

Meeting/Workshop Reports

Saskatchewan River Basin Regional Hydroclimate Project Exploratory Workshop

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This Exploratory Workshop was held to examine the feasibility of launching a GEWEX Regional Hydroclimate Project (RHP) in the Saskatchewan River Basin (SRB). It was hosted by the Canadian National Hydrology Research Centre and organized by Howard Wheeler, the Canada Excellence Research Chair (CERC) of Water Security at the University of Saskatchewan and Vice-Chair of the GEWEX Scientific Steering Group. In his opening remarks, Dr. Wheeler gave an overview of the CERC Program and GEWEX, and described how an SRB RHP could bring Canadian climate, hydrology, water quality, and social science scientists together to provide a GEWEX science focus on issues in Canada, including rapid climate change, interprovincial water allocations, and water access licensing.

Rick Lawford presented a history of the GEWEX RHPs and their roles in determining the variability of water budgets in different regions and their contributions to process understanding and regional model development. Experience has shown how important it is to have well-defined science questions for RHPs, as well as information requirements for effective water resources management, science and data collection to support GEWEX goals, and the appropriate scoping of basin studies and modeling systems.

Deborah Belvedere presented the proposed plans for a new U.S.-led RHP called the Terrestrial Regional North American Hydroclimate Experiment (TRACE). It is planned as an interdisciplinary, international and interagency project for regional-scale climate prediction, to assess the availability of clean water, and for understanding and predicting water cycle extremes.

In his presentation, John Pomeroy noted that most of the streamflow in the SRB is generated in the headwaters of the Rocky Mountains and that three provinces use the water as it flows eastward to the Hudson Bay. The nature of the topography and soils in Saskatchewan and Manitoba leads to more local cycling of water, as very little runoff from these areas joins the streamflow in the main river channels that cut through the landscape. In light of hydrological nonstationarity, a better ability for modeling this complex system is needed to address the water management problems that are emerging in the SRB.

Ronald Stewart's presentation showed the importance of understanding the vertical moisture fluxes and large-scale circulation features of the atmospheric water cycle in the SRB

in assessing how atmospheric and surface processes couple to create climate extremes. To fully understand these features, he recommended that SRB RHP research include the diurnal processes, the structure of precipitation, deep atmospheric convection, surface fluxes, sublimation/evaporation processes, and the variability of extremes.

In reviewing hydrological science requirements for the SRB RHP, John Pomeroy noted the issues in modeling processes such as snow accumulation and melt and the importance of defining the appropriate scale for studying these, as well as the role that slopes and vegetation play in snowmelt. He also reviewed the role of wetlands and sloughs in the prairie environment in terms of groundwater recharge and the need to model large areas that do not contribute to the flows in the rivers. Calibration data for base flows and water in storage are often absent leading to difficulties in modeling these processes. The understanding of processes, improved process models and the widespread use of remote sensing data to provide support for better parameterizations in models is needed.

Stuart Marshall showed how glaciers in the Rocky Mountains contribute to river systems on the prairies and how they are becoming a rapidly diminishing resource as glacier areas decrease due to melting.

Garth van der Kamp reported that groundwater data from the 100 separate wells in the SRB have recently been standardized and are available for analysis. He noted the need for a more representative groundwater model for the SRB that would include all the stores of subsurface moisture (e.g., soil moisture) and a data system that would integrate ground- and surface surface water data.

Howard Wheeler noted that water quantity and quality issues in the SRB are the result of natural variability (i.e., temperature) and anthropogenic effects, and suggested that including more water quality studies in the RHP could enable GEWEX to expand its relevance to water managers. He added that the CERC Programme examines water quality, especially in the South Saskatchewan River to Saskatoon, where nutrients added to the river system by agricultural practices are leading to eutrophication in lake systems.

Amin Elshorbagy noted that the development of a modeling system that accurately represents managed water resource systems and infrastructure at different scales is a priority given the possible need to renegotiate federal-provincial water agreements and the interest in moving beyond naturalized flow modeling to the incorporation of specific human interventions in flow estimates.

Alain Pietroniro provided an overview of modeling systems available for simulations and predictions in the SRB, including the Global Environmental Multiscale Model (GEMS) Community Environmental Modeling System Surface and Hydrology System (MEC-MESH). GEMS has a modular structure that supports the use of source code development by different contributors, and is used to classify non-contributing

areas. Issues requiring attention include non-contributing areas, snow accumulation and snowmelt, basin delineation in complex terrain, large-scale soil moisture representation, and a better system for the calculation of naturalized flows.

Patricia Gober described the challenges related to integrating different knowledge systems and viewpoints for effective water management, and finding ways to deal with the inevitable water resources uncertainty for effective policy development.

Based on the presentations, some of the issues identified for an SRB RHP included determining the optimum size for the RHP, the “black hole” in terms of knowledge of processes in the delta at the downstream end of the SRB, the effects of climate change on glaciers, water management, and socio-economic development of the basin, and the potential role that paleo-records could play in SRB RHP studies.

An SRB RHP would have a rich mosaic and heritage of experience and past projects to build upon that include historical data sets, models, and fieldwork infrastructure. Current projects that could be used as building blocks for some of the SRB RHP activities include the Prairie Adaptation Research Collaborative (PARC) research, which studies past, present, and future hydroclimatic variability of the North Saskatchewan River Basin; the CERC Programme’s SRB studies, and the work by the International Institute of Sustainable Development (IISD), which concerns the role of loadings of phosphorus and nitrogen in runoff as a critical cause of eutrophication in Lake Winnipeg.

Projects that have built the extensive body of expertise that exists on the prairies include:

- the Mackenzie GEWEX Study (MAGS), one of the five original GEWEX RHPs;
- a proposed demonstration project to test the degree to which the process understanding and model capability developed in MAGS could explain the SRB’s climate system known as the Saskatchewan River Basin GEWEX Experiment (SAGE);
- the Drought Research Initiative (DRI) and its efforts to better understand the physical characteristics and processes influencing Canadian prairie droughts and to contribute to their better prediction and improved societal preparation; and
- the models, data sets and observational infrastructure of the Boreal Ecosystem-Atmosphere Study (BOREAS)/Boreal Ecosystem Research and Monitoring Sites (BERMS).

Other heritage studies include the Improved Processes and Parameterization for Prediction in Cold Regions (IP3) Network, which documented and modeled cold season processes, and the Western Canadian Cryospheric Network (WC2N) comprehensive study of glaciers in Alberta and British Columbia, which documented historical glacier variability and recent changes in glacier extent.

The participants broke into three discussion groups (meteorological component, land-surface hydrological component, and water management and policy applications component) to consider science questions for the RHP and to address issues related to implementation. These groups developed a list of research questions around issues of extremes; prediction at



Location of the Saskatchewan River Basin and some of the observational components that could contribute to a Saskatchewan River Basin Regional Hydroclimate Project.

different time scales; hydrometeorological processes (including snow accumulation and snow melt); dynamic computation of non-contributing areas; hydrological processes in the foothills; groundwater processes; and past and future climates and their impacts on water resources including water quality.

Although critical data are missing, such as water use data, there was a general consensus that we are well positioned to begin with the synthesis of the many data sets that are available. Efforts related to modeling should focus on improving and coupling models and assessing the reliability of reanalysis products to determine which ones need to be improved.

The hydrological community felt that the SRB in its entirety should constitute the RHP and that the research agenda should focus on the vertical processes in this region (e.g., groundwater–surface water–atmosphere interactions). In order to improve the use of science in decision-making and knowledge transfer, the research should be transferable when the need or opportunity arises. Foresight experiments, analysis of ecosystem services, an effective data portal and user engagement through simulation exercises have the potential to increase the societal benefits from the SRB RHP.

Lake Diefenbaker was proposed as a testbed for examining possible effects on limnological stratification and the biogeochemical cycling of warmer temperatures associated with climate change. The importance of planning and budgeting for outreach and community involvement and the promotion of linkages was emphasized. It was also suggested that in light of regional oil developments there may be some possibilities to secure joint private sector and government funding for the SRB RHP.

In the discussion on next steps, it was noted that the results of the Workshop should be used to build toward a preliminary implementation plan and proposal. The proposal would focus on a broad, scientifically sound RHP that includes all of the science interests in the SRB, but highlights the components that are of most interest to GEWEX. Workshop participants stressed the need to ensure that the science questions chosen for the Project would be those that would generate an enthusiastic involvement from the science community.

Next steps include:

- Preparing a White Paper.
- Discussing plans with user groups, stakeholders and the science community to obtain collaboration.
- Identifying possible sources of funding and securing preliminary funding to launch the effort.
- Engaging senior government officials with Environment Canada, Agriculture and Agri-food Canada, as well as provincial program managers.
- Preparing a short document based on the White Paper and submitting it to the GEWEX Hydroclimatology Panel for feedback, endorsement, and support.