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Organizers/sponsors:

National Taiwan University Research Center for Future Earth
Department of Geosciences, National Taiwan University
Research Center for Environmental Changes, Academia Sinica
Preparation Committee of the Association of Pan-Pacific Anthropocene
Quaternary Research Group, Geological Society Located in Taipei

Agenda

Date: Saturday, October 27, 2018
Venue: B1 Conference Room, Department of Geosciences, National Taiwan University

08:30-08:50	**Registration**
08:50-09:00	**Opening**
Session 1: Modern and proxy records (1) / Chair: Dr. C.-C. Shen	
09:00-09:30	***Dr. Huang-Hsiung Hsu,*** *Research Center for Environmental Changes, Academia Sinica* Reduced TC activity and enhanced anticyclone in the WNP in a warmer world-projection and mechanism
09:30-10:00	***Dr. Ashish Sinha,*** *Dept. of Earth Sciences, California State University* Anthropogenic forcing of Indian Summer Monsoon
10:00-10:30	***Dr. Stacy Carolin,*** *Institute of Geology, University of Innsbruck* Understanding the selective western tropical Pacific rainfall response to abrupt climate events sourced from the North Atlantic
10:30-10:50	**Coffee Break**
Session 2: Modern and proxy records (2) / Chair: Dr. Abby Ren	
10:50-11:20	***Dr. Yusuke Yokoyama,*** *Atmosphere and Ocean Research Institute, The University of Tokyo* Climate change and anthropogenic environmental signals captured in high-resolution coral skeletal geochemistry
11:20-11:50	***Dr. Kristine DeLong,*** *Dept. of Geography and Anthropology, Louisiana State University* Hydroclimate change from corals and other paleoclimate archives: Insights from the CoralHydro2K and Iso2K Synthesis Projects
11:50-12:20	***Dr. Shaw-Chen Liu,*** *Institute for Environment and Climate Research, Jinan University* An observation-based perspective of winter haze days in four major polluted regions of China
12:20-14:00	**Lunch Break**
Session 3: Historic and archaeological records / Chair: Dr. Kristine L. DeLong	
14:00-14:30	***Dr. Pao-Kuan Wang,*** *Research Center for Environmental Changes, Academia Sinica* Construction of the REACHES climate database based on historical documents of China
14:30-15:00	***Dr. Ivy Hui-Yuan Yeh,*** *School of Humanities, Nanyang Technological University* The desertification of the ancient oases in Han dynasty (202 BC–220 AD) in Northwestern China
Session 4: Biodiversity and geohazards / Chair: Dr. Ivy Hui-Yuan Yeh	
15:00-15:30	***Dr. I-Ching Chen,*** *Dept. of Life Sciences, National Cheng Kung University* Winter monsoon counteract the hydroclimatic influences of cloud in tropical Asia montane forest
15:30-16:00	***Dr. Tso-Ren Wu,*** *Graduate Institute of Hydrological & Oceanic Sciences, National Central University* If the 1960 Chile tsunami event had occurred in a different location along the Peru-Chile Trench
16:00-16:20	**Coffee Break**
16:20-16:50	**Panel discussion: APPA, the 1st ConPPA on May 14-17, 2019**

Abstracts

Session 1: Modern and proxy records (1)

Reduced TC activity and enhanced anticyclone in the WNP in a warmer world - projection and mechanism

Huang-Hsiung Hsu[1*], Chia-Ying Tu[1], Ping-Gin Chiu[1], and Shian-Jiann Lin[2]

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[2] NOAA/Geophysical Fluid Dynamics Laboratory, Princeton

Abstract

GFDL high-resolution (25-km) AGCM HiRAM was used for AMIP-type time-slice simulations for the present (1979-2008) and the end of century (2074-2100). HiRAM well simulates mean climatology, Asian Monsoon seasonal evolution, and frontal activity. Strength of simulated extreme precipitation is compatible with TRMM precipitation. The ensemble-mean SST increase projected by CMIP5 CGCMs under RCP8.5 was superimposed on the present SST to force the end-of-century simulation. Tropical cyclone activity in the western North Pacific is projected to be significantly weakened at the end of the 21st century. This result was reproduced by using MRI-AGCM of 20-km resolution and in the time-slice experiments forced by different projected SST patterns. This projected change is triggered by the contraction of convection toward the tropics and the corresponding anomalous subsidence poleward of the equatorial convection belt. Strongest response occurs in the western North Pacific and results in significantly weakened convection and westward extension of the subtropical anticyclone in the western North Pacific. Relative contribution of SST changes in various basins to the changes in the WNP is assessed. Hypothesis is proposed to explain why the response to the global warming in the western North Pacific is stronger than those in other regions.

Anthropogenic forcing of Indian summer monsoon

Ashish Sinha

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Abstract

Even subtle shifts in the amounts and spatial-temporal patterns of Indian summer monsoon rainfall are among the potentially most serious impacts of climate change in South Asia. Instrumental observations show that summer rainfall over large parts of South Asia, and particularly, over central and northern India, has declined over the past five to seven decades. A number of studies in the recent years have linked this declining trend to a range of anthropogenic factors. These include: (1) increased anthropogenic aerosol loading over south Asia; (2) reduced land-sea thermal contrast due to radiative-forced warming of the Indian Ocean; (3) an eastward shift in the locus of summer rainfall (i.e., enhanced rainfall over western tropical Pacific) in response to radiative forcing from anthropogenic greenhouse gases; (4) increased irrigation and intensification of agriculture; (5) and large-scale changes in land use and land cover resulting from human activities. In addition, it has also been suggested that the recent decades long declining trend in monsoon rainfall is, in fact, a part of a longer-term multicentennial scale declining trend that commenced circa ~1600 AD with large-scale land use and land cover changes in the Indo-Gangetic belt. However, any attribution of 'forced' changes in monsoon rainfall from anthropogenic activities, warrants a careful consideration of the monsoon's natural variability on decadal to sub centennial timescales because it is on precisely these timescales that the anthropogenic–forced changes are superimposed on monsoon's natural climate variability. In this talk, I will provide a comprehensive review of key observational, modeling and paleoclimate studies that summarize the state-of-the art and highlight the current uncertainties and caveats in our understanding of how Indian monsoon may behave in the near-and-long-term future in response to the continued anthropogenic forcing.

Understanding the selective western tropical Pacific rainfall response to abrupt climate events sourced from the North Atlantic

Stacy Carolin[1*], Frances Buckingham[2], Sharon Hoffman[3], Jess Adkins[4], Kim Cobb[5], Jud Partin[6], Sang Chen[4], David Lund[7]

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[2] University of Oxford, Oxford
[3] University of North Carolina, Wilmington, North Carolina
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[6] The University of Texas at Austin, Austin, Texas
[7] University of Connecticut, Storrs, Connecticut

Abstract

Evidence indicates that an unprecedented event of Atlantic meridional overturning circulation (AMOC) weakening relative to the last millennium occurred within the past 50 years, possibly associated with the simultaneous melting of the Greenland ice sheet due to anthropogenic activity (Rahmstorf et al., 2015). A weakened AMOC is the suggested response to several North Atlantic-triggered events that occurred during the Holocene, last deglaciation, and last glacial period and resulted in abrupt climate change in several far-field regions around the world.

The original trigger is still debated, however, as is the concept of a differentiated global response dependent on the type of event. Here we present a detailed analysis of rainfall records constructed from multiple Mulu and Buda (Borneo) stalagmites. The samples were collected from a site that has demonstrated a significant correlation between local rainwater isotopes (proxy) and regional rainfall amount (Moerman et al., 2014). The high-resolution, U/Th-dated, replicated records span the 8.2 ka, Younger Dryas, Heinrich, and Dansgaard-Oeschgar events, all global multi-century length climate shifts that are characterized by abrupt, decadal-scale onsets. The stalagmite records reveal a selective response of western tropical Pacific rainfall, which we use to infer differences in the original event trigger and in the resulting AMOC response. We comment on what insight we have gained from this collection of recorded abrupt climate changes, particularly on how the western tropical Pacific may respond in the future to a likely AMOC weakening.

Session 2: Modern and proxy records (2)

Climate change and anthropogenic environmental signals captured in high-resolution coral skeletal geochemistry

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[3] Kochi Core Center, JAMSTEC, Kochi

Abstract

High-resolution measurements of trace elements (TE) as well as radiocarbon (14C) in corals can be used to reconstruct past variability in ocean conditions and anthropogenic fingerprint in the surface of the Earth. We have recovered several large Porites coral in Western Pacific along with the pathways of the Kuroshio. Measurements of TE/Ca in corals obtained from northwestern Pacific record more than 400 years of sea surface temperature (SST) and revealed that the punctuated severe cold SSTs are able to correlate with severe famine events in historical documents. Anthropogenic environmental changes also are recorded in corals. Seasonally measured radiocarbon in coral skeleton clearly indicates a significant increase in ^{14}C level from 1947 to 1998 related to atmospheric nuclear bomb testing. Recent 30 years of records together with Boron isotopes are capturing ocean acidification due to fossil fuel emissions. On the decadal scale, the northward shift of NEC bifurcation latitude after 1976, the year as known as Pacific Decadal Oscillation regime shift from negative to positive, was concurrent with the abundant westward propagating mesoscale eddies in the Subtropical Countercurrent region and stronger Kuroshio transport off the east Taiwan, which may be represented by a smaller ^{14}C level difference between Ishigaki and Guam after 1976.

Hydroclimate change from corals and other paleoclimate archives: Insights from the CoralHydro2K and Iso2K Synthesis Projects

Kristine L. DeLong

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Abstract

The Past Global Changes (PAGES) project helps coordinate and promote past global change research including the PAGES2K efforts of the past seven years. These projects bring together archive experts to collect, compile, and synthesize paleoclimate records for the past 2000 years. Data archives such as NOAA Paleoclimate and Pangaea were used to build these databases that have machine reading capabilities and integration with R, MatLab, and now Python computing environments. Projects included Ocean2K, Iso2K, and the new CoralHydro2k efforts. Ocean2K along with continental-scale 2K projects produced new computer-readable databases of all published paleoclimate records that met the project criteria (resolution, length, age etc.). PAGES2K and Ocean2K resulted in low- and high-resolution synthesis reports of global, multi-proxy paleoclimate data for the past 2000 years that have revealed a long-term cooling over the past millennium followed by the recent warming, with possible multi-decadal to centennial temperature variability in some regions. However, changes in atmospheric-oceanic circulation or hydroclimate have yet to be assessed on a global scale. The PAGES2K Phase 2 project, Iso2k is working on a global compilation of multiproxy $\delta^{18}O$ and δD records for the past 2000 years that can be used to investigate spatiotemporal variability and secular trends in global hydroclimate. In the ocean, coral $\delta^{18}O$ in the western equatorial Pacific is found to reflect salinity rather than (or in addition to) temperature, providing potential quantitative constraints on past moisture balance from corals. Iso2K is near completion with papers and database being prepared for publication. CoralHydro2K is a new project under phase three of PAGES2K that is just starting. Coral oxygen isotopic ratios ($\delta^{18}O$) are typically used to reconstruct sea surface temperature (SST), and by extension SST-driven El Niño-Southern Oscillation variations despite the influence of both SST and the $\delta^{18}O$ of seawater on coral $\delta^{18}O$. The ideal way to isolate past seawater $\delta^{18}O$ ($\delta^{18}O_{sw}$) variations is via paired coral $\delta^{18}O$ and Sr/Ca analyses. Many coral $\delta^{18}O$ records with paired Sr/Ca records already exist in the paleoclimatic literature that may be able to provide some insight into past $\delta^{18}O_{sw}$ and thus salinity changes due to the nature of the strong positive, yet regionally variable, relationship between salinity and $\delta^{18}O_{sw}$. This project is currently compiling existing records and starting as a workgroup that is looking for people to help contribute to the effort.

An observation-based perspective of winter haze days in four major polluted regions of China

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Abstract

An observation-based approach is used to examine key characteristics of winter haze days in four major polluted regions in China. Major findings in this study are: First, there was no significant trend in the number of winter haze days in most provinces and districts in eastern China from 1973 to 2012, contrary to the two-and-half-time increase in emissions of particulate matter and its precursors (PM emissions) in the same period of time. Second, meteorological and climate conditions rather than PM emissions are in control of the interannual variability variabilities and trends of winter haze days. These interannual variability variabilities (ranging from 24 to 125%) poses pose as a substantial masking effect that must be overcome by any control of PM emissions before its impact becoming statistically detectable. Finally, we find that global warming may have contributed significantly to the trend of winter haze days in eastern China.

Session 3: Historic and archaeological records

Construction of the REACHES climate database based on historical documents of China

Pao-Kuan Wang[1*], Kuan-Hui Elaine Lin[1], Yi-Chun Liao[2], Hsiung-Ming Liao[1], Yu-Shiuan Lin[1], Ching-Tzu Hsu[1], Shih-Ming Hsu[1], Chih-Wei Wan[1], Shih-Yu Lee[1], I-Chun Fan[1], and Te-Tian Ting[3]

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[2] Department of Atmospheric Sciences, National Taiwan University, Taipei
[3] School of Big Data Management, Soochow University, Taipei

Abstract

We will describe the methodology of an ongoing project of constructing an East Asian climate database REACHES based on Chinese historical documents. The record source is *Compendium of Meteorological Records of China in the Last 3000 Years* which collects meteorology and climate related records from mainly official and local chronicles along with a small number of other documents. We report the digitization of the records covering the period 1644-1795. Chinese historical times and location names are converted into Gregorian calendar and latitudes and longitudes. A hierarchical database system is developed that consists of the hierarchies of domains, main categories, subcategories, and further details. Historical events are then digitized and categorized into such a system. Code systems are developed at all levels such that the original descriptive entries are converted into digitized records suitable for treatment by computers. Statistics and characteristics of the digitized records in the database are described.

The desertification of the ancient oases in Han dynasty (202 BC–220 AD) in Northwestern China

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Nanyang Technological University, Singapore

Abstract

This project investigates the desertification of ancient oases during the Han dynasty (202 BC–220 AD) in Hexi corridor located in Gansu, China. To aid this process, archaeological evidences and historical literature records will be examined. There were more than 120 ancient cities in the Hexi corridor during the Han dynasty, the highest number of ancient cities preserved with all its diversities from the different times in history. However, the oases suffered desertification due to anthropogenic activities that took place around 2,000 years ago. The desertification of the ancient oasis in the Hexi Corridor was mainly caused by the political and military situation, the introduction of farming and animal husbandry, the utilization of water resources as well as the people's lack of understanding of the natural environment. The main reason for the desertification in the late Han Dynasty can be pointed to the inception of a large-scale development of agriculture. Wudi Emperor built up Hexi through the setting up counties as well as having soldiers and people move to the border zones for the system of Tun Tian (the process of setting up garrison stations for troops and peasants to open up wasteland and to grow food grains). This resulted in the rapid growth of the economy and society of Hexi, which allowed it to become an area that was known to be rich in resources in the whole of northwest of China. However, the ill effects of the development of Hexi were many. The hinterland of the oasis was affected due to aggressive land reclamation and some downstream areas suffered water scarcity due to the large amounts of water diverted for the farmland. In addition, these areas were located at the forefront where sand erosion had taken place. The vegetation in sand fixing areas too suffered due to the increase in the number of quicksand and this can be attributed to the artificial development of Hexi corridor. It is thus not surprising the downstream areas underwent desertification and eventually turned into a desert.

Session 4: Biodiversity and geohazards

Winter monsoon counteract the hydroclimatic influences of cloud in tropical Asia montane forest

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Abstract

Tropical montane cloud forests (TMCF) are unique ecosystems characterized by frequent cloud immersion. Stable hydroclimate maintains high level of species endemism and regulates water resource far beyond the geographic extents of TMCF. So far, vulnerability assessment of TMCF has focused on the changes of cloud behavior and its impacts on the stability of hydroclimates. However, in a typical montane cloud forest in monsoon Asia, we found that decreasing winter monsoon may counteract the influences of decreasing cloud, leading to a warmer but less variable climate regime. We applied multiple dendroclimatic proxies to reconstruct year-round cloud and diurnal temperature range for the past 480 years (AD 1533-2012) in a montane forest in Taiwan. The cloud amount kept decreasing since 1940s but expected drying or higher temperature variability was not obvious. Instead, warming of winter due to weakening of east Asia winter monsoon was much faster than warming in summer, resulting a reduced temperature seasonality. We provided the first cloud reconstruction in South East Asia and pointed out that the modulation of monsoon in hydroclimates should be taken into account in TMCF in Asia.

If the 1960 Chile tsunami event had occurred in a different location along the Peru-Chile Trench

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Abstract

The 1960 earthquake, Mw 9.5, in Chile was the largest one ever recorded by the modern instrument. The tsunami triggered by the earthquake effected many harbors such as Hilo bay in Hawaii, and Keelung harbor in Taiwan. The earthquake epicenter was located on the Peru-Chile Trench, which is the longest trench on earth with a length of 5,900 kilometers. Along this trench, many large earthquakes occurred. One question was raised: if the epicenter of 1960 event had been located in a different part of Peru-Chile Trench, could the tsunami have been even larger than the current record? To answer this question, we preformed Impact Intensity Analysis (IIA) and Tsunami Arrival Time Analysis (TATA) methods. The IIA method was based on the Green's function. A series of unit sources were placed over the ocean area. The tsunami impact intensity was obtained by recording the maximum tsunami height on the study site. This method is efficient on reducing the number of scenarios, and reveals the source-sensitive regions. However, the tsunami directionality was ignored in the IIA method. The tsunami directionality is especially important to the trench-type tsunami, such as the Peru-Chile Trench. For this, we newly developed the TATA method to inspect the effect of source directionality by counting the similar arrival time from each source region. Based on the results of IIA and TATA methods, we found that moving the epicenter of 1960 Chile event northward for about 500 km, the wave height increased significantly in Keelung and Hilo.

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