



# Newsletter

Dec. 2019 NO. 12

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### Visitors

Ahluwalia H. (IFMS), Chang KY (LBNA, USA), Chen T. (UMD, USA), Chien MH (NYU, USA), Chu P. (UH Manoa, USA), Feng F. (CAS, China), Feng Y.

(CSU, USA), Jia X. (ZJU, China), Koh T. (NTU, Singapore), Kuo Y. (NCAR, USA), Li F. (UCLA, USA), Li T. (UH Manoa, USA), Li W. (ZJU, China), Lee RW (NCAS, UK), Levine A. (UW, USA), Long C. (ZJU, China), Lu J. (PNNL, USA), Miyoshi T. (RCCS, JP), Moseley C. (MPI, Germany), Rasmussen K. (CSU, USA), Qian J. (CCRS, Singapore), Roundy PE (SUNY Albany, USA), Shen B. (SDSU, USA), Stuecker MF (PNU, Korea), Tao W. (NASA, USA), Tzeng CT (UP, USA), Wang B. (UH, USA), Wang W. (SUNY Albany, USA), Zheng F. (IAP, CAS, China)

### Research Highlights

- ◆ Role of coastal convection to moisture buildup during the South China Sea summer monsoon onset
- ◆ Tracking a Long-Lasting Outer Tropical Cyclone Rainband: Origin and Convective Transformation

### 2019 Doctors' and Masters' Theses

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## Award

- ▶ Professor Jong-Dao Jou was named as an Emeritus Professor in 2019.
- ▶ Professor Cheng-Shang Lee received the NTU Outstanding Teaching Award in Teaching Award in 2018.
- ▶ Professor Jen-Ping Chen received the NTU Outstanding Teaching Award in Teaching Award in 2018.
- ▶ Assistant Professor Yen-Ting Hwang received the NTU Outstanding Teaching Award in Teaching Award in 2018.
- ▶ Professor Hung-Chi Kuo received the title of Chair Professor of NTU in 2019-2020
- ▶ 周仲島教授榮聘為本校108年度榮譽教授。
- ▶ 李清勝教授獲107學年度教學優良獎。
- ▶ 陳正平教授獲107學年度教學優良獎。
- ▶ 黃彥婷助理教授獲107學年度教學優良獎。
- ▶ 郭鴻基教授榮獲108年度臺灣大學講座(108-111)。

## Personnel Changes

- ▶ Professor Guang-Rong Hsu retired from the department on February 1, 2019.
- ▶ Professor Jong-Dao Jou retired from the department on August 1, 2019.
- ▶ Professor Chun-Chieh Wu began serving as the Dean of the College of Science on August 1, 2019.
- ▶ Assistant Technician Chi-Bao Fu began serving in the department on September 2, 2019.
- ▶ 徐光蓉教授自108年2月1日起退休。
- ▶ 吳俊傑教授自108年8月1日起擔任理學院院長。
- ▶ 周仲島教授自108年8月1日起退休。
- ▶ 傅七寶助理技師自108年9月2日起於本系服務。



### Retirement of Prof. Guang-Rong Hsu

A retirement party for Professor Guang-Rong Hsu was held on January 31, 2019.

徐光蓉教授於2月1日退休，本系於108年1月31日舉辦期末餐會暨退休餐會，歡送徐老師。

### Retirement of Prof. Jong-Dao Jou

On June 21, the department of Atmospheric Science held a retirement thanksgiving party in honor of Prof. Jong-Dao Jou. Teachers and students from National Central University, National Taiwan Normal University, Chinese Culture University, Academia Sinica, Central Weather Bureau, and National Science and Technology Center for Disaster Reduction were all invited to present their academic research. Prof. Chou also shared reflections from his 30-years of tenure in the Atmospheric Sciences Department. It was a heartwarming farewell party for everyone.

本系於6月21日下午假大氣科學系系館舉辦了周仲島教授榮退感恩會並邀請了來自中央大學、師範大學、文化大學、中央研究院、中央氣象局及國家災害防救科技中心等國內大氣界同仁以及系上師生分享了學術研究心得，周老師也分享自己在大氣系30多年的教學心得點滴，大家一起度過了一場溫馨感人的歡送會。



### Professor Chun-Chieh Wu took office as the Dean of the College of Science

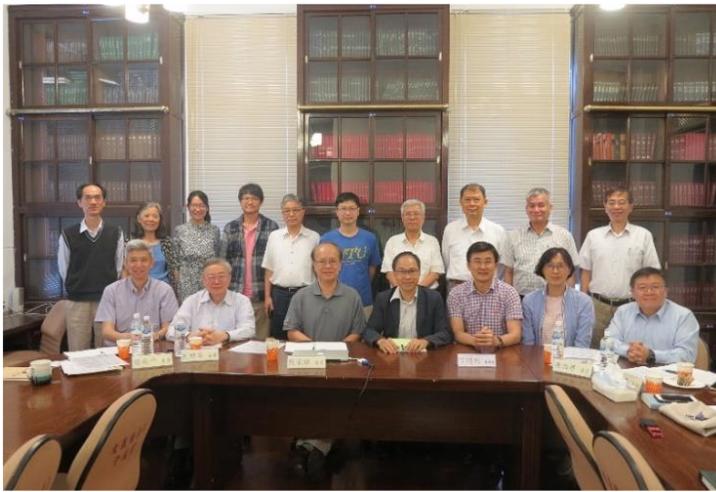
Professor Chun-Chieh Wu took up the post as the Dean of the College of Science on August 1, 2019, and had a group photo with the former Deans in the inauguration ceremony.

本系吳俊傑教授於108年8月1日就任理學院院長，並舉行交接典禮，圖為新舊院長與歷任院長合影。

## The Department Assessment

The Department Assessment was held in our department from May 16th to 17th. We invited five scholars, including Professor William K.M. Lau of University of Maryland (Commissioner), Professor Ngar-Cheung Lau of Chinese University of Hong Kong, Professor Jin-Yi Yu of University of California Irvine, Professor Shang-Ping Xie of University of California San Diego, and Professor Shu-Hua Chen of University of California Davis to serve on the assessment committee so as to better understand our current research and teaching standards and its future outlook.

Over the course of two days, the Dean of the College of Science first welcomed the committee and emphasized the importance of this evaluation for each department. This was followed by separate interviews with teachers, staff members, post-doctorate researchers, and student representatives of each department from the bachelor's and master's programs respectively. On the second day, the committee conducted another conference with the NTU's Dean of Academics and NTUAS's faculty to further understand the department teaching and research plans.



**Group Photo of Department Assessment**

本系於5月16至17日舉辦5年一次的教學研究單位實地訪評。此次評鑑邀請五位國外著名學者擔任委員，包括美國馬里蘭大學劉家銘教授(召集人)、香港中文大學劉雅章教授、美國爾灣加州大學余進義教授、美國聖地牙哥加利福尼亞大學謝尚平教授及美國加利福尼亞大學戴維斯分校陳淑華教授，了解本系研究及教學現況與展望。在這兩天行程中，首先由本校理學院劉緒宗院長歡迎評鑑委員蒞臨，表達臺大校方對各系舉辦教學研究單位評鑑如同系所體質體檢的重視，接著分別與系上教師、職員、博士後研究員和大學部及研究所學生代表進行座談，並於第二天與本校教務長及本系全體專任教師，進行綜合座談，深入了解系上教學及研究的運作及規畫。

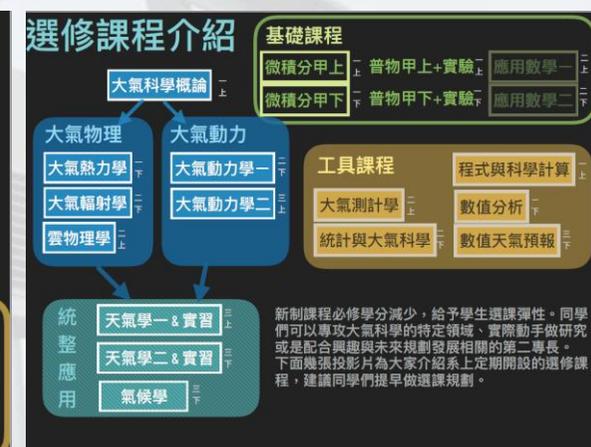
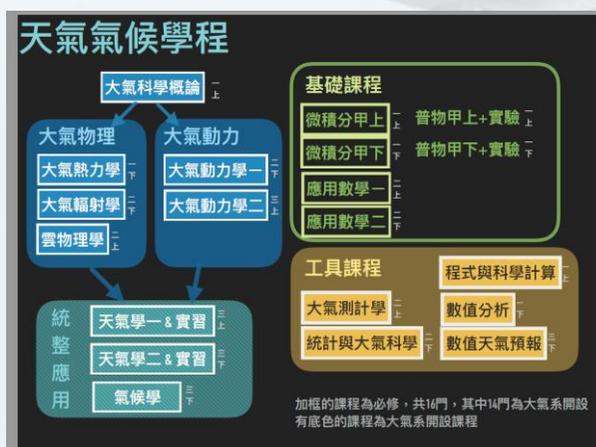


Group Photo of Department Retreat

## The Department Retreat

The Department Retreat was held on August 13, 2019. All teachers participated in this retreat to continue the discussion on changes for undergraduate courses and to further adjust the required courses such that these courses are more relatable and more concrete for students. Each teacher also provided a course in their expertise for the master's program to enhance the effects of learning for students.

本系教師於8月13日參加靜修會，會議由全體老師出席凝聚共識。在大學部課程方面，延續上次課程改革方向，進一步微調必修課程，讓課程銜接更完善、學生的學習更紮實。在研究所課程方面，邀請每位老師提供一門招牌課程，讓教師專長與研究所課程做最佳結合，提升學生學習效果。



## Guidelines for Undergraduate Courses



## NTU Azalea Festival

Every year around March, National Taiwan University will hold the NTU Azalea Festival for two days. This year's festival was held from March 16th to 17th, with activities including departmental exhibitions, student club exhibitions, and performances that attracted high schoolers from all over Taiwan to learn about each department of NTU as they decide on a direction for their future studies.

臺灣大學每年3月都會舉辦為期兩天的杜鵑花節。今年於3月16日至17日舉行，活動內容包括學系博覽會、社團聯展以及表演活動，吸引臺灣各地高中生前來參，認識臺大各個科系，作為升學時的參考。



## Commencement

NTU's commencement ceremony took place on the morning of June 1, 2019, along with the dean's award ceremony. In the afternoon, a hooding ceremony for the new graduates of NTUAS was held in the department, with family and friends sharing in this joyous occasion. The students graduating from NTUAS

in 2019 include 30 Bachelors', 11 Masters', and 2 Doctorate degree holders.

臺灣大學畢業典禮在6月1日於臺大體育館舉辦。並於當天下午，在系上進行畢業典禮，由系主任撥穗，並邀請畢業班導師及畢業生親友共同參與。今年系上共有30名學士，11名碩士及2名博士畢業。





### Parents' Day

Every year in September before school begins, NTU will hold a Parents' Day for incoming students. The Atmospheric Sciences Department welcomes parents to come to stay updated on departmental events, to take a look at the classes and learning environment we provide, and also to participate in some interactive activities.

臺灣大學於每年9月開學前，舉辦校級新生家長日。本系邀請家長們了解大氣系系況、課程及環境，並進行交流活動。



### 2019 Undergraduate In-house Summer Research and Oversea Education Program -- Poster Presentation and Award

To promote undergraduate research in our department, the In-House Summer Research has been initiated in the summer of 2019, with the participation of 20 junior and sophomore-year students, advised by 8 faculty members. In addition, five undergraduate students obtained the opportunity of summer academic exchange to at SUNY Albany, NCAR, and CSU through the overseas educational program. These students share their experiences and summer research results at the Department of Atmospheric Sciences on September 19, 2019.

為促進本系大學部學生研究能量，本系於2019年夏天首次舉辦大氣系大專生暑期研究活動，共有20位大三與大二的學生分別接受八位系上教師的指導進行研究。此外，有五位大學部同學參與海外教育計畫，於暑假前往美國紐約州立大學歐本尼分校、NCAR、科羅拉多州路大學進行交流與研究，並於9月19日於大氣科學系舉辦海報競賽，分享同學在暑期研究計畫與海外教育計畫研究的成果。



## PIRE Program

The 2019 PIRE annual conference was held on August 5 to 7 at the Sun Moon Lake Taiwan Beauty Hotel. Dr. Everette Joseph, the Chair of NCAR Mesa Laboratory, led a team of 12 researchers, 10 postgraduates, and 6 undergraduate students from the United States of America. About 30 people from Taiwan attended this conference, including our department chair, Dr. Po-Hsiung Lin, and Professor Jen-Ping Lin, along with teachers from institutions such as NCU, Academia Sinica, NTNU, NCU, NCCU, and CWB, and postgraduate and undergraduate students. This conference focuses on research advancements on topics such as extreme weathers, regional weathers, ensemble forecast, promote further collaborations between Taiwan and America PIRE. 2019 PIRE 年度會議在8月5日至7日於日月潭臺灣真美會館舉行，美方團隊由美國國家大氣研究中心主任 Dr. Everette Joseph 領軍，包括教師與研究人員12人，包括教師與研究人員12人，研究生10人，大學部學生6人。

國內則包括本系林博雄主任及陳正平老師以及多位中大，中研院，師大，政大，中正大學，中央氣象局等單位老師，研究生以及大學部學生約30人與會，會中針對極端氣候與天氣，區域氣候，系集預報，降水微物理，防災緊急應變與決策，計畫評估等面向進行研究進展報告，促進臺美PIRE進一步合作。



## CoS Travel Grants and Scholarship

Under the reimbursement of CoS Travel Grants and Scholarship, our department encourages students to attend international conferences. Master students Chong Yong Li, Yi Hsuan Lin, and Tsz Ying Wu attended AOGS in Singapore. Through seminars from different fields during the conference, students gain new knowledge and enhance overseas academic exchanges. The topics of this conference included aerology, geology, hydrology, astrology, oceanography, biogeochemistry, and energy applications.

在理學院國際交流獎學金補助下，本系積極鼓勵學生參加國際會議。碩士班研究生李宗勇、林宜萱及吳姿瑩於7月28日至8月2日在新加坡參加亞洲大洋洲地球



科學學會年會(AOGS)，會議主題包含大氣、地質、水文、天文、海洋、生物地球科學以及能源應用等等，藉由會議中不同領域的短講，學習新知識並增進國際學術交流。

### 2019 UAW Workshop

On August 21, Professor Chong-Hsin Sui and five other professors led a group of 12 researchers to Tokyo University to attend the 2019 University Allied Workshop on Climate and Extreme Weather. The topics of the conference were mainly about seasons, sub seasons, and extreme weather, where both parties released their research results. Through discussions, they sorted out the crucial breakthroughs of their current researches to become the focus of their future research and collaborations.

本系隋中興老師及5位老師於8月21至23日帶領12位研究生至日本東京大學參加2019UAW 研討會。會議內容著重於季節、次季節、極端天氣三個尺度相關議題。雙方師生發佈最新研究成果，共同進行交流，透過提供雙方討論的契機，整理出



關鍵的、突破性的科學議題，作為彼此後續研究重點，發展未來持續且深入的交流與合作。

### NTU Anniversary Celebration Sports Day

The students from our department received a silver medal in the team swimming competition of NTU Sports Day on October 19, 2019. Also NTU held NTU Anniversary Sports Day on November 23-24, students of NTUAS joined the contest actively.

本系大學部同學參加10月19日全校運動會游泳比賽，獲得團體賽銀牌獎。另，本校於11月23、24日舉行108年度全校運動會，由本系林博雄主任帶領大學部學生參賽。



## 2019 NTUAS Week

Students from our department set up a booth at Xiao-Fu square on December 2-6, selling healthy and delicious homemade food and drinks, and weather-related Storm Glass to promote the our department to the others and enhance the communication between our students.

今年12月2日至6日系上大學部學生在小福廣場擺設為期一週的攤位，販售健康美味的自製食物和飲料以及與天氣相關的天氣瓶（Storm Glass），藉由此活動推廣大氣系，並促進系上學生的交流，達到增進本系凝聚力的效果。



## 2019 Atmospheric Cup Table Tennis Friendship Championship

The department students teamed up to attend 2019 Table Tennis Friendship Championship at NTU Sports Center held by Meteorological Society of Republic of China (December 29, 2019).

本系學生桌球隊參加 2019 中華民國氣象學會桌球聯誼賽(12月 29 日假台灣大學綜合體育館)



Group photo of NTUAS contestants

## 2019 NTU-ZJU Seminar on Atmospheric Sciences

The NTU-ZJU Seminar on Atmospheric Sciences was held on May 6th, 2019, through May 7th, 2019. Professor Long Cao, Professor Guo Qing Zai, Professor Xiao Fan Li, Professor Xiao Jing Jia, Professor Pei Jun Zhu, Professor Wei Jun Li, Professor Dan Tong Liu, Professor Dao Huang, and nine other scholars of ZJU Atmospheric Science Department visited and conducted academic exchange with professors from our department.

### 2019台大浙大大氣科學學術交流會議程

日期/時間	主題	主持人
5月6日 09:30-10:00	Opening	台大大氣系林博雄主任
5月6日 10:00-12:00	對流與天氣/氣候動力與環境變遷/大氣物理化學【短講：浙大/翟國慶 李小凡 吳仁廣 朱翟國慶：浙閩沿海山地短飆線發生背景數值試驗 李小凡：Thermal and micro-physical effects of ice cloud on torrential rainfall over north China 吳仁廣：A local instantaneous view of TC genesis over the NW Pacific during boreal summer	洪惠敏 陳正平 周仲島
5月7日 09:30-12:00	【09:30-10:10 議題：陸面過程對區域氣候影響】 【10:20-11:00 議題：季內至年際氣候震蕩】	臺大大氣系羅敏輝老師/賈曉靜 浙大：吳仁廣 / 臺大大氣系隋中興老師
5月7日 14:30-15:50	專題討論課程演講 曹龍：地球系統模擬的幾個應用 賈曉靜：Influence of Autumn Tibet Plateau Snow Cover on Winter Temperature over North America 李衛軍：Air-pollution aerosol interactions produce more bioavailable iron for ocean ecosystems	
5月7日 16:20-18:00	對流與天氣/氣候動力與環境變遷/大氣物理化學 【短講：台大/黃彥婷;浙大/劉丹彤 黃道】	中研院/杜佳穎 李威良
2019/5/7 18:30	晚宴	

本系於2019年5月6至7日舉辦台大浙大大氣科學學術交流會，浙江大學大氣系共有曹龍教授、翟國慶教授、吳仁廣教授、李小凡教授、賈曉靜教授、朱佩君教授、李衛軍教授、劉丹彤教授及黃道教授等9人來訪，並與本系教師進行學術短講交流。



Group Photo of NTU-ZJU Seminar on Atmospheric Sciences

## The 8th International Conference on Fog-Fog Collection and Dew

The department co-organized The 8th International Conference on Fog, Fog Collection and Dew jointly with Normal University, Central University, Donghua University, Pingtung University of Science and Technology and Environmental Protection Society of Taiwan at NTU's Shih-Liang Chien Lecture Hall on July 14-19, 2019, with researchers from 26 different countries and a total attendance of approximately 130 people.

The topic of this conference was on issues about mist and dew, including chemistry, physics, deposition/formation, and interplay of surface and vegetation. An ice breaker was held at the beginning of the conference on July 14th, followed by lectures, poster presentations with one-minute explanations, and poster displays on July 15th through 16th, and July 19th. On July 17, the attendees of the conference visited the NTU Experimental Xitou Forest Area to further understand the field research area and the equipment used in the study.



**Group photo of the 8<sup>th</sup> International Conference on Fog-Fog Collection and Dew**



This triennial international academic conference successfully gathered experts of this field from all over the world to present their latest findings related to vegetation and life cycle of mist and dew at the atmospheric boundary layer, and it also provided an opportunity for academic exchange on the collection of mist and dew. The guests praised the conference for its schedule and location, thus, successfully allowing Taiwan to have an opportunity to be recognized in the international academic world.

本系於2019年7月14-19日，假綜合教學館錢思亮講堂與師範大學、中央大學、東華大學、屏東科技大學及中華民國環境保護學會合辦合辦第八屆霧-霧收集-露國際研討會，與會人員自美洲、歐洲、亞洲、非洲及大陸地區等26個不同國家研究學者共計約130人，系上有多名博碩生發表論文及演說。該會議主題為霧和露相關議題，包含化學、物理學、沉積/形成與地表和植被的相互作用、量測與監測、模式建置和預報及水資源等。研討會首先於7月14日假台大校史館舉辦Ice Breaker，進行會前交流，於7月15-16日及19日假臺大綜合教學館舉行會議，進行方式包含口頭演講、海報發表1分鐘短講以及海報區展示等，為了增進實地訪查之互動交流，更於7月17日安排與會者參觀臺大溪頭實驗林區之研究試驗站，介紹雲霧收集及通量塔等相關設備。本次研討會成功舉辦這次三年一度的國際性學術活動，匯集世界各地相關之領域專家學者進行交流，針對植被和大氣邊界層內霧和露水生命週期感興趣的科學家的最新研究成果，以及霧和露水的收集生產提供學術交流的機會。



**Group photo of 2019 Metrological Conference for Cross-Strait Youngman**

### 2019 Metrological Conference for Cross-Strait Youngman

Our department held the 2019 Metrological Conference for Cross-Strait Youngman with the Meteorological Society of the Republic of China and the Department of Atmospheric Sciences of National Central University on November 25-26. About 50 teachers and students from institutions such as Nanjing University of Information Science & Technology, University of Science and Technology of China, Chengdu University of Information Technology, Yunnan University, Sun Yat-sen University, Ocean University of China, China University of Geosciences, Fudan University, Tsinghua University, Northeast Agricultural University, Beijing Normal University, and our department attended this conference. The opening host for the conference was Dr. Pay-Liam Lin from NCU. Each person also conducted a 15-minute short speech during the conference, with topics including atmosphere, weather, and climate change...etc, to promote a scholarly exchange of atmospheric sciences between cross-strait Youngman.

本系於11月25-26日與中華民國氣象學會及中央大學大氣科學系假臺大管理學院B1教室合辦舉行2019兩岸青年大氣科學學術研討會，與會人員來自中國地區南京信息工程大學、中國科學技術大學、成都信息工程大學、雲南大學、中山大學、中國海洋大學、中國地質大學、復旦大學、清華大學、東北農業大學、北京師範大學等以及本系師生共計約50人。開場主持人由中央大學林沛練老師主持，會中每人進行15分鐘短講，內容包括氣候、天氣及環境變異等議題，促進兩岸青年對大氣科學的學術交流。



Dr. Tse-Chun Chen of University of Maryland visited the department on January 28, 2019, and delivered a seminar titled “How to improve forecasts by identifying and deleting detrimental observations?”.



Dr. Bo-Wen Shen of San Diego State University visited the department on January 3, 2019, and delivered a seminar titled “Butterfly effects and chaos: New insights revealed by a generalized Lorenz model”.



Kiangsu-Chekiang College from Hong Kong visited the department on Feb. 22, 2019.



Dr. Frank Jui-Lin Li of UCLA, visited the department on March 12, 2019, and delivered a seminar titled "Potential faster Arctic sea ice retreat triggered by falling ice greenhouse effect".



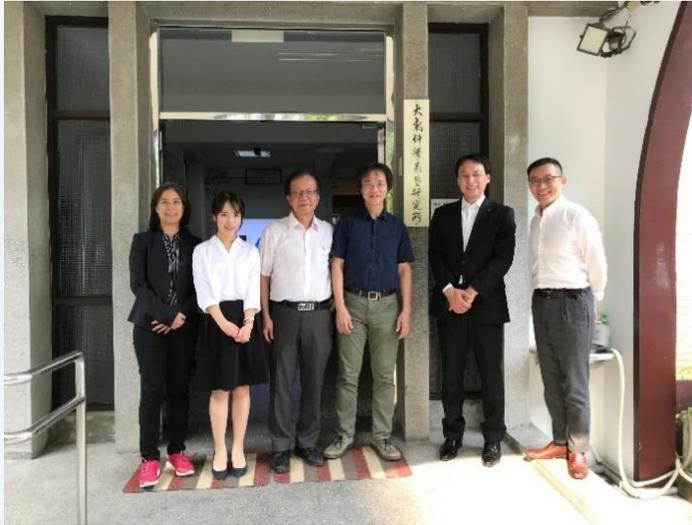
Dr. Aaron Levine of University of Washington, visited the department on March 12, 2019, and delivered a seminar titled "Contributions of Westerly Wind Bursts, Easterly Wind Bursts, and the Seasonal Cycle to the Unusual 2014-2016 El Nino".



Dr. Wei-Kuo Tao of NASA, visited the department on March 20, 2019, and delivered a seminar titled "GPM (CSH) Latent Heating (LH) Algorithm and Its Retrieved LH Structures".



Prof. Paul E. Roundy of University at Albany SUNY, visited the department on March 18, 2019, and delivered a seminar titled "Tropical-Extratropical Teleconnections".



Japan Weather Association visited the department and give a recruitment briefing on March 21, 2019.



Dr. Fei Zheng of Institute of Atmospheric Physics Chinese Academy of Sciences, visited the department on March 21, 2019, and delivered a seminar titled “Improved ensemble mean forecasting of ENSO events by a zero mean stochastic error model of an intermediate coupled model”.



Prof. Wei-Chyung Wang of University of New York at Albany, visited the department on April 23, 2019, and delivered a seminar titled “Aerosol-cloud interactions and climate variability over east China”.



Dr. Tsung-Han Li of University of Hawaii at Manoa, visited the department on April 18, 2019, and delivered a seminar titled “The role of boundary-layer dynamics in tropical cyclone intensification”.



Prof. Cao Long, Prof. Xiaojing Jia, and Researcher Weijun Li of Zhejiang University, visited the department on May 7, 2019, and they presented talks titled “Applications of the Earth’s System Simulations”, “Influence of Autumn Tibet Plateau Snow Cover on Winter Temperature over North America” and “Air-pollution aerosol interactions produce more bioavailable iron for ocean ecosystems”.



Dr. Harinder Ahluwalia, Chair of IFMS, visited the department on April 26, 2019, and delivered a seminar titled “Development of weather enterprise in Canada: IES experience”.



Prof. Pao-Shin Chu of University of Hawaii-Manoa, visited the department on May 28, 2019, and delivered a seminar titled “Improving ENSO forecasts using Bayesian model averaging”.



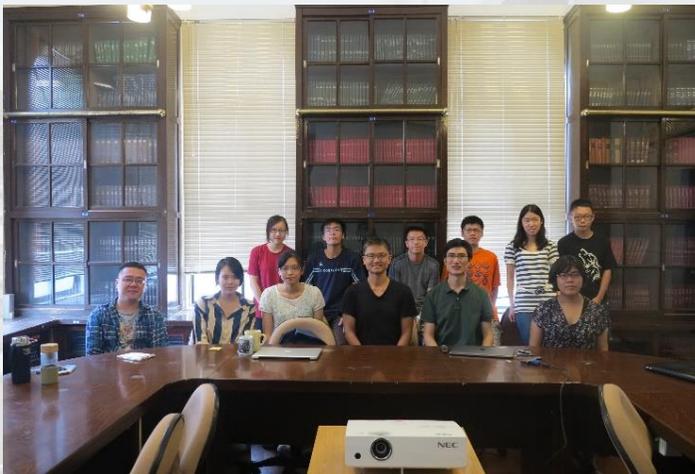
Prof. Ying-Hwa Kuo of NCAR, visited the department on May 9, 2019, and delivered a seminar titled “Impact of GPS RO Data on Tropical Cyclogenesis”.



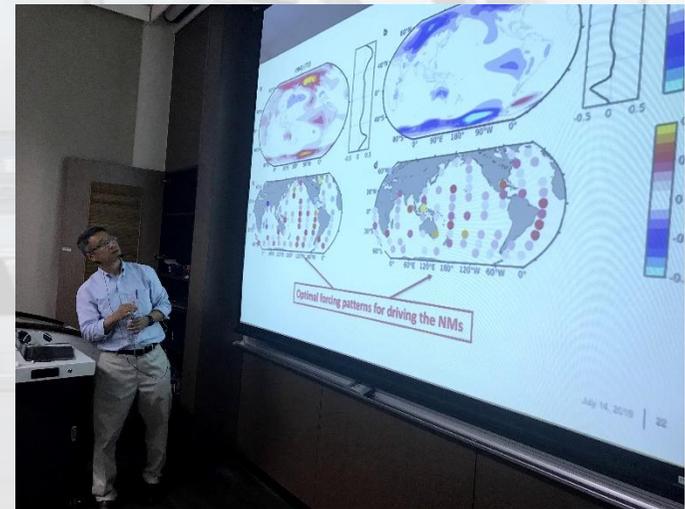
Prof. Tieh-Yong Koh of Nanyang Technological University of Singapore, visited the department on July 4, 2019, and delivered a seminar titled “Multi-scale convection in the tropics: modelling and observations”.



Prof. Kristen Rasmussen of Colorado State University, visited the department on June 5, 2019, and delivered a seminar titled “Changes in Future Flash Flood-Producing Storms in the U.S.”



Prof. Feng Wei Feng of Chinese Academy of Sciences, visited the department on August 19, 2019, and delivered a seminar titled “Hydro-geodesy research progress”.



Dr. Jian Lu of Pacific Northwest National Laboratory, visited the department on July 15, 2019, and delivered a seminar titled “On the optimal forcing for mitigating global warming”.



Dr. Jian-Hua Qian of Center of Climate Research Singapore, visited the department on September 24, 2019, and delivered a seminar titled "Mechanisms for the Vanguard Pattern of Rainfall Variability in the Maritime Continent Associated with the Madden-Julian Oscillation".



Dr. Ya-Chien Feng of Colorado State University, visited the department on September 6, 2019, and delivered a seminar titled "Meteorological applications of advanced radar refractivity retrievals".



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Dr. Robert W. Lee of National Centre for Atmospheric Science, Reading, UK and Dr. Chris Moseley of MPI, Germany visited the department on October 23 & November 5, 2019, and delivered seminars titled "ENSO modulation of MJO teleconnections to the North Atlantic & Europe" & "Understanding the dynamics of convective extreme precipitation events".



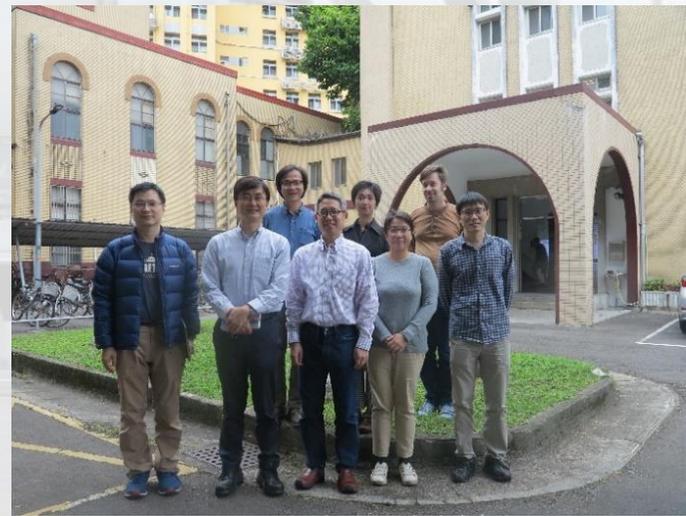
Dr. Malte F. Stuecker of IBS Center for Climate Physics, Pusan National University, visited the department on November 26, 2019, and delivered a seminar titled "Regional climate change from the tropics to the poles".



Dr. Kuang Yu Chang of Lawrence Berkeley National Laboratory, visited the department on November 12, 2019, and delivered a seminar titled "Identifying, Quantifying and Predicting Ecosystem Responses to Changing Environmental Conditions from Local to Global Scales".



Dr. Kai Chih Tseng of Princeton University and Ph.D. Student from Mu Hua Chien of Center for Atmosphere Ocean Science and Mathematics, Courant Institute, New York University visited the department on December 31, 2019. They presented talks "The Madden Julian Oscillation and Tropical-Extratropical Teleconnections" and "Hurricane-like vortices in the conditionally unstable moist convection".



Dr. Takemasa Miyoshi of Data Assimilation Research Team, RIKEN Center for Computational Science visited the department on November 29, 2019, and delivered a seminar titled "Big Data Assimilation: A New Science for Weather Prediction and Beyond".

## Role of coastal convection to moisture buildup during the South China Sea summer monsoon onset

### 沿岸對流在南海夏季季風爆發期間大氣快速濕化過程中所扮演的角色

Wei-Ting Chen\*, Chien-Ming Wu, Wei-Ming Tsai, Peng-Jen Chen, and Po-Yen Chen

陳維婷\*、吳健銘、蔡偉銘、陳鵬任、陳柏言

Chen et al. (2019) combines the satellite-based convective system analysis and idealized cloud-resolving simulations to investigate the increase of ocean moisture and the occurrence of propagating coastal organized convection during the sharp transition of the South China Sea (SCS) summer monsoon onset. Using multi-year observations of TRMM 3B42 rainfall estimates, CloudSat vertical cloud mask, and reanalysis data sets, the statistics of object-based precipitation systems of various horizontal scales, moisture budget, and basin-scale local circulation are derived. Before the monsoon onset, an anomalous vertical circulation is developed over the SCS basin, with updrafts over land associated with the active diurnal convection and anomalous subsidence over ocean suppressing the precipitation. When the low-level winds switch to westerlies after the onset, the number of large (> 300 km), propagating convective systems increases over the Philippine coast, accompanied with the sharp moisture buildup over ocean within 10 days. The moisture budget suggests that the local contribution from convective vertical mixing is the major moisture source during the first pentad after the onset. To study the response of moisture buildup and convection organization to low-level wind shear, idealized simulations with a setting of land and ocean similar to the scale of the SCS are carried out using the 3D cloud-resolving VVM developed in NTUAS. The simulations capture the essential features of the observed evolution of moisture and convection. In the no-shear environment, a strong basin-scale circulation is formed, which suppresses the ocean moisture development. When large-scale vertical wind shear is imposed to represent the changes of large-scale circulation during the onset pentad, organized convection systems are increased over the coastal ocean and propagate toward the open ocean, accompanied by fast ocean moistening within 5–10 days.

Chen et al. (2019)利用衛星觀測對組織性對流系統進行長期統計，並結合理想化雲解析模擬，探討南海夏季季風快速轉換期間，大氣水氣增加與沿岸組織性對流系統發展的過程。我們使用了多年的TRMM 3B42衛星降水產品、CloudSat衛星雲剖雷達之垂直雲量分布觀測以及再分析資料，統計了組織性降水系統的數量、水氣收支與南海局地大氣環流在南海夏季風爆發前後二十天期間的演變。在季風爆發之前，南海周圍陸地島嶼已有活躍的日夜對流，伴隨的局地大氣環流在陸地上空有更強的上升運動、在海上則有更強的下沉運動，對海上的水氣與對流發展提供額外的抑制作用。

當南海的大尺度風場在低層大氣轉為西風，南海東側靠菲律賓沿岸開始出現水平尺寸300公里以上的大型組織性對流系統，此類系統的數量在十日內明顯增加且發生位置逐漸往海中央擴展，伴隨海上大氣快速增濕以及局地環流的轉換。為了解在不同背景低層風切下海上大氣濕化速度與沿岸對流發展的差異，我們使用台大大氣科學系開發了3D雲解析VVM模式，依據南海的海陸地形分布進行了理想化實驗。在背景風場為微弱東風且無垂直風切的模擬中，陸地日夜對流活躍、海洋濕化過程與對流活動受到局地環流抑制。當背景風場低層改為微弱西風後，海洋東側沿岸逐漸發展出組織性對流且逐日往海洋中心發展，海洋在五至十日內快速增濕，模擬結果清楚掌握了觀測到的水氣與對流活動演變特徵。

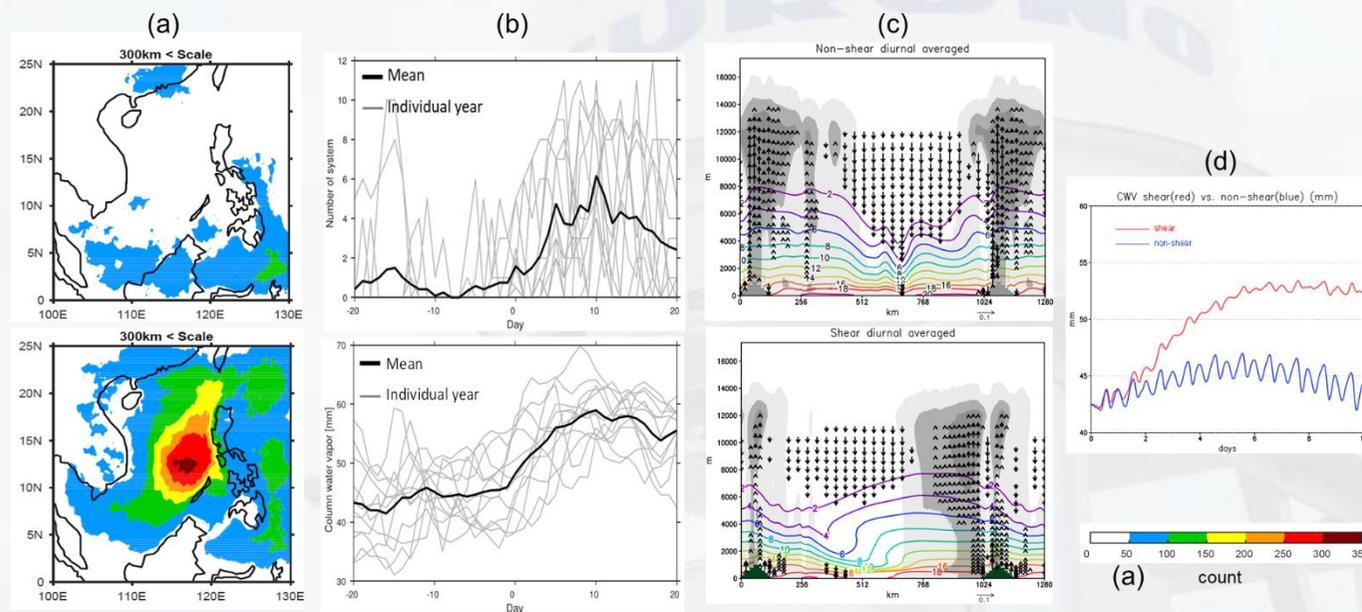


Figure 1. (a) Spatial distribution of the occurrence frequency of large precipitating systems (horizontal scale > 300 km) identified from satellite during the 20-day period before (top) and after (bottom) SCS monsoon onset. (b) Temporal evolution of observed large precipitating systems (top) and column-integrated moisture (bottom) over the SCS ocean during the +/-20-day onset period in the typical activation years. Gray lines: individual years; black line: composite mean. (c) Zonal-vertical cross section of cloud fraction (grey shading), vertical velocity (vectors), and water vapor mixing ratio (contour) in the cloud-resolving simulations without (top) and with (bottom) low-level westerlies. (d) Simulated temporal evolution of column-integrated moisture over ocean without (blue) and with (red) low-level westerlies.

圖1 (a) TRMM 3B42觀測統計1998-2014年間水平尺寸超過300公里的大型降水系統在南海夏季季風爆發前後的發生數量:(上排)前二十天、(下排)後二十天。(b)南海夏季季風爆發前後二十天期間,(上排)衛星觀測大型降水系統數量與(下排)再分析資料氣柱垂直積分水氣量的演變(灰線:各年、黑線:多年合成平均)。(c)理想化雲解析模擬結果中,南北向平均的雲量(灰色色階)、水氣(彩色等值線)、垂直運動(黑色箭頭)剖面:(上排)背景風場無垂直風切、(下排)背景風場低層為西風。(d)雲解析模擬中海洋大氣垂直積分水氣量的時序變化:(藍線)背景風場無垂直風切、(紅線)背景風場低層為西風

## Tracking a Long-Lasting Outer Tropical Cyclone Rainband: Origin and Convective Transformation

Cheng-Ku Yu, Che-Yu Lin, and Jhang-Shuo Luo

In addition to the eye and eyewall, tropical cyclone rainbands (TCRs) are the most striking and persistent feature of tropical cyclones (TCs). They are conveniently classified into inner and outer rainbands based on the degree to which convection is influenced by the inner-core vortex circulation. Theoretically, inner TCRs and outer TCRs have been traditionally considered as manifestations of vortex Rossby waves and inertia-gravity waves, respectively. This point of view has been shaken recently. In particular, Yu et al. (2018) documents not only a frequent similarity between the outer TCRs and squall lines (~58%) but also some variability in structural features of the observed outer TCRs. However, owing to the inherent limitation of observations in both temporal and spatial coverage, investigations for nearly all of the previous studies are primarily confined to the mature stage of the rainband's lifetime so that little is learned about the initiation and/or evolving scenarios of the outer TCRs. The primary objective of this study is to use Central Weather Bureau and Japan Meteorological Agency radar and surface observations to document a long-lasting outer TCR of Typhoon Jangmi (2008) over a considerable period of time (~10 h) from its formative to mature stage.

Detailed analyses indicate that the TCR was initiated on the eastern side of the TC as it detached from the upwind segment of a stratiform rainband located close to the inner-core boundary (Fig. 1). The outer rainband, as it propagated cyclonically outward, underwent a prominent convective transformation from generally stratiform precipitation during the earlier period to highly organized, convective precipitation during its mature stage (Fig. 2). This observed transformation was accompanied by a clear trend of surface kinematics and thermodynamics toward squall-line-like features. Furthermore, the observed intensification of the rainband was not simply related to the spatial variation of the ambient CAPE or potential instability; instead, the dynamical interaction between the pre-rainband vertical shear and cold pools, with progression toward increasingly optimal conditions over time. The increasing intensity of cold pools was suggested to play an essential role in the convective transformation for the rainband. These important evolving aspects of surface and precipitation characteristics for the TCR were summarized schematically in Fig. 3. The convective transformation, as documented in the present case, is anticipated to be one of the fundamental processes determining the evolving and structural nature of outer TCRs.

Citation: **Yu, C.-K.\***, C.-Y. Lin, and J.-S. Luo, 2019: Tracking a long-lasting outer tropical cyclone rainband: Origin and convective transformation. *J. Atmos. Sci.*, 76, 3267-3283, doi: 10.1175/JAS-D-19-0126.1.

Reference: **Yu, C.-K.\***, C.-Y. Lin, L.-W. Cheng, J.-S. Luo, C.-C. Wu, and Y. Chen, 2018: The degree of prevalence of similarity between outer tropical cyclone rainbands and squall lines. *Sci. Rep.*, 8, 8247, doi: 10.1038/s41598-018-26553-8.

## 長生命期颱風外圍雨帶之追蹤：起源與對流轉變

游政谷 林哲佑 羅章碩

颱風雨帶是除了眼牆(eyewall)之外颱風內部最顯著的結構特徵與強降水集中區。颱風雨帶依照受到颱風內核渦旋環流的影響程度，一般可區分為內圍雨帶與外圍雨帶。在理論上，科學家長期以來一直認為內圍/外圍雨帶為颱風環流內部大氣波動(如渦旋羅士比波與重力波)的表徵。但此一傳統想法最近已有所動搖，尤其近期研究Yu et al. (2018)指出約58%的外圍雨帶具有飈線的特性，且外圍雨帶具有多樣化的降水與氣流結構。然而，由於觀測上的限制，過去絕大多數的研究僅針對外圍雨帶成熟期進行分析，對於其生成與演變過程了解甚少。本研究結合中央氣象局與日本氣象廳的雷達與地面觀測資料，針對薔蜜颱風(2008)中的長生命期(約10小時)外圍雨帶從生成期至成熟期進行詳細分析探討。透過觀測分析發現，此外圍雨帶是由颱風內核區域邊界的層狀雨帶上風處所分離出來(圖1)。當雨帶遠離颱風中心向外移動的過程中，其降水型態有明顯的轉變，從初期的層狀性降水轉變為成熟期具有高度組織的對流性降水(圖2)。伴隨著此對流轉變的過程中，雨帶在運動場與熱力性質上也愈趨向於飈線的特徵。此外，我們也發現雨帶降水強度的增加與環境的對流可用位能或潛在不穩定度較無關，反而是與雨帶前的垂直風切與冷池在動力上的交互作用有關，隨著雨帶降水的增強，逐漸傾向於風切與冷池平衡的最佳狀態(optimal condition)，而冷池的增強對於雨帶中的對流轉換發揮了關鍵的作用。圖3的示意圖勾畫出颱風外圍雨帶的地面與降水特徵主要演變過程。本研究所描述的對流轉換過程可能是決定颱風外圍雨帶演變及結構特性的一個基本過程，此假說有賴未來觀測與數值模擬研究進一步評估與確認。

Citation: **Yu, C.-K.\***, C.-Y. Lin, and J.-S. Luo, 2019: Tracking a long-lasting outer tropical cyclone rainband: Origin and convective transformation. *J. Atmos. Sci.*, 76, 3267-3283, doi: 10.1175/JAS-D-19-0126.1.

Reference: **Yu, C.-K.\***, C.-Y. Lin, L.-W. Cheng, J.-S. Luo, C.-C. Wu, and Y. Chen, 2018: The degree of prevalence of similarity between outer tropical cyclone rainbands and squall lines. *Sci. Rep.*, 8, 8247, doi: 10.1038/s41598-018-26553-8.

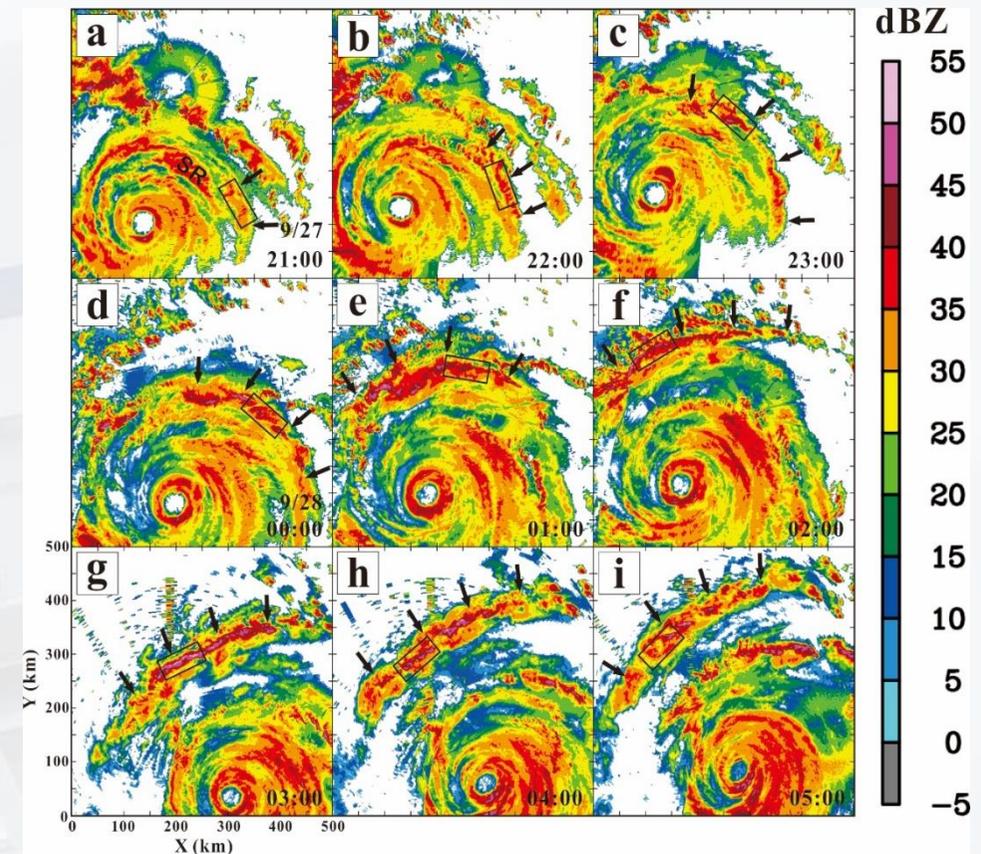


Fig. 1. Hourly low-level reflectivity composite (dBZ) associated with Typhoon Jangmi during the study period from 2100 UTC 27 Sep to 0600 UTC 28 Sep. The thick arrows highlight the location of the studied TCR. The inset box ( $40 \times 80 \text{ km}^2$ ) indicates the location for calculating the mean vertical cross sections shown in Fig. 2. During the initiation of the TCR, it detached from an upwind segment of a stratiform rainband that is marked by SR in (a).

圖1. 2008年9月27日2100 UTC至28日0600 UTC伴隨薔蜜颱風之逐時低層雷達回波合成圖(dBZ)。圖中粗箭頭標示本研究所分析雨帶之位置。黑色方框( $40 \times 80 \text{ km}^2$ )為圖2計算平均回波垂直剖面的位置。當雨帶在生成時，其由層狀雨帶的上風處分離出來，此層狀雨帶在(a)圖中以SR標記。

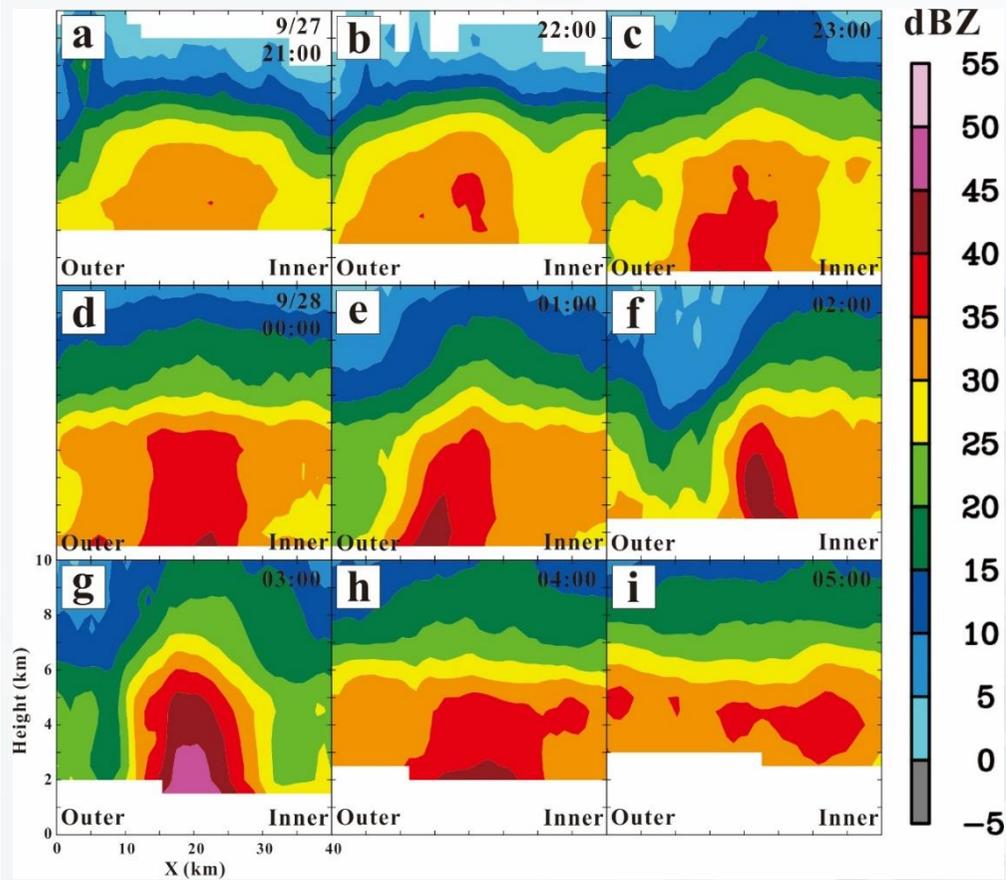


Fig. 2. Mean vertical cross sections of reflectivity (dBZ; color shading) calculated along inset boxes in Fig. 1 at times corresponding to each of the analysis periods in Fig. 1.

圖2. 沿著圖1黑色方框所計算出之平均回波(dBZ, 以色階表示)垂直剖面圖, 分析時間與圖1分析時間相對應。

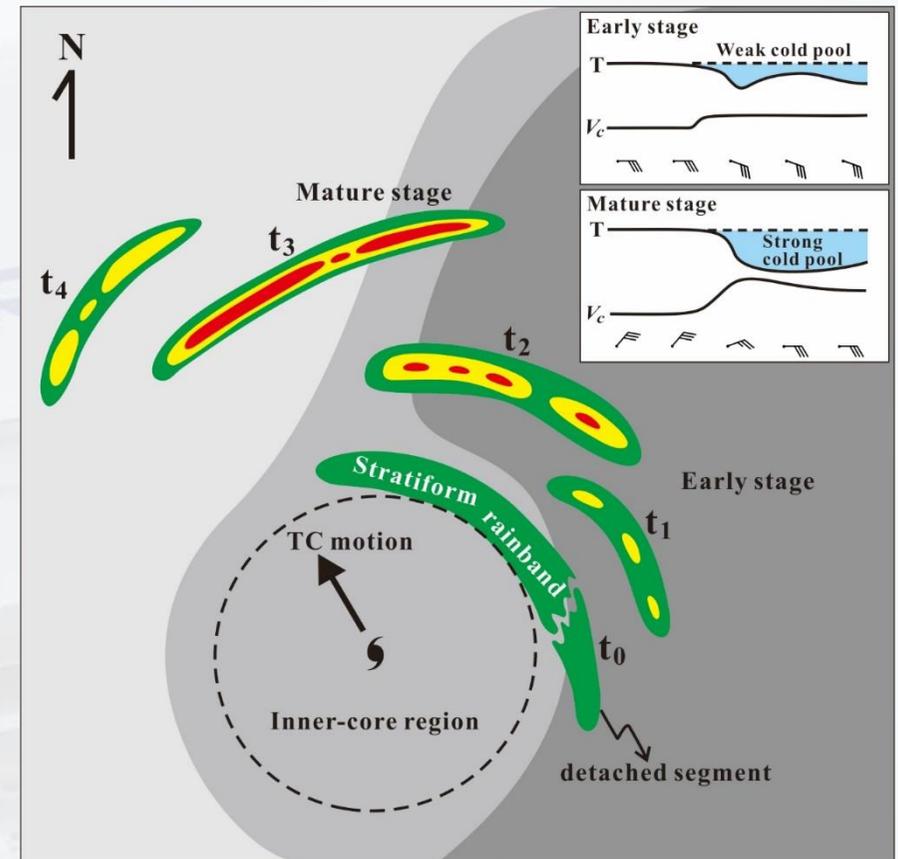


Fig. 3. Schematic diagram illustrating the evolving aspects of precipitation and surface characteristics of the studied TCR from its formative to mature stage (~10 h). Color shading indicates conceptual precipitation features of the rainband documented over different time periods of observations  $t_0$ – $t_4$ , and gray shading indicates the spatial variation of environmental CAPE associated with the typhoon circulation, with darker shading denoting larger CAPE values. The dashed circle denotes the inner-core boundary of the typhoon, and the thick arrow indicates the TC motion. A qualitative depiction of surface temperature and wind fluctuations associated with the TCR during its early and mature stages is shown in the upper right.

圖3. 颱風雨帶由生成期至成熟期(約10個小時)之降水演化與地面特徵示意圖。彩色色階表示不同時期( $t_0$ – $t_4$ )雨帶的降水特徵。灰色色階為在颱風環流中, 環境CAPE的空間分布情形, 顏色越深表示CAPE值越大。虛線圓圈表示颱風內核區域的邊界, 粗箭頭表示颱風移動方向。此外, 右上角的圖示也定性描述了雨帶在初期與成熟期之地面溫度與風場擾動的特徵。

## 2019 Doctor's Theses

- Chia-Wei Lan Changes in Seasonal Precipitation and its Impacts on the Terrestrial Hydrological Cycle
- Jae-Deok Lee Investigation of Potential Mechanisms for the Rapid Intensification of Tropical Cyclones: Polygonal Eyewalls and Diurnal Variation of the Convective Area and Eye Size

## 2019 博士論文

- 藍嘉偉 季節降水變化及其對陸地水文循環的影響
- 李在德 影響颱風快速增強潛在機制之探討：多邊形眼牆及強對流區與颱風大小之日變化

## 2019 Master's Theses

- Shih-Wen Tsou The representation of moist convection using 3D Convolutional Neural Networks
- Hsin-Yu Chu The Study on the Impact of Mesoscale Convective Vortices on Tropical Cyclogenesis using Cloud Resolving Model
- Chung-Yu Lai An analysis of wind field characteristics in the northern and southern metropolitan areas of Taiwan during the typhoon period
- Yi-Hsuan Lin The Remote Effect of Typhoon Khanun (2017) on the Heavy Rainfall over Eastern Taiwan – Evaluation of Uncertainty Based on Ensemble Simulations

## 2019 碩士論文

- 鄒適文 應用三維卷積神經網路在濕對流的參數化
- 朱心宇 以雲解析模式探討中尺度對流渦漩對熱帶旋生之作用
- 賴重祐 颱風侵襲期間臺灣南北都會區風場特徵分析
- 林宜萱 卡努颱風(2017)對台灣東部降雨的遠距影響-系集模擬與不確定性探討

## 2019 Master's Theses

## 2019 碩士論文

Zong-Yong Lee	Intensity Change of Tropical Cyclone Embedded in Moderate-Sheared Environment: The Role of the Low-Level Flow Direction	李宗勇	中等風切環境下颱風強度的演變-低層環境風風向的角色
Syuan-Ping Chen	Mechanisms of Orographic Precipitation over Mt. Da-Tun Associated with Typhoon Meari (2011)	陳渲屏	伴隨米雷颱風(2011)之大屯山地形降水機制分析
Min-Ken Hsieh	Effects of orographically induced low-level moisture convergence and inversion strength on upslope fog: a case study at Xitou	謝旻耕	地形產生之低層水氣輻合效應與逆溫強度對上坡霧的控制:溪頭個案研究
Nai-Chen Liao	On the Forecast of Summer Afternoon Short-Duration Thunderstorm over Taipei Basin.	廖乃臻	雙北盆地夏季午後短延時劇烈降水預報探討
Yu-Rui Huang	Roles of Interactions of Typhoon Nesat (2017) and Haitang (2017) in the Formation and Structure of Outer Tropical Cyclone Rainbands	黃宇睿	雙颱風共伴下之颱風外圍雨帶個案觀測研究
Yun-Ya Chu	Mechanisms of Heavy Rainfall from Afternoon Thunderstorms in Northern Taiwan	朱韻雅	北台灣午後對流的強降雨事件發展機制
Iat-Hin Tam	The impact of Ice Microphysics and Ambient Instabilities on Nocturnal Convective System Maintenance	譚日軒	冰相微物理過程與環境不穩定度對晚間對流系統維持的影響