Seismic effects on snow stability and avalanches

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A coincidence of terms when snow pack, lying on mountain slope, has special unstable inner structure with an occurrence of an earthquake can cause catastrophic avalanches. This phenomenon was observed not only at natural environment (in mountains of Peru, Russia or Japan) but also at big quarries with artificial strong ground motion caused by mine explosions. For example at the Khibiny mountains (Kola peninsula, Russia) or at the Taumi-kozan, (Itoigawa city, Japan). It is possible to expect, that present expansion of industrial activities into mountains and occurring sea-rise will increase a number of earthquakes globally. Due to this a probability of such events as seismically induced avalanches can grow at snow mountain regions.

The forecast of seismic avalanches is in close connection with short-term earthquake forecast. Since this task still has no reliable solution (except now-term forecast in 10-30 seconds before S-wave appearing), we can lead seismic avalanche forecast to a determination of the period of probable avalanche activation under seismic events. For this purpose the change of snow shear strength must be understood.

Evaluation of snowpack stability for examination of seismic effects and avalanche forecast was conducted in Khibiny Mountains, Kola peninsula, Russia (by Chernous et al., 2000, 2002, 2006) and some observations and experiments were done in Japan (Higashiura et al., 1979; Ogura et al., 2001; Abe and Nakamura, 2000). But since the nature of the snow pack response to a strong ground motion is still not well known the study of it is necessary.

In the frame of this question first joint series of laboratory experiments on the problem of seismic effects on snow stability and avalanches were conducted on 26-30 of November 2007 at the Cryospheric Environmental Simulator (CES) at the National Research Institute for Earth Science and Disaster Prevention.

The preliminary results show the clear significant increase of a shear load on the snow pack under shaking (ay=1.08 m/sec^2) up to 34% of its value (from 1.0 kg to 1.34 kg) leading to a break of a snow sample. The further analysis of the obtained data will afford to make more precise conclusions and to advance method for further research and experiments in the CES.