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Trends in Surface temperature at High Latitudes

Josefino C. Comiso
NASA Goddard Space Flight Center

Abstract

The earliest signal of a climate change is expected to be found in the polar regions where warming is expected to be amplified on account of ice-albedo feedbacks associated with the high reflectivity of snow and ice. Because of general inaccessibility, there is a general paucity of in situ data and hence the need to use satellite data to observe the large-scale variability and trends in surface temperature in the region. Among the most important sensors for monitoring surface temperature has been the Advanced Very High Resolution Radiometer (AVHRR) which was first launched in 1978 and has provided continuous thermal infrared data since 1981. The top of the atmosphere data are converted to surface temperature data through various schemes that accounts for the unique atmospheric and surface conditions in the polar regions. Among the highest source of error in the data is cloud masking which is made more difficult in the polar region because of similar signatures of clouds and snow/ice covered areas. The availability of many more channels in the Moderate Resolution Imaging Spectroradiometer (MODIS) launched on board Terra satellite in December 1999 and on board Aqua in May 2002 (e.g., 36 visible and infrared channels compared to 5 for AVHRR) made it possible to minimize the error. Further capabilities were introduced with the Advanced Microwave Scanning Radiometer (AMSR) which has the appropriate frequency channels for the retrieval of sea surface temperature (SST). The results of analysis of the data show an amplified warming in the Arctic region, compared with global warming. The spatial distribution of warming is, however, not uniform and during the last 3 decades, positive temperature anomalies have been most pronounced in North America, Greenland and the Arctic basin. Some regions of the Arctic such as Siberia and the Bering Sea surprisingly show moderate cooling but this may be because these regions were anomalously warm in the 1980s when the satellite record started. Also, the SST in the Arctic basin is observed to be anomalously high in 2007 when the perennial ice cover declined dramatically to its lowest extent. In the Antarctic, surface temperature trends are much more moderate with the most positive trends occurring in the Antarctic Peninsula and parts of Western Antarctica while some cooling are observed in the Antarctic Plateau and the Ross Sea. The trends in SST in the region is similar to global averages but precipitation from more evaporation may have a key role in the spatial distribution of surface temperature in the ice covered region .