PICTURES OF THE MONTH

Warm Cloud over North Central Florida

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1. Satellite observations

On the morning of 3 February 1976, a very high resolution (0.62 km) infrared (WHR) 8–13 μm Defense Meteorological Satellite Program (DMSP) photo was received in real time at the Cape Canaveral Forecast Facility (CCFF). The photo displays the emission temperature of clouds/land/water in varying shades of gray with colder temperatures appearing whiter and warmer temperatures blacker. The satellite meteorologist uses the gray shade of a cloud to determine its relative height, with high clouds appearing whiter (colder) than low clouds in a standard atmosphere (where the lapse rate is positive). On occasion where there is a negative lapse rate (inversion), temperatures increase with altitude and the method fails. This photo (Fig. 1) is an example of this exceptional situation, capturing the presence of warm stratus (Anderson *et al.*, 1971) over north central Florida.

In Fig. 1, the WHR imagery shows a relatively clear view of the state of Florida except for a dark triangular area in the north central portion of the state. On this infrared product, up to 16 gray shades can be depicted. For this particular image, the thermal range chosen was 288 to 263 K, i.e., a 25 K spread. This setting means that any thermal emission greater than 288 K is black, any emission less than 263 K is white, with appropriate gray shades depicting emissions in between. In this figure, there were no emission sources cold enough to be depicted as white.

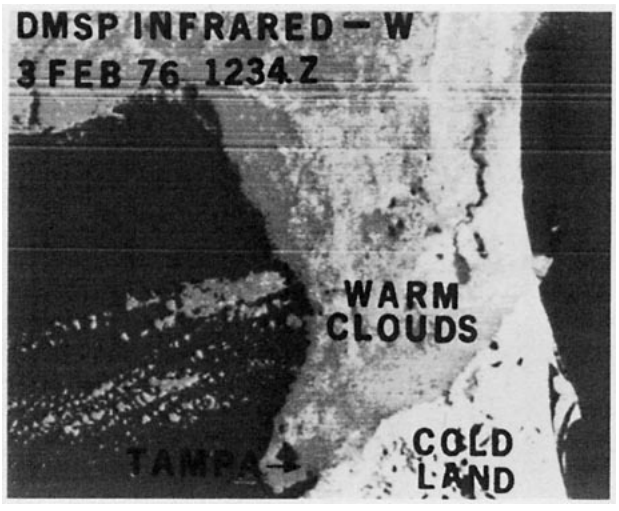

FIG. 1. DMSP high-resolution infrared photo of warm cloud over north central Florida.

2. Corroborating meteorological data

At first examination, the triangular area was mistakenly thought to be a warm land area. However, an examination of the simultaneous low-light visible (H) imagery (Fig. 2) clearly shows a triangular cloud over the area. This photo was obtained at the same time as Fig. 1.

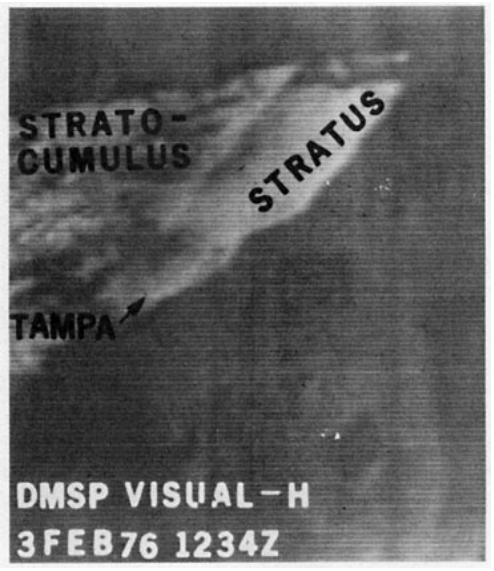

FIG. 2. DMSP night visual (low-light capability to see by moonlight or early morning/late evening sunlight) image. North is at the top of the picture; Lake Okeechobee is dimly visible in the lower, right portion of the photo.

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TABLE 1. Florida reporting stations (1200–1300 GMT).

Station	Clouds	Surface temperature (°C)
Tampa	14 BKN	5
Daytona	14 BKN	3
Cape Canaveral	15 SCT	2
Orlando	CLR	3
Gainesville	CLR	4

The synoptic sequence at nearby reporting stations indicates the following stratus clouds and surface temperatures in the 1200–1300 GMT data.

A Tampa, Fla., sounding which was in the southwest area of the triangular cloud is shown in Fig. 3. On this sounding, a sharp low-level subsidence inversion and moisture peak are shown at 950–900 mb (460–610 m). This corroborates the existence of a low-level cloud as recorded by the Tampa observation and sounding.

3. Cloud-top temperature

Fig. 4 is an example of thresholding, a technique in which imagery is processed in four gray shades. Each of these gray shades depicts a different thermal range as chosen by the satellite meteorologist to enhance certain features inherent in the data. In Fig. 4, the thermal ranges are as follows: 276 K, 274 K, 272 K; i.e., black depicts emission temperature greater than 276 K, dark gray 276 to 274 K, light gray 274 to 272 K, and white <272 K. The area around Tampa, which is covered by the warm stratus cloud, indicates a thermal emission very close to 275 K. It is important here to mention that the emission temperature is not equivalent to the actual temperature of the cloud/land/water surface; however, an approximate linear relationship exists between the two. Using the calibration data

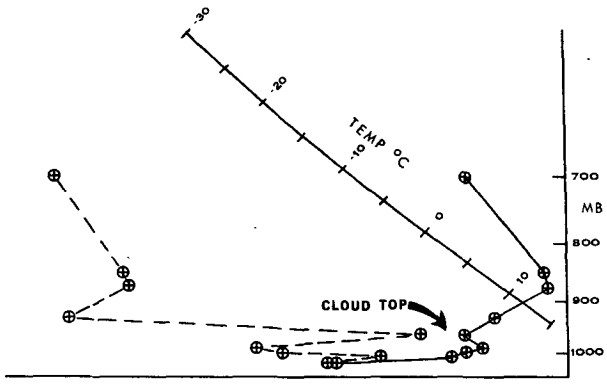

FIG. 3. Tampa upper air sounding, 1200 GMT 3 February 1976, plotted on skew T-log P diagram.

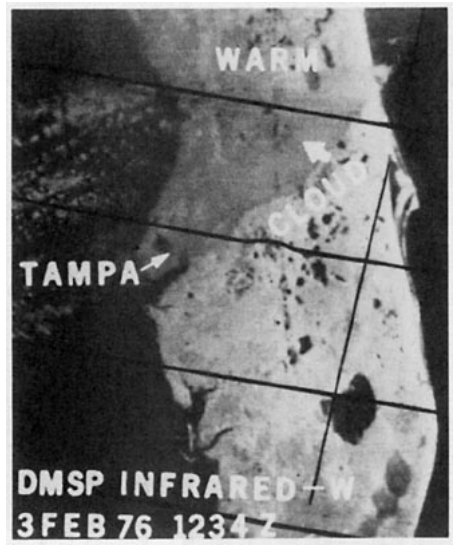

FIG. 4. DMSP high-resolution infrared with threshold processing. Black represents emission temperature greater than 276 K, dark gray between 274 and 276 K, light gray between 272 and 274 K, and white colder than 272 K. This picture corresponds with Fig. 2.

in the *DMSP Users Guide* (Dickinson *et al.*, 1974), an actual temperature of the cloud top should be 275 +8 K or 283 K. Naturally, this emission temperature should approximate the cloud top temperatures from the Tampa sounding (Fig. 3). Examination of this sounding indicated a cloud-top temperature of very nearly 10°C (283 K) which is in excellent agreement.

4. Conclusion

This photo is by no means intended to cast doubt on the credibility of IR satellite imagery but rather to present an accolade to the versatility which is possible when processing this data. The possibility for misinterpretation of satellite imagery is a fact we have to live with (Ernst, 1975). However, through the use of techniques such as thresholding and low-light day and night visual data, the satellite meteorologist is provided with a quantitative tool to evaluate such anomalies.

REFERENCES

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