

1.7A. COMPARISON OF TROPOPAUSE ALTITUDE DETERMINATION BY THE PLATTEVILLE
RADAR, SUNSET RADAR AND THE NWS RAWINSONDE

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INTRODUCTION

During the month of March, 1981 the Sunset and Platteville Radar and Platteville Radar were operated primarily with vertical antenna beams. These radars are both VHF ST (Stratosphere-Troposphere) radars. The separation between them was 63 km, the Sunset site located in the foothills of the Rocky mountains and the Platteville site was in the plains, just east of the mountains. Both radars were operated continuously for about three weeks with a time resolution of a few minutes. Both made measurements in the 4-20 km altitude interval with an altitude sampling of 1.2 km.

The purpose of this paper is to compare the estimation of the altitude of the tropopause by these two radars with the altitude of the tropopause derived from standard NWS rawinsondes. The results of vertical wind measurement for the two radars was presented in a earlier paper (BALSLEY et al., 1981) and a comparison of the reflectivities was presented in (GAGE et al., 1983).

DESCRIPTION OF EXPERIMENT

The two radar systems used in this experiment are located near the towns of Sunset and Platteville, CO. Their relative locations are indicated on the map in Figure 1. Note that the site alignment is approximately east-west, i.e., in line with the prevailing wind pattern. An outline of the profile of the ground surface altitude on the line between the two sites appears at the bottom of Figure 1. The location of both sites relative to the continental divide and the beginning of the plains region is evident: Sunset is located in the foothills close to the divide, while Platteville is situated in more of a plains environment. Line-of-sight between the two radars is about 63 km.

System parameters for both Sunset and Platteville are given in Table 1. Both systems are pulsed, VHF Doppler radars operating at intermediate power levels which use phased arrays comprised of lines of coaxial-cable dipoles. More complete descriptions can be found for Sunset in GREEN et al. (1979) and for Platteville in ECKLUND et al. (1979). The Sunset and Platteville systems are similar, the main difference is that the Sunset beam can be steered electronically, while the Platteville beams are fixed.

In this experiment both radar systems operated almost exclusively with vertically directed beams, the exception being that Sunset performed a three-position scan every 12 hours to measure the horizontal wind field as well. This procedure did not cause an appreciable deterioration of the vertical data.

Data from both systems were processed in similar ways to afford the best comparison. The time resolution in the present data set has been standardized by appropriate computer averaging. Both radars were sampled at altitude intervals of 1.2 km. The Sunset radar used a vertical resolution of 1 km and the Platteville radar used a vertical resolution of 2.4 km.

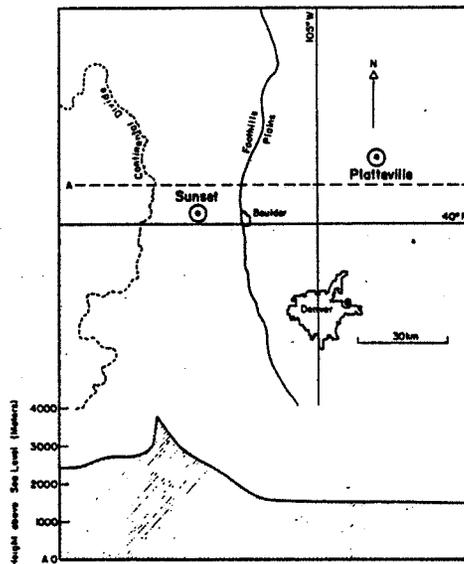


Figure 1. Map of the experimental area.

Table 1. Radar system parameters

| | | Platteville | Sunset |
|-------------|----------------------------|------------------------|---------------------------------|
| Transmitter | Frequency | 49.920 MHz | 40.475 MHz |
| | Peak pulse power | 15 kW | 50 kW |
| | Average power | 133 W | 1.0 kW |
| | Pulse width | 16 μ s | 7 μ s |
| | Pulse rate | 555 Hz | 5.4 KHz |
| Receiver | Noise figure | \sim 3 dB | \sim 3 dB |
| | Bandwidth | Matched to pulse width | Matched to pulse width |
| | Filtering (range gate) | Bessel | Gaussian |
| Antenna | Area | 10^4 m^2 | $3.6 \times 10^3 \text{ m}^2$ |
| | Beamwidth (two-way) | \sim 2° | \sim 4.6° |
| | Direction | Vertical | Vertical (occasionally oblique) |
| | Efficiency | .39 | .30 |
| Processing | Coherent averaging | 256 pulses (digital) | 210 pulses (analog) |
| | Spectral resolution | 64 points | 256 points |
| | Doppler spectral bandwidth | 1.1 Hz | 12.8 Hz |
| | | | |

RESULTS

Figure 2 shows typical vertical profiles of S/N observed by both radars. The difference in the vertical resolutions of the radars is evident in the greater detail shown in the Sunset curve. The increase in sensitivity of the Platteville radar because of its longer pulse length is evident in its greater altitude range.

An objective technique for determining tropopause altitudes was presented in GAGE and GREEN (1982). This technique was used to determine tropopause altitude from both the Sunset Radar and Platteville Radar data sets. Figure 3

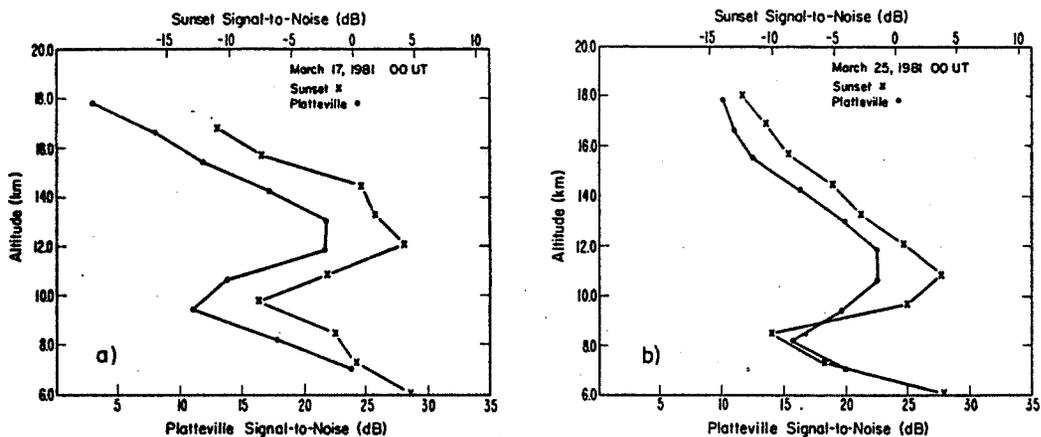


Figure 2. Vertical profiles of signal-to-noise ratio observed by the Sunset and Platteville radars (a) 00 UT 17 March 1981; (b) 00 UT 25 March 1981.

compares a time series of tropopause altitudes determined from both radars and the corresponding NWS Denver rawinsonde data.

In Figure 3, it can be seen that the tropopause altitude determined from the data from each of the two radars are in about the same agreement with each other as with that determined from the rawinsonde data. At the times when poor agreement is evident, the altitude of the tropopause is changing rapidly leaving open the possibility that the observed difference is real.

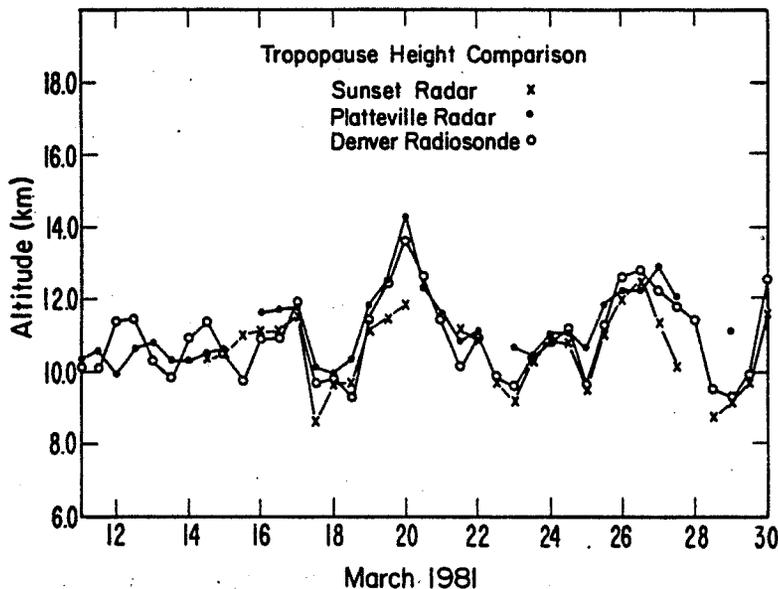


Figure 3. Comparison of tropopause heights determined from Sunset and Platteville radar data with tropopause heights determined from routine NWS Denver soundings.

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