8.2 DEVELOPING A TECHNIQUE FOR VERIFYING RADIOSONDE SOLAR RADIATION CORRECTION ALGORITHMS

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1. Introduction

The National Weather Service (NWS) has developed a technique for verifying the algorithm used with radiosondes for applying radiation corrections to temperature measurements. Both solar and infrared corrections are applied to temperature measurements, but the solar correction has the greatest effect. However, the algorithm within either the government-furnished or vendor-furnished software/firmware must be validated to ensure the corrections are being applied properly as a function of time of day, latitude and solar angle. This paper describes a technique procedure developed by the NWS to evaluate the implementation and the impact of solar radiation corrections.

2. Baseline Comparison

Procedures were developed to evaluate the implementation and impact the time of day and latitude have on radiation corrections. For the development of these procedures an upper air sounding was made at Sterling VA on 25 July 2002 at 22:31 local (L) time. The flight lasted 101 minutes and terminated at 00:12L on 26 July. This allows the sounding to be conducted in total darkness, and therefore, would have no solar radiation correction applied. The ground equipment used to track the balloon flight was an operationally configured NWS Automatic Radiotheodolite. The data processing for the sounding was accomplished using the NWS PC based MicroART system.

In addition to the normal data processing of the sounding, the demodulated audio signal from the radiosonde was also simultaneously recorded from the same ground equipment using a Digital Audio Tape (DAT).

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The DAT was then used to replay the sounding back into the MicroART computer for various release times. For the initial evaluation of these procedures, each time the DAT was replayed the date as well as the latitude and longitude of the original flight were used.

For a baseline test the DAT was replayed with a release time of 02:00L and compared against the actual 22:31L flight data. Figure 1 is the temperature plots for the 22:31L live flight and the 02:00L playback.

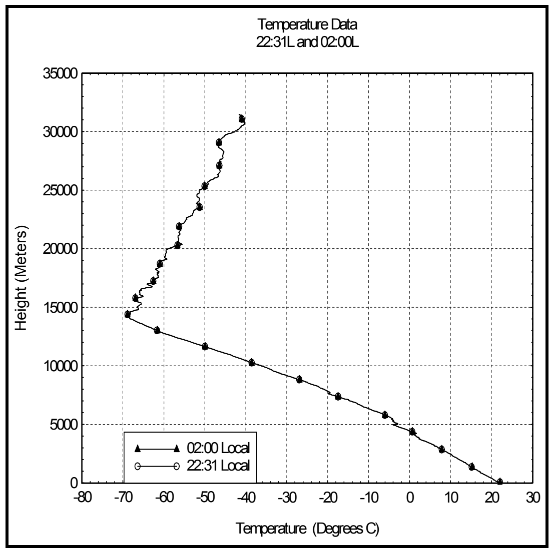

Figure 1. Temperature plots for the 22:31L live flight and the 02:00L playback.

As indicated in Figure1, there is very little difference in the temperature profiles. Figure 2 is a plot of the smoothed temperatures differences. Note, the data below 15,000 meters has a negative bias where temperature is decreasing with height and a positive bias above that altitude where temperature is increasing with height. This indicates a small timing error, which most likely resulted from the synchronization of the DAT and the starting of the MicroART software. In this case it is believed the timing error is on the order of one second or less. Other than this, the data are in very good agreement indicating the MicroART system applied no solar radiation correction to the 02:00L sounding, as expected.

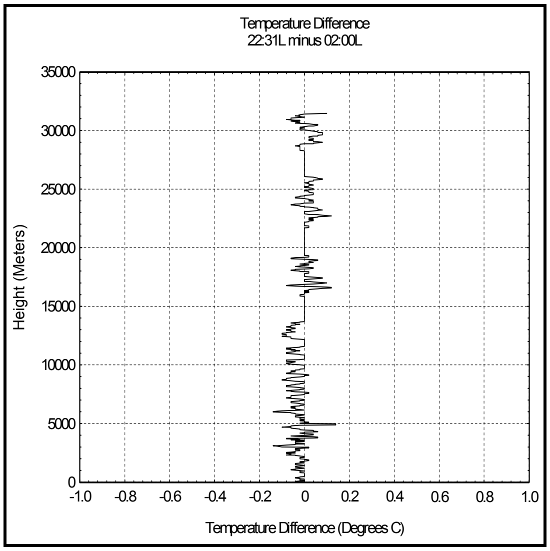

Figure 2. Temperature difference plot for the 22:31L live flight minus the 02:00L playback.

3. Time Series Comparison

For the evaluation of the developed procedures a time series comparison was conducted. This was accomplished by replaying the digital recording five more times. Each time the recording was played back the MicroART PC was set so the release times would increment by one hour starting one hour after the 02:00L baseline test. This start time was selected to demonstrate the procedures could be used to evaluate solar radiation corrections during a sunrise event. Table 1 is a summary of the release times for which the DAT was replayed into MicroART.

Test #	Time (Local)	Time (UTC)
1	02:00	06:00
2	03:00	07:00
3	04:00	08:00
4	05:00	09:00
5	06:00	10:00
6	07:00	11:00

Table 1. Summary of release times used.

The date used for the time series was 25 July 2002; again this is the date for the actual flight. Sunrise at Sterling, VA, on 25 Jul was 05:34L.

The temperature data for each of the replayed data sets are plotted in Figure 3. This plot indicates there is a gradual departure in temperature with height as the time series progresses farther from the 02:00L data set.

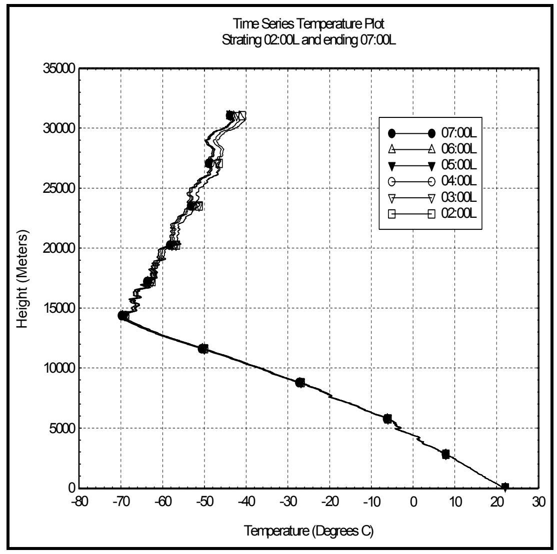

Figure 3. Temperature plots for all replayed data sets.

To further determine if the developed procedures are effective in evaluating the implemented solar radiation correction, the temperature differences between the 02:00L sounding and each of the other soundings was plotted as shown in Figure 4.

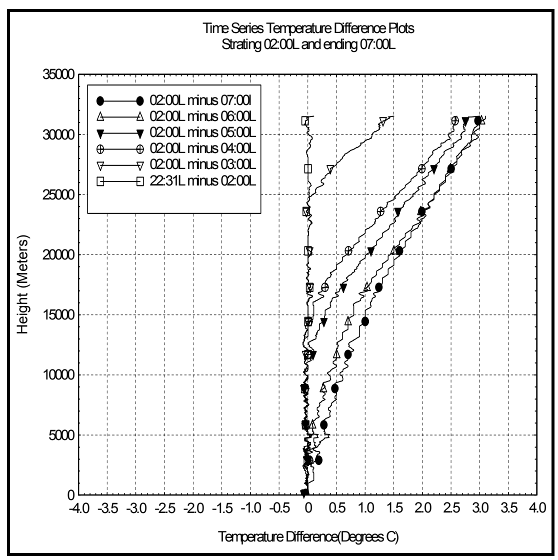

Figure 4. Temperature difference plots for all flights, including the baseline data set.

As indicated in Figure 4, the temperature differences from the 02:00L nighttime sounding gradually increase as the time and solar elevation angle increase with successive flights. As time progresses each flight is getting cooler as the solar radiation correction algorithm attempts to compensate for increasing solar radiation that would be occurring if these were real flights. Additionally, even though the 03:00L sounding would have ended before sunrise at Sterling, the system begins to apply a correction starting at about 25,000 meters or 84 minutes into the flight. This would indicate the corrections were being calculated based on the current time and or altitude.

4. Conclusions

The technique described in this paper appears to be very effective in identifying the applied solar radiation correction with regards to time. It is believed these same procedures can be used to validate solar corrections in terms of location i.e., change to latitude instead of time. In the future it is anticipated a similar series of digital recordings will be played back into MicroART in which the time will be held constant and the latitude and longitude will vary.

The final component will be varying the time and latitude/longitude to determine the solar radiation correction across all parameters. Future work in this area will be forthcoming.

5. Acknowledgements

The authors would like to thank Paul Rockwood for technical support in preparing the digital recordings and data reduction.