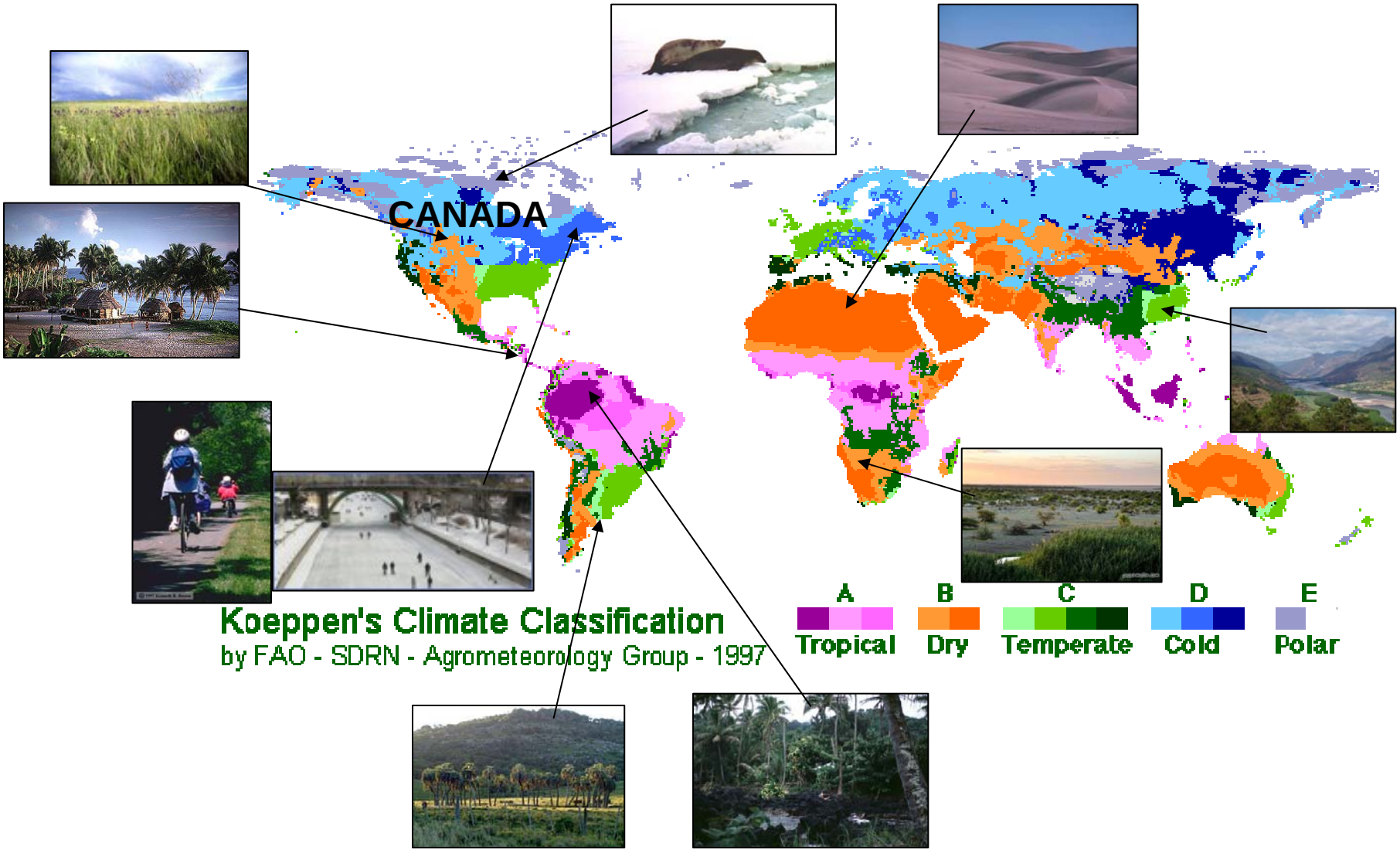
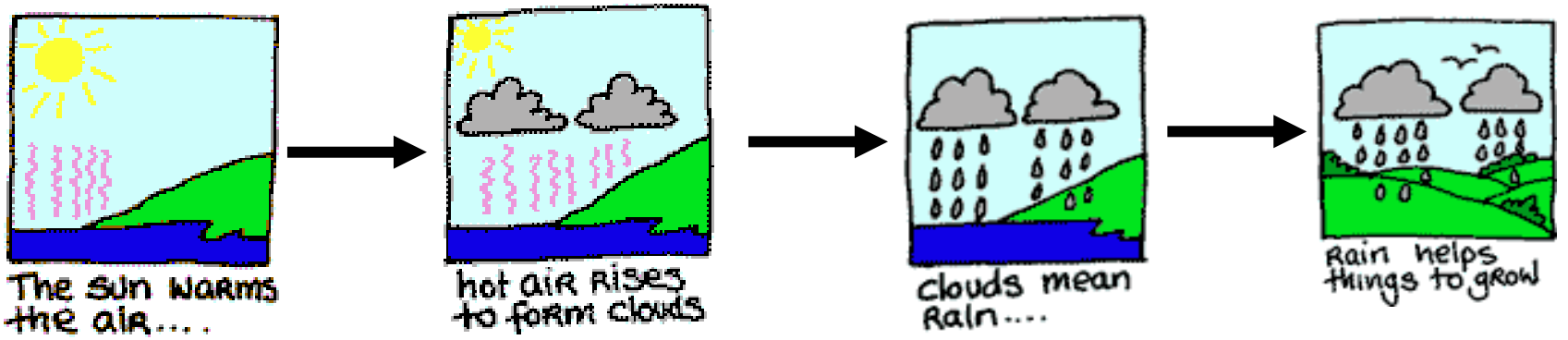
What is climate change?

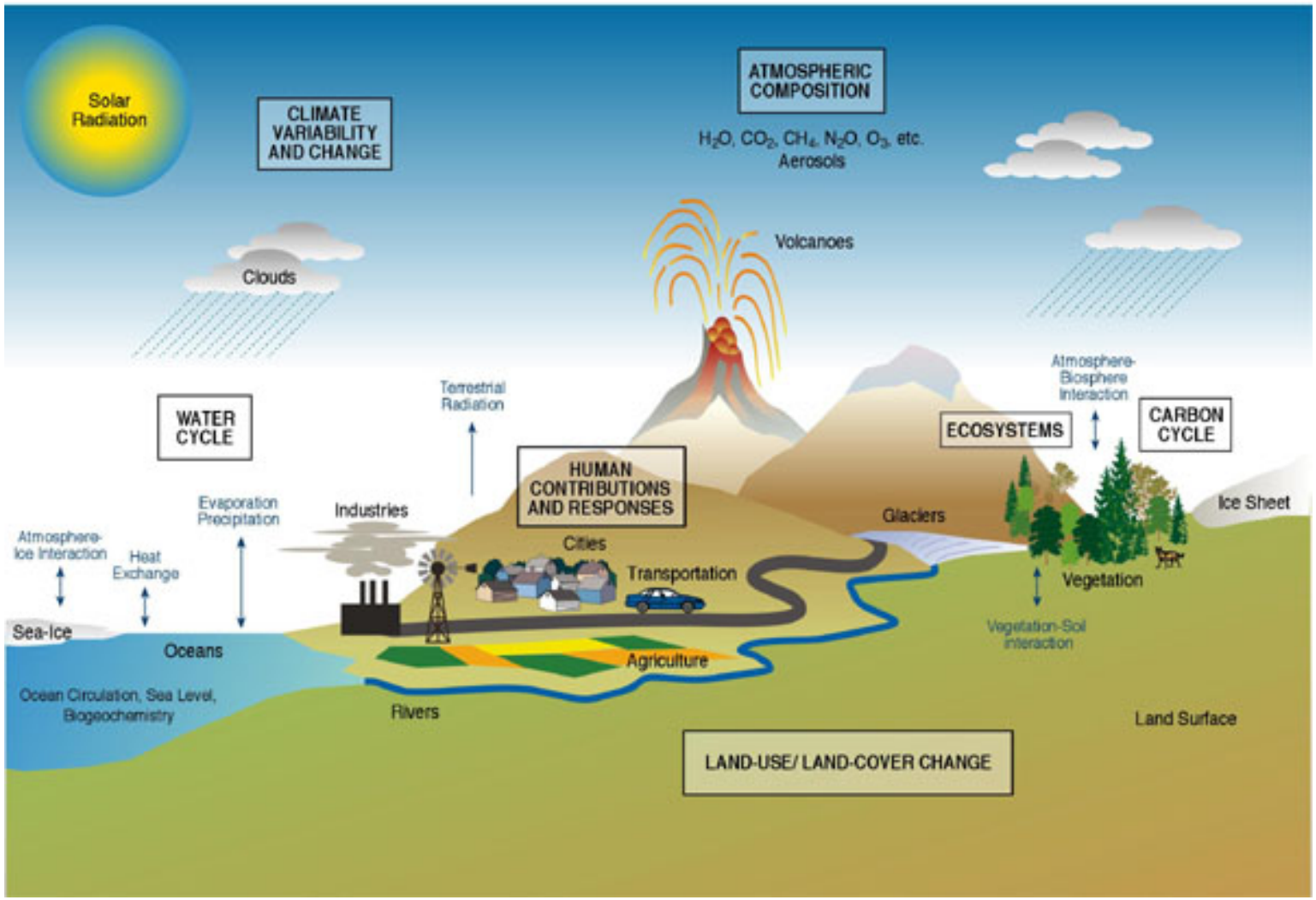
What is the difference between climate and weather?

CLIMATES OF THE WORLD



What does drive the climate?




Solar Radiation
CLIMATE VARIABILITY AND CHANGE
ATMOSPHERIC COMPOSITION
H_2O, CO_2, CH_4, N_2O, O_3, etc.
Aerosols
Volcanoes
Clouds
Terrestrial Radiation
WATER CYCLE
HUMAN CONTRIBUTIONS AND RESPONSES
Atmosphere-Biosphere Interaction
ECOSYSTEMS
CARBON CYCLE
Evaporation Precipitation
Industries
Glaciers
Ice Sheet
Atmosphere-Ice Interaction
Heat Exchange
Cities
Transportation
Vegetation
Sea-Ice
Oceans
Agriculture
Vegetation-Soil Interaction
Ocean Circulation, Sea Level, Biogeochemistry
Rivers
Land Surface
LAND-USE/ LAND-COVER CHANGE

CLIMATE CHANGE IS:

Variation in climate over many years,

from decades to millions of years.

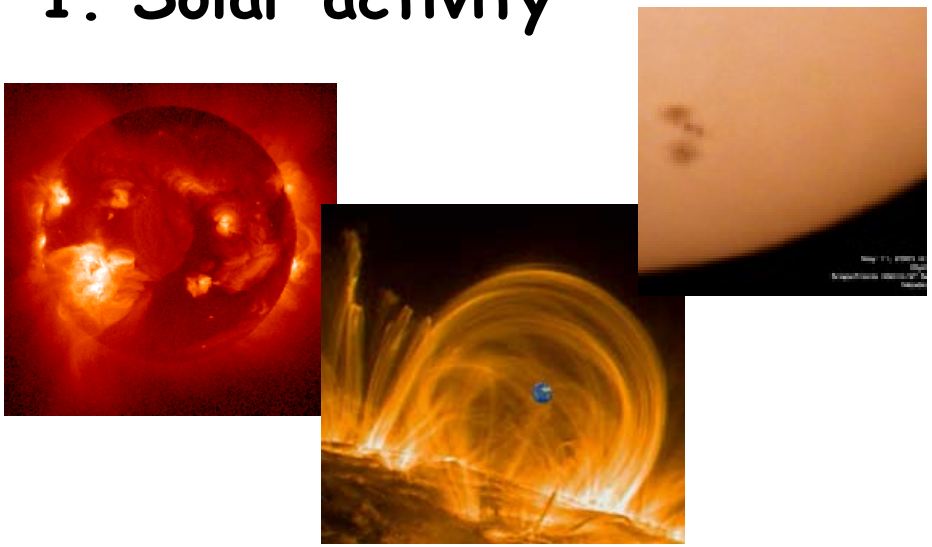
CLIMATE CHANGE INCLUDES

EXTREME EVENTS

(frequency and intensity)

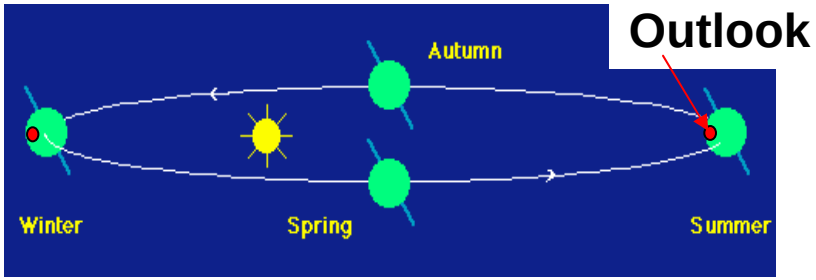
Natural causes:

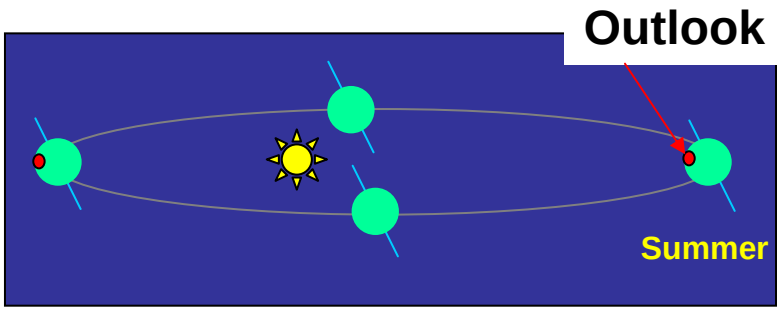
1. Solar activity



2. Volcanic activity

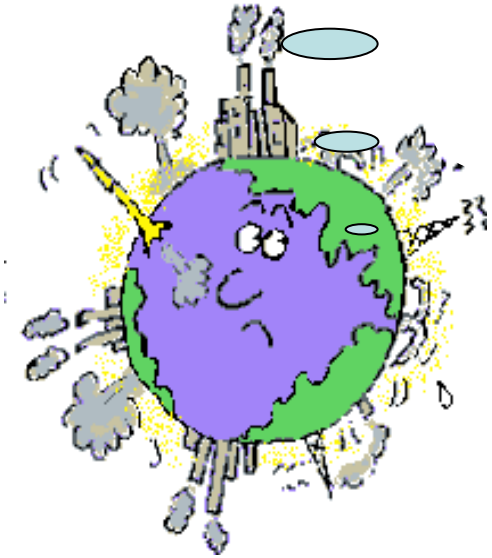
3. Changes in the Earth's orbit



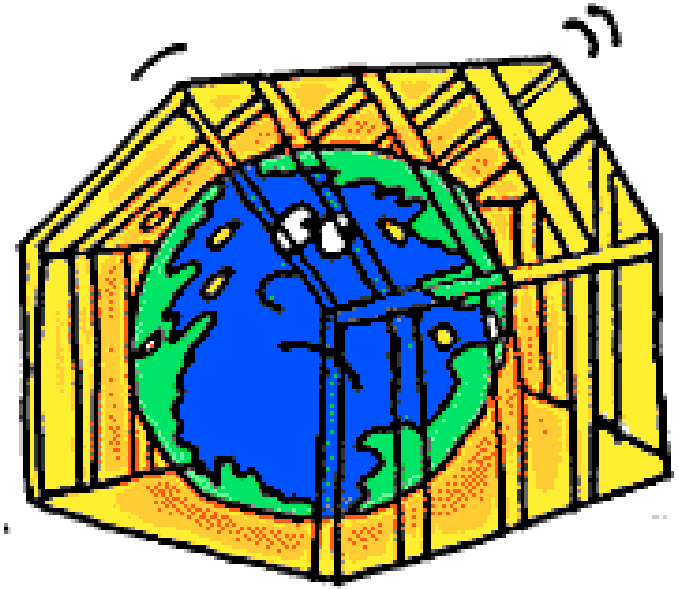


Human causes:

Pollution



Greenhouse effect

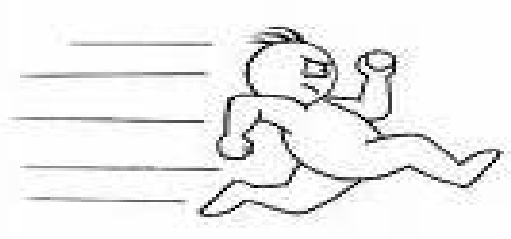


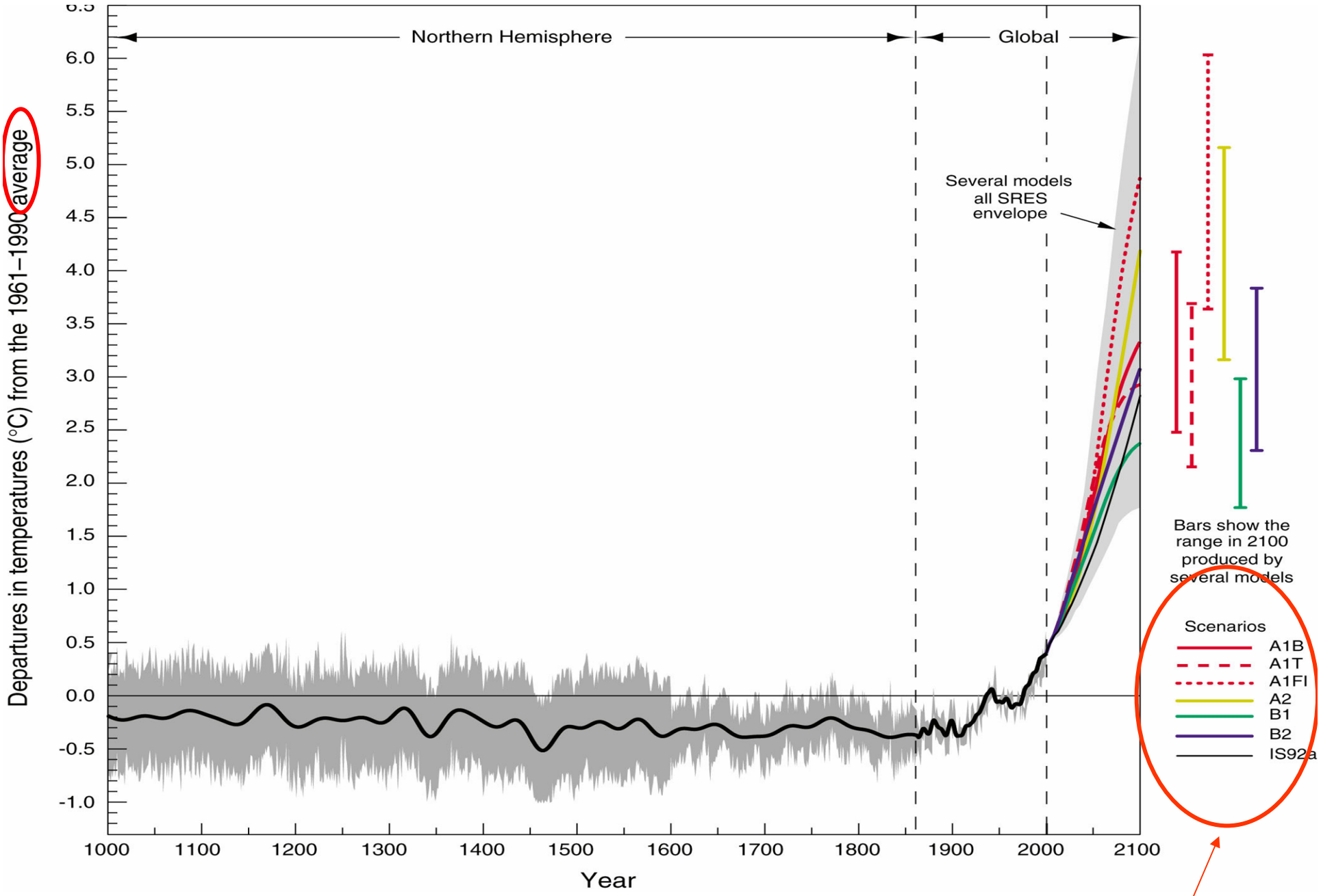
Global warming

What does make this climate change different from past climate changes?

This climate change is happening

FASTER.





Courtesy of Dr. David Sauchyn. Prairie Adaptation Research Collaborative.

Plausible alternative futures

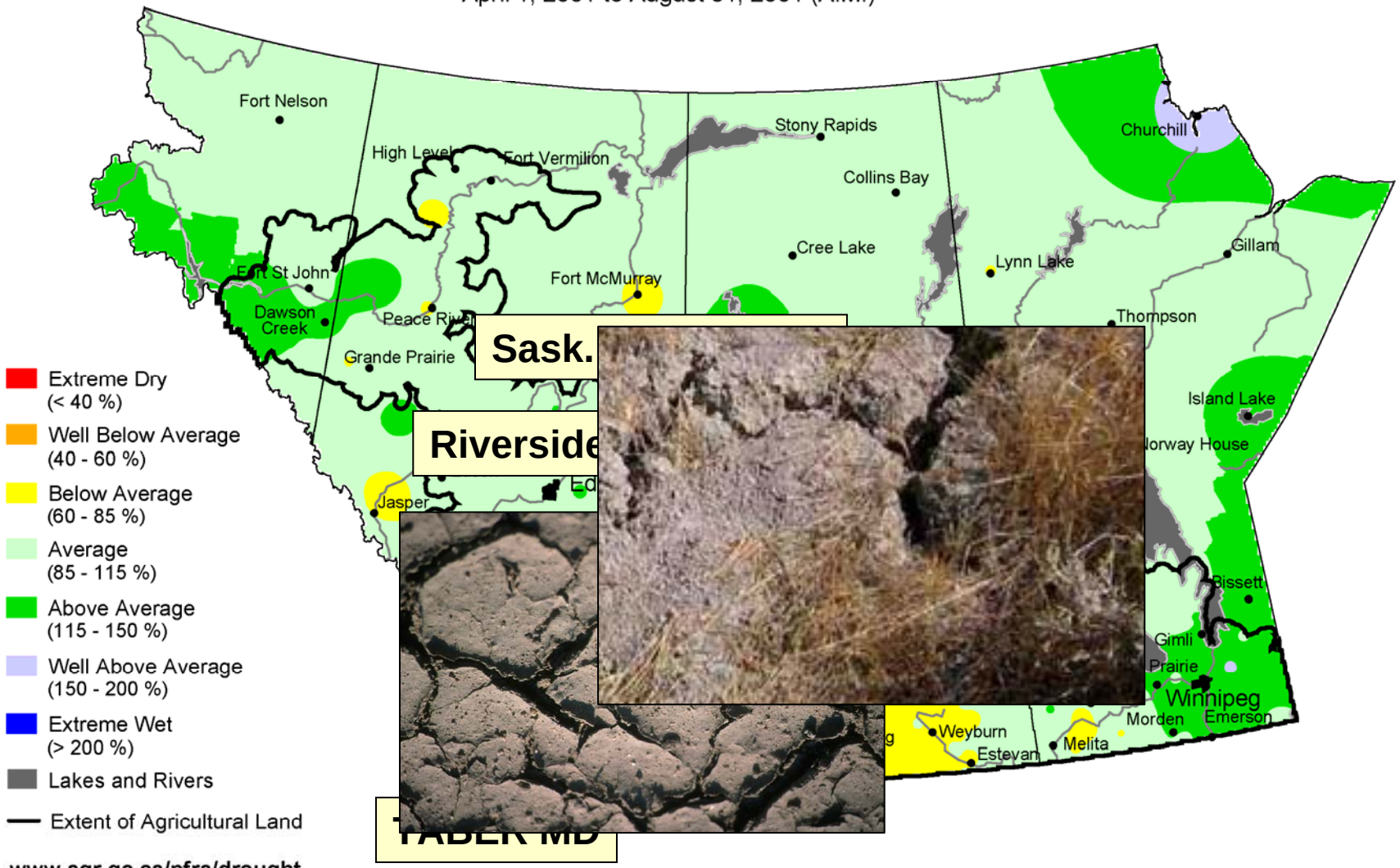
Agriculture and Agri-Food Canada

Agriculture et Agroalimentaire Canada

South Saskatchewan River Basin DROUGHT

Percent of Average Precipitation

April 1, 2001 to August 31, 2001 (A.M.)



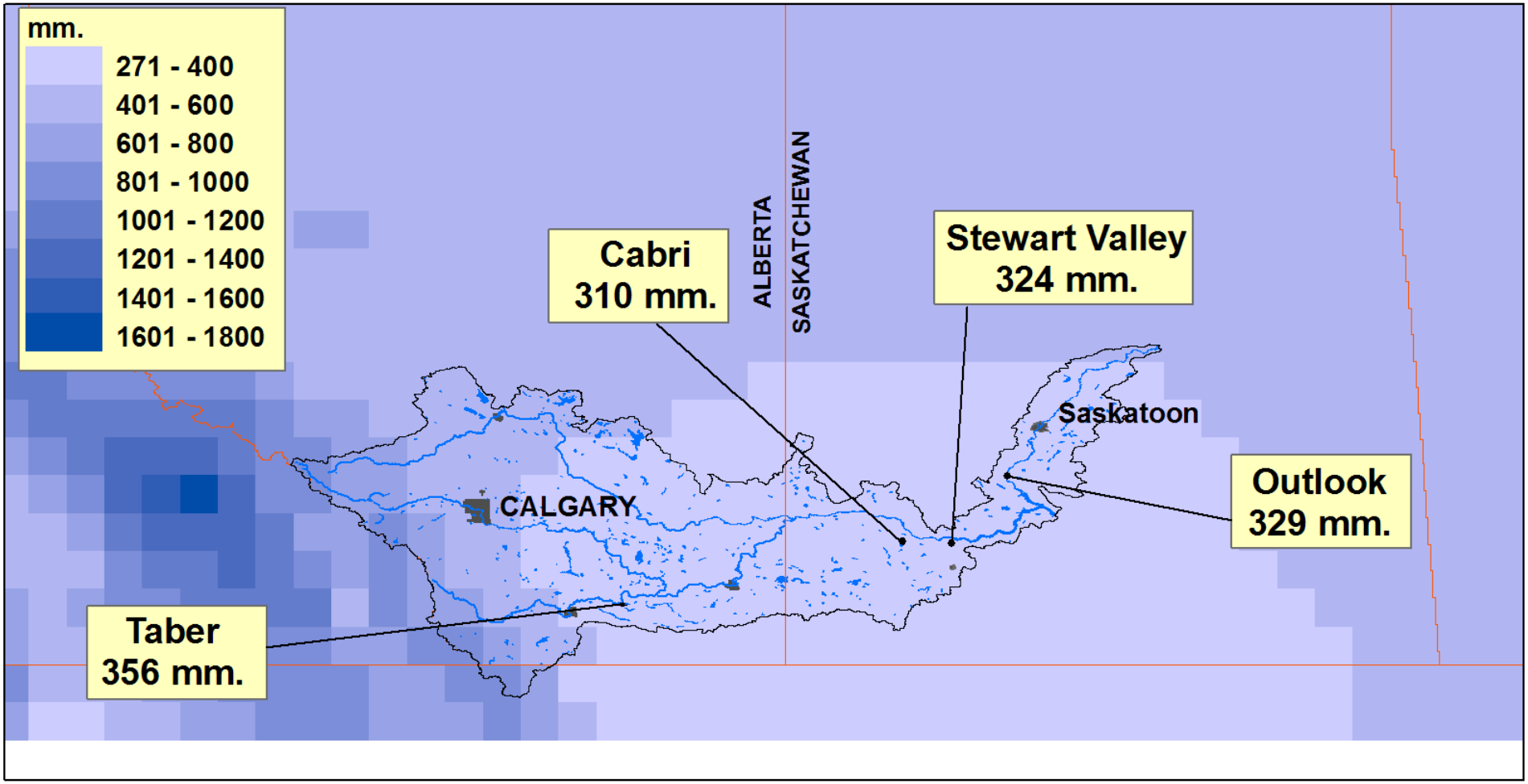
www.agr.gc.ca/pfra/drought

Prepared by Agriculture and Agri-Food Canada (PFRA) using data from the Timely Climate Monitoring Network and the many federal and provincial agencies and volunteers that support it.

Canada

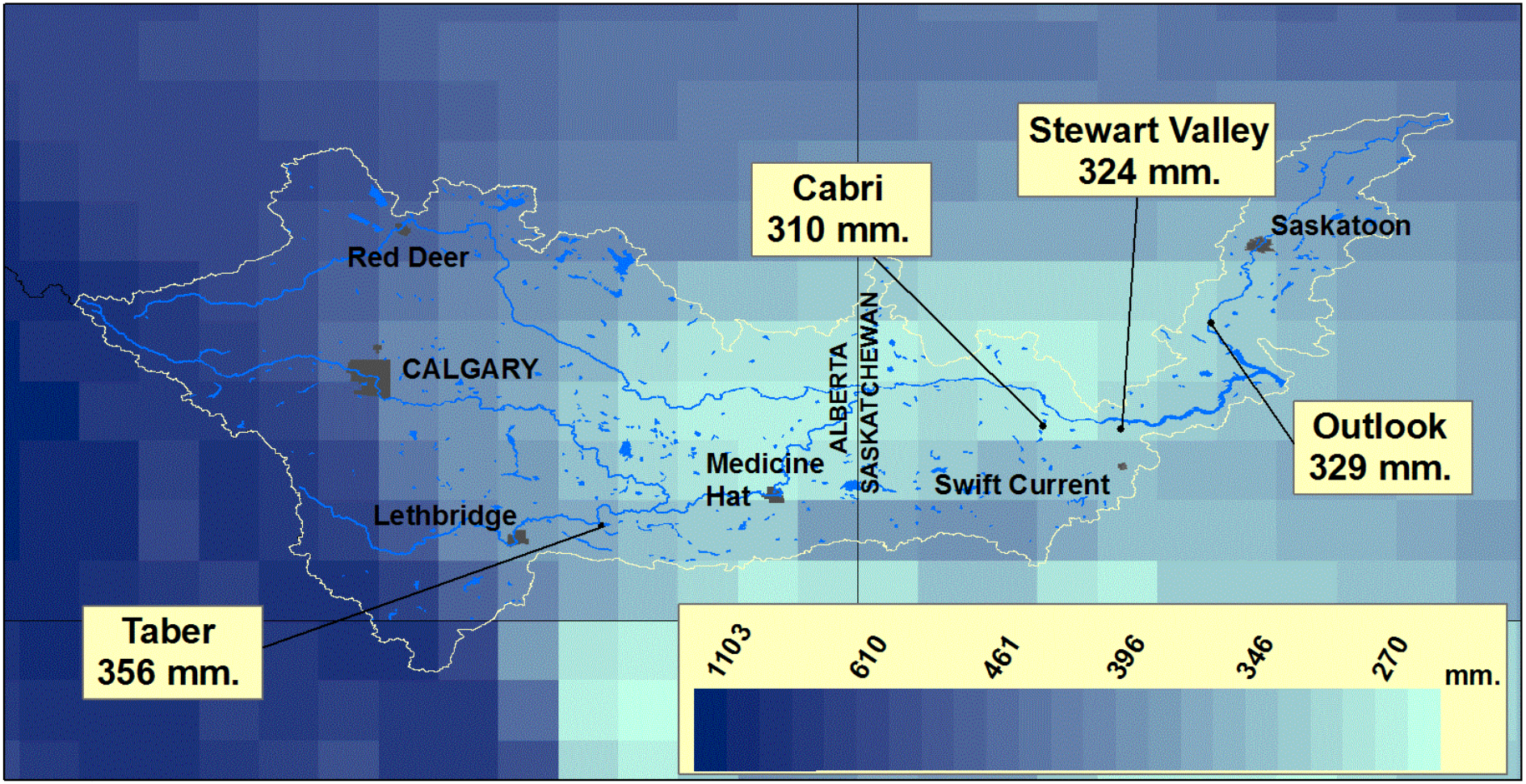
PRECIPITATION

Annual Total Precipitation 1961 - 1990 . South Saskatchewan River Basin.



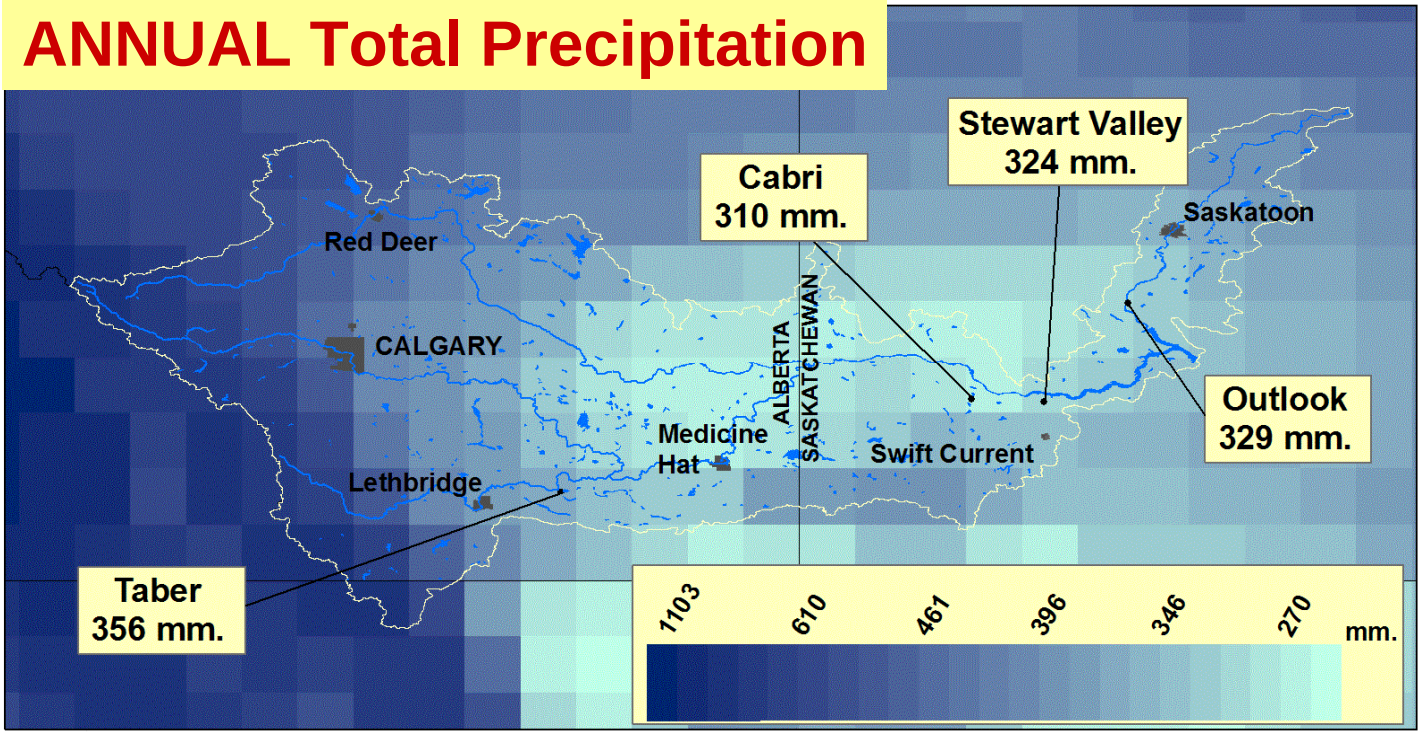
Source: Suzan Lapp, 2007. (Normals from Mckenney et al. 2006).

Annual Total Precipitation 1961 - 1990 . South Saskatchewan River Basin.



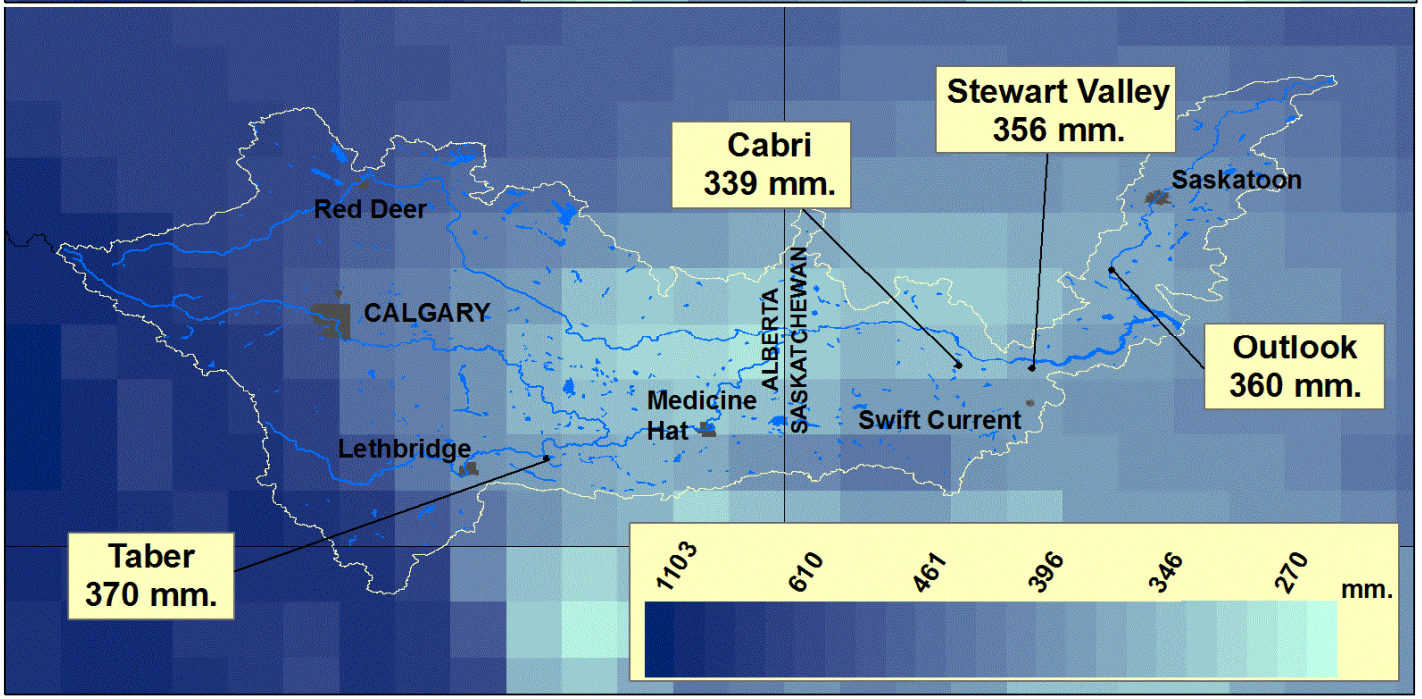
Source: Suzan Lapp, 2007. (Normals from Mckenney et al. 2006).

ANNUAL Total Precipitation



Annual Total Precipitation 1961 - 1990. South Saskatchewan River Basin.

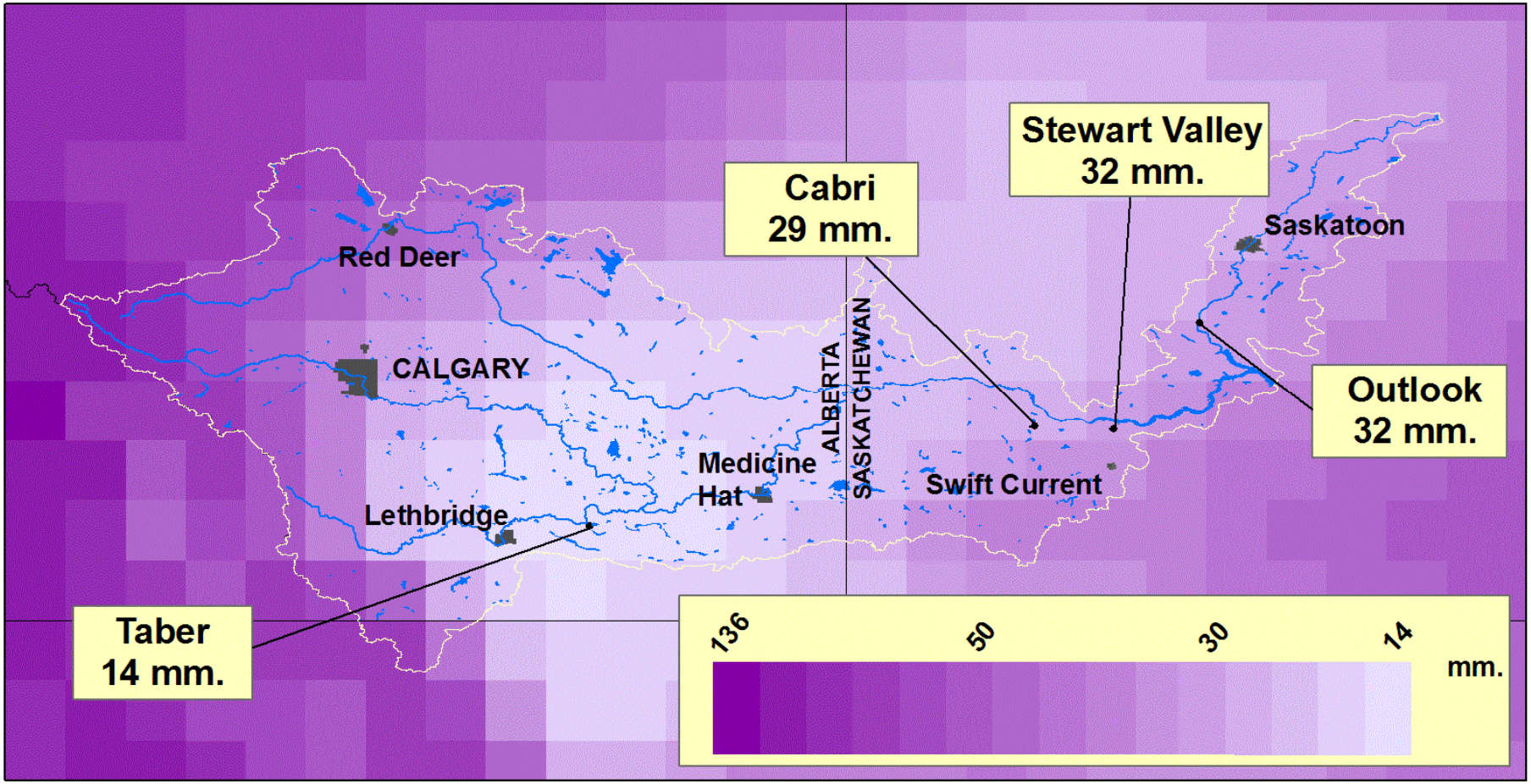
Source: Suzan Lapp, 2007. (Normals from Mckenney et al. 2006).



Annual Total Precipitation 2050. South Saskatchewan River Basin.

Source: Suzan Lapp, 2007. (GCM data from WCRP CMIP3 multi-model database).

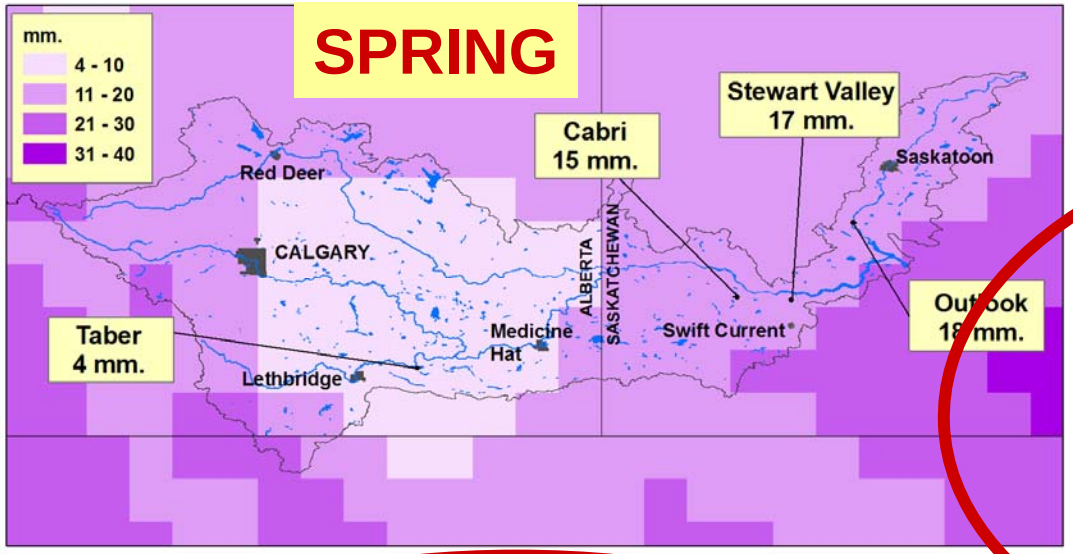
Increase in Annual Total Precipitation by 2050

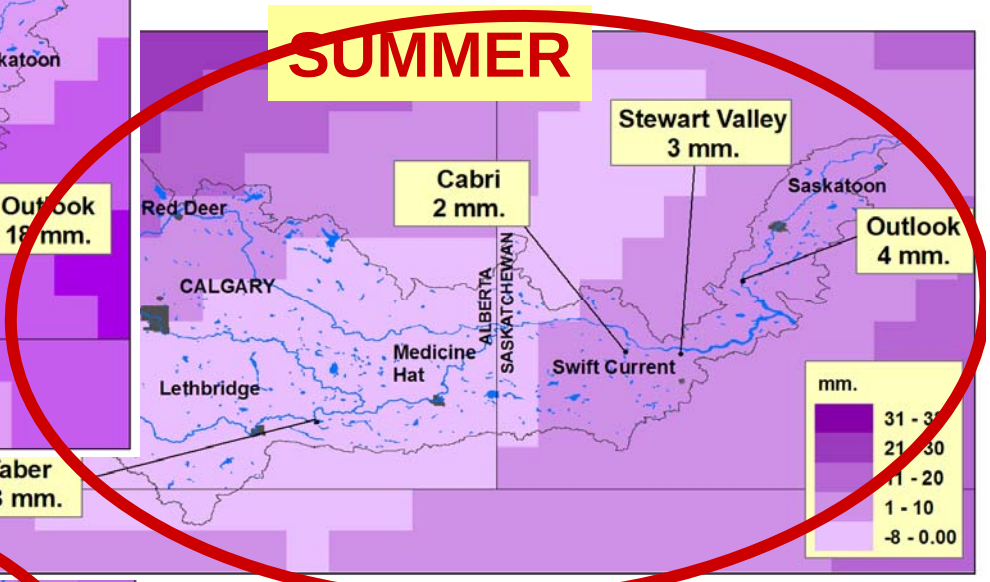


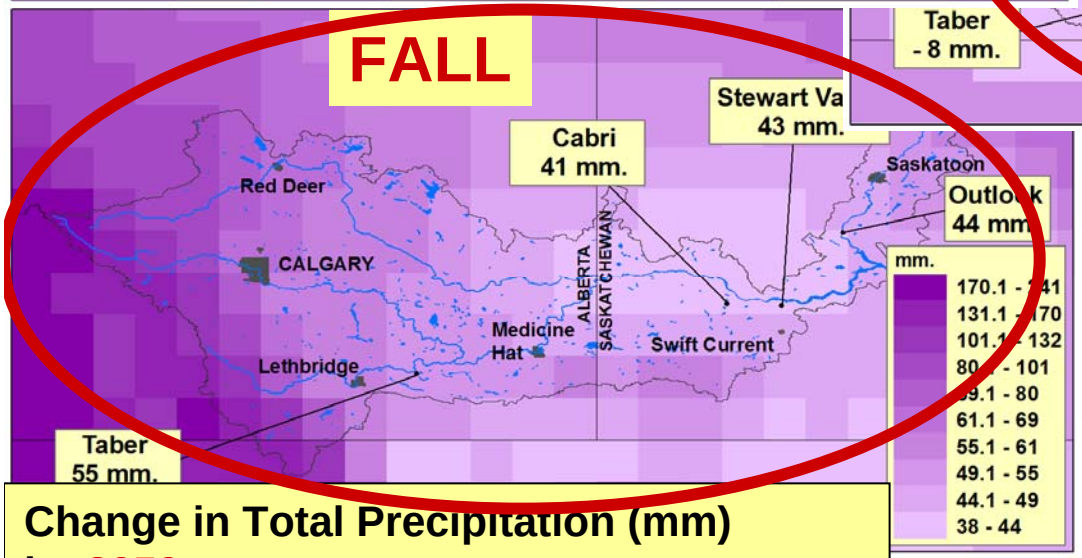
Source: Suzan Lapp, 2007. (GCM data from WCRP CMIP3 multi-model database).

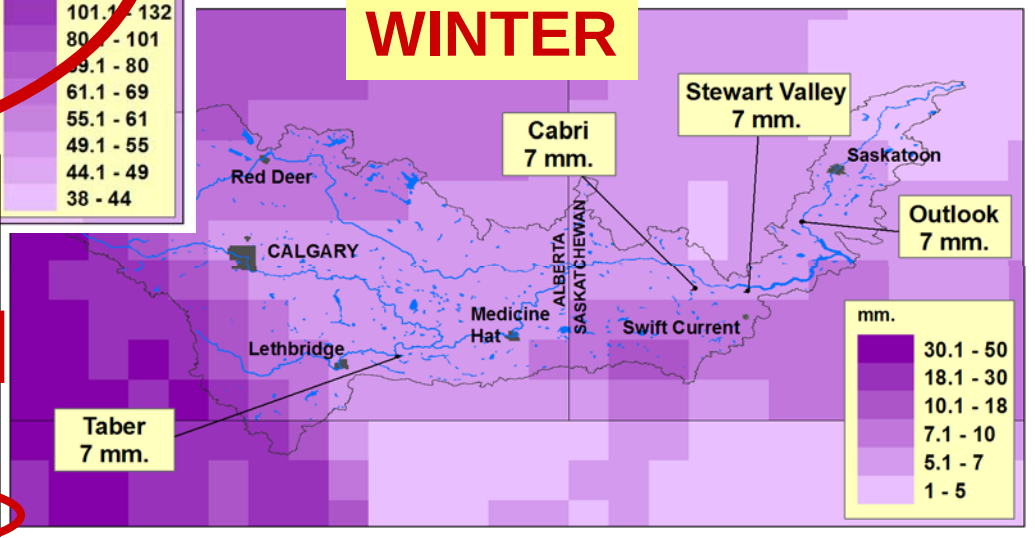
Expected increase in annual total precipitation by 2050:

Outlook	32 mm.
Stewart Valley	32 mm.
Cabri	29 mm.
Taber	14 mm.







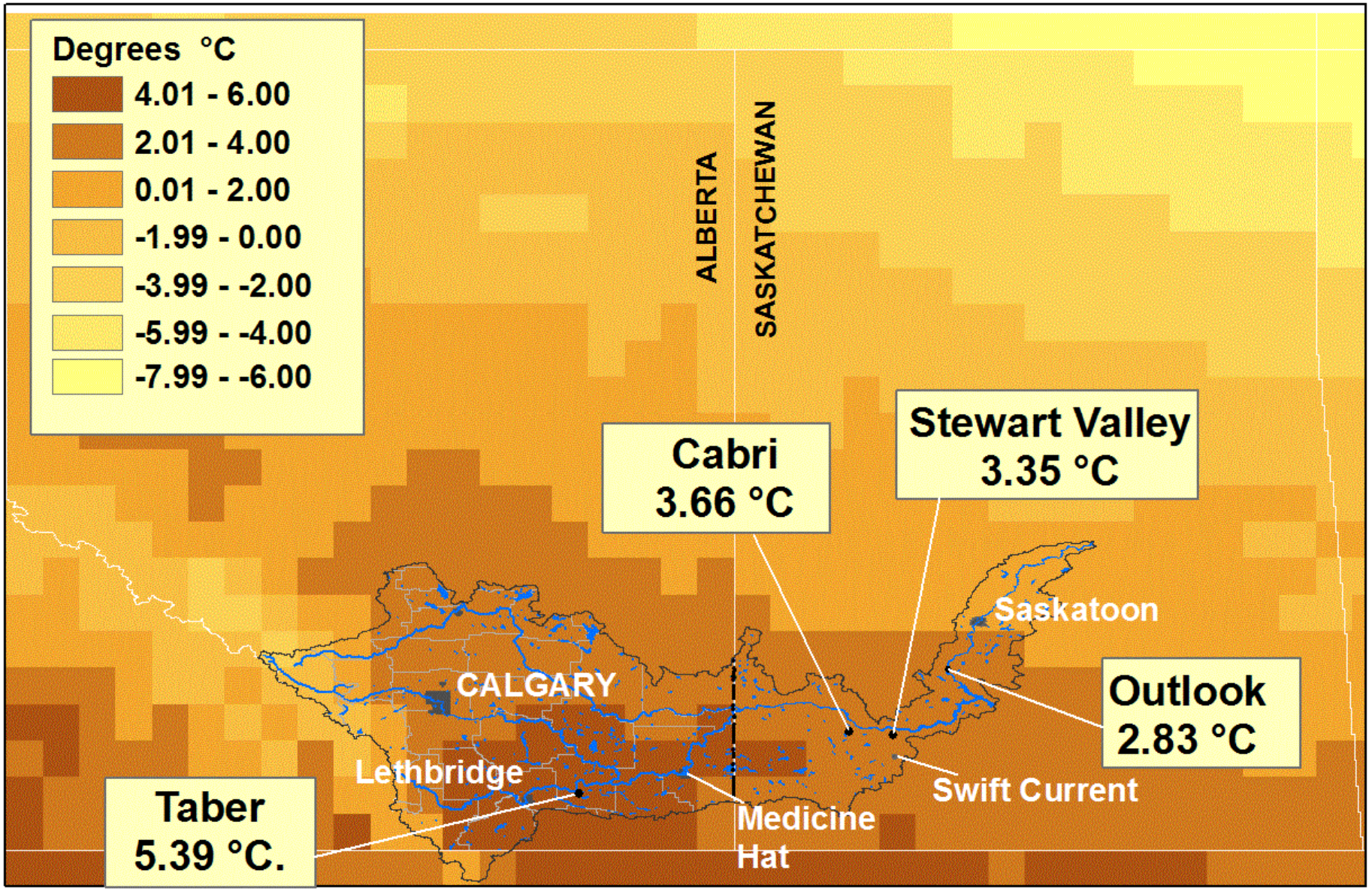


Change in Total Precipitation (mm) by 2050:

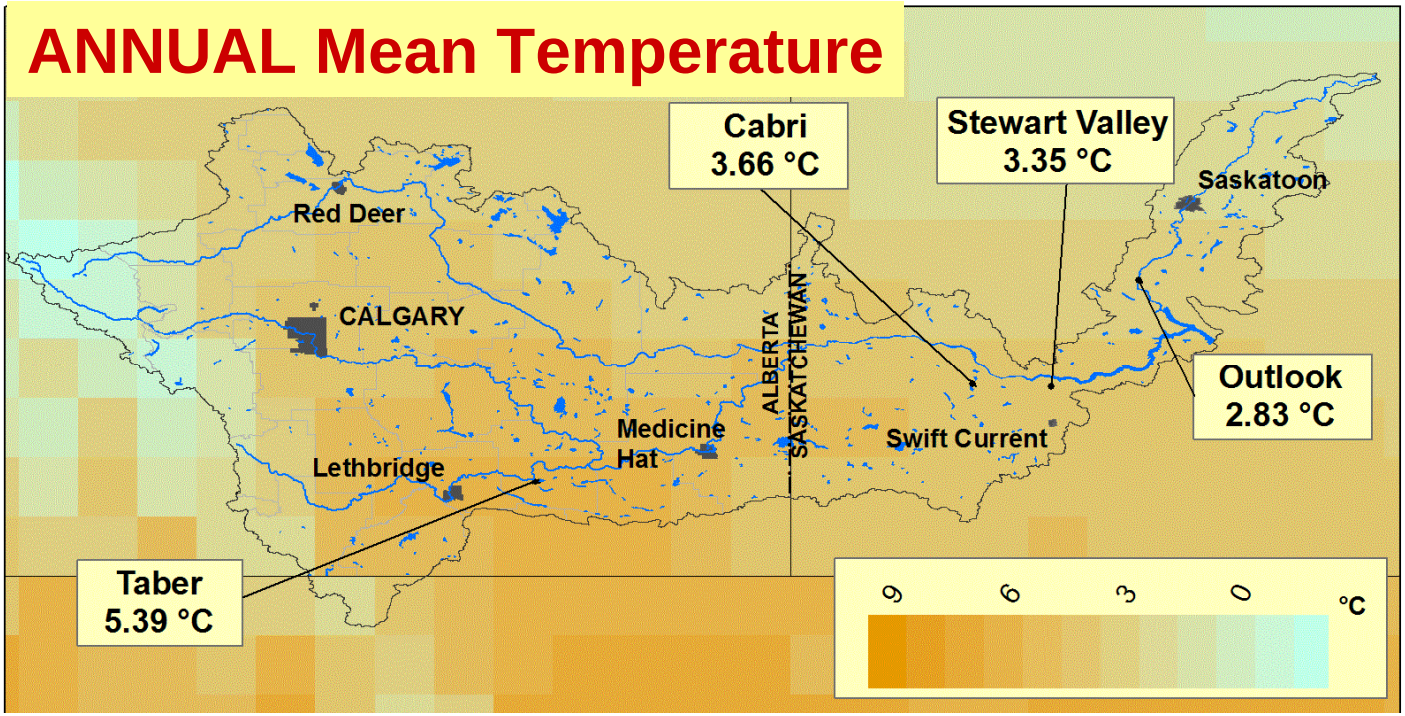
	Taber	Cabri	Stewart V.	Outlook
Fall	55	41	42	44
Spring	4	15	17	18
Winter	7	7	7	7
Summer	-8	2	3	4

TEMPERATURE

Annual Mean Temperature 1961-1990. South Saskatchewan River Basin.

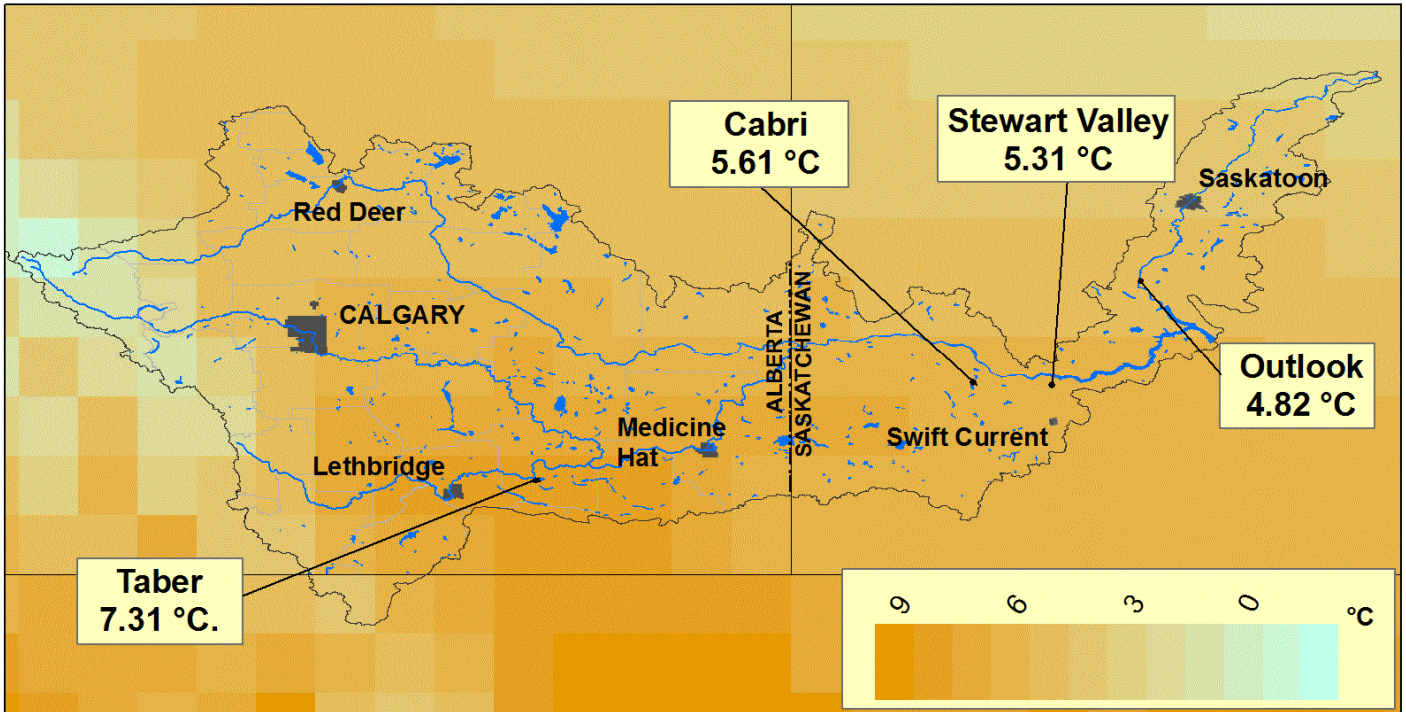


Source: Suzan Lapp, 2007. (Normals from Mckenney et al. 2006).



Annual Mean Temperature 1961 - 1990. SSRB.

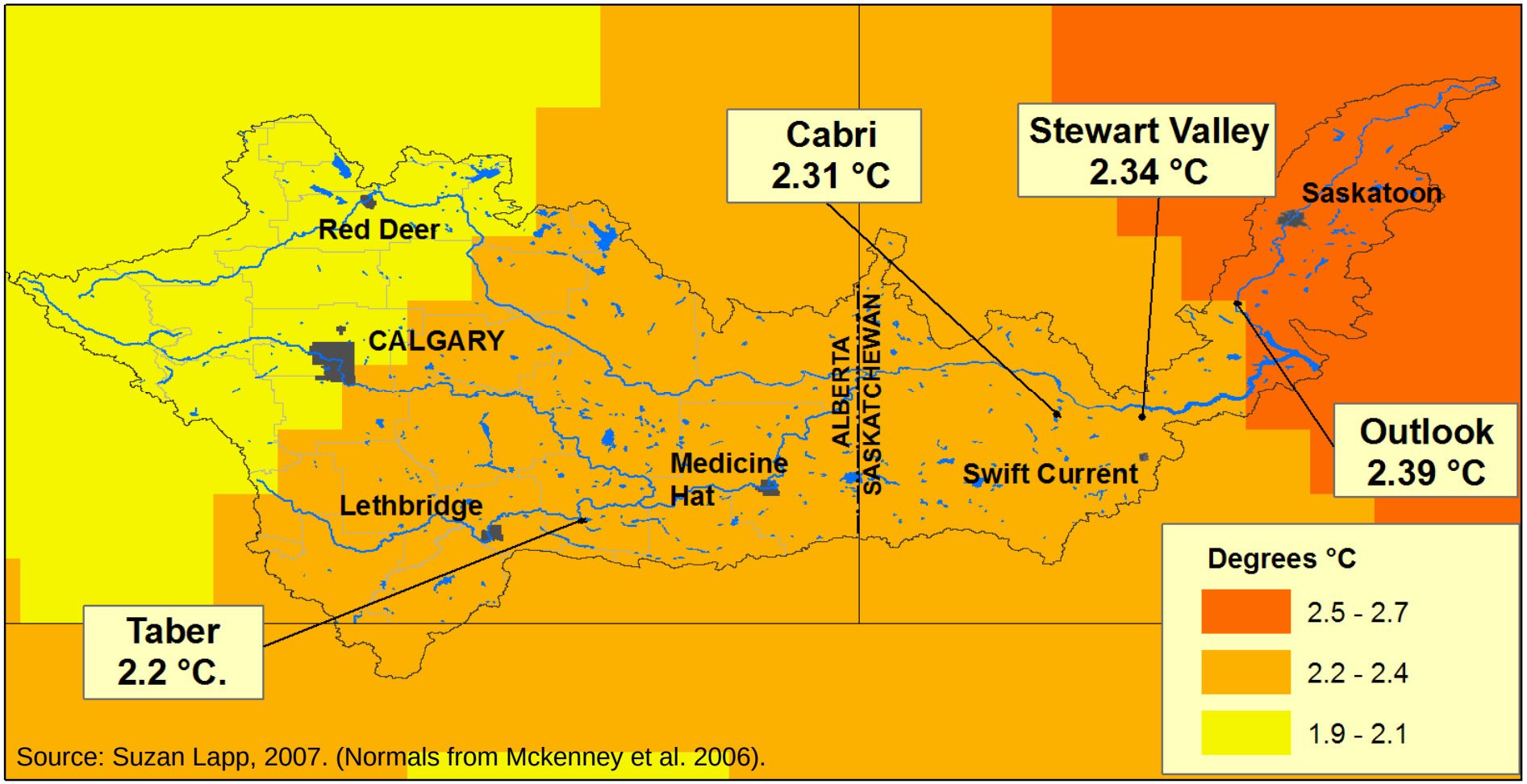
Source: Suzan Lapp, 2007. (Normals from Mckenney et al. 2006).



Annual Mean Temperature Scenario for 2050. Median model: CGCM3.1 T47 B1(2). SSRB.

Source: Suzan Lapp, 2007. (GCM data from WCRP CMIP3 multi-model database).

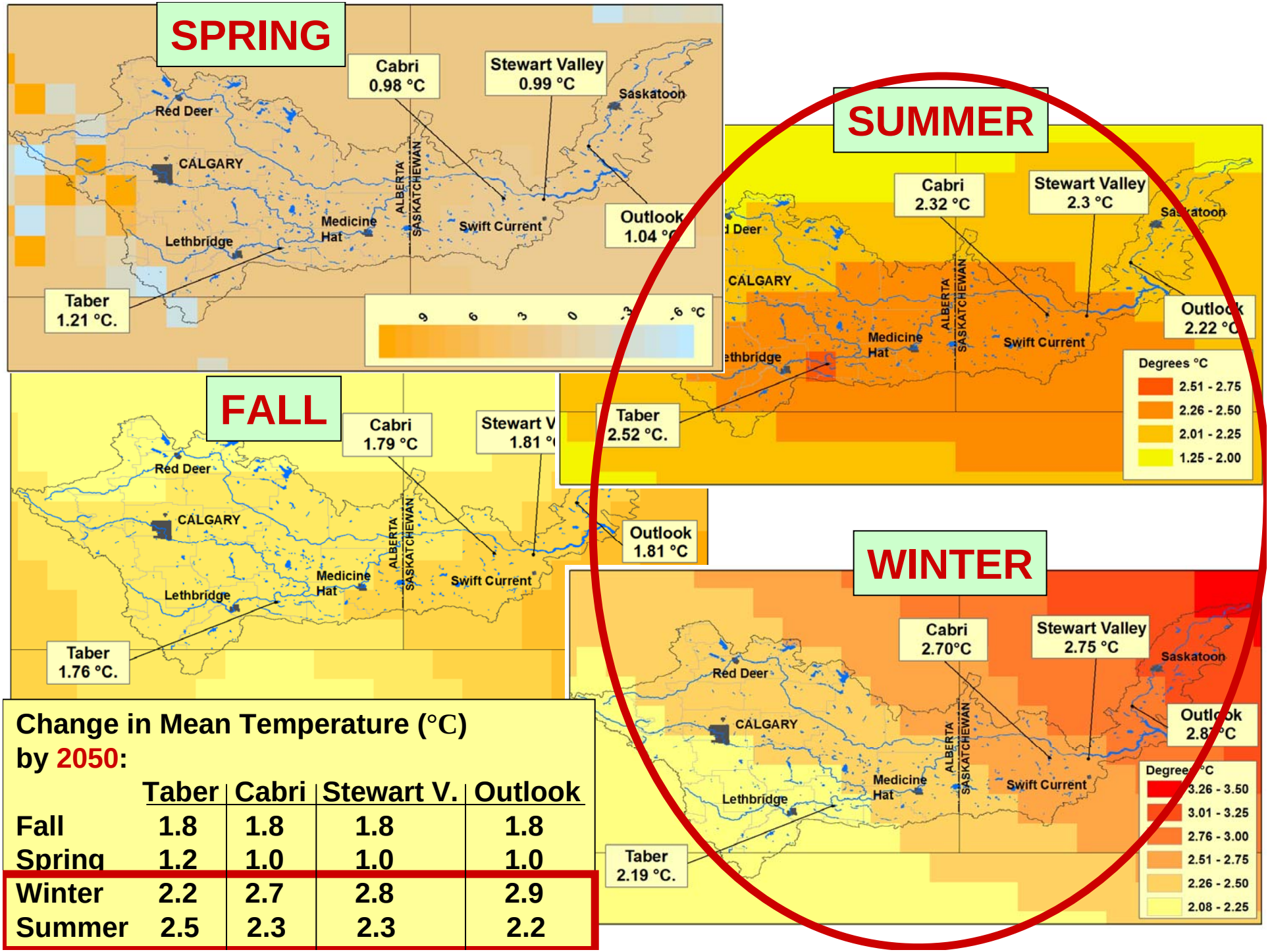
Increase in Annual Mean Temperature by 2050



Source: Suzan Lapp, 2007. (Normals from Mckenney et al. 2006).

Expected change in annual mean temperature by 2050:

Outlook	2.39°C
Stewart Valley	2.34°C
Cabri	2.31 °C
Taber	2.20 °C

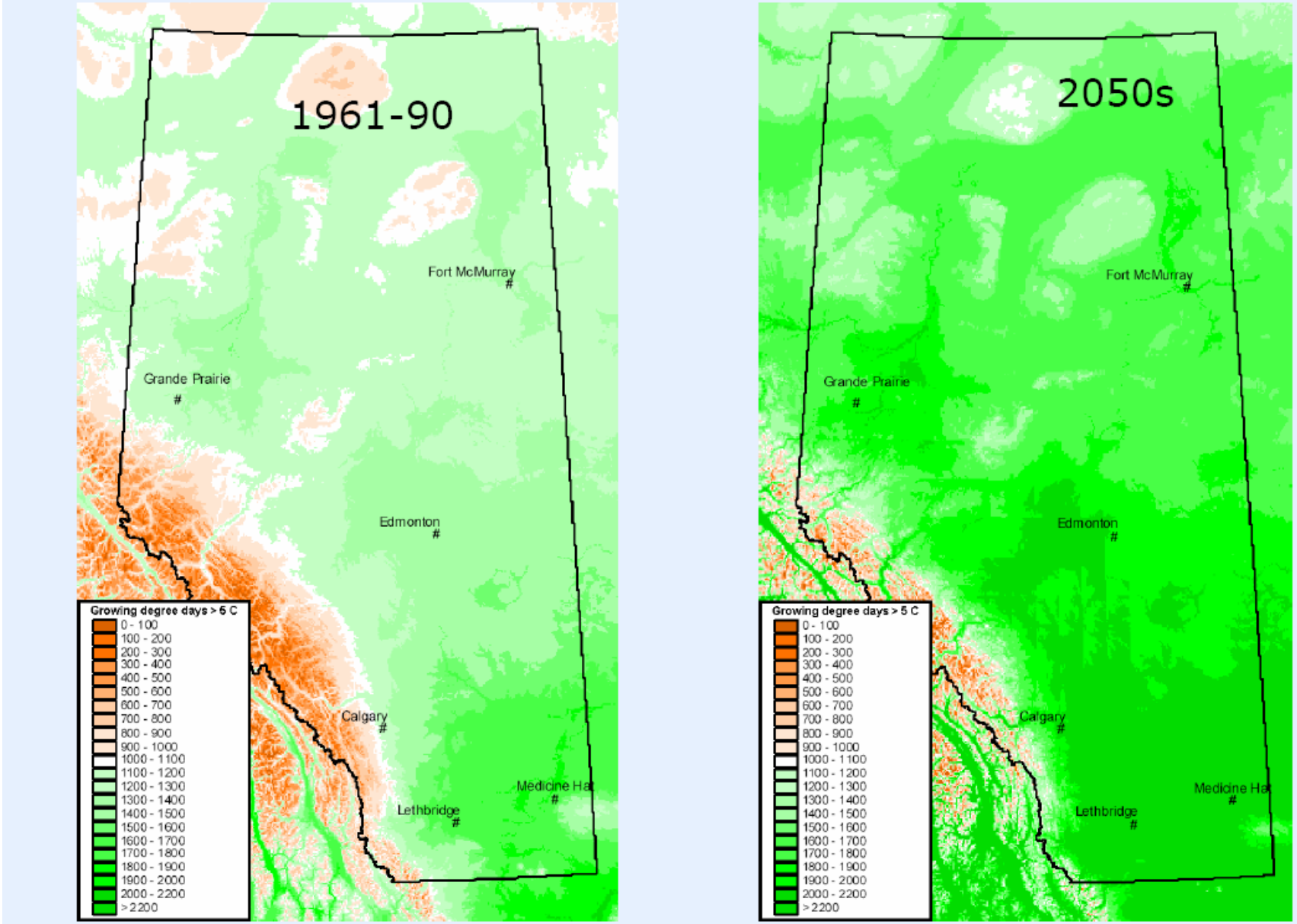


Change in Mean Temperature (°C) by 2050:

	Taber	Cabri	Stewart V.	Outlook
Fall	1.8	1.8	1.8	1.8
Spring	1.2	1.0	1.0	1.0
Winter	2.2	2.7	2.8	2.9
Summer	2.5	2.3	2.3	2.2

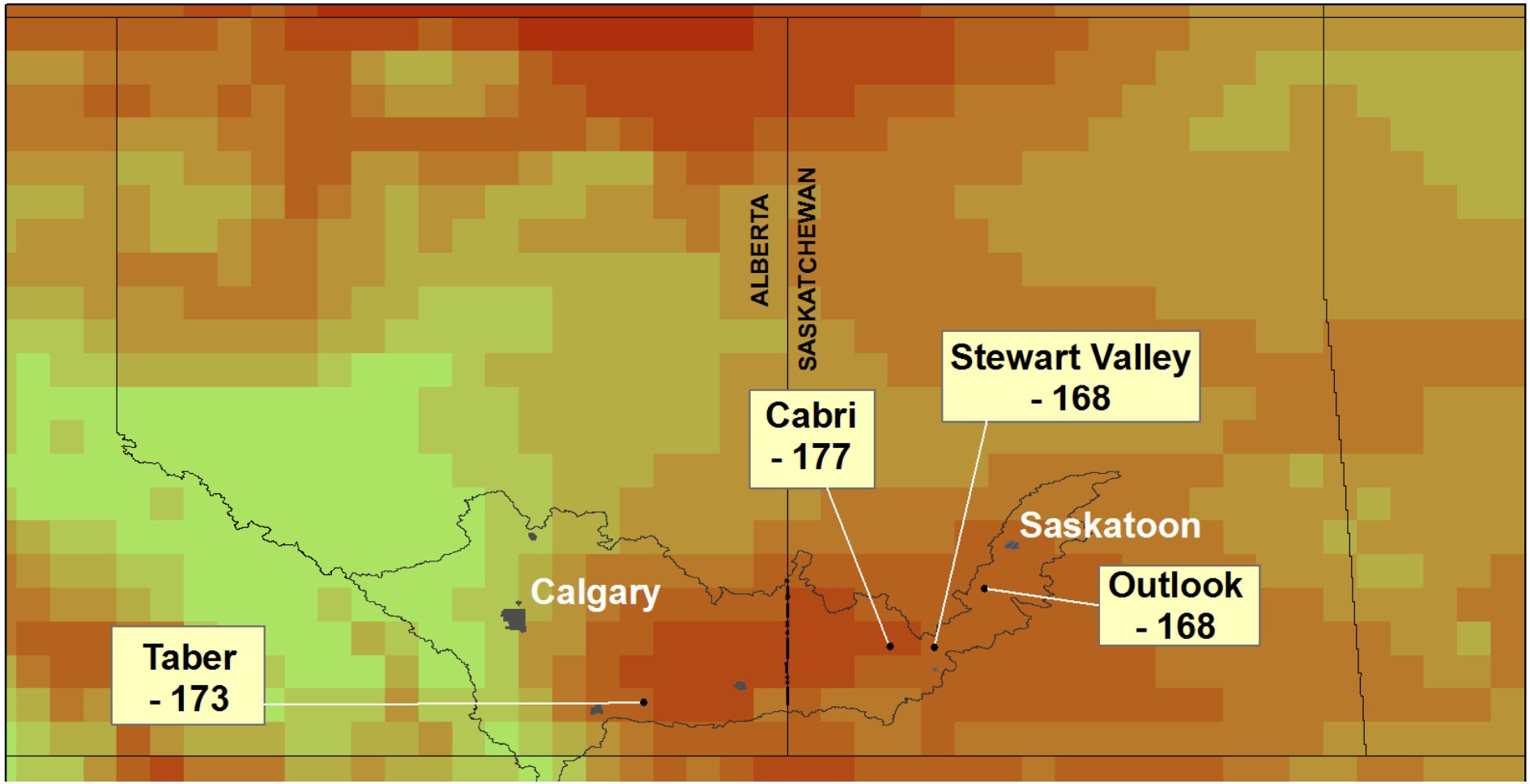
Growing Degree Days > 5⁰ C

Barrow and Yu, 2005



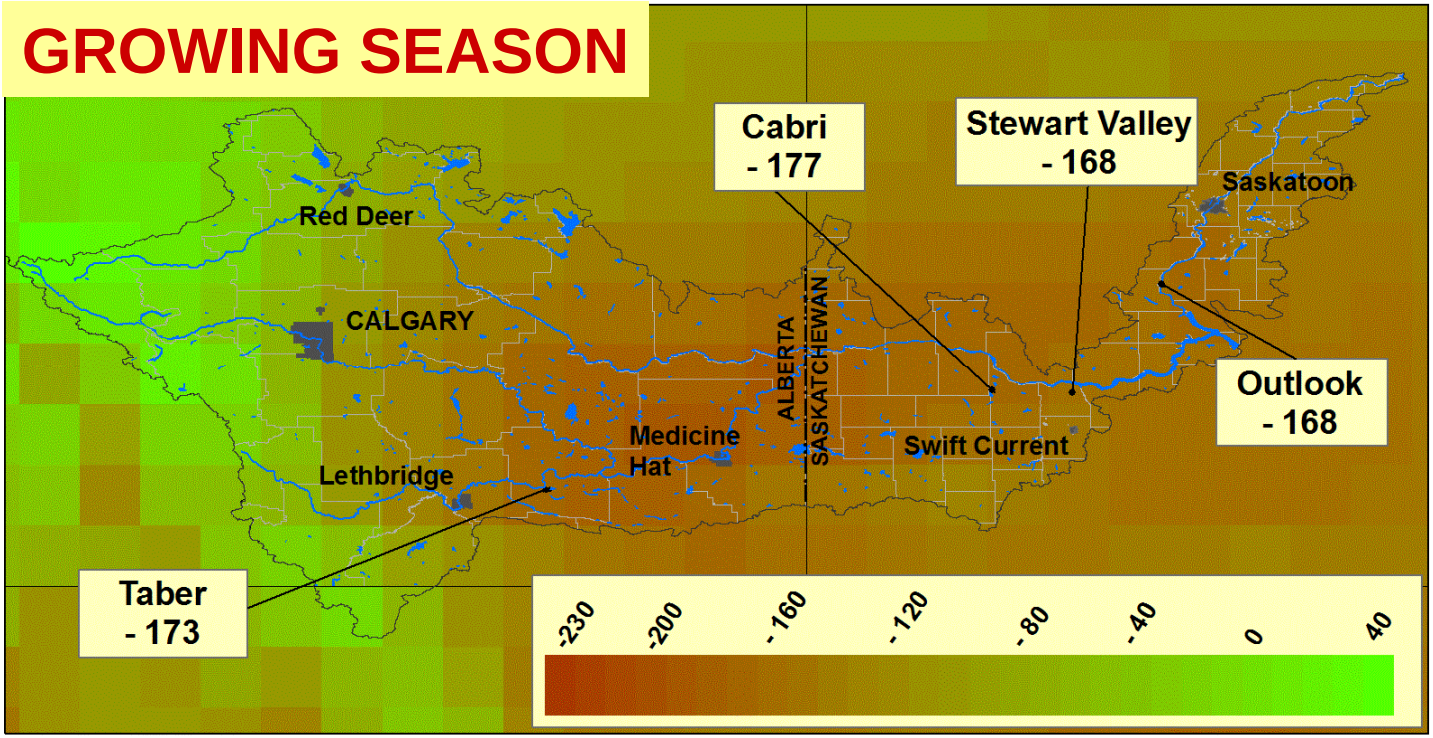
Courtesy of Dr. David Sauchyn. Prairie Adaptation Research Collaborative.

CLIMATE MOISTURE INDEX: GROWING SEASON

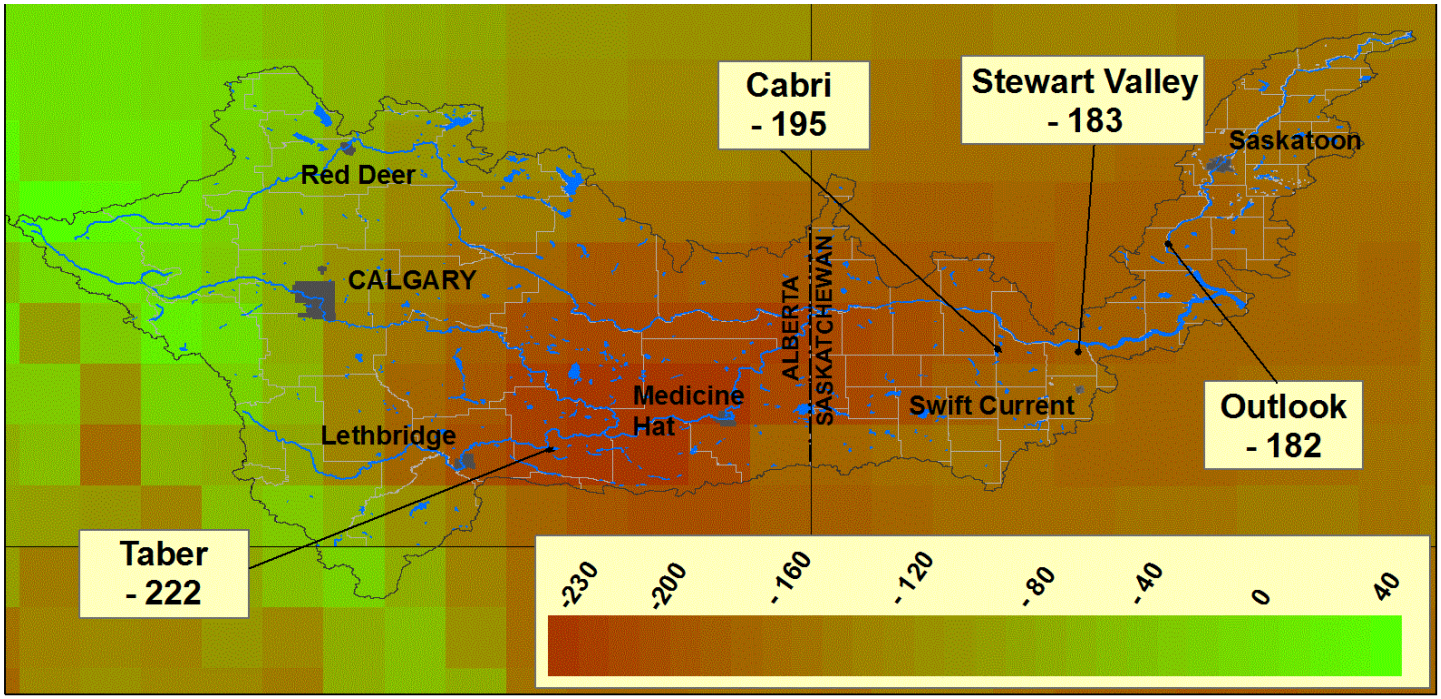


Source: Suzan Lapp, 2007. (GCM data from WCRP CMIP3 multi-model database).

GROWING SEASON



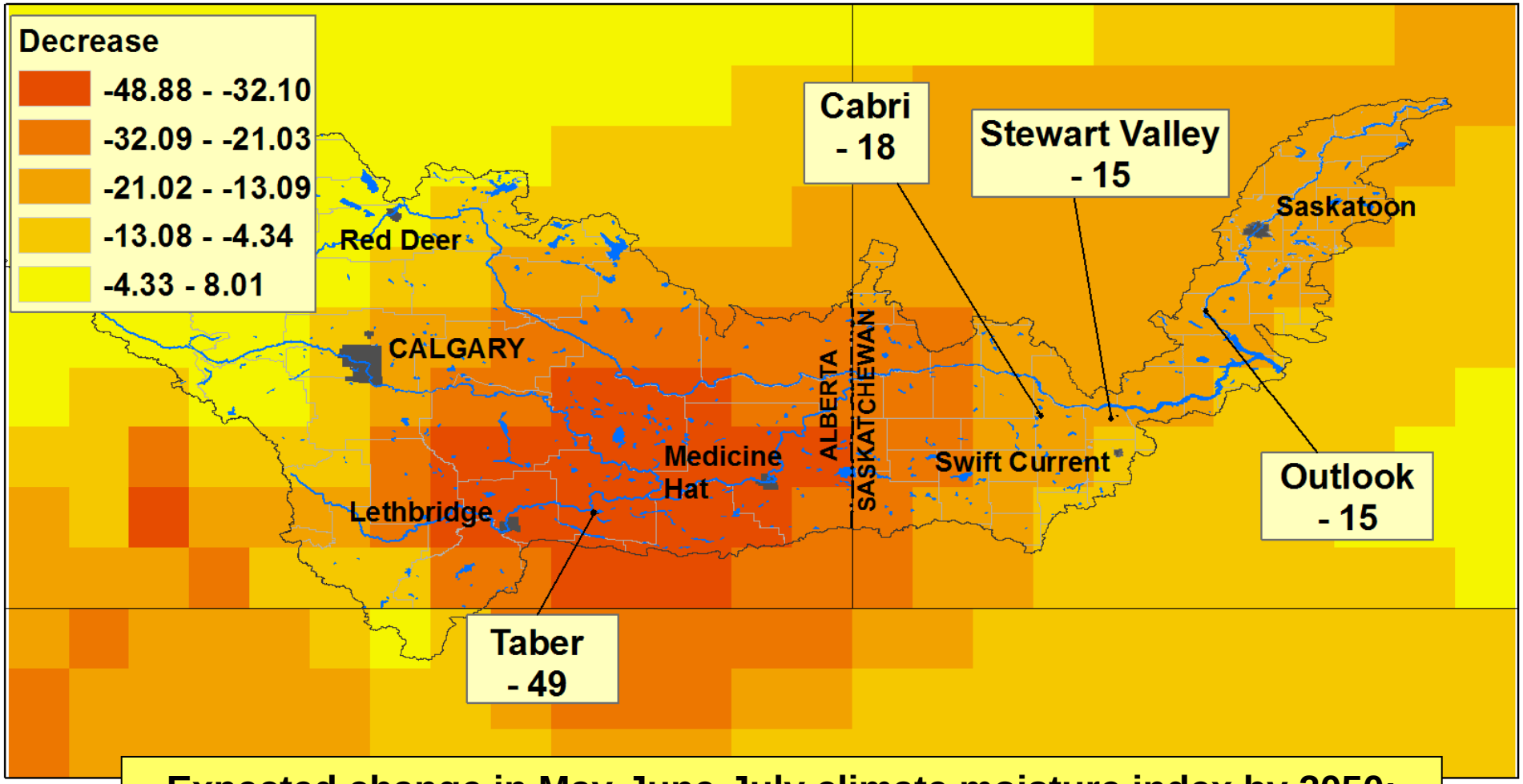
May-June-July Climate Moisture Map, 1961 - 1990. South Saskatchewan River Basin.



May-June-July Climate Moisture Map, 2050 . South Saskatchewan River Basin. Median model: CGCM3.1 T47 B1(2). SSRB.

Source: Suzan Lapp, 2007. (GCM data from WCRP CMIP3 multi-model database).

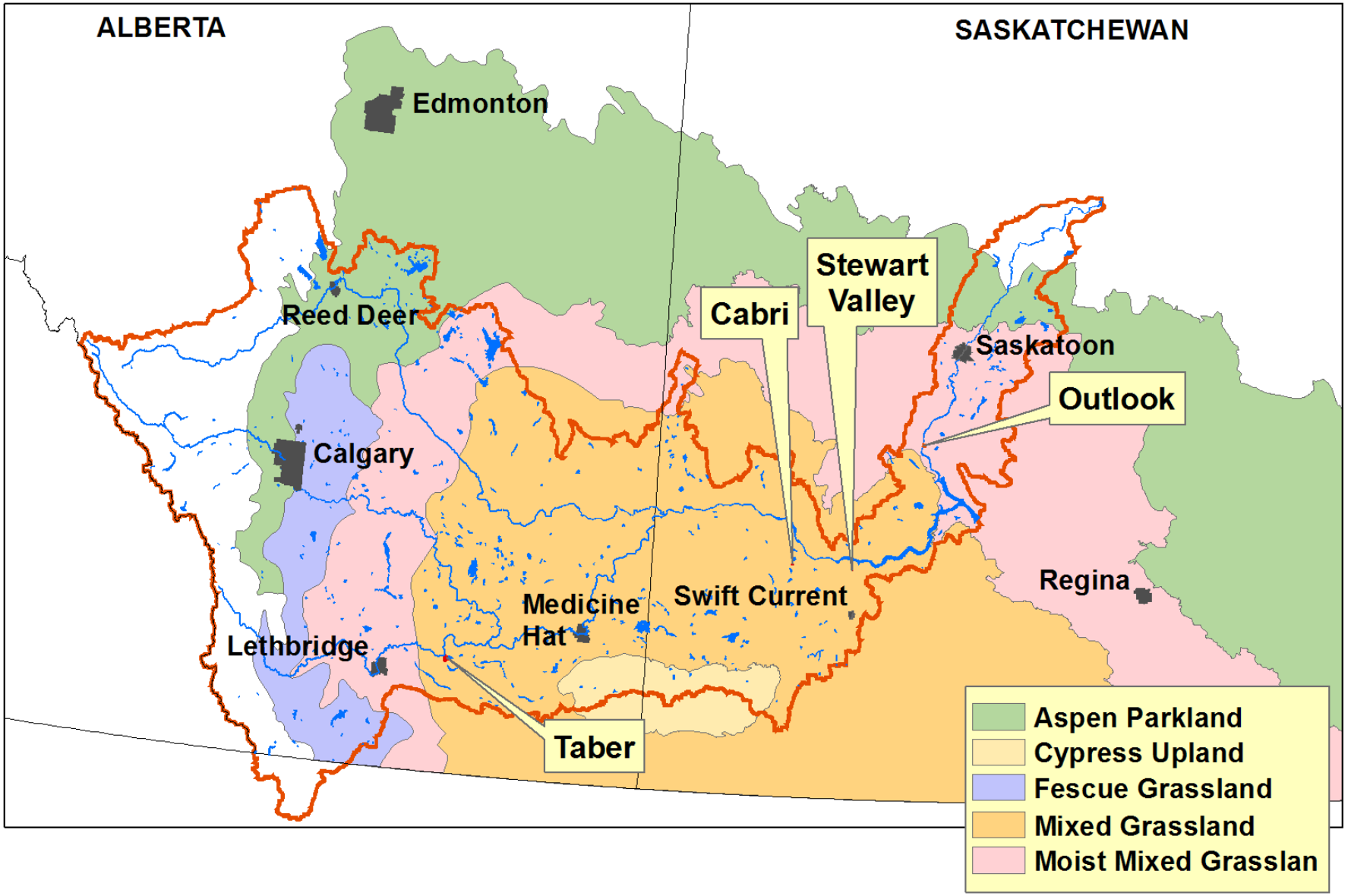
Decrease in Climate Moisture by 2050: Growing Season (May-June-July)



Expected change in May-June-July climate moisture index by 2050:

Outlook	-15
Stewart Valley	-15
Cabri	-18
Taber	-49

Prairie Ecoregions in the South Saskatchewan River Basin



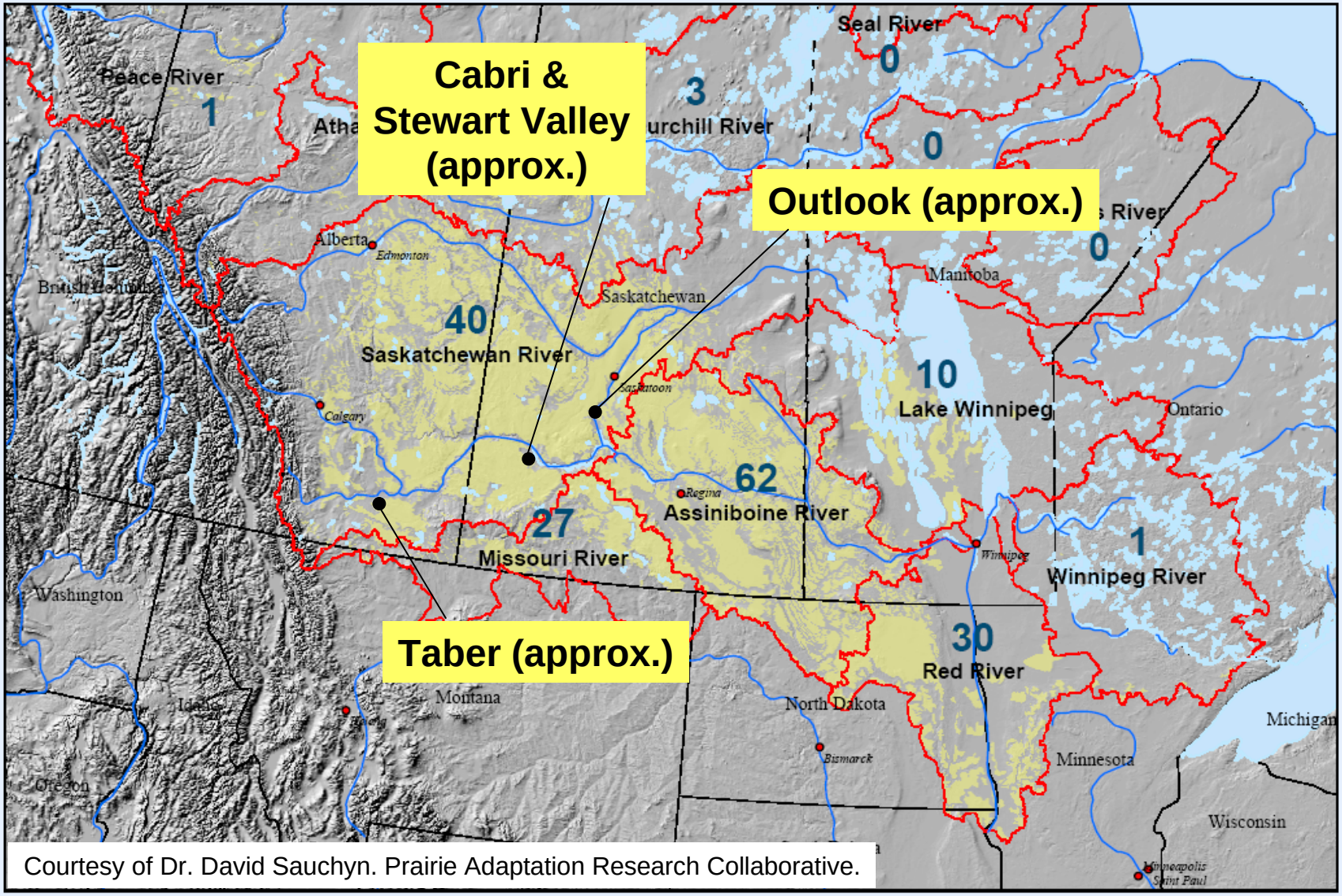
Vegetative Transition Occurs as the Ecosystem Dries....

Courtesy: Ron Anderson

Caption: David Sauchyn

Prairie Drainage Basins

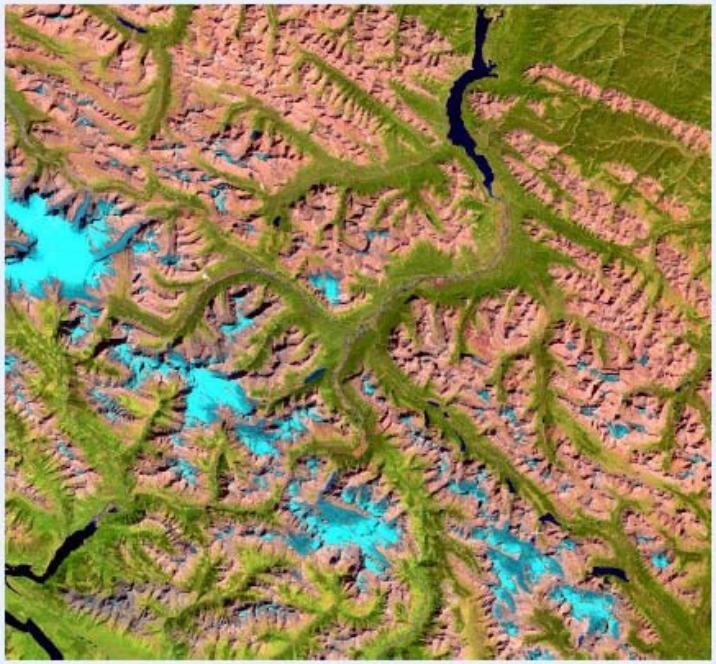
Non-contributing drainage area (percent of total basin area) for prairie drainage basins
-median annual runoff-



Source: Non-contributing area - Agriculture and Agri-Food Canada, P.F.R.A.
Elevation data - Environmental Systems Research Institute

Climate Change Impacts on Rocky Mountain glaciers

Demuth and Pietroniro, 2001

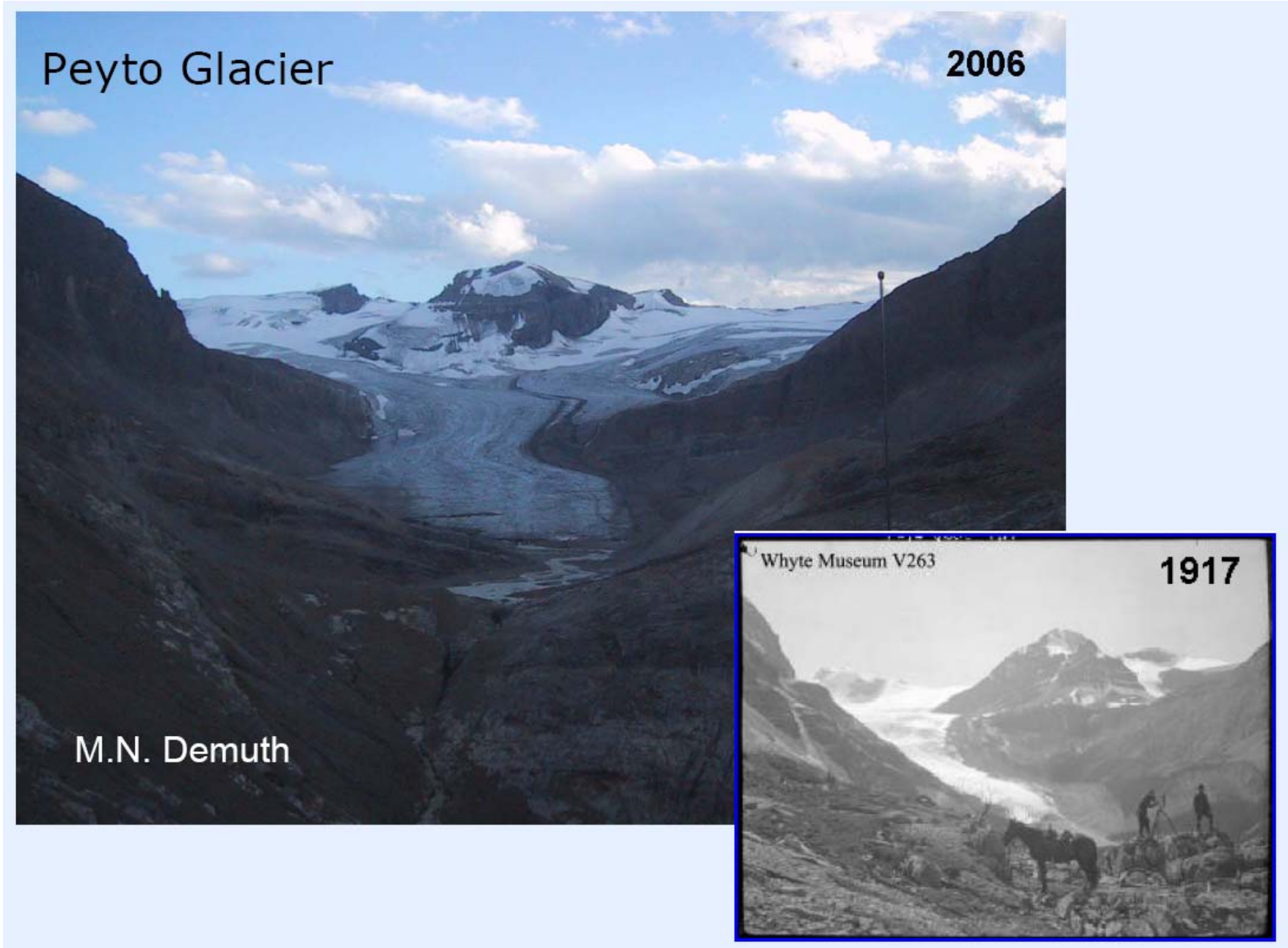


Glacier cover has decreased rapidly in recent years; it now approaches the least extent in the past 10,000 years

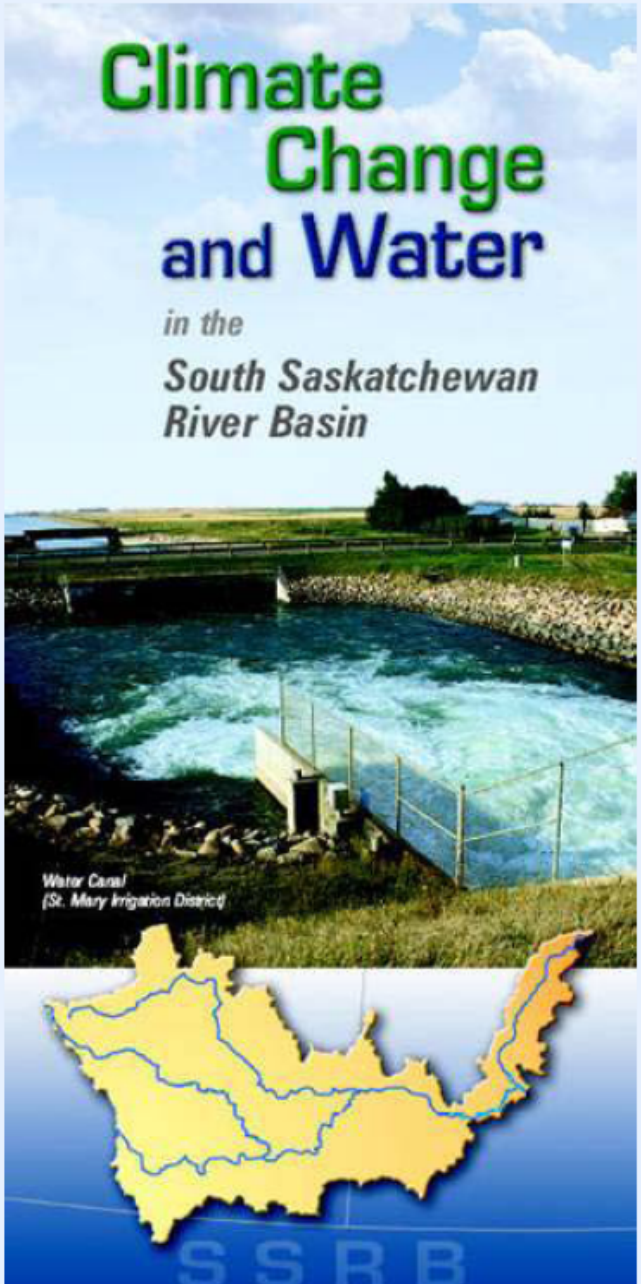
A phase of increased stream flow from global warming has past; basins have entered a potentially long-term trend of declining flows

Declining supplies of glacier runoff have serious implications for the adaptive capacity of downstream surface water systems and for trans-boundary water allocation

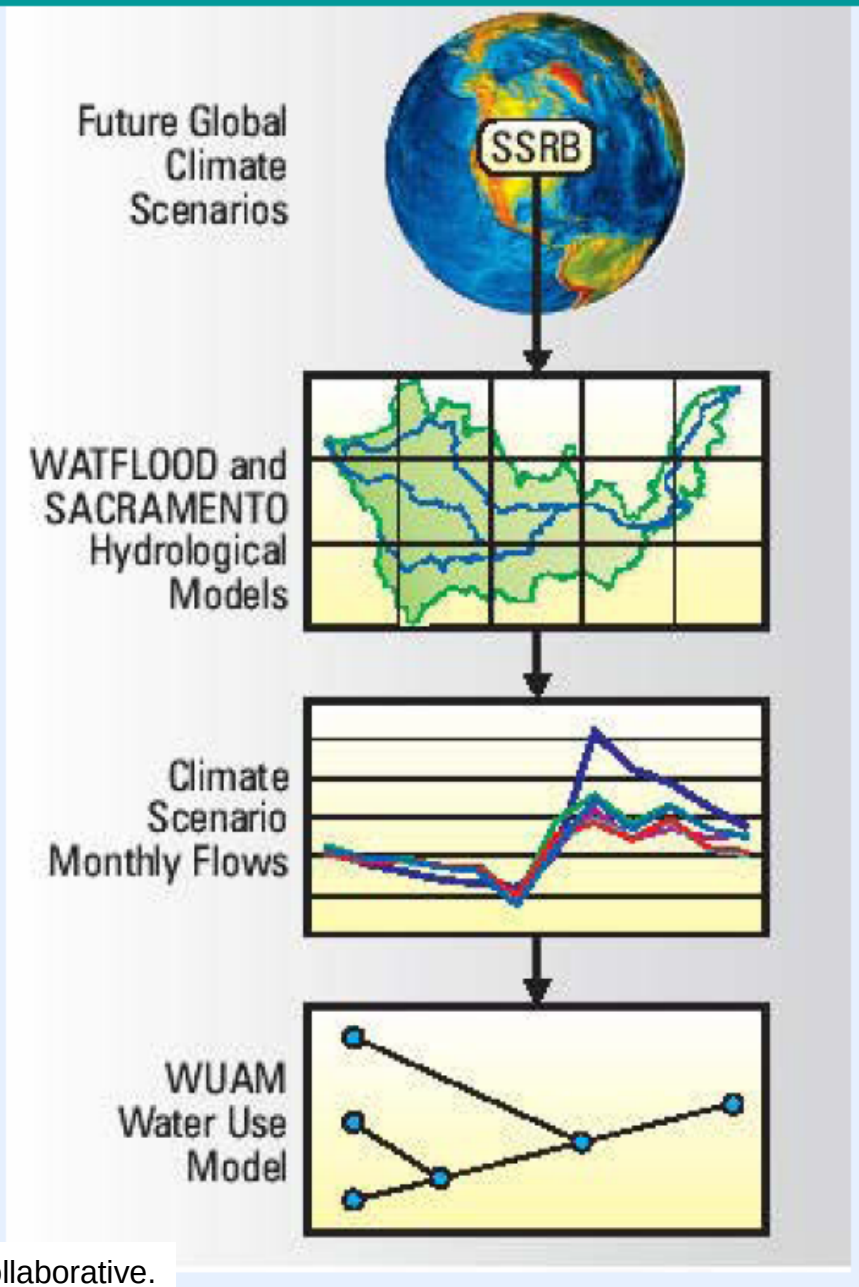
Courtesy of Dr. David Sauchyn. Prairie Adaptation Research Collaborative.



Courtesy of Dr. David Sauchyn. Prairie Adaptation Research Collaborative.

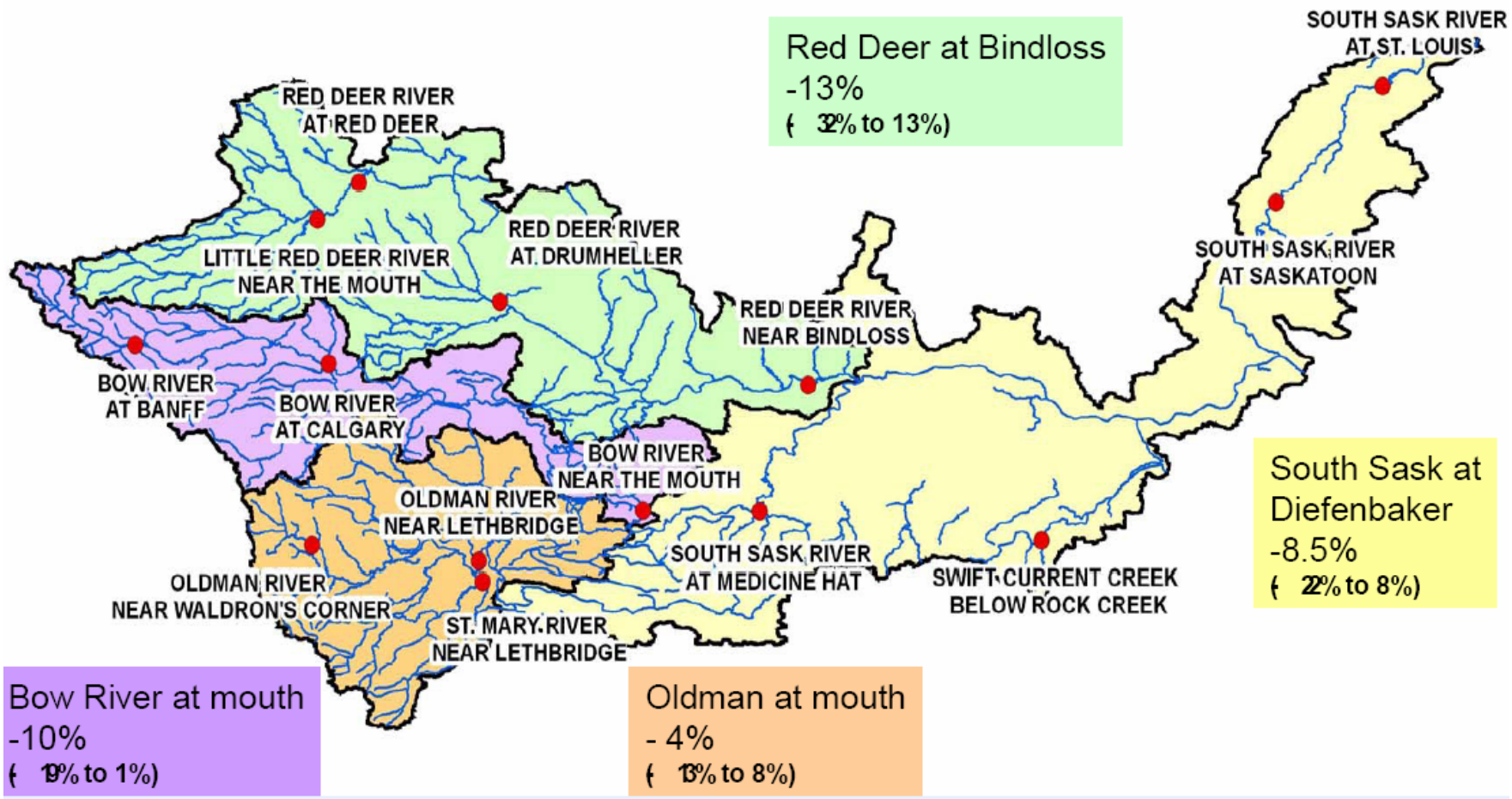


http://www.parc.ca/ssrb/index.htm



Courtesy of Dr. David Sauchyn. Prairie Adaptation Research Collaborative.

GCM scenario results, 2039 – 2070, cumulative flows



Courtesy of Dr. David Sauchyn. Prairie Adaptation Research Collaborative.

Use of Irrigation - Acres. Census of Agriculture 2001
South Saskatchewan River Basin

Red Deer
Calgary
Lethbridge
Medicine Hat
Swift Current
Saskatoon
ALBERTA
SASKATCHEWAN
815 acres
Cabri
Stewart Valley
Outlook
29,226 acres
3,260 acres
282,986 acres
Taber

ACRES
Less than 1,000
1,001 - 5,000
5,001 - 10,000
10,001 - 100,000
100,001 - 282,986

Zero acres or supressed to protect confidentiality

Data Source: Statadistics Canada.Agricultrural Census 2001.