

James Scourse² (44 (0)1248 382876; j.scourse@bangor.ac.uk)

¹DGO, UMR CNRS 5805, Université Bordeaux 1 Av. des facultés, Talence 33405, France

²School of Ocean Sciences, University of Wales (Bangor) Menai Bridge, Anglesey LL59 5EY, United Kingdom

High resolution paleoclimatic and paleoceanographic studies have shown that the orbital forcing may not have been the only control on ice sheet growth and decay (e.g. Heinrich events), then suggesting major feedback mechanisms implying both the atmosphere, the cryosphere, the oceans and the biosphere. Global climate modeling is one of the best methods of investigating these mechanisms and models of intermediate complexity have furnished a lot of robust hypothesis. Nevertheless, ice-sheets usually considered into these models are often classically resumed to massive polar ice-caps, following the pattern of those that were developed among large continental areas during glacial maxima. Until now, few simulations have tested the impact and the sensitivity of the response of small-sized and medium latitude ice-sheets. These ice-sheets, such as for example, the British and Irish ice-sheets in western Europe, constitute however the more reactive part of the larger ice-caps, especially during periods of deglaciation while minor environmental changes could act drastically versus the global ice-sheet evolution. During Glacial Maxima of the four last climatic cycles, western European palaeoenvironments were characterized by low-stands of sea-level, then allowed the emersion of the Channel. The majority of the great north-western European merged into one unique drainage system, the "Channel River system". This palaeoriver would have been the convergence point of the melt-waters coming from the European glaciers (Alps), the British/Irish ice-sheet, and as well as, in part, from the Pennoscandian ice-sheet. Here we will present data from five hemipelagic cores retrieved on the Celtic margin which was directly connected to the Channel palaeoriver during low-stands of sea-level. These cores all display a typical laminated sedimentological facies during at least one period of the four last glacial Terminations. Very high sedimentation rates, together with geochemical and micropaleontological evidences suggest massive local iceberg decay during the final step of the deglacial processes. Such a recurrent phenomenon, that furthermore seems to involve seasonal mechanisms, could help us to understand the modality and the timing of ice-sheet melting during these key periods that glacial/interglacial shifts are.

GC14A CC: 524 C Monday 1530h

Northern Climate Properties, Trends, and Impacts of Change: Past, Present, and Future I

Presiding: A P Trishchenko, Natural Resources Canada; H Leighton, McGill University; K Szeto, Meteorological Service of Canada

GC14A-01 1530h INVITED

Global warming and abrupt climate change

Andrew J Weaver¹ ((250) 472-4001; weaver@uvic.ca)

Claude Hillaire-Marcel² ((514) 987-4630; chm@uqam.ca)

¹University of Victoria, School of Earth and Ocean Sciences University of Victoria PO Box 3055, Victoria, BC V8W3P6, Canada

²UQAM, GEOTOP, UQAM C.P. 8888, Montreal, PQ H3C 3P8, Canada

Despite recent the recent IPCC (2001) assessment that "Most models show weakening of the Northern Hemisphere Thermohaline Circulation (THC), which contributes to a reduction of surface warming in the northern North Atlantic. Even in models where the THC weakens, there is still a warming over Europe due to increased greenhouse gases." there is still a widespread misunderstanding of the possible consequence of climate change on the Atlantic Ocean Meridional Overturning. In particular, it is often touted, especially in the media that a possible consequence of anthropogenic greenhouse gas emissions is: "Global warming will cause the onset of the next ice age". Here we document the history from where this misconception arose and quantitatively show how it is impossible for an ice age to ensue as a consequence of global warming. Through analysis of the paleoclimate record as well as a number of climate model simulations, we also suggest that it is very unlikely that the Atlantic Meridional Overturning will cease to be active in the near future. We further suggest that a region where intermediate water formation may shut down is in the Labrador Sea,

although this has more minor consequences for climate than if deep water formation in the Nordic Seas were to cease.

GC14A-02 1545h

The Response of the Canadian Arctic Cryosphere to the Extreme Warm Summer of 1998

Ross D. Brown¹ ((514) 421-4772; ross.brown@ec.gc.ca)

David E. Atkinson² ((902) 426-0652; datkinso@nrcan.gc.ca)

Bea T. Alt³ ((613) 822-2562; bea.alt@sympatico.ca)

¹Meteorological Service of Canada, 2121 Trans Canada Highway, Dorval, QC H9P 1J3, Canada

²Geological Survey of Canada (Atlantic), Bedford Institute of Oceanography 1 Challenger Drive P.O. Box 1006, Dartmouth, NS B2Y 4A2, Canada

³Balanced Environments Associates, 5034 Leitrim Road, Carlsbad Springs, ON K0A 1K0, Canada

1998 was the warmest year on record in Canada (and globally) with extensive summer warming over the Canadian Arctic. A collaborative project involving three Canadian federal government departments, nine Canadian universities, and the private sector, examined the effects of this unusual warmth on snow, ice and permafrost conditions, to document the responses, and to place these in a 30-40 year context. 1998 was characterized by an extended melt season which generated extremes (in various regions) of thaw penetration, snow-free season, lake-ice-free season, glacier melt, and the duration and extent of open water. Synoptic events and preconditioning were observed to play an important role in the response of the Arctic cryosphere to warming episodes. The study also provided an opportunity to assess the capability of current cryospheric monitoring networks in the Canadian Arctic.

GC14A-03 1600h

Atmospheric Energy Budget for Northwestern Canada

Kit Kong Szeto (416-739-4889; Kit.Szeto@ec.gc.ca)

CRB, Meteorological Service of Canada, 4905 Dufferin Street, Downsview, ON M3H5T4, Canada

The Mackenzie River Basin in Northern Canada is characterized by strong interannual variability of cold season low-level atmospheric temperatures. In addition, some of the strongest warming signals in the Northern Hemisphere have been observed over the basin. To understand the nature of these observed thermal behaviors of the basin, the atmospheric enthalpy budget for the basin was studied with the NCEP reanalysis dataset. Processes responsible for the development of extreme warm/cold winters over the basin are investigated by examining both the atmospheric heat budget and large-scale atmospheric conditions associated with the anomalous winters within the study period. Based on the results of this study, a conceptual model summarizing the mechanisms governing the basin's thermal response to changes in large-scale conditions was developed. Application of the conceptual model to understanding the cold season temperature bias in regional climate modeling results for the basin will also be discussed.

GC14A-04 1615h

Mid-tropospheric Temperature Regulation During the Arctic Winter

Maria A Tsukernik^{1,2} (303-492-6115; tsukerni@colorado.edu)

Thomas N Chase² (tchase@cires.colorado.edu)

Mark C Serreze¹ (serreze@kryos.colorado.edu)

¹National Snow and Ice Data Center (NSIDC), University of Colorado UCB 449, Boulder, CO 80309, United States

²Cooperative Center for Research in Environmental Science (CIRES), University of Colorado UCB 216, Boulder, CO 80309, United States

Observations indicate a minimum mid-troposphere Arctic winter temperature of about -45°C at 500 hPa. This minimum temperature coincides with that predicted for moist adiabatic ascent over a sea surface near its salinity-adjusted freezing point. NCAR/NCEP Reanalysis data show that convective heating maxima averaged over the 50-70°N latitude band coincide both in longitude and altitude with total horizontal energy flux maxima entering the Arctic, indicating the significance of convection over open water on the winter Arctic energy budget. NCAR CCM single column model experiments simulating convective warming of a cold

airmass moving over open water and radiative cooling as it moves again over cold land/sea ice support the hypothesis that the -45°C threshold can be maintained for 10-14 days after convective warming occurs. We speculate on the implications of this regulatory mechanism on surface temperatures.

GC14A-05 1630h

Northern Climate and Thermohaline Circulation Interactions

Zhaomin Wang ((514)398-7448; wangz@zephyr.meteo.mcgill.ca)

McGill University, 805 Sherbrooke Street West Dept. of Atmos. and Oceanic Sci., Montreal, QC H3A 2K6, Canada

An updated version of the McGill Paleoclimate Model, with the inclusion of simplified polar regions and atmospheric dynamics to calculate surface winds, is employed to study interactions between the northern climate and the thermohaline circulation (THC). By gradually adding fresh water to or extracting it from the North Atlantic Ocean for the present-day climate, a THC hysteresis diagram is obtained. Under the present-day forcing, there exist mainly two modes of the THC: an 'on' and an 'off' mode. The northern climates corresponding to these two modes are first presented. It is found that there exist significant differences between the 'on' and 'off' modes for the northern surface air temperature and precipitation, boreal forest, northern hemisphere sea ice extent and continental ice over North America. Feedbacks from other components on the THC are then investigated. Further sensitivity experiments are carried out to understand the stability of the THC.

GC14A-06 1645h

Changes In Climate, Potential Forest Fire Danger, And Land Use In High Latitudes Of The Northern Hemisphere

Pavel Y Groisman¹ (+1-828-271-4347;

pasha.groisman@noaa.gov); Richard W Knight¹; Richard R Heim¹; Vyacheslav N Razuvayev²; Boris G Sherstyukov²; Nina A Speranskaya³; Kirill V Tsytchenko³; Paul H Whitfield⁴; Heikki Tuomenvirta⁵; Erik Foerland⁶; Hans Alexandersson⁷

¹National Climatic Data Center, 151 Patton Avenue, Asheville, United States

²Russian Institute for Hydrometeorological Information, 6 Koroleva Street, Obninsk, Russian Federation

³State Hydrological Institute, 2d Line, Basil Island, St. Petersburg, Russian Federation

⁴Meteorological Service of Canada, 700 - 1200 West 73rd Avenue, Vancouver, BC V6P 6H9, Canada

⁵Finnish Meteorological Institute, P.O. Box 503, Helsinki 00101, Finland

⁶Norwegian Meteorological Institute, N-0313, Oslo, Norway

⁷Swedish Meteorological and Hydrological Institute, Folkborgsvägen 1, Norrköping, Sweden

Significant climatic changes over the high latitudes in the 20th century have been reflected in numerous variables of economic, social, and ecological interests, including the natural frequency of forest fires. Using meteorological information for the past century, we found a significant (sometimes a twofold) increase in indices that characterize the weather conditions conducive to forest fires. The areas where this increase was statistically significant coincide with the areas of most significant warming during the past several decades in Central Alaska and in Siberia, south of the Arctic Circle. Systematic changes in land use over the Great Russian Plain have been documented for the past 60 years. Forested area has increased during this period over the entire Plain. The area of agricultural land and (specifically) of arable land have decreased in the central and northern parts of the Plain. Specifically, in the 1950s, the area of arable land in the Volga River Basin was the same as the area of the forested land. During the following 50 years the area of arable land has decreased by 16 percent and the area of forested land has increased by the same amount.