ER2-lidar measurements of stratocumulus cloud top structure on July 14, 1987

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On July 14, 1987 NASA's ER2-high altitude aircraft flew a mission to measure the structure of stratocumulus clouds off the coast of California. A flight pattern was executed so that the two-dimensional variability of the clouds could be detected. The technique of analysis of the lidar data to measure cloud tops is as follows: First each signal is searched for its maximum in return strength. This maximum is caused by scattering of the laser light off cloud particles or from the ocean surface. Next the variance of the signal return above the level of maximum backscatter is determined. Cloud top is assigned to a level (above the level of maximum backscatter) where the backscatter exceeds the average variance. This two-step process is necessary because the level of maximum backscatter does not correspond to the cloud top. Ocean surface returns are easily separated from cloud returns in this process, descibed in detail by Boers, Spinhirne and Hart (1988).

Analysis of the data so far has shown that there were very few breaks in the clouds. Furthermore the layer top was very flat with local oscillations not exceeding 30 m. Such small cloud top variations are still well within the range of detectability, because the precision of our technique of cloud top detection has previously been established to be 13-15 m. Figure 1 shows a detailed linescan recording of the stratocumulus clouds, near one of the few breaks in the clouds. The small cloud top variability is evident, except near the break, where the sea surface return is also visible. The scale on the left is in km. The thick mark indicating the surface does not entirely correspond to the level of the surface return. This reflects the inaccuracies of determining the exact altitude based on the pressure-altitude scale.

This data is presently being analyzed to compute cloud top distributions and fractional cloudiness. The aim of this research is to relate the fractional cloudiness to the mean thermodynamic structure of the boundary layer. We plan to compute spectral scales of the cloud top variability in two dimensions to determine the orientation of the clouds with respect to the mean wind. Furthermore the lidar derived cloud top distribution will be used in the computation of the thermodynamic and radiation budget of the boundary layer.

Reference: R.Boers, J.D.Spinhirne and W.D.Hart, 1988: Lidar observations of the fine scale variability of marine stratocumulus clouds. J.Appl.Meteor, 27, June.

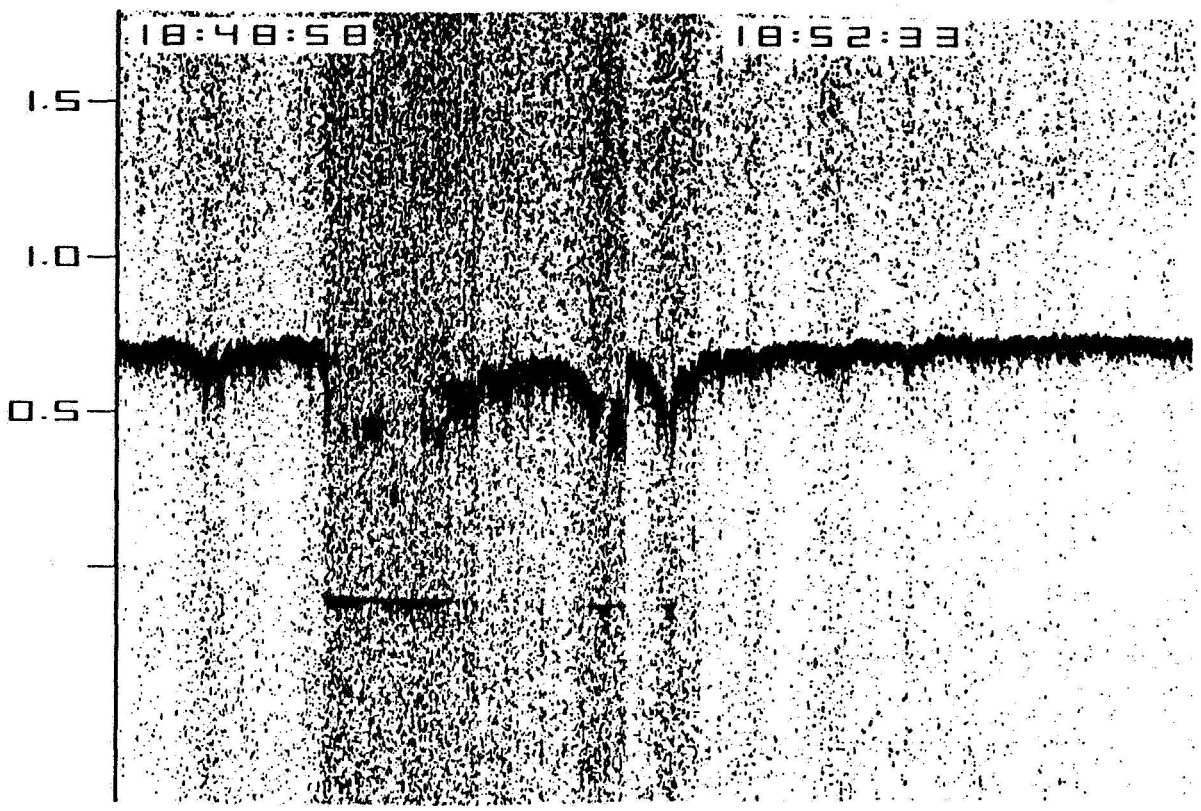

Figure 1. Linescan recording of backscatter profiles taken aboard the ER2-aircraft on July 14, 1987. The ER2 was flying at a nominal altitude of 18 km. Both cloud and sea surface reflections are visible. Pressure altitude scale is offset with respect to the ocean surface level (visible from the surface signal return).