PROJECT TITLE

Extreme sea ice years in the Antarctic

PROJECT DESCRIPTION

The goal of this project is to explain why Antarctic sea ice extent reached extreme levels at several points during the satellite record spanning the last 40 years. The extent of sea ice that rings the Antarctic continent has a very large annual cycle, ranging from 3 million square kilometres in February to over 19 million square kilometres at its maximum in September. Although much of the ice is less than 1 metre thick, it has a profound effect on many aspects of the Antarctic environment, including the ocean circulation, marine ecosystems, and the transfer of gases such as CO2 at the ocean/atmosphere interface. The extent of the ice can also heavily impact BAS ship operations, especially the resupply of our Antarctic stations during Southern Hemisphere summer. The inter-annual variability of Antarctic sea ice extent is large and there have been a number of years of very large positive and negative sea ice anomalies, both regionally and hemisphere-wide over the last 40 years. Some recent regional anomalies (such as in the Weddell Sea in 2016/17) have been linked to deep storms at critical times in the annual cycle of sea ice growth or melt. However, to date there have not been any studies examining the atmospheric conditions that led to large ice anomalies earlier in the satellite era; this project will aim to fill this gap. We will use the NASA records of daily sea ice extent, area and concentration starting in 1979 derived from passive microwave instruments on the polar orbiting satellites. The availability of daily fields of sea ice parameters at a horizontal resolution of 20 km allows the detailed evolution of sea ice anomalies to be examined. The atmospheric conditions will be obtained from the European Centre for Medium-range Weather Forecasts (ECMWF) ERA5 reanalysis, which provides hourly data since 1979 on critical atmospheric parameters that are important in sea ice growth and melt, such as the near surface wind speed and direction, and near-surface temperature. The project will focus particularly on the role of individual spring and summer storms in ice melt episodes that lead to the establishment of large negative sea ice anomalies. The importance of the timing of severe storms will be examined in the persistence of negative anomalies. We will also examine the role of storms close to the sea ice maximum in September when strong southern flow of cold air can create large positive ice anomalies

SUGGESTED LENGTH – 8 weeks

JOB DESCRIPTION

The successful candidate will learn about the nature and variability of Antarctic sea ice using our web-based interface that allows the display of sea ice concentration on selected days for the Southern Ocean as a whole and individual sectors around the continent. This system can also display critical atmospheric data, such as the mean sea level pressure and near-surface wind field. The daily NASA sea ice extent and area data are held in Excel spreadsheets and these will be used to identify the extreme sea ice years for the Antarctic as a whole and selected sectors of the Southern Ocean. The data will also allow the temporal evolution of the ice anomalies to be computed in the periods leading up to the extremes. Individual case studies will be examined using the web-based system that gives access to the atmospheric fields. The successful candidate with be managed and mentored by Prof John Turner and Dr Caroline Holmes who have extensive experience in sea ice research and linking sea ice variability to atmospheric conditions. The early career scientist (ECS) will be a member of the Polar Climate and Prediction (PCAP) group and will take part in the monthly meetings of PCAP. This will give

the ECS experience of how science is planned and evolves within an active and dynamic research group. There is extensive scope for the ECS to suggest how the research should evolve as many factors play a part in sea ice variability. The project will show the complexity of high latitude climate change and the interactions between the atmosphere, ocean and ice, and the links between Antarctic sea ice and the rest of the Earth system.

WHAT ARE WE LOOKING FOR?

Experience of using Excel spreadsheets is essential. It would be very useful if the applicant had experience of programming in Python or Matlab, numerical analysis and statistical methods. Knowledge of graphics using Python or Matlab would also be valuable