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Drought, Climate Change and the Canadian Prairies

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The occurrence of drought is a ubiquitous feature of the global water cycle. Such an extreme does not necessarily lead to an overall change in the magnitude of the global water cycle but it of course affects the regional cycling of water. Droughts are recurring aspects of weather and climate extremes as are floods and tornadoes, but they differ substantially since they have long durations and lack easily identified onsets and terminations. Drought is a relatively common feature of the North American and Canadian climate system and all regions of the continent are affected from time-to-time. However, it tends to be most common and severe over the central regions of the continent. The Canadian Prairies are therefore prone to drought.

Droughts in the Canadian Prairies are distinctive in North America. The large scale atmospheric circulations are influenced by blocking from intense orography to the west and long distances from all warm ocean-derived atmospheric water sources; growing season precipitation is generated by a highly complex combination of frontal and convective systems; seasonality is severe and characterized by a relatively long snow-covered and short growing seasons; local surface runoff is primarily produced by snowmelt water; there is substantial water storage potential in the poorly drained, post-glacial topography; and aquifers are overlain by impermeable glacial till, but there are also important permeable aquifers.

One example of Prairie drought is the recent one that began in 1999 with cessation of its atmospheric component in 2004/2005 and many of its hydrological components in 2005. This event produced the worst drought for at least a hundred years in parts of the Canadian Prairies. Even in the dust bowl of the 1930s, no single year over the central Prairies were drier than in 2001. The drought affected agriculture, recreation, tourism, health, hydro-electricity, and forestry in the Prairies. Gross Domestic Product fell some $5.8 billion and employment losses exceeded 41,000 jobs for 2001 and 2002. This drought also contributed to a negative or zero net farm income for several provinces for the first time in 25 years with agricultural production over Canada dropping an estimated $3.6 billion in 2001/2002. Previously reliable water supplies such as streams, wetlands, dugouts, reservoirs, and groundwater were placed under stress and often failed.

Despite their enormous economic, environmental, and societal impacts, there has never been a coordinated and integrated drought research program in Canada. To begin to address these issues related to drought, the Drought Research Initiative, DRI was established. The overall objective of 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 and largely ended in 2005". DRI is focused on five research objectives:

1. Quantify the physical features of this recent drought
2. Improve the understanding of the processes and feedbacks governing the formation, evolution, cessation and structure of the drought
3. Assess and reduce uncertainties in the prediction of drought and its structure
4. Compare the similarities and differences of the recent drought to previous and future droughts
5. Apply progress to address critical issues of importance to society

Major progress is being made within each of these research areas. These coordinated studies furthermore represent an essential step towards our ultimate goal which is to better assess whether there will be more droughts in the future over this region due to climate change, what features these droughts will exhibit, and how

we can best prepare for them. The focus of these activities is on changes to occur over the next several decades and significant progress is being made in addressing these issues as well.

The purpose of this presentation is to provide an overview of all these studies related to past and future Canadian Prairie drought and to point out implications for other regions of the world.