# The application of Soil Water Index to landslide prediction in snowy regions: Sensitivity analysis in Japan and preliminary results at Tomsk, Russia

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## 1. Introduction

Soil Water Index (SWI) is conceptual soil water stored in three-layer tank model, which is calculated by hourly precipitation and represents the condition of long-term precipitation. A landslide is likely to occur when SWI exceeds its maximum value in the past decade at the area [1]. In Japan, SWI is routinely used for landslide prediction.

As a problem of SWI, snowfall is treated as rainfall which directly percolates into the soil even in winter, i.e., SWI cannot predict landslides in the snowmelt season in its present form. Because we are going to apply SWI for landslide prediction in Tomsk, Russia, this is a serious problem. Another problem on the meteorological data in Russia is that hourly precipitation is not usually measured but 3-hourly or daily data are available alone. Therefore, sensitivity analysis on the temporal resolution of precipitation is necessary before applying SWI to Tomsk. In this presentation, we show the sensitivity analysis of SWI in Japan and preliminary results obtained by applying SWI to the meteorological data at Tomsk.

## 2. Sensitivity analysis in Japan

Heavy rainfall event occurred in the southern part of Japan in July 2012, which was selected for the sensitivity analysis. When we gave observed precipitation (Prec_obs in Fig.1) to calculate SWI, it showed sharp peak at 6:00 12th, July when landslides actually occurred (Fig.1). In contrast, when we gave "daily precipitation/24" as hourly precipitation to calculate SWI (Prec_equal in Fig.1), the peak of SWI lagged 18 hours later than the actual peak although it exceeded SWI for the past decade (Fig.1). From this sensitivity analysis, observed hourly precipitation is necessary to predict landslide's occurrence correctly.

## 3. Application of SWI in Tomsk

In spring, 2010, Tomsk suffered from severe flood. SWI was modified to reproduce snowfall-snow accumulation-snowmelt to reproduce the increase of SWI in spring. The precise condition is as follows.

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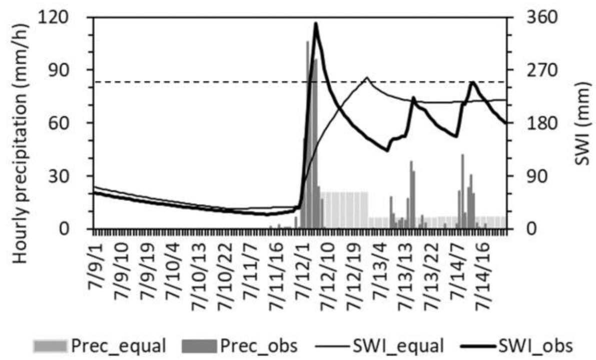


Fig.1 Precipitation and SWI from 1:00 9th to 24:00 14th, July 2012 (Japan Standard Time) at the station near the heavy rainfall event. Dashed line is the maximum SWI (245mm) in 2002-2011.

The threshold of snowfall/rainfall was set as 2 degree. Snowmelt occurred when air temperature was larger than 0 degree, and calculated by degree-hour method. Snowmelt factor (0.7mm/day) was determined by trial and error to reproduce snow appearance/ disappearance from 2009 to 2010 (Fig.2b). Hourly precipitation was given by "daily precipitation/24". Hourly air temperature was reproduced by sine curve using maximum and minimum temperatures.

Figure 2(a) shows daily precipitation and calculated SWI at Tomsk from Oct. 2009 to Sep. 2010. The increase of SWI in spring was well reproduced by the above procedure. We also found the above parameters were transferable to the other years (Figures not shown), i.e., they were robust.

SWI in 28th April, 2010 was 31mm which is larger than the maximum SWI (29mm) in snowmelt season in 1999-2008 at Tomsk. Namely, we can predict landslides in the snowmelt season by referring to SWI in the snowmelt season.

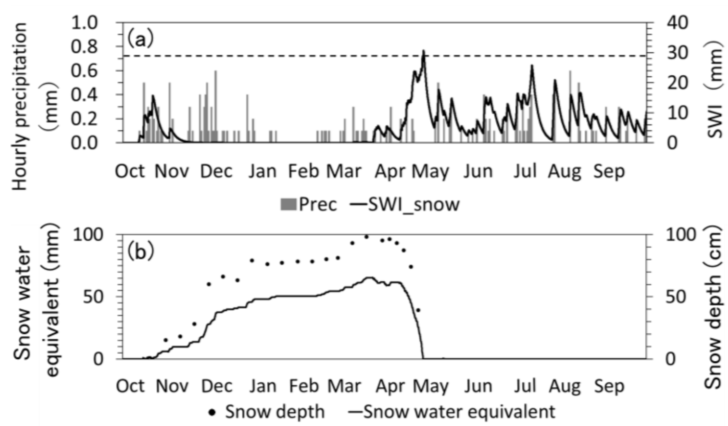


Fig.2 Precipitation, SWI, calculated snow water equivalent, and observed snow depth at Tomsk from Oct. 2009 to Sep 2010. Dashed line of (a) is the maximum SWI (29mm) in the snowmelt season in 1999-2008.

[1] K. Okada et al. Tenki, 2001 (in Japanese)