

英 文 要 旨

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論文題目 On the Factors of Turbulence Associated with Transverse Bands

The purpose of this study is to contribute to the safe operation of aircraft by clarifying the characteristics of the appearance of transverse bands (TVBs) occurring near Japan and the factors of turbulence associated with the TVBs.

From six years of data, it was found that TVBs near Japan are mainly generated by jet streams and that their frequency and location of occurrence depend on seasonal changes in jet streams. It was also found that the TVBs associated with jet streams occur more frequently during the daytime than during the nighttime.

An analysis of 201 cases, which the turbulence associated with TVBs could be identified, showed that more than 95% of the TVBs occurring near Japan were accompanied by turbulence. In particular, the proportion of Moderate turbulence was significantly higher for the TVBs with wave-like patterns on cloud tops (WPC) than without WPC, and a similar trend was seen even outside of the TVBs. Regarding the TVBs with WPC, Moderate turbulence was observed within 4,000 ft (≈ 1.2 km) above and below the cloud, indicating that turbulence area extended over a wide vertical range.

The radiosonde data confirmed that cases with moderate turbulence satisfied either the Kelvin-Helmholtz instability or the static instability under vertical shear. The simulations also reproduced TVBs corresponding to both instabilities and showed the gravity waves generated in relation to the formation of the TVBs propagating through the stable layer. When the WPC was clear, it was inferred that turbulence due to the breaking of Kelvin-Helmholtz billows existed near the cloud top.

Our analysis points toward the Kelvin-Helmholtz instability, thermal-shear instability, and stable layers as necessary factors of turbulence associated with the TVBs.