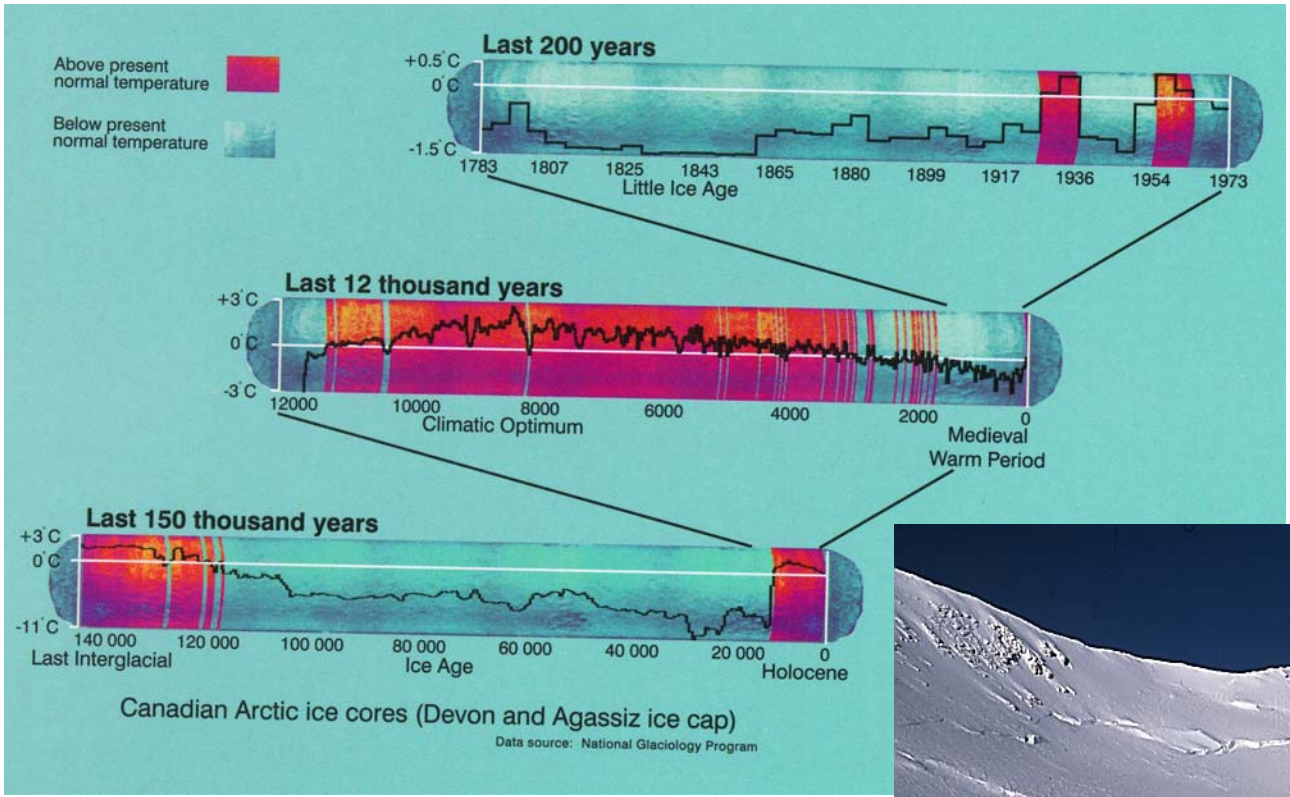
Climate Change and How it Affects Alberta

Dave Sauchyn, Prairie Adaptation Research Collaborative
University of Regina

May 13, 2002, Banff, Alberta

Climate is Always Changing



From GSC Misc. Report 71 (2001)

Ice cores, tree rings,
lakes and oceans sediments:
windows on the past

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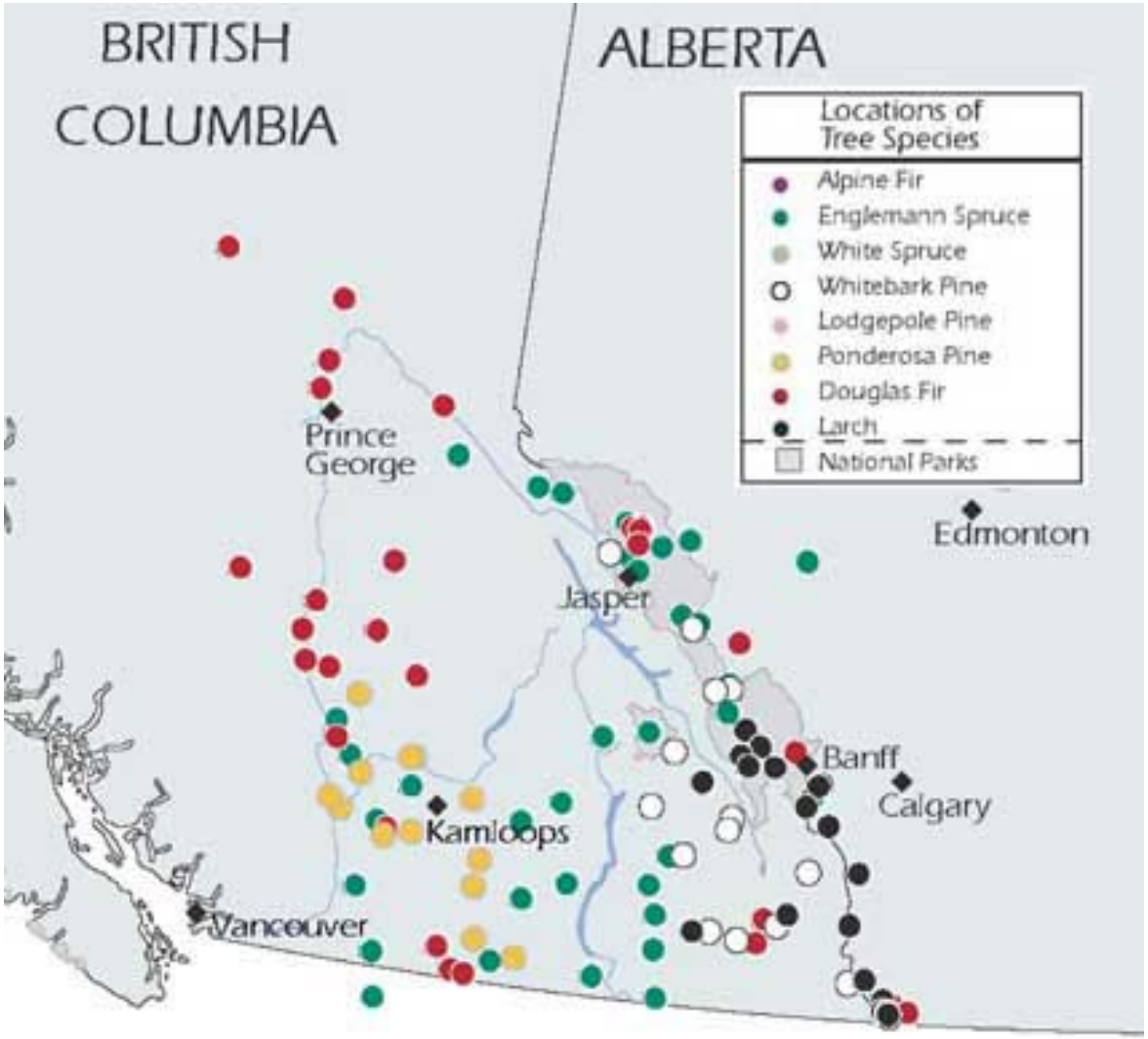
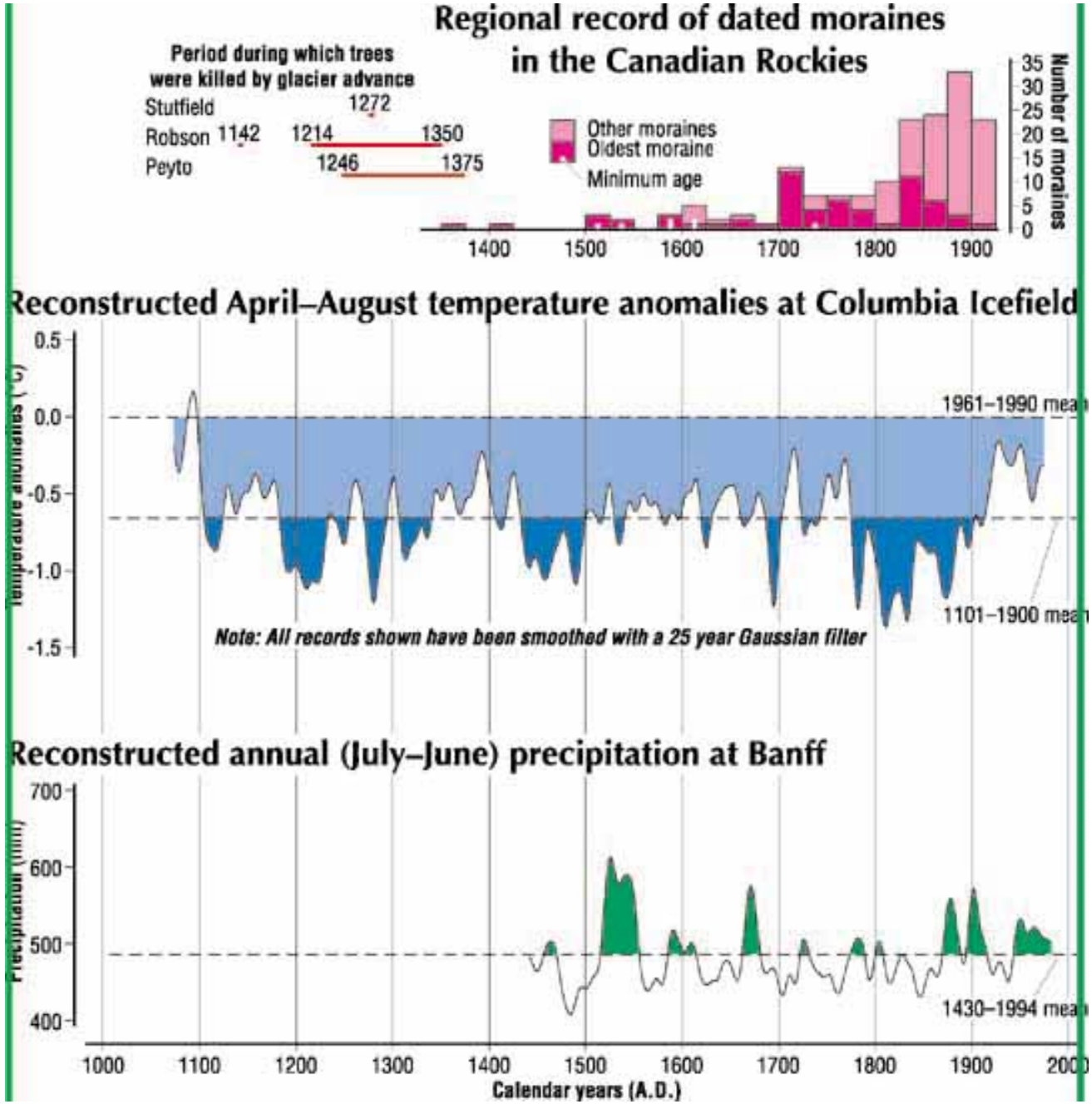
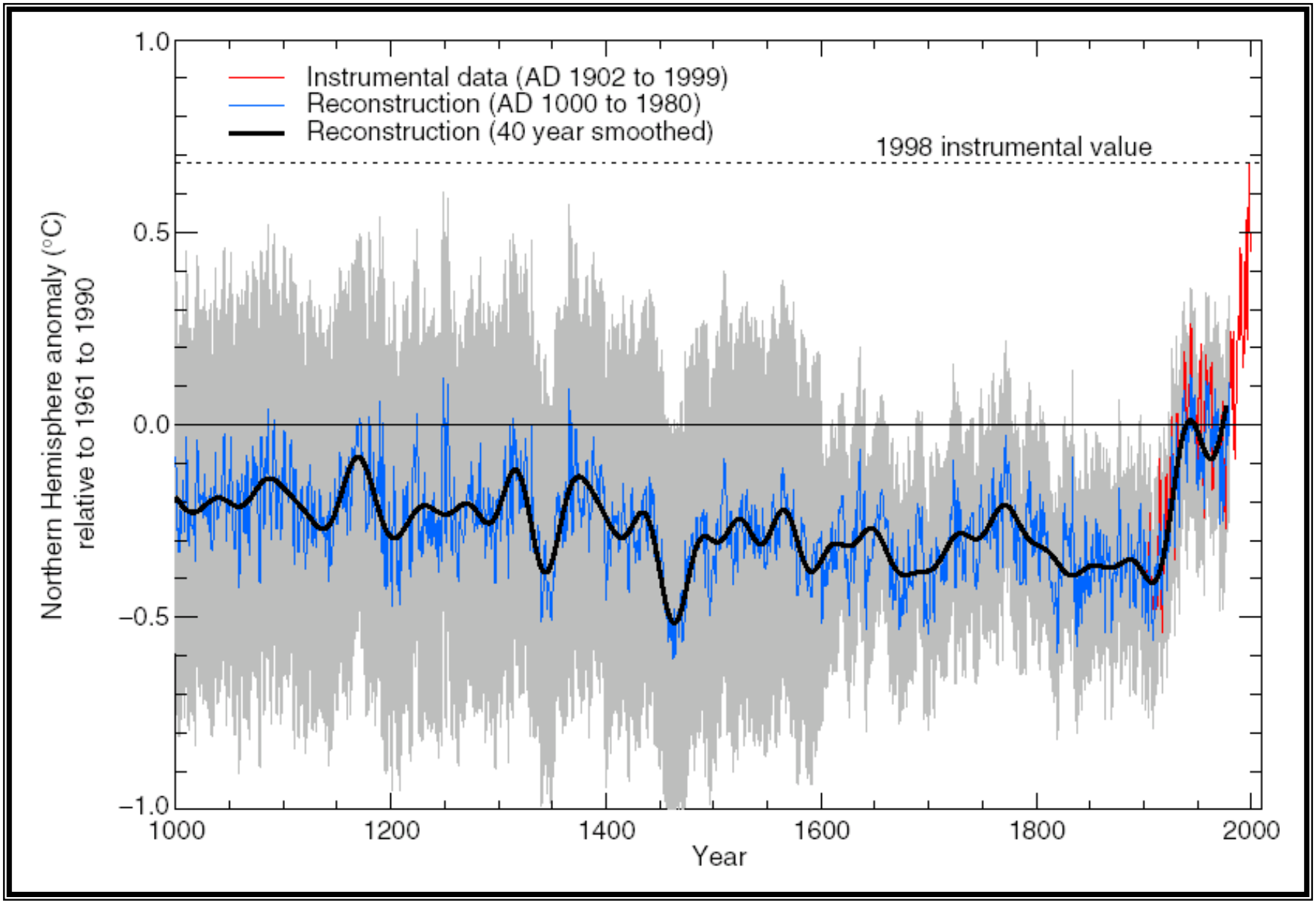


Tree Ring Chronologies, University of Western Ontario, Dendrogeomorphology Laboratory
(Dr. Brian Luckman)


Regional record of dated moraines in the Canadian Rockies
Period during which trees were killed by glacier advance
Stutfield 1272
Robson 1142 1214 1350
Peyto 1246 1375
Other moraines
Oldest moraine
Minimum age
Number of moraines
0
5
10
15
20
25
30
35
1400
1500
1600
1700
1800
1900
Reconstructed April–August temperature anomalies at Columbia Icefield
Temperature anomalies (°C)
0.5
0.0
-0.5
-1.0
-1.5
1961–1990 mean
1101–1900 mean
Note: All records shown have been smoothed with a 25 year Gaussian filter
Reconstructed annual (July–June) precipitation at Banff
Precipitation (mm)
700
600
500
400
1430–1994 mean
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
Calendar years (A.D.)

Northern Hemisphere (1000 years) temperature records



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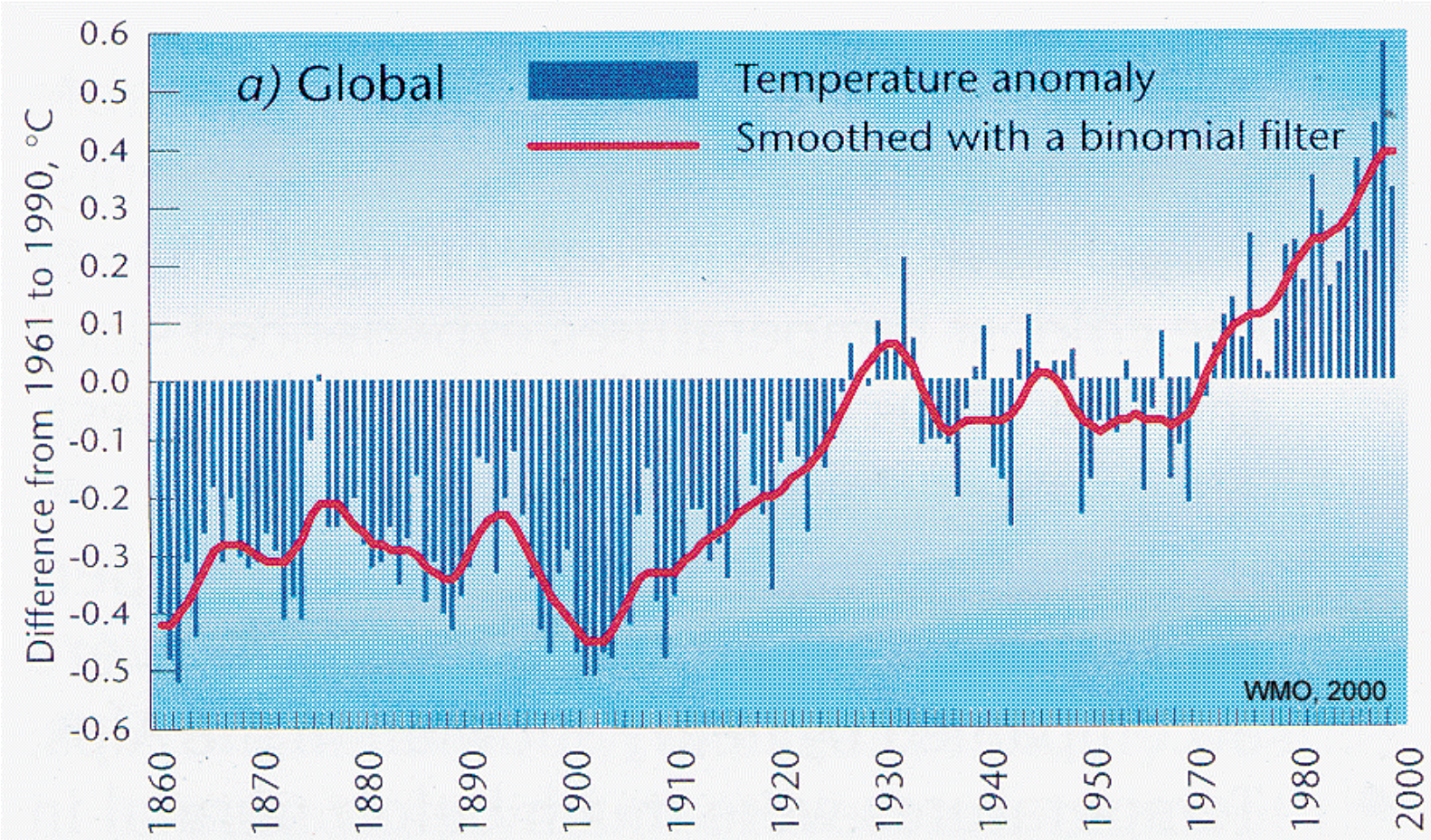
Global Annual Air Temperatures



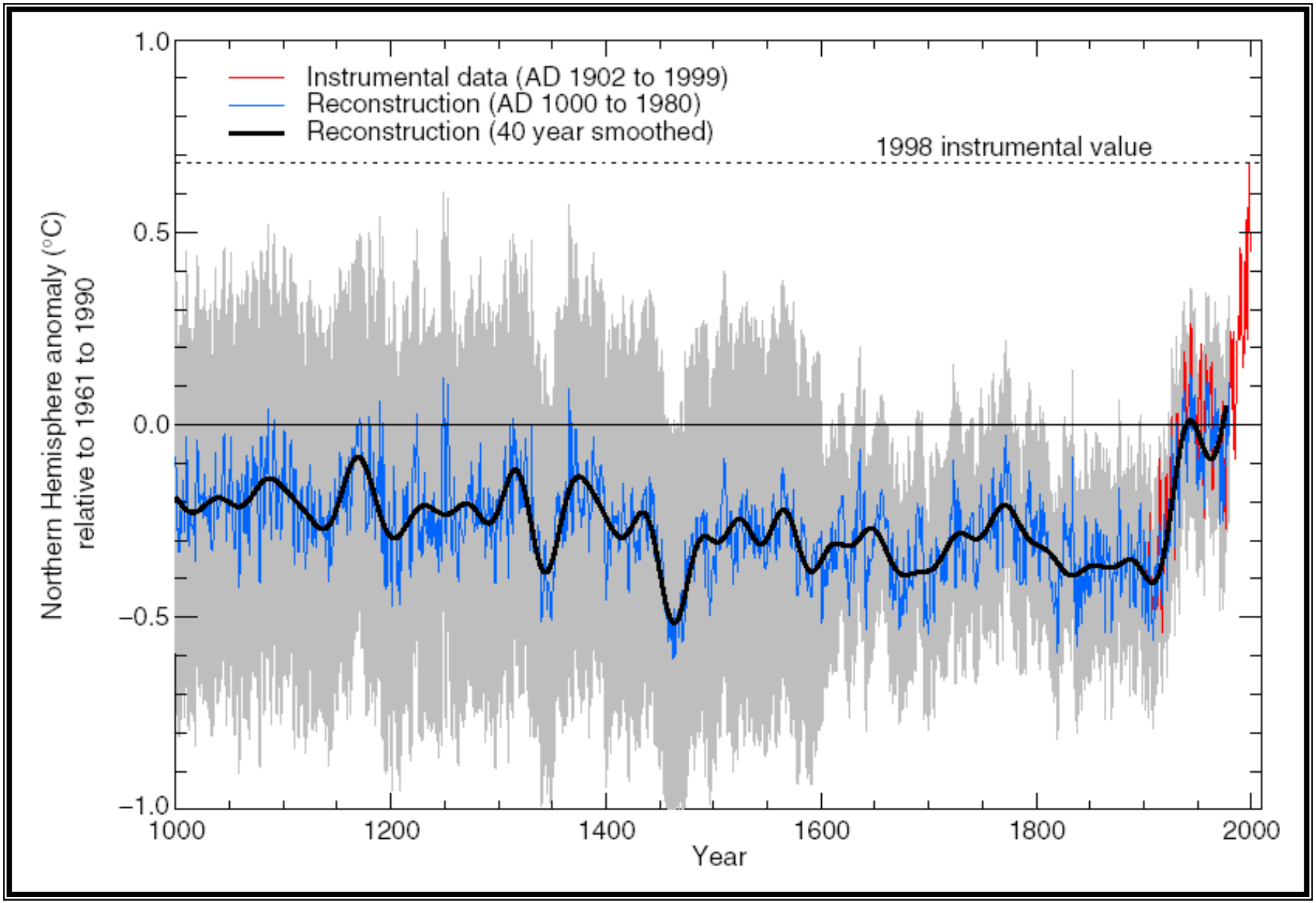
[1] Huang and Pollack 1999 [2] WMO Bulletin 1999 [3] IPCC 1996

2002 – Thus far is the warmest year on record

The first three months of this year were the warmest globally since records began in 1860 and probably for 1,000 years.

Dr. Geoff Jenkins, Director, Hadley Centre, UK

Northern Hemisphere (1000 years) temperature records



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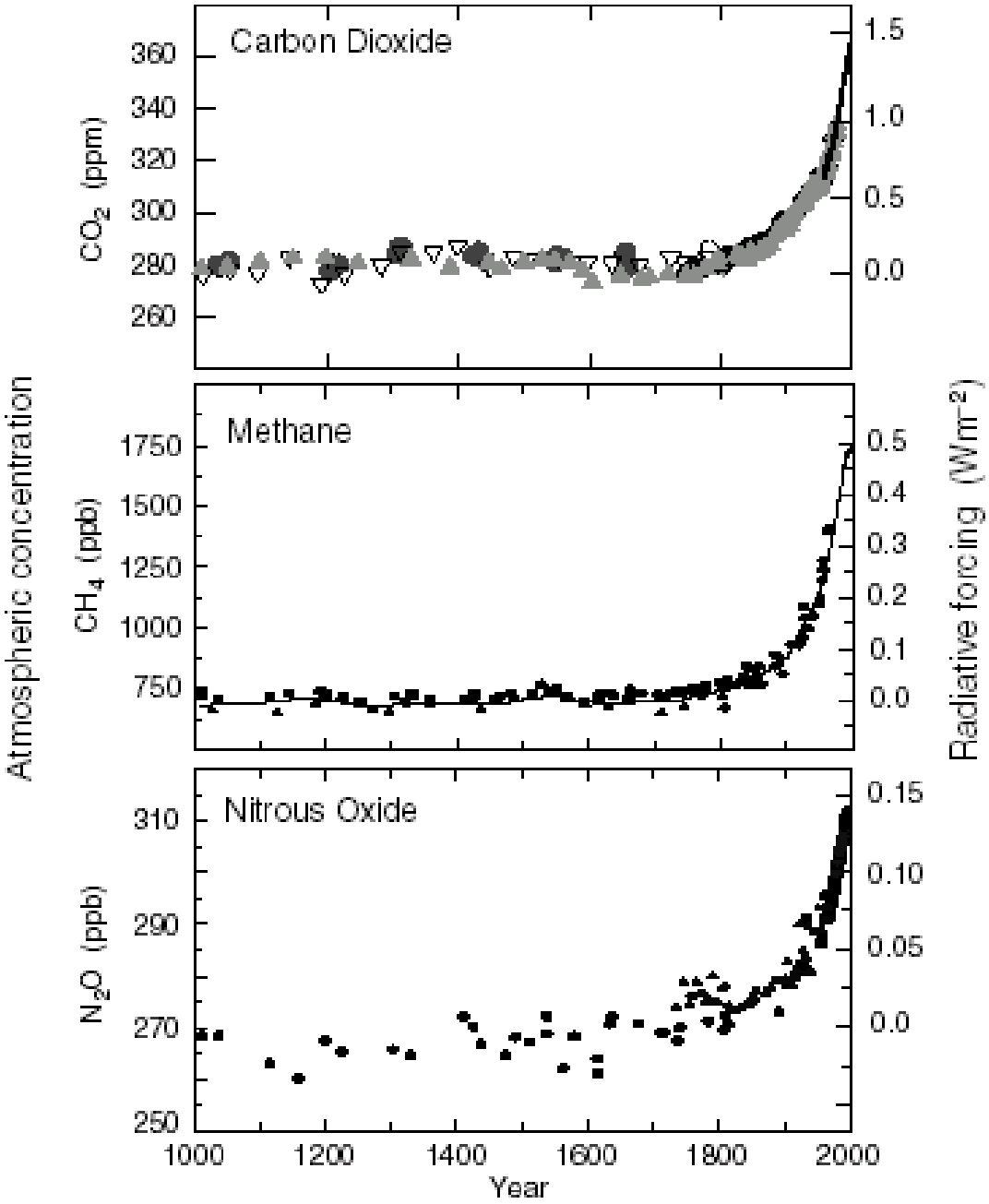
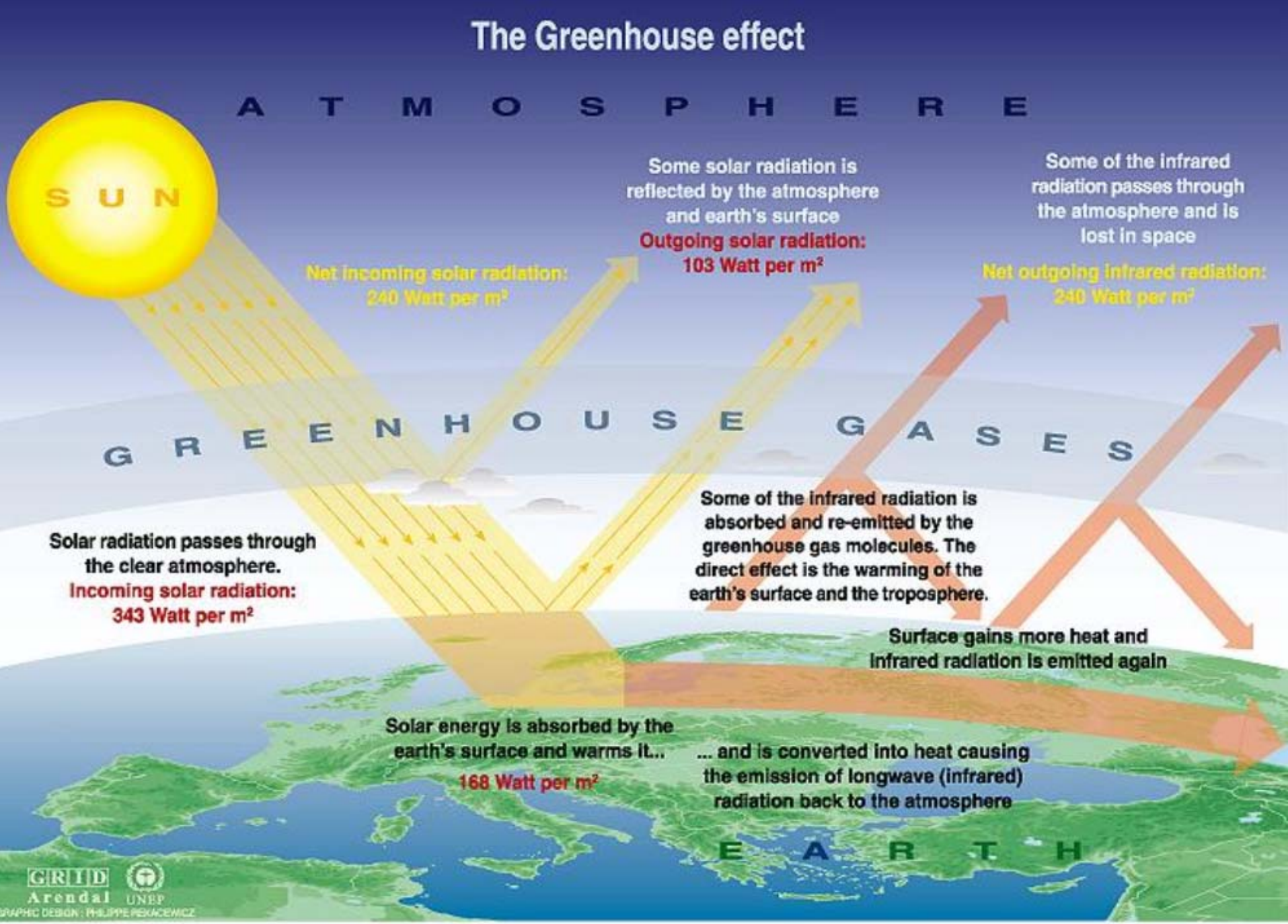
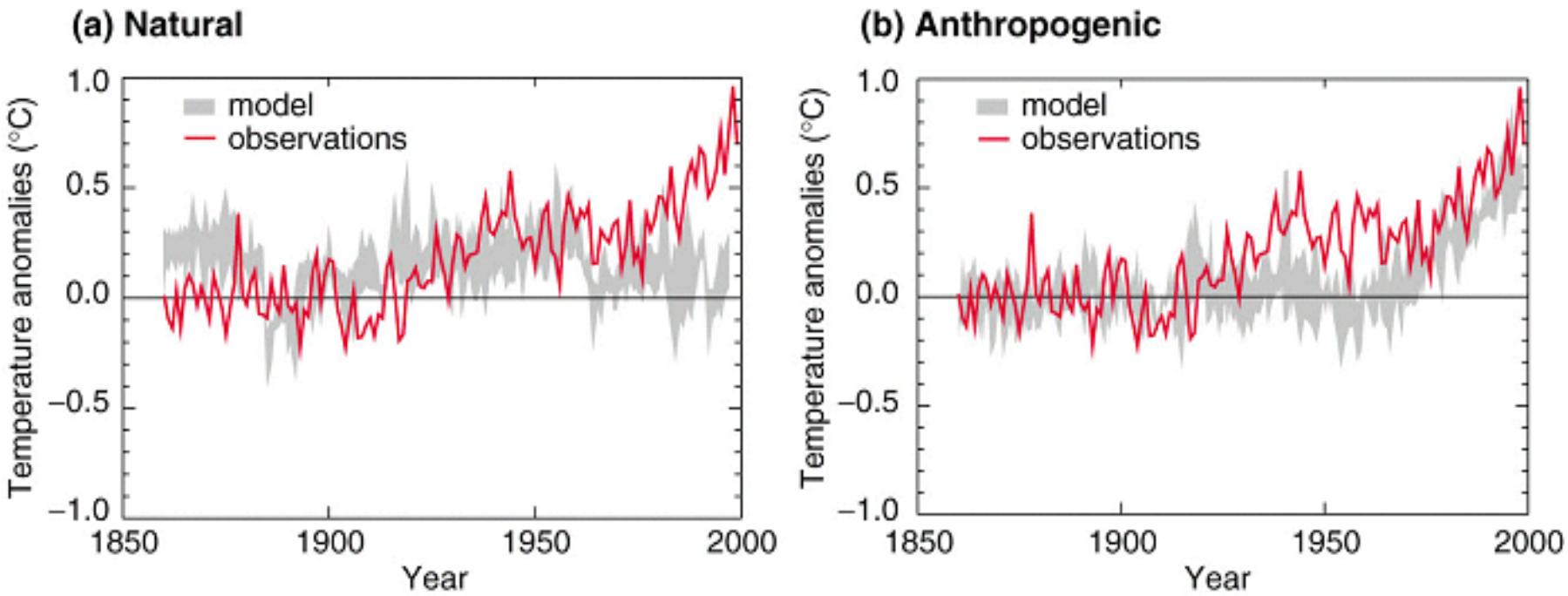

Carbon Dioxide
Methane
Nitrous Oxide
Atmospheric concentration
Radiative forcing (Wm-2)
CO2 (ppm)
CH4 (ppb)
N2O (ppb)
360
340
320
300
280
260
1750
1500
1250
1000
750
310
290
270
250
1.5
1.0
0.5
0.0
0.5
0.4
0.3
0.2
0.1
0.0
0.15
0.10
0.05
0.0
1000
1200
1400
1600
1800
2000
Year

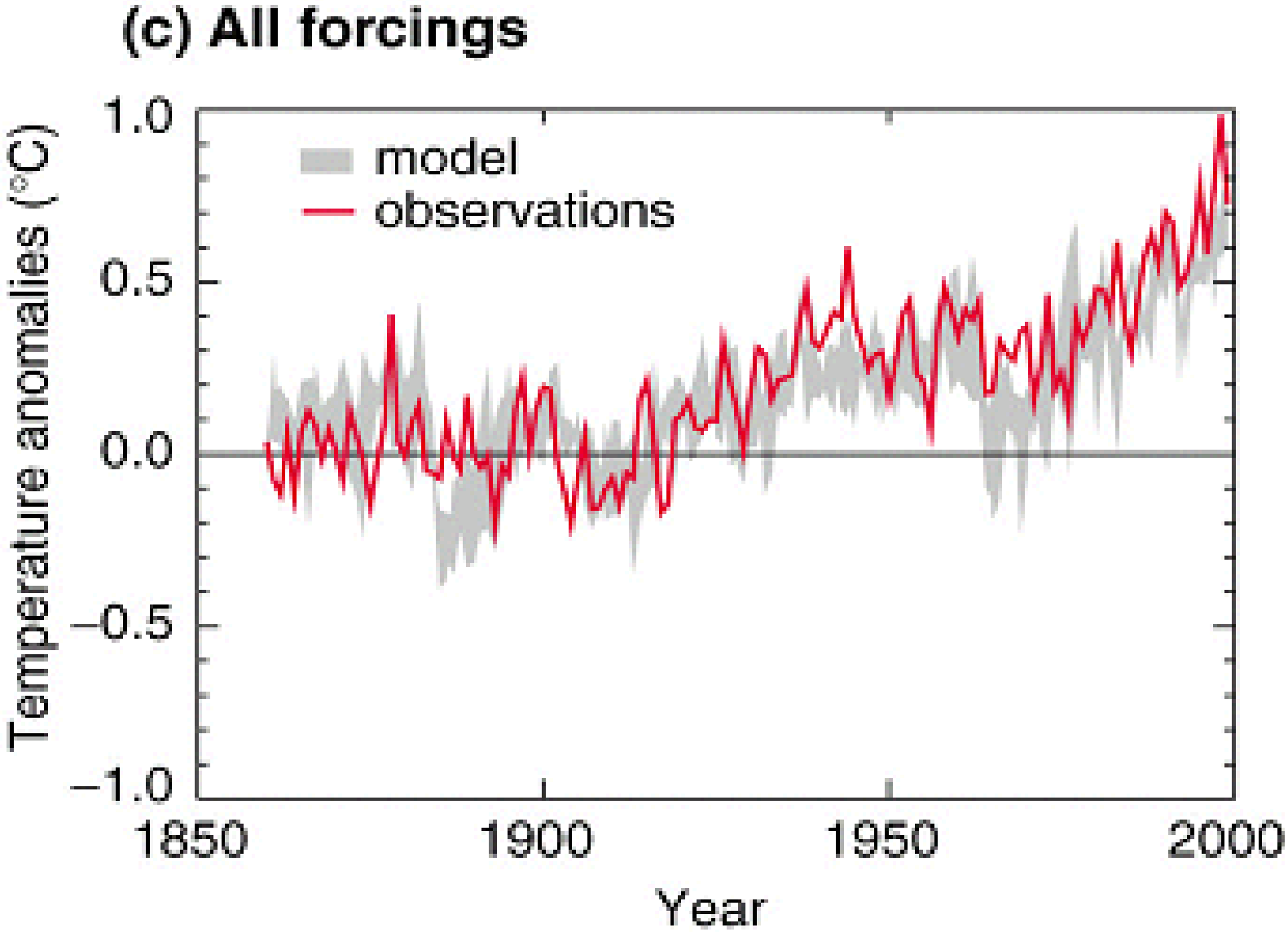
The Greenhouse effect



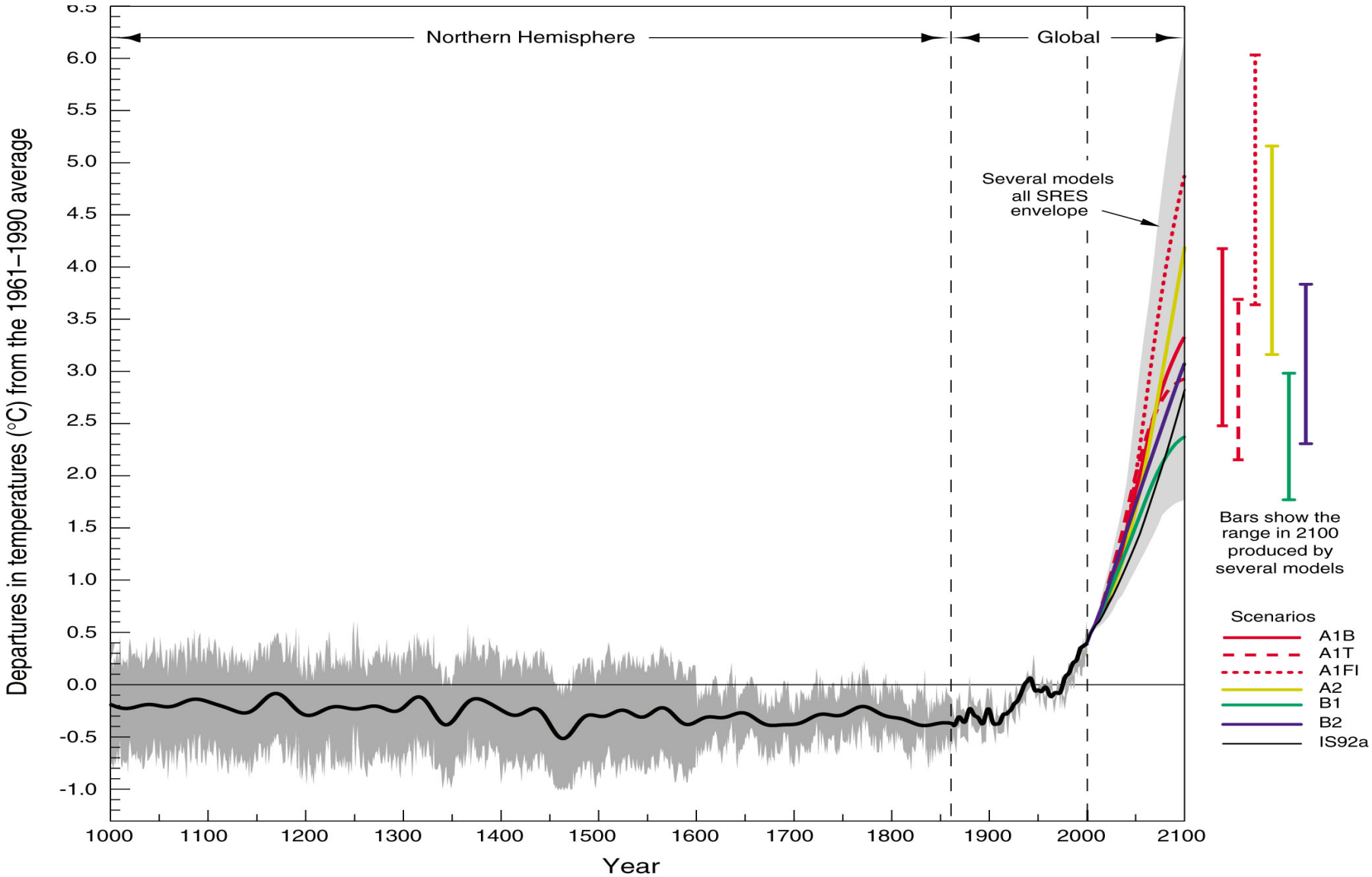
Sources: Okanagan university college in Canada, Department of geography, University of Oxford, school of geography; United States Environmental Protection Agency (EPA), Washington; Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1996.

Climate Change involves both human and "natural" factors

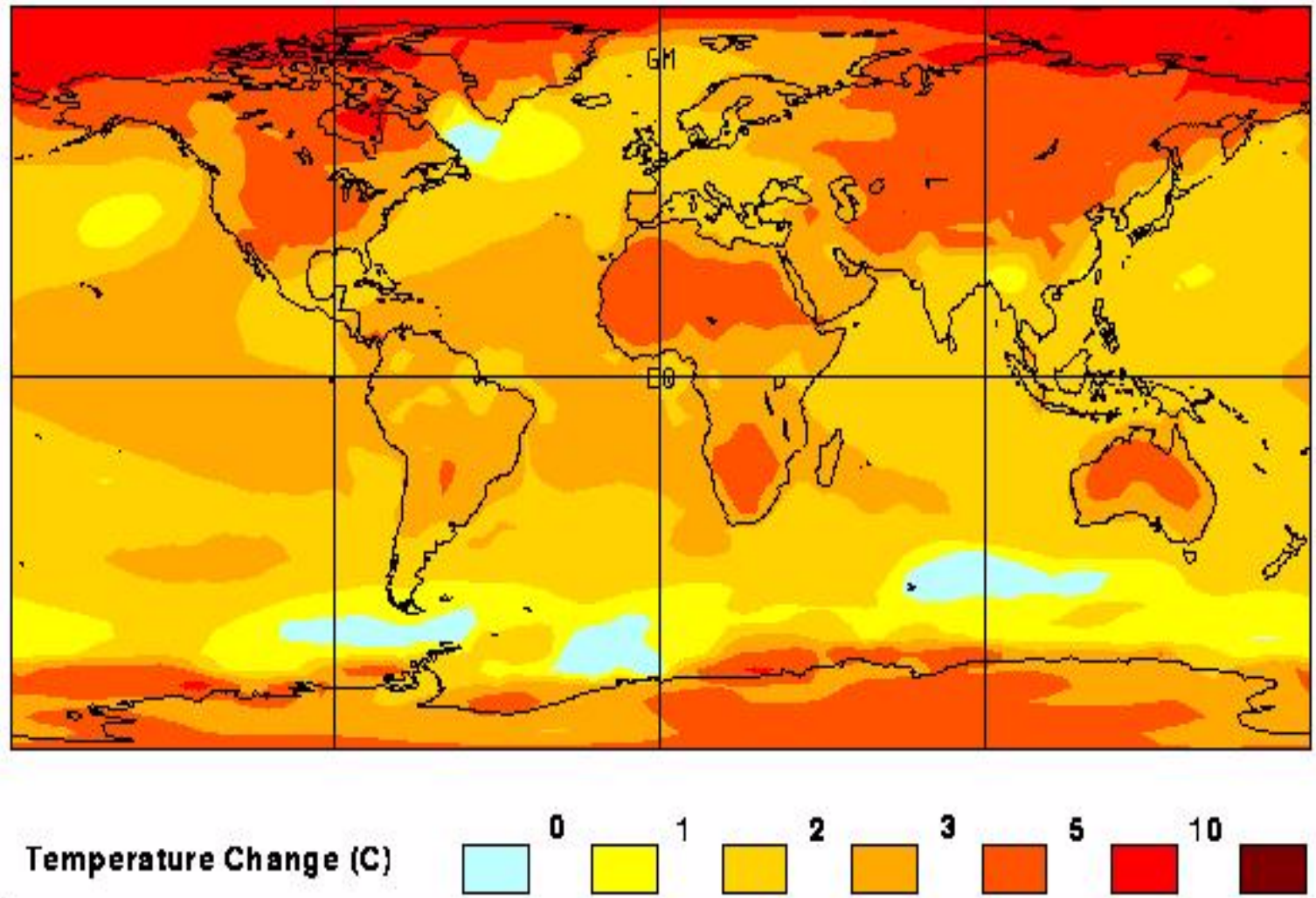



(c) All forcings
model
observations
Temperature anomalies (°C)
1.0
0.5
0.0
−0.5
−1.0
1850
1900
1950
2000
Year

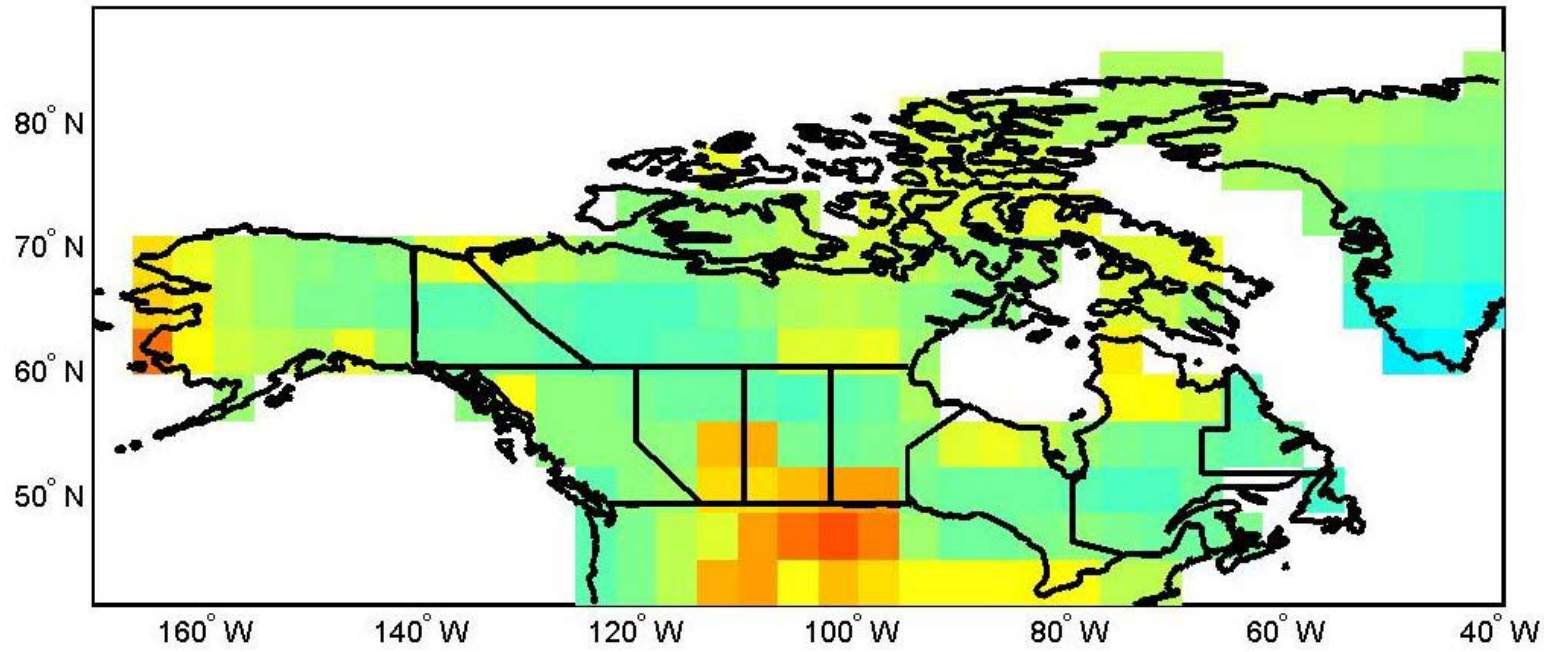
Temperature Projections for 21st Century



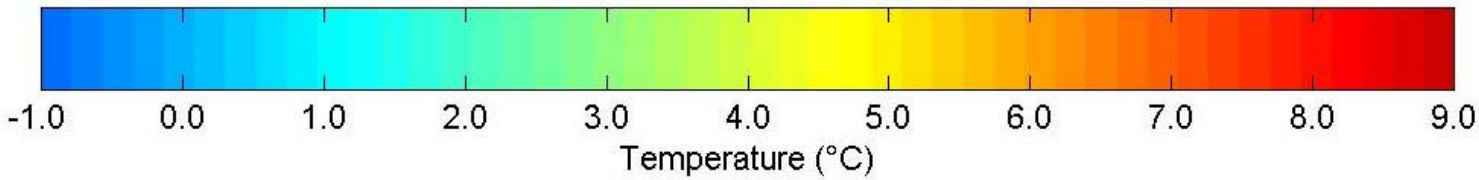
Projected Temperature Change, 1910 - 2040



Combined Effect of Projected Greenhouse Gas and Sulphate Aerosol Increases.- Canadian Model



CGCM1, Mean Spring Temperature Change 2050



http://www.cics.uvic.ca/scenarios/index.cgi

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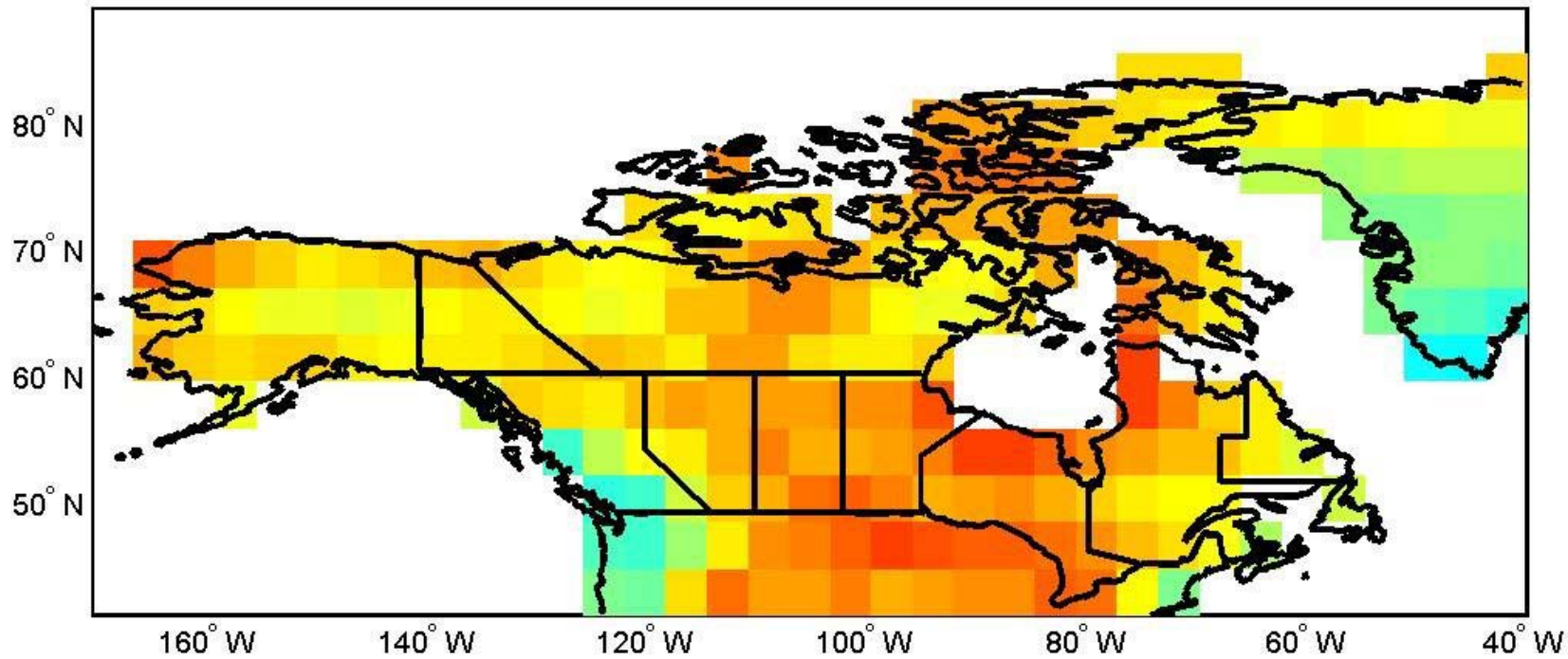
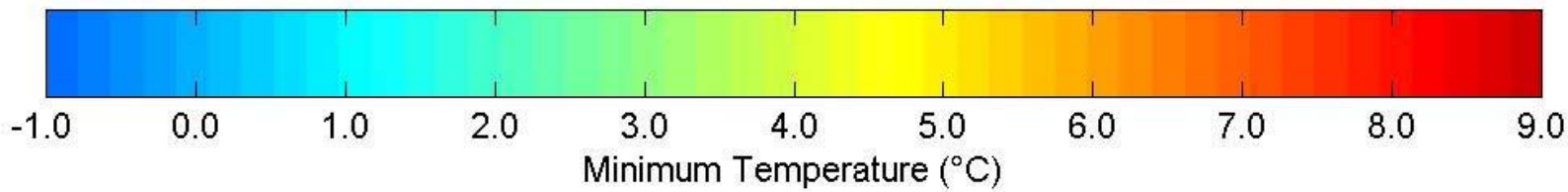


CGCM1, Mean Winter Temperature Change 2050



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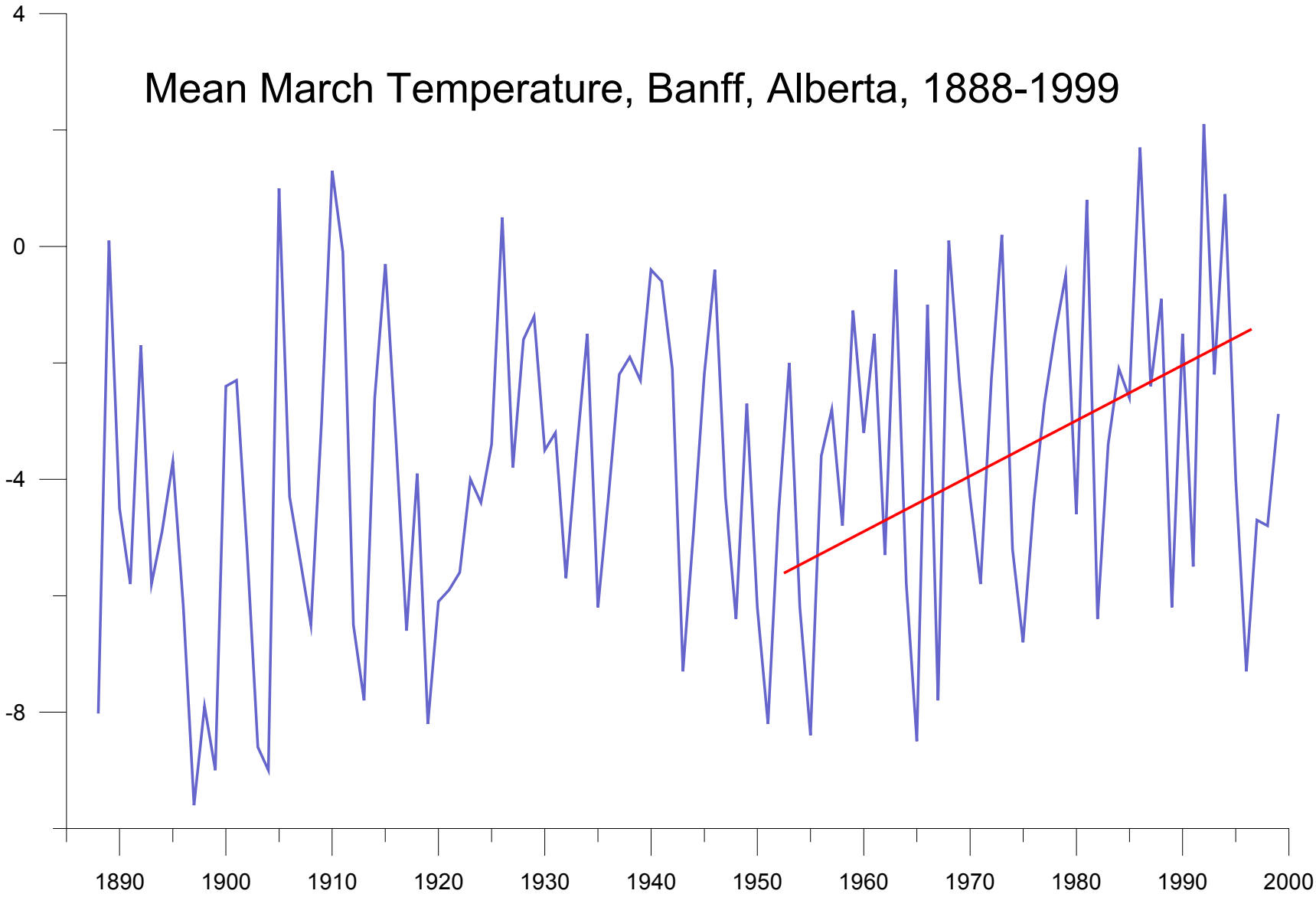

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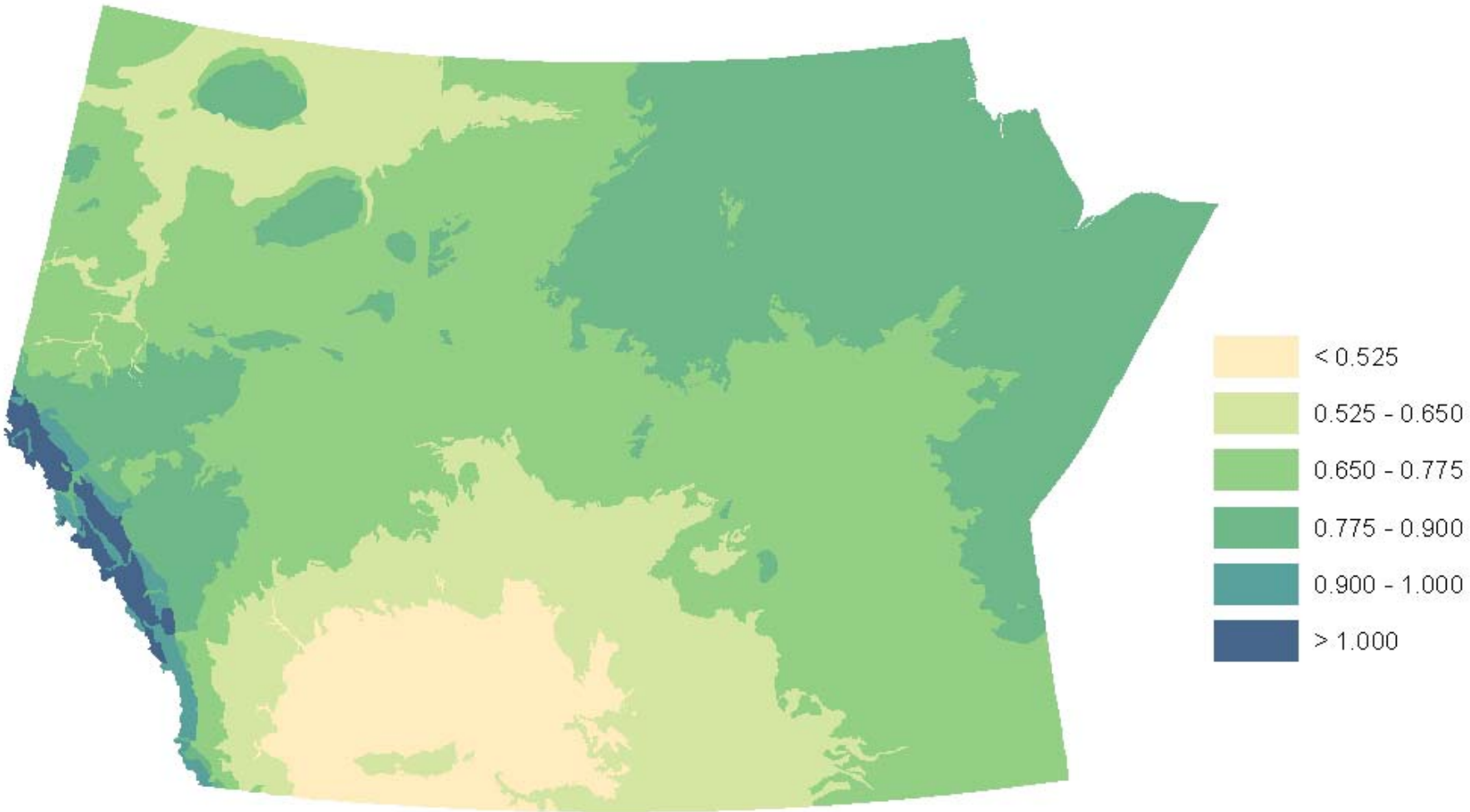
Projections for the future climate of the Prairie Provinces

Temperature	increasing, greater in winter than summer, greater at night than during day
Precipitation	great uncertainty, annually small increase to significant decrease
Evaporation	increased
Soil moisture	decreased
Growing season	increased
Water Resources	increased variability, earlier peak flows
Extreme events	increased frequency and magnitude

Ratio of Precipitation to Potential Evapotranspiration for the Prairie Provinces

1961-1990



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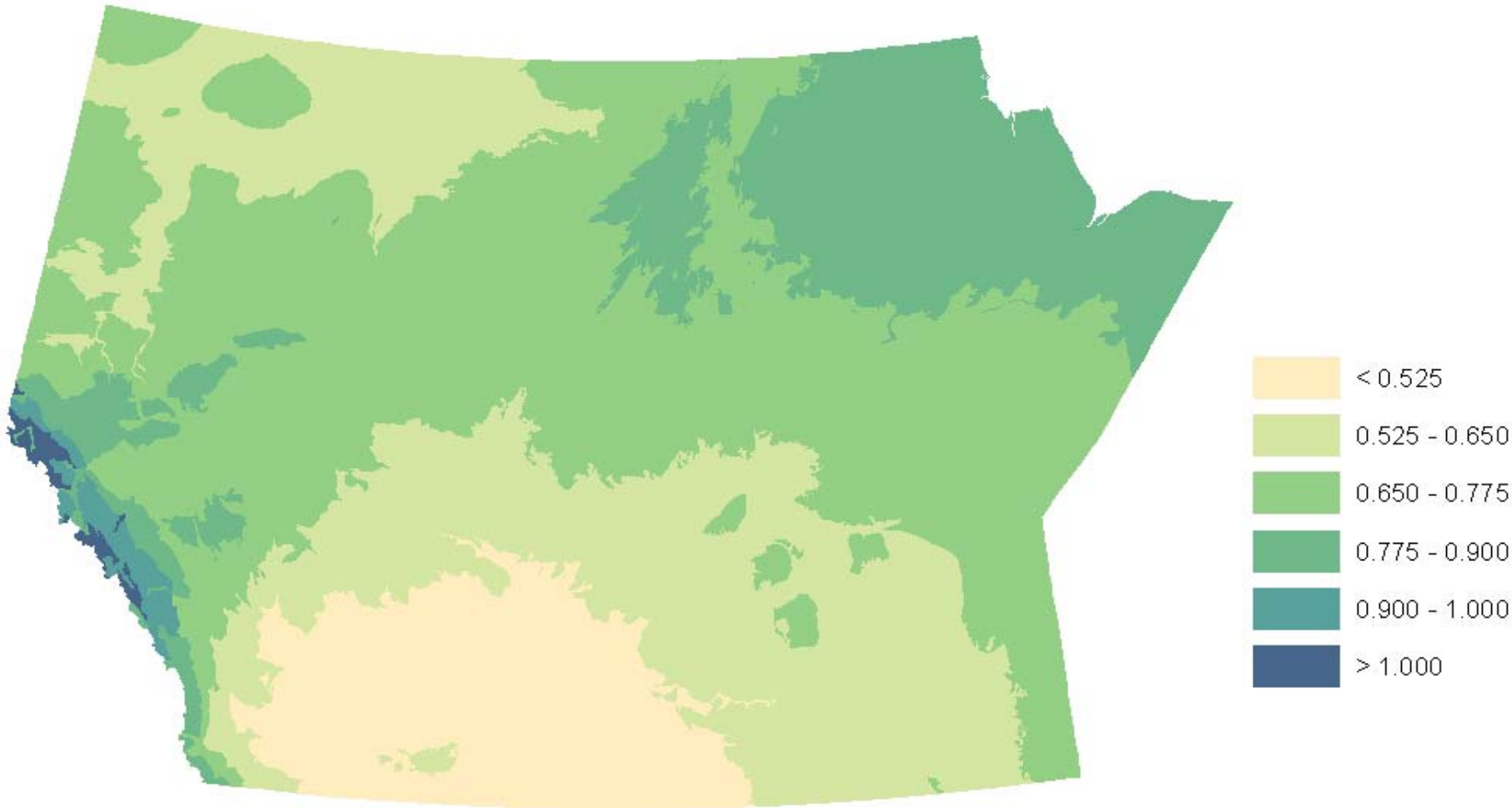
Ratio of Precipitation to Potential Evapotranspiration for the Prairie Provinces

2040-2069



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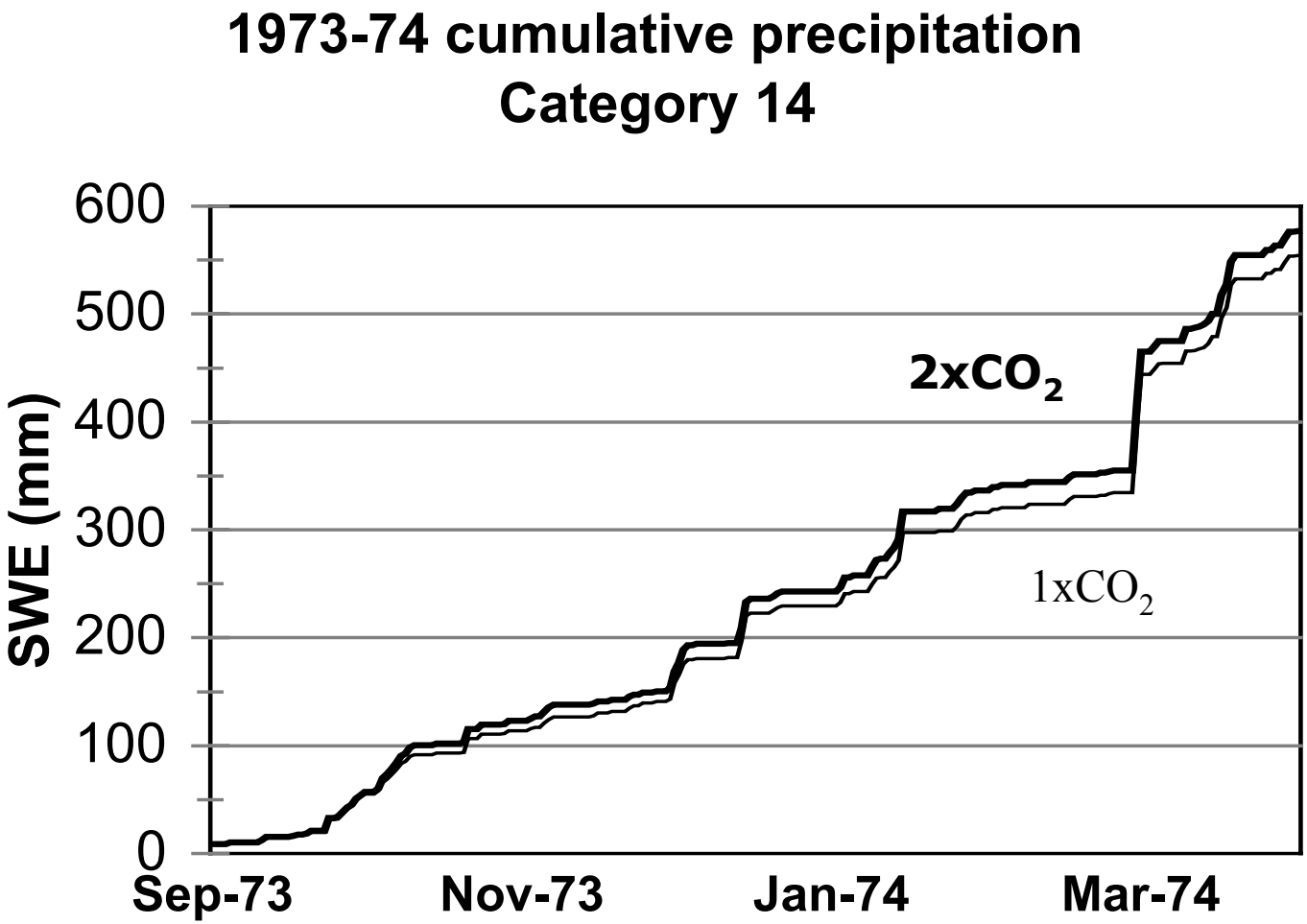
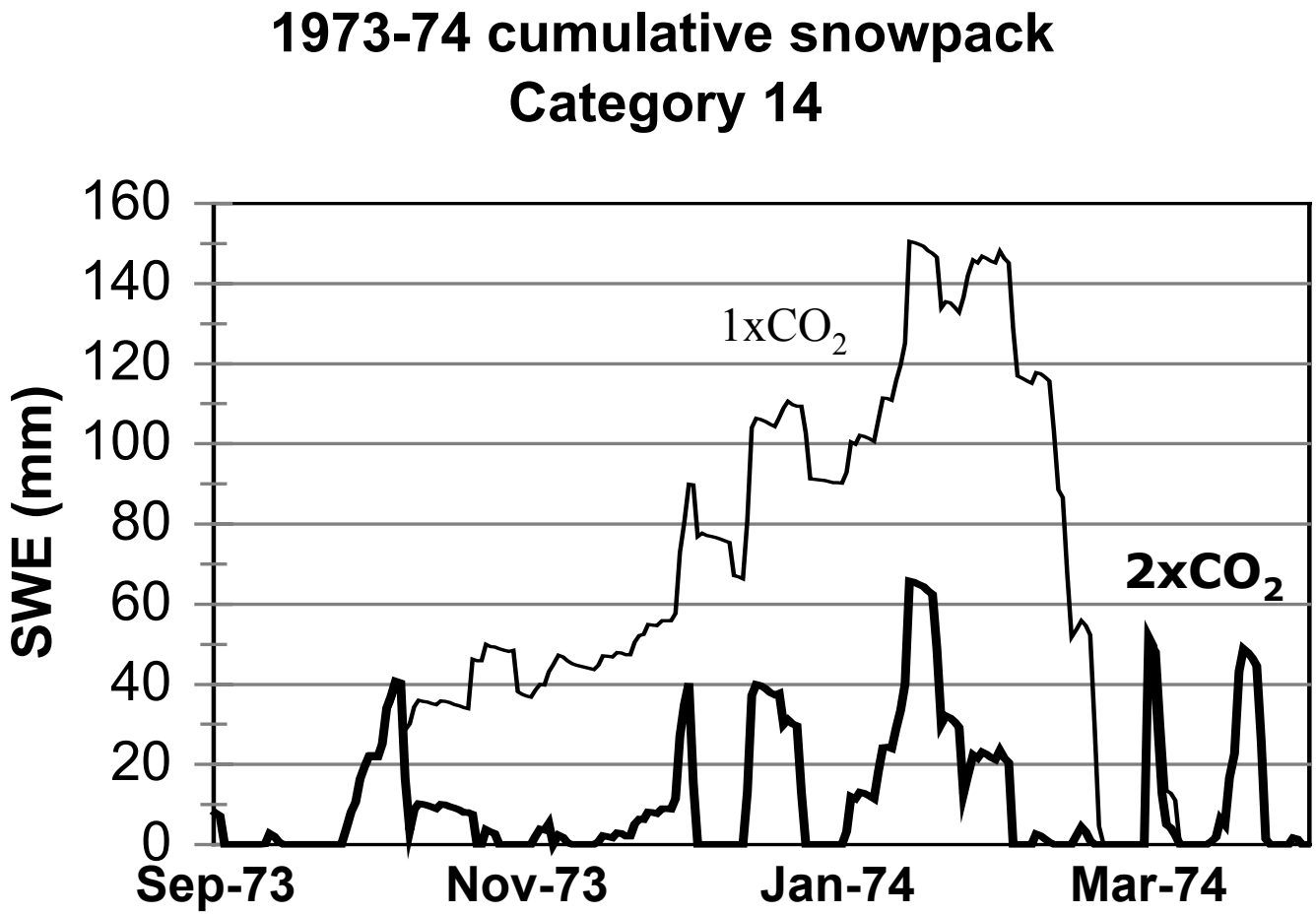
Climate Warming Impacts on Alpine Snowpacks

Lapp, Suzan L., 2002. Climate warming impacts on alpine snowpacks in western North America. MSc Thesis, University of Lethbridge, In progress.

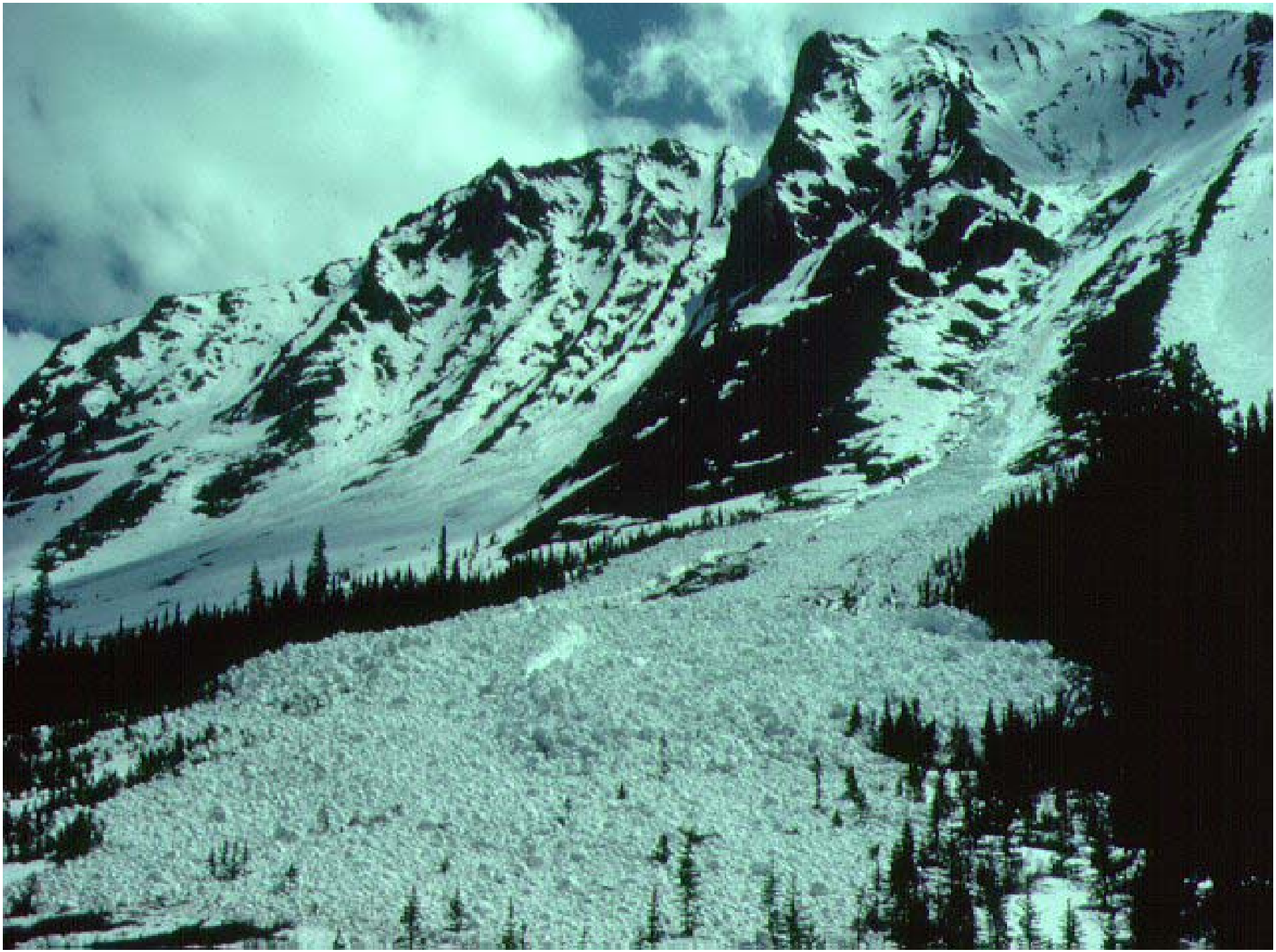
Lapp, S., J. Byrne, I. Townshend and S. Kienzle. Climate Warming Impacts on Snowpack Accumulation in an Alpine Watershed: A GIS Based Modeling Approach. Hydrological Processes, under review.

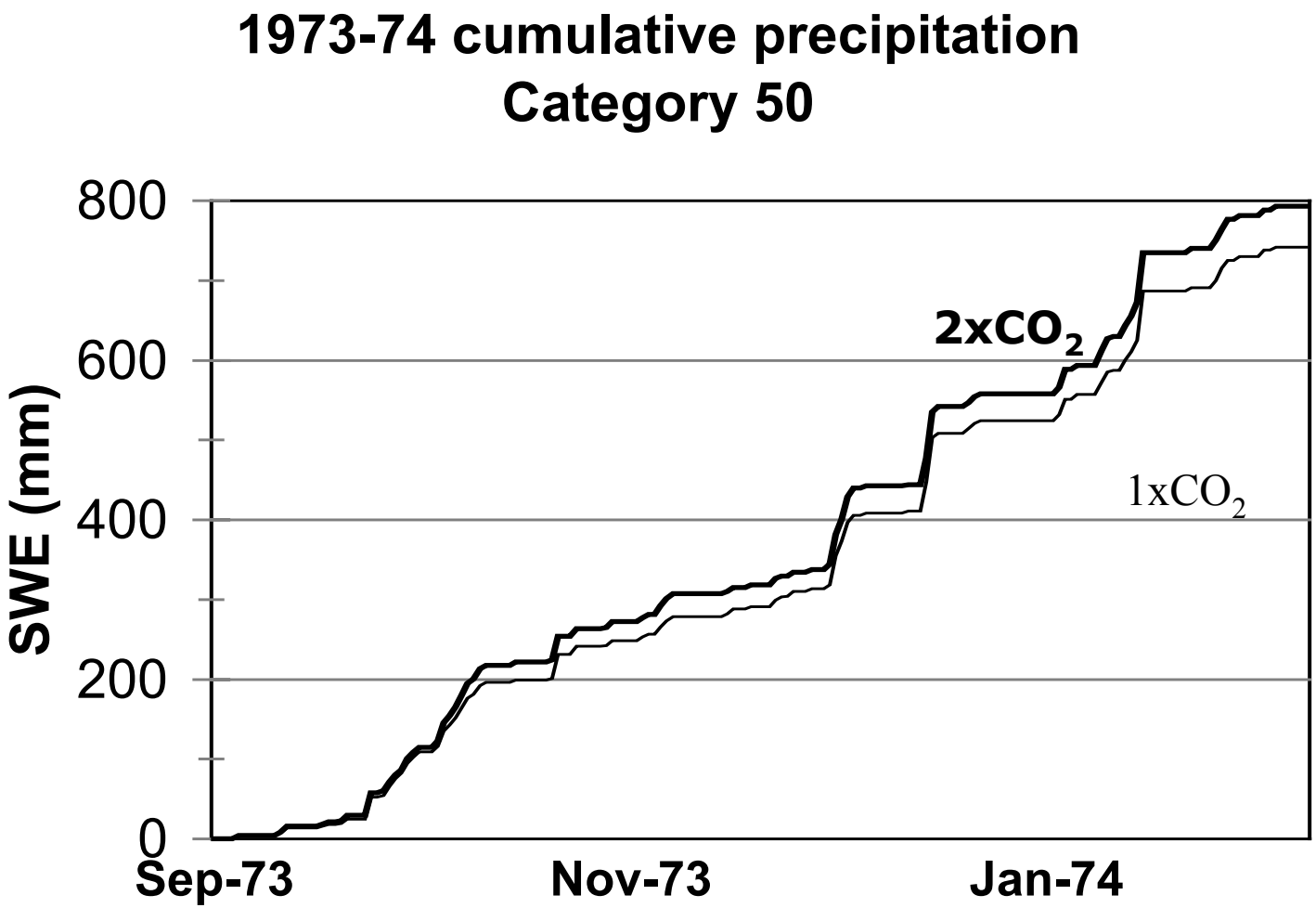


Cumulative precipitation for the winter period for category 14 (elevation 1401-1600m, slope 0-42%, aspect east) under 1xCO_2 and 2xCO_2 conditions.

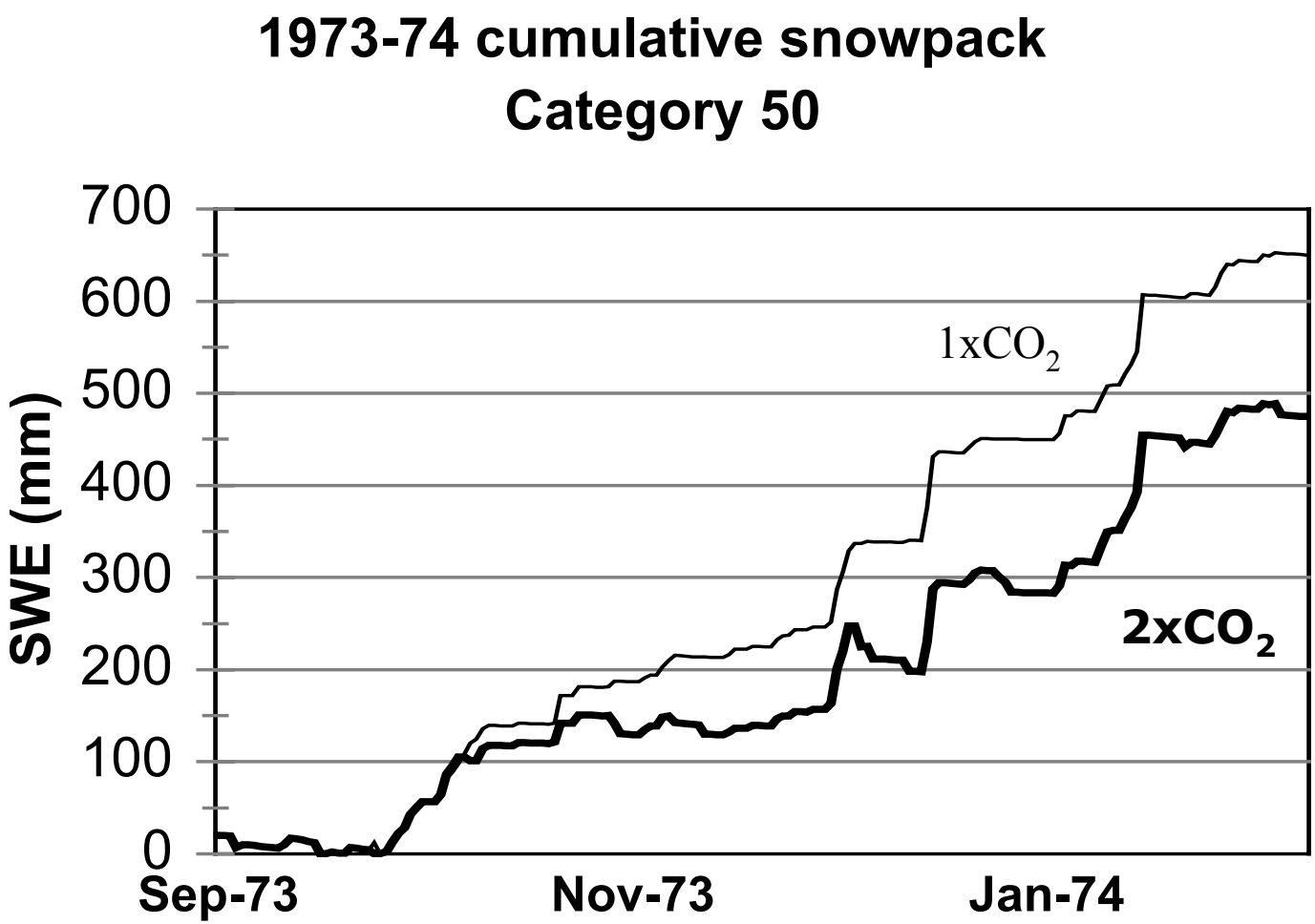


Cumulative snowpack for the winter period for category 14 (elevation 1401-1600m, slope 0-42%, aspect east) under $1xCO_2$ and $2xCO_2$ conditions.



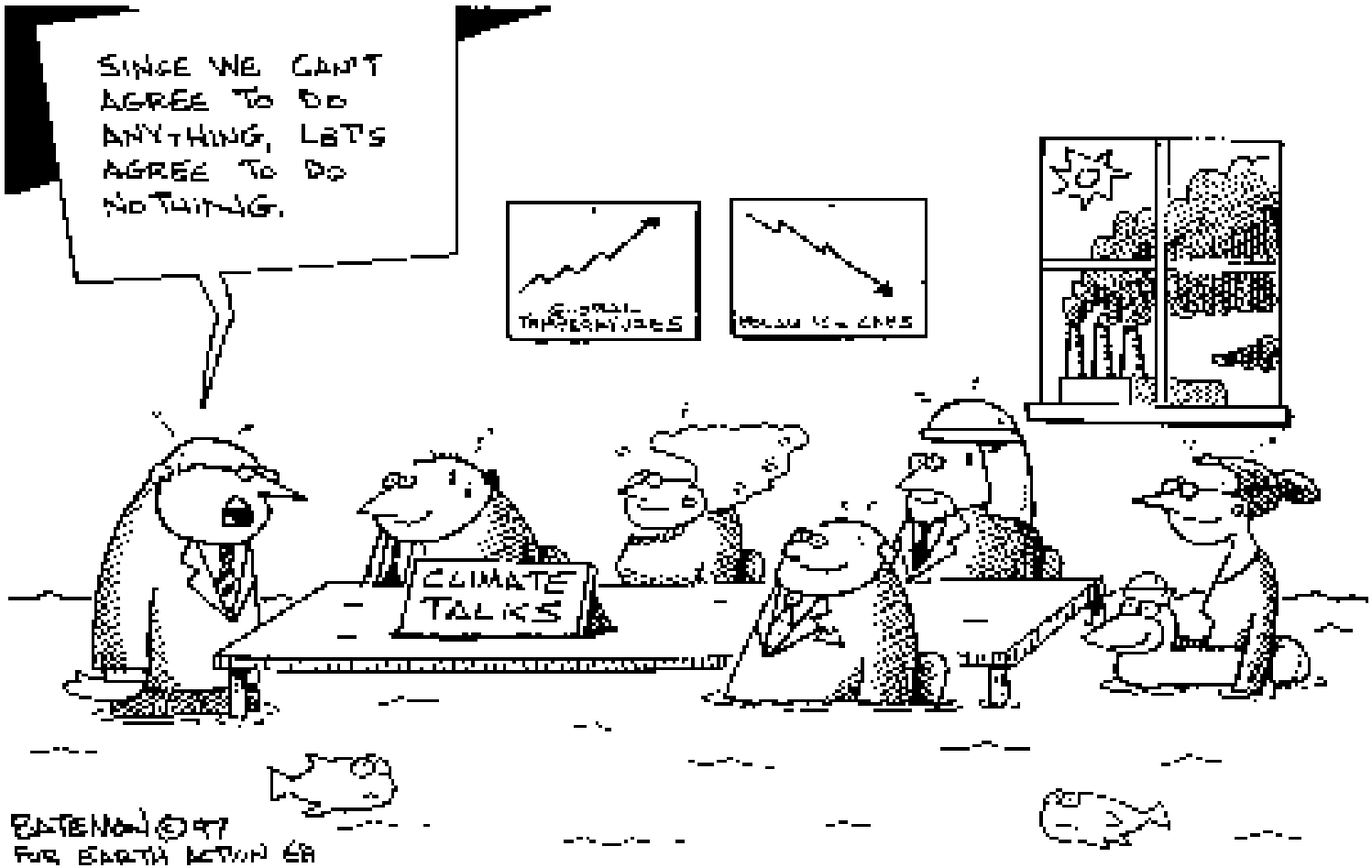


Cumulative precipitation for the winter period for category 50 (elevation 2001-2200m, slope 0-42%, aspect east) under 1xCO_2 and 2xCO_2 conditions.



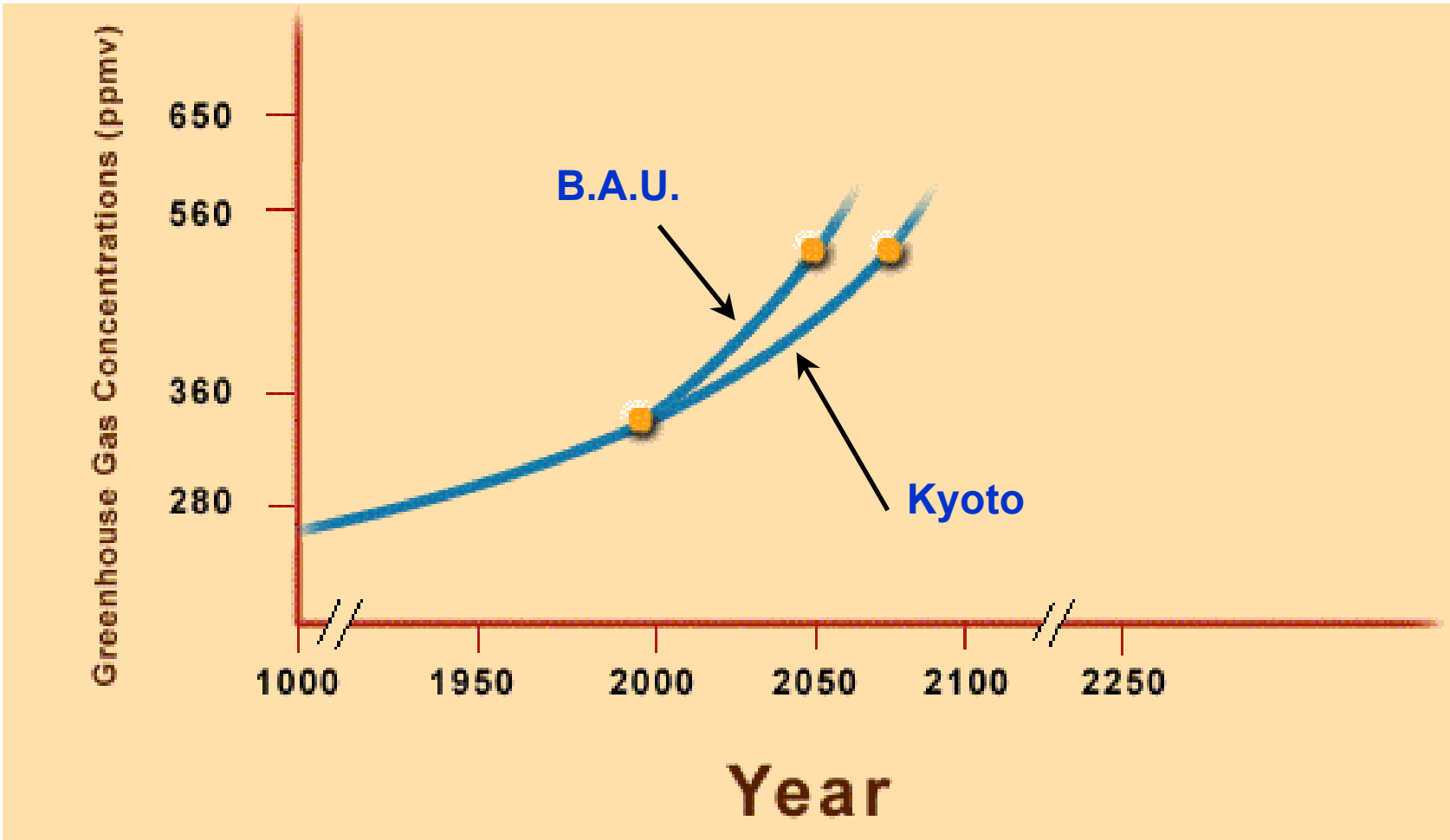
Cumulative snowpack for the winter period for category 50 (elevation 2001-2200m, slope 0-42%, aspect east) under 1xCO_2 and 2xCO_2 conditions.

What can we do?

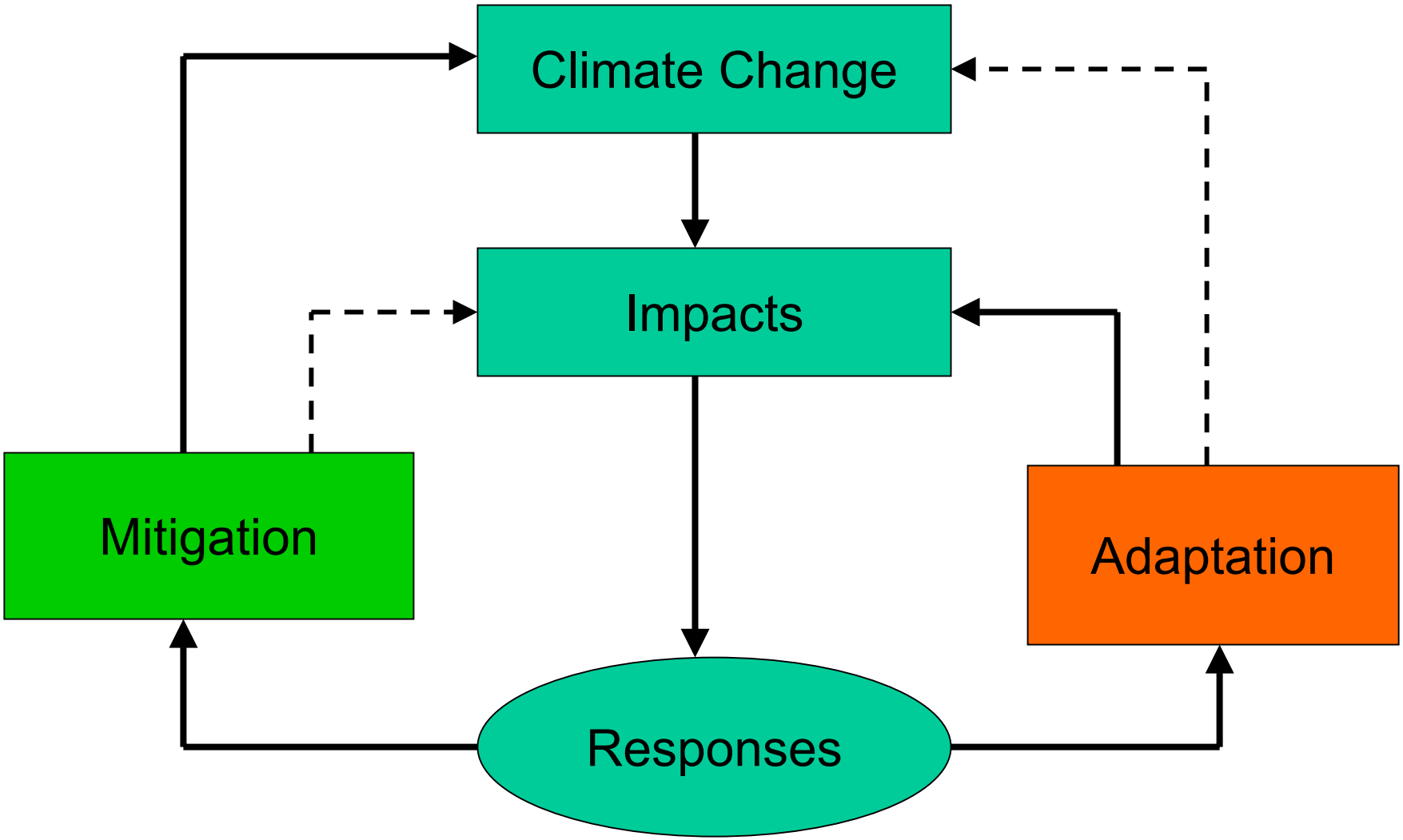


Kyoto Is An Important First Step

(delays doubling by about 20 years)



Addressing Climate Change:
Mitigation and Adaptation



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www.parc.ca

The Prairie Adaptation Research Collaborative is a facilitative, interdisciplinary research network established to understand the potential impacts of climate change on the Canadian Prairie Provinces and conduct research necessary to develop appropriate adaptation strategies.

PARC Project # 55

The impact of climate change on the glaciers of the Canadian Rocky Mountain eastern slopes and implications for water resource-related adaptation in the Canadian prairies

Mike Demuth, Geological Survey of Canada
Al Pietroniro, National Water Research Institute

Climate Change Impacts on Rocky Mountain glaciers

- 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

ADAPTATION:

- Degree to which adjustments are possible in practices, processes, or structures of systems to projected or actual changes of climate

- Adaptation can be spontaneous or planned and can be carried out in response to, or in anticipation of changes in conditions

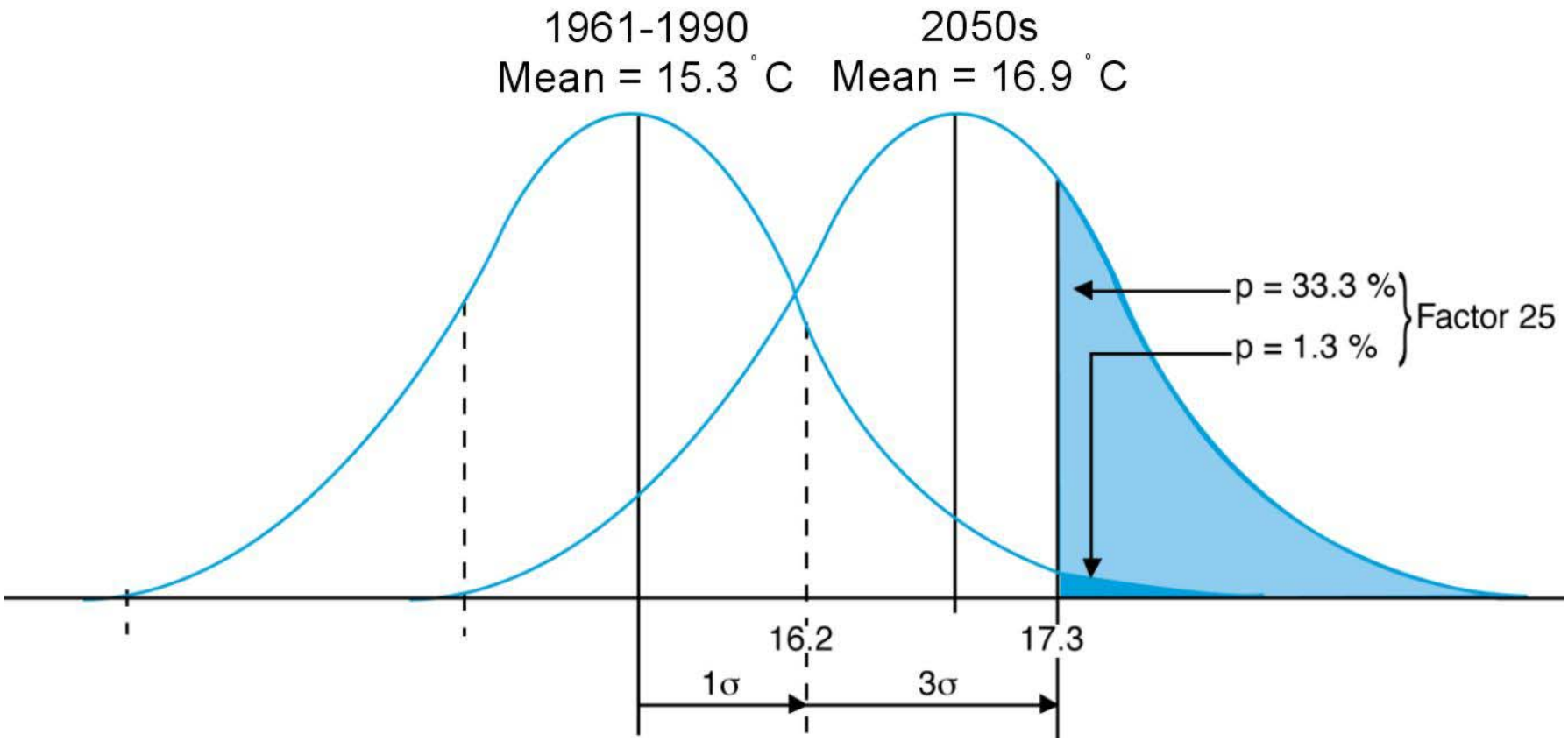
- Represents a practical means of accommodating current climatic variability and extreme events, as well as adjusting to longer term climatic change

- Estimated that Canada spends $11 billion responding to current climatic variability

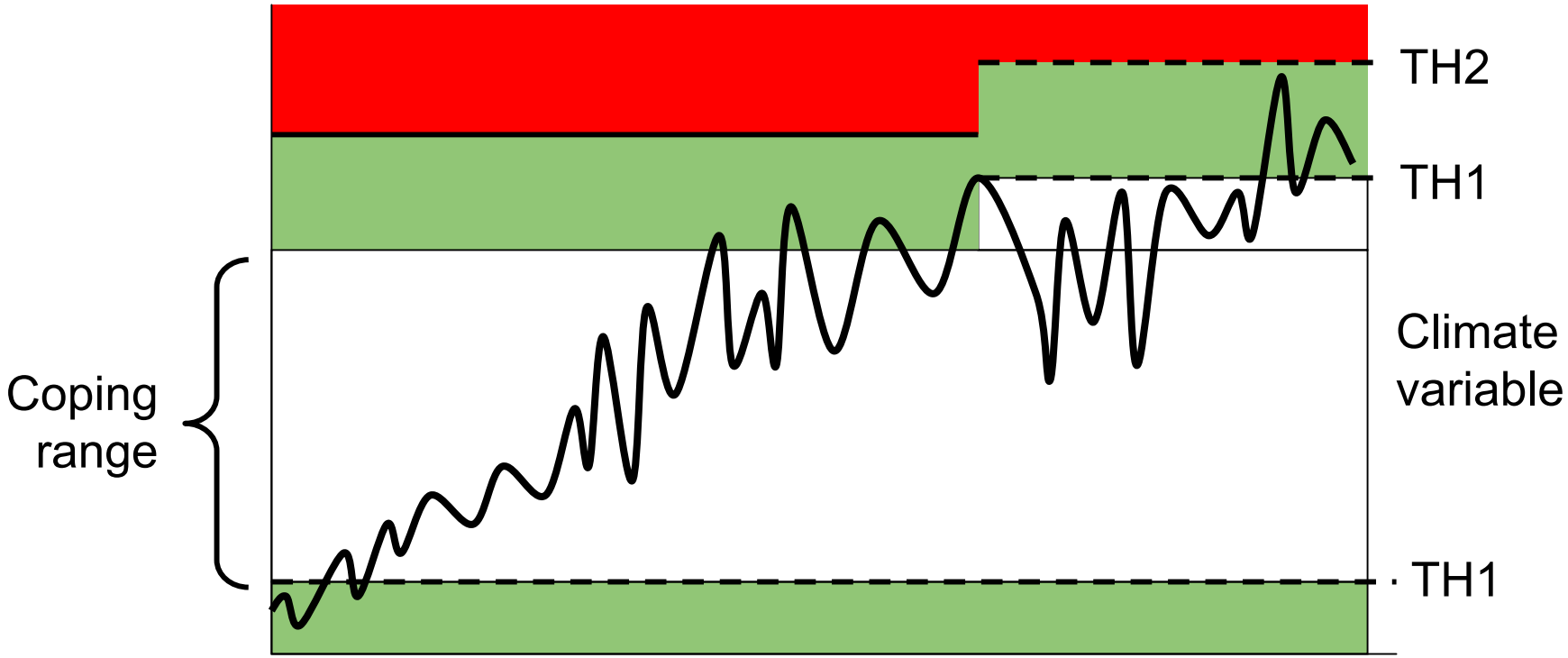
Adaptation to Climatic Variability

A projected increase in climate variability, including more frequent drought and major hydroclimatic events, is the most ominous climate change scenario. It is a more formidable and complex challenge than the adaptation of practices, processes and infrastructure to long-term climate trends. More extreme climate anomalies are more likely to exceed natural and engineering thresholds beyond which the impacts of climate are much more severe.

Climate change and extreme climatic events



Impact (Risk) Assessment & Adaptation



Realistic climate change impact assessments must take adaptation into account (Pittock and Jones, 2000)

Adaptation Options