

# Trends in 20<sup>th</sup> Century Climate

- Material taken from the most recent IPCC report
  - Found here: [www.ipcc.ch](http://www.ipcc.ch) (click on “Publications and Data”)
  - What is the IPCC?
- Global Trends
- Regional Trends
- Pacific Northwest
- Summary

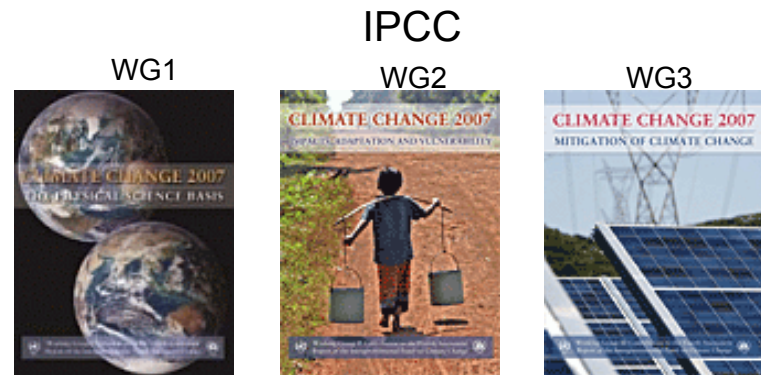
Readings: 4<sup>th</sup> Assessment of Climate Change by the IPCC; Chapter 3 and the executive Summaries of Chapters 4 and 5 in the Working Group 1 Report.  
[www.ipcc.ch/publications\\_and\\_data/ar4/wg1/en/contents.html](http://www.ipcc.ch/publications_and_data/ar4/wg1/en/contents.html)

- Mandate of the IPCC
  - to provide the decision-makers and others interested in climate change with an objective source of information about climate change.
  - to assess on a comprehensive, objective, open and transparent basis the latest scientific, technical and socio-economic literature produced worldwide relevant to the understanding of the risk of human-induced climate change, its observed and projected impacts and options for adaptation and mitigation.
- The IPCC does not conduct any research nor does it monitor climate related data or parameters
- IPCC reports
  - must be of high scientific and technical standards, and aim to reflect a range of views, expertise and wide geographical coverage.
  - must be neutral with respect to policy, although they need to deal objectively with policy relevant scientific, technical and socio economic factors.

## What is the IPCC?

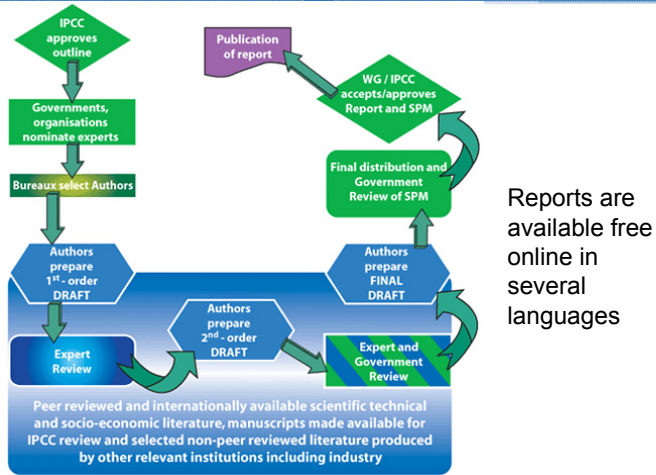
- WHAT?
  - A scientific intergovernmental body set up by the World Meteorological Organization (WMO) and by the United Nations Environment Programme (UNEP)
- WHO?
  - Thousands of scientists all over the world contribute to the work of the IPCC as authors, contributors and reviewers
  - Governments participate in plenary Sessions of the IPCC where main decisions about the IPCC work program are taken and reports are accepted, adopted and approved. They also participate in the review of IPCC Reports.

[www.ipcc.ch/about/index.htm](http://www.ipcc.ch/about/index.htm)



- Regular Assessments mandated by governments (UN) 1990, 1995, 2001, 2007, 2014 ...
- Summarize state of climate science\* (WG1), impact of climate change (WG2), and possible mitigation options (WG3)

\* Must be published in the peer-reviewed literature



A typical IPCC report takes ~ five years to produce and involves ~2700 scientists

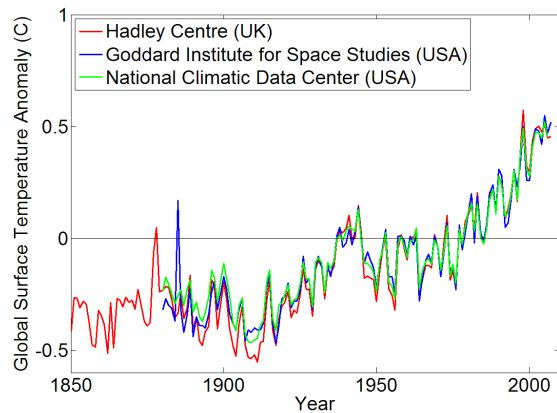


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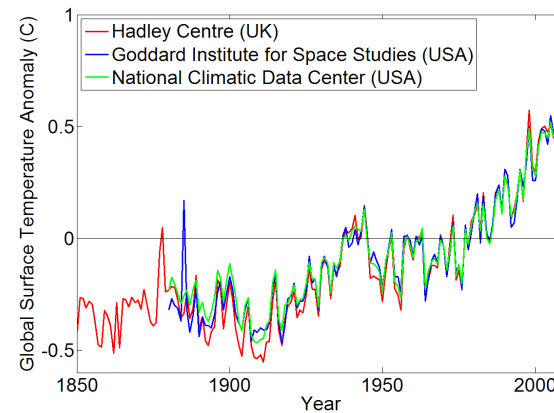
### Increasing surface temperature: vocabulary

"Global-Annual Average Surface Temperature (GAAST)"  
 primarily index of change (although not what we really care about)



"Temperature Anomaly" change with respect to some reference period (here 1961-1990)

"How accurate is the surface temperature record?"



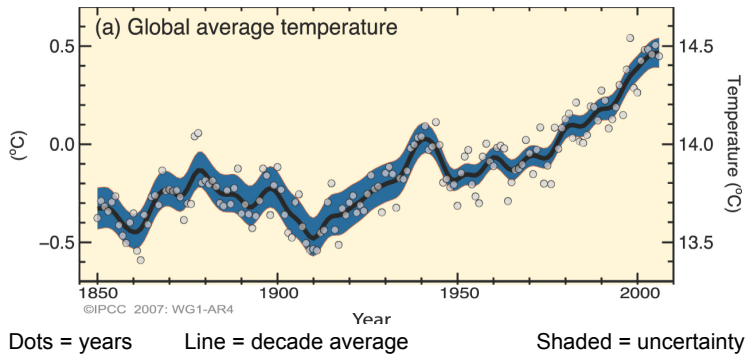
#### Quantifying Uncertainty

- key aspect of scientific method, knowledge
- Often difficult to do

#### One (partial) approach:

- independent groups analyzing the ~same data set

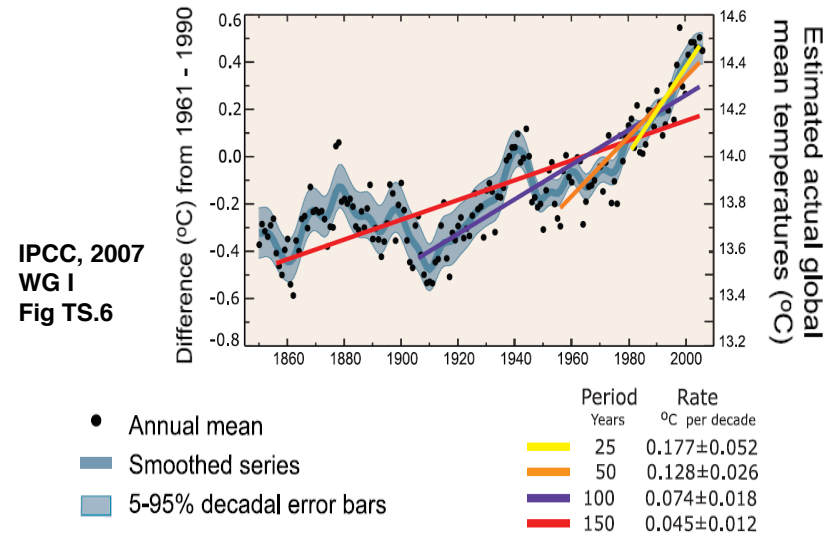
# Global Annual Average Temperature



- The global annual averaged surface temperature has risen about 0.85°C (1.5°F) in the past 100 years
- The past decade is the warmest in the instrumental record

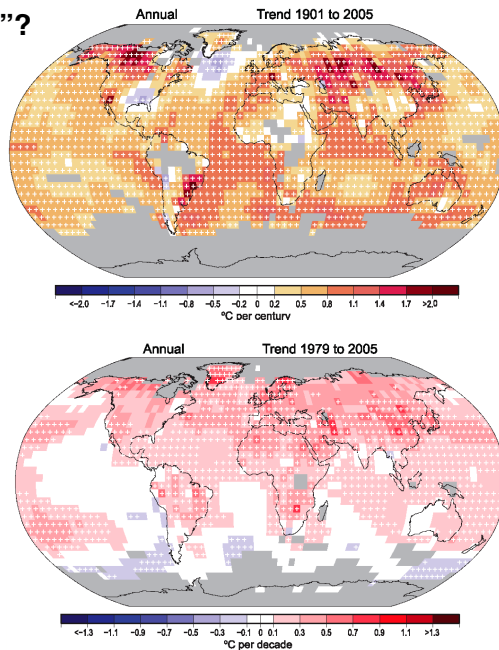
IPCC Fig SPM3

# The warming trend is accelerating



## Is the warming "Global"?

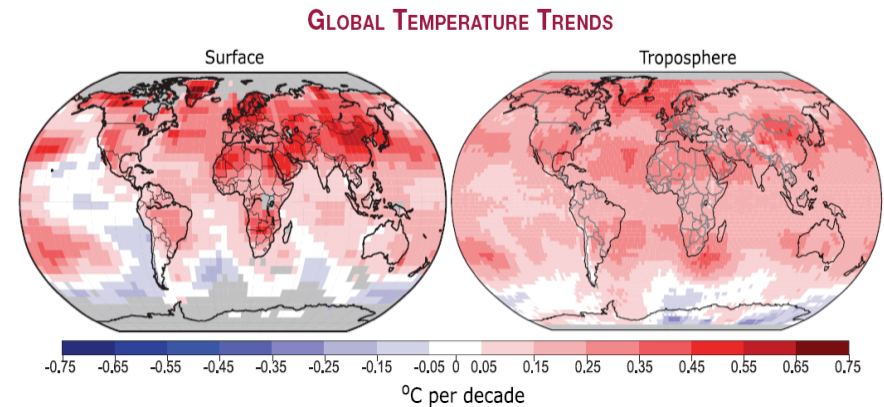
IPCC, 2007, WG I, Fig 3.9: Patterns of linear warming trends for the surface air temperature for the periods (top) 1901-2005 and (bottom) 1979-2005.



Trends significant at the 5% level are indicated by white + marks. Grey areas: not enough data to determine trend.

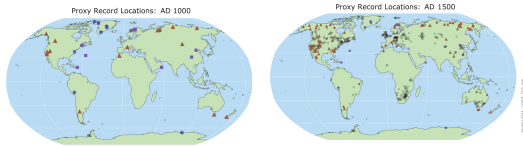
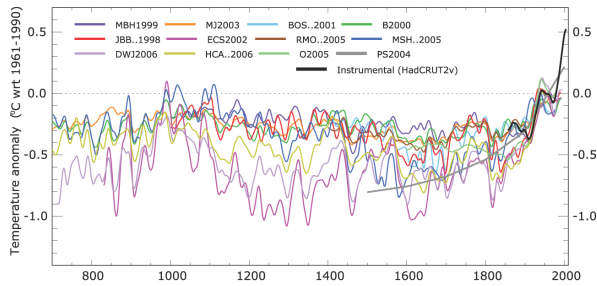
Yes, although enhanced over land at in northern extratropics (as expected)

## Warming extends above the surface



IPCC, 2007, WG I, Fig TS.6: Patterns of linear warming trends over the period 1979-2005 for the surface (left, from thermometers) and lower atmosphere (right, from satellite).

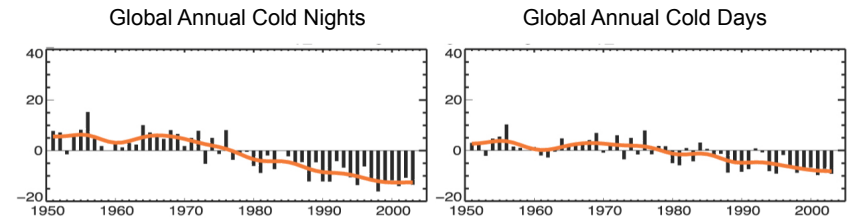
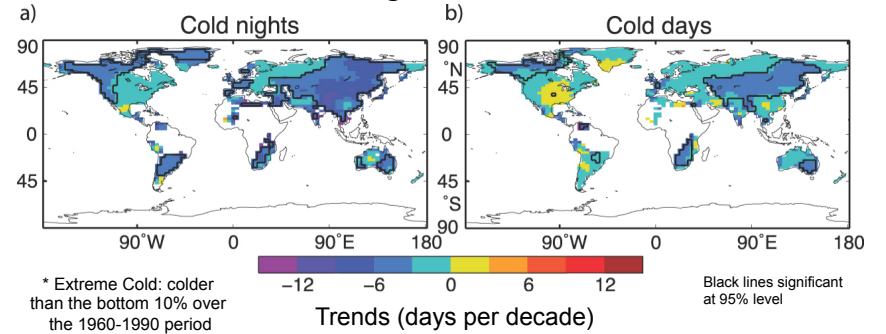
## Northern Hemisphere annual average surface temperature



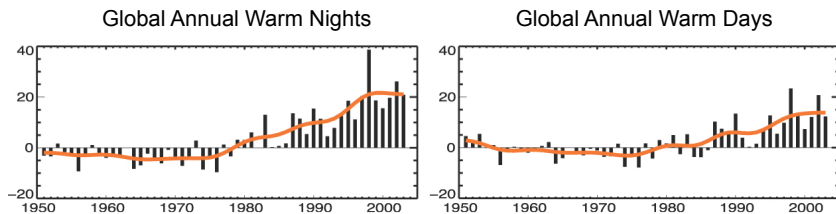
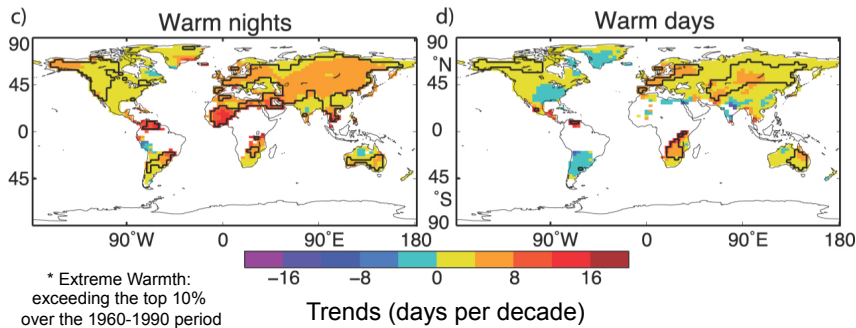
Tree rings ▲ Boreholes ● Ice cores ★ Other ■

IPCC 2007 TS.20

## Decreasing Extreme\* Cold

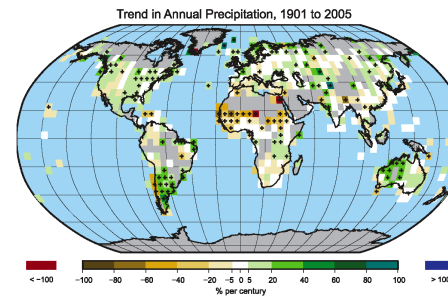


## Increasing Extreme\* Warmth

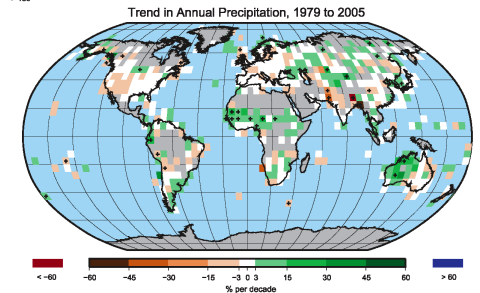


IPCC WG1 2009; FAQ 3.3, Figure 1.

## Trends in Annual Land Precipitation



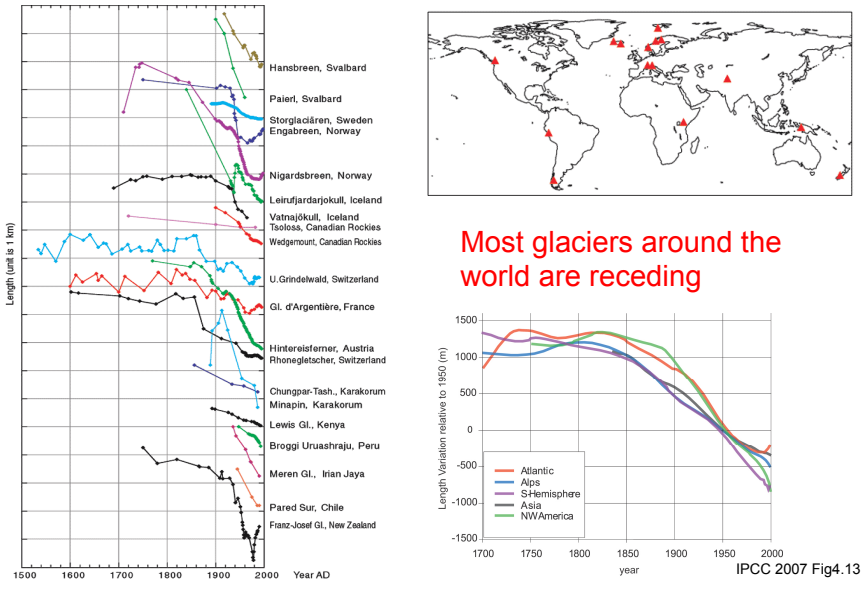
Trend for 1901 to 2005 (left, % per century) and 1979 to 2005 (bottom, % per decade). The percentage is based on the means for the 1961 to 1990 period.



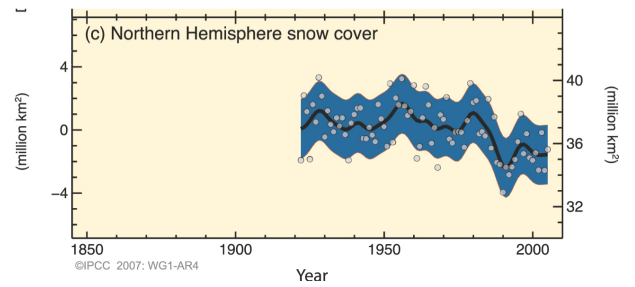
Areas in grey have insufficient data to produce reliable trends. Trends significant at the 5% level are indicated by black + marks.

IPCC WG1 2007 Figure 3.13.

## Changes in Glacier Length 1500-2000



## Northern Hemisphere Snow Cover



Snow cover has decreased by 7.5% since 1922.

Shaded areas show 95% uncertainty levels. Zero represents the 1961-1990 average.

IPCC 2007 WG1 Fig SPM3

## Atmospheric Water Vapor

