

Preliminary Report on Flight Observations of 1976 and 1978 in the Nepal Himalayas*

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Abstract

The Glaciological Expedition of Nepal had two chartered flights in 1976 and nine flights in 1978 to almost all parts of the Nepal Himalayas, and more than 9,000 photographs were taken in order to investigate the distribution and characteristics of glaciers in this region.

The glacier classification of Watanabe (1976) is confirmed that there are the Nepal type glaciers with lower termini and the Tibet type glaciers with higher termini. In case comparative studies on the glacier size, it is necessary to check the location of the contemporary termini, since the debris-covered glacier does not show the exact present terminus and the present active terminus is located in the middle part of the debris-covered ice, but the debris-free glacier exactly show the present terminus.

There is, in the Himlung Himal of the central Nepal, found the enormous glacial expansion stage of which is estimated to be the 16th century.

1. Introduction

Glacial phenomena, controlled by topographic as well as climatic conditions, are well developed in the Nepal Himalayas. The varieties of topographic-climatic conditions are thought to produce the areal distributions and characteristics of glaciers such as physical properties of glacier ice, mass balance, glacier flow, debris contents of glaciers and other characteristics, which influence the characteristic distributions and shapes of glaciers in a certain area.

To make an inventory of glaciers and to know the areal characteristics of glacier distributions is fundamental not only for the glaciology of the

Great Himalayas, but also for the utilization of glaciers based on works of the glacier inventory in the Nepal Himalayas. However, it is impossible to observe the areal characteristics of glacier distributions by ground surveys, since it is difficult to walk all over the Nepal Himalayas in a short time due to the steep mountainous topography. So, flight observations over almost all of the Nepal Himalayas were conducted by the Glaciological Expedition of Nepal in 1976 and 1978.

2. Flight courses

In 1976, the Glaciological Expedition of Nepal

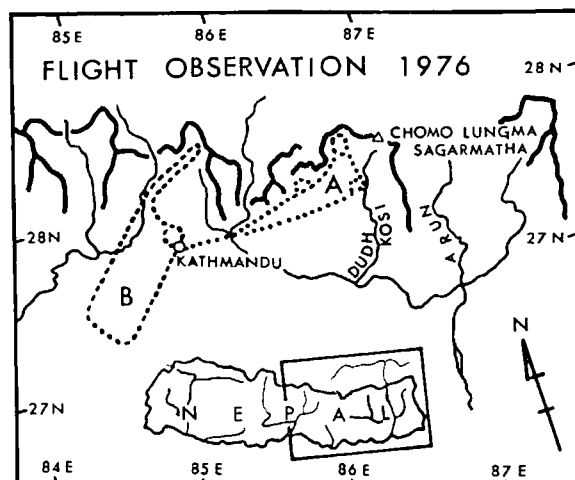


Fig. 1-1. Flight observation courses of 1976. There are two flights (A and B) in 1976.

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(GEN) had two flights (A and B) (Fig. 1-1) and (1976). The preliminary report on the glacier more than 1,200 photographs were taken (Table 1). inventory of the Dudh Kosi region was published (Higuchi *et al.*, 1978).

Flight (A) on Nov. 4, 1976.

The GEN had a chartered flight to Khumbu Himal and Shorong Himal in the north-west of the Dudh Kosi region, east Nepal, for completing a glacier inventory of the region, since there was a lack of photographic information in that part of the Dudh Kosi region in spite of several other flights from 1970 to 1975 reported by Higuchi *et al.*

Flight (B) on Dec. 14, 1976.

This flight was planned to take aerial photographs of glaciers in Langtang Himal and to make measurements of the air temperature over the Nepal Himalayas from Langtang Himal in the north to the Siwalik ranges in the south.

The results on the air temperature measurements

Table 1. Lists of aerial photographs taken in 1976 and 1978. Flight names, dates, flight areas covered, flight time, number of photographs taken and kind of film (BW (black and white), CS (colour slide), CP (colour print) and IP (infrared)) and flight members are shown in this list.

Flight Name	Date	Flight Area	Flight Time	BW	CS	CP	IP	Flight Members
A	4 Nov., 1976	Khumbu Himal-Rolwaling Himal	121 minutes	500	300			H. Higuchi, H. Fushimi, T. Yasunari and T. Ohata
B	14 Dec., 1976	Langtang Himal-Siwalik Ranges	64 minutes	200	200		20	C. Nakajima, H. Fushimi and S. Kotake
a	27 Apr., 1978	Kanchenjunga Himal-Shorong Himal	180 minutes	595	560	25		K. Higuchi, Y. Ageta and K. Ikegami
b	18 Oct., 1978	Khumbu Glacier	39 minutes	320	105			O. Watanabe and H. Fushimi
c	22 Oct., 1978	Ganesh Himal-Langtang Himal	168 minutes	390	105			O. Watanabe, T. Yasunari and K. Ikegami
d	15 Nov., 1978	Api, Saipal and Takpu Himal	382 minutes	425	315	35		H. Higuchi, H. Fushimi and T. Yasunari
e	16 Nov., 1978	Annapurna Himal-Ganesh Himal	130 minutes	425	420	35		H. Higuchi, H. Fushimi and T. Yasunari
f	21 Nov., 1978	Kangchenjunga Himal-Ganesh Himal	118 minutes	285	245		70	H. Higuchi and H. Fushimi
g	11 Dec., 1978	Jugal Himal-Khumbu Himal	145 minutes	495	210	175		H. Fushimi, T. Yasunari and A. Nagoshi
h	12 Dec., 1978	Kanjiroba Himal-Manaslu Himal	223 minutes	705	490	105	105	H. Fushimi, T. Yasunari and A. Nagoshi
i	13 Dec., 1978	Dhaulagiri Himal-Manaslu Himal	179 minutes	600	630	105	35	H. Fushimi, T. Yasunari and A. Nagoshi

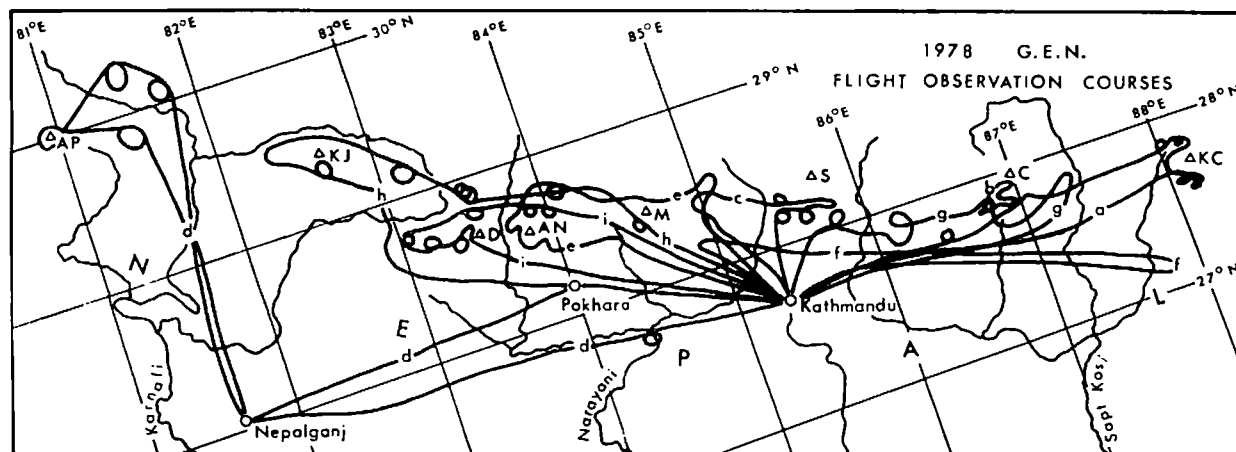


Fig. 1-2. Flight observation courses of 1978. There are nine flights (a-i) in 1978.

of the flights (A) and (B) were reported by Yasunari and Nakajima (1978).

In 1978, the GEN had nine (a-i) chartered flights in a Pilatus Turbo Porter aircraft, except flight (f) in a Hawker Siddeley 748, to the almost all parts of the Nepal Himalayas (Fig. 1-2), and more than 8,000 photographs were taken (Table 1).

Flight (a) on Apr. 27, 1978.

This flight covered the easternmost part of the Nepal Himalayas; the Kangchenjunga region, Lumbasamba Himal and the south-east part of the Khumbu Himal. Many oblique photographs were taken in Shorong Himal, since the GEN was planning to send a field party to the region during the summer monsoon season in 1978.

Flight (b) on Oct. 18, 1978.

This flight was planned to take vertical photographs of the Khumbu Glacier in the north of the Khumbu Himal, but it was not succeeded in taking the vertical photographs due to a defect in the camera used. The flight covered only the Khumbu Glacier and the northern part of the Hongu valley in the south-east of the Khumbu Himal.

Flight (c) on Oct. 22, 1978.

This flight covered Ganesh Himal, Langtang Himal and the west part of the Jugal Himal. The measurements of ground temperature by the infrared radiometer and the samplings of the aerosol particles over Kathmandu and Langtang Himal were also made during this flight. These results are reported in this issue (Yasunari, 1980, Ikegami et al. 1980).

Flight (d) on Nov. 15, 1978.

This flight had the aim of taking the aerial photographs of the most north-western part of the Nepal Himalayas. The flight distance was so long that we made a night stop at Pokhara on Nov. 14 and stopped at Nepalganji for refueling on the way to the region. Takpu Himal, Api, Nampa and Saipal regions were photographed on this flight.

Flight (e) on Nov. 16, 1978.

This flight covered the central part of the Nepal Himalayas; Annapurna Himal, Muktinath Himal, Manaslu Himal and Ganesh Himal. It was so windy that we could not fly near to the mountains in the southern part of the Annapurna Himal.

Flight (f) on Nov. 21, 1978.

This was a flight on a Hawker Siddeley 748. The flight course was very far from the mountain areas, except that in the south of the Langtang Himal, and it was not possible to take good pictures of glaciers on this flight.

Flight (g) on Dec. 11, 1978.

This flight had the aim of photographing glaciers in the areas between Langtang Himal and Khumbu Himal, and to take vertical photographs of the lower part of the Khumbu Glacier. Though the weather was very windy, these observations covered Jugal Himal, the Choba Bamare region, Rolwaling Himal and the southern part of the Khumbu Himal.

Flight (h) on Dec. 12, 1978.

This flight was planned over Dhaulagiri Himal, but it was very windy in that region and the plan was changed to Kangjiroba Himal. The flight covered Kangjiroba Himal, Mukut Himal and the south-west part of the Manaslu Himal.

Flight (i) on Dec. 13, 1978.

It was very calm even at high altitudes in this time of the year and we planned flight observations in Dhaulagiri Himal as only this region was left for photographing. This flight covered Dhaulagiri Himal and the northern part of the Annapurna Himal.

Most photographs are oblique, except vertical ones of the lower part of the Khumbu Glacier taken on Dec. 11, 1978, but they are still useful for knowing the areal characteristics of the glaciers for making an inventory as had been proposed by Higuchi et al (1976). Since the flight altitude was quite high, ranging from 7 to 8 km, and the flight courses were along the valley systems when there were peaks and ridges higher than the flight altitude, those photographs covered glacier distributions over wide areas in the Nepal Himalayas.

Since time-interval photographs were taken of the same glaciers, stereoscopic pairs of air photographs are available for mapping the shapes of glaciers and their distributions.

3. Discussions and results

Watanabe, Endo and Ishida (1967) reported on the differences of glacier types between the Takpu (Fig. 2), near the border between north-western Nepal and Tibet, on the northern side of the Great



Fig. 2. Aerial photograph of the Takpu Glacier in north-western Nepal.



Fig. 4. Aerial photograph of an ice cap in the north of the Dolpo region, central Nepal.

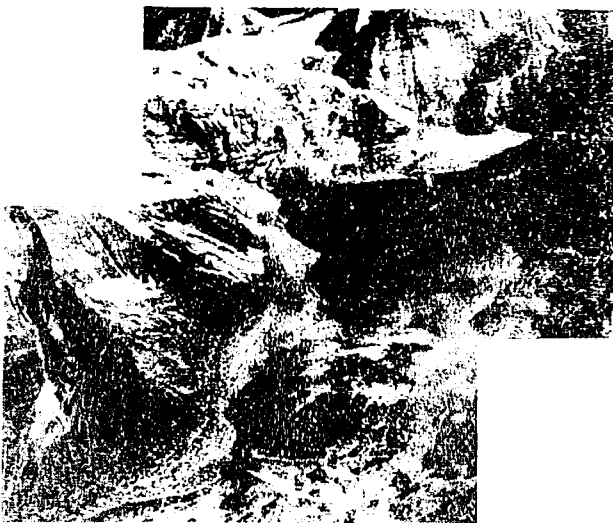


Fig. 3. Aerial photograph of the Ghustung (Kaphe) Glacier in the Dhaulagiri Himal, central Nepal.

Himalayas, and the Ghustung (Kaphe) Glacier (Fig. 3), near Mt. Dhaulagiri, on the southern side of the Great Himalayas. He also catalogued 80 representative glaciers on the southern side and northern side of the Nepal Himalayas, and reported that the glaciers in the Nepal Himalayas are classified into two types: longer "Nepal type glaciers" with lower termini and shorter "Tibet type glaciers" with higher termini, and that the length of the glaciers is longer in eastern Nepal than in the western Nepal (Watanabe, 1976).

The observations of the GEN 1978 also confirmed that there are differences in the glacier types in the south and in the north of the Great Himalayas, and the present authors agree with the conclusion of Watanabe's glacier classification that the lowest elevation of the Nepal type glaciers is lower than that of the Tibet type glaciers. We found a typical Tibet type glacier, which is situated on gentle

topographic conditions and a kind of an ice cap in the north of the Dolpo region, north-western Nepal (Fig. 4). However, it cannot be said that the length of the glaciers of the Nepal type glaciers is necessarily longer than that of the Tibet type glaciers as Watanabe (1976) stated, since many glaciers of the former type have a debris-covered area in the lower part of the glacier, which is a fossil ice body having no direct relation to the present glacier flow; the present active terminus is located in the middle part of the debris-covered ice (Kodama and Mae, 1976, Fushimi, 1977) (Fig. 5).



Fig. 5. Aerial photograph of the Khumbu Glacier, Khumbu Himal, east Nepal.

It is supposed that Watanabe (1976) took the fossil ice body for the present glacier terminus since most of his compilations were not done by his own field study, but were based on reports of mountaineering expeditions. A specialized field study is necessary to determine the location of the present active terminus of the Nepal type glacier with debris-covered downstream part in order to compare it with the length of a presently active Tibet type glacier, because the Tibet type glaciers usually have debris-free termini and show the exact length of the present active glaciers. In other words, in case comparative studies are made on the glacier size at the time of the formation of the fossil ice, it is necessary to check the location of the contemporary moraine of the Tibet type glacier.

Our observations also suggest a general trend for the length of glaciers to be longer in eastern Nepal than in western Nepal (Watanabe, 1976); however the contemporary termini should be compared for the same reason mentioned above. We found that glaciers of the Himlung Himal (Fig. 6) in the Marsyandi river basin in the central



Fig. 6. Aerial photograph of the Himlung Himal in the north-western region of the Manaslu Himal, central Himal.

Nepal Himalayas show an enormous glacial expansion stage which can be correlated with the morphological characteristics of the moraine in the Thuklha stage in the Khumbu Himal, the stage of which is estimated to be the 16th century by ^{14}C dating (Fushimi, 1978). This shows that the local topographic-climatic conditions reflect the formation of the glacial phenomena and the development of the glacier size.

Further analyses of aerial photographs are needed to know the present state of glaciers; the characteristics of glacier types, the shape and length of glaciers and the other glacial characteristics.

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