SATCHEL SOUNOINGS OVER THE ALPHEX AREA

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1. Introduction

A physical retrieval method was used to prepare the material to be presented at the First International TOVS Study Conference. Only the ALPHEX orbits were processed.

The software used is based on the Physical Retrieval TOVS Export Package (TEP) which is described in a paper presented at the Conference by W.L. Smith et al. In the following, only the differences among the two packages will be described.

2. Method

a. The retrieval scheme is applied to the set of calibrated located radiances which were distributed by CIMSS to all participants.

b. The first guess profile is computed using a statistical regression scheme which uses only upper tropospheric and microwave channels. The statistical regression coefficients are the operational ones.

c. Profiles are produced from a 3 x 3 field of view (FOV) array and the clearest observations are selected as in the TEP. The average of the clearest HIRS observations affected by the surface is obtained using a weighted average, the weights being proportional to the inverse of the roughness of the underlying surface (computed using the Navy high resolution topography) in order to reduce the effects of rapidly varying elevation within the FOVS.

d. ECMWF 1000 mb analyses of temperature, relative humidity, and height are used to compute the pressure hydrostatically at the surface whose elevation is a weighted average using the high resolution topography.

e. Skin temperature is computed using channels 8, 18 and 19 and two adjacent FOVS at a time. The channels 18 and 19 values, uncorrected for solar contamination, are used. The aim is to correct for different cloud amounts in each couple of FOVS assuming that:

- average skin temperature $T_s$ is the same for both FOVS,
- average cloud top temperature $T_c$ is the same for the two FOVS,
- the product of the square of the transmissivity (computed from the surface) times the surface reflectance ($\tau_s^2 r_s$) is equal for channels 18 and 19 and in the two FOVS, and
- the same is true for the square of the transmissivity computed from the cloud top times the cloud top reflectance ($\tau_c^2 r_c$).
The system of six non-linear equations with six unknowns \((T_s, T_r, \tau_s^2, \tau_r^2, N_1, N_2)\), the last two being cloud amount in the two FOVS) is solved iteratively using the well known scheme

\[
T_s^{n+1} = T_s^n - \frac{\phi(T_s^n)}{\partial \phi/\partial T(T_s^n)}
\]

where \(\phi(T)\) is a function to be minimized.

3. Preliminary Results

The results are presented in Figures 1 to 4. In each figure the hand drawn ECMWF analysis is also plotted. Several conclusions can be made.

- ECMWF operational analysis do not allow discrimination between true atmospheric features and those associated with noise in the retrieval process because of its intrinsic smoothness. Therefore, there is a need to utilize higher resolution conventional analyses.

- The retrievals are in good agreement with the available conventional data in the 1000-700, 700-500 (and 1000-500) mbar comparisons; trough and ridge axes are quite in agreement. However, gradients of relative topography are more pronounced in correspondence to a developing trough over west Europe.

- In the 300-100 mb and 500-300 mb layers the satellite derived relative topography gradients are much weaker than those in the ECMWF. A lack of ability to detect the tropopause level is evident.

- A preliminary comparison between satellite and Raob thicknesses shows good agreement. The radiosonde data reveal several features such as gradients and mesoscale troughs and ridges which are also present in the satellite derived analysis.
Figure 1(a). 1000/500 millibars relative topographies. Full lines are satellite derived values for 4 March passes subjectively analyzed and hand contoured. Dashed lines are hand contoured ECMWF analyses. Numbers denote geopotential decameters.
Figure 1(b). Same as Figure 1(a) for 5 March passes.
Figure 2(a). 1000/700 millibars analysis. TOVS data are from 4 March passes. Symbols as in Figure 1(a).
Figure 3(a). 500/300 millibars analysis. TOVS data are from 4 March passes. Symbols as in Figure 1(a).
Figure (3b): Same as Figure 1(a) for 5 March passes.
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