

The basics of climate change and debunking the myths

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Northern Chugach and Harvard Glacier



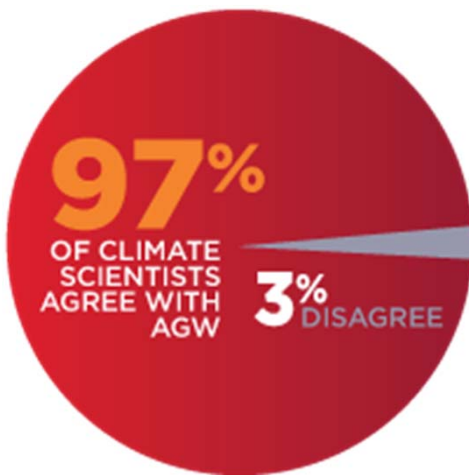
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Overview

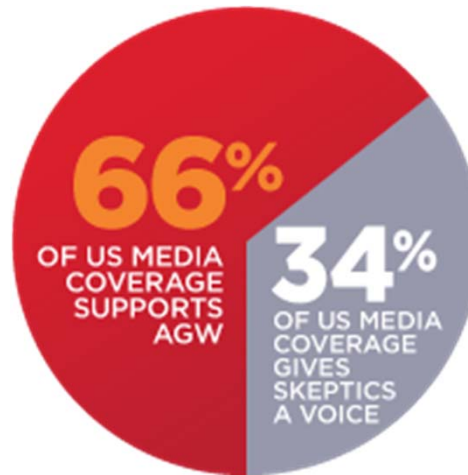
- The consensus gap
- Weather vs climate
- Climate influences on Alaska
- Climate variability
- Climate change
- Some common myths..

The “consensus gap”

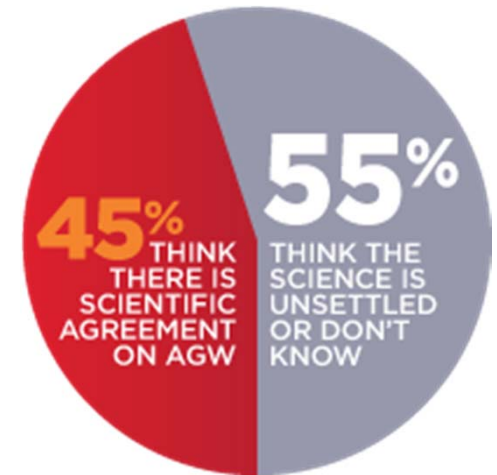
- Gap between the public perception of consensus on anthropogenic global warming and the reality of 97% agreement among climate scientists.
- When people don't realize there's a scientific consensus, they're less likely to support climate action.



The Science



The Media

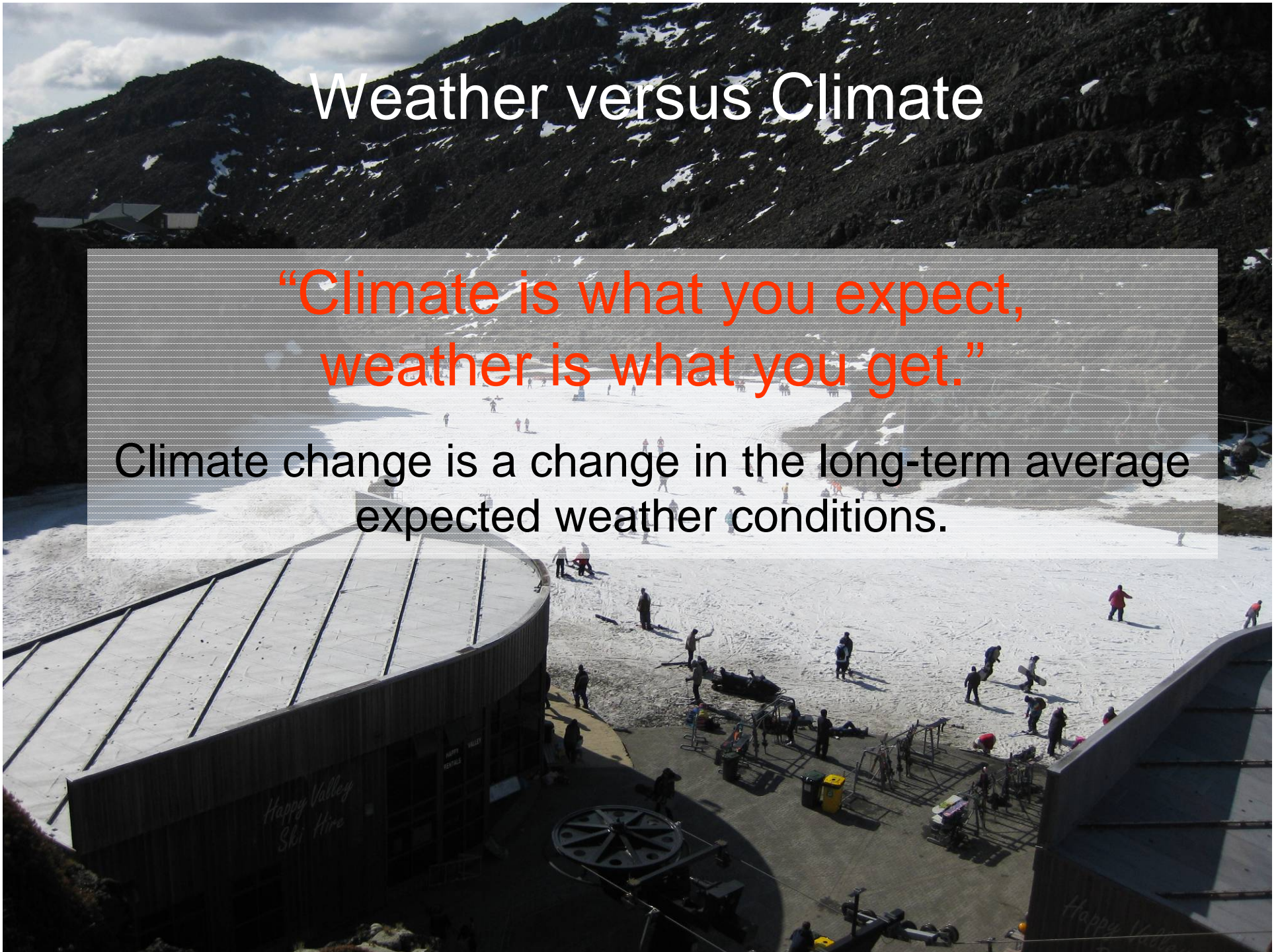


The Public

Weather versus Climate

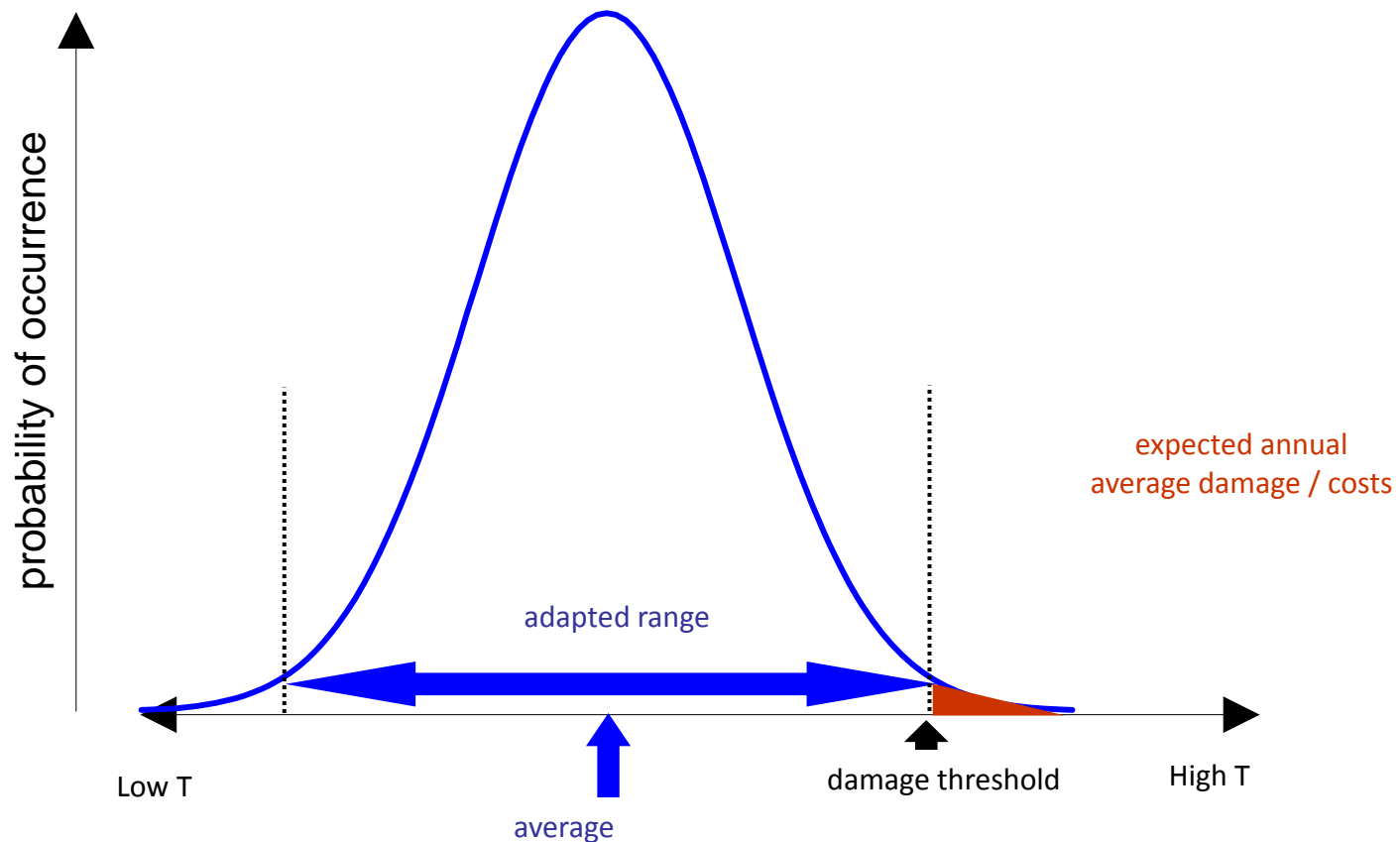
“Climate is what you expect,
weather is what you get.”

Climate change is a change in the long-term average
expected weather conditions.

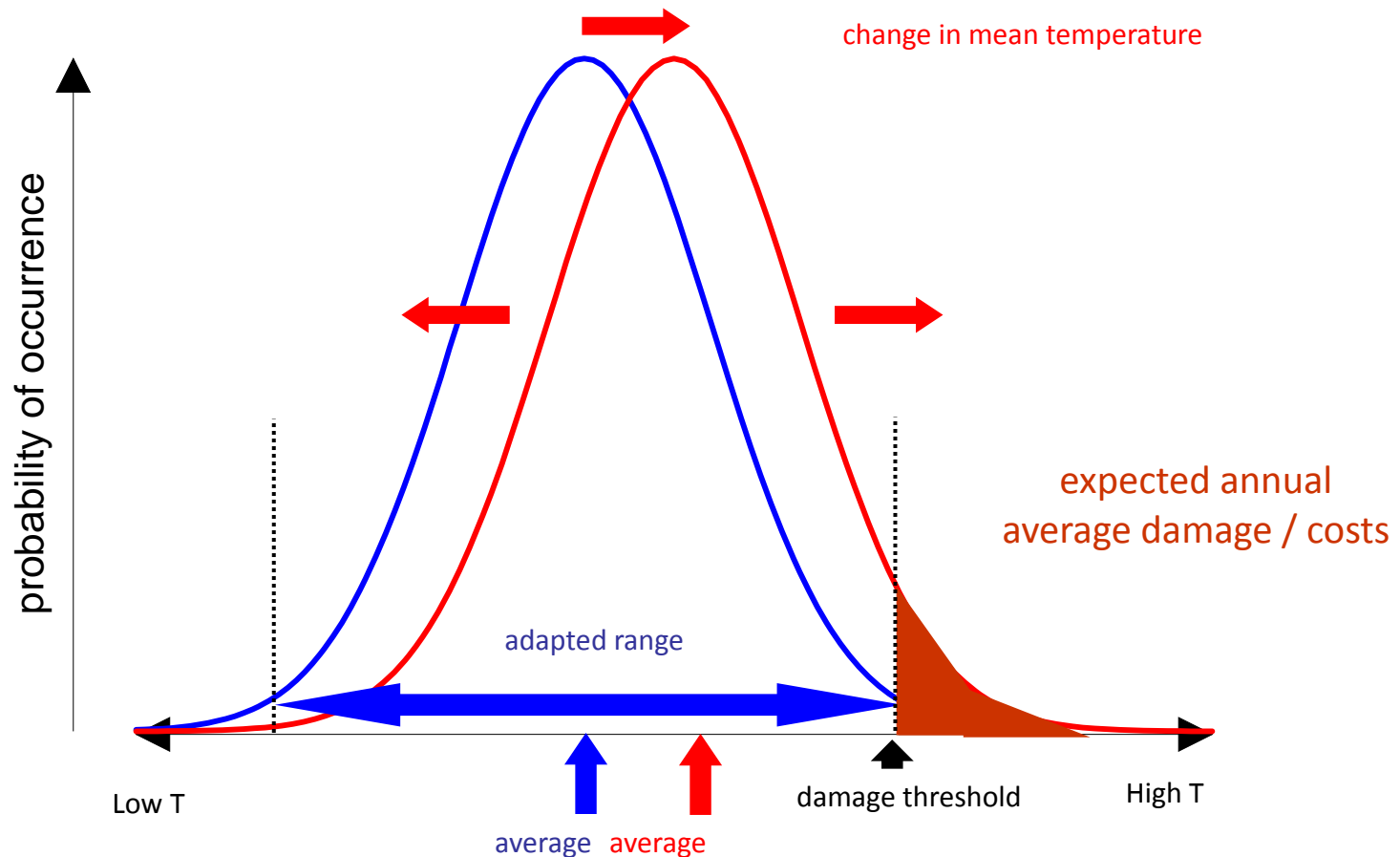


Weather vs average climate

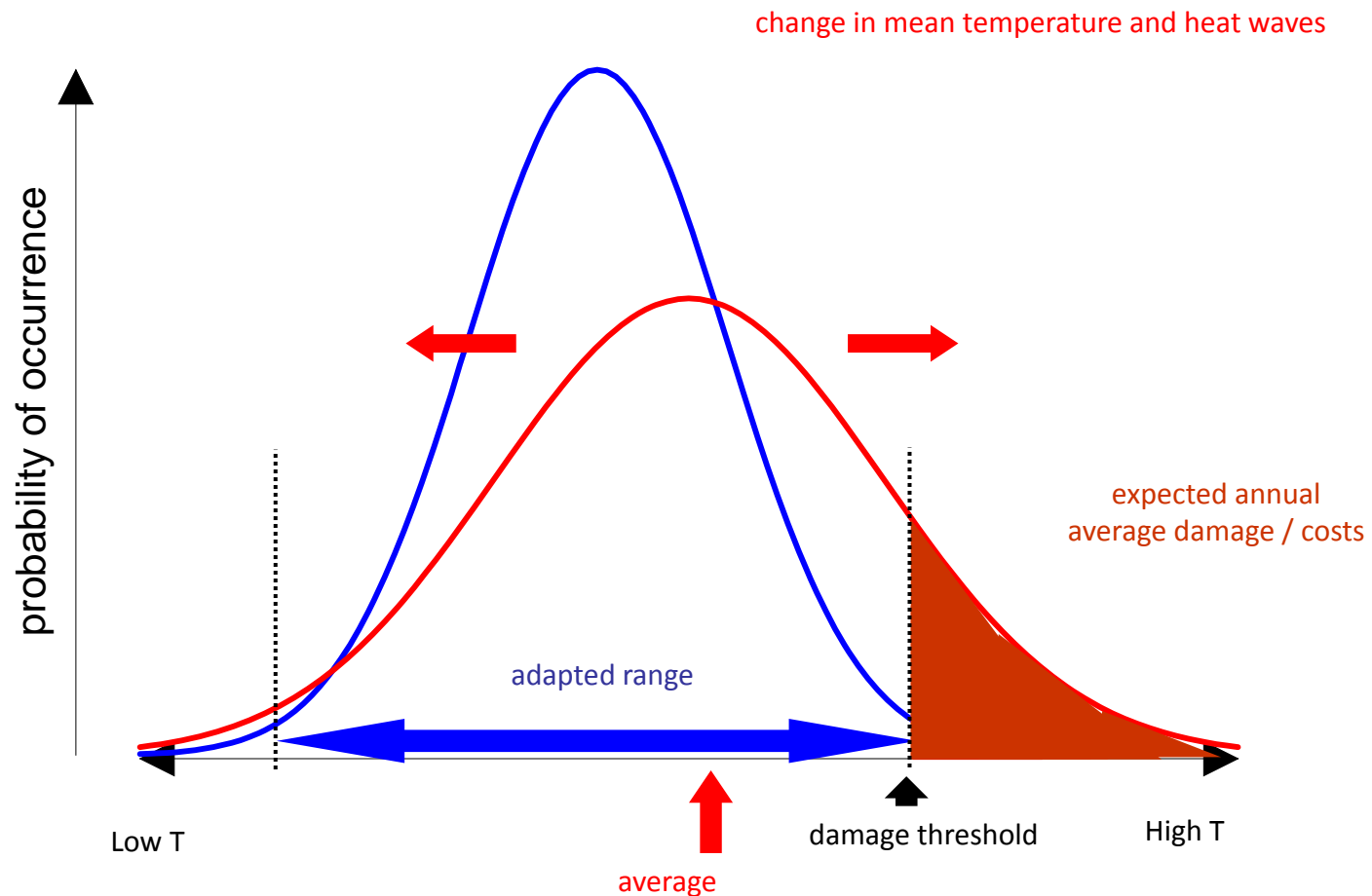
Schematic example: warmer temperatures



Weather vs average climate



Weather vs average climate

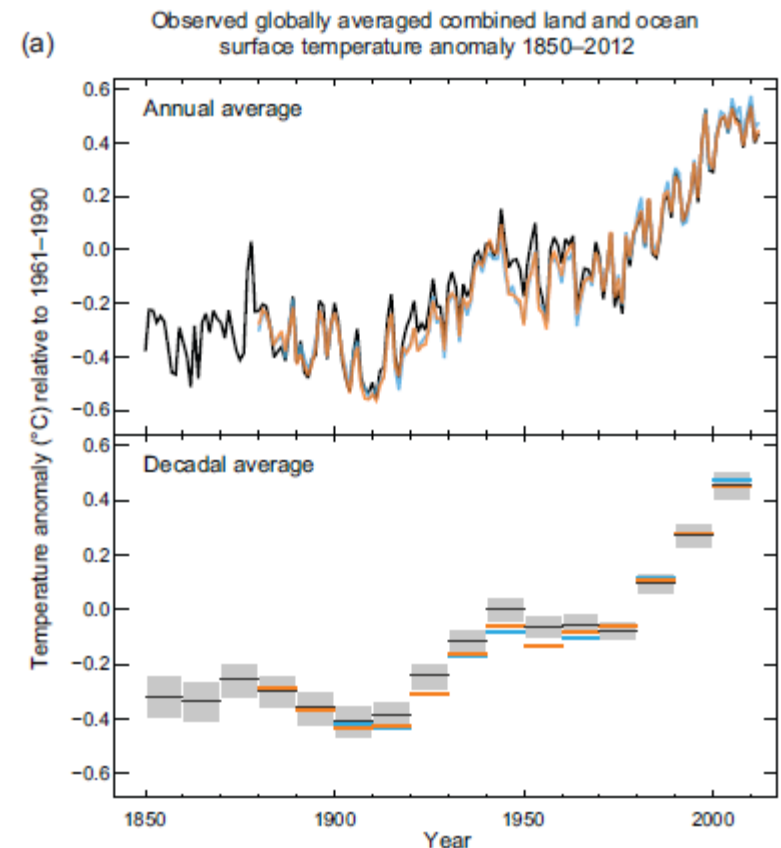


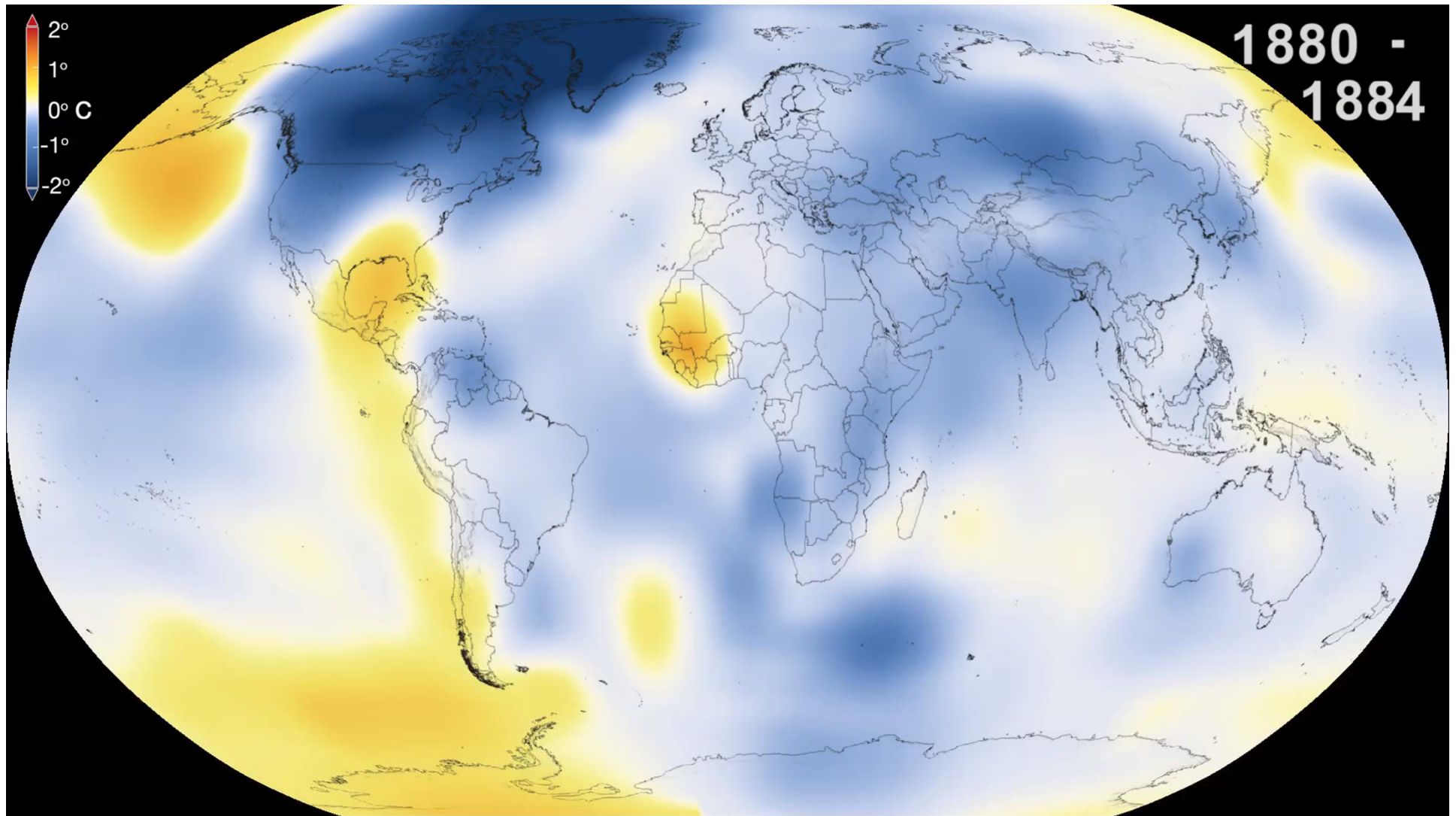
Climate Influences on AK

- Alaska is affected by
 - El Niño-Southern Oscillation (ENSO) 1-2 years
 - Interdecadal Pacific Oscillation (IPO) 20-30 years
 - Climate change/global warming 50-100+ years
- Climate features influence westerly flow over S. AK.
 - Track of storms, temperature, rainfall, snowfall
 - Decades of stronger/weaker westerlies
 - Westerlies increasing in winter through the coming century

Variability vs Change

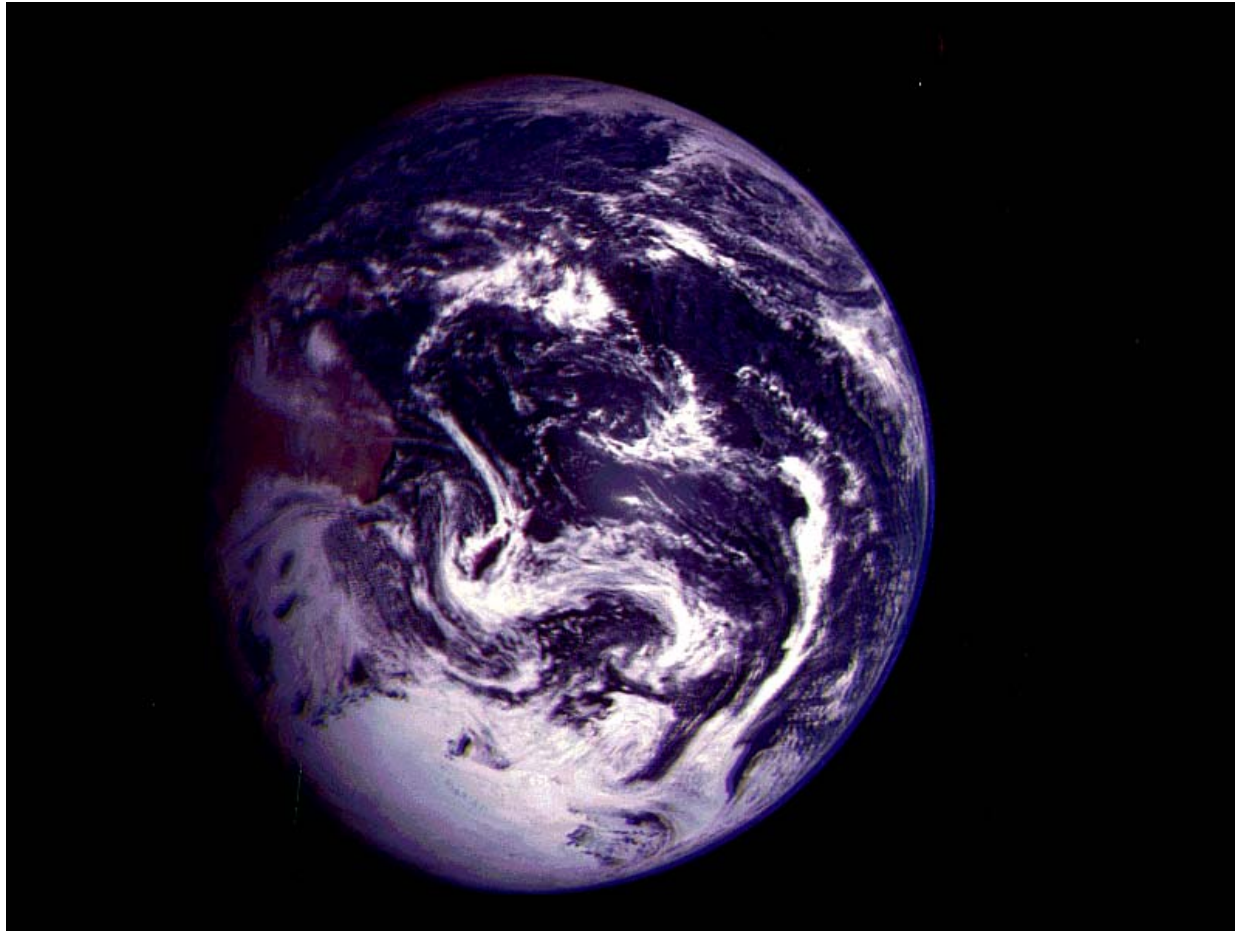
- Decadal climate variability vs Climate change?
- When does a pattern indicate a “change”?
 - The 10 warmest years in the instrumental record, with the exception of 1998, have now occurred since 2000.





**Progression of changing global surface temperature anomalies from 1880 through 2014.
Higher than normal temperatures are shown in red and lower than normal temperatures are shown in blue.
The final frame represents the global temperatures 5-year averaged from 2010 through 2014.**

Climate Change



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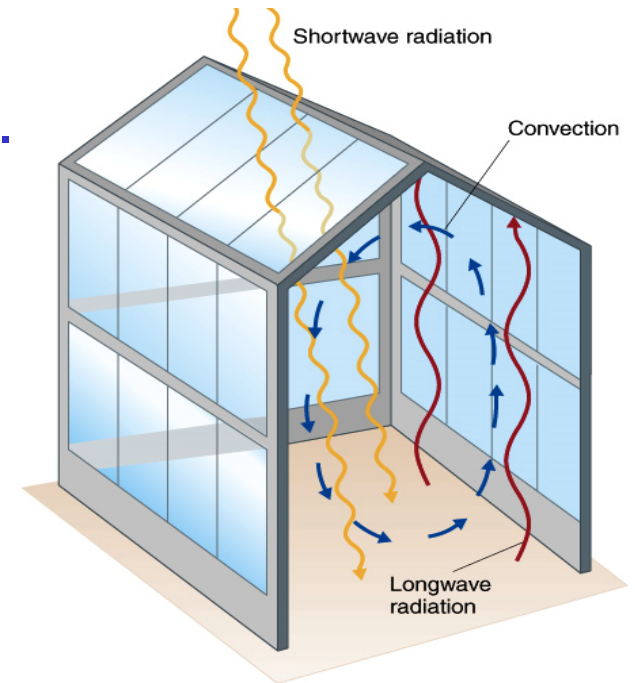


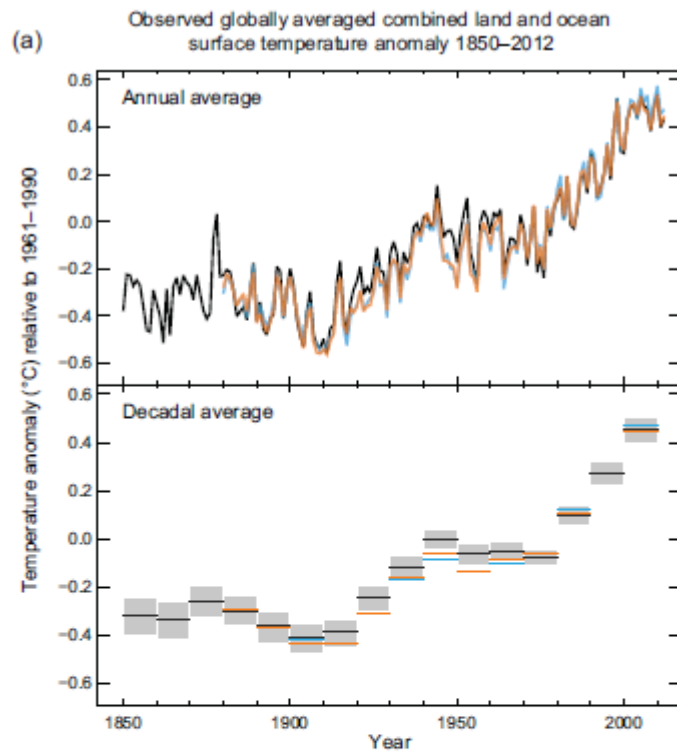
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Background

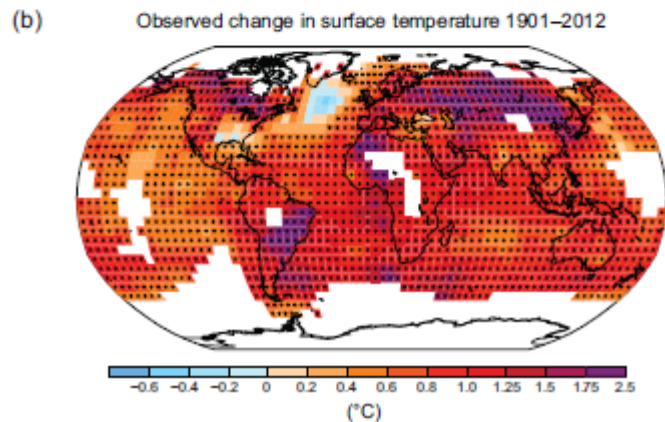
- Carbon dioxide (CO_2) is an important trace gas in Earth's atmosphere
 - Approx. 0.04% (400 parts per million).
- Despite small concentration, CO_2 is a potent greenhouse gas and plays a vital role in regulating Earth's surface temperature.
 - Without greenhouse gasses the Earth's temp would be -18°C (0°F)
- But industrial revolution has greatly increased CO_2
 - Resulted in global temp increase of 0.8°C since 1880



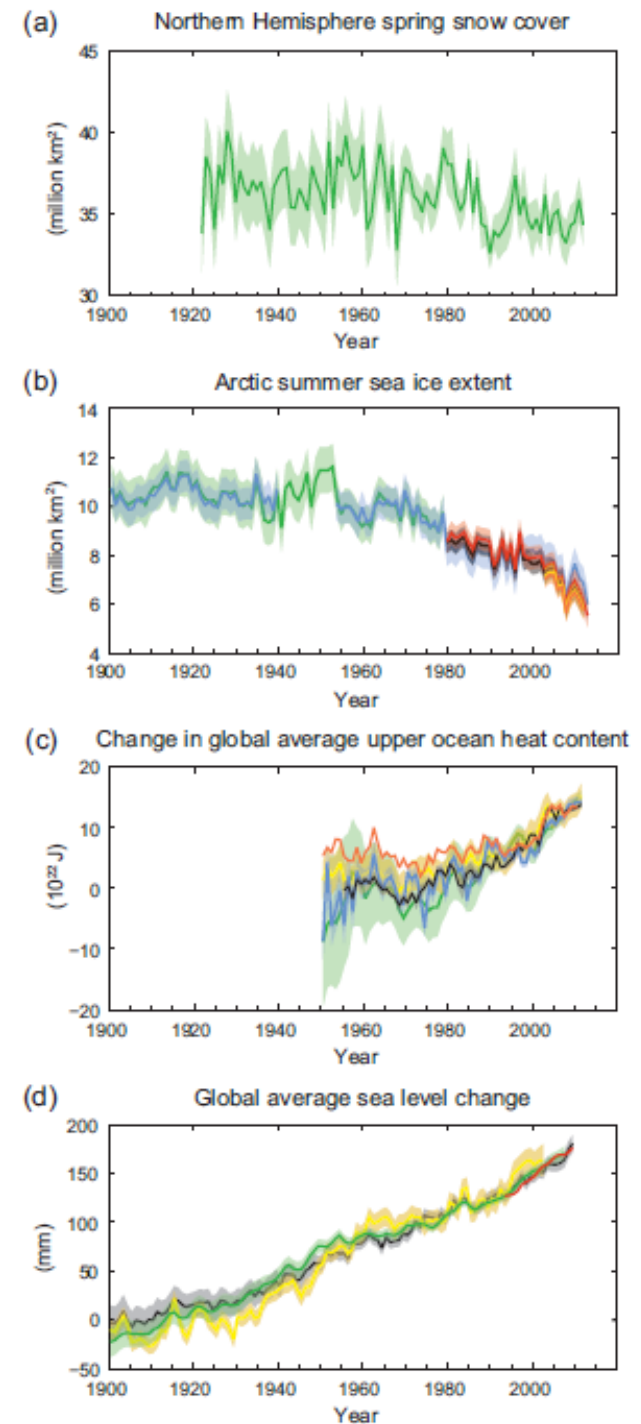


Warming in the climate system is unequivocal

IPCC, 2015



Source: IPCC AR5

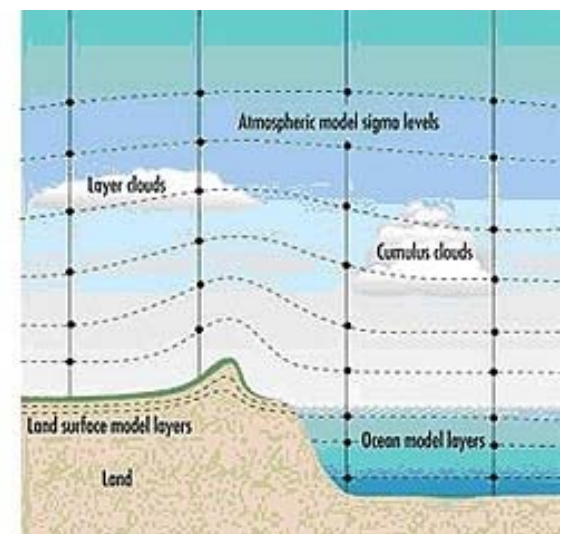


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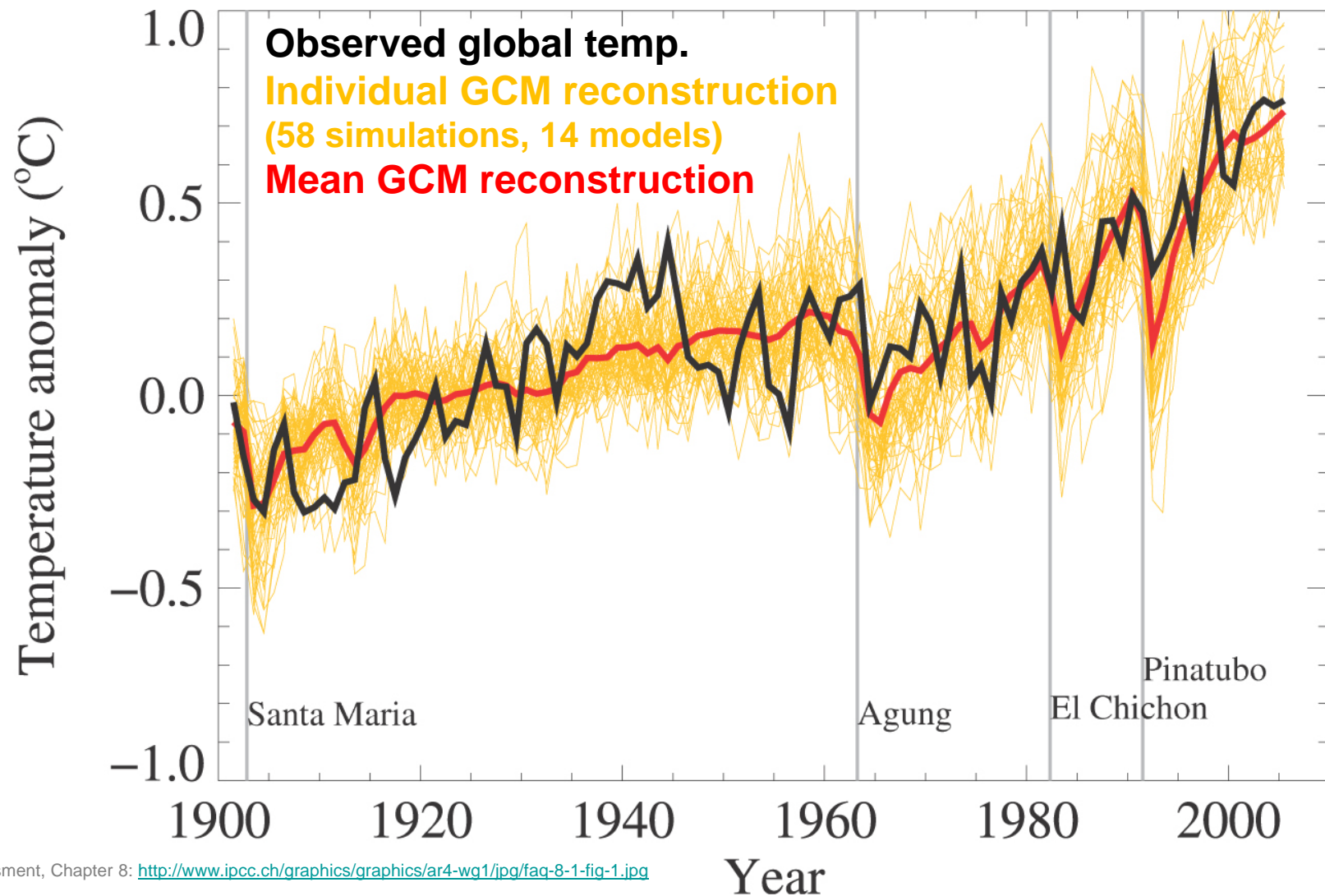


General Circulation Models (GCMs):

- Account for 3D properties of the atmosphere and ocean
- Predictions based on range of weather and climate variables
- Connect to RCM for local / regional resolution



How accurate are GCMs?



IPCC 4th Assessment, Chapter 8: <http://www.ipcc.ch/graphics/graphics/ar4-wg1/jpg/faq-8-1-fig-1.jpg>

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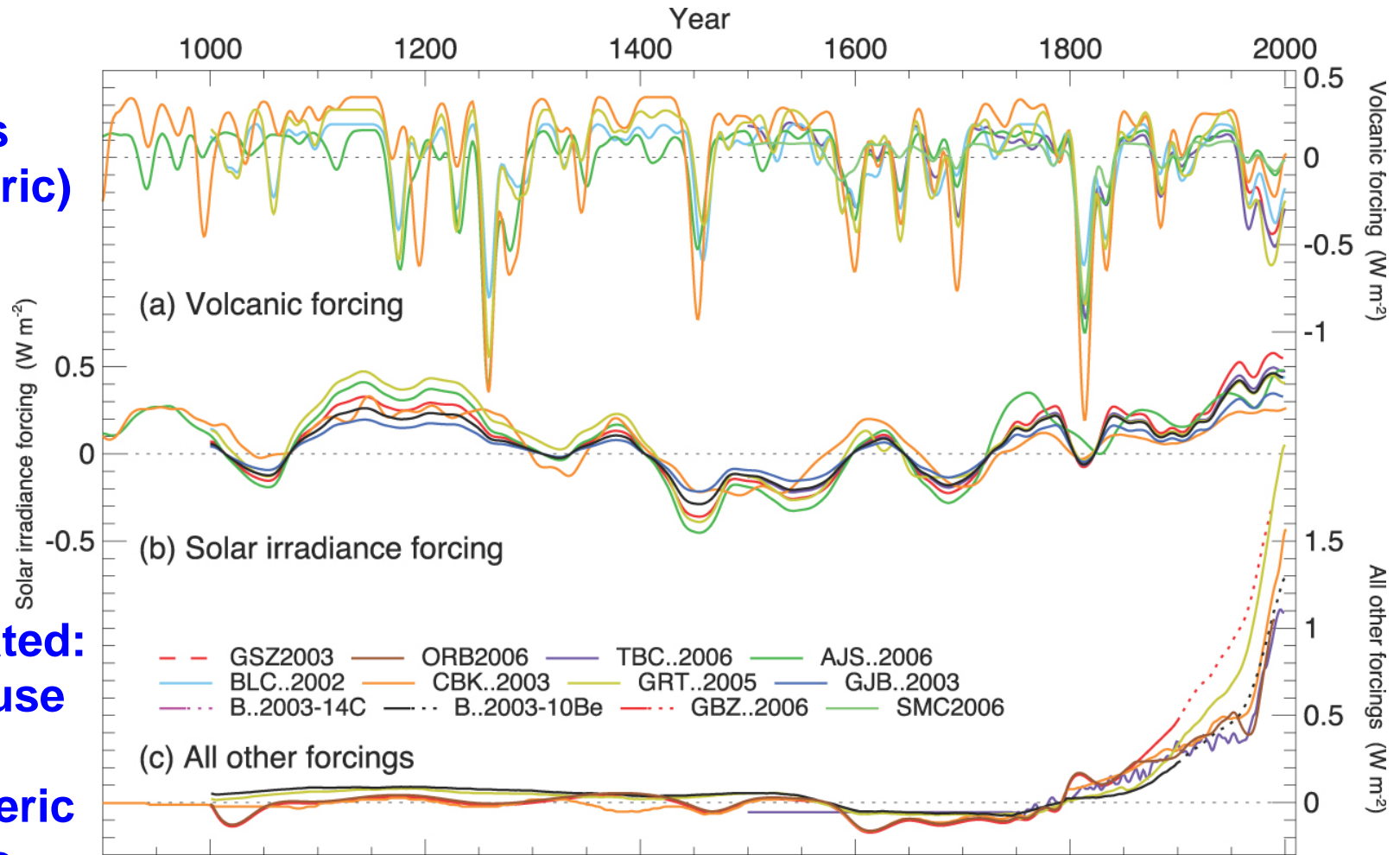
Why is climate warming?

**Aerosols
(stratospheric)**

**Solar
output**

Human-related:

- greenhouse gasses
- tropospheric aerosols



IPCC 4th Assessment, Chapter 6, Fig. 13: <http://www.ipcc.ch/graphics/gr-ar4-wg1.htm>

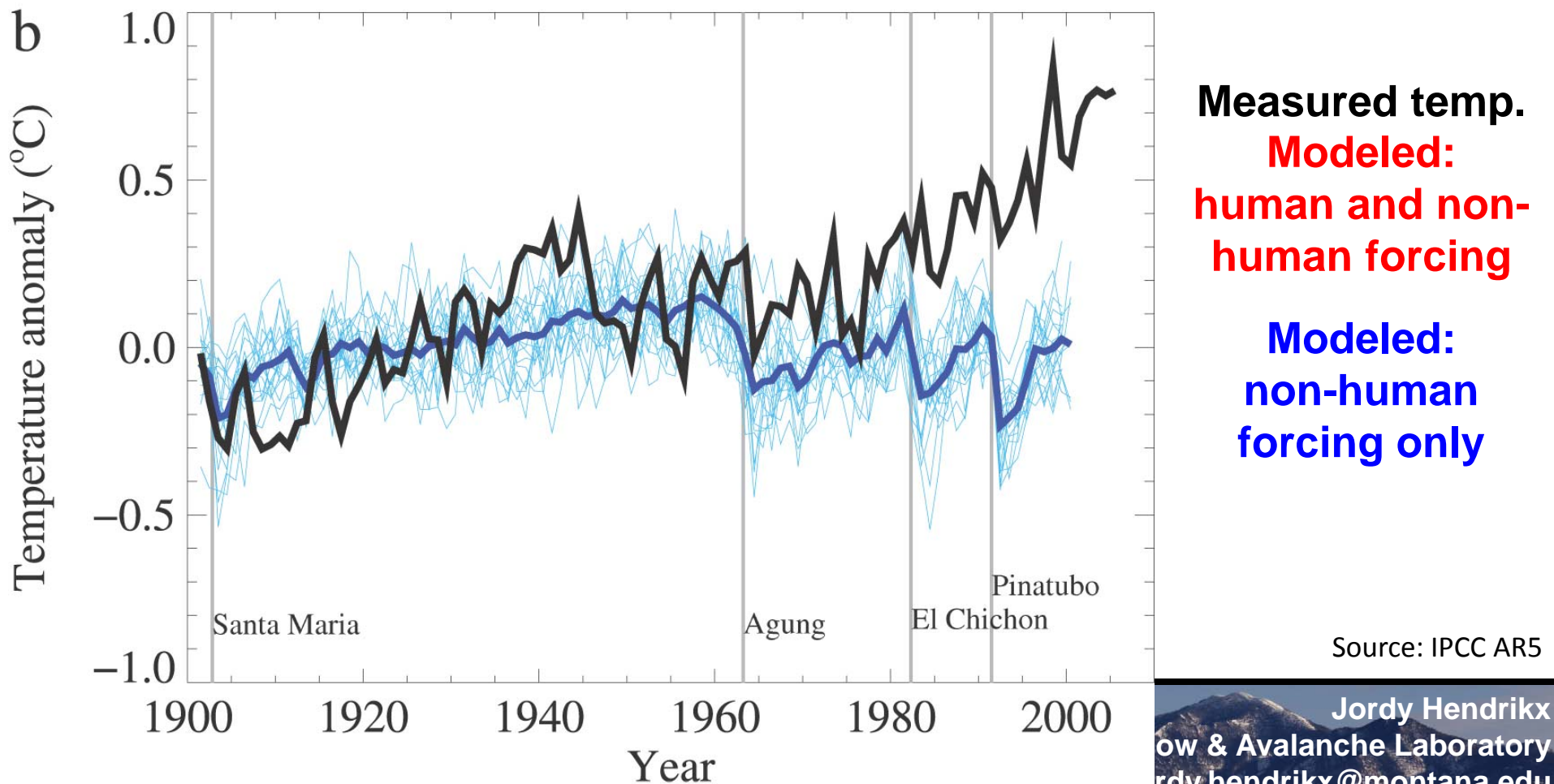
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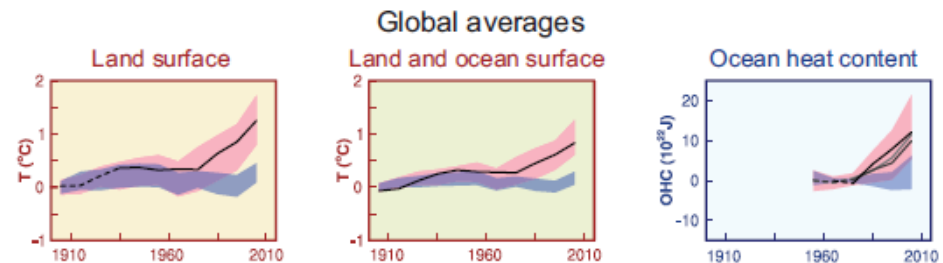
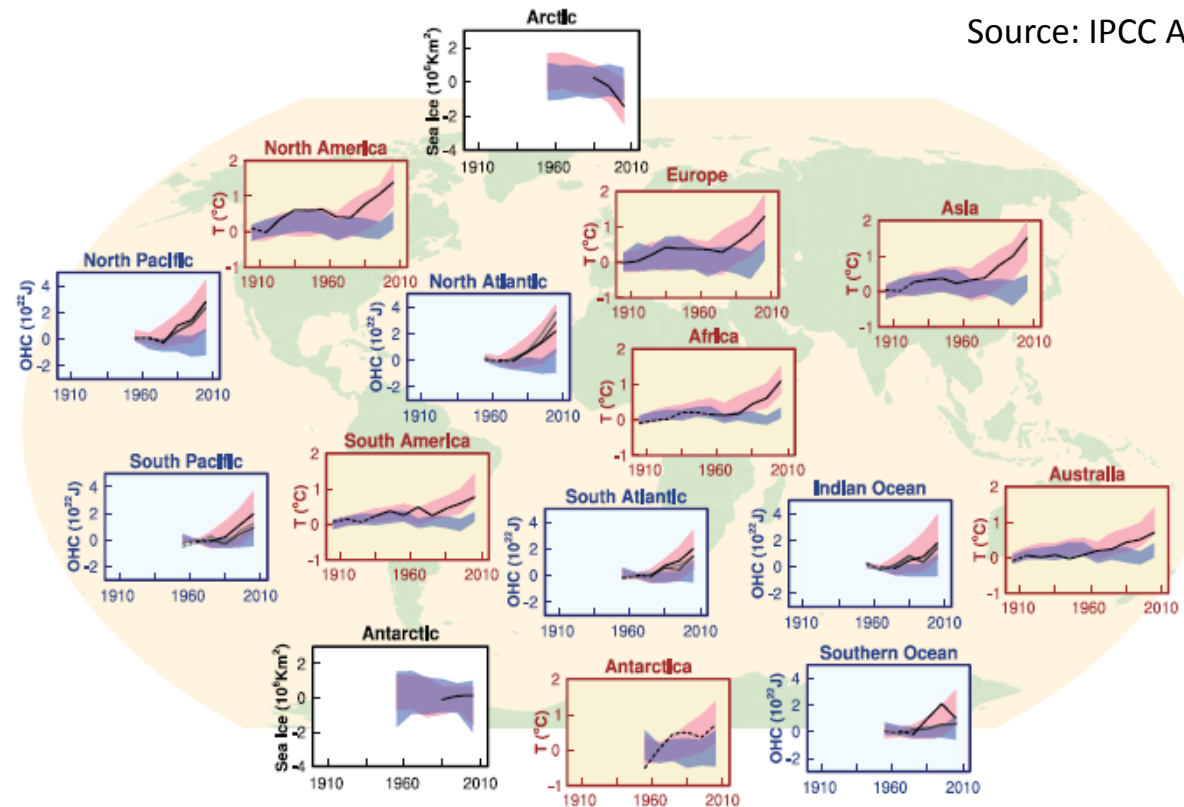
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Why is climate warming?

- Run an experiment with GCMs:



Globally we observe the same mismatch without the anthropogenic forcings.

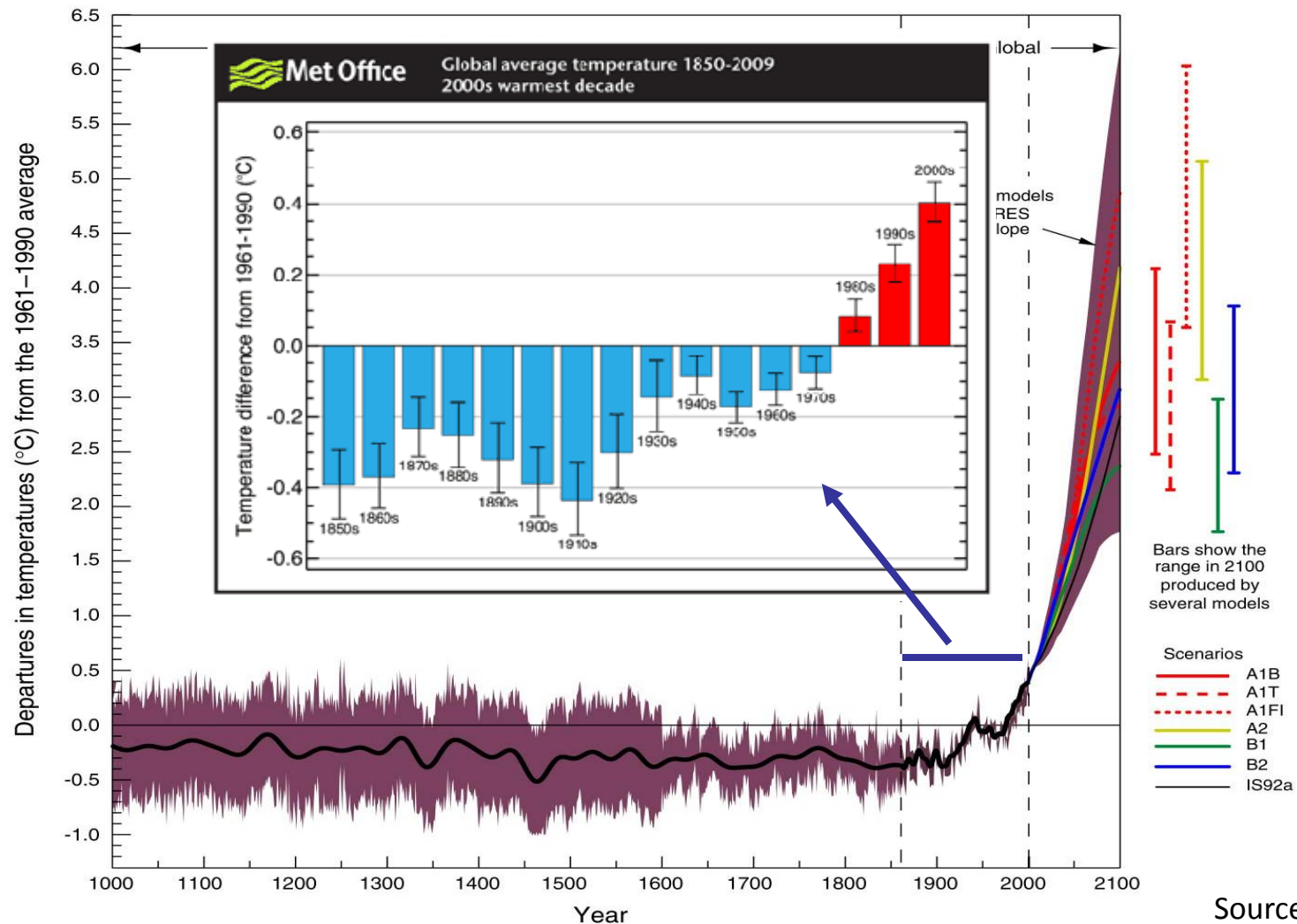


≡ Observations

Models using only natural forcings

Models using both natural and anthropogenic forcings

Past & predicted future temperatures



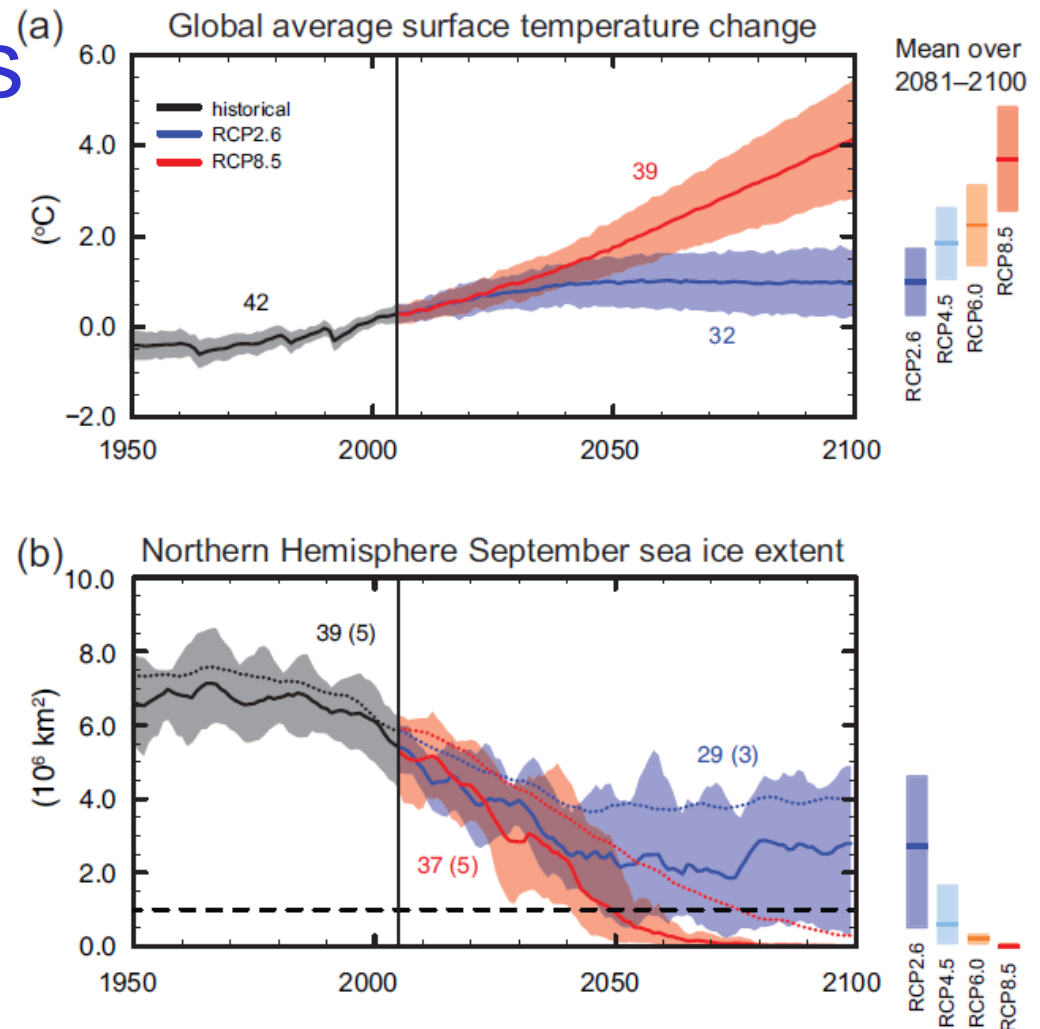
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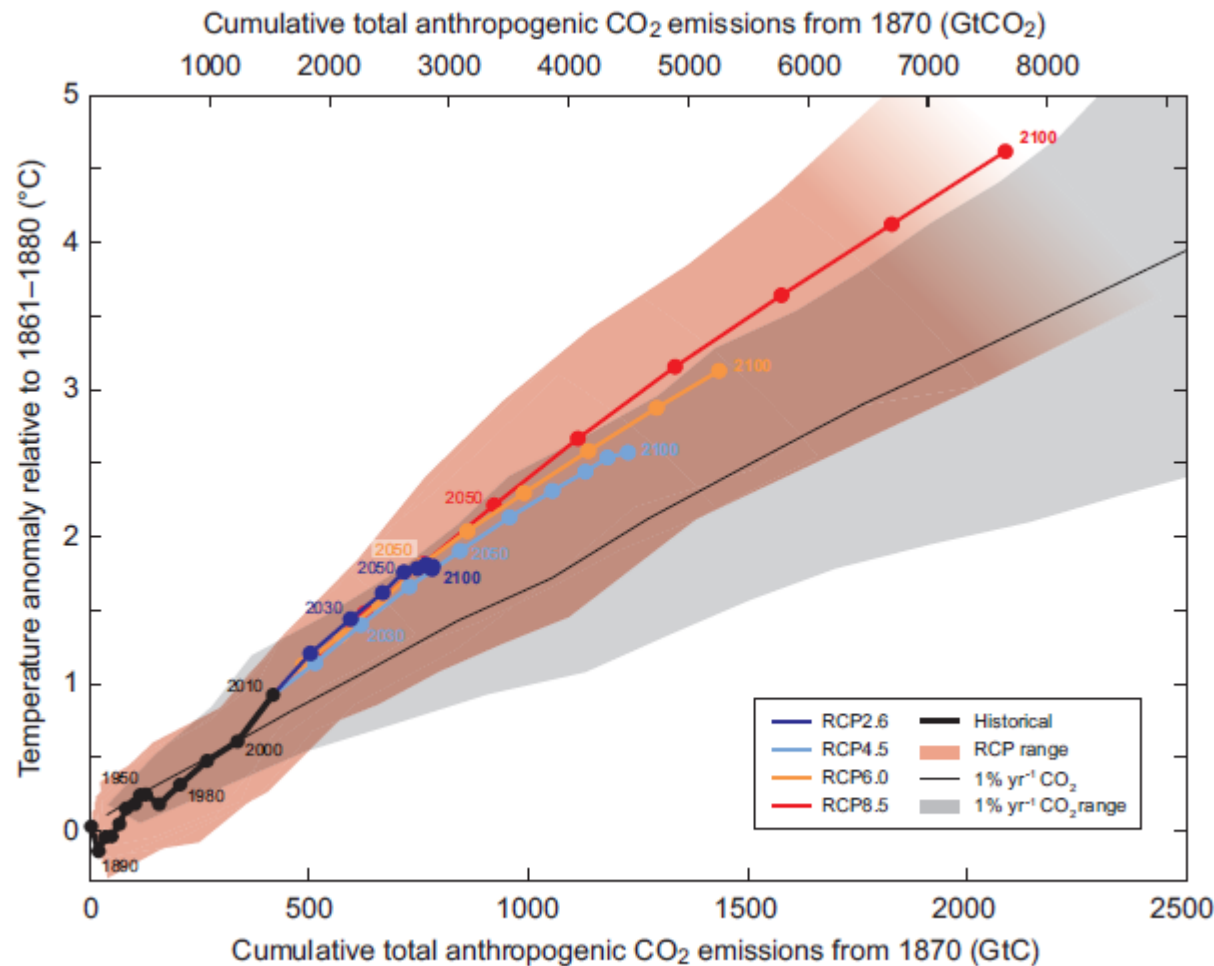
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Future projections

- Future change will depend on global emissions.
- Scenarios developed:
 - Representative Concentration Pathway (RCP)
 - RCP8.5 (8.5 Wm^{-2}) in 2100, 1370 ppm, 3.7°C
 - RCP2.6 (2.6 Wm^{-2}) in 2100, 490 ppm, 1.0°C



Observed changes: greenhouse gases



Observed emissions tracking near the upper RCP trajectory.

Source: IPCC AR5

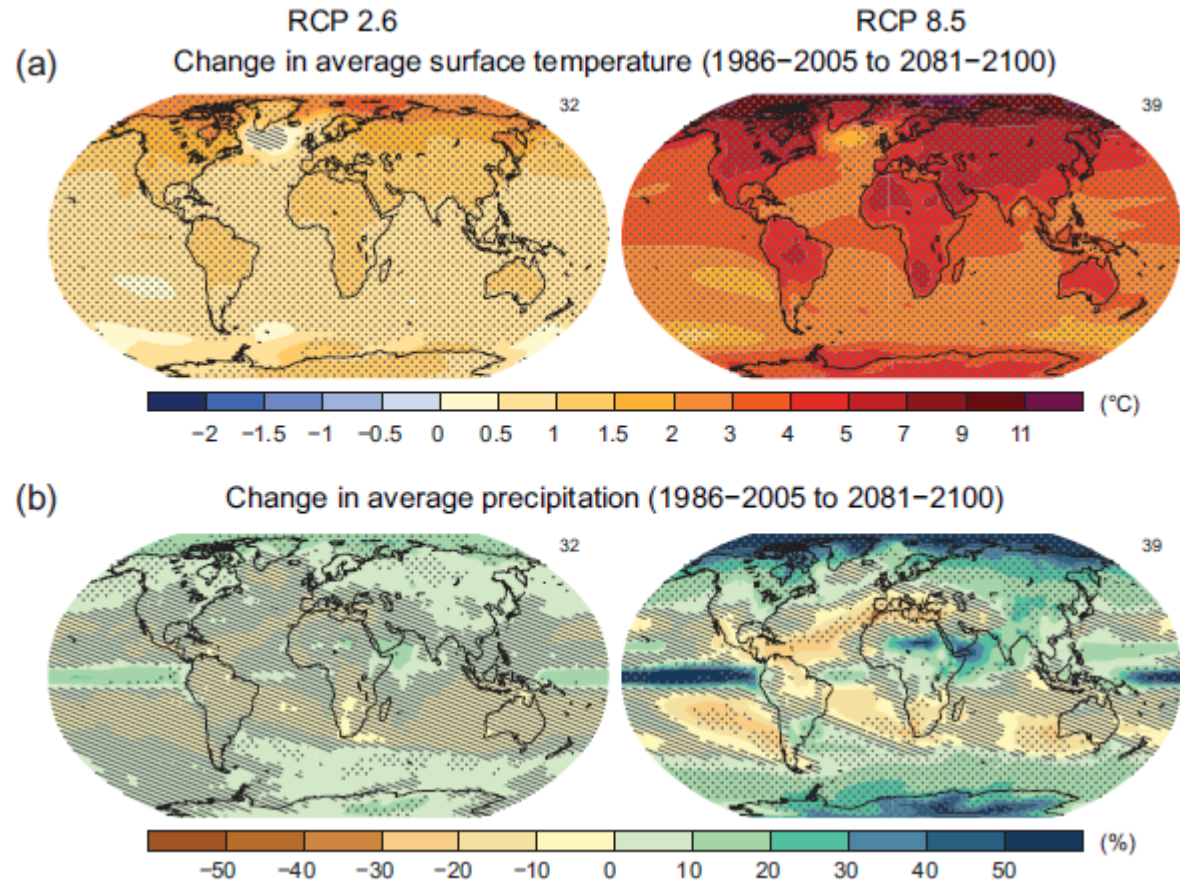
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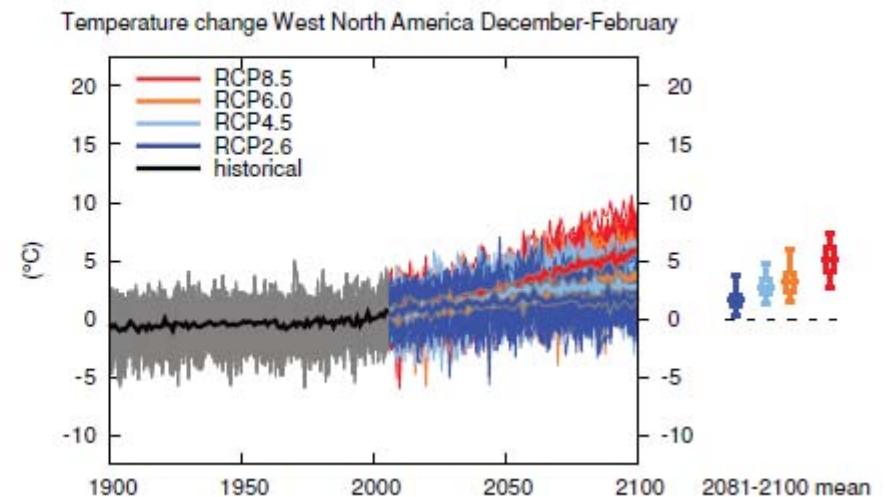
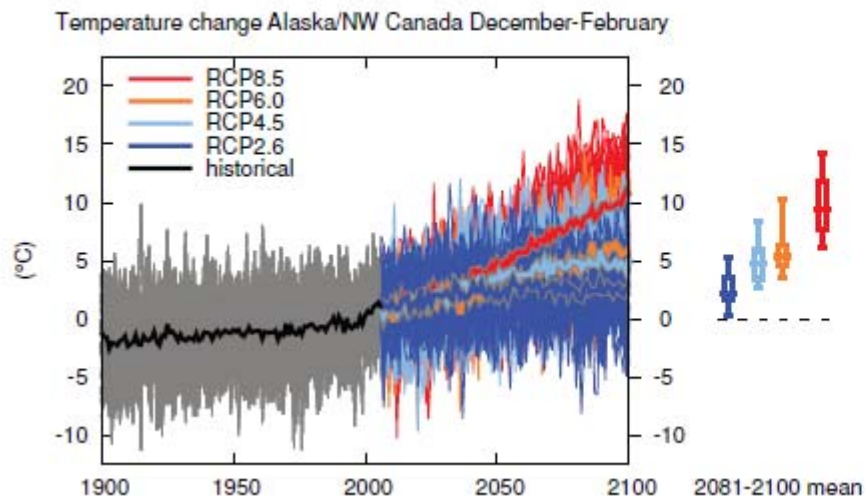
Projected Future Temperatures

- Projected warming in 21st century is expected to be
- **Greatest** over land and at most northern latitudes
- **Least** over the Southern Oceans and parts of the North Atlantic Ocean



Alaska vs the lower 48?

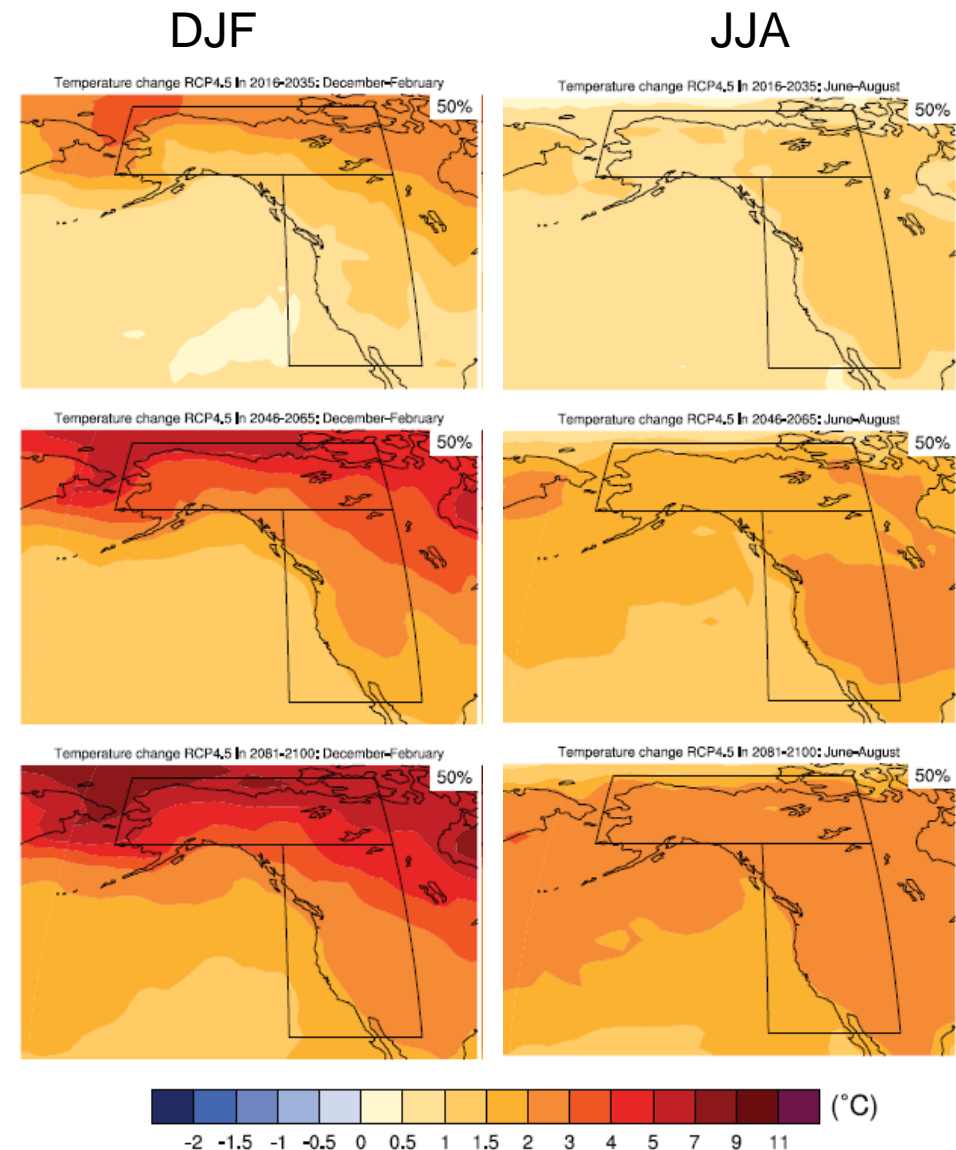
- Alaska will warm much faster than the lower 48
 - Arctic Amplification
- Most pronounced in the winter (DJF)



AK Temperature Projections 2090s

Source: IPCC AR5

- Winters warming much more than summers
- More warming in far north



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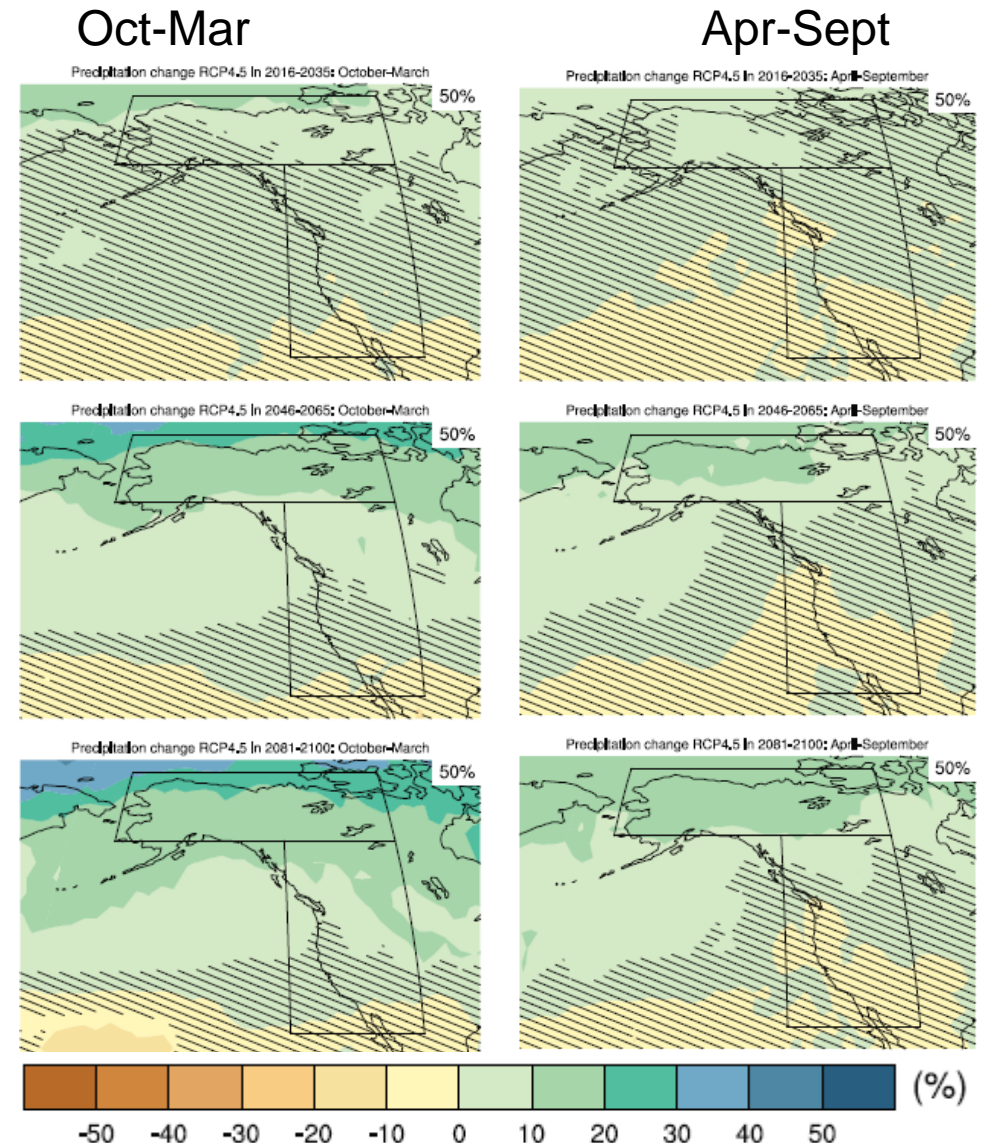


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AK Precipitation Projections 2090s

Source: IPCC AR5

- Winters will be much wetter, and more so than the summers.
- More increases in precipitation in far north.

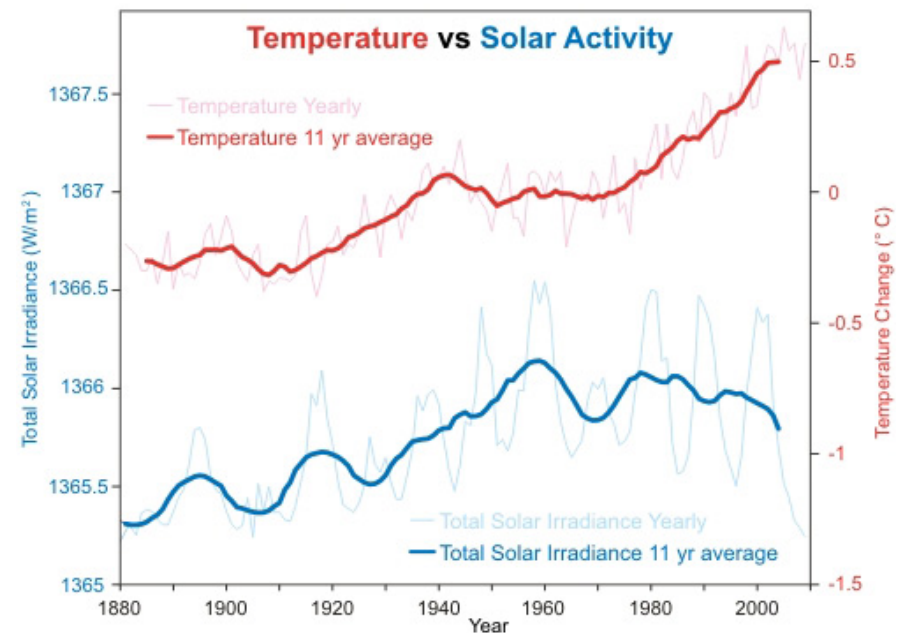


Some common myths..

- *The climate has changed before:*
 - Greenhouse gasses (mainly CO₂) were involved in most of the climate changes in Earth's past.
 - When they were reduced, the global climate became colder. When they were increased, the global climate became warmer.
 - When CO₂ levels jumped rapidly, the global warming that resulted was highly disruptive and sometimes caused mass extinctions.
 - Rate of change is key = We are emitting CO₂ faster than even the most destructive climate changes in earth's past.

Some common myths..

- *It's the Sun:*
 - Over the last 35 years the sun has shown a slight cooling trend. However global temperatures have been increasing.
 - The only way to blame the sun for the current rise in temperatures is by “cherry picking” the data.



<https://www.skepticalscience.com/argument.php>

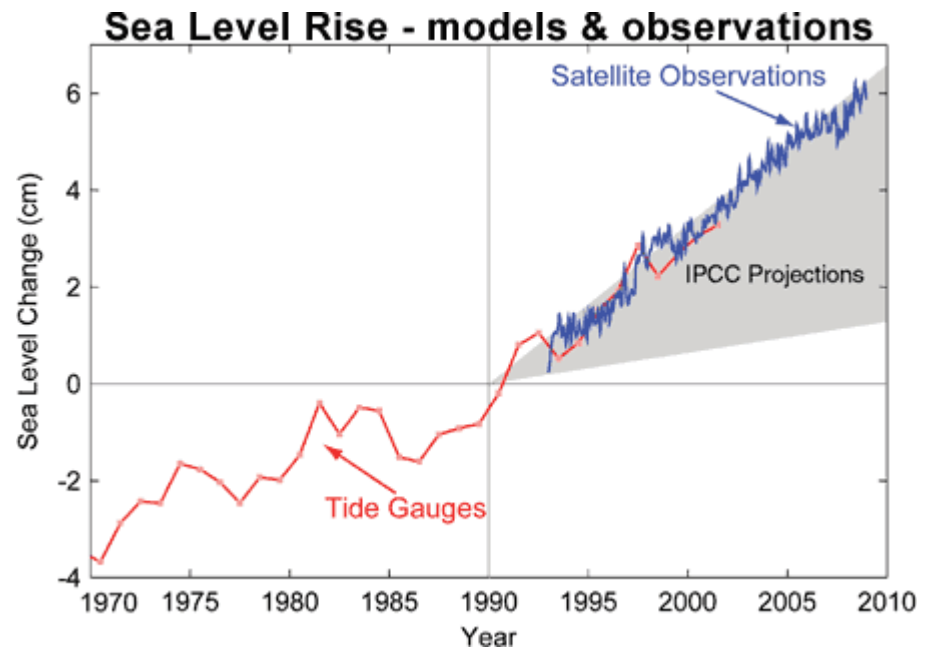
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Some common myths..

- *Models are unreliable:*
 - Climate models are mathematical representations.
 - Models are built to estimate *trends* rather than events.
 - Typically trained on observed data in hindcast mode.
 - The climate models are likely conservative in the predictions they produce.



Summary

- Climate change is real
- We have observed it across a range of indicators
 - Temperatures / Sea ice / Snow cover / Glaciers etc.
- It is being caused by human emissions
- It will have a substantial impact on Alaska over the next 10+ – 100s of years
- Our choices **CAN** make a difference!
- More information
 - <https://www.ipcc.ch/report/ar5/>