changes from year to year and can have a different seasonal evolution from climatology, e.g. due to an advance or delay in spring 'green-up', changes in temperature and precipitation patterns, different irrigation or crop harvesting, forest fires, deforestation, desertification, hailstorm, flooding or drought affected vegetation. Recently, NESDIS has produced 'real-time' weekly green vegetation fraction from the remote sensor AVHRR. In this study, this new data set is tested in the Noah land-surface model coupled with the 12-km mesoscale Eta model to make 0-3 day simulations for the growing seasons. Resulting surface fluxes, and 2-meter dew-point and air temperature will be compared to those predicted by the operational Eta model, and to observations including data from various mesoscale observing networks

A34A-05 1630h

UPDATE ON HIGH-PERFORMANCE INSTRUMENTED AIRBORNE PLATFORM FOR ENVIRONMENTAL RESEARCH (HIAPER)

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The High-Performance Instrumented Airborne Platform for Environmental Research (HIAPER) will be a medium sized jet aircraft capable of operating in the upper troposphere to lower stratosphere, highly modified to carry a substantial scientific research payload. The vision for this project emerged from the community in the 1980s, reviewed and approval by the National Science Board starting 1997, and received its first funding in FY 2000. HIAPER is being designed to serve a broad cross-section of the geosciences community. Because of its long duration and downward and upward looking ports as well as other aspects of the platform, HIAPER will significantly enhance capabilities available to the ocean sciences community. The continued involvements of the community in the design of this research platform as well as on-board instrumentation are hallmarks of the project. Rationale for HIAPER, a project overview, and the science needs it will fulfill are discussed. Particular attention will be given to current status of the project and the opportunities for community input instrumentations to be carried by HIAPER.

URL: http://www.hiaper.ucar.edu/

A41A CC: 220 C-E Thursday 0830h

Ice Cores: Contributions to Climate Variability and Dynamics I Posters

(joint with B, OS, C, GC, PP)

Presiding: **C A Shuman,** NASA Goddard Space Flight Center

A41A-01 0830h POSTER

Reconstruction of interannual Antarctic climate variability from ice cores

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Antarctica represents a significant gap in efforts to achieve reliable reconstructions of interannual to century-scale climate variability. A reliable reconstruction of Antarctic climate on these timescales requires obtaining precisely dated ice cores at high temporal resolution, and with sufficient spatial coverage to adequately capture large-scale climate variability. Ice cores retrieved by the International TransAntarctic Scientific Expedition (ITASE) program are a major step towards this goal. As part of US ITASE, ice cores were obtained from twenty-three sites that are widely distributed across the West Antarctic Ice Sheet, providing continuous records of snow chemistry covering at least 200 years. These cores have been dated at better-than-annual resolution, primarily though the identification of summer peaks in non-sea-salt sulfate (nss-SO_4). Validation of the timescales was achieved through independent identification of other seasonal variations and marker horizons. Dating precision to within 1-2 months is demonstrated by the occurrence of spring-time nitrate peaks 3 months before the nss-SO_4 maxima, by the identification of distinct mid-winter warming in some years in both instrumental temperature records and stable isotope ratios, and by the timing of hydrogen peroxide maxima. Dating accuracy to within ± 1 one year is demonstrated by volcanic marker horizons, Tambora (1815-1816) being the most prominent. Additional validation of the ± 1 year accuracy is provided by the tracing of isochronal layers from site to site using high-frequency ice penetrating radar observations. Reconstruction of climate variability from the ice core data is achieved in three stages. First, satellite-derived anomalies are used to define characteristic patterns of Antarctic temperature variability by conventional EOF analysis; this provides approximately 20 years of monthly data. Using instrumental weather station data (largely from the Antarctic coastline)] as predictor variables, we obtain a reconstruction of the principal components of Antarctic temperatures, with coverage over the entire continent back to 1961. Finally, the resulting 40+ years of spatiotemporal variations in Antarctic temperatures are used as a calibration target for the ice core data. Our current reconstruction uses five stable isotope records from West Antarctica, plus data from Talos Dome and Law Dome. The results show an overall warming of Antarctica since at least the early 1960s, but with cooling in the summer months. Preliminary results also suggest overall warming since the mid 1800s, with significant multi-decadal scale variations. These results, if further validated, will have important implications for the interpretation of recent observed trends in the Southern Annular Mode/Antarctic Oscillation. Major contributors to this work, in addition to this listed authors, include D. Dixon, G. Hamilton, S. Kaspari, A. Kurbatov, P. Mayewski, B. Spikes (University of Maine), M. Albert, S. Arcone, A. Gow, D. Meese (CRREL), C. Shuman (NASA/Goddard), M. Frey (University of Arizona), M. Wumkes (Glacier Data) and T. van Ommen (Antarctic CRC).

A41A-02 0830h POSTER

8 Glacial-Interglacial Cycles high Resolution Record of Chloride, Nitrate and Sulphate from EPICA-Dome C ice-core (Antarctica).

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Fast Ion Chromatographic measurements of chloride, nitrate and sulphate were carried out in a continuous way and high depth resolution (up to 2.0 cm) along the EDC96 and EDC99 ice cores, drilled at Dome C (East Antarctica, 75° 06' S; 123° 23' E; 3233 m a.s.l.) in the framework of the EPICA (European Project for Ice Coring in Antarctica) program. The deeper ice core (EDC99) reached the depth of 3200 m (about 100 m above the bedrock) during the 2002-2003 Antarctic Campaign. The EDC99 ice core (present time accumulation at Dome C: around 25 kg m-2 yr-1) is expected to cover about 900 kyrs. The continuous measurements of chloride, nitrate and sulphate, carried out directly on site, show sharp concentration changes in the glacial-interglacial transitions and during the interstadial periods. The comparison between chemistry, dust, ice-isotopic and marine-isotopic profiles enlightens source, atmospheric-circulation and snow-composition changes able to affect the load and persistency of the components in the snow layers. In particular, changes in snow acidity and in accumulation rates drive post-depositional processes affecting the snow concentration of chloride and nitrate. On the other hand, sulphate fluxes seem to be quite constant along several glacial-interglacial cycles, allowing the use of the inverse concentration as a proxy of the snow accumulation rate (dry deposition is dominant at Dome C). The inverse-concentration profile of sulphate is compared to a preliminary accumulation.rate trend, carried out on the basis of the dD profile, and to the dD profile obtained by marine-sediment cores. A very sharp similarity was shown by the different record and the anomalous pattern of the isotopic-marine stage 13 is fully confirmed by the inverse sulphate record.

A41A-03 0830h POSTER

Interactions Between Solar Forcing And Decadal To Centennial Scale Climate Dynamics 1700-2000

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Annually resolved Pacific ice core and coral records are shown to contain variability on decadal to centennial timescales resulting from internal dynamics and solar forcing. The maximum correlation occurs at a lag of three years with respect to the solar forcing suggesting an oceanic link in the response. In addition, a reversal in the sign of the correlation between the ice core record, a proxy for temperatures in the North Pacific, and the solar forcing occurred around the start of the 20th century. We argue that this behaviour is the result of a non-linear resonant interaction between the solar forcing and internal dynamics of the climate system.

A41A-04 0830h POSTER

Ice core records of Late Holocene climate variability in the Dry Valleys, Antarctica

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The Dry Valleys region of Antarctica represents a unique transition environment between coastal and interior portions of the continent. Previously developed paleoclimate records from the surrounding area, including shallow and deep ice cores, lake cores, and glacial deposits, indicate a complex evolution of Holocene climate dynamics, however the resolution of available records is usually not sufficient to resolve interannual to decadal processes. In particular, the interaction of various ocean/atmosphere phenomena (e.g., ENSO, Antarctic Oscillation, Antarctic Circumpolar Wave) that may be responsible for regional and/or larger scale climate events during the late Holocene (e.g., Little Ice Age) remains unresolved. Over the next two Antarctic field seasons, we plan to recover intermediate length (200-350 m) ice cores from several sites in the Dry Valleys, with the goal of producing annually-dated paleoclimate records for at least the last 2000 years. As part of site selection activities during the 2004/04 season, snowpit sample profiles, shallow (20 m) firn cores, and GPS and ground penetrating radar data were collected from three glacier accumulation zones in the Dry Valleys (Clark, Commonwealth, and Blue Glaciers). Calibration of isotope, major ion, and trace element data from the snowpits and shallow cores with available meteorological data from automatic weather stations in the Dry Valleys will be presented and discussed.

A41A-05 0830h POSTER

Creep of Granular Ice With and Without Dispersed Particles

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The effects of dispersed particles on creep and related phenomena have been studied in polycrystalline laboratory-grown ice. The importance of the dislocation density during creep has been analyzed using a dislocation-based model of anelasticity to estimate the

effective mobile dislocation density. Results indicate that under a constant stress of 1.45 MPa, particles increase the creep rate at particle concentrations up to 1 wt. %, above which the creep rate slightly decreases. At lower levels from 0.1 - 1.4 MPa, ice with 1 wt. % particles shows higher creep rates compared with particle-free ice, with the difference increasing at higher stress levels. Power-law creep behavior with an exponent of 3 was observed for both particle-free and particle-containing ice when the strain rate was greater than 7×10^{-9} s^{-1}. However, a transition to linear behavior was observed for both materials when the strain rates were below 7×10^{-9} s^{-1}. The results suggest that the transition is related to the strain rate rather than the stress. Model calculations show that the linear behavior is associated with the constant dislocation density, which can be explained by Harper-Dorn creep, while power-law behavior is associated with increased dislocation densities. This research was supported by NSF Office of Polar Programs, Arctic Natural Sciences Program (OPP 011737), Dr. Jane Dionne, Program Manager.

A41A-06 0830h POSTER

Determining the Orientations of Ice Crystals Using Electron Backscatter Patterns

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The presentation will show how electron backscatter diffraction can be employed to determine crystal orientations in ice. The technique involves obtaining and indexing electron back-scatter patterns (EBSPs) from uncoated ice using a scanning electron microscope equipped with a custom-built cold-stage and an Orientation Imaging System. Unlike any of the currently-used methods, the EBSP-based technique has considerably higher angular and spatial resolution and is significantly faster. We also present an orientation image map of a muti-grain region in laboratory-grown ice constructed by automatically indexing the EBSPs using an HKL, Inc Channel 5 Orientation Imaging System and discuss possible applications of the technique to the study of natural ice. Primarily, the focus will be on the characterization of the microstructure of dynamically recrystallized glacier ice whose texture is intrinsically related the flow process. Other applications include obtaining orientation images from frozen water-containing materials, such as clathrate hydrates. This research was supported by Army Research Office grant DAAD 19-03-1-0110 and National Science Foundation grants OPP-9981379 and OPP-0221120.

A41B CC: 220 C-E Thursday 0830h

Oxygen-18: Connecting Climate Models, Observations, and Paleodata I Posters *(joint with B, H, OS, C, GC, PP)*

Presiding: **G Hoffmann,** Laboratoire des Sciences du Climat et de l'Environnement**; A Paul,** University of Bremen

A41B-01 0830h POSTER

Gridding Global $\delta^{18}O_{water}$ and Interpreting Core Top $\delta^{18}O_{foram}$

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Estimations of the oxygen isotope ratio in seawater ($\delta^{18}O_{water}$) traditionally have relied on regional $\delta^{18}O_{water}$ to salinity relationships to convert seawater salinity into $\delta^{18}O_{water}$. This indirect method of determining $\delta^{18}O_{water}$ is necessary since ?18Owater measurements are relatively sparse. We improve upon this process by constructing local $\delta^{18}O_{water}$ to salinity curves using the Schmidt *et al.* (1999) global database of $\delta^{18}O_{water}$ and salinity. We calculate local $\delta^{18}O_{water}$ to salinity relationship on a 1x1 grid based on the closest database points to each grid box. Each ocean basin is analyzed separately, and each curve is processed to exclude outliers. These local relationships in combination with seawater salinity (Levitus, 1994) allow us to construct a global map of $\delta^{18}O_{water}$ on a 1x1 grid. We combine seawater temperature (Levitus, 1994) with this dataset to predict $\delta^{18}O_{calcite}$ on a 1x1 grid. These predicted values are then compared to previous compilations of core top $\delta^{18}O_{foram}$ data for individual species of foraminifera. This comparison provides insight into the calcification habitats (as inferred by seawater temperature and salinity) of these species. Additionally, we compare the 1x1 grid of $\delta^{18}O_{water}$ to preliminary output from the latest GISS coupled Atmosphere/Ocean GCM that tracks water isotopes through the hydrologic cycle. This comparison provides insight into possible model applications as a tool to aid in interpreting paleo-isotope data.

A41B-02 0830h POSTER

Seasonal Variations in the $\delta^{18}O$ Values of Global Meteoric Water and Climate Dynamic Patterns

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Climate change often manifests itself through changes in seasonal weather patterns and dynamics, but paleoclimate records rarely have intra-annual resolution. The precipitation $\delta^{18}O$, either directly measured or indirectly inferred from other datable materials, is one of the most widely used proxies for paleoclimate studies. It is important, therefore, that we understand the seasonal distribution of meteoric $\delta^{18}O$ in relation to climate dynamics. Here we present a study of the $\delta^{18}O$ seasonality pattern of global meteoric water and discuss its strong connection to the general circulation of the atmosphere. We used the GNIP (Global Network for Isotopes in Precipitation) database (IAEA/WMO, 2001; Global Network for Isotopes in Precipitation) for this study. For each station having at least 12 months of measurements, we fit the mean and the phase and amplitude of an annual sine curve using the least-squares method. The mean annual $\delta^{18}O$ is generally highest in the tropics and lowest toward the poles, but there is a narrow zone of slightly lower $\delta^{18}O$ at the equator. The phase of the seasonal variation in precipitation $\delta^{18}O$ is surprisingly uniform within each of four world zones. North of 30 °N latitude, the most ^{18}O-enriched precipitation falls in early July. South of 30 °S, the maximum ^{18}O enrichment occurs in early January. Between the equator and 30 °N, precipitation $\delta^{18}O$ reaches a maximum in February, which is nearly opposite to the August isotopic maximum between the equator and 30 °S. At the equator, 30 °N, and 30 °S the isotopic maximum often occurs in September or March. The magnitude of seasonal variation in precipitation $\delta^{18}O$ appears to decrease toward the equator. In addition, marine and coastal seasonality across the globe is significantly smaller than continental seasonality. It appears that the seasonality in precipitation $\delta^{18}O$ is controlled by the global circulation cells of the atmosphere through their effects on evaporation, moisture transport, and precipitation patterns. A few small regions with $\delta^{18}O$ anomalous for their respective zones are affected by monsoons or by stationary mesoscale circulation systems that influence local water vapor transport.

A41B-03 0830h POSTER

An Oxygen-18 Proxy Record of Recent Hurricanes in Belize: Speleothems as a new Tool for Paleotempestology

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The high winds, storm surge, and extreme precipitation produced by landfalling tropical cyclones (hurricanes and tropical storms) generate some of the most deadly and destructive natural disasters faced by coastal populations. Stakeholders such as coastal planners and developers, property owners, emergency planners, and (re)insurers are concerned about future risk from the most devastating events, particularly because significant changes in climatic boundary conditions have been projected for this century. However, historical tropical cyclone records are not sufficient to address the sensitivity of hurricane intensity to projected changes, and modeling exercises have as yet been unable to settle the debate. Consequently, paleotempestologists have turned to the geologic record for more information about past hurricane activity that could be used to improve forward models. Toward that end, we have developed a new proxy for individual tropical cyclone rainfall events using very high-resolution $\delta^{18}O$ analyses of speleothem calcite. This proxy is based on the depleted isotopic signature of tropical cyclone rainfall compared to other summer season meteoric waters. We applied recent developments in microsampling techniques to a rapidly growing speleothem from Belize, Central America. The resulting record (20 micron sampling interval, yielding ∼weekly temporal resolution) allowed us to detect individual, historical tropical cyclone events over the last three decades. The speleothem $\delta^{18}O$ paleotempestology proxy facilitates very accurate estimates of the time between tropical cyclone events: the proxy was able to resolve two hurricanes that struck Belize in the same year. The recurrence interval (RI) we estimated using the speleothem hurricane record agrees closely with the RI published for the same period by the Belize Meteorological Service. Preliminary work indicates that the $\delta^{18}O$ storm signal preserved in speleothem calcite carries some information about the local storm intensity (a function of storm category at landfall and distance from storm track). This new tool for paleotempestology can complement existing proxies based on coastal sediments, corals, and tree rings. By extending such records into the geologic past, when climatic conditions (such as sea surface temperature patterns, position of the North Atlantic High, etc.) were different from today's, it should be possible to resolve more exactly the relations between hurricane activity and specific climatic boundary conditions. This will enable modelers to more accurately project hurricane recurrence in light of expected future trends.

A41B-04 0830h POSTER

Variability of water isotopes in a coupled ocean-atmosphere-sea ice model

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We incorporate the physics of water isotopes ($H_2^{18}O$, HDO) into the state-of-the-art GISS GCM, including a full atmosphere, dynamic ocean, sea ice and land surface components. The water isotopes follow every aspect of the hydrological cycle (including a prognostic cloud water scheme) with fractionation at relevant changes of phase. We use the control run of this model to examine the modelled variability of the water isotopes on seasonal, interannual and interdecadal timescales and how this is coupled to variation in temperature, salinity and other climate variables. In particular, we examine the variability of isotope ratios and the deuterium excess as a function of the AO/NAO circulation pattern in the Northern Hemisphere and the overturning streamfunction in the North Atlantic.

A41B-05 0830h POSTER

Modeling the Phase Relationship Between Global Ice Volume and the Mean Oxygen-Isotope Composition of the Ocean

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A two-dimensional (latitude-height) thermomechanical ice-sheet model is used to simulate the oxygen-isotope distribution in a Pleistocene ice sheet. In order to study the relationship between global ice-volume and