Climate Change and Vancouver Island

VANCOUVER ISLAND UNIVERSITY

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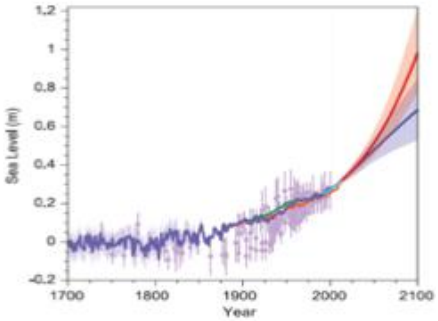
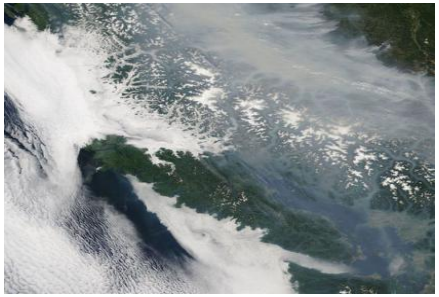
ACER

Outline

- Overwhelming burden of evidence
- Main causes of climate change
- Climate change and Vancouver Island
  - Increase in extreme weather events
  - Increase in flooding and landslides
  - Sea level rise
  - Increase in smoke from wildfires
  - Other health stresses
- Summary

The South Coast and Fraser Valley joined Vancouver Island at Level 4 drought conditions on Wednesday, July 15th. Click for full image. (B.C. Government)



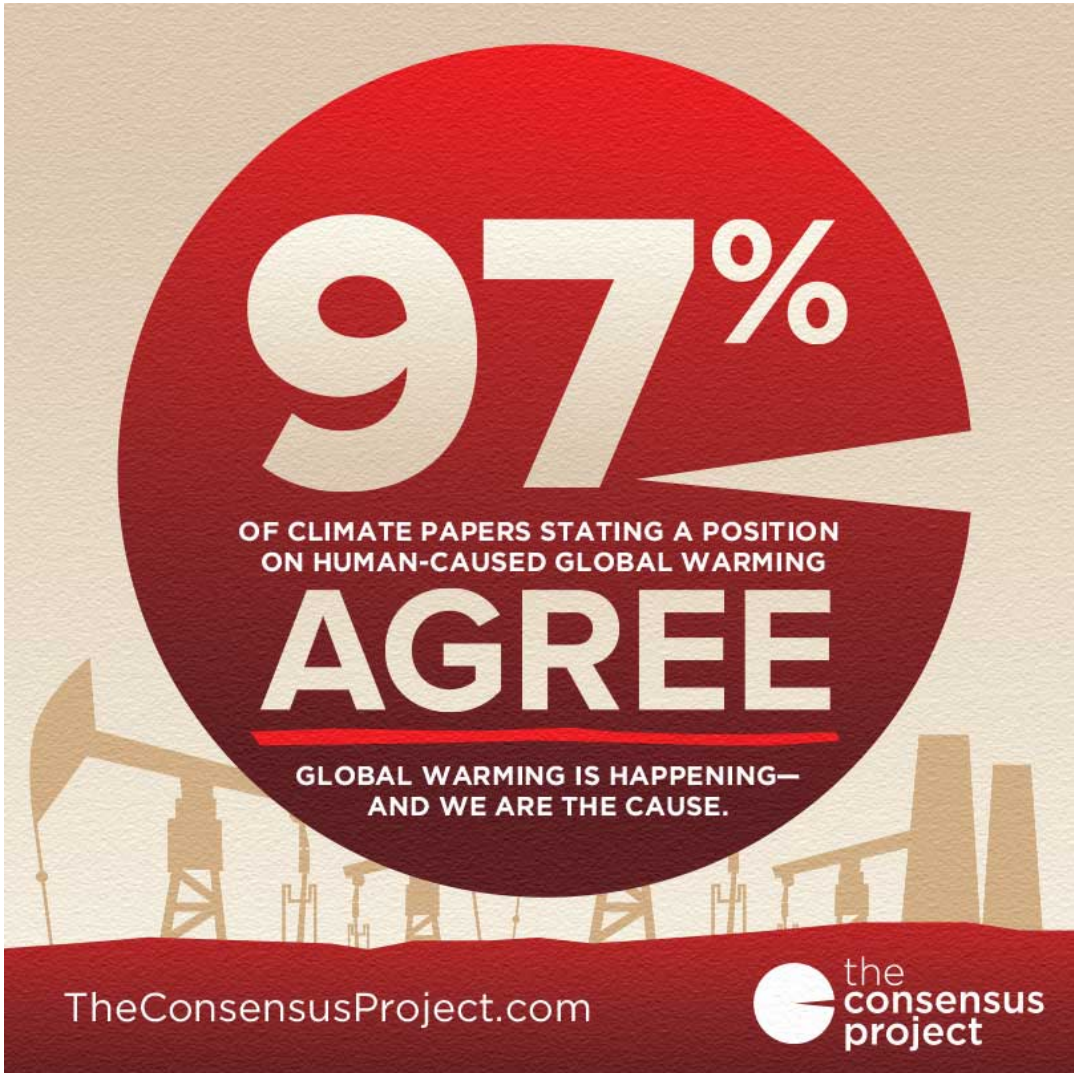


Overwhelming burden of evidence

Intergovernmental Panel on Climate Change (IPCC)

www.ipcc.ch

2014: “It is extremely likely **[>95%]** that human influence has been the dominant cause of observed warming since the mid-20th century”



DEPARTMENT OF DEFENSE

2014 CLIMATE CHANGE ADAPTATION ROADMAP

- The U.S. military refers to climate change as a **“threat multiplier”**
- “The impacts of climate change will intensify the challenges of global instability, hunger, poverty, and conflict”
- “The Department of Defense sees climate change as a present security threat, not strictly a long-term risk”
- “Climate change threatens half of US bases worldwide”




Overwhelming burden of evidence

Intergovernmental Panel on Climate Change (IPCC) www.ipcc.ch

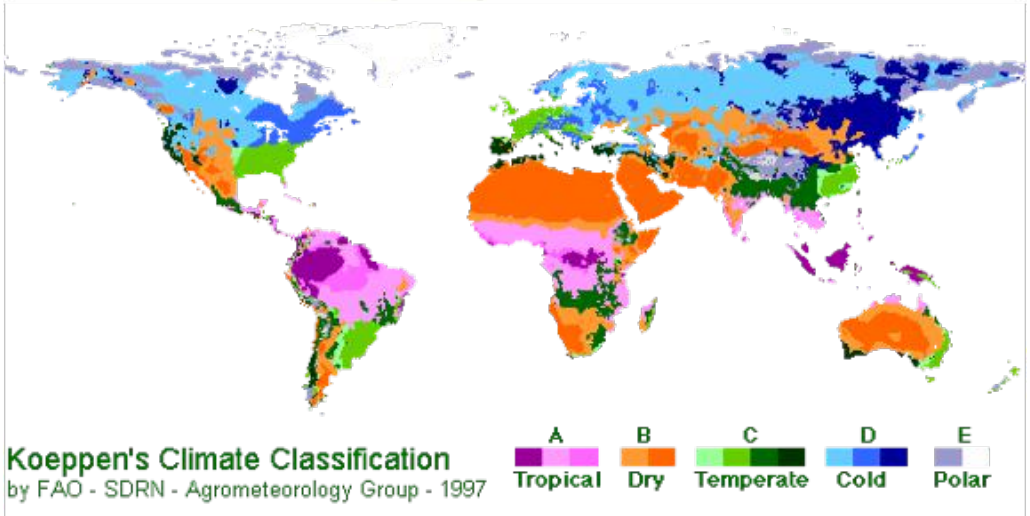
2014: 5th Assessment Report (AR5) Summary

- Humans have caused the majority of present day climate change
- The warming is largely irreversible
- Most of the heat is going into the oceans
- Current rates of ocean acidification are unprecedented
- To stay below 2 ^{o}C of warming, most fossil fuels must stay buried in the ground

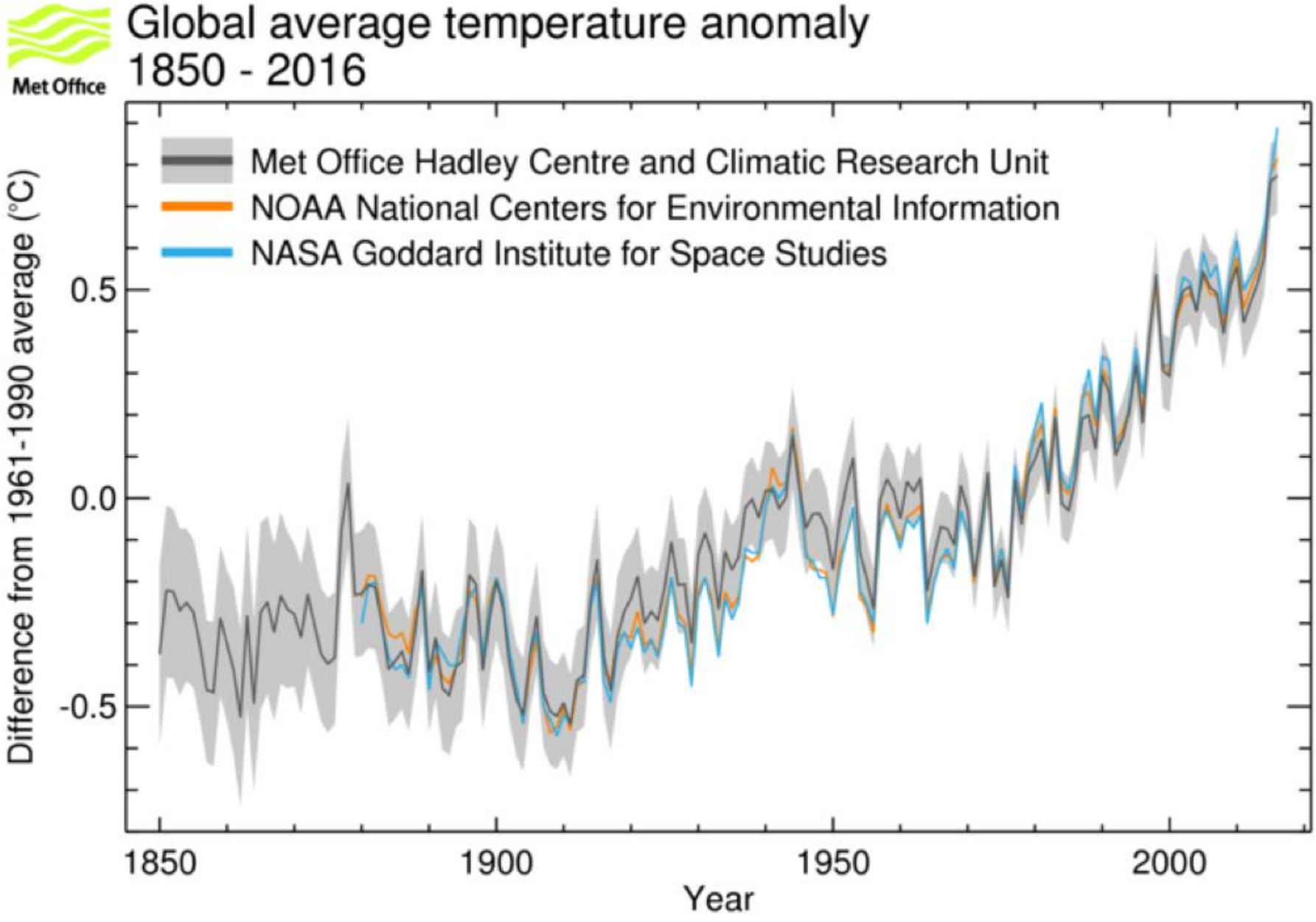
Main causes of climate change

Weather is the state of the atmosphere at a specific place and time.

Climate is the average weather over a long period of time. The standard averaging period is 30 years.

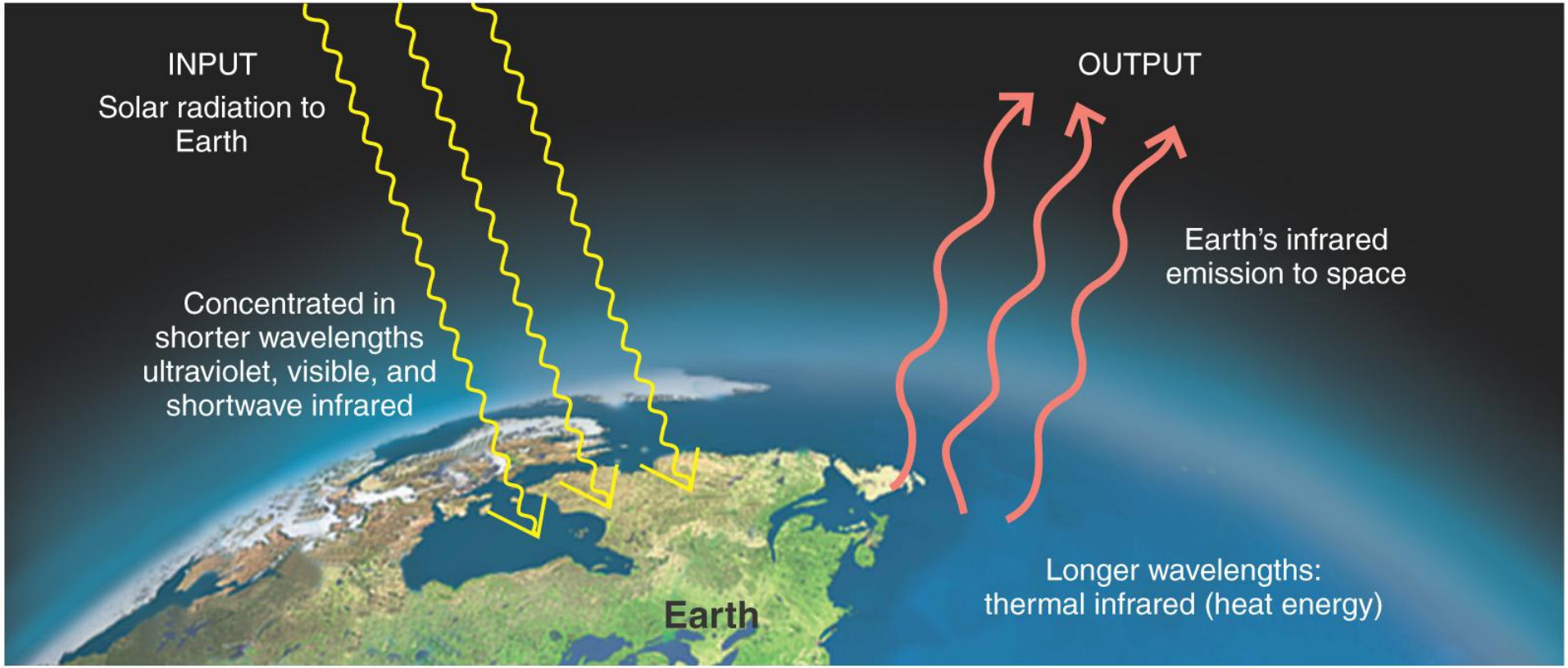


Main causes of climate change



Main causes of climate change

When the net outgoing thermal energy is equal to the net incoming solar radiation the Earth is in radiative equilibrium



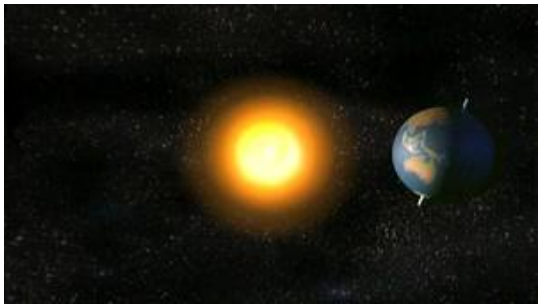
Main causes of climate change

When the net outgoing thermal energy is equal to the net incoming solar radiation the Earth is in radiative equilibrium

Deviations from equilibrium imply a radiative forcing

Forcings may be external:

1. Changes in solar output
2. Changes in Earth's orbit

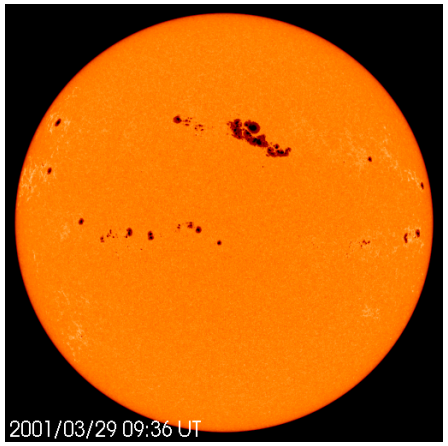


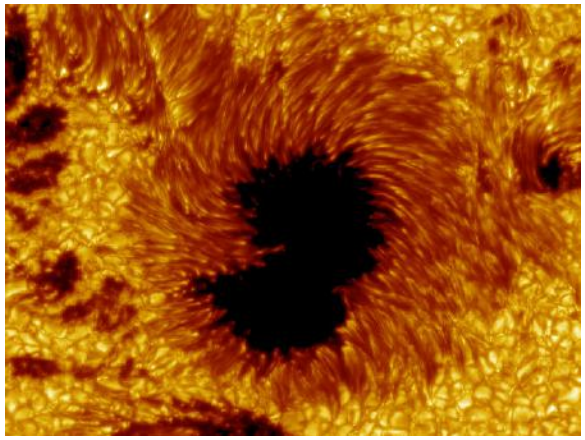
or internal:

3. Changes in surface energy balance
4. Changes in circulation
5. Changes in atmospheric composition

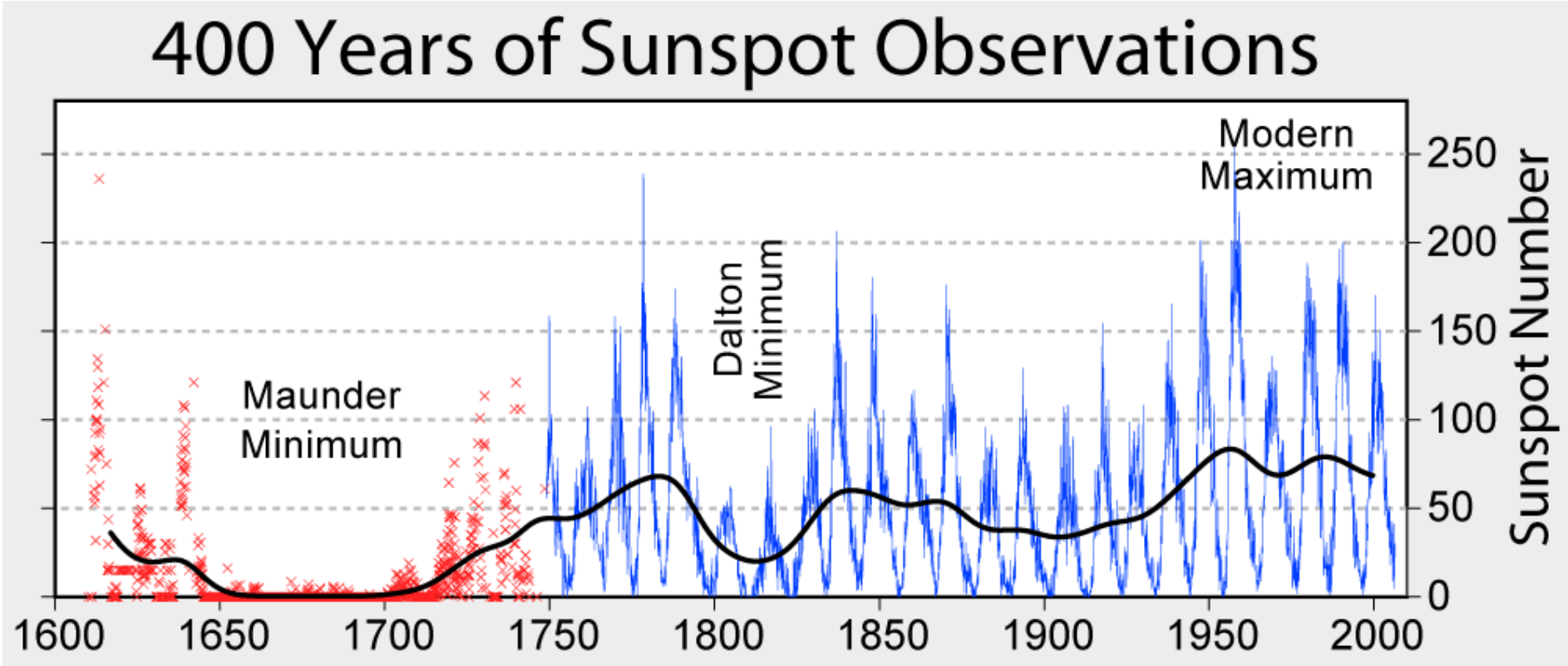
All act all the time but at varying strengths and time scales

1. Changes in Solar Output

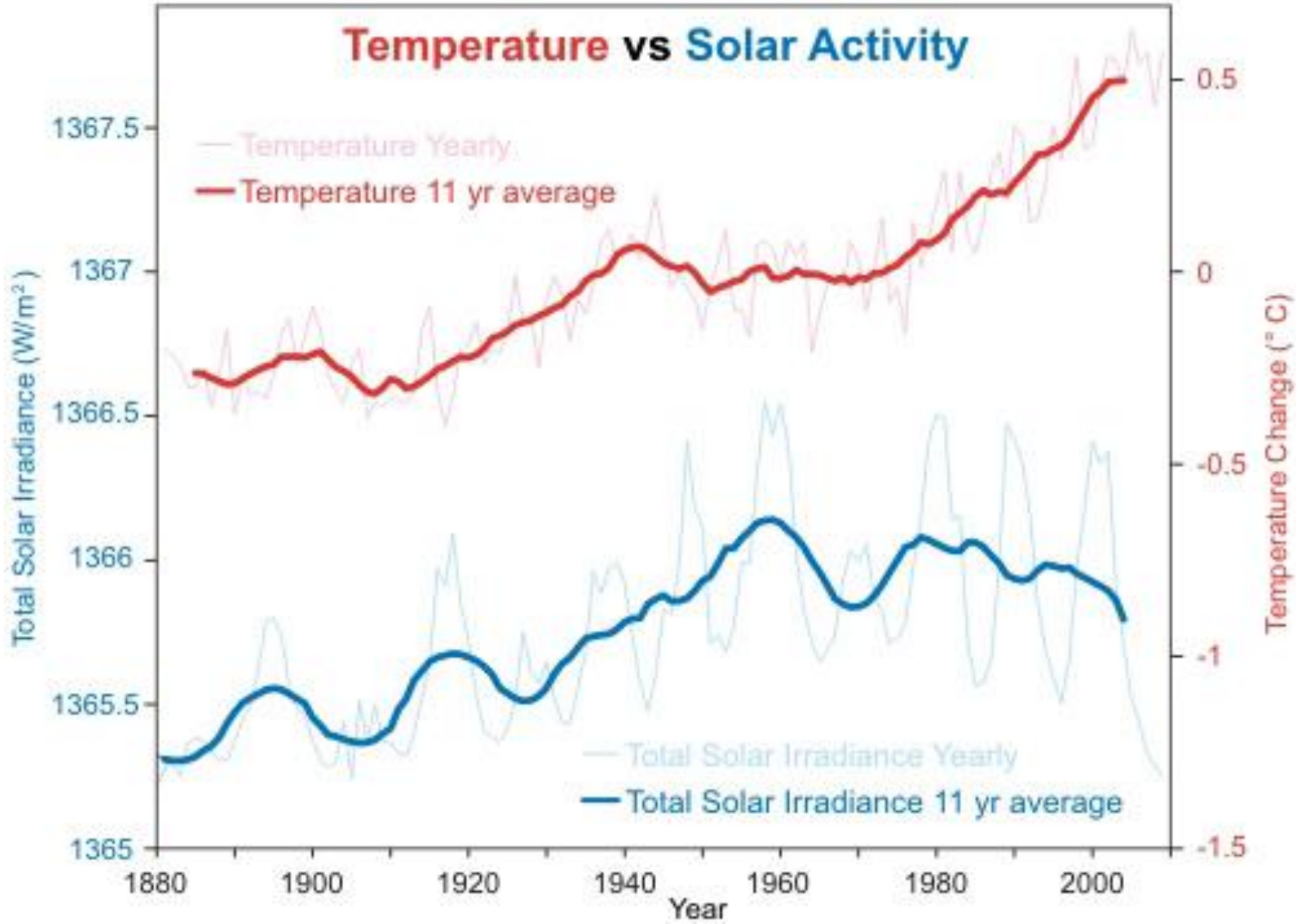




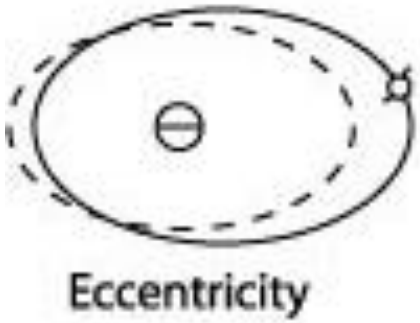
Sunspots have a strong 11-year cycle



1. Changes in Solar Output



2. Changes in Earth's Orbit

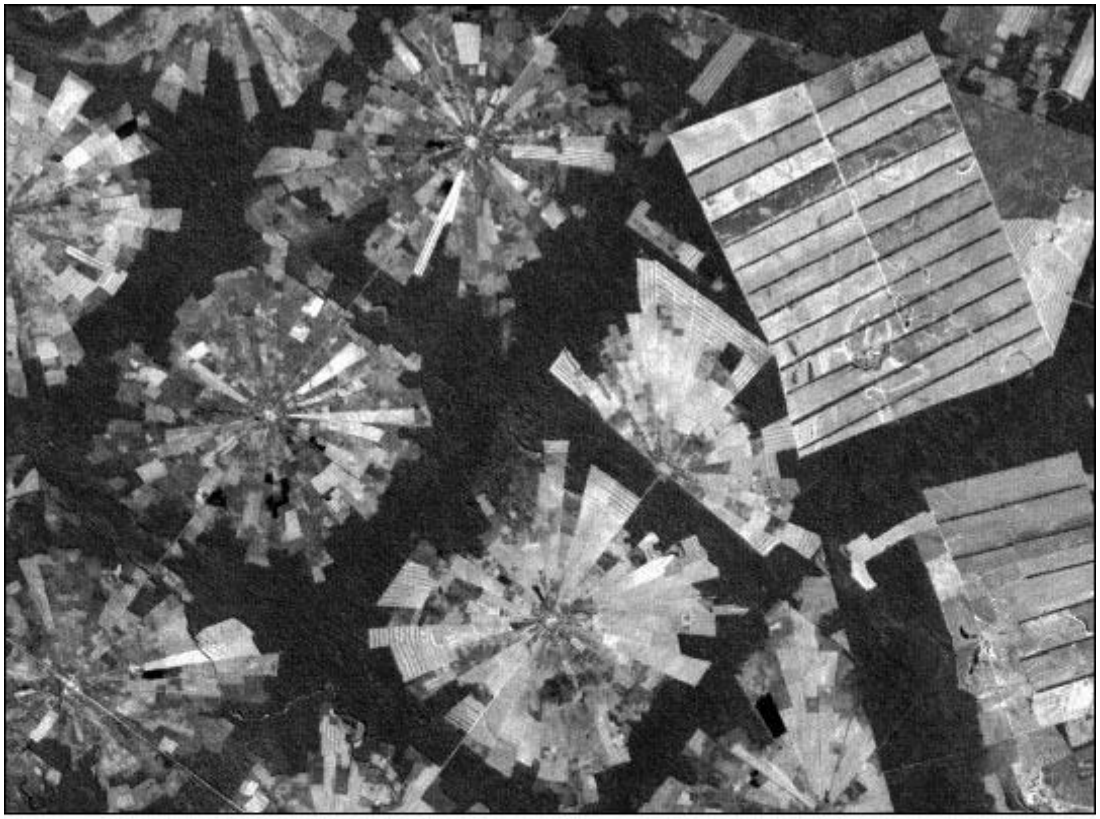


100 thousand year cycle

41 thousand year cycle

19 thousand year cycle

3. Changes in Surface Energy Balance



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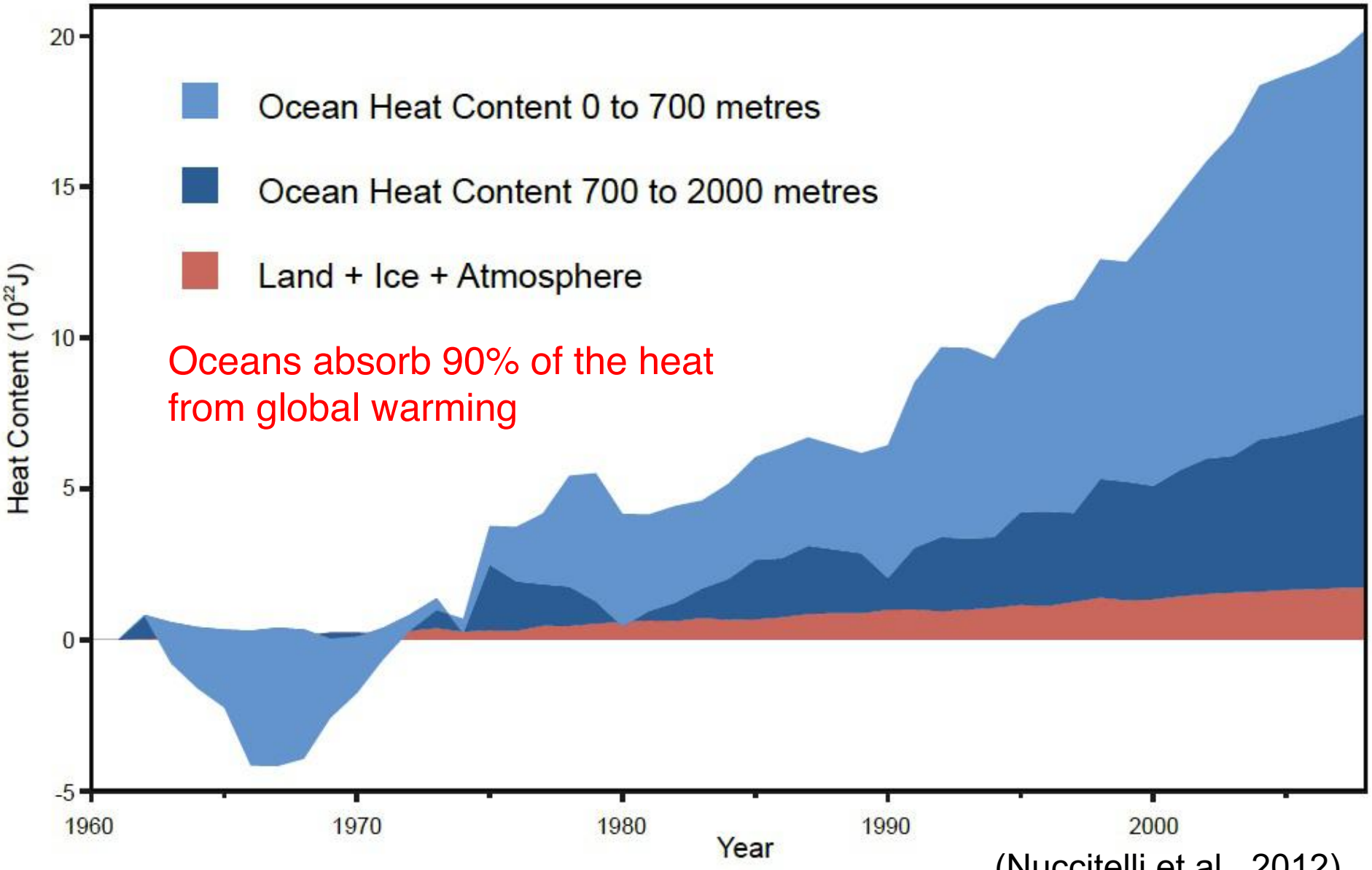
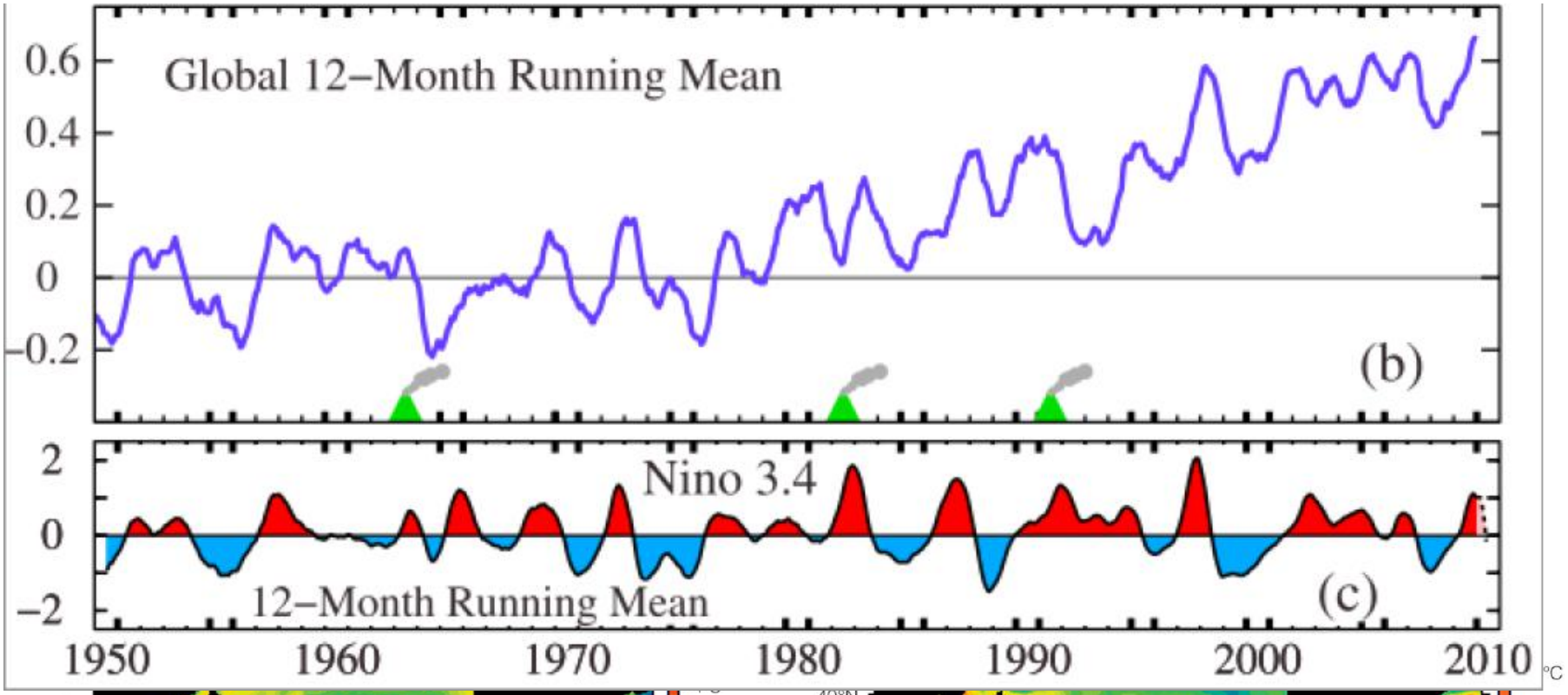
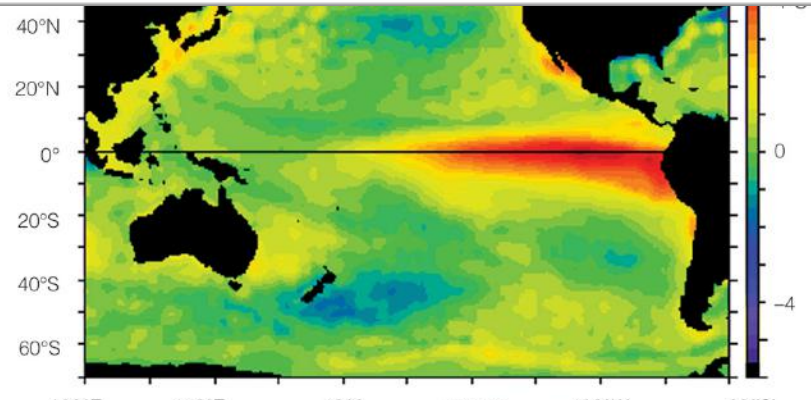


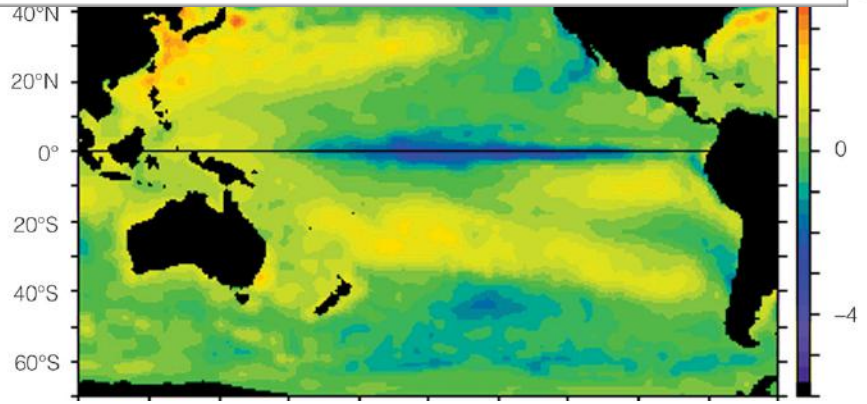
(Nuccitelli et al., 2012)

4. Changes in Circulation



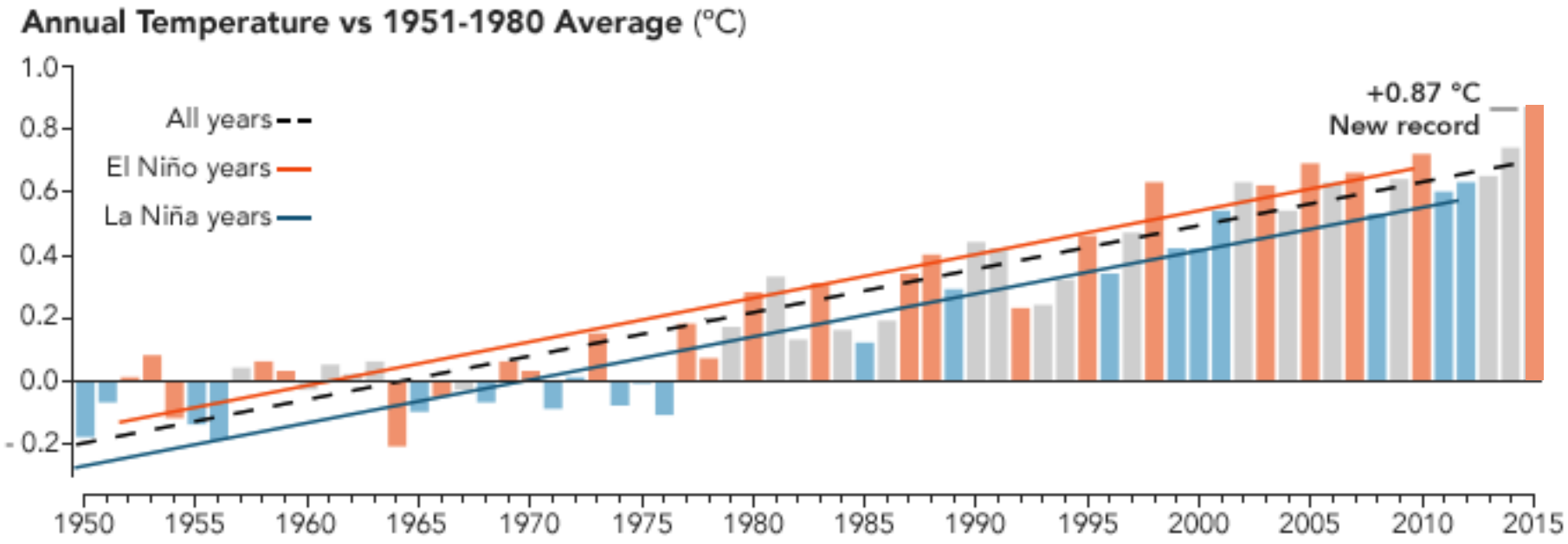


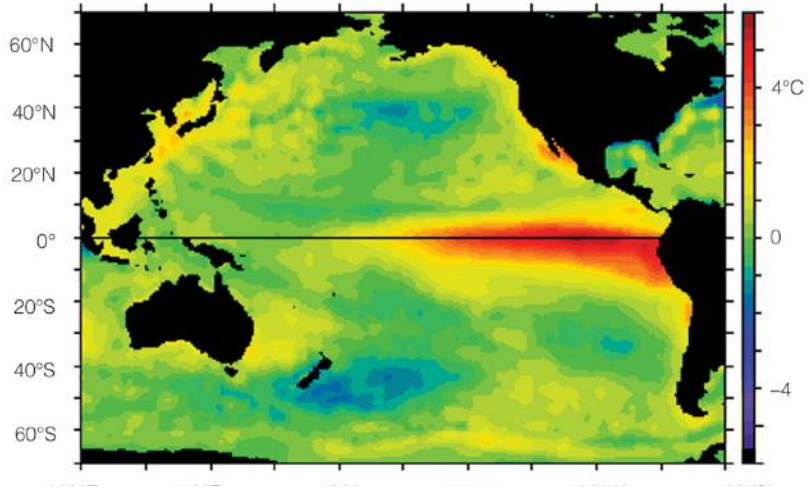
El Niño



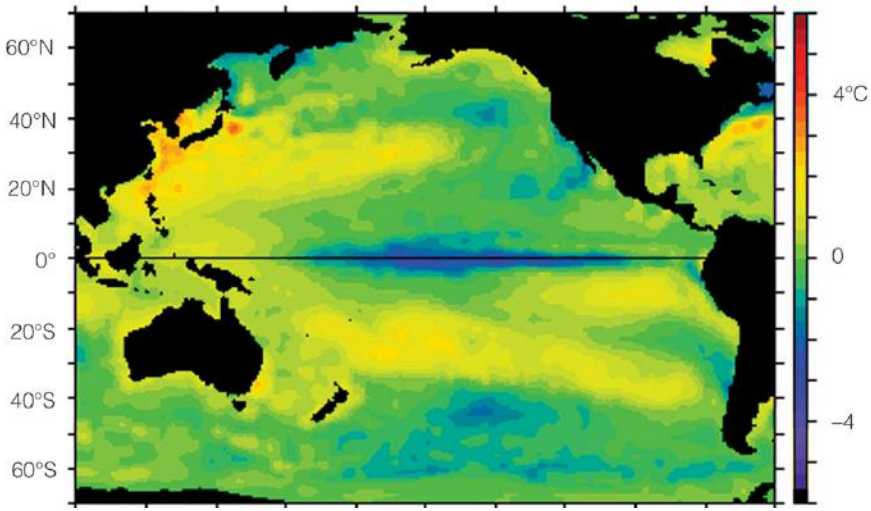
La Niña

4. Changes in Circulation





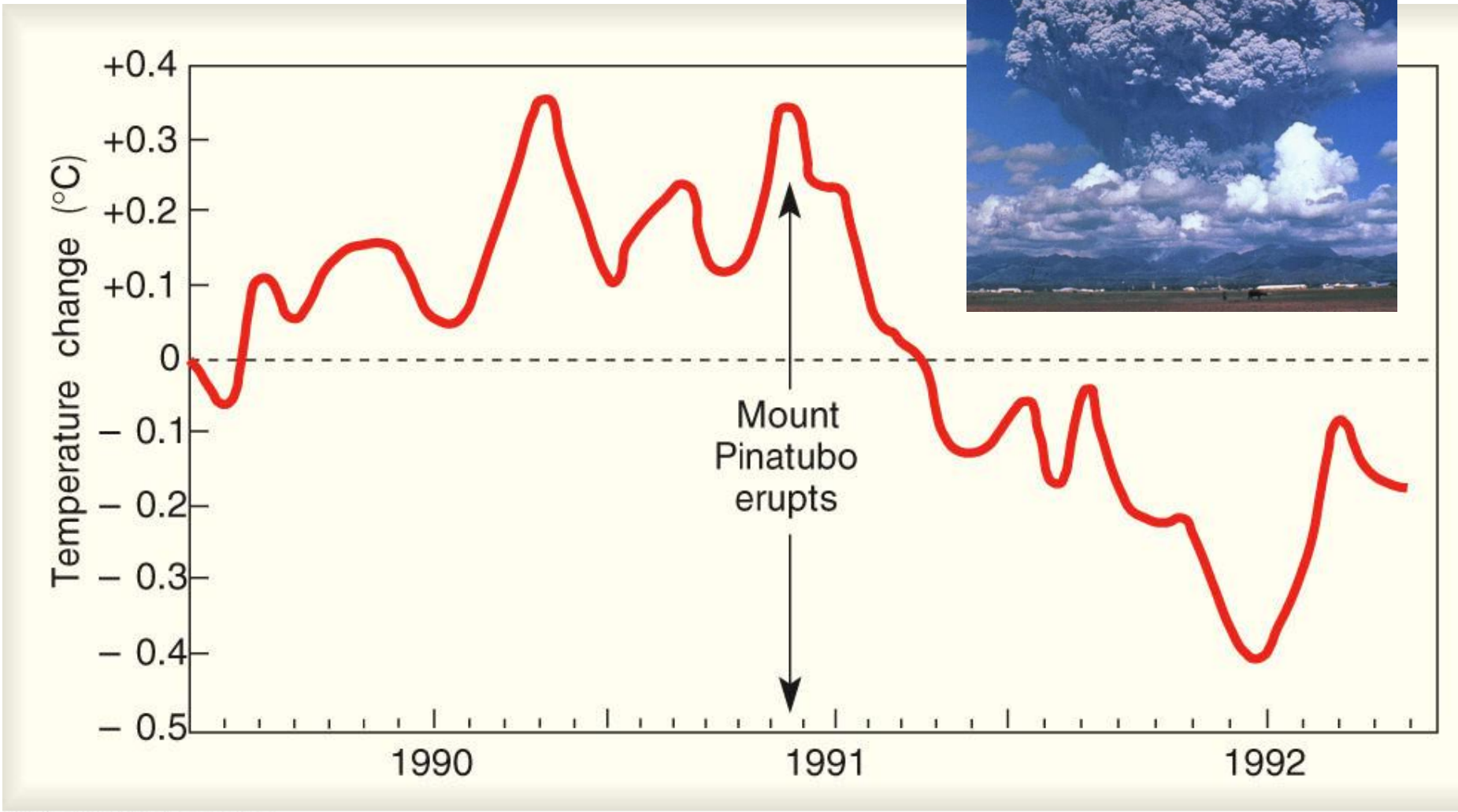
El Niño



La Niña

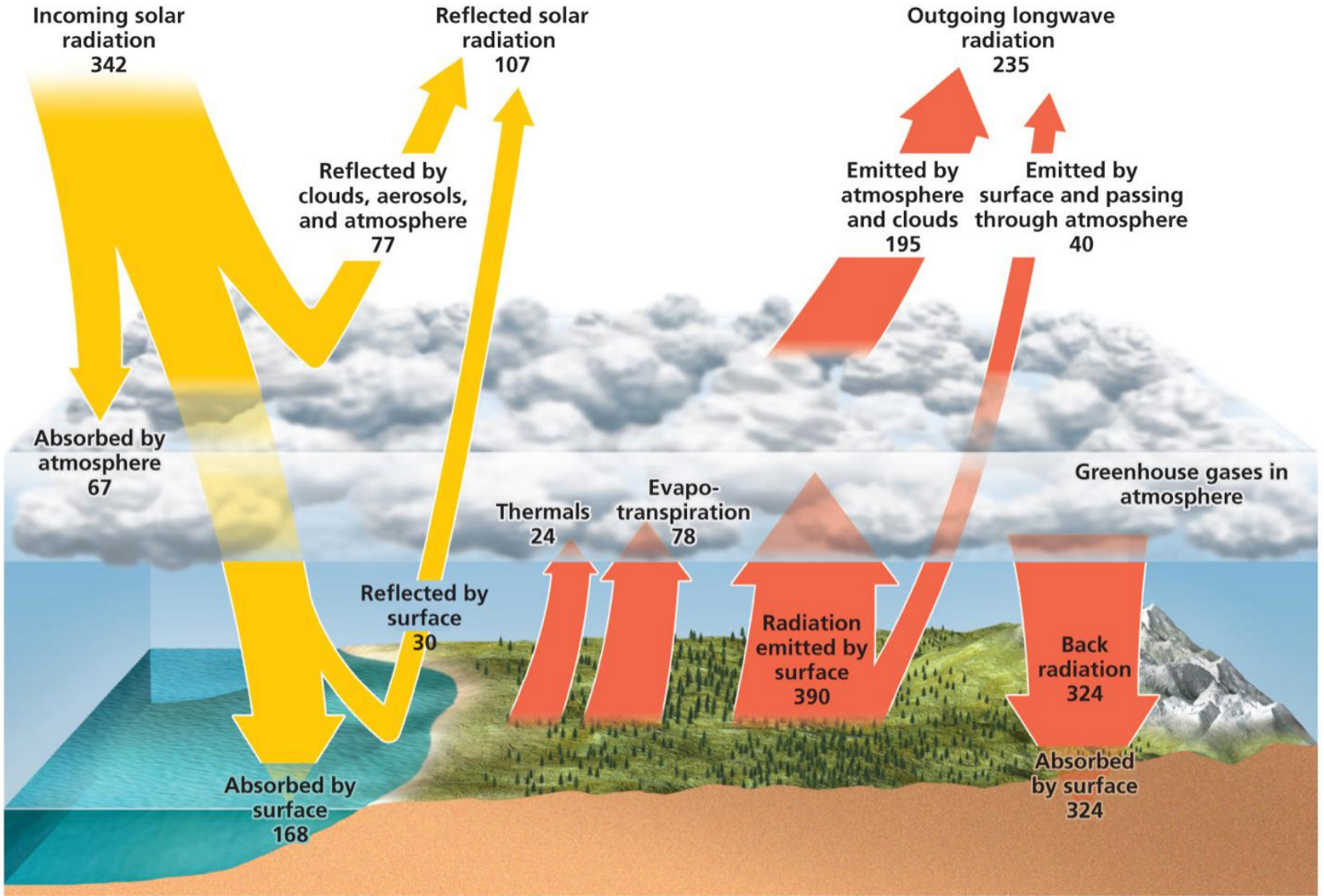
5. Changes in Atmospheric Composition

Aerosols: scatter incoming solar radiation

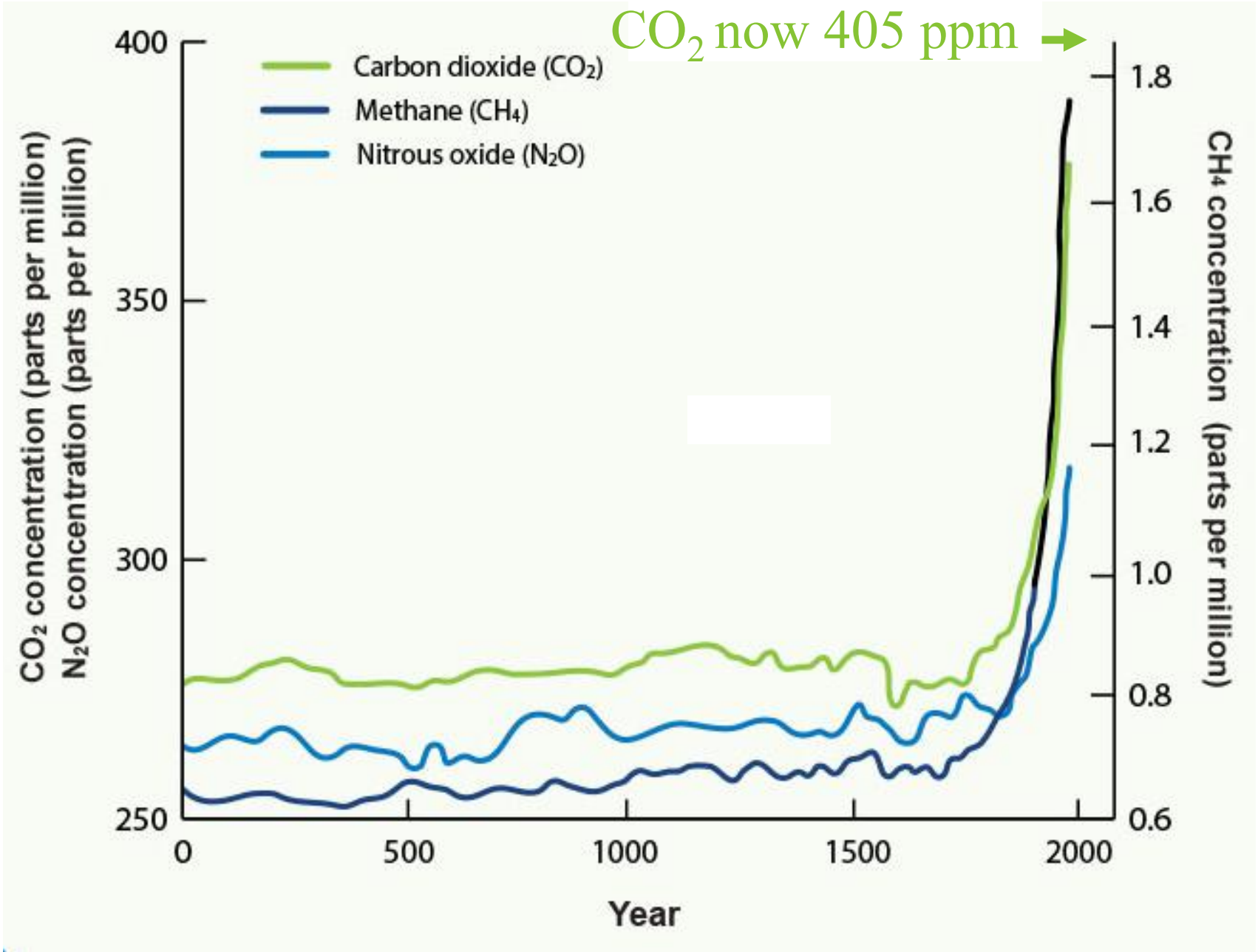


5. Changes in Atmospheric Composition

Greenhouse Gases: trap thermal energy from Earth

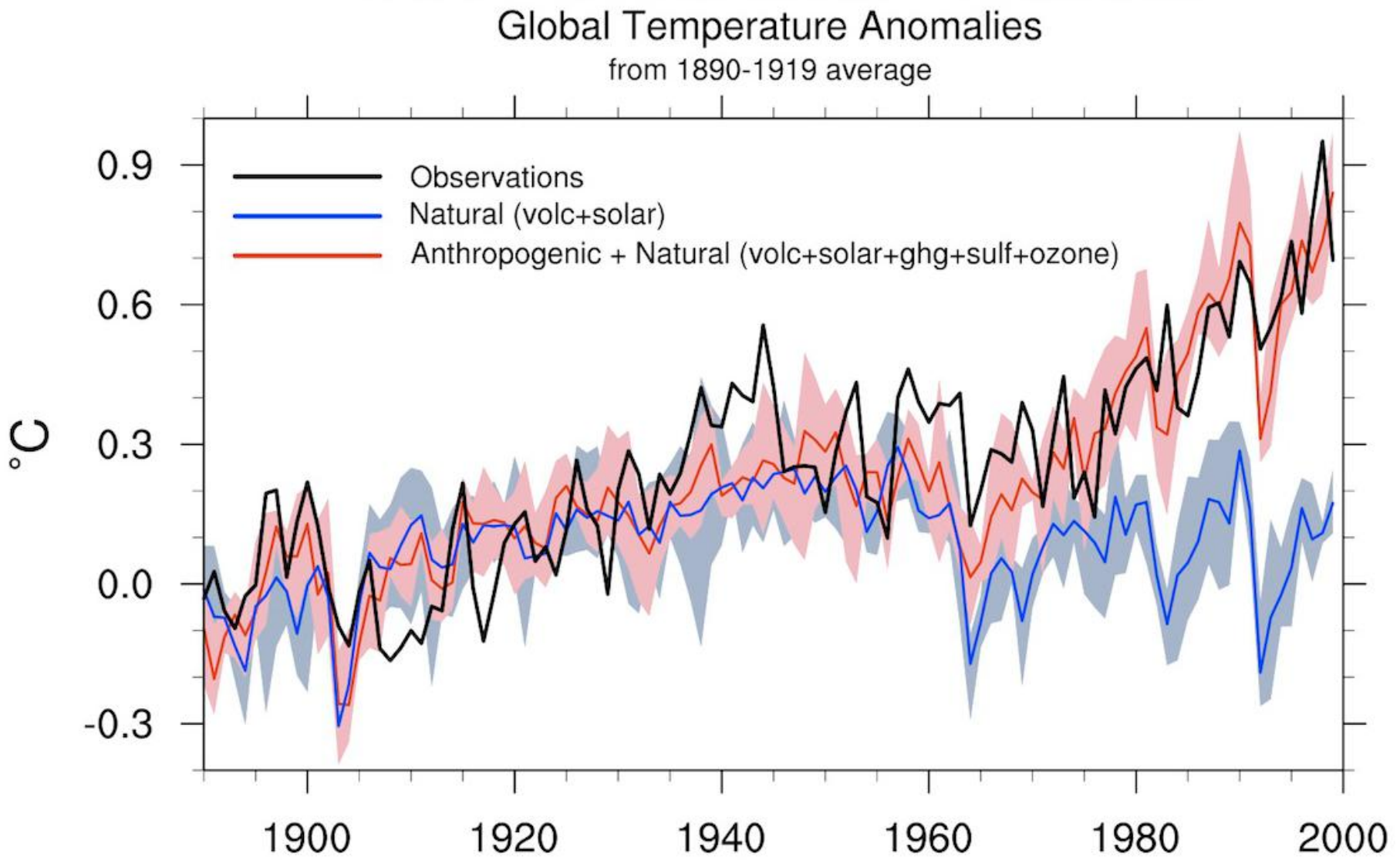


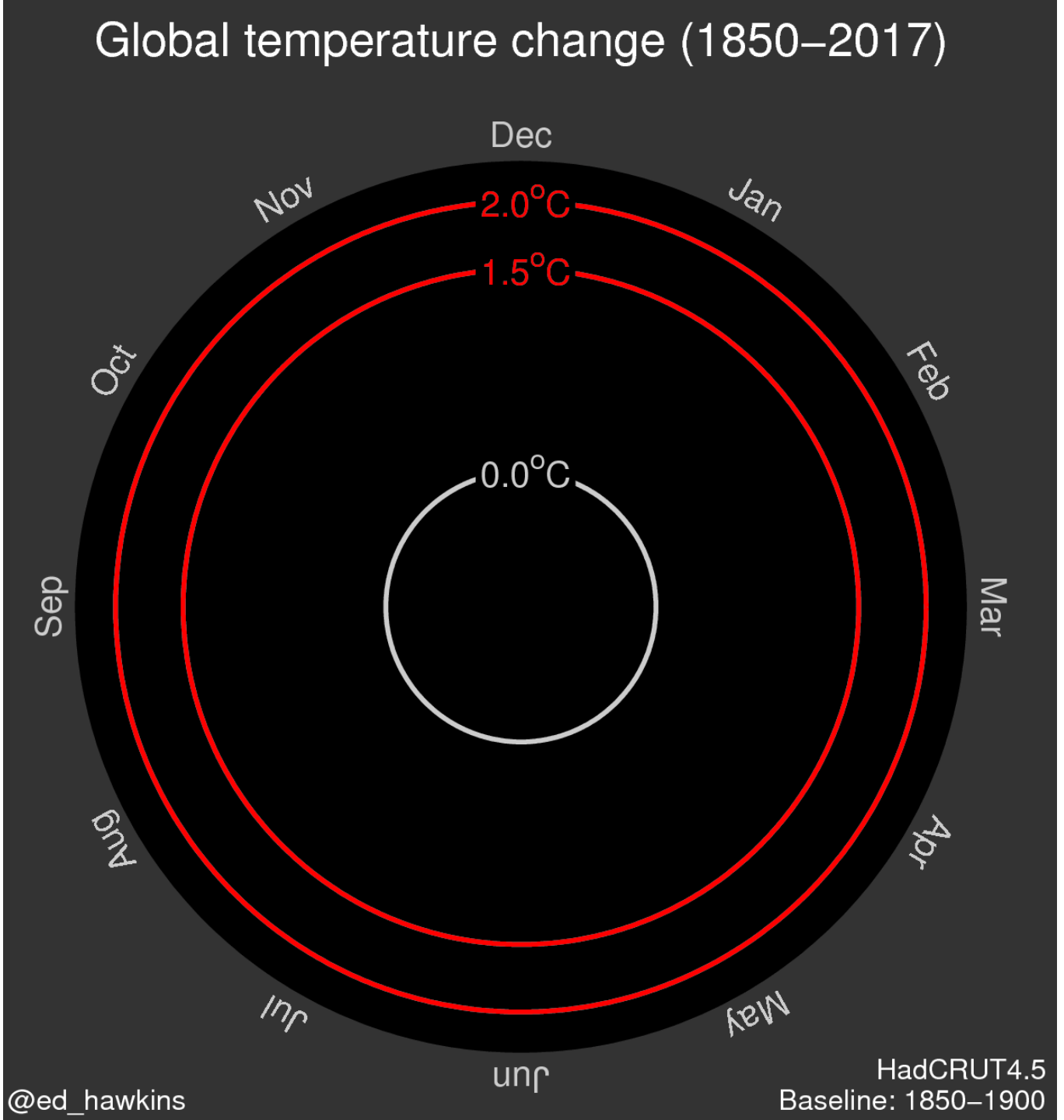
5. Changes in Atmospheric Composition



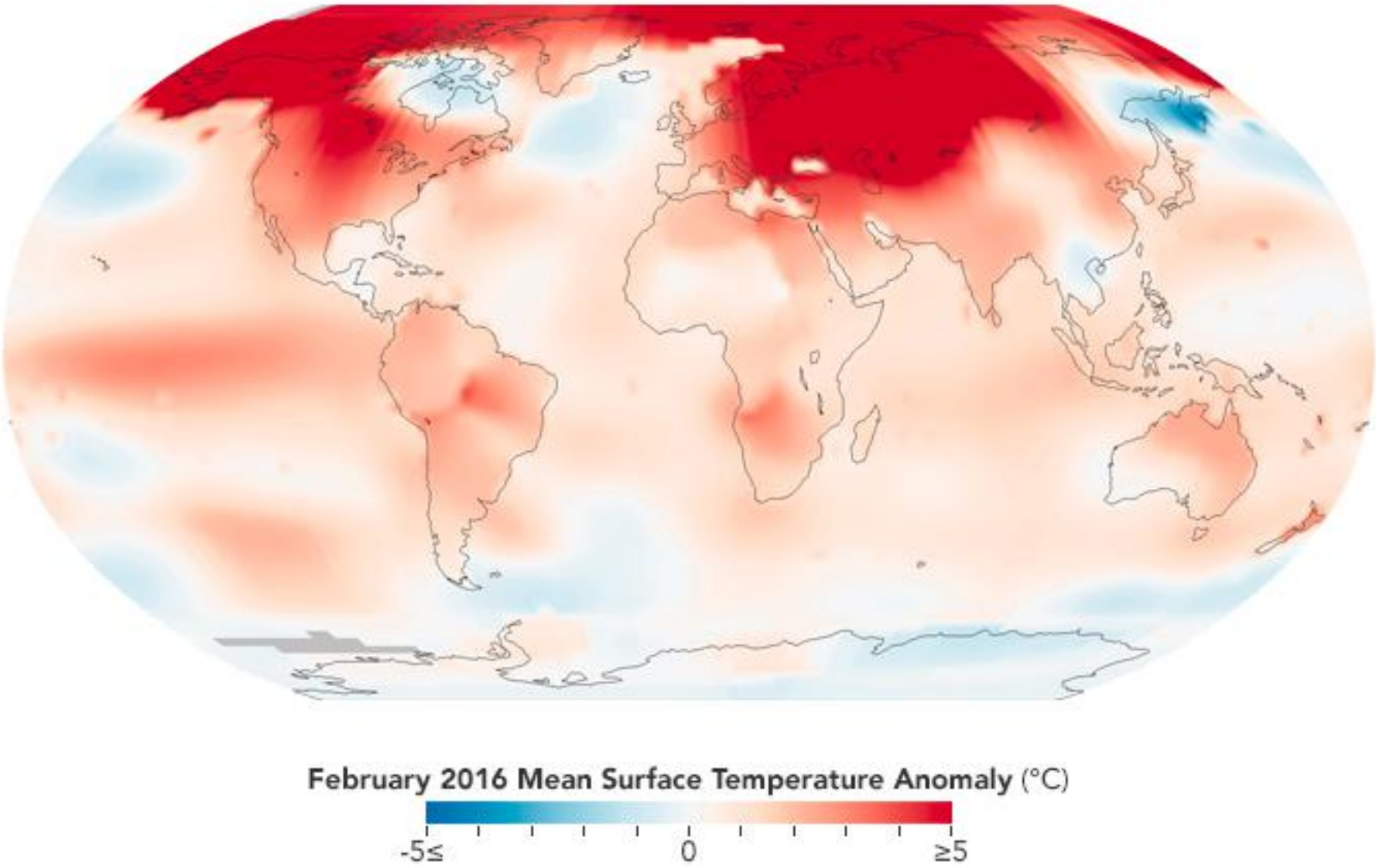
Main causes of climate change

Global Average Temperature: With and without human influence




Global temperature change (1850–2017)
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
2.0°C
1.5°C
0.0°C
@ed_hawkins
HadCRUT4.5
Baseline: 1850–1900

Average Surface Temperature



February 2016: warmest February of 136 yr record; 0.5 °C warmer than previous record

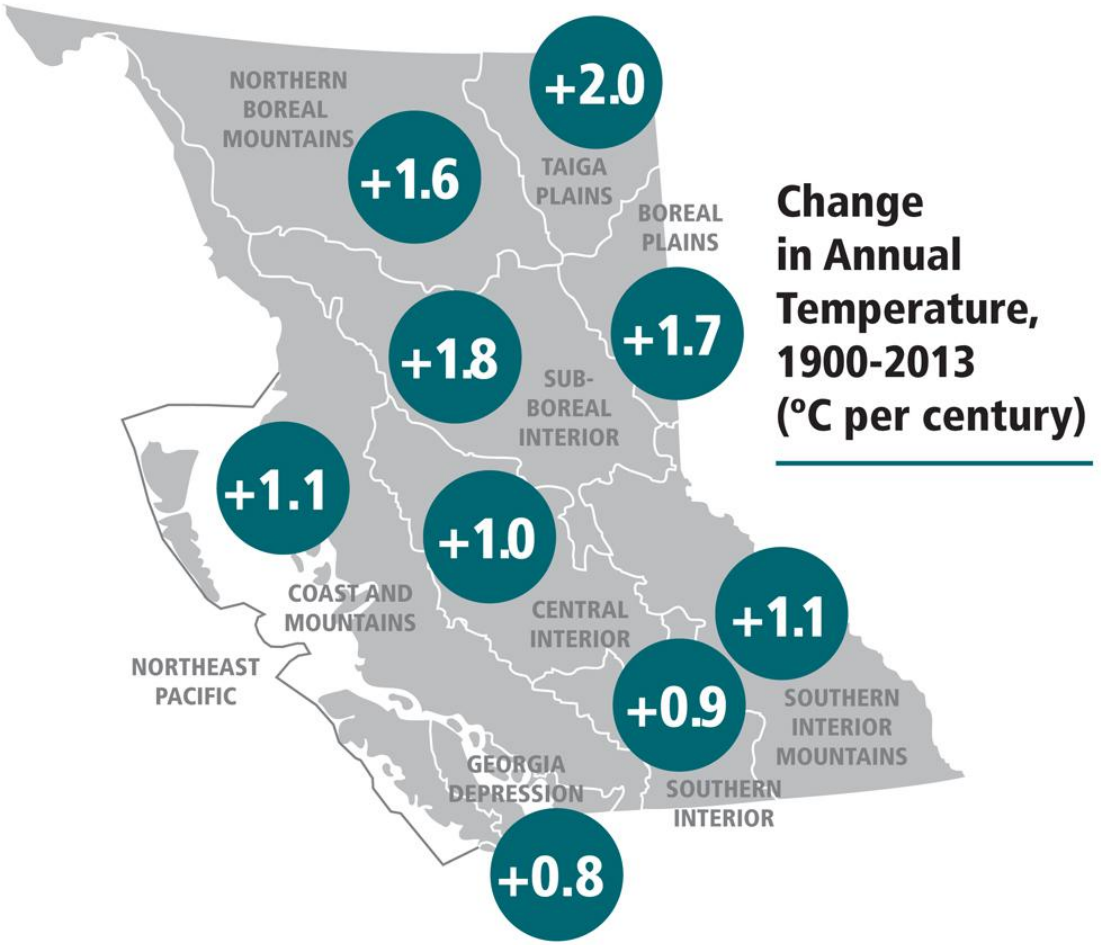
Climate Change and Vancouver Island

Vancouver Island annual temp increased 0.8 ˚C

We should expect

- Relatively warm years will increase in frequency
- Year to year natural variation will persist

Average Annual Temperature



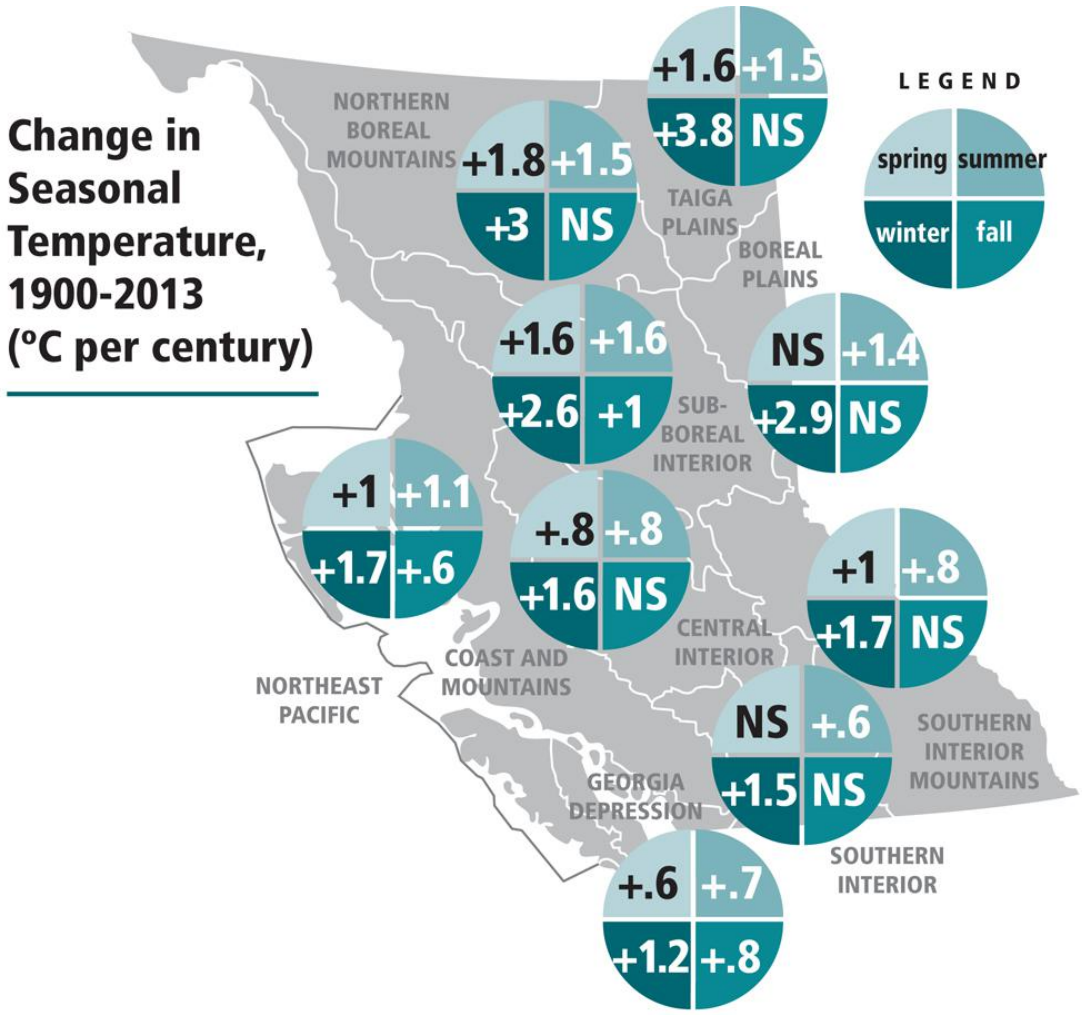
SOURCE: Data from Ministry of Environment Climate Related Monitoring Program and Environment Canada. Trend Analysis for 1900 through 2013 conducted by PCIC, 2014 for the Ministry of Environment Climate Action Secretariat. NOTES: All trends are positive and indicate warming.

Climate Change and Vancouver Island

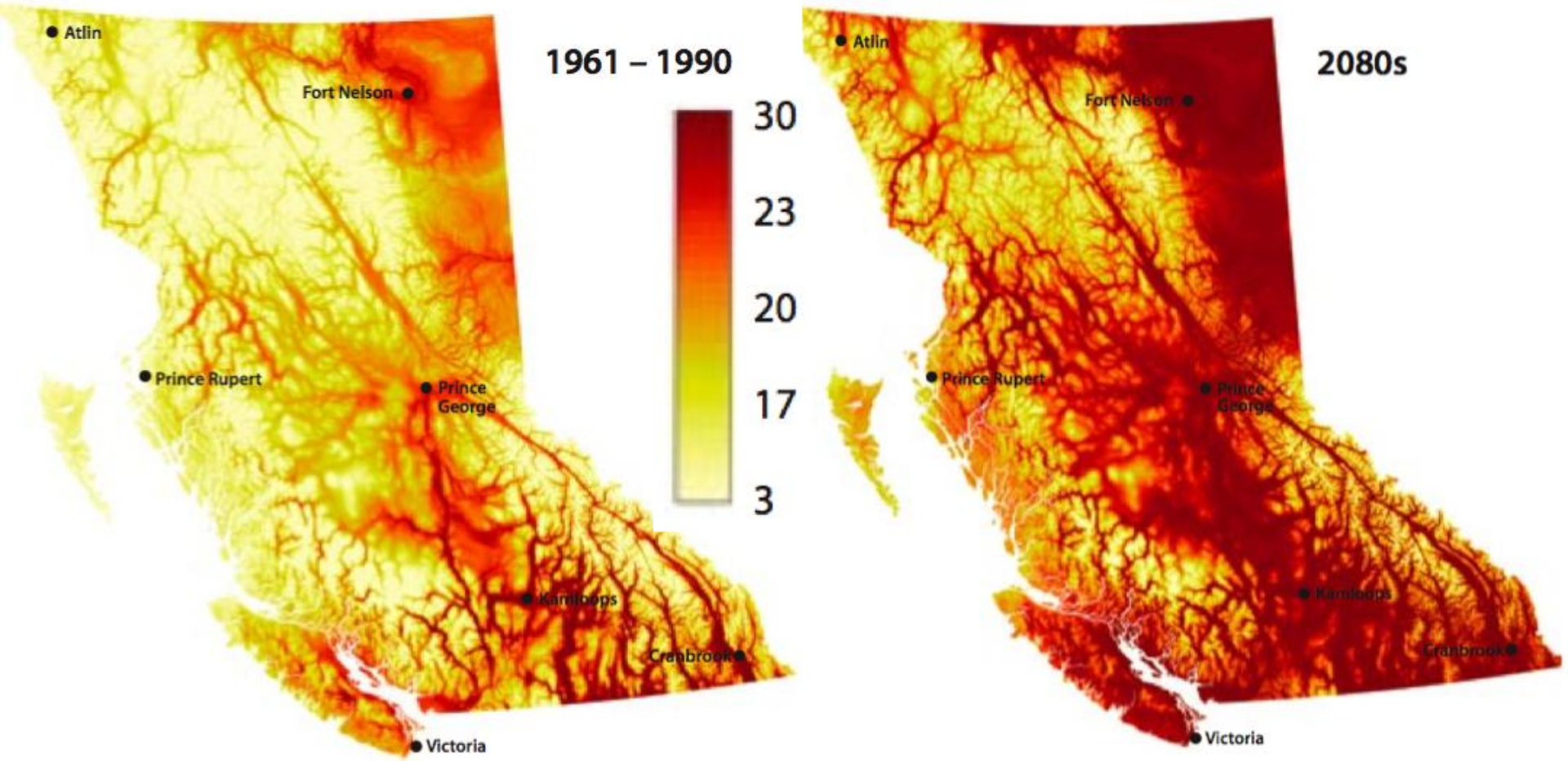
Average Seasonal Temperature

Vancouver Island average winter warming 1.2˚C

Greater warming in the winter than in other seasons



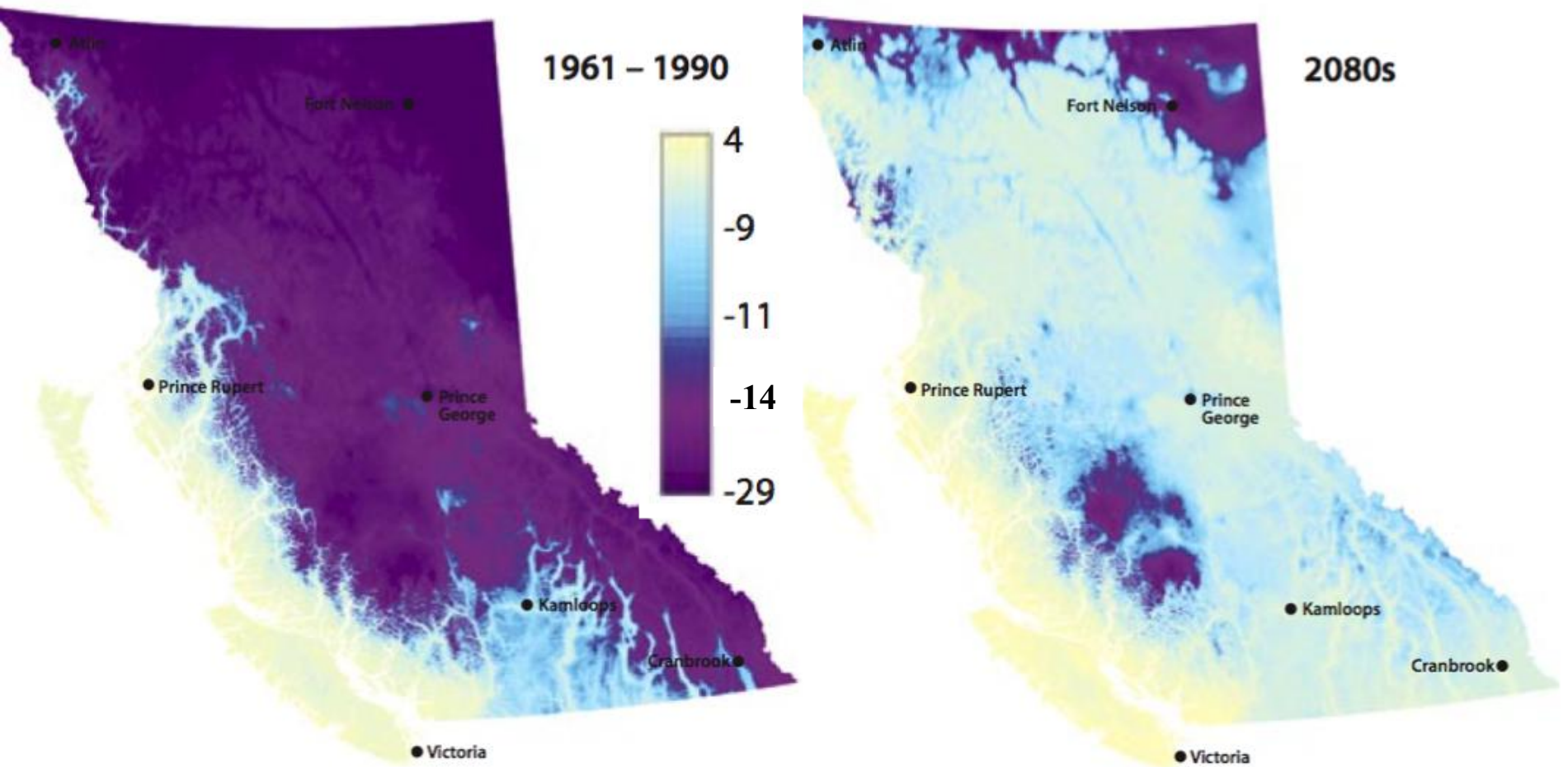
Climate Change and Vancouver Island



Mean Maximum Temperature, July (°C)

ClimateBC

Climate Change and Vancouver Island



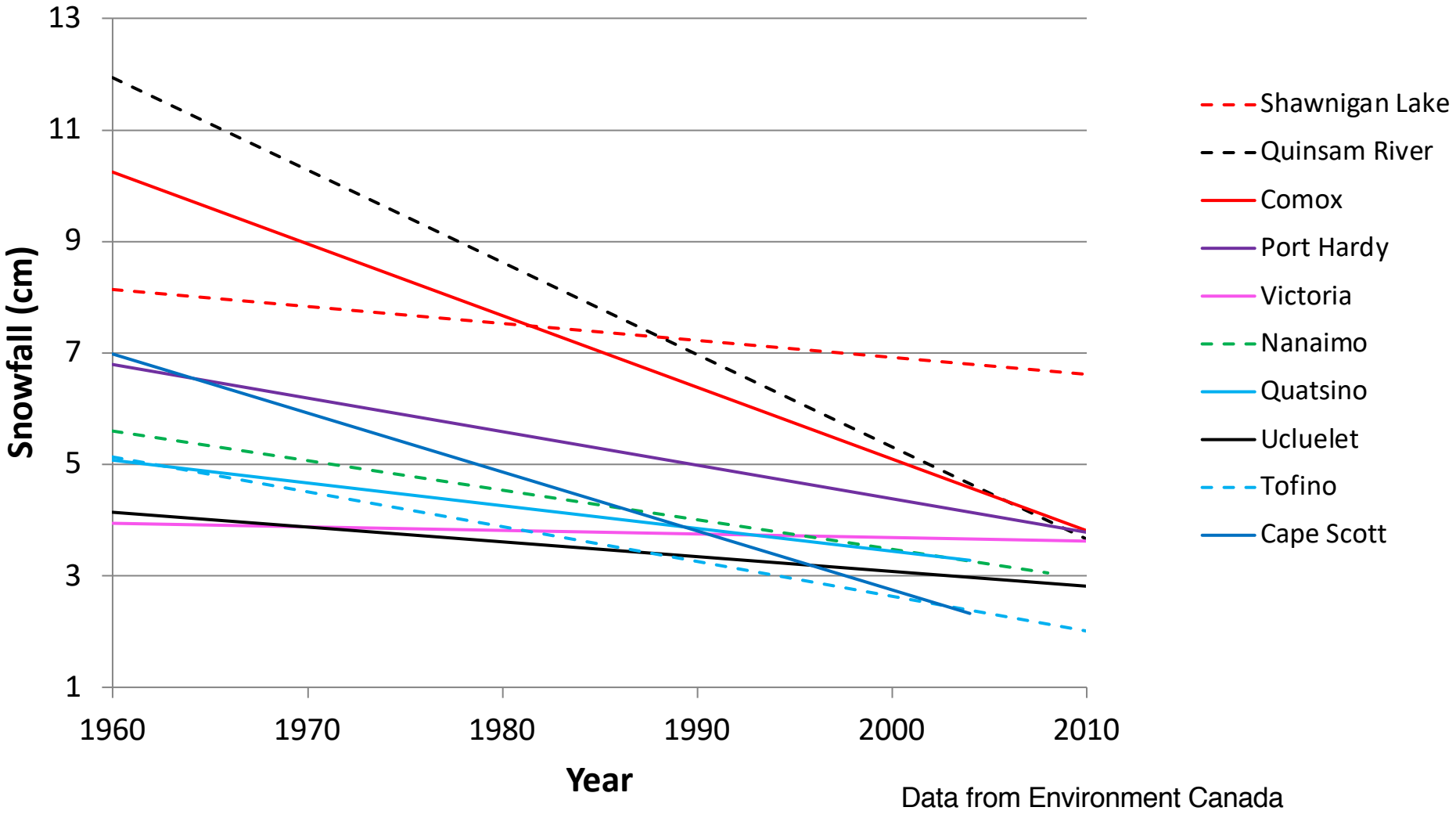
Mean Minimum Temperature, January (°C)

- Reduced snowpack and earlier snowmelt

ClimateBC

Climate Change and Vancouver Island

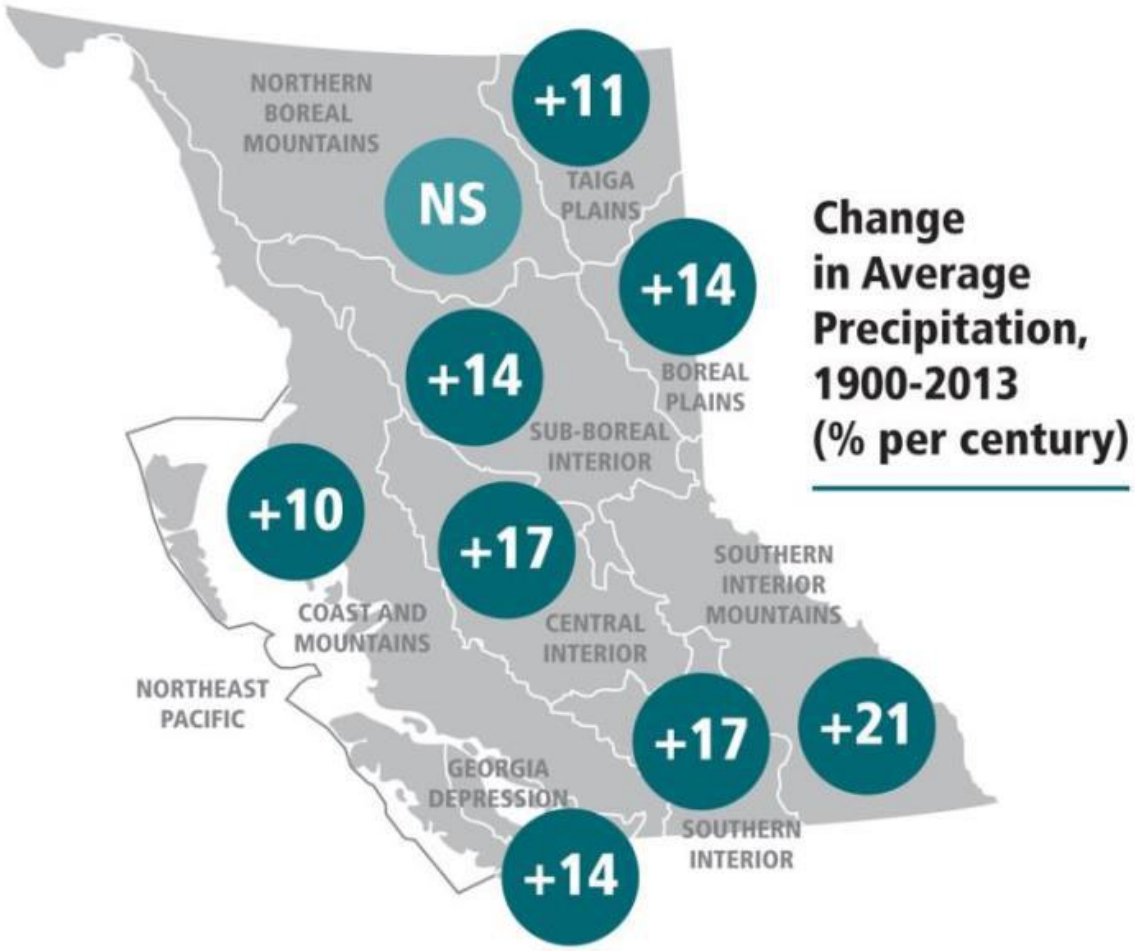
Annual snowfall trends on Vancouver Island



Data from Environment Canada

Climate Change and Vancouver Island

Average annual precipitation

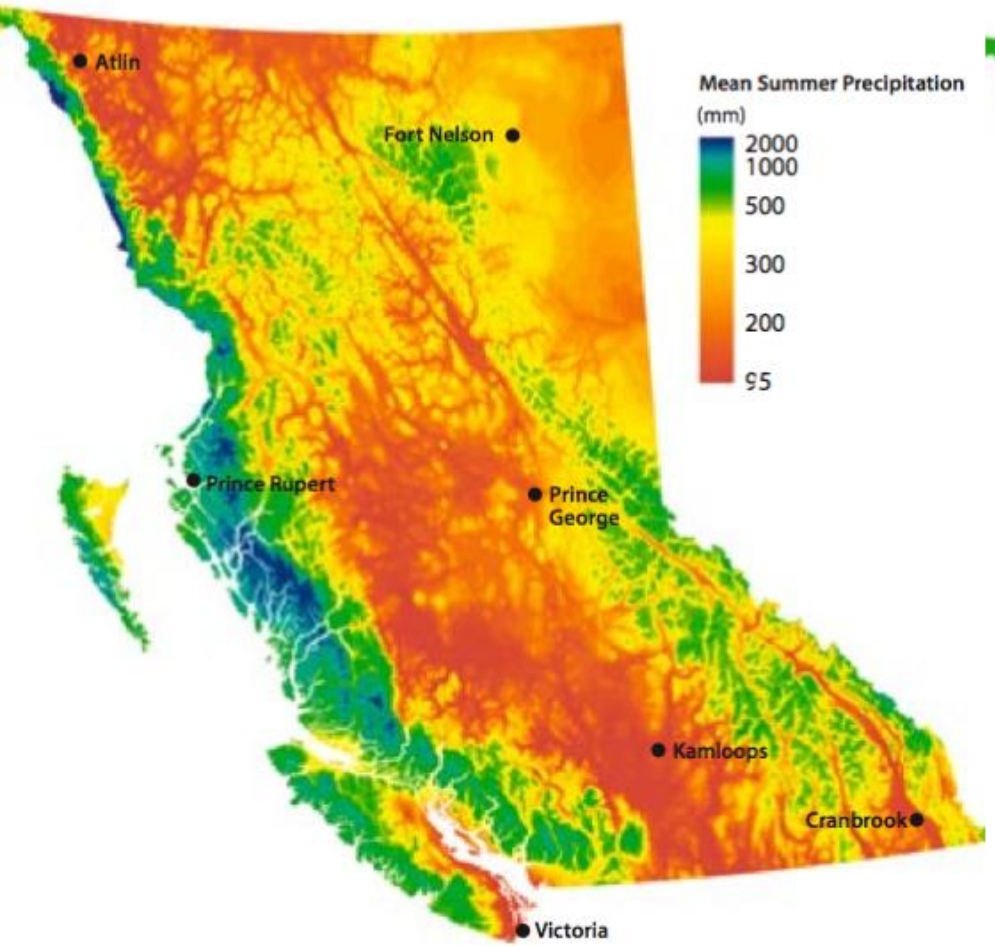


Increased 14% on Vancouver Island

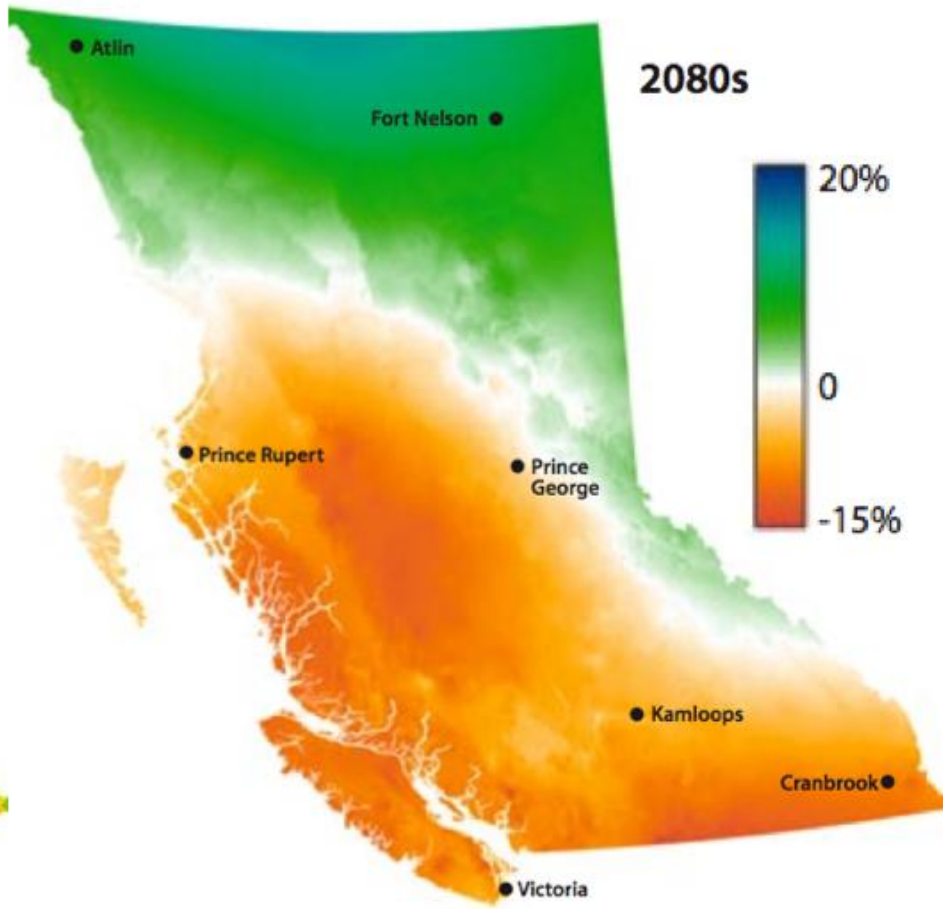
We should expect

- More frequent heavy precipitation events
- A shift poleward of mid latitude storms
- Increase in the strength of the most extreme storms

Climate Change and Vancouver Island

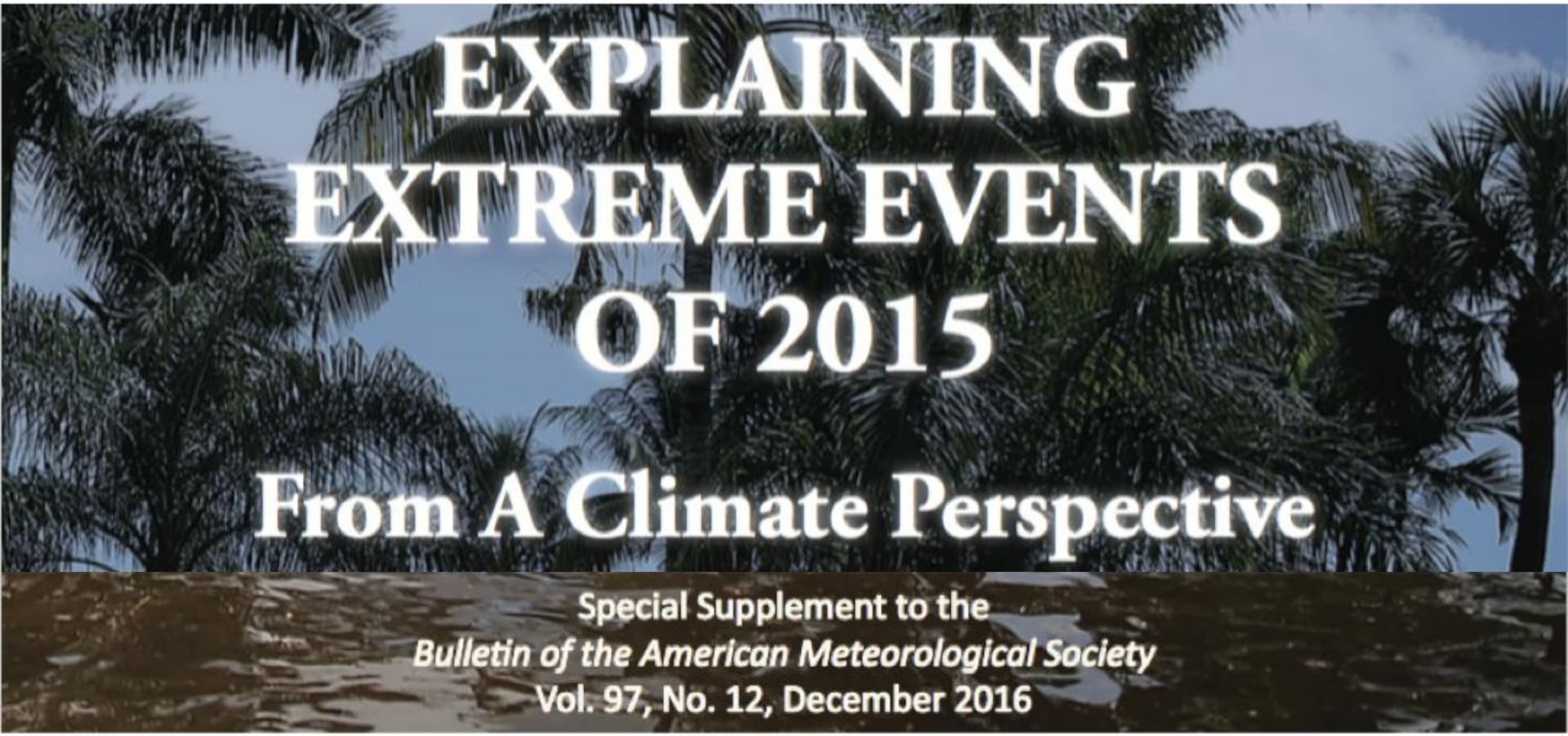


Mean Summer Precipitation (mm)



Percent Change relative to 'Normal' (1961 – 1990)

- Increased forest fire frequency and severity due to warming and drying
- Drier areas may experience regeneration problems due to an increase in summer droughts



"What is the chance that a particular extreme event would have occurred without climate change?"

2015: "Without exception, all the heat-related events studied in this year's report were found to have been made more intense or likely due to human-induced climate change"

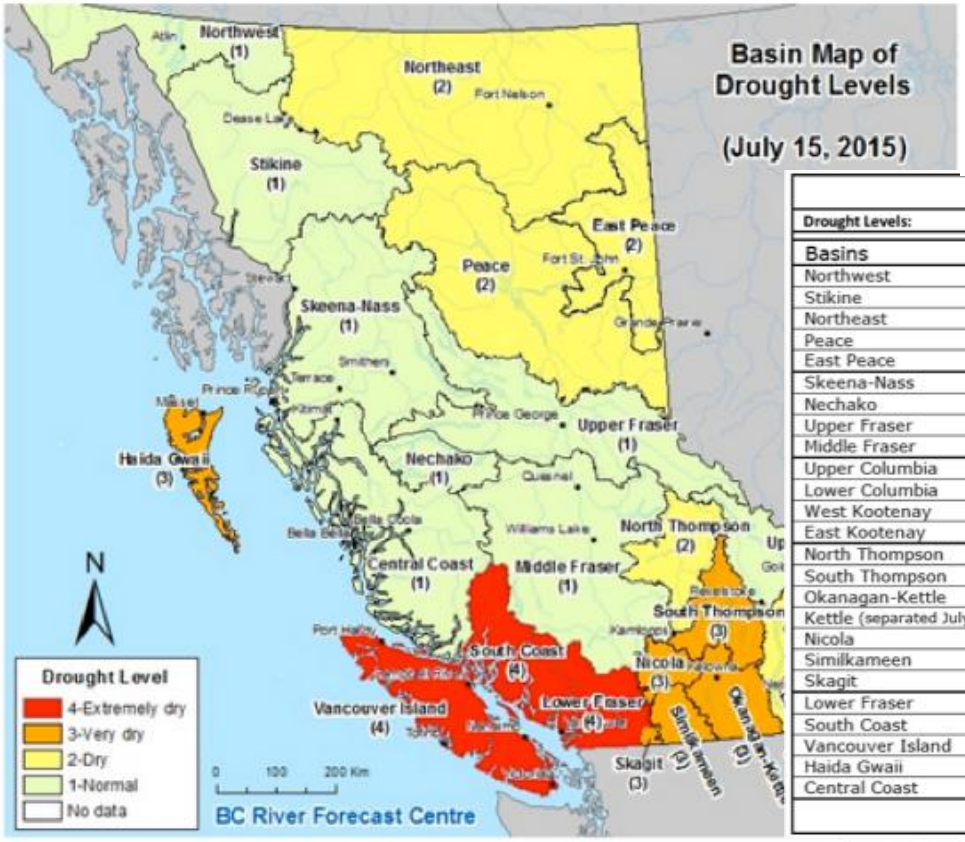
Arctic Warming and the Jet Stream

Climate Change and Vancouver Island

Level 4 drought declared for South Coast and Lower Fraser

'Extremely dry' conditions mean water managers may soon bring in tighter restrictions

CBC News Posted: Jul 15, 2015 1:40 PM PT | Last Updated: Jul 15, 2015 4:41 PM PT



The 2015 Extreme Drought in Western Canada

2015 DROUGHT LEVELS AT A GLANCE

Drought Levels:	1	Normal		2	Dry		3	Very Dry		4	Extremely Dry		
Basins	15-May	28-May	25-Jun	03-Jul	09-Jul	15-Jul	21-Jul	23-Jul	05-Aug	06-Aug	20-Aug	03-Sep	17-Sep
Northwest	2	1	1	1	1	1	1	1	1	1	1	1	1
Stikine	2	1	1	1	1	1	1	1	1	1	1	1	1
Northeast	1	1	1	1	2	2	2	2	2	2	1	1	1
Peace	1	1	1	1	2	2	2	2	2	2	2	1	1
East Peace	1	2	1	1	2	2	2	2	2	2	2	1	1
Skeena-Nass	1	1	1	1	1	1	1	2	2	2	2	1	1
Nechako	1	1	1	1	1	1	1	1	1	1	1	1	1
Upper Fraser	1	1	1	1	1	1	1	2	2	2	2	2	1
Middle Fraser	2	1	1	1	1	1	1	2	2	3	3	3	2
Upper Columbia	1	1	1	1	1	1	1	2	2	2	2	2	1
Lower Columbia	1	1	2	2	2	2	2	2	2	3	3	3	2
West Kootenay	1	1	2	2	2	2	2	2	2	3	3	3	2
East Kootenay	2	1	2	2	2	2	2	2	2	3	3	3	1
North Thompson	1	1	1	1	2	2	2	2	3	3	4	4	2
South Thompson	1	1	2	2	3	3	3	4	4	4	4	4	3
Okanagan-Kettle	2	2	2	2	3	3	3	3	4	4	4	4	3
Kettle (separated July 23)								4	4	4	4	4	3
Nicola	2	2	2	2	3	3	4	4	4	4	4	4	3
Similkameen	2	2	2	2	3	3	3	4	4	4	4	4	3
Skagit	1	1	1	1	3	3	3	4	4	4	4	3	2
Lower Fraser	2	2	3	3	3	4	4	4	4	4	4	3	2
South Coast	2	2	3	3	3	4	4	4	4	4	4	3	2
Vancouver Island	2	3	3	4	4	4	4	4	4	4	4	3	2
Haida Gwaii	1	3	3	3	3	3	3	3	3	3	2	1	1
Central Coast	1	1	1	1	1	1	1	1	1	1	1	1	1

Prepared By: Water Management Branch, Ministry of Forests, Lands and Natural Resource Operations
Last Update: September 18, 2015

The South Coast and Fraser Valley joined Vancouver Island at Level 4 drought conditions on Wednesday, July 15th. Click for full image. (B.C. Government)

Warm late-winter temperatures and the associated reduction in snowpack set the stage for the 2015 drought

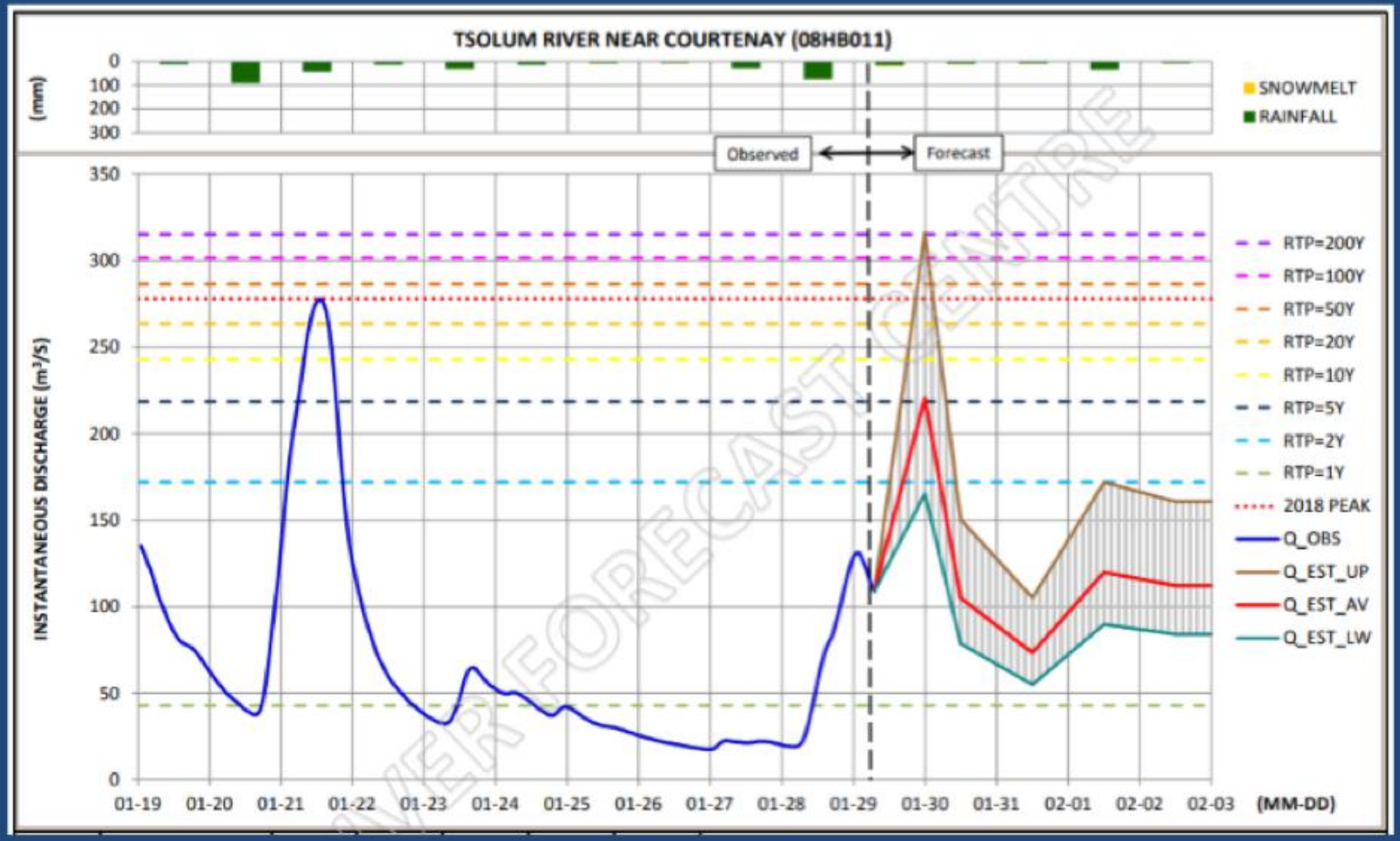
Climate Change and Vancouver Island

Increase in flooding and landslides

Courtney, 2014

Lantzville, 2018

Climate Change and Vancouver Island



Climate Change and Vancouver Island

Sea level rise

Vancouver near top of list of cities threatened by rising sea levels

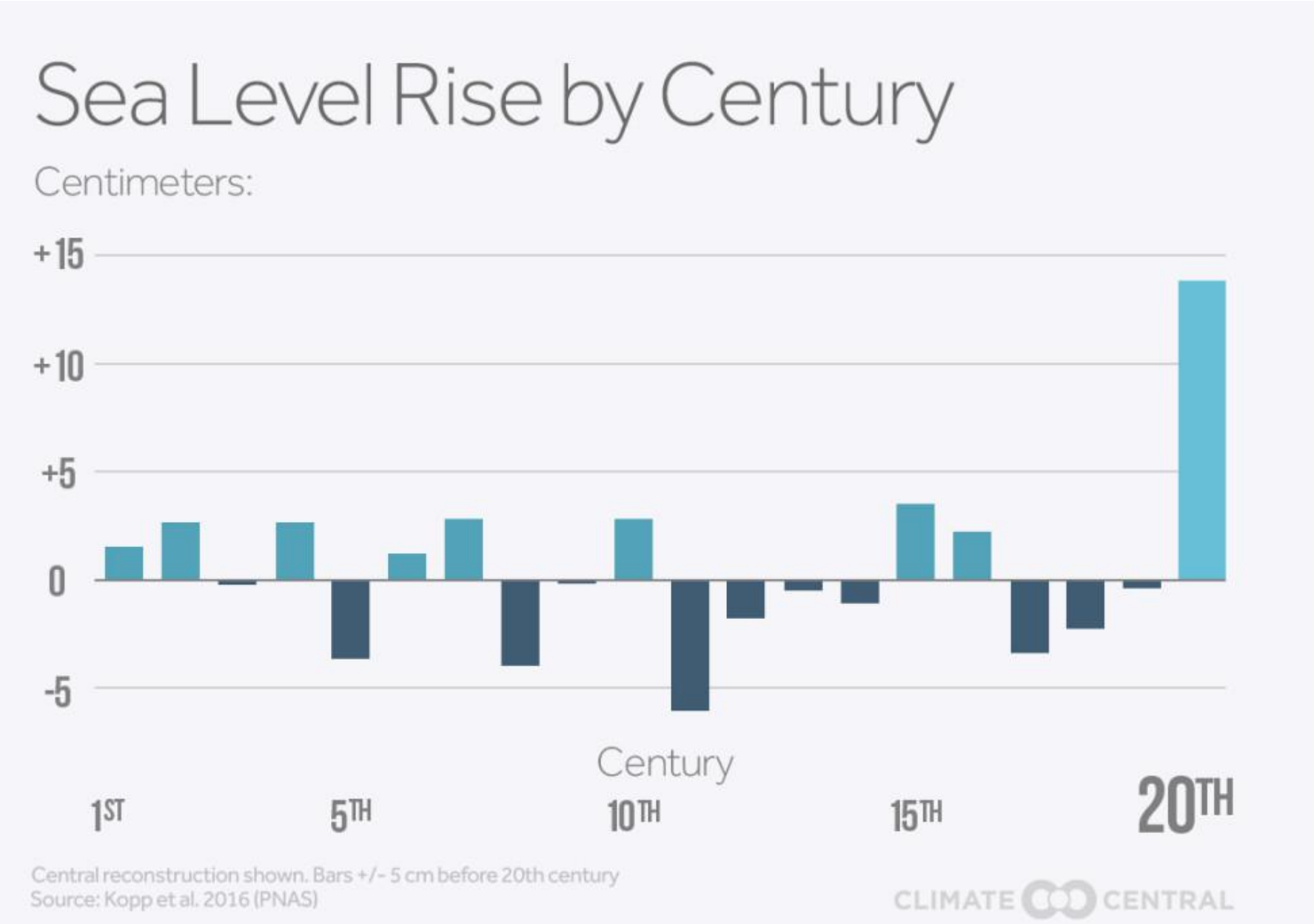
DENE MOORE

VANCOUVER — The Canadian Press

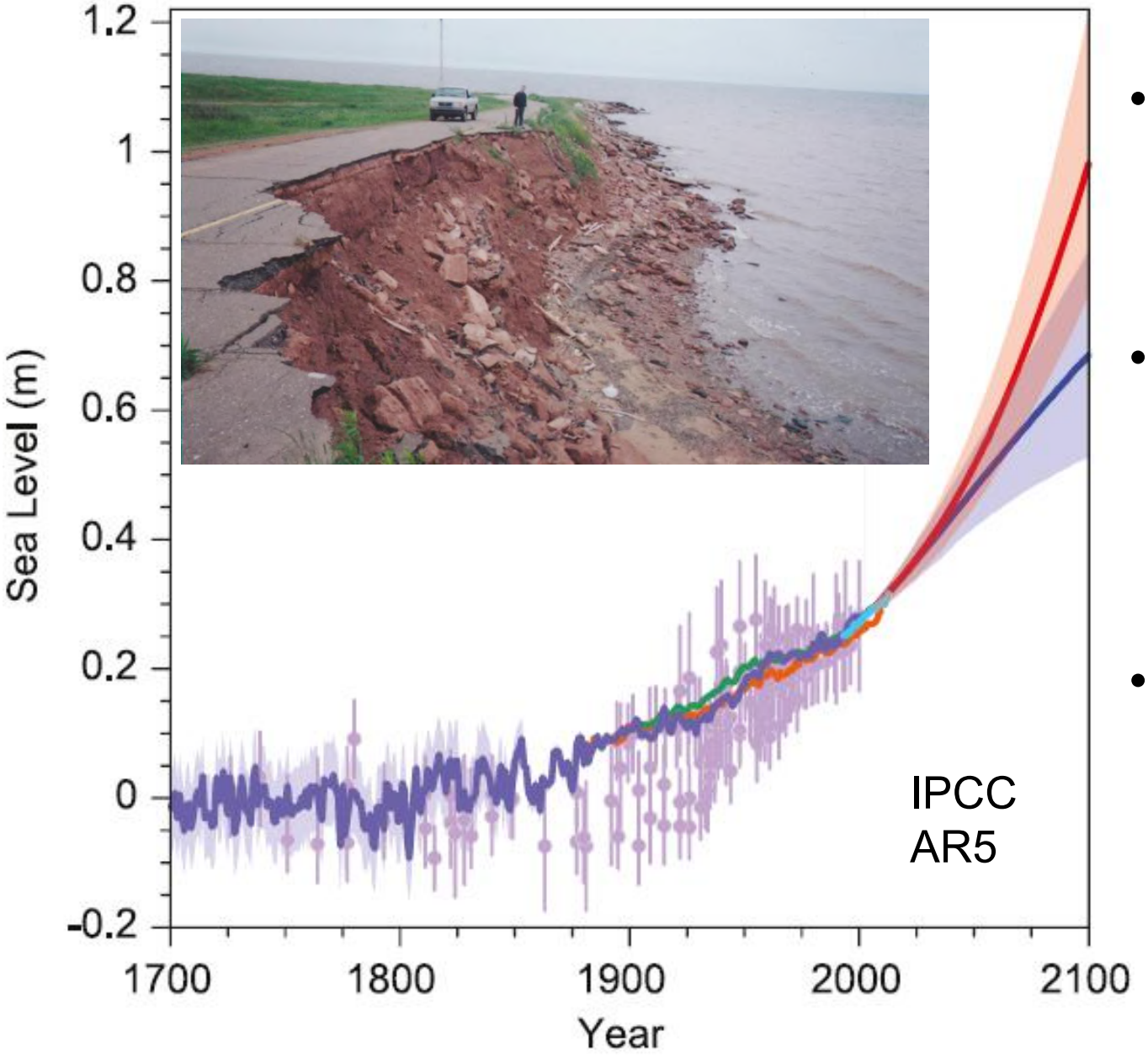
Published Tuesday, Aug. 20, 2013 10:23PM EDT

Last updated Wednesday, Aug. 21, 2013 12:34PM EDT

Sea Level Rise



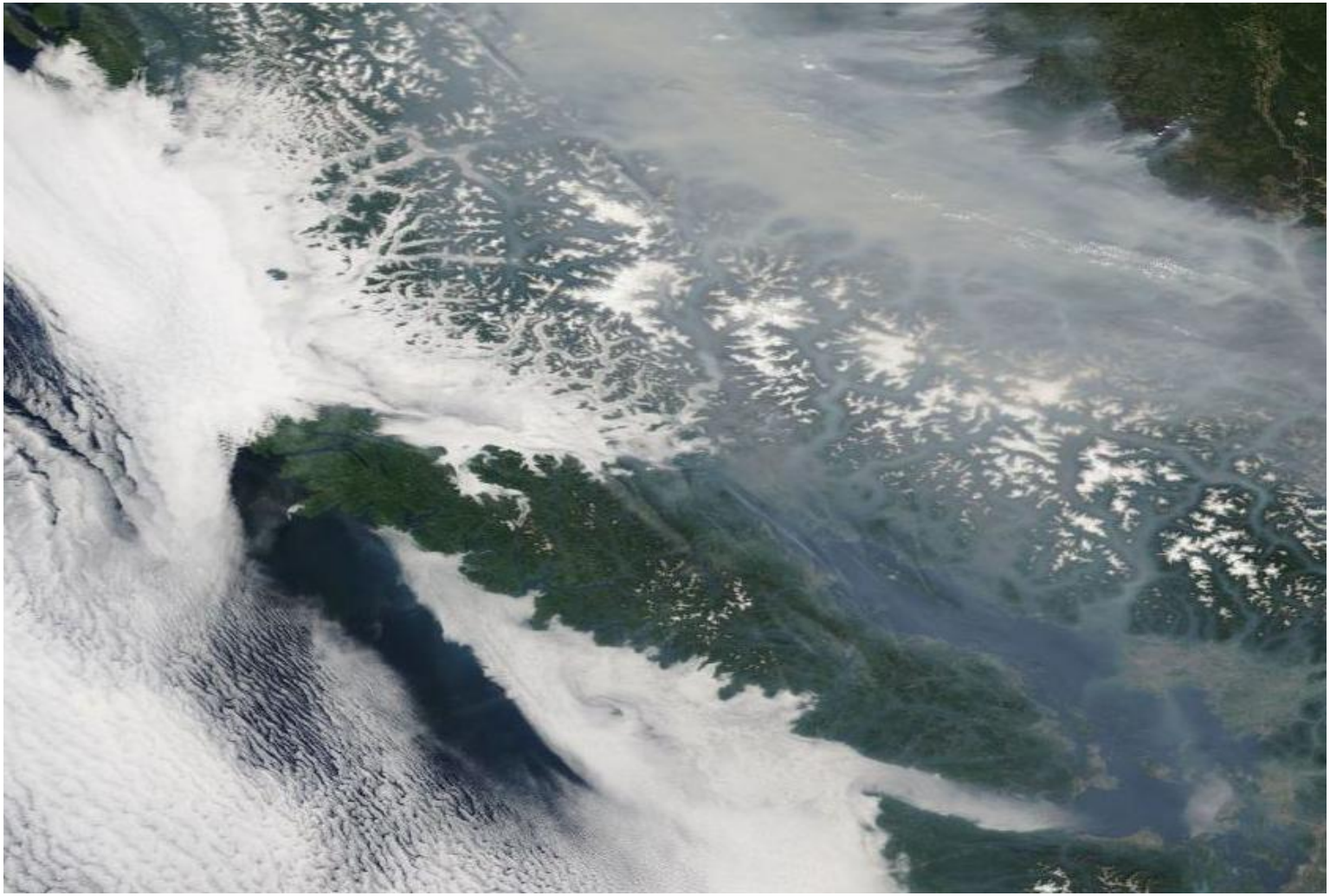
Sea Level Rise



- 20 cm of sea level rise in the last century
- Sea level is currently rising at 3.4 cm per decade
- Average rate from 1950 – 2009 was 1.7 cm per decade

Climate Change and Vancouver Island

Increase in smoke from wildfires



CAMPBELL RIVER MIRROR

Health risk from smoky skies off the charts in parts of B.C.

Kamloops, B.C., saw an air quality health risk rating of 18 — on a scale that normally stops at 10

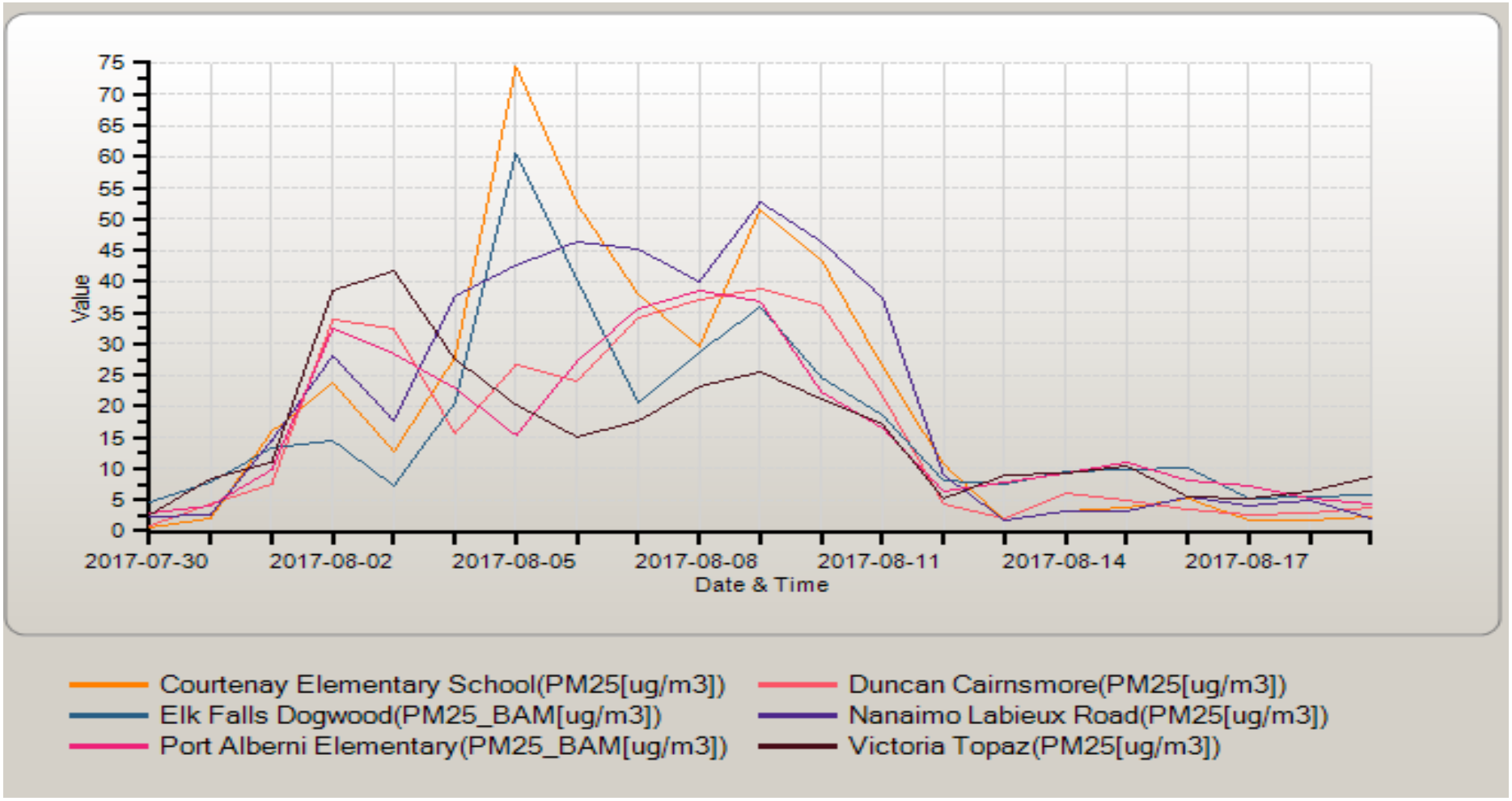
By Lisa Johnson, CBC News Posted: Aug 02, 2017 12:12 PM PT | Last Updated: Aug 02, 2017 8:34 PM PT

Smoke from wildfires filtering to Vancouver Island

The haze in the sky is from the more than 100 wildfires burning throughout the province.

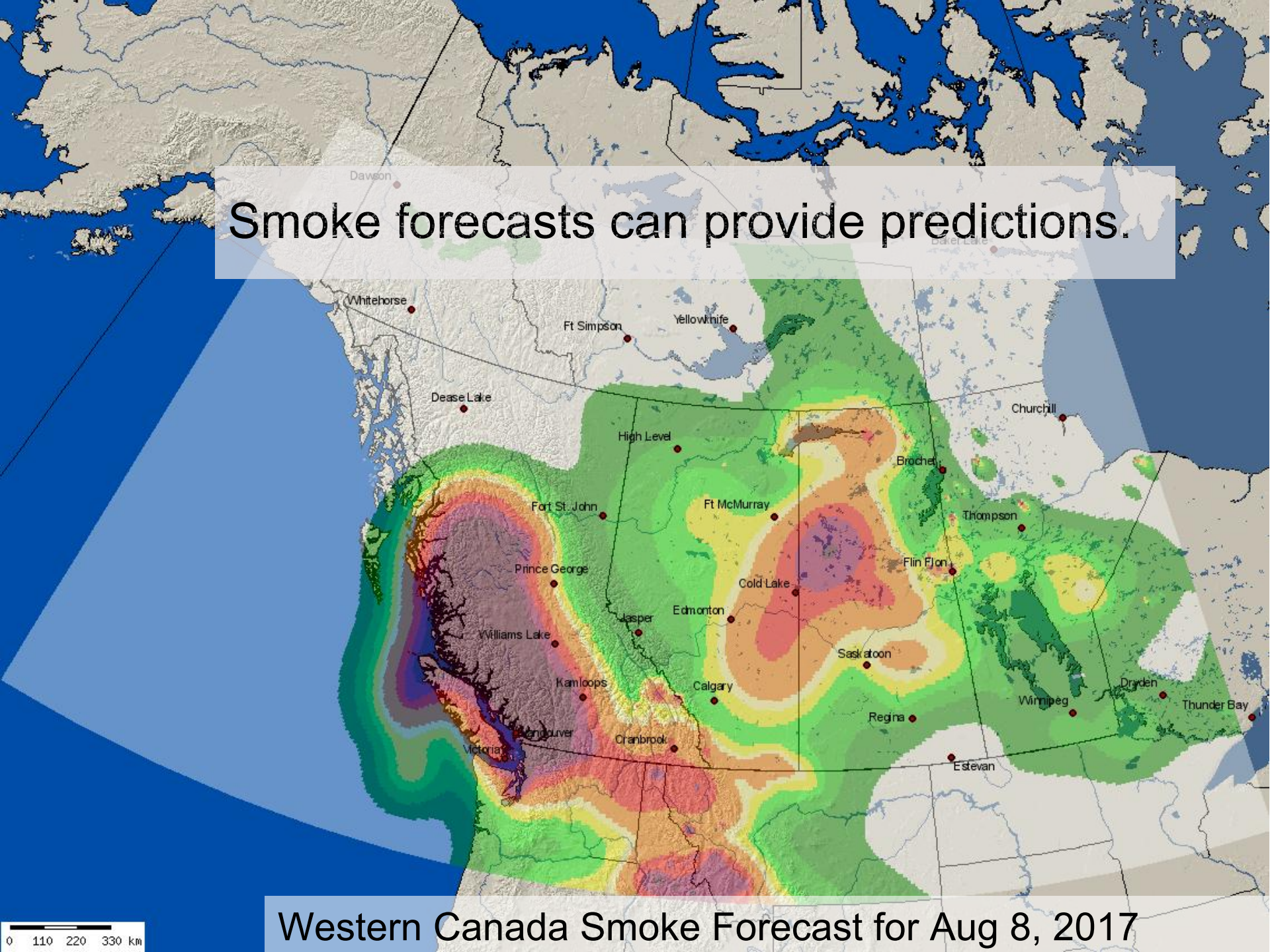
RAGNAR HAAGEN / Aug. 1, 2017 12:00 p.m. / LOCAL NEWS / NEWS

Daily PM2.5 Levels across Vancouver Island



Graph created by Dr. Paul Hasselback (VIHA)

Smoke forecasts can provide predictions.



Western Canada Smoke Forecast for Aug 8, 2017

Climate Change and Vancouver Island

Other health stresses

- Drinking water systems that lack adequate coping mechanisms are vulnerable to extreme precipitation

- Heat stress effects

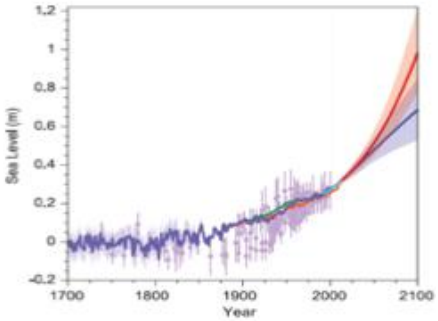
- Increase in pollen

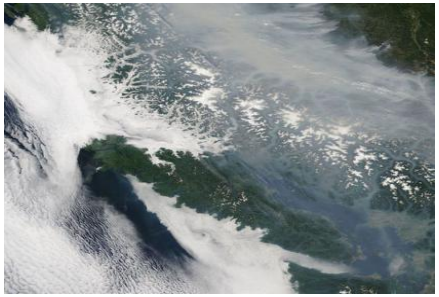
Summary

- We are already seeing the effects of human caused climate change locally

- Vancouver Island can expect
  - Increase in extreme weather events
  - Increase in flooding and landslides
  - Sea level rise
  - Increase in smoke from wildfires
  - Heat stress effects
  - Increase in pollen

The South Coast and Fraser Valley joined Vancouver Island at Level 4 drought conditions on Wednesday, July 15th. Click for full image. (B.C. Government)





Summary

- We are already seeing the effects of human caused climate change locally

- Vancouver Island can expect
  - Increase in extreme weather events
  - Increase in flooding and landslides
  - Sea level rise
  - Increase in smoke from wildfires
  - Heat stress effects
  - Increase in pollen

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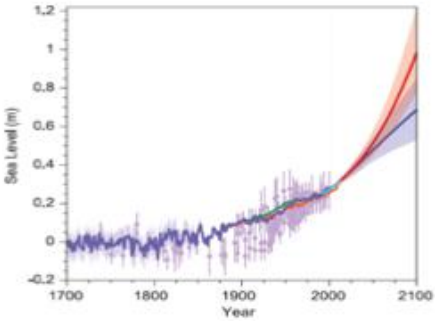

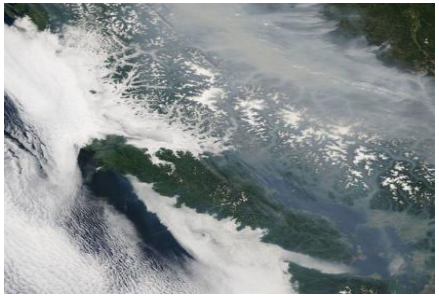

Questions?

Great Resources

[The Truth About Global Warming (~12 min video)]

[Disruption (~50 min video)]

[The Psychology of Climate Change Communication]

[Skeptical Science]

[IPCC]

Global Temperature Increase

2000-2009 compared to the average of 1951-1980