Canadian Foundation for Climate and Atmospheric Sciences (CFCAS)
Fondation canadienne pour les sciences du climat et de l'atmosphère (FCSCA)

2007 DRI Progress Report

Project Title:

Investigator:

1.0 Progress (beginning January 2007 to end December 2007)

1.1 **Describe progress towards meeting the project objectives for those theme areas where you have received funding for 2006-2007. How are the original milestones being met (be specific)? List the key objectives and results achieved to date as well as any relevant application(s) of the results.**

1.1.1 Objectives

The overall objective of the Drought Network Initiative (DRI) is *to better understand the physical characteristics of and processes influencing Canadian Prairie droughts, and to contribute to their better prediction, through a focus on the recent severe drought that began in* 1999.

To address this overall objective, the Network is focussed on complementary and cross-cutting research objectives that correspond to the following themes:

1. **Theme 1: Quantify the physical features of this recent drought:**
   a)spatial and temporal features,
   b) flows of atmospheric and terrestrial water and energy into and through the region, and their storage and redistribution within the region.

Observation well data from across the prairie region have been collected from the respective provincial groundwater agencies (AB, SK, MB). For AB and MB this involved selection of the most suitable observation wells (long records, not disturbed by nearby pumping). The data are now being compiled into a single format so that the patterns of groundwater level changes across the prairies can be assessed.

Data on changes of water levels in closed-basin prairie lakes have been updated to include the cessation of the drought. This study, most of which was carried out with funding from PARC, is now completed and journal publication is anticipated early in 2008.These closed-basin prairie lakes are sensitive indicators of cumulative changes in precipitation, runoff and lake evaporation and can therefore provide rigorous tests of hydrological models for the prairies. Water level changes in the lakes also represent significant changes of water storage in the region.

2. **Theme 2: Improve the understanding of the processes and feedbacks governing the formation, evolution, cessation and structure of the drought.**

A modeling study of soil moisture and groundwater recharge at a pine forest site has been started as part of a PhD research program. The site in question is the jackpine site of Fluxnet/BERMS in the southern boreal forest of Saskatchewan, at the northern edge of the forest-prairie transition zone. The advantage of this site is that four flux towers have been in continuous operation since about 1997, including the 2001-2003 drought years. Soil moisture, groundwater level and streamflow data are also available. These data allow assessment of how soil moisture and groundwater storage changed during the drought and how transpiration by the trees changed in response to the depletion of moisture stores during the drought. The results of the modeling will be extended to prairie sites where groundwater level data are available and where the role of groundwater in supplying water for transpiration can be assessed.

Research is on-going on the use of the geological weighing lysimeter method can be used to understand the changes of water storage during the drought. This method involves analysis of changes of groundwater level in deep confined formations. Promising results at several sites have been obtained, but more rigorous analysis of the data by means of modeling is required. Data from geological lysimeters from three prairie sites were collected continuously during the drought and are now being evaluated.

3. **Theme 3: Assess and reduce uncertainties in the prediction of drought and its structure.**

1.2. **What contributions have you made, if any, to the unfunded themes of DRI through support in kind.**

Theme 4: Compare the similarities and differences of the recent drought to previous droughts over this region and those in other regions, in the context of climate variability and change.

Theme 5: Apply our progress to address critical issues of importance to society.

The region-wide compilation of observation well data (roughly 1965-2005) and lake level data (1910 – 2006) can also serve as a basis to compare the effects of the recent drought with previous droughts.

1.3. Describe you plans for research during the coming year and the following year and outline how the expected results will support the deliverables and goals of DRI.

Changes of groundwater level in shallow wells during the drought will be described in relation to climate data, for the purpose of quantifying the changes in groundwater storage in response to drought.

The geological weighing lysimeter data will be used to assess and improve how hydrological models handle changes of the vertical water balance (mostly evapotranpiration) during the drought. The lysimeter data provide detailed data on rates of evapotranspiration, averaged over areas of 1 to 100 km^2, depending on the depth at which the sensors are emplaced below the ground. This scale of measurement corresponds well to the grid-size of regional hydrology models.

2.0 Impact

2.2 Describe the significance / impact of the results achieved to date and how this new knowledge has influenced research policy, enhanced research collaboration or competitiveness, or helped attract or train skilled personnel.

Address the following items, as appropriate:

- **The impact of the project on government policy development (federal, provincial or municipal);**
- **How the project has expanded contacts in partner organizations, or increased cross-disciplinary cooperation;**
- **Whether and how it has improved the reliability of predictive methods;**
- **The impact of the project on your own institution;**
- **Whether and how the project has helped increase funding from other agencies, or led to new partnerships;**
- **Any current (or potential) commercial or social applications, which the results may have;**
- **Links with international initiatives and the potential impact of these;**
- **Anticipated benefits of the work for Canadians.**

The lake level data, compiled for the first time across the prairie region, serves to provide a regional perspective on the on-going changes and thus provides an improved understanding of the driving mechanisms such as land-use changes, increased length of ice-free periods and diversions/drainage.

The geological weighing lysimeter method may in time find wide application for testing hydrological models and for real-time assessments and forecasting of droughts and floods.

3.0 Dissemination

3.1 Provide information on dissemination of the research results (publications, including journal names and whether refereed), conference contributions, seminars, workshops or videos, websites or other methods of transferring the results.

van der Kamp, G., S. Marin B. Davison, B. Toth, A. Pietroniro, H. Maathuis and N. Kouwen, 2007. Use of deep groundwater observation wells for continuous monitoring of kilometre-scale vertical water balance. CMOS-CGU Congress, St. John's NL, May 28-June 1, 2007

van der Kamp, G., I. Judd-Henrey, A. Barr, R. Granger, 2007. Surface and subsurface hydrology of the Prince Albert Model Forest and the surrounding area. Invited presentation at workshop on "Wetlands and watersheds in forested ecosystems. Prince Albert SK, Feb 20, 2007.