Proc. NIPR Symp. Polar Meteorol. Glaciol., 9, 196, 1995

AN ESTIMATION OF THE WARMING RATE BY WARM AIR ADVECTION OVER SYOWA STATION (ABSTRACT)

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We present an analysis of warm air advection by using radiosonde wind data from 1967 to 1993 at Syowa Station, Antarctica.

Assuming that the warm air located at the left-hand side of the thermal wind is carried to the upper air of the station by the mean wind velocity, the warming rate (℃/day) over Syowa is calculated as

$$\overline{V} \cdot \frac{\partial T}{\partial n} \cdot 3600 \cdot 24 = -0.041 \cdot \frac{V_1 \cdot V_2 \cdot \sin(D_2 - D_1)}{\ln P_1 - \ln P_2},$$

where P_1, V_1, D_1; pressure, wind velocity, wind direction at the bottom of the layer respectively,
P_2, V_2, D_2; same above at the top of the layer respectively.

Six layers are selected between 700 and 30 hPa for the analysis.

The annual mean warming rate between 700 and 200 hPa is 1.1°C/day, which is nearly well balanced with the cooling rate by long wave radiation observed with radiation sondes. The seasonal variation has a twin-peaked shape, with the maximum monthly mean value of 1.7°C/day in March and 1.6°C/day in August, minimum of 0.4°C/day in January and 0.8°C/day in May, suggesting a relation with the frequency of blizzards.

It is shown by observations every 12 hours that antarctic severe blizzards bring warm air not only to the troposphere, but also to the stratosphere with a slight delay. The annual mean warming rate between 100 and 30 hPa, however, shows the negative value of −0.7°C/day. Strong cool air advection occurs from September to November, with the minimum monthly mean value of −4.0°C/day in October. Cooling by long wave radiation plus cold air advection should be compensated for by adiabatic heating in the strong downward air current.

A significant trend in the warming rate could not be detected in spite of the existing negative trend in stratospheric temperature accompanying the ozonehole.

(Received December 5, 1994; Revised manuscript received May 15, 1995)