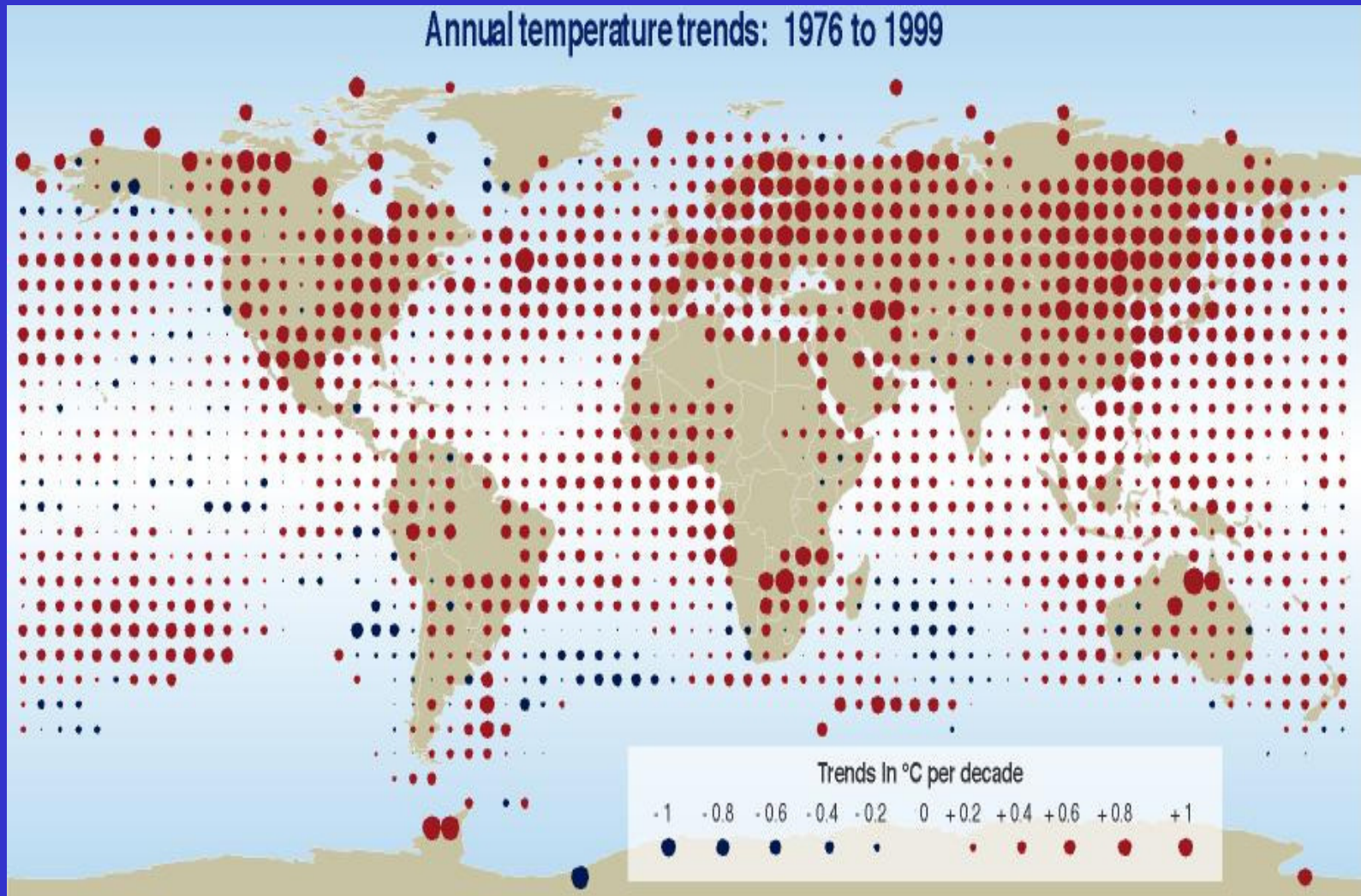


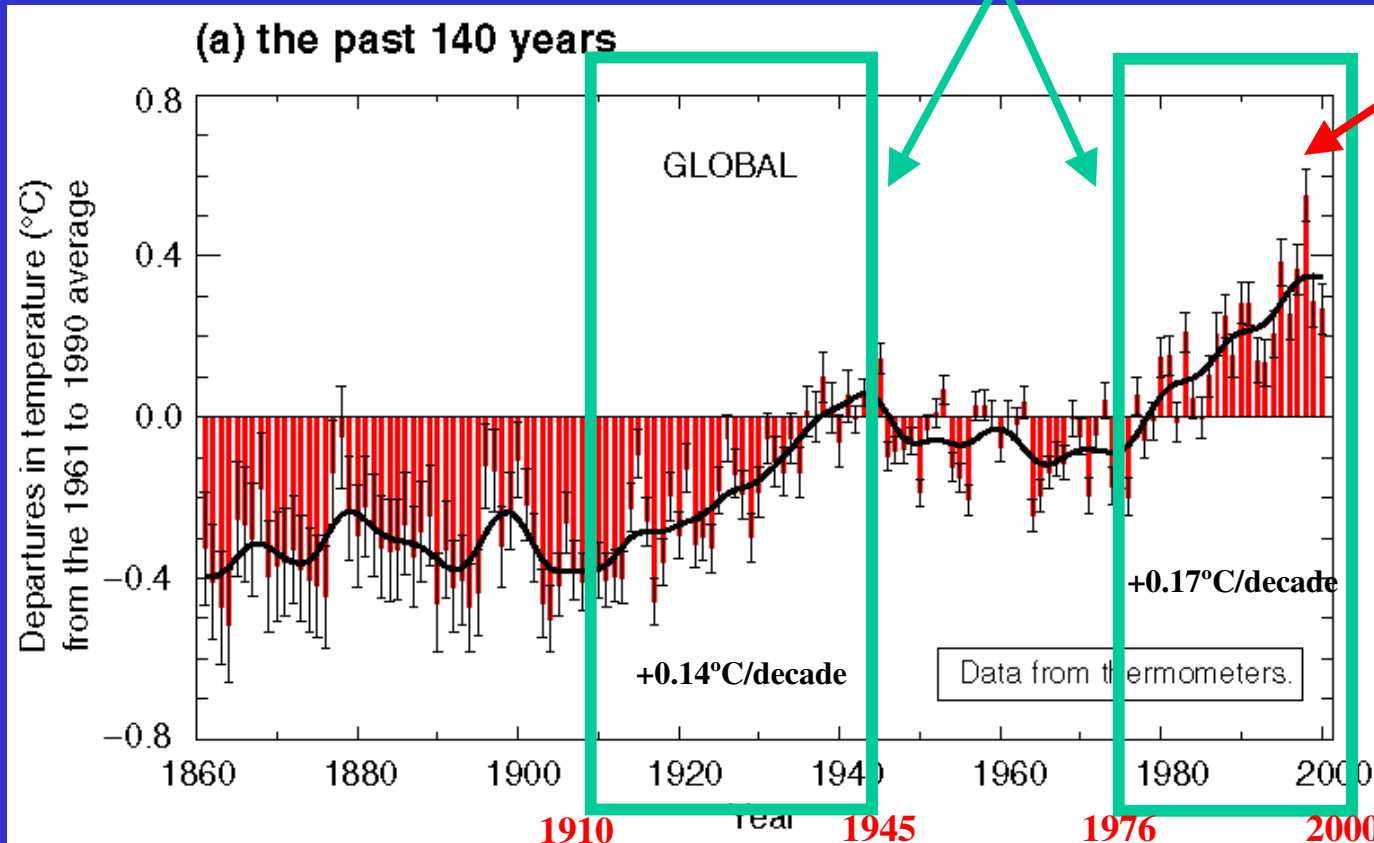
Chapter 16: Climate Changes



Global Surface Temperature

most of the warming happened

the warmest year is 1998

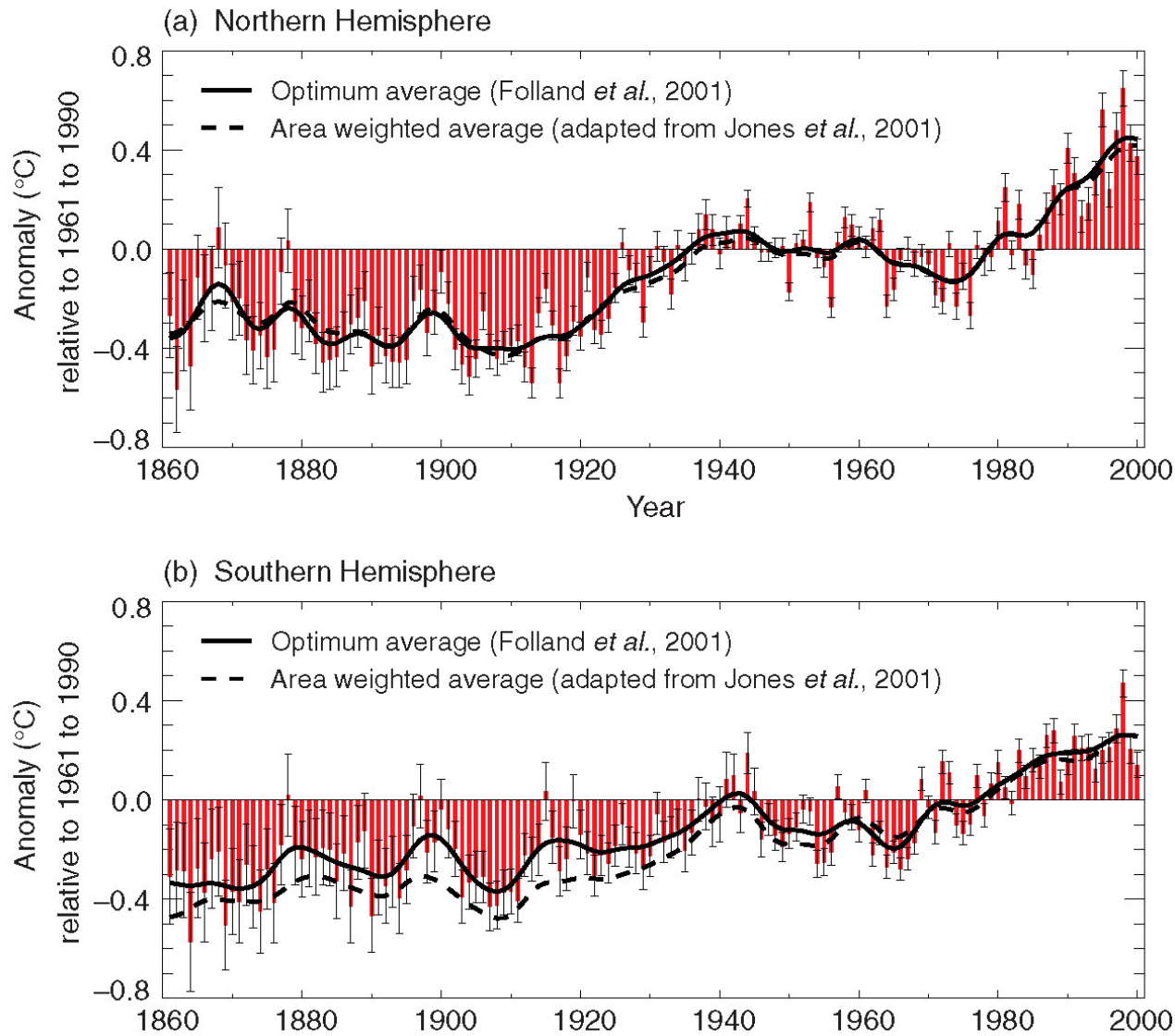


Warmest years	
(1)	1998 – 0.63 $^{\circ}\text{C}$
(2)	2005 – 0.58 $^{\circ}\text{C}$
(3)	2002 – 0.56 $^{\circ}\text{C}$
	2003
(4)	2004 – 0.54 $^{\circ}\text{C}$
(5)	2001 – 0.51 $^{\circ}\text{C}$

The global average surface temperature has increased over the 20th century by about 0.6 $^{\circ}\text{C}$.



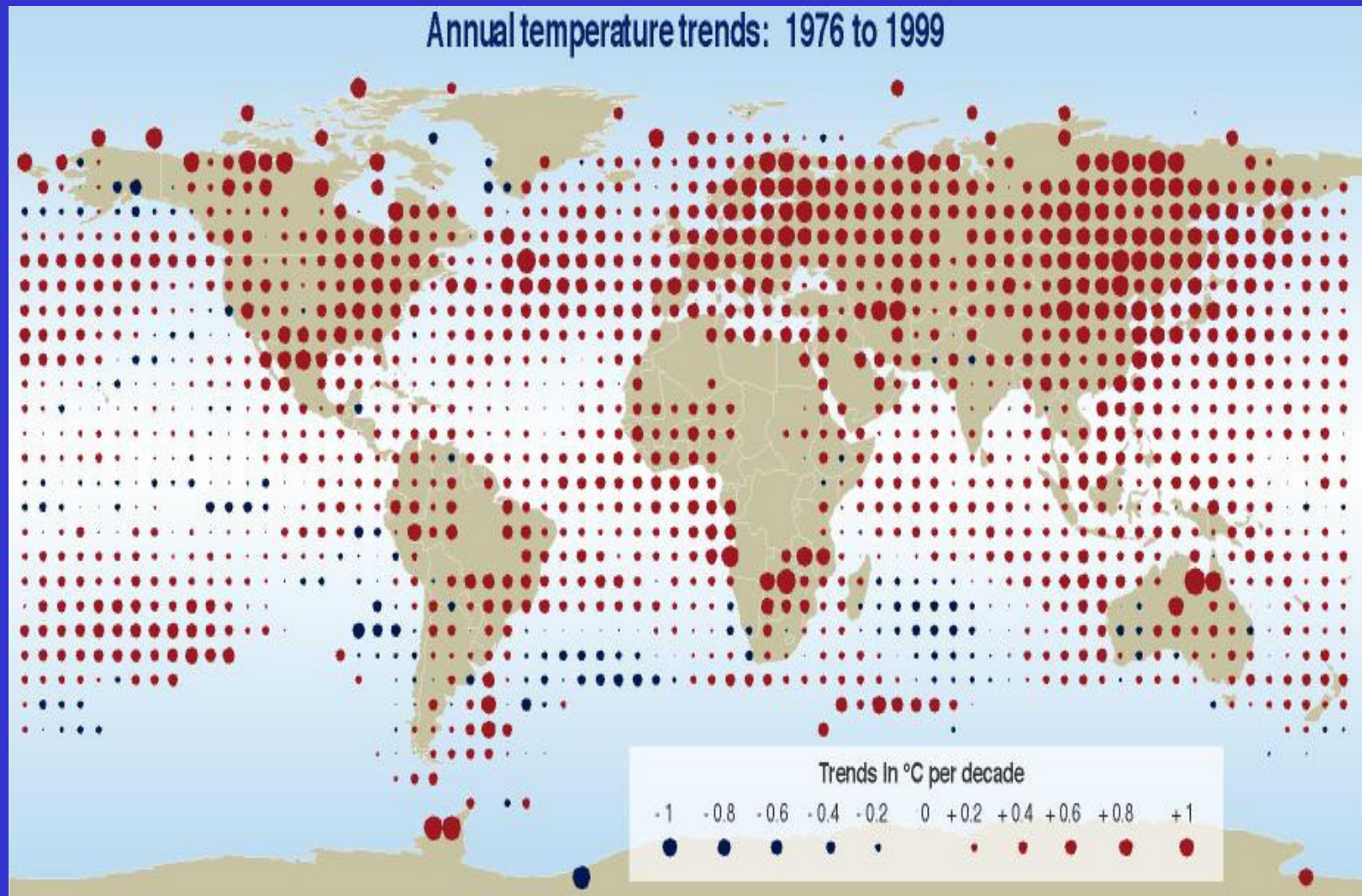
More Warming in the N.H.



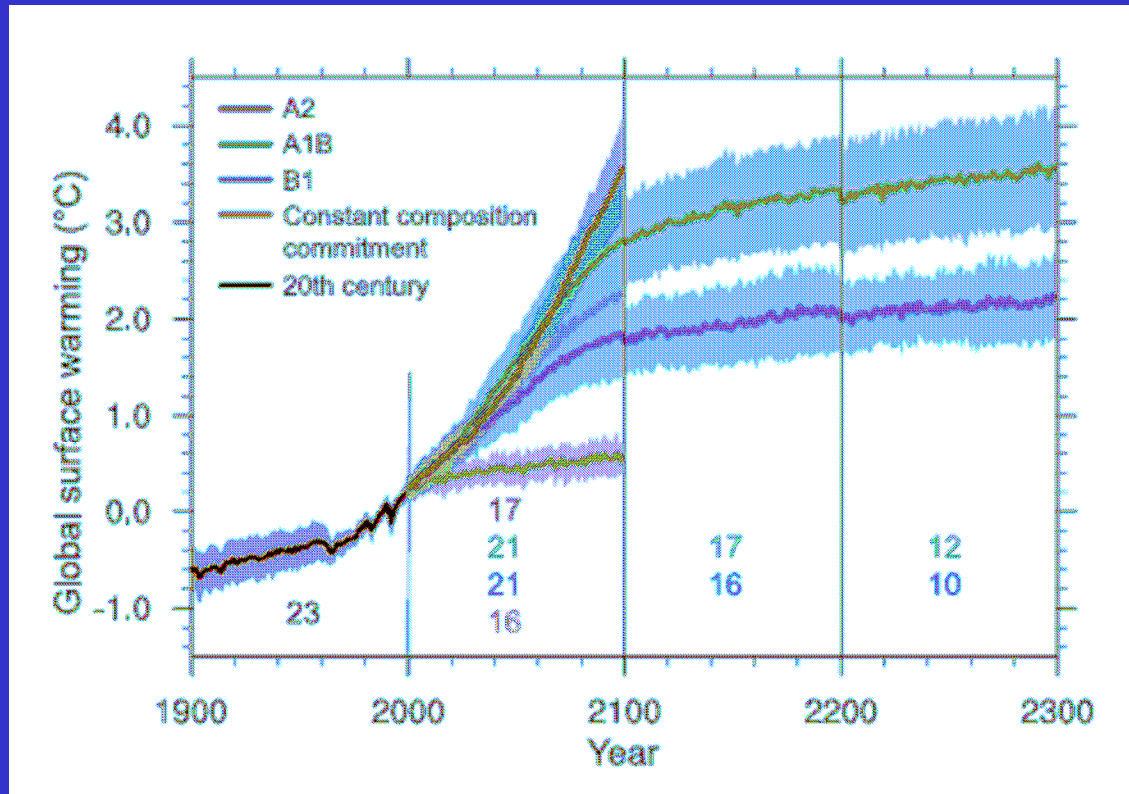
Both the earlier period of warming (1910 to 1945) and the more recent one (1976 to 1999) saw rates of warming about twice as great in the Northern Hemisphere than in the Southern Hemisphere.



Faster Warming Trend Over Lands

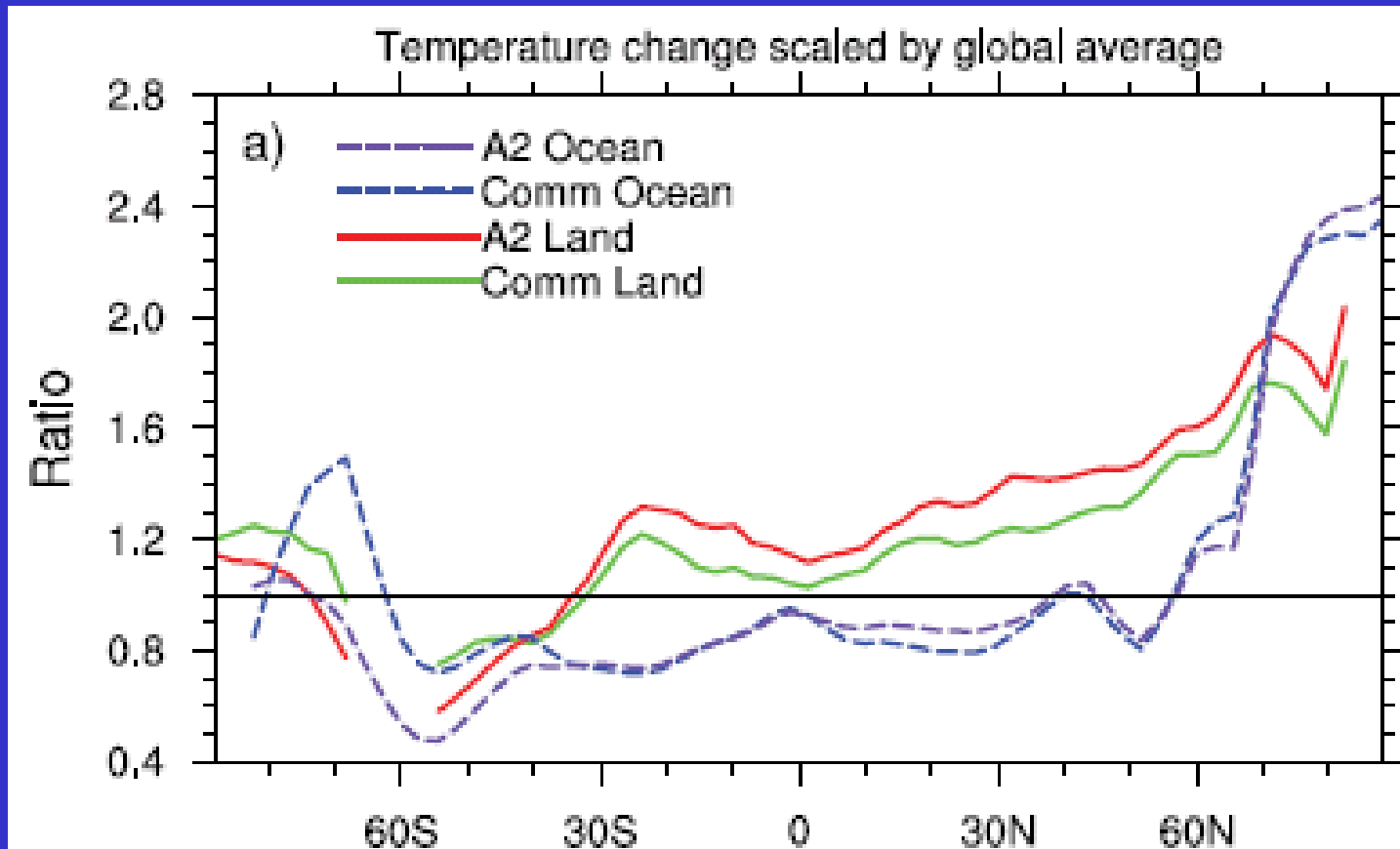


Projected Surface Warming (relative to 1980-1999)

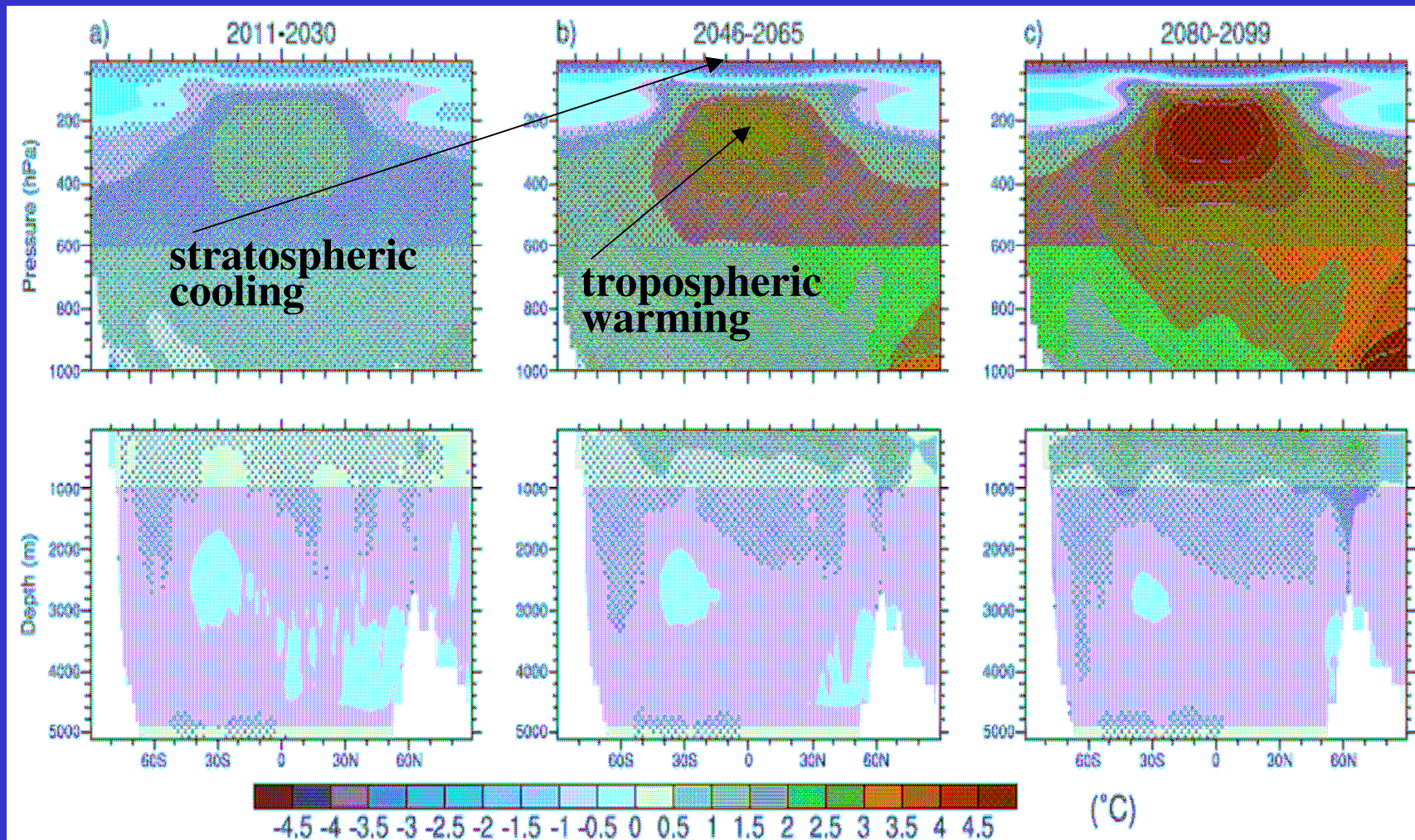


	Global mean warming (°C)			
	2011–2030	2046–2065	2080–2099	2180–2199
A2	0.64	1.65	3.13	
A1B	0.69	1.75	2.65	3.36
B1	0.66	1.29	1.79	2.10
Commit ^a	0.37	0.47	0.56	

Warming Pattern / Ocean vs. Land (during 2080-2099)

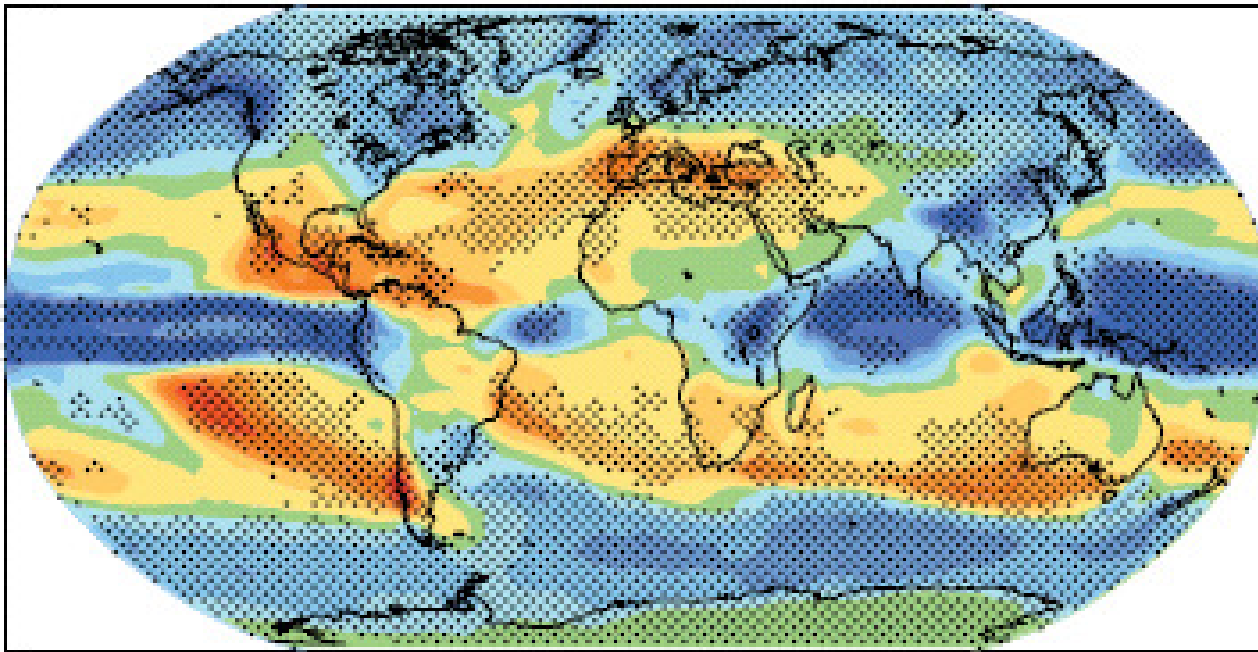


Vertical Distribution of Warming



Projected Precipitation Changes

a) Precipitation



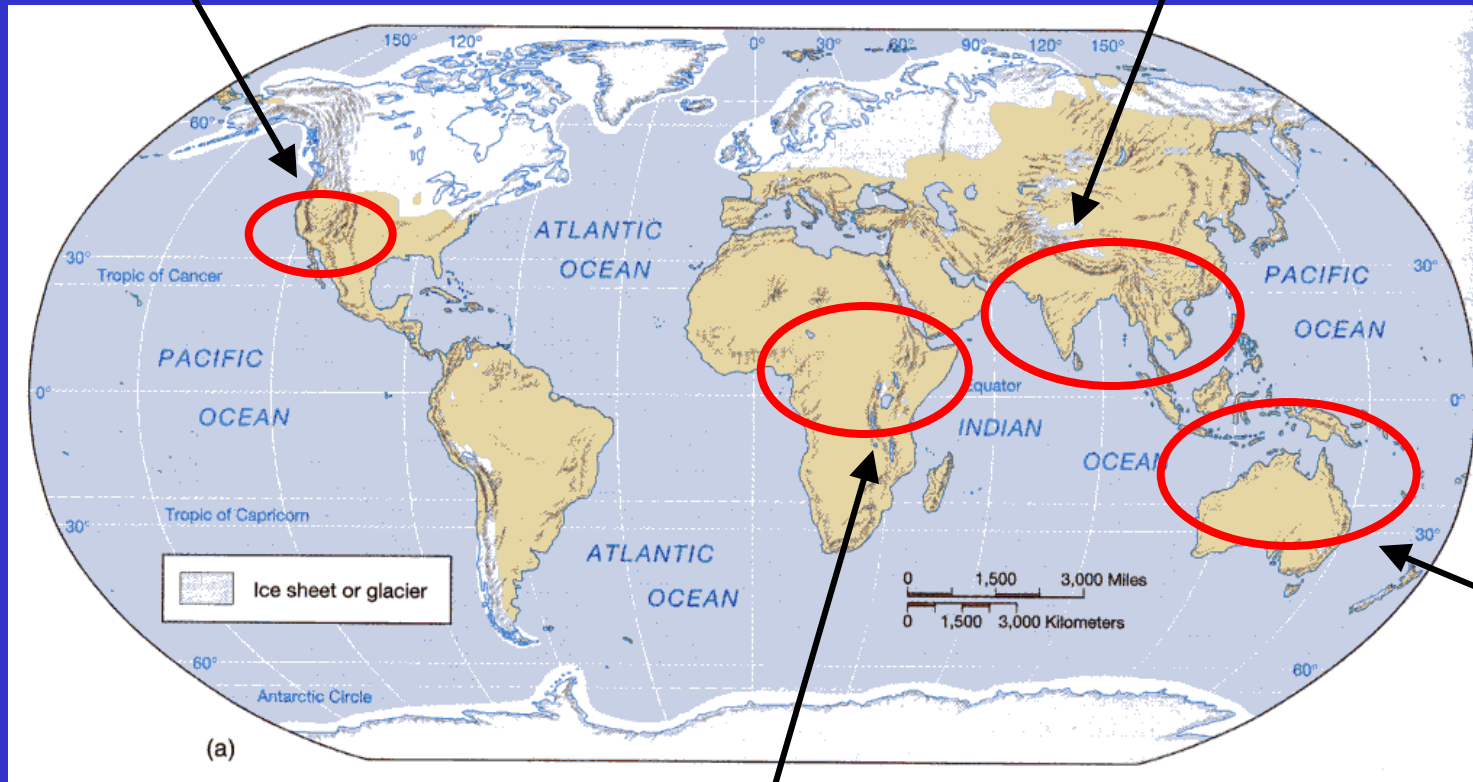
- Precipitation generally increases in the areas of regional tropical precipitation maxima (such as the monsoon regimes) and over the tropical Pacific.
- Precipitation generally decreases in the subtropics and increases at high latitudes → due to the poleward shift of the storm track → due to the expansion of the Hadley circulation.



Projected Monsoon Precipitation Changes

North America Monsoon (**decrease**)

Asian Monsoon (**increase**)



Australian Monsoon (**increase**)

Weaker monsoon circulation
+ more water vapor available
= increase monsoon rainfalls

West Africa Monsoon (**increase**)



Projected Hurricane Activities

- Most recent published modelling studies projected a decrease in the overall number of storms.
- Although less confidence, studies projected decrease of relatively weak storms in most basins, with an increase in the numbers of the most intense tropical cyclones.



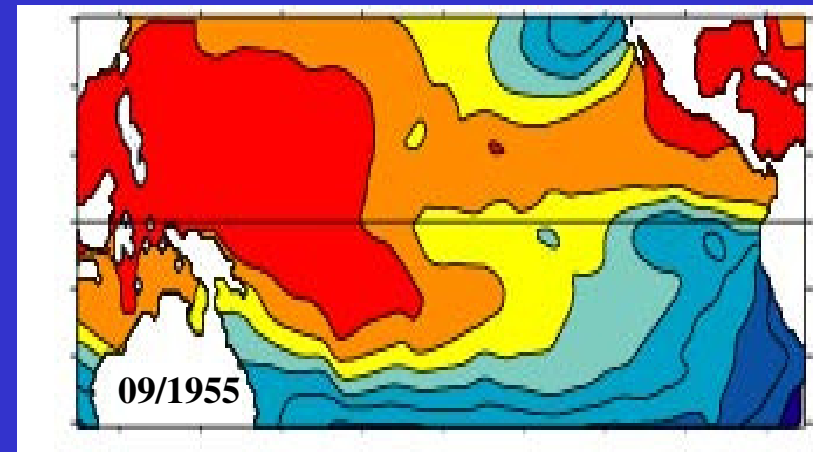
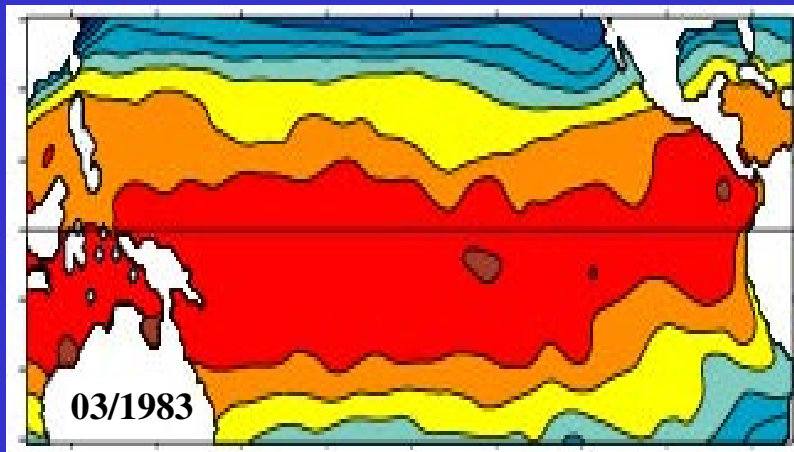
Projected Extratropical Storms

- For a future warmer climate, a poleward shift of storm tracks in both hemispheres that is particularly evident in the SH, with greater storm activity at higher latitudes.
- A future tendency for more intense extratropical storms, although the number of storms could be less.

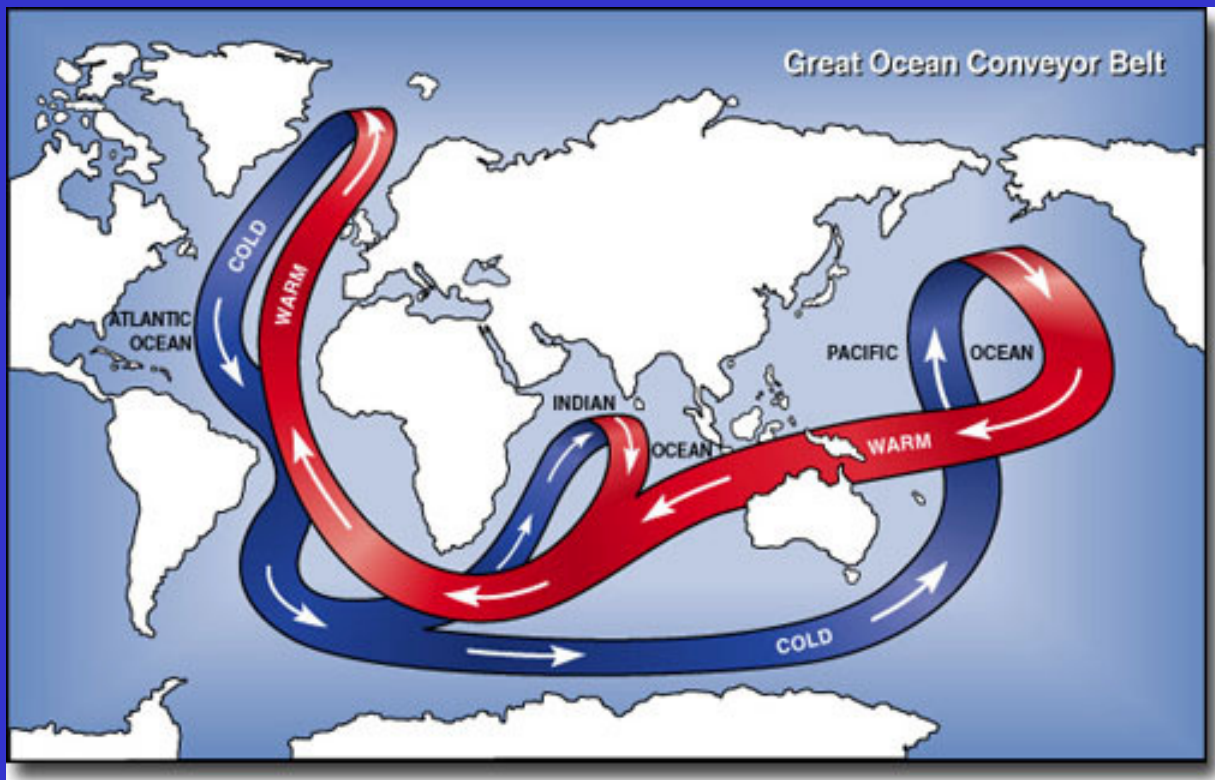


Projected ENSO Activity

- No conclusion: different AOGCMs project different results.
- Mean state in the Pacific will become more El Nino-like.



Projected Change in Atlantic Meridional Overturning Circulation (MOC)



- The MOC is an indicator of ocean circulation changes in response to global warming.
- The MOC is projected to slow down in the future.
- It is due to the warming and increased precipitation at higher latitudes.
- The weakened MOC will help to reduce global warming at higher latitude, because less heat will be transported there.



Global Warming and Sea-Level Change

