

## TEMPERATURE DECADEAL CHANGE OVER POLAR REGION AS SEEN FROM TOVS AND NCEP REANALYSIS

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### 1. INTRODUCTION

Changes in the Arctic in recent decades have gained more and more attention in the community. However, the amount of actual upper-air data are very sparse in the polar region, which makes the climate analysis problematic.

A new major research tool to study the Arctic atmosphere in the 1980s and 1990s is the TOVS Polar Pathfinder (Path-P) satellite data set (Francis and Schweiger, 2000). We compare the NCEP/NCAR reanalysis with this TOVS Path-P data set. These data provide temperature and moisture at ten/five standard pressure levels on a 100 × 100 km grid north of 60°N on a daily basis. This data set is the first of its kind that can diagnose atmospheric characteristics across the Arctic basin in a consistent manner and with good horizontal resolution.

### 2. RESULTS

Because of a prominent shift in the AO in 1989, our base decade for the past 20 years is 1980–1988, and 1989–1998. The top panels in Fig. 1 show the temperature decadal change at 300 hPa based on NCEP reanalysis (left), and TOVS (middle) gridded temperature field. The bottom panel shows the decadal change at 900 hPa. Both data sets show similar trends in terms of temperature change during the last two decades, but they differ in patterns and magnitude. At 200 hPa, the TOVS data show stronger cooling over the central Arctic than NCEP reanalysis, while at 900 hPa, TOVS data show stronger warming over Alaska and Northern Canada, while over Siberia, NCEP shows a slight cooling (about 1 degree), and the TOVS shows a 1–2 degree warming instead.

In considering possible sources of errors in the satellite data, changes in instrumentation may have introduced time-varying biases into the time series. This is especially true for the TOVS Path-P set, when comparisons are made between measurements from different sequential satellites. For example, the DELTAS (corrections used in the calibration procedure) were specifically computed only for NOAA-10, 11, and 12, which is valid for the period from 1/1/1987 to 9/16/1991, 9/17/1991 to 12/31/1994, and 1/1/1995 to 12/31/1996, respectively. However, in the current version of Path-P the DELTAS from NOAA-10 were used for NOAA-6 through

9 (for the period 7/12/1979 to 12/31/1986) and the DELTAS from NOAA-11 were used for NOAA-14 (from 1/1/1997 to 12/31/1998). This may partially explain the large positive temperature anomalies at 300 hPa in the early 1980s (Fig. 2, top). Similarly, at 900 hPa significant negative anomalies are found in the early 1980s (Fig. 2, bottom).

In order to compensate for this over correction for the NOAA-6, 7, 9, and 14 period, we adjust the temperature fields at each level based on the running means of the temperature time series. The curves were obtained from the internet at [http://psc.apl.washington.edu/pathp/html/validation/calibration\\_frames.html](http://psc.apl.washington.edu/pathp/html/validation/calibration_frames.html). We first determined the average value at each level for each satellite period relative to the NOAA-10 period, and then subtracted this average value from the temperature field to get an absolute TOVS temperature analysis for the period from July 1979 to December 1986.

We then recomputed the decadal temperature change based on the corrected TOVS data set; the results are shown in the right panel of Fig. 1. Now the pattern and strength of the decadal temperature change are more similar between the TOVS and NCEP reanalysis. Comparing the right panels with the left, we can see that at 300 hPa, the cooling in the central Arctic is about the same: 3°K. At 900 hPa, the warming magnitude was reduced to 3°K over most of Alaska and Northern Canada, as in the NCEP reanalysis. The weak cooling over Siberia and southeast of Greenland is visible in the TOVS data.

We believe that the recalibrated TOVS data set represents more closely the temperature over the polar region in the past 20 years. Our future studies will be based on this recalibrated data set.

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### 3. REFERENCE

Francis, J., and A. Schweiger, 2000: A new window opens on the Arctic, *Eos Trans AGU*, 81(8), 77, 83.

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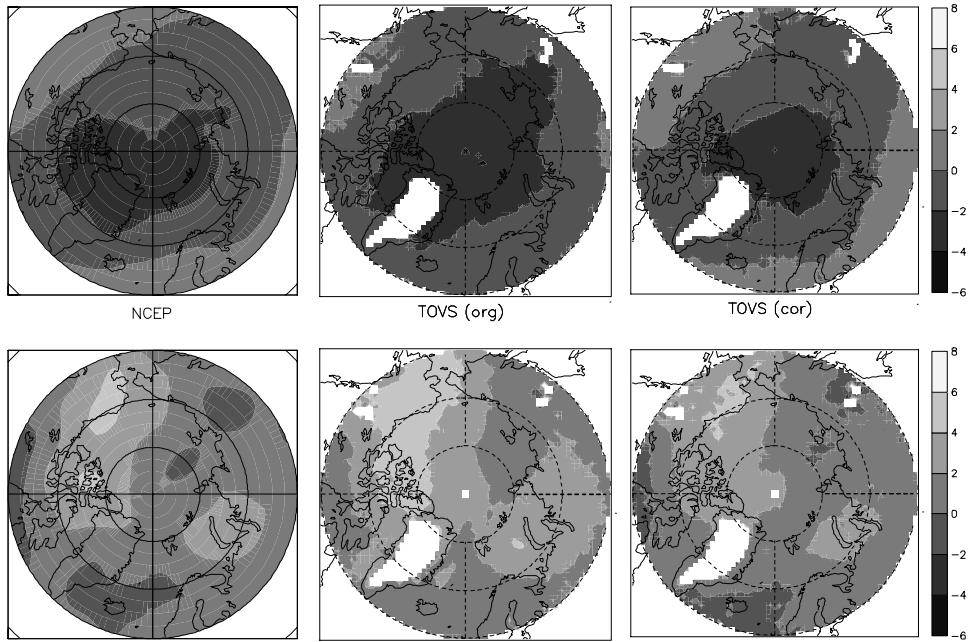


Fig. 1. The decadal temperature changes based on NCEP/NCAR reanalysis (left panels) and TOVS Path-P (right four panels) data set. The top panels are for 300 hPa, while the bottom panels are for 900 hPa. The middle column is from the original TOVS data set, and the right column is based on re-calibrated TOVS data.

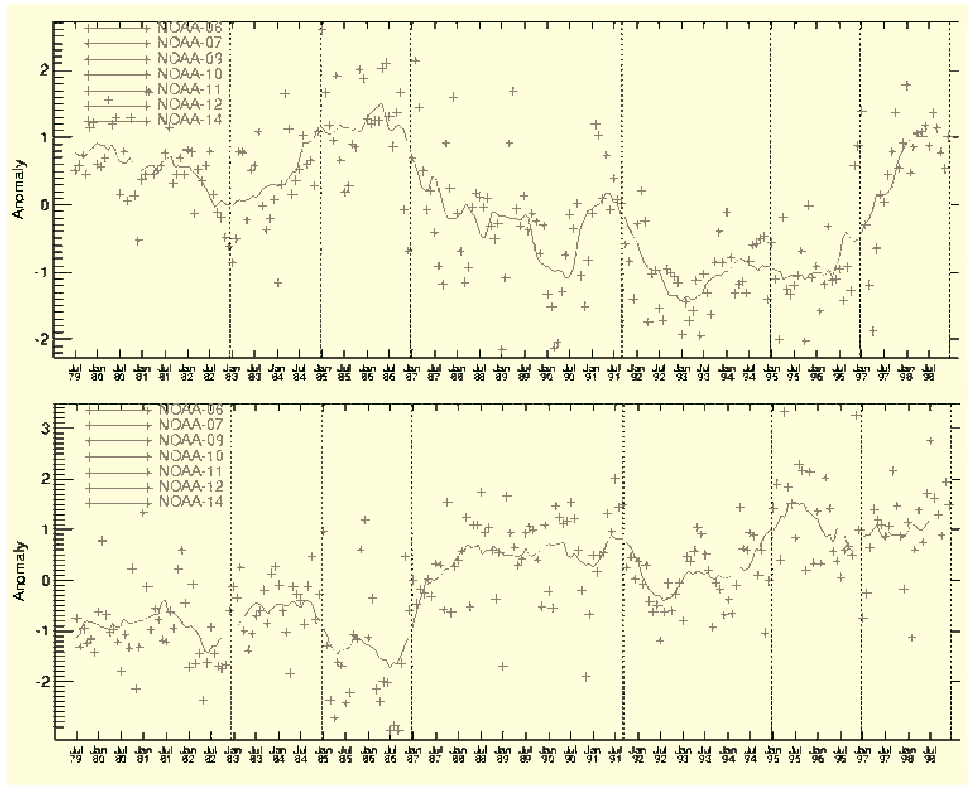


Fig. 2. Monthly departures from monthly averages over the entire time series for (top) 300 hPa, and (bottom) 900 hPa based on TOVS Path-P data set. The line is a 1-year running mean.