P3.20 THE USAGE OF GOES IMAGER CLEAR-SKY RADIANCE IN THE NCEP GLOBAL DATA ASSIMILATION SYSTEM

Xiujuan Su [1]*, John Derber[2], Jim Jung[3],
Yoshihiko Tahara[4], Dennis Keyser[2], Russ Treadon[2]
1: SAIC, Camp Springs, Maryland
2: EMC/NCEP/NWS/NOAA, Camp Springs,Maryland
3: CIMSS, Camp Springs, Maryland
4: UCAR, Camp Springs, Maryland

1. INTRODUCTION

The National Environmental Satellite, Data, and Information Service (NESDIS) and the Cooperative Institute for Meteorological Satellite Studies (CIMSS) have been producing Geostationary Operational Environmental Satellite (GOES) imager clear sky brightness temperatures (CSBT) since November 2001. The data includes one visible and four infrared channels. The data were examined for possible use in the NCEP Global Data Assimilation System (GDAS). Severe cloud contamination was found in the surface channel data when the satellite observations were compared to Aviation six-hour forecast. Feedback from NCEP and ECMWF prompted NESDIS and CIMSS to reexamine their cloud clearing scheme. Several changes were made to the CSBT production algorithm and the new CSBT product has been generated since July 2002. The product was examined with the GDAS system, and it was found that the quality has greatly improved, especially for surface channels.

2. DATA

The CSBT data are generated hourly, but only data closest to the analysis times: 00, 06, 12, and 18 UTC are used. For the surface channels 2, 4, and 5 (3.9 μm,10.7 μm, and 12.0 μm wavelength respectively), the data over land are not examined because of uncertainties in land surface characteristics. In addition, data from channel 2 are discarded when the solar zenith angles are less than 90 degrees because of sun glint effects.

* Corresponding author address: Xiujuan Su, EMC(201), 5200 Auth Rd., Camp Springs, MD 20746; e-mail Xiujuan.Su@noaa.gov

The data were examined by comparing brightness temperatures derived from the GDAS profiles with the CSBT. The background departures (differences between observations and first guess) of the surface channels show that large negative values usually occur in areas where the clear sky fraction is small, as shown in Figure 1. Figure 2 is a scatter plot of the background departures for the surface channel 4 verse clear-sky fraction, which shows that there is a larger tail at lower clear-sky fractions. The scatter plot of background departures for the channel 3 (6.7 μm, water vapor channel) vs. clear-sky fraction also have a tail at lower clear-sky fractions and are shown in Figure 3, although some spread at larger clear-sky-fractions also exists. These background departure features make it likely that the observations with larger negative background departure values are cloud contaminated. Time series of all background departures were examined. There are diurnal variations of background departures for surface channels. Closer examination showed a portion of the variation may have been caused by the lack of a diurnal variation in the SST used in the GDAS. Also, the time series confirms the mid-night effect for GOES-8 (Koepken, 2002, personal communication).

3. THE DATA QUALITY CONTROL

Since the data show possible cloud contamination, the next step is to perform data quality control to remove the problematic data. For this purpose, an eight-day period, August 3 to 10 2002, was chosen. Only quality control procedures and results for GOES-10 are

discussed here since the same principles are applied to GOES-8. The general statistics for the differences between the observed and first guess CSBT are listed in Table 1. There is a negative bias for the surface channels (2, 4, and 5) and positive bias for the water vapor channel (3) between observed and the GDAS calculated CSBT. Generally speaking, the large positive departures (>=5K for the surface channels, >=10.0 K for the WV channel) usually occur in coastal regions where the specification of surface properties (temperature, land/ocean, emissivity, etc.) is uncertain, and the large negative departures usually occur where the clear sky fractions are small. To develop a quality procedure, we looked at the scatter plots of background departures verse clear sky fractions, and calculated the mean values of background departure for every 10% clear sky fraction. After examining these results, the data with clear sky fractions less than 40% are considered to be cloud contaminated. The correlation between background departure for the surface channels (2, 4, and 5) and clear-sky fractions are much smaller (0.32, 0.46, 0.42 vs. 0.24, 0.34, and 0.30) after the data with less than 40% clear-sky fraction are removed. In addition, the histograms of background departures for all channels are more normal distributed according to the χ^2 goodness of fit test. After removing the data which may be cloud contaminated, the data with the background departures greater or less than two times standard deviations are also removed. The general statistics for the data after quality control are listed in Table 2. The background departure for channel 4 after quality control is shown in Figure 4.

The quality control procedure described above is quite conservative, some good data may be removed through the procedure. With the incorporation of quality indicators in the CSBT, the usage of data and our quality control procedures may be modified in the future. We are presently testing the assimilation of the water vapor channel in our GDAS and the evaluating its impact on our forecast. We are also planning to test, and eventually, assimilate the surface channels because of their significant near surface moisture signal.

Table 1 The statistics of background departures (observed minus first guess)after our quality

Channel No.	2	3	4	5
Sample size	284266	747433	680571	680571
Mean (K)	-0.65	2.96	-1.07	-0.90
Std. Dev.(K)	0.58	2.01	1.01	1.19
Max. Value(K)	24.01	17.32	18.04	15.56
Min. Value (K)	-19.56	-16.56	-15.30	-26.96

Table 2 The statistics of background departures (observed minus first guess)after our quality control procedures

Channel No.	2	3	4	5
Sample size	128050	376943	340411	339531
Mean (K)	-0.50	2.98	-0.69	-0.49
Std Dev.(K)	0.37	1.56	0.58	0.68

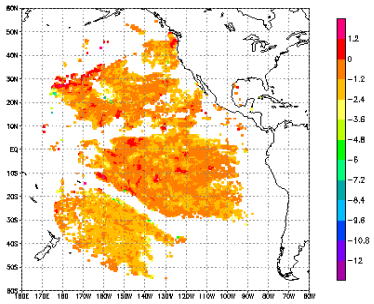

Figure 1 The background departure for channel 4 on 2002080306

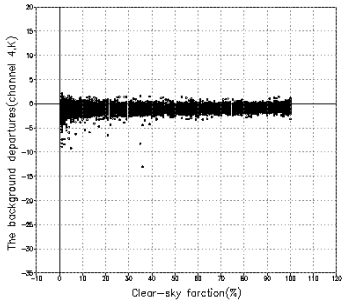

Figure 2 The clear-sky fraction vs. the background departure for channel 3 0n 2002080306

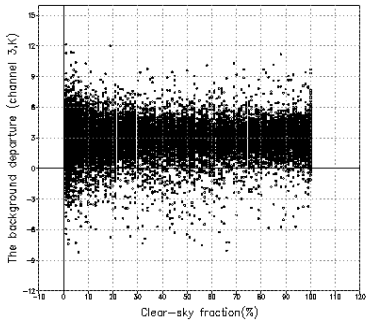

Figure 3 The clear-sky fraction vs. the background departure for channel 3 on 2002080306

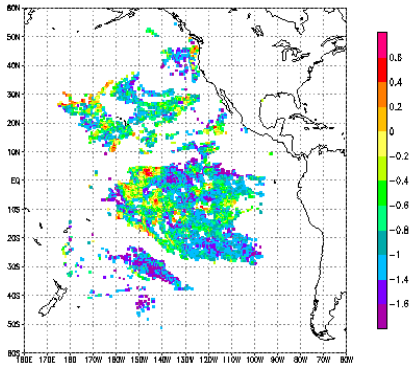

Figure 4 The background departure for channel 4 after quality control on 2002080306