LETTER TO THE EDITOR

Interpretation of time variations of particle-borne radioactivity

By HENNING RODHE, *Institute of Meteorology, University of Stockholm, Sweden*

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In a recent paper, Chen et al. (*Tellus 6*, 1970) describe the results of measurements of fallout particles in the ground level air at Fayetteville (36° N, 94° W), Arkansas, observed after the December 24, 1967, Chinese nuclear explosion. The authors show graphically the daily values of the concentration of radioactive particles and try to interpret the variations in terms of meteorological conditions, particularly time of arrival of computed trajectories.

Since I think that there are some aspects that need to be clarified, I would like to make a few comments.

There are of course strong practical reasons for using 300 mb and 500 mb as those heights at which trajectories are computed. Before the contrary has been proved, it is however not clear how well it can be assumed, as in Chen's paper, that the cloud from the beginning is divided into two more or less distinct parts located at those heights, and then interpret the peaks in the observed radioactivity as the arrival of the "500-mb-cloud" or the "300 mb-cloud". A more natural assumption would be that the cloud initially had a certain dimension —possibly larger than 500 to 300 mb—and that it is subsequently continuously deformed by the vertical shear of the horizontal wind. The horizontal extension of the cloud could then be approximately estimated by the distance between the endpoints of the trajectories at the top and the bottom-levels of the cloud. Variations on shorter time scales than the time of passage of the cloud could then be attributed to changes in meteorological conditions of a more local character, e.g. the passage of an upper level trough.

The first arrival of the trajectories at 300 mb and 500 mb in the described case were stated by the authors as 4 and 7 days respectively after the detonation. If the cloud were at least as thick as the 300–500 mb layer it would thus take some 3 days for the cloud to pass. At the second or third passages this time would be correspondingly longer. It is therefore difficult to see how one could use one-dimensional (zonal) trajectories for the interpretation of daily variations in ground level concentration after travel times up to several weeks.

There are few direct measurements of the size of a cloud after such long travel times. The Krakatoa dust in cloud 1883 was observed to take three or four days to pass over places in the equatorial zone after its second circuit (Lamb, 1970), but it seems probable that the vertical shear was smaller in that case than in the mid-latitude westerlies, where the Chinese bomb was exploded.

Even if trajectories are computed with more precise methods, the uncertainties in the position of the endpoint are likely to be rather large. Djurić (1961) compared computed trajectories with data from balloons at the 300 mb level. He found deviations of roughly 25% of the trajectory length between observed and computed geostrophic trajectories. The use of other wind approximations yielded trajectories which differed appreciably from the geostrophic ones, but were not a significant improvement compared with the balloon trajectories. This is another reason why computed trajectories should be used with care in circumstances like this.

REFERENCES

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