

WEDNESDAY 19 FEBRUARY 2003: POLAR WEATHER AND GLOBAL CLIMATE

Grant Bigg: Polar lows and their impact on the North East Atlantic

Polar lows, or mesocyclones, have long been recognised as causing extreme weather events, with strong winds and heavy precipitation. However, it is not generally realised how ubiquitous these sub-synoptic cyclonic features are in the troposphere. Here we will see how widespread and numerous these events are over the NE Atlantic, and how strongly coupled their occurrence is to the large-scale atmospheric circulation by focusing on the extreme change in the Atlantic atmosphere associated with the switch from a strongly positive to strongly negative North Atlantic Oscillation Index during the mid-1990s. The large air-sea fluxes of polar mesocyclones, and their association with synoptic-scale features and the sea-ice edge, means that variation in their occurrence may be linked to changes in convection in the sub-polar ocean.

Ian Renfrew: Air-sea-ice interaction, north and south

In the polar regions, air-sea-ice interactions govern much of the local climate dynamics. At the poles, the ocean loses heat to the atmosphere and gains salt if sea ice is formed. These processes increase the density of the ocean and can cause it to sink - thus forming the overturning branch of the main oceanic thermohaline circulation. The processes are different in the North and in the South, but both play vital roles in the global ocean circulation, and thus the global climate system.

In the North, open ocean convection in the Greenland-Iceland-Norwegian Seas and the Labrador Sea is triggered by large air-sea heat fluxes during cold air outbreaks from Greenland and the Arctic ice pack, and from Labrador. Results from a recent international programme of research, The Labrador Sea Deep Convection Experiment, will be used to illustrate the state of knowledge regarding open ocean convection.

In the South, open ocean convection appears to be intermittent and shallow convection over the continental shelves seems to be the dominant trigger for the overturning process. Again cold air outbreaks over coastal polynyas and the coastal ocean take heat out of the ocean, which, if the ocean is at freezing point, leads to the formation of sea ice and the rejection of salt. The cold saline water mass becomes more dense and sinks, transforming through a number of pathways into Antarctic Bottom Water. Results from a recent study of air-sea heat fluxes and sea ice formation in coastal polynyas in the Weddell Sea will be presented.

Marc de Keyser: Weather forecasting for Antarctic operations

The work of an operational weather forecaster at Rothera Research Station is to produce specific weather forecasts for British Antarctic Survey operations. Aviation activities especially need a very precise and accurate prediction of the weather conditions. Aircraft in the Antarctic are often operating in marginal conditions concerning visibility, low clouds, gale force katabatic winds, horizontal definition and contrast. A major part of this talk will be spent to tackle the problem of fog and low stratus events on several locations of the Antarctic continent. However, in the first part of my presentation, I will highlight my personal motivation and explain why I twice spent five months as a meteorologist in

the Antarctic. I will also describe the daily routine at the base and the information used to make an Antarctic weather forecast.

Michiel van den Broeke: The southern annular mode and Antarctic climate

The interaction of the large scale circulation with the near-surface climate is not simple in Antarctica, because the Antarctic surface layer is characterised by strong horizontal and vertical temperature gradients and persistent katabatic winds. In this presentation we describe Antarctic surface temperature changes in response to the Antarctic Oscillation (AAO). The AAO represents in essence temporal variability in the strength of the Southern Hemisphere polar vortex. During conditions of AAO positive polarity (strong large scale westerly circulation), an eastward shift occurs in the position of the south Atlantic storm centre. This cuts off the atmospheric branch of the Weddell Gyre, causing surface temperatures in the Weddell Sea and over the Antarctic Peninsula to rise by up to 8 K. On the other hand, a cooling of up to 5 K occurs locally in East Antarctica in places where near-surface easterly winds have decreased over the perennial ice. The temperature response is amplified over the flat ice shelves, which has important implications for the viability of the Antarctic Peninsula ice shelves.

John Turner: Climate variability and change in the Antarctic Peninsula

Over the last 50 years annual mean near-surface air temperatures on the western side of the Antarctic Peninsula have risen by up to 3 dec C - the largest temperature increase in the Southern Hemisphere. This has taken place in parallel with changes in the flora and fauna of the region and the disintegration of a number of floating ice shelves. The warming is largest in the winter season and is confined to the lowest layers of the atmosphere. Around the Peninsula there is a close coupling between the atmospheric circulation, sea ice extent and oceanic conditions that allows feedback mechanisms to amplify small signals of change.

Mike Bentley: Reconstructing past climates in the Antarctic Peninsula

Reconstructing past climate change has been attempted from analysis of ocean sediments, ice, lake sediments, moss and peat accumulations, glacial moraines and raised marine features. A reasonably consistent picture of climate change through the last several thousand years is emerging from these proxy records. We can now estimate the configuration of the ice sheet at the Last Glacial Maximum and demonstrate a number of changes in ice extent and climate since then. The main features of this are: warming and ice retreat following the end of the last glaciation, a mid-Holocene warm period (c. 2000-4000 years ago) and pre-20th Century cooling. One marine record also shows a striking cyclicity of climate change from prominent cycles in marine productivity. A number of challenges remain, most notably improving the dating of proxy records, extending the spatial resolution (especially to the east side of the Antarctic Peninsula), better links with modellers, and understanding the mechanisms of regional climate change.