Bulletin of Glacier Research 4 (1987) 87–90

Ice avalanches on Soler Glacier, Patagonia

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(Received December 22, 1986; Revised manuscript received January 22, 1987)

Abstract

Ice avalanches were observed using 8-mm time-lapse photography on Soler Glacier, in northern Patagonia, Chile. A simple analysis of the frequency of avalanches recorded showed that the predominant duration of the avalanches was from 10 to 30 seconds. It was also suggested that the number of occurrence of avalanches was strongly affected by high air temperature and snowfall above the icefield.

1. Introduction

Soler Glacier is located on the eastern side of the Northern Patagonia Icefield, Chile. The ablation area of the glacier is about 7 km long and 1.5 km wide. About the northern half of its surface area is covered by debris, while the southern half consists of clean ice surface. The former is fed with ice from the south-eastern slope of Mt. (Cerro) Hyades (3078 m a.s.l.), mainly through avalanching over the exposed rocks, whereas the clean ice comes from the icefield through an icefall (Aniya and Naruse, 1986; Aniya and Naruse, 1987). Therefore, the ice avalanche is one of the predominant forms of ice supply from the accumulation area to the ablation area of Soler Glacier. However, no measurements of ice avalanche activities on Soler Glacier have been made. Some recordings of ice avalanches were carried out using time-lapse photography at the glacier on January 1, 1984, and November 12, 13 and 17, 1985.

2. Observations and analysis of 8-mm photographs

Ice avalanches originating from the glacier above rock cliffs were photographed on four days using 8-mm time-lapse photography from the base camp and the terminus of the glacier. The distance between the observation point and the icefalls was approximately 8 km. The time intervals between frames were 5 s on January 1, 1984, 15 s on November 12, 1985 and 60 s on November 13 and 17, 1985. Figure 1 gives photographs showing an example of an ice avalanche which occurred on January 1, 1984. The slope of the rock cliff marked by arrows in Fig. 1 is approximately 50-60 degrees, and that on the upper ice surface is 30-40 degrees. From Fig. 1 we can determine the duration time of the ice avalanche, that is approximately 20 s. The distribution of duration time of avalanches is shown in Fig. 2. The time may give us information on the relative magnitude of each avalance. A predominant duration time of the avalanches was in the range from 10 to 30 s. Duration time could only be analyzed for the data on January 1, since on the other days the time intervals of 15 s and 60 s were too long to analyze.

Figure 3 shows the time distribution of avalanche activities with various durations in the day-time of January 1. A question mark indicates a period of no measurement due to blowing down of a tripod with camera by strong wind. Hourly numbers of avalanche occurrence for four days of observations are shown in Fig. 4. It is noticed that avalanches occurred frequently before noon when the radiation was strong on January 1. This tendency suggests that the flow velocity of the icefall is considered to increase, since abundant water from ice melting may accelerate the basal sliding of the glacier (Naruse, 1987).

Figure 5 shows the variations of precipitation at base camp, air temperature at the glacier camp and

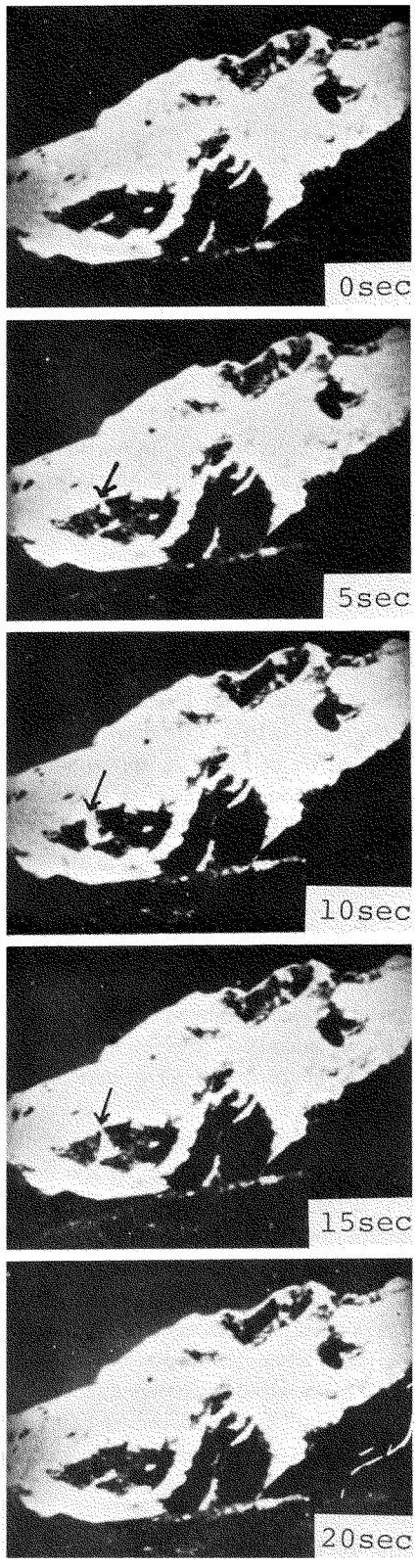

Fig. 1. Photographs of an ice avalanche over a rock cliff on the southeastern slope of Mt. Hyades, taken on January 1, 1984. Arrows indicate an ice avalanche. Soler Glacier flows from the left to right in the photographs.

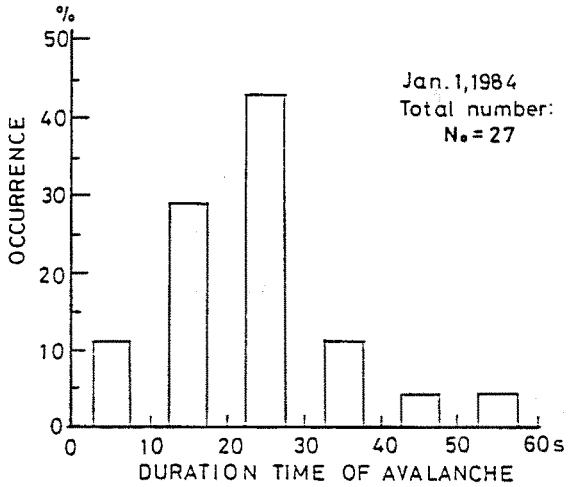

Fig. 2. Frequency distribution of durations of ice avalanches on January 1, 1984.

the number of avalanches per hour on November 12, 13 and 17, 1985. A particular relationship between the rainfall and the occurrence of avalanches could not be recognized due to the lack of measurements. It was clear that much new snow deposited on the slope above the rock cliff during November 15 to 16. Photographs taken on November 17 exhibit powder snow avalanches. Therefore, snowfall on the ice surface above the rock cliff may have increased the occurrence of avalanches, as seen in Figs. 4 and 5.

3. Concluding remarks

Alean (1985) investigated the relationship between ice avalanche activity and mass balance of a high-altitude hanging glacier in the Swiss Alps. According to his study, the annual ice loss due to ice avalanches from the glacier can be taken as an indication of average total net accumulation above the ice cliff where the avalanches originate. In the present study, however, the frequency of ice avalanche occurrence could only be roughly estimated. Since no determinations of their volumes were attempted we cannot discuss the mass balance of the glacier. More detailed studies of ice avalanches should contribute to clari-

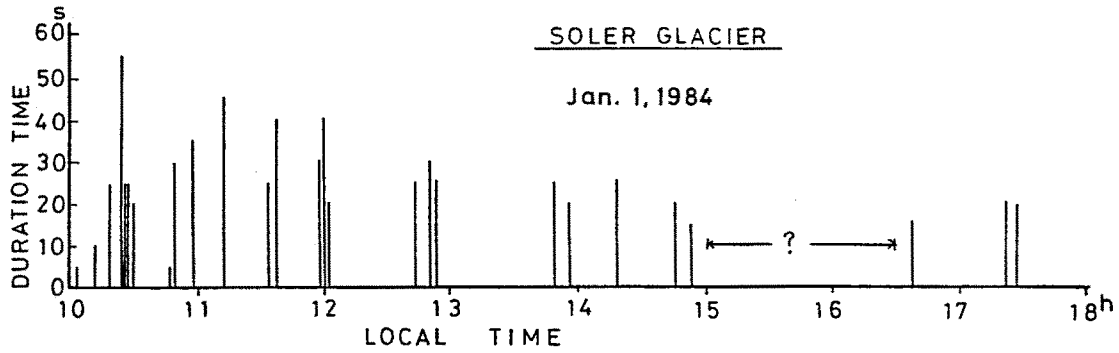

Fig. 3. Distribution of occurrence of ice avalanches with duration time on January 1, 1984. A question mark indicates a period of no observation.

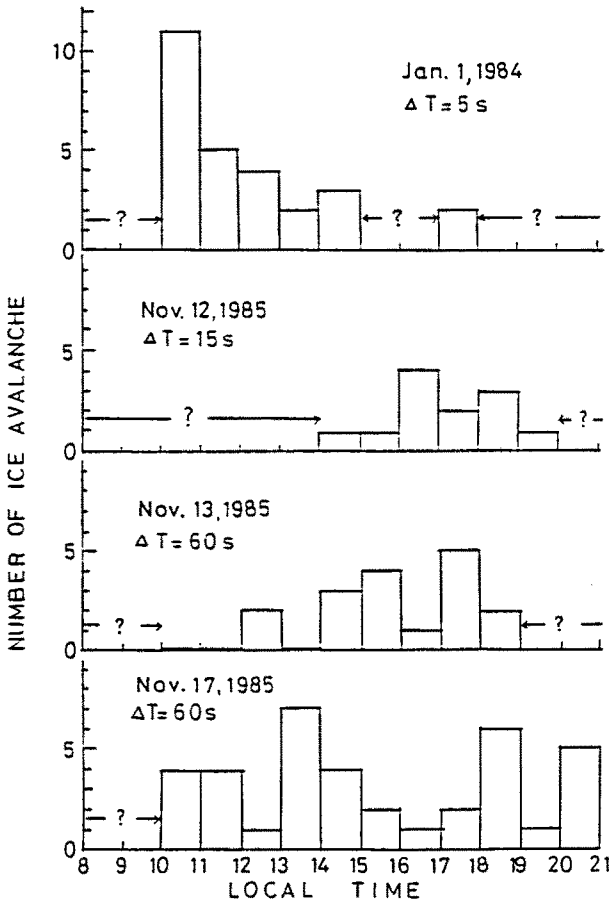

Fig. 4. Variations in hourly number of ice avalanches. Question marks indicate periods of no observation. ΔT indicates the time interval between frames.

fying the mechanism of mass balance of such a glacier as Soler. Time-lapse photography may be an expedient and useful method for this study.

References

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Resumen

Avalanchas de hielo en el Glaciar Soler, Patagonia

Mediante una máquina filmadora de 8 mm se observó avalanchas de hielo en el Glaciar Soler, Hielo Patagónico Norte, durante el 1° de Enero de 1984 y el 12, 13 y 17 de Noviembre de 1985. Los intervalos de tiempo de filmación fueron de 5 s el 1° de Enero de 1984, 15 s el 12 de Noviembre de 1985 y 60 s el 13 y 17 de Noviembre de 1985. La frecuencia de ocurrencia de avalanchas de hielo pudo ser estimada en forma aproximada en el presente estudio y su duración predominante estaba en el rango de 10 a 30 segundos (Fig. 2).

La fotografía a intervalos puede ser uno de los métodos expeditos y útiles para este tipo de estudios. Sin embargo, estudios más detallados sobre avalanchas de hielo debieran contribuir a aclarar aún más el mecanismo de balance de masa de un glaciar como el Glaciar Soler.

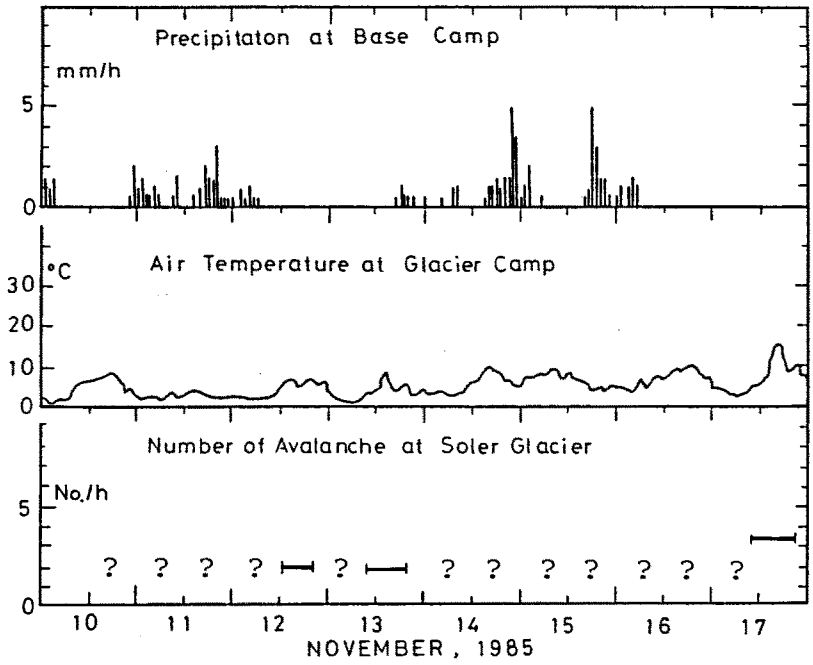

Fig. 5. Relationship between variations of precipitation at the base camp, air temperature at the glacier camp and the number of avalanches per hour on November 12, 13 and 17, 1985. Question marks indicate periods of no observation.