

Aerial photographic surveys over Soler, Nef and San Rafael Glaciers

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Abstract. Aerial surveys were carried out on November 15, 1983 and January 11, 1984. The first one covered the San Rafael and Soler Glacier areas for reconnaissance. The second mission covered only the Soler Glacier area and vertical aerial photographs with forward overlaps were taken for stereoscopic analyses, using a 6×6 cm format camera. The nominal scale of these photographs varies from 1:39,000 to 1:36,000. Utilizing these vertical photographs, an uncontrolled mosaic of Soler Glacier was assembled from the 45 prints at a nominal scale of 1:20,000.

1. Introduction

Originally the aerial survey had two objectives: 1) to reconnoiter the San Rafael and Soler Glacier areas, which were our destination for research activities, and 2) to cover the perimeter of the Northern Icefield in order to photograph the terminus of the outlet glaciers. The second objective is to facilitate comparisons with trimetrogon aerial photographs taken in 1944 and 1945, and the vertical photographs taken in 1974 and 1975 by the USAF, from which the glacial advance/retreat can be revealed.

The austral summer of 1983–84 was unusually bad for the Northern Icefield. Consequently, there was no single day which would permit a photographic mission over the Northern Icefield while we were in Coihaique in November and January. We could barely fly over the San Rafael and Soler Glacier areas on November 15, 1983, and over the Soler and Nef Glacier areas on January 11, 1984 (Fig. 1 and Table 1). This is a summary report of these flights.

Table 1. Aerial Survey Missions.

Date	Airplane	Cruising Speed	Flight Hours	Nominal Flying Height above Sea Level	Type of Photography
Nov. 15, 1983	Cessna Aztec twin engine	200 km/h	2:51–5:59	Variable	Oblique (35 mm and 6×6)
Jan. 11, 1984	Cessna	200 km/h	11:28–2:46	Over Soler 10500 ft (3200 m) 6000 ft (1830 m) Over Nef 11500 ft (3500 m)	Vertical (6×6) and Oblique (35 mm)

Table 2. Photographic Equipment.

Camera:	Zenza Bronica SQ-Am. Lens Shutter, Single Reflex, TTL, Automatic with motor drive. So called 6×6 frame (picture size 55.6 mm×55.6 mm). Grided focusing screen.
Lens:	80 mm, F2.8
Filter:	UV
Film:	Kodak Ektachrome 200 Daylight Professional Film (ASA 200). EPD 220. Reversal.

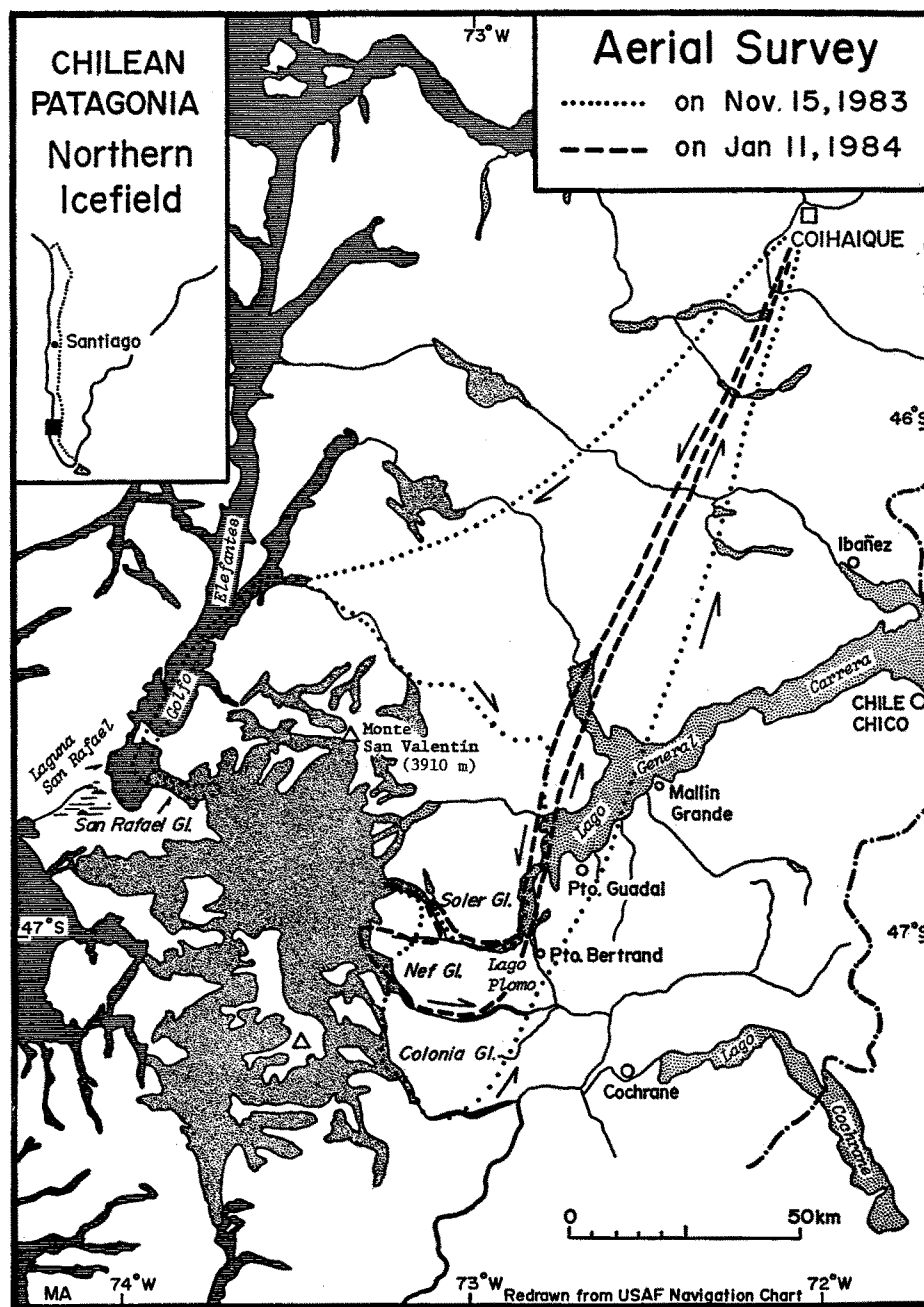


Fig. 1. Flight courses of the two aerial surveys.

For this aerial survey, a large format, non-cartographic camera was used (Table 2). The reason we chose a 6×6 cm format camera was that the photograph would be square-shaped. When it is enlarged, it can be handled and used just like regular aerial photographs, and it is easier to plan on the flights. It was originally intended to use a 50 mm wide angle lens in order to obtain a higher B/H ratio, but the small diameter of the bay hole (80 mm) prevented its use due to excessive circular trimming of the frame. Even with an 80 mm lens, circular

trimming could not be avoided, but it was tolerable. The bay hole is located under the copilot's seat and one has to sprawl in order to look into the view finder when photographing. This bay hole to accommodate vertical photographing has proved very useful and these photographs taken over the Soler Glacier area on the second mission revealed very interesting features of the glacier and proglacial area, which would hardly be recognized on the ground.

2. Mission on November 15, 1983

This flight was largely for reconnaissance, because weather did not permit a circumferential flight over the Northern Icefield, and also at that time the airplane was not yet equipped with a bay hole. Photography was therefore restricted to oblique photographs through glass windows. Fortunately, clouds were high enough to permit flight under the clouds over Lagoon San Rafael and San Rafael Glacier, and we could fly in as close as to the edge of the accumulation area. Then we crossed the icefield along Exploradores River to Lake General Carrera, and flew along Soler River, and over Soler, Nef and Colonia Glaciers before heading north back to Coihaique.

3. Mission on January 11, 1984

This mission covered the Soler Glacier area including the neighboring Nef Glacier. The flight was intended to take vertical photographs and H. Kondo was on board as an assistant.

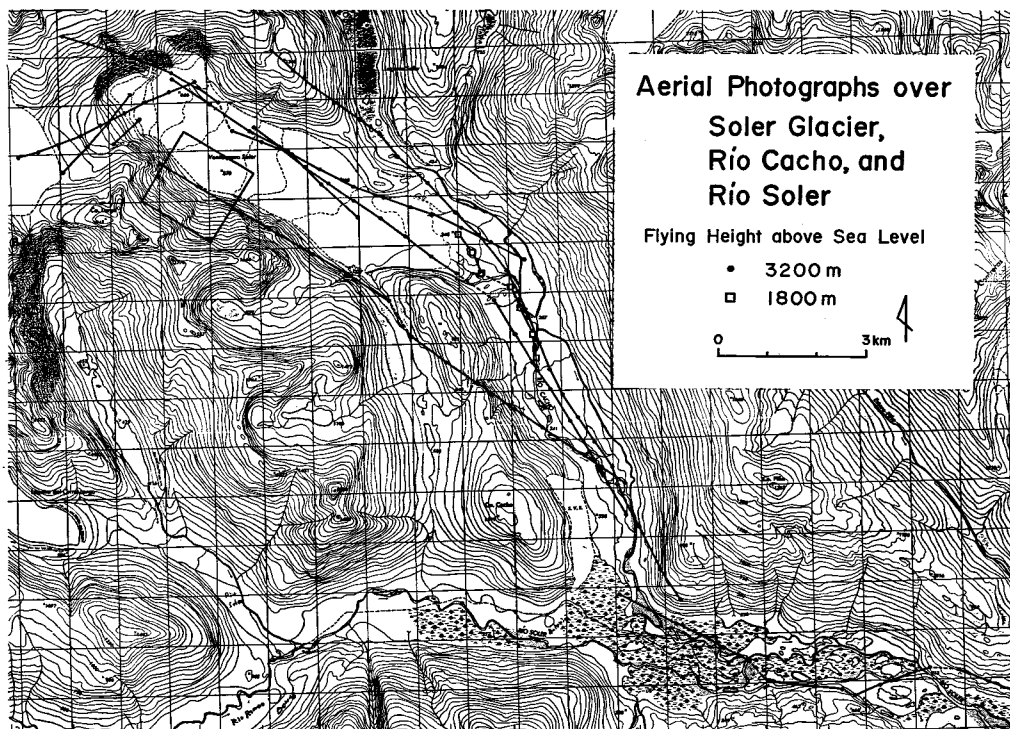


Fig. 2. Flight lines over Soler Glacier, Cacho and Soler Rivers. A square indicates an approximate areal extent covered by a single photograph.

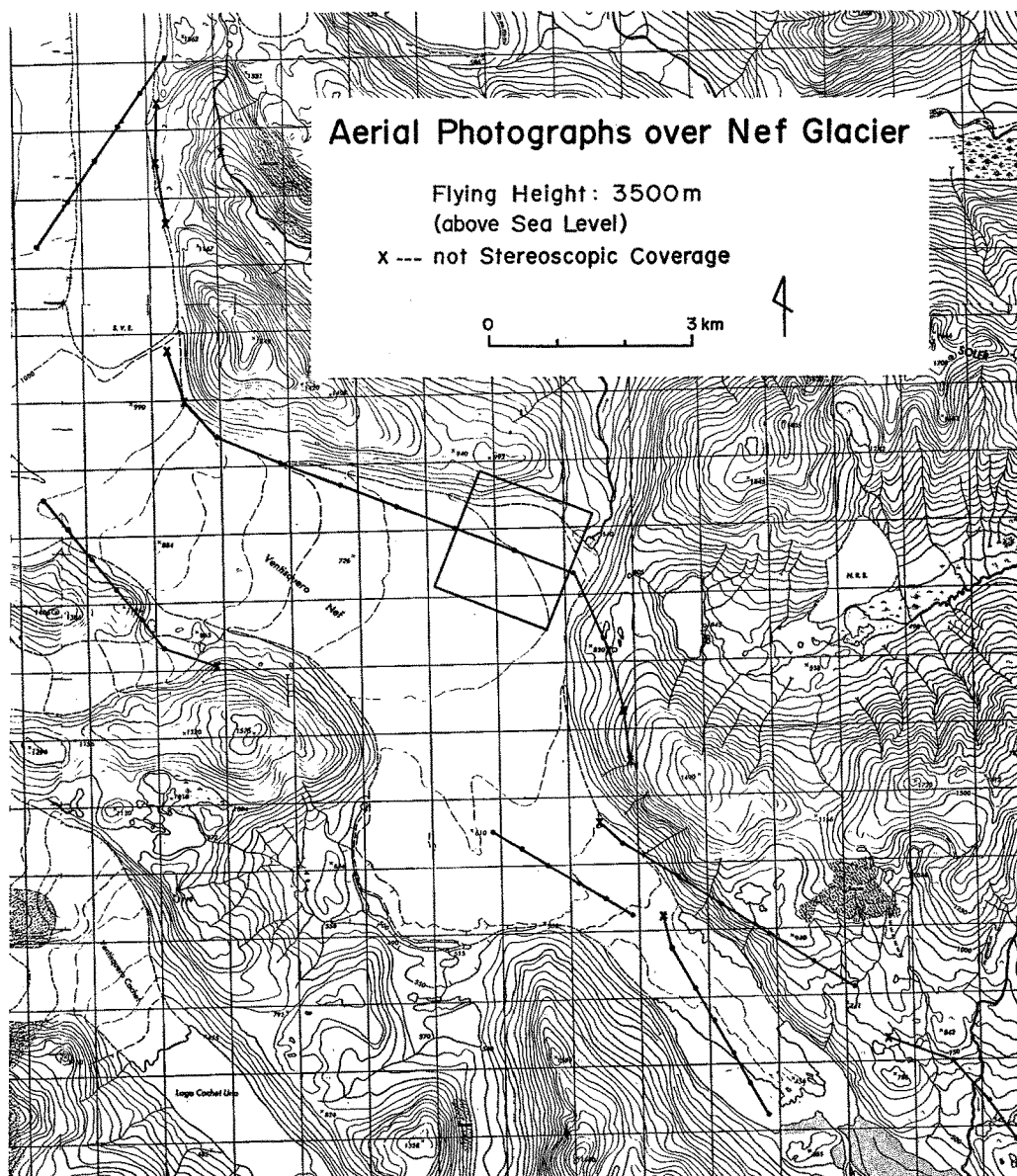


Fig. 3. Flight line over Nef Glacier. A square indicates an approximate areal extent covered by a single photograph.

Flight lines over Soler Glacier, Cacho and Soler River valleys are shown in Figure 2, and those over Nef Glacier in Figure 3. Since a roll of film had only 22 exposures, it was impossible to take a long flight line owing to frequent film change. Often we missed good targets while changing film. Although these flight lines are shown in almost straight lines, actual flight course have a lot of deviations (drift and crab). This is partly because the pilot was unfamiliar with this kind of flight: flying straight between the two points in order to take overlapping photographs. The pilot tended to fly along interesting ground features in a sinuous pattern, and I had to adjust the camera by rotating while looking into the view finder, result-

ing in crabs. Another factor is of course strong air turbulence. This was particularly severe at lower altitudes. As results of these conditions, the stereoscopic coverage is not perfect in some areas.

Since Soler Glacier and the moraine field at the head of Cacho River valley were the main sites for glaciological and geomorphological studies, a large portion of the flight was spent here to ensure good, complete stereoscopic coverage. The glacier was essentially covered with two flight courses along the northern and southern edges. Although flying over the icefall from the icefield was very difficult due to topography and air turbulence, good coverage was obtained by several flights. The moraine field was also well covered by several flights. One flight was at lower altitude ($H = 1830$ m): however, it was not good owing to severe air turbulence. For these areas of research interest, the stereoscopic coverage turned to be almost complete. Photograph 4 (see front page) shows an example of these photographs in stereo.

The coverage of Nef Glacier was not as successful as that of Soler Glacier, because the glacier was too big for this type of photography and weather was deteriorating. By the time we finished the Soler area, clouds were coming down from the icefield and time was getting short so that we had to make haste photographing. In order to cover the glacier from bank to bank, it was necessary to fly at least four courses along the glacier with this camera and the flying height of about 3500 m above sea level. It was obviously impractical to do so, and we decided to fly mainly along the northern and southern edges. Flight lines were fragmented, however, due to cloud interference and sinuous flight patterns. Consequently, the stereoscopic coverage is not good with a few gaps here and there.

4. Photographing and scale of vertical aerial photographs

All photographing was accomplished automatically by setting the exposure at F 11, with motor drive, while looking into the view finder, and the computed exposure timing was relayed by the assistant. Altogether 12 rolls of 22 exposure film pack were taken, totaling 264 exposures. There were many wasted shots, however, due to light-leak when changing film: 180 frames were unaffected and usable for analyses.

The amount of forward overlaps varies from as little as 30 percent to as much as 70 percent. The quality of photographs is very variable. Generally speaking, however, they are underexposed. This is particularly true for the Cacho River valley, moraine fields, and where glacier and rock/vegetation are mixed in one frame. Photographs showing glacier only are generally of good quality.

Nominal scales of vertical aerial photographs, computed by using the 1:50,000 topographic map, vary from 1:39,000 to 1:36,000, depending upon the flight lines. For example, in front of the glacier snout, it is about 1:36,000, while at Lake Soler it is about 1:39,000. Further up around the icefalls on the southeastern side of Mt. Hyades, it is computed to be 1:38,000. These scale variations indicate that it was not caused by the difference in ground elevations, but rather by flying height fluctuations due to air turbulence. The scale variation is completely negligible, however, for practical uses such as assembling the mosaic and stereoscopic interpretation.

5. Mosaic of Soler Glacier

The uncontrolled mosaic of Soler Glacier (Photo. 5, front page) was prepared from 45 direct prints of the original slides. The scale of the prints ranged from about 1:20,000 (Cacho

River) to 1:22,000 (glacier), and the scale of the assembled mosaic is equivalent to approximately 1:20,000. This scale and the graphic bar scale were determined from the distance between the two survey stations located across the glacier, to the south of Lake Soler, and comparisons with the 1:50,000 topographic map. This approximate scale is good for almost all of the mosaic area: however, lengthwise the scale is slightly larger. By comparing the distance from the base of the icefall to the snout, the lengthwise scale is about 1:19,000.

Acknowledgments

Zenza Bronica Co., Tokyo, Japan, kindly let us borrow two camera bodies (SQ-Am), and 50 mm, 80 mm and 250 mm lenses for this aerial survey. Thanks are also due to "Don Carlos" in Coihaique, which has made a bay hole in their Cessna in order to make vertical photographing possible, and the pilot, Carlos R. Leon, who cheerfully made these strange flights.

Resumen. Reconocimiento fotográfico aéreo de los Glaciares Soler, Nef y San Rafael

Se efectuó un levantamiento aéreo el 15 de Noviembre de 1983 y el 11 de Enero de 1984 (Fig. 1 y Tabla 1). El primero fue mayormente un reconocimiento de terreno, cubriendo nuestra área programada de investigación de los Glaciares San Rafael y Soler. Las fotografías son oblicuas y están tomadas con una cámara de 35 mm a través de las ventanas de vidrio. En la segunda misión, en la cual se cubrió solamente el área del Glaciar Soler debido a condiciones meteorológicas, se usó una cámara no cartográfica de formato grande (6×6 cm) para tomar fotografías verticales (Tabla 2). Una ventanilla de piso en un Cessna permitió tomar fotos verticales mientras la cámara era sostenida por mano. Las líneas de vuelo sobre los Glaciares Soler y Nef se muestran en las figuras 2 y 3 respectivamente. La cobertura estereoscópica del área del Glaciar Soler está casi completa. Sin embargo sobre el Glaciar Nef hay algunos espacios sin cobertura debido a limitación de tiempo y a condiciones meteorológicas.

Todas las fotografías fueron tomadas en forma automática ajustando la exposición en F11 y con impulso motriz. En total se tomó 12 rollos de película de 22 exposiciones, que suman 264 disparos. Sin embargo, sólo 180 fotos resultaron suficientemente buenas para análisis, debido a filtración de luz durante el cambio de película. La calidad de las fotografías es muy variable. En general sin embargo están subexpuestas. Aquellas que sólo muestran glaciar en el recuadro son usualmente de buena calidad. De todas formas, han resultado ser una excelente fuente para estudiar el glaciar y los campos de morrenas. La escala nominal de estas fotografías varía entre 1:39.000 y 1:36.000. Estas variaciones de escala fueron ocasionadas más bien por la fluctuación de la altura de vuelo que por diferencias en cotas de terreno.

Utilizando estas fotografías, se preparó un mosaico no controlado del Glaciar Soler (véase al fotografía 5, página anversa) a partir de 45 copias directas de los diapositivos originales. La escala del mosaico compuesto es aproximadamente 1:20.000, determinada principalmente por la distancia entre dos estaciones de levantamiento terrestre (véase Reporte 10). Longitudinalmente, la escala es algo mayor, cerca de 1:19.000.