Lifetime of Halley: Risk of the Brunt Ice Shelf Calving

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1 Introduction

The Brunt Ice Shelf lies on the eastern edge of the Weddell Sea and is fed mainly by ice flowing from Dronning Maud Land. Stations have been permanently occupied since 1956 with the current station, Halley V (erected in 1990) located at approximately S75º 35’, W26º 36’ on the Brunt Ice Shelf. It is currently positioned about 8km from 1958 ice front (the earliest recorded reliable position) and will reach this in approximately 10 years. The last known calving event is predicted to have occurred around 1949, hence the 1958 position can be inferred to represent the position of the ice front following its most recent calving event.

2 The Calving Problem

The calving problem stems from two main mechanisms: crack extension and iceberg impact. Firstly, crack extension is primarily evident in the McDonald Ice Rumples with further risk at the hinge line/grounding zone and Precious Bay (Figure 1). At these locations extension may be sufficient to generate rifting instigating a potential calving event. Secondly, the risk of iceberg impact originates from Stancomb-Wills Ice Stream, a rapidly moving body of ice that has been extending for the last 50 years and is currently at its most advanced state. The potential break up of this ice front, poses the threat of collision with the front of the Brunt Ice Shelf and the likely break off of its nose. This threat is dependent on whether the thickness of the iceberg would allow drift or cause grounding. There is also a continuous supply of icebergs being transported in the strong coastal currents to the Brunt Ice Shelf posing further risk of collision.

3 The Risk: When and Where?

The risk of losing Halley to a calving event will increase as the station approaches and passes the location of the most recent calving front. This is assumed to have formed between 1949 and 1955, thus by the year 2009 there is a 50% probability of losing the station by calving. Uncertainties, however, still remain: For example, the mechanism responsible for the last calving event is unknown e.g., was it through natural rifting or iceberg collision prompted by the disintegration of Stancomb-Wills? In terms of where calving could occur, four risk zones have been identified (Figure 1). The McDonald Ice Rumples, hinge line/grounding zone and Precious Bay are regions where calving may occur through crack extension, whereas the disintegration of Stancomb-Wills could instigate calving through iceberg collision.

4 The monitoring system

At present a GPS network surrounding the Halley base station (Figure 1) has been established and baseline lengths are re-measured every 3 months. Any unusual change in baseline length could indicate the opening of a crack, thus providing necessary warning of a potential calving event. A continuous GPS system has also been established at the base station providing a means of obtaining both short term positioning and long term monitoring of the Brunt Ice Shelf. In the 2002/2003 field season expansion of the current GPS network will provide more detailed baseline monitoring, enhancing and improving the already established system. It is also intended to complete a Ground Penetrating Radar profile of the GPS network surrounding Halley providing subsurface imaging of structures and features within the ice shelf. Furthermore, an extensive seismic survey on the Brunt Ice Shelf will provide background information regarding water column thickness enabling the calculation of tidal currents. Finally testing of passive seismic equipment is aimed to develop a technique for detecting initial crack propagation through acoustic signals emitted by the fracturing ice.

5 Summary

In conclusion, there is an identified risk of the Brunt Ice Shelf calving and thus the potential loss of the Halley field station. This risk is increasing as the station approaches and passes the position of the last calving front with crack extension and iceberg collision as potential mechanisms. Four main risk zones have been identified (Figure 1) and a monitoring system established. Further seismic and radar surveys are to be completed in the 2002/2003 field season.

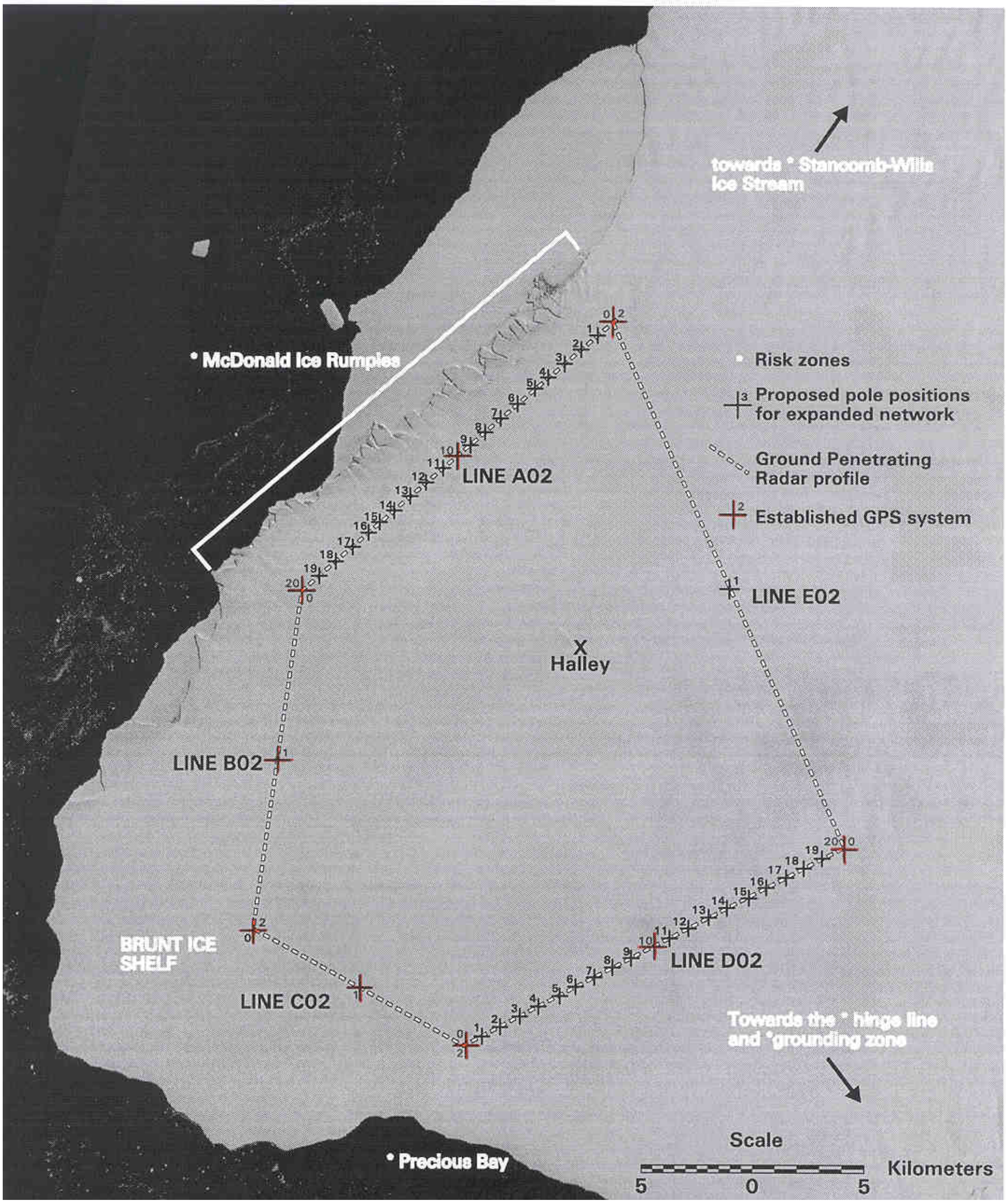

Figure 1: *Location of risk zones, GPS network and Ground Penetrating Radar profile.*