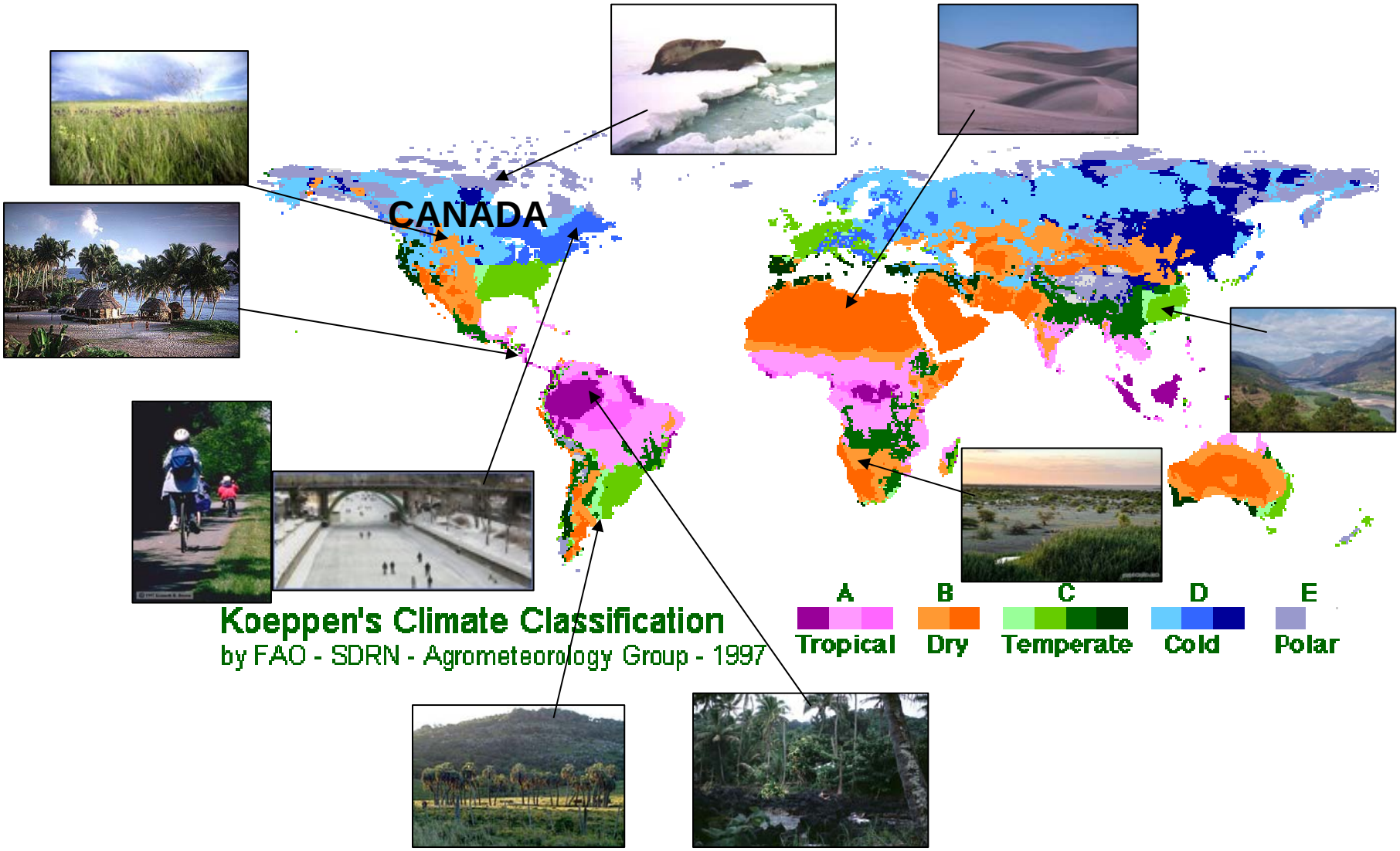
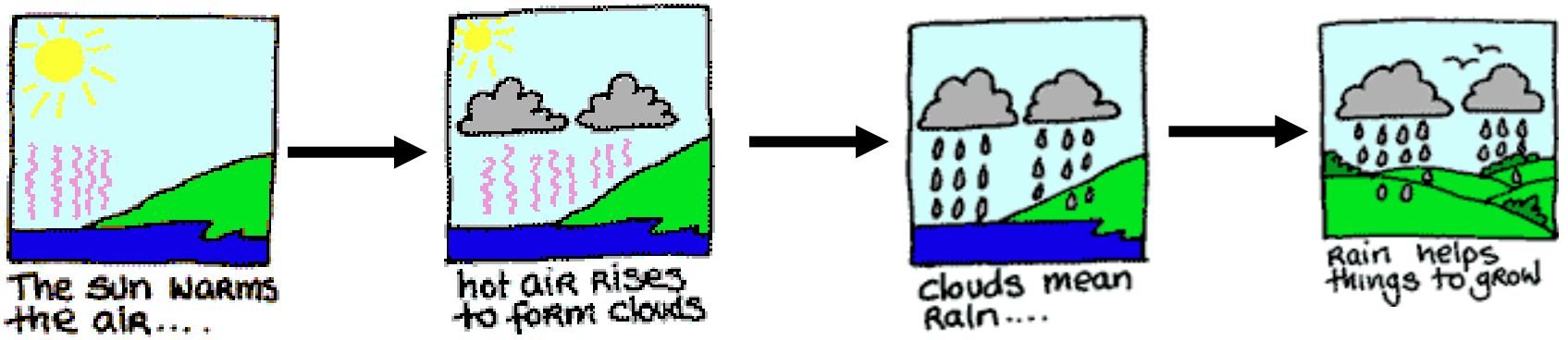
# What is climate change?

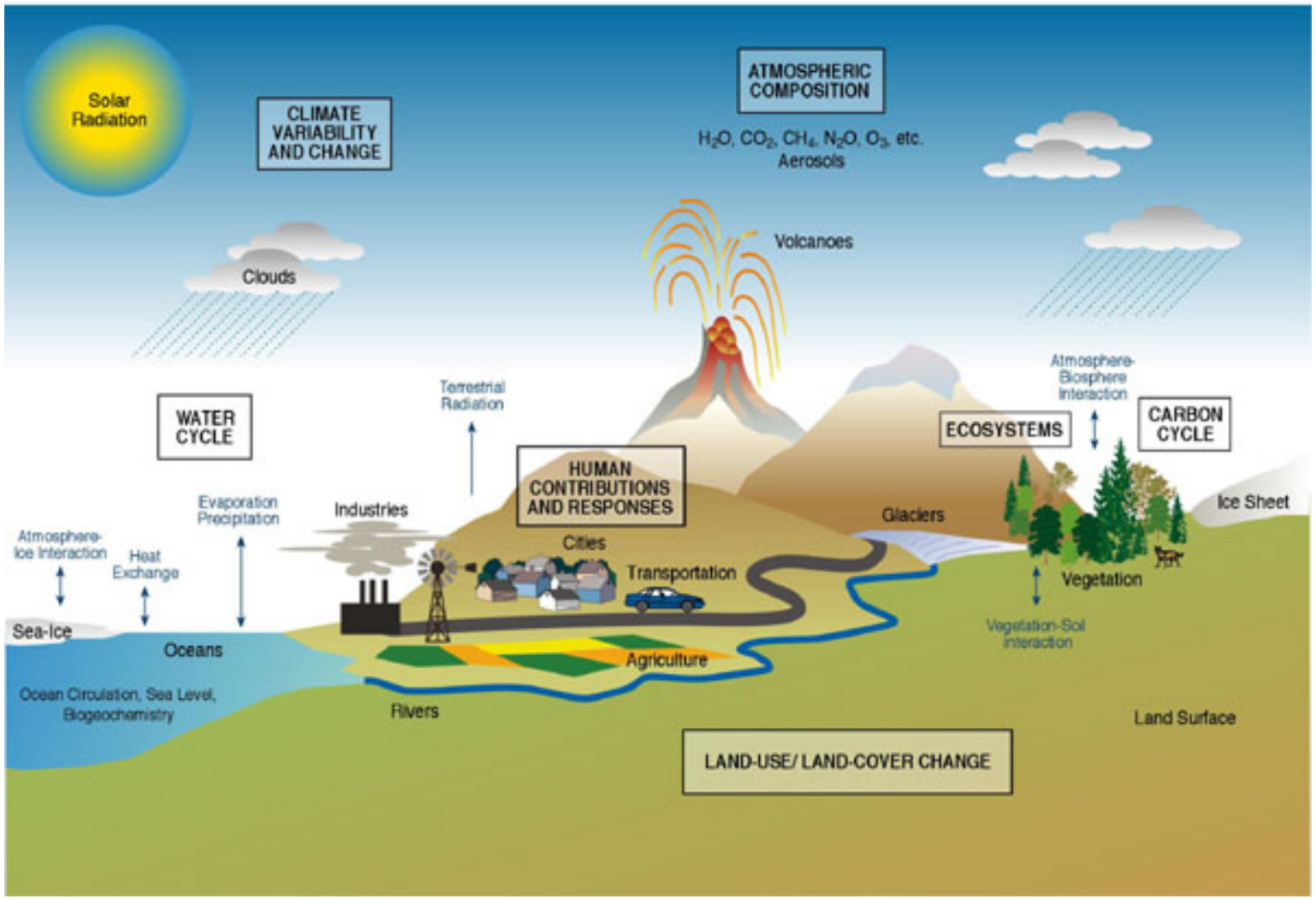

# What is the difference between climate and weather?

# 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.**

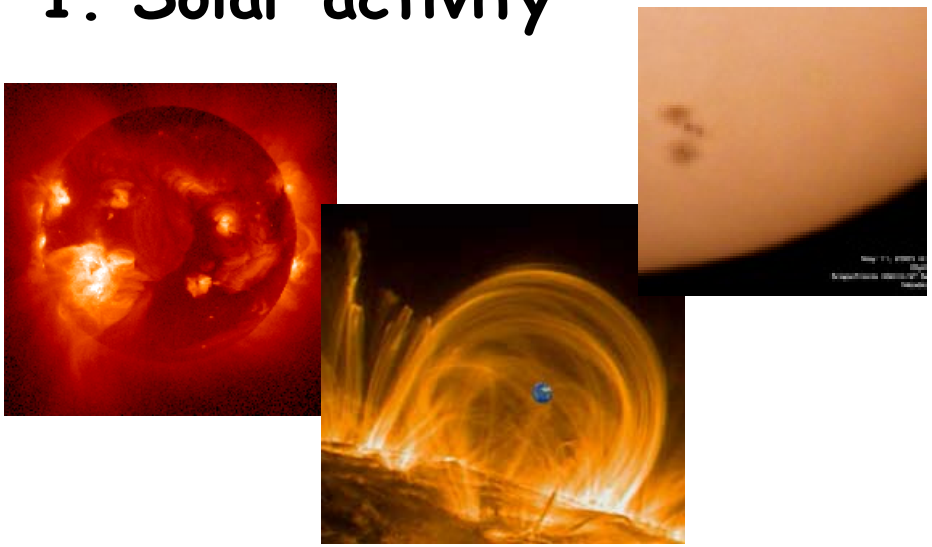
# CLIMATE CHANGE INCLUDES

## EXTREME EVENTS

## (frequency and intensity)

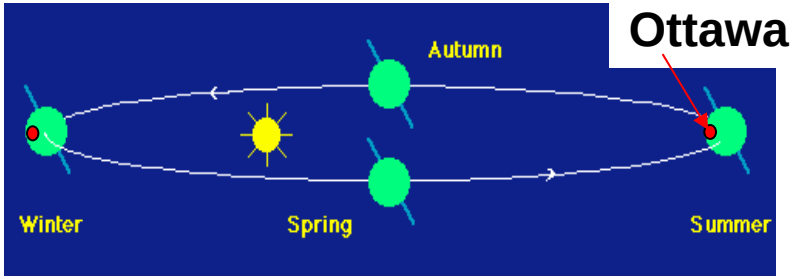
# Natural causes:

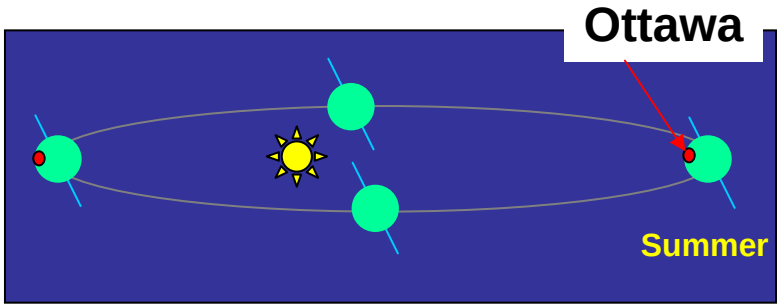
## 1. Solar activity



## 2. Volcanic activity

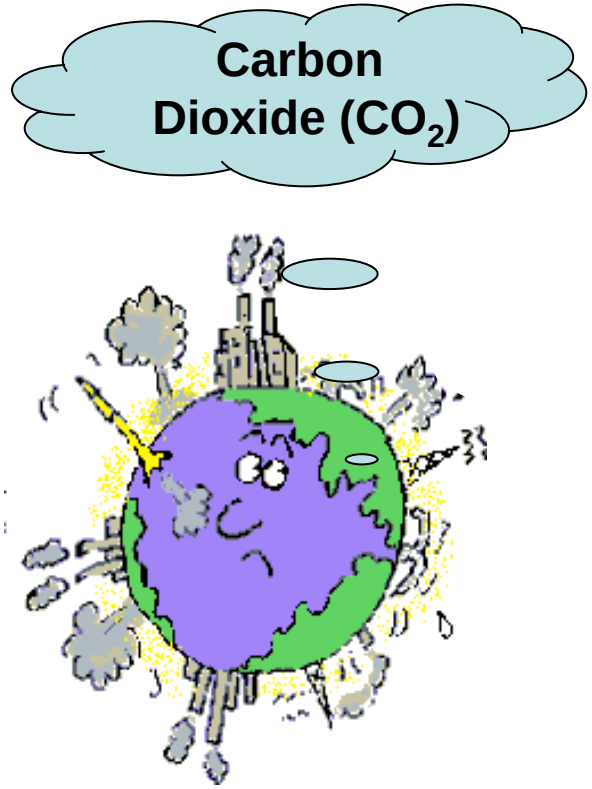

## 3. Changes in the Earth's orbit



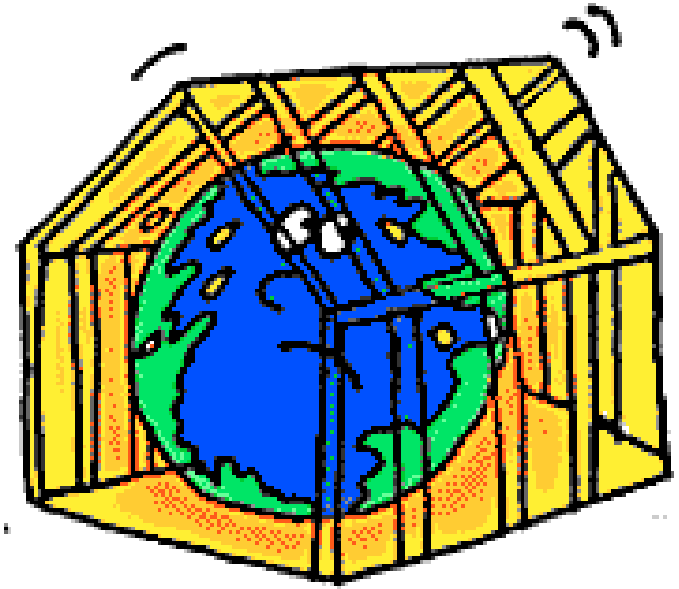



# Human causes:

# Pollution




## Greenhouse effect

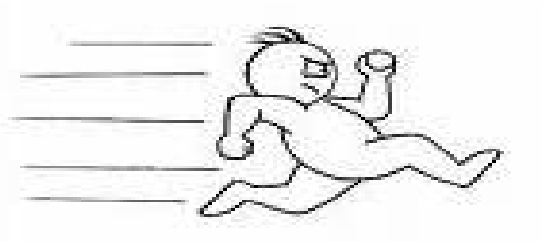


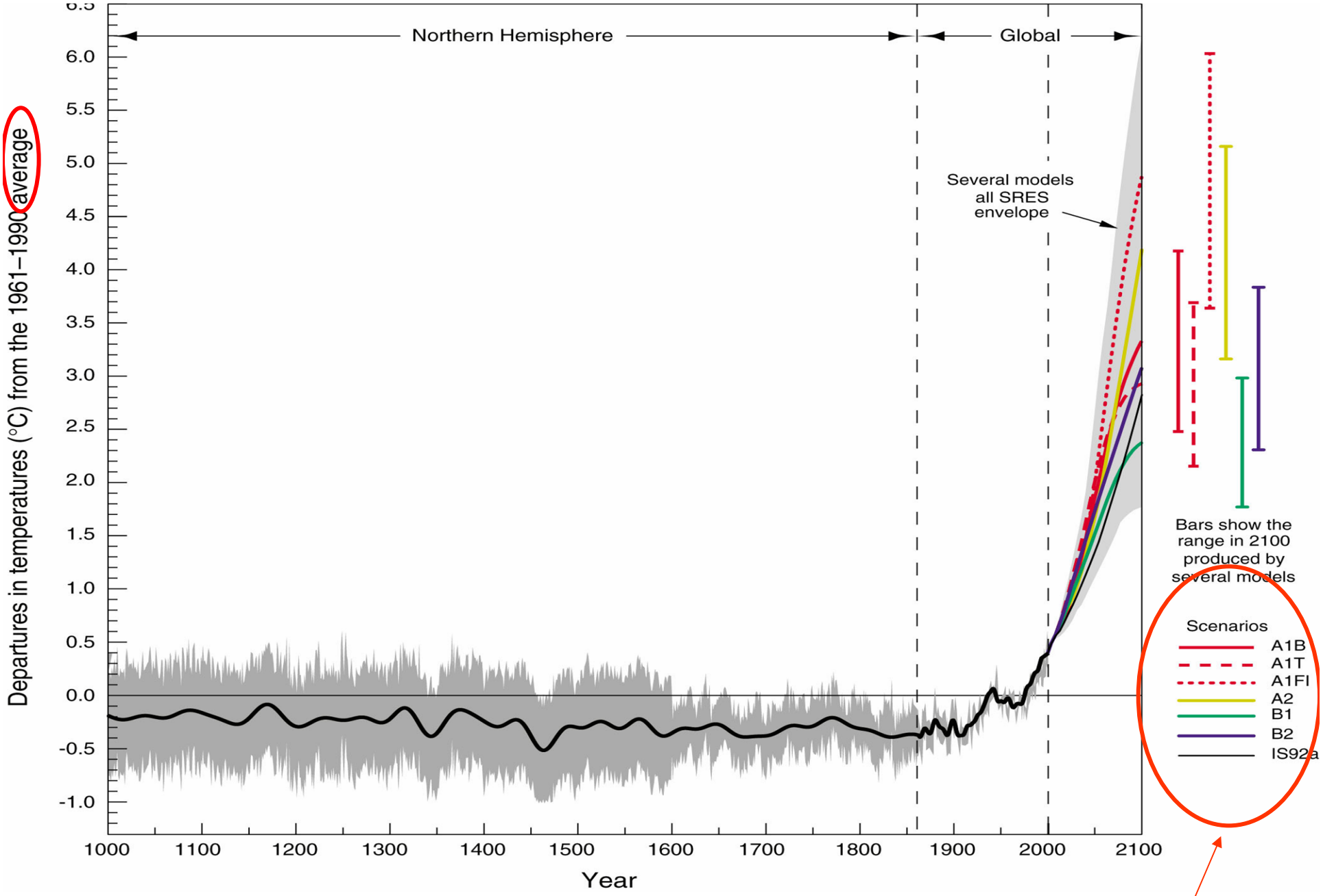
## Global warming

**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.

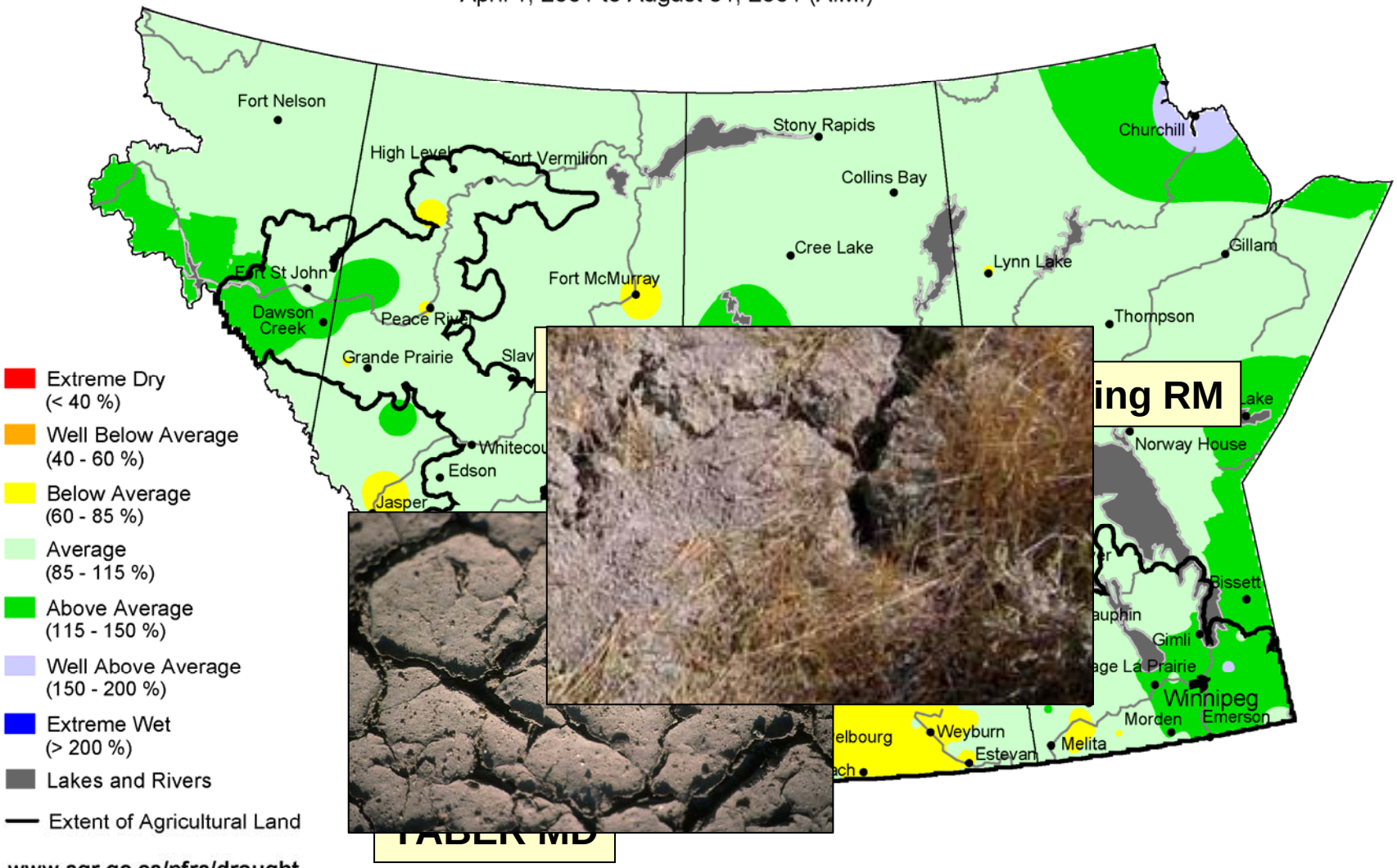
Plausible alternative futures

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.)



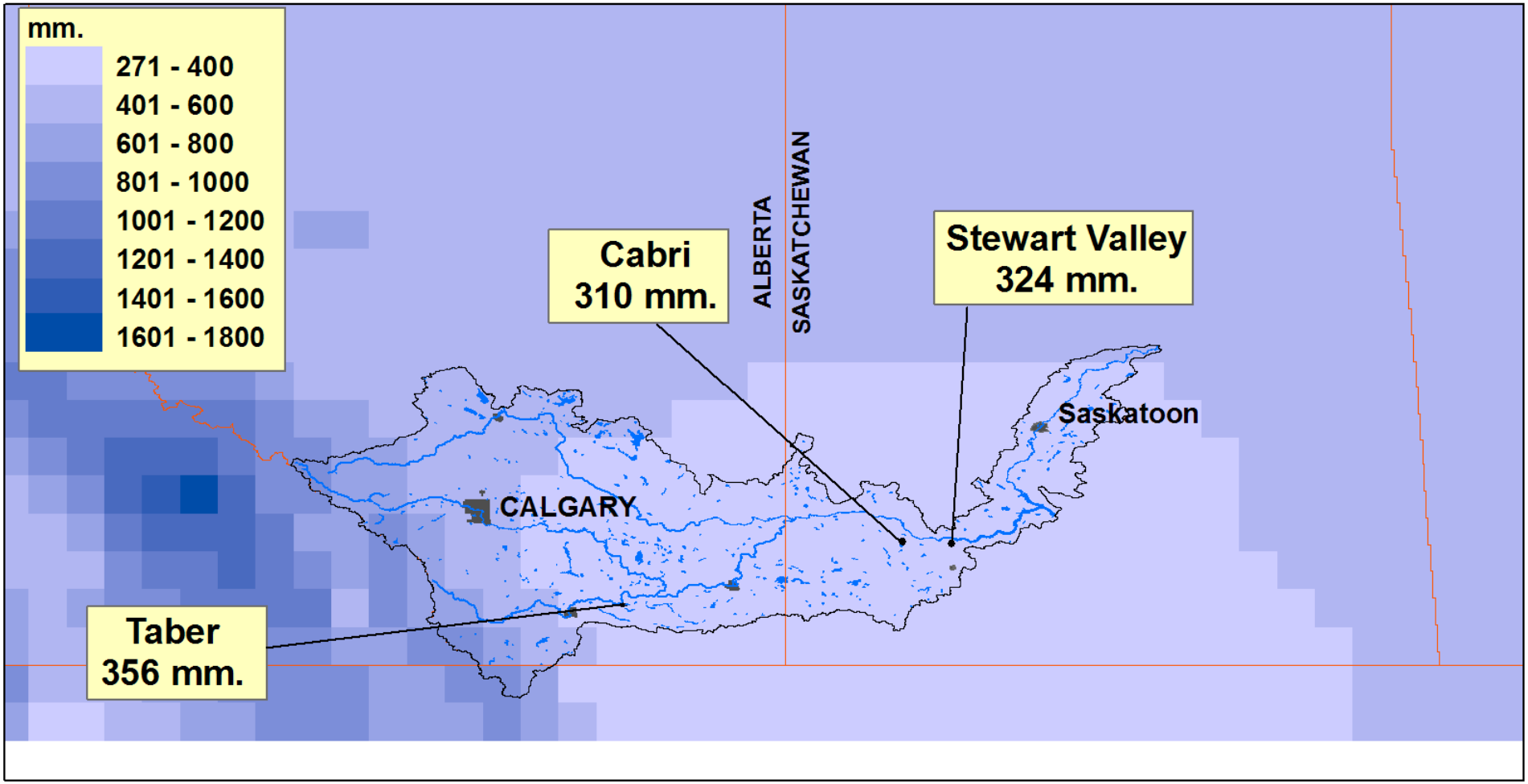

www.agr.gc.ca/pfra/drought

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

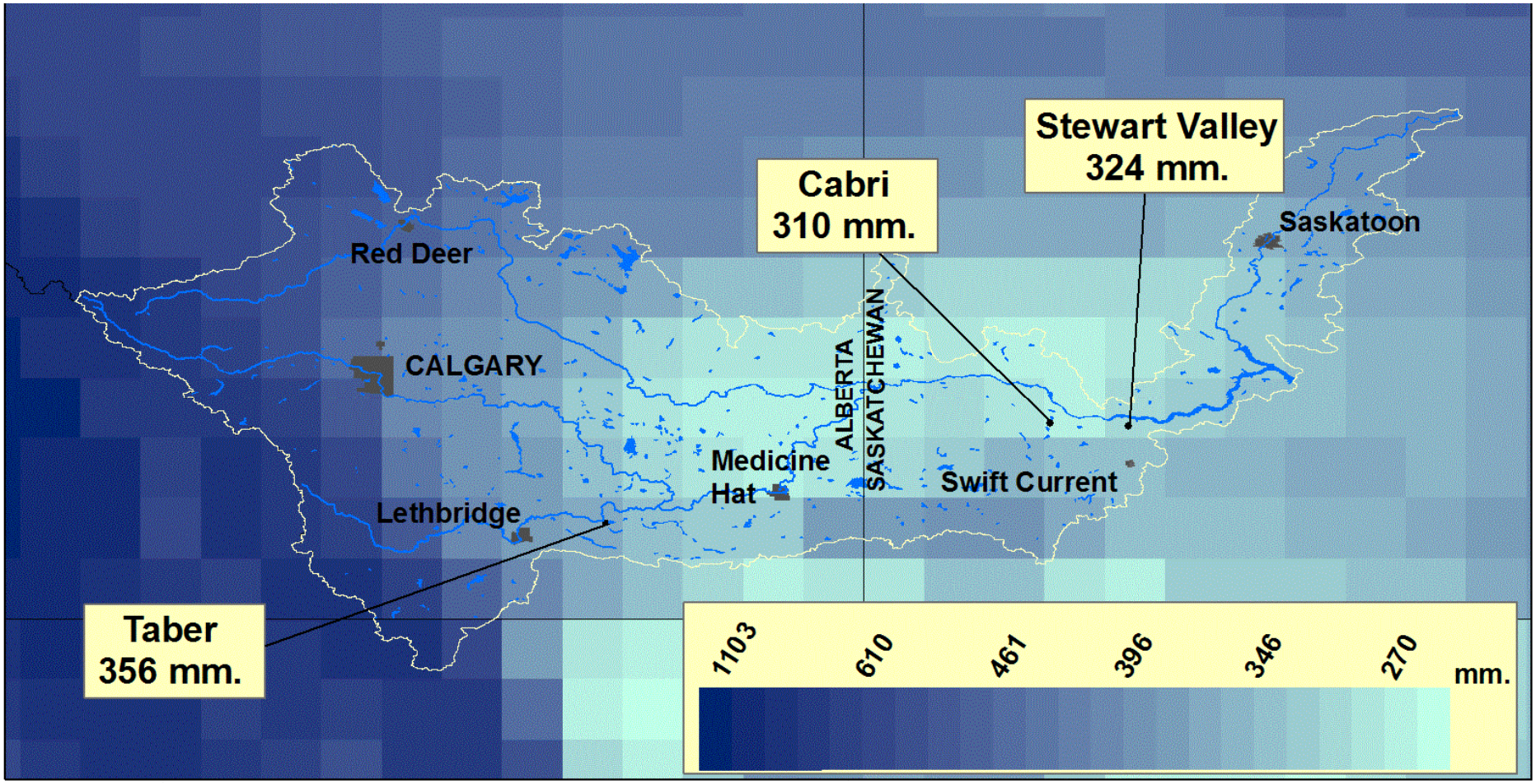
# PRECIPITATION

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

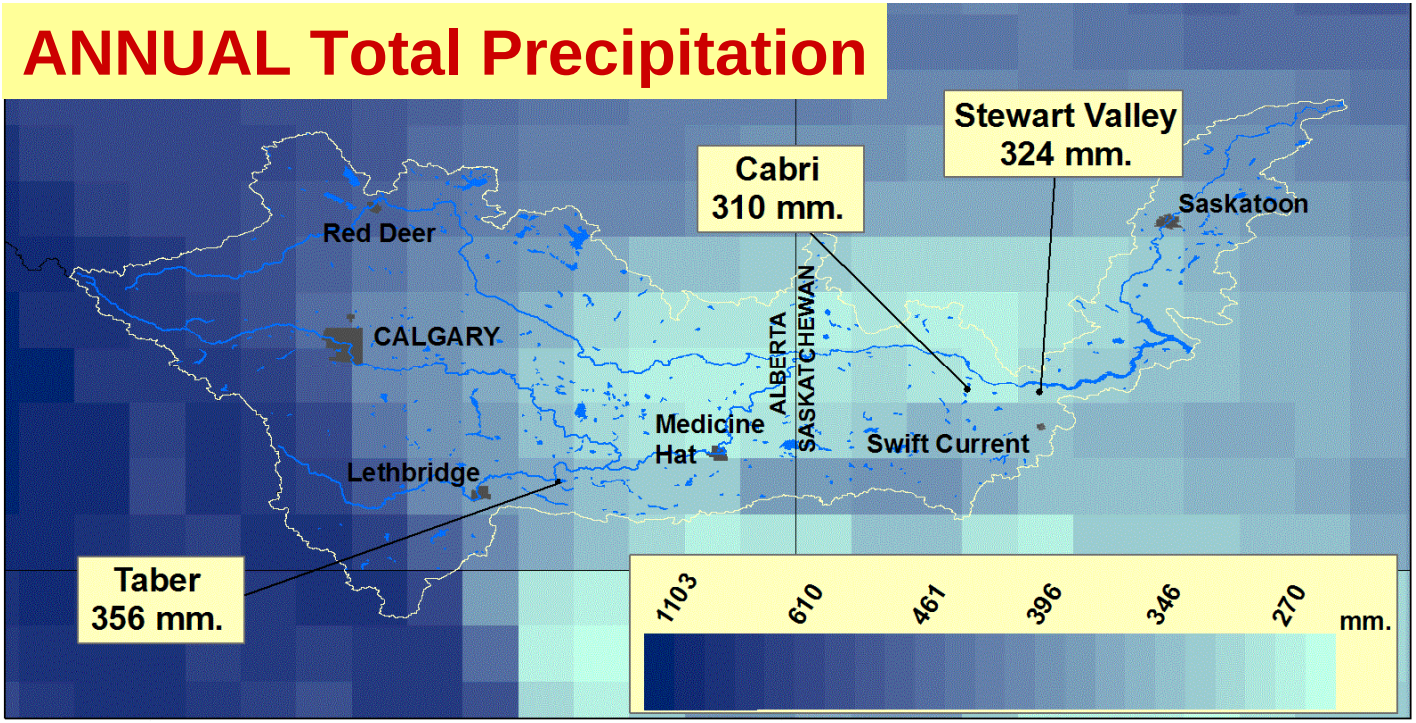



Source: Suzan Lapp, 2007. (Normals from Mckenney et al. 2006).

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

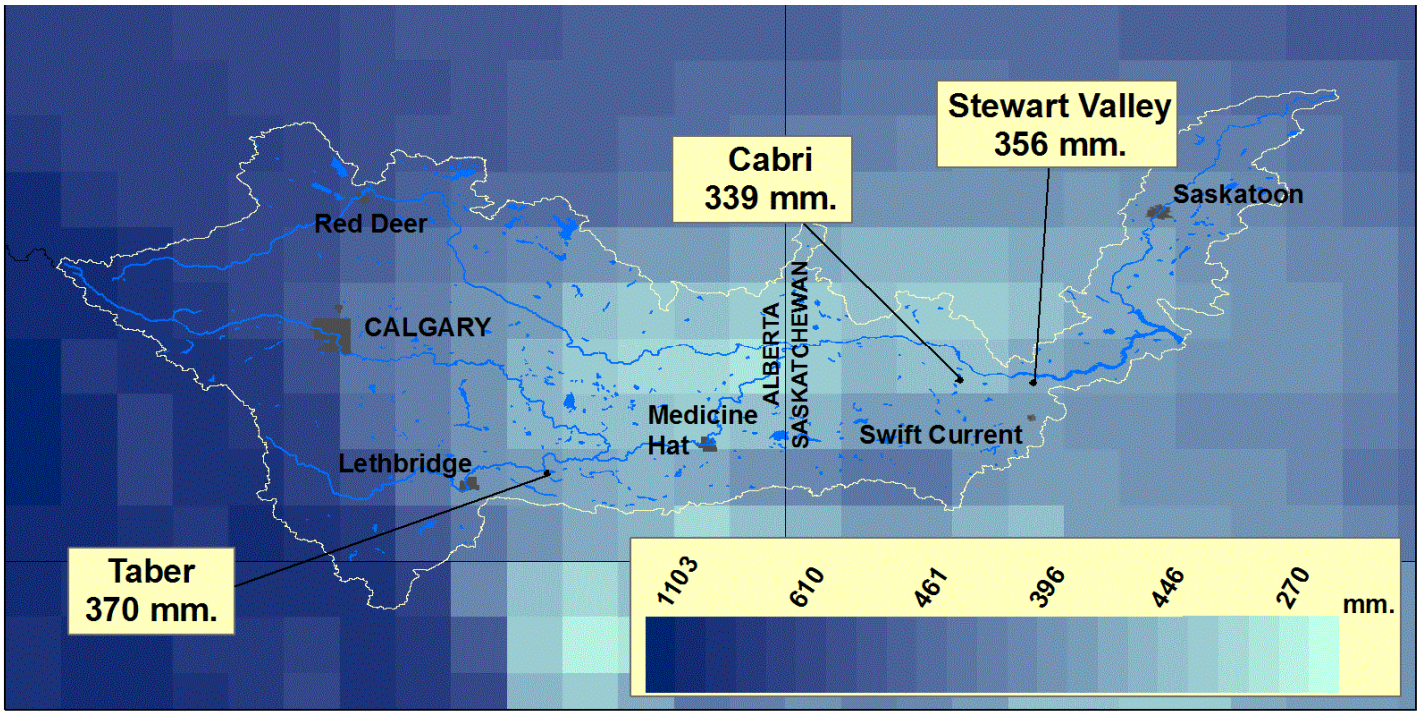



Source: Suzan Lapp, 2007. (Normals from Mckenney et al. 2006).




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

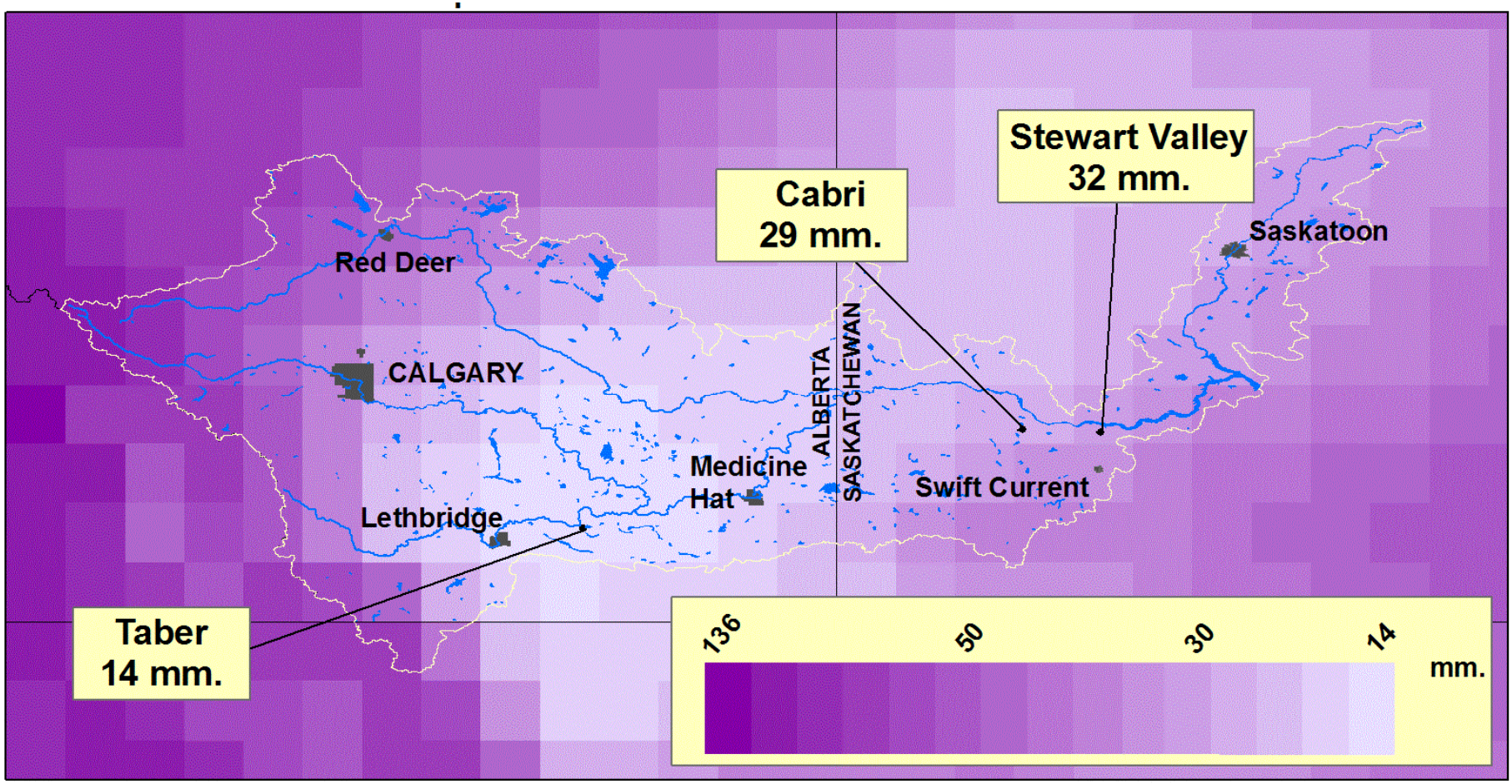
Source: Suzan Lapp, 2007. (Normals from Mckenney et al. 2006).




**Annual Total Precipitation 2050. South Saskatchewan River Basin.**

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

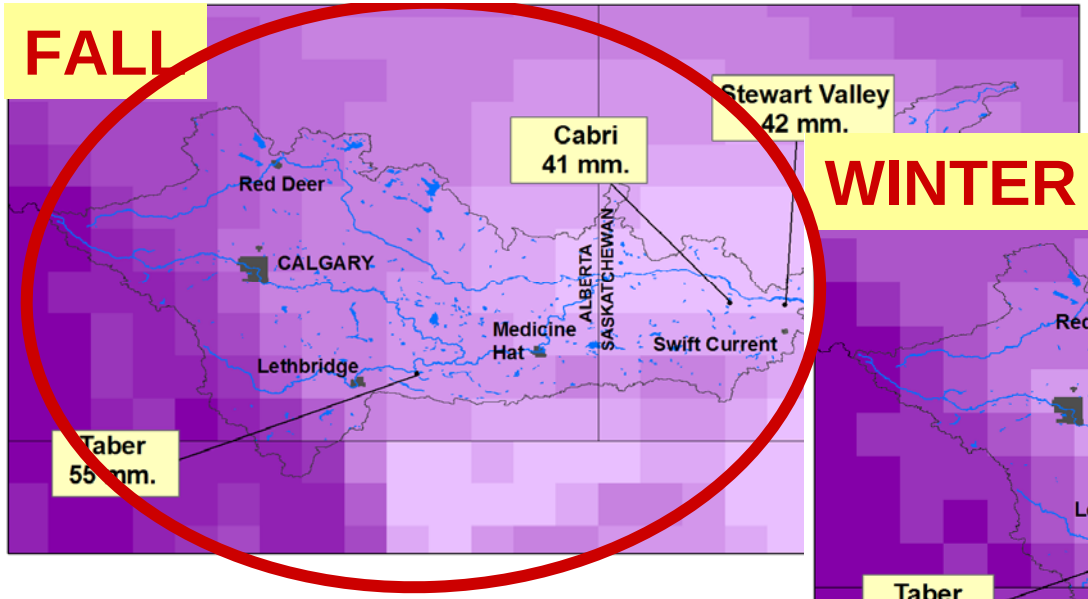
# Increase in Annual Total Precipitation by 2050

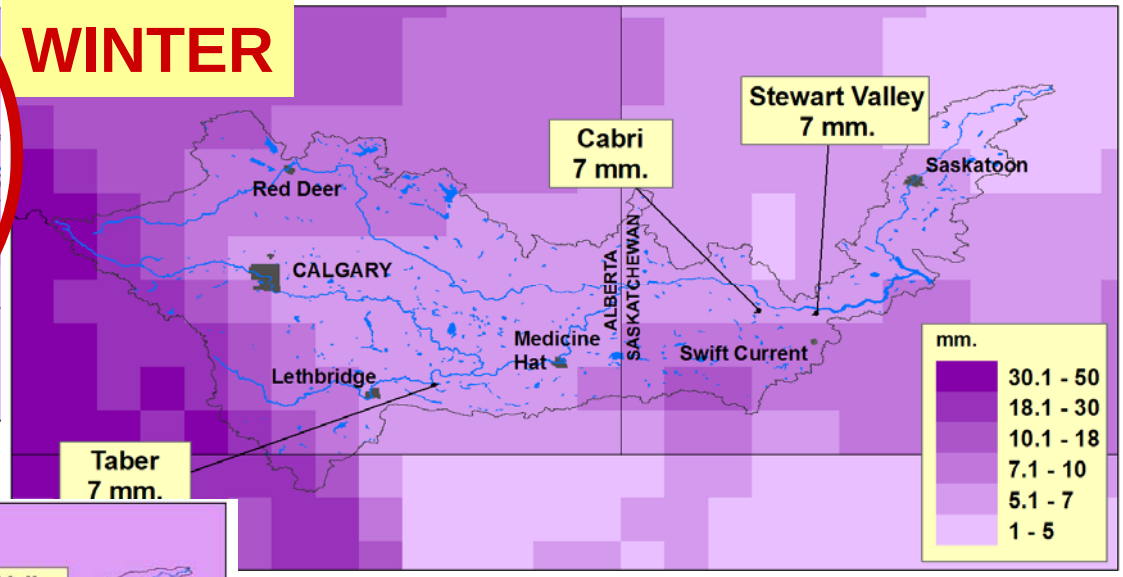


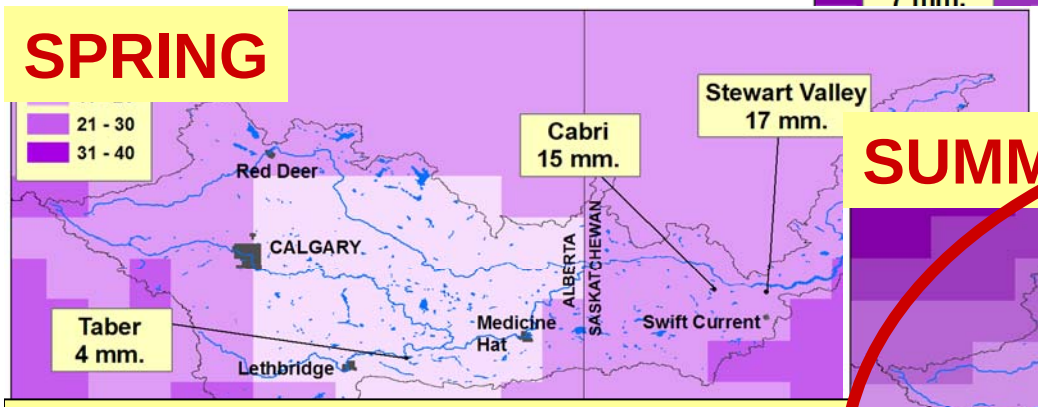

Source: Suzan Lapp, 2007. (GCM data from WCRP CMIP3 multi-model database).

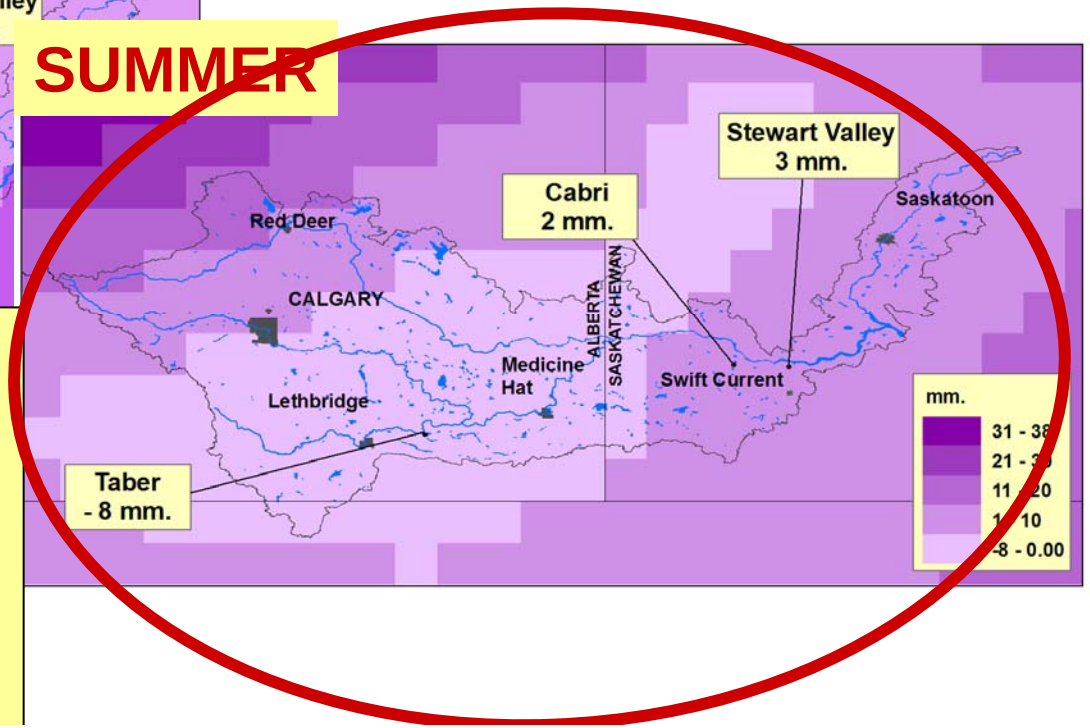
**Expected increase in annual total precipitation by 2050:**

| | |
|---|---|
| **Cabri** | **29 mm.** |
| **Taber** | **14 mm.** |
| **Stewart Valley** | **32 mm.** |



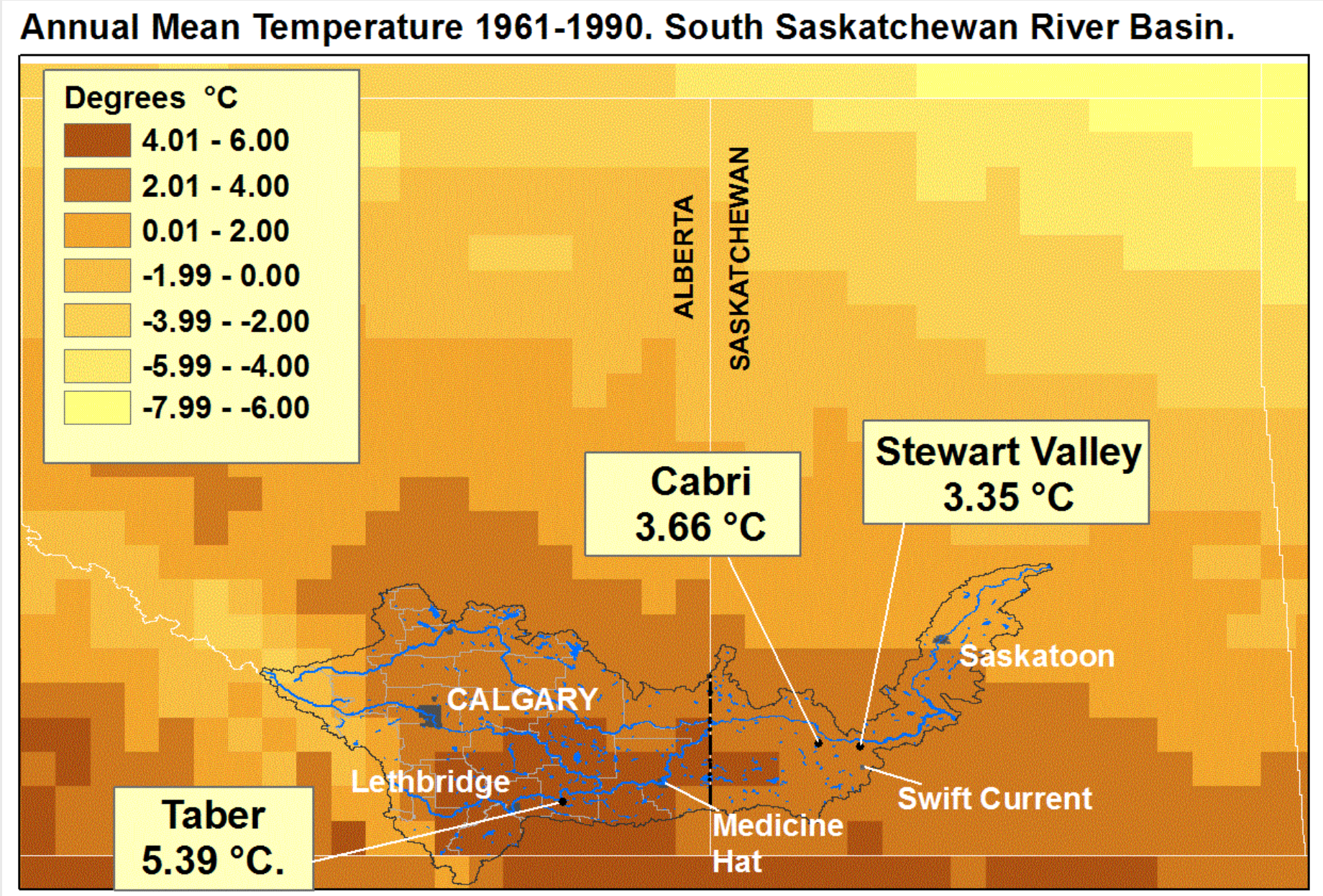



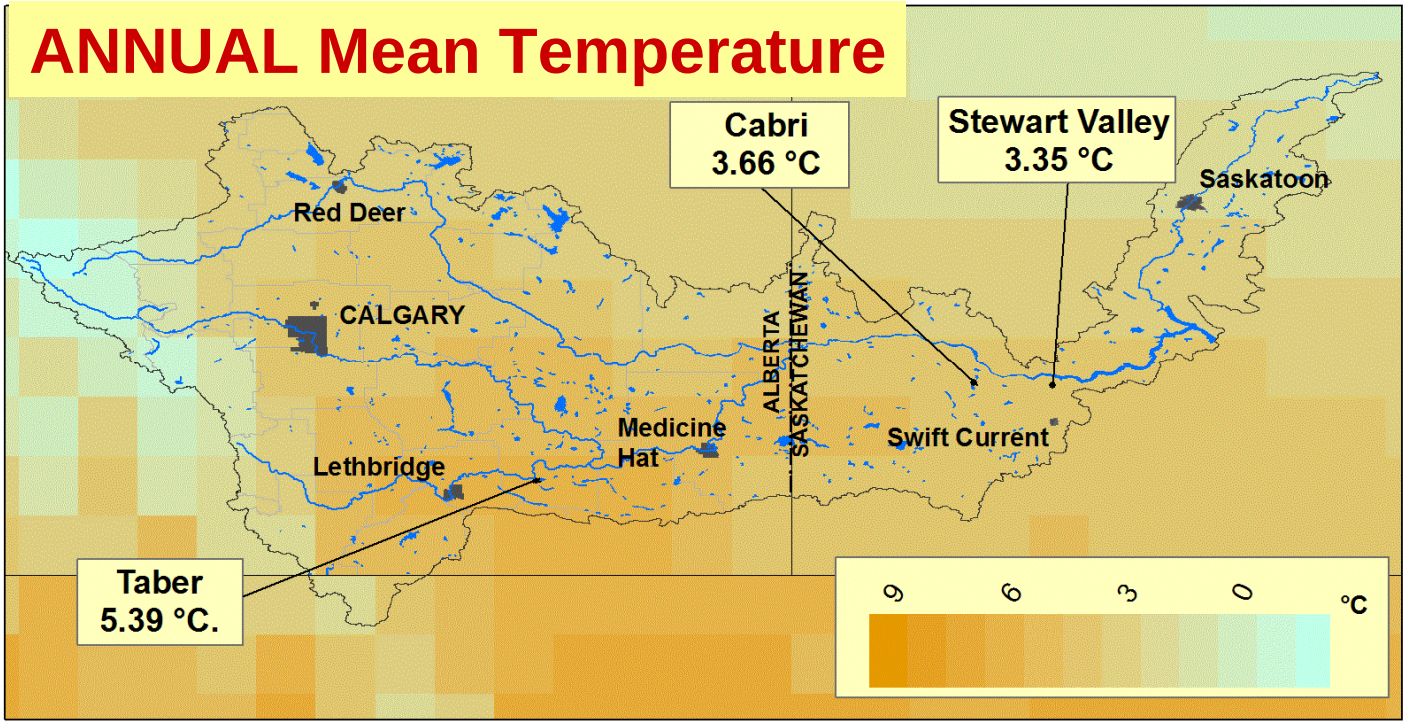

**Change in Total Precipitation (mm) by 2050:**

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

# TEMPERATURE

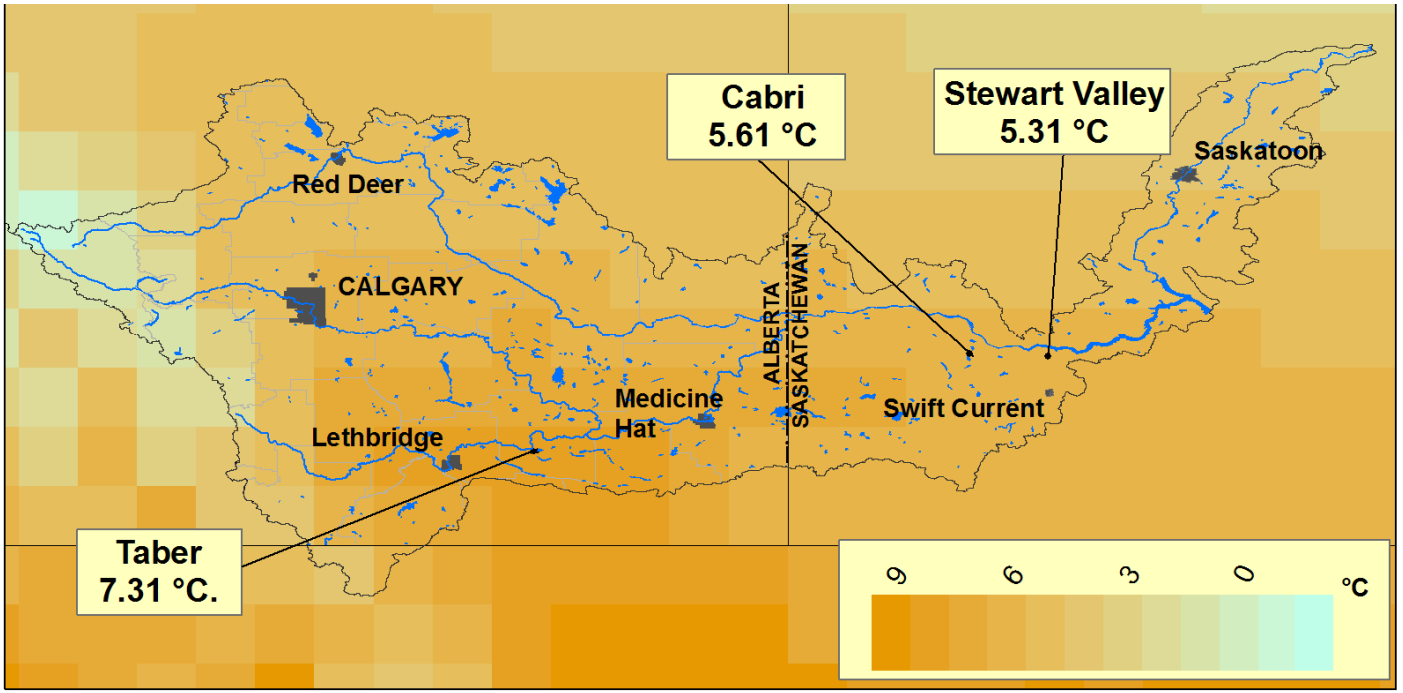



Source: Suzan Lapp, 2007. (Normals from Mckenney et al. 2006).




**Annual Mean Temperature 1961 - 1990. SSRB.**

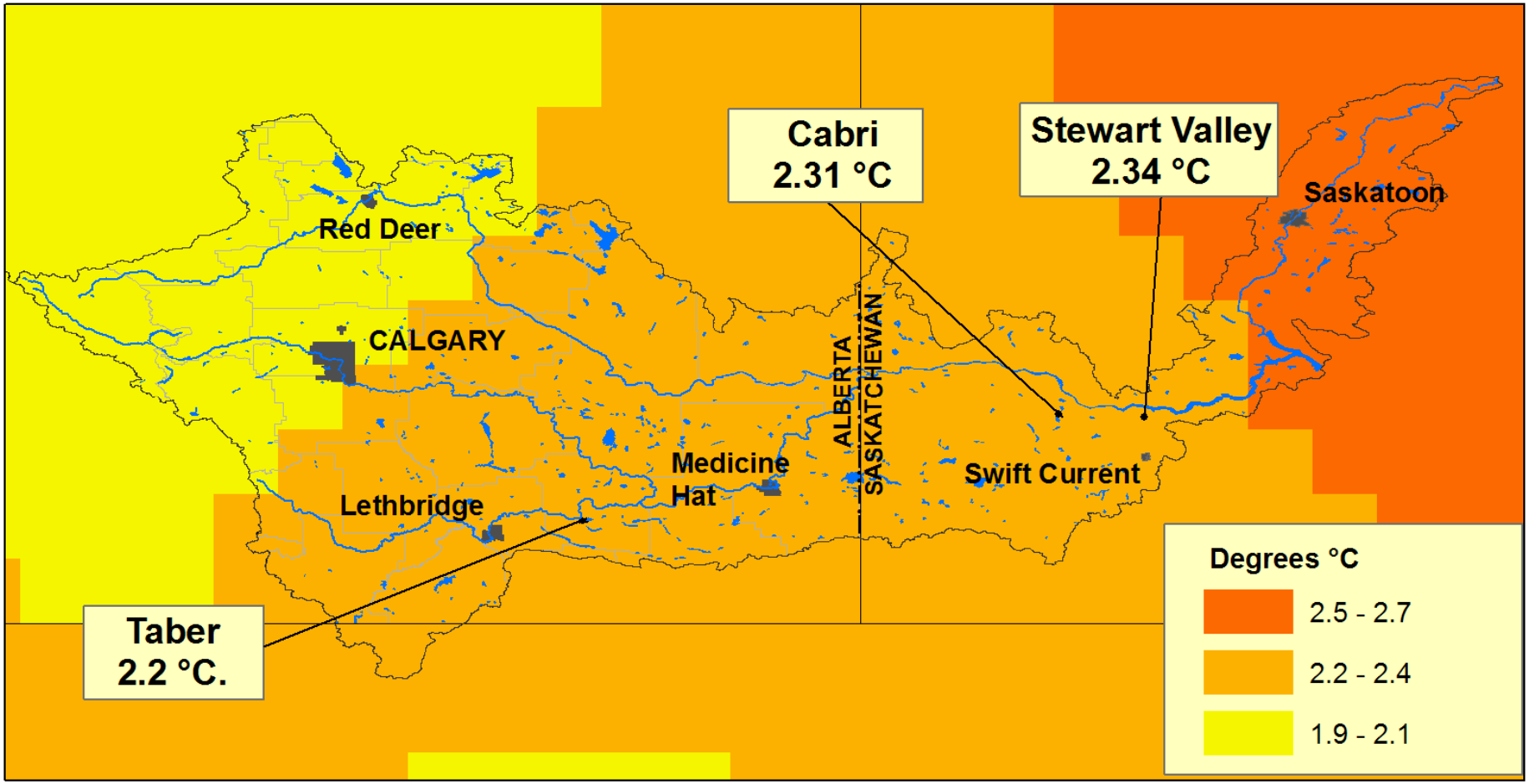
Source: Suzan Lapp, 2007. (Normals from Mckenney et al. 2006).




**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).

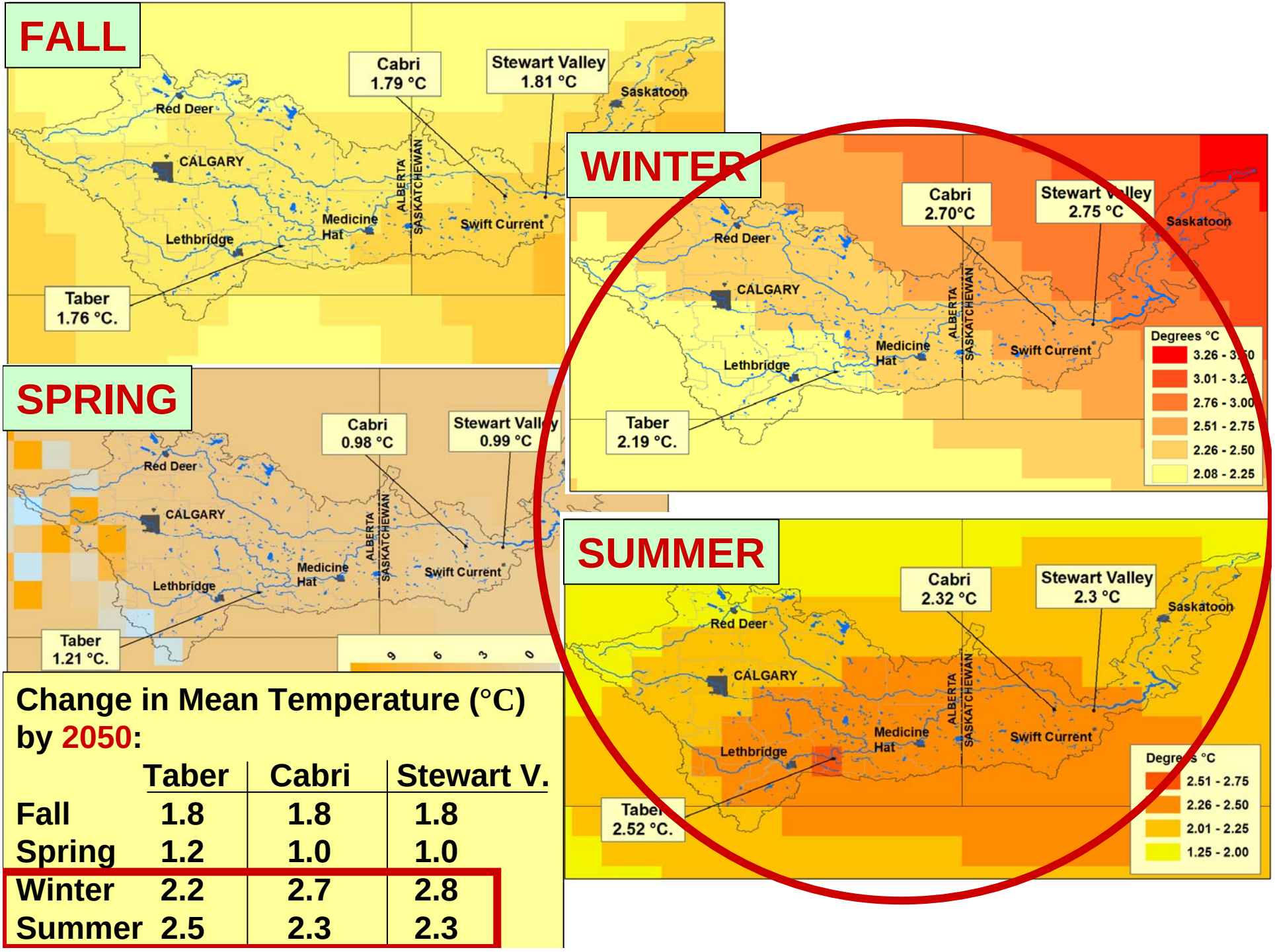
# Increase in Annual Mean Temperature by 2050




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

**Expected change in annual mean temperature by 2050:**

| | |
|---|---|
| **Cabri** | **2.31 °C** |
| **Taber** | **2.20 °C** |
| **Stewart Valley** | **2.34°C** |

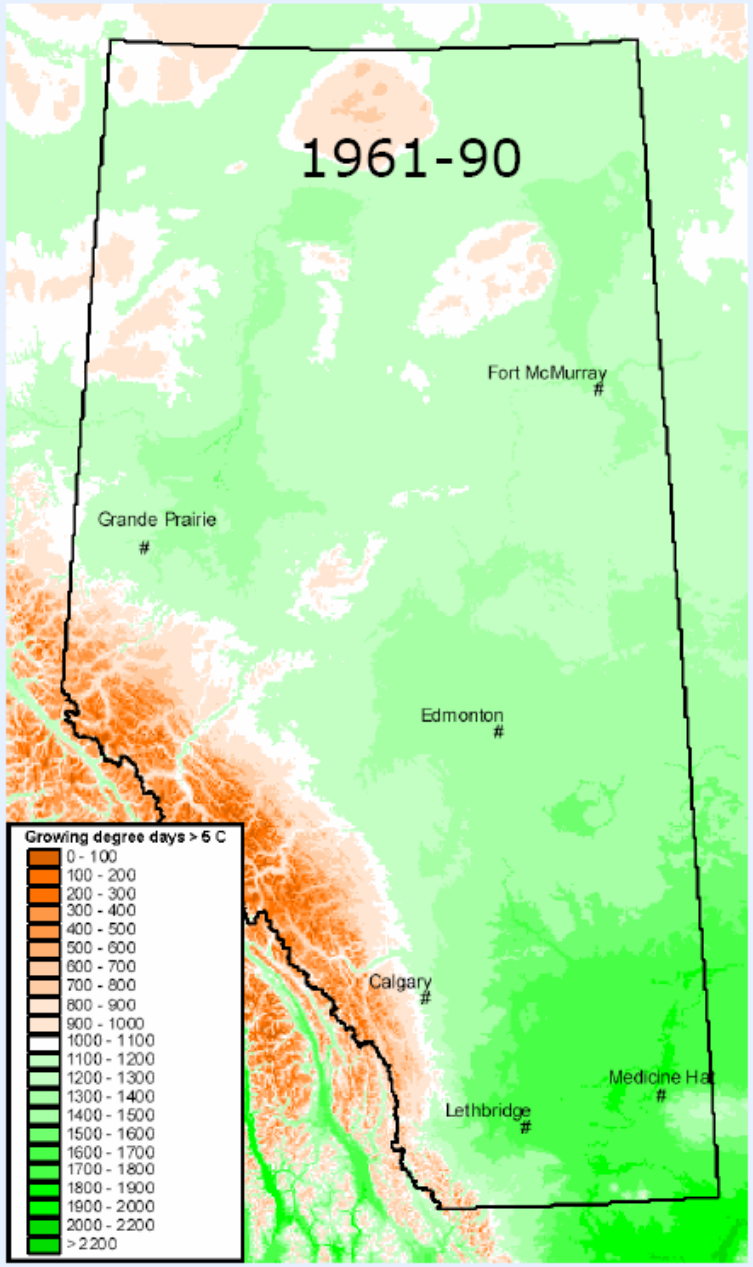


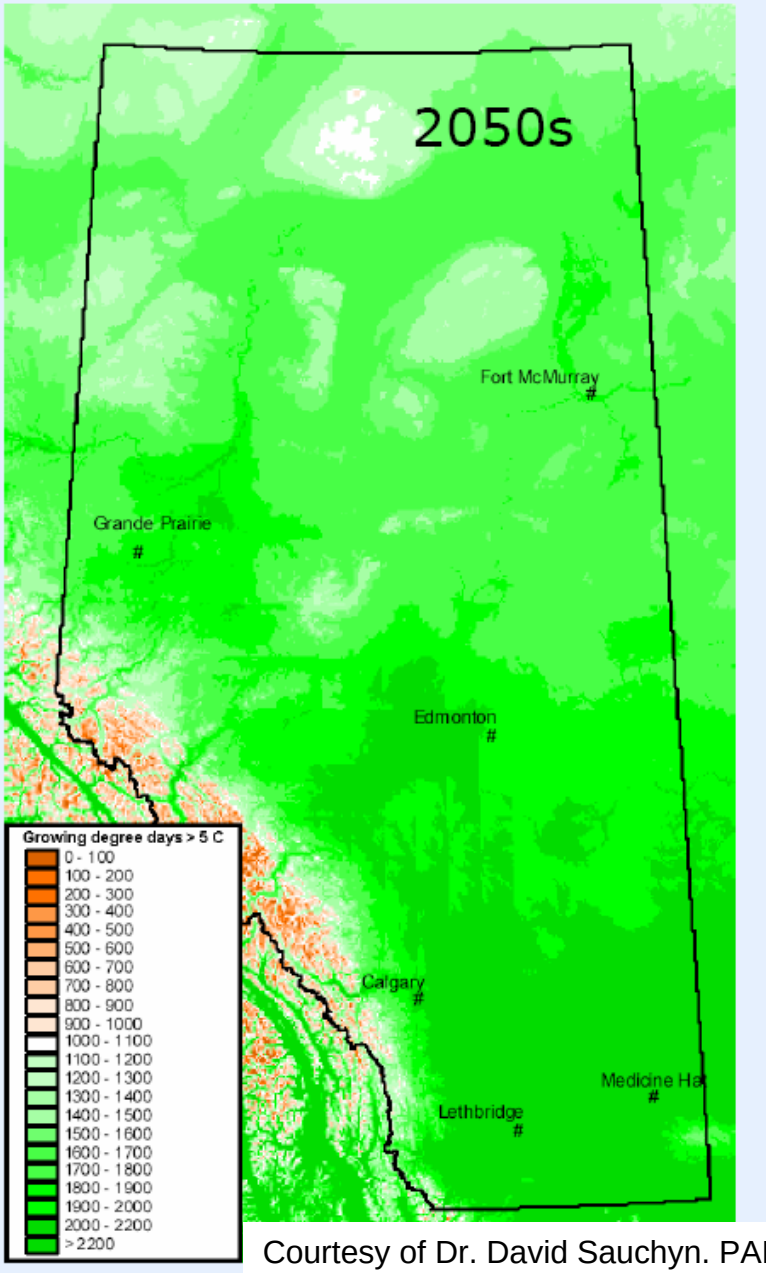

**Change in Mean Temperature (°C) by 2050:**

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

# Growing Degree Days > 5⁰ C

Barrow and Yu, 2005

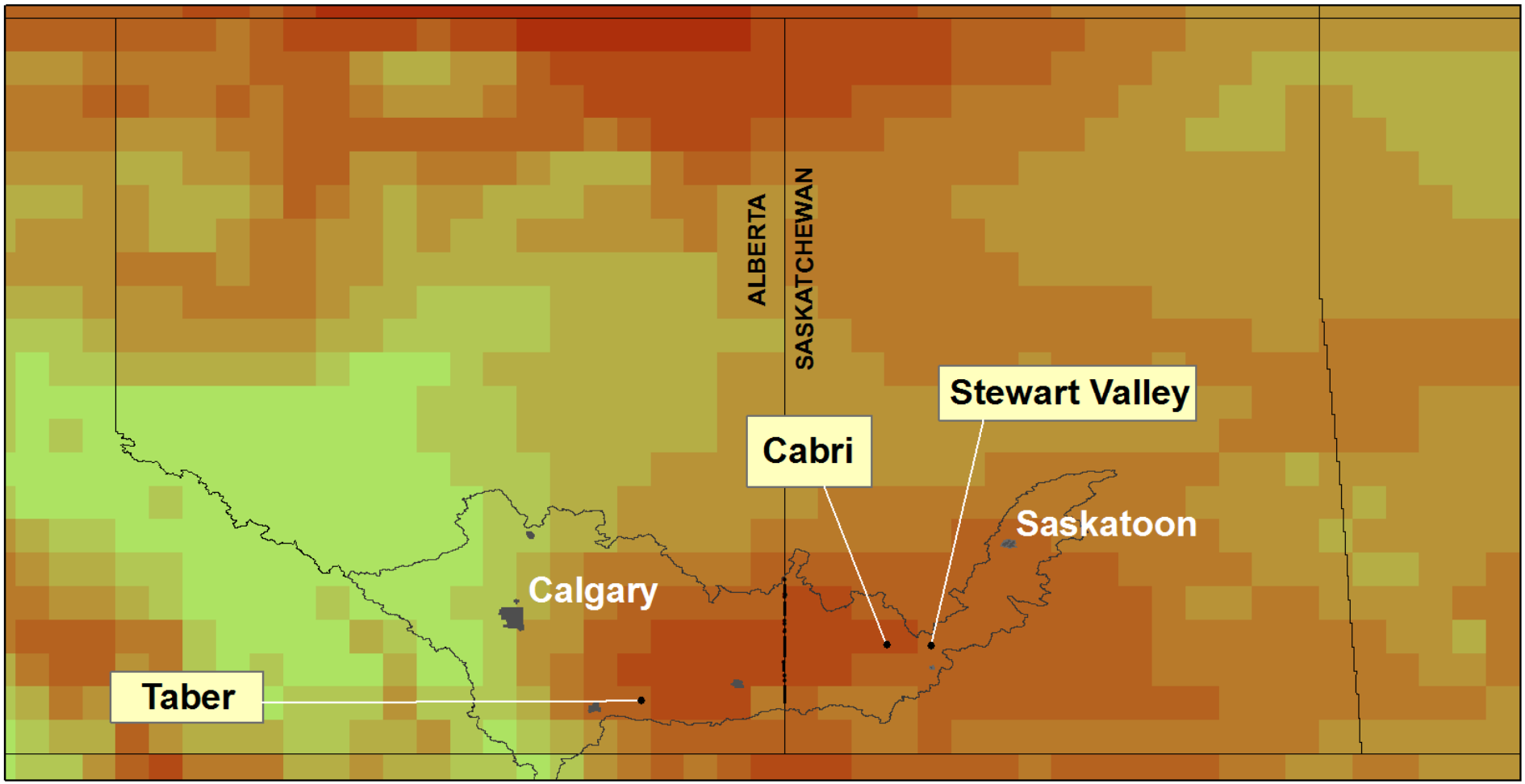



Courtesy of Dr. David Sauchyn. PARC.

# CLIMATE MOSITURE INDEX: GROWING SEASON

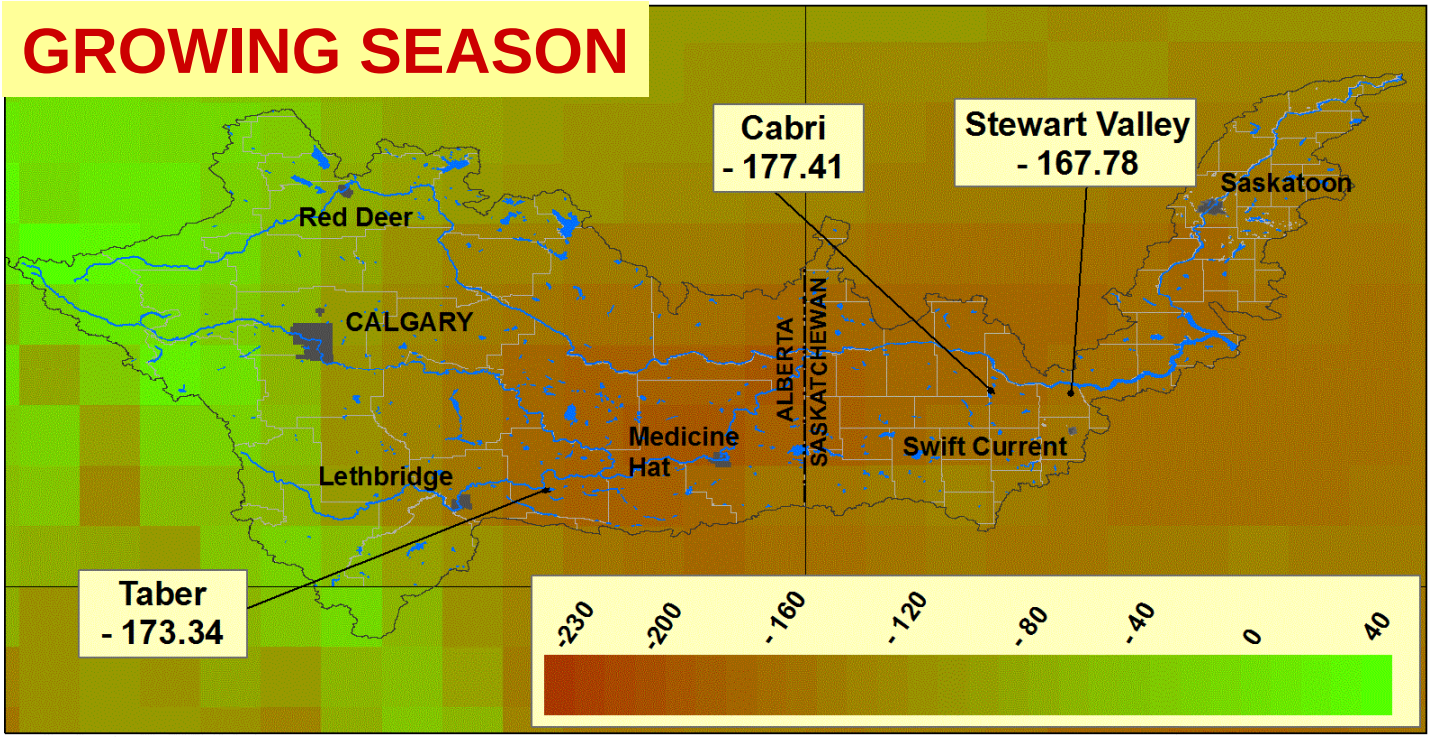
**Climate Moisture Map: May-June-July, 1961-1990 . South Saskatchewan River Basin.**



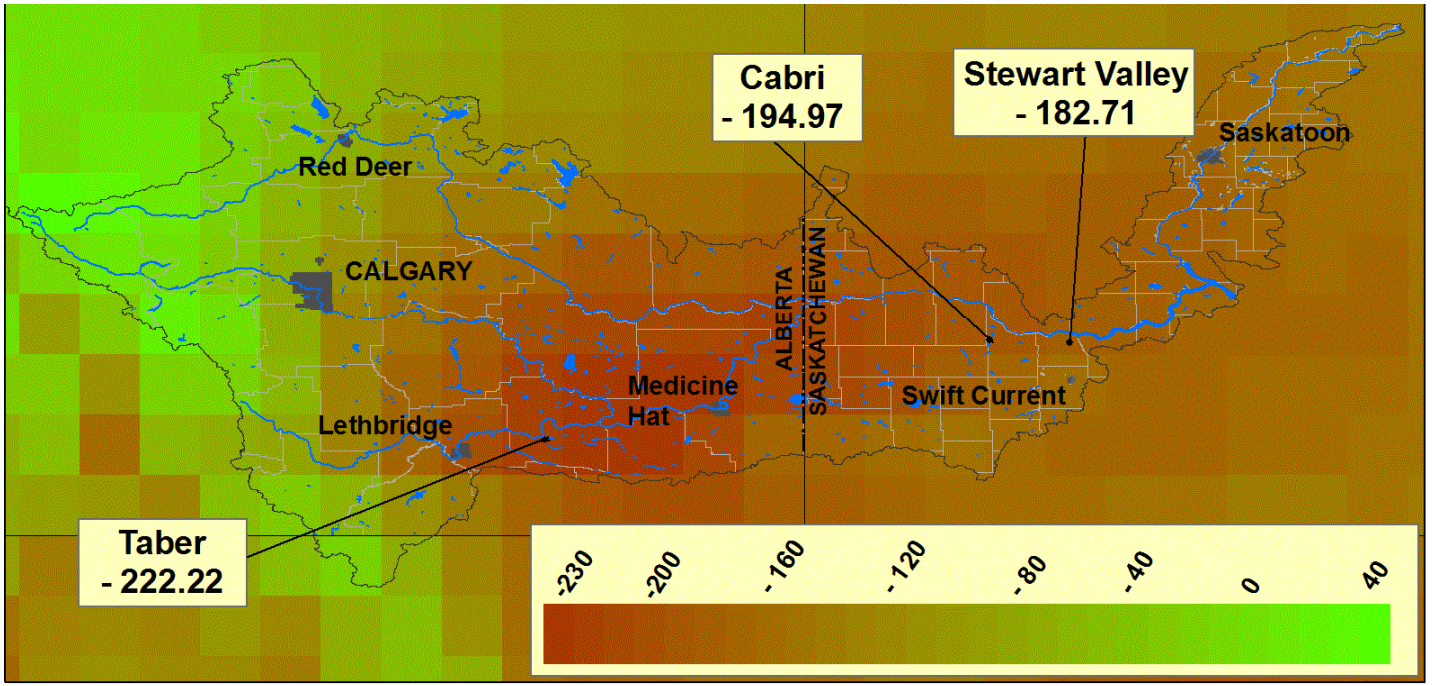

**Median: CGCM3.1 T47 B1(2)**

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

# GROWING SEASON



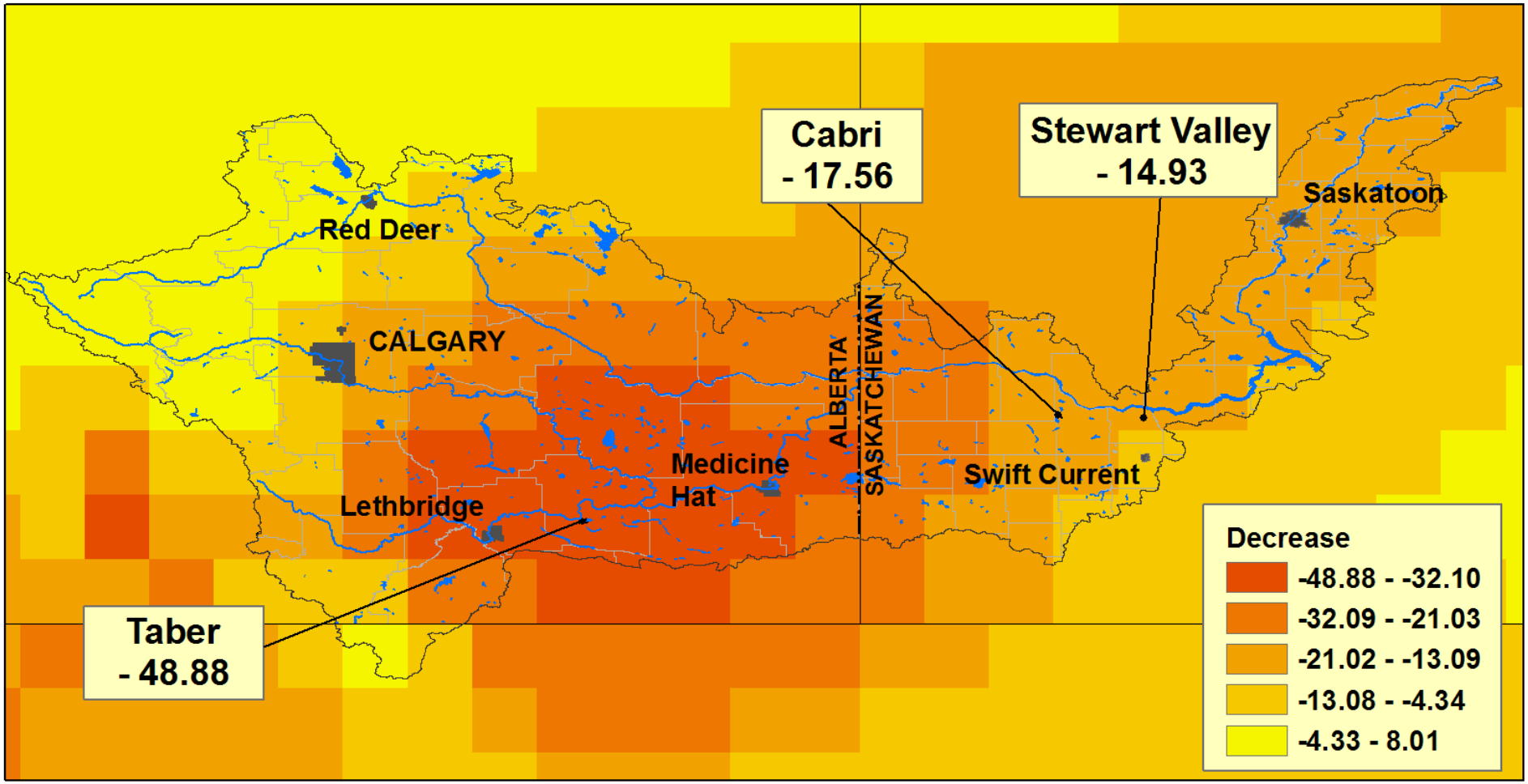

**May-June-July Climate Moisture Map, 1961 - 1990. South Saskatchewan River Basin.**




**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:**

| | |
|---|---|
| Cabri | 17.56 |
| Taber | 48.88 |
| Stewart Valley | 14.93 |

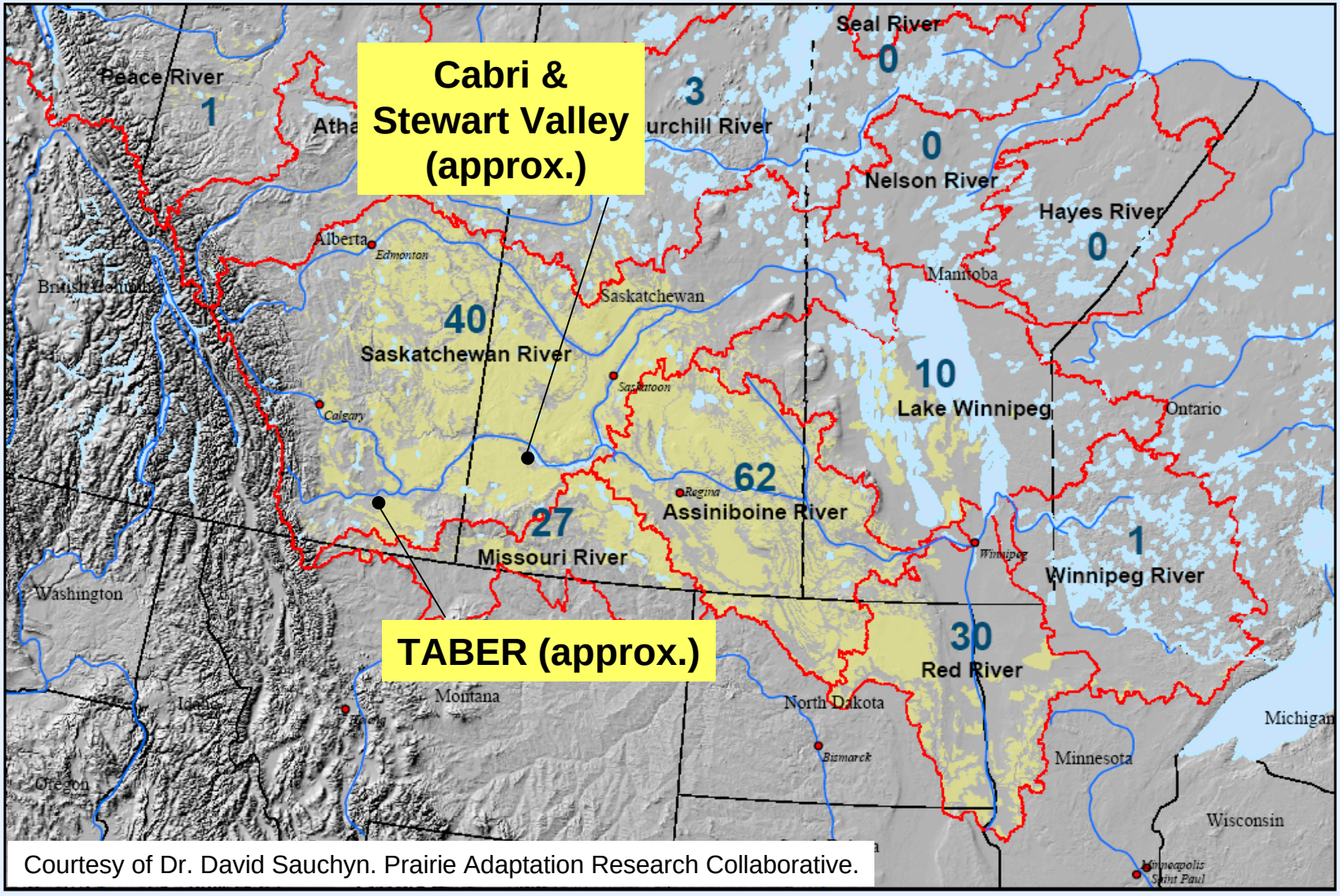
# Vegetative Transition Occurs as the Ecosystem Dries....


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-**



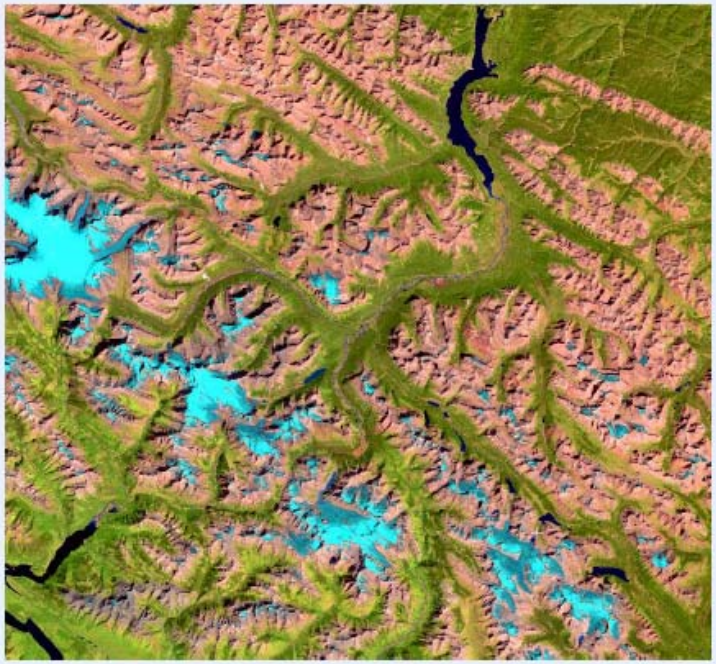

Courtesy of Dr. David Sauchyn. Prairie Adaptation Research Collaborative.

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

0 50 100 200
Kilometers

# Climate Change Impacts on Rocky Mountain glaciers

Demuth and Pietroniro, 2001

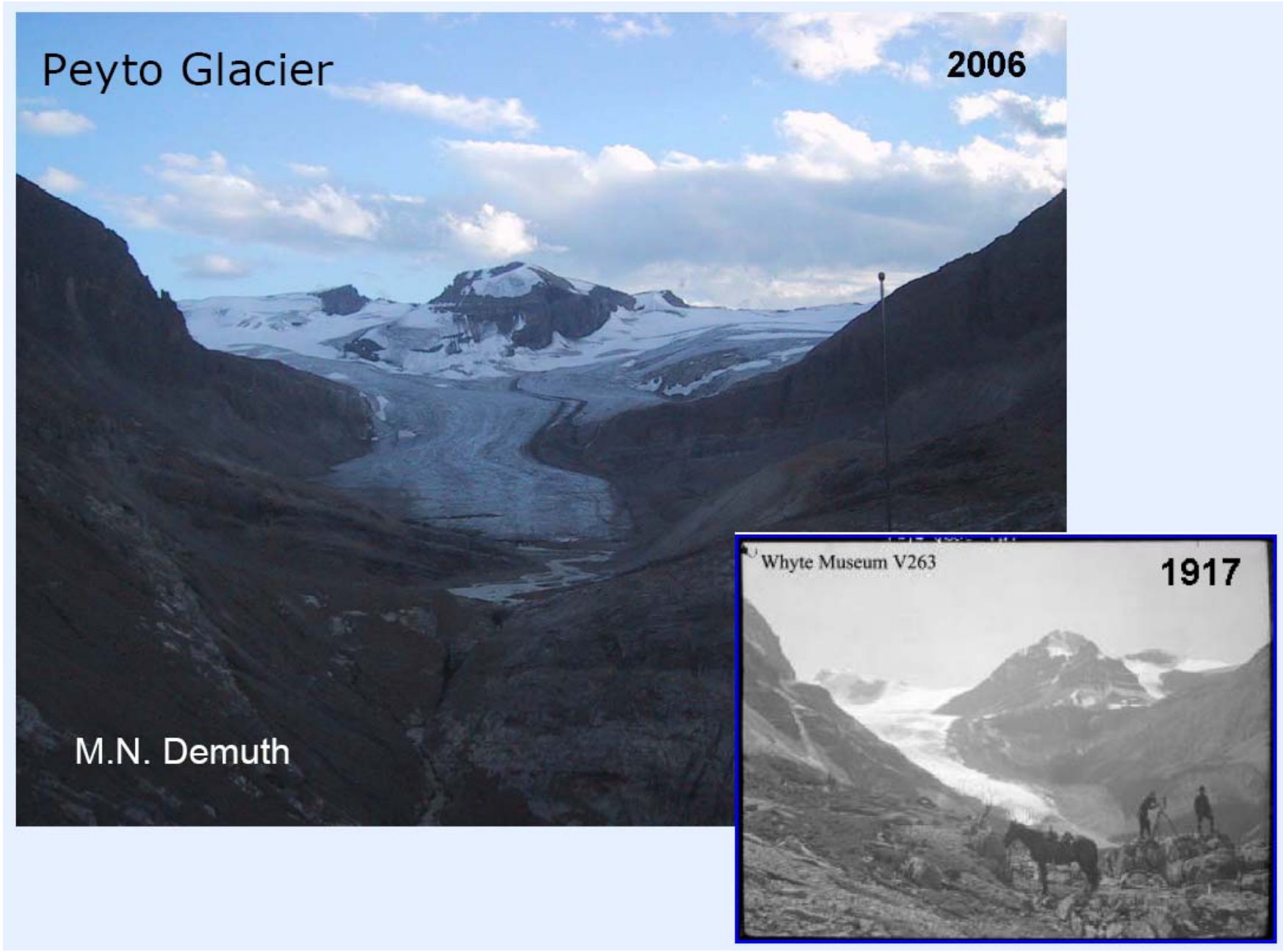


Glacier cover has decreased rapidly in recent years; it now approaches the least extent in the past 10,000 years

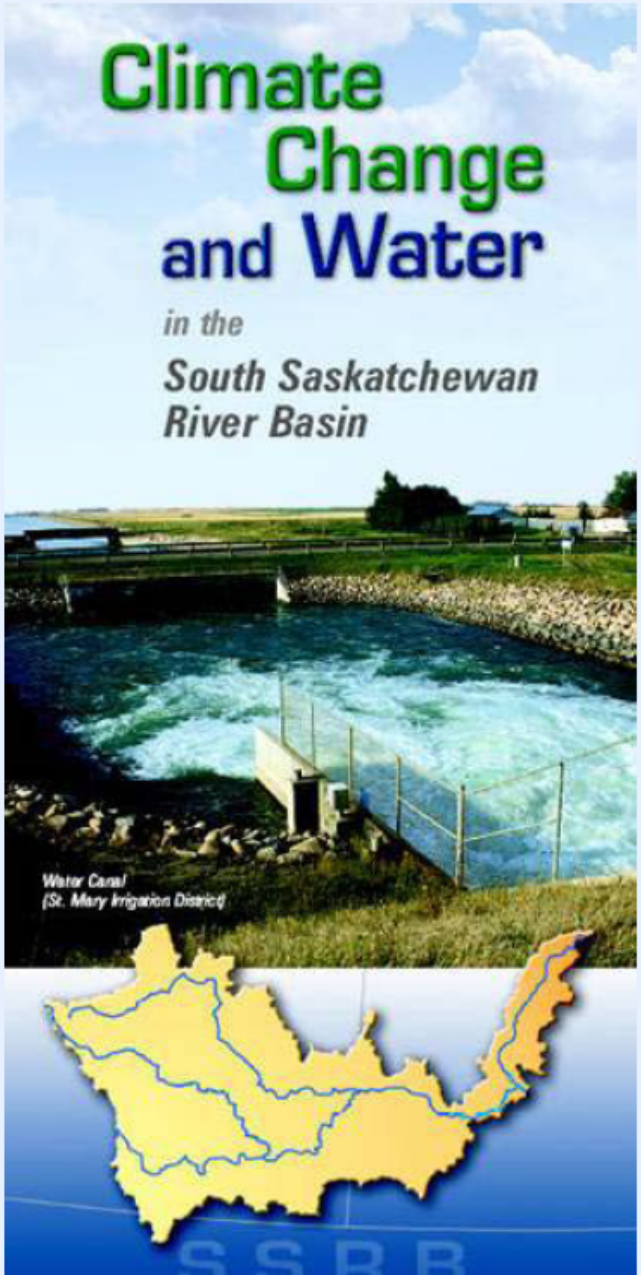
A phase of increased stream flow from global warming has past; basins have entered a potentially long-term trend of declining flows

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

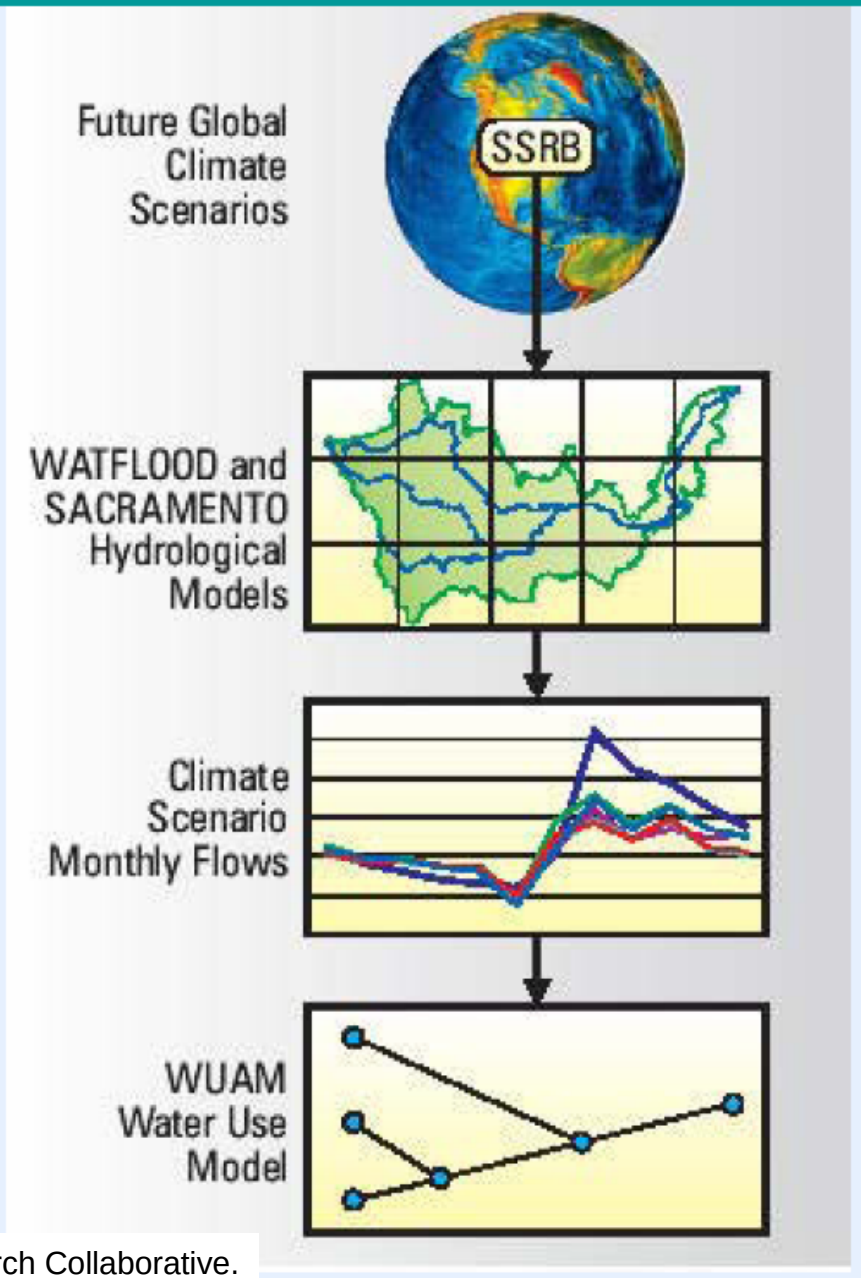
Courtesy of Dr. David Sauchyn. Prairie Adaptation Research Collaborative.




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

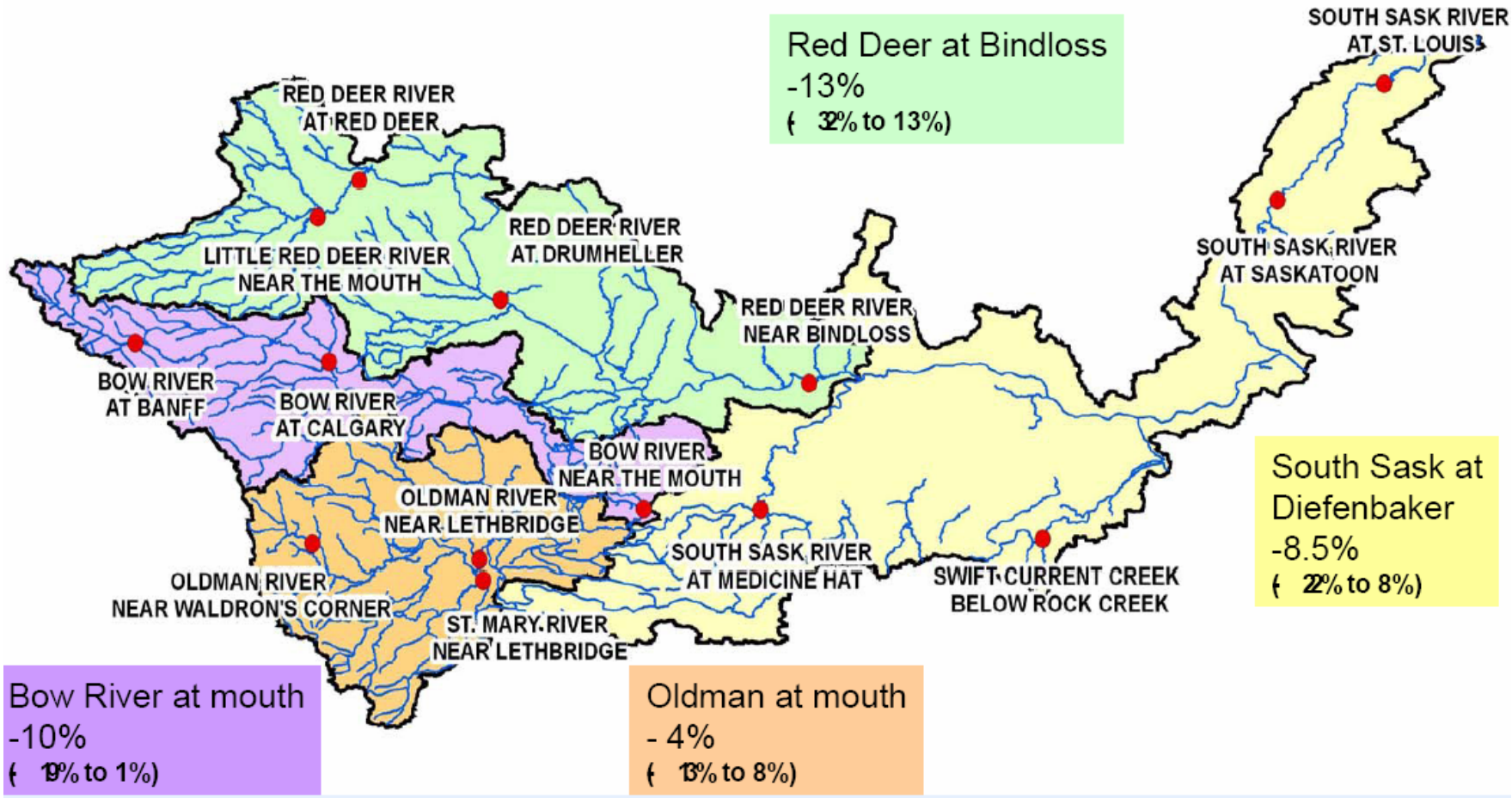



http://www.parc.ca/ssrb/index.htm




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
Outlook
Cabri
Stewart Valley
Taber
ALBERTA
SASKATCHEWAN
815 acres
282,986 acres
29,226 acres
3,260 acres

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.