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2019 Conference on Pan-Pacific Anthropocene (ConPPA)

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	1800-2100	**Conference Banquet** Kuanhe Restaurant (No. 237-6, Section 1, Datong Road, Xizhi District, New Taipei City)	

2019 第一屆泛太平洋人類世研討會(ConPPA)

日期	時間	議程	會議室
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	1630-1700	海報時間	504
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5 月 16 日	1300-1500	**電影欣賞座談會：「看見臺灣」** 放映影片 (93 分鐘) 與講評討論 講評人 臺灣大學地質系 魏國彥 教授	401
	1500-1530	茶敘時間	
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	1800-2100	**會議晚宴** 寬和宴展館 (新北市汐止區大同路一段 237-6 號)	

Tracks

Track 1. Climate Variability and Change in the Anthropocene

Dr. Huang-Hsiung Hsu (Research Center for Environmental Changes, Academia Sinica)
Dr. John Chiang (University of California, Berkeley, USA)

Track 2. Anthropocene Historical Record

Dr. Pao-Kuan Wang (Research Center for Environmental Changes, Academia Sinica)
Dr. Kam-Biu Liu (College of the Coast & Environment, Louisiana State University, USA)

Track 3. Terrestrial Proxy Records of Anthropocene

Dr. Liangcheng Tan (Institute of Earth Environment, Chinese Academy of Sciences, Xi'an)
Dr. Ashish Sinha (Department of Earth Sciences, California State University)

Track 4. Marine Proxy Records

Dr. Kristine DeLong (Department of Geography and Anthropology, Louisiana State University)
Dr. Yusuke Yokoyama (Atmosphere and Ocean Research Institute, The University of Tokyo)

Track 5. Anthropogenic Geohazard

Dr. Tso-Ren Wu (Graduate Institute of Hydrological & Oceanic Sciences, National Central University)
Dr. Adam Switzer (Earth Observatory of Singapore, Nanyang Technological University, Singapore)
Dr. Jiun-Chuan Lin (Department of Geography, National Taiwan University)

Track 6. Biodiversity and Ecosystem Health in the Pan Pacific Realm

Dr. Hsieh Chih-Hao (Institute of Oceanography, National Taiwan University)
Dr. I-Ching Chen (Department of Life Sciences, National Cheng Kung University)

Track 7. Archaeology and Civilization in the Asia-Pacific Realm

Dr. Ivy Hui-Yuan Yeh (School of Humanities, Nanyang Technological University, Singapore)
Dr. Felicia Beardsley (Sociology and Anthropology Department, University of La Verne, USA)

Opening Lecture

Time: Tuesday, 14th May, 0830-0845
Venue: Conference Room 507

Prof. Mark Williams
School of Geography, Geology and the Environment,
University of Leicester
Chair: Chuan-Chou Shen

Topic:
The Anthropocene

Abstract:
Each year humans move about 20 times more sediment than all of the world's rivers, utilize enough freshwater to drain the African Great Lakes Malawi and Victoria dry, add 36 billion tons of carbon dioxide to the atmosphere, and use more than 500 exajoules of energy from primary resources like oil, gas and coal. Humans have reshaped the biosphere, translocating plants and animals beyond their indigenous ranges, appropriating some 25-40% of the net primary production of plants and concentrating biomass in a small range of organisms – 7.6 billion Homo sapiens – and the organisms they consume, like chickens, cows and maize. Whilst the fossil record of archaic humans extends back nearly 3 million years, for much of that time, patterns of human influence were highly regional, beginning in Africa and gradually expanding throughout the world. However, from the mid-20th century onwards the accelerating signature of human global consumption can be demarcated by the spread of, for example, plastics, radiogenic isotopes from nuclear detonations, fly ash from thermal power stations, invasive species such as the giant African snail, and the globally traded materials that build our modern cities. These leave a clear and stratigraphically distinctive signature of human over-consumption of Earth resources, and thus of a geologically distinctive Anthropocene.

Plenary Lecture

Time: Wednesday, 15th May, 1400-1500
Venue: Conference Room 401

Prof. Gretta Pecl
Director, Centre for Marine Socioecology, and ARC Future Fellow
Institute for Marine and Antarctic Studies
University of Tasmania
Chair: I-Ching Chen

Topic:
Our oceans in the Anthropocene

Abstract:
There is now compelling evidence that suggests humanity's impact on the Earth has pushed the world into a new geological epoch, the Anthropocene. Accelerating growth in human population and per capita consumption, coupled with widespread habitat loss, has led to a step-change in the climatic, biological and geochemical signatures of human activity. Extinction rates of flora and fauna are far above the long-term average, and plastic in our waterways and oceans is virtually ubiquitous. Moreover, increased concentrations of CO2 in the atmosphere have led to increases in extreme weather, sea level rise, changes in ocean currents and connectivity, ocean acidification and warming waters. One of the most pervasive effects of climate change is a global redistribution of the planet's species with plants and animals, on land and in the ocean, shifting latitude, elevation and depth to keep pace with preferred environmental conditions. As the global climate changes, human well-being, ecosystem function, and even climate itself are increasingly affected by this shifting geography of life. Climate-driven species redistribution therefore presents intriguing ecological challenges to unravel, as well as fundamental philosophical questions and urgent issues related to ecology, fisheries, food security, Indigenous and local livelihoods, and many other aspects of human well-being. This presentation will highlight some of the key anthropogenic trends in our oceans, focussing on climate-driven species redistribution and the adaption planning and adaptation actions underway at international, national and local scales.

Plenary Lecture

Time: Wednesday, 15th May, 1530-1630
Venue: Conference Room 401

Prof. Peter Bellwood
Emeritus Professor (Archaeology)
School of Archaeology and Anthropology
Australian National University
Chair: Felicia Beardsley

Topic:
Were prehistoric human migrations in Southeast Asia and Oceania initiated by non-anthropogenic environmental changes?

Abstract:
Current research in archaeology, ancient DNA and comparative linguistics demonstrates the reality of a number of major prehistoric population dispersals into and through Southeast Asia, and onwards into Australia/New Guinea and Oceania. Apart from those of pre-sapient hominins, which remain obscure in their details, we have the following that merit discussion with respect to their potential associations with environmental changes:

1. The initial dispersal of Homo sapiens, variously dated by different authorities between 100 and 55 kya. This migration eventually reached Australia and New Guinea across the sea gaps of Wallacea.

2. The major Neolithic migrations of food producers from southern China into Mainland and Island SE Asia, dating mainly between 3500 and 1500 BC. These involved in linguistic terms the expansions of the Austroasiatic and Austronesian language families and their speakers, and to a lesser extent Tai/Daic. This migration, or at least its Austronesian-speaking arm, ultimately reached Polynesia.

Relationships between island sizes and sea levels (including land connections and visibility) during the Pleistocene have been highlighted recently, especially in connection with the initial settlements of Australia and New Guinea, which involved ocean crossings. However, in my presentation I will focus mainly on the Neolithic migrations. Two widely-discussed topics here concern (i) the relationship between the rise of postglacial sea level and the diminishing availability, prior to 1500 BC, of lowland alluvial soils suitable for growing rice (this is an important issue for mid-Holocene Austronesian dispersal through eastern Taiwan), and (ii), the relationship between increased ENSO occurrences of winds of westerly origin and the settlement of Remote Oceania.

Plenary Lecture

Time: Thursday, 16th May, 1530-1630
Venue: Conference Room 401

Prof. Brian Hoskins
Department of Meteorology
University of Reading
Chair: Huang-Hsiung Hsu

Topic:
The challenge of climate change

Abstract:
Climate change provides a huge challenge to scientists. Thermodynamic arguments underlie most of the aspects in which we have understanding and confidence, and this is sufficient to know that mitigating anthropogenic climate change is an imperative. However, the range of warmings given by climate models remains as large as it was 40 years ago. With the more recent interest in climate extremes, it is becoming essential to obtain a better picture of how the dynamics of the atmosphere and ocean may change.

A discussion will also be given of the international process for considering the mitigation of climate change, and the example of the Climate Change Act in the UK will be described. The challenge of climate change to engineers, business and politicians, and to society in general will be highlighted.

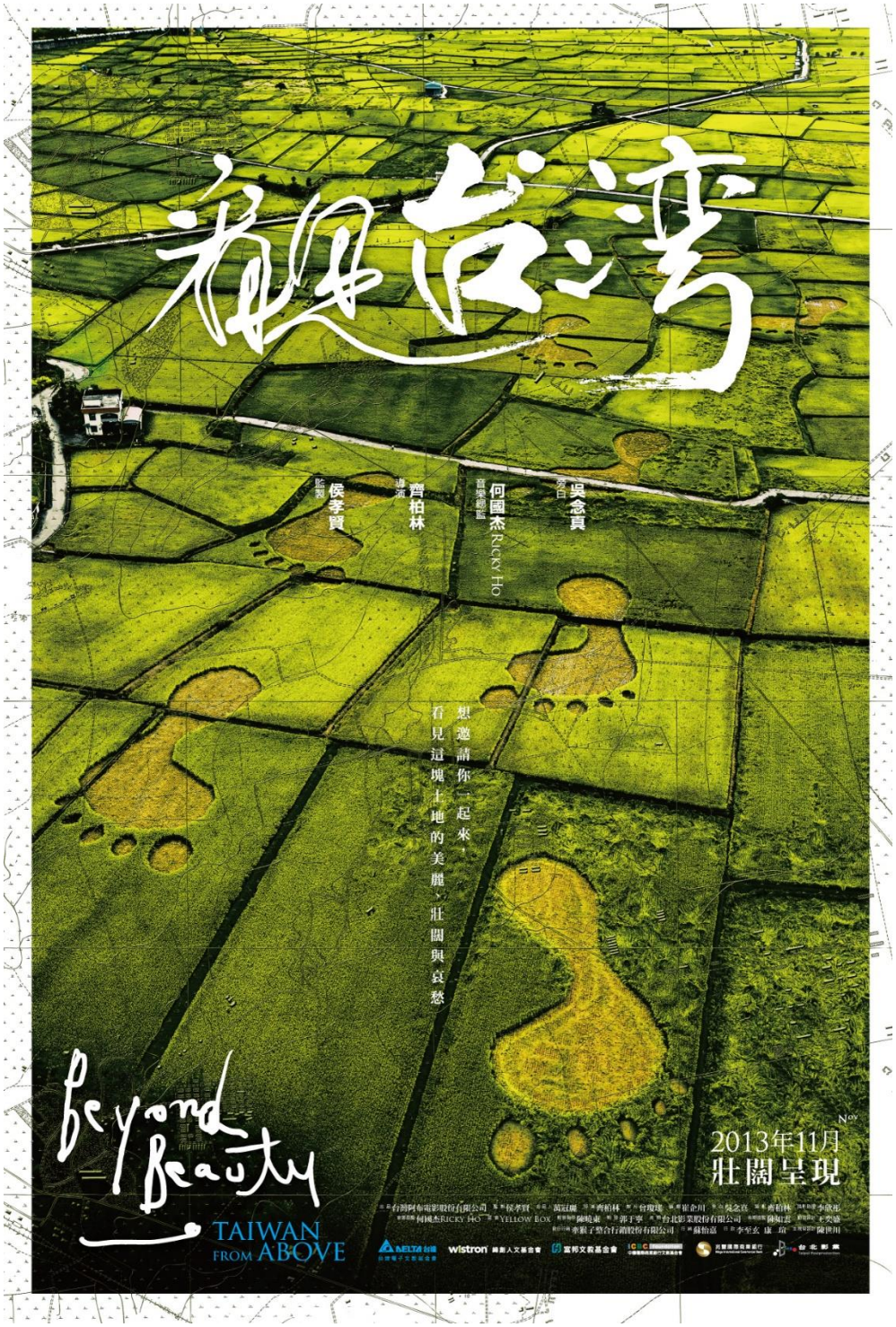
Movie Lecture

“Beyond Beauty: Taiwan from Above”

Time: Thursday, 16th May, 1300-1500
Venue: Conference Room 401

Movie (93 min) and discussion

Commentator: Prof. Kuo-Yen Wei
Department of Geosciences, National Taiwan University



Time: Tuesday, 14th May, 0845-1000
Venue: Conference Room 507
Track 1. Climate Variability and Change in the Anthropocene
Chair: John Chiang

Start-End	No.	Author(s)	Title
0845-0900	T1-00-O	Shaw Chen Liu et al.	On the trends of haze in four major polluted regions of China
0900-0915	T1-01-O	B. Fosu et al.	Greenhouse gases may increase aerosol loading in the Indo-Gangetic plains by stabilizing winter atmosphere
0915-0930	T1-02-O	Chia-Chi Wang et al.	Climate Effects of Anthropogenic Aerosol Forcing on Tropical Precipitation and Circulations
0930-0945	T1-03-O	Chen-Ling Jenny Hung et al.	Individual and combined impacts of future land-use and climate change on stormflow in two nested watersheds
0945-1000	T1-04-O	Desak Putu Okta Veanti et al.	The Impact of Climate Change on Cooling Energy Demand in Indonesia Based on Representative Concentration Pathways (RCP) Scenarios

Time: Tuesday, 14th May, 1030-1200
Venue: Conference Room 507
Track 1. Climate Variability and Change in the Anthropocene
Chair: Huang-Hsiung Hsu

Start-End	No.	Author(s)	Title
1030-1045	T1-05-O	John C. H. Chiang et al.	Intensification of the pre-Meiyu rainband in the late 21st century
1045-1100	T1-06-O	Chia-Wei Lan and Min-Hui Lo	Seasonal Shifting Changes in Precipitation among 1979-2016
1100-1115	T1-07-O	Yen-Ting Hwang et al.	Local and Remote Control on Tropical Circulation and Precipitation under Anthropogenic Climate Change
1115-1130	T1-08-O	Huang-Hsiung Hsu	Reduced TC Activity and Enhanced Anticyclone in the WNP in a Warmer World: Projection and Mechanism
1130-1145	T1-09-O	Lewis Todd Clint and Ming-Chien Su	Climate change in the Caribbean: Challenges and vulnerabilities in building resilience to tropical cyclones
1145-1200	T1-10-O	Mehnaz Rashid et al.	Increases in water stress in India at 1.5 and 2-degrees of global warming

Time: Tuesday, 14th May, 1330-1500
Venue: Conference Room 507
Track 1. Climate Variability and Change in the Anthropocene
Track 3. Terrestrial Proxy Records of Anthropocene
Chair: Ashish Sinha

Start-End	No.	Author(s)	Title
1330-1345	T1-11-O	Gagan Mandal et al.	Wind and Sea ice Control on the Deglacial Atlantic Southern Ocean Upwelling: A Modeling Perspective
1345-1400	T1-12-O	Keith B. Rodgers et al.	Coupling of Surface Ocean Heat and Carbon Perturbations Over the Subtropical Cells under 21st Century Climate Change
1400-1415	T1-13-O	Ting-Hui Lee and Min-Hui Lo	The Role of ENSO in Modulating the Maritime Continent's Deforestation Effects
1415-1430	T3-29-O	Haiwei Zhang et al.	A 200-year annually laminated stalagmite record of precipitation seasonality in southeastern China and its linkages to ENSO and PDO
1430-1445	T3-30-O	Tianli Wang et al.	The selection of a suitable primary marker for the Anthropocene
1445-1500	T3-31-O	Jun Inoue et al.	Records of sedimentary carbonaceous-fly-ash particles in East Asia and their chemical compositions: Implication for industrial activity during the Anthropocene

Time: Tuesday, 14th May, 1530-1700
Venue: Conference Room 507
Track 3. Terrestrial Proxy Records of Anthropocene
Chair: Haiwei Zhang

Start-End	No.	Author(s)	Title
1530-1545	T3-32-O	Shanjia Zhang and Guanghui Dong	Sedimentary records of prehistoric human impact on the environment in northwest China
1545-1600	T3-33-O	Ashish Sinha and Gayatri Kathayat	Anthropogenic Forcing of Indian Summer Monsoon Rainfall?
1600-1615	T3-34-O	Gayatri Kathayat et al.	Did Anthropogenic-induced decline in Atmospheric CO_2 triggered the Indian Monsoon Failures during the late 16^{th} to mid 17^{th} Century?
1615-1630	T3-35-O	Keyan Fang	Synchronous multi-decadal climate variability of the whole Pacific areas revealed in tree rings since 1567
1630-1645	T3-36-O	Ludvig Löwemark et al.	Understanding oxygen isotope records of climate change: Insights from a 5-year, daily resolved $\delta^{18}O$ precipitation record from Krabi, Thailand
1645-1700	T3-37-O	Tsai-Wen Lin et al.	The change of precipitation and human impact recorded in a subtropical mountain lake, north-eastern Taiwan since 3000 years BP

Time: Wednesday, 15th May, 0830-1000
Venue: Conference Room 507
Track 3. Terrestrial Proxy Records of Anthropocene
Chair: Gayatri Kathayat

Start-End	No.	Author(s)	Title
0830-0845	T3-38-O	Qiufang Cai and Yu Liu	300-yr drought variability in central North China inferred from tree rings and the possible driving mechanism
0845-0900	T3-39-O	Haibo He et al.	The sensitivity of the carbon sink by coupled carbonate weathering to climate and land-use changes: Sediment records of the biological carbon pump effect in Fuxian Lake, Yunnan, China, during the past century
0900-0915	T3-40-O	Jyh-Jaan Steven Huang et al.	The role of XRF-core scanning in the study of the Anthropocene – opportunities and challenges
0915-0930	T3-41-O	Burr George et al.	A history of the modern Aral Sea (Central Asia) since the Late Pleistocene
0930-0945	T3-42-O	Decheng Xiong et al.	Interactive effects of warming and nitrogen addition on fine root dynamics of a young subtropical plantation
0945-1000	T3-43-O	Xiaofei Liu et al.	Root litter inputs exert greater influence over soil C sequestration than does aboveground litter in a subtropical natural forest

Time: Wednesday, 15th May, 1030-1200
Venue: Conference Room 507
Track 2. Anthropocene Historical Record
Track 7. Archaeology and Civilization in the Asia-Pacific Realm
Chair: Kuanhui Elaine Lin, Felicia Beardsley

Start-End	No.	Author(s)	Title
1030-1045	T2-24-O	Huei-Fen Chen et al.	Tracks of tropical cyclones in Northwestern Pacific Ocean correspond to the ITCZ shifts and NAO phase over the past 2ka
1045-1100	T2-25-O	Pao K. Wang et al.	Experiments on the reconstruction methods and calibration of the climate series derived from REACHES historical database of China in 1644-1911
1100-1115	T2-26-O	Kam-Biu Liu	Some thoughts on the use of historical records in paleotempestology: Data quality, event validation, and hypothesis testing
1115-1130	T7-81-O	Kuo-Fang Chung	Population genomics of Paper mulberry supports the “out of Taiwan” hypothesis of Austronesian expansion and migration
1130-1145	T7-82-O	Felicia Beardsley	Charting Climate Change in the Archaeological Record of the Western Pacific
1145-1200	T7-83-O	Jacobus Bracker and Birte Meller	Archaeology in the Anthropocene: from the past to the present to the future

Time: Thursday, 16th May, 0830-0945
Venue: Conference Room 507
Track 4. Marine Proxy Records
Chair: Kristine DeLong, Yusuke Yokoyama

Start-End	No.	Author(s)	Title
0830-0845	T4-58-O	Yusuke Yokoyama	Antarctic ice sheet stability detected from mid latitude sea level records
0845-0900	T4-59-O	Akanksha Singh and Ludvig Löwemark	Bioturbation on the Yermak Plateau showing a relationship to sea ice conditions and productivity
0900-0915	T4-60-O	Chung-Che Wu et al.	Reef vulnerability in Anthropocene: Sensitive responses by the 1991 Mount Pinatubo volcanic eruption
0915-0930	T4-61-O	Kristine L. DeLong et al.	Tropical Atlantic Warm Pool Sea Surface Temperature Variability During the Last Interglacial: A Comparison of Coral-Based Reconstructions and Climate Models
0930-0945	T4-62-O	Shoko Hirabayashi et al.	Western Pacific variability detected through high-resolution bomb-derived radiocarbon measurements on corals

Time: Thursday, 16th May, 1030-1200
Venue: Conference Room 507
Track 5. Anthropogenic Geohazard
Track 6. Biodiversity and Ecosystem Health in the Pan Pacific Realm
Chair: Adam Switzer, I-Ching Chen

Start-End	No.	Author(s)	Title
1030-1045	T5-68-O	Hsiao-Chun Tseng et al.	Social-environmental analysis of methane in the South China Sea and bordering countries
1045-1100	T5-69-O	Alexander Kunz et al.	Microplastic pollution in the Tamsui River system (Taipei, Taiwan): abundance, mass balance, and seasonal variation
1100-1115	T5-70-O	Juan Liu et al.	Thallium distribution and isotopic fractionation in industrial slags and environmental implications
1115-1130	T6-74-O	Wei-Ping Chan et al.	The Velocity of Climate Change and Species Tracking in Global Mountains
1130-1145	T6-75-O	Wan-Hsuan Cheng et al.	Biodiversity and Ecosystem Functioning Relationship Varies Depending on Functional Specificity
1145-1200	T6-76-O	Pei-Hsuan Yao et al.	Fate of Arsenic in the Arsenic-tainted Paddy Rice Ecosystem at Guan-Du, its Origin and Impacts

Poster Session

Board No.	Poster No.	Author(s)	Title
14-PP-001	T1-14-P	Yuan-Jen Lin et al.	The uncertainty in the evolution of climate feedback traced to the strength of the Atlantic Meridional Overturning Circulation
14-PP-002	T1-15-P	Wan-Ru Huang et al.	Decadal fluctuations in the western Pacific recorded by long precipitation records in Taiwan
14-PP-003	T1-16-P	Pei-Chun Hsu et al.	Correlated Changes in Synoptic Eddy Activity and Temperature Gradient under Global Warming
14-PP-004	T1-17-P	Chao-An Chen et al.	Changes in Seasonal Precipitation in the Western North Pacific and East Asia under Global Warming in two high-resolution AGCMs
14-PP-005	T1-18-P	Wen-Shu Lin and Yen-Ting Hwang	The Evolving Sea Surface Temperature Patterns Formation and Their Impacts on the Tropical Precipitation and Atmospheric Circulation under Global Warming
14-PP-006	T1-19-P	Yong-Jhih Chen et al.	Distinct patterns of cloud changes associated with decadal variability and their contribution to observed cloud cover trends
14-PP-007	T1-20-P	Tao Xu et al.	Stable isotope ratios of typhoon rains in Fuzhou, Southeast China, during 2013–2017
14-PP-008	T1-21-P	Hung-Yi Tseng et al.	A Two-stage Tropical Atmospheric Circulation Response to Extratropical Thermal Forcing in an Aquaplanet Slab Ocean Model
14-PP-009	T1-22-P	Chih-Hua Tsou et al.	ENSO and Abrupt Change of Tropical Storm activity in the late 1990s
14-PP-010	T1-23-P	Chi-Cherng Hong et al.	Warming of SENP SST and Its Possible Effects on the East Asia Climate
14-PP-011	T2-27-P	Junhui Zhang et al.	Holocene dust variations revealed from Altai peat sediments in Northwest China
14-PP-012	T2-28-P	Kuan-Hui Elaine Lin et al.	Reconstructed typhoon series 1644-1911 and implications of general atmospheric-oceanic circulation
14-PP-014	T3-45-P	Yong Zhang and Xuemei Shao	A 2000-yr moisture history in the western Qilian Mountains of northwestern China: Evidence from tree rings
14-PP-015	T3-46-P	Chenxi Xu et al.	Increased variability of Thailand's Chao Phraya River peak-season flow and its association with ENSO variability: Evidence from tree ring $\delta^{18}O$
14-PP-016	T3-47-P	Guanghui Dong and Fengwen Liu	Detecting human impact on vegetation variation in northeast Tibetan Plateau during Bronze Age based on charcoal analysis
14-PP-018	T3-49-P	Ashish Sinha et al.	Climate Change in the Fertile Crescent
14-PP-019	T3-50-P	Hsin-Lin Wei et al.	Weakening of Asian monsoon, not cloud cover change, determines the climatic variability in montane cloud forest
14-PP-020	T3-51-P	Ke Lin et al.	Anthropogenic influence on monsoonal rainfall and vegetation in southwestern China over the past 300 years

Board No.	Poster No.	Author(s)	Title
14-PP-021	T3-52-P	F. Ye et al.	Soil properties and distribution in the riparian zone: the effects of fluctuations in water and anthropogenic disturbances
14-PP-022	T3-53-P	Jianghu Lan et al.	Responses of cyanobacteria to climate and human activities at Lake Chenghai over the past 100 years
14-PP-023	T3-54-P	Qiufang Zhang et al.	Ecophysiological process regulates the growth of Cunninghamia lanceolata to suit short-term warming and nitrogen addition in the sub-tropical regions
14-PP-024	T3-55-P	JiaoJiao Ji et al.	Effects of nitrogen deposition on the root biomass of subtropical fir saplings
14-PP-025	T3-56-P	Zhang Guilin et al.	Climate and environment change of desert/loess transition zone and its impact on prehistoric human activities since 6 ka B.P.
14-PP-026	T3-57-P	Yu Liu et al.	Anthropogenic aerosols cause recent pronounced weakening of Asian Summer Monsoon relative to last four centuries
14-PP-027	T3-58-P	Changfeng Sun et al.	Sunshine duration changes during the past 500 years in the southeastern Tibetan Plateau and its relationship to volcanic eruptions
14-PP-028	T4-63-P	Bethany Behrens et al.	Beryllium-10 as a partial constraint on ice sheet meltwater discharge from Wilkes Basin, East Antarctica
14-PP-029	T4-64-P	Bor-Jiun Jong et al.	Ba/Ca in planktonic foraminifera: Indicator of riverine freshwater input to the Arctic Ocean
14-PP-030	T4-65-P	Adam D. Sproson et al.	Anthropogenic osmium in macroalgae from Tokyo Bay reveals regional-scale contamination from catalytic convertors
14-PP-031	T4-66-P	Naoto Fukuyo et al.	Late Holocene sea level and environment changes at Tongatapu island in the South Pacific reconstructed from radiocarbon dating of shellfish
14-PP-032	T4-67-P	Kosuke Ota et al.	Radiocarbon fluctuations induced by intrusions of cold water recorded in Abalone shells in the coastal area of Northern Pacific Otsuchi Bay, Japan
14-PP-033	T5-71-P	Jędrzej Majewski et al.	Varied sedimentological characteristics of the 2018 Palu-Donggala Tsunami and the potential for preservation of historical tsunami deposits on the coastline of the Palu Bay
14-PP-033	T5-71-P	Adam D. Switzer et al.	Tsunami deposits of the 2018 Palu earthquake reflect the low power and short-term inundation of the tsunami and the limited availability of nearshore source sediments.
14-PP-034	T5-72-P	Graham Wong et al.	Assessing the mass balance and seasonal variation of microplastic contamination in the river network of Taipei Basin
14-PP-035	T5-73-P	En-Yang Joshua Yang et al.	Spatial distribution of micro and mesoplastic after extreme weather events at the northern coast of Taiwan
14-PP-036	T6-77-P	Yi-Wei Liu et al.	Geochemistry constraints on diverse growth and calcification responses of multiple coccolithophore species to ocean acidification

Board No.	Poster No.	Author(s)	Title
14-PP-037	T6-78-P	Chuan-Ho Tang et al.	Modeling lipid profile of coral responded to ambient warming as a biomarker of the thermal sensation
14-PP-038	T6-79-P	Nick Ching-Min Sun et al.	Mortality and morbidity in wild Taiwanese pangolin (*Manis pentadactyla pentadactyla*)
14-PP-039	T6-80-P	Pin-Hsin Hu	A new method to simulate plant diversity and to investigate its impact on climate in an Earth System Model
14-PP-040	T7-84-P	Kazuhiko Fujita et al.	Inception of human impacts on coral reef environments, Okinawa Island, Japan
14-PP-041	T7-85-P	Xinxin Zuo et al.	The mixed rice and millet agriculture in Neolithic age lower Minjiang River: Phytolith evidence from the Baitoushan site

Presentation Guide (Registration)

Registration Center

Venue: 4 F, Taipei Nangang Exhibition Center
Time: 0800 – 1700
*Full service consists of pre-registration, on-site registration, meetings services, register for field trips and other auxiliary services.

Presentation Guide (Oral)

1. Prepare Your Presentation

Length of presentation material should be in accordance with your time allotted. Total duration including Q&A and speaker changeover is 15 minutes for each talk. Please refer to the Final Program for actual presentation schedules. You are kindly requested to be at the presentation room at least 15 minutes before the session starts.

2. Determine Your Audio-Visual Needs

Each meeting room comes equipped with a laser pointer, computer, LCD projector and screen. The computers in the meeting rooms are being provided to Windows-based PC users. The PC will be configured with Windows Operating System. Please bring your presentation files in thumb drives. For MAC-laptop users, please bring your own VGA adapter cable.

3. Create a Backup Copy of Your Presentation

We recommend that you bring at least 2 copies of your presentation to the meeting for backup purposes. Thumb drives are acceptable.

4. Give Your Presentation

Be considerate to the other speakers and audience by staying within your allocated time. The allocated time for your presentation includes a discussion and changeover to the next speaker. Session Chairs will hold you to the allotted time. This is essential to ensure adequate time for questions and discussion as well as adherence to the schedule. Please discuss the same material as reported in your abstract submission. At the end of the meeting, all presentation files will be destroyed.

Presentation Guide (Poster)

1. Locate Your Poster Board

Poster presentations will be held from Tue-14 May to Wed-15 May 2019 at the Poster Hall (Room 504). Poster boards are pre-assigned and marked with your Poster No. Please feel free to approach the Poster Help Desk for assistance.

2. Poster Set-up, Question and Answer (Q & A) Session and Tear-down

Poster Set-up:
Tue-14 May, 0830-1230
*Poster Q & A:
Wed-15 May, 1200-1400
Wed-15 May, 1630-1700
Poster Tear-down:
Wed-15 May, 1700-1715
*Presenter attendance required during Poster Q&A

3. Prepare Your Poster

• Poster spec：Portrait paper，within 85 cm（W）x 150 cm（H）range
• Place your Poster No, Abstract Title and Authors' names prominently at the top of the poster to allow viewers to identify your abstract easily. Presenter's Name must be underlined and in Bold Letterings.
• Authors' names, e-mails and address information must be provided in case the viewer is interested in contacting you for more information.

4. Set Up Your Poster

• Posters should be set-up by 14 May, 1230 (Tue)
• Posters are scheduled to be on display from 14 May,1230 (Tue) to 15 May, 1700 (Wed). Poster Q & A Session is as scheduled and presenter attendance is required during the session.
• Adhesive tapes and scissors are available at the Poster Help Desk, nearby the poster boards. If you have special needs for your poster presentation, please bring those supplies with you to the meeting.

5. Remove Your Poster

• Posters must be removed after the viewing time by 15 May, 1715 (Wed).
• After this time, posters remaining on the boards may be removed and discarded by cleaners. ConPPA will not be responsible for posters and materials left on poster boards after the stated hours.

Abstracts

T1-00-O

On the trends of haze in four major polluted regions of China

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Abstract

Trends of haze days in four major polluted regions of China, namely Beijing-Tianjin-Hebei (BTH), Yangtze River Delta (YRD), Pearl River Delta (PRD) and Sichuan Basin (SCB) are analyzed for the period 1973-2017. Significant upward trends are observed in BTH, YRD and PRD. However, the values of trends reveal substantial regional and temporal differences. The trends also depend on the severity of haze, with greater trends for heavy haze days. In addition, significant differences exist between the trends of haze and those of emissions of air pollutants. Climate and meteorological conditions can be shown to be the primary driving force in determining the inter-annual variability as well as the trends of haze days in the four major polluted regions of China.

Keywords: Trends of haze, Emission control, Climate change

T1-01-O

Greenhouse gases may increase aerosol loading in the Indo-Gangetic plains by stabilizing winter atmosphere

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Abstract

The concentration of aerosols along the Indo-Gangetic Plains (IGP) and their adverse effects on human health and the environment are increasing, particularly in winter, when the IGP is prone to high anthropogenic aerosol loading (i.e. particulate matter – PM). In this study, three reanalysis datasets including the MERRA aerosol reanalysis were analyzed to characterize the relationship between winter atmospheric stability and aerosols. Due to the lack of long-term aerosol observations, an empirical relationship between PM and the atmospheric temperature lapse rate was derived. It is shown that PM and stability have a strong relationship at the lower troposphere. Analyses of Coupled Model Intercomparison Project (CMIP5) single-forcing experiments indicate that the recent stabilization of the atmosphere in the IGP can be explained by both greenhouse gas (GHG) and aerosol forcings. Since a more stable atmosphere traps more PM, stabilization alone can increase aerosols even in the absence of changes in emission sources. Regional simulation with fixed anthropogenic aerosol loading also supports this finding. Thus, enhanced stabilization caused by both aerosols and GHG in the atmosphere can further increase winter aerosol loading in the IGP.

Keywords: Aerosols, Stabilization, Greenhouse gases

T1-02-O

Climate Effects of Anthropogenic Aerosol Forcing on Tropical Precipitation and Circulations

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Abstract

Aerosols are one of the key factors influencing the hydrological cycle and radiation balance of the climate system. Although most aerosols deposit near their sources, the induced cooling effect is on a global scale and can influence the tropical atmosphere through slow processes, such as air-sea interactions. This study analyzes several simulations of fully coupled atmosphere–ocean climate models under the influence of anthropogenic aerosols, with the concentrations of greenhouse gases kept constant. In the cooling simulations, precipitation is reduced in deep convective areas but increased around the edges of convective areas, which is opposite to the "rich-get-richer" phenomenon in global warming scenarios. Tropical convection is intensified with a shallower depth, and tropical circulations are enhanced. The anomalous gross moist stability (M') mechanism and the upped-ante mechanism can be used to explain the dynamic and thermodynamic processes in the changes in tropical precipitation and convection. Asymmetric responses are found in the shift of intertropical convergence zone (ITCZ) and enhancement of Hadley circulation. The ITCZ shifts southward consistently in most of the simulations with increased northward energy transport by the Hadley circulation. Furthermore, enhancement of the Hadley circulation is more consistent than the change in the Walker circulation in the cooling simulations. The change in the Hadley circulation is not as negligible as in the warming cases in previous studies, which explains the consistency of the ITCZ shift in the cooling simulations.

Keywords: Aerosol cooling, Tropical circulation, Tropical precipitation, Gross moist stability, ITCZ shift

T1-03-O

Individual and combined impacts of future land-use and climate change on stormflow in two nested watersheds

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Abstract

Climate and land-use change affect hydrologic systems in a complex manner. Stormwater simulation models can help to distinguish between the hydrologic effects of land-use change and climate change scenarios and measure their relative magnitudes. This study compares simulated impacts of projected land-use and climate change on urban stormflow in two small, highly urbanized watersheds of the upper Rocky Branch Watershed in Columbia, South Carolina, USA, using the U.S. Environmental Protection Agency (EPA)'s Storm Water Management Model (SWMM). Runoff responses for moderate-magnitude storms under various land-use change scenarios with differing imperviousness were contrasted with runoff responses using various climate-change scenarios. Three land-use change scenarios, based on U.S. EPA's Integrated Climate and Land Use Scenarios (ICLUS) and three climate-change scenarios, based on the World Climate Research Programme's CMIP3 altered climate regimes (hot/dry, median change, and warm/wet conditions) were applied to near-term (2035) and far-term (2060) periods for both peak discharge and storm runoff volumes at a headwater and a downstream stream-gauge site. Changes in flow events simulated by the climate-change scenarios were much greater than with land-use change and were highly seasonal. The maximum increase occurred with the combination of a warm/wet climate and two land-use scenarios (A2, A1) for the 2035 and 2060 scenarios. At the headwater and downstream gauges, the warm/wet scenario caused larger increases than land-use changes in peak discharges and total event runoff volumes from late spring to early fall for both 2035 and 2060. However, the combined climate and land-use change scenario produced a greater increase than the sum of changes from the individual scenarios. These results have implications for integrated climate-impact assessment, urban planning, and policy decisions related to storm runoff and water quality.

Keywords: Headwater, Land-use change, Climate change scenarios, Stormwater modelling, Urban flood hydrology

T1-04-O

The Impact of Climate Change on Cooling Energy Demand in Indonesia Based on Representative Concentration Pathways (RCP) Scenarios

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Abstract

Air conditioning system in a building is necessary to maintain air temperature at a certain comfort level, especially in tropical countries such as Indonesia. Global warming was believed to accelerate the increase in energy consumption for air conditioning as a consequence of rising surface temperatures. This study aims to quantify the changes in energy consumption used for air conditioning systems based on Cooling Degree Days (CDD) that is calculated from the daily average temperature in Indonesia based on RCP 4.5 and 8.5 scenarios. Projections for the future scenarios is compared with the energy consumptions in 2010. The results showed that energy consumptions increase up to 10 kWh/m2 year in 2030 for both scenarios. In 2050, RCP 8.5 scenario estimates higher increase in energy consumption, around 8 to 24 kWh/m2 while RCP 4.5 shows increases around 4 to 20 kWh/m2 year. Then, in 2080 the energy needed for cooling increases further, around 24 to 42 kWh/m2 year for RCP 8.5 and around 20-30kWh/m2 for RCP 4.5. The highest changes is expected to occur in South Sumatra and South Kalimantan.

Keywords: Air conditioning, Cooling degree day, Global Warming, Surface temperature, Climate scenario

T1-05-O

Intensification of the pre-Meiyu rainband in the late 21st century

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Abstract

Changing land-ocean thermal contrasts are usually implicated in the response East Asian summer monsoon rainfall to global warming. We highlight an additional and physically distinct influence whereby increased meridional stationary eddy circulation downstream of the Tibetan Plateau intensify the early summer rainfall over southeastern China and drives a stronger moisture flux convergence, intensifying the rainband. This effect occurs robustly across the CESM large ensemble RCP 8.5 simulations, and only for the pre-Meiyu stage (mid-May through late June). The westerly jet impinging on the Plateau is enhanced during this time, suggesting that an orographic influence on the westerlies as the root cause. The increased westerlies result from increased tropical upper tropospheric temperatures that enhance the meridional temperature gradient at the latitudes of the Plateau. Our results highlight the potential role of the westerlies in altering the East Asian monsoon in the late 21st century, resulting from a fortuitous positioning of the Plateau at the edge of the Tropics.

Keywords: East Asia, Monsoon, Precipitation, Climate Projection

T1-06-O

Seasonal Shifting Changes in Precipitation among 1979-2016

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Abstract

As the global atmosphere warms, water vapor concentrations increase with rising temperature at the rate of 7%/K in accordance with the Clausius–Clapeyron relationship. Studies have found that both the intensity and frequency of heavy rainfall events are likely to increase due to the rising water vapor. In addition, our previous studies suggested that increased precipitation is found in wet seasons and decreased precipitation is found in dry seasons from both observations and model simulations as the troposphere warms. Mann and Park (1996) used harmonic function to describe the temperature seasonal cycle and investigated the seasonal shifting in the near surface air temperature. Pal et al. (2013) demonstrated that the onset of the dry period over the Lower Mississippi River valley is 2-3 weeks earlier from 1930 to 2009. Although the seasonal shifting in precipitation is crucial for water resource management, especially over the regions with distinct seasonality of precipitation, rare studies have explored the issues of the seasonal shifting in precipitation. In this study, we used daily multi-source weighted-ensemble precipitation (MSWEP) data from 1979-2016, which has the global gridded precipitation dataset at daily time scale. The preliminary results show that some regions have clear seasonal shifting in wet and dry seasons, such as north Indian, north America monsoon regions, and the regions with extratropical cyclone activities. Furthermore, the dry season over the north Indian move earlier about 21.6 days/decade from 1979 to 2016, indicating the earlier raining season. We will further investigate the primary mechanisms for such increased rainfall over the north Indian region before the rainy season.

Keywords: Global warming, Seasonal shifting, Seasonal cycle

Local and Remote Control on Tropical Circulation and Precipitation under Anthropogenic Climate Change

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Abstract

The local control of tropical sea surface temperature has long been recognized to play a critical role in determining the position of the tropical rain belt. The newly developed global energetic constraint, on the other hand, has emphasized extratropical influence on tropical precipitation. A potential confusion arises: As the climate warms, the local perspective predicts a southward shift of the tropical rain belt toward the equator, caused by an El Niño-like warming pattern; whereas the energetic perspective points to a northward shift of the tropical precipitation due to positive feedbacks over Northern Hemisphere high latitudes and enhanced heat uptake over Southern Ocean. Here we point to a structural change in Hadley Circulation when reconciling the two perspectives. An inter-tropical convergence zone (ITCZ) index and a precipitation centroid (PC) index are defined to quantify the meridional displacement of the zonal-mean rainfall peak and the overall tropical precipitation pattern, respectively. In the Community Earth System Model (CESM) Large Ensemble Project's historical and RCP8.5 simulations, the two indices evolve differently. The ITCZ index and the position of Hadley Cell center is initially stationary but begin to shift southward toward an enhanced equatorial warming pattern that appears after the 1990s. On the other hand, dominated by precipitation changes in the subtropics, the PC first shifts southward when aerosols cool the Northern Hemisphere during the 20th century, and then migrates northward after year 2000 when greenhouse gas warming is larger in the Northern than Southern Hemisphere. The structural changes in Hadley Circulation and tropical precipitation can also be seen in other global climate models participated in CMIP (the Coupled Model Intercomparison Project of the World Climate Research Program). Understanding the local and remote influences shed new lights on predicting regional climate change.

Keywords: Hadley Circulation, Tropical Precipitation, Global Warming

T1-08-O

Reduced TC Activity and Enhanced Anticyclone in the WNP in a Warmer World: Projection and Mechanism

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Abstract

The 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.

T1-09-O

Climate change in the Caribbean: Challenges and vulnerabilities in building resilience to tropical cyclones

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Abstract

Caribbean Small Island Developing States (SIDS) are one of the most vulnerable regions in the world and highly effected by the impacts of climate change. The Caribbean sustained extensive loss and damage in the years 2010-2017 and accounted for approximately US$100 billion. This impedes the development aspirations of SIDS in an already challenging and vulnerable setting. This paper discusses how socio-economic factors exacerbate the adverse impacts of climate change and reinforce existing vulnerabilities. The Emergency Events Database (EM-DAT) was used to compile tropical cyclone data from 19 countries between 1980-2017. Data was complemented by interviews with 10 stakeholders from the island of St. Vincent and the Grenadines to identify the main factors hindering the region to build resilience. Statistical analysis was used to analyse the adverse economic impacts on the productive, infrastructure, and social sector. From the interviews, four main factors that hinder resilience building were identified: 1) lack of finance, 2) high public debts, 3) income status, 4) need for specific vulnerability indexes for Caribbean Islands. Recommendations resulting from the data analysis are: abandoning the per capita national income and the economic vulnerability as an eligibility criterion for access to concessional and non-concessional financial development assistance as well as disregarding per capita GDP of SIDS for accessing finance.

Keywords: Caribbean Small Island Developing States, Climate change adaptation, Tropical cyclone, Vulnerability, Loss and damage.

T1-10-O

Increases in water stress in India at 1.5 and 2-degrees of global warming

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Abstract

Anthropogenic warming along with the unabated population increase pose a severe threat to freshwater resources and is expected to increase water stress, particularly in vulnerable regions, e.g., India. We present the first assessment of near future water stress (WS) in India at 1.5 and 2-degrees scenarios compared to preindustrial climate conditions, using two global hydrological models viz., WaterGAP2 and PCR-GLOBWB with three global climate models input forcings, viz., GFDL-ESM2M, MIROC5 and HadGEM2-ES under 6.0 RCP (Representative Concentration Pathways) climate and SSP2 (shared socioeconomic pathways) population projections. We observe a drastic increase in WS under the warming scenarios with a noticeable intra-seasonal shift affecting around half a billion people. Thus, the 1.5 and 2-degrees temperature increase are unsafe thresholds with substantial damage to water availability. Our simulations project robust changes in the hydrological fluxes with an extreme spatiotemporal variability; these changes are a result of the combined impact of climate change and population increase. Although it is difficult to segregate these two signals due to combined impacts, we have identified the vulnerable regions with the dominance of at least one signal. Our simulations also emphasize the adverse effects of 1.5 to 2-degrees temperature increase on water availability/consumption vis-à-vis water stress in India. Limiting both the temperature and population increase can result in substantial benefits not only in water security but also in the food and socio-economic development.

Keywords: India, anthropogenic warming, Water stress, Food security, Global hydrological models, Global climate models

T1-11-O

Wind and Sea ice Control on the Deglacial Atlantic Southern Ocean Upwelling: A Modeling Perspective.

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Abstract

Deep ocean accumulated more respired carbon during each glacial times making Southern Ocean (SO) the most prolific of all the oceans for carbon storage. SO upwelling acts as a window for the communication between the carbon-rich deep water and the atmosphere. Therefore, even a slight change in deglacial SO upwelling would potentially alter atmospheric deglacial CO_2 concentration. With few paleorecords, modeling perspective on the response of SO upwelling to the last deglacial Northern hemisphere millennial events need to be investigated. In this study, we track this change by analyzing transient fully Coupled General Circulation model simulation forced by changes in greenhouse gasses, orbital forcing, meltwater discharge and ice-sheet history. Model simulation indicates stronger SO upwelling during millennial events in consistence with upwelling and deglacial atmospheric CO_2 paleorecords. Simulation shows that SO upwelling has a negative correlation with deglacial meltwater discharge in the Northern Hemisphere ocean. This suggests an interhemispheric oceanic interconnection with change in deep ocean salinity and temperature in the Southern Hemisphere Atlantic basin. We also evaluated the deglacial change in SO upwelling with atmospheric influence and have found that greater wind stress results in greater SO upwelling. However, we also found that wind stress alone cannot account for greater upwelling towards the Onset of Holocene and have argued that, it can be explained by a combination of wind stress and sea ice modulated buoyancy forcing. Therefore, simulation demonstrates that atmosphere, ocean and cryosphere are dynamically interlinked through the last deglaciation during the late Pleistocene. Moreover, it highlights the role of SO ventilation to deglacial increase in atmospheric CO_2. This insight could project future climate change modeling studies pertaining to change in atmospheric CO_2 concentration with global warming.

Keywords: Southern Ocean, Upwelling, Sea ice, Westerlies, Meltwater discharge

T1-12-O

Coupling of Surface Ocean Heat and Carbon Perturbations Over the Subtropical Cells under 21st Century Climate Change

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Abstract

It is well established that the ocean plays an important role in absorbing anthropogenic carbon (C_{ant}) from the atmosphere. Under global warming, Earth system model simulations and theoretical arguments indicate that the capacity of the ocean to absorb C_{ant} will be reduced relative to what would be absorbed by an unperturbed physical state of the ocean, with this constituting a positive carbon-climate feedback. Recent studies emphasize the importance of the subpolar North Atlantic and/or the Southern Ocean in sustaining such feedbacks, although for these regions a consensus view has not emerged regarding the mechanistic controls on marine carbon-climate feedbacks. Here we apply a suite of sensitivity simulations with an individual Earth system model to demonstrate that the surface waters of the shallow overturning structures (spanning 45°S-45°N) sustain nearly half of the global carbon-climate feedback. Mechanism denial is applied in the Earth system by disallowing the secular trend in the physical state of the ocean under climate change, while simultaneously allowing the transient effects of heating/freshening on the solubility of CO_2 in surface seawater. The main results indicate that heat and carbon coupling is the dominant driver of carbon-climate feedbacks over 45°S-45°N, and that this occurs through perturbations to the buffering capacity of seawater rather than through changes in ocean stratification and subduction rates. Results over the Pacific Ocean will be the point of emphasize in the presented material.

Keywords: Pacific Ocean, Carbon cycle, Coupled climate feedbacks

T1-13-O

The Role of ENSO in Modulating the Maritime Continent's Deforestation Effects

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Abstract

The Maritime Continent (hereafter MC) has suffered from severe deforestation in the past few decades. Studies have shown that deforestation will lead to local warming. Chen et al. (2018) used CESM (Community Earth System Model) to investigate the effect of deforested MC based on using the climatological sea surface temperature (SST), and found an increasing zonal surface temperature gradient in tropical Pacific, which is accompanied with intensified trade wind. They also indicated that even the evapotranspiration was reduced due to deforestation over the MC's islands, the moisture convergent from ambient ocean increase the precipitation. The magnitude of the increased precipitation is comparable to the precipitation rising in La Niña year. However, the interaction of deforested MC and ENSO (El Niño–Southern Oscillation) is not clear. In this study, we explore whether the ENSO can modulate the MC deforestation's impacts, particularly focusing on changes in the trade wind over the central Pacific by using CESM CAM (Community Atmosphere Model) and CLM (Community Land Model)with prescribed El Niño and La Niña SST, respectively. The model simulation shows that the zonal temperature gradient (surface temperature in MC minus Niño3.4 SST) are highly correlated to zonal wind at 850hPa (140E to 170W). After deforestation, the temperature in MC increased. Preliminary results show that the rising zonal temperature gradient accompanies with intensified easterly wind anomaly in La Niña simulation. However, the westerly wind also intensified under the decreasing zonal temperature gradient in El Niño simulation.

Keywords: Deforestation, ENSO, CESM, Equatorial trade wind

T1-14-P

The uncertainty in the evolution of climate feedback traced to the strength of the Atlantic Meridional Overturning Circulation

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Abstract

In coupled climate models forced with a CO_2 increase, effective climate sensitivity generally rises after a few decades owing to a more positive climate feedback. This change in climate feedback ranges from -0.18 to 1.05 W m^{-2} K^{-1} across CMIP5 models, adding another uncertainty in determining climate sensitivity. In this study, we suggest that the intermodel spread of changes in climate feedback can be partially traced to the evolution of the Atlantic Meridional Overturning Circulation (AMOC). Models with stronger AMOC recovery tend to project more amplified warming in the Northern Hemisphere (NH) a few decades after a quadrupling of CO_2. Tropospheric stability then decreases as the NH gets warmer, which leads to an increase in both the lapse-rate and shortwave cloud feedbacks. Similar relationships between the AMOC variation and radiative anomalies are also found in unforced decadal variability. Our results suggest that constraining future ocean circulation changes will be necessary for accurate climate sensitivity projections.

Keywords: Climate sensitivity, Climate feedbacks, Atlantic Meridional Overturning Circulation, Radiative budget, Greenhouse gas forcing

T1-15-P

Decadal fluctuations in the western Pacific recorded by long precipitation records in Taiwan

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Abstract

A 110-year precipitation record in Taiwan, located in the western edge of the subtropical North Pacific, depicts a pronounced quasi-decadal oscillation (QDO). The QDO in Taiwan exhibits a fluctuating relationship with the similar decadal variations of sea surface temperature (SST) anomalies in the central equatorial Pacific known as the Pacific QDO. A regime change was observed around 1960 in that the decadal variation of Taiwan's precipitation became more synchronized with the Pacific QDO's coupled evolutions of SST and atmospheric circulation than before, while the underlying pattern of the Pacific QOD did not change. Using long-term reanalysis data and CMIP5 single-forcing experiments, the presented analysis suggests that increased SST in the subtropical western Pacific and the strengthened western extension of the North Pacific subtropical anticyclone may have collectively enhanced the relationship between the Taiwan precipitation and the Pacific QDO. This finding provides possible clues to similar regime changes in quasi-decadal variability observed around the western Pacific rim.

Keywords: Precipitation, Taiwan, Pacific quasi-decadal oscillation, Subtropical anticyclone

T1-16-P

Correlated Changes in Synoptic Eddy Activity and Temperature Gradient under Global Warming

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Abstract

The effect of human-induced climate change on weather systems has recently received much attention. Many studies have suggested the links between anthropogenic global warming and synoptic phenomena. However, robust observational evidence and model simulations that confirm these links in a global scale are lacking. Here we use singular value decomposition analyses to reveal robust covarying signals between mean poleward temperature gradient and synoptic eddy activity under global warming. We note that the radiative effect of greenhouse gases acts to warm the troposphere and cool the stratosphere, resulting in enhancement of equator-to-pole temperature difference in the upper troposphere and lower stratosphere (UTLS). We observed increasing trends in weather–timescale eddy kinetic energy associated with a steepened poleward temperature gradient in the midlatitude UTLS regions in the Southern Hemisphere winter/summer and the Northern Hemisphere winter over the past six decades. The findings suggest that if greenhouse gas–induced warming continues to amplify the equator-to-pole temperature contrast, extratropical synoptic disturbances in the upper troposphere may become increasingly active.

Keywords: Global warming, Synoptic system, Eddy activity, Temperature gradient, Singular value decomposition

T1-17-P

Changes in Seasonal Precipitation in the Western North Pacific and East Asia under Global Warming in two high-resolution AGCMs

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Abstract

Precipitation over the western North Pacific and East Asia region (WNP-EA) exhibits more complicated seasonal features than that over other monsoonal regions. To estimate seasonal precipitation change over the western North Pacific and East Asia region (WNP-EA), we use High-resolution Atmospheric Model (HiRAM) (50 km resolution) to conduct a series of simulations forced by Representative Concentration Pathways 8.5 (RCP8.5) scenario with the fifth phases of the Coupled Model Intercomparison Project (CMIP5) ensemble sea surface temperature (SST) changes. Three more members forced by different SST warming patterns are also conducted to investigate the sensitivity of future projections regarding various SST forcing (SST'_{spa}). We also assess the sensitivity associated with model dependence by comparing with the results of the Meteorological Research Institute-Atmospheric General Circulation Model (MRI-AGCM3.2S) projections. The major findings are: 1) Weakened atmospheric circulation in all seasons; 2) More precipitation over most of the northern East Asian continent and the northern WNP oceanic region in all seasons; 3) An anomalous anticyclonic circulation (AAC) together with decreased precipitation over the oceanic WNP-EA and reduced typhoon-related rainfall in the typhoon season; and 4) Largest sensitivity to various SST'_{spa} in spring comparing with other seasons. The aforementioned changes are similarly seen in both the HiRAM and MRI-AGCM3.2S, suggesting the reliability of our findings. The moisture budget indicates the dominance of dynamic contribution to the reduced precipitation. By contrast, the increased precipitation may be associated with various processes such as enhanced upward motion, increased water vapor or surface evaporation.

Keywords: Precipitation change, The western North Pacific and East Asia, High-resolution atmospheric model, Global warming

T1-18-P

The Evolving Sea Surface Temperature Patterns Formation and Their Impacts on the Tropical Precipitation and Atmospheric Circulation under Global Warming

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Abstract

The goal of this study is to examine the mechanisms of the evolving sea surface temperature (SST) patterns under an abrupt quadrupling of CO_2 forcing among CMIP5 models and investigate how the SST patterns influence tropical precipitation and atmospheric circulations. Two SST patterns are explored: (1) El Niño-like warming is first induced by suppressed evaporative cooling in the equatorial region and becomes conspicuous with time due to the involved ocean dynamics, such as the decreased strength of equatorial upwelling. The changes in SST warming pattern directly affects the stability and precipitation, which is known as warmer-get-wetter mechanism. The El Niño-like SST warming pattern offers a local control for the intertropical convergence zone, which keeps shifting southward to the equator, with hemispheric symmetric mode of Hadley Circulation (HC) reinforcing in the deep tropics sides. (2) The interhemispheric SST asymmetry pattern is first caused by increasing tropical trade wind in the Southern Hemisphere (SH) and decreasing in the Northern Hemisphere (NH), which results in greater warming in the NH. From the energetic perspective, the interhemispheric warming imbalance provides a remote control on tropical precipitation: an anticlockwise cross-equatorial HC is induced to balance the energy, inferring a southward energy transport toward the cooler SH via the upper branch and a northward shifting of precipitation centroid (PC) causing by the northward moisture transport via the lower branch. On the other hand, the southern tropics warms up after decades of quadrupling CO_2 when the Southern Ocean stop acting as a heat sink, which leads to reversal cross-equatorial HC, causing a northward cross-equatorial flux and a southward shift of PC. Improving our understanding of the temporal evolution of SST patterns is vital to help us construct future precipitation patterns and atmospheric circulations with higher confidence.

Keywords: Evolving sea surface temperature, Global warming, CMIP5 models, Tropical precipitation, Hadley circulation

T1-19-P

Distinct patterns of cloud changes associated with decadal variability and their contribution to observed cloud cover trends

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Abstract

With the goal of understanding the relative roles of anthropogenic and natural factors in driving observed cloud trends, this study investigates cloud changes associated with decadal variability including Pacific Decadal Oscillation (PDO) and Atlantic Multi-decadal Oscillation (AMO). In the pre-industrial simulations of CMIP5 global climate models (GCMs), the spatial patterns and the vertical structures of the PDO-related cloud cover changes in the Pacific are consistent among models. Meanwhile, the models show consistent AMO impacts on high cloud cover changes in the tropical Atlantic along with the subtropical and central tropical Pacific, and low cloud cover changes in the North Atlantic and the subtropical Northeast Pacific. The changes of the cloud cover associated with PDO and AMO can be understood via the relationships between large-scale meteorological parameters and clouds on inter-annual timescale. The low cloud changes are tightly linked to SST anomalies, and the high clouds anomalies are associated with vertical motion anomalies. In addition, the estimated high, low, and total cloud cover trends associated with the decadal variability in the period of 1983 to 2009 are consistent with those trends in satellite records. On the other hand, the pattern of the estimated greenhouse gas (GHG) forced cloud cover trends differs from that related to decadal variability, and may explain the observed downward trend in cloud cover between 30-40 degrees latitude in both hemispheres and the upward trend in the subtropical Southeast Pacific. In most models, the magnitudes of the estimated decadal variability contribution to the observed cloud cover trends are larger than those contributed by GHG, suggesting the observed cloud cover trends are more closely related to decadal variability than to GHG-induced warming.

Keywords: Decadal variability, Cloud, Satellite observation, Climate sensitivity

T1-20-P

Stable isotope ratios of typhoon rains in Fuzhou, Southeast China, during 2013–2017

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Abstract

Stable isotope ratios (δ^2H and $\delta^{18}O$) in precipitation not only show a certain response to climate change at different time scales, but also have strong linkages to extreme weather events such as tropical cyclones (hurricanes/typhoons). Typhoon activity in the coastal region of Southeast China is quite intense, bringing huge amounts of moisture; thus, contributing to extreme rainfall in this region. The existing isotope data in Southeast China is available on a monthly or daily temporal resolution, which is inadequate to study 1-2-day-long typhoon rainfall events at a particular location. In this study, hourly rainfall δ^2H and $\delta^{18}O$ data are collected for eight typhoon events from 2013–2017 in Fuzhou, Southeast China. The total correlation between δ^2H and $\delta^{18}O$ is obtained as $\delta^2H = 7.41\ \delta^{18}O + 0.81$ (R^2=0.96, N=220). All the eight typhoon events reveal a similar variability pattern in $\delta^{18}O$ values which can be divided into three stages. More positive $\delta^{18}O$ values occur in the first and third stages, while the second stage is dominated by most negative $\delta^{18}O$ values, exhibiting an inverted U-shaped pattern. The positive $\delta^{18}O$ values during the first and third stages are governed by re-evaporation. The precipitation during the second stage has distinctly lower $\delta^{18}O$ values than the weighted average $\delta^{18}O$ of summer precipitation in Fuzhou. Some of these values are slightly lower than those of the water vapor over the Pacific Ocean's surface. No significant relationship is observed between precipitation $\delta^{18}O$ and temperature as well as the amount of precipitation during the second stage. We hypothesize that the significant ^{18}O-depletion is mainly caused by the 'rain shield effect', which refers to combination of large-scale convection, high condensation efficiency, and recycling of isotopically depleted vapor in rain shield areas leading to very negative $\delta^{18}O$ values during typhoon system. These findings suggest the use of stable isotope ratios as important tracers of typhoon water.

Keywords: Typhoon, Rainfall, Stable isotope ratios, Southeast China, Rain shield effect

T1-21-P

A Two-stage Tropical Atmospheric Circulation Response to Extratropical Thermal Forcing in an Aquaplanet Slab Ocean Model

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Abstract

With the goal of understanding the mechanisms and the time scales of extratropical-tropical interactions, this study investigates the transient responses of atmospheric energy and momentum fluxes to a time-invariant extratropical thermal forcing in an atmospheric model coupled to an aquaplanet mixed layer ocean. Two distinct stages of the tropical responses are observed from an imposed extratropical heating: (1) The decrease in the meridional temperature gradient in midlatitudes leads to a rapid weakening of the eddy momentum flux and a slight reduction of the Hadley Cell strength in the forced hemisphere. (2) Once the tropical sea surface temperature is influenced by the imposed forcings, the cross-equatorial Hadley Cell develops and the Intertropical Convergence Zone shifts toward the warmer hemisphere. The transient analysis reveals that the Hadley Cell weakening in the first stage is related to the decreased eddy momentum flux divergence and its response time scale is independent of the mixed layer depth (MLD). In contrary, the time scales of the development of the second stage cross equatorial cell increase as MLD increases, ranging from about 7 months for the case with 50m MLD to about 15 months for the case with 200m MLD. This study merges the momentum and energetics perspectives of extratropical influence on tropical circulations. The results suggest that the subtropical response triggered by variations in momentum budget occurs in a timescale that is distinct from the deep tropical response controlled by thermal processes. Once developed, the deep tropical cross-equatorial cell response is an order of magnitude stronger than the initial subtropical response and dominate the anomalous circulation in the new equilibrium state.

Keywords: Extratropical-tropical interactions, Hadley Circulation, Intertropical Convergence Zone (ITCZ)

T1-22-P

ENSO and Abrupt Change of Tropical Storm activity in the late 1990s

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Abstract

The Asian coastal populations have significantly increased in recent decades. To prevent and reduce the disaster by the intense tropical storms (TS), TS activities changes have received considerable attention. In the late 1990s, TS genesis frequency was abruptly decreased in the western North Pacific (WNP). At the same time, intense TS were abruptly increased. The mechanisms responsible for the abrupt change of TS genesis frequency and TS intensity in the WNP since the late 1990s were investigated in this study. A novel synoptic-scale eddies (SSE) kinetic energy budget equation was adopted to quantitatively estimate the relative contributions of mean and SEE interaction and Intraseasonal Oscillation (ISO) and SSE interaction. The results show that the anticyclone anomaly associated with mega-La Niña (cold ENSO) in the late 1990s substantially reduced the mean-SSE interaction and TS genesis frequency, while the warm oceanic condition in the WNP enhanced the ISO-SSE interaction and increased intense TS frequency in the South China Sea and Philippine.

Keywords: Tropical Storm, ENSO, Intraseasonal Oscillation (ISO), Synoptic-Scale Eddies(SSE), ISO-SSE interaction

T1-23-P

Warming of SENP SST and Its Possible Effects on the East Asia Climate

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Abstract

Observation revealed that the SST in the Subtropical Eastern North Pacific (SNENP), in where having the local maximum of the variance of surface wind, exhibited an interdecadal warming since 2010. This warming was increasing and became stronger in future projection estimated by the CMIP5 simulations. The physical processes response for the SENP warming was investigated. It revealed that the SENP warming was primarily resulted from the weakening of prevailing northeastern wind and was maintained by the wind-evaporation-SST feedback. Observation further indicates that the Atlantic quadruple SST, the second EOF of Atlantic SST that also exhibited an interdecadal increasing since 2010, contributes substantially to the weakening of northeastern prevailing wind. Substantial impact of SENP warming on the East Asia climate, including the western north Pacific subtropical high (WNPSH), monsoon rainfall and TC activity were demonstrated.

Keywords: Subtropical Eastern north Pacific (SNENP) warming, Atlantic quadruple SST, Prevailing wind, Wind-evaporation-SST feedback, Western north Pacific subtropical high (WNPSH)

T2-24-O

Tracks of tropical cyclones in Northwestern Pacific Ocean correspond to the ITCZ shifts and NAO phase over the past 2ka

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Abstract

The northwestern Pacific Ocean and south China sea are where tropical cyclones occur most frequently. This study collected data of paleotyphoons found in China's official historical records over the past two thousand years with known typhoon activity reports. The collected data is then subjected to statistical analyses focusing on typhoon activity in coastal regions of southeastern China to garner a better understanding of the long-term evolution of moving paths and occurrence frequency, especially those typhoons making landfall in mainland China. We analyzed the data with the year and month of each typhoon event, as well as the number of events in a ten-year period. The result shows that (1) the tracks of typhoon correspond to the north/southward migration of the ITCZ and phase of NAO, which shows a nearly 30-yr and a 60-yr cycle during the LIA. (2) paleotyphoons made landfall in mainland China one month earlier during MWP than those during LIA. According to paleotyphoon records over the last two thousand years, typhoons made landfall in southeastern China frequently around 490-510 A.D., 700-850 A.D., and after 1500 A.D. The number of typhoons striking Guangdong Province peaked during the coldest period in 1660-1680 A.D.; however, after 1700 A.D., landfall has migrated farther north.

Keywords: Tropical cyclone, Record, ITCZ, NAO

T2-25-O

Experiments on the reconstruction methods and calibration of the climate series derived from REACHES historical database of China in 1644-1911

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Abstract

In this study, we report several methods performed to test the sensitivity of the temperature and precipitation index systems used for reconstructing historical temperature and humidity series. A frequently used technique to evaluate the intensity of the cold-warm or dry-wet conditions is to construct an index system so as to quantify qualitative descriptions. However, different indexing methods may result in different reconstructed series of varying quality, and hence it is important to examine the pros and cons of these methods. We used data series derived from REACHES database that consists of high spatio-temporal resolution data in China from 1644 to 1911. Temperature and humidity index series were constructed based on modified cold-warm index (CWI) and drought-flood index (DFI). Different sets of the indexing systems were developed to test their robustness and sensitivity by varying certain criteria. In addition, we also tested two aggregation methods for deriving geographical areal mean to determine their advantages/disadvantages. These experiments were designed to understand the benefits and caveats of the reconstruction methods as instrumental data of the time are not available. The statistical characteristics of the reconstructed series were compared.

Moreover, to validate the reconstructed series, we used data series in Global Historical Climatology Network (GHCN) to calibrate the reconstructed temperature series in Beijing, Tianjin, Shanghai, and Hong Kong. Instrumental data are available for these locations dating back to the mid to late 19th century and thus provide partial overlaps with the reconstructed historical index series. Our preliminary result shows very high correlation (r ~ 0.68) between the instrumental and one reconstructed index series in Beijing but more tests will be performed, and the results will be reported during the conference.

Keywords: Climate reconstruction, Historical climatology, Temperature index, Humidity index, Method experiments

T2-26-O

Some thoughts on the use of historical records in paleotempestology: Data quality, event validation, and hypothesis testing

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Abstract
Paleotempestology is still a relatively young science. While much progress has been made in the application of geological proxy techniques in the reconstruction of tropical cyclone events during the past two decades, relatively few historical records have been compiled from different geographical regions that are based on archival or documentary evidence. In this paper, I will draw upon examples from the literature to discuss some methodological and theoretical issues in the development and application of the historical records in paleotempestology. It is hoped that these examples can shed light on our effort to find a way to move the field forward.

T2-27-P

Holocene dust variations revealed from Altai peat sediments in Northwest China

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Abstract

Peat records enable the reconstruction of changes in the global mineral dust cycle and therefore provide a key tool for understanding relationship between the climate and atmospheric circulation during the Holocene. Two core sediments on peat sedimentary sequences in arid regions of the Altai Mountains, Northwest China were investigated using the integrated analysis of mineral-magnetic and geochemical data, HIRM and Pb concentration therefore proved to be the most useful parameters to illustrate the dust variations in Altai Mountain peat. The variations of hematite content and Pb concentration influenced possible mechanism can be divided into three distinct stages throughout the Holocene. Dust flux decreased progressively during the early（1.1 to 6.0 ka BP）and late-Holocene. Both HIRM and Pb fluxs were both the relatively lowest in the mid-Holocene（6.0 to 4.0 ka BP）. This may be a signal of a period of decreased dust from the sources. Therefore, the colder climate in the dust provenance offers a more suitable precondition for the dust emission in the early and late-Holocene, in contrast to the mid-Holocene.

Key words: Dust, Magnetic minerals, Geochemical data, Altai mountains

T2-28-P

Reconstructed typhoon series 1644-1911 and implications of general atmospheric-oceanic circulation

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Abstract

This study used Reconstructed East Asian Climate Historical Encoded Series (REACHES) database (Wang et al. 2018) to reconstruct historical typhoon series in the East and South Coasts of China during the Qing dynasty (1644-1911). Among 98,221 documentary records in the Qing dynasty, we retrieved 1,538 records documented with 'typhoon' (Chinese character 颱) or 'hurricane' (颶), with descriptions of other compounding effects such as strong wind, torrential rain and storm surge to consist of the data set. To avoid repetition and multiple counting of the same typhoon event, records that have temporal (± 1 days) and spatial (±2∘degree latitude/longitude) proximity were combined to account for one single typhoon event. The method was based on the systematic database approach and the records were examined by researchers to check data quality.

The analysis shows in total 807 reconstructed typhoon events during the period, an average of 3.02 typhoon events per year. The reconstructed series demonstrate clear multi-decadal to centennial variabilities in the East and South Coasts. The 17^{th} century was the period with active typhoon activities; fluctuation in the earlier half of the 18^{th} century was relatively small and was followed by dynamic variations throughout the later 18^{th} and 19^{th} centuries. Typhoon activities had obvious spatial differences at interannual and decadal fluctuations, especially presenting 2-3 and 6-8 years periodicities through spectral analysis. The reconstructed series were validated through intercomparison with other reconstructed series (R=0.847 for South Coast and R=0.616 for East Coast). Additional comparison with sunspot (SS), Western Pacific sea surface temperature (SST), Atlantic Multidecadal Oscillation (AMO), and Pacific Decadal Oscillation (PDO) indices has revealed the changing temporal-spatial typhoon patterns to be associated with the general atmospheric-oceanic circulations over the centuries.

T3-29-O

A 200-year annually laminated stalagmite record of precipitation seasonality in southeastern China and its linkages to ENSO and PDO

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Abstract

In southeastern China (SEC), the precipitation amount produced by the East Asian summer monsoon (EASM) is equivalent to that during the non-summer monsoon (NSM) period, both of them significantly affecting agriculture and socioeconomy. Here, we present a seasonally-resolved stalagmite $\delta^{18}O$ record ($\delta^{18}O_s$) for the interval 1810-2009 AD from E'mei Cave, Jiangxi Province, Southeast China. Comparison between $\delta^{18}O_s$ and instrumental data indicates that the $\delta^{18}O_s$ variability is primarily controlled by the precipitation seasonality (i.e., the ratio of EASM/NSM precipitation) modulated by the El Niño/Southern Oscillation (ENSO) on interannual to interdecadal timescales. Higher (lower) $\delta^{18}O_s$ values thereby correspond to lower (higher) EASM/NSM ratios associated with El Niño (La Niña) events. Significant correlations with ENSO and the Pacific Decadal Oscillation (PDO) indicate that the precipitation seasonality in SEC is remarkably influenced by the ocean-atmospheric circulation, with lower (higher) EASM/NSM ratios resulting from the warm (cold) phases of ENSO/PDO. The progressively increased $\delta^{18}O_s$ since 2005 AD may have resulted from increased central Pacific El Niño under continued anthropogenic global warming. The relationship between seasonal precipitation and $\delta^{18}O_s$ with ENSO/PDO, however, still requires further studies.

Keywords: Stalagmite, EASM, ENSO, PDO, WPSH

T3-30-P

The selection of a suitable primary marker for the Anthropocene

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Abstract

The Anthropocene has yet to be formalised as a new epoch, and a robust Global Boundary Stratotype Section and Point (GSSP) with an appropriate primary marker must be established. Here we systematically analysed stratigraphic records of five possible markers: $^{239+240}$Pu, spheroidal carbonaceous particles (SCPs), plastics, NO_3^- + $\delta^{15}N$, and Pb. The potential of each as a primary marker for the Anthropocene was assessed on the basis of the requirements of long-term preservation, wide-ranging distribution, and globally synchronized human-related variations in the mid 20th century. The results indicate that $^{239+240}$Pu is the most suitable primary marker owing to its globally synchronous peak during the 1950s. Local and regional variations in SCP and Pb concentrations in geological facies preclude their use as primary markers, but they may have applications as secondary markers. NO_3^- and $\delta^{15}N$ are not appropriate markers because of natural variations caused by the global nitrogen cycle. Further research on sedimentary plastics is required to assess their applicability as an Anthropocene marker. Additional work is also needed for Pb, particularly considering that Pb isotope ratios reflect the globally enhanced consumption of leaded gasoline after World War II, which may be reflected in a globally synchronous change during the 1950s.

Keywords: Anthropocene, GSSP, Primary marker, Stratigraphic records

T3-31-O

Records of sedimentary carbonaceous-fly-ash particles in East Asia and their chemical compositions: Implication for industrial activity during the Anthropocene

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Abstract

Spheroidal carbonaceous particles (SCPs) are a type of carbonaceous fly ash, resulting from high-temperature combustion of fossil fuels. Because SCPs are well preserved in sediments since last century all over the world, the particles are considered to be a suitable indicator for the Anthropocene. Although in Europe and US sedimentary SCP records (SCP concentrations) have been extensively examined since 1990s, in East Asia the SCP records were scarcely examined. In the last decade, we and other researchers have worked on sedimentary SCPs in East Asia, mainly in Japan and China. In Japan, the first appearance of SCPs in the early 20th century and the peaks in 1970s were found, whereas in China the onset of the SCP record dates back middle 20th century and SCP concentrations peak at 1990s or 2000s. Moreover, we examined the chemical compositions of the sedimentary SCPs collected in East Asian countries. The chemical composition varies significantly with time and place. Consequently, the chemical composition of SCPs probably reflects the types of fossil fuel consumed in each of the countries and periods. These facts suggest that examining the chemical composition of SCPs can be an effective tool to identify the characteristics of the past industrial activity in respective regions.

Keywords: Spheroidal carbonaceous particles (SCPs), Carbonaceous fly ash, Chemical composition, Industrial activity, Fossil-fuel combustion

T3-32-O

Sedimentary records of prehistoric human impact on the environment in northwest China

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Abstract:

The Anthropocene has been increasingly discussed and debated in recent years. Northwest China has a long history of human settlement and is one of the Bronze Age metallurgical centers, however, the impact of prehistoric human activities on the environment has not been well understood. Here we systematically collected natural and anthropogenic sediment samples from late Neolithic-Bronze Age sites, and drilled the adjacent lake sediment. X-ray fluorescence (XRF) measurement and thermal optical reflectance (TOR) were conducted on heavy metal elements (Cu, Ni, Pb, Zn, Cr and As) of archaeological sediment and black carbon of lacustrine sediment, respectively, to explore the imprints of prehistoric human activities on environment. Our results indicate human copper smelting activity led to evident sediment pollution, and intensive agriculture production and smelting activities exerted evident impact on fire frequency in northwest China. Comparing with other records, we conclude the black carbon in lacustrine sediment provide an effective record of anthropogenic impacts on surrounding environment. We argue that remarkable increase in heavy metals and black carbon in terrestrial sediments caused by human activities may be a potential indicator of the start of the Anthropocene.

Keywords: Northwest China, Bronze Age, Anthropocene, Black carbon, Sediment pollution

T3-33-O

Anthropogenic Forcing of Indian Summer Monsoon Rainfall?

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Abstract

Instrumental observations show that summer monsoon rainfall over parts of South Asia declined by ~ 10% during the latter half of the 20th century. This decline has been attributed to a range of anthropogenic factors including: 1) increased anthropogenic aerosol loading over south Asia; (2) reduced land-sea thermal contrast due to radiative-forced warming of the Indian Ocean; (3) increased irrigation and intensification of agriculture; and (4) large-scale human-induced changes in land use and land cover. More recent observations however show that a possible reversal in the Indian monsoon strength has occurred over the last two decades, although, it is not clear whether this reversal stems from anthropogenic factors (e.g., increased GHG forcing and/or decreased aerosol loading) or a manifestation of monsoon's natural variability. Here we examine high-resolution proxy records of Indian monsoon in an effort to provide a baseline of its natural variability against which, recent changes in monsoon can be assessed in the context of the last few millennia. Our analysis suggests that identifying anthropogenic-forced changes in monsoon rainfall against a backdrop of large natural variability remain a non-trivial task. In a companion talk, we will discuss a possible exception to this conundrum by showing that a series of severe droughts in South Asia during the late 16th and early 17th century may have resulted from anthropogenic-induced decline in atmospheric CO_2.

Keywords: Indian Monsoon, Aerosol Loading, Droughts, Anthropogenic Forcing, Proxy Records

T3-34-O

Did Anthropogenic-induced decline in Atmospheric CO_2 triggered the Indian Monsoon Failures during the late 16th to mid 17th Century?

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Abstract

Proxy records from 'Monsoon Asia' reveal a near-century (*ca.* 1580-1650 CE) interval of weakened summer monsoon that was punctuated by several sub-decadal episodes of 'extreme' droughts or "monsoon failures". The latter, notably evident in proxy records from India, likely exceeded the severity and duration of modern droughts, which may have contributed to societal stress in the region. While the (reduced) solar forcing is widely invoked to explain the past episodes of weaker monsoon, the onset of a weaker monsoon period at *ca.* 1580 CE predates the Maunder Minimum (nominally, 1645 to 1715 CE), and thus, requires a different causal mechanism(s). Here we analyze new and existing hydroclimate proxy records and suggest that the weakening of Indian monsoon, particularly during a 40-year period centered at ~1610 CE, may have occurred in response to a period of globally coherent cooler temperatures, the latter possibly forced by a prominent decrease in the atmospheric CO_2 level by ~ 10 PPM recorded in Antarctic ice cores between *ca.* 1570 and 1620 CE. This drop in atmospheric CO_2, dubbed as the "Orbis Spike" (a proposed GSSP for the Anthropocene at *ca.* 1610 CE), has been attributed to the "Colombian Exchange"—a period of cultural and biological exchanges between the Old and New Worlds in the 16th century that led to massive depopulation of the Americas, abandonment of farms, and regrowth of forests with an attendant uptake of CO_2, although other mechanisms have also been proposed. To an extent the 'Orbis Spike' was anthropogenically driven and a case for CO_2-temperature-monsoon relationship can be established, the monsoon failures during the late 16th to mid 17th century may represent a testbed for assessing the monsoon's sensitivity to anthropogenic forcing.

Keywords: Indian Monsoon, Colombian Exchange, Orbis Spike, Anthropogenic Forcing, Proxy Records

T3-35-O

Synchronous multi-decadal climate variability of the whole Pacific areas revealed in tree rings since 1567

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Abstract

Oceanic and atmospheric patterns play a crucial role on modulating climate variability from interannual to multi-decadal timescales by, causing large-scale co-varying climate changes. The brevity of the existing instrumental records hinders the ability to recognize climate patterns before the industrial era, which can be alleviated by using proxies. Unfortunately, proxy based reconstructions of oceanic and atmospheric modes of the past millennia often have modest agreements with each other before the instrumental period, raising questions about the robustness of the reconstructions. To ensure the stability of climate signals in proxy data through time, we first identified tree-ring datasets from distant regions containing coherent variations in Asia and North America, and then interpreted their climate information. We found the multi-decadal covarying climate patterns of the middle and high latitudinal regions around the northern Pacific Ocean agreed quite well with the climate reconstructions of the tropical and southern Pacific areas. This indicates a synchronous variability at multi-decadal timescale of the past 430 years for the entire Pacific Ocean. This pattern is closely linked to the dominant mode of the Pacific sea surface temperature (SST) after removing the warming trend. Our study indicates the presence of the Pacific multi-decadal variability (PMV).

Keywords: Multi-decadal climate change, ENSO, Tree ring

T3-36-O

Understanding oxygen isotope records of climate change: Insights from a 5-year, daily resolved $\delta^{18}O$ precipitation record from Krabi, Thailand

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Abstract

Variations in oxygen isotopes in speleothems are often interpreted to reflect variations in the amount of precipitation controlled by changes in climate phenomena such as the monsoon or ENSO. However, this amount effect has recently been questioned, favoring other mechanisms such as moisture source(s), rainout history, or the influence of local convection. A more than 5 years long daily resolved precipitation and $\delta^{18}O$ record from Thailand allows the relationship between precipitation patterns and rainwater $\delta^{18}O$ to be examined. Rainfall at the Krabi station was highly irregular with rain events ranging from 0.1 mm to nearly 150 mm per day. Rainwater $\delta^{18}O$ values vary from -17.50 to 8.24 ‰, with a long-term average close to -5 ‰. We demonstrate that while daily and amounted weighted seasonal $\delta^{18}O$ values show no correlation with rain amount, the amount weighted monthly values display a significant correlation with monthly rainfall. Statistical comparison to atmospheric parameters reveal a strong correlation to outgoing longwave radiation, suggesting that local convection rather than precipitation amount control variations in rainwater $\delta^{18}O$ in this region. Comparison to a short cave drip water record suggests that the atmospheric $\delta^{18}O$ signal is recorded with a muted amplitude in the drip water, and with a lag of one to two weeks.

The change of precipitation and human impact recorded in a subtropical mountain lake, north-eastern Taiwan since 3000 years BP

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Abstract

Lake sediment is one of the most useful terrestrial archives for reconstructing the monsoon record in tropical Pacific. However, Holocene paleoclimate archives retrieved from various lakes in Taiwan have shown discrepancies in their recorded climate variability. This is exacerbated by the lack of modern sedimentological observations which limit our understanding of the mechanisms controlling lake sedimentation. In order to reconcile this issue, sediment traps were collected monthly since July 2017 at Cueifong Lake (24°30' N, 121°36' E, 1840 m above sea level) in northeastern Taiwan, enabling us to identify the main factors controlling sediment deposited in Cueifong Lake and link these to seasonal precipitation variability. The modern findings have been applied to the lake sediment, allowing core records to be used for paleoclimatic reconstructions of a ~1.8 m long sediment core covering the last ~3 kyr. A multi-proxy approach analysis was applied to the sediment core. Our modern findings indicate that decreases in sediment grainsize occur during high lake level periods, which correspond with winter monsoon season. In the core record, three periods of sediment fining (high Rb/Sr, reduced mean grain-size) can be observed during 1040-1150 yr BP, 1680-1810 yr BP, and 2400-2550 yr BP, accompanied by decreased TOC and thus point towards high lake level periods. Additionally, we find another period of sediment fining between 1900-2010 CE, accompanied by a sharp increase in the inc/coh ratio. This most likely correlates to a logging event around the Taiping Mountain during 1912-1982 CE. Our results not only demonstrate how climate and human activity interact with the lake record but also highlight the need to better link modern observations and paleo-records.

Keywords: XRF core scanning, Grain size, TOC, Late Holocene, Human activity

T3-38-O

300-yr drought variability in central North China inferred from tree rings and the possible driving mechanism

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Abstract

North China, one of the main industrial and agricultural (mainly wheat and maize) production areas in China, is facing severe problems of water shortage. Drought is occurring frequently in this area. Tree ring cores from two different regions of North China were collected and the relationship between tree rings and climate were analyzed. The results indicated that the radial growth of trees in both areas were moisture limited. Therefore, a 306-yr March-August Palmer drought severity index (PDSI) since 1703 and a 246 May-July PDSI were reconstructed, respectively. Though the two studied area is about 600km, the PDSI reconstructions were comparable with each other after 11-yr moving average. Their decadal-scale variability was almost synchronous with other PDSI or streamflow reconstructions nearby, which suggest that the drought variation in North China was almost simultaneous during the last 300 years. The possible driving mechanism could be attributed to solar activity and large-scale ocean-land-atmosphere interaction.

Keywords: North China, Drought reconstruction, Indian-Pacific Ocean SST, East Asian summer monsoon, Solar activity

T3-39-O

The sensitivity of the carbon sink by coupled carbonate weathering to climate and land-use changes: Sediment records of the biological carbon pump effect in Fuxian Lake, Yunnan, China, during the past century

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Abstract

Recent studies show that the carbon sink attributable to the weathering of carbonate rocks may have been greatly underestimated if the biological carbon pump (BCP) effect in transferring dissolved inorganic carbon (DIC) to organic carbon (autochthonous OC) by aquatic photoautotrophs is neglected. The uptake of DIC by aquatic photoautotrophs may reach 0.7 Pg C/a globally, indicating that the carbon sink by the coupled carbonate weathering with aquatic photosynthesis mechanism (CCW) may be an important control in climate change. In order to understand the sensitivity of the CCW carbon sink to changes of climate and land-use, a systematic study of modern trap and 100-year-long core sediments was conducted in Fuxian Lake, (Yunnan, SW China), the second-deepest plateau oligotrophic freshwater lake in China. It was found that (1) the autochthonous OC in the lake sediments was characterized by lower C/N ratios and higher $\delta^{13}C_{org}$. By means of an n-alkanes compound calculation, the proportions of autochthonous OC were determined to be in the range, 60~68% of all OC; (2) increase in the autochthonous OC accumulation rate ($OCAR_{auto}$) was accompanied by an increase in the inorganic carbon accumulation rate (ICAR) in both the trap and core sediments; (3) $OCAR_{auto}$ in core sediments increased significantly with global warming and land-use change, from 1.06 g C $m^{-2}yr^{-1}$ in 1910 to 21.74 g C m^{-2} yr^{-1} in 2017. The increasing carbon sink may act as a negative feedback on global warming if the trend holds for all lakes globally. This study is the first to quantify the burial flux of organic carbon generated by the BCP effect in lakes and may contribute to solving the problem of the missing carbon sink in the global carbon cycle.

Keywords: Coupled carbonate weathering, Biological carbon pump effect, Autochthonous organic carbon, Carbon sink, Lake sedimentation

T3-40-O

The role of XRF-core scanning in the study of the Anthropocene – opportunities and challenges

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Abstract

As the global human population continues to grow, understanding the intricate interaction between humanity and its surrounding environment is a fundamental and social-relevant goal of modern Earth and Environmental Sciences to develop the concept of the Anthropocene. However, the abrupt and rapid signals of human-environmental interactions, such as the anthropogenic activities as well as their related consequences, are extraordinarily challenging to decipher from natural archives at societally-relevant timescales (i.e. sub-annual to decadal resolution) by conventional geochemical analytical techniques. During the recent decade, the fast, non-destructive, multi-element, and ultra-high resolution X-ray fluorescence core scanning (XRF-CS) technique has been introduced to assess elemental variations down to annual and even sub-annual timescales. This presentation therefore aims at introducing a wide range of XRF-CS scientific applications in the study of the Anthropocene, including:

- lacustrine cores from Lake Meihua (northeastern Taiwan) to study how human activities known from historical records can be recorded in lacustrine sediments.
- river sediment cores from Nankan River (northwestern Taiwan) for characterizing heavy metal pollution events by rigorous multivariate statistical analysis.
- tree-ring cores from northwestern Taiwan to explore the elemental behavior among different tree species.
- ion-exchange resins from central Taiwan to monitor heavy metal pollution in a complex drainage system in a rapid and economical manner.

This presentation will also outline the current methodological challenges and provide possible solutions. A recommended procedure of data evaluation, calibration, and interpretation will be presented which allows harvesting the full potential of the XRF-CS technique.

Keywords: XRF-core scanning, Anthropocene, Elemental indicators

A history of the modern Aral Sea (Central Asia) since the Late Pleistocene

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Abstract

The catastrophic demise of the Aral Sea in the late twentieth century has stimulated significant international efforts to understand the geological, hydrological, and climatological controls on lake level at timescales ranging from years to millennia. Here we extend this time range to the Late Pleistocene with sedimentological, chronological and paleontological results from a core that dates from ca. 17.6 kyr cal BP. To our knowledge, this Aral Sea core (B-05-2009) is the oldest directly-dated sediment record with multiple late Pleistocene ^{14}C dates currently available from the region. The core shows that the modern Aral Sea formed at least as early as the end of the Last Glacial Maximum. The main source of water was most likely glacial meltwater from the Tian Shan, Pamir, and other distant mountain systems in the modern day Aral Sea watershed, carried by the Syr Darya and Amu Darya rivers. The Late Pleistocene section of the core contains ostracods and foraminifera throughout, providing evidence that the lake supported life since its inception. Our chronology suggests a relatively high average sedimentation rate at the onset of lake development, and a significant sedimentation hiatus around the time of the Pleistocene/Holocene boundary.

Keywords: Aral Sea, Late Pleistocene, Ostracods, Foraminifera, Central Asia

T3-42-O

Interactive effects of warming and nitrogen addition on fine root dynamics of a young subtropical plantation

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Abstract

Forest aboveground production and soil carbon (C) pools are closely linked to fine root dynamics. Uncertainty about the effects of warming and nitrogen (N) deposition on fine root dynamics limits our ability to predict how C will transfer between biological and atmospheric pools in tropical and subtropical forests. In order to examine the effects of warming and N deposition on fine roots in subtropical plantations, we used a randomized complete block design with factorial soil warming (ambient, ambient + 5 ℃) and N deposition (ambient, ambient + 80 Kg N ha^{-1} yr^{-1}) manipulation. Minirhizotrons were used to monitor fine root production, mortality and turnover rate of *Cunninghamia lanceolata* seedlings for two years. We found warming had positive effects on annual fine root production, mortality and turnover rate both under ambient and increased N addition. N addition had positive effects on annual fine root production, mortality and turnover rate in the warmed plots, but had no influence on annual fine root production, mortality and turnover rate in the unwarmed plots. Warming and N addition had an additive (not interactive) effect on fine root production, mortality and turnover rate. There was an interaction between warming and N addition on living fine root biomass in the second year. These changes can be largely attributed to belowground/aboveground C allocation. In addition, increased fine root turnover rate after warming implies accelerated root C inputs to soils, which may affect soil C and nutrient dynamics. Nitrogen addition may exacerbate this. There was no acclimation of root respiration to warming, which may alter C balance and cause more CO_2 release to the atmosphere through autotrophic respiration.

Keywords: *Cunninghamia lanceolata*, Fine root turnover, Nitrogen deposition, Soil warming, Subtropical plantation

T3-43-O

Root litter inputs exert greater influence over soil C sequestration than does aboveground litter in a subtropical natural forest

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Abstract

Changes in plant net primary production due to climate change can influence aboveground and belowground litter inputs to forest soils. However, the effects of such changes on soil carbon storage remain largely unknown, especially in subtropical forest ecosystems. We report the first investigation of the responses of soil carbon (C) content and soil microbial community structures to both aboveground and belowground litter (root) manipulation in the subtropics. After only 3 years of treatment, aboveground litter addition and root exclusion respectively caused a 9% and 21% reductions in soil C concentration in the 0-10 cm soil, though likely through different mechanisms. The reduction of soil C with aboveground litter addition was attributed to a priming effect, while reduced root-derived C inputs were likely the cause of the C reduction associated with root exclusion. PLFA analysis showed that both aboveground and belowground litter manipulation reduced bacterial biomass by 15%-60%, but a reduction in actinobacteria biomarkers of 46%-58% was observed only in root exclusion treatment. Fungi, arbuscular mycorrhizal fungi, and ratios of Gram-negative to Gram-positive bacteria and bacteria to fungi did not differ among treatments. Through simultaneous manipulation of aboveground and belowground litter inputs, our results show that root-derived C inputs exert a stronger control on soil C content and microbial community structures than aboveground litter does in subtropical natural forest soils. Our study also highlights that that both increases in aboveground litter and decreases in belowground C input to soil can lead to reduced soil C storage.

Keywords: Detrital input and removal treatment; Soil carbon; Soil microbial; Climate change; Subtropical forest

T3-45-P

A 2000-yr moisture history in the western Qilian Mountains of northwestern China: Evidence from tree rings

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Abstract

The understanding of the relationship between climatic change and social activities in ancient China mainly depend on high-resolution climatic-proxy series for the past two thousands, however, lots of climatic series were conducted in eastern China, more than 1000 years high-resolution climatic proxies are scarce in western China, especially in the area nomads inhabited. Here, we present an 1775-year (241–2015CE) reconstruction of May–June self-calibrating Palmer Drought Severity Index (scPDSI) in the western Qilian Mountains of northwestern China that is based on nearly two millennia-long ring-width chronologies derived from long-lived Qilian Juniper trees (Juniperus przewalskii Kom.). The reconstruction demonstrated obvious decadal variations of moisture over the past two millennia. The drought duration in the 17th century is the longest, while the driest and wettest periods are the late 5th century and the 3rd century, respectively. Some of wet periods corresponded to a high incidence of the social rising events in ancient China, while wars between nomadic and farming groups were waged during dry periods in general. In the meantime, results of the multi-tape method analysis and wavelet analysis further confirmed the relationship between regional hydroclimate variability and solar activity forcing

Keywords: Drought, Tree ring, Qilian Mountains

Increased variability of Thailand's Chao Phraya River peak-season flow and its association with ENSO variability: Evidence from tree ring $\delta^{18}O$

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Abstract

We present a statistically robust reconstruction of Thailand's Chao Phraya River peak-season streamflow (CPRPF) that spans the 257 years from 1748-2005 CE. Our reconstruction is based on tree ring cellulose $\delta^{18}O$ series derived from three *Pinus merkusii* sites from Laos and Thailand. The regional $\delta^{18}O$ index accounts for 57% of the observed variance of CPRPF, as measured at Nakhon Sawan. Spatial correlation and 21-year running correlation analyses reveal that CPRPF is greatly influenced by the regional precipitation variations associated with the El Niño-Southern Oscillation (ENSO). Periods of enhanced and reduced ENSO activity are associated with strong and weak ENSO-streamflow correlation, respectively. At the longer timescale, the Pacific decadal oscillation (PDO) appears to modulate the ENSO-streamflow correlations. Subsequently, the most extreme flood events along the Chao Phraya River occurred during periods of increased frequency of La Niña events that coincide with extended cold phases of the PDO. The documented CPRPF reconstruction could aid management planning for Thailand's water resources.

Keywords: Chao Phraya River streamflow reconstruction, Asian Summer Monsoon, *Pinus merkusii* tree ring $\delta^{18}O$, El Niño-Southern Oscillation, Pacific Decadal Oscillation, Tropical dendroclimatology.

T3-47-P

Detecting human impact on vegetation variation in northeast Tibetan Plateau during Bronze Age based on charcoal analysis

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Abstract:

The Tibetan Plateau is one of the harshest environments for human permanent settlement, while Bronze Age witnessed human extensive expansion to areas above 3000 meters above sea level (m asl) on the northeast Tibetan Plateau (NETP) under a cooling climate, which was facilitated by agriculture innovation brought by prehistoric trans-Eurasia culture exchange. However, how human intensive colonization influenced natural environment on the NETP during that period has not been clearly understood, though some scholars argue that year-round human settlement on the high areas of NETP post 3600 BP resulted in the rise of fire frequency and *Stellera* pollen. Here we report new data of charcoal analysis from 14 Bronze sites dated between 3600-2300 BP in NETP, which reveals an abnormal spatial pattern for wood utilization, the ratio between the remains of thermophilic broad-leaved trees and cryophilous conifers is much higher in Bronze sites above 2500 m asl than those below 2500 m asl. With comparison to archaeological and paleoclimate studies, we conclude that the rapid increase of human settlement and activity on high altitude areas of NETP since 3600 BP was responsible for the depletion of conifers that were preferred resources for human wood utilization, which promoted Bronze groups to utilize broad-leaved trees as alternative woods in areas above 2500 m asl of NETP during Bronze Age.

Keywords: Charcoal records, Bronze sites, Northeast Tibetan Plateau, Climate change, Human activity

Climate Change in the Fertile Crescent

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Abstract

The ancient Fertile Crescent—a quarter-moon shaped region stretching from the Persian Gulf to eastern Mediterranean, what is now modern-day Iraq, Syria, Jordan, Lebanon, Israel and northern Egypt, has been home to some of the world's oldest civilizations. The region has been struck by several multi-year droughts in the last two decades and the seasonal precipitation over the region has declined by as much as 15% over the last century. Furthermore, experiments with climate models suggest that the current drying trend may well persist into the future and that the entire 'Fertile Crescent' may disappear by the turn of this century. Here we assess the severity of the region's modern droughts and the drying trend in the longer context of its hydroclimate variability over the past four millennia. We used temporal variations in speleothem oxygen and carbon isotopes from Kuna Ba Cave in northern Iraq to reconstruct a high-resolution history of rainfall variations over the Fertile Crescent. Our speleothem records reveal a wide spectrum of hydroclimate variability in the region characterized by multi-centennial trends and quasi-oscillatory variability with several step-like shifts in the mean climate of the region over the last 4000 years. Importantly, however, our data also indicate that the severity of the modern droughts in the region such as during the 2007-2010 CE is unmatched by any previous droughts at least over the last 2 millennia, and possibly even over the last four millennia. These observations imply a possible role of anthropogenic forcing in shaping the recent climate trends in the Fertile Crescent.

T3-50-P

Weakening of Asian monsoon, not cloud cover change, determines the climatic variability in montane cloud forest

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Abstract

Tropical montane cloud forests (TMCF) are unique ecosystems characterized by frequent cloud immersion. Stable hydroclimate maintains a 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, large-scale climate driver, such as monsoon may interact with local clouds to mediate climatic variability. In montane cloud forests in Taiwan, the cloud cover kept decreasing since 1950s, but annual temperature variability (TAR) was also reduced. Increasing minimum temperature in the coldest season and decreasing maximum temperature in the warmest season both contributed to the reducing TAR. We found that temperature in the coldest season was mainly mediated by winter monsoon, while the cloud cover has limited direct effect. Temperature in the hottest season was largely determined by precipitation, which was influenced by summer monsoon without the effect of cloud cover change. As such, the change of monsoon system, not cloud cover, dominates climatic variability in montane cloud forest. We applied multiple dendroclimatic proxies to reconstruct local climates for the past 480 years (AD 1533-2012). The dynamics of cloud cover are within the range of long term fluctuation. However, the magnitude of warming in the cold season has never been observed for the past half millennium. We provided the first cloud reconstruction in Asian montane cloud forest where the weakening of prevailing monsoon systems has led to a warmer but less variable climate regime.

Keywords: Annual temperature variability, Tree ring, Stable oxygen isotope

Anthropogenic influence on monsoonal rainfall and vegetation in southwestern China over the past 300 years

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Abstract

Here we present yearly resolved records of oxygen ($\delta^{18}O$) and carbon ($\delta^{13}C$) isotopic ratios spanning the past 300 years (1700-2003 AD), established from two aragonitic stalagmite samples from Xianren Cave, Yunnan, southwestern China.

Our $\delta^{18}O$ records display numerous decadal variations as well as two centennial cycles, with an amplitude ~1.7‰ (from -10.1‰ to -8.4‰). The two records resemble remarkably between each other and stalagmite data from the region, which suggests that the stalagmite $\delta^{18}O$ represents primarily a change in regional Indian summer monsoon intensity. The $\delta^{18}O$ records also show a significant but negative correlation with China temperature, except for the past 70 years during which all the stalagmite $\delta^{18}O$ and China temperature increase. The decoupling between the Indian summer monsoon and China temperature in the recent decades underscores the emerging impacts of anthropogenic forcing, in a region much broader than the East Asia summer monsoon territory.

Contrary to the $\delta^{18}O$ records, our $\delta^{13}C$ records show a stepwise change in the last 300 years. The values vary between -8.8‰ and -10.4‰ during the first 140 years, then increase rapidly by as much as ~3‰ from 1840 to 1880 A.D., and stabilize at ~ -7.5‰ afterwards. Such dramatic stepwise change cannot be attributed to gradual changes in regional rainfall or vegetation type. As this area became populated in early to mid Qing Dynasty, we propose that the dramatic shift in $\delta^{13}C$ was caused by human disturbance on the original forest coverage. The continuously high $\delta^{13}C$ values after 1880 AD probably indicate that the soil coverage in the limestone area, once disrupted by human activity, has not been recovered.

Keywords: Indian summer monsoon, Stalagmite, $\delta^{18}O$, $\delta^{13}C$, Human activity

T3-52-P

Soil properties and distribution in the riparian zone: the effects of fluctuations in water and anthropogenic disturbances

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Abstract

Dam on river generates large riparian zone around the reservoir that changes the natural fluctuation in water level (FWL) and intensity of anthropogenic disturbance (AD, i.e. human activities triggering pollutant input). Knowledge about how riparian soil properties respond to such changes remains limited. The aims of this study were to identify the distribution of soil properties in the riparian zone and determine which types of factors, local-scale FWL or regional-scale AD, have a larger effect on the soil properties. A total of 144 composite soil samples, collected from two riparian areas in four sampling surveys, were investigated. Multivariate regression tree analysis indicated that the variation in soil properties was mainly controlled by FWL (40.1%) compared with the minor role of AD (2.1%). Soil total carbon, total nitrogen and organic matter were mainly affected by AD, whereas FWL had a major influence on soil pH, ammonium and nitrate. Along the elevation gradient (150–175 m), the soil properties were determined mainly by the sampling elevation, accounting for 67.6% of the variation, followed by short-term (5.6%) and long-term flooding (3.3%). The 167.5-m elevation was proposed to be the threshold that divides the riparian zone into two different response zones. Soil below 167.5 m was mainly affected by local-scale FWL, whereas that above 167.5 m was largely affected by regional-scale AD. This proposed threshold suggests that riparian soil management around the Three Gorges Reservoir should consider both local- and regional-scale factors and that different approaches and strategies for ecological restoration need to be applied along an elevation gradient.

This work was supported by the National Natural Science Foundation of China [41303053, 41571497]. We are grateful to the Kaizhou Science & Technology Commission for assistance in sampling and background data collection.

T3-53-P

Responses of cyanobacteria to climate and human activities at Lake Chenghai over the past 100 years

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Abstract

Cyanobacteria play important roles in carbon and nutrient cycling in aquatic systems. The number of cyanobacteria in lakes has increased over recent decades, threatening both water quality and ecosystem management. However, because of a lack of long-term monitoring, the factors that control the interannual variability and diversity of cyanobacteria are poorly known. In this study, we use genetics and geochemical records of a vertical-down sediment core to investigate the impacts of climate change and human activities on the long-term (100-year) abundance and diversity of cyanobacteria at Lake Chenghai, southwestern China. The results show that before 1980 AD, the nutrient level of Lake Chenghai was still in a generally natural state, and human impacts were relatively weak; whereas after 1980 AD the gene copy number and relative abundance of cyanobacteria have been significantly increased compared with the average of the past 100 years, suggesting that major changes in both human activities and hydrological conditions could have occurred since then. The phosphorus concentration and lake level changes are thought to have significant impacts on the biomass of cyanobacteria in this lake. We contend that both human activities and the decrease in lake water level, which led to enrichment of nutrients in the water, could have resulted in an increase in the abundance of cyanobacteria and the total phosphorus and carbonate contents in lake sediments. The results of this study suggest that controls on nutrient inputs and lake water levels are necessary to ensure the sustainability of Lake Chenghai, especially under a continuous global warming scenario.

Keywords: DNA, Cyanobacteria, TP, Lake sediments, Lake Chenghai

T3-54-P

Ecophysiological process regulates the growth of Cunninghamia lanceolata to suit short-term warming and nitrogen addition in the sub-tropical regions

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Abstract

Uncertainties about the response of plant eco-physiological mechanisms to elevated temperature and nitrogen (N) deposition make it difficult to predict the performance of plants under future climatic conditions in the sub-tropical regions. We measured photosynthetic parameters, the contents of osmoregulatory substances, oxidant substances, protective enzymes, and endogenous hormones in *Cunninghamia lanceolata* under conditions of soil warming and N addition. We used six treatments: (1) unwarmed and unfertilized (CT), (2) unwarmed and high N (HN), (3) unwarmed and low N (LN), (4) warmed and unfertilized (W), (5) warmed and high N (WHN), and (6) warmed and low N (WLN). We found that the R_d/Pn_{max} was the lowest in the W treatment, but the height was almost with the same as that of the CT. Plants under W showed plasticity of protective capacity by increasing peroxidase contents. N addition enhanced photosynthesis and promoted growth. The WLN treatments increased R_d/Pn_{max} and decreased indoleacetic acid, gibberellin, and cytokinin contents, which might caused reduction in the absorption of nutrients and growth of the plants in the short-term. There were no significant differences in the content of osmoregulatory substances among the different treatments. We conclude different mechanisms may exist between W and N addition treatments that probably depend on adjustments through the physiological and biophysical processes. This study provides a new reference for forest management in view of the future climate changes.

Keywords: Global change, Protective enzymes, Photosynthesis, Endogenous hormones

T3-55-P

Effects of nitrogen deposition on the root biomass of subtropical fir saplings

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Abstract

Plant underground biomass is an important part of carbon storage in the global terrestrial ecosystem and plays an important role in the carbon cycle of the global ecosystem. The global atmospheric nitrogen deposition increases steadily and has a complex impact on the ecosystem of the forest underground ecosystem. In this study, the response of root biomass and vertical distribution to nitrogen deposition was studied by field nitrogen deposition simulation experiment with young Chinese fir. The results showed that low nitrogen treatment did not significantly change the root biomass of Chinese fir saplings, but high nitrogen treatment significantly increased the biomass of thick roots and total roots. The biomass of fine roots and coarse roots decreased significantly with the deepening of soil layer, and the proportion of fine roots in each soil layer was not significantly changed by nitrogen fertilization. The saplings of Chinese fir adapt to the change of environment by adjusting the biomass of thick roots in the subtropical nitrogen deposition environment for a long time.

Keywords: Nitrogen deposition, Root biomass, Vertical distribution, Chinese fir

T3-56-P

Climate and environment change of desert/loess transition zone and its impact on prehistoric human activities since 6 ka B.P.

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Abstract

Baihemiao core (38°35′9.89″N, 109°24′0.71″E) was drilled in desert/loess transition zone. The core is 619 cm in length, and from top to bottom, mainly consists of yellowish brown eolian sand (0-88 cm), grey brown sand (88-150 cm, 155-235 cm, 472-615 cm), black silty peat (150-155 cm, 235-366 cm, 615-619 cm) and sandy silt (366-472 cm). The bottom of the core (619 cm) was dated to cal. 6 ka B.P. by using precise radiocarbon date. Then high resolution fossil pollen data was used for reconstructing vegetation succession and climate change. In addition, ancient archaeological sites in 6~3 ka B.P. were counted, and their spatial and temporal distribution information were analysed in order to explore how optimum climate and extreme climate event affected human activities. The result shows that 12,921 pollen grains in total were counted and identified in 42 samples, mainly including Pinus, Picea, Abies, Betula, Quercus, Tamarix, Artemisia, Chenopodiaceae, Poaceae, Leguminosae, Thalictrum, Cyperaceae, Ephedra, Humulus, Myriophyllum and Selaginellaceae. Herbaceous pollen dominated by Artemisia and Chenopodiaceae account for 75% to 99% of total pollen percentage content, and tree pollen content was 1% to 24%. Vegetation types experienced four phases since 6 ka B.P., including typical steppe, desert grassland, dry steppe and desert grassland. Vegetation succession presents four phases of climate change. 6.0~4.2 ka B.P., climate was warm and moist. 4.2~1.1 ka B.P., extreme arid climate event occurred and climate distinctly became dry. After 1.1 ka B.P., the moist climate resumed and then turned to dry condition. Climate change and archaeological data indicate ancient human activities was closely related to climate and ecosystem change. East Asian summer monsoon brought rainfalls and controlled water sources change in semi-arid and arid region, and then affected rain-fed agriculture, human activities and archaeological culture succession. 6.0~4.2 ka B.P., relatively sufficient rainfall and high vegetation cover fixed Mu Us desert. Desert/loess transition zone expanded northwest. Moist climate condition and good ecological environment contributed to agriculture development and population growth. Therefore, archaeological sites increased rapidly and spatial space of human activities expanded. However, 4.2~3.0 ka B.P., archaeological sites decreased and human activities fade. The development of archaeological culture was interrupted because extreme dry climate event of 4.2 ka B.P. and continuous dry climate conditions. Water sources were lack and made a severe impact on rain-fed agricultural production and human subsistence. Therefore, climate change was testified as a significant influencing factor of archaeological culture succession.

Keywords: Desert/loess transition, Pollen record of peat, 4.2 ka B.P., Extreme dry climate event, Human activities

T3-57-P

Anthropogenic aerosols cause recent pronounced weakening of Asian Summer Monsoon relative to last four centuries

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Abstract

The Asian Summer Monsoon (ASM) affects ecosystems, biodiversity, and food security of billions of people. In recent decades, ASM strength (as represented by precipitation) has been decreasing, but instrumental measurements span only a short period of time. The initiation and the dynamics of the recent trend are unclear. Here for the first time, we use an ensemble of ten tree-ring width chronologies from the west-central margin of ASM to reconstruct detail of ASM variability back to AD 1566. The reconstruction captures weak/strong ASM events and also reflects major locust plagues. Notably, we found an unprecedented 80-year trend of decreasing ASM strength within the context of the 448-year reconstruction, which is contrary to what is expected from greenhouse warming. Our coupled climate model shows that increasing anthropogenic sulfate aerosol emissions over the Northern Hemisphere could be the dominant factor contributing to the ASM decrease.

Keywords: Asian Summer Monsoon, Tree-ring chronology, Precipitation reconstruction, Anthropogenic aerosol

T3-58-P

Sunshine duration changes during the past 500 years in the southeastern Tibetan Plateau and its relationship to volcanic eruptions

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Abstract

Sunshine is as essential as temperature and precipitation for tree growth, but sunshine duration reconstructions based on tree rings have not yet been conducted in China. In this study, we presented a 497-year sunshine duration reconstruction for the southeastern Tibetan Plateau using a width chronology of *Abies forrestii* from the central Hengduan Mountains. The reconstruction accounted for 53.5% of the variance in the observed sunshine during the period of 1961–2013 based on a stable and reliable linear regression. This reconstructed sunshine duration contained six sunny periods (1630–1656, 1665–1697, 1731–1781, 1793–1836, 1862–1895 and 1910–1992) and seven cloudy periods (1522–1629, 1657–1664, 1698–1730, 1782–1792, 1837–1861, 1896–1909 and 1993–2008) at a low-frequency scale. The multi-taper method spectral analysis showed that the reconstructed sunshine contained 2.3- to 7.7-year interannual cycles, 60.2-year and 78.7-year multidecadal cycles and 114-year centennial cycles at a 95% significant level. The series also had 12.6-year, 20.0-year and 35.2-year interdecadal periods at a 90% level. Running variance analyses indicated that the variability in sunshine increased sharply and peaked after 1970 and this might imply that the variation rule of sunshine in this region was altered owing to increasing human activities. There was an increasing trend from the 16th century to the late 18th and early 19th centuries and a decreasing trend from the mid-19th to the early 21st centuries. The decrease in sunshine particularly in recent decades was likely due to increasing atmospheric anthropogenic aerosols. In terms of the interannual variations in sunshine, weak sunshine years matched well with years of major volcanic eruptions.

Keywords: Sunshine duration reconstruction, Southeastern Tibetan Plateau, Tree-ring width, Volcanic eruption

T4-58-O

Antarctic ice sheet stability detected from mid latitude sea level records

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Abstract

Future stability of polar ice sheets in particular West Antarctic ice sheet (WAIS) is anticipated under the currently ongoing climate change. Satellite based observations have been clearly capturing the signals of sea level rise namely melting of polar ice sheets during the last 50 years. However global mean sea level (GMSL) has been risen as 120m or more since the end of the last glacial (eg., Yokoyama et al., 2018 *Nature*, 2019a *Oceanography*) thus it is crucial to distinguish between sea level signals from natural forcing (ie. glacial and interglacial) from total GMSL changes to understand anthropogenically induced values. We have studied various locations in mid latitude coastal sites including near Taiwan (Iriomote Is) and Indian ocean (Sri Lanka, Maldives etc) and found that rising of GMSL had been ceased at around 4,000 years ago (eg., Yokoyama et al., 2019b *QSR*). This was coincided with widespread collapse of WAIS (Yokoyama et al., 2016 *PNAS*) which was caused by atmospheric forcing transmitted from low latitude climate changes via atmospheric bridge. Thus recent acceleration of GMSL rise is unique phenomenon and likely induced from recent global warming.

T4-59-O

Bioturbation on the Yermak Plateau showing a relationship to sea ice conditions and productivity

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Abstract

The Arctic Ocean is partly covered by sea ice throughout the year and almost completely in winters. The variability in these sea-ice conditions highly influence the Earth's global energy budget by affecting the surface albedo, which in turn controls the exchange of heat and moisture between the atmosphere and the ocean and contributes to global heat transfer. In spite of the Arctic having such an importance in the global climate system, our knowledge about Arctic climate variability on longer time scales is quite limited. One of the main problems is the poorly constrained age control. So, in my work, I have used the radiocarbon dating method to obtain dates from different depths in order to construct a better age model for the Yermak plateau. This area which is located at the entrance to the Arctic Ocean off the north-western coast of Svalbard is highly sensitive to climate change. Another part of my work is to understand the past sea ice variability. For this part, I have studied the X-Ray Radiography images of sediment cores from different depths and have observed the abundance of bioturbation structures from different depths to understand the paleo sea ice record from this region, as it is directly related to changes in one of the environmental parameters i.e. food availability. The availability of food in a certain location is highly controlled by geographical position through the relation with ice margin or continental shelves. Consequently, temporal variations in bioturbation abundance and trace fossil diversity have the potential to reveal changes in food flux, and consequently the sea-ice conditions. Therefore, this study of bioturbation pattern and trace fossils has a great potential to provide an important source of paleoenvironmental information for the Arctic Ocean.

Keywords: Sea ice condition, Age model, Arctic Ocean, Bioturbation

Reef vulnerability in Anthropocene: Sensitive responses by the 1991 Mount Pinatubo volcanic eruption

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Abstract

Widespread coral bleaching and mortality has occurred intensively and frequently under global warming conditions. However, abrupt and extensive mortality episodes, such as which occurred in the South China Sea (SCS) in mid-1991, cannot be explained solely on the basis of high summer sea surface temperatures. Here we examine this event in the light of time series rare earth elements, trace element Al/Ca ratios, and micro-domain images from coral samples collected in the SCS region. Results demonstrate that modern coral reefs were strongly imposed by a giant volcanic eruption, the 1991 Mount Pinatubo volcanic eruption. Our findings highlight contemporary continental near-shore reefs are more susceptible than their open-ocean counterparts. Given that the integrity of the biosphere has reached a high-risk planetary boundary in the Anthropocene, fully understanding the diverse biogeochemical processes and external impacts on reefs are needed for the sustainability of the biosphere.

Keywords: Coral reef, Volcanic eruption, Anthropocene

T4-61-O

Tropical Atlantic Warm Pool Sea Surface Temperature Variability During the Last Interglacial: A Comparison of Coral-Based Reconstructions and Climate Models

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Abstract

The Last Interglacial (LIG), when sea level was ~6 m higher than today, serves as an analog for future climate scenarios yet only a few paleoclimatic reconstructions with seasonal to decadal resolution exist for this interval. Hispaniola, located in the northern Caribbean Sea, is a desirable site for producing sea surface temperature (SST) reconstructions as it is situated in the northern sector of the Atlantic Warm Pool (AWP), a primary moisture source region for precipitation in Central and North America, and this location has significant correlations with SST and precipitation anomalies for much of the AWP. Here we present an early LIG (128.6 ka) monthly-resolved coral SST reconstruction from a well-preserved *Siderastrea siderea* subfossil coral spanning 75 years from the northern coast of Hispaniola (19.913ºN, 70.925ºW). We compare our LIG SST reconstruction with three modern *S. siderea* microatolls, the longest spanning 84 years (1926–2010 CE) located near Port-au Prince, Haiti (18.479070°N, 72.668659°W), as well as the Community Climate System Model version 3 (CCSM3) 125 ka LIG model simulation. We find similar SST seasonal cycles in the LIG coral (3.7ºC) and LIG simulation (3.8ºC) that are greater than those in the modern Haitian corals, observed SST (ERSSTv4.0 and HadISSTv1.1), and CCSM3 20th century simulations. This seasonal variability is consistent with the findings of other LIG coral reconstructions in the tropical Atlantic Ocean suggesting that orbital insolation changes are driving LIG SST seasonality in this region. Furthermore, our LIG reconstruction reveals larger multidecadal (2.8ºC, ~20–30 years/cycle) and interannual variability (3.0ºC, ~3–8 years/cycle) than the modern coral reconstructions and SST records in the AWP yet similar variability is present in the LIG model simulation but with a reduced magnitude. This interannual and decadal variability may reflect variations in the northern extent of the AWP on these time scales, which covary with tradewind strength, westward moisture transport to the Americas, and precipitation in the Caribbean Sea region.

Keywords: GCM, Hispaniola, Coral, Sr/Ca

T4-62-O

Western Pacific variability detected through high-resolution bomb-derived radiocarbon measurements on corals

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Abstract

The North Equatorial Current (NEC) bifurcates into the Kuroshio Current (KC) and the Mindanao Current (MC), which are both western boundary currents in the Pacific Ocean to the east of the Philippine coast. The NEC-KC-MC current system plays an important role in climate change because it connects tropical and subtropical areas and transports heat poleward. However, the relationship between the NEC-KC-MC system and climatic events such as El Niño-Southern Oscillation and Pacific Decadal Oscillation (PDO) remains difficult to study due to lack of long duration and continuous observational records. High-resolution radiocarbon (^{14}C) measurements on coral skeletons can be used to reconstruct continuous and seasonal/interannual variability in ocean conditions. We report seasonal-scale $\Delta^{14}C$ data from Ishigaki Island along the KC and Currimao in which record conditions of Kuroshio Loop Current regions to reconstruct the KC variability. The results reveal the existence of early bomb-^{14}C spikes of nuclear bomb tests in the 1950s in the KC area and inside of the South China Sea (SCS). Based on a comparison of our data with previously reported data from Guam and Palau, $\Delta^{14}C$ in ocean surface layers was affected by upwelling related to southward migration of the NEC bifurcation latitude in the Mindanao Dome region and mesoscale eddies at the Luzon Strait and around Ishigaki and Taiwan after 1976, when the PDO phase changed from negative to positive. The $\Delta^{14}C$ in Currimao was also affected by the transport of a SCS water mass to the northwest of Luzon Island. This transport was triggered by the southward shift of the bifurcation latitude associated with the 1976 regime shift, which led to a decrease in the magnitude of Kuroshio intrusion into the Luzon Strait.

Keywords: Coral, Radiocarbon, Western Pacific, Kuroshio, Kuroshio Loop Current

T4-63-P

Beryllium-10 as a partial constraint on ice sheet meltwater discharge from Wilkes Basin, East Antarctica

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Abstract

The relationship between the Antarctic ice sheets and global climatic and oceanographic change is of major scientific and societal interest as it provides a link between climate and ice sheet dynamics. This link may assist in modeling the response of the ice sheets to future climate changes. The ice sheet of Wilkes Land, East Antarctica is an important focus area as it is susceptible to retreat due to the low-lying nature of Wilkes Basin and its down-sloping trough. Here, we present beryllium-10 analysis of a high-resolution marine sediment core from Adélie Basin, East Antarctica. The data reveals meltwater discharge from the East Antarctic Ice Sheet of Wilkes Basin immediately following Last Glacial Maximum ice retreat at ~10 ka as well as at ~6.5 ka and ~4 ka. Our age model was constructed using a new age-depth modeling routine which accounts for errors in both age and depth. Oceanic warming was most likely the driving force behind the influx of meltwater from the Wilkes Land ice shelf, shown by an increase in sea ice and the *Fragiliariopsis curta* diatom group. The timing of meltwater influx complements the 4.2 ka event, a period of abrupt global climatic change.

Keywords: Beryllium-10, East Antarctica, Marine sediments, Holocene

T4-64-P

Ba/Ca in planktonic foraminifera: Indicator of riverine freshwater input to the Arctic Ocean

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Abstract
The riverine freshwater input in the Arctic Ocean has profound impacts on global climate and ocean systems. Large amounts of freshwater from rivers and ice sheet melting input to the Arctic Ocean, changing the seawater salinity and subsequently the ocean stratification, as well as circulation. Such changes have the potential to cause shifts in the global climate and ocean systems. However, the interaction between freshwater input and ocean circulation is not yet fully understood. Oxygen isotopes in planktonic foraminifera, commonly used to reconstruct the freshwater events, have potential biases caused by other environmental factors, such as seawater temperature, pH, or vital effects. To avoid these biases, we introduce the Ba/Ca in planktonic foraminifera as a proxy for riverine freshwater input. The primary source of seawater Ba is from continental weathering brought to the ocean by rivers. Unaffected by other environmental factors, Ba/Ca in planktonic foraminifera can reflect the Ba/Ca in seawater, and consequently the variations of riverine freshwater discharge in the past. The Ba/Ca ratios are analyzed by the coupled plasma mass spectrometry in the High-precision Mass Spectrometry and Environment Change Lab, National Taiwan University. In this study, the variations in freshwater input in the Arctic Ocean during the last deglaciation and Holocene are reconstructed two cores based on changes in Ba/Ca in planktonic foraminifera. The preliminary results show a slight decrease in Ba/Ca in core AO96-B7 during the Holocene. While the Ba/Ca increased during early Holocene in core LOMROG12-TC03. Our study will reconstruct the spatial difference of Ba/Ca values in the Arctic Ocean during the Holocene, which will allow us to examine the changes in the environment due to the freshwater discharge.

Keywords: Paleoceanography, Arctic Ocean, Planktonic foraminifera, Ba/Ca, Freshwater input

T4-65-P

Anthropogenic osmium in macroalgae from Tokyo Bay reveals regional-scale contamination from catalytic convertors

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Abstract

Osmium released by anthropogenic activities such as sewage processing, catalytic convertor use in automobiles and smelting has a unique isotopic ($^{187}Os/^{188}Os$) signature that has been detected in coastal sediments, rivers, lakes, rain and snow and which has impacted the global Os budget making it an important tracer of the hydrological cycle. However, despite over two decades of research, direct measurement of ultra-low Os abundances in water remains analytically challenging, thus hampering its routine analysis. Recent studies suggest macroalgae (seaweed) concentrate Os from water whilst maintaining the waters original isotopic composition. We present Os isotope data for macroalgae collected from Tokyo Bay, a body of water that connects Tokyo city, the most populous metropolitan area in the world, with the Pacific Ocean. The $^{187}Os/^{188}Os$ of macroalgae close to Tokyo are incredibly low indicative of an anthropogenic source and increases progressively towards Pacific Ocean $^{187}Os/^{188}Os$ values seawards. We utilize CO_2 emission estimates from EAGRID2010 to determine the abundance of Os emitted from various anthropogenic sources in the studied region and compare this to macroalgae data. Modelling suggests the major source of anthropogenic Os to Tokyo Bay is that emitted from catalytic convertor use in new automobiles. This signature is being transferred to the Pacific Ocean and suggests Os isotopes in macroalgae may become a powerful tracer of the hydrological cycle, similar to tritium from hydrogen bomb testing in the 1960s and Pb from leaded petrol usage prior to the 1980s.

Keywords: Macroalgae, Osmium, Pollution, Japan, Catalytic, Emission

Late Holocene sea level and environment changes at Tongatapu island in the South Pacific reconstructed from radiocarbon dating of shellfish

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Abstract

We study the late Holocene paleoenvironmental changes of Tongatapu Island, the Kingdom of Tonga using bivalves of *Gafrarium tumidum* excavated from archaeological sites. Radiocarbon measurements on those shells had been conducted and marine reservoir effects (ΔR) were acquired for the last ca. 3,000 years. *G. tumidum* lives in intertidal zone thus it can be an archive to record surface ocean circulation patterns in the local coastal environment. Our results show that ΔR increases from ca. 219 to ca. 368 years since the last ~2.6 cal kyr. The results suggest that the main cause of the increasing reservoir effect is a closure of the lagoon by relative sea level changes causing increasing flux of radiocarbon depleted water from land because Tongatapu island consists of Pleistocene limestone. Such a closure would raise the ratio of fresh water (and terrestrial carbon) in the lagoon and decrease SSS (sea surface salinity), consistent with the observed decrease in bivalve size over the past 2600 years and the increase in ΔR. This scenario is consistent with the study of Clark et al. (2015) independently deduced based on archeological study.

Keywords: Holocene, Southern Pacific, Paleoenvironment studies, Local marine reservoir effect, Bivalves

T4-67-P

Radiocarbon fluctuations induced by intrusions of cold water recorded in Abalone shells in the coastal area of Northern Pacific Otsuchi Bay, Japan

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Abstract

Variations in ocean currents can provide better understanding of the coastal environmental and ecosystems changes. Although record of seawater radiocarbon is a unique proxy of water masses properties, their temporal resolution is limited in particular at high latitude ocean. This is because of limited distribution of biological archives, such as reef building corals, which are often find the low latitude ocean. Here we report the high resolution radiocarbon ($\Delta^{14}C$) measurements on three abalone shells with seasonal resolution using accelerator mass spectrometry. Abalone shells were obtained from Otsuchi Bay, where the cold Oyashio Current (OC) and the warm Kuroshio Current (KC) converge. The OC has more depleted radiocarbon than that of the KC due to mixture with radiocarbon depleted subsurface water. We compared $\Delta^{14}C$ values with the sea surface temperature (SST) anomaly in the Sanriku region and with indexes of regional climate variabilities such as ENSO, PDO and NPGO. $\Delta^{14}C$ values ranged from 5.4 ‰ to 31 ‰ and indicated seasonal variations. Namely $\Delta^{14}C$ values decreased by approximately 5 ‰ in winter, which was attributed to significant mixing of OC water. $\Delta^{14}C$ values clearly shows the OC inflow in 2013, 2015 and 2017 and it can be used to reconstruct fluctuations between past water masses. In addition, the $\Delta^{14}C$ values are possibly affected by climate variabilities. The $\Delta^{14}C$ value significantly increased two timing, when the El Niño started on 2014 summer and it finished on 2016 summer since OC weakened in winter. The OC inflow could have stronger influenced by PDO and NPGO. The ocean behavior, timing of ENSO, and North Pacific climate variabilities are complicatedly linked, it is key to understanding potential triggers and forcing mechanisms.

Keywords: AMS, Radiocarbon, Abalone Shell, Oyashio Current, Kuroshio Current

Social-environmental analysis of methane in the South China Sea and bordering countries

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Abstract

The study is a preliminary assessment of the greenhouse effect of methane (CH_4) emissions in the South China Sea (SCS) on human welfare using the Driver-Pressure-State-Impact-Response (DPSIR) framework and the Systems Approach Framework (SAF). The SCS is surrounded by nations of the Asia-Pacific region that are currently experiencing rapid urbanization, industrialization and economic growth, and is one of the most contested maritime areas of the world. Climate change may aggravate regional tensions, promote natural disasters, create climate refugees and reduce food security by reducing the size of fish catches and crops. International environmental protection, as well as the mitigation of, and adaptation to, climate change not only protect environmental sustainability, but also provide an international platform of cooperation for all countries around the SCS. The study analyzed the economic drivers and human activities that cause the pressure on the environment and increase CH_4 emissions in the region. In addition, the possible future impact of climate change on human welfare is also discussed in the study. Finally, the study identified eight management responses across various spatial and temporal scales that can be useful in addressing the issue of GHG (CH_4) in the SCS.

Keywords: South China Sea, CH_4, greenhouse gases, Driver-Pressure-State-Impact-Response, Systems Approach Framework

T5-69-O

Microplastic pollution in the Tamsui River system (Taipei, Taiwan): abundance, mass balance, and seasonal variation

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Abstract

Environmental pollution with plastic is a growing problem in oceanic, coastal, riverine and terrestrial habitats. Plastic objects and fragments have a variety of negative impacts to the environment. In recent years numerous studies were performed to study the occurrence, amount and distribution of microplastic particles in the marine environment. Even though rivers have been identified as an important input source of plastic and microplastic to the oceans there is still a lack of understanding how much freshwater and terrestrial environments are affected by microplastic pollution. In this study samples were taken from the four major rivers in the Taipei Basin, and analyzed for their microplastic contamination. Sampling was done using a manta net (300 µm mesh size) which was lowered from bridges into the rivers. In the laboratory organics were removed, samples washed and sieved to 0.3-5 mm size, microplastic particles were manually extracted, counted, as well as classified according to their shape and color. Preliminary results showed that all four rivers contained microplastic particles in varying amounts, ranging in average from a few particles up to 150 particles per m^3. Based on the first results, estimated 65 tons of microplastic are carried each year in the surface layer of the rivers in the Taipei Basin into the Taiwan Strait. During subsequent sampling, seasonal variation of the microplastic concentration was found, indicating that rainfall washes microplastic from land into the rivers. However, this is investigated in upcoming studies.

Keywords: Microplastic, River, Pollution, Fluvial environment, Taipei Basin

Thallium distribution and isotopic fractionation in industrial slags and environmental implications

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Abstract

Thallium (Tl) is a non-essential heavy metal with a high toxicity. Tracing sources of Tl is crucial to improve our understanding of its pollution and natural cycles in the environment. In an effort to lay the foundation for tracking the Tl pollution, concentrations of Tl and its isotopic fractionation were systematically evaluated during the pyrite roasting for sulfuric acid production, South China. Large variations of Tl isotope compositions (expressed as ε^{205}Tl, the deviation of the ^{205}Tl/^{203}Tl ratio of a sample from the NIST SRM 997 Tl isotope standard in parts per 10^4) were found among the pyrite ore and its four different roasting wastes (i.e. fluidized-bed furnace slag (FS), boiler slag (BS), cyclone fly ash (CA) and electrostatic precipitation fly ash (EA)). The starting raw pyrite ore had a ε^{205}Tl value of +1.28. The ε^{205}Tl of EA (–0.11) was the lightest measured. The BS (ε^{205}Tl = +8.34) and CA (ε^{205}Tl = +2.17) showed a slight enrichment in the heavier Tl isotopes relative to the starting material. The FS had the heaviest ε^{205}Tl (+16.24) in the system. Further calculation indicates that initial fractionation during the generation of a Tl-rich vapor is followed by Rayleigh type fractionation as Tl condenses onto the pyrite waste surfaces. According to the obvious differences of pyrite ore and its smelting wastes and the measurement precision, Tl isotopes could be a new potential tool for tracing pollution of Tl and associated metals.

Keywords: Thallium isotope, Pyrite, Smelting

T5-71-P

Varied sedimentological characteristics of the 2018 Palu-Donggala Tsunami and the potential for preservation of historical tsunami deposits on the coastline of the Palu Bay

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Abstract

A magnitude 7.5 earthquake struck Palu Bay and the surrounding settlements in central Sulawesi, Indonesia, on the 28th of September 2018. Coseismic discontinuous subsidence of up to ~1.5 m was observed in several locations. A combination of co-seismic fault displacements and marine landslides resulting from the earthquake generated a tsunami which affected coastlines within Palu Bay with wave heights up to 8 m high. Palu Bay has a varied depositional environment. In the east and west of the bay the coastline is erosional with locally steep coastlines, little accommodation space and is dominated by coarse sand and gravel. In contrast in the south, the coastal sediments are finer, dominated by medium grain sands, silts and clays. In November 2018, we surveyed and sampled four tsunami deposit transects, one each in the east and west and two in the south. We present described and sampled the tsunami deposits from four transects. The tsunami deposits sampled on the east and west coastlines were well preserved with thicknesses locally exceeding 10 cm and extending up to 250 m inland. The deposits comprised mainly coarse to medium sands. However, the deposits already illustrated signs of post depositional change due to lack of accommodation space and heavy rainfall. In the south of the bay, the deposits were thinner, not exceeding 5 cm, and comprised mainly medium to fine grain sands, their extend inland was similarly up to 250 m. Unaltered tsunami deposits were only preserved in areas where clean up work had not been done. But the widespread co-seismic subsidence and pre-existing ponds and coastal lowlands increase the likelihood of preserving the tsunami deposits in the geological record

Keywords: Tsunami, Palu, Donggala, Indonesia

T5-71-P

Tsunami deposits of the 2018 Palu earthquake reflect the low power and short-term inundation of the tsunami and the limited availability of nearshore source sediments.

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Abstract

On 28 September 2018, a magnitude 7.5 earthquake struck north of Palu, Central Sulawesi, Indonesia at 6:03 pm local time. The large, shallow, earthquake generated a tsunami with inundation depths above terrain of up to 6m and run ups of up to 10 m above sea level and inundation distances in excess of 400m. A compound tsunami was likely generated by a combination of minor fault displacement and multiple submarine landslides. In addition to the tsunami the region experienced co-seismic coastal subsidence that in places exceeded 1m and likely exacerbated the inundation of tsunami waves in areas including Palu city. During a post tsunami survey in November 2018 we sampled four transects for sediment analysis; two in Palu City and one each on the eastern and western coasts of Palu Bay. The tsunami deposits in Palu City are predominantly massive, fine- to medium-grained sand and were thin (mostly <5cm thick) and patchy. The sedimentology of the Palu samples likely reflects a combination of a tsunami with a relatively short wavelength and a source area with limited sediment availability. In contrast to the Palu city samples sediments found in the transects on the east and especially on the west coast of Palu Bay were coarser (medium- to coarse-grained sand), thicker (>5cm) and more continuous. Particularly well preserved the East Coast sample at Pantoloan showed little reworking and allowed for detailed sediment analysis. Here the deposits fine and thin landward and are identified as a continuous sand sheet that extends more than 250m inland. Grain size ranges from coarse-grained sand to silty-fine-grained sand at the landward extent. This site also contained blocks of a damaged sea wall that together with grain size data suggest that velocities exceeded 5 $m.s^{-1}$ more than 130m from the beach. The tsunami deposits of Palu Bay generally exhibit massive structure, a coarsening upward sequence, a non-systematic landward fining trend, and a sharp depositional (rarely erosional) basal contact with the underlying substrate. Overall, the Palu Bay deposits have sedimentologic and stratigraphic characteristics that show a hybrid signature common to both storm and tsunami deposits that likely reflect the short wavelength, relatively low power and short-term inundation of the compound tsunami and the limited availability and nearshore source of the sediments.

T5-72-P

Assessing the mass balance and seasonal variation of microplastic contamination in the river network of Taipei Basin

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Abstract

The presence of microplastics has been a growing concern in recent years. In spite of the increasing interest in microplastics, the majority of studies have focused on the existence of microplastics in marine environments, while little emphasis placed on freshwater systems. With an estimate of over 1.2 million tonnes of plastic entering the oceans annually via rivers, Asian countries are listed as the main producers of mismanaged plastic wastes. The city of Taipei, with its 55% recycling rate and plastic reforms is estimated to discharge 2.54 kilotonnes of plastic per year into the Taiwan Strait. This research presents a case study of establishing a mass balance for microplastics (in the size range of 0.3 - 5 mm) flowing through the rivers of the Taipei Basin into the Taiwan Strait. The Taipei Basin is comprised of three large tributaries: Dahan, Xindian, and Keelung River, which merge into Tamsui River. Using a manta trawl, sampling was performed at the mouth of each tributary. Preliminary results show microplastics in Keelung River (maximum of 172.0 particles/m^3 and 548.5 mg/m^3), Xindian River (maximum of 164 particles/m^3 and 65.2mg/m^3), Dahan River (maximum of 195.5 particles/m^3 and 171.9 mg/m^3) and Tamsui River (maximum of 158.4 particles/m^3 and 100 mg/m^3). Aside from general microplastic flux across all river profiles, seasonal variations were also detected. Increase of microplastic was observed during the onset of heavy precipitation. Being the first to quantify the presence of microplastic in the Taipei Basin, our study will help sets a baseline for future microplastic research.

Keywords: Microplastic, Riverine distribution, Plastic pollution, Plastic flux, Taiwan

T5-73-P

Spatial distribution of micro and mesoplastic after extreme weather events at the northern coast of Taiwan

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Abstract
Since the invention of plastic, people are constantly creating plastic waste. The manufacturing and usage of plastic have increased rapidly because people are relying more and more on plastic in daily life. Many studies have shown that plastic can act as an environmental hormone and disrupt endocrine and nervous system of organisms. Living beings, especially marine organisms are critically threatened by plastic debris. Therefore, this case study aims to show how many plastic particles on a beach are a potential threat to marine organisms. We will collect samples before and after a typhoon strikes in order to observe the difference in abundance. This study classified two size classes of 'microplastics' (1~5mm) and 'mesoplastics' (5~25mm) by using two different sizes of sieves in diameter 1mm and 5mm. Although the mechanism of how plastic debris accumulate on a beach remains uncertain, we are looking forward to see more plastic debris once a typhoon strikes at the same beach. Sampling will be continued throughout the year 2019 in the hope to get data from another typhoon strike. The purpose of this poster is to raise public awareness and encourage people to cut down the use of plastic.

Keywords: Microplastic, Mesoplastic, Marine debris, Typhoon, Sandy beach

T6-74-O

The Velocity of Climate Change and Species Tracking in Global Mountains

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Abstract

Species have been moving in response to recent changes in climate, but there is still a lack of systematic assessment on how climate change is affecting species movements in global mountains. Here, we provide the first global assessment of climate change velocity (in m $year^{-1}$) in mountain regions by dividing the temperature lapse rate (in °C km^{-1}) into the warming rate at terrain surfaces (in °C $year^{-1}$). We applied the moist adiabatic lapse rate (MALR), derived from local temperature and water vapor, and found that MALR varies substantially between 3 and 9 °C km^{-1} around the world. Using this approach, we identified high-velocity mountain regions and found that increasing surface temperature leads to higher climate velocity, especially in dry mountain regions. Intriguingly, high climate velocity could also occur in wet regions with lower lapse rates, such as mountains in Himalaya-Hengduan, Saudi Arabia, Great Rift Valley, Brazilian Highlands, and Guatemala. Then, we re-estimated the rates at which species would have to shift to keep pace with climate change. We found that the degree of lagging may be overestimated in previous meta-analyses. In the cases of low climate velocity, mountain species track reasonably well with climate velocity. In contrast, upslope migrations of mountain species substantially lagged behind the climate change in regions with high climate velocity. In conclusion, our study helps identify mountains with high climate velocity, which can inform conservation priorities as well as provide a better physical basis for understanding the ecological impacts of global climate change in mountain regions.

T6-75-O

Biodiversity and Ecosystem Functioning Relationship Varies Depending on Functional Specificity

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Abstract

Although it is generally accepted that the shape in biodiversity and ecosystem functioning (BEF) relationship would change through different ecosystem functioning indices, whether and how this change can be attributed to the specificity behind the selected ecosystem function still require further quantitative examination. Here, we examined the relationship between bacterial biodiversity and 31 different carbon substrates utilization profiles obtain from EcoplateTM (Biolog Inc.). To quantify the shape of each BEF relationship, the slope in linear regression was accessed to represent inverse redundancy index. To estimate functional specificity, two different indices (1) Bertz complexity index and (2) the number of responsible operational taxonomic unit (OTU) were as used. Overall, significant positive relationships in BEF were widely observed. Furthermore, after removing the function utilized polymers, a significant positive pattern was found between the inverse redundancy index and Bertz complexity index. Our results showed that the biodiversity loss did impact ecosystem functioning, and this impact would increase if the considered function utilized a more complex substrate.

Keywords: Bacterial community, Biodiversity and ecosystem functioning, Functional redundancy

T6-76-O

Fate of Arsenic in the Arsenic-tainted Paddy Rice Ecosystem at Guan-Du, its Origin and Impacts

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Abstract

When conducting a systematic investigation of heavy metals in soil citywide, we found the paddy soils hold anomalously high level of 8-458 mg kg^{-1} for arsenic (As) and 23-600 mg kg^{-1} for lead (Pb) in Guan-Du Plain, an important rice production region and recreation area in Taipei metropolis. Compared to other cereals, paddy rice (Oryza sativa) is particularly susceptible to As accumulation. Rice is the staple food in Asia. Thus, we are interesting in addressing this contaminated phenomenon and its potential impacts on both ecosystem and human health. Geographical information systems (GIS) technique was taking as a platform to integrate various spatiotemporal information. The hot spot was occurred within Beitou Irrigated Group, next to Daye Rd. Features of Pb isotopic tracer, suggested a 50-m adjacent Beitou Industrial District was not the candidate. They are significantly influenced by the irrigated water in the past 150 years, with high As and Pb contents by geochemical genetic reaction from Geothermal Valley. Above pollutant transport model was validated and supported by Binary mixing model and cluster analysis. Despite high As level in the soil, rice grains at Guan-Du do not accumulate arsenic, with concentrations staying below 1 mg kg^{-1} but about twice that of rice produced at other sites in Taiwan. So far, there is no epidemiological evidence of illness or cancer linkage the consumption the rice cultivated from arsenic-rich soils at Guan-Du. Although obvious health problems have not been found, long-term exposure to As through regular consumption of rice and incidental oral ingestion of soil may pose a potential health risk. The remediation of As and Pb in Guandu Plain merits further study.

Keywords: Arsenic contamination, Environmental forensic, Lead isotopic tracer, Guan-Du, Paddy rice ecosystem

Geochemistry constraints on diverse growth and calcification responses of multiple coccolithophore species to ocean acidification

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Abstract

There are gaining concerns on the potential impacts of CO_2-induced ocean acidification on marine life. Coccolithophore, which is one of the major primary producers and accounts for about half of the calcium carbonate production in the ocean, it plays an important role in the carbon cycle and ocean food web. Culture experiments revealed that the calcification and photosynthesis response of coccolithophores to ocean acidification is complex and diverse. It has been observed that a coastal coccolithophore species might regulate its calcification vesicle pH and switch the carbon source to sustain the growth under acidic experimental treatments. However, whether different calcification site pH regulation and different inorganic carbon speciation utilization are the control mechanisms of the diverse growth responses of different coccolithophore species to ocean acidification is still unknown. Here we combined $\delta^{11}B$, $\delta^{13}C$, $\delta^{18}O$, trace elemental ratios (B/Ca, Mg/Ca, and Sr/Ca), and PIC/POC results to investigate the impact of ocean acidification on three species of coccolithophores that were reported to exhibit various growth rates, PIC/POC ratios, as well as diverse growth responses to ocean acidification. Preliminary results show distinct isotopic composition and/or fractionation patterns of the three species, suggesting different pH regulation and different inorganic carbon utilization strategies may be applied. We further compare isotopic results with elemental ratios results to evaluate the potential kinetic effect on the elemental incorporation and on the isotopic fractionation of the coccolithophores, and hence to better constrain the growth and calcification responses of coccolithophores to ocean acidification.

Keywords: Ocean acidification, Coccolithophores, pH regulation, Inorganic carbon sources

T6-78-P

Modeling lipid profile of coral responded to ambient warming as a biomarker of the thermal sensation

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Abstract

Thermal stress causes mass coral bleaching and mortality, showing a high susceptivity to climate change of coral. Membrane lipids constitute the basic structural element to create cell a dynamic structure according to the circumstance. The lipid profile of coral responded to environmental factors could be a specific biomarker as well as give an insight into the mechanism of effect. Glycerophosphocholine profiling of the coral *Seriatopora caliendrum* responded to ambient warming (26.5–29.5°C for 2–8 days) was therefore performed using a lipidomic methodology in this study. Ambient warming alters the lipid profile with a decrease of carbonic anhydrase activity prior to the photophysiological stress-induced responses in the coral. Warming-induced lipid variations in the coral were well modeled based on the incubated temperature as a useful tool for indicating the thermal sensation. Based on the physicochemical properties, the changed lipids logically indicated an accommodation to the perturbation of membrane dynamics and the consequent oxidative condition, implicating a basic action model of thermal stress on coral.

Keywords: Biomonitoring, Carbon dioxide, Metabolomics, Oxidative stress, Phospholipid

T6-79-P

Mortality and morbidity in wild Taiwanese pangolin (*Manis pentadactyla pentadactyla*)

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Abstract

Globally, pangolins are threatened by poaching and illegal trade. Taiwan presents a contrary situation, where the wild pangolin population has stabilized and even begun to increase in the last two decades. This paper illustrates the factors responsible for causing mortality and morbidity in the wild Taiwanese pangolin (*Manis pentadactyla pentadactyla*) based on radio-tracking data of wild pangolins and records of sick or injured pangolins admitted to a Taiwanese wildlife rehabilitation center. Despite being proficient burrowers, results from radio-tracking show that Taiwanese pangolins are highly susceptible to getting trapped in tree hollows or ground burrows. Data from Pingtung Rescue Center for Endangered Wild Animals showed that trauma (73.0%) was the major reason for morbidity in the Taiwanese pangolin with trauma from gin traps being the leading cause (77.8%), especially during the dry season, followed by tail injuries caused by dog attacks (20.4%). Despite these threats, Taiwan has had substantial success in rehabilitating and releasing injured pangolins, primarily due to the close collaboration of Taiwanese wildlife rehabilitation centers over the last twenty years.

Keywords: Anthropogenic mortality, Dog attack, Gin trap, Radio-tracking, Rehabilitation, Wildlife rescue center

T6-80-P

A new method to simulate plant diversity and to investigate its impact on climate in an Earth System Model

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Abstract
Terrestrial biodiversity hotspots are expected to change under global warming and these changes are potentially irreversible. Additionally, climate itself is also influenced by changes of vegetation both quantitatively and qualitatively. The relationship between climate and vegetation is complex because the two are deeply entangled. Studies often use comprehensive Earth System Models (ESMs) to understand the connections on a global scale. In ESMs, terrestrial biochemical and biophysical processes are commonly parameterized semi-empirically using a maximum of twenty discrete plant functional types (PFTs). This discretization considerably simplifies the eco-morphorphysiological features of plants. Even though PFTs provide fairly reasonable representation of vegetation, they do not fully account for variations of plant traits. For example, plant diversity can never be properly represented in ESMs with PFTs. This could lead to overestimates of plant responses under a changing climate, because plants may change discretely in the model. To improve ESMs, this study exploits a new approach to describe vegetation, a plant-functioning trade-off scheme. This scheme will be implemented in the ICON-Earth System Model. Instead of empirically selecting plant types, this new method mechanistically describes plant-growth forms following several ecophysiological principles: First, it considers the trade-offs of plant growth by letting each plant use an individual growth strategy in order to utilize its resources to growth or to reproduce. Second, on these innovative plant species, this new approach mimics the concept of "Environmental filtering", where environmental conditions are used to eliminate unsuitable plant growth strategies. In this way, a more continuous and physiology-oriented plant composition can be obtained in any given environment. Using this new vegetation scheme in ICON-ESM, we investigate what changes in vegetation emerges under a different climate and how climate is influenced by plant diversity.

Keywords: Plant diversity, Trade-offs, Environmental filtering, Acclimation

T7-81-O

Population genomics of Paper mulberry supports the "out of Taiwan" hypothesis of Austronesian expansion and migration

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Abstract

The settlement of Remote Oceanic islands by Austronesian-speaking peoples (hereafter Austronesians) concludes the last stage of Neolithic human expansion. Recent archaeological, linguistic, and human genomic data of ancient DNA are increasing favoring the "Out of Taiwan hypothesis for Austronesian dispersal". However, this "farming language dispersal hypothesis" still lacks genetic supports of commensal crops and/or domesticated animals that were transported by Austronesian ancestors from East Asia into Oceanic islands. Paper mulberry (*Broussonetia papyrifera*), a fibrous, dioecious, and weedy tree species native to China, Taiwan, and Indochina, was documented to be introduced and clonally propagated by Austronesian ancestors for making bark cloth, an iconic and highly symbolic object of Austronesian material culture. Previous studies based on chloroplast sequence data indicate a southern Taiwanese origin of a majority of the Pacific paper mulberry, providing a circumstantial evidence for the "out of Taiwan" hypothesis. To unveil the transport history of Pacific paper mulberry, we investigate the sex distribution using sex marker, reconstruct the phylogeography using restriction site-associated DNA sequencing (RADseq), and date the historical events using chloroplast genome sequences. Our molecular and genomic data indicate that Pacific paper mulberry is predominately female and was originated in southeastern Taiwan. Molecular dating and population genomics indicate that paper mulberry was transported "out of Taiwan" approximately 5,500 years ago, with its patterns and timing of transports into Oceania highly congruent with recent anthropological records, providing a strong support for the "out of Taiwan" and "farming language dispersal" hypotheses of Austronesian dispersal.

Keywords: Commensal approach, Molecular dating, Plastome sequences, RADseq, Tapa cloth

T7-82-O

Charting Climate Change in the Archaeological Record of the Western Pacific

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Abstract

Studies on climate change in the western Pacific are limited, and frequently relegated to isolated studies on the timing of first occupations, changes in settlement patterns, transitions in the built environment, marked changes in resource use and subsistence practices, oral histories on storm patterns and legendary origins, shifts in regional and trans-oceanic interaction spheres, modifications in navigational knowledge, and studies on post-depositional effects in the archaeological record. Many studies have attempted to isolate contributing factors to changes in the archaeological record, e.g., changes in unidentified climate perturbations versus natural cycles in climate variability, timing and localized patterns of El Nino-Southern Oscillation within the Oceanic climate environment, changes in the Intertropical Convergence Zone and South Pacific Convergence Zone, effects of active geological events. Archaeological research focuses on specific sites and generalized patterns within the archaeological record. Oral histories on Yap, for example, document major cultural upheaval of extreme prejudice at a time identified as “before the before”. Archaeologically, this cultural act is unidentified; however, historically it is linked to major coastal erosion dating to A.D. 1200-1400, a period of increased storminess. Other cultural disruptions in the western Pacific archaeological record, e.g., related to megalithic sites like Nan Madol, are attributed to extreme El Nino events during the 17th century, a time of major site abandonment, shifting settlement patterns, and alterations to socio-political-economic structures. Attempts to draw direct connections to climate change have been unsuccessful, owing to the complex cultural interactions with island- and oceanic environments. Presented here is a summary of archaeological studies within the western Pacific correlating transformations in the archaeological record with cultural activity, climate variation, and changing oceanic environments.

Key Words: Western Pacific, ENSO, Archaeology, Nan Madol, Islands

Archaeology in the Anthropocene: from the past to the present to the future

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Abstract

Modern western conceptions of Earth and society follow the categorial difference between nature and culture derived from Cartesian thinking. However, the threat of a world-wide climate catastrophe points to the fact that human agency and nature are densely and complexly entangled. Geosciences are discussing a new geological era: the Anthropocene which is characterized by the conspicuous impact of anthropogenic activity visible in Earth's geology and ecosystems. Such developments challenge the traditional views of the relation of Earth and humans which also shaped past archaeological interpretations. The human involvement in shaping Earth, as it becomes apparent in the debate on the geochronological era of the Anthropocene, now invites humanities, especially social and cultural studies to take part in this interdisciplinary discussion. The importance of disciplines like archaeology lies in its capability to identify alternative concepts of Earth and humans in different cultures and societies which question contemporary views and show alternative solutions for crises in the relation or better: assemblage of Earth and its inhabitants, and thereby contribute to the development of sustainable futures. In a dialogue we will discuss examples from the archeological records, representing concepts of nature and culture, respectively humans and environments, as they become visible in certain material remains. The examples will range from material remains material of architecture to such of conflict scenarios from ancient Cambodia, Vietnam, and further Southeast Asia to Oceania. However, archaeology needs to develop a theoretical and methodical framework to analyze these relations. Hence, the second part of the papers will, on the basis of the discussed examples, introduce cornerstones of an Archaeology in the Anthropocene.

Keywords: Archaeology, Anthropocene, Sociocultural Change, Concepts of Nature

T7-84-P

Inception of human impacts on coral reef environments, Okinawa Island, Japan

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Abstract

Coral reef ecosystems are now being threatened by global environmental changes and human impacts. However, it is still argued that when and how increasing human populations historically affect coral reef ecosystems. This is because limited studies have been conducted on long-term environmental and ecological changes in coral reefs. In this study, we examined the geochemistry and micropaleontology of sediment cores drilled from the reclaimed areas of Naha City (Okinawa Prefecture, Japan), where pristine coral reefs had been reclaimed. 10-m deep cores with a recovery of >90% were obtained from six sites in coastal reclaimed areas of Naha City. In order to determine the timing and impacts of anthropogenic influences (e.g., terrigenous inputs and human activity), major elements ratio (e.g., SiO_2/CaO) was measured by EDX (XRF), and mineral compositions (quartz/carbonates) were determined by XRD. To reveal long-term reef environmental changes, grain-size compositions, and the taxonomic composition and abundance of foraminiferal assemblages were analyzed. Results showed that Holocene sediments with several meters in thickness cover the Pleistocene limestone (the Ryukyu Group), and are overlain by landfill sediments and soils. The Holocene cores consist mainly of bioclastic carbonate sand and mud with *in situ* corals and coral gravels, and increasingly contain terrigenous siliciclastics in the upper part of cores. Radiocarbon ages of fossil *in situ* corals and molluscs indicate that coral reefs developed at least 7-6 ka in offshore areas, and at ca. 5-4 ka in inshore areas, and that some cores may record historical changes in terrigenous sediment inputs into coral reef environments, starting from periods of the Gusuku (since 11th to 12th century) and Ryukyu Kingdom (since 15th century).

Keywords: Coral reef, Human impact, Sediment input, Geochemistry, Micropaleontology

The mixed rice and millet agriculture in Neolithic age lower Minjiang River: Phytolith evidence from the Baitoushan site

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Abstract

Questions about origin and spread of rice and millet agriculture have always been the hot topics in archaeobotany and agricultural archaeology research. The beginning and development process of agriculture in the lower reaches of Minjiang River are of great importance to the research on the timing and route of southward dispersal of agriculture and proposed initial expansion of proto-Austronesians. However, due to the lack of detailed archaeobotanical work, the beginning of rice and millet farming in this region remain unclear. In this study, phytolith analyses, together with radiocarbon dating of samples from a newly excavated site named Baitoushan in the lower reaches of Minjiang river, showed that rice and millet have already arrived in the lower Minjiang river region around 5,000 cal a BP. A mixed rice and millet agriculture may thus have been established in this region. This is the first time that millet was found in the Tanshishan cultural layer (ca.5000-4300 cal a BP) of the lower Minjiang River. This study provides new evidence for the spread of rice and millet to the southeast coastal areas of China, as well as sheds lights on the understanding of early cultural communications between Taiwan and the mainland of China in the Neolithic Age.

Keywords: Origin of agriculture, Microfossil, Archaeobotany, Fuzhou basin