"Asian Ice Core Array (AICA): Reconstruction of Past Physical and Chemical Climate over Central Asia.
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This research is coordinating with CliC (Climate Criosphere Program), CEOP-HE (Coordinated Energy and water – cycle Observations Project – High Elevation), NEESPI (North Eurasia Environmental Science Partnership Initiative) and CADIP (Central Asia Deep Ice-coring Project: http://www.sci.uidaho.edu/cae/cadip/CADIP_whitepaper_May_2006.pdf)

Project Summary

Intellectual merit: Based upon a strong demonstration of the use of ice core records for understanding past physical and chemical climate change developed from our past ice core research (Antarctica, Arctic, North Pacific and Asia) we propose to analyze and interpret a new array of Asian ice cores. We will utilize five existing and will collect one new ice core for analysis and interpretation in order to substantially increase the geographic extent and more notably enhance reconstruction of past climate over Asia. The new Pamir ice-core will be drilled for 200-300 m to see the strength and resolution of paleoclimate signal and to be ready for deep (1,000 m) ice-core drilling. The six AICA records will be annually dated to 300-500 years (multi-annually dated in deeper sections), sub-annually-resolved reconstructions of past climate (atmospheric circulation, temperature, precipitation rate, and atmospheric chemistry) utilizing continuous, co-registered measurements (n>45) of: major ions, trace elements, and stable isotope series, plus selected sections for microparticle grain size distributions. Primary objectives for this research address:

(1) Asian climate variability - How do major Asian circulation features (eg., Asian monsoon, westerlies, polar air masses, Siberian and Tibetan Highs) vary on annual to longer scales? What factors (eg., solar variability, volcanic activity, greenhouse gases) control changes in the major circulation features impacting Asia? What are the associations between Asian climate and global (e.g., ENSO, cross-equatorial flow, NAO, PNA, WPO, AO, PDO) circulation features? Can Asian climate be simulated and predicted from the state of past atmospheric circulation patterns (analog modeling)? How does the interaction between tropical and ex-tropical circulation impact climate over Asia? What are the regional climatic changes to be expected in near future based on trends? Is there evidence of climate events such as the LIA and MWP in Asia? Are Asian climate change events related to climate change in other regions?

(2) Environmental change over Asia - How have natural versus anthropogenic sources for chemical species (notably sulfate, nitrate, and select heavy metals and trace and major elements (Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Pb, Bi, U, As, Tl, Al, S, Ca, Ti, V, Cr, Mn, Fe, Co, Cu, Zn) varied in the atmosphere over central Asia? Are spatial and temporal variations in contaminants related to changes in contaminant source areas or production? Have changes in atmospheric circulation impacted distribution of chemical species in the atmosphere over central Asia?

Broader impacts: The Eurasian continent is the largest landmass in the World, exerting substantial influence on atmospheric and terrestrial systems and the 2.5 billion people living in the region. Changes in climate over this region have dramatic impacts on humans and ecosystems. Further changes in water resources and desertification over this heavily populated region may cause unpredictable consequences all over the World. However, instrumented records of climate and environmental variability over the region are sparse. Ice cores from Asian glaciers provide a proven source of high-resolution records of past climate dynamics and chemistry of the atmosphere extending back at seasonal resolution centuries to millennia. AICA will provide: unprecedented understanding of physical and chemical climate variability; a baseline for assessing modern climate variability in the context of human activity; and a contribution to the prediction of future climate variability for Asia. Results will be translated into publicly accessible information through public lectures, media appearances and an extensive on-going outreach activity. Our ice core research provides a major basis for curriculum in K-12 and University plus a foundation for several field and laboratory based graduate theses and undergraduate student projects. The AICA high resolution, multivariate analyses proposed will set a new level of in-depth temporal and spatial multi-variable analyses and interpretation for Asian ice core research. Likelihood of success for proposal objectives is very high since previous records from this region have produced significant contributions. We expect AICA results to be of particular significance to climatologists, paleoclimatologists, atmospheric chemists, geochemists, climate modelers, solar-terrestrial physicists, and environmental statisticians. The joint project will support two PhD students for 3 years each and undergraduate salaries and research.

More details: The Eurasian continent is the largest landmass in the World, exerting substantial influence on atmospheric and terrestrial systems and the 2.5 billion people living in the region. Changes in climate over this region have dramatic impacts on humans and ecosystems. Further changes in water resources and desertification over this heavily populated region may cause unpredictable consequences all over the World. However, instrumented records of climate and environmental variability over Asia barely cover the last 100 years and throughout portions of the continent data is sparse if not totally absent. Ice cores from Asian glaciers provide high-resolution records of past climate dynamics and chemistry of the atmosphere extending back at seasonal resolution centuries to millennia. A spatially distributed array of ice cores from Asia is essential to understand the regional differences in Asian climate and chemistry of the atmosphere. Results from the new core (200-300m) to be collected as part of this study, Fedchenko Glacier in the Pamir, will be used to demonstrate feasibility of this site for recovery of the deepest (1,000m) and longest (~200,000 years) ice core record potentially available outside of the polar latitudes.