Study of Mill Island ice core (East Antarctica): A sensitive site for high resolution ocean climate signals?

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Mill Island (65° 30' S, 100° 40' E, see Figure 1) is a new ice core site, situated in East Antarctica. The location experiences high and consistent precipitation, making it the ideal site for producing high-resolution climate records from the southern hemisphere. The ice core was drilled to 120m during the 2009/10 field season. This study aims to retrieve detailed seasonality, particularly timing and delays. This new ice core record from Mill Island will be used to calibrate climate proxies against instrumental data, and to perform a regional comparison and synthesis with the established nearby Law Dome ice core proxies, e.g., the use of Methane Sulphonic Acid (MSA) as a proxy for regional sea-ice conditions (Curran et al., 2003); the use of sea salt as a proxy for wind strength (Goodwin et al., 2004).

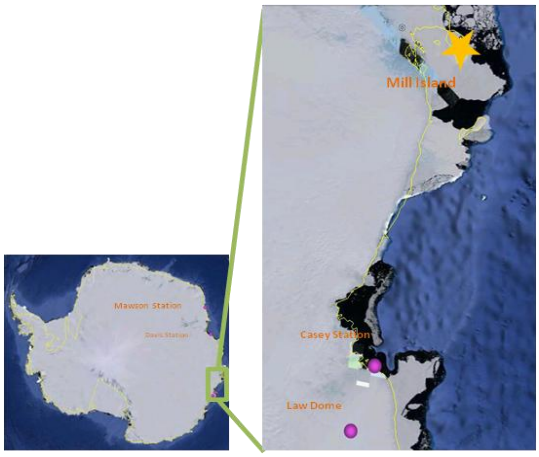

Fig 1. Location of Mill Island, East Antarctica.

As it stated in the International Panel on Climate Change (IPCC) Fourth Assessment Report (AR4, 2007), there are inadequate climate data in some regions of the world. This investigation of climate proxies from the Mill Island ice core will contribute to closing the knowledge gap in the southern hemisphere. This project will help to answer the key questions "what changes are occurring in the climate of Antarctica and the Southern Ocean?" and "what are the links between these changes and the global climate system?" (Figure 2).

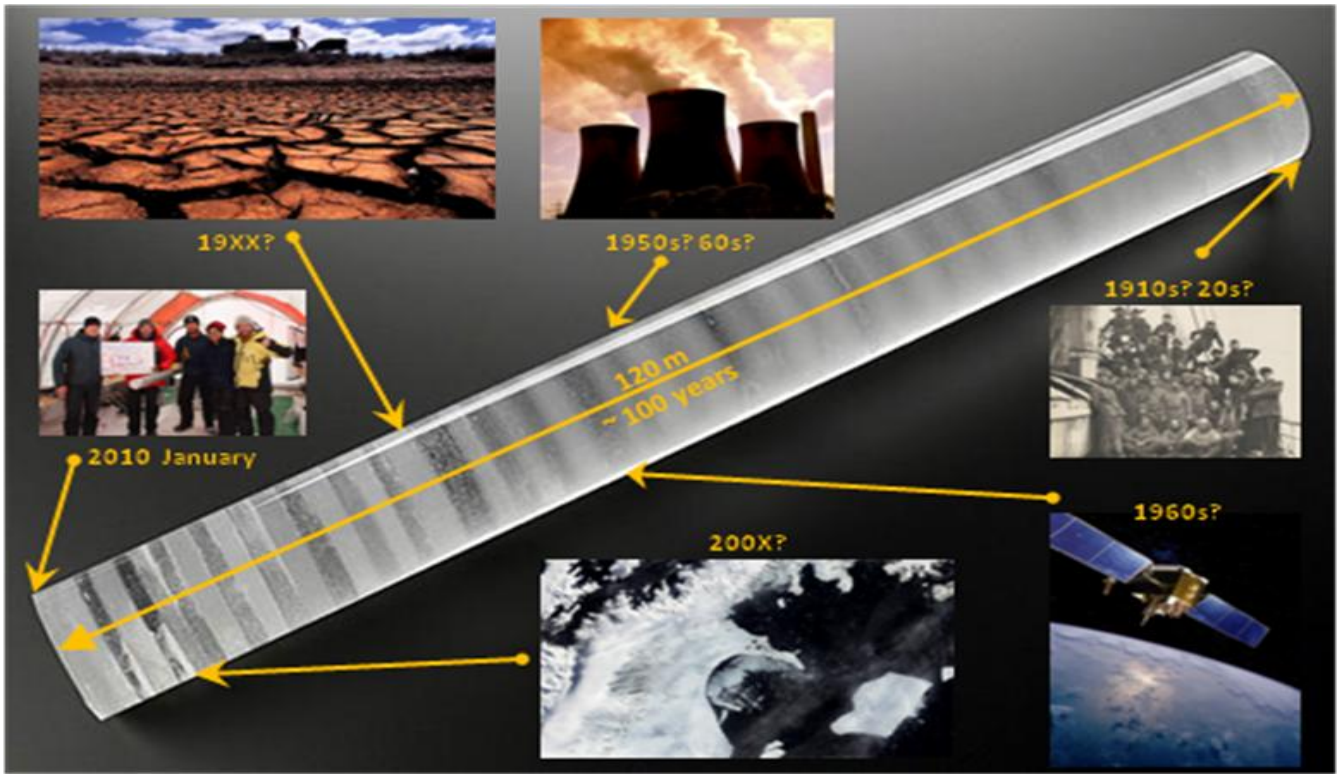

Fig 2. Schematic of the glaciochemical study of the Mill Island ice core records.

The following measurements have been completed, to date, for the top 10m of the ice core: Hydrogen peroxide (HOOH) using a fluorescence detector; trace ion chemistry using an ion chromatograph; and stable isotopes of oxygen and hydrogen using a mass spectrometer. Preliminary investigations from this short record reveal unique seasonality and timing of HOOH, MSA, sea salt, isotopes, and accumulation at this Mill Island site.

Mill Island has a particularly high snow accumulation rate (average 1.61 m ice equivalent accumulation during 2009) giving a high resolution record of trace chemical species. The record demonstrates high sea salt concentrations during the winters of 2006 and 2007, and low concentrations in 2008 and 2009 (Figure 3). The MSA profile shows clear seasonality with highest concentration during summer 2006/2007 (Figure 3).

Due to the lack of Automatic Weather Station (AWS) near Mill Island, this study uses forecast data provided by the Australian Polar Limited Area Predictive System (PolarLAPS) to compare with the ice core record. The climatological wind regime is persistently from east-southeast. Wind speed is generally higher during the austral autumn and winter (April to September). We propose that wind-driven transport from the ocean to the ice core site is a strong component of the sea salt ice core signal (in agreement with Goodwin et al., 2004). We will discuss similarity and differences of the weather features between 2006/07 and 2008/09.

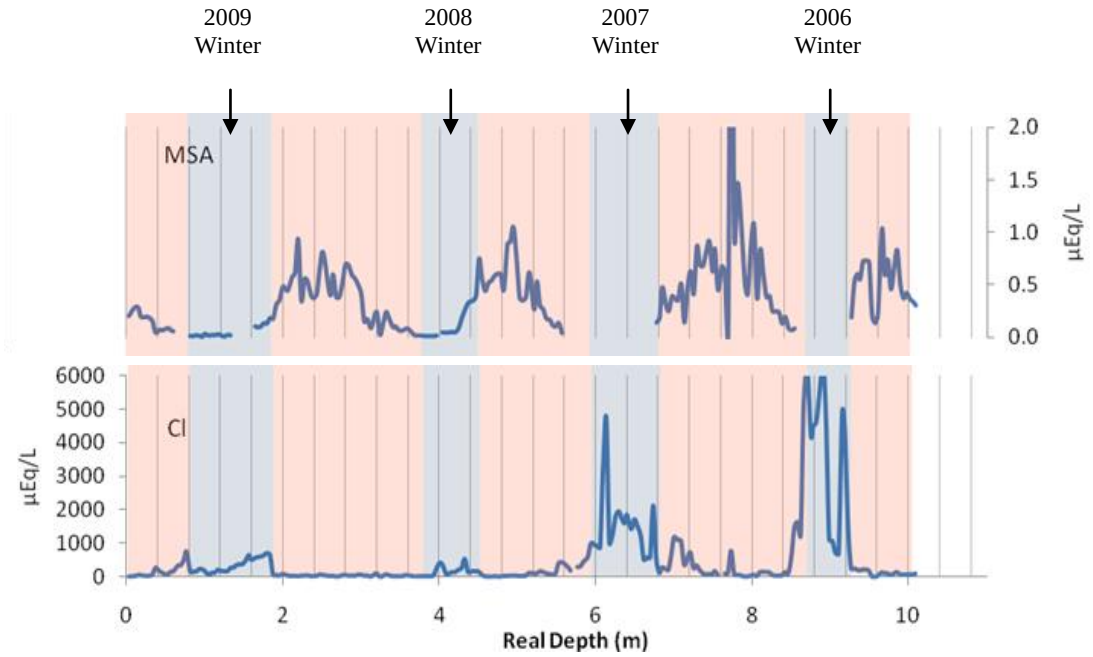

Fig 3. MSA and Cl profiles from the Mill Island PICO ice core record.

References

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IPCC (2007): Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, 104 pp.