

Global Land-Atmosphere System Study (GLASS)

Reporting Period: October 2005 to October 2006

Starting date:

End date (where appropriate):

URL: hydro.iis.u-tokyo.ac.edu/GLASS

Chair(s) and term dates: Andy Pitman (Chair) and Bart van den Hurk (Deputy-Chair)

Overview:

GLASS is within the GEWEX Modelling and Prediction Panel (GMPP). Our focus is the terrestrial surface within modelling and prediction. We have a well structured program in four specific areas:

- "LoUCo" - Local uncoupled projects. This developed out of PILPS (www.pilps.mq.edu.au) and now includes PILPS, iPILPS, SNOWMIP-2, PILPS C-1, PILPS-urban, and PILPS semi arid.
- "LoCo" - Local coupled projects. This includes interactions between the surface and the boundary layer.
- "GloUnc" - Global uncoupled. This includes GSWP-2, LDAS initiatives.
- "GloCo" - Global coupled. This includes GLACE and LUCID.

GLASS is working closely within the local coupled projects with GABLS and has links to a large variety of external programs through our programs.

Objectives:

We coordinate land-based projects within GMPP. We aim to identify key science needs within the community and establish projects to address these science questions. We are largely process-based, aiming to understand the role of the land within the global system on short, medium and long timescales. We address this by simple uncoupled experiments, building through locally-based coupled experiments through to global scale coupled experiments that are linked to large scale programs.

Status:

"LoUCo" - Local uncoupled projects

SNOWMIP2 [<http://www.cnrm.meteo.fr/snowmip/>]

SnowMIP2 will compare results of around 40 land-surface models, driven with measured meteorological data over a wide range of snow and forest canopy conditions, at the following five locations: Colorado (USA), Erlenhöhe (Switzerland), Hitsujigaoka (Japan), Hyytiälä (Finland) and Saskatchewan (Canada). Model accuracy and uncertainty will first be investigated by aggregating results from each model over all five measurement sites. Further analyses will include both between-site and intra-seasonal comparison (i.e. entire snow season, accumulation only and ablation only) of each model as a whole. Currently, model results are being collected (due December 1 2006).

iPILPS [<http://ipilps.ansto.gov.au>]

The aim of the iPILPS initiative is to contribute to an international intercomparison of current state-of-the-art isotope parameterization efforts in coupled climate, atmospheric and earth system models by promoting comparison among land-surface schemes that incorporate isotopic representation under the auspices of GLASS.

A special issue of *Global and Planetary Change* was published in 2006 that presented the results of the 2005 workshop and intercomparison study. Work is continuing to develop further isotope enabled models and a further intercomparison study is planned for 2007.

PILPS Carbone

The PILPS-C1 coupled Carbon/SVAT inter-comparison experiment is an initiative within the GEWEX/GLASS local uncoupled action. The main goal of this project is to compare both heat (latent and sensible) fluxes and net carbon fluxes simulated by different kinds of surface models forced with in-situ measurements from the Loobos site in the Netherlands which belong to the CARBOEUROPE/EUROFLUX network.

For the future, as it was discussed in 2005, we would like to launch a second phase of the project comprising simulation for a larger number of sites (the first phase was done with 1 site: Loobos) including different types of vegetation to address some interesting questions such as:

- Is some ecosystem types are systematically better simulated than
- others (or the opposite) ?.

- Is there some common features in discrepancies between models and data
- within the same ecosystem type ?
- Is the variability (observed/simulated) within an ecosystem less than
- inter-ecosystem variability ?
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Difficulties here are the lack of resources to coordinate the project, although there are people willing to participate. A proposed project to coordinate was not funded. So the question is still who could coordinate such experiment? A paper describing the results of Phase 1 is in preparation.

PILPS-semi arid

The objective of this study is the comparison of models that simulate water, energy, and carbon cycles with continuous observations at five different sites in the southwestern United States. The project is being coordinated by Luis Bastidas, Hoshin Gupta, Bart Nijssen, Bill Emmerich, and Eric Small (collectively referred to as the PILPS San Pedro coordinating team). Papers are in preparation for publication and preliminary results were presented at the 86th AMS Annual meeting in Atlanta in January 2006. This part of GLASS is reaching conclusion. With the successful submission of two key papers, GLASS will close this initiative.

PILPS-urban

This has not moved forward because a funding request submitted was unsuccessful. The intent is to re-submit this proposal in 2006/7.

“LoCo” - Local coupled projects

A GLASS/GABLS workshop was organised in September 2005, where results were presented on both uncoupled and coupled single-column runs. The importance for vertical land-atmosphere interaction both for nocturnal boundary layers and for (daytime) hydrological fluxes is evident.

In the Land Information System (LIS) at NASA infrastructure is built with which a suite of land and boundary layer models can be coupled. A couple of simulations for the ARM area are carried out both to reveal the sensitivity of land/atmosphere states to the choice of the models coupled, and to develop additional (preferably observable) diagnostics that can ‘measure’ the degree of land-atmosphere coupling.

“GloUnc” - Global uncoupled

- GSWP-2 - <http://www.iges.org/gswp/>

The GSWP-2 program is in finalization stage. A highly successful project has led to a suite of deliverables in terms of data, science outcomes and cross-community communication.

“GloCo” - Global coupled

- GLACE (<http://glace.gsfc.nasa.gov/>)

GLACE (Global Land-Atmosphere Coupling Experiment) is a multi-model intercomparison experiment focusing on the ability of land surface state to affect rainfall generation and other atmospheric processes. The experiment quantified the strength of land-atmosphere coupling in different global atmospheric models used for weather and climate studies. GLACE is emerging as one of the highlights of GEWEX science in the last decade. A Series of high impact publications, including a Science paper, has highlighted the advances made by GLACE. Key papers include Koster et al. (2004), Guo et al. (2006) and Koster et al. (2006).

- LUCID “Land-Use and Climate, Identification of robust impacts”

LUCID will identify and quantify the impacts of land-used induced land-cover changes on the evolution of climate between the pre-industrial epoch and present-day. The use of a) multi-model and b) ensemble simulations will allow us to assess the robustness of the identified changes. Assessment will be carried out by looking not only at the mean climate but also at climate variability. Assessment will also be made on the potential impact land-use induced land-cover change can have on the sea-surface temperatures and on ocean circulation. Among the final objectives: make sure land-use induced land-cover changes are accounted for in simulations that will be run for the next IPCC report (5th).

Progress in 2006 has been limited because of the 4th Assessment report of the IPCC has kept most of the climate modelling groups we want to involve has been fully committed. We plan a re-launch of LUCID late in 2006.

Status:

We expect to contribute to Landflux's activities as they relate to modelling terrestrial processes. We also hope to develop closer links in land data assimilation in operational centres. Products including microwave remote sensing – and its assimilation of products into LSMs may be combined with other data sources including SMOS and FAPAR to identify stress. Assimilation of LAI is also a priority area. Our plan is to encourage the removal of soil moisture nudging via assimilation of remotely sensed data. GLACE-2 is a long-term objective requiring significant encouragement of the community. We plan to work closely within GMPP to build stronger links to GABLS and GCSS. The former link is developing well via LoCo, but links with GCSS require significant development in part due to a relative lack of understanding between the communities. GEWEX, through GMPP, can play a strategic role in bridging these gaps.

Future LoUnc developments

- RAMI (the RAdiation transfer Model Intercomparison) and PILPS have developed a benchmarking project for radiative transfer processes in land surface models. This initiative is being conducted by Jean-Luc Widlowski, Kendal McGuffie and Bernard Pinty. This will be conducted through 2007.
- Snowmip-2 will be completed through 2007.
- PILPS Semi-arid will be completed in 2007.

Future LoCo activities

Also at NASA SCM experiments have focused on explaining what parameter in the atmospheric model have a great impact on the degree of coupling in the US GLACE hotspot. This experiment is to be used as template for a wider SCM intercomparison study, to be drafted and implemented in 2007.

The second GABLS intercomparison study is to be extended with a set of simulations where land states are included as a freely evolving set of parameters. First experiments are being done at a small number of institutes, but a broader initiative is to be launched in 2007.

Future GloUnc activities

- Some discussion of a GSWP-3 initiative has been raised but there are concerns over the value of this in the absence of a key science question. However, the Landflux initiative coupled with aspects of modelling through a GSWP-type initiative offers opportunities for significant future advances. Initial discussions indicate opportunities exist within the Landflux initiative – and we expect that developments in this areas will occur through 2007.

Future GloCo activities

- GLACE-2 has been proposed. The GLASS panel supports GLACE-2 and recognises the value in building on the strong scientific outcomes from GLACE. We have concerns relating to the scale of computational effort required for GLACE-2 and we are initiating a consultation program with modelling groups to identify scale of participation.
- We anticipate LUCID being launched in 2007 with initial outcomes expected in early 2008.

Summary

GLASS is an active panel with a well structured program that has been delivering strong science outcomes over the last five years. We are clear on our strategies for the next 12 to 24 months and have identified some longer term evolving strategies. Emerging links within GMPP offer further innovative science opportunities, in particular the links across GLASS programs, and the links between GLASS, GABLS and GCSS.

List of key publications

Rutter, N. and R. Essery, 2006, Evaluation of forest snow processes models (SnowMIP2), *Geophysical Research Abstracts*, Vol. 8, 05921, 2006 SRef-ID: 1607-7962/gra/EGU06-A-05921

- Koster, R.D., P. A. Dirmeyer, Z. Guo, G. Bonan, E. Chan, P. Cox, C.T. Gordon, S. Kanae, E. Kowalczyk, D. Lawrence, P. Liu C-H. Lu, S. Malyshev, B. McAvaney, K. Mitchell, D. Mocko, T. Oki, K. Oleson, A.J. Pitman, Y.C. Sud, C.M. Taylor, D. Versegny, R. Vasic, Y. Xue and T. Yamada, 2004, Regions of coupling between soil moisture and precipitation, *Science*, **305**, 1138-1140.
- Guo, Z., P.A. Dirmeyer, R.D. Koster, G. Bonan, E. Chan, P. Cox, C.T. Gordon, S. Kanae, E. Kowalczyk, D. Lawrence, P. Liu, C-H. Lu, S. Malyshev, B. McAvaney, J.L. McGregor, K. Mitchell, D. Mocko, T. Ok4, K.W. Oleson, A.J. Pitman, Y.C. Sud, C.M. Taylor, D. Versegny, R. Vasic, Y. Xue and T. Yamada, GLACE: The Global Land-Atmosphere Coupling Experiment. 2. Analysis, *J. Hydrometeorol.*, *in press*.
- Koster, R. D., Z. Guo, P. A. Dirmeyer, G. Bonan, E. Chan, P. Cox, C. T. Gordon, S. Kanae, E. Kowalczyk, D. Lawrence, P. Liu, C.-H. Lu, S. Malyshev, B. McAvaney, K. Mitchell, D. Mocko, T. Oki, K. Oleson, A. Pitman, Y. C. Sud, C. M. Taylor, D. Versegny, R. Vasic, Y. Xue, and T. Yamada, 2005: GLACE: The Global Land-Atmosphere Coupling Experiment. 1. Overview and results. *J. Hydrometeor.*, (in press).
- Bastidas, L.A. and E. Rosero and B. Nijssen 2006, PILPS semi-arid experiment: preliminary results, Land-Atmosphere Interactions: Coupled Model Development, Data Assimilation, Predictability, and Process Studies (Joint with 18th Conference on Climate Variability and Change and 20th Conference on Hydrology) [Paper J5.6]
- Henderson-Sellers, A., 2006, Improving land-surface parameterization schemes using stable water isotopes: Introducing the 'iPILPS' initiative, *Global and Planetary Change*, **51**, 3-24.
- Gat J. and Peter L. Airey , 2006, Stable water isotopes in the atmosphere/biosphere/lithosphere interface: Scaling-up from the local to continental scale, under humid and dry conditions, *Global and Planetary Change*, **51**, 25-33.
- Henderson-Sellers, A., M. Fischer, I. Aleinov, K. McGuffie, W.J. Riley, G.A. Schmidt, K. Sturm, K. Yoshimura and P. Irannejad, 2006, Stable water isotope simulation by current land-surface schemes: Results of iPILPS Phase 1, *Global and Planetary Change*, **51**, 34-58.
- Twining, J., D. Stone, C. Tadros, A. Henderson-Sellers and A. Williams, 2006, Moisture Isotopes in the Biosphere and Atmosphere (MIBA) in Australia: A priori estimates and preliminary observations of stable water isotopes in soil, plant and vapour for the Tumbarumba Field Campaign, *Global and Planetary Change*, **51**, 59-72.
- Fischer M., and K. Sturm, 2006, REMOiso forcing for the iPILPS Phase 1 experiments and the performance of REMOiso in three domains, *Global and Planetary Change*, **51**, 73-89.
- Yoshimura, K., Shin Miyazaki, Shinjiro Kanae and Taikan Oki, 2006, Iso-MATSIRO, a land surface model that incorporates stable water isotopes, *Global and Planetary Change*, **51**, 90-107.
- Aleinov, I., and G.A. Schmidt, 2006, Water isotopes in the GISS ModelE land surface scheme, *Global and Planetary Change*, **51**, 108-120.
- Fischer M., 2006, iCHASM, a flexible land-surface model that incorporates stable water isotopes, *Global and Planetary Change*, **51**, 121-130.

List of meetings, workshops

- GLASS will contribute to a Landflux meeting in 2007.
- We anticipate other contributions to other meetings and workshops but nothing specific at this time.

List of members and their term dates:

There has been no change in membership.