SHORTER CONTRIBUTION

551. 509. 66 : 551. 576

Aero-photographic Observation of Cloud over the Coastal Area of the Japan Sea in the Winter of 1964

By

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(Received January 5, 1965)

1. Introduction

The modification of the polar-continental air-mass from the Eurasian Continent over the Japan Sea is remarkable in winter due to large air-sea temperature differences. The active cumulus convections in the moist and unstable stratification caused by the heating and evaporation from the underlying sea surface is considered to cause the intense snowfall over the downstream coastal area of the Japan Sea.

The aerial photographic observation of the cloud over the Japan Sea, where the meteorological observation had been scarcely made, was planned by the Heavy Snow Storm Project for the purpose of getting information on the modification and heavy snowfall.

As a part of the synthetic observations on the heavy snow storm in the mid-winter of 1964, two observation flights were carried out on February 2nd and 3rd. The synoptic weather situation of those days are very briefly explained as follows. As seen in the surface weather map at 21.00 J. S. T., February 2, reproduced from the daily

Fig. 1. Surface weather map at February 2nd, 21.00 J. S. T.

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Fig. 2(b). The paths of the observation flight on February 3rd.

cessive images of the apparent horizon, which is indispensable for knowing the precise attitude of the camera system. The overlap of the vertical and the high-oblique photographs was about 20%.

The exposure interval was 14 sec. and the obtained overlap of the successive vertical photographs was about 70% for the cloud whose height is 3000 m. (The overlap, of course, depends on the cloud height.) About 200 and 400 frames of photographs by both cameras were obtained during the flight on February 2nd and 3rd respectively.

3. Mosaic and height contour map

To have the general view of the cloud distribution and features along the aviation paths, a mosaic was made of the successive vertical photographs of cloud. As the magnification of the cloud depends on its height, the mosaic is, strictly speaking, possible only for clouds existing at approximately the same height. The mosaic was

Photo. 1. Mosaic for frame 105~133 (13h06m~12m) and the corresponding high-oblique photographs on February 2nd.

Photo. 2. Mosaic for frame 212~234 (12h53m~13h00m) and the corresponding high-oblique photographs on February 3rd.

made concerning the main cloud layer consisting of the cumulo-type cloud, and therefore some high clouds appear to be discontinuous on the mosaic picture. As for the high-oblique photographs, it is impossible to make a mosaic in the usual manner, because the image is distorted. Thus the frames of high-oblique photographs are attached along the corresponding portion of the mosaic above mentioned to show the cloud distribution on the right side of the path. All mosaic and corresponding high-oblique photographs are presented in the "Data of Heavy Snow Storm Observation in 1964" (1964) published by M. R. I. and, as an example, two parts of the mosaic for February 2nd and 3rd are reproduced in Photos 1 and 2 respectively.

The height of cloud can be measured by using the successive photographs on the principle used in the usual aero-topographic survey (See the textbook by E. L. MERRITT (1958)). For the contouring of the cloud height, an optical system called "Multiplex", a multi-projector-type and complementary-colored stereoscopic plotter was adopted. As this was different from topographic survey, no control-point was available, and, in addition, the movement of clouds was not known exactly, and thus the obtained absolute value is not so accurate. However, the relative undulation of the cloud top is well measured by the plotter above mentioned.

The obtained height contour maps of cloud for February 2nd and 3rd are presented in Figs. 3 and 4 respectively. In these maps the contours are drawn at intervals of 100 m, and they are labeled in the unit of 100 m.

A general idea of the cloud distribution and cloud features over the coastal area of the Japan Sea will be obtained by looking at both the mosaics and the contour maps. The precise analysis of the cloud photographs and the study on the heavy snowfall by using both these results and also other necessary data obtained by radar, radiosonde and surface observation have been carried out by the members of the research group and will be published in a later report.

Acknowledgment——The authors wish to express thanks to Dr. H. ARAKAWA and Dr. K. TAKAHASHI for their encouragement throughout this work.

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1964 年冬期日本海沿岸における雲の航空写真観測

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1964 年 2 月 2 日および 3 日に北陸沿岸の日本海上で雪雲の航空写真観測を行った。この観測時における雲の分布・様相の概要を、垂直写真の mosaic, 斜写真および "multiplex" を使用して得た雲の height contour map によって示した。

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Fig. 3(a). Contour map for frame 89~92 (13h01m~02m). The distance between the successive principal points (small circles near center line of the figure) is about 1,500.

Fig. 3(b). Same as Fig. 3(a), but for frame 99~103 (13h03m~04m) on February 2nd.

Fig. 3(c). Same as Fig. 3(a), but for frame 111~114 (13h06m~07m) on February 2nd.

Fig. 3(d). Same as Fig. 3(a), but for frame 118~123 (13h08m~09m) on February 2nd.

Fig. 3(e). Same as Fig. 3(a), but for frame 134~141 (13h11m~14m) on February 2nd.

Fig. 3(f). Same as Fig. 3(a), but for frame 170~184 (13h20m~23m) on February 3rd.

Fig. 4(a). Same as Fig. 3(a), but for frame 148~156 (12h34m~36m) on February 3rd.

Fig. 4(b). Same as Fig. 3(a), but for frame 190~205 (12h48m~52m) on February 3rd.

Fig. 4(c). Same as Fig. 3(a), but for frame 204~222 (12h51m~56m) on February 3rd.

Fig. 4(d). Same as Fig. 3(a), but for frame 221~239 (12h56m~13h00m) on February 3rd.

Fig. 4(e). Same as Fig. 3(a), but for frame 238~256 (13h00m~04m) on February 3rd.

Fig. 4(f). Same as Fig. 3(a), but for frame 255~273 (13h04m~08m) on February 3rd.

Fig. 4(g). Same as Fig. 3(a), but for frame 272~289 (13h08m~12m) on February 3rd.

Fig. 4(h). Same as Fig. 3(a), but for frame 288~306 (13h12m~15m) on February 3rd.

Fig. 4(i). Same as Fig. 3(a), but for frame 305~321 (13h15m~20m) on February 3rd.

Fig. 4(j). Same as Fig. 3(a), but for frame 320~334 (13h20m~23m) on February 3rd.

Fig. 4(k). Same as Fig. 3(a), but for frame 333~344 (13h23m~26m) on February 3rd.