PICTURE OF THE MONTH

A Funnel Cloud in the Eye of Hurricane Norbert?

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ABSTRACT

Tornadoes are often reported as tropical cyclones make landfall. In this note I present photographic evidence of a possible funnel cloud in the eye of Hurricane Norbert in the Eastern Pacific, far from landfall.

1. Introduction

Although they are rarely, if ever, photographed, tornadoes are often reported as tropical cyclones make landfall (e.g., Novlan and Gray, 1974). They are associated with the strong vertical wind shear generated at low levels as the surface winds are retarded by friction over the land (Gentry, 1983). This suggests that the source of rotation is probably the tilting of horizontal vorticity onto the vertical, as in the mesocyclone found in midlatitude supercells (e.g., Rotunno, 1981). The purpose of this note is to present what may be the first photographic evidence of a funnel cloud in the eye and eyewall of a tropical cyclone.

2. Discussion

The photograph shown in Fig. 1 was taken by the author during a research flight into Hurricane Norbert, in the Eastern Pacific, approximately 240 km southwest of the southern tip of the Baja Peninsula. The arrows indicate what appears to be a ropelike cloud formation which extends horizontally across the eye at the level of the stratocumulus below, and vertically up the side of the inner edge of the eyewall. This cloud formation looks remarkably like a funnel cloud, even though funnel clouds are usually much shorter and not so horizontally oriented. It was not noticed until after the photograph had been developed, and hence it is not known if rotation was evident.

The region where this feature was observed, just radially inward from the eyewall, sometimes has very strong vertical shear even well out to sea, and also has strong horizontal shear (see Fig. 3 of Jorgensen, 1984). The mesocyclone which appeared in analyses of airborne Doppler-radar measurements done by Marks and Houze (1984) in the eyewall of Hurricane Debby (1982) occurred well out over the ocean. This suggests that vortices can be produced by tilting of the vertical shear onto the horizontal and subsequent stretching even out over the open ocean. It is also possible that vortices can be produced by the stretching of ambient vorticity associated with horizontal shear just inside the eyewall.

It is not known whether the cloud feature shown in Fig. 1 is merely an interesting curiosity or a significant feature. Its length and horizontal orientation are certainly enigmatic. Most of the efforts of research flights into tropical cyclones have involved *in situ* and remote measurements of meteorological parameters. Perhaps the time is ripe to give more attention to visual cloud features.

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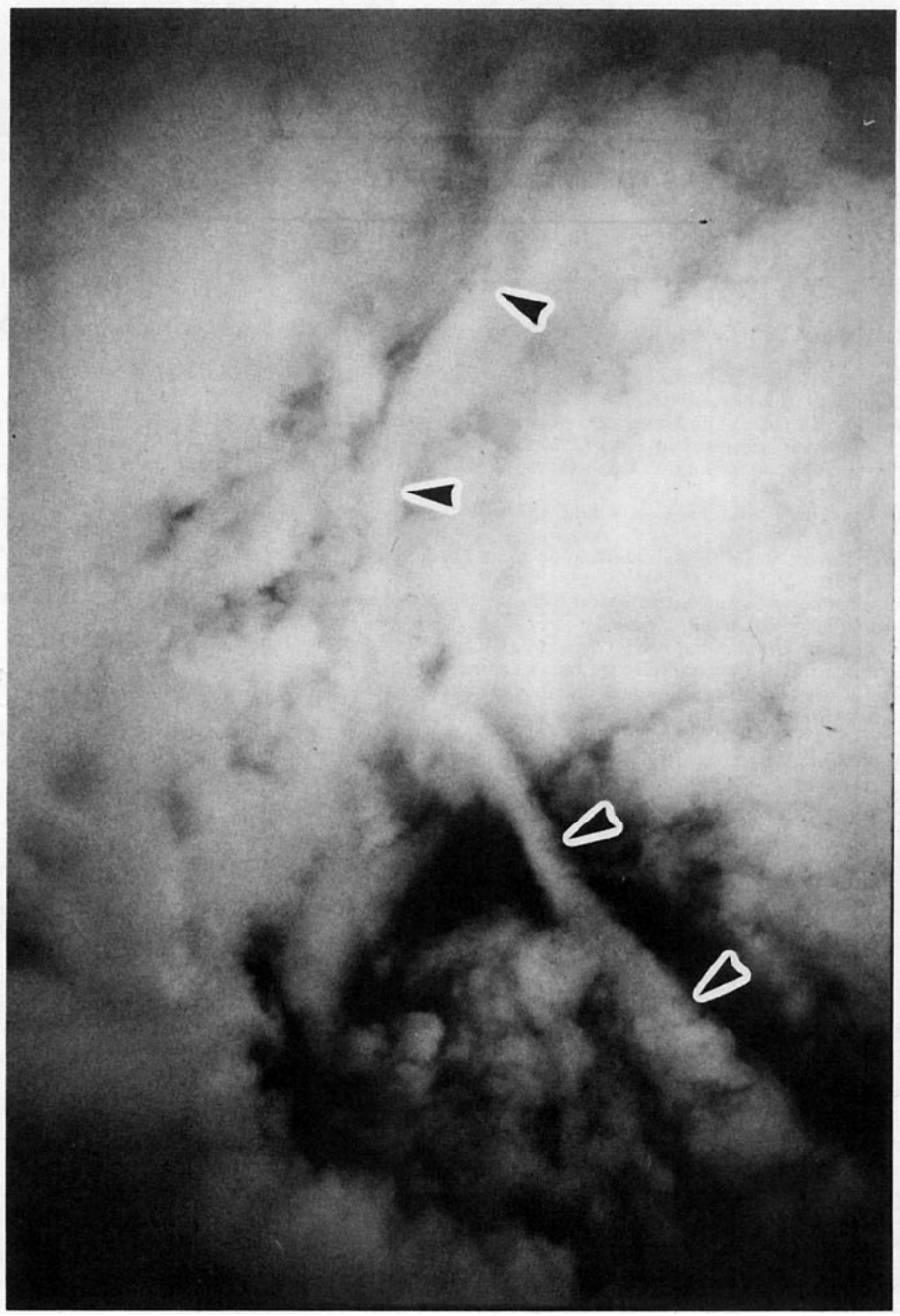

FIG. 1. Photograph taken by Howard B. Bluestein at 1735 PDT (0035 GMT 25 Sep 1984) on 24 Sep 1984 at 22.32°N, 112.19°W, at the 478-mb level, aboard NOAA-42 P-3 aircraft. Wide angle view (using a 28 mm lens), looking downward, slightly, at the western side of the eyewall. The arc of dark area in the lower-right of the photograph is the sea surface inside the eye. The bright cloud regions in the upper right and upper-left hand sides of the photograph are the eyewall, which slopes radially outward from the center.

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