KN–1

INTENSIFIED WARMING OF THE ARCTIC: CAUSES AND IMPACTS ON MIDDLE LATITUDES

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Over the past century, the Arctic has warmed at about twice the rate of the rest of the globe. The amplified Arctic warming of recent decades has resulted in part from reduced sea ice and snow cover, as shown by the seasonality of the polar amplification, which is strongest during the autumn season of greatest sea ice loss. However, there is also theoretical and observational evidence that a key contributor to amplified polar warming is the increased poleward transport of heat and moisture into the Arctic. Variations of poleward fluxes of sensible heat as well as water vapor, a strong greenhouse gas, are consistent with the recent polar-amplified warming. Oceanic heat transport also appears to have played a role in the past decade.

There is emerging evidence that the warming Arctic can influence mid-latitude weather and climate. The warmer and moister atmosphere of an ice-diminished Arctic during autumn has been associated with enhanced autumn snow cover in Asia., which in turn has been linked to wintertime anomalies of anatmospheric circulation pattern that impact Eurasian winter climate. In a feedback of sea ice loss onto the atmospheric circulation of autumn and early winter, reduced sea ice has been shown to have contributed to an increase in the lower atmosphere temperatures, increased tropospheric pressures, and reduced zonal (westerly) winds aloft in recent years. An intriguing possibility is a linkage between these reduced westerlies and the anomalously negative phase of the Arctic Oscillation during the early period of several recent winters. The extreme negative Arctic Oscillation brought exceptional cold and snow to Europe and the eastern United States. Other recent studies support the notion that reduced Arctic sea ice cover in autumn affects the frequency of wintertime blocking events, leading to persistence or slower propagation of extreme temperatures in middle as well as high latitudes. While internal variability cannot be dismissed as the explanation of these anomalies in recent winters, the physical consistency of sea ice loss and early-winter reductions of westerly winds suggests that the warming Arctic may already be influencing middle latitudes.

KN–2

ARCTIC WARMING AND ITS CONSEQUENCES FOR PERMAFROST

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The northern permafrost region contains approximately 50% of the estimated global below-ground organic carbon (C) pool and more than twice as much as is contained in the current atmospheric carbon pool.

The sheer size of this carbon pool, together with the large amplitude of predicted arctic climate change implies that there is a high potential for global-scale feedbacks from arctic climate change if these carbon reservoirs are destabilized.

In addition to the carbon available for microorganisms to produce methane and carbon dioxide in the active layer of permafrost landscapes, carbon and free methane gas stored for hundreds or thousands of years in permafrost are increasingly liberated by talik formation under thaw lakes and by coastal erosion.

The role of methane emission due to the destabilization of gas hydrates within or under the permafrost along with the Arctic warming is still almost unknown and can only be roughly estimated.

Significant gaps exist in our current state of knowledge that prevent us from producing accurate assessments of the vulnerability of the arctic permafrost to climate change, or of the implications of future climate change for global greenhouse gas (GHG) emissions.

The European PAGE21 project “Permafrost and its global effects in the 21st century” directly addresses these questions through a close interaction between monitoring activities, process studies and modeling on the pertinent temporal and spatial scales. PAGE21 is directly linked to the Japanese-EU cooperative GRENE-TEA project, the Canadian ADAPT project and the Nordic Centre of Excellence DEFROST project.

In this presentation, we present an overview of the current state of knowledge on permafrost and its evolution in regard to warming air temperatures in the Arctic as well as the strategy behind the PAGE21 project and the coordination of field activities with international partners.

KN–3

CATASTROPHIC REDUCTION OF SEA-ICE IN THE ARCTIC OCEAN - ITS IMPACT ON THE MARINE ECOSYSTEMS IN THE POLAR REGION-

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The sea-ice in the Arctic Ocean has dramatically reduced during the past decade. The drastic sea-ice reduction would cause a complicated and difficulty to understand the changes in marine ecosystem surrounding the Arctic Ocean, because “disadvantage” phenomena such as ocean acidification and “advantage” phenomena such as improving light condition for marine organisms, respectively, are simultaneously progressing. Therefore, aims of this project are 1) to understand temporal changes in primary production, 2) to understand the physiological response of marine phyto- and zooplanktons having carbonate tests on warming or freshening associated with sea-ice melting, 3) to develop a new model for marine ecosystems in the Arctic Ocean, to reproduce the primary production by using the model and to understand the response of marine ecosystems on the environmental changes caused by rapid sea-ice reduction.

In this presentation, we will show an overview of this project and a seasonal change in biogenic components flux obtained at the Northwind abyssal plain by a year round time series sediment trap system. We will also consider the mechanism of change in biogenic fluxes associated with the seasonal sea-ice extent. The seasonal change in major planktons (diatoms and mesozooplankton), physiological response of coccolithophorid on environmental changes caused by sea-ice melting by culture experiments, the quantitative analysis of dissolution of pteropods tests and model result for low trophic level ecosystem in the Arctic Ocean will be presented as a part of this project in the Sessions of ISAR-3.