The latitudinal gradient of global warming

Introduction

Global warming is the rise in temperature that Earth is experiences since the late 19th century. Since the early 20th century, Earth's mean surface temperature has increased by about 0.8 °C. Climate model projections summarized in the 2007 Fourth Assessment Report (AR4) by the Intergovernmental Panel on Climate Change (IPCC) indicate that during the 21st century the global surface temperature may increase by 1.1 to 2.9 °C for their lowest emissions.
Future climate change and associated impacts will vary from region to region around the globe. Warming is expected to be strongest in the Arctic, with the continuing retreat of glaciers, permafrost and sea ice. In the present analysis the latitudinal variation of the temperature increase is analysed to confirm with data the expected stronger and faster warming of the northern latitudes.

Methods

In this analysis data in the Time Series Browser were used, which is a browser of all the monthly weather station temperature data from the NOAA National Climatic Data Center (http://climatemodels.uchicago.edu/timeseries/). In order to detect the presence of a latitudinal gradient in the temperature increase, the globe was classified into six latitudinal bands (30° each), for each band 10 stations were selected with good data coverage from 1900 up to present day. For the band 60-90 S only five stations were available with long enough time series. Data from each station were normalised subtracting the average 1900-1950 temperature value from each time series, and were then averaged into a composite temperature change record.

Results

Results retrieved for the six latitudinal bands are reported in Table 1 and Figure 1. All latitudinal bands are experiencing a positive temperature trend and besides the 60°-90° N band is observed to warm almost twice as faster than the 30° N - 30° S bands.

Latitudinal Band	Temperature Trend (°C/decade)
90 - 60 N	0.28
60 - 30 N	0.19
30 - 0 N	0.15
0 - 30 S	0.17
30 - 60 S	0.19
60 - 90 S	0.21

Table 1: Temperature trend observed at different latitudinal bands.

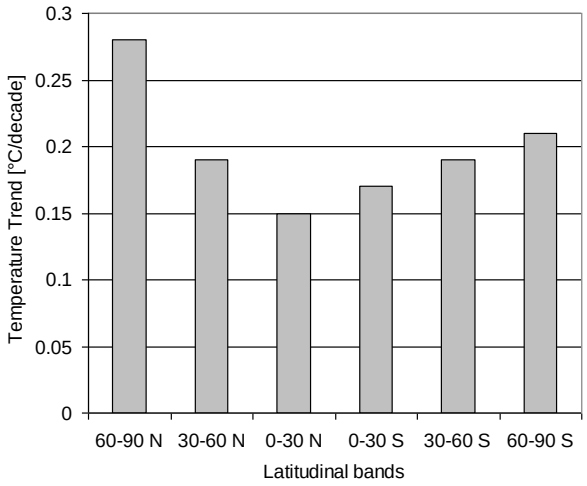

Figure 1: Temperature trend in degrees per decade

The main reason for this warming trend at the North Pole is the positive feedback induced by melting ice and snow. The melting ice exposes darker surfaces (land and/or ocean water) which have a much lower albedo and absorb heat instead of reflecting it, as the ice does. This heat warms both the air and the water and speeds up the melting of more ice.

Another reason is that there's less humidity in the Arctic than in the tropics, hence more energy can go directly into temperature increase (sensible heat) and not into water evaporation (latent heat).

The pole warming faster and therefore melting at increasing speed represents a big issue because if all the polar ice sheets melted global sea levels would rise by more than 60 m.