INTERACTION BETWEEN WIND AND SNOW SURFACE

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Abstract. The horizontal and vertical wind velocity fluctuations were measured using two sonic anemometers at a height of 135 cm above a snow surface under a transverse snow wave-forming condition. A snow-wave was formed when the wind at a height of 1 m blew at a speed of more than 7 m s\(^{-1}\) after an approximate accumulation of from 10 to 20 cm of new snow on a snowfield. For example, when a snow-wave had a wavelength of 10 m and a wave height of 15 to 20 cm, the measured horizontal and vertical velocity components showed that they had a frequency peak of 0.7 Hz in coherence and co-spectrum corresponding to this wavelength. The results suggest that wind turbulence and snow-wave formation interact with each other.

1. Introduction

Kobayashi and Ishida (1970, 1972, 1974) have studied wind turbulence during the time of drifting snow using sonic anemometers on snowfields in Hokkaido. When a surface layer of deposited snow is being redistributed by wind, surface microreliefs (for example, ripples, sastrugi, snow-waves, snow-dunes, snow-barchans, etc.) are formed (Kobayashi, 1971). In particular, a transverse snow-wave has a wavelength in the direction perpendicular to the wind. The wavelength is about the same size as the scale of turbulence. Descriptions and classifications of surface reliefs formed by a wind action have been made by many investigators, such as Cornish (1914), Hatakeyama (1936), Bagnold (1954), Doumani (1966), Oura (1966), and Kobayashi (1971). This paper has the main purpose of identifying the interaction between wind turbulence and snow-wave formation.

2. Classification of Deposition/Erosion Patterns

When a surface layer of deposited snow is being redistributed by the wind, surface microreliefs, as shown in Figures 1(a)-(f), are formed on a snowfield. The micro-reliefs formed during the time of snow drifting can be classified by depositional and/or erosional patterns into the following four types:

1. Deposition type (deposition dominant): dunes, ripples, barchans;
2. Erosion type (erosion dominant): sastrugi, pits;
3. Equilibrium type (deposition in equilibrium with erosion): ripples, small sastrugi;

Ripples, as shown in Figure 1(a), are small transverse waves with wavelengths from 5 to 10 cm and wave heights (from trough to crest) from 2 to 5 mm. Formed at a time
Fig. 1(a)-(f). Varieties of wavy features.
(a) Ripples, (b) Sastrugi, (c) pits (in Antarctica).