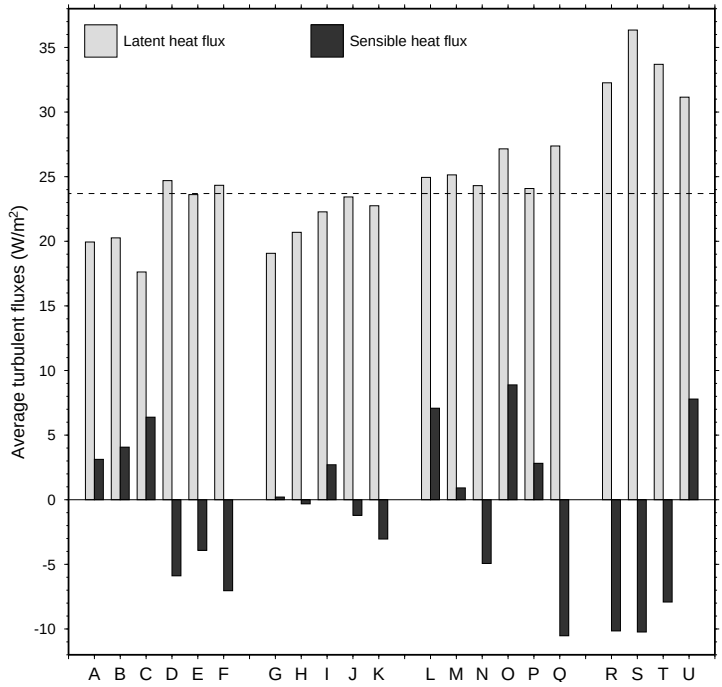
Four group of models can be identified :



- The vertical line gives an estimate of the latent heat flux based on an annual water balance.
- Group 4 models (blue) overestimate annual mean latent heat flux.
- All other models are within the uncertainty of the estimate.
- A wide range of sensible heat fluxes is observed.

Sublimation is the major cause of uncertainty between models in this region of the world.

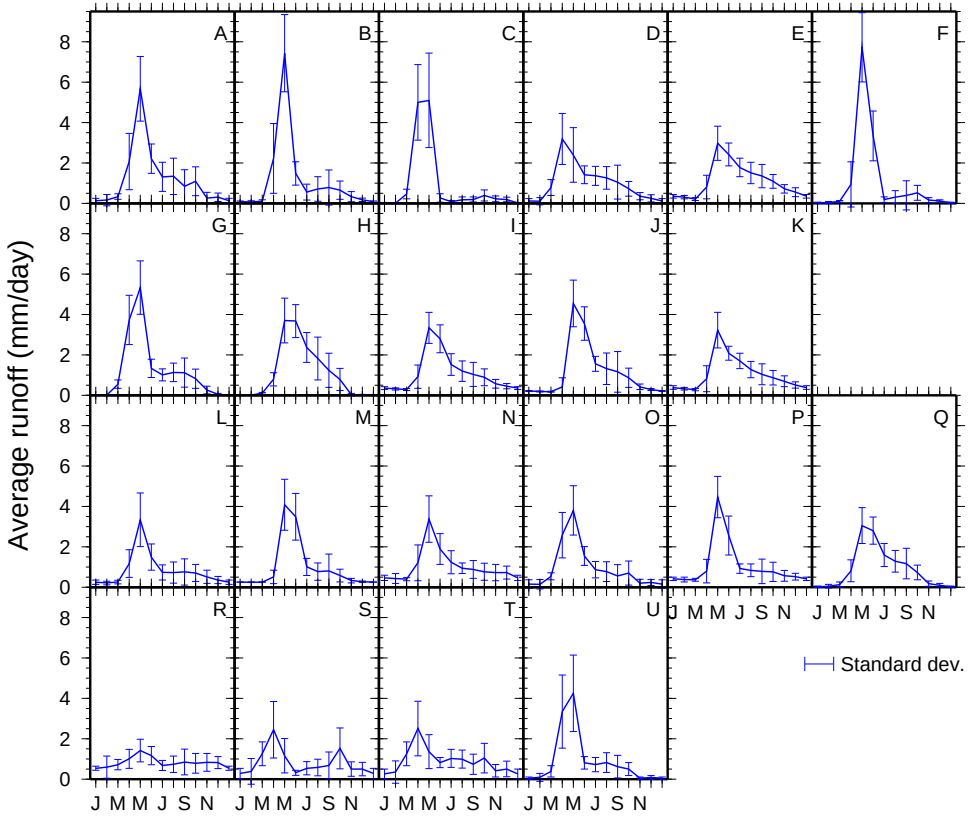




The large differences in the sensible heat flux are explained by the de-coupling of the atmosphere and surface in stable conditions.

These are very sensitive situations, especially in un-couped land-surface schemes, which can lead to very large near surface temperature gradients.

How do these differences impact the simulated river outflows ?



Models which include a representation of lakes and wetlands (H,J) do not stand out.

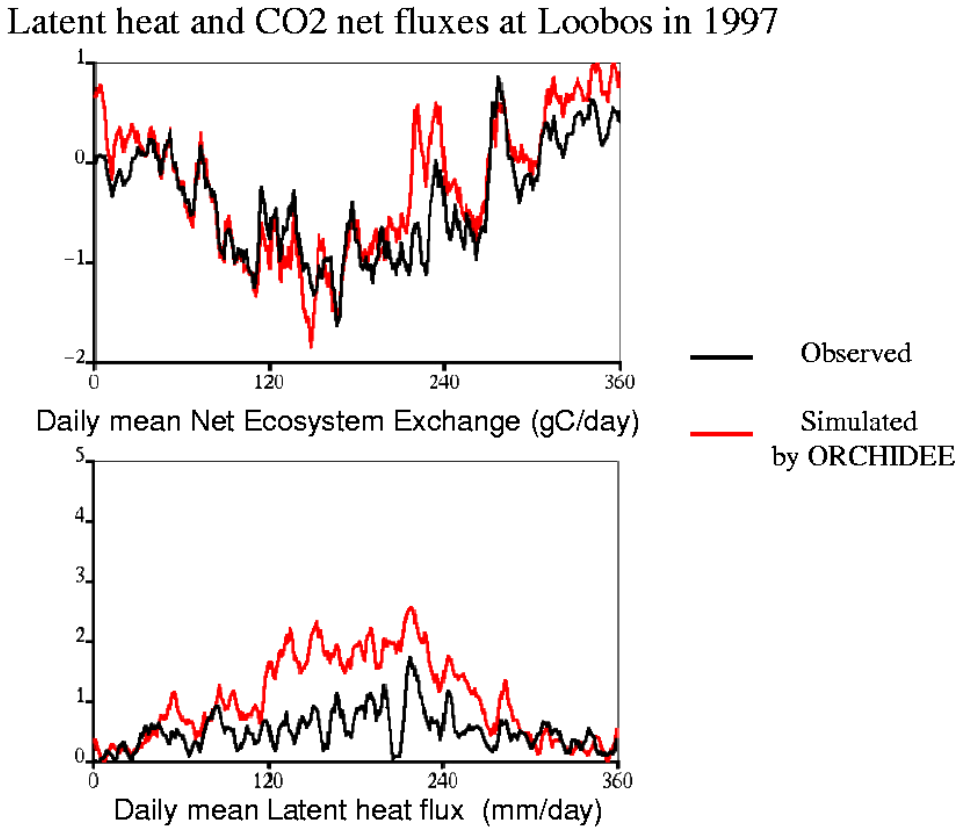
2.2. PILPS-C1 : *Nicolas Viovy*

This is the first experiment which will evaluate the ability of land-surface models to simulate carbon fluxes.
The selected data is from the Euroflux site at Loobos in the Netherlands. This is a 100 year old forest standing on a sandy soil.

- Which models are able to represent both the biophysical and biogeochemical processes ?
- Can models reproduce the observed carbon sinks ?

The first simulations will be un-constrained, this should allow the models to run in their GCM configuration and simulate all processes.
In a second step parameters will be prescribed to narrow down differences.
This type of experiment bring with it new problems : How should the carbon cycle be spun-up in the models ? It is proposed to run a 100 year spin-up with data reconstructed from historical observations.

The data and the feasibility of the experiment was tested with ORCHIDEE at IPSL :

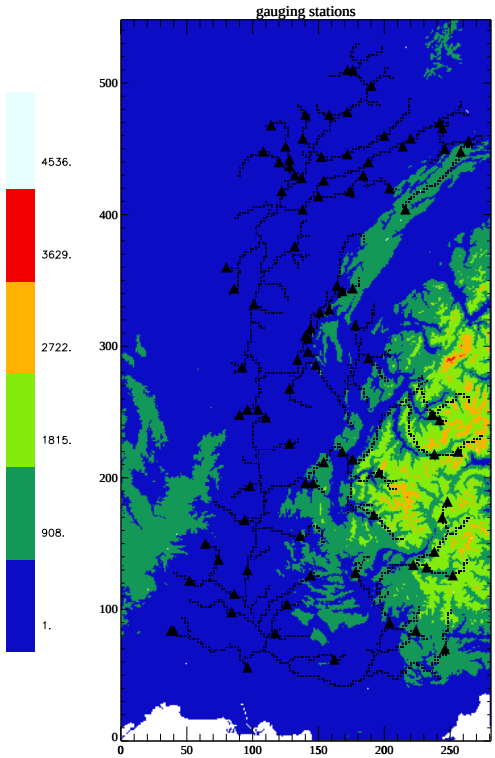


The release of forcing data is set for January 2002.

3. Global-scale/Off-line action

Coordination : Paul Dirmeyer, Taikan Oki

3.1. Rhône-AGG : *A. Boone, F. Habets, J. Noilhan*

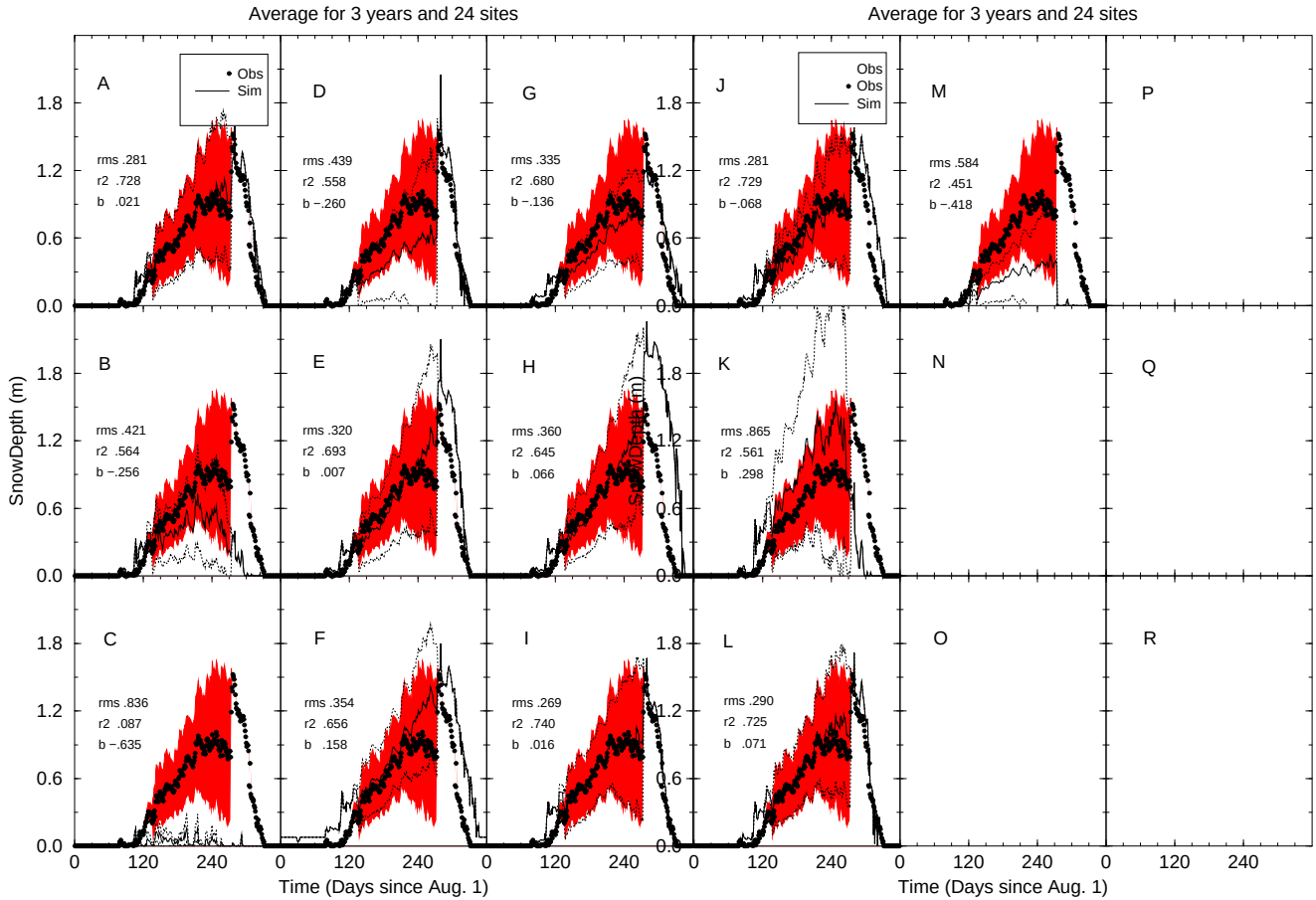


- How do the various LSMs simulate the discharge compared to the observations for several annual cycles and sub-basins?
- Are the sub-grid runoff and drainage parameterizations scale dependent?
- How do results compare among the various aggregation methods employed?
- How does soil moisture scale among the schemes?
- What is the impact of grid resolution on the simulated SWE and snowmelt runoff?

The Rhône-AGG experiment will hold it's workshop from the 5th to the 7th of November 2001.

13 models are participating in the Rhône experiment.

First results for the validation of the snow cover at 24 stations :



3.2. Planed experiments : *Paul Dirmeyer, Taikan Oki*

GSWP-2 will use the ISLSCP-II data to perform global off-line simulations over a 10 year period. Inter-annual variability of soil moisture will be the focus.
In the meantime GSWP-1.5 will help prepare phase 2 (P.I. : Taikan Oki)
The following questions will be addressed :

- How Sensitive are LSMs to errors in the forcing data ?
- How well can LSMs be validated at the global scale with remote sensed data ?
- Are the drying out cycles of LSMs comparable ?
- Are the CO_2 fluxes simulated at the global scale comparable ?

The added value to GSWP-1 will be :

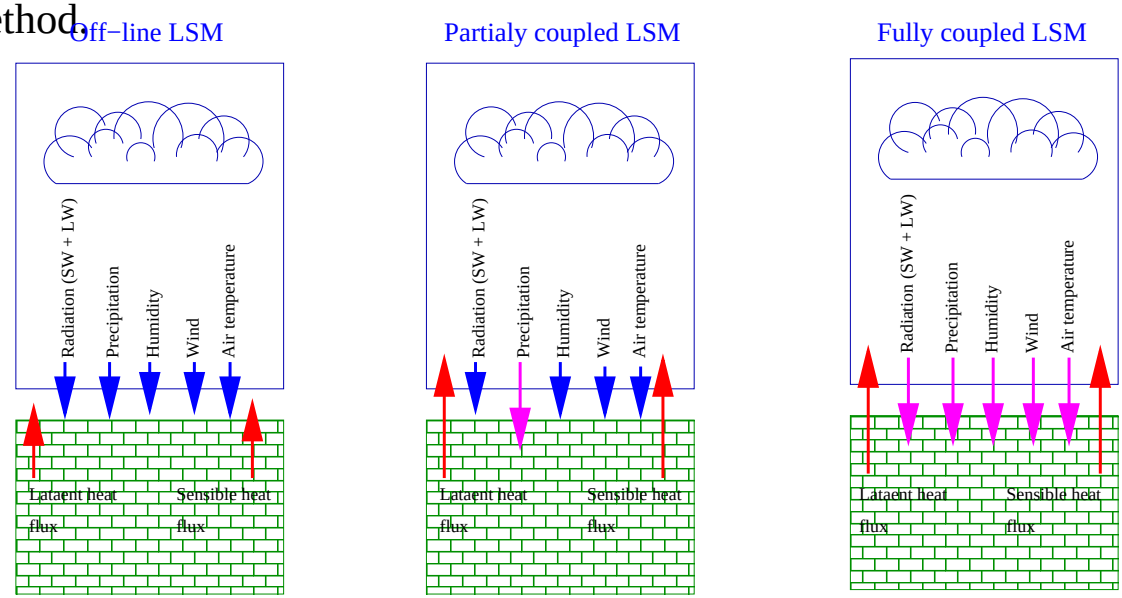
- Updated and improved forcing data,
- the participation of more schemes and
- bring in the remote sensing and GAIM/IGBP communities.

4. Local-scale/Coupled action

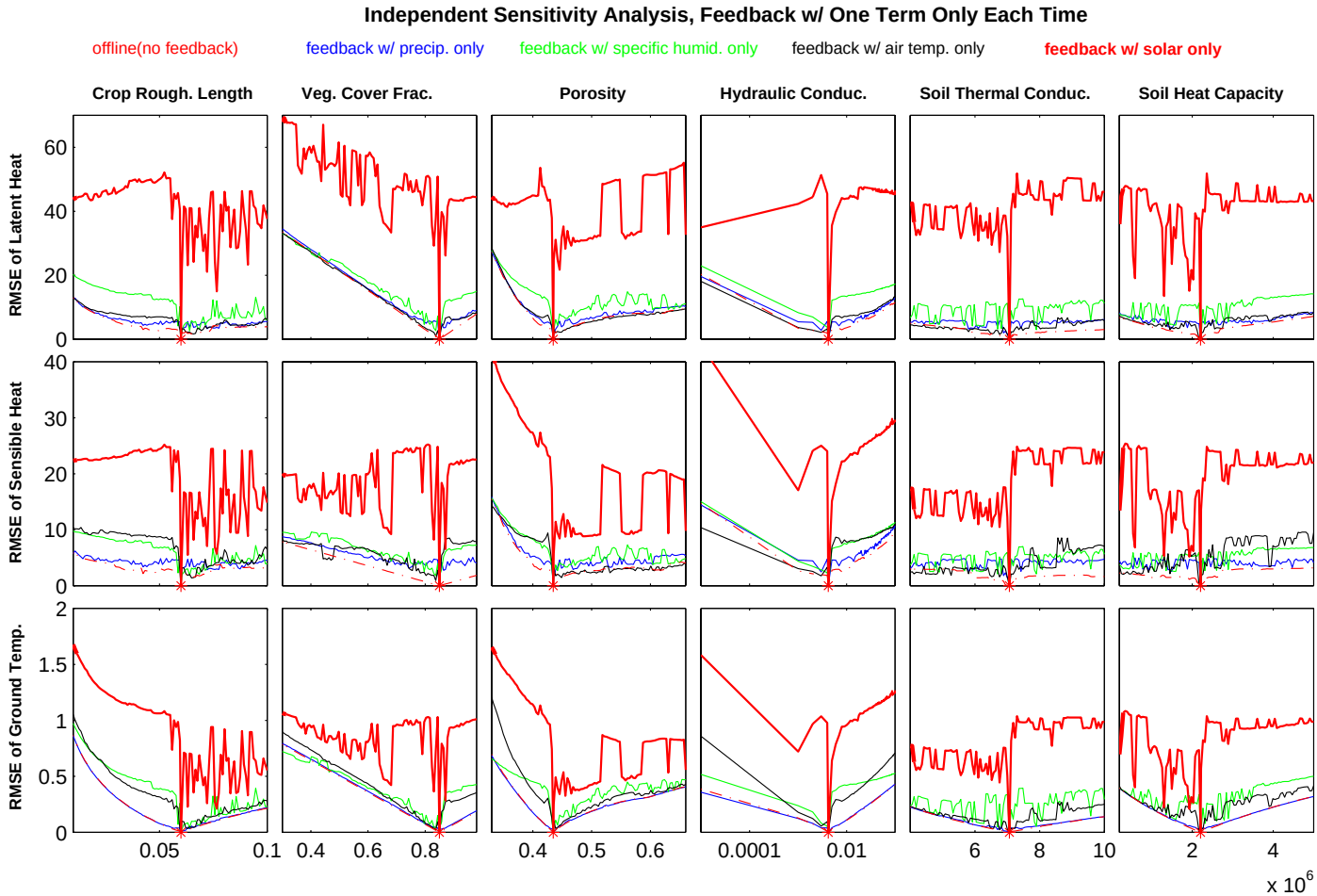
Coordination : Hoshin Gupta, Paul Houser, Pedro Viterbo

4.1. Some evidence of the importance of coupling : *Luis Bastidas, Hoshin Gupta*

In each case the optimal parameters are determined using a Multi-Criteria method.



- Does the coupling to the atmosphere modify the parameters found ?
- Is the convergence toward the optimal parameters modified ?
- Is any of the forcing predominant in the behaviors of the fully coupled system ?


Independent Sensitivity Analysis, Feedback w/ One Term Only Each Time
offline(no feedback)
feedback w/ precip. only
feedback w/ specific humid. only
feedback w/ air temp. only
feedback w/ solar only
Crop Rough. Length
Veg. Cover Frac.
Porosity
Hydraulic Conduc.
Soil Thermal Conduc.
Soil Heat Capacity
RMSE of Latent Heat
RMSE of Sensible Heat
RMSE of Ground Temp.
0.05
0.1
0.4
0.6
0.8
0.4
0.5
0.6
0.0001
0.01
6
8
10
2
4
x 10^6

4.2. Forcing LSMs for data assimilation : *Paul Houser, Pedro Viterbo*

The various XLDAS projects under way have already shown the value of using off-line LSMs for data assimilation.
Still a number of problems exist :

- The lack of atmospheric feedback reduces the impact of some observations.
- The near surface atmospheric variable errors can not be used to extract information.

A simplified forcing method is needed to keep the advantage of an off-line system but giving some atmospheric feedback.

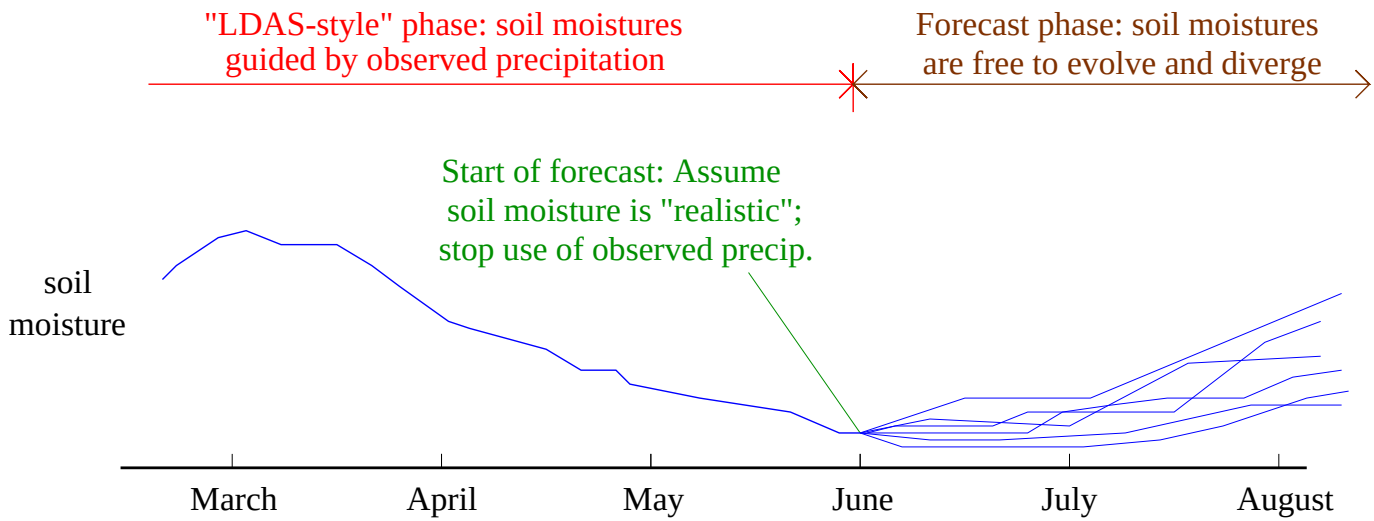
A workshop will be held on this topic early in 2002.

5. Global-Scale/Coupled action

Coordination : Peter Cox, Randy Koster

5.1. The poor man's LDAS : *Randy Koster*

Currently an experimental design which would apply a flux correction on precipitation is explored.

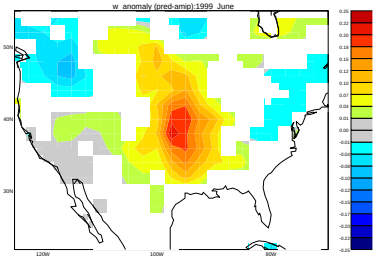
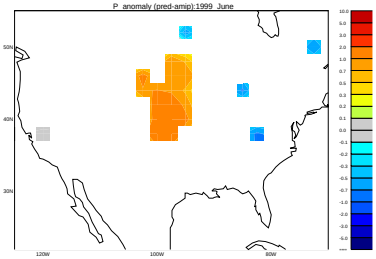
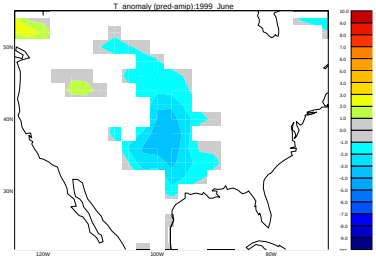
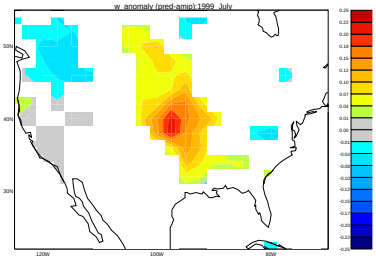
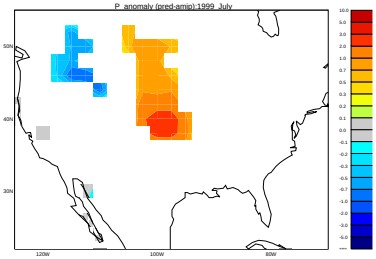
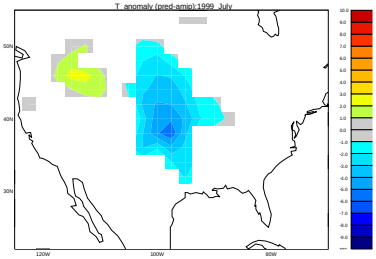
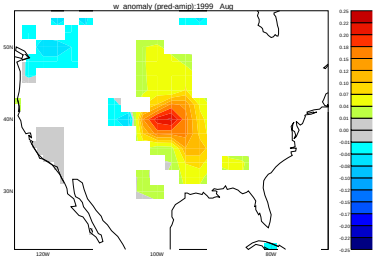
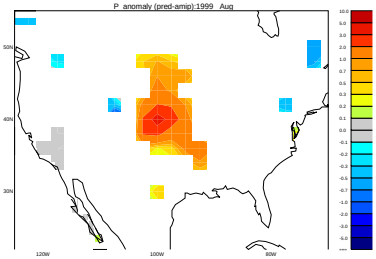
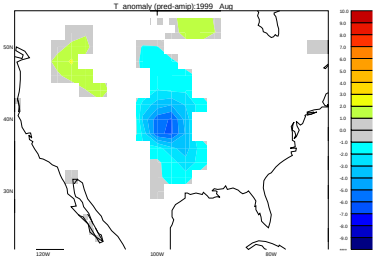


This experimental set-up allows to determine in mutli-model ensemble :

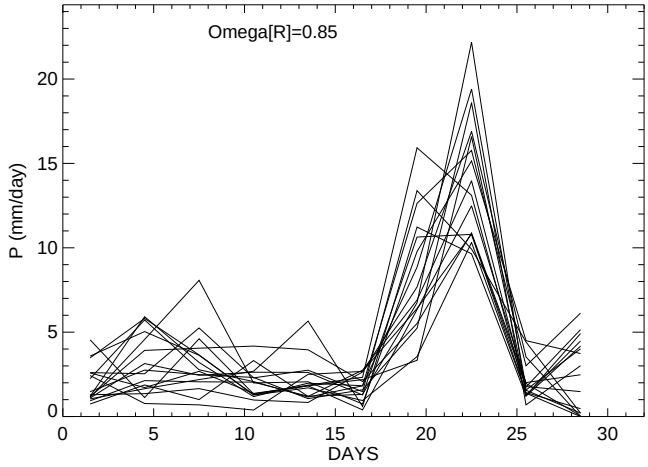
- The value of improved precipitation for land-surface processes,
- The resulting improvement in the simulated climate,
- And finally the role of improved initial conditions at the surface.

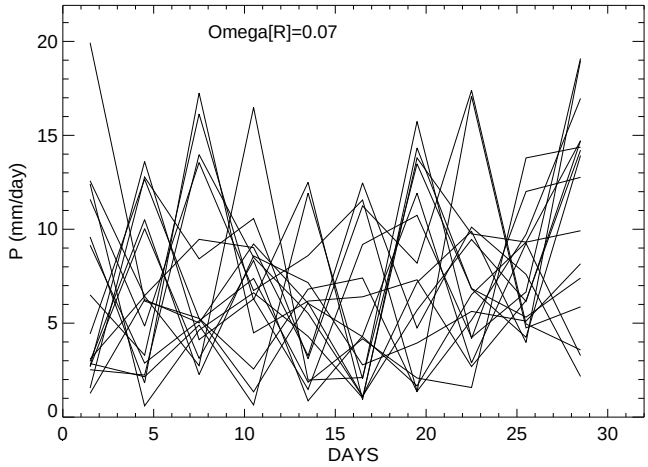
ANOMALY DIFFERENCES DUE TO SOIL MOISTURE INITIALIZATION

"Initialization" ensemble minus "AMIP" ensemble.
(Differences shown only where significant at 5% level.)

	ROOT ZONE MOISTURE	PRECIPITATION	TEMPERATURE
June, 1999			
July, 1999			
Aug., 1999			

An alternate experimental design would be to restore in an ensemble of simulations the surface to the output of a previous experiment (Labeled R). This is then be compared to an ensemble of the free running GCM (Labeled F).





Each ensemble is characterized by the ratio of signal variance to total variance : Ω_P.

The two ensemble in this experiment can then be compared by the difference in Ω_P :

$\Omega_P(R) - \Omega_P(F)$ **small :**

Restoring the surface at each time step will not have strongly modified the internal variability.

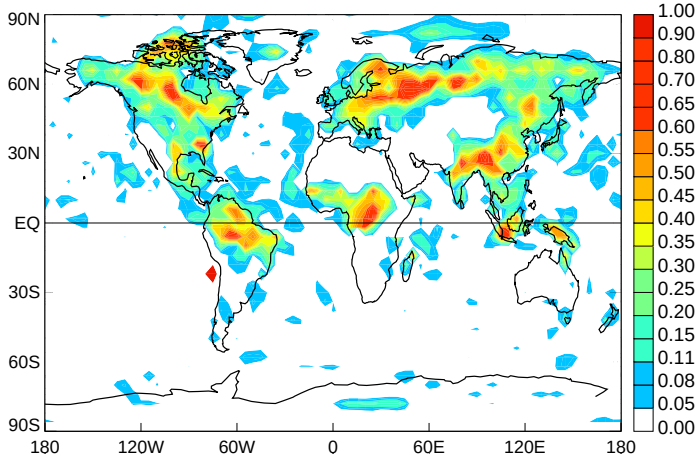
$\Omega_P(R) - \Omega_P(F)$ **large :**

The constraint on the surface has strongly reduced the internal variability of the model.

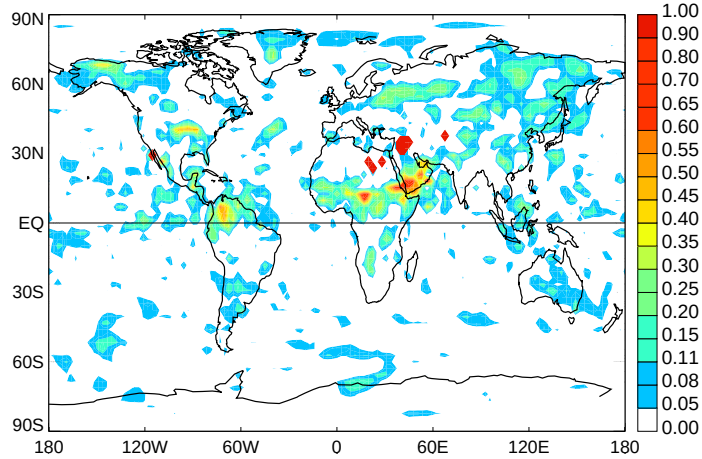
Models show a wide range of sensitivity in land-atmosphere interactions

$\Omega_P(R) - \Omega_P(F)$ for precipitation

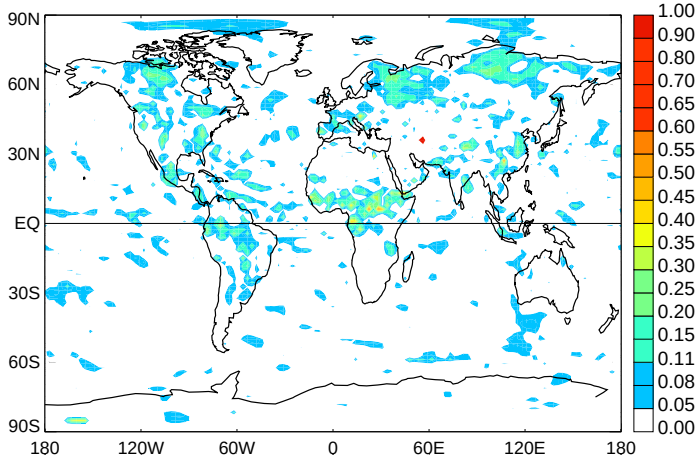
NSIPP



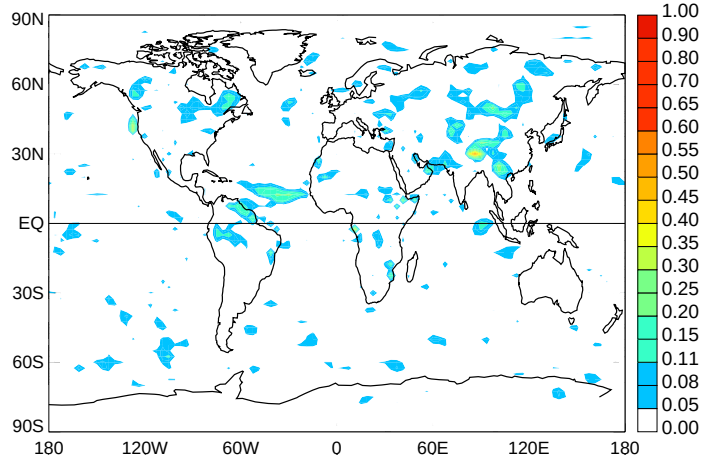
CCM3/BATS



COLA



HadAM3



6. conclusions

- All actions are progressing well, even if some delays have occurred.
- The infrastructure action ALMA has already proved it's usefulness.
- The local-coupled action needs to intensify it's activity. It is going to be key for the interactions of GLASS with :
  1. GCSS for an improved land-surface treatment in cloud experiments.
  2. GABLS to look for a better way of forcing land-surface schemes outside of atmospheric models.
  3. XLDAS to improve LSM setups for data assimilation.

Items on next weeks meeting of the panel are :

- Review of current and planed experiments.
- GSWP-1.5 is late but key to the interaction with the remote-sensing community.
- Discuss the request from GCSS for a better solution than prescribing surface fluxes in cloud resolving models.
- Discuss the request of CLIVAR-AAMP for experiments to evaluate the role of surface processes in monsoonal systems.