

The potential influence of Arctic freshwater fluxes on rapid climate change in the North Atlantic

Background

The Arctic has over the last 2-3 decades warmed more than other regions of the world, and the ice cover has decreased by ~10% (Johannessen *et al.* 1999; 2003). Climate models indicate that anthropogenic global warming will be enhanced in the northern high latitudes due to complex feedback mechanisms in the atmosphere–ocean–ice system (Bengtsson *et al.* 2003). The predicted warming in the Arctic over the next 50 years is of order 3-4°C, more than twice the global average, while the ice cover is predicted to reduce by ~40% during summer and ~10% during winter. By 2100 the Arctic Ocean is predicted to be “a blue ocean” during summer. This suggests that the Arctic may be where the most rapid and dramatic changes take place during the 21st century with major ramifications for mid latitude climate.

A major component in the high-latitude climate system is the oceanic flux of heat, freshwater and salt between the North Atlantic, Nordic Seas and Arctic Ocean (Oliver & Heywood 2003). These fluxes are investigated in the ASOF programme (ASOF 2002), that aims to implement the long term critical measurements needed to understand the high-latitude ocean’s steering role in decadal climate variability. There have been significant changes in ocean climate over the last decades, such as freshening of the deep North Atlantic Ocean (Dickson *et al.* 2002) and decreased deep overflow in the Faeroe Bank Channel (Hansen *et al.* 2001). This project will address a critical element of the fluxes, namely the freshwater fluxes between the Arctic Ocean and Nordic Seas. The project will bring together diverse observational data sets and model runs to provide a synthesis of the current and likely future role of freshwater in changing or maintaining the climate of Europe. Recent coupled climate simulations have indicated the critical importance of freshwater in slowing or halting the meridional overturning circulation (Vellinga & Wood 2002; Dong & Sutton 2002; Pardaens *et al.* 2003).

Objectives

The overall aim is to quantify the Arctic freshwater budget and fluxes to the Nordic Seas and assess the likelihood for changing Arctic freshwater budgets under IPCC climate change scenarios resulting in rapid climate change impacting on European climate. Specifically, our objectives are to:

- Compile, improve and update observational data sets of relevance for freshwater budgets (oceanography, sea ice, glaciers, river discharge) in the North Atlantic, Nordic Seas and Arctic Ocean.
- Improve and validate coupled ice-ocean models for large and regional scale fluxes of heat and freshwater as well as high-resolution models for process studies.
- Statistically analyse observational data and model simulations over the last 50 years for location and periods of TS and sea ice anomalies; quantify variabilities and trends in freshwater fluxes and budgets.
- Assess the capacity under IPCC forcing scenarios for freshwater induced rapid climate change in the North Atlantic.

References

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