Avalanches and snow mobile traffic around Longyearbyen, Svalbard.

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ABSTRACT: Longyearbyen is situated in a mountainous landscape, thus infrastructure, living and travelling in and around Longyearbyen is highly affected by mountain slope processes. This mountain landscape undergoes changes during the whole year as a consequence of freezing and thawing, snow melting, erosion, rock fall or snow avalanches, mainly due to the high arctic climate. The CRYOSLOPE Svalbard project marks the first systematic attempt to observe these mountain slope processes and investigate how they affect traffic and infrastructure. A year round observation program observes mainly snow avalanches, their spatial occurrence and timing as well as meteorological and snow pack factors controlling the slope processes. Subsequently this data is related with the amount of snow mobile traffic directly affected in the valleys.

KEYWORDS: High arctic, Svalbard, snow avalanches, radar traffic counting.

1 INTRODUCTION AND STUDY AREA

Svalbard's main settlement Longyearbyen, located at 78°13'N in the high arctic, is situated in a mountainous landscape (Figure 1), consisting of steep mountain slopes with highest peaks reaching 1000 m a.s.l. Infrastructure in the valley Longyeardalen (Figure 2) as well as traffic, mainly on the most used snow mobile route to the mining settlements Svea and Barentsburg (Russian settlement) can be affected by slope processes, especially snow avalanches.

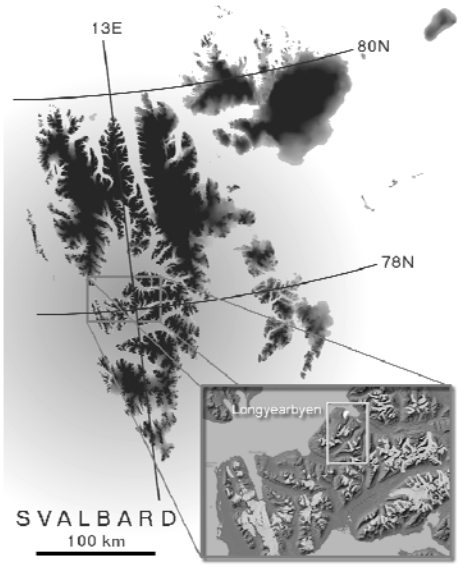

Figure 1: Study area in central Spitzbergen, main island of the Svalbard Archipelago.

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Precipitation at sea level is only about 190 mm water equivalent (Førland et al., 1997), but it is systematically underestimated (Humlum, 2002). This is mainly because snow precipitation, as the dominant type of precipitation is under large wind influence and therefore difficult to measure. The average wind speed in 08/09 was 6,6 m/s with a maximum of 19,1 m/s on 25 December at Gruvefjellet (Figure 2). The average wind direction is from 189 degrees with the strongest and most persistent wind speeds from SE to SSE. As a consequence, cornices build up on the west facing mountain crests, for example in Longyeardalen (Figure 2), endangering the infrastructure in the valley once they break down triggering the biggest slab avalanches observed.

This study presents first results from the Norklima CRYOSLOPE SVALBARD project 2007-2009 "Climate change effects on high arctic mountain slope processes and their impact on traffic in Svalbard". Eckerstorfer et al, 2008 showed statistical analysis on spatial and temporal distribution of snow avalanches observed in an approximately 16.8 m² study area around Longyearbyen, along the 70 km most used snow mobile track. This study presents avalanches that triggered during the snow mobile season and consequently relates these slope processes with the amount of snow mobile traffic directly affected.

2 METHODS

A total of 132 fieldwork trips in the study area were carried out in the two last winter field seasons, observing 577 avalanches and digging 109 snow pits. This data is stored in a database, accessible on the project webpage (www.skred-svalbard.no). Additional data comes from

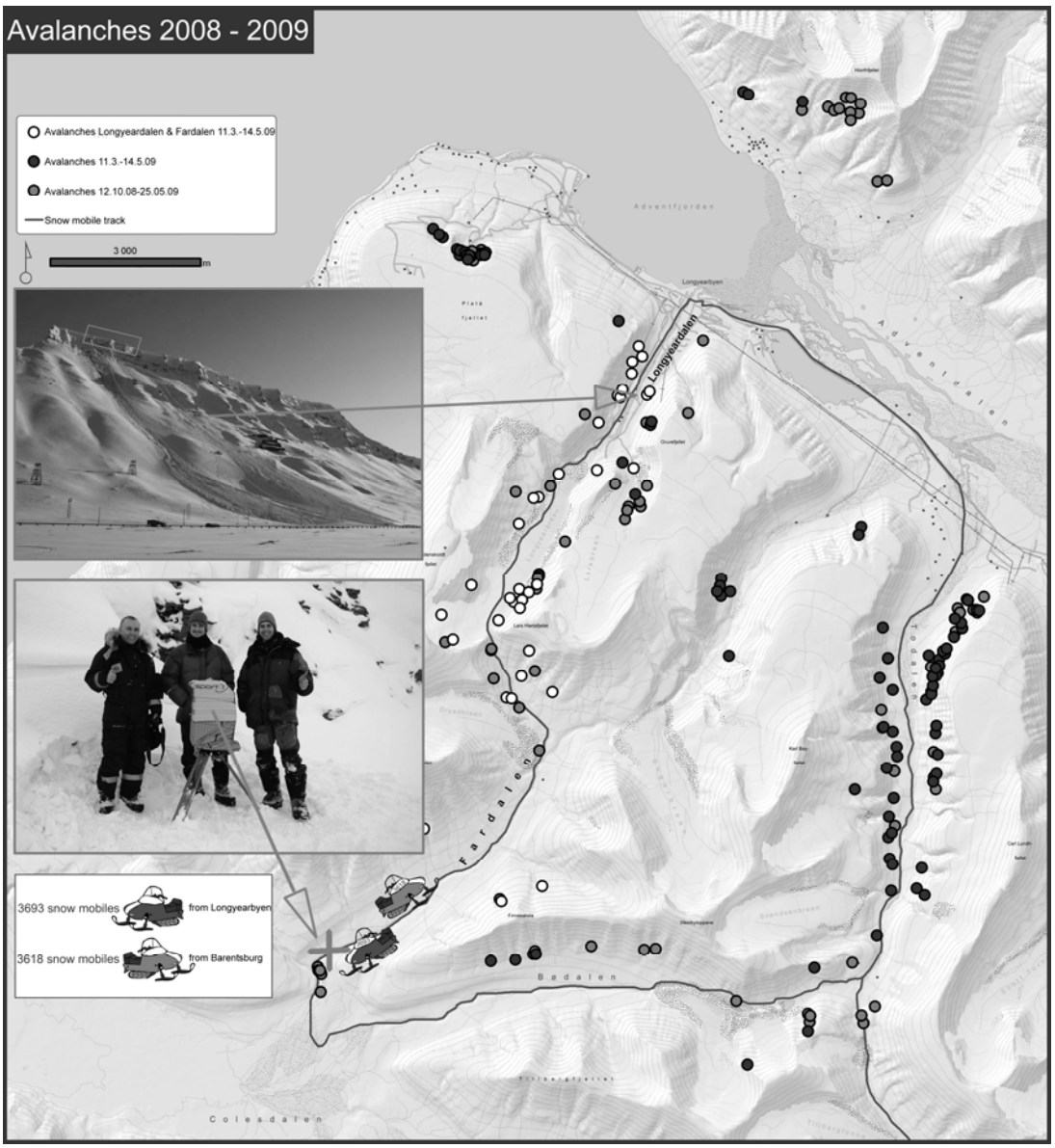

Figure 2: Avalanches and snow mobile traffic around Longyearbyen in 2008-2009.

meteorological stations in and around the study area. Furthermore a radar, provided by the Norwegian national road authorities was placed in Fardalen in spring 2009 (11.3 – 14.5) to quantify the snow mobile traffic.

3 RESULTS

3.1 Avalanches

A total of 203 avalanches were observed in the period from 12 October 2008 to 25 May 2009 (Figure 2). 123 avalanches (61 % of the total amount) released along the snow mobile track from Longyeardalen through Fardalen, Bødalen, Todalen and Adventdalen in the period from 11 March to 14 May when the radar was operating. 36 avalanches (29 % of the total amount) released along the snow mobile track from Longyearbyen over Longyearbreen and further through Fardalen, with most avalanches observed on Longyearbreen (47 %), followed by Longyeardalen (28 %) in the same period.

From these 36 avalanches, 44 % were slab avalanches, the morphological type of avalanche which is most dangerous for the snow mobile traffic. Four avalanches were consequently triggered by snow mobile (1 casualty) and 1 slab was triggered by a hiker.

Three out of the 36 avalanches stopped at a slope inclination between 0-5 degrees, another 4 avalanches stopped between 5-10 degrees. The largest avalanche during the radar period (11.3 – 14.5) was a snow mobile triggered slab on Longyearbreen with an estimated volume of 39200 m³. Most avalanches were observed on 11 April with 10 releases followed by 5 May with 6 releases. On 30 March between 16 and 16.30

in the afternoon, a big piece of a cornice from Gruvefjellet (Figure 2), bordering Longyeardalen on its east side broke down and triggered a slab which buried the street between Longyearbyen and the southern part of the settlement, Nybyen.

3.2 Snow mobile traffic

7311 snow mobiles passed the radar between 11 March and 14 May, 3693 (51 %) came from Longyearbyen (Figure 2). An average of 118 snow mobiles per day was counted. The maximum daily amount of 326 snow mobiles passed the radar on Saturday, 21 March. On this particular day, no snow mobile passed the radar between 00:00 – 08:00, then a peak of snow mobiles, coming from Longyearbyen, was observed between 10:00 – 11:00 with 43 scooters and a delayed peak with 42 snow mobiles between 14:00 – 15:00 coming back from Barentsburg. This suggests that most traffic is on day trips (Figure 3).

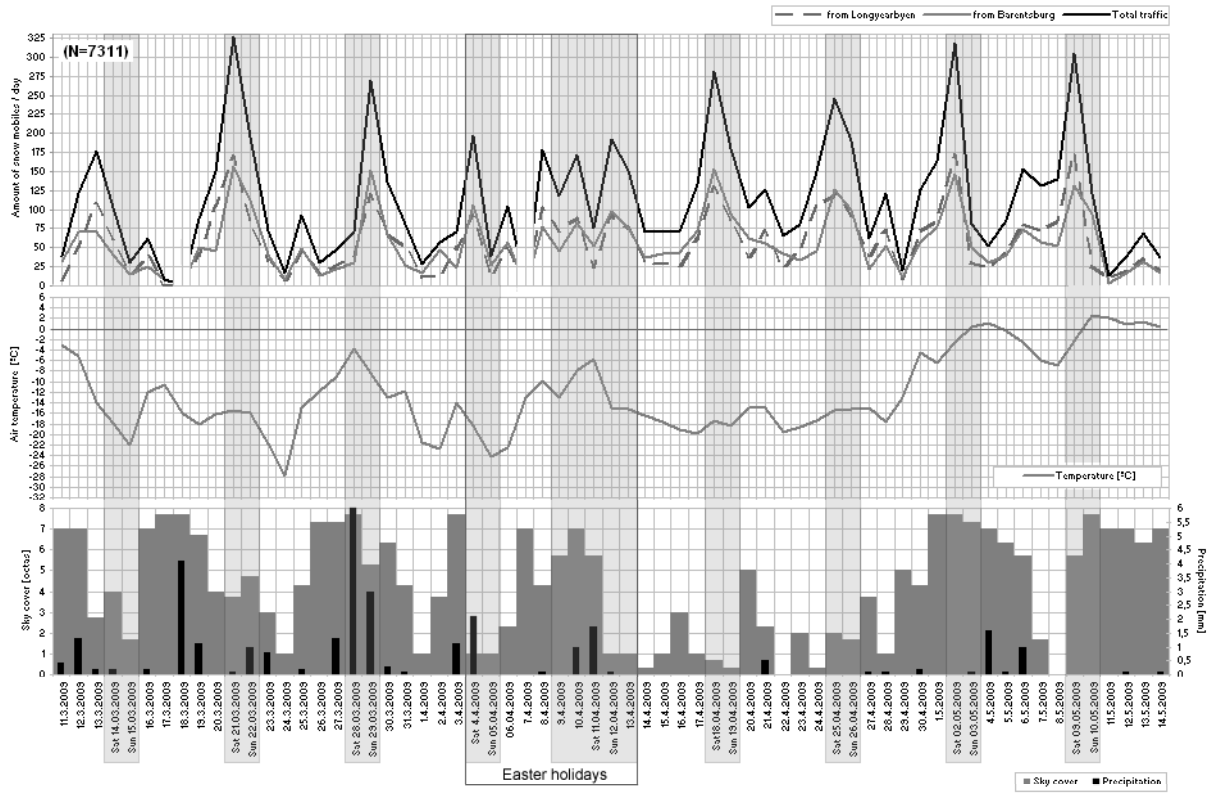

Figure 3: Daily snow mobile traffic, daily air temperature curve, daily cloud cover and daily precipitation rates from Gruvefjellet.

The daily snow mobile traffic in Fardalen shows the following characteristics (Figure 3):

- Significant peaks during the weekends, except at Easter, indicating that inhabitants mainly drive their snow mobiles during the weekends. During the week, mainly tourist companies are operating daily group trips from Longyearbyen.
- A slight increase in snow mobile traffic towards the end of the season can be observed, probably due to rising temperatures.
- The tourist companies did not carry out trips during the Easter holidays.
- There is no direct relationship between the cloud cover and the amount of snow mobile traffic. Even on weekends with complete overcast, many snow mobiles passed the radar.
- There are some smaller peaks during the weeks in the amount of traffic which might be explained with nice weather (13.3, 28.4, 7.5,…).
- Precipitation also does not seem to affect the snow mobile traffic significantly. Only on 28 March with high snow precipitation, the weekend peak was delayed to Sunday.
- 23 March – 25 March was the period with the lowest air temperatures during the radar counting period with consequently also low traffic.

4 DISCUSSION

Infrastructure and traffic are directly affected by slope processes, especially snow avalanches in and around Longyearbyen. During the CRYOSLOPE Svalbard project period 2007-2009, a monitoring program aiming to observe avalanches and their determining meteorological

and snow pack factors was established. In spring 2009, the snow mobile traffic on the most used snow mobile track was registered. This study shows, that during the period of the most snow mobile traffic around Longyearbyen (between early March and mid May), 61 % of all avalanches observed in the snow season 2008/2009 (between beginning of October and end of May) released. This suggests that the peak of the snow mobile traffic season goes along with the peak of the avalanche activity, underlined also by the many slab avalanches and the largest avalanches observed in this period. The thickest snow cover can be also observed during this period, reached by the end of April. From the beginning of May, air temperatures get close to the freezing point and the snow pack starts to melt.

The tourist sector accounts for a larger part of the snow mobile traffic, especially in the weeks, on the route Longyearbyen to Barentsburg mainly for daily trips. While the local inhabitants of Longyearbyen dominate the weekend traffic in the avalanche exposed landscape south of Longyearbyen. Notable is also, that this traffic is daily based, since almost the same amount of snow mobiles passed the radar in both directions on a day.

5 ACKNOWLEDGEMENTS

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