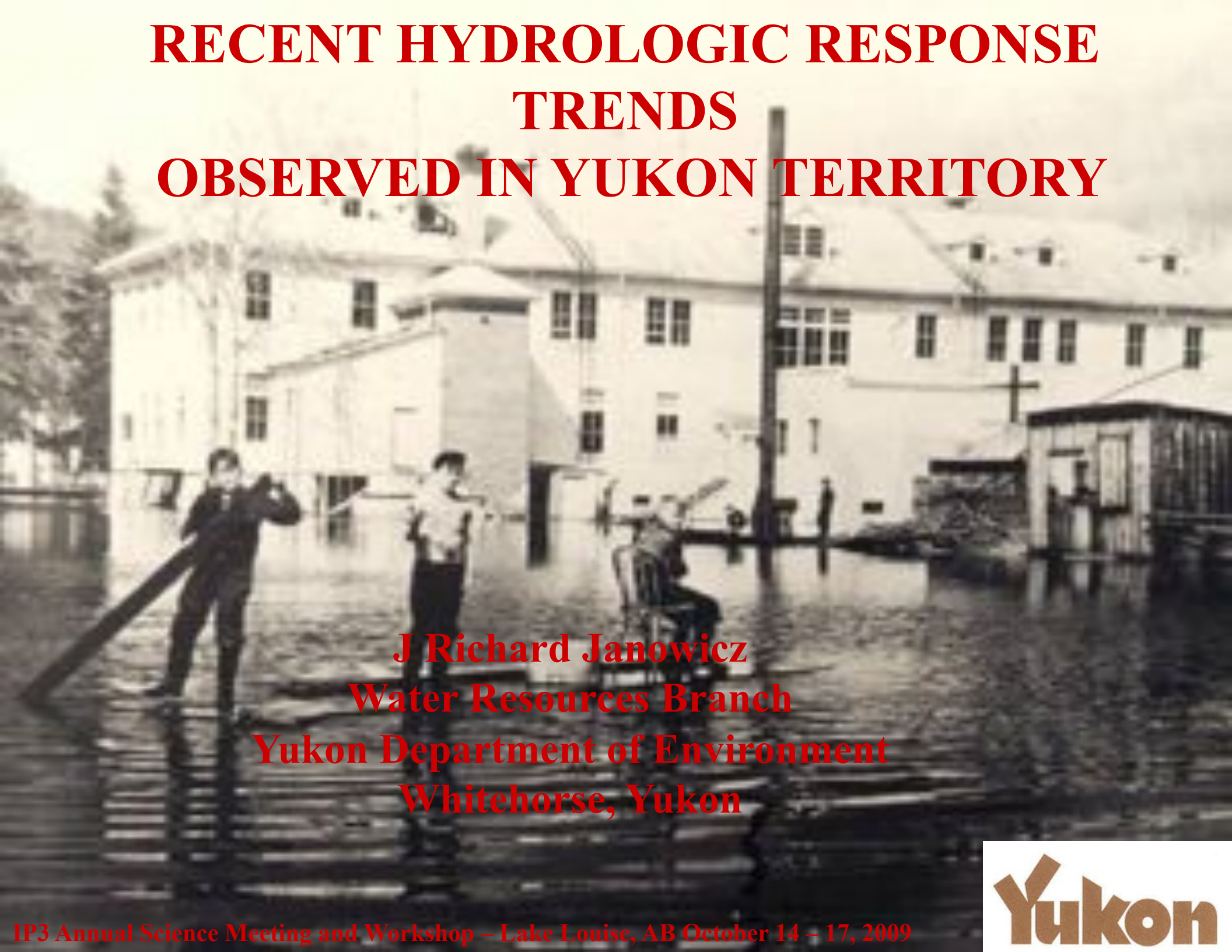


# **RECENT HYDROLOGIC RESPONSE TRENDS OBSERVED IN YUKON TERRITORY**



**J Richard Janowicz  
Water Resources Branch  
Yukon Department of Environment  
Whitehorse, Yukon**

**Yukon**

# CLIMATE CHANGE /WARMING

- Climate Warming Yukon Reality
- Yukon Government Implemented Climate Change Action Plan
  - Impact
  - Adaptation
  - Mitigation

# OBJECTIVES

- Summarize Recent Changes In Climate
- Document Changes in Yukon Hydrologic Response to Warming Over The Last 3 Decades
  - Permafrost
  - River Ice
  - Glaciers

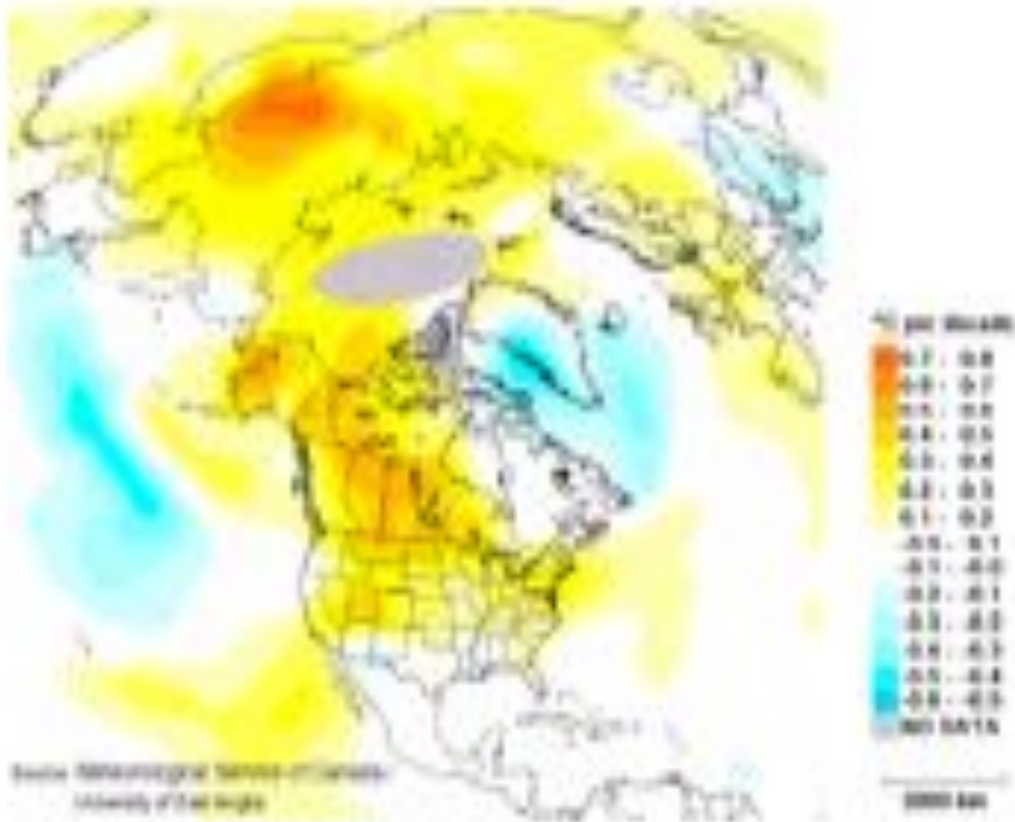


● Old Crow

● Dawson City

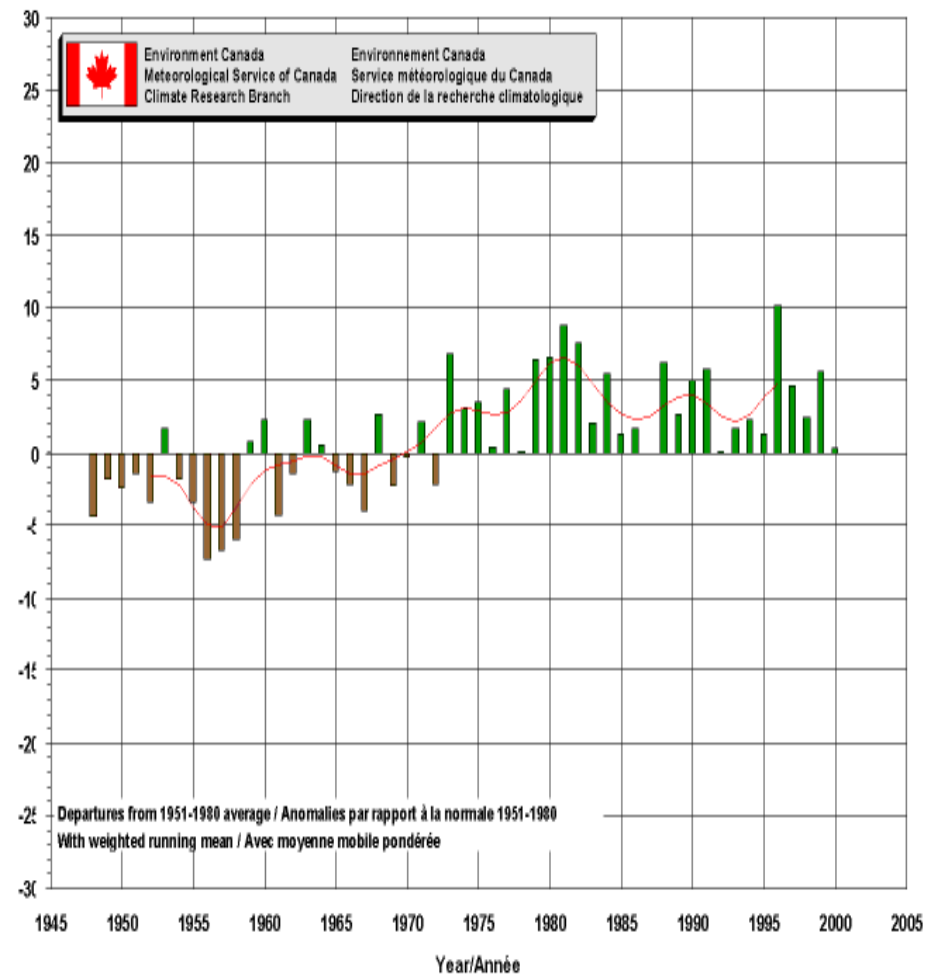
● Whitehorse

## Annual Surface Air Temperature Trends 1961-1990



# HISTORICAL TEMPERATURE AND PRECIPITATION

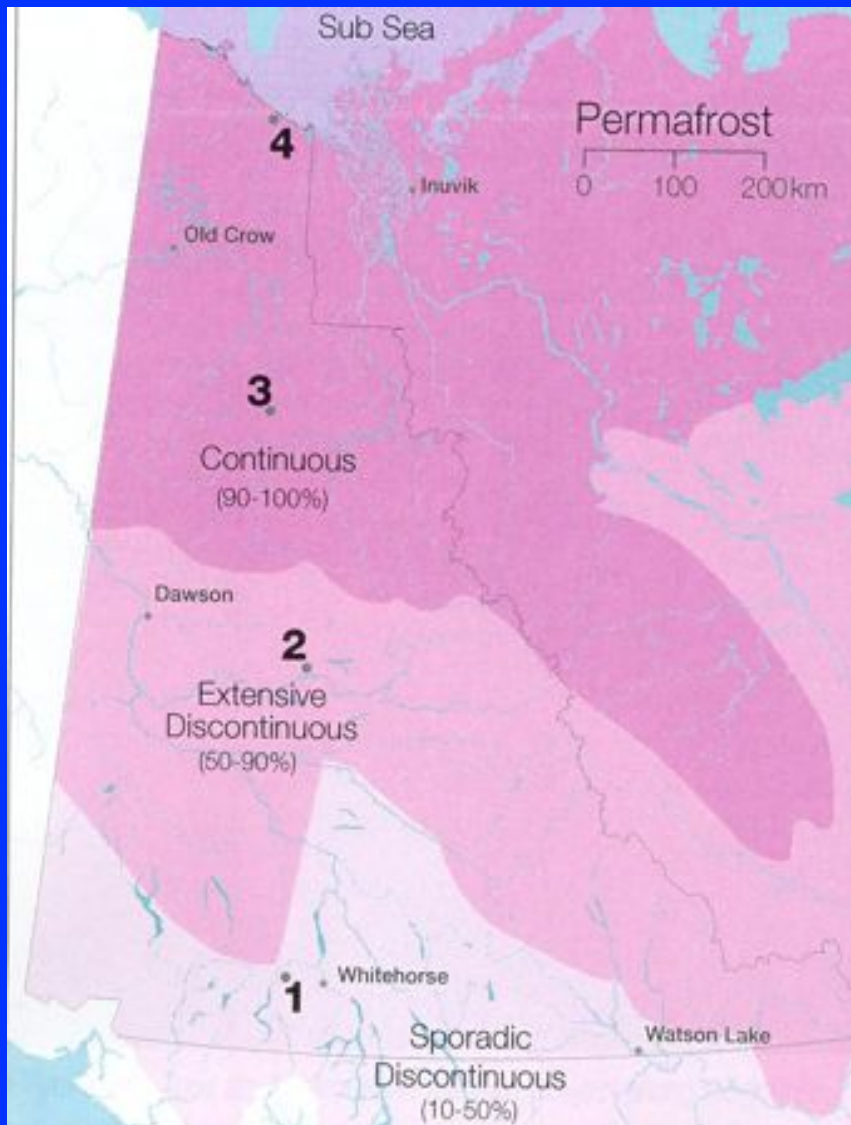
Annual national precipitation departures with weighted running mean, 1948-2000  
Anomalies des précipitations annuelles nationales et moyenne mobile pondérée, 1948-2000



- Summer Temp + 2 - 6 ° C
- Winter Temp + 4 - 6 ° C
- Summer Precip + 5 - 10 %
- Winter Precip -10 - + 20 %

# CLIMATE WARMING IMPACTS ON HYDROLOGIC RESPONSE

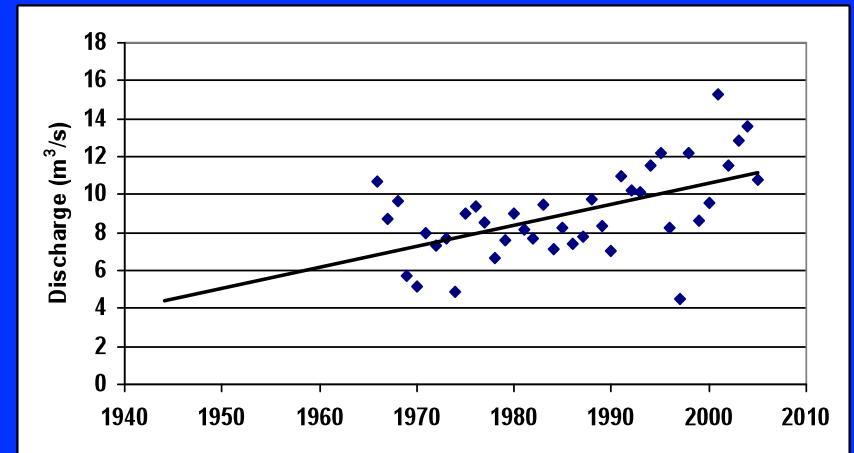
## PERMAFROST DISTRIBUTION



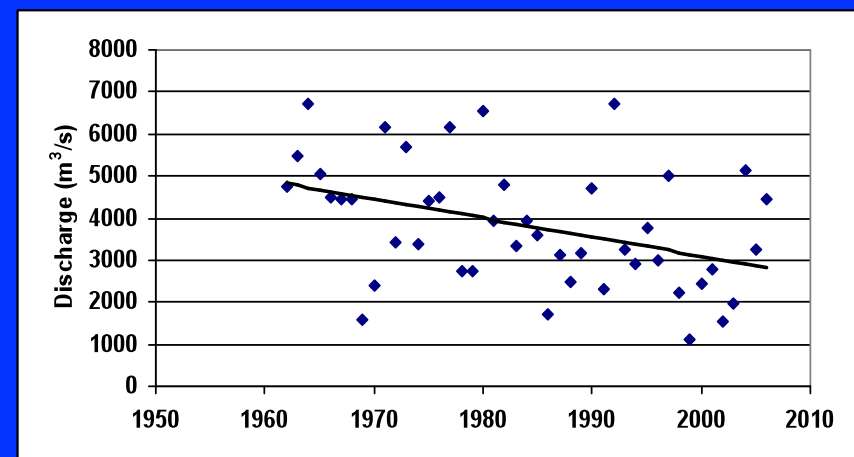
- Winter Low Flows Increasing Due to Greater Groundwater Contributions to Winter Streamflow
- Peak Flows Decreasing Due to Longer Pathways to Stream Channel

# CLIMATE WARMING IMPACTS ON HYDROLOGIC RESPONSE

Winter Low  
Flows



Klondike R ab Bonanza Cr



Peel R bl Canyon Cr

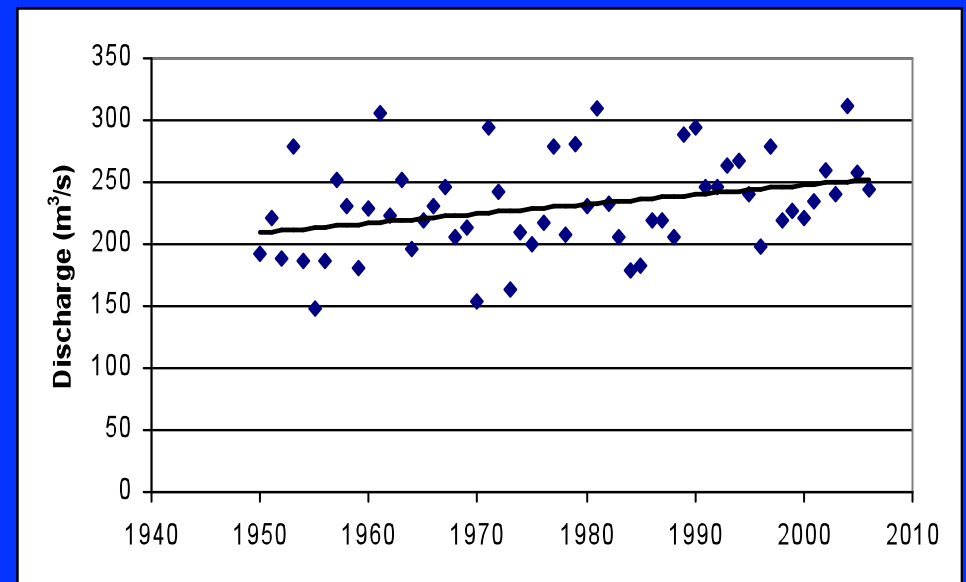
Spring /Summer Peak Flows

# CLIMATE WARMING IMPACTS ON HYDROLOGIC RESPONSE

## Increasing Peak Flows Due to Melting Glaciers



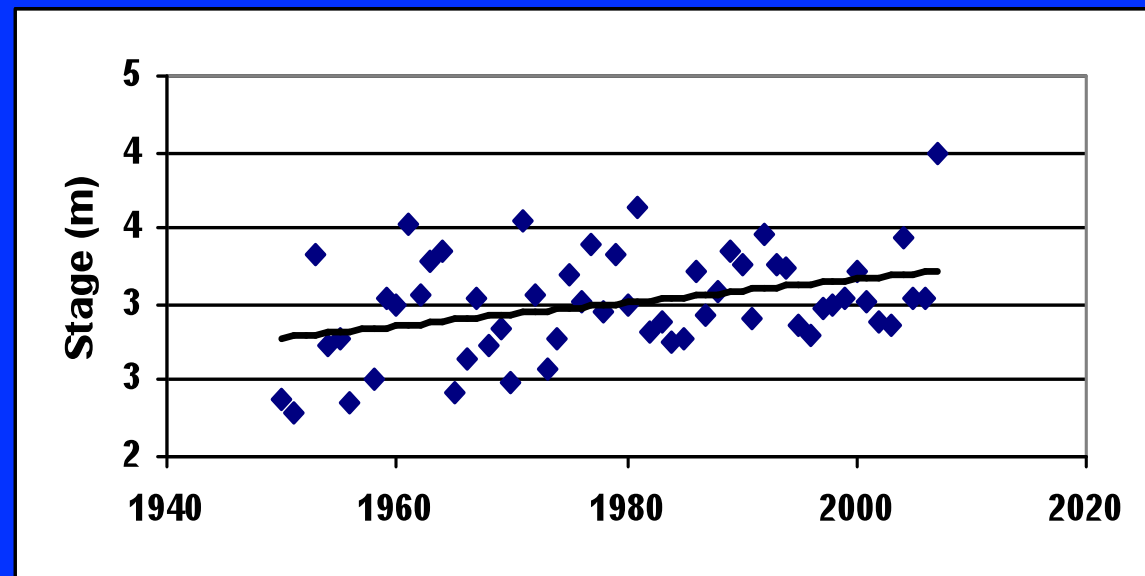
Atlin River nr Atlin





# CLIMATE WARMING IMPACTS ON HYDROLOGIC RESPONSE

## MARSH LAKE MAXIMUM STAGE 1950 – 2007



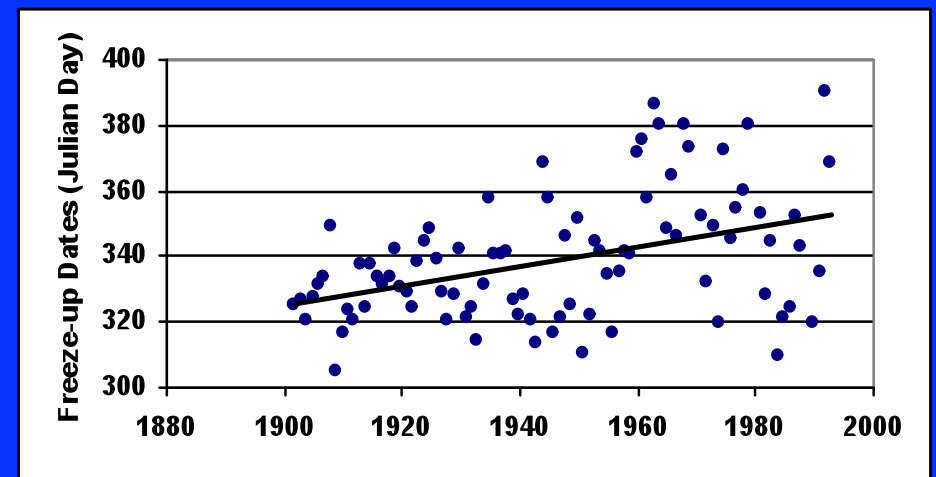
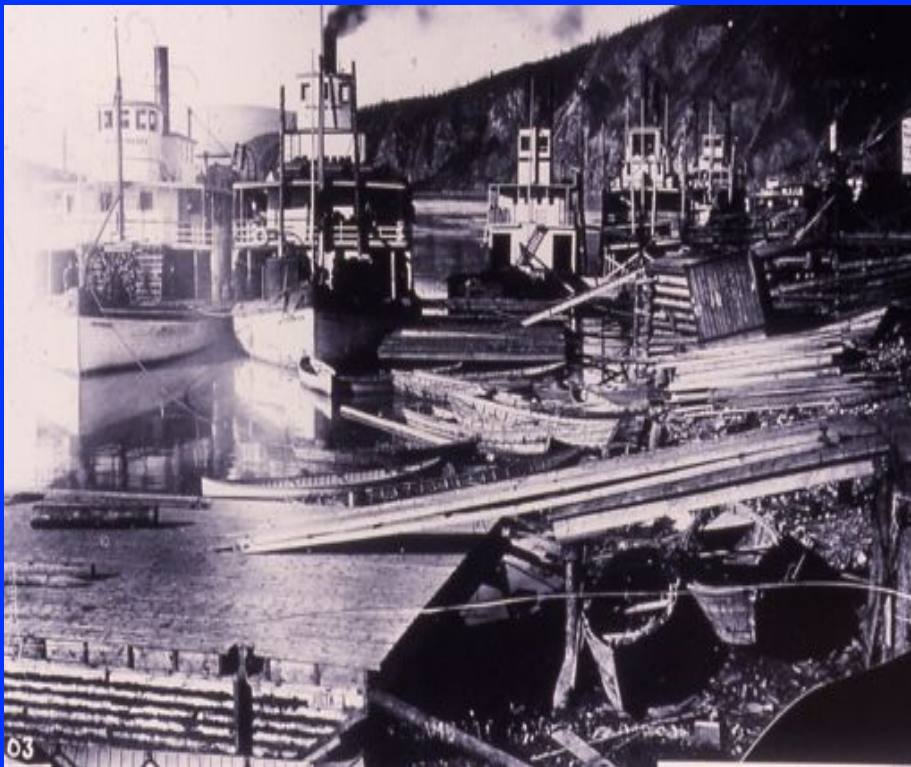
# CLIMATE WARMING IMPACTS ON HYDROLOGIC RESPONSE

## RIVER ICE REGIMES



# RIVER ICE REGIME TRENDS

## Freeze-up Timing

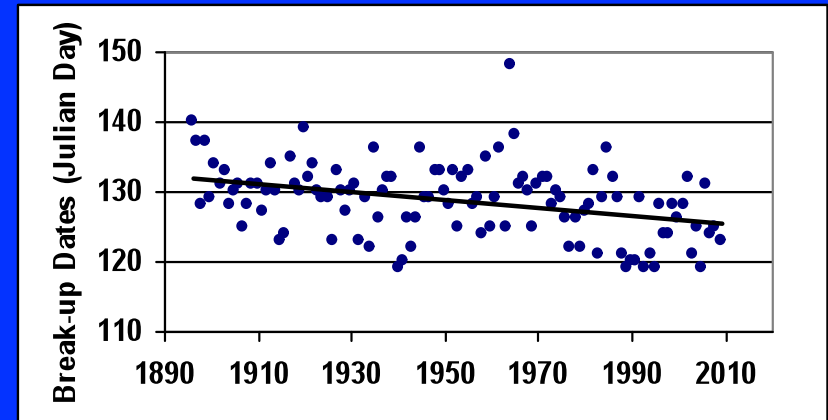


Yukon River at Whitehorse (1902-1993)

- Freeze-up timing delayed approximately 30 days since 1902

# RIVER ICE REGIME TRENDS

## Break-up Timing



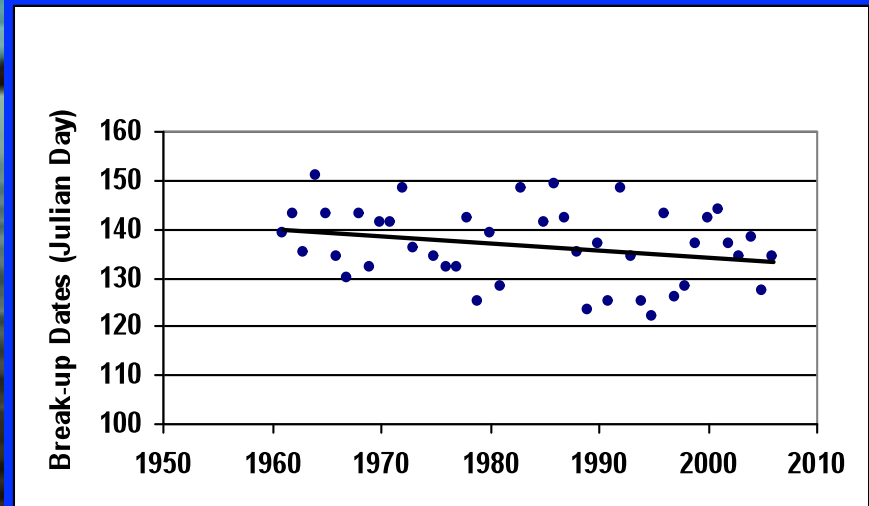
Yukon River at Dawson (1896-2009)

- Break-up Timing Advanced 6 days per century

# RIVER ICE REGIME TRENDS



## Break-up Timing

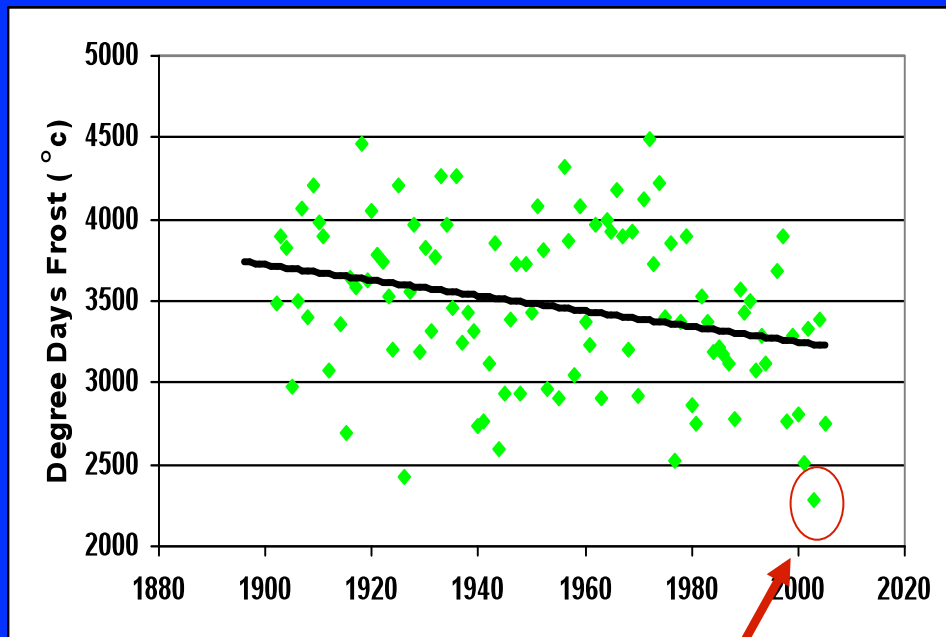


Porcupine River at Old Crow (1961  
- 2009)

# RIVER ICE REGIME TRENDS

## 2002/03 Mid-Winter Klondike River Ice Jam and Flooding

Dawson City Winter Temperatures 1902 - 2005



Klondike River Ice Jam - 2003



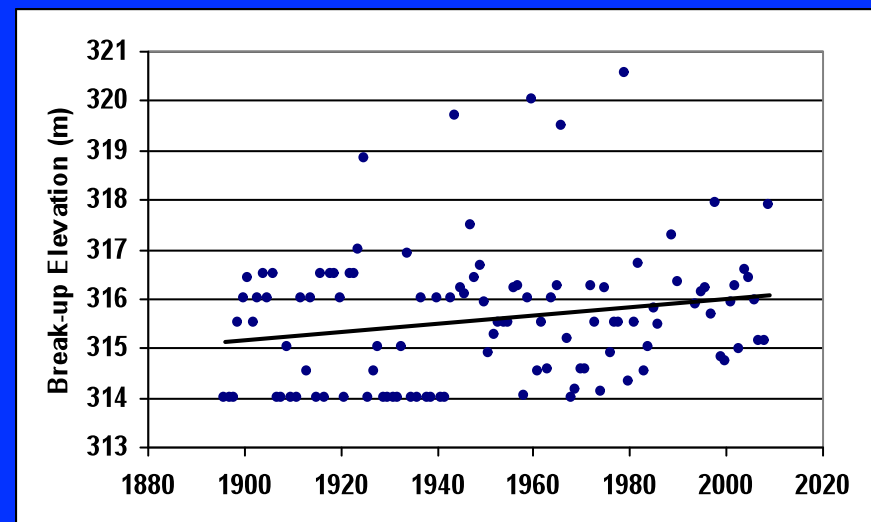
2002/03 warmest winter

# RIVER ICE REGIME TRENDS



Dawson - 1979

## Break-up Severity



Yukon River at Dawson Annual  
Maximum Break-up Elevation  
(1896 - 2009)

# CLIMATE CHANGE TRENDS

## Teleconnection Influence



- El Nino
- La Nina
- ENSO
- PDO
- PNA



# RIVER ICE REGIME TRENDS

## 2009 Break-up

- Winter Colder than Normal (thick ice)
- Snowpack 150 – 175 % Normal
- Early Spring (1<sup>st</sup> 3 weeks April) Colder than Normal
- Rapid Warming to Record High Temperatures

# RIVER ICE REGIME TRENDS

## 2009 Break-up

- Yukon Break-up Normally Spans 30 Days
- Yukon Wide Dynamic Break-up Events Occurred Within 7 days
- Ice Jams and Flooding Occurred in Numerous Locations (also locations not prone to ice jams)
- Minor Flooding Occurred at Dawson City & Old Crow
  - 150 km downstream Eagle, Alaska experienced flood of record

# Eagle, Alaska – May 4, 2009



# RIVER ICE REGIME TRENDS



# SUMMARY



- Climate Change Reality in Yukon
  - Teleconnections?
- Freeze-up Timing Delayed 30 Days
- Break-up Timing Advanced 6-day/century

- More Frequent Occurrence Mid-winter Break-up
  - Greater Frequency Ice Jam Flooding
- Greater Severity Ice Jam Flooding

# ACKNOWLEDGEMENTS

- Jessica Boucher Carried out Climate Data Analyses
- Holly Goulding - Teleconnections
- Robert Stillwell Compiled Ice Observation Data
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THANK YOU

