Observation of mesospheric gravity waves with an All-Sky Camera at King Sejong Station, Antarctica (62° 13'S, 55° 47'W)

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Abstract

We have carried out all-sky imaging of the OH Meinel airglow layer in the period from 2008 through 2014 at Korean Antarctic King Sejong Station (KSS). We analyzed the images observed for a total of 143 clear moonless nights and found 94 events of short period (<1 hr) band-type waves.

1. Introduction

Gravity waves are typically generated by meteorological disturbances and orographic structures in the lower atmosphere and propagate into the mesosphere (Nielsen et al., 2009). The observed phase speeds are between 8 and 66 m/s, with typical values of 10 ~ 40 m/s (Fig. 3b). The horizontal wavelengths range from 10 to 50 km with majority being 15 to 25 km (Fig. 3a).

2. Observation and Data analysis

All-sky Camera

KSS All-Sky Camera has been operating since its installation in May 2008. The optical system collects lights from CCD imaging system with multi-wavelength filter wheel to capture the 2-D structures of the gravity waves in different altitude (Table 1).

Data Analysis

In this study, we analyze OH airglow images that contain short period (<1 hr) band type waves. Despite the 7-year observation period (2008-2014), the number of wave events is relatively small, only 94, because of cloudy weather conditions at KSS (Table 2). The observed OH image (Fig. 1a) was unwrapped and mapped onto a 600 x 600 km geographic grid images (Fig. 1b); the background feature and stars were also removed. The wave parameters were extracted from unwrapped images by using a pixel intensity profile perpendicular to wave crests (Fig. 1c).

3. Results & Discussion I

The Observed Wave Characteristics

The observed wave propagation shows strong anisotropy of dominant westward propagation (Fig. 2a). Comandante Ferraz (62° 13'S, 55° 47'W) station noticed the same anisotropy (Bagetson et al., 2009).

Both stations observe wave from the same source around King George Island, Antarctic Peninsula. The observed phase speeds also exhibit strong anisotropy in such a way that westward phase speeds are relatively low (Fig. 2b). Halley Station (75° 5'S, 26° 7'W) observed the similar tendency (Nielsen et al., 2009).

This may be related to the background wind field below the OH airglow layer. The horizontal wavelengths range from 10 to 50 km with majority being 15 to 25 km (Fig. 3a).

The observed phase speeds are between 8 and 66 m/s, with typical values of 10 ~ 40 m/s (Fig. 3b). The observed periods span from 5 to 60 min, dominant periods being 5 ~ 15 min (Fig. 3c).

4. Results & Discussion II

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5. Summary

We analyze all-sky OH airglow images observed during 2008-2014 over KSS and find 94 short period band-type wave events in total.

The observed waves are mostly westward propagating with relatively lower phase speeds than eastward waves.

The eastward wind seems to make ducted structures in which westward gravity waves propagate through the wind field, resulting in fewer gravity waves in freely propagating mode over KSS.

The wave sources should be different for the two stations, leading to different propagation directions.

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