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"CIRREX'93"
PRELIMINARY RESULTS OF ONE YEAR LIDAR SURVEY OF CIRRUS AT MID- LATITUDE

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A one year monitoring of cirrus cloud have been conducted during 1993 starting in January until december. One of the main objective of "Cirrex'93" is derive a climatology of cirrus cloud regarding their geometrical properties - cloud base and top altitude - and optical and radiative properties - optical density, emissivity. CIRREX'93 is a ground-based experiment, carried out at LMD (48°4N, 02°0E) near Paris. A backscatter lidar operating at 0.53 μm and a PRT-5 radiometer were used simultaneously, with pyranometer and pyrgeometer. In addition, daily atmospheric soundings are provided by a nearby operational meteorological station - 5 km away.

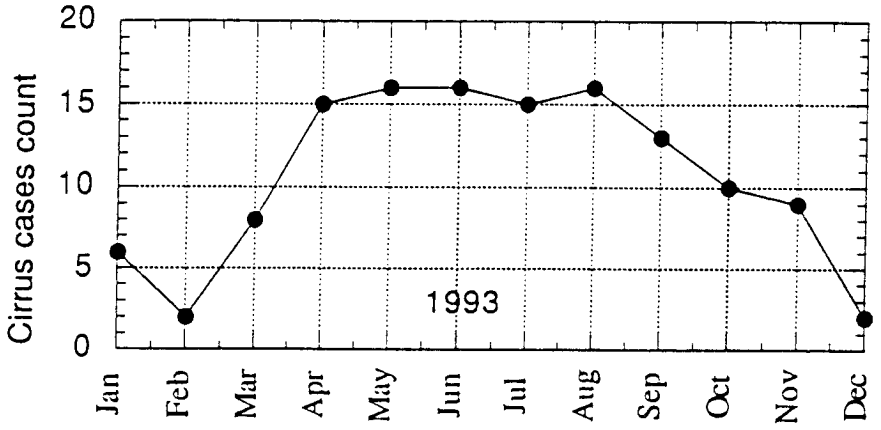

Figure 1. *Lidar observations of Cirrus clouds versus the month of the year.*

During CIRREX'93, 51 cirrus cases were recorded (one per day), while 136 cases were obseved naked eye by an observer. The difference is mainly due to the occurence of multilayer clouds, for we focused on single cirrus layer such situation corresponding to the strongest (warming) radiative effect. The 51 cases are spread over the year (see Fig. 1). This lidar climatology is very close to the one obtained previously at the same location using naked eye observation. Single cirrus clouds occur more frequently in spring and summer. The location of the station not far from the Atlantic ocean (about 300 km), with no hills higher than 400 m in between, make the climatology representative of mid-latitude oceanic Europ. For each of the 51 cases we calculate a mean value for every parameter. Then we derive minimum and maximum values, and mean and standard for the parameters. The cirrus climatology is presented in table 1. On each day 100 to 300 lidar files are recorded, each one is an average of 400 lidar shots. A file is recorded in about one minute.

Table 1 : Optical and geometrical parameters derived from lidar measurements at 0,53 μm during CIRREX'93 for the 51 cirrus cases observed.

Parameter	Minimum	Maximum	Mean	Standard dev.
Base (km)	5.0	11.0	8.0	1.7
Top (km)	8.0	13.0	10.8	1.3
Extinction (km^{-1})	0.010	0.420	0.150	0.092
Backscatter (km^{-1} sr^{-1})	0.0010	0.0250	0.0095	0.0055
Optical density	0.01	0.55	0.21	0.15
Thickness (km)	0.5	6.0	2.8	1.5
Lidar ratio (sr^{-1})	0.030	0.090	0.060	0.015

The optical density is obtained using the slope method provided the signal-to-noise ratio (SNR) at cloud top is sufficient - larger than 3. The backscatter coefficient (β) is derived using a logarithmic inversion technique, while the lidar ratio is obtained by an iterative method making a comparison of optical densities obtained directly using the slope method and the logarithmic inversion. A simple relationship betwen the optical density and geometrical thickness is often proposed to parametrize the optical properties from the range height from the cirrus top and the base. A plot of the optical density versus the geometrical thickness displays a satisfactory correlation of 80% on thedaily mean values (see Fig. 2). The preliminary results of CIRREX'93 conducted at LMD will be discussed in detail at the 17 ILRC.

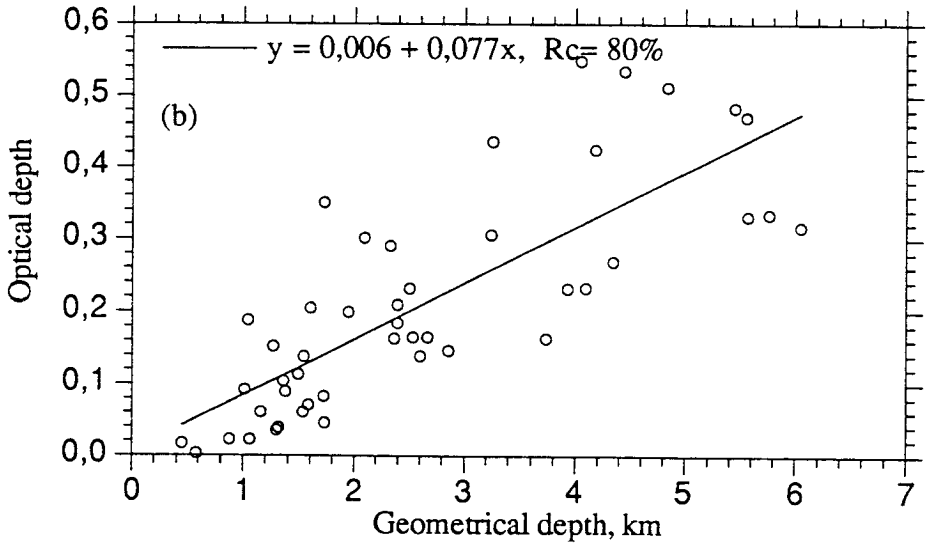

Figure. 2. *Optical depth (δ) versus geometrical depth (H) plot, showing a correlation of 80%. 51 mean values of (δ,H) have been calculated and displayed (one point per cirrus case). The least squares regression lines are fitted to the data.*