DISPERSION OF ARTIFICIAL CLOUDS IN THE STRATOSPHERE

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ABSTRACT

Extensive research programmes concerning the environmental impact of the injection of polluting species into the stratosphere by aircraft are at present in the course of development in several countries under the sponsorship of national committees : CIAP in the USA, COMESA in the United Kingdom and COVOS in France.

The aim of the present work, supported by COVOS, is to contribute to the determination of the dispersion rate of materials injected within the stratosphere. Artificial clouds of titanium tetrachloride are used as tracers. They are created by explosion, at a chosen altitude, of balls containing liquid $TiCl_4$, hanging from a sounding balloon.

Recordings of the three-dimensional shapes of the clouds during dispersion and wind transportation are done by two kinds of optical apparatus mounted on the same azimuth plateform : a photographic camera and a lidar including a Q-switch ruby laser giving 1 Joule pulses at a repetition rate of 1 per second.

Experiments were performed in November 1973 at "La Montagne de Lure" in south-east France. Propagations of 19 artificial clouds with altitudes ranging from 14 to 19 km were recorded for about 30 minutes each. Processing of these recordings shows the following main features :

- The altitude of the cloud remains about constant.
- The cloud takes the shape of a long column, sometimes nearly linear, sometimes curved due to the important effect of the wind shear, the difference of altitude between the two ends being of the order of 300 m and the speed of lengthening ranging from 0.5 to 3m/s.
- The speed of horizontal broadening of the column decreases with time. Several hundreds of second after explosion, we find horizontal diffusivity K_H ranging from 1 to 8 m^2/s.
- The vertical length, given by the lidar signal, increases quickly during about 200 seconds and then decreases more slowly. This fact is due to the lengthening by the wind shear masking the effect of the vertical eddy diffusivity as was already shown by other authors.

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