NOTES AND CORRESPONDENCE

A Remark on the Upward Velocity and the Excess Temperature in the Cumulus Convection Observed by Means of Dropsonde Observations

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The dynamical function of convective activities has become to be taken into account for atmospheric models of larger scale phenomena. In understanding the mechanism of energy redistribution it is required to observe physical parameters characterizing the cumulus convection such as the excess temperature, the excess humidity, the updraft velocity, the area ratio of the core region, *etc.* A couple of observational techniques have been developed to measure the situation inside of the developing cumuli by radar or airplane, but they are not yet fully cultivated. However, even by means of conventional radiosonde observation there still remains a possibility to obtain some information concerning the cumulus convection. An example will be given here.

As an item of the Heavy Snow Storm Research Project Observation, dropsonde observation flights have been performed along the coastal area of the Hokuriku District where the convective activity is the most predominant during wintertime under the influence of the warm Japan Sea. On January 20, 1966 five dropsondes were released successively within 75 min over a small area as given in Fig. 1, where the locations of release are indicated by crossed circles along the flight path given by the full line. A brief sketch of echoes on the radar scope is entered in this figure to show the convective activity.

A remarkable fact is that the dropsonde released at 13.46 LST gives anomalous temperature distribution compared with other observations and, at the same time, the abnormality is also found in the fall velocity. In Fig. 2

Fig. 1. The full line is the flight path labeled with local time on January 20, 1966. The crossed circles show the locations of releasing dropsonde. Radar echoes at 13.46 LST are entered schematically.

Fig. 2. The fall velocity of the dropsonde released at the 13.46 LST (solid line) and the average value (broken line) as a function of pressure height.

is given the fall velocity* of this particular sonde by solid line as a function of pressure height. The broken line in this figure shows the average fall velocity of 9 observations made in two days. As is seen from this figure, the fall velocity of dropsondes with the same size parachutes assumes almost uniform value increasing slightly towards lower levels when it is expressed in mb/min unit, while the one under question shows remarkably small value around 800 mb level indicating the existence of upward current. The temperature distribution obtained by this sounding is presented in Fig. 3 by the dotted line. The solid line is the averaged value of other four dropsonde observations and one routine rawin sonde observation made within three hours in the same region. We thus obtain the anomalous temperature ΔT and anomalous fall velocity $\Delta\omega$ as given in Fig. 4.

Since the updraft core region occupies about

Fig. 3. The temperature distribution obtained by the dropsonde released at 13.46 LST (broken line) and the averaged temperature distribution obtained from other observations (solid line).

* Signals from the built in timer in the receiving system were recorded simultaneously with the dropsonde signals.

Fig. 4. The excess temperature ΔT in $^{\circ}\text{C}$ (broken line) and the updraft velocity $\Delta\omega$ in mb/min (solid line).

one tenth of the total area, it is quite probable that one of ten observations made in the highly convective region gives the field in a cumulus cloud. From this reasoning we can postulate that the anomalous field shown in Fig. 4 gives the excess temperature and the updraft velocity. Then the maximum excess temperature of 2°C and the maximum updraft velocity of 28 mb/min (about $5\text{ m}\cdot\text{sec}^{-1}$) both found at 800 mb level seem to be quite reasonable (Cunningham and Glass, 1965 and Battan and Theiss, 1966). By this amount of characteristic values we can easily show that the convective upward energy transfer corresponds to the energy supply from the sea surface. Related quantitative discussions will be given in the future.

References

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- Cunningham, R., M. and M. Glass, 1965: Cumulus cloud-group history and structure in relation to precipitation growth. *Proc. of Conf. on Cloud Physics*, Tokyo, May, 1965. Supplement 109-118.

ドロップ・ゾンデによる積雲対流内の上昇速度と
excess temperature の観測例

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