



Kansas and Climate Change

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Simulating human land cover change in global climate models



Outline

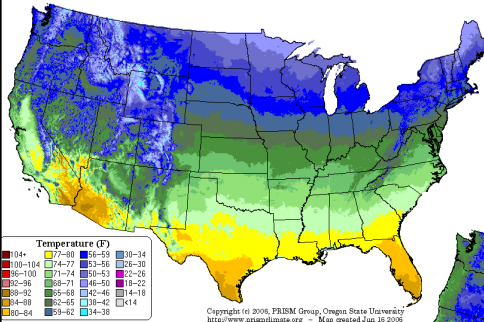
Kansas and climate change

- Background on Kansas Climate
- Kansas Climate over the last century
- Global Climate over the last century
- If we can't trust the weatherman what about climate projections – How reliable are climate models
- Climate projections
- Climate impacts



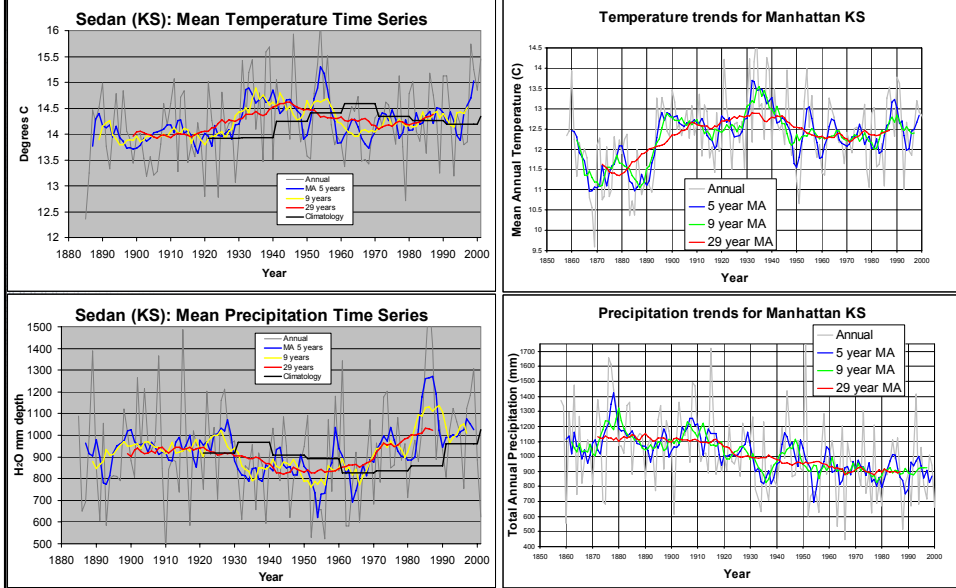
Background on Kansas Climate

Maximum Temperature: Annual Climatology (1971–2000)

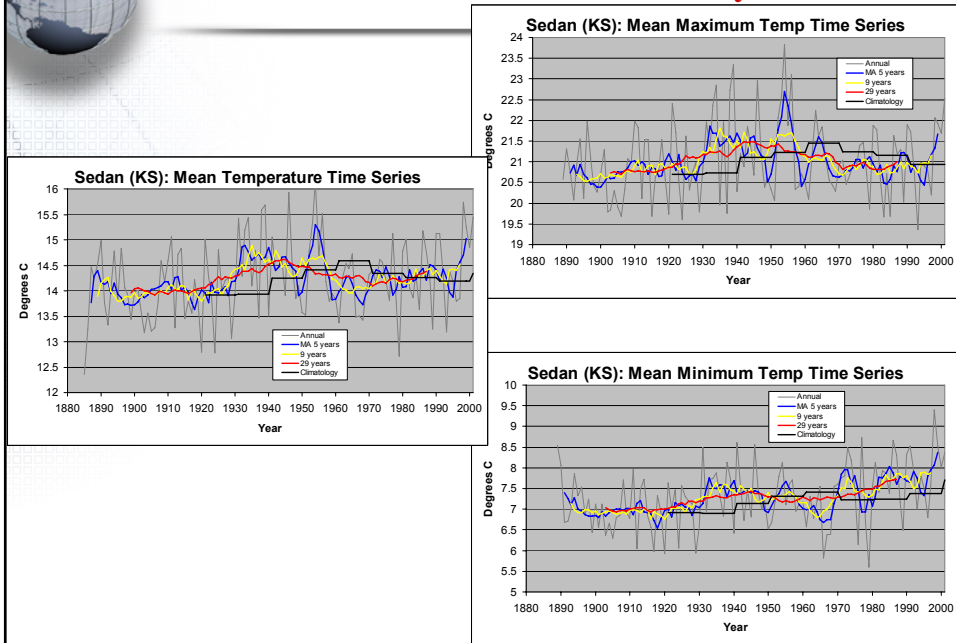




Kansas Climate over the last century



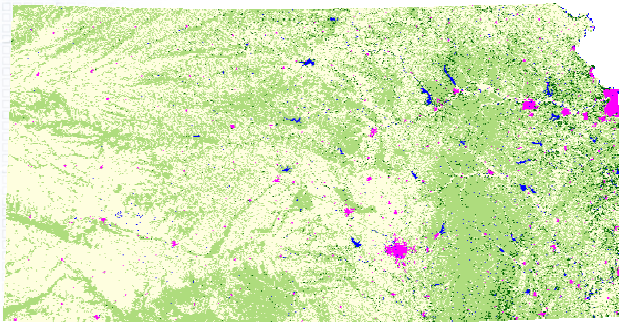
Kansas Climate over the last century





Kansas Climate over the last century

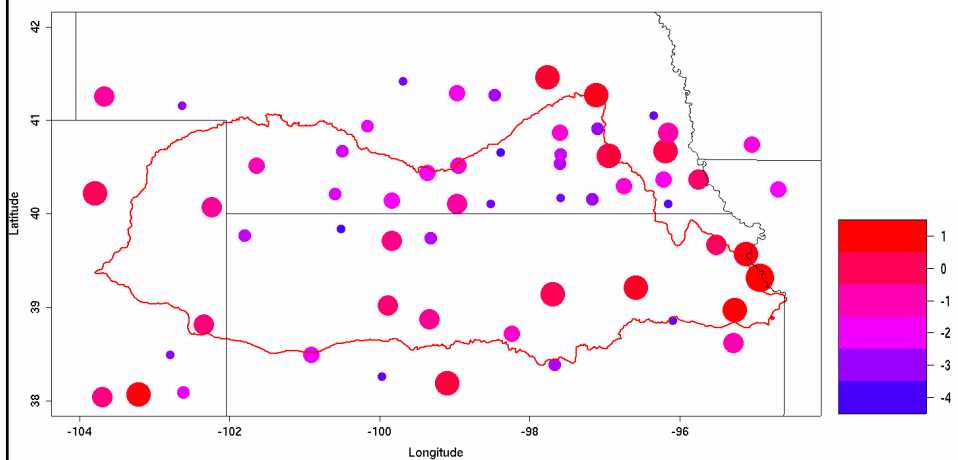
Kansas Land Cover Patterns



- 91 % overall accuracy

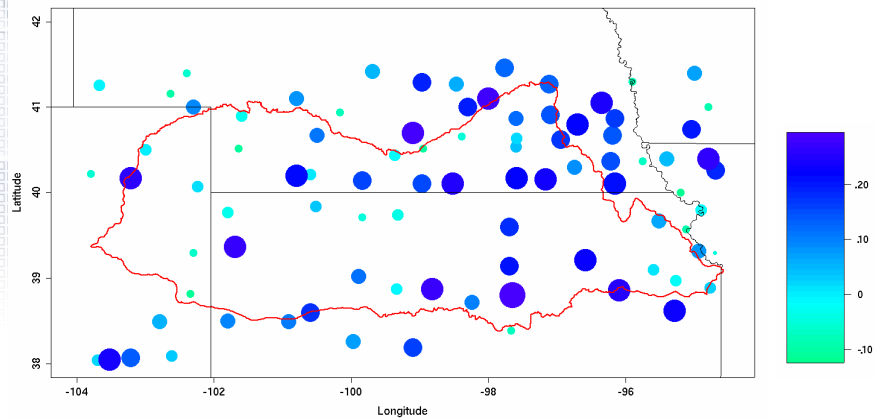


Kansas Climate over the last century

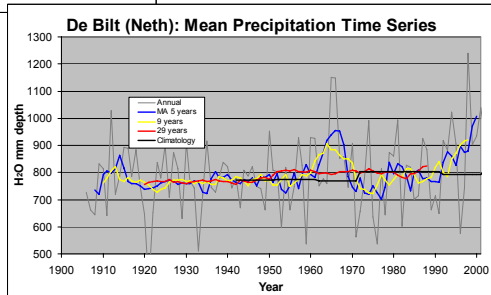
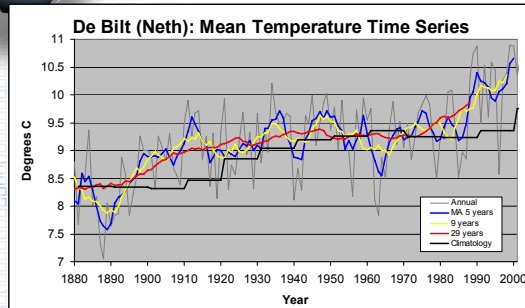




Kansas Climate over the last century



Global Climate over the last century





Global Climate over the last century

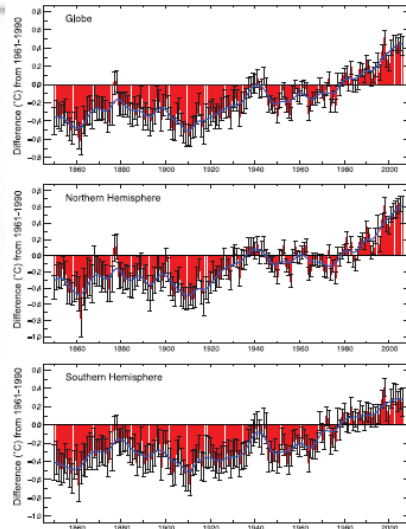
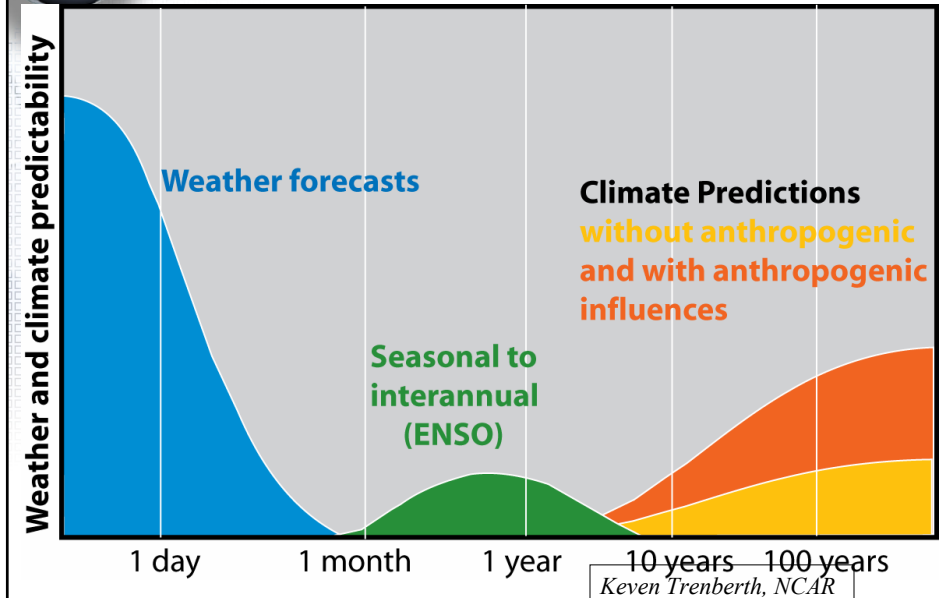


Figure 3.6. Global and hemispheric annual combined land-surface air temperature and SST anomalies $^{\circ}\text{C}$ (red) for 1850 to 2006 relative to the 1961 to 1990 mean, along with 5 to 95% error bar ranges, from HadCRUT3 (adapted from Brohan et al., 2006). The smooth blue curves show decadal variations (see Appendix 3.A).

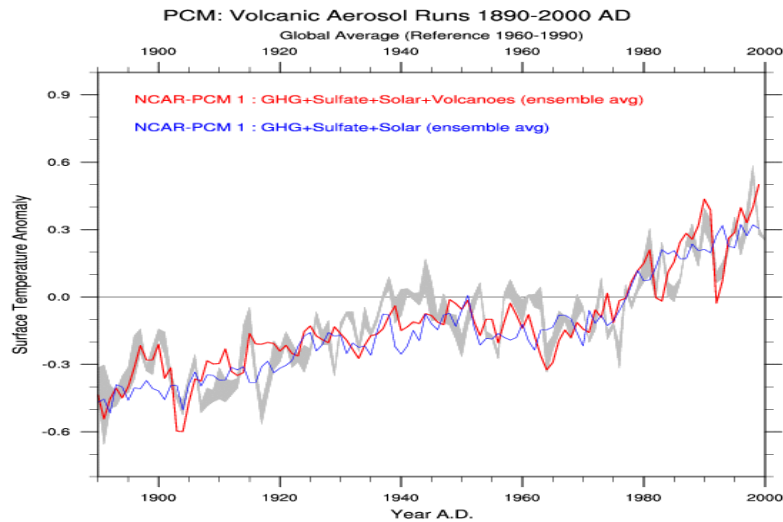


How reliable are climate models

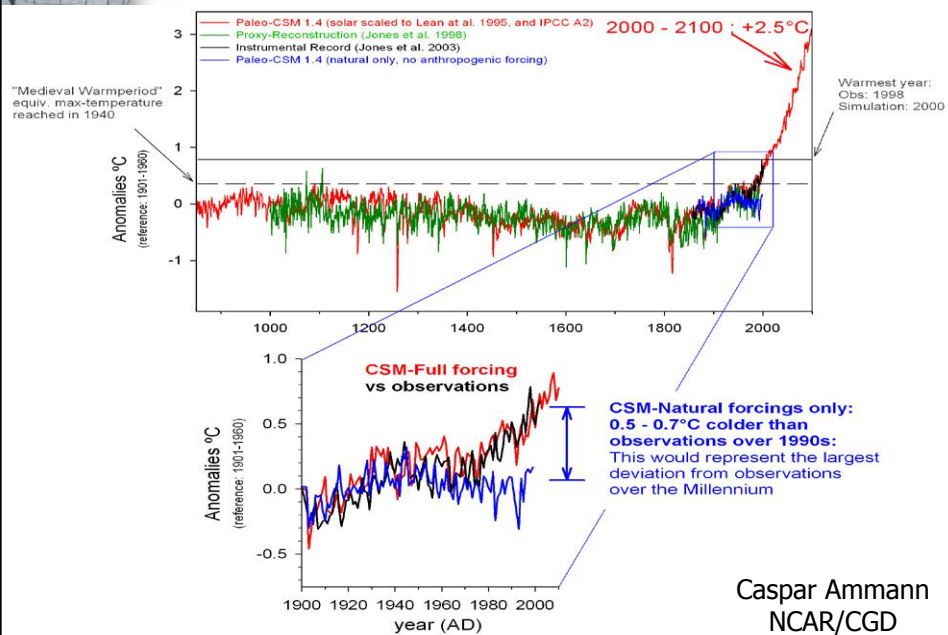




How reliable are climate models



How reliable are climate models

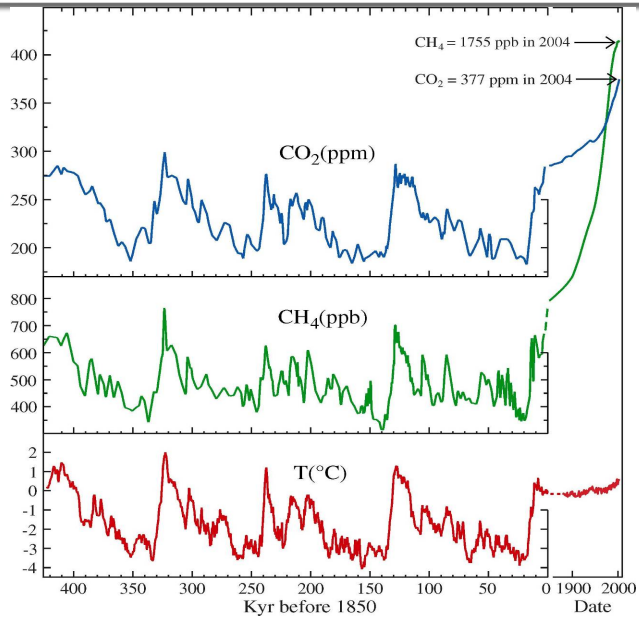




Climate projections

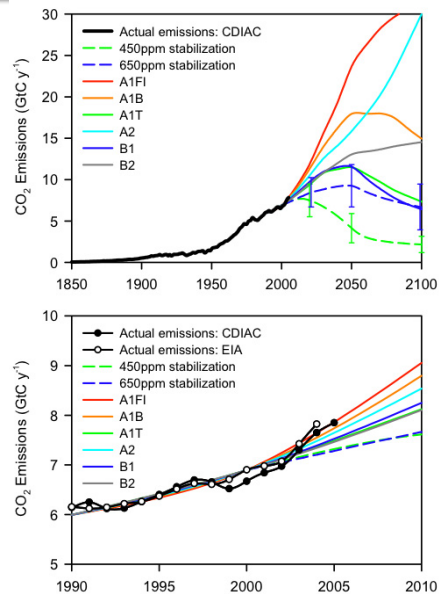
CO₂, CH₄ and estimated
global temperature
(Antarctic $\Delta T/2$
in ice core era)
0 = 1880-1899 mean.

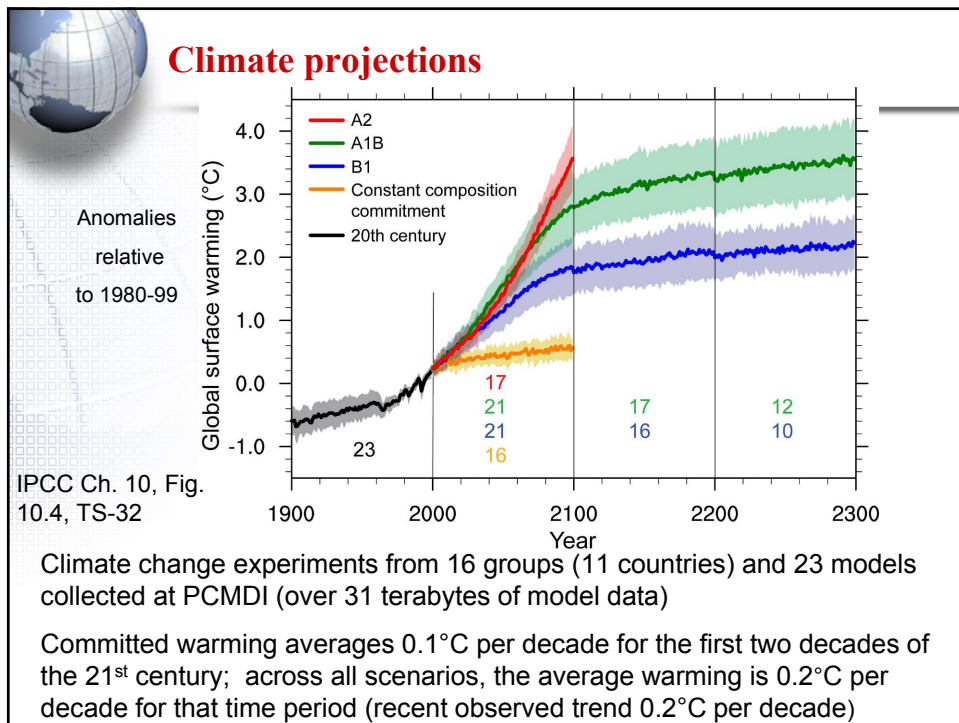
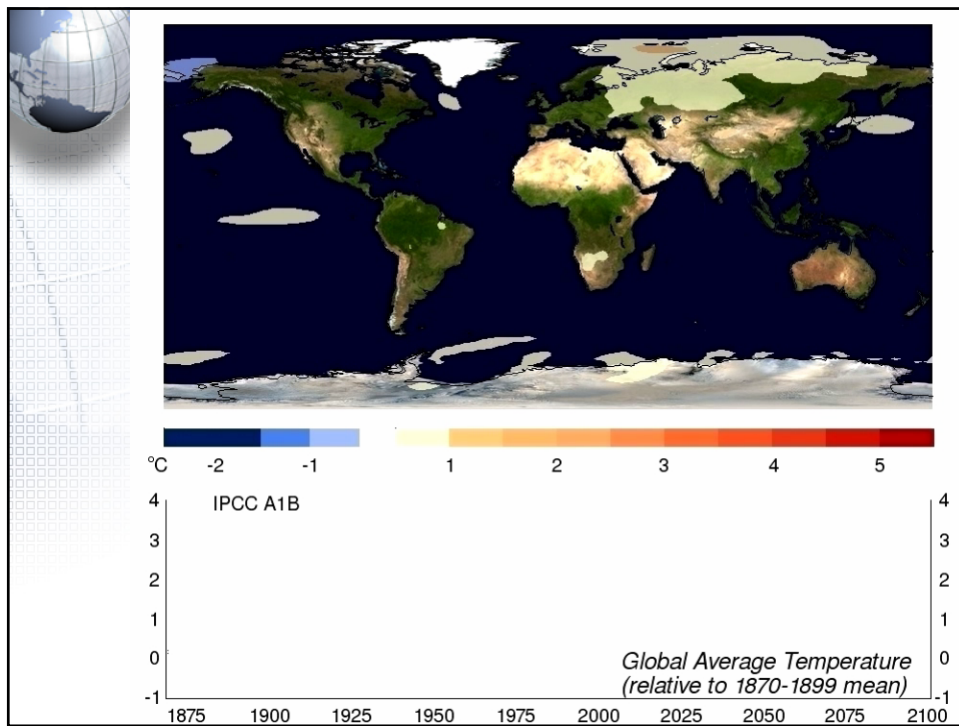
Source: Hansen, *Clim.
Change*, **68**, 269, 2005.

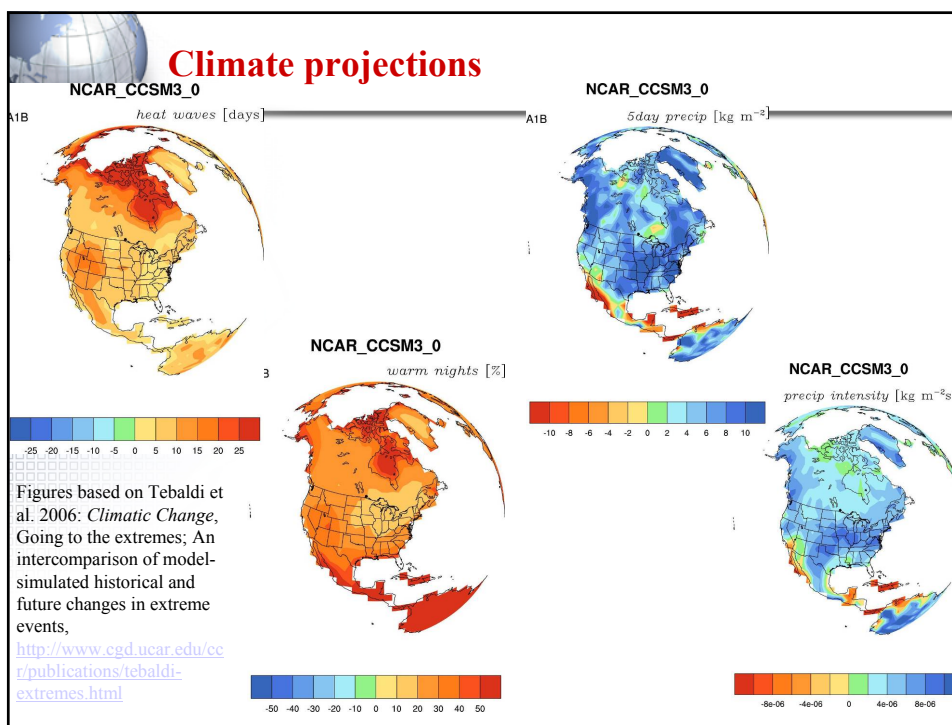
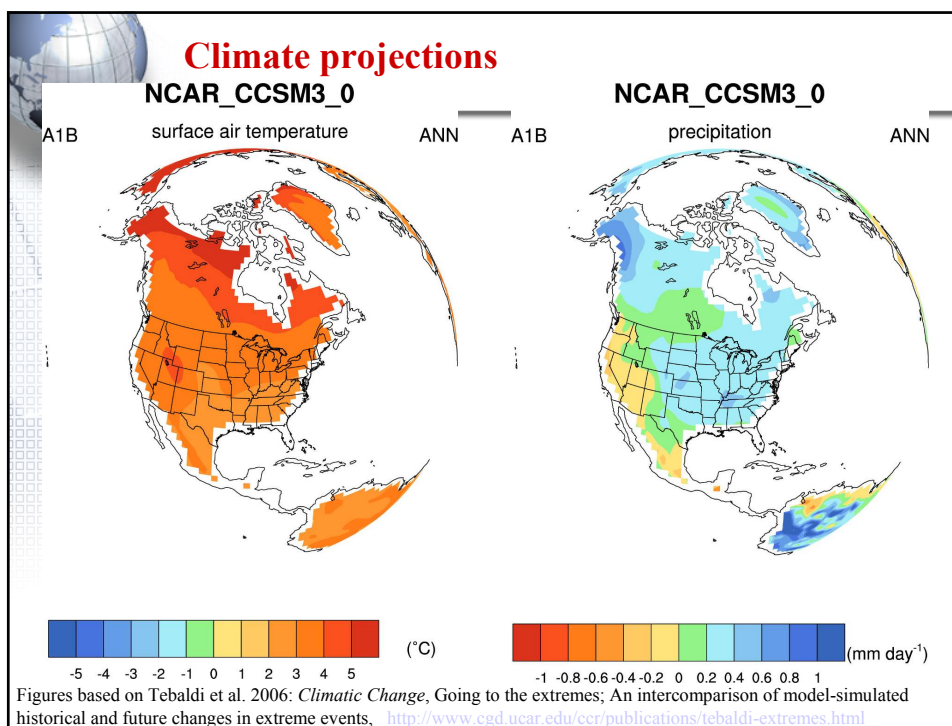


Climate projections

Raupach et al., PNAS, 2007

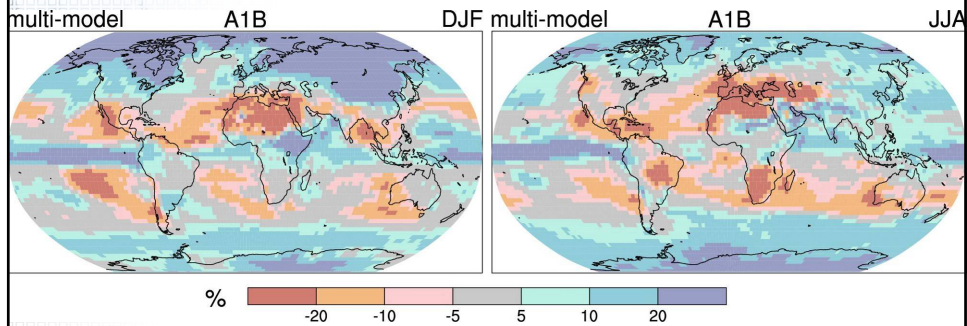








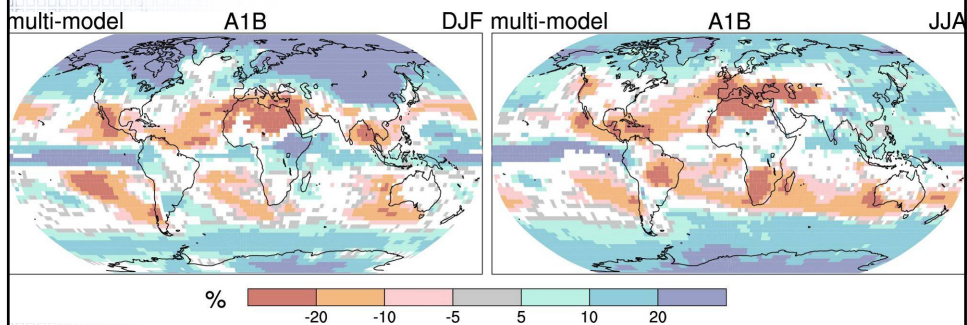
Climate projections



Multi-model average precipitation % change, medium scenario (A1B), representing seasonal precipitation regimes, total differences 2090-99 minus 1980-99



Climate projections



White areas are where less than two thirds of the models agree in the sign of the change



Climate projections

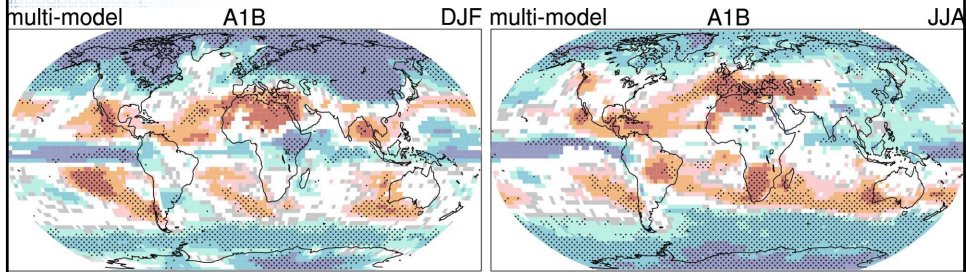
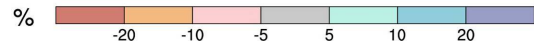


Fig. SPM-6

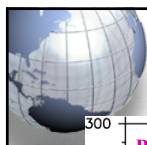


Stippled areas are where more than 90% of the models agree in the sign of the change

Precipitation increases very likely in high latitudes

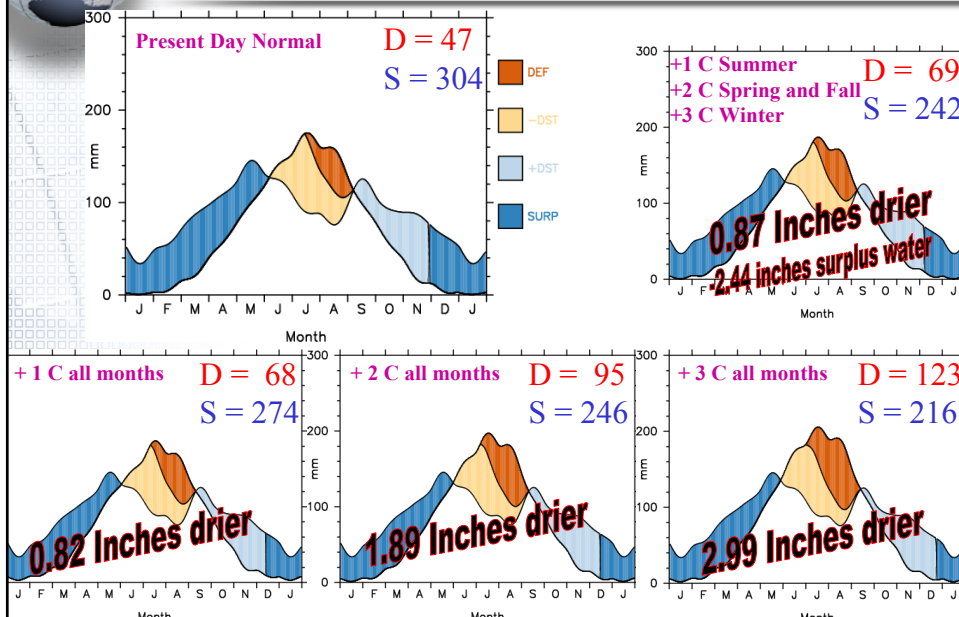
Decreases likely in most subtropical land regions

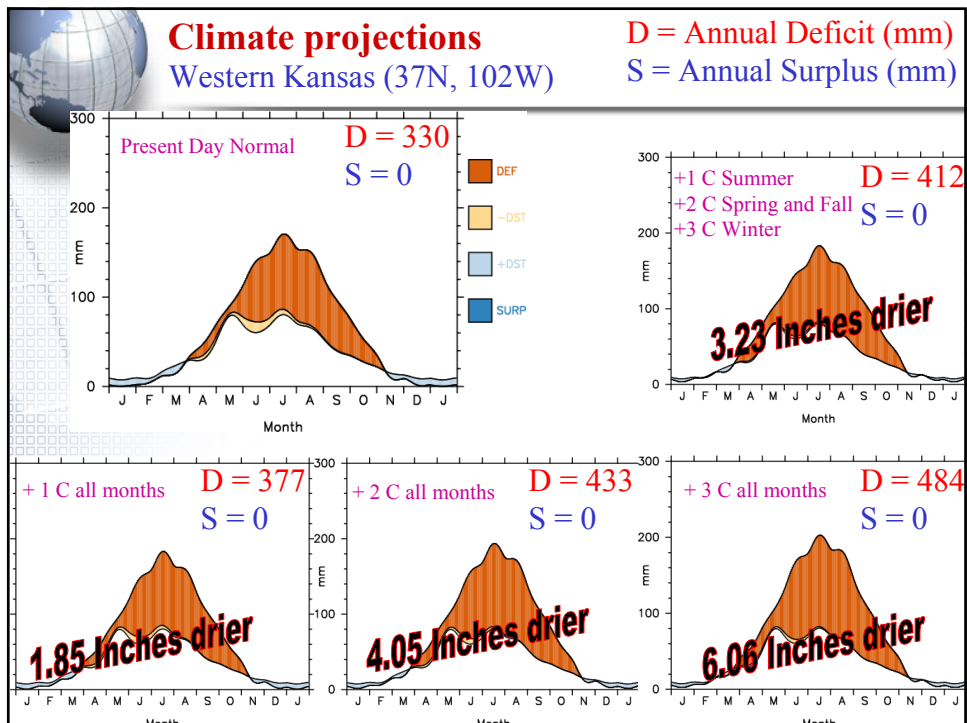
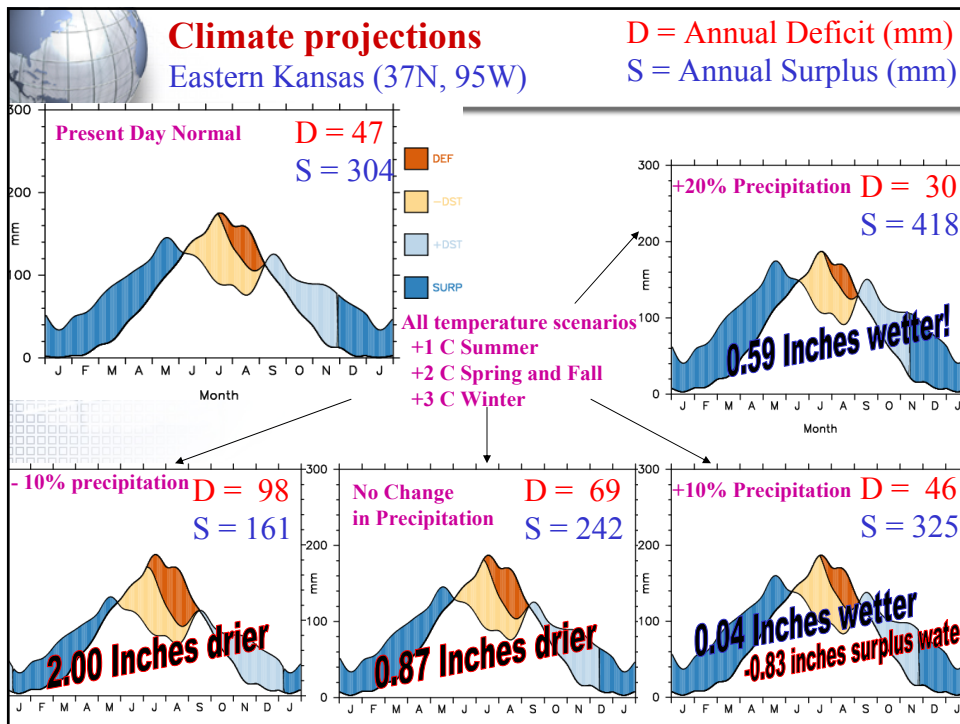
This continues the observed patterns in recent trends

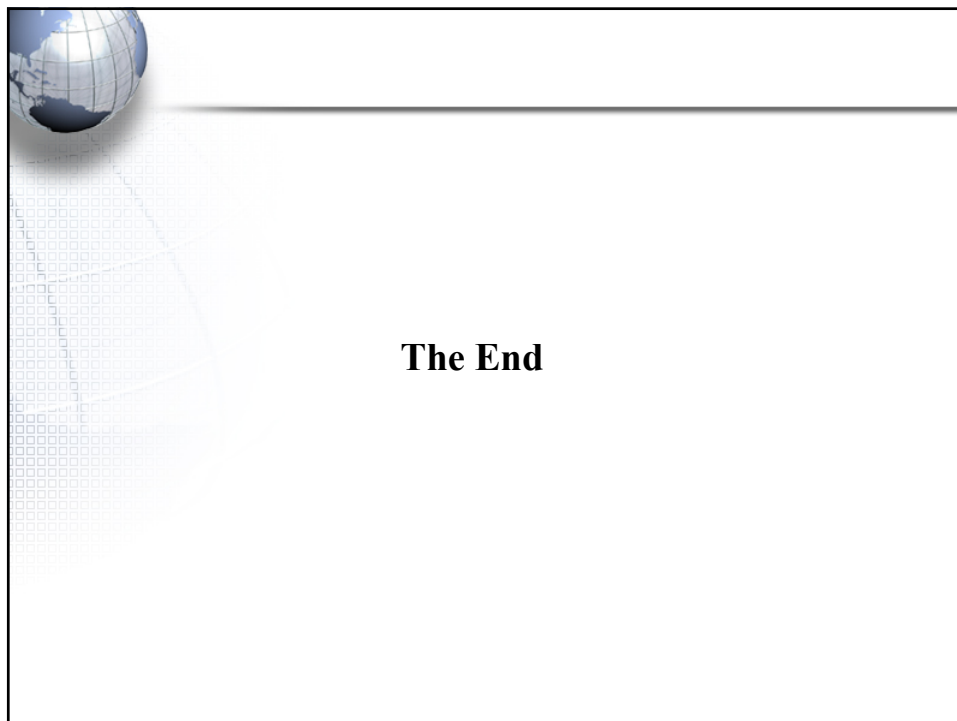
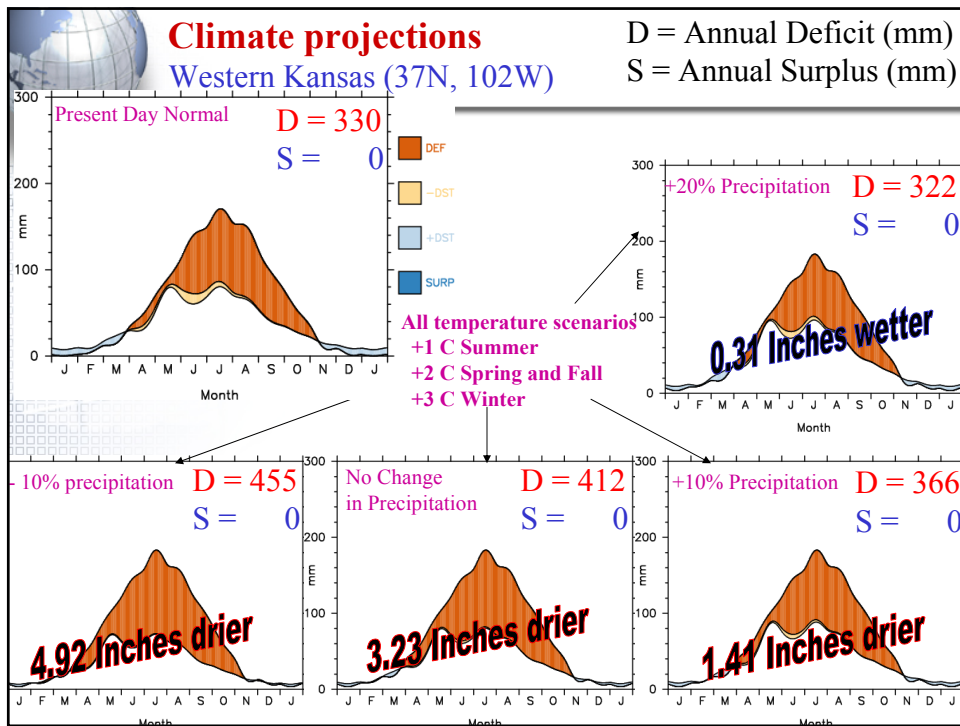


Climate projections Eastern Kansas (37N, 95W)

D = Annual Deficit (mm)
S = Annual Surplus (mm)



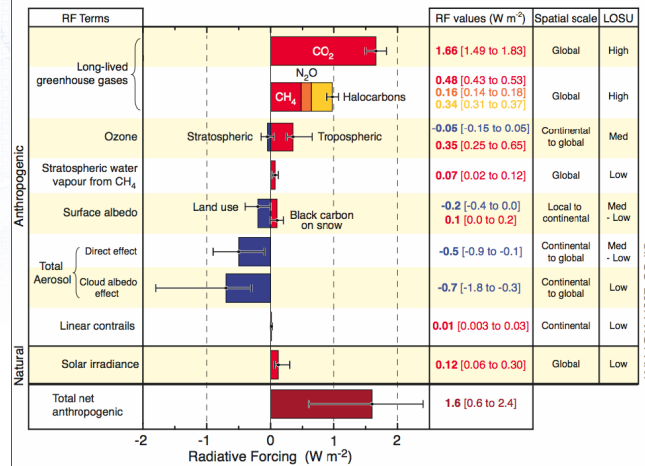






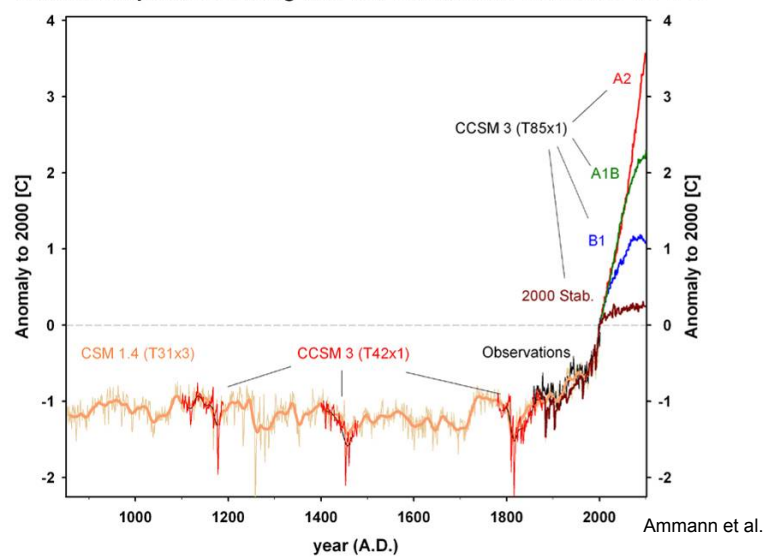
IPCC Report on Anthropogenic Climate Impacts

Radiative Forcing Components

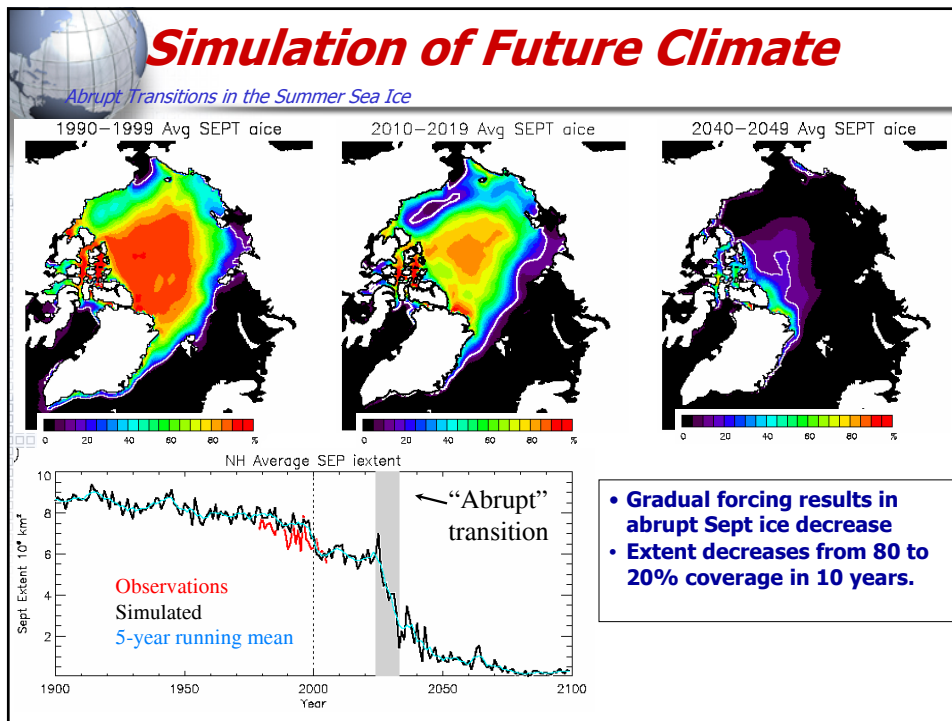
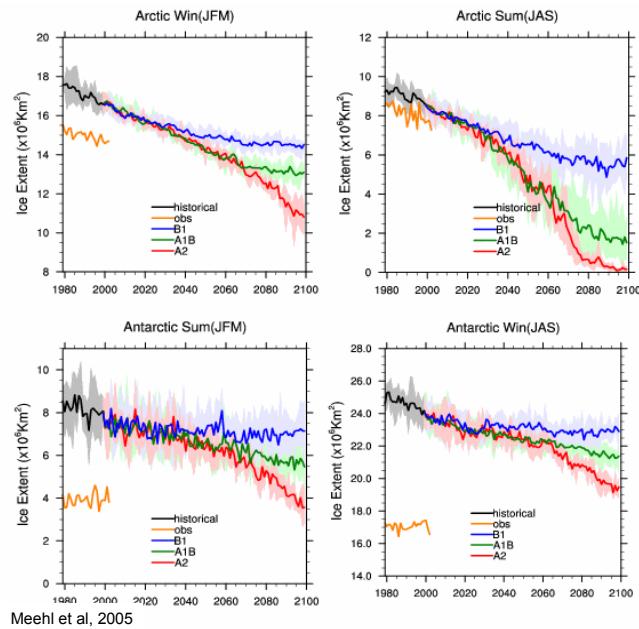


How reliable are climate models

Global Temperature during the Last Millennium / Scenarios to 2100



Changes in Sea Ice Coverage





Simulating Human Land Cover Change in Global Climate Models

Future Directions

- Combine the urban and other land cover datasets at 1 km resolution – use multiple satellite derived sources
- Develop transient datasets compatible with the present Day MODIS derived dataset based on past population and other country level statistics
- Develop a soil degradation model and accompanying datasets
- Develop fire model based on land cover and other national level statistics

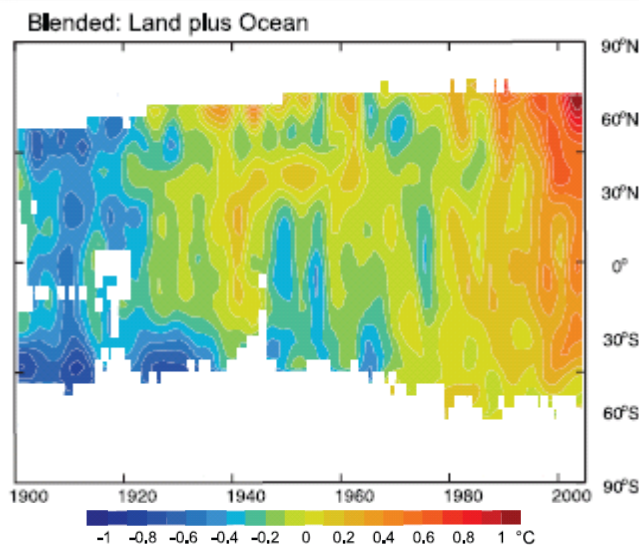
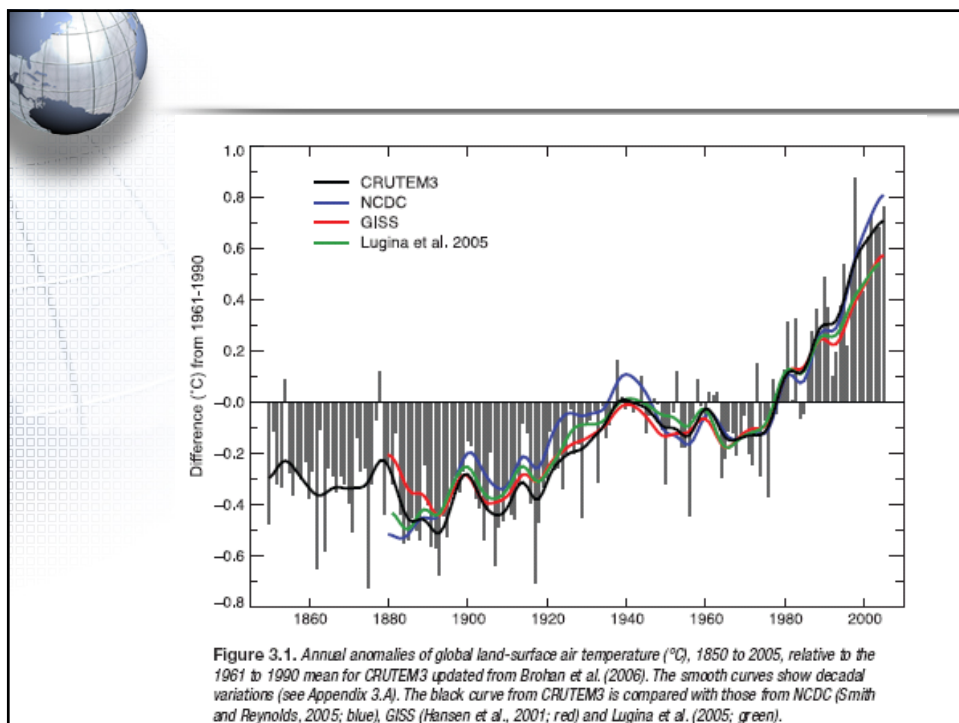
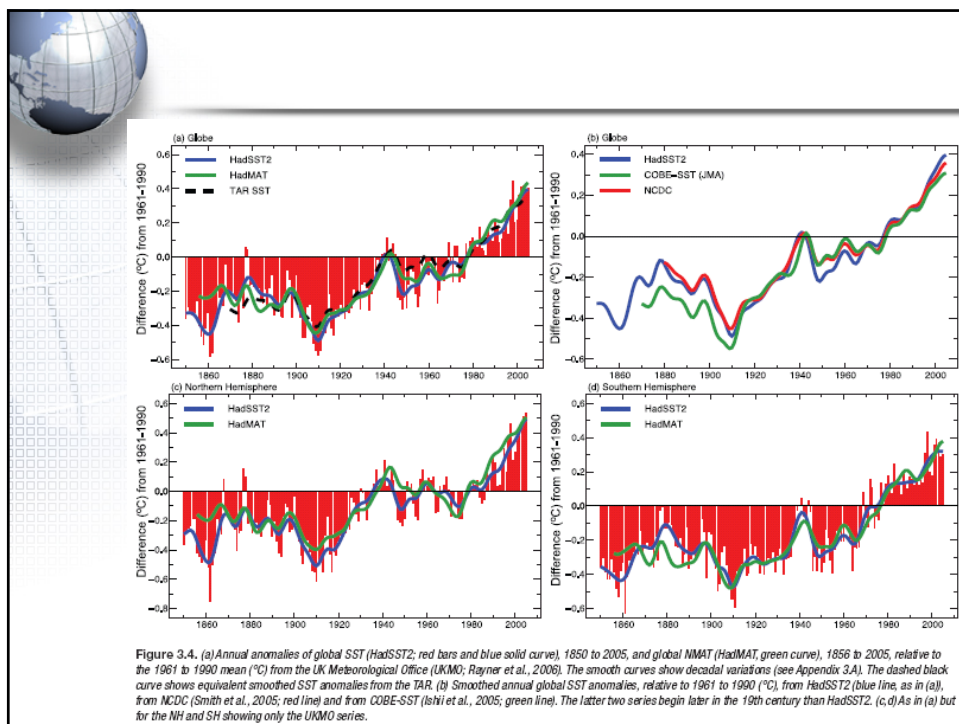


Figure 3.5. Latitude-time sections of zonal mean temperature anomalies (°C) from 1900 to 2005, relative to the 1961 to 1990 mean. Left panels: SST annual anomalies across each ocean from HadSST2 (Rayner et al., 2006). Right panels: Surface temperature annual anomalies for land (top, CRUTEM3) and land plus ocean (bottom, HadCRUT3). Values are smoothed with the 5-point filter to remove fluctuations of less than about six years (see Appendix 3.A); and white areas indicate missing data.



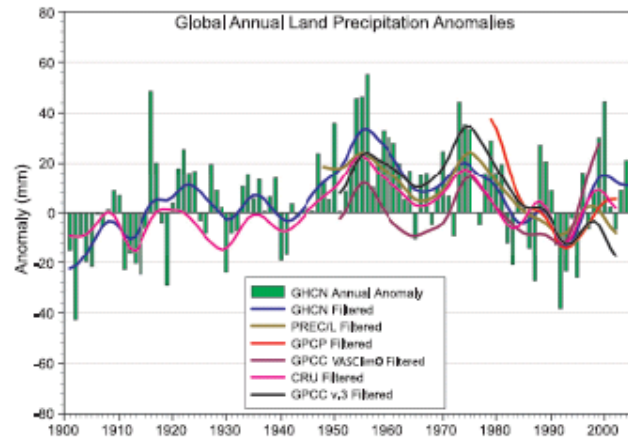


Figure 3.12. Time series for 1900 to 2005 of annual global land precipitation anomalies (mm) from GHCN with respect to the 1981 to 2000 base period. The smooth curves show decadal variations (see Appendix 3.A) for the GHCN (Peterson and Vose, 1997), PREC/L (Chen et al., 2002), GPCP (Adler et al., 2003), GPCC (Rudolf et al., 1994) and CRU (Mitchell and Jones, 2005) data sets.

IPCC, 2007