

Recent trends in the onset of the snow melting season related to wet-snow avalanches in Hokkaido, Japan

Objectives

- In 2023, **wet-snow avalanches** that caused national road closures occurred in the first period of the remarkable snowmelt season. These were **earlier than usual seasons** in Hokkaido.
- To clarify the recent **trends in the onset of the snowmelt** season related to **wet-snow avalanches**, two avalanche events that occurred in 2023 were examined as case studies.

Conclusions

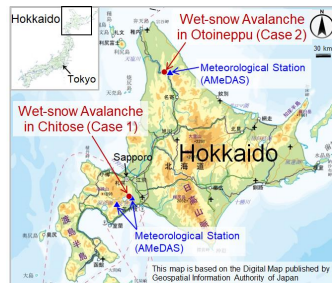
- The **snowmelt season** related to **wet-snow avalanches** tends to **start earlier**, although **large amounts of snow remain** at the start of the season in Hokkaido.
- Therefore, snowmelt seasons such as 2023 are expected to increase in the near future, and we need to pay attention to the possibility of more frequent wet-snow avalanches.

Results

Case 1: Chitose

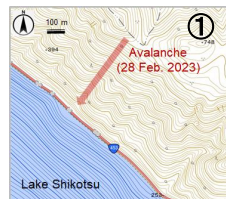
Features of the day when a wet-snow avalanche occurred in 2023

- The avalanche occurred on 28 February 2023 on a **south-facing slope**.
- The snow on south-facing slope received **solar radiation** directly, so it was enough to **melt immediately** as the first remarkable snowmelt due to rising air temperature.
- The **day when the avalanche occurred** was the **first day** in 2023 when the **daily mean air temperature exceeded 4.0°C** after snow depth exceeded 100 cm.

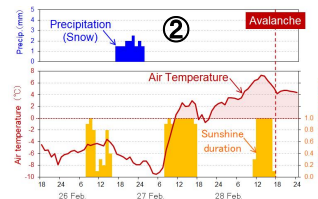


Geographical map

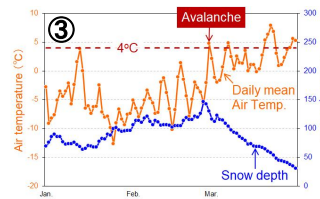
AmEDAS : Automated Meteorological Data Acquisition System of the Japan Meteorological Agency (JMA)



Topographical map



Hourly meteorological data



Daily meteorological data

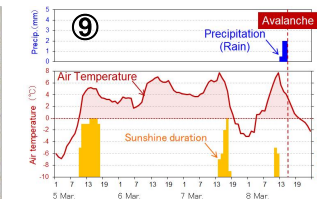
Case 2: Otoiueppu

Features of the day when a wet-snow avalanche occurred in 2023

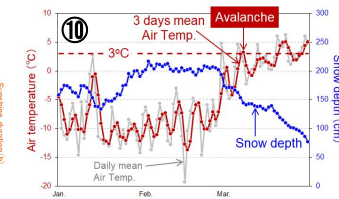
- The avalanche occurred on 8 March 2023 on a **north-facing slope**.
- Because of the north-facing slope and **less solar radiation**, a **few days duration** of rising air temperature (e.g., 3 days) was required for remarkable snowmelt.
- The **day when the avalanche occurred** was the **first day** in 2023 when the **3 days mean air temperature exceeds 3.0°C**.



Topographical map



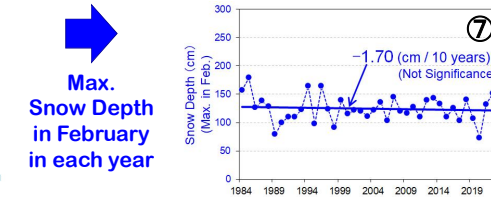
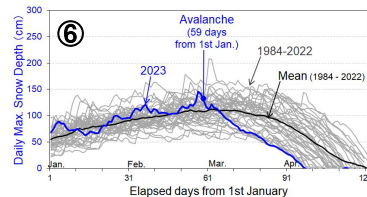
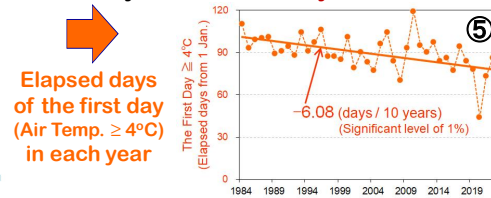
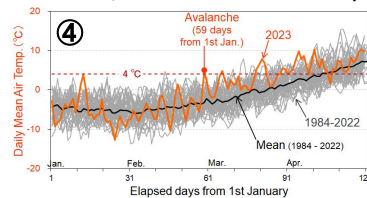
Hourly meteorological data



Daily meteorological data

Trends in the onset of snowmelt related to avalanches

- The day when the **daily mean air temperature exceeded 4.0°C** in 2023 was the **second earliest** such day in the last 40 years (1984 - 2023).
- The day tends to appear **6 days earlier every 10 years** (i.e., 30 days per 50 years).
- The **snow depth** before the days when the avalanche occurred in 2023 was **slightly higher than the mean** depth for the past.
- However, the maximum snow depth in February **did not exhibit any obvious trends**.

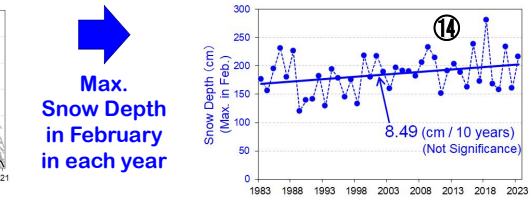
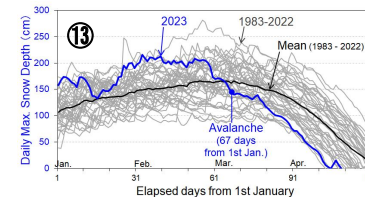
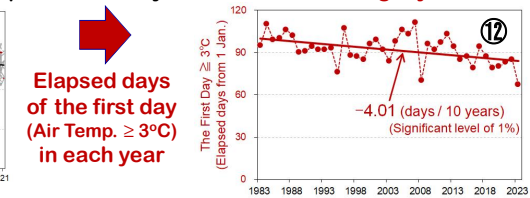
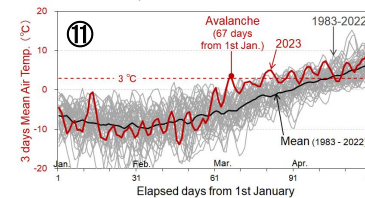


Comparisons with the last 39 years

Temporal changes and trends

Trends in the onset of snowmelt related to avalanches

- The day when the **3 days mean air temperature exceeded 3.0°C** in 2023 was the **earliest** such day in the last 41 years (1983 - 2023).
- The day tends to appear **4 days earlier every 10 years** (i.e., 20 days per 50 years).
- The **snow depth** before the days when the avalanche occurred in 2023 was **higher than the mean** depth for the past.
- In addition, the maximum snow depth in February tends to **increase slightly**.

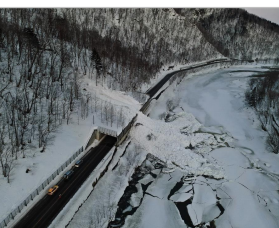


Comparisons with the last 40 years

Temporal changes and trends



Avalanche in Chitose (Case 1)



Avalanche in Otoiueppu (Case 2)