

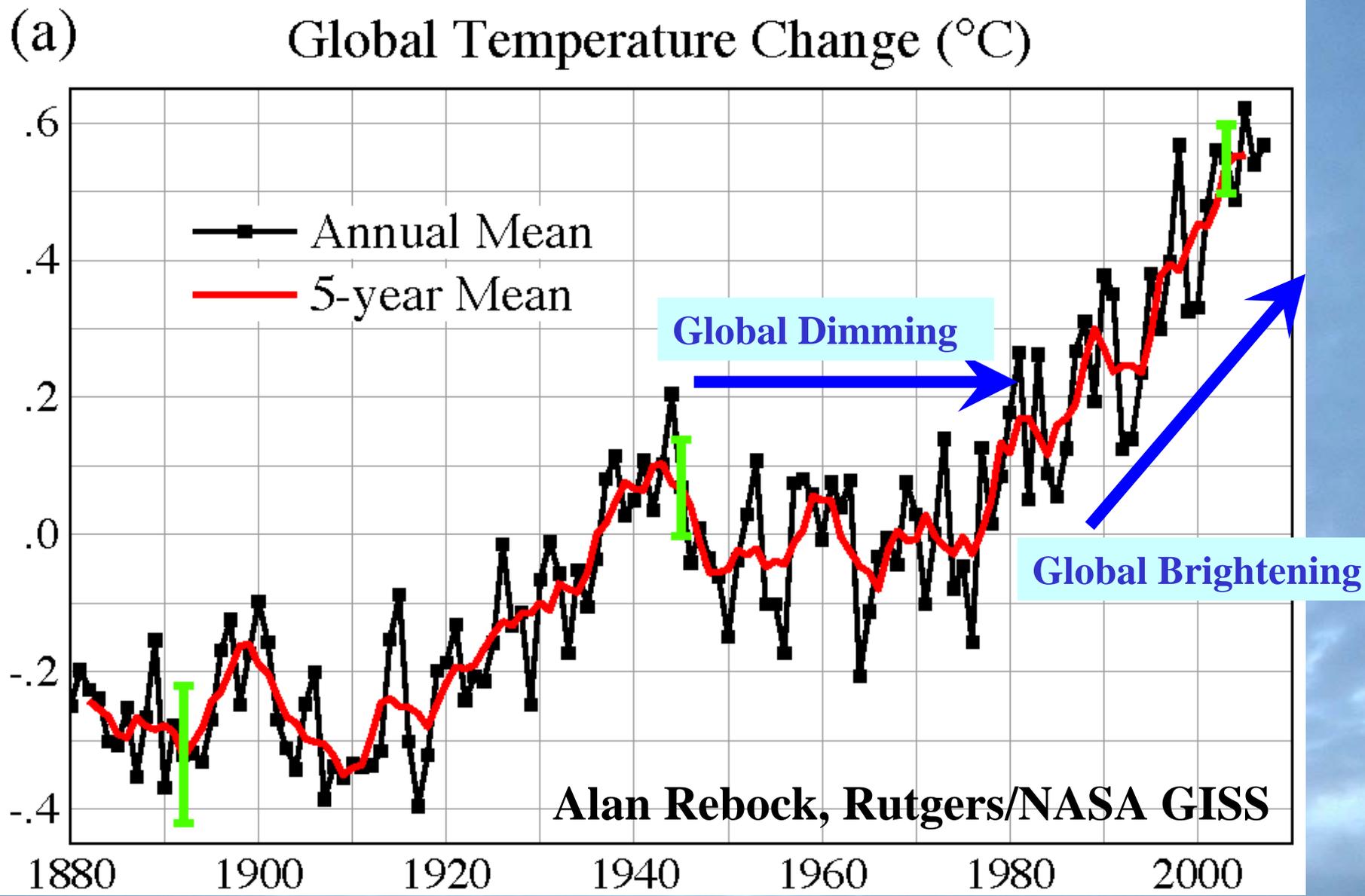


Global Dimming and Brightening: An Opportunity for ARM

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**Ells Dutton, John Augustine, Warren Wiscombe,
Martin Wild and Connor Flynn**

Climate Impact

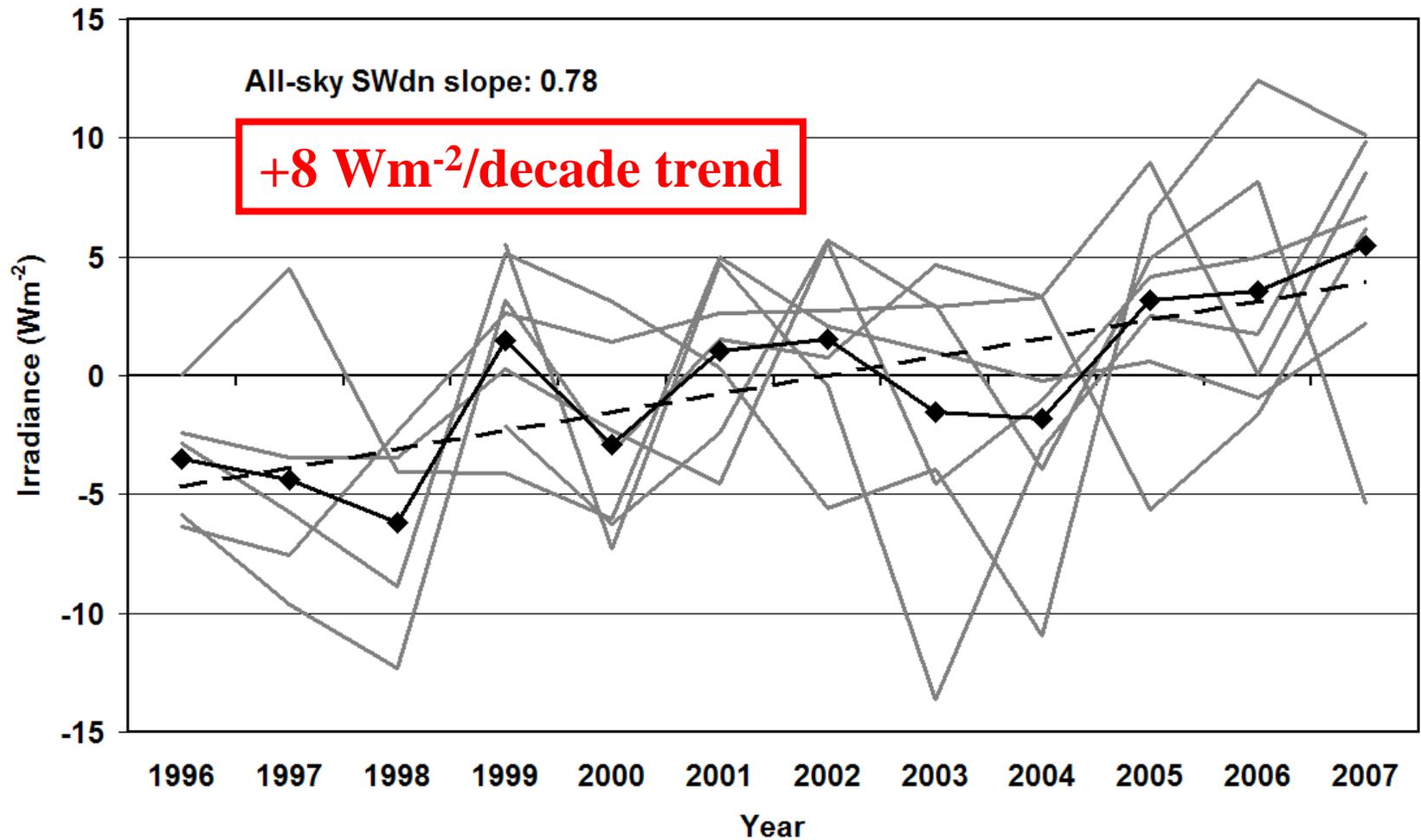


Need to Quantify Causes of GDB

- **Clear-sky**
 - **Aerosol direct effect**
 - **Hydration effects (air traffic)?**
- **Clouds**
 - **Aerosol indirect and semi-direct effects**
 - **Greenhouse warming feedbacks?**
 - **Other (synoptic climate variability, etc.)**

US Sites All-Sky SWdn

US Sites Yearly All-Sky SWdn Anomalies



Other Regions SWdn, Wild et al.

	1990s	2000-2005
USA		
Central America		
Europe		
China/Mongolia		
Japan		
Korea		
India		
Antarctica		

US Summary

- All-sky increase of 8 $\text{Wm}^{-2}/\text{decade}$ is far greater than the Wild et al. (2008) wide spread estimate of 2 $\text{Wm}^{-2}/\text{decade}$ for 1986-2000
- Also more than twice the 2-3 $\text{Wm}^{-2}/\text{decade}$ increase in downward surface longwave radiation during the same time period
- Only half of the US increase occurs under clear-skies, an increase in diffuse SW
- But weak at best relationship to AOD changes
- Strong relationship to cloud amount changes

Summary

- **Global Brightening is still widespread, except for places like India and China (massive pollution)**
- **Less coherent and pronounced than 1990s**
- **Variety and balance of individual causes is great, they work to create a brightening almost everywhere**
- **This suggests some overall principle at work, whose details play out differently in different regimes, requires local and regional explanations**

ARM Role

- **GDB is real, it is significant, it is not being well represented in the GCMs**
- **Its cause has a major cloud component**
 - **And is regional in details**
- **ARM is best suited to study these cloud (and aerosol) causes**
- **Requires long-term analyses/modeling as opposed to IOP-process type approach**
- **ARM can not only hop on the GDB bandwagon, I really believe that ARM can lead the parade!**