IPCC AR5 report states that "it is extremely likely that human influence has been the dominant cause of the observed warming since the mid twentieth century", and that "1983-2012 was likely the warmest 30-year period of the last 1400 years"

Annual Global Land Temperature 0.8 0.6 0.4 0.2 -0 -0.2 -0.4 -0.6 -0.8 1995 1985 1990 2000 2005 2010

A Fundamental Question

Is the increase in temperatures a reflection of a shift in the mean, a change in its variability, or both?

Important question - May be more difficult for society to adapt to increasing climatic variation than altered mean conditions. (Huntingford et al. Nature 2013)



Simplified Example of Operational vs. IPCC Climate Model Run with increasing CO₂ in a Given Year



IPCC uninitialized "Free" run

168 different but plausible summers per year of model runs. Model errors become useful. Can build a nice PDF.

EARLY 1983-1986 LATE 2009-2012

672 summers/period

- Shift in the mean
- Heat Waves more likely



Regional Climate Variability and Change



The Central U.S. Warming Hole

During summer there is a negative temperature anomaly in the midst of continental and global warming - the so called "Warming Hole".

The Great Plains Low-Level Jet (GPLLJ) is linked to the development of the warming hole through the Atlantic Multidecadal Oscillation (AMO) and Pacific Decadal Oscillation (PDO).

Highlights the importance of understanding the interplay between natural and anthropogenic climate change on regional scales.







V850 & Precip Climatology



NALLJ Variability Modes & Precipitation



NALLJ Variability Modes & Precipitation







Changes in Regional Precipitation Variability

Observed Change in Heavy Precipitation



Precipitation is increasing. Is the variability also changing during the 1950-2010 period?

Can count early (1950-79) and recent (1980-2010) epoch 1 SD exceedance.

30-year moving standard deviation for 1950-2010.

Shows that springtime regional precipitation variability is increasing over the last 60 years

NCA - Global climate is changing and this is apparent across the U.S. in a wide range of observations. The global warming of the past 50 years is primarily due to human activities, predominantly the burning of fossil fuels.



Backup Slides

Temperature Difference Between Recent and Early Periods

672 "seasons" for each period Recent = 2009-2012 Early = 1983-1986

