LoCo Implementation plan – version 1

The Local Coupled (LoCo) action of GLASS finds its origin already in the De Bilt workshop of April 2003. Since then, further developments of ideas to materialize this action have taken place, in particular around the Kyoto 2004 GLASS panel meeting. In that particular preparation stage, an anticipated list of pilot studies was compiled, together with a priority ranking. In this section this list is recapitulated, together with a proposed strategy to transfer the recommendations from the De Bilt 2005 workshop into real experimental actions.

The overall strategy is to initiate LoCo model comparison experiments in small groups, where experience with definition of diagnostic measures and software infrastructure can be gained. In a later stage, these experiments may be advertised to a wider community.

Goals of LoCo

The overarching goal of LoCo is to **accurately understand, model and predict the role of local land – atmosphere coupling in the evolution of land-atmosphere fluxes and state variables, including clouds.**

The science questions addressed in this theme can be roughly grouped in the following categories:

- Are the results of PILPS, GSWP, or data assimilation experiments affected by the lack of land surface-atmosphere coupling?
- Can we explain the physical mechanisms leading to the coupling strength differences found in GLACE or other coupled NWP/climate experiments?
- Is there an observable diagnostic that quantifies the role of local land-atmosphere coupling?

Overview of phases and experiments

The LoCo experiments will be divided into 3 phases:

- **Phase 1**: model-derived boundary conditions: here, lateral and upper/lower boundary conditions are taken from large scale model experiments like reanalysis data or GLACE model output
- **Phase 2**: observation based boundary conditions: here initial profiles and boundary conditions are taken from observations as much as possible
- **Phase 3**: representation of spatial heterogeneity and its impact on turbulent exchange and cloud formation.

These phases not necessarily progress chronologically in this order. On the short term, two themes have been identified which are considered to be ready for experimental exploration:

- Stable boundary layer experiments
- Single Column Experiments addressing hydrological coupling strength in GLACE results.

These are the themes that have been discussed most extensively during the workshop. However, during the earlier preparation of LoCo implementation plans more experimental themes have been defined. Further implementation of most of these is to be postponed until later. The table below gives an overview of the experimental ideas so far. The cells shaded in orange are detailed below.

	Phase 1 Model-derived b.c.'s	Phase 2 Obs.-derived b.c.'s	Phase 3: Clouds/spatial heterogeneity
A: GLACE hotspots/transect	Develop/refine LoCo diagnostics Link GSWP2/GLACE		Cloud formation/ superparameterization
B: CASES 99 with GABLS		Coupled simulations as presented by Steeneveld et al. (2005)	Intermittent turbulent parameterization
C: Cabauw	Revisit PILPS	Further development of diagnostics like $\partial RH/\partial t$ as in Ek & Holtslag(2004)	
D: IHOP/SGP with GCSS		Trier et al. (2004)	Link up with GCSS including CRM's

Experimental details

- The **GLACE hotspots Single Column Experiments** are designed to get insight in the physical mechanisms that are responsible for the differences in land-atmospheric coupling strength between various models participating in GLACE. Of primary interest is the impact of formulations of convection, surface evaporation and boundary layer ventilation on the vertical communication between the surface and the atmosphere. In the GLACE hotspots this communication is strong, implying also that lateral advection of water has a relatively low contribution to the precipitation variability, compared to the vertical coupling. This set of experiments is to be implemented via the following activities
  - Bart vd Hurk is likely to be funded for 2 PhD-positions addressing the interplay between a local hydrological feedback and large scale circulation patterns that allow for strong feedbacks. Part of the study consists of defining diagnostic variables that may be obtained from single column or regional climate model integrations, and may lead to improved insight in the physical processes involved. This PhD-project is not yet approved, but expected to begin early 2006.
  - Similarly, Randy Koster has a one-year position for execution and analysis of SCM studies in one of the GLACE hotspots, addressing the role of various physical processes.
  - Joseph Santanello, Jr. (supervised by Christa Peters-Lidard) is funded for 5 years to enhance the LIS infrastructure to allow for coupled surface-atmosphere simulations in a standardized software environment. Apart from infrastructural efforts, his work will include case studies with SCM's in order to refine the diagnostic measures of coupling strength, like the role of the residual layer or the possibility to use profiling satellite data to observe vertical profiles.

- The **further development of the RH-tendency equation** is addressed in the continuing collaboration between Michael Ek, Bert Holtslag and KNMI-staff. Discussions are currently taking place on how to extend the Cabauw analyses.
- The **stable boundary layer experiments for CASES99** are well addressed during the workshop. It is recommended to repeat the simulations for 3 subsequent diurnal cycles using PBL-models extended with a simple surface energy balance model, as proposed by Steeneveld et al (2005). Apart from announcing a formal new CASES99 experimental phase, a limited number of groups are targeted to repeat Steeneveld's simulations, including KNMI (Lenderink et al) and NASA (Christa Peters-Lidard).

A detailed timeline is not included in these descriptions. It is anticipated that one year from now these three experiments have already gained sufficient additional insight to continue the LoCo implementation planning.

References
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