Analysis of Cloud Top Heights in boundary layer inversions

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Introduction

Significant variations in the cloud top height (CTH) of inversion capped boundary layer clouds have been noted in CREW intercomparison exercises. One major cause is the dual solution allowed by the temperature profile - positions above and below the inversion can provide the same radiating temperature.

Amongst the CREW algorithms there are various approaches to handling these issues and whilst answers to some questions might be clear (e.g. that a boundary layer cloud top should lie within the lower mixed layer), others (e.g. is the cloud top always at the inversion cold point) are currently open. With the investigation here, we hope to clarify some of these issues and provide guidance to the design of algorithmic approaches to boundary layer cloud CTH estimation.

To support the investigation we use CALIPSO data and associated ECMWF profiles to characterise the CTH of boundary layer clouds in relation to characteristic feature points of the boundary layer inversion - the inversion base and top.

Data

Ten CloudSat/CALIPSO overpasses from August 2006 were analysed using EUMETSAT's AVAC-S software. The search for boundary layer inversions was limited to latitudes between -50 and 50 degrees. CALIPSO Cloud Top Height's were analysed.

Results

Statistics were calculated, with the following restrictions: lat_{min}=-50, lat_{max}=50, Δh_{invtop} < 750 m, Δh_{invbot} > -750 m, Δt > 1 K, where
Δh = CALIOP CTH – INV TOP/BOT, and Δt = inversion strength.
Total: 3243, Above: 223, Inside: 2245, Below: 775
Out of the 223 cases, where CALIOP CTH was detected above the inversion top, 216 cases where within one model level above the inversion top.