change, as well as the response strategies undertaken by the regions residents, will be felt throughout the nation and the world. The national assessment of Climate Change Impacts on the United States has pointed out that the northern Great Plains could be favored under global warming scenarios in that future climates could increase crop yields [Reilly, Tubiello, McCarl, and Melillo, 2000]. Yield, though, is only one measure of the consequences that rapid warming might have on this region. Challenges to a changing environment must be met by people. Producers here, as well as in other agricultural regions, already function under multiple stresses that are completely separate from climate variability and change. These include falling prices, globalization, complex trade relations, changes in government policy, environmental constraints, and changing consumer preferences. It is against the backdrop of these stresses that pending climate changes must be considered.

Interactions with stakeholders through the NGP Assessment workshops, held in 1997 and 1999, identified key concerns and outlined potential mitigation and optimization strategies for the consequences of climate change in this region. We will present examples of the successful implementation of some of these strategies: actions that farmers and ranchers are employing to 1) increase their awareness of environmental factors, 2) enhance their ability to respond quickly to environmental change, 3) improve their economic returns, and 4) decrease environmental degradation. We will also highlight other no regrets actions and policies under consideration that may offer individual producers greater flexibility in their management decisions and provide a healthier environment for society at large.

U42A MC: Hall D Thursday 1330h

The Science of Abrupt Climate Change and the Implications for Public Policy II

Presiding: **R Alley,** Pennsylvania State University**; A R Isern,** National Science Foundation

U42A-0008 1330h POSTER

Possible role of different helio-geophysical factors in abrupt climate change

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As shown by recent investigations, galactic cosmic rays (GCR) exert a considerable influence on physical and chemical processes in the troposphere, including development of cloudiness. More intense (less intense) GCR fluxes result in the increasing (decreasing)lower cloudiness (Palló Bagó and Butler, 2000; Marsh and Svensmark, 2000) and, as a consequence, in lower (higher) near-surface temperatures. Modulation of GCR fluxes can be caused by variations in solar activity (from days to thousands of years on time scale) and changes in the geomagnetic field (from hundreds to thousands of years on the time scale).The additive effect of these factors, together with effect of other climatic processes in the Earth's atmosphere (for instance, Henrich events), can lead to an abrupt climate change. Examples of the additive effect of changes in the geomagnetic field and solar activity can be the Younger Dryas cooling event and abrupt climate change around 2,700-2,800 years BP. Both these cooling events occured, as follows from proxy data, during the minimum of quasi-2,400-year solar cycle and , hence, Gothenburg and Etrussia geomagnetic exursions. These effects lead to enhancement of the GCR flux, and, hence, to colling of the lower troposphere. At the Holocene boundary, the additive effect of three factors contributing to climate warming was observed. The first was an abrupt increase in the geomagnetic field, which resulted in weaker GCR fluxes. The second factor was the growth in the activity of the 2,400-year solar cycle, which enhanced solar radiation and weakened GCR fluxes. The third was astronomical factors (the Milankovitch effect) which also contributed to climate warming. The effects of the factors mentioned above enhanced each other, which could lead to the abrupt climate change at the Holocene boundary. Analysis has shown that abrupt climate change events occure as a rule, if several helio-geophysical and climatic factors are acting simultaneously in the same direction. This work was supported by EC (grant INTAS 97-3100 and IC 15CT98-0123 EXTRATERRESTRIAL) and RFBR (grant 00-05-64921).

U42A-0009 1330h POSTER

The Ice Core Correllation Game: What can we learn about global climate

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Prominent changes in oxygen qnd deuterium isotopic composition of the ice and in the methane concentrations in trapped atmosphere in ice cores allow a detailed correlation of ice core records from the arctic and antacrtic.

U42A-0010 1330h POSTER

The Rapidly Diminishing Arctic ice Cover and its Potential Impact on Navy Operational Considerations

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Observations made from U.S. Navy Fleet submarines during the 1990s have revealed a dramatic decrease in thickness, when compared to historical values, of the central Arctic Ocean pack ice cover. Estimates of this decrease have been as high as 40%. Remote sensing observations have shown a coincident decrease in the areal extent of the pack. The areal decrease has been especially apparent during winter. The overall loss of ice appears to have accelerated over the past decade, raising the possibility that the Northwest Passage and the Northern Sea Route may become seasonally navigable on a regular basis in the coming decade. The ice loss has been most evident in the peripheral seas and continental shelf areas. For example, during winter 2000-2001 the Bering Sea was effectively ice-free, with strong and immediate impacts on the surrounding indigenous populations. Lessening of the peripheral pack ice cover will presumably, lead to accelerated development of the resource-rich regions that surround the deep, central Arctic Ocean basin. This raises potential issues with respect to national security and commercial interests, and has implicit strategic concerns for the Navy. The timeline for a significantly navigable Arctic may extend decades into the future; however, operational requirements must be identified in the nearer term to ensure that the necessary capabilities exist when future Arctic missions do present themselves. A first step is to improve the understanding of the coupled atmosphere/ice/ocean system. Current environmental measurement and prediction, including Arctic weather and ice prediction, shallow water acoustic performance prediction, dynamic ocean environmental changes and data to support navigation is inadequate to support sustained naval operations in the Arctic. A new focus on data collection is required in order to measure, map, monitor and model Arctic weather, ice and oceanographic conditions.

U42A-0011 1330h POSTER

Reconstruction of the Surface Temperature Change in Central Greenland During D/O 12, 45 Kyr B.P.

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Air bubbles preserved in polar ice cores are unique archives of past atmospheric composition. Recently, it has been shown that air bubbles isotopic composition (N-15, Ar-40) enables to quantify past abrupt changes in polar regions. In this study, a high resolution measurement of nitrogen and argon isotopes in an ice core from Greenland allows to determine past surface temperature variations and the ice age-gas age difference during the Dansgaard-Oeschger event 12 recorded around 45,000 years before present. These results imply a mean surface temperature change of 8.2 ± 0.8 ^{o}C and permit to determine a $\delta^{18}O_{ice}$-temperature coefficient of 0.54 ± 0.05 $^{o}/_{oo}/^{o}$C and therefore bring a new constraint to calibrate the isotopic paleothermometer during glacial period. Moreover, a direct comparison with methane concentration will be presented to discuss the phase relationship between the warming and the methane increase.

U42A-0012 1330h POSTER

Rapid Climate Change at Siple Dome, Antarctica

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The 1004 m deep ice core from Siple Dome, Antarctica contains a paleoclimate record that spans at least the last 100,000 years. The most striking features of the paleoclimate record are two intervals at roughly 15 and 20 kyr BP. Both events are characterized by a transition period of reduced ice accumulation followed by an abrupt and persistent increase in surface temperatures. For the 15 kyr event the duration of the transition period was less than a few hundred years and ice accumulation dropped to zero or negative rates. The magnitude of the increase in surface temperature was at least 3 degrees and ice accumulation rates where similar before and after the event. For the 20 kyr event the duration of the transition period was less than 100 years and possibly as short as 50 years. The magnitude of the step increase in surface temperature was about 5 degrees and the ice accumulation rate was at least one-third lower after the event than before. Deuterium excess measurements indicate the two events had differe

U42B MC: 134 Thursday 1330h

Virtual Earth Laboratories II *(joint with NG, GP, S, T, DI, MR)*

Presiding: **H Bunge,** Princeton University**; L Stixrude,** Univ. of Michigan**; J Tromp,** California Institute of Technology**; R Hollerbach,** Univ. of Glasgow

U42B-01 1335h INVITED

Prospects for Realistic Models of Planetary Dynamos

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