



Agenda Item: ATCM 13

Presented by: SCAR

Original: English

Submitted: 14/03/2014

SCAR Lecture: "Back to the Future: Past Antarctic Climates, Ice Sheet History & Their Relevance for Understanding Future Trends"

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Polar ice is an important component of the modern climate system, affecting global sea level, ocean circulation, heat transport, marine productivity, and planetary albedo. Antarctica became glaciated ~34 million years ago whereas full scale, permanent Northern Hemisphere continental ice only began forming ~3 million years ago. The study of ice cores retrieved from the Antarctic ice cap has afforded major breakthroughs in understanding natural climate variability over the last 800,000 years, and offers insight into the future response of the Earth to anthropogenic forcing. However, the correlations between (i) the records of temperature, CO₂, and ice sheet volume (and equivalent sea level), and (ii) the mechanisms responsible for glacial-interglacial cycles (i.e., role of atmospheric CO₂) have not been yet fully elucidated.

With current rising atmospheric greenhouse gases resulting in rapidly increasing global temperatures (IPCC, 2013), studies of polar climates and ice sheet dynamics and stability are prominent on the research agenda. The lower values of forecasted atmospheric CO₂ and temperatures in the IPCC AR5 report (2013) for the end of this century have not been experienced on our Planet for over 5 million years (i.e. before the Arctic ice sheets formed), and the higher forecasted values since before the ice sheets in Antarctica formed. Antarctica and its margins are therefore the only place to retrieve the long-term records needed for a detailed understanding of how ice sheets responded to past climate forcings and how they might respond in the future.

The overarching goal of the SCAR PAIS (Past Antarctic Ice Sheet Dynamics) Scientific Research Programme is to improve confidence in predictions of ice sheet and sea level response to future climate change and ocean warming. For this, PAIS aims to improve understanding of the sensitivity of East, West, and Antarctic Peninsula Ice Sheets to a broad range of climatic and oceanic conditions. Study intervals span a range of timescales, including past “greenhouse” climates warmer than today, and times of more recent warming and ice sheet retreat during glacial terminations. The PAIS research is based on data-model integration and intercomparison, and the development of “ice-to-abyss” data transects, extending from the ice sheet interior to the deep sea. The data-transect concept will link ice core, ice sheet-proximal, offshore, and far-field records of past ice sheet behaviour and sea level, yielding an unprecedented view of past changes in ice sheet geometry, volume, and ice sheet-ocean interactions.