Glacier Snowline Survey, 1995

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ABSTRACT

The end-of-summer snowline survey of 48 "index" glaciers of the Southern Alps, undertaken in March 1995 indicated that 194-95 was the strongest positive balance year recorded since these records began in 1976-77.

KEYWORDS: glacier, snowline, equilibrium line altitude

1. INTRODUCTION

This aerial survey continued a glacier/climate monitoring programme commenced in 1977 for the New Zealand Glacier Inventory, where the position (altitude) of the end-of-summer snowline is photographed annually on a set of some 48 selected glaciers arranged in transects across the Southern Alps. Glacier snowline altitudes give a direct value for glacier health and balance, whereas glacier frontal positions are modified by response times and glacier dynamics. During the flight various additional glacial and geomorphological features were photographed. This year the survey was again highly successful in that for the second successive year, all of the index glaciers, ranging from southern Fiordland to the Inland Kaikoura Range of the Southern Alps, were photographed.

2. METHOD

The method involves taking simple oblique photographs of the position of the end-of-summer glacier snowlines. Topographic maps are then compared with the photographs to derive snowline altitudes. A folder of maps showing the glacier locations, together with copies of past photos of each glacier is held by the navigator seated beside the pilot. The photographer operates from the back seat, shooting from both sides of the aircraft. At each glacier, previous photographs are duplicated closely to assist comparisons from year to year. This year, in addition to the index glaciers, a special effort was made to photograph the frontal positions of all of the major valley glaciers, and a large number of thickening and advancing glaciers were monitored. It was originally intended to photograph glaciers not previously photographed for the N.Z. Glacier Inventory, but excessive residual snow cover made this an impractical objective. The flight was made at 10,000 ft altitude which has been found to give the best angle on the glacier snowlines.

3. PREPARATIONS

The flight should be made on the elusive "last perfect day before the first winter snowfall", at the end of significant summer melt. The flight was planned for the first clear weather after the end of February 1995 and took the opportunity of anticyclonic conditions which persisted

from mid February. The flight was made in a Cessna Cardinal 177, DAO, chartered from Aspiring Air at Wanaka airfield. This high wing aircraft is eminently suitable as it has no obstructing wing struts and a relatively high cruising speed. The pilot, Davida Mead, had a wide knowledge of the mountains. Jane Forsyth was the navigator and Trevor Chinn was the photographer. The combined detailed mountain knowledge of the party permitted direct "front window" navigation without any flying time lost to searching for our positions on the maps.

4. ITINERARY

An anticyclone approached the country on the morning of 4 March 1995 (Fig. 1), giving still cloudless weather over the Southern Alps. The flight commenced from Wanaka airfield, beginning with the Dart-Shotover-Arawata section and then south to Fiordland. The first leg returning to Wanaka was completed in 3.3
hrs. The Dart Glacier was in shadow and good pictures of the snout were unobtainable for the third year running.

The second leg covered the glaciers west of the Main Divide as far north as Arthurs Pass. The flight revisited the Dart Glacier, where good quality pictures were obtained in the midday lighting. The second leg was completed in 3 hrs, and an overnight stop made at Hokitika.

On 5 March the weather remained clear for the third leg to Lewis Pass, Nelson Lakes glaciers and the Inland Kaikoura Range.
After 2.1 hrs this leg was completed with a refuelling stop at Rangiora.

The remaining eastern glaciers from Whitcombe Pass to Hawea were covered in 2.4 hrs, with cloud beginning to build up west of the Divide. The first nor'west winds were encountered during the descent over Lake Hawea.

The snowlines remained visible only until 16 - 17 March when the first winter snow fell (Fig. 1). By the 20th, snow had descended to the bush line.

5. RESULTS

For the second time, all the South Island index glaciers were covered during the flight. This took a total of 10.8 hrs flying time. Small diversions to photograph some 43 of the large valley glacier termini contributed about 0.5 hr. The flight time was less than for last year (11.2 hrs) mainly because very few circles were made to position the plane. Those turnabouts that were made were to allow film changes at times when the 3 cameras ran out of film simultaneously. The programme used two slide films, nine 35mm print films and twelve ten-shot 120 films.

The photographs have been analysed by positioning this year's snowline elevation for each glacier within previous photographs, ranked in ascending order of snowline elevation. The snowline altitude for 1995 was then interpolated both from the values of previous years, and from contoured mapped. This year, the majority of the snowlines were the lowest recorded, indicating a year of strong positive balance on the glaciers which will encourage the current advances to continue.

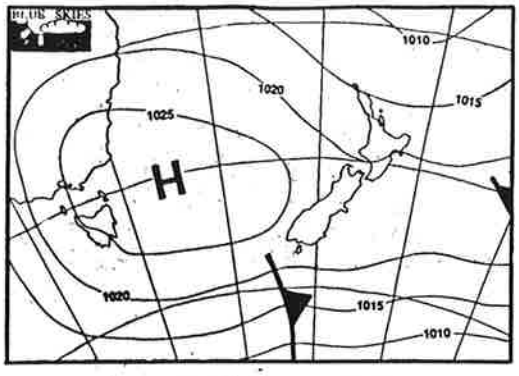
Results for individual glaciers are summarised in the histograms for each glacier in Figures 2 to 11, where they are given as departures from the estimated steady-state equilibrium line altitude (ELA) - the snowline position to maintain the glaciers in balance with their present size. For glaciers in balance this would normally be the mean of a number of years readings, but as the glaciers have been dominated by positive balances since this programme commenced, this altitude has been estimated from glacier morphology. These results are summarised in Figure 12. 100% of the glaciers surveyed had positive balances. Spatial variations in these balances are presented as a plot of the departure of the snowline surface from the steady-state ELA over the Southern Alps in Figure 13.

The 1995 mean snowline elevation is compared with previous years in Fig. 14. The 1994-95 glacier year had the most strongly positive balance recorded since this series of records began in 1977.

Otago Daily Times, Friday, March 3, 1995

WEATHER REPORT

Noon Forecast



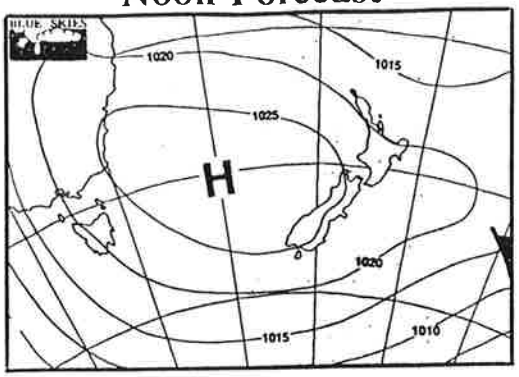
REGIONAL FORECASTS

Otago, Southland: Mostly fine and often sunny today with some areas of cloud at times, especially near the coast. A few isolated showers are possible. Expect light south-westerly winds and cold temperatures. temperatures becoming milder during the day. Outlook for tomorrow: Mostly fine and generally sunny with some cloud at times. Milder temperatures with moderate south-westerly winds.

Otago Daily Times, Saturday, March 4, 1995

WEATHER REPORT

Noon Forecast



REGIONAL FORECASTS

Otago, Southland: Mostly fine and often sunny with some areas of cloud at times, especially near the coast. Milder temperatures with moderate south-westerly winds dying out. Outlook for tomorrow: Mostly fine and generally sunny with some cloud at times. A few isolated showers may affect the south coast. Milder temperatures with light westerly quarter winds.

OTAGO DAILY TIMES Saturday March 18 1995

More snow around Queenstown

Queenstown. — The cold snap which left snow on the mountain tops around Queenstown earlier this week is not letting up.

Coronet Peak ski area manager Andy Chapman said snow was now down to 1000m on both the Remarkables and Coronet ski-fields. Mount Cook Group's latest ski-field acquisition, Mount Hutt, has several centimetres of snow on its the slopes.

Figure 1. Weather situation at the time of the 1995 survey flight.

NORTHERN GLACIERS

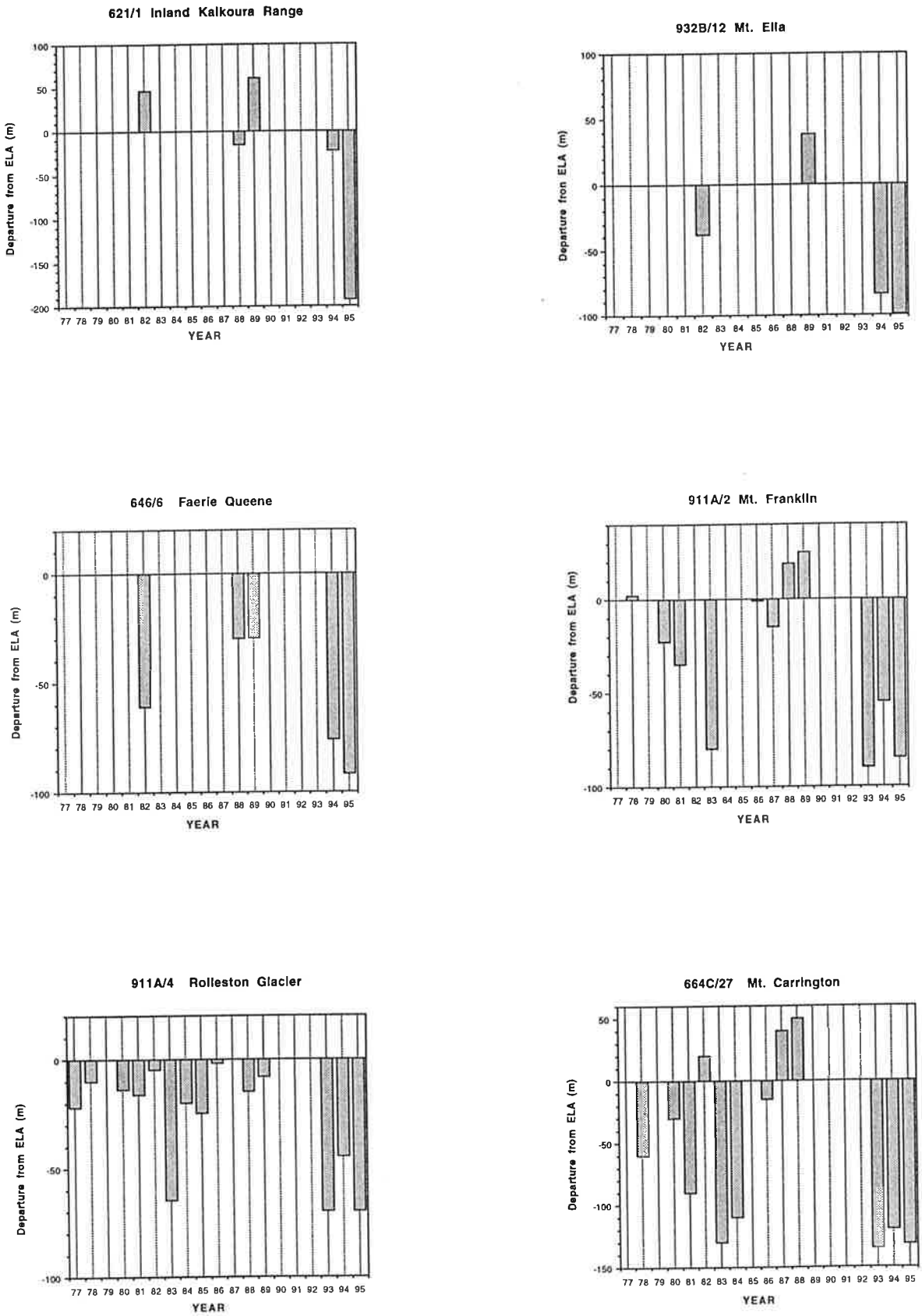


Figure 2. Snowline elevation departures from the estimated steady-state ELA values for each of the Northern Glaciers. Missing values indicate years when the glacier was not surveyed.

SECTION 1 AVOCA - KOKATAHI

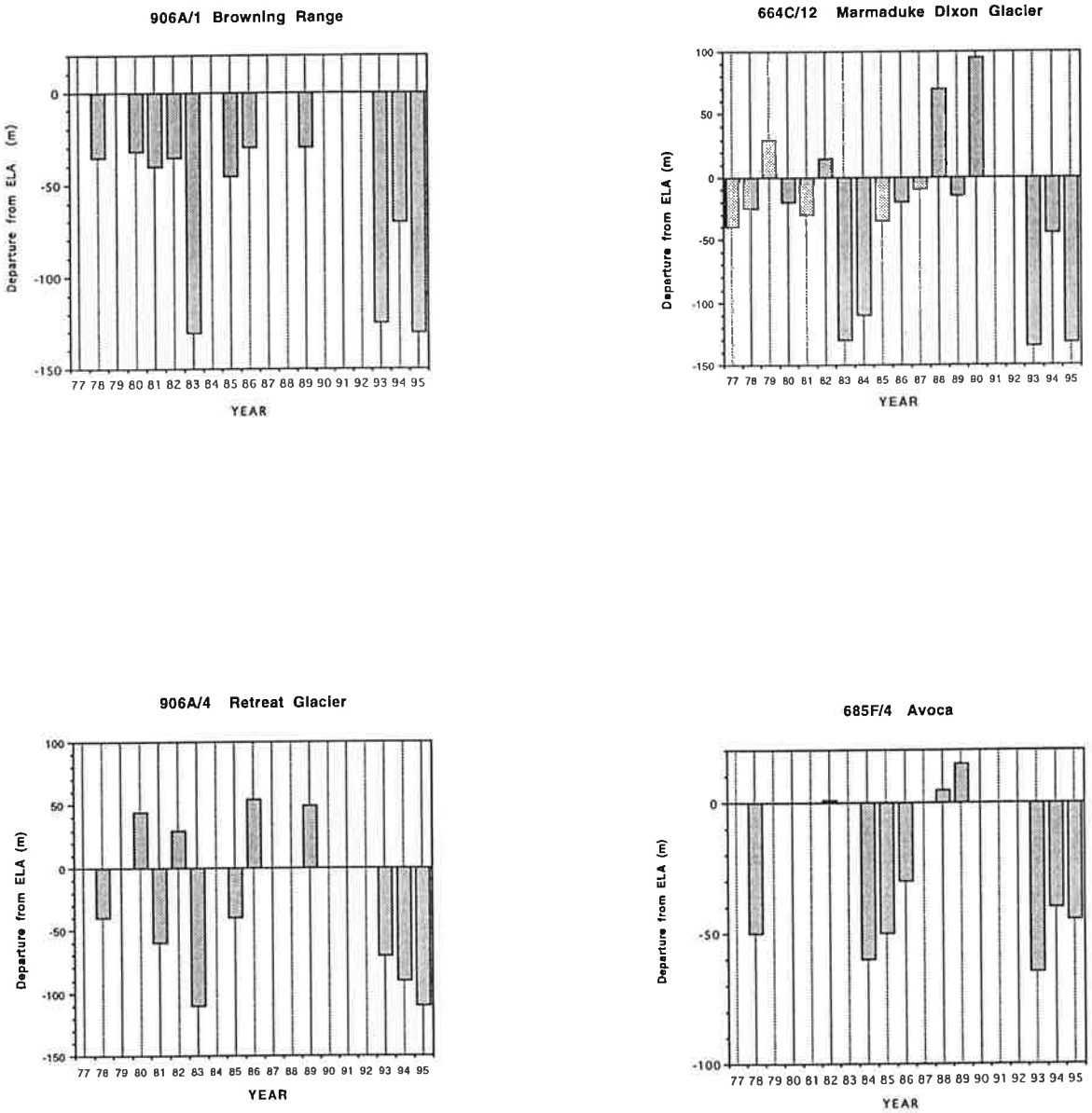


Figure 3. Snowline elevation departures from the estimated steady-state ELA values for each of the glaciers of Section 1. Missing values indicate years when the glacier was not surveyed.

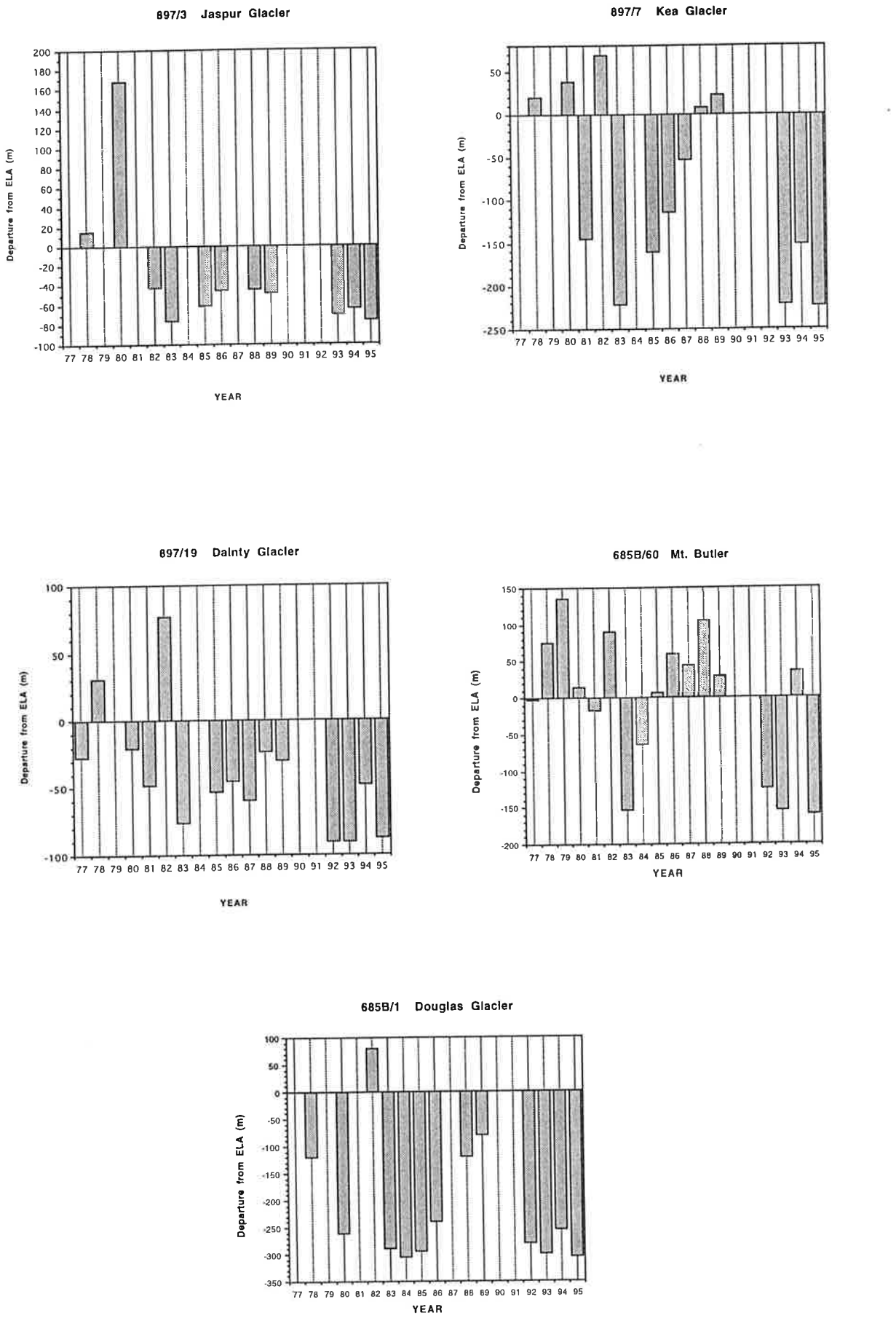
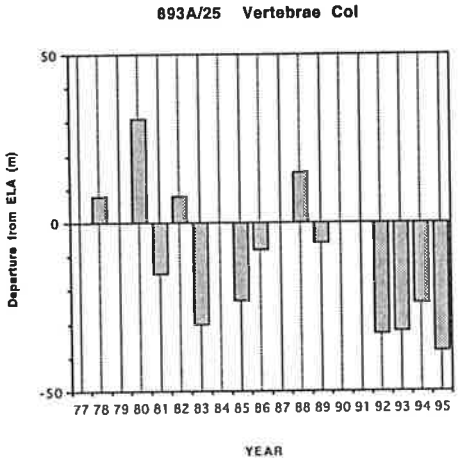


Figure 4. Snowline elevation departures from the estimated steady-state ELA values for each of the glaciers of Section 2. Missing values indicate years when the glacier was not surveyed.



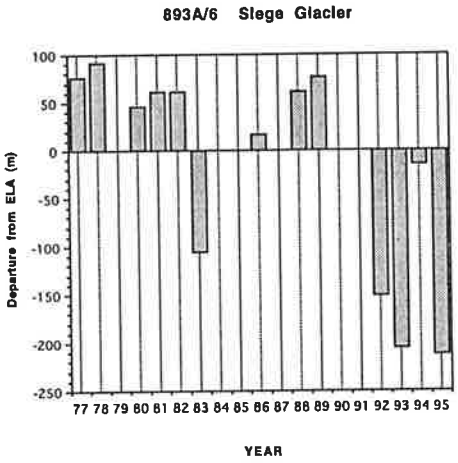


Figure 5. Snowline elevation departures from the estimated steady-state ELA values for glaciers intermediate between sections 2 and 3. Missing values indicate years when the glacier was not surveyed.

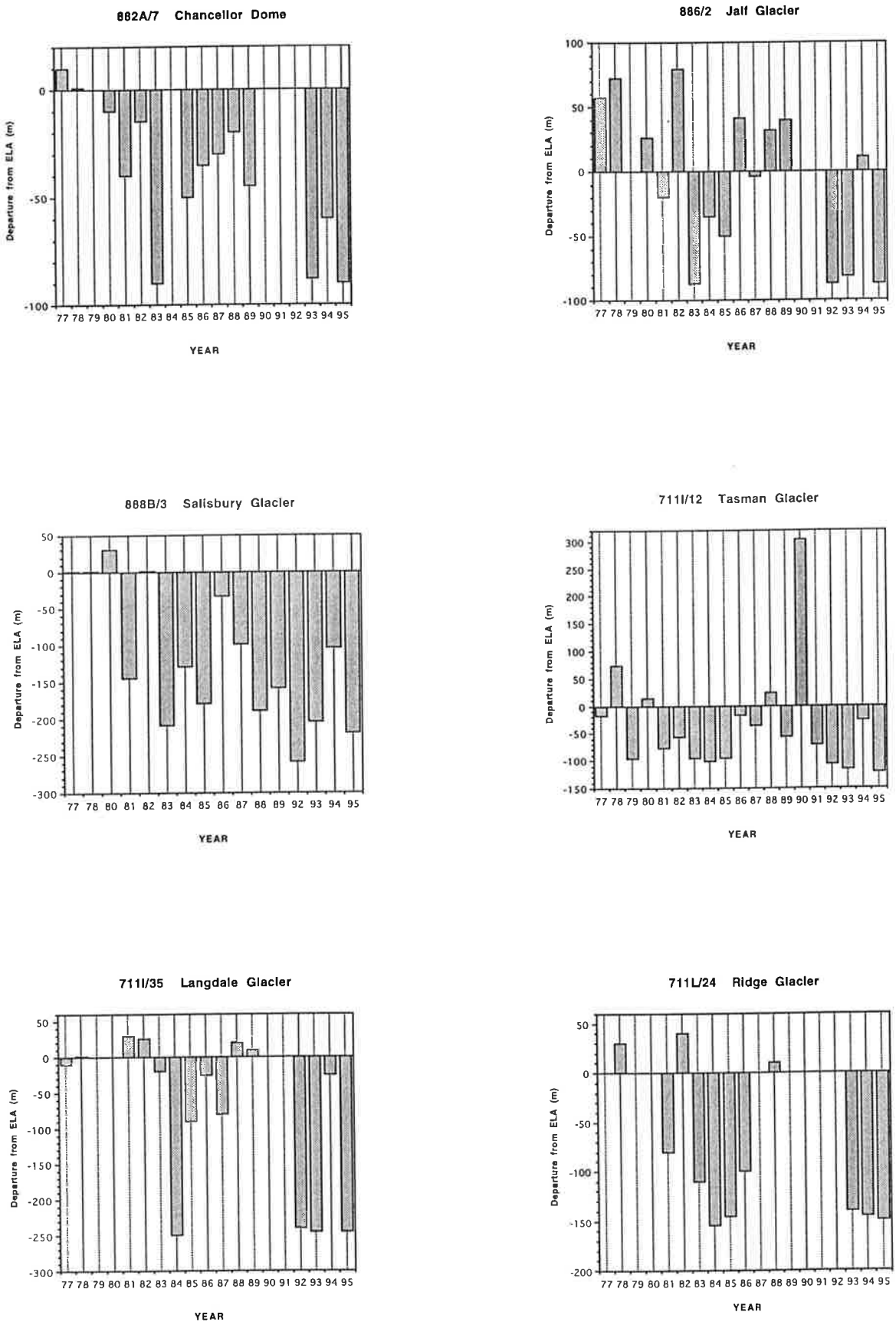


Figure 6. Snowline elevation departures from the estimated steady-state ELA values for each of the glaciers of Section 3. Missing values indicate years when the glacier was not surveyed.

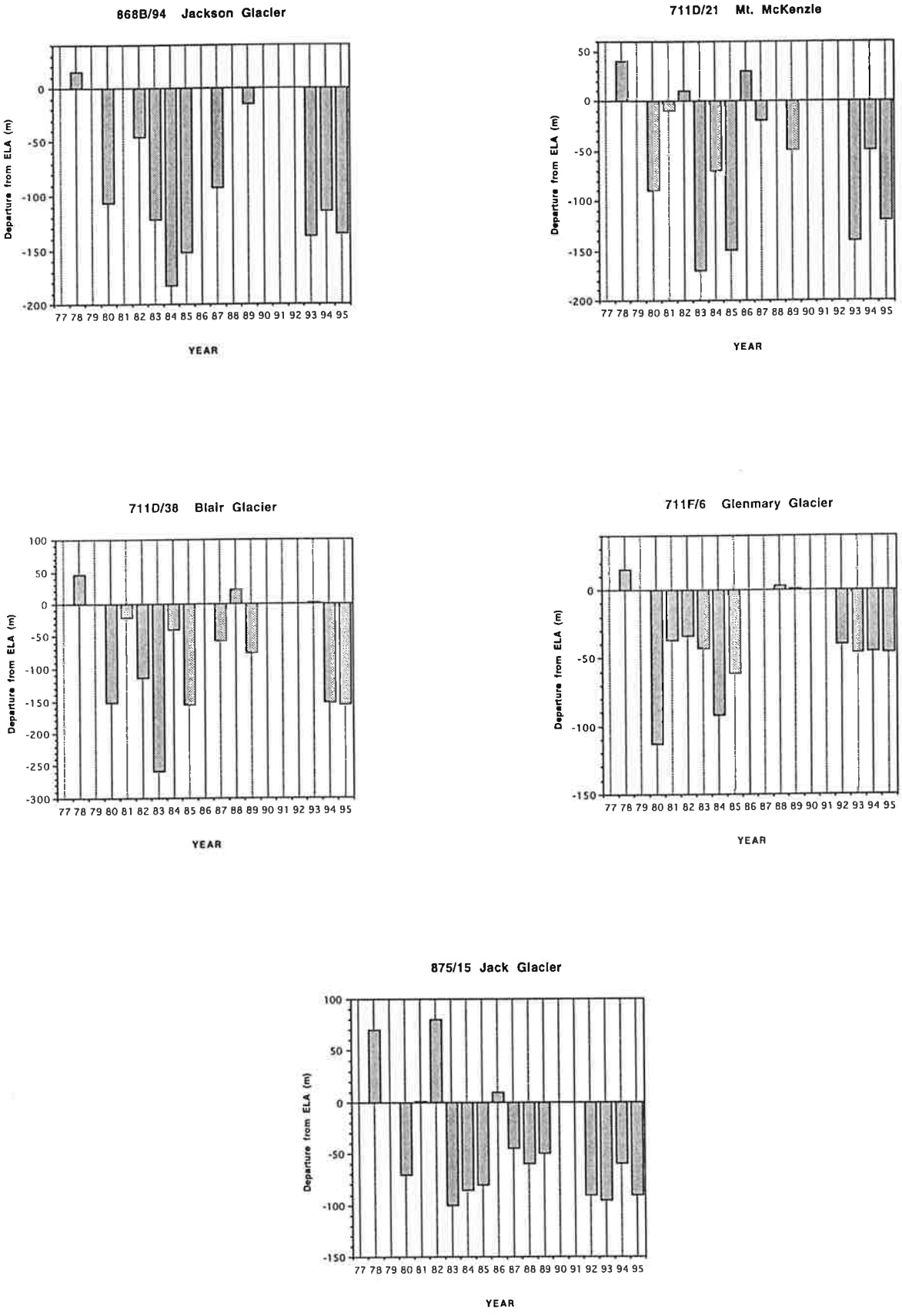


Figure 7. Snowline elevation departures from the estimated steady-state ELA values for each of the glaciers of Section 4. Missing values indicate years when the glacier was not surveyed.

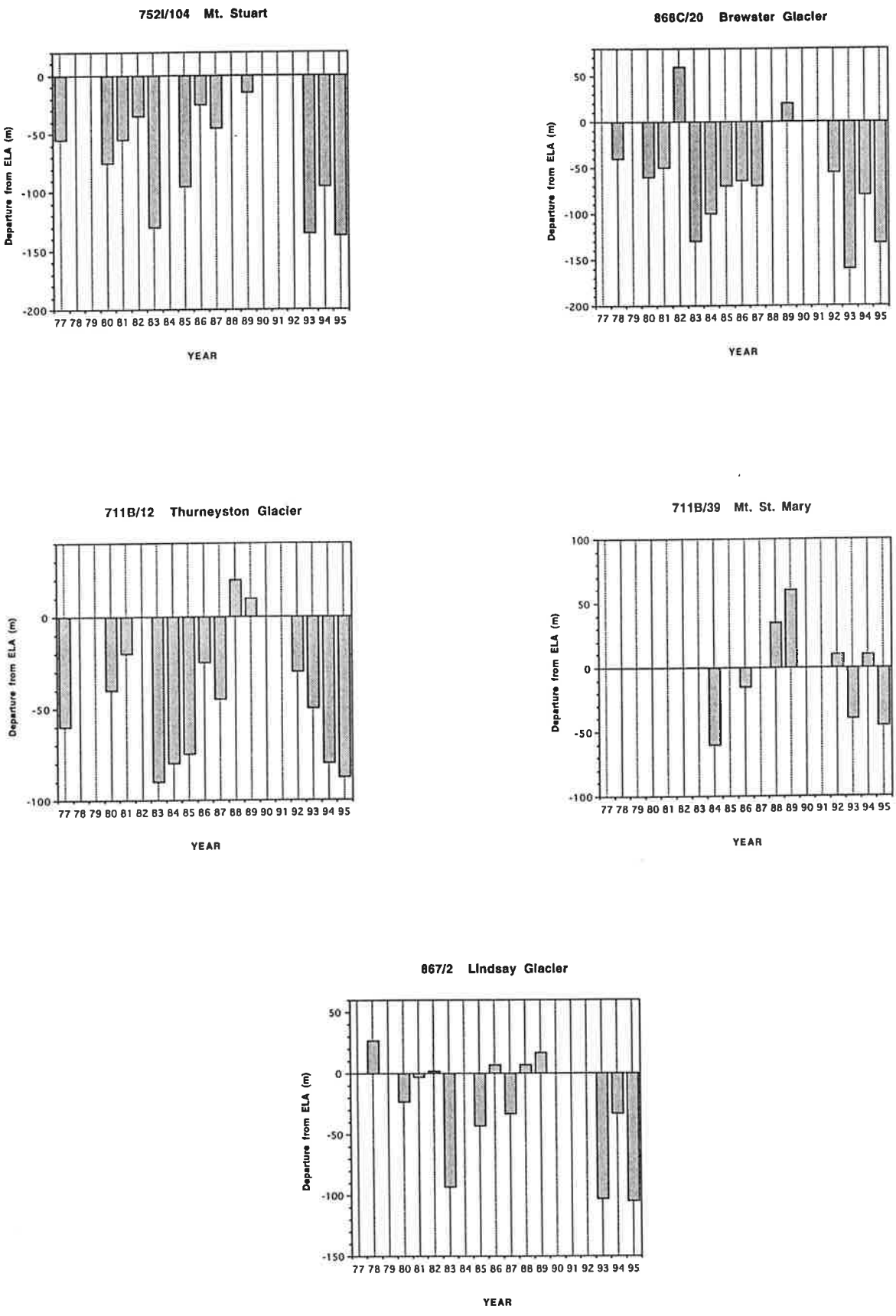
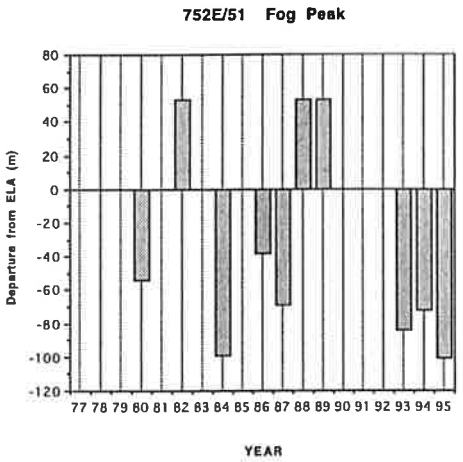
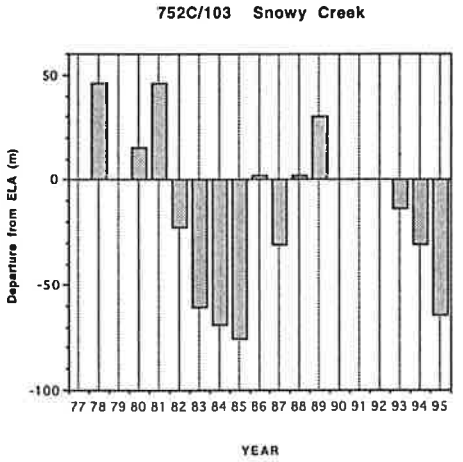
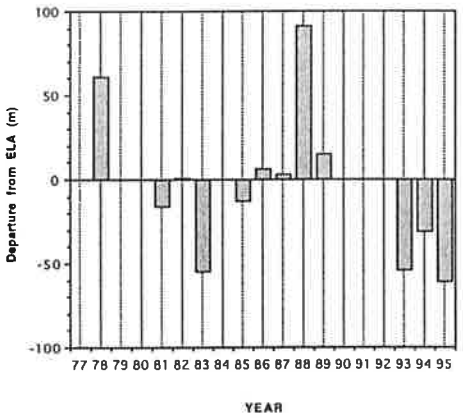
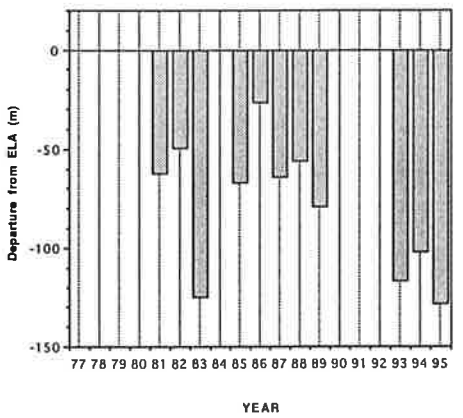


Figure 8. Snowline elevation departures from the estimated steady-state ELA values for each of the glaciers of Section 5. Missing values indicate years when the glacier was not surveyed.









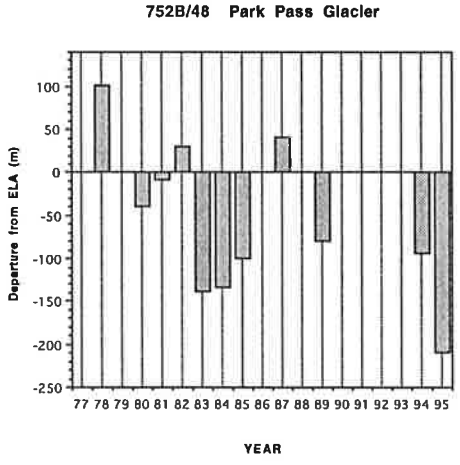


Figure 9. Snowline elevation departures from the estimated steady-state ELA values for each of the glaciers of Section 6. Missing values indicate years when the glacier was not surveyed.

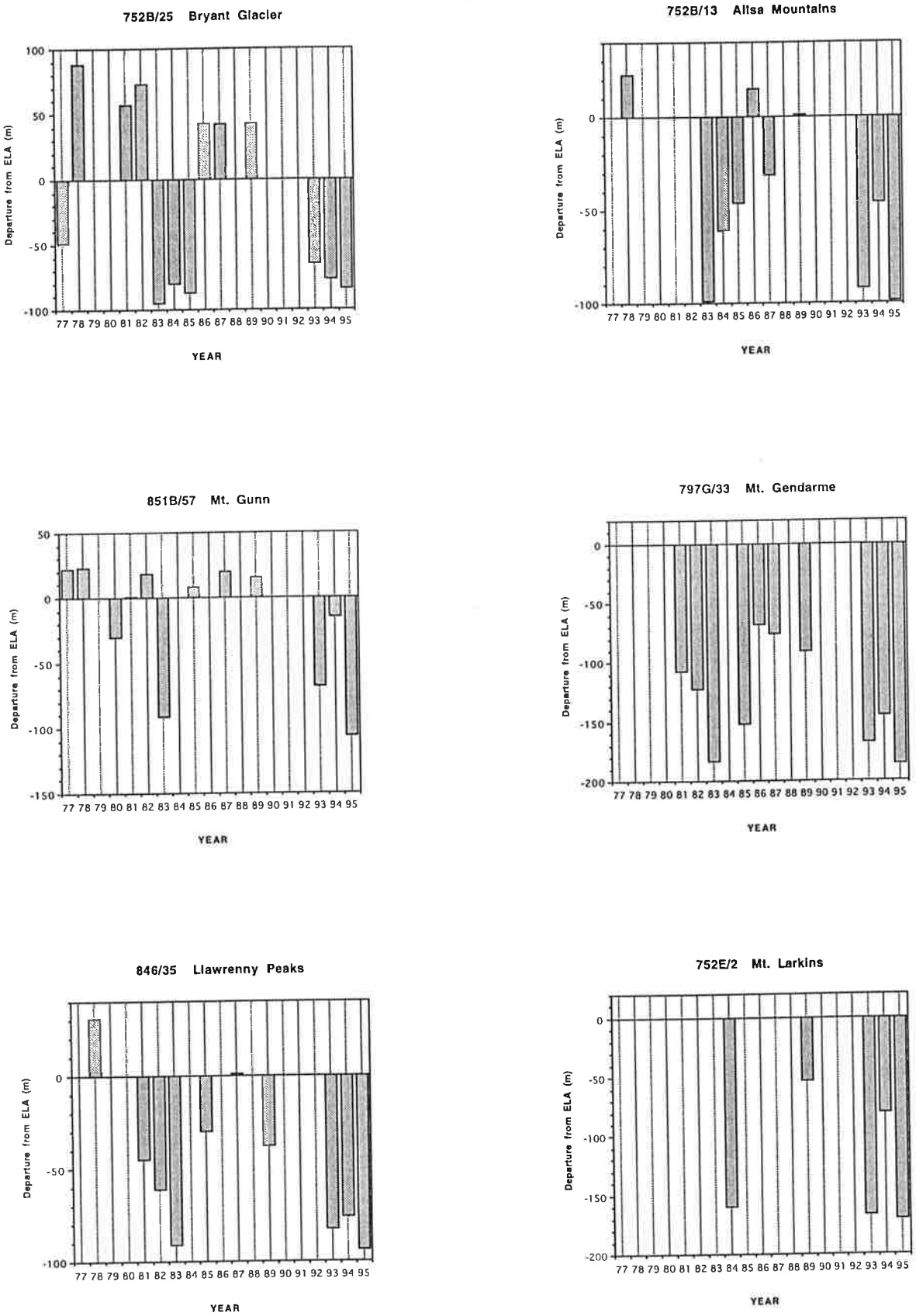


Figure 10. Snowline elevation departures from the estimated steady-state ELA values for each of the glaciers of Section 10. Missing values indicate years when the glacier was not surveyed.

SOUTHERN GLACIERS

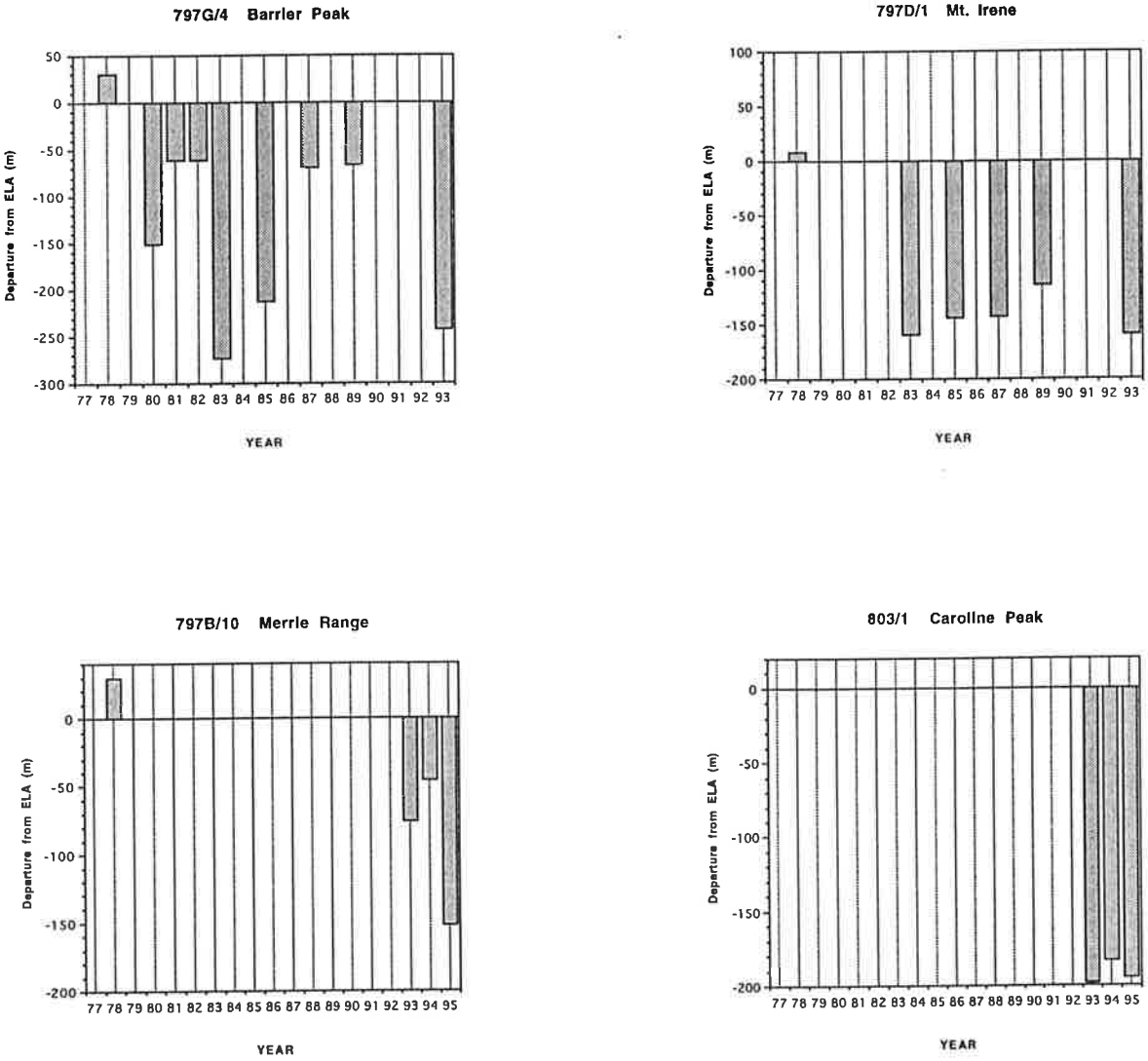
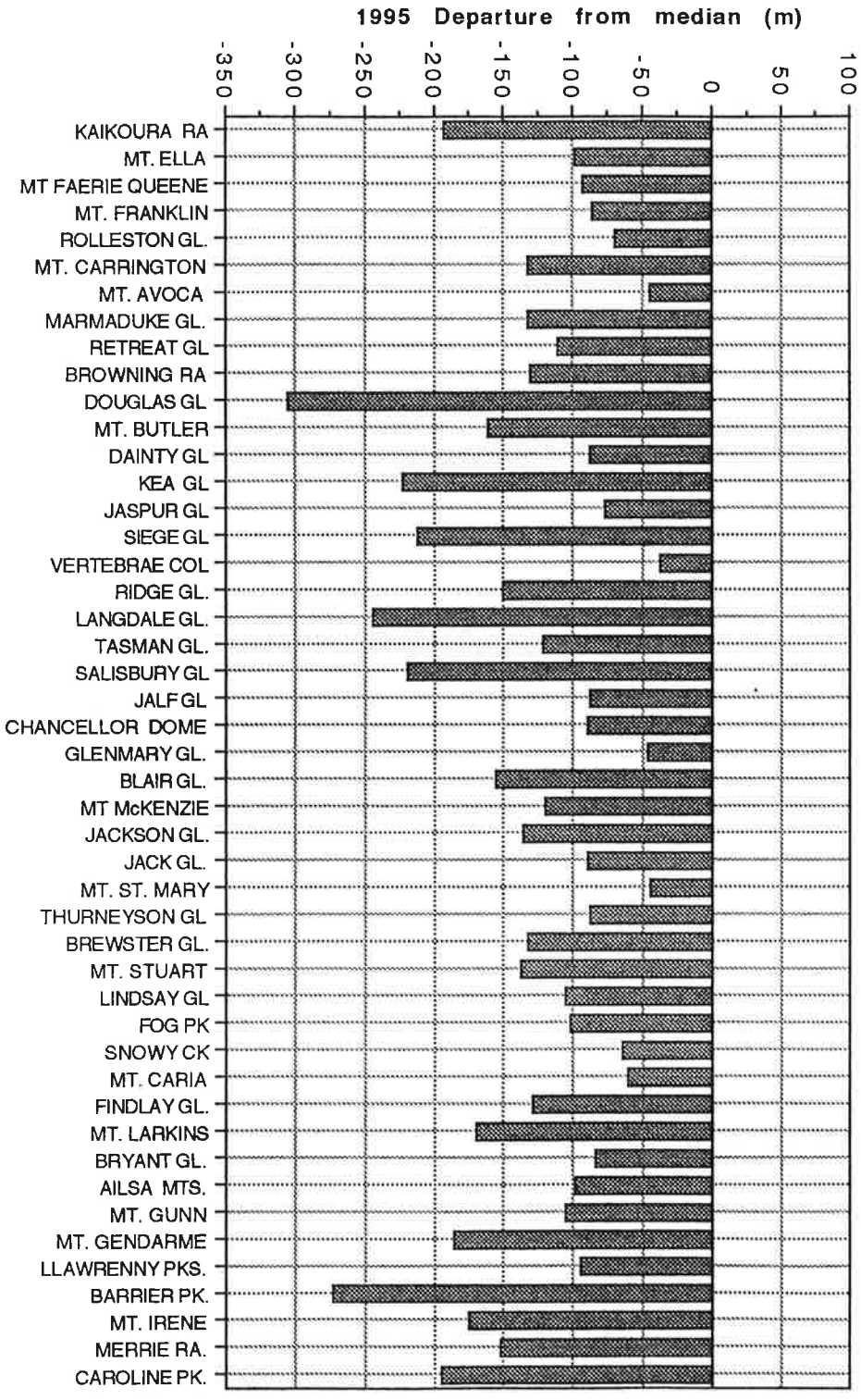


Figure 11. Snowline elevation departures from the estimated steady-state ELA values for each of the mid-south Fiordland glaciers. Missing values indicate years when the glacier was not surveyed.



1995 SNOWLINE ELEVATIONS

Figure 12. Summary of the 1995 snowline elevations

1995 SNOWLINE ELEVATION DEPARTURE FROM ELA

ON DIAGRAMMATIC DISTRIBUTION OF INDEX GLACIERS

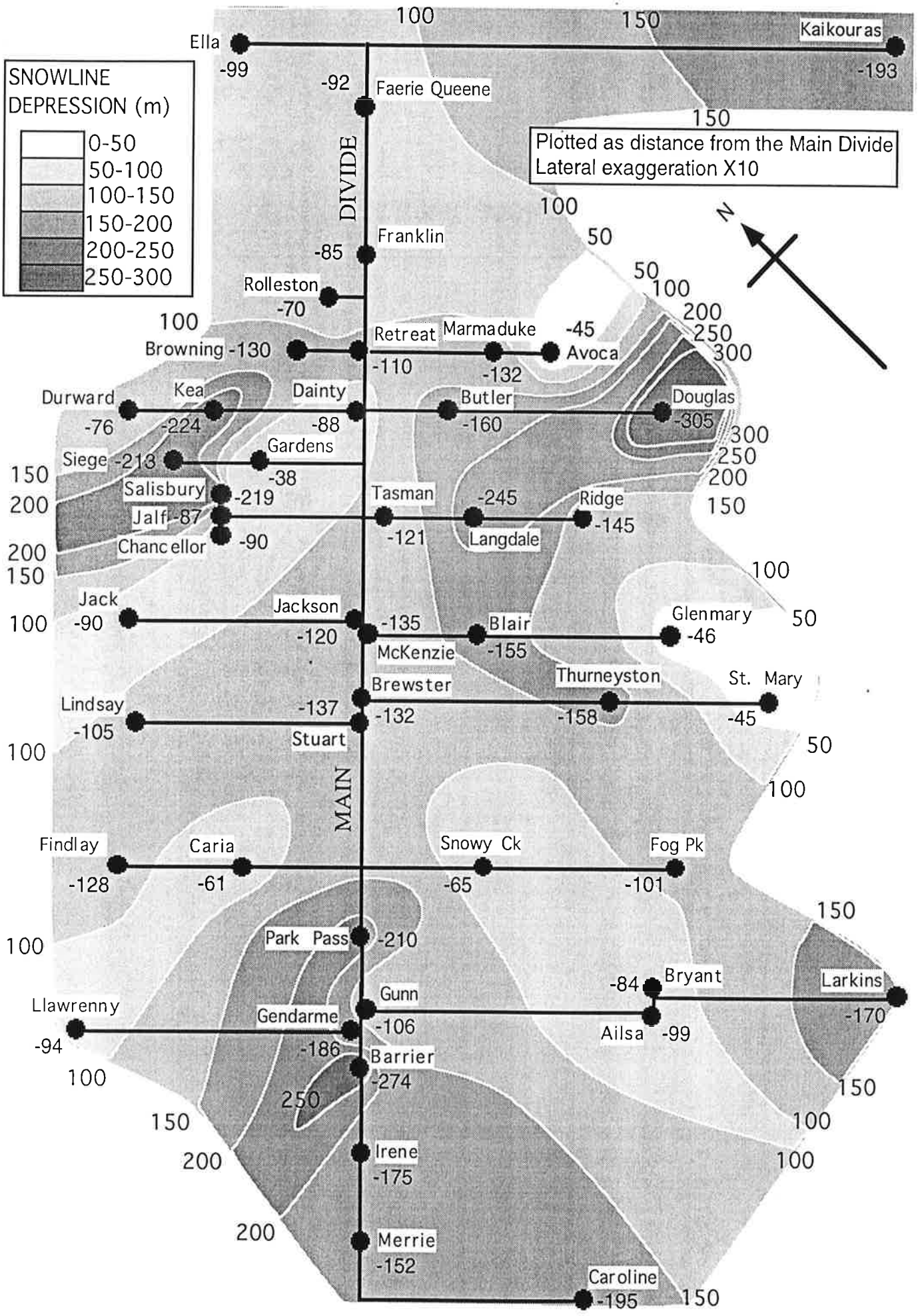


Figure 13. 1995 snowline elevation departures from the steady-state ELA.

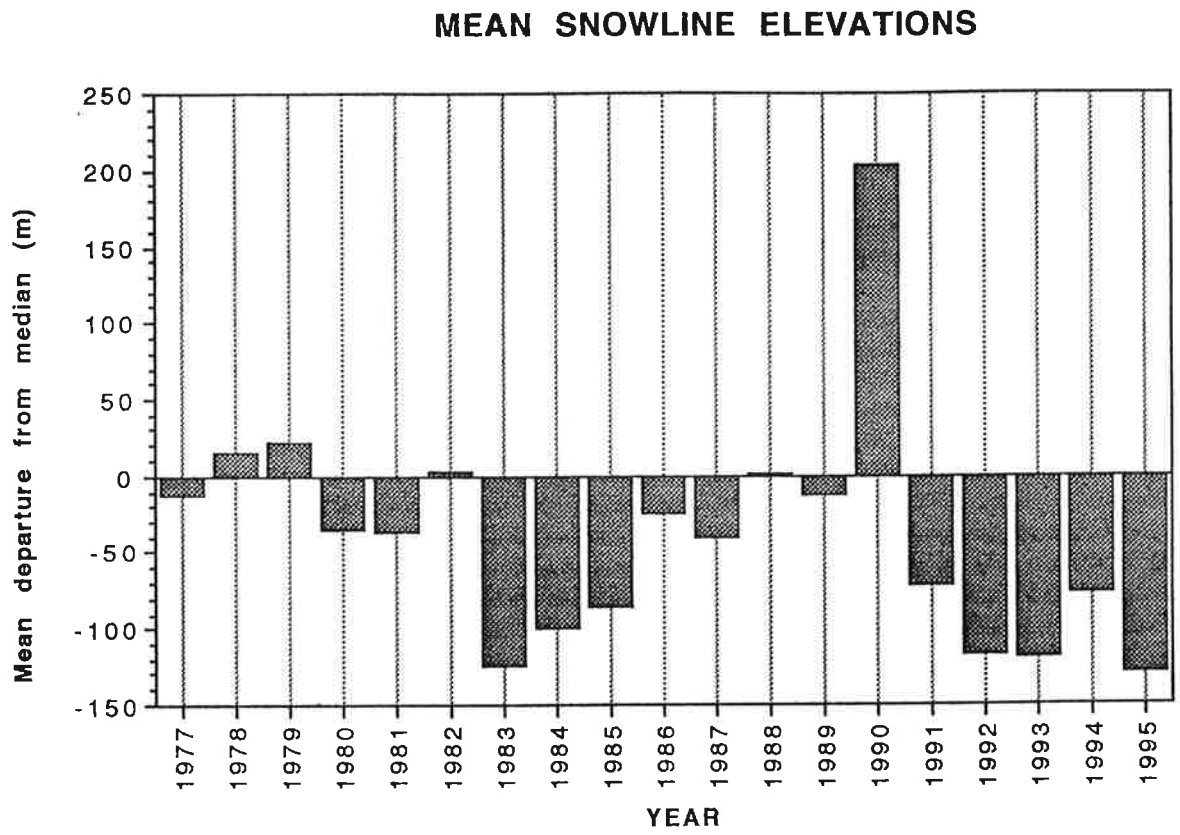


Figure 14. Annual variations from 1977 to 1995, of means of all surveyed snowline elevation departures from the steady-state ELA.