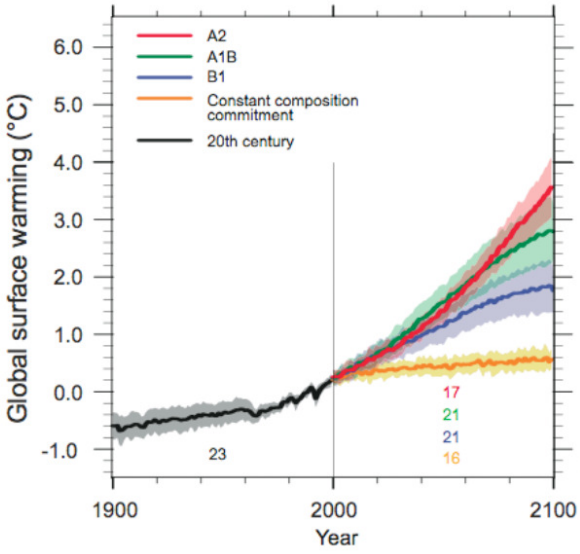
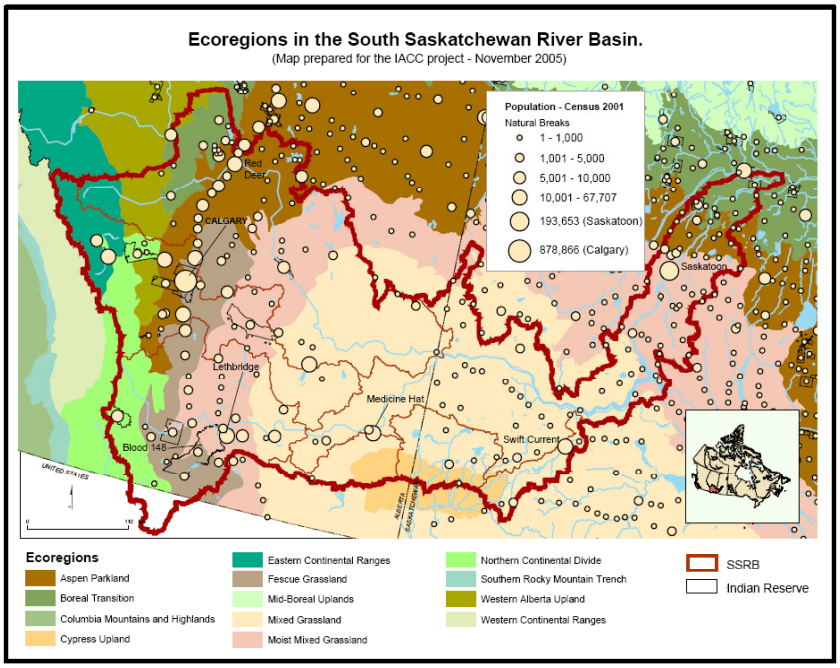
Future Climate Conditions in the South Saskatchewan River Basin

Dave Sauchyn, Cesar Perez Valdivia, Suzan Lapp
Prairie Adaptation Research Collaborative, U of R
Elaine Wheaton, Virginia Wittrock, Saskatchewan Research Council

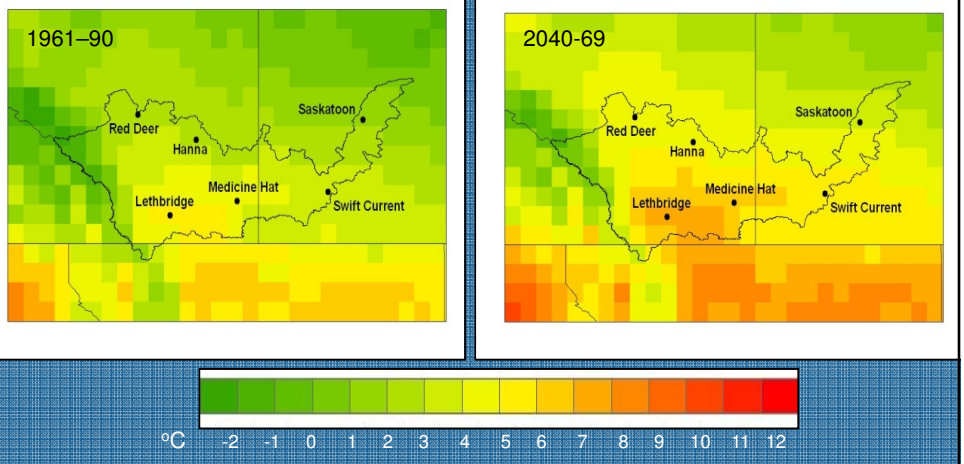
Stakeholder Workshop on Water and Climate in Saskatchewan: The Institutional Adaptations to Climate Change Project, November 26, 2009 , Regina.

Anthropogenic warming and sea level rise would continue for centuries, even if greenhouse gas concentrations were to be stabilized (IPCC 2007)



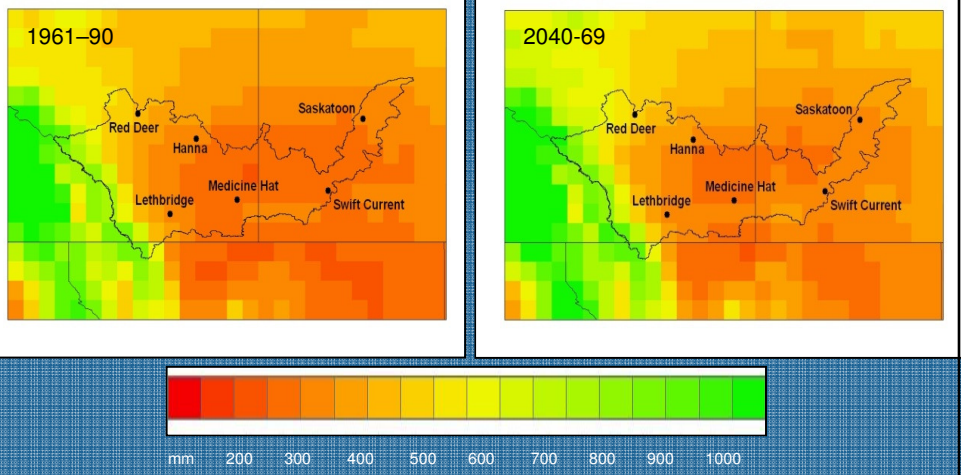


Annual Temperature



Annual temperature for the SSRB. The baseline (1961–90) conditions are mapped on the left. These median scenarios were derived from the Canadian Global Climate Model (CGCM) version 3.1/T47 and greenhouse gas emission scenario B1(2).

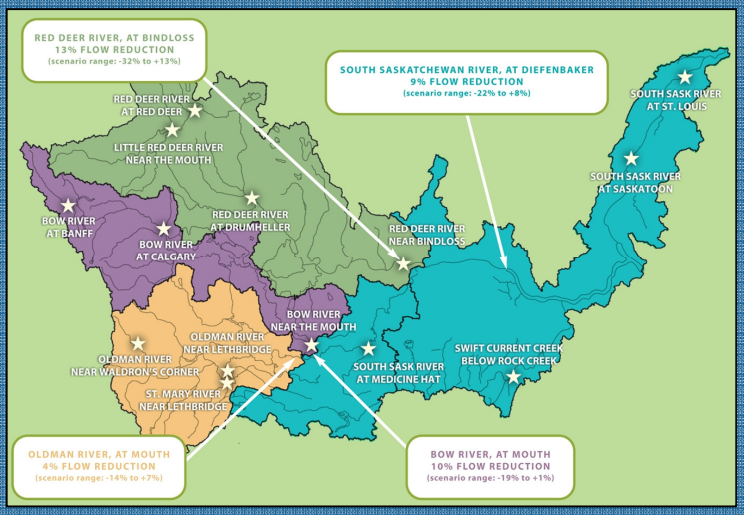
Annual Precipitation



Annual precipitation for the SSRB. The baseline (1961–90) conditions are mapped on the left. These median scenarios were derived from the Canadian Global Climate Model (CGCM) version 3.1/T47 and greenhouse gas emission scenario B1(2).

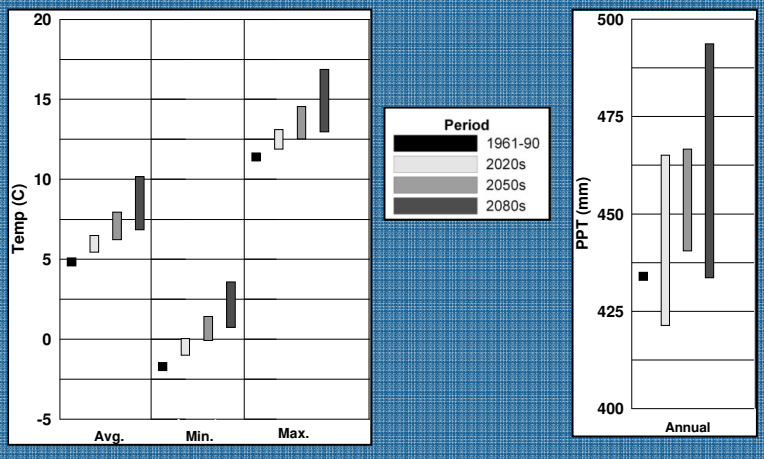
Mountain snowmelt supplies most of the water for the rivers in the South Saskatchewan River Basin. Glaciers supply about 2% of the flow. Toth et al. 2009

Future River Flow



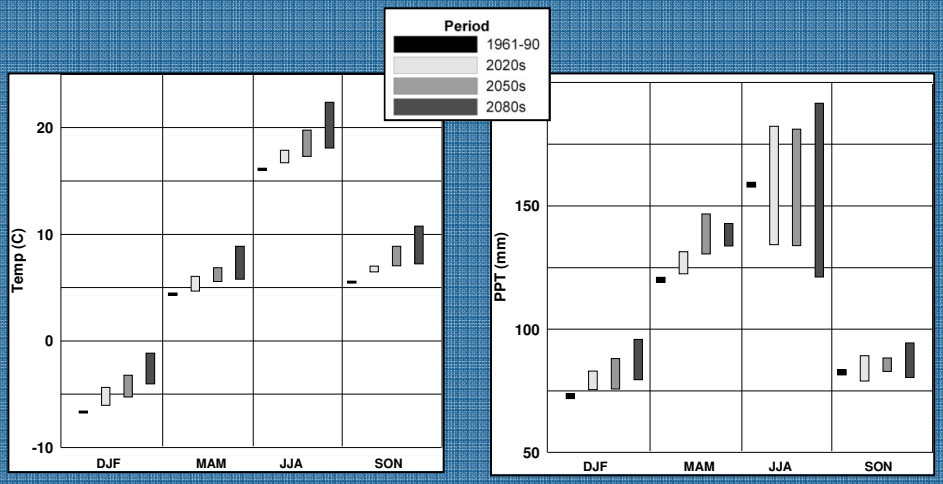
Average flow reductions range from 4 to 13% based on six GCM scenarios (2039-70), Martz et al. 2007. Map by: D. Perrick and D. Campbell

Scenarios for Lethbridge, AB



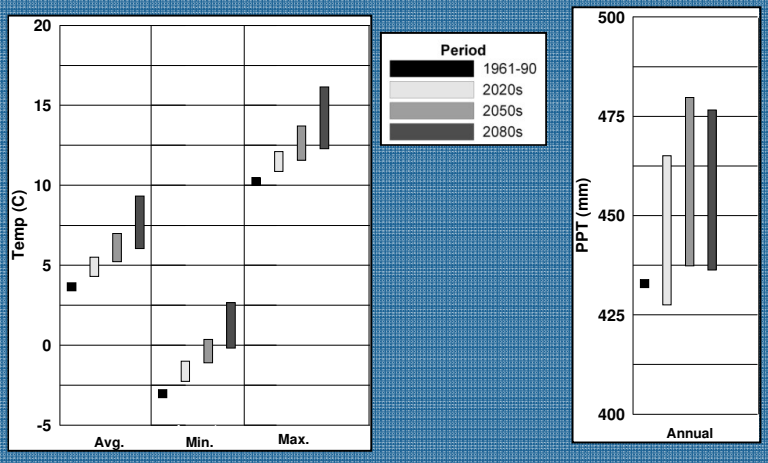
Annual future climate scenarios for Lethbridge, Alberta for a range of five scenarios reflected in the length of the vertical bars.

Scenarios for Lethbridge, AB



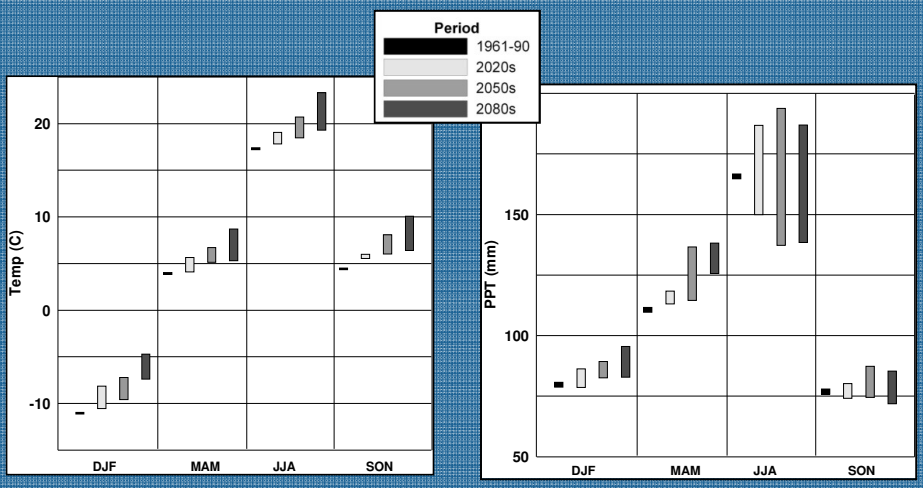
Future climate scenarios for Lethbridge, Alberta by season, and for a range of five scenarios reflected in the length of the vertical bars.

Scenarios for Swift Current, SK



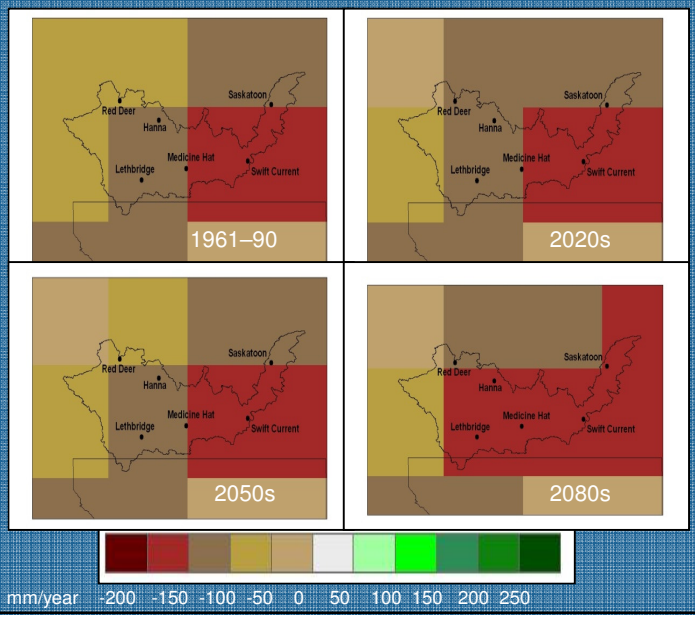
Annual future climate scenarios for Swift Current, Saskatchewan for a range of five scenarios reflected in the length of the vertical bars.

Scenarios for Swift Current, SK



Future climate scenarios for Swift Current, Saskatchewan by season, and for a range of five scenarios reflected in the length of the vertical bars.

Climate Moisture Index (May, June, July)



Median scenarios of May-June-July, Climate Moisture Index (P-PET) for 1961–90, the 2020s, 2050s and 2080s, from CGCM3.1/T47 B1(2).

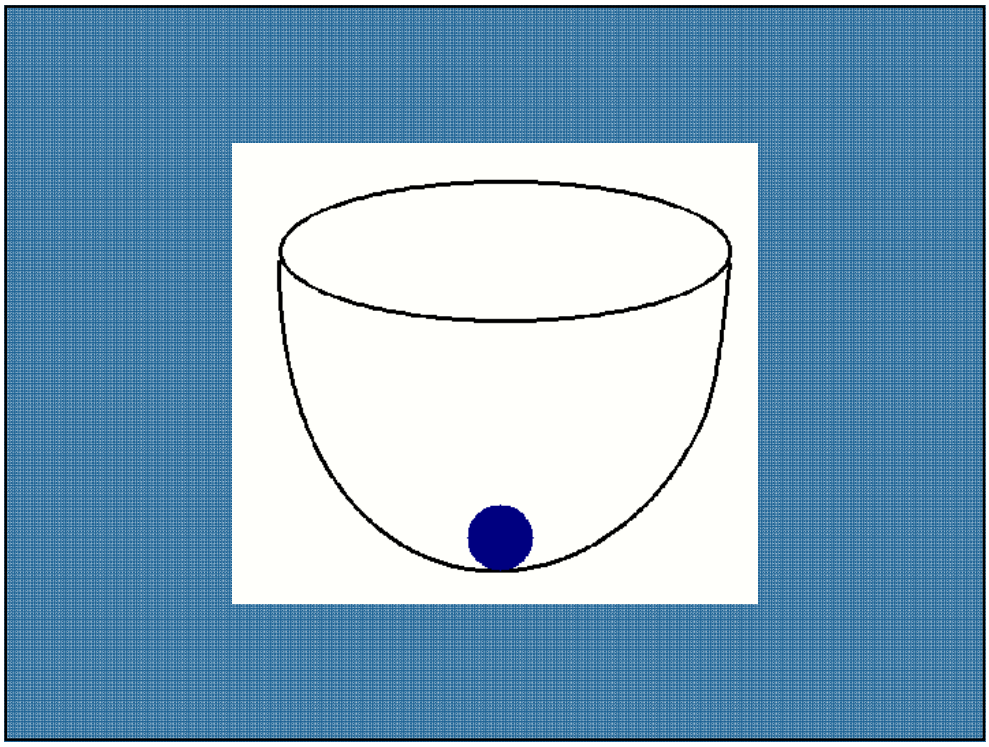
Many regional climate changes can be described in terms of **preferred patterns of climate variability** and therefore as changes in the occurrence of indices that characterize the strength and phase of these patterns.

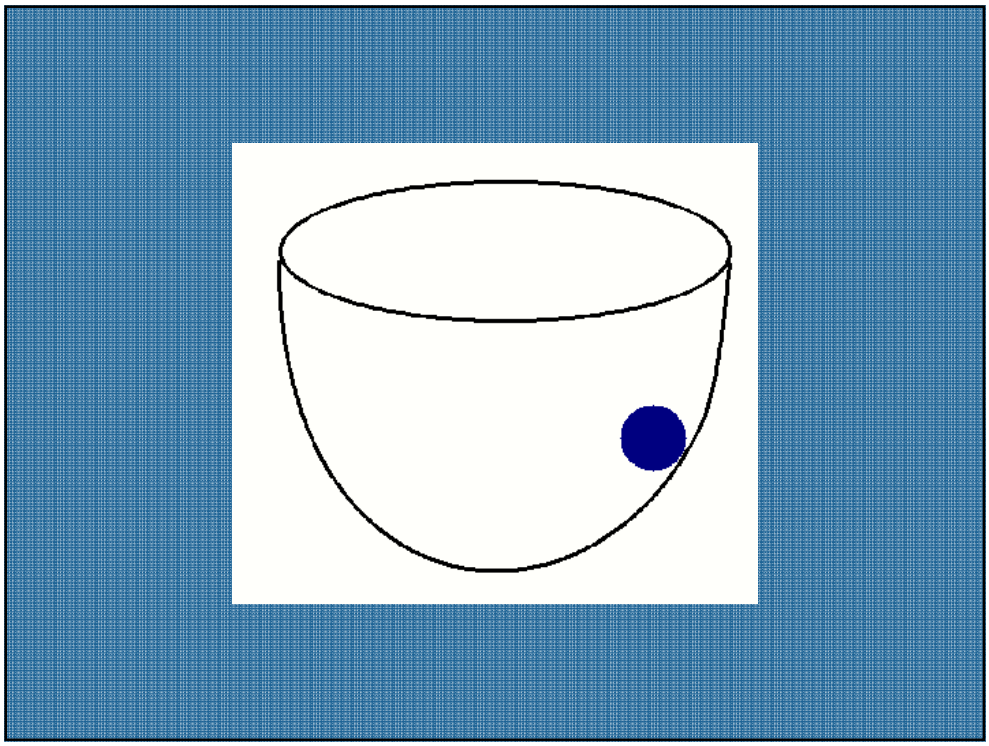
There is evidence that their existence can lead to **larger-amplitude regional responses to forcing than would otherwise be expected**. In particular, a number of the observed 20th-century climate changes can be viewed in terms of changes in these patterns. It is therefore important … to consider **the extent to which observed changes related to these patterns are linked to internal variability or to anthropogenic climate change**.

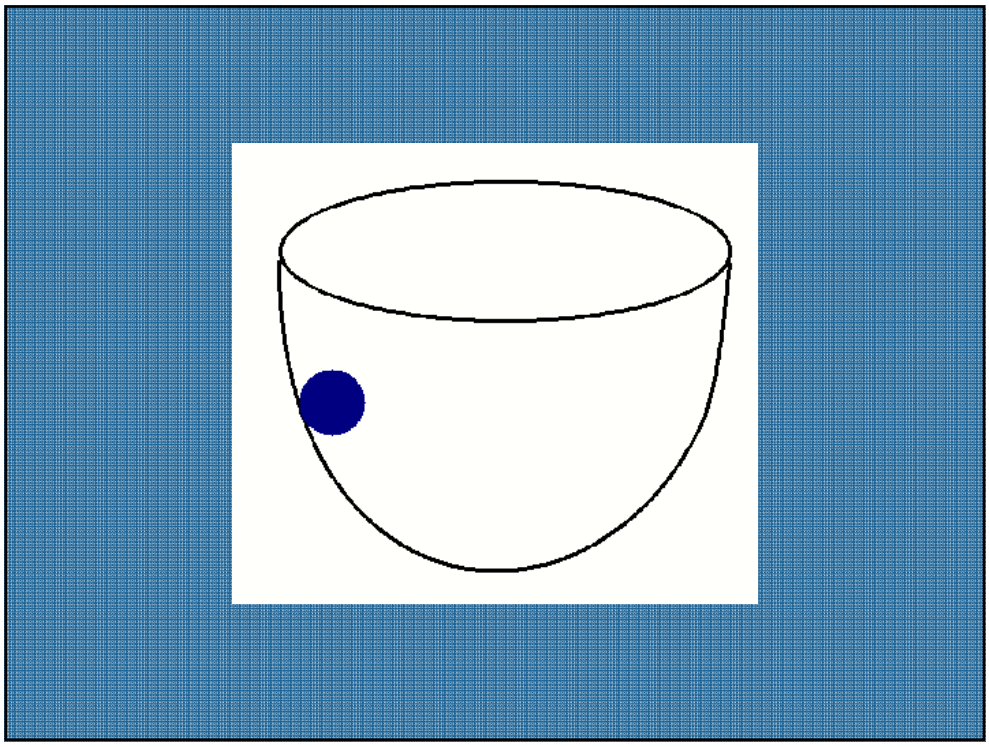
Because up to 90% of the incident solar radiation is reflected by snow and ice surfaces, while only about 10% is reflected by the open ocean or forested lands**, changes in snow and ice cover are important feedback mechanisms** in climate change.

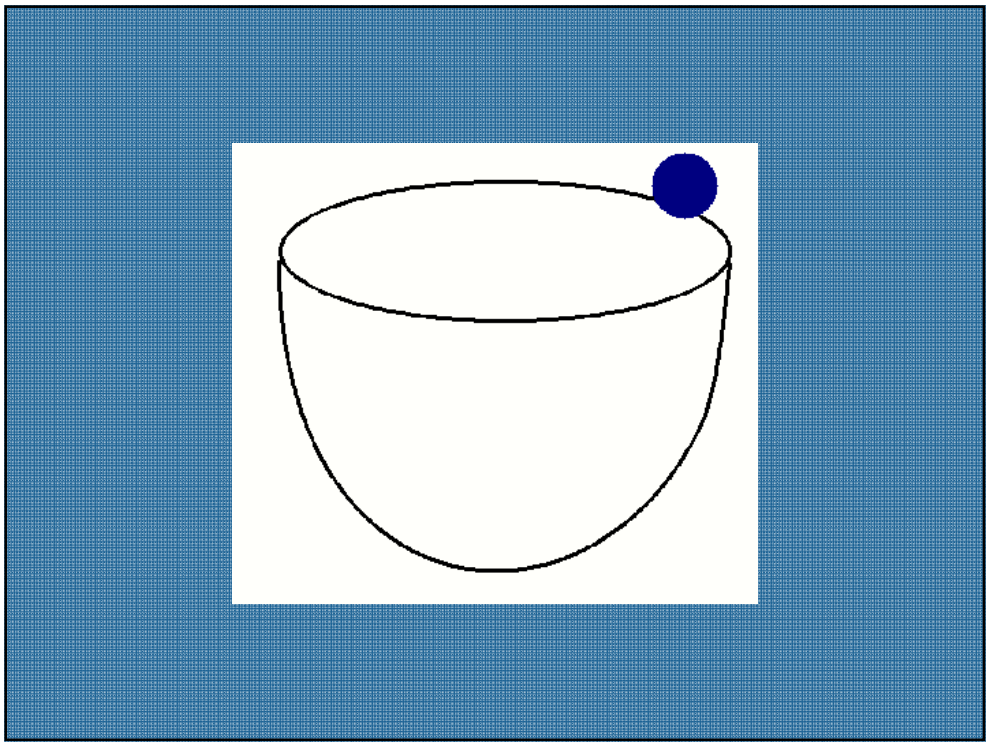
Specific humidity increases in a warming world and **represents an important positive feedback** to climate change. Consistent with rising amounts of water vapour in the atmosphere, there are widespread **increases in the numbers of heavy precipitation events**

Although precipitation has increased in many areas of the globe, the area under drought has also increased. **Drought duration and intensity has also increased**.









1. **Drought: Prairie provinces, 1980**
   Prairie provinces, 1980. Poor wheat yield due to cereal crop drought that occurred in parts of the Prairies (drought continued from 1979); severe and widespread... more information.
   Dead: 0 **Injured:** 0 **Evacuated:** 0

3. **Drought: Prairie Provinces to ON, 1988**
   Prairie provinces and Central and Southern ON, Jul 5-11 1988. . Drought caused damage to Ontario corn. Drought caused dust storm frequency to increase; duck... more information.
   Dead: 0 **Injured:** 0 **Evacuated:** 0

4. **Drought: Prairie provinces, 1979**
   Prairie provinces, 1979. Poor wheat yield due to cereal crop drought that occurred in parts of the Prairies (drought continued into 1980)... more information.
   Dead: 0 **Injured:** 0 **Evacuated:** 0

5. **Drought: Prairie provinces, 1984**
   Prairie provinces, 1984. The worst agricultural drought since the 1930s to occur in the Prairies; severe and widespread surface water droughts reported on the Prairies... more information.
   Dead: 0 **Injured:** 0 **Evacuated:** 0

9. **Drought: Prairie provinces, 1931**
Prairie provinces, 1931-1938. The "dirty thirties"; dust storms, plant rust, heat waves, grasshopper plagues and water shortages plagued western Canada for almost... more information.
Dead: 0 **Injured:** 0 **Evacuated:** 0

10. **Drought: Prairie provinces, 1989**
Prairie provinces, 1989. Cereal crop drought occurred in parts of the Prairies; severe and widespread surface water droughts reported on the Prairies... more information.
Dead: 0 **Injured:** 0 **Evacuated:** 0

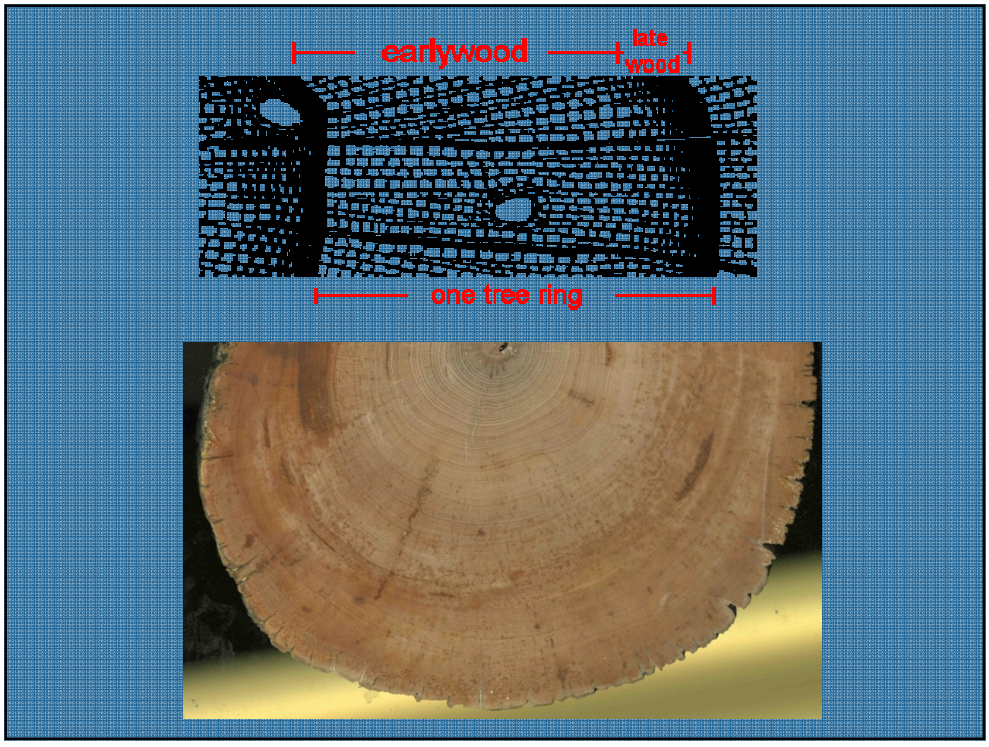
12. **Drought: Prairie provinces, 1961**
Prairie provinces, 1961. One of the worst agricultural droughts to occur in the Prairies; among the most severe and widespread surface water droughts ever to occur... more information.
Dead: 0 **Injured:** 0 **Evacuated:** 0

14. **Drought: Western Canada, 1985**
Western Canada, 1985. Second drought year in a row; one of the worst agricultural droughts to occur in the Prairies; insect infestations. On June 8, there was... more information.
Dead: 0 **Injured:** 0 **Evacuated:** 0

16. **Drought: Prairie provinces, 1977**
Prairie provinces, 1977. Cereal crop drought occurred in parts of the Prairies; among the most severe and widespread surface water droughts ever to occur on the... more information.
Dead: 0 **Injured:** 0 **Evacuated:** 0

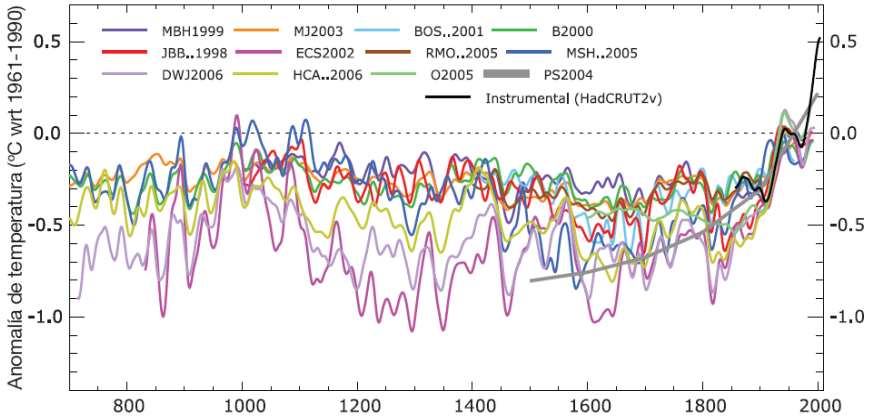
17. **Drought: Prairie provinces, 1990**
Prairie provinces, 1990. Cereal crop drought occurred in parts of the Prairies... more information.
Dead: 0 **Injured:** 0 **Evacuated:** 0

18. **Drought: Prairie provinces, 1992**
Prairie provinces, 1992. Livestock yields were low in northern Alberta and Saskatchewan due to dry conditions; severe and widespread surface water droughts reported... more information.

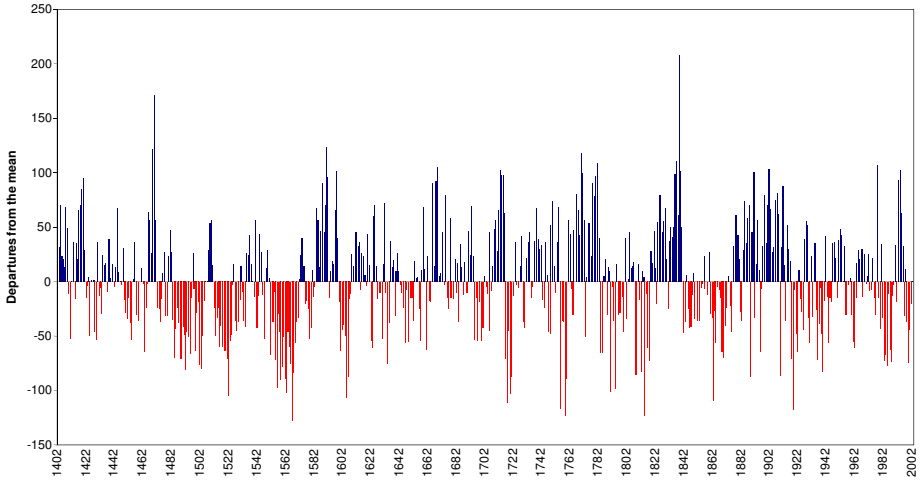


ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

Reconstrucciones De Temperaturas Del Hemisferio Norte



South Saskatchewan River at Medicine Hat, 1402-2004



Axelson, Sauchyn, Barichivich 2009

Future Exposures

- The expected climate conditions may be beneficial for the SSRB. Some benefits of climate change include:
  - Longer, warmer, frost-free growing season
  - Warmer winters
- These conditions create opportunities, including the possibility to diversify production by introducing new crops, and the potential for greater use of more winter crops

Photos (top to bottom): South Saskatchewan River at Outlook, M. Hadarits; Zero tillage, D. Corkal; Grain, D. McLennen; Outlook railway bridge, D. McLennen; Pasture, D. McLennen

Future Exposures

- Some of the risks associated with climate change identified by the IACC project for the SSRB:
  - Warmer temperatures in summer can increase the possibility of heavy rains leading to flooding, and can also lead to water scarcity
  - Higher evapotranspiration, decreased snowmelt runoff and a shift in the timing of the dominant flow from summer to spring will affect surface and groundwater supplies and water quality, especially in summer months
  - Scenarios project a greater frequency in extreme events, particularly droughts. Droughts of greater length and severity will most likely happen

Future Exposures

- These risks will have serious implications for water supplies, economic activities, ecosystems, and human health
  - Dryland farmers will face serious challenges as a result of reduced soil moisture
  - Strategies utilized by ranchers such as storing spring runoff for stock water may be problematic if winters are warmer
  - Irrigators will suffer shortages during drought, as they may not receive full water allocations
  - Reduced water resources and increasing water consumption and demand will present challenges for all water users as well as decision makers
  - Water conflicts could arise as a result of increasing water scarcity and drought coupled with increasing demand for water

Future Exposures

- Climate change has negative implications for rural people and rural communities
- Measures need to be taken to increase the adaptive capacity of communities to cope with climate change

Photo: Small town in rural Saskatchewan, J. Pittman