By ice floe to the North Pole

July 20 2007

Jürgen Graeser with a tethered ballon for atmspheric measurements at the AWIPEV research Base. Photo: Heiko Gericke/Alfred Wegener Institute

At the end of August, an unusual expedition under Russian leadership will leave for the Arctic Ocean.

One of the participants is Jürgen Graeser of the Alfred Wegener Institute for Polar and Marine Research, one of the research centres of the Helmholtz Association. For the first time in the history of Russian research using drifting stations, a German researcher will take part in the North Pole drifting station NP-35. With his data recordings of the atmosphere, Graeser will supplement measurements carried out by the Russian project partners, who will be focusing their investigations on sea ice, primarily performing measurements close to the ice. Through this collaboration, the project partners intend to advance the currently patchy

data situation in the Arctic and hope to gain a better understanding of these key regions for global climate change.

Experience with regular Russian drifting stations in the pack ice dates back to 1952 when the research station NP-2 was launched. Whereas previous drifting stations were dedicated exclusively to Russian research, the international station planned within the framework of the International Polar Year will, for the first time, include a German participant of the Alfred Wegener Institute, Jürgen Graeser. The planned project will be carried out in conjunction with the Arctic and Antarctic Research Institute (AARI) in St Petersburg. On August 29, 2007, a total of 36 expedition participants will board the Russian research vessel 'Akademik Fedorov' in the Siberian harbour of Tiksi. In the vicinity of Wrangel Island, i.e. between 80 and 85 degrees northern latitude and between 170 degrees eastern and 170 degrees western longitude, a stable ice floe will be chosen as the base for the drifting station 'North Pole 35' (NP-35). The selection will be based on long-term satellite observations of the ice and will be verified by helicopter from the research vessel.

During the course of winter, the ice floe will drift in the Arctic Ocean and across the North Pole. During the drift, a variety of measurements carried out at the station will provide information about current climate change. The 'Akademik Fedorov' is scheduled to evacuate the station after approximately one year. With regard to over-wintering personnel, it is planned to use 'Polar 5', the research aircraft of the Alfred Wegener Institute, to fly out Jürgen Graeser and five Russian colleagues after approximately eight months, in April 2008. For this purpose, a landing strip will be constructed on the ice.

The Russian colleagues will be investigating the upper ocean layer and sea ice, as well as snow cover. Atmospheric measurements of meteorological parameters such as temperature, wind, humidity and air pressure, will be added through recordings of trace gases such as carbon

dioxide and ozone. Jürgen Graeser will examine two topics. On the one hand, he will use a captive balloon system to measure meteorological parameters in the so-called planetary boundary layer, which is the lowest layer of the atmosphere extending to approximately 1500 metres. In addition, he will use ozone sensors to measure the ozone layer in the stratosphere up to approximately 30 kilometres altitude.

Jürgen Graeser has been a technician at the research unit Potsdam of the Alfred Wegener Institute and has many years of experience with Arctic and Antarctic expeditions. His special areas of interest are aerology and meteorology. His expertise includes balloon-based, radiation and meteorological measurements.

The Arctic represents a key region for global climate change. Measurements of sea ice and atmospheric parameters in the Arctic Ocean are still incomplete. Through the current project, researchers intend to identify key processes in the atmosphere and alterations of the sea ice cover in order to examine the coupling of sea ice and atmosphere. The project is one of many during the International Polar Year. More than 50,000 scientists and technical staff from over 60 countries are joining force to explore the polar regions. Their goal is to study the role of the Arctic and Antarctic in shaping the climate and the earth's ecosystems.

The planetary boundary layer (PBL) identifies the lowest atmospheric layer, extending from the surface to approximately 1500 metres altitude. In the Arctic, this layer is characterised by frequent temperature inversions, i.e. by very stable atmospheric stratification which suppresses vertical movements of the air. A realistic representation of the planetary boundary layer is crucial for the construction of climate models, as it is this layer that determines the lower marginal conditions for all calculations. Particularly, the investigation of processes influenced directly by the boundary layer, requires exact knowledge of the state of

the PBL.

AWI scientists in Potsdam use the regional climate model HIRHAM to construct mesoscale fields of pressure, temperature and wind in which cyclones (low pressure regions) and their trajectories are identified. Specifically, they are examining the relationship between cyclone development and various surface conditions (e.g. sea ice cover). Elucidating the connection between the Arctic planetary boundary layer and mesoscale cyclones and their trajectories is the goal of these investigations.

Discovery of the Antarctic ozone hole in 1985 triggered intensive exploration efforts of the polar ozone layer. This layer is located between 15 and 25 kilometres altitude in the stratosphere. Many chemical processes of ozone depletion in the Antarctic have since been explained, and the connection of ozone destruction with anthropogenic emissions of chlorofluorocarbons (CFCs) and halons has been proven beyond doubt.

During specific winters, severe ozone losses over the Arctic, and hence much closer to home, have already contributed to a reduction in ozone layer thickness over Europe – leading to an increase of harmful ultraviolet radiation on the earth's surface. However, to date the ozone depletion in the Arctic is not as pronounced as over the Antarctic. Compared to the Arctic, ozone layer thickness in the Antarctic is much more variable, with only about half of the observed inter-annual variability explained by known chemical mechanisms. Hence, dynamic processes which remain only partly understood are equally important in determining thickness of the ozone layer over the Arctic as the chemical decomposition of ozone.

At the Arctic station of the Alfred Wegener Institute in Ny Ålesund on Spitsbergen (79°N), for instance, a strong annual ozone variation of 30

percent was detected at an altitude of 25 to 30 kilometres. Apparently, it is synchronised with variability of the sun, but cannot be explained by known chemical or other dynamic processes. Investigating the cause of this variability will be the focus of ozone measurements at NP-35. Data records from the drifting station will, for the first time, produce high resolution vertical profiles of ozone distribution in the central Arctic, north of 82 degrees latitude – currently a blank spot on the global ozone distribution map. These unique data will be combined with existing ozone profiles from the Arctic and Sub-Arctic. Calculations of air movement in conjunction with chemical models will contribute to an understanding of seasonal and annual variability of stratospheric ozone in the Arctic.

Source: Alfred Wegener Institute for Polar and Marine Research