National Taiwan University
Atmospheric Sciences

No. 2
August 2008

Newsletter

臺大大氣系所簡訊

Contents

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News

Tribute to Prof. Chung-Yi Tseng

On 11 June 2008, Prof. Chung-Yi Tseng delivered his last lecture at NTU before his scheduled retirement on 31 July 2008 . Led by the department head, a large crowd of faculty, staff, and students lined up outside the lecture hall to pay tribute and say farewell to him. Prof. Tseng has been an inspiring hero in the department. In 1973, he lost both sides of his hearing when he was pursuing his PhD study at Univ. of Oklahoma in Norman, Oklahoma, U.S.A. He overcame this serious handicap and obtained his PhD degree in 1975. He then returned to Taiwan and served both in the Institute of Physics, Academia Sinica and NTUAS. Despite his disability, he inspired and nourished many students who are now active contributors including leaders in the field of Atmospheric Science in Taiwan, in both academic institutions as well as operational centers.

Throughout the past 32 years, he taught diligently and it is a miracle that he continues to be able to speak without hearing after 40 years. He has also authored several books on Atmospheric Radiation and Remote Sensing and numerical methods that have been used as textbooks in many courses in Taiwan. The department wishes him the best and all happiness in his retirement. More information on Prof. Tseng can be found in the following links: web: and blog:
http://idv.sinica.edu.tw/cytseng
http://www.wretch.cc/blog/soyongdori

本系與中研院地球科學所合聘的曾忠一教授於今年 7 月底退休。在過去 32 年的教學生涯裡，曾老師克服聽覺障礙，持續教授多門重要課程，並撰寫多本數值方法與大氣輻射方面的熱門教科書，化育無數優秀學生。

From left to right: Kuang-Jung Hsu(徐光蓉), Huang-Hsung Hsu(許晃雄), Chung-Yi Tseng(曾忠一), Ho Lin(林和), Wu-Ron Hsu(許武榮), Ching-Chi Wu(吳清吉), Chun-Chieh Wu(吳俊傑).

New Department Chairman

Professor Jen-Ping Chen completed his three-year term of the department chairmanship on July 31, 2008. Professor Chun-Chieh Wu assumed the responsibility starting August 1, 2008.

陳正平教授三年系主任的任期已於民國 97 年 7 月 31 日屆滿，自民國 97 年 8 月 1 日起由吳俊傑教授繼任本系系主任工作。

National Science Council Outstanding Research Award

Prof. Chun-Chieh Wu received one of the 35 Outstanding Research Awards from the National Science Council in February 2008. This annual award was especially competitive this past year in which only the top 0.3% of the principal investigators of the NSC research grants were honored for their accomplishments during the most recent five-year period. Professor Wu received a citation from NSC proclaiming him to be one of the most outstanding researchers in geosciences (including earth science, atmospheric science and oceanography) in recent years. “He has obtained highly significant research results on many important scientific issues including fundamental typhoon dynamics, typhoon-terrain interaction, typhoon-ocean interaction, and targeted typhoon observation and its theories. The quality, intensity, depth and breadth of his research have been highly cited and recognized, and have high impact in the international scientific community. He has also contributed significantly to the enhancement of the international visibility of Taiwan on the typhoon and atmosphere/ocean research.”

吳俊傑教授為地科(含地科、大氣、海洋)學門近年研究表現最優異的全方位學者之一。對颱風動力理論、颱風與地形、颱風與海洋交互作用、颱風策略性觀測及其理論等多項重大科學議題皆有令人讚賞之具體研究成果，其展現的研究品質及能量驚人，研究深度及廣度備受肯定，成果在國際學術界具高度的實質影響力，深受推崇與矚目。也對提升台灣整體颱風與大氣/海洋研究在國際之能見度，有非常重大貢獻。

National Science Council Atmospheric Sciences Review Panel

Professor Huang-Hsiung Hsu assumed the position as the convener of the Atmospheric Sciences review panel of the National Science Council in January 2008. The main mission of the panel is to review and evaluate research proposals and visiting scientist proposals. In addition to these regular review tasks, the panel continues to push for the establishment of the community observational platform. Tasks currently in the planning phase include the establishment of an airborne measurement platform and a summer school for special research topics.

許晃雄教授從 2008 年 1 月起擔任國科會地球科學學門大氣科學領域審議小組召集人，負責研究計畫、延攬研究學者等審查工作。除了例行的審查工作，今年還持續推動大氣科學研究共用平台之建立，正規劃中的還有「飛機觀測平台之建置」與暑期專題研習營。

Wu Ta-You Popular Science Book Prize in Translation

Professor Wu's translated book "Typhoon" in Chinese also received this year's Gold Book Mark Prize - the Wu Ta-You Popular Science Book Prize in Translation. The book was translated from the original English book "Divine Wind" by Professor Kerry Emanuel of MIT which received the Louis J. Battan Author's Award from the American Meteorological Society in 2007.

吳俊傑教授所翻譯的「颱風」一書甫獲得吳大猷科普書翻譯類金鐘獎。此書原文為麻省理工大學 Kerry Emanuel 教授所著之 Devine Wind.

Graduation Commencement

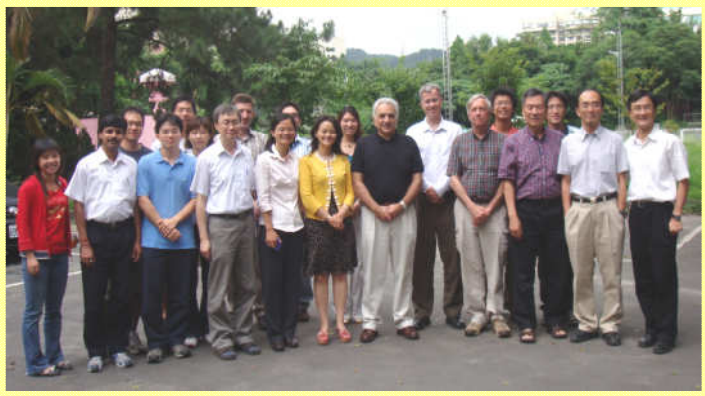
The University commenced the 2008 Graduation ceremony in the morning of June 7th. Immediately afterward, a diploma granting ceremony was performed in the College of Science, in which NTUAS senior student, Miss Pei-Yun Hsie, had the honor to represent all students of the College of Science to deliver the valedictorian speech. In the same afternoon NTUAS also held a hooding ceremony for each graduating student, with family and friends sharing this joyful degree day. The students graduated from NTUAS this year include about 30 Bachelors, 12 Masters and 2 Ph.Ds.

Photo: hat tossing by NTUAS graduates in their academic dress.

台灣大學 2008 年畢業典禮於 6 月 7 日上午舉行，理學院隨即進行畢業證書頒發儀式，並由本系大學部畢業生謝佩芸代表致畢業感言。當天下午回到系裡，在大氣系進行撥穗儀式，並邀請畢業生親友觀禮。今年大氣系畢業學生包括 30 名學士，10 名碩士，以及 2 名博士。

NTU-SUNYA Atmospheric Sciences Workshop

In July 2006, a Memorandum of Understanding to promote education and research collaboration was signed between NTUAS and two organizations of the University at Albany, State University of New York (SUNYA), U.S.A. The two SUNY organizations are the Department of Earth and Atmospheric Sciences (DEAS) and the Atmospheric Sciences Research Center (ASRC). In June 2008, a team of five SUNYA scientists, including Kenneth Demerjian (Head of the ASRC), Chris Thorncraft (Head of DEAS), David Fitzjarrald, Wei-Chyung Wang and Qi Zhang visited NTU-AS. A two-day workshop was held with foci on boundary layer processes, monsoon and typhoon multi-scale interactions, atmospheric chemistry, and regional climate. Following the workshop, the faculty members of the two universities carried out a round-table discussion that resulted in an arrangement for future collaborations and student exchange activities.



A group photo of the "SUNYA-NTU Bileteral Workshop" during 2008 June 5 to 6. From left to right: Cheng-Chueh Liu (NTU), Anupam Hazra (NTU), Chen-Wei Tang (NTU), Chien-Jung Hsu (NTU, RCEC), Haotien Jiang (NTU); Veon Chu (NTU), J-P Chen (NTU, Department Chair), Guenter Engling (RCEC), Hui-Ming Hung (NTU), Chung-Che Lee (NTU), Qi Zhang (SUNY), Hsian-He Lee (NTU), Ken Demerjian (ASRC Director), Chris Thorncraft (Head of DAES), David Fitzjarrald (SUNY), Li-wei Kuo (NTU), Wei-Chyung Wang (SUNY), Chien-Hsuen Wang (NTU), Huan-Hsiung Hsu (NTU), Chun-Chieh Wu (NTU).

2008 年 6 月 5-6 日，臺大與紐約州立大學雙邊研討會，與會人員合影。由左而右：劉承玨(臺大)、安海瑞(臺大)、湯臣偉(臺大)、許乾忠(臺大、RCEC)、姜皓天(臺大)、朱淑華（臺大）、陳正平(臺大，系主任)、白光宇(RCEC)、洪惠敏(臺大)、李宗哲（臺大）、張琦(SUNY)、李湘鶴(臺大)、Ken Demerjian (SUNY, ASRC Director)、Chris Thorncraft (SUNY, DEAS Head), David Fitzjarrald, (SUNY)、郭力維(臺大)、王維強(SUNY)、王建勛(臺大)、許晃雄(臺大)、吳俊傑(臺大)。

International Workshop for Numerical Ocean Modeling and Prediction (IWNOP) held at NTU on 23-25 April, 2008

NTUAS hosted IWNOP, the first international workshop on numerical ocean modeling and prediction in Taiwan on 23-25 April 2008. It brought together international leading scientists and experts to discuss modern ocean modeling and prediction, using the most advanced numerical techniques and at scales ranging from coastal ocean to basin wide. In addition to being the host of the workshop, NTUAS was joined by cosponsors including the National Science Council, the National Central University's Graduate Institute of Hydrological & Oceanic Science, and the National Applied Research Laboratory. The workshop was organized by Professor Yu-heng Tseng of NTUAS, Professor Chris Mooers of University of Miami, and Professor Malcolm J. Bowman of State University New York at Stony Brook. Professor Tseng also chaired the local organizing committee with several other NTUAS faculty members serving as committee members.

The three-days workshop included oral and poster presentations of invited and contributed papers. The thirteen oral presentations were organized into three sessions:

- Advanced numerical modeling techniques
- Air-sea-ice interactions, and
- Model nowcast and forecast assessment

These themes represent the most challenging topics in the latest numerical ocean modeling research. More than 70 participants came from various countries around the world. The opening remark was delivered by Dr. Robert Lai, the chairman of Taiwan's National Applied Research Laboratories. The first keynote speech was delivered by Dr. Emil Vassilev Stanev (head of Institute for Coastal Research, GKSS, Germany) who introduced the latest coastal observation and Forecasting System for the German Bight. Two other keynote speeches were given, respectively, by Prof. Kyung-Il Chang of Seoul National University, who discussed the development of data assimilated East China Sea ocean model, and Prof. Malcolm Bowman of SUNY- Stony Brook, who detailed a predictive storm surge modeling system for the Northeastern Seaboard of the U.S. Among the invited lecturers are Dr. Avichal Mehra of NCEP/EMC/Marine Modeling and Analysis Branch; Prof. Christopher N.K. Mooers, of Univ. of Miami (also Director of RSMAS/Ocean Prediction Experimental Laboratory); Dr. Joanna Staneva from GKSS; Dr. David Dietrich, President of AcuSea Inc.; Prof. Jinyu Sheng, of Dalhousie Univ., Canada; Dr. Joanna Staneva, Institute of Coastal Science, GKSS, Germany; Prof. Wen-Yih Sun, of Purdue Univ.; Dr. Mei-ying Lin, Taiwan Typhoon and Flood Research Institute; Prof. Naoki Hirose, of Kyushu Univ., Japan; and Dr. Masafumi Kamachi, Meteorological Research Institution, Japan.

A collection of selected papers and presentations from this workshop will be published in a special issue in *Terrestrial, Atmospheric and Oceanic Sciences*, in summer 2009. More information and upcoming news about IWNOP can be found on the website http://efdl.as.ntu.edu.tw/workshop/iwnop.

第一屆國際海洋數值模式與預報研討會(IWNOP)順利的於 2008 年 4 月 23~25 日在台大大氣系舉行，並圓滿完成。國際多位頂尖科學家、專家聚首於此，三天的研討會主要議題包含 (1) 最新海洋數值模式方法 (2) 海-氣-冰交互作用 (3)模式預報與評估。研討會由台大大氣科學系主辦，國家科學委員會、國立中央大學水文與海洋科學研究所以及國家實驗研究院海洋科技中心籌備處亦共同協辦，總共有來自台灣、日本、韓國、美加、歐洲世界各地超過七十名的學者參與此次研討會。

本研討會主要由台大大氣科學系曾于恆教授，美國邁阿密大學 Chris Mooers 教授，與紐約州立大學石溪校區 Malcolm J. Bowman 教授籌畫。研討會中的論文與報告選集，預計將在 2009 年夏天於地球科學集刊作專刊介紹，有關於本研討會 (IWNOP) 的更多訊息與最新消息請上研討會網站查詢 http://efdl.as.ntu.edu.tw/workshop/iwnop。

Multi-scale Interactions in the Tropical Western North Pacific during Summer

The tropical Western North Pacific (WNP) is affected significantly by the fluctuations of different time and spatial scales of the monsoon trough (MT) and anticyclonic ridge (ACR). The multi-scale interactions among the interannual, intraseasonal and sub-monthly large-scale variations and tropical cyclones (TC) are crucial factors influencing summertime weather and climate in the WNP. This project is led by Professor Huang-Hsiung Hsu who graduated from NTUAS in 1978 and received his Ph.D. from the University of Washington in 1986. He pursued a two-year postdoctoral study at University of Reading before returning to Taiwan to join the faculty of the department in 1989.

During the El Niño summer, the warm sea surface temperature (SST) shifts eastward toward the dateline. This results in the further southeastward extension of MT and major convection region than in the normal year. The active region of intraseasonal oscillation (ISO) and TC, which tends to occur over the warm SST/active convection region, also shifts further southeastward than normal. On the other hand, during the La Niña summer when the warm SST/active convection region shifts to the northwest of its normal location and the active region of ISO and TC shifts similarly to the northwest (C.-H. Tsou and P.-C. Hsu 2008, personal communication).

Professor Hsu and colleague (Ko and Hsu 2006) identified a sub-monthly (8-30 days) wave pattern that propagates northwestward from the tropical Philippine Sea to the East China Sea. The wave pattern is often accompanied by a TC, which is embedded in the cyclonic circulation area of the wave pattern. Both the sub-monthly wave and the TC are found to be more active and better organized during the westerly phase of ISO in WNP, when MT is strong and extends eastward into the Philippine Sea. On the contrary, both are weak and poorly organized in the easterly phase of ISO, when MT is weak and retreats westward to the South China Sea. Most recent results show that the distinct characteristics between the ISO westerly and easterly phases can be attributed to the ISO modulation on MT and ACR. The ISO in the westerly phase provides a favorable background (e.g., enhanced MT and moisture convergent zone) for the wave-TC pattern development, while the ISO in the easterly phase provides a less favorable environment.

These phenomena all reveal the modulation of the larger-scale circulation on motions of smaller time and spatial scales through the effect on MT/ACR. While the low-frequency large-scale circulation has a clustering effect on TCs, the latter tend to occur with large amplitude in the positive vorticity background flow which significantly enhances the total strength of the positive vorticity. Conversely, when no TC exists or when only the synoptic anticyclone is found, the contribution to the total vorticity field from the synoptic- and meso-scale disturbances is relatively small. This is because the negative vorticity associated with these disturbances is much weaker than the positive vorticity of TCs. The contribution of TCs is therefore not offset by the disturbances of the negative vorticity. This contrast may lead to the enlargement of climate variability.

This hypothesis is at odd with the traditional concept that long-term averaging or low-pass filtering can remove the signal of high frequency fluctuation. This traditional concept may not be correct because the occurrence of a few extreme events may significantly enlarge the ensemble mean and variability. To verify this hypothesis, a TC-removal scheme was applied to the reanalysis such as ERA40, NCEP, and JRA25 reanalysis. The 850-hPa vorticity variance of the original and TC-removed fields were calculated and compared. The variance difference is defined as the TC contribution to climate variability. The results indicate that along the TC tracks TCs contribute more than 50 percent of variance in the interannual and intraseasonal time scales over the tropical western North Pacific (Figure 1). The strong clustering effect of El Niño on TCs also enhances the vorticity difference between El Niño and La Niña. The significant contribution of TC to intraseasonal variability in the summer of 2004 is also confirmed by model simulations using a general circulation model (GCM) and a regional model. This finding suggests the occurrence of a two-way interaction between TC and climatic fluctuations (Hsu et al. 2008a, b).

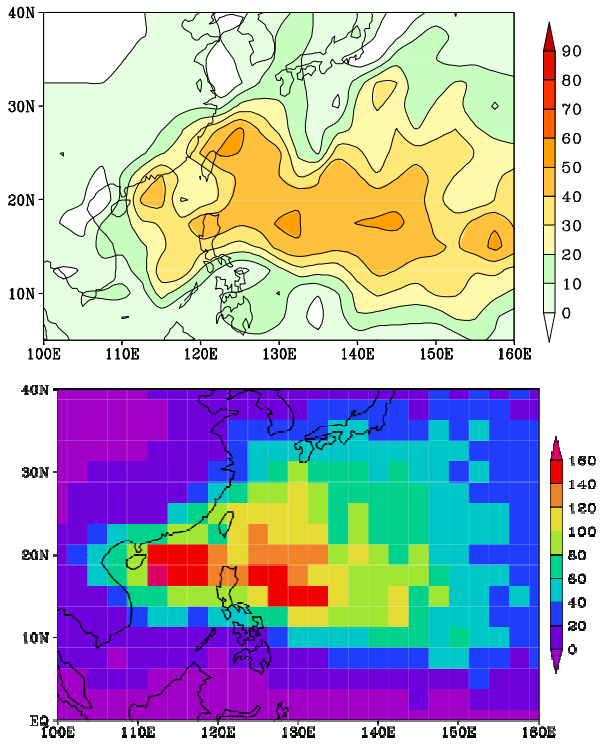


Figure 1: (Upper) Percentage of 850-hPa vorticity variance contributed by TC and (lower) TC track: the largest TC contribution occurring over the major tracks.

These results raise a question on the definition of climate variability in the TC-prone regions. Traditionally, climate variability is often interpreted as the variability of low-frequency climatic perturbations. The present results, however, point out that these climatic perturbations may contain the contribution from TCs, which fluctuate in much shorter periods and smaller spatial scale.

In regions such as the tropical western North Pacific, where the meso-synoptic scale and large scale systems are closely intertwined and the multi-scale interaction is likely one of the key processes affecting the climate variability, the contribution from the severe weather systems like TCs has to be taken into account to understand the mechanisms leading to climate variability. Most of the GCMs used to simulate past climate suffers from the poor simulation of climate variability in the tropical Western North Pacific during the boreal summer. The results reported here imply that the inability to resolve and simulate TCs may be one of the key weaknesses of the GCM leading to the poor simulation.

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Ko, K.-C., and H.-H. Hsu, 2006: Sub-monthly circulation features associated with tropical cyclone tracks over the East Asian monsoon area during July-August season. *J. Meteor. Soc. Japan*, 84, 871-889.

許晃雄教授於 1978 年自本系大學部畢業，於 1986 年獲美國華盛頓大學(西雅圖)博士學位。1987-1989 年於英國 University of Reading 做博士後研究，後即返回母系服務，於 1992 年升任正教授。他的研究興趣包括：赤道季內震盪東移與北移機制、海陸分佈與地形的影響、夏季熱帶西北太平洋季內震盪；東亞夏季雨量年際變異三胞結構的特性與可能機制、青藏高原熱源的影響、東亞夏季風的肇始與亞洲夏季風的首次轉變；年代際震盪與氣候變遷，如 1950 年代東亞夏季氣候瞬變、1980 年代北半球的急速暖化、年代際遙相關與氣候變遷、台灣氣候變遷；以及熱帶西北太平洋的多重尺度交互作用和颱風對大尺度環流的反饋。

Field Research with Special Observation Platforms

Meteorological research needs data but in many cases conventional observations are not available. Thus, field experiments are often launched to obtain data from special observational platforms. An expert in conducting field projects is Professor Po-Hsiung Lin, who received his B.S. in 1984 and his Ph. D. in 1996 both of which from NTUAS. He started working the department since 1987 first as a teaching assistant and later joined the faculty.

In 1997 Professor Lin participated in the South China Sea Monsoon Experiment (SCSMEX) and directed two observation programs at Dongsha Island from April to July, 1998. They are the solar radiation measurement in cooperation with NASA Goddard Space Flight Center (GSFC) scientists (Lin et al. 2002) and the Aerosonde test flights over ocean. Aerosonde is an unmanned aerial vehicle designed by US and Australian scientists for typhoon reconnaissance. The Central Weather Bureau (CWB) and National Science Council acquired eight Aerosondes for typhoon observations around Taiwn and Professor Lin was charged with the responsibility of conducting the Aerosonde observation operations at Dungsha Island by leading the Taiwan Aerosonde Team (TAT). After SCSMEX, his field works continued with solar radiation measuremenst for climate research in cooperation with GSFC and Academic Sinica researchers in winter, and Aerosonde observations of typhoons in summer.

Aerosonde at Hengchun airport (September 9,2005)

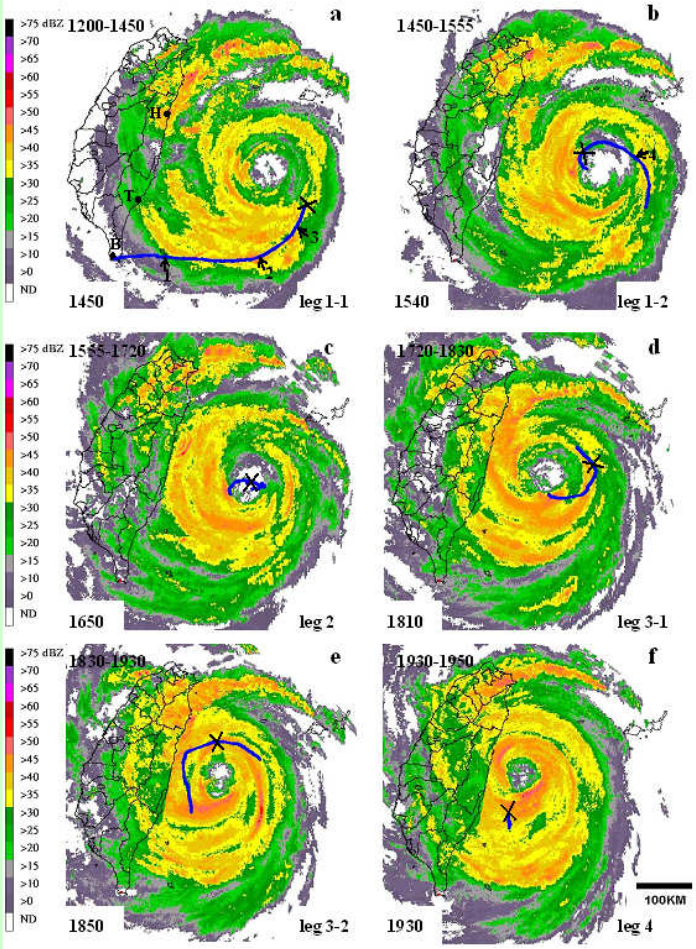
From 2000 to 2005, Professor Lin and the TAT crew conducted 15 reconnaissance flights, with three of them approaching the eye of typhoons. The most dramatic case occurred on Oct. 1, 2005 when the Aerosonde flight penetrated two rainbands and the high-wind eyewall to arrive at the center of Super Typhoon Longwang. Professor Lin and his crew successfully made a vertical sounding in the eye before penetrating the eyewall outbound. This sets the world record for UAV reconnaissance and survival flight into the eye of tropical cyclones with wind and temperature measurements. (Lin and Lee, 2008).

In summer 2002, Professor Lin joined another typhoon observation program DOTSTAR (Dropsonde Observations for Typhoon Surveillance near the TAiwan Region) led by Prof. Chun-Chieh Wu (Wu et al. 2004, also see the January 2008 issue of NTUAS Newsletter). Professor Lin coordinated the flight crew in monitoring dropsonde data onboard. From 2003 to 2007, 27 flights with 457 dropsondes were processed

Professor Lin has visited NASA/GSFC three times in recent years to conduct cooperative research using SCSMEX solar radiation data. Currently, the Research Center of Environmental Research at Academic Sinica is supporting Professor Lin to do long-term solar surface radiation and aerosol optical depth measurements in Taipei and Tainan cities and indoor calibration since 2001.

Professor Lin also developed special courses on atmospheric instrumentation and measurements. From 2000 to 2007, his course, *field measurement of atmospheric environment*, implemented a one-week field campaign at the University Highland Farm (2100 m height) in Nantou County. This course was cited as the Best Course in Earth Sciences by Minister of Education in 2005. In 2007, Professor Lin started a course on *TV Weather* in cooperation with the NTU Institute of Journalism with the students practicing on their own TV weather reports on the campus TV studio.

Research Highlights



The composite radar reflectivity with Aerosonde location marked by the black X sign at time (UTC) shown at the bottom left of 1 October 2005. The blue curve shows the flight track during the period (UTC) shown at the upper left. Flight leg tags are labeled at the under right corner in each graph. Numbers 1, 2, 3 and 4 show the locations of Aerosonde at 1300, 1400, 1430 and 1510 UTC, respectively. Letters H, T and B show the location of Hua-lien radar, Tai-tung and the ground base, respectively. (Image courtesy of Central Weather Bureau)

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林博雄教授於 1984 年自本系大學部畢業，1996 年獲得博士學位，並於 1997 年起擔任助理教授。1998 年到 2005 年的研究重心在於無人飛機 Aerosonde 的颱風穿越觀測；2005 年 10 月 1 日深夜完成強烈颱風龍王的眼牆穿越和颱風中心的盤旋觀察為無人飛機世界首開記錄。Aerosonde 團隊將在 2009 年啟用第三代完全自組的氣象無人飛機，進行臺灣臨近海域的邊界層觀測和種雲實驗。此外，林博雄參與吳俊傑教授主持的追風計畫，負責航路規畫和隨機領隊。2003~2007 期間已經完成 27 航次 457 份投落送(dropsonde)颱風環流偵察觀測，同時也協助中央氣象局進行 2006~2008 年的西南氣流飛行觀測規畫與執行。林教授冬季期間的研究重點放在台北和台南的地面太陽輻射與氣膠光學厚度的量測，以及鹿谷溪頭(1100m)、新竹五峰鄉觀霧(2000m)、仁愛鄉梅峰(2100m)、新中橫公路塔塔加(2800m)，以及氣象局玉山測站(3858m)的山地氣象雲霧觀測與分析。

Chemical Reactions and Properties of Aerosol Particles

Aerosols are solid or liquid particles suspending in the air. They play several key roles in the atmosphere: affecting climate by scattering and absorbing radiation and by modifying the occurrence and reflectivity of clouds, changing the chemistry of the atmosphere by providing surface for heterogeneous reactions, decreasing our visibility and causing adverse health effects. With the increasing fossil fuel emission and pesticide usage in agricultural activities, people are vulnerable to the increased air pollution. The research program led by Professor Hui-Ming Hung aims to understand the chemical and physical processes of aerosol particles using novel experimental approaches and advanced analytical instruments, and their implications in the atmosphere.

Professor Hung received her B.S. in 1993 and M.S. in 1995 from the Chemistry department of NTU, and received her Ph.D. on Chemistry from Caltech in 2000 with interdisciplinary training in physical chemistry, spectroscopy and environmental sciences. After doing research at Harvard University and McGill University (Canada), she returned to Taiwan in the fall of 2007 to join the NTUAS faculty.

In the atmosphere, organic matter is a major component of atmospheric aerosols and has become an important topic because of its complex physical properties (Hung et al. 2005; Hung and Ariya 2007). Due to the heterogeneous reaction between organic particles with gas-phase oxidants, such as O_3, OH and NO_3 radicals, the aged organic aerosols are found to have higher hygroscopicity, (Figure 1). Professor Hung's group currently uses the attenuated total reflectance infrared spectroscopy (ATR-IR) method to measure the oxidation of unsaturated fatty acid droplets with ozone and use different type of mass spectrometry to analyze the products. This method directly probes the oxidation of deposited aerosol particles. This research studies how the relative humidity and physical phase of aerosol affect the oxidation kinetics. Moreover, the chemical reactivity of deposited droplets might be different from the suspended particles. To address this issue, her research group is in the process of constructing an aerosol flow tube infrared spectroscopy (AFT-IR) system which will be able to monitor the oxidation process of suspended aerosol particles. This system can then combine with a particle sizer and cloud condensation nucleation chamber to measure cloud condensation nuclei (CCN) activation. The potential of organic aerosols, either before or after oxidation, to form ice nuclei will be studied by controlling the AFT tube temperature and monitoring the variation of IR spectra (Han et al. 2002; Hung et al. 2003).The product identification at both gas and aerosol phases will be determined using several mass spectrometry methods.

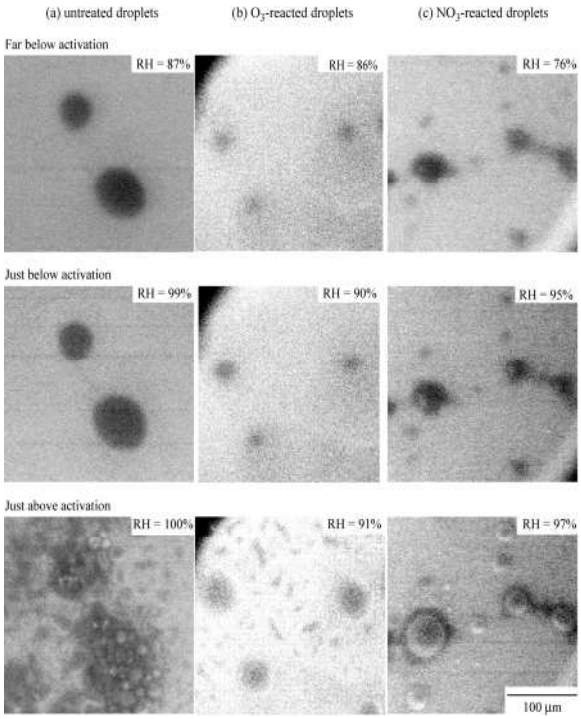

Figure 1: Micrographs obtained by environmental scanning electron microscopy (ESEM). Columns show images collected of (a) untreated oleic acid droplets, (b) O_3-treated droplets, and (c) NO_3-treated droplets. Rows, shown for increasing relative humidity, reveal that hygroscopic droplet growth occurs at an activation relative humidity. The precise humidity depends upon droplet treatment (Hung et al. 2005).

These experimental studies are essential to quantify the effect the aerosol on the atmospheric system. Integration of experimental results with a computational kinetics model will elucidate mechanistic details such as gas and liquid diffusion, mass accommodation, and chemistry happening in gas, liquid and the interface phases. The results then can be incorporated into the global/regional model with the influence of

heterogeneous/multiphase interactions of gas-phase species on aerosol particles and cloud droplets (Martin et al. 2004). The identification of oxidation products will also provide a complete risk assessment for parent chemical species, with the implication of aerosol particles on human health. (http://hmhung.as.ntu.edu.tw)

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洪惠敏教授，1993 年台大化學系學士，1995 年台大化學碩士，2000 年加州理工學院化學博士。曾於美國哈佛大學及加拿大邁基爾大學分別從事大氣物理化學及雲模式研究，於 2007 年秋天至本系擔任助理教授。其研究領域為大氣物理化學—實驗探討大氣中氣膠的異相化學反應及其影響。此類的化學反應在大氣中扮演重要的角色；例如，臭氧層的破壞及雲雨的形成；同時氣膠粒子的物理化學性質亦隨著它們在大氣中的存在時間而不同。目前洪教授的研究計畫專注於研究大氣中氣膠粒子和活性氣體(例如：臭氧、OH、NO3)之間的氧化反應。研究的進行從了解未飽和脂肪酸氣膠粒子和臭氧反應開始，利用紅外線光譜來偵測此反應在不同溫度及溼度的動力學，並分析它們的物理化學性質變化；進而可利用簡單模式去探討這些氧化反應在大氣中的影響。

Aerosol-Cloud Interactions and Effects on Precipitation and Climate

Aerosol and cloud processes have strong influence on the chemical, hydrological, and radiative budgets of the atmosphere, and through these processes human activities may significantly alter the balances of our climate system. A project to study these interactions by developing parameterization schemes for the microphysical processes of aerosols and clouds is being led by Professor Jen-Ping Chen, who was a graduate of NTUAS in 1982. Professor Chen received his Ph.D. from Penn State in 1992 and conducted postdoctoral research at the Scripps Institution of Oceanography before returning to join the NTUAS faculty in 1994.

The first set of the schemes developed is a two-moment warm cloud parameterization (Chen and Liu 2004) that was derived from statistical analyses of results from a binned cloud microphysical model (Chen and Lamb 1999), with consideration of the effects of cloud condensation nuclei (CCN) and giant CCN. Professor Chen collaborated with Professor Wei-Chyung Wang's group at SUNY-Albany to incorporate the scheme into the MM5 to simulate the influence of anthropogenic CCN on cloud radiation and precipitation efficiency (Cheng et al. 2007). The results generally confirm the Twomey's indirect effect on warm clouds by CCN (Figure 1), but also showed opposite effects from giant CCN (Figure 2). The scheme was further coupled with the cold-cloud processes to examine the effect of aerosols on mixed-phase processes. Preliminary results indicated that, due to complicated cold-cloud mechanisms, precipitation may be either depressed or enhanced as a consequence of increase CCN (Figure 3). Additional ice nucleation mechanisms were also added into this model to examine the role of mineral dust and bacteria, acting as ice nucleating agent, in the development of precipitation. Currently, a complementary parameterization scheme is under development for simulating the evolution of aerosols and their coupling with cloud microphysics.

Another related work of Professor Chen is the development of a regional model to simulate the deflation, transport, and deposition of mineral dust, using the MM5 as the meteorological driver (Chen et al. 2004). The deflation module considers detailed emission coefficients

and dust size distributions that are specific to the properties of the land surface. This model has been used by the Environmental Protection Agency for routine forecast of dust storm activities in East Asia and resultant dust loading and deposition over the region. A new version with mineral dust processes coupled with the meteorological model is currently under development, which will also include the effect of mineral dust on cloud microphysics. Professor Chen's group also collaborated with Professors Ivar Isaksen (University of Oslo) and Wei-Chyung Wang by incorporating the aerosol mechanisms into a global climate and chemistry model (GCCM), with coupled chemistry and meteorological processes, to examine the direct and indirect effects of aerosols on climate.

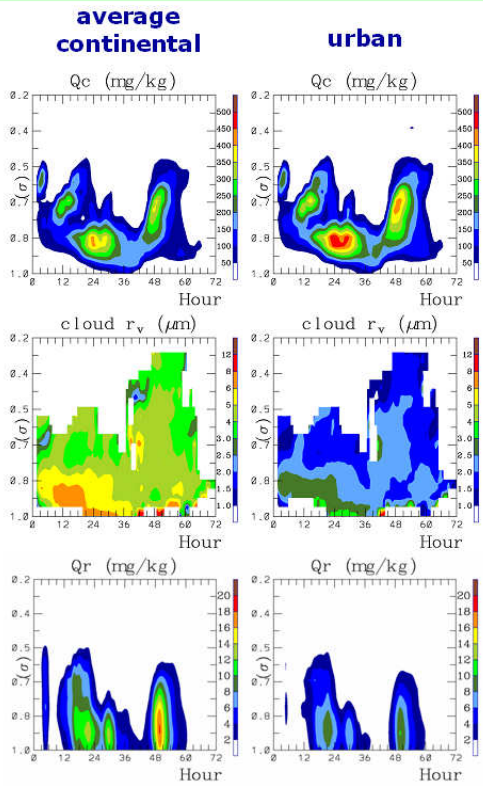

Figure 1: Domain-averaged cloud water content (top), effective radii (middle) and rainwater content (bottom) under different aerosol scenarios for a simulated warm cloud system. Left and right columns are for average continental and urban aerosol types, respectively.

陳正平教授 1982 年自本系大學部畢業，於 1992 年自美國賓州州立大學取得博士學位後，在加州大學聖地牙哥分校之 Scripps 海洋學院進行博士後研究，於 1994 年回本系任職副教授，並於 1999 年升任正教授。研究興趣主要為雲微物理過程、氣膠微物理過程，以及氣膠與雲之交互作用，利用數值模式探討不同種類之氣膠對氣候以及降水之影響。

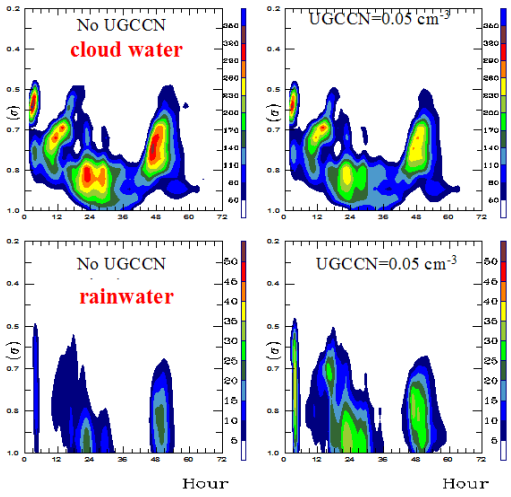

Figure 2: Effect of giant CCN on cloud water content (top) and rainwater content (bottom) for the same cloud shown in Figure 1. On the left are results without giant CCN and on the right are with 0.05 cm^{-3} giant CCN.

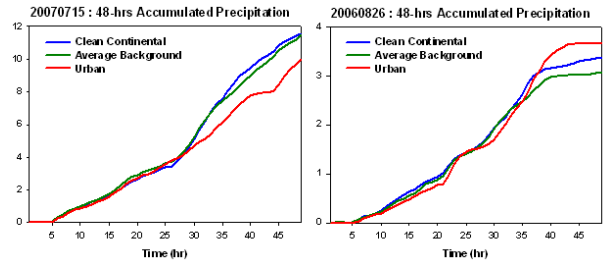

Figure 3: Effects of CCN types on surface precipitation for two strong convective cloud systems. One case (left) showed depressed surface rainfall while the other (right) showed minor depression initially but more total rainfall toward the end.

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