

PICTURE OF THE MONTH

Observations of Isolated Mesoscale Cellular Convection Cells

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ABSTRACT

What appeared to be isolated mesoscale convection cells embedded in an otherwise solid deck of stratocumulus clouds were observed from a commercial air liner as it approached the coast of the state of Washington on a flight from Tokyo. The presence of cells of the correct dimensions was confirmed by a satellite photograph of the area.

The writer flew nonstop from Tokyo to Seattle on the night of 9–10 July 1976.

He had spent much of the previous year studying the characteristics of mesoscale cellular convection cells (Burt and Agee, 1977) from data taken during the Japanese Air-Mass Transformation Experiment (AMTEX-75) which had taken place in the East China Sea in February 1975. This led to the habit of studying cloud formations during flight for signs of organized convection.

At the time the plane was approaching the coast, there was a deep low centered several hundred miles to the west of southern British Columbia over a segment of the great circle route from Tokyo to Seattle. According to the airline, the plane flies a minimum time path taking into account the wind distribution. Although records for this particular flight were not kept, it is probable that the plane was flying considerably south of its normal path in order to take maximum advantage of the westerly winds to the south of the low that was lying over its normal flight path.

Dawn broke as the plane was approaching the coast. A nearly solid deck of stratocumulus clouds was observed well below the plane. As soon as it was light enough to observe the characteristics of the clouds, isolated circular patches of clouds were observed embedded in the stratocumulus cloud deck. Each patch had a distinct but narrow circular band of clear or nearly clear air around it. There was more vertical development at the tops of the cloud masses within the patches than in the clouds surrounding them. The clouds were distinctly different inside and outside of the clear rings.

From the estimated ground speed of the aircraft and

sightings from the edge of a window to the outer top of the wing and the cells one could estimate their diameter by timing how long it took to pass from the western edge to the eastern edge of each cell. The cells were 30–40 km across. This is within the normal range in diameter of mesoscale cellular convections that are often identifiable in large groups from satellite photographs (Agee and Dowell, 1974).

Fig. 1 is a segment of a satellite photograph of the area taken at 1545 GMT 10 July 1976 about an hour after the plane landed in Seattle. It shows a number of faint circular dark rings off the west coast of Oregon and Washington. Their diameters are a little less than the width of the Strait of Georgia between Vancouver Island and the mainland, i.e., in the range 30–40 km, the diameter of the cells observed from the plane.

Fig. 2 is a blowup of the area of interest of the part of the 1545 GMT photograph. It shows what appear to be mesoscale cloud cells in various stages of development and decay. The letters identifying the cells are placed to the northwest of each feature of interest.

Fig. 3 shows schematic cross sections of the cells at three different stages of development. The height of swelling cumulus clouds within the cells was estimated to be of the order of 1 km above the height of the stratocumulus clouds surrounding the cells.

Cells in the early stages of development are indicated by the letters A and B on Fig. 2 and are of the type indicated by the first stage in Fig. 3. They are brighter than the surrounding cloud deck and show some faint signs of the dark circles of clear ascending air surrounding them.

More mature cells, labeled 2nd stage in Fig. 3 and C and D in Fig. 2, show wide dark circles of clear ascend-

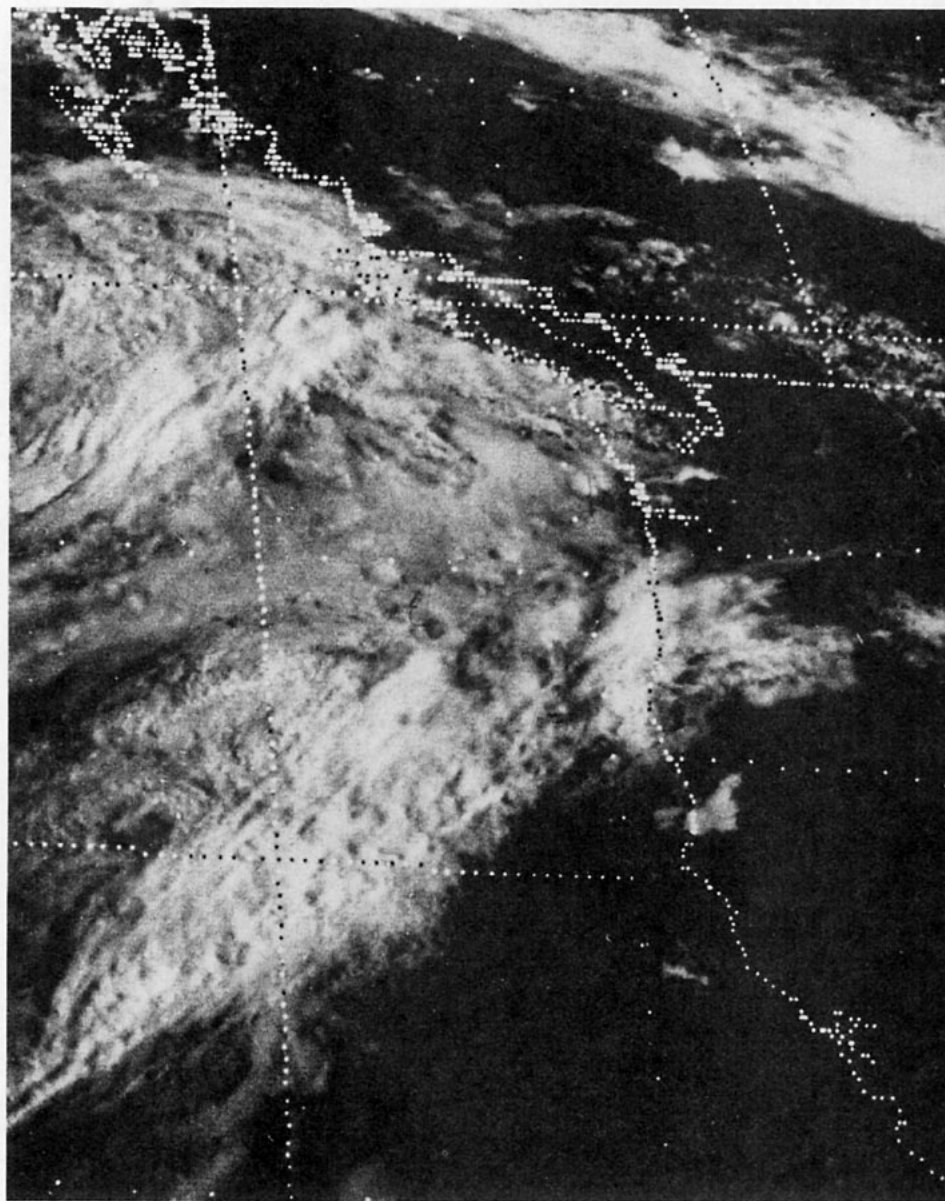


FIG. 1. Satellite photograph of the eastern half of the North Pacific Ocean, 1545 GMT 10 July 1976.

ing air with small white patches of clouds in the center. The cell labeled C is particularly symmetrical.

The final or third stage (Fig. 3) shows up as dark circular clear holes in the cloud deck, i.e., the residual effects of the cloud elements have subsided or dissipated leaving black clear holes. Two holes are labeled E and F in Fig. 2 but a number of other holes of various sizes can be seen to the east of E and F.

It is interesting to note that the next satellite photograph taken only half an hour later did not show any

evidence of second- and third-stage cells, although some first-stage cells could be identified.

The observed circular cloud patches have some of the characteristics of mesoscale cellular convection cells, i.e., size, shape, surrounding clear rings and enhanced convection within the patch. They have, however, usually been reported in large groups in the literature. This is the first report of the possibility of isolated cells of these dimensions within an otherwise solid cloud deck.

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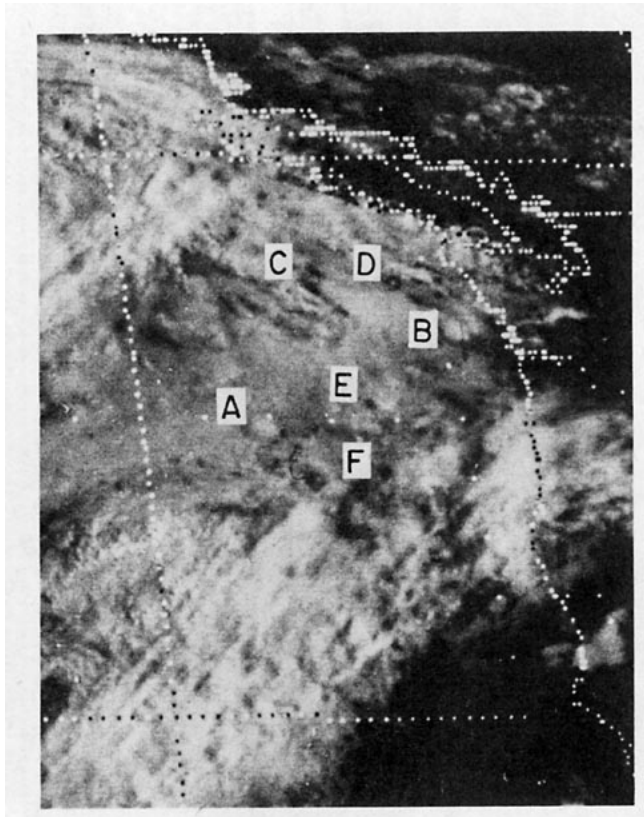


FIG. 2. High-contrast blowup of the 1545 photograph showing cloud details in the area west of the Oregon and Washington coasts. The letters are to the northwest of various features that they identify.

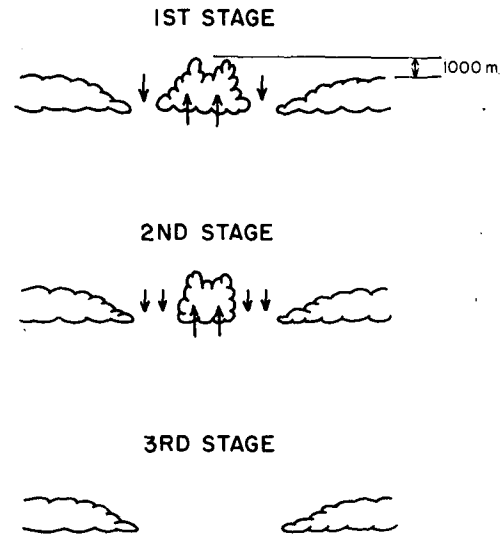


FIG. 3. Schematic cross sections through mesoscale convection cells showing various stages of development and dissipation.

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