CONVAIR-580 STATE PARAMETER CALIBRATIONS FOR MID-SAFARI 2000

Name of Instrument and Parameter: Rosemount (Model 830BA) pressure

Date of Calibration: 23 August 2000

Method of Calibration: Calibrated against station pressure at the South African Weather Bureau Pietersburg station. Also conducted wing-tip-to-wing-tip flight with the South African Aerocommanders.

Person Carrying Out Calibration: CARG personnel

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RESULTS OF CALIBRATION

The Pietersburg station pressure at sounding release time (1100 UTC) was 885.9 hPa. The Convair-580 static pressure from the Rosemount 830BA sensor rolling down the runway (and nearest the SAWB station) was 885.3 hPa, a difference of just 0.6 hPa. This is within the Rosemount manufacturer's error bar of 0.1%.

On 23 August 2000 (UW Flt 1821) the Aerocommanders and the Convair-580 targeted 700 hPa static pressure as the level for an in-flight comparison of data. Both aircraft were within about 50-100 m horizontal distance of each other while flying at this level. No other flight levels were flown for this purpose, and no data has been exchanged as of this date.

Conclusions: No corrective action required.

Name of Instrument and Parameter: Reverse flow temperature (in-house manufactured)

Date of Calibration: 23 August 2000

Method of Calibration: Comparison against the South African Weather Bureau rawinsonde launched from Pietersburg, SA, at 1100 UTC on 23 August 2000.

Person Carrying Out Calibration: CARG personnel

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RESULTS OF CALIBRATION

The radiosonde-aircraft comparison extended from near the surface to above 16,000 feet ASL and a temperature range from 23° C to -7° C. The correlation between the radiosonde and the Convair-580 reverse flow static temperature (tstatr) was 0.98. However, the Convair-580 reverse flow temperature was generally **lower** than the Pietersburg rawinsonde temperature by about 2° C (see Figure 1). This temperature offset was little affected by pressure, the magnitude of the temperature, or true airspeed. Thus, it appears that the offset is fairly constant in value. The most accurate adjustment of the Convair-580 tstatr relative to the Pietersburg sounding can be obtained by applying the following equation to the raw tstatr temperatures:

$$tstatr_{corrected} = 0.98(tstatr_{raw}) + 2.2 \qquad (1)$$

The effect of this correction is shown in Figure 2.

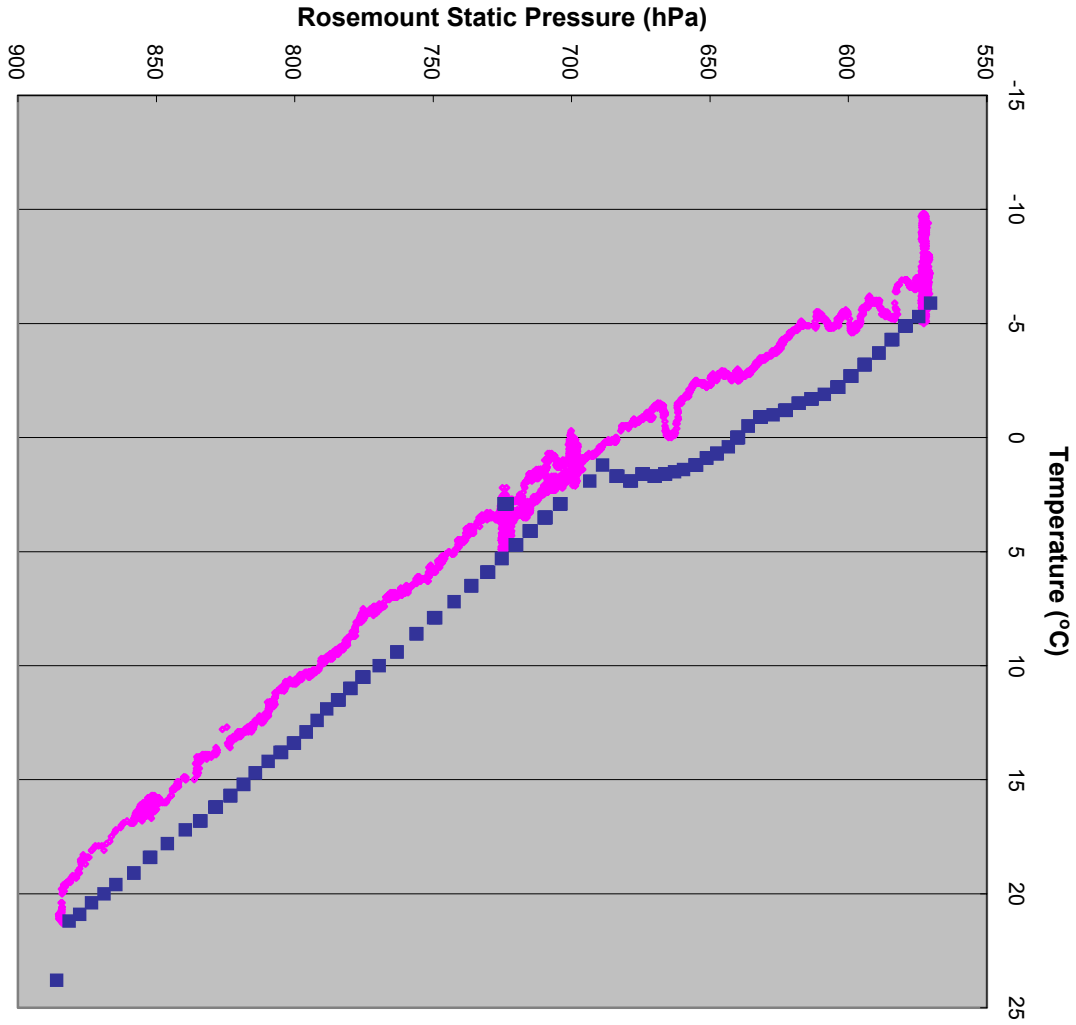

Figure 1. A comparison of the Pietersburg, South African Weather Bureau, rawinsonde temperatures (solid squares) and the raw reverse flow static temperatures (light gray line) The rawinsonde was launched from Pietersburg, South Africa, at 1100 UTC, 23 August 2000.

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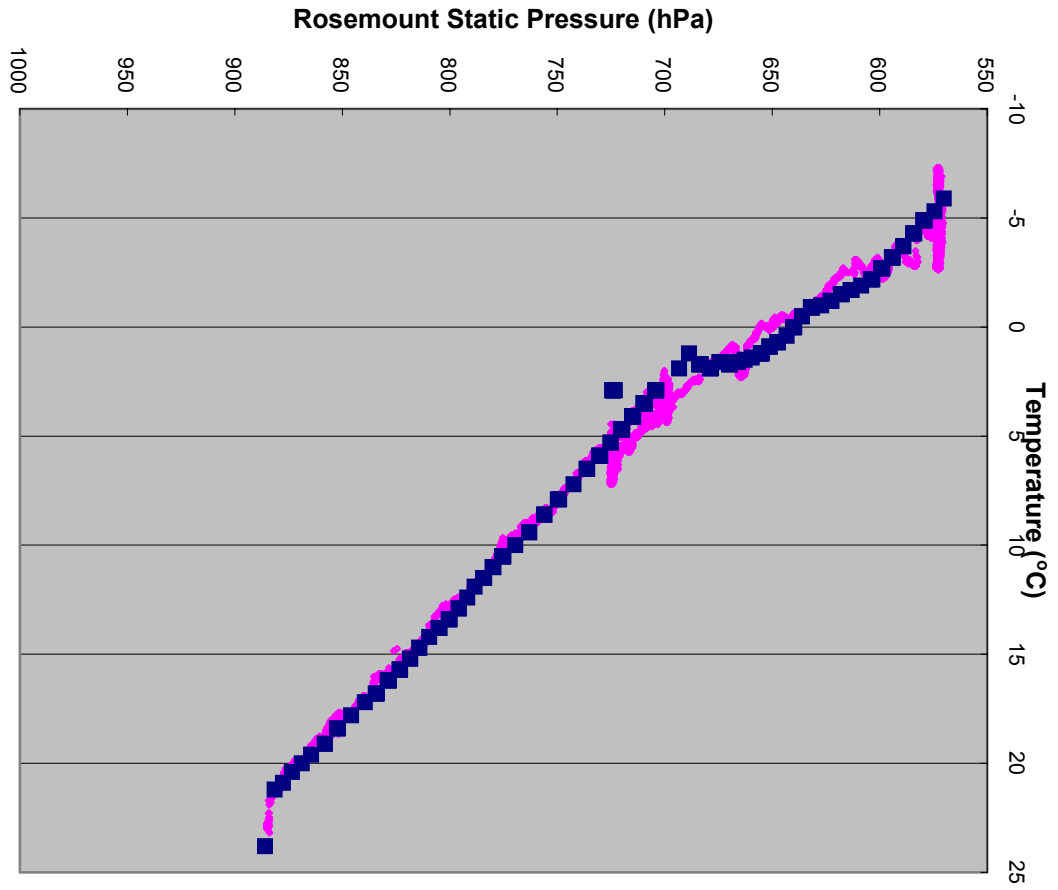

Figure 2. A comparison of the Pietersburg, South African Weather Bureau, rawinsonde temperatures (solid squares) and the adjusted reverse flow static temperatures using Eqn (1) (light gray line). The rawinsonde was launched from Pietersburg, South Africa, at 1100 UTC, 23 August 2000.

Conclusion: For UW flights 1821 through 1839 (end of SAFARI 2000), apply Eqn (1) to obtain the most accurate values of static temperatures from the raw values of tstatr.

Name of Instrument and Parameter: Rosemount (Model 102CY2CG) temperatures

Date of Calibration: This instrument is no longer usable due to a malfunction that occurred during the ferry of the aircraft from Kwajalein, Marshall Islands, to Seattle, Washington, in 1999. The malfunction causes the Rosemount temperature to drift between 5 and 15 ° higher than the true temperature and sometimes this occurs in level flight at constant true airspeed. The fluctuations have not been correlated with any existing parameter that might allow for a correction.

Method of Calibration: None

Person Carrying Out Calibration:

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RESULTS OF CALIBRATION

No calibration performed.

Conclusion: The Rosemount temperature data should not be used in SAFARI 2000.

Name of Instrument and Parameter: Cambridge (Model TH 83-244) dewpoint temperature

Date of Calibration: 23 August 2000

Method of Calibration: Comparison against the South African Weather Bureau rawinsonde launched from Pietersburg, South Africa, at 1100 UTC on 23 August 2000.

Person Carrying Out Calibration: CARG personnel

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RESULTS OF CALIBRATION

The Cambridge chilled mirror dewpoint temperature (dp_{raw}) exhibited a high correlation (r=0.93) with the Pietersburg rawinsonde dewpoint temperature. However, an offset was present, with dp_{raw} higher than the rawinsonde dewpoint over most of the altitude range that the rawinsonde was tracked. Some of the scatter in the data is most likely due to real fluctuations in humidity. The balloon was launched on a partly cloudy day consisting of scattered small cumulus clouds, indicating considerable inhomogeneities in the humidity field. The aircraft and the balloon did not travel the exact same path. Some of the scatter is also due to the heating and cooling cycle that the Cambridge sensor undergoes in order to produce condensation and then evaporation of water on the mirror's surface. These cycles cannot be completely eliminated in this type of comparison. Regions where the dewpoint is indicated to be below about -20° C are not considered reliable data.

Based on a best fit least squares method, the Cambridge raw dewpoint temperatures (dp_{raw}) should be adjusted by the following factors to retrieve the most accurate dewpoints:

$$dp_{corrected} = 1.1(dp_{raw}) - 1.43 \qquad (2)$$

The effect of applying Eqn. (2) is shown in Figure 4.

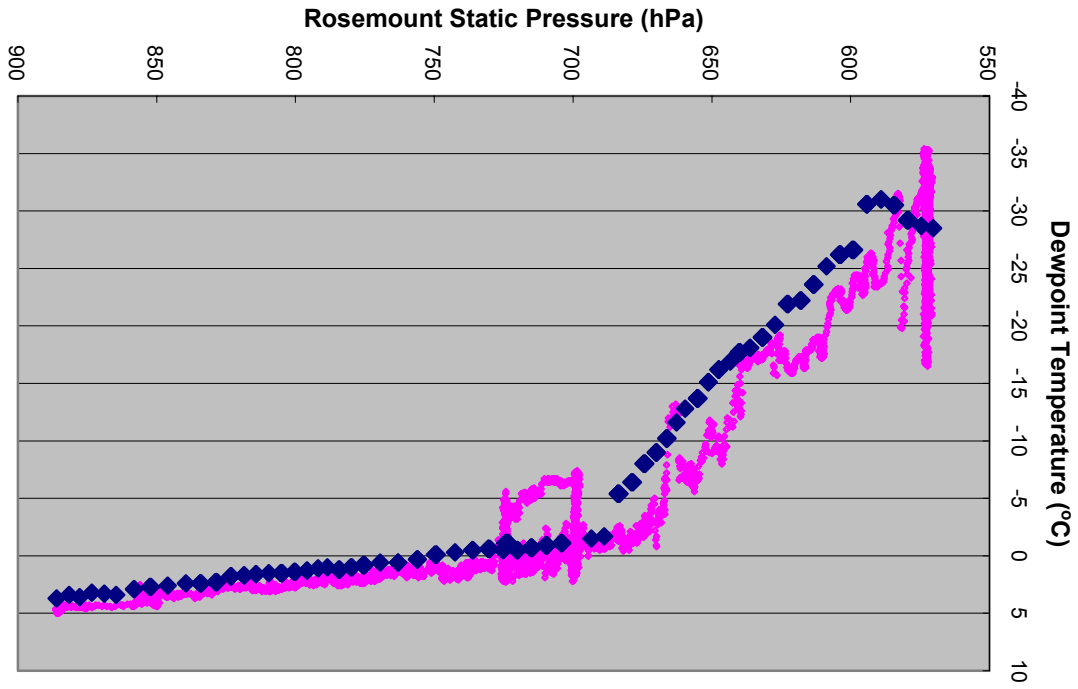

Figure 3. A comparison of the Pietersburg, South African Weather Bureau rawinsonde dewpoints (solid diamonds) and the raw Cambridge chilled mirror dewpoint temperatures (light gray line). The rawinsonde was released from Pietersburg, South Africa, at 1100 UTC, 23 August 2000.

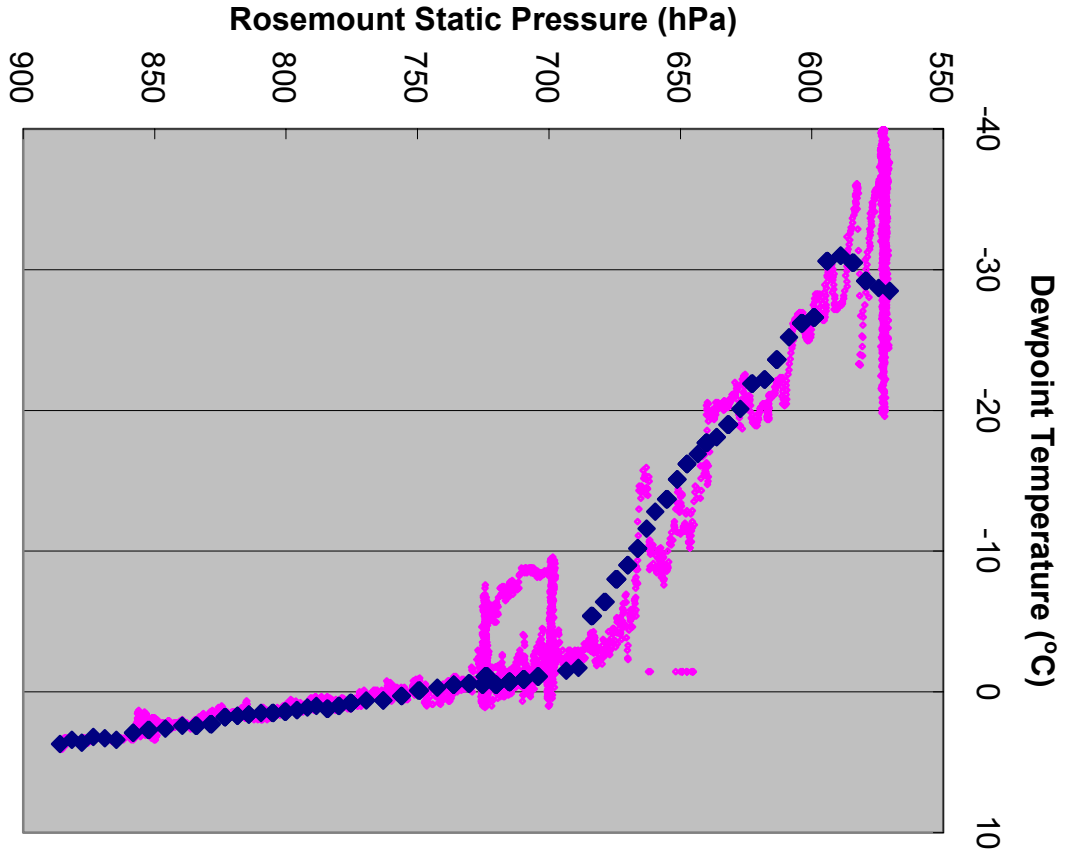

Figure 4. A comparison of the Pietersburg, South African Weather Bureau rawinsonde dewpoints (solid diamonds) and the adjusted Cambridge chilled mirror dewpoint temperatures using Eqn. (2) (light gray line). The rawinsonde was released from Pietersburg, South Africa, at 1100 UTC, 23 August 2000.

Conclusion: For UW flights 1821 through 1839 (end of SAFARI 2000), apply Eqn (2) to obtain the most accurate values of Cambridge chilled mirror dewpoint temperatures from values of dp_{raw}.

Name of Instrument and Parameter: Ophir (Model IR-2000) absolute humidity

Date of Calibration: 23 August 2000

Method of Calibration: Comparison against the South African Weather Bureau rawinsonde launched from Pietersburg, South Africa, at 1100 UTC on 23 August 2000.

Person Carrying Out Calibration: CARG personnel

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RESULTS OF CALIBRATION

The Ophir-derived dewpoints and Pietersburg rawinsonde dewpoint temperatures were highly correlated (r^2=0.91). Some of the scatter between the two is undoubtedly due to real inhomogeneities in humidity on a partly cloudy day with scattered cumulus clouds. Also, the aircraft and the balloon did not travel identical paths. However, the magnitude of the scatter in the regions where the ambient dewpoint is less than -25° C is large and is thought to be a limitation of the Ophir probe in measuring extremely low values of absolute humidity. Dewpoints below about -20° C from the Ophir sensor should not be used.

Apart from the limitation noted above, the most noticeable difference between the raw Ophir-derived dewpoints (dp_o_{raw}) and those indicated by the rawinsonde was that dp_o_{raw} was slightly lower than the rawinsonde dewpoint temperature at lower altitudes, higher than the rawinsonde at mid-levels, and lower again than the rawinsonde dewpoint temperature in the upper portion of the sounding.

A least squares fit to the two data sets yielded:

$$dp\_o_{corrected} = 0.83(dp\_o_{raw}) + 0.4 \qquad (3)$$

Comparisons of Figure 5 and Figure 6 shows the effects of using Eqn. (3).

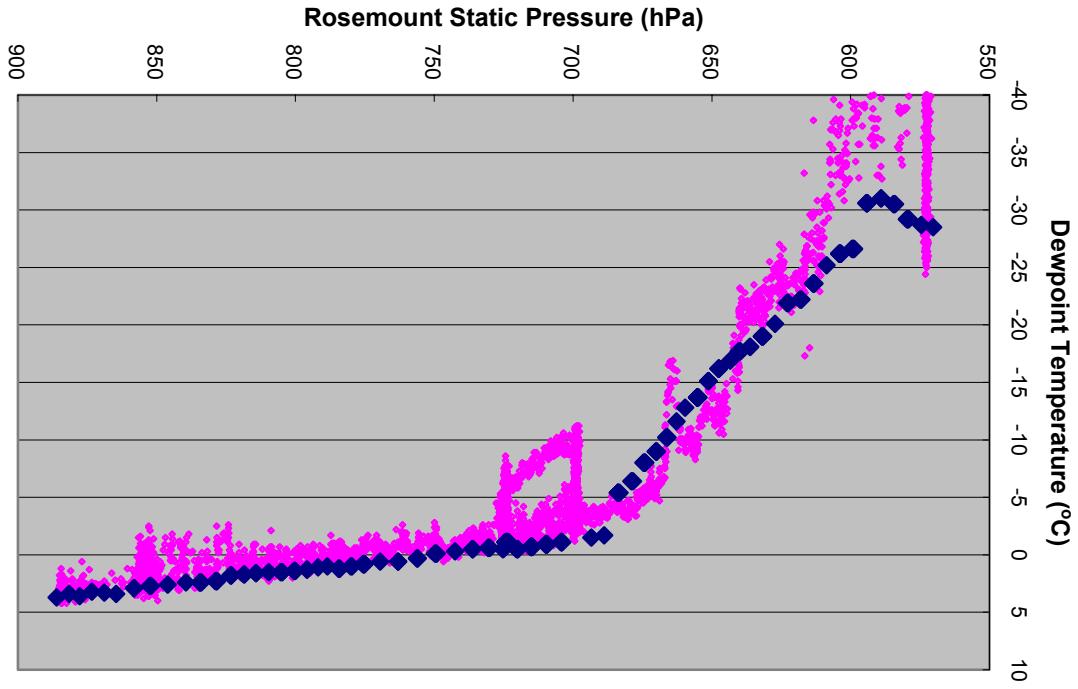

Figure 5. A comparison of the Pietersburg, South African Weather Bureau rawinsonde dewpoints (solid diamonds) and the raw Ophir-derived dewpoint temperatures (light gray line). The rawinsonde was released from Pietersburg, South Africa, at 1100 UTC, 23 August 2000.

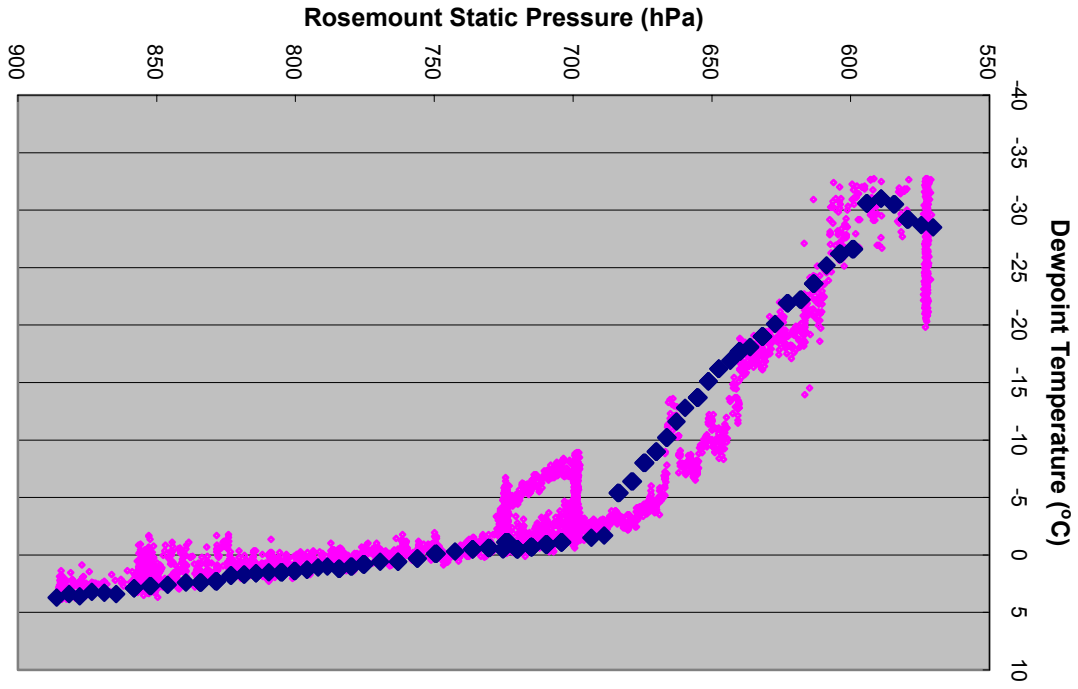

Figure 6. A comparison of the Pietersburg, South African Weather Bureau rawinsonde dewpoints (solid diamonds) and the adjusted Ophir-derived dewpoint temperatures using Eqn. (3) (light gray line). The rawinsonde was released from Pietersburg, South Africa, at 1100 UTC, 23 August 2000.

Conclusion: For UW flights 1821 through 1830 apply Eqn (3) to obtain the most accurate dewpoint temperatures from the raw Ophir-derived dewpoint temperatures (dp_o_{raw}). However, for reasons possibly related to smoke sampling and perhaps lack of a regular cleaning routine, the Ophir began to indicate significantly lower dewpoints

compared with the Cambridge chilled mirror device from UW flight 1830 through UW flight 1838, a period in which there were no calibrations. From the clouds that were sampled in a few of those flights, it is clear that the Ophir was indicating dewpoint values that were low by several °C to as much as 10° C. However, there were also periods during these same flights when the Ophir dewpoint was too high and indicated saturated conditions when the absence of clouds at flight level suggested otherwise.

The performance of the Ophir improved considerably on UW Flight 1839, when the Ophir-derived and Cambridge dewpoints were in good agreement for much of the flight. We attribute this to the likelihood (not documented) that the Ophir was cleaned after flight 1838. Thus, for the UW flights 1830 through 1839, the Cambridge dewpoints should be used instead of the Ophir dewpoints.

Name of Instrument and Parameter: Omega Engineering (Model 0S3701) surface temperature

Date of Calibration: None

Method of Calibration: None

Person Carrying Out Calibration: NA

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RESULTS OF CALIBRATION

This instrument was not calibrated. However, the qualitative temperature trends when the aircraft was flying within about 500 m of the surface appear reliable. (Can also be used to estimate widths of those portions of fires, clouds, or dense smoke when the aircraft is just above them.)