Cirrus observations in the tropical tropopause layer over the western Pacific

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1. Introduction

Cirrus clouds in the tropical tropopause layer (TTL), between 12 and 18 km, are keys for the dehydration of the air entering the stratosphere and for the Earth's radiation budget. Recently, several measurements have been made to characterize the nature of these high-altitude clouds by using satellites, aircrafts, and ground-based remote sensing techniques. In this presentation, we will discuss the three-campaign results of ship-borne lidar measurements over the western Pacific, and emphasize the important role of equatorial Kelvin waves in controlling the TTL cirrus.

2. Observations

A polarization lidar at the wavelengths of 1064 nm and 532 nm was continuously operated on the research vessel Mirai in the three campaigns. The locations and time periods are (1) 2.0N, 138.0E, 9 Nov. to 9 Dec. 2001, (2) 2.0N, 138.5E, 15 Nov. to 14 Dec. 2002, and (3) 7.5N, 134.0E, close to Palau, 14 Dec. 2004 to 11 Jan. 2005. Three hourly intensive radiosounding was also made on the vessel during all these campaigns.

3. Results

Meteorological data analyses show that in the TTL, a packet of equatorial Kelvin waves propagated over the vessel during the campaigns (2) and (3). The lidar captured corresponding variations in the TTL cirrus. For the case of campaign (3), clouds suddenly appeared when the cold phase of the wave came over the vessel in late December 2004, and after the cold phase had passed, in early January 2005, rather thick clouds still remained in the TTL. The latter is probably due to continuous wet-air transport over the vessel. We will discuss the results of trajectory analysis which considers radiative heating and slow ascent in the TTL. These results as well as those for other campaigns clearly show the important role of large-scale disturbances in the TTL. We will also discuss the local-time dependence of the high-altitude cirrus clouds.