出國報告(出國類別：其它)

出席國際氣象研討會報告書

服務機關：交通部 民用航空局 飛航服務總臺

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派赴國家：美國

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摘要

職於 2009 年 8 月 15 至 21 日間奉派因公前往美國猶他州鹽湖城出席美國氣象學會（American Meteorological Society, AMS）第 13 屆中尺度氣象研討會 (Conference on Mesoscale processes)，並於會議中口頭發表「An analysis of tropical cyclone formations in the South China Sea during the late season (南海冬季熱帶氣旋形成之分析)」之論文。除擴展中尺度氣象相關研究領域的見聞，同時瞭解中尺度過程最新理論及數值模式預報技術發展，且與各國專家及作業人員交流，研討會過程中也學習到寶貴的經驗。由本屆研討會中議題可看出，各國大量使用中尺度數值模式針對各類中小尺度劇烈天氣診斷分析是最常被廣泛討論。其中以目前臺北航空氣象中心所使用之氣象研究與預報模式(Weather Research and Forecasting Model, WRF)，爲各專家學者進行研究診斷及作業單位進行預報分析最常使用的中尺度數值模式之一。

目錄

一、目的

此行目的在於出席美國氣象學會主辦的第 13 屆中尺度氣象研討會(Conference on Mesoscale Processes)，會期自 2009 年 8 月 17 至 20 日爲期四天。職於 2009 年 4 月投稿至美國氣象學會，很榮幸吾人發表的論文能被大會接受，大會並安排口頭發表。此論文與臺灣大學大氣科學系李清勝教授合作，題目爲「An analysis of tropical cyclone formations in the South China Sea during the late season (南海冬季熱帶氣旋形成之分析)」。投稿論文之英文長摘要如附錄 B。

大氣演變是多重尺度的，從數分鐘生命期的積雲對流至一年四季周期變化的大尺度環流系統，而所謂中尺度天氣系統即介於兩者之間 (2000-2km) 的尺度範圍。近年來中尺度氣象的研究，配合雷達和飛機觀測，無論在觀測事實、理論研究和數值試驗愈來愈完備，對預報技術的提升有很大的進展。以航空氣象相關預報產品的有效時期介於 2 至 30 小時之間，相當於一般常見中尺度天氣系統的生命期，例如單一雷暴系統至梅雨鋒上多胞對流尺度系統。而有些影響飛行活動的低雲，發生在暖海洋面上的冷性低雲，雖似穩地性天氣，也是與淺對流有關的天氣現象，因此了解中尺度對流系統的結構與生成演變機制，利於中尺度氣象預報技術發展，有助於航空氣象預報準確度的提升。

本屆中尺度氣象研討會主要討論的議題包括中尺度降水系統、中尺度過程的理論與模式分析探討、實驗計畫結果分析、地形效應和熱力或動力機制導致之中尺度環流系統、熱帶與溫帶氣旋結構演變和中尺度可預報度及資料同化。會議期間，特別邀請美國氣象學會院士日裔教授 Roger M. Wakimoto 進行專題演講。而 Wakimoto 教授曾以 1982 年在 Joint Airport Weather Studies 計畫中的機場風切研究著名。

二、過程

此次行程始於 98 年 8 月 15 日，晚間 23:10 分搭乘華航 CI 004 班機從臺北飛舊金山，於當地時間晚間 19:50 抵達舊金山。隔日 16 日上午驅車前往離舊金山約一百餘公里的加州大學戴維斯分校(University of California, Davis)，與陳淑華教授及其博士生柳懿秦小姐會合，一同出席本次研討會。同日下午，前往沙加緬度國際機場搭乘 PM4:23 分達美航空 DL4872 班機飛往鹽湖城。晚間八點抵達本次研討會舉辦地點鹽湖城 Sheraton Hotel 下榻。

美國氣象學會成立於 1919 年，其會員包含教授、學生及各氣象作業單位。每個月出版多達 11 種氣象學術期刊，每年也舉辦十餘場次國際性學術研討會。中尺度氣象研討會緣起於 1975 年在 Los Vegas 召開的 Conference in Regional Mesoscale Modeling, Analysis & Prediction。1983 年在奧克拉荷馬州 Norman 召開第一屆，之後美國氣象學會固定每兩年召開一次，今年是第 13 屆在鹽湖城舉辦。17 日上午研討會尚未開始前，前往註冊辦公室報到領取會議相關資料，八點四十五分整會議開始進行。本次會議主席爲加州大學洛杉磯分校(University of California, Los Angeles) Robert Fovell 教授。Fovell 教授過去幾年也曾多次來臺進行學術訪問。另一位主席是北卡羅萊納州立大學(North Carolina State University) Sandra Yuter 教授。自 8 月 17 至 20 日 4 天議程於鹽湖城 Sheraton Hotel 國際會議廳，每日上午 8 點至下午 6 點舉行，一共進行 18 個分區議程，四日研討會議程如附錄 C。

本次研討會口頭(Oral)報告有 104 篇；海報張貼有 48 篇。共計 152 篇。論文其中以美國居多達 123 篇；日本 9 篇；加拿大 8 篇；臺灣 3 篇；澳洲 4 篇；英國 3 篇；法國 1 篇；中國 1 篇。18 個議程分爲下列領域：

+中尺度降水系統(Mesoscale precipitation systems) 19 篇；研究結果作業化(Transferring research results to operation) 4 篇；中尺度過程理論與模式分析探討(Theoretical and modeling studies of mesoscale processes) 21 篇；實驗計畫結果分析(Results from recent field research programs) 8 篇；山岳、海岸地形及其它熱力導致之中尺度環流系統(Orographic, coastal and other thermally driven mesoscale circulation systems) 14 篇；山岳波與障礙流(Mountain wave and obstacle flows) 4 篇；熱帶與溫帶氣旋之結構演變(Structure and evolution of tropical and extratropical cyclones) 24 篇；中尺度可預報度及資料同化(Mesoscale predictability and data assimilation) 10 篇及兩次海報張貼議程 48 篇。其中以中尺度降水系統和熱帶與

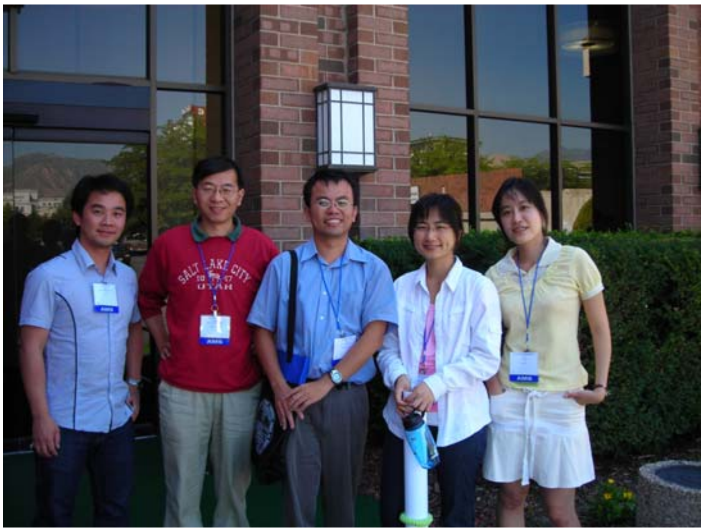
溫帶氣旋之結構演變的論文數量最多。大會於第 2 天上午，特別邀請美國氣象學會院士、日裔教授 Roger M. Wakimoto 進行 30 分鐘專題演講，回顧中尺度氣象相關研究在過去歷史上重要的里程碑。而 Wakimoto 教授曾以 1982 年在 Joint Airport Weather Studies 計畫中的機場風切研究著名。另外，於第 3 天下午六時議程結束後，舉行地中海水文循環實驗計畫召集會議(Gathering for HYMEX Meeting)。

職口頭發表文章題目爲「An analysis of tropical cyclone formations in the South China Sea during the late season, 南海冬季熱帶氣旋形成之分析」，論文屬於熱帶與溫帶氣旋之結構演變領域，安排在議程第 4 天 20 日上午第 15 場次第 7 位報告，於九點三十分發表。這也是職於第一次在國際會議以英文進行口頭報告，所以難免感到緊張，所以事前透過多次的練習準備，以求全程英文簡報的流暢度。AMS 針對議程流程時間要求尤其嚴格，每個人只有 12 分鐘口頭報告時間和 3 分鐘問題回答。在演講桌上備有倒數計時器，在報告進行到第 10 分鐘，燈號由綠轉橙色，進入第 12 分鐘轉爲紅色閃燈，以提醒報告人；即使是大師級的學者演說，欲罷不能也被要求時間控制在至多 15 分鐘內；本次口頭報告投影片如附錄 D。職所報告內容主要是南海伴隨寒潮爆發東北季風南下之熱帶氣旋生成。據觀測顯示在冬季（11~12 月）時，南海熱帶氣旋形成頻率仍高於西太平洋地區（16%>13.7%）；強寒潮情況下，南海熱帶地區氣旋式渦度，因低層輻合與組織深對流之增強，即使接近赤道地區科氏力偏小，仍可發展接近熱帶氣旋強度，例如 2001 年赤道颱風畫眉(Vamei)。南海南部地區與婆羅洲構成的特殊地形，在冬季盛行東北季風下，有利低層相對渦度在婆羅洲西北海域的聚集。針對形成與非形成個案進行分析比較，顯示季內震盪(Madden-Julian Oscillation)期間激發較多的對流，初始渦旋形成的機率是較高的；但是初始渦旋要進一步發展爲熱帶氣旋的機率反而略低。即較多的對流和初始渦旋環流反而不利於組織進一步形成熱帶氣旋，故此類熱帶氣旋形成是較偏向於隨機發展過程。12 分鐘口頭報告後，進行三分鐘提問。賓州大學(Pennsylvania State University) 的大陸籍張福青教授 (Prof. Fuqing Zhang) 以非常快速的英文提問，第一次尙未了解他的意思；後來換句話說，才了解他的問題；其問題在南海冬季的海溫分布對熱帶氣旋形成的影響。這部分尙未深究，僅就氣候統計上，說明冬季南海海溫分布的情形，在南海北部溫度梯度較大，南海南部海溫仍然偏高利於熱帶氣旋形成。

本次研討會有關於臺灣天氣議題的論文有 6 篇，其中大多與 2008 年西南氣

流實驗有關。這些論文分別來自猶他州立大學徐偉新「Mesoscale convective systems along the Mei-Yu front over South China Sea and Taiwan」；臺灣大學賴曉薇「Structure of subtropical mesoscale convective vortex during the SoWMEX/TiMREX」；美國國家大氣科學研究中心(National Center for Atmospheric Research, NCAR) 李文兆博士「Overview of SoWMEX/TiMREX」；科羅拉多州立大學 Richard H. Jackson 教授「Preliminary result from the SoWMEX/TiMREX」；中央大學楊明仁教授「Evolution of tangential and radial flows of Typhoon Nari (2001) at landfall」和科羅拉多州立大學 Katja Friedrich「What is the difference between orographic precipitation in the European Alps and Taiwan?」。由於今(98)年 8 月 8 日臺灣受莫拉克颱風侵襲造成慘重的損失，也引起國際社會注意，因此多位來自臺灣的學者也在報告中提及莫拉克颱風侵襲期間在臺灣南部山區，帶來破紀錄的累積雨量，三天累積降雨接近 2800 mm。再次突顯出臺灣獨特的陡峭地形，西南氣流在迎風面有強烈的地形舉升加強的作用，再配合颱風雨帶伴隨中尺度對流系統不斷的移入陸地，造成極端的降雨事件。

由於本次研討會有多數學生參與口頭報告和海報張貼議程；因此，最後一日議程在 20 日下午 4:45 分結束，大會 9 位審查委員也挑選出優秀的學生口頭報告人和海報張貼報告人。同日晚間前往鹽湖城國際機場搭乘 PM9:20 分達美航空 DL1189 班機返回沙加緬度機場再驅車轉往舊金山。順道無班休假後於 8 月 24 日搭乘凌晨 1:50 分華航 CI003 自舊金山返國，於 25 日清晨 5:30 分抵達桃園國際機場。



98 年 8 月 20 日與中央大學楊明仁教授(左 2)及出席本次研討會之臺灣友人(右 1 及右 2)合影。

三、心得

由本屆研討會眾多論文中，大量使用中尺度數值模式針對各類中小尺度劇烈天氣進行模擬診斷分析是最常被廣泛討論。其中以使用之氣象研究與預報模式(Weather Research and Forecasting Model, WRF)，為各專家學者進行研究診斷及作業單位進行預報分析最常使用的中尺度數值模式。民航局自民國95年1月起執行「航空氣象現代化作業系統強化及支援計畫」，委託NCAR持續進行航空氣象現代化系統的各項強化發展工作，其主要工作之一為建置新一代的氣象模式預報系統WRF，取代原有的第五代中尺度數值預報模式(Fifth-Generation NCAR/Penn State Mesoscale Model, MM5)模式，以提高氣象預報的空間解析度與預報能力，進而滿足新一代的航空氣象作業需求。目前WRF數值模式也正是臺北航空氣象中心航空氣象現代化作業中為臺北飛航情報區內使用最大量的數值天氣預報產品之一。

WRF是一個完整的可壓縮非靜力模式，採用通量形式的完整方程組，是專為研究以及作業單位所設計的模式；因此在任何方面的研究進展，均可迅速實際應用在作業單位上。模式設計的目標主要是針對高解析度的中尺度系統(>1~10km)，同時已建立方便的4維資料同化方法，以及融合了MM5、美國國家環境預報中心(National Centers for Environmental Prediction, NCEP) 等現有模式中表現較好的各類參數化方法。此外，其高度的模組化設計，可容許使用者輕易加入新的參數化方法。WRF模式可進行實際或是理想個案的模擬，並已建立平行化模組，可適用於大多數的PC叢集運算系統上。WRF可選擇使用地形跟隨高度的垂直座標系統（σ座標），或是地形追隨質量的垂直座標。網格設計採用Arakawa C-grid，且使用3階的Runge-Kutta時間差分法，可容許較大的積分時間步長(time step)。此外，WRF採用5階的平流前差分方法進行計算平流項，就正確率及計算效率上，均較MM5好。在WRF模式中，質量、動量、熵…等參數均為保守量，但在MM5中這些重要參數並不保守；因此，WRF模式的模擬結果一般也較為合理。所以WRF模式在各國氣象作業和學術單位已被大量採用，以彌補全球區域模式時間和空間解析度的不足。

研討會中有多篇關於WRF資料同化的研究，包括最常使用的傳統地面及觀測資料的同化。亦有雷達或衛星風場的同化技術，例如QuikSCAT風場和衛星反演可降水量、溫溼度剖面場等觀測資料進入WRF同化系統。目前臺北航空氣象所使用的WRF模式，已將福衛三號衛星COSMIC GPS無線電掩星法資料成功地加

入WRF-Var*[註一]模組進行同化。近年有關資料同化的測試除了各類非傳統觀測資料的同化，新的資料同化技術也被引進。例如WRF系集預報技術也成爲模擬診斷劇烈天氣系統的新方法，利用系集卡曼濾波器(The square-root ensemble Kalman filter, EnKF)的資料同化研究平臺(Data Assimilation Research Testbed, WRF/DART*[註三])系集預報技術。在預報過程中有新的觀測資料進來時，用此觀測資料與預報值來決定出最佳的分析值。此方法利用最新觀測資料來更新預報值，有利於預報結果不會偏離實際大氣太遠，使得預報誤差降低，進而改善數值模式預報結果。相關論文報告有NCAR Jeffrey Anderson 「DART/WRF: A community mesoscale ensemble data assimilation facility」、「Error and uncertainty in ensemble predictions of tropical storms」和奧克拉荷馬大學 Nusrat Yussouf 「Impact of the variations of precipitation particle parameters within the same microphysics scheme in radar data assimilation using EnKF data assimilation technique」和Dustan M. Wheatley「Application of a WRF mesoscale ensemble data assimilation system to severe weather events during spring 2009」等論文。而WRF在數值方法上的計算效率優於MM5，容許更多不同資料同化技術上的敏感度測試，但WRF/DART技術將耗用更多的計算資源，需學界未來更多的研究測試報告及驗證，以了解對預報技術之影響程度爲何。

在研討會後兩周，即九月初AMS也在網路上公布研討會所有文章的投影片及報告人現場錄音檔案，方便會後回顧整理。故上述論文可至下列網址連結：
http://ams.confex.com/ams/13Meso/techprogram/programexpanded_558.htm

四、建議

職此次奉派前往美國鹽湖城參加美國氣象學會舉辦之第 13 屆中尺度氣象研討會。並於會議中口頭發表中尺度氣象相關之論文，除擴展中尺度氣象相關研究領域的見聞，同時瞭解中尺度過程最新理論及數值模式預報技術發展，且與各國專家及作業人員交流，研討會過程中也學習到寶貴的經驗。身爲機場氣象觀測人員，鮮少有參加國際性氣象研討會並發表論文的機會，此次從投稿論文短摘要接受 AMS 審查、長摘要及投影片之定稿、英文演講之逐字稿準備和事前練習、論文口頭發表及現場問題回答乃至參加研討會的過程也學習到許多不曾在國內研討會所能遭遇過的經驗。

以下爲職等此次研習之建議：

一、　航空氣象預報產品與一般中尺度天氣系統的生命期相當，而了解中尺度對流系統的結構與生成演變機制，對於預報或觀測員針對中小尺度系統未來消長之研判有正面的幫助。此次奉派參加確實增長了專業知能，瞭解世界各國在中尺度氣象預報作業及最新理論研究成果。爲提升預報及觀測人員素質，增進航空氣象預報作業品質，建議持續派員參加類似之國際性氣象研討會。除了中尺度氣象研討會之外，美國氣象學會預訂在 2010 年 1 月 17 至 21 日 AMS 第 90 屆年會期間，在美國亞特蘭大召開第 14 屆航空航太氣象研討會(Conference on Aviation, Range, and Aerospace Meteorology, ARAM)，該研討會每兩年召開一次，也是全世界規模最大的航空氣象國際研討會之一，此類研討會將可列入優先考慮派員參加。

二、　WRF-Var*[註一]建立方便的四維變分*[註二]資料同化模組，提供各類觀測資料的同化。而 WRF/DART*[註三]爲最新之資料同化技術，在本屆研討會中也被廣泛討論中，建議列爲未來模式資料同化技術改進方法之一。因此，有關這部分未來民航局與中央氣象局之「氣象資料與預報模式系統作業技術合作協議」建議列入討論議題之一。

附錄 A 註解說明

註一：WRF-Var

WRF 數值模式是由數個模組化的程式所構成，WRF-Var 爲資料同化模組。主要是處理額外的傳統或非傳統觀測資料同化進入模式初始場之工具，並且運用變分原理尋求模式初始場的最佳化，以求模式初始場的平衡性及預報積分過程的穩定性，避免數值方法的不穩定導致模式的預報積分中斷。

註二：四維變分

一般資料同化方法從早期的三維變分，演進到四維變分。三維變分只改善模式初始場的第一猜測值後，即進行模式積分預報，不再加入新的觀測資料。而四維變分除了改善第一猜測值的初始場，在模式開始積分預報期間，如有最新的衛星、雷達及飛機觀測資料將立即進入同化系統，即刻修正預報分析場，以最實際的觀測資料來最佳化分析場，以改善預報準確度。

註三：WRF/DART

2007 年 NCAR 最新發展的資料同化技術，有別於 WRF-Var。建立在傳統系集預報概念，結合卡曼濾波器的技術，針對模式分析場進行調整，隨著模式積分預報同化最新觀測資料，將使分析場更接近實際大氣狀態。其採用多組初始場進行分析及預報，透過卡曼濾波系集平均決定出最佳化的初始場，降低預報誤差。目前應用在颱風渦旋初始化過程爲最多，能有效維持模式中颱風的強度及結構，以改善颱風路徑及強度預報。

附錄 B 論文英文長摘要

15.7 AN ANALYSIS OF TROPICAL CYCLONE FORMATIONS IN THE SOUTH CHINA SEA DURING THE LATE SEASON

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1. INTRODUCTION

During the boreal winter, eastern Asia is dominated by a strong and steady monsoon, which develops as the continent cools and the Siberian anticyclone strengthens. Previous studies have shown that the northeasterly cold surge that comes off of Asia leads to an intensification of convective disturbances in the near-equatorial region. These disturbances, which may have originated from the semi-stationary near-equatorial trough over the coast of north Borneo or from a westward propagating wave in the western North Pacific (WNP) can intensify and become a tropical cyclone (TC) (Chang et al 1979). For example, tropical storm (TS) 29w and one of the most near-equatorial Typhoon Vamei which formed in the southern SCS during the boreal winter of 2001 were associated with the northeasterly cold surges are from the semi-stationary near-equatorial trough. Chang et al. (2003) noted that the formation of Vamei was associated with an interaction of an exceptionally strong and persistent northwesterly cold surge that created the large background cyclonic vorticity at the equator, and a weak Borneo vortex that drifted into the southern tip of the South China Sea. They reasoned that while the cold-surge and Borneo vortex events are both common during the boreal winter, the shift of the vortex center such that much of the cyclonic circulation lies over land contributes to the fact that it is extremely rare for the vortex to intensify and organize as a TC.

From 1972 to 2005, about one thousand TCs formed in the WNP. During the same period, 131 TCs formed in the SCS, with an annual average of 3.9. Almost no TC formation occurs in the SCS from January to March, but the number of TC formations increases significantly in May and June (mei-yu season) and accounts for 18.3% of the total number of TCs in the SCS. This number is significantly higher than that (9.7%) in the WNP. Similar situation occurs in December during which the percentage of storm formations is 8.4% for the SCS but is only 4.6% for the WNP. Also the monthly formation rates in the WNP decrease gradually from August to February while in the SCS a second maximum occurs in December. Lee et al. (2008) examined the mesoscale features of 124 TC formations in the WNP during 1999–2004. Based on low-level wind flow and surge direction, the formation cases are classified into six synoptic patterns. The monthly distribution of the six flow patterns suggests that the northeasterly cases, 15 % of total, may be related to the cold surges in the SCS during Asian winter monsoon.

The unique topography of the southern SCS, which includes the Malay Peninsula and Borneo, acts to channel the flows toward the equator. Cold surge winds are dry, but are moistened significantly at the southern SCS due to the long overwater trajectory. The gradient of planetary vorticity together with blocking and deflection due to topography may contribute to TC formations such as the equatorial typhoon Vamei in 2001 (Chang et al., 2003). Additionally, the interactions among the synoptic-scale Borneo vortex, northeasterly cold surge, and the intraseasonal Madden-Julian oscillation (MJO) during the boreal winter contribute to the variability of deep convections in the region (Chang et al. 2005).

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2. DATA

Data from various sources are used in this study. First, the climatology of TC formations in the SCS during 1972–2005 is based on the best-track data from the JTWC. The daily weather charts of JMA are used to address the surface features. Additionally, the infrared and visible satellite imageries from the Geostationary Meteorological Satellites (GMS), Geostationary Operational Environmental Satellite-9 (GOES-9) and Multi-functional Transport Satellite (MTSAT-1R) in the same 34-yr period are examined as a comparison with the surface features. The daily mean interpolated outgoing longwave radiation (OLR) with a 2.5^{o} latitude/longitude resolution is taken from the National Oceanic and Atmospheric Administration (NOAA). The six-hourly National Centers for Environmental Prediction (NCEP) reanalyses with the same resolution are used to analyze the upper-level features. To monitor the MJO activity, Wheeler and Hendon (2004) developed a seasonally independent index which is based on a pair of empirical orthogonal functions (EOFs) of the combined fields of near-equatorially averaged 850-hPa zonal wind, 200-hPa zonal wind, and satellite-observed outgoing longwave radiation (OLR) data.

3. CHARACTERISTICS OF SCS TC FORMATION

DURING THE LATE SEASON

During the period of 1972-2005, twenty two TCs formed in the SCS during the late season (only one case in January). Eleven of these storms originated from the disturbances located in the southern SCS and are classified as semi-stationary cases. The others were associated with westward-propagating disturbances which originated in the WNP and passed the Philippines. These systems are classified as westward-moving cases. The best tracks of these two types of cases reveal that the moving directions of semi-stationary cases are more diversified when compared to those of the westward-moving cases. The westward-moving cases generally are located to the south of the subtropical high where stable easterly prevail. Many semi-stationary cases, however, are located at the western edge of the subtropical high where the steering flow is less well-defined. Therefore, the systems might move toward different directions, westward, northward or even eastward.

The average maximum intensities are 44 kt and 46 kt for semi-stationary and westward-moving TCs, respectively. These numbers are about the same as that (43 kt) of the typical frontal-type formation case (Lee et al., 2006). However, they are significantly smaller to those of TCs in the WNP due to the smaller water mass in the SCS. For those cases which develop to TS intensity, the time periods from the first 25 kt to 35 kt are 28 h and 21 h for the semi-stationary and westward-moving cases. These numbers are much smaller than that (47 h) for the typical frontal-type formations. They are also smaller than those of TCs in the WNP during the mei-yu (35.7 h) and late (36.4 h) seasons. In other words, the initial development of a TC in the SCS is relatively faster especially for the westward-moving cases.

4. COMPOSITES OF FORMATION AND NONFORMATION CASES

To help understand the formation process of a TC in the SCS during the late season, it is important to also examine those disturbances which developed to a well-recognized stage but do not develop to TCs (hereafter termed the nonformation cases). Therefore composite of the nonformation cases are studied and compared against that of the semi-stationary cases (hereafter termed the formation cases).

To examine the general environments of the formation and nonformation cases, composites are done for the 11 formation cases and 33 nonformation cases using the NCEP reanalysis. Composite analyses show that eleven of formations originated from the southern SCS and the 33 nonformation cases have a closed surface isobar that lasts for at least 48 h but does not develop into a TD. For the nonformation cases, the time when the closed surface isobar first formed is referred as the zero-time reference (Lee et al. 2006). This applies to the composites of the formation cases as well so that they do not have a higher intensity when compared with the nonformation composites. The low level disturbance near the coast of North Borneo and one-third of the low level circulations located at the Borneo landmass did not develop further after 36 h of the zero-time reference once they reached the maximum relative vorticity (Fig. 1b). During the boreal winter at low level troposphere in the SCS, there is cyclonic shear at the left side of the northeasterly. But the northeasterly are accompanied by a cold surge north of the nonformation cases, which are weaker in magnitude and the environmental cyclonic vorticity in the southern SCS is weaker than that of formation cases.

The midlevel (500 hPa) circulation shows that 48 h after the zero reference time, it is clear that the subtropical high ridge extends just over the SCS for nonformation (Fig. 2b), which is similar to the westward-moving case (Fig. 7b). The displayment of positive vorticity is contracted closer the Borneo landmass. For the formation group, however, the subtropical high only dominates east of 120° E, not the SCS so that deep convection is not suppressed (Fig. 2a). Upper level (200-hPa) divergent flow demonstrates that although a similar diffluent structure exists at upper levels as in the formation and nonformation cases, the divergent flow over the southern SCS that is associated with the anticyclone provides an upper-level environment that is conducive to formation (Fig. 2c).

To compare the convection distribution during the formation process, the OLR comparison between formation (Fig. 3a) and nonformation (Fig. 3b) cases is presented. Two days before to three days after the zero-reference time, in the formation cases, the lower area of OLR located in the southern SCS and extending to the entire maritime continent. In contrast, the convection in the nonformation cases is always weaker and less widespread in the southern SCS (Fig 11b).

The scatter plot for 925-hPa relative vorticity and 200-hPa divergence reveals that the distribution between formation and nonformation cases is separable at early formation process (Fig. 4a). At the latter formation process, it is more significant (Fig. 4b). Due to the decreasing of vertical wind shear and increasing of 850-hPa relative humidity, the distribution at early formation process (Fig. 4c) is broad than these at latter formation process. Meanwhile the 850-hPa relative humidity in formation cases is always higher than that in nonformation cases (Fig. 4d). The statistics also shows that 83.2 % of formation, the 925-hPa relative vorticity is above 2.49×10^{-5} s^{-1} (average vorticity minus one standard deviation), only 44.8 % of nonformation is above the value. For 700-hPa relative humidity, the formation is greatly larger than nonformation (83.9 % v.s. 8.6 %). For general the vertical wind shear of nonformation is stronger than that of formation, but the difference of percentage (the value is above average vertical wind shear plus one standard deviation, 14.7 m s^{-1}) is smaller. Also the difference of 200-hPa divergence is not significant.

Aerial averages of several quantities can also distinguish the environmental conditions in which formation and nonformation are embedded. The average 925-hPa relative vorticity within a 500-km radius that is centered on the surface pressure minimum for the formation cases maintains a magnitude between 2.7×10^{-5} s^{-1} to 3.5×10^{-5} s^{-1} after the reference time (Fig. 5a). It is larger than that of a typical frontal-type formation (2×10^{-5} s^{-1} to 3×10^{-5} s^{-1}). However the nonformation cases have a smaller magnitude of 925-hPa vorticity (2×10^{-5} s^{-1} to 2.5×10^{-5} s^{-1}) for the duration of time. Both of magnitude changes for formation and nonformation cases is small during the entire duration. The result of genesis potential (850-hPa minus 200-hPa relative vorticity; McBride and Zehr 1981) change is similar to the 925-hPa relative vorticity. The 200-hPa divergence associated with the formation case continues to be high 36 h after (about the time of reaching 25kt) the reference time, which is favorable for further intensification of the TD (Fig. 5b). In contrast, the divergence associated with the non-formation case is smaller throughout the period. The low level relative humidity is also different between the formation and nonformation, especially the 700-hPa relative humidity reveals that formation is increasing above 85 % at latter formation process and it is always 15 % higher than nonformation (Fig. 5c). The average 200–850-hPa deep environmental-vertical wind shear (within a radius from 500 to 900-km) for the nonformation cases (Fig. 13d) is 2–3 m s^{-1} smaller than it is for the formation cases at the zero-reference time. The formation case also has a similar decrease in the magnitude of vertical wind shear throughout the period. The nonformation case initially has vertical wind shear that is an average of 2 m s^{-1} smaller than the formation case. Then it continuingly increases to a value that is larger than the formation case 48 h after the zero-reference time. Although the climatological flow of winter monsoon is that the strong 200-hPa southwesterly over low level northeasterly create larger vertical wind shear in the region, where the values of vertical wind shear for the formation cases during the late season is 2-4 m s^{-1} larger than it is for the typical frontal-type formation cases associated with the mei-yu front, the tendency of decreasing vertical wind shear is more favorable for development.

Whatever the 925-hPa composite of nonformation and formation cases, the background northeasterly are pretty strong with a value of 13-15 m s^{-1} is over the western SCS. Aerial averages of 925-hPa total wind of northeasterly are about 11 m s^{-1} for formation at the zero-reference time (Fig. 6c). At about 36 h, which is around the time that formation cases reach 25kt, it is decreasing. At 60 h, when it is a developing tropical storm, it intensified again. However, the nonformation case has no significant change in magnitude during the duration. In the 925-hPa composite, the center of the vortex is oriented along the western Borneo coastline. Chang et al. (2005) explained that although the presence of the surge acts to increase the strength of the vortex, the surge results in a shift of the vortex center from being located over the southern SCS to being near the Borneo landmass. Therefore, the decreasing northeasterly at 30 h after the zero-reference time prevents the shift of the low-level circulation center of the formation cases from the southern SCS to a location near the Borneo landmass.

The difference between northeasterly in the formation and nonformation cases shows (Fig. 6a) that there has a one-time significant intensification before 30 h and a one-time significant weakening within approximately 30h to 60h. As for the space distribution, the maximum occurs at about 30 h in the eastern SCS and then a significant weakening follows until that at 60 h. There is a minimum area at 120°E. The sequence is similar to the results for aerial averages of 925-hPa northeasterly (Fig. 6c). However the difference between formation and non-formation is minor (about 1-2 m s^{-1}). In order to realize the differences whether is significant or not, the T-test statics and trend is presented. In Fig 16b, the 925-hPa wind vector is mean flow of formation minus non-formation during the weakening of northeasterly (30 to 60 h), the cyclonic circulation is still located at north of Borneo, but the negative tendency of northeasterly in the northern SCS is significant. Also near the equatorial SCS is negative with 2 m s^{-1}.

The distribution of positions is also consistent with the change of northeasterly. The position at 30 h of formations (Fig. 7a) gradually moves northward away from the Borneo coastline when the northeasterly are significantly decreasing at 60 h (Fig. 7b). However, the change of the northeasterly for nonformation is too minor to affect its low level circulation shift, it is no obvious southwestwardly or northwardly motion. (Fig. 7c-d).The tendency difference of 925-hPa relative humidity shows that it is positive during the early formation process at the eastern SCS and there are two maximum in the west of Borneo and Luzon (Fig. 8a). Because cold and dry northeasterly flow experience a warm water in the eastern SCS that results in moistening the low level troposphere. Moreover there is a negative minimum over the Vietnam landmass. While the weakening of northeasterly after 30 h in the northern SCS, it is negative in the northwestern SCS during the latter formation process (Fig. 8b). Meanwhile the strong northeasterly axis is also in the western SCS (Fig. 1). This allows formation cases not be weakened by the cold and dry air incursion along the Vietnam coast. The result is similar to Chang et al. (1979).

5. DISCUSSION AND CONCLUSIONS

Among the 131 TC formations in the SCS during 1972–2005, 22 occurred from November to January. In addition, 11 of these were from the Pacific and steered by the easterly of subtropical high, moving to the SCS, while the remaining 11 were semi-stationary and developed originally in the southern SCS. In contrast, 33 nonformation cases in the SCS during the period of 1972-2005 were identified in order to distinguish them from the 11 semi-stationary formation cases. These are cases with a similar low-level circulation origin, namely, from the southern SCS near the coast of north Borneo. In these, the vorticity in the southern SCS is smaller. Because of the influence of a strong subtropical high, deep convection is suppressed in the SCS. Although a similar, diffluent structure exists in upper levels as in the semi-stationary formation, it appears that the development and divergence over the low-level disturbance is weaker. At the early state of formation process, the stronger northeasterly is favorable for formation cases to induce larger cyclonic vorticity environment in the southern SCS. However the strong northeasterly at the latter formation process may also result in the system becoming too close to the Borneo landmass. Also it may lead the cold and dry air incursion along the Vietnam coast to suppress convection due to stabilizing effect. The early formation period shows the larger westerly vertical wind shear (Fig. 9a) and low-level north wind located at the northern SCS with strong cold advection (Fig. 9b). The latter formation period shows that the largest humid difference near 700 hPa reaches 15 % and there is a warm core anomaly near 500 hPa accompanying the stronger updraft. Moreover the low-level cold advection at the northern SCS and the vertical wind shear also weaken (Fig. 9c and d). Whereas the nonformations experience smaller vertical wind shear (about 7 m s^{-1}) than the formations during the early period, later they continually increase and become larger than the formations. Moreover, the climatological flow of the winter monsoon is that the strong 200-hPa southwesterly over low level northeasterly cause larger vertical wind shear in the region, where the values of vertical wind shear for the nonformation cases during the late season is 2-4 m s^{-1} larger than for the typical frontal-type formation cases.

Comparing the probability of TC formation between the mei-yu and late season reveals that the percentage of incipient lows developing to TC intensity associated with the mei-yu front is 64.7 % (11/17), which is much higher than the 25 % (11/44) of these associated with the Borneo vortex during the late season. In addition, the average formation time (from 25kt to TS) of a typical front-type case is 47 h, which is indicative of a weak and slow-developing formation. However, of the formation time of semi-stationary cases during the late season is only 28.3 h, which is a weak but faster-developing formation. In general, the average formation time of WNP cases during the winter period is 36.4 h, which is also slower-developing than those of the semi-stationary case associated the Borneo vortex. Liebmann et al. (1994) showed that the ratios of storms and typhoons formed per TD are the same in the convective phase as they are in the dry phase of the MJO, but they did not include nonformation cases because the identification of incipient disturbance is highly subjective. The probability of incipient vortex formations when the MJO is present is more than twice as when the MJO is absence (Fig. 10b). Importantly, formation is from a stochastic process to physical deterministic process when intensification, which are different scenarios and mechanisms. The stronger equatorial westerly during the active MJO period would produce stronger cyclonic shear vorticity thus is favorable for triggering more convection activity and more vortex formations. However, more vortices or cloud clusters is not necessarily more favorable for an incipient vortex to organize into a TC. Therefore, the probability for an incipient vortex to become a TC is actually higher during the non-MJO period in the SCS during the late season. Such feature suggests that the TC formation in the SCS during the late season is like a stochastic process. Nonetheless the environment for formations reveals that the low level relative vorticity and humidity during initial formation period are already significantly different from that for nonformations. Thus the favorable setup of synoptic environment is still a precursor to determine the cloud cluster further development.

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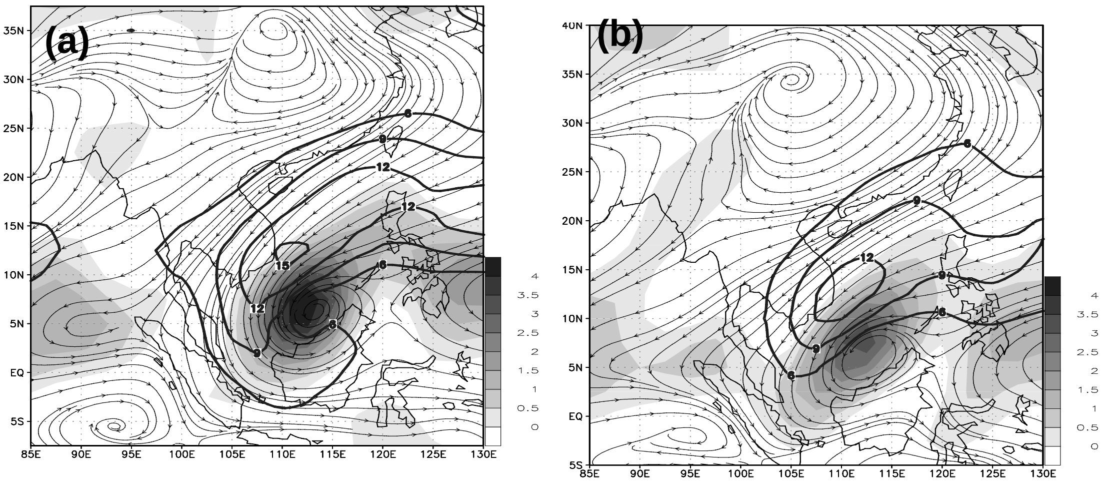


FIG. 1. The 925-hPa flow field for (a) formations and (b) nonformations at 925 hPa. At 48 h. The heavy contours are isotachs (minimum wind speed is 6 m s^{-1} with interval of 3 m s^{-1}). Shadings show positive relative vorticity (interval: 0.5×10^{-5} s^{-1}).

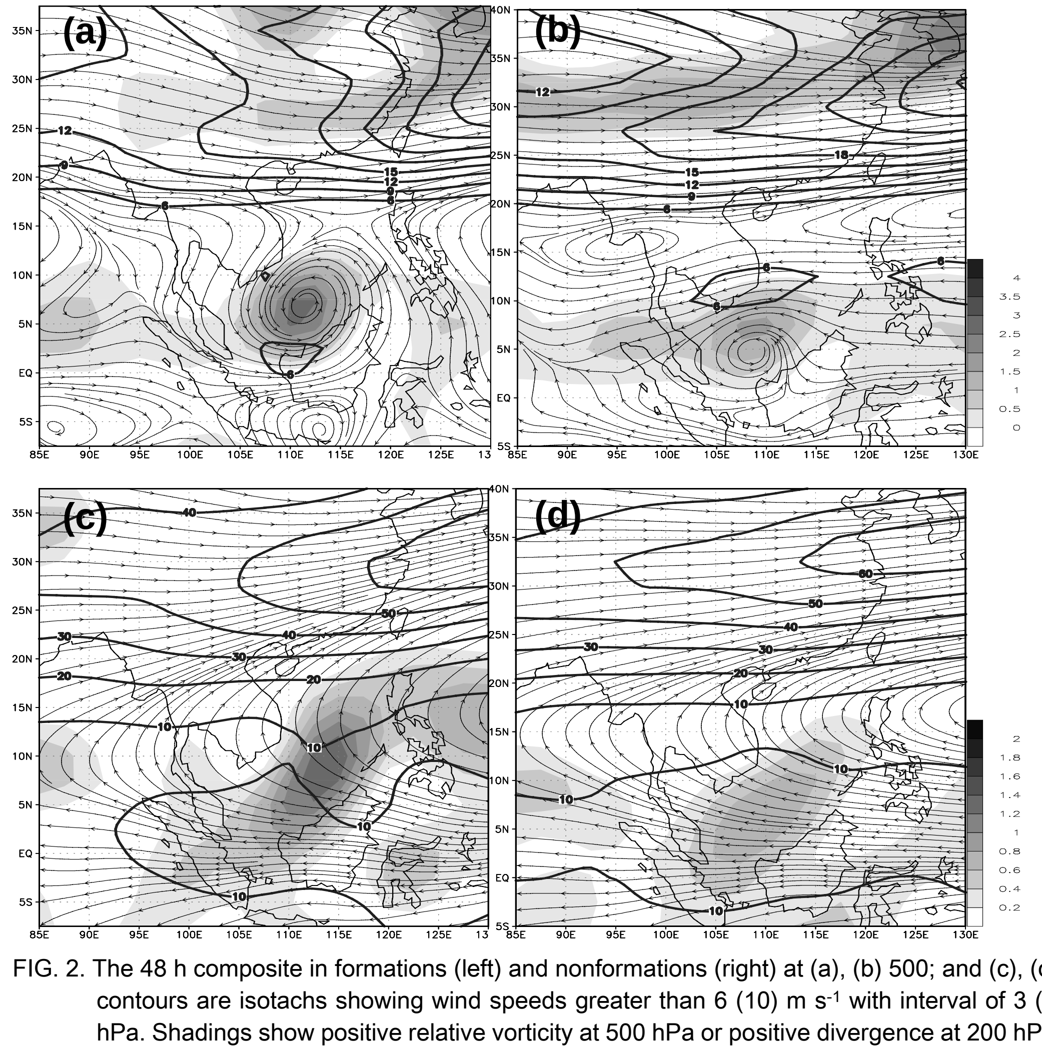


FIG. 2. The 48 h composite in formations (left) and nonformations (right) at (a), (b) 500; and (c), (d) 200 hPa. The heavy contours are isotachs showing wind speeds greater than 6 (10) m s^{-1} with interval of 3 (10) m s^{-1} at 500 (200) hPa. Shadings show positive relative vorticity at 500 hPa or positive divergence at 200 hPa (interval: 0.5×10^{-5} s^{-1} for upper and 0.2×10^{-5} s^{-1} for lower).

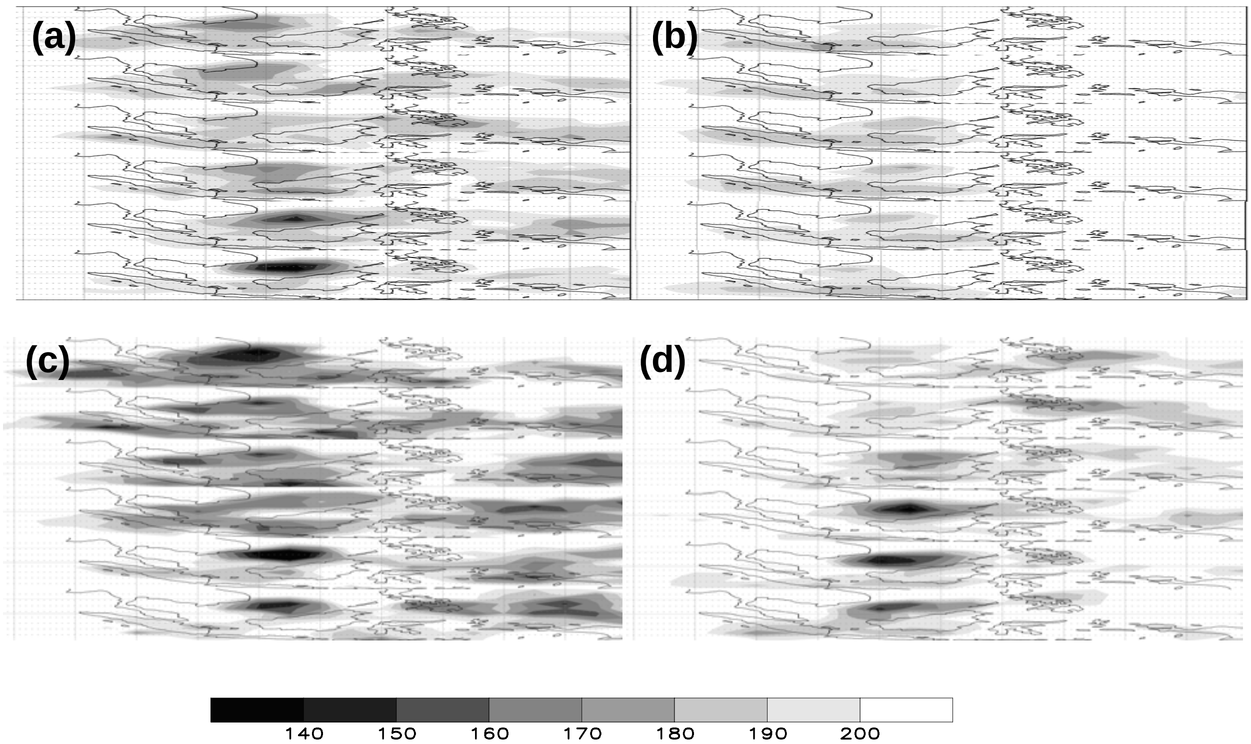


FIG. 3. Composite OLR (W m^{-2}) distribution from three days before to two days after of the zero-reference time for the (a) formations and (b) nonformations. During (c) MJO, (d) non-MJO period for the formations.

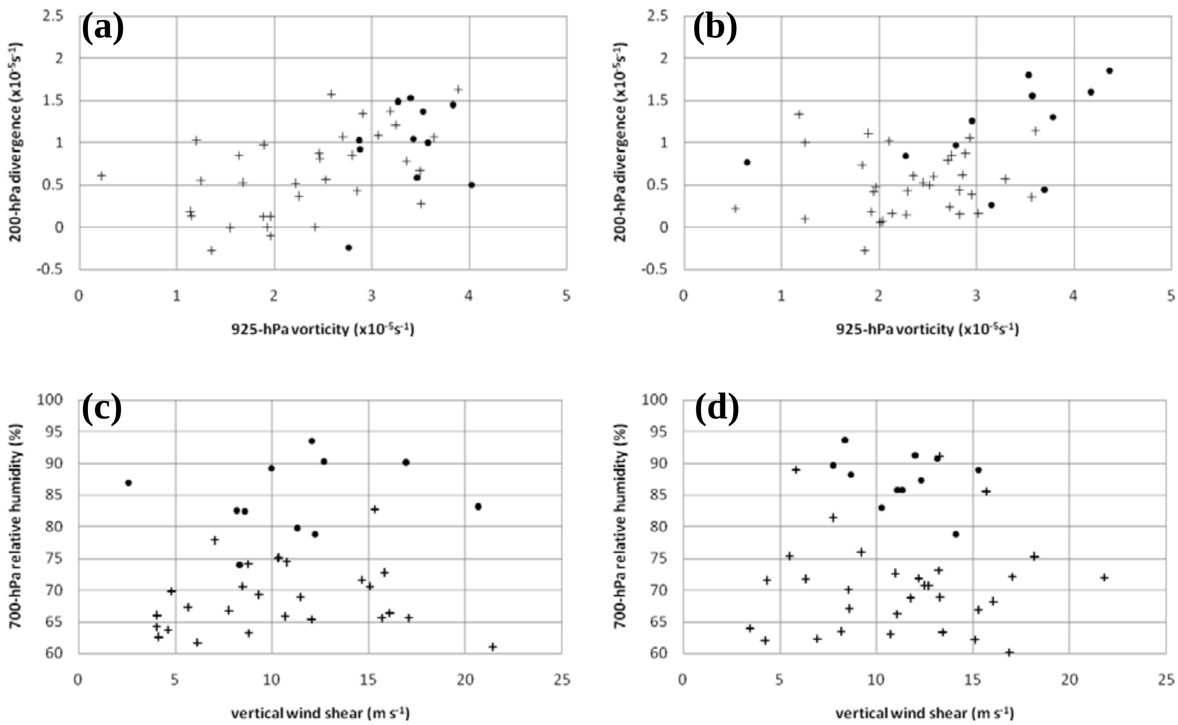


FIG. 4. Scatter plots of formation (dot) and nonformation (cross). (a), (b) 925-hPa vorticity verse 200-hPa divergence; (c), (d) vertical wind shear verse 700-hPa relative humidity. (a), (c) at 24h ; (b), (d) at 72h.

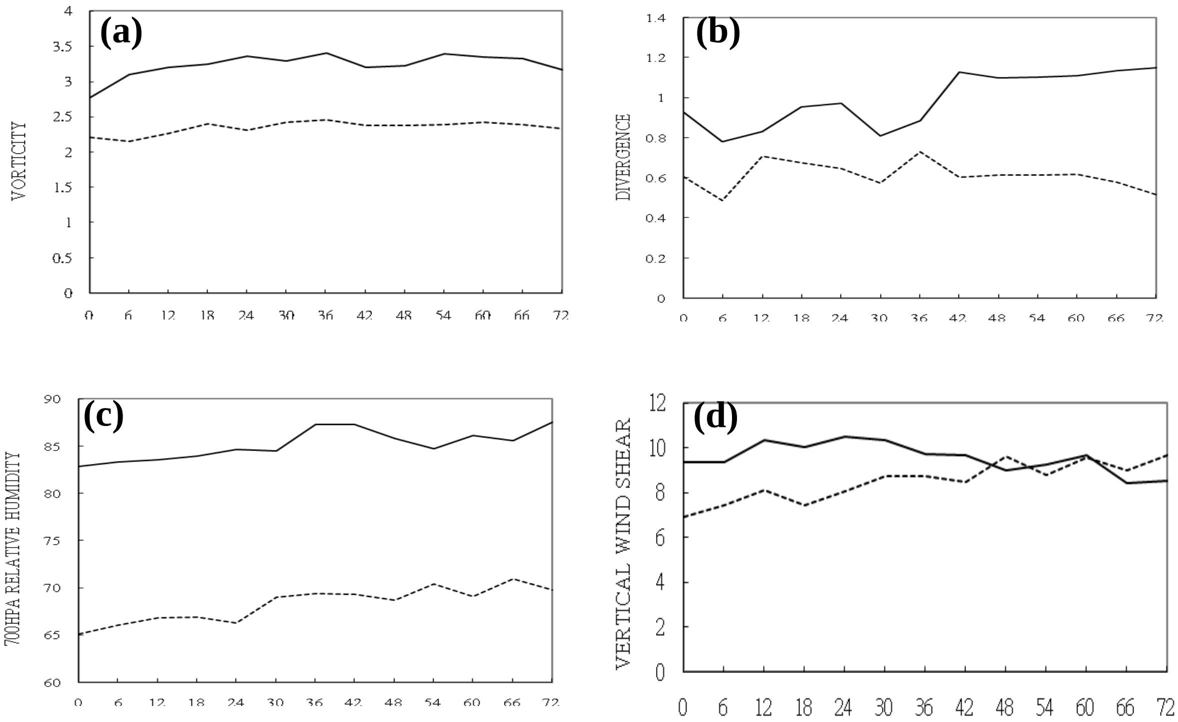


FIG. 5. (a) Averaged 925-hPa relative vorticity (unit: 10^{-5} s^{-1}), (b) 200-hPa divergence (unit: 10^{-5} s^{-1}), (c) 700-hPa relative humidity (unit: %) (d) 200–850-hPa vertical wind shear magnitude (unit: m s^{-1}) for the formation (solid) and non-formation (dashed) cases.

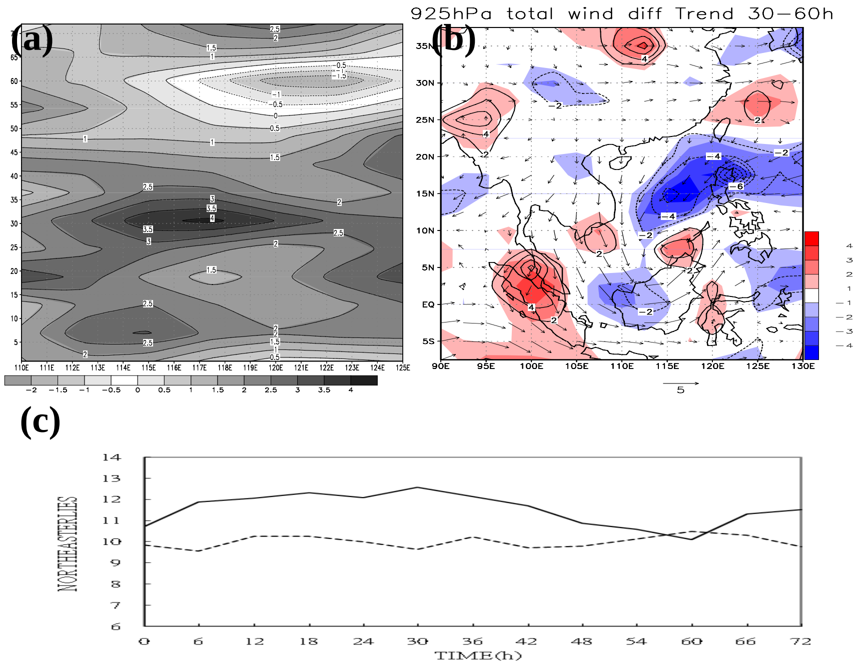


FIG. 6. (a) The 925-hPa northeasterly difference (formation minus nonformation) at 7.5° north of disturbance center, (b) tendency of wind speed (shaded; unit: m s^{-1}) from 30 h to 60 h ,wind vector is the mean flow, inside the contour is passing the 95% confident level and (c) the time series assessing the quantity of the aerial average of the northeasterly (m s^{-1}) for 5°×15° area that is 5° north of disturbance center for formation and nonformation cases.

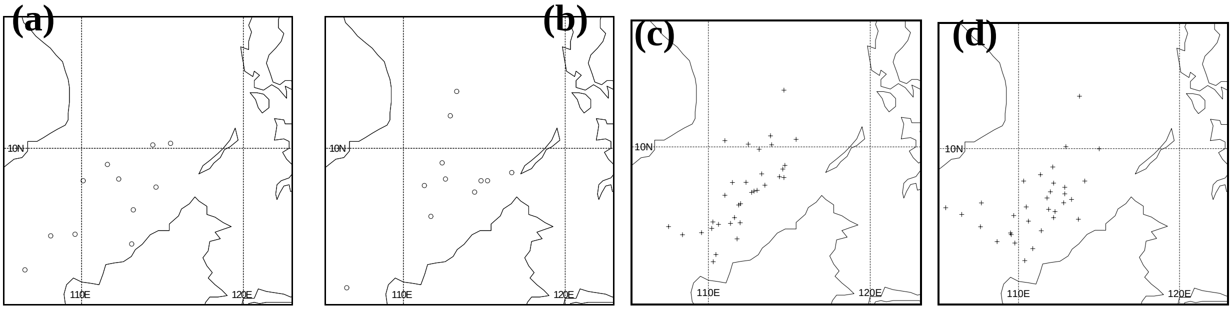


FIG. 7. The position for formations at (a) 30, (b) 60 h and for nonfomations at (c) 30, (d) 60 h after surface closed-isobar feature is identified.

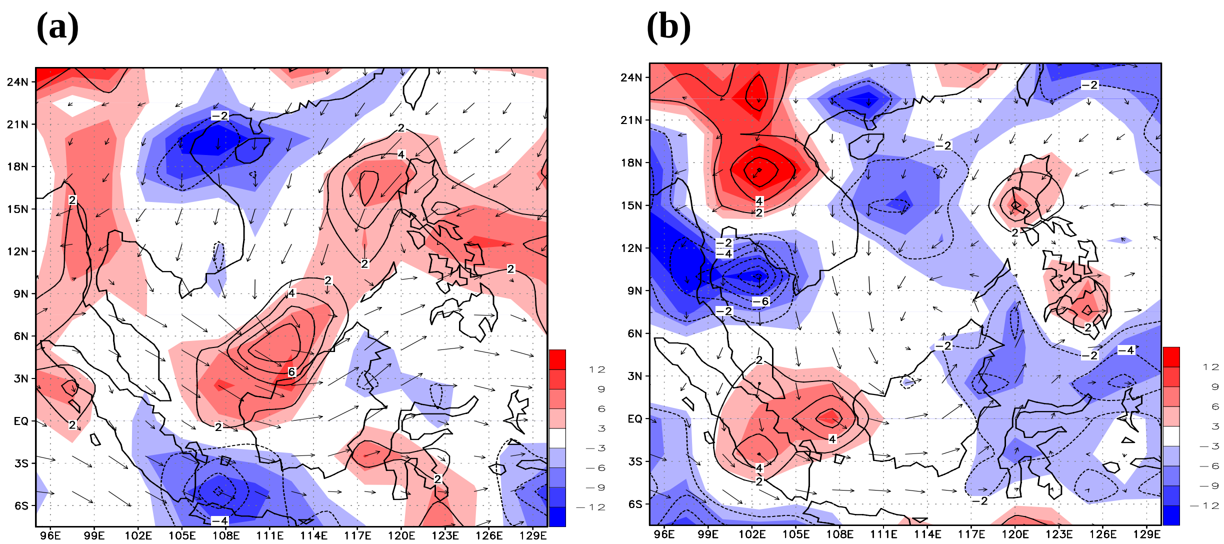


FIG. 8. The tendency difference (formation minus nonformation) of 925-hPa relative humidity (shaded; unit:%) from (a) 0 h to 30 h and (b) 30 to 72 h. Wind vector is the mean flow and inside the contour is passing the 95% confident level.

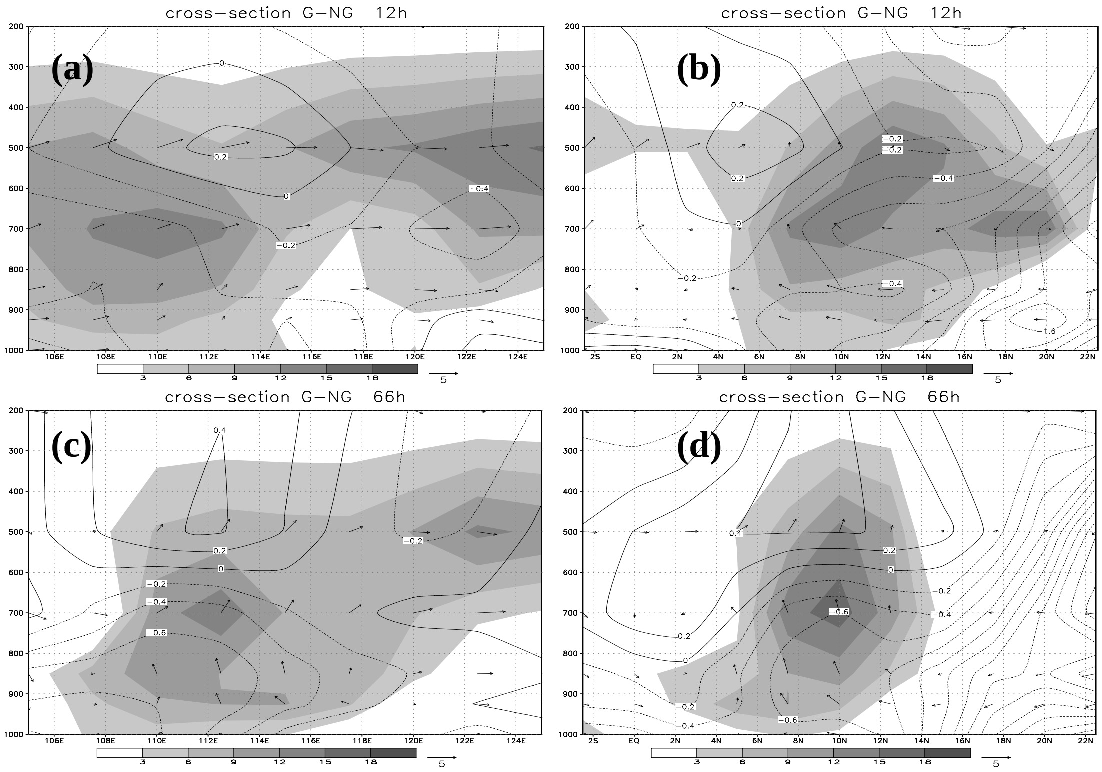
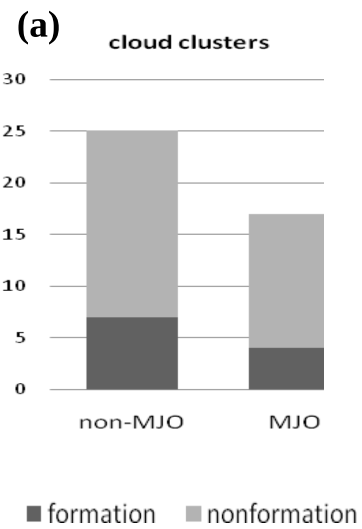


Fig. 9 The difference (formation minus nonformation) of temperature (contour) and humidity (shaded) of vertical cross section along (a), (c) 7.5°N and (b), (d) 112.5°E. (a) and (b) are at 12 h, (c) and (d) are at 66 h.



(b)

	non- MJO	MJO
no- vortex	2373	361
vortex	109	40
% of total days	4.4%	10%

FIG. 10. The TC formation probability with the MJO and non-MJO in terms of (a) cloud clusters and (b) incipient vortex formation probability.

附錄 C 議程表

13TH CONFERENCE ON MESOSCALE PROCESSES

AMS Committee on Mesoscale Processes
Robert Fovell, Chairperson
Scott A. Braun, Melissa Bukovsky, Shu-Hua Chen , Craig Epifanio, Vanda Grubisic, Matthew D. Parker, David Reynolds, Chris Snyder, and Sandra Yuter

Conference Program Committee
Robert Fovell and Sandra Yuter, Chairpersons
Scott A. Braun, Matthew D. Parker, George Bryan

Sunday 16, August Common Times

5:00 P.M.–7:00 P.M.	Registration Opens-Orion

Monday 17, August Common Times

7:30 A.M.–6:00 P.M.	Registration Continues Throughout the Conference-Orion
10:00 A.M.–10:30 A.M.	Coffee Break-Arches/Deer Valley
12:00 P.M.–1:30 P.M.	Lunch Break-Wasatch
2:30 P.M.–4:00 P.M.	Coffee Break with Poster Viewing-Arches/Deer Valley

8:45 A.M.–10:00 A.M.
Session 1: MESOSCALE PRECIPITATION SYSTEMS I-The Canyons

Chair(s): S. B. Trier, NCAR, Boulder, CO

8:45 A.M. Welcoming Remarks.

9:00 A.M.
1.1 *Dynamic Tropopause Mesoscale Disturbances as Triggers of Warm Season Severe Weather Episodes in the Southwest.* **Lance F. Bosart**, SUNY - Univ. at Albany, Albany, NY, J. E. Matusiak, T. J. Melino, S. R. Sukup and E. Pytlak

9:15 A.M.
1.2 *Repeating patterns of precipitation and surface pressure evolution in midlatitude mesoscale convective vortices.* **Eric P. James**, Colorado State Univ., Fort Collins, CO and R. H. Johnson

9:30 A.M.
1.3 *The dependence of high-precipitation supercells on preexisting airmass boundaries: a targeted modeling study.* **Jennifer M. Laflin**, Univ. of Nebraska, Lincoln, NE and A. L. Houston

9:45 A.M.
1.4 *Mesoscale precipitation features and dynamics of a winter storm in Central Oklahoma.* **Jana Lesak Houser**, Univ. of Oklahoma, Norman, OK and H. B. Bluestein

10:00 A.M.
1.5 *Radar reflectivity as a proxy for convective mass transport.* **Gretchen L. Mullendore**, Univ. of North Dakota, Grand Forks, ND, A. J. Homann, C. Schumacher and K. Bevers

10:30 A.M.–12:00 P.M.
Session 2: MESOSCALE PRECIPITATION SYSTEMS II-The Canyons

Chair(s): Matthew D. Parker, North Carolina State Univ., Raleigh, NC

10:30 A.M.
2.1 *Maintenance of mesoscale convective systems over Lake Michigan.* **Nicholas D. Metz**, Univ. at Albany/SUNY, Albany, NY and L. F. Bosart

2.2 PAPER WITHDRAWN

10:45 A.M.
2.3 *Convection-permitting simulations of the diurnal cycle of warm-season precipitation in the lee of the Rocky mountains.* **S. B. Trier**, NCAR, Boulder, CO, C. A. Davis and D. A. Ahijevych

11:00 A.M.
2.4 *Mesoscale convective systems crossing the Appalachian Mountains.* **Casey E. Letkewicz**, North Carolina State Univ., Raleigh, NC and M. D. Parker

11:15 A.M.
2.5 *A climatology of convective systems over the Northeast U.S. and their structural evolution from the lee of the Appalachians to the Atlantic Coast.* **Kelly Lombardo**, Stony Brook Univ./SUNY, Stony Brook, NY NY and B. A. Colle

11:30 A.M.

2.6 *A radar-based climatology of high precipitation events in the European Alps: 2000–2007.* **James V. Rudolph**, *Univ. of Colorado, Boulder, CO, K. Friedrich and U. Germann*

1:30 P.M.–2:30 P.M.
13MESO
Session 3: MESOSCALE PRECIPITATION SYSTEMS III-The Canyons

Chair(s): Gretchen L. Mullendore, Univ. of North Dakota, Grand Forks, ND

1:30 P.M.

3.1 *A climatology of high lapse rates and their influence on the occurrence (or non-occurrence) of severe weather over the central United States.* **Jason M. Cordeira**, Univ. of Albany/SUNY, Albany, NY, T. J. Galarneau and L. F. Bosart

1:45 P.M.

3.2 *Convective initiation ahead of squall lines involving small hills.* **Seung-hee Kim**, Univ. of California, Los Angeles, CA and R. G. Fovell

2:00 P.M.

3.3 *The response of simulated nocturnal convective systems to a low-level jet.* **Adam J. French**, North Carolina State Univ., Raleigh, NC and M. D. Parker

2:15 P.M.

3.4 *Comparison of the level of neutral buoyancy observed from soundings and radar.* **Amanda J. Homann**, Univ. of North Dakota, Grand Forks, ND, G. Mullendore, J. S. Tilley and S. T. Jorgenson

2:30 P.M.–4:00 P.M.
Poster Session 1: POSTER SESSION I - Arches/Deer Valley

CoChair(s): Sandra E. Yuter, North Carolina State Univ., Raleigh, NC
Chair(s): Robert Fovell, Univ. of California, Los Angeles, CA

P1.1 *Study of microphysical and thermodynamic structures within supercell thunderstorms.* **Katja Friedrich**, Univ. of Colorado, Boulder, CO, J. Wurman and K. A. Kosiba

P1.2 *Megers between isolated supercells and quasi-linear convective systems: a preliminary study.* **Adam J. French**, North Carolina State Univ., Raleigh, NC and M. D. Parker

P1.3 *Mobile sounding measurements of the near storm environment during VORTEX2.* **Matthew D. Parker**, *North Carolina State Univ., Raleigh, NC, A. J. French, C. E. Letkewicz, M. J. Morin, K. Rojowsky, D. Stark and G. H. Bryan*

P1.4 *NRL COAMPS Real-Time Forecast during VOCALS-Regional Experiment.* **Shouping Wang**, NRL, Monterey, CA, Q. Jiang, L. W. O'Neill, X. Hong, H. Jin, W. T. Thompson and X. Zheng

P1.5 *A spatial and temporal distribution of convection over the Northeast U.S. during the warm season.* J. Murray, and **Brian A. Colle**, Stony Brook Univ./SUNY, New York

P1.6 *Sensitivities of storm divergence and stratiform rain production to microphysics and cumulus parameterizations.* **Larry J. Hopper Jr.**, Texas A&M Univ., College Station, TX and C. Schumacher

P1.7 *Possible stretching mechanisms producing the tornado vortex in the mid-level.* **Masahisa Nakazato**, MRI, Tsukuba, Ibaraki, Japan, O. Suzuki, K. Kusunoki, H. Yamauchi and H. Y. Inoue

P1.8 *Diurnal cycle of monsoon thunderstorms in Arizona and New Mexico from spaceborne and surface-based radar.* **Christina Wall**, Univ. of Utah, Salt Lake City, UT, E. J. Zipser and C. Liu

P1.9 *Mesoscale Convective Systems along the Mei-Yu Front Over South China Sea and Taiwan.* **Weixin Xu**, Univ. of Utah, Salt Lake City, UT and E. Zipser

P1.10 *Structure of Subtropical Mesoscale Convective Vortex during SoWMEX/TiMREX.* **Hsiao-Wei Lai**, National Taiwan Univ., Taipei, Taiwan, C. A. Davis and B. J. D. Jou

P1.11 *Numerical investigation of internal wave-vortex interactions.* **Tyler D. Blackhurst**, Brigham Young Univ., Provo, UT and J. C. Vanderhoff

P1.12 *Simulations of internal gravity waves approaching a critical level.* **Brian Patrick Casaday**, Brigham Young Univ., Provo, UT and J. C. Vanderhoff

P1.13 *A Case Study of a Large-Amplitude Inertia–Gravity Wave over the Southeast.* **James Ruppert**, SUNY/Univ. at Albany, Albany, NY and L. F. Bosart

P1.14 *An intercomparison of T-REX mountain wave simulations.* **James Doyle**, NRL, Monterey, CA, S. Gabersek, L. R. Bernardet, J. M. Brown, A. Doernbrack, E. Filaus, V. Grubisic, Q. Jiang, D. J. Kirshbaum, O. Knoth, S. Koch, I. Stiperski, S. Vosper and S. Zhong

P1.15 *Three-dimensional characteristics of stratospheric mountain waves during T-REX.* **James Doyle**, NRL, Monterey, CA, Q. Jiang, R. B. Smith, W. Cooper, V. Grubisic and J. B. Jensen

P1.16 *The Complex Bora Flow in the Lee of Southern Velebit.* I. Stiperski, Meteorological and Hydrological Service, Zagreb, Croatia, B. Ivancan-Picek and **Vanda Grubisic**, Univ. of Vienna

P1.17 *Beyond Long's solution: a Newton solver for nonlinear mountain waves with rotation.* **Kevin C. Viner**, Texas A&M Univ., College Station, TX and C. C. Epifanio

P1.18 *Whistler Mountain climatology: Temperature lapse rates in complex terrain.* **Lisa N. Erven**, Univ. of British Columbia, Vancouver, BC, Canada and I. McKendry

P1.19 *Influence of turbulence and dynamics on dust transport in Owens Valley.* **Qingfang Jiang**, UCAR Visiting Scientist, NRL, Monterey, CA, M. Liu and J. Doyle

P1.20 *Statistics and dynamics of aircraft encounters of turbulence over Greenland.* **Todd P. Lane**, Univ. of Melbourne, Melbourne, Vic., Australia, J. D. Doyle, R. D. Sharman, M. A. Shapiro and C. D. Watson

TUESDAY

P1.21 *High resolution modeling of convective outflow in complex terrain.* **Andrew J. Newman**, Colorado State Univ., Fort Collins, CO and R. H. Johnson

P1.22 *Interaction of a mountain lee wave with a basin cold pool.* G. Young, Penn State Univ., University Park, PA, **Brian Gaudet**, Penn State Univ., N. L. Seaman and D. R. Stauffer

P1.23 *Structure and evolution of numerically simulated misocyclones along a snowband over the Shonai region on 25 January 2008.* **Wataru Mashiko**, MRI, Tsukuba, Japan, S. Hayashi, K. Kusunoki, H. Y. Inoue, K. Bessho, S. Hoshino, M. Nakazato and H. Yamauchi

P1.24 *Snow-to-liquid ratio variability and prediction at a high-elevation site in Utah's Wasatch Mountains.* **Trevor I. Alcott**, Univ. of Utah, Salt Lake City, UT and W. J. Steenburgh

P1.25 *Climatology of Fronts and Associated Surface Baroclinic Zones in the Great Lakes Region.* **Neil F. Laird**, Hobart & William Smith Colleges, Geneva, NY, M. Payer, R. Maliawco and E. G. Hoffman

P1.26 *A study of the effect of the Great Lakes on deep convective systems.* **Thomas E. Workoff**, Univ. of Illinois, Urbana, IL and D. A. R. Kristovich

P1.27 *Summer midtropospheric perturbations over the U.S. northern plains: Climatology and NAM forecasts.* **Shih-Yu Wang**, Iowa State Univ., Ames, IA and T. C. Chen

4:00 P.M.–5:00 P.M.
Session 4: MESOSCALE PRECIPITATION SYSTEMS IV-The Canyons

Chair(s): David B. Mechem, Univ. of Kansas, Lawrence, KS

4:00 P.M.
4.1 *Distant effects of recurving tropical cyclones on rainfall production in midlatitude convective systems.* **Russ S. Schumacher**, NCAR, Boulder, CO, and Texas A&M Univ., College Station, TX, T. J. Galarneau and L. F. Bosart

4:15 P.M.
4.2 *An analysis of the pre-storm environment of intense convective systems in West Africa.* S. D. Nicholls, Rutgers Univ., New Brunswick, NJ and **Karen I. Mohr**, NASA/GSFC

4:30 P.M.
4.3 *Numerical simulations of the evolution of long-lived episodes of organized convection in Africa.* **A. G. Laing**, NCAR, Boulder, CO and C. A. Davis

4.4 PAPER WITHDRAWN

4:45 P.M.
4.4A *Mesoscale Radiatively-Induced Anvil Spreading.* **Steven K. Krueger**, Univ. of Utah, Salt Lake City, UT and M. A. Zulauf

5:00 P.M.–6:00 P.M.
Session 5: TRANSFERRING RESEARCH RESULTS TO OPERATIONS-The Canyons

Chair(s): Russ S. Schumacher, NCAR, Boulder, CO

5:00 P.M.
5.1 *Evaluation of WRF model forecasts of environmental parameters for severe-weather forecasting from the NOAA HWT Spring Experiments.* **Michael C. Coniglio**, NOAA/NSSL, Norman, OK, K. L. Elmore, J. S. Kain, S. J. Weiss, M. Xue and M. L. Weisman

5:15 P.M.
5.2 *A Prototype future hurricane prediction system: Realtime cloud-resolving ensemble data assimilation and forecasting during the 2008 Atlantic season.* **Yonghui Weng**, Texas A&M Univ., College Station, TX, F. Zhang, J. Gamache and F. D. Marks

5:30 P.M.
5.3 *Assessing the total mountain drag in the Met Office weather forecast model: how sensitive is it to horizontal resolution?* **Stuart Webster**, Met Office, Exeter, Devon, United Kingdom, S. Vosper, A. Brown and S. Smith

5:45 P.M.
5.4 *Utilizing high-resolution WRF model output to improve NWS forecasts in complex terrain.* **Brett E. McDonald**, NOAA/NWSFO, Riverton, WY

Tuesday 18, August Common Times

10:00 A.M.–10:30 A.M.	Coffee Break-Arches/Deer Valley
12:00 P.M.–1:15 P.M.	Lunch Break-Wasatch
3:30 P.M.–4:00 P.M.	Coffee Break-Arches/Deer Valley

8:00 A.M.–10:00 A.M.
Session 6: THEORETICAL AND MODELING STUDIES OF MESOSCALE PROCESSES I-The Canyons

Chair(s): Craig Epifanio, Texas A&M Univ., College Station, TX

8:00 A.M.
6.1 *Cooked boundaries: results from numerical experiments.* **Anthony E. Reinhart**, Univ. of Nebraska, Lincoln, NE and A. L. Houston

8:15 A.M.
6.2 *An idealized comparison of one-way and two-way grid nesting.* **Lucas M. Harris**, Univ. of Washington, Seattle, WA and D. R. Durran

8:30 A.M.
6.3 *The life cycle of an undular bore and its interaction with a shallow, intense cold front.* **Daniel C. Hartung**, Univ. of Wisconsin, Madison, WI, J. A. Otkin, J. E. Martin and D. D. Turner

8:45 A.M.

6.4 *The numerical simulation of infrasound generated by convective storms.* **David A. Schecter**, NorthWest Research Associates, Redmond, WA and M. E. Nicholls

nwra.com

9:00 A.M.

6.5 *Horizontal scale selection associated with mesoscale gravity wave/convection coupling.* **Todd P. Lane**, Univ. of Melbourne, Melbourne, Vic., Australia and F. Zhang

9:15 A.M.

6.6 *Gravity wave propagation through time-dependent shear.* **Julie C. Vanderhoff**, Brigham Young Univ., Provo, UT

9:30 A.M.

6.7 *Predictability and dynamics of a squall line and bow echo event during BAMEX.* **Christopher Melhauser**, Penn State Univ., University Park, PA, F. Zhang, M. Weisman and D. P. Jorgensen

9:45 A.M.

6.8 *Assessment of the vertical exchange of heat, moisture, and momentum above a wildland fire using observations and mesoscale simulations.* **Joseph J. Charney**, USDA Forest Service, East Lansing, MI, M. T. Kiefer and D. Keyser

10:30 A.M.–12:00 P.M.
Session 7: THEORETICAL AND MODELING STUDIES OF MESOSCALE PROCESSES II-The Canyons

Chair(s): H. Dawn Reeves, NOAA/NSSL, Norman, OK

7.1 Has Been Moved. New Paper Number 4.4 A.

10:45 A.M.

7.2 *Aerosol indirect effects on cold pools and the feedbacks to subsequent convective development.* **Susan C. van den Heever**, Colorado State Univ., Fort Collins, CO

11:00 A.M.

7.3 *Modeling aerosol impacts on convective storms in different environments.* **Rachel L. Storer**, Colorado State Univ., Fort Collins, CO, S. C. van den Heever and G. Stephens

11:15 A.M.

7.4 *The role of cumulus congestus in the tropical western Pacific.* **David B. Mechem**, Univ. of Kansas, Lawrence, KS and A. J. Oberthaler

11:30 A.M.

7.5 *A Coastally Trapped Wind Reversal Along the Gulf of Alaska.* **Emily L. Niebuhr**, Univ. of Wisconsin, Madison, WI and M. Hitchman

11:45 A.M.

7.6 *A Framework for Understanding and Modeling Mesoscale Weather Systems Using the Ensemble of Multiple Parameterizations of Physical Processes at the Land Surface and in the Atmosphere.* **Zong-Liang Yang**, Univ. of Texas, Austin, TX, G. Y. Niu and X. Jiang

1:15 P.M.–1:45 P.M.
Session 8: INVITED LECTURE-The Canyons

CoChair(s): Sandra E. Yuter, North Carolina State Univ., Raleigh, NC
Chair(s): Robert Fovell, Univ. of California, Los Angeles, CA

Lecturer: Roger M. Wakimoto, NCAR, Boulder, CO

1:45 P.M.–3:30 P.M.
Session 9: THEORETICAL AND MODELING STUDIES OF MESOSCALE PROCESSES III-The Canyons

Chair(s): George H. Bryan, NCAR, Boulder, CO

1:45 P.M.

9.1 *Observations and simulations of a long-lived tornadic mesocyclone that formed in a low-CAPE environment with PV banners spawned by the Colorado Front Range.* **Bart Geerts**, Univ. of Wyoming, Laramie, WY, T. Andretta, J. Vogt, Y. Wang and S. Luberda

2:00 P.M.

9.2 *Importance of horizontally inhomogeneous environmental initial conditions to very short range thunderstorm forecasts.* **David J. Stensrud**, NOAA/NSSL, Norman, OK and J. Gao

2:15 P.M.

9.3 *Some Lessons on the Predictability of Convective Systems over a 36 h Timeframe.* **Morris L. Weisman**, NCAR, Boulder, CO , K. Manning and D. Dowell

2:30 P.M.

9.4 *Aircraft measurements and numerical simulations of gravity waves in the extratropical UTLS region during the START08 field campaign.* **Fuqing Zhang**, Pennsylvania State Univ., University Park, PA, M. Zhang, K. P. Bowman, L. Pan and E. Atlas

2:45 P.M.

9.5 *Observations of tropospheric, convectively generated gravity waves from atmospheric profiling platforms.* **Daniel R. Adriaansen**, Univ. of North Dakota, Grand Forks, ND, M. J. Alexander and G. L. Mullendore

3:00 P.M.

9.6 *Generation of inertia-gravity waves from jets within vortex dipoles.* **Shuguang Wang**, Columbia Univ., New York, NY and F. Zhang

3:15 P.M.

9.7 *Mechanisms for spontaneous gravity-wave generation within a dipole vortex.* **Chris Snyder**, NCAR, Boulder, CO, R. Plougonven and D. J. Muraki

4:00 P.M.–6:00 P.M.
Session 10: RESULTS FROM RECENT FIELD RESEARCH PROGRAMS-The Canyons

Chair(s): Bart Geerts, Univ. of Wyoming, Laramie, WY

4:00 P.M.
10.1 *Overview of SoWMEX/TiMREX.* **Wen-Chau Lee**, NCAR, Boulder, CO, B. J. D. Jou and C. R. Chen

4:15 P.M.
10.2 *Preliminary results from the SoWMEX/TiMREX sounding network.* **Richard H. Johnson**, Colorado State Univ., Fort Collins, CO, P. E. Ciesielski, Z. Finch and A. J. Newman

4:30 P.M.
10.3 *What is the difference between orographic precipitation in the Europe Alps and Taiwan?* **Katja Friedrich**, Univ. of Colorado - Boulder, Boulder, CO, T. M. Weckwerth, W. C. Lee, U. Germann and L. Panziera

4:45 P.M.
10.4 *A numerical study of the evolving convective boundary layer and orographic circulation around the Santa Catalina Mountains in Arizona.* Part I: circulation without deep convection. **Cory Demko**, Univ. of Wyoming, Laramie, WY, B. Geerts and Q. Miao

5:00 P.M.
10.5 *A re-evaluation of the role of subsidence in valley and basin warming.* **Thomas Haiden**, Central Institute for Meteorology and Geodynamics, Vienna, Austria

5:15 P.M.
10.6 *Unexpectedly strong convection under an inversion-topped marine boundary layer.* **Sandra E. Yuter**, North Carolina State Univ., Raleigh, NC, D. B. Mechem, C. W. Fairall and W. A. Brewer

5:30 P.M.
10.7 *Characteristics of tropical cyclogenesis predictability: Perspectives from T-PARC/TCS08.* **James Doyle**, NRL, Monterey, CA, C. M. Amerault, C. A. Reynolds and H. Jin

5:45 P.M.
10.8 *HYMEX, an experimental program dedicated to the hydrological cycle in the Mediterranean.* **Philippe J. Drobinski**, Institut Pierre Simon Laplace/Laboratoire de Météorologie Dynamique, Palaiseau, France, V. Ducrocq and P. Lionello

6:00 P.M.–7:30 P.M.
GATHERING FOR HYMEX MEETING-The Canyons

WEDNESDAY

Wednesday 19, August Common Times

10:00 A.M.–10:30 A.M.	Coffee Break-Arches/Deer Valley
12:00 P.M.–1:30 P.M.	Lunch Break-Wasatch
2:30 P.M.–4:00 P.M.	Coffee Break With Poster Viewing-Arches/Deer Valley

8:00 A.M.-10:00 A.M.
Session 11: OROGRAPHIC, COASTAL AND OTHER THERMALLY DRIVEN MESOSCALE CIRCULATION SYSTEMS I-The Canyons

Chair(s): David Whiteman, Univ. of Utah, Salt Lake City, UT,

8:00 A.M.
11.1 *Urban land-use and pollution impacts on mesoscale circulations and convection over Houston.* **Gustavo Carrió**, Colorado State Univ., Fort Collins, CO and W. R. Cotton

8:15 A.M.
11.2 *Mesoscale analysis and WRF model verification of a low-level jet, bay breeze, and undular bore at the Howard Univ. Beltsville Research Site.* **Kevin Vermeesch**, SSAI, Greenbelt, MD, M. Weldegaber, B. B. Demoz and D. Venable

8:30 A.M.
11.3 *Large-eddy simulation of sea and lake breezes and sensitivity to forcing mechanisms.* **Erik T. Crosman**, Univ. of Utah, Salt Lake City, UT and J. D. Horel

8:45 A.M.
11.4 *Warm-season MCS initiation and development influenced by land/lake thermodynamic contrasts near the Great Lakes.* **Alan F. Srock**, Univ. at Albany/SUNY, Albany, NY and L. F. Bosart

9:00 A.M.
11.5 *Dynamics of Diurnal Variation of Stratus Clouds in Monterey Bay Area.* **Shouping Wang**, NRL, Monterey, CA, Y. Jin, Q. Jiang and Q. Wang

9:15 A.M.
11.6 *A mesoscale model intercomparison of coastal refractivity.* **Tracy Haack**, NRL, Monterey, CA, C. Wang, S. Garrett, A. Glazer and R. E. Marshall

9:30 A.M.
11.7 *Impact of the Andes Cordillera on a mid-latitude cold front.* **Bradford S. Barrett**, United States Naval Academy, Annapolis, MD

9:45 A.M.
11.8 *Orographic effects on coastal cyclogenesis in New England.* **Thomas E. Robinson Jr.**, Univ. of Massachusetts, Lowell, MA and F. P. Colby

10:30 A.M.–12:00 P.M.
Session 12: OROGRAPHIC, COASTAL AND OTHER THERMALLY DRIVEN MESOSCALE CIRCULATION SYSTEMS II-The Canyons

Chair(s): Scott A. Braun, NASA/GSFC, Greenbelt, MD

10:30 A.M.
12.1 *Climatological and dynamical evolution of a warm-season coastal jet in the New York Bight region.* **Brian A. Colle**, Stony Brook Univ./SUNY, Stony Brook, NY and D. R. Novak

10:45 A.M.
12.2 *Characteristics and dynamic aspects of Chilean coastal jet.* **Qingfang Jiang**, UCAR Visiting Scientist, NRL, Monterey, CA, S. Wang and L. W. O'Neill

11:00 A.M.
12.3 *Multi-season observational study of precipitation structures along the Oregon Cascade windward slope.* **Justin A. Crouch**, North Carolina State Univ., Raleigh, NC and S. E. Yuter

11:15 A.M.
12.4 *The detection and significance of diurnal pressure and Potential Vorticity anomalies east of the Rockies.* **Yanping Li**, Yale Univ., New Haven, CT and R. B. Smith

11:30 A.M.
12.5 *Isothermalcy in a basin atmosphere produced by nocturnal cold air intrusions.* **C. David Whiteman**, Univ. of Utah, Salt Lake City, UT, S. W. Hoch and M. Lehner

11:45 A.M.
12.6 *Linear theory calculations for the sea breeze in a background wind: The equatorial case.* T. Qian, Texas A&M Univ., College Station, TX, **Craig C. Epifanio**, Texas A&M Univ. and F. Zhang

12:00 P.M.–1:30 P.M.
COMMITTEE LUNCHEON-Sundance

1:30 P.M.–2:30 P.M.
Session 13: MOUNTAIN WAVES AND OBSTACLE FLOWS-The Canyons

Chair(s): Michael Coniglio, NOAA/NSSL, Norman, OK

1:30 P.M.
13.1 *Forecasts of persistent valley cold pools in the Bonneville Basin by a mesoscale model.* **H. Dawn Reeves**, NOAA/NSSL, Norman, OK and D. J. Stensrud

1:45 P.M.
13.2 *Observations and modeling of breaking waves in the lee of the Medicine Bow Mountains.* **Jeffrey R. French**, Univ. of Wyoming, Laramie, WY, S. Haimov, V. Grubisic, M. Xiao and L. D. Oolman

2:00 P.M.
13.3 *Trapped Lee Wave Interference in Presence of Surface Friction.* I. Stiperski, Meteorological and Hydrological Service, Croatia, Zagreb, Croatia and **Vanda Grubisic**, Univ. of Vienna

2:15 P.M.
13.4 *Resonant wave-wave instability in rotating and nonhydrostatic mountain waves.* **Kevin C. Viner**, Texas A&M Univ., College Station, TX, C. C. Epifanio and D. J. Muraki

2:30 P.M.–4:00 P.M.
Poster Session 2: POSTER SESSION II-Arches/Deer Valley

CoChair(s): Robert G. Fovell, Univ. of California, Los Angeles, CA
Chair(s): Sandra E. Yuter, North Carolina State Univ., Raleigh, NC

P2.1 *Simulations of environmental conditions conducive to formation of lake-to-lake bands.* J. T. George, South Dakota School of Mines and Technology, Rapid City, SD, **M. R. Hjelmfelt**, South Dakota School of Mines, W. J. Capehart and D. A. R. Kristovich

P2.2 *Numerical simulation of impacts of the Great Lakes on cold frontal passages.* T. S. Axford, South Dakota School of Mines and Technology, Rapid City, SD, **M. R. Hjelmfelt**, South Dakota School of Mines, W. J. Capehart and D. A. R. Kristovich

P2.3 *Mesoscale GEM-LAM modeling of atmospheric refractivity in coastal environments.* **Anna Glazer**, EC, Dorval, QC, Canada, T. Haack, J. Mailhot and S. Gaudreault

P2.4 *Assessment of Remote Automated Weather Station (RAWS) observations.* **Xia Dong**, Univ. of Utah, Salt Lake City, Utah and J. D. Horel

P2.5 *Sensitivity of surface temperature analyses to background and observation errors.* **Daniel Tyndall**, Univ. of Utah, Salt Lake City, UT and J. Horel

P2.6 *DART/WRF: A community mesoscale ensemble data assimilation facility.* **Jeffrey Anderson**, NCAR, Boulder, CO, N. Collins, J. Hacker, G. S. Romine, C. Snyder, H. Liu, T. Hoar, D. C. Dowell and R. Torn

P2.7 *Design of artificial rain system by means of sea water vapor equipment heated by sunlight.* **Hideyo Murakami**, Tohwa Univ., Fukuoka-City, Japan

P2.8 *Proposal for sunlight shield system to decrease cyclone power.* **Hideyo Murakami**, Tohwa Univ., Fukuoka-City, Japan

P2.9 *A numerical study of the evolving convective boundary layer and orographic circulation around the Santa Catalina Mountains in Arizona.* Part II: Interaction with deep convection. **Cory Demko**, Univ. of Wyoming, Laramie, WY and B. Geerts

P2.10 *Observations of spatially-variable lake-breeze movement in the vicinity of Chicago, IL.* **Jason M. Keeler**, Univ. of Illinois, Urbana, IL and D. A. R. Kristovich

P2.11 *The mesoscale kinetic energy spectrum of a baroclinic life cycle.* M. L. Waite, Univ. of Victoria, Vic., BC, Canada and **Chris Snyder**, National Center for Atmospheric Research

P2.12 PAPER WITHDRAWN

THURSDAY

P2.13 *Air mass characterization at the Whistler Mountain air chemistry site.* **John P. Gallagher**, Univ. of British Columbia, Vancouver, BC, Canada and I. G. McKendry

P2.14 *Characteristics and Numerical Simulations of Atmospheric boundary layer heights in the arid regions of Northwest China.* **Minjin Ma**, Univ. of Utah and Lanzhou Univ., Salt Lake City, UT, Z. Pu, S. Wang and Q. Zhang

P2.15 *Preferential Storm Pathways and Mountain Precipitation over the Intermountain West.* **Matthew E. Jeglum**, Univ. of Utah, Salt Lake City, UT and W. J. Steenburgh

P2.16 *Idealized simulation of a Great Basin cyclone and attendant fronts.* **Gregory L. West**, Univ. of Utah, Salt Lake City, UT, W. J. Steenburgh and J. B. Olson

P2.17 *Climatology of Lake-Effect Precipitation Systems over the Great Salt Lake, UT and Lake Tahoe, CA/NV.* **Neil F. Laird**, Hobart & William Smith Colleges, Geneva, NY, B. Albright, S. Ganetis, J. Popp and A. Stieneke

P2.18 *WRF model simulations of tropical convection observed during the Tropical Warm Pool International Cloud Experiment (TWP-ICE).* K. Wapler, German Weather Service, **Todd P. Lane**, The Univ. of Melbourne, P. T. May, C. Jakob, M. J. Manton and S. T. Siems

P2.19 *Mesoscale aspects of tropical cyclogenesis from extratropical precursors over the North Atlantic during 2004–2008.* **Thomas J. Galarneau Jr.**, SUNY, Albany, NY, L. Bosart, C. A. Davis and R. McTaggart-Cowan

P2.20 *Effect of cloud processes on hurricane tracks: Idealized simulations and operational forecasts.* **Robert G. Fovell**, Univ. of California, Los Angeles, CA and D. J. Boucher

P2.21 *Dynamics and predictability of Hurricane Humberto (2007) revealed from ensemble analysis and forecasting.* **Jason Sippel**, NASA/GSFC, Greenbelt, MD and F. Zhang

P2.22 *Idealized simulations of the impact of dry Saharan Air Layer air on Atlantic hurricanes.* **Scott Braun**, NASA/GSFC, Greenbelt, MD, J. Sippel and D. S. Nolan

4:00 P.M.–6:00 P.M.
Session 14: STRUCTURE AND EVOLUTION OF TROPICAL AND EXTRATROPICAL CYCLONES I-The Canyons

Chair(s): Brian A. Colle, Stony Brook Univ./SUNY, Stony Brook, NY

4:00 P.M.
14.1 *Discrete Frontal Propagation over the Sierra/Cascade Mountains and Intermountain West.* **W. James Steenburgh**, Univ. of Utah, Salt Lake City, UT, C. R. Neuman, G. L. West and L. F. Bosart

4:15 P.M.
14.2 *The effects of small-scale turbulence on maximum hurricane intensity.* **George H. Bryan**, NCAR, Boulder, CO and R. Rotunno

4:30 P.M.
14.3 *Comparison of an analytical and a numerical model for hurricane potential intensity.* G. H. Bryan, NCAR, Boulder, CO and **Richard Rotunno**, NCAR

4:45 P.M.
14.4 *Hurricane Helene (2006): A case of Saharan Air Layer influence?* **Scott Braun**, NASA/GSFC, Greenbelt, MD, C. L. Shie, J. Sippel and D. S. Nolan

5:00 P.M.
14.5 *Tropical Storm Debby: Genesis dynamics and the relevance of the Saharan air layer.* **Jason Sippel**, NASA/GSFC, Greenbelt, MD and S. Braun

5:15 P.M.
14.6 *The impact of Saharan Air Layer on tropical cyclone genesis and intensification.* **S.-H. Chen**, Univ. of California, Davis, CA, C. T. Cheng, S. H. Wang and J. P. Chen

5:30 P.M.
14.7 *Evolution of tangential and radial flows of Typhoon Nari (2001) at landfall.* **Ming-Jen Yang**, National Central Univ., Jhongli City, Taiwan, T. C. C. Wang and C. Y. Weng

5:45 P.M.
14.8 *Do Tropical Cyclones Intensify by WISHE?* **Michael T. Montgomery**, NPS, Monterey, CA, R. K. Smith, S. V. Nguyen and J. Persing

Thursday 20, August Common Times

10:00 A.M.–10:30 A.M.	Coffee Break-Arches/Deer Valley
12:30 P.M.–1:45 P.M.	Lunch Break-Wasatch
3:15 P.M.–3:45 P.M.	Coffee Break-Arches/Deer Valley

8:00 A.M.–10:00 A.M.
Session 15: STRUCTURE AND EVOLUTION OF TROPICAL AND EXTRATROPICAL CYCLONES II-The Canyons

Chair(s): Jason Sippel, NASA/GSFC, Greenbelt, MD

8:00 A.M.
15.1 *Sting jets and the diagnosis of conditional symmetric instability.* **Oscar Martínez-Alvarado**, Univ. of Reading, Reading, Berks., United Kingdom and S. L. Gray

8:15 A.M.
15.2 *Life cycle and mesoscale frontal structure of an Intermountain cyclone.* **Gregory L. West**, Univ. of Utah, Salt Lake City, UT and W. J. Steenburgh

8:30 A.M.
15.3 *The Overland Reintensification of Hurricane Danny (1997).* **Nick P. Bassill**, Univ. of Wisconsin, Madison, WI and M. C. Morgan

8:45 A.M.
15.4 *Defining the Lifecycle of the Extratropical Transition of Tropical Cyclones using the Deviation Angle Variance Technique for Remotely-Sensed Imagery.* **David E. Kofron**, Univ. of Arizona, Tucson, AZ, M. F. Pineros, E. A. Ritchie and J. S. Tyo

9:00 A.M.
15.5 *Adjoint-derived forecast sensitivity study of the extratropical transition of Floyd (1999).* **Michael C. Morgan**, Univ. of Wisconsin, Madison, WI

9:15 A.M.
15.6 *A numerical modeling study of the microphysical processes leading to tropical cyclogenesis under different environmental conditions.* **Andrew B. Penny**, Univ. of Arizona, Tucson, AZ and E. A. Ritchie

9:30 A.M.
15.7 *An analysis of tropical cyclone formations in the South China Sea during the late season.* **Yung-Lan Lin**, National Taiwan Univ., Taipei, Taiwan and C. S. Lee

9:45 A.M.
15.8 *Relating Convective Intensity Proxies to Tropical Cyclone Intensity Changes Using 10 Years of TRMM Data.* **Ellen Ramirez**, Univ. of Utah, Salt Lake City, UT and H. Jiang

10:30 A.M.–12:30 P.M.
Session 16: STRUCTURE AND EVOLUTION OF TROPICAL AND EXTRATROPICAL CYCLONES III-The Canyons

Chair(s): Jim Steenburgh, Univ. of Utah, Salt Lake City, UT

10:30 A.M.
16.1 *Impact of lapse rates upon low-level rotation in idealized storms.* **Matthew D. Parker**, North Carolina State Univ., Raleigh, NC

10:45 A.M.
16.2 *The development of surface signatures of mesoscale convective vortices.* **Christopher A. Davis**, NCAR, Boulder, CO and T. J. Galarneau

11:00 A.M.
16.3 *The development and intensification of multiple misocyclones in shallow cumulus convection over the warm ocean during winter cold outbreak.* **Tetsuya Takemi**, Kyoto Univ., Uji, Kyoto, Japan, H. Y. Inoue, K. Kusunoki and K. Bessho

11:15 A.M.
16.4 *Microphysical-dynamical interactions in an idealized tropical cyclone simulation.* **Steve Herbener**, Colorado State Univ., Ft. Collins, CO and W. R. Cotton

11:30 A.M.
16.5 *Application of adjoint-derived sensitivity gradients to tropical cyclone intensification.* **Brett T. Hoover**, Univ. of Wisconsin, Madison, WI and M. C. Morgan

11:45 A.M.
16.6 *Multi-scale vortex interaction during genesis of Hurricane Dolly (2008).* **Juan Fang**, Nanjing Univ., China, Nanjing, China and F. Zhang

12:00 P.M.
16.7 *Top-down vs bottom-up genesis of tornadoes and tropical cyclones.* **William R. Cotton**, Colorado State Univ., Fort Collins, CO

12:15 P.M.
16.8 *The genesis and maintenance of a strong tornadic vortex through the process of vorticity confinement.* **Gregory J. Tripoli**, Univ. of Wisconsin, Madison, WI and M. L. Buker

1:45 P.M.–3:15 P.M.
Session 17: MESOSCALE PREDICTABILITY AND DATA ASSIMILATION I-The Canyons

Chair(s): S.-H. Chen, Univ. of California, Davis, CA

1:45 P.M.
17.1 *A statistical analysis on the predictability of tropical cyclogenesis.* **Dianna N. Nelson**, Univ. of Wisconsin, Madison, WI and M. C. Morgan

2:00 P.M.
17.2 *Assessing the impact of Airborne Doppler Lidar wind profiles on hurricane track and intensity forecasts.* **Lei Zhang**, Univ. of Utah, Salt Lake City, UT, Z. Pu and B. Gentry

2:15 P.M.
17.3 *Error and uncertainty in ensemble predictions of tropical storms.* **Jeffrey Anderson**, NCAR, Boulder, CO, C. Snyder, H. Liu and J. Hacker

2:30 P.M.
17.4 *Application of a WRF mesoscale ensemble data assimilation system to severe weather events during spring 2009.* **Dustan M. Wheatley**, CIMMS/Univ. of Oklahoma, Norman, OK, M. Coniglio and D. J. Stensrud

2:45 P.M.
17.5 *The impact of assimilating retrieved total precipitable water and sounding data from AIRS and MODIS on severe weather simulations.* **Yi-Chin Liu**, Univ. of California, Davis, CA and S. H. Chen

3:00 P.M.
17.6 *Examination of the impact of variable terrains on surface data assimilation.* **Zhaoxia Pu**, Univ. of Utah, Salt Lake City, UT

3:45 P.M.–5:00 P.M.
Session 18: MESOSCALE PREDICTABILITY AND DATA ASSIMILATION II-The Canyons

Chair(s): Zhaoxia Pu, Univ. of Utah, Salt Lake City, UT

3:45 P.M.
18.1 *Modeling extremely cold stable boundary layers over interior Alaska using a WRF FDDA system.* **Brian J. Gaudet**, Penn State Univ., University Park, PA, D. R. Stauffer, N. L. Seaman, A. Deng, J. E. Pleim, R. Gilliam, K. Schere and R. A. Elleman

4:00 P.M.
18.2 *Impact of the variations of precipitation particle parameters within the same microphysics scheme in radar data assimilation using EnKF data assimilation technique.* **Nusrat Yussouf**, CIMMS, Norman, OK and D. J. Stensrud

18.3 PAPER WITHDRAWN

4:15 P.M.
18.4 *Flow-dependent, inexpensive, high-resolution ensembles for Coupled Ensemble Prediction.* **Xiaodong Hong**, NRL, Monterey, CA, C. Bishop, T. R. Holt, J. Doyle, P. Martin and Q. Jiang

4:30 P.M.
18.5 *Exploring the predictability of mesoscale cyclogenesis using ensemble data assimilation.* **P. Alexander Reinecke**, NRL, Monterey, CA, D. Durran and J. Doyle

4:45 P.M. CONFERENCE ENDS

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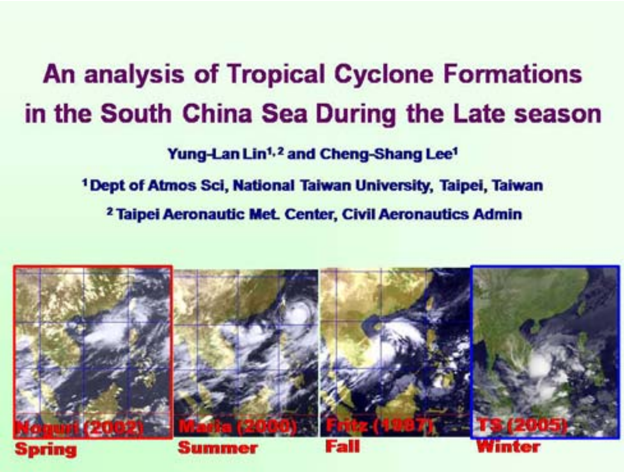
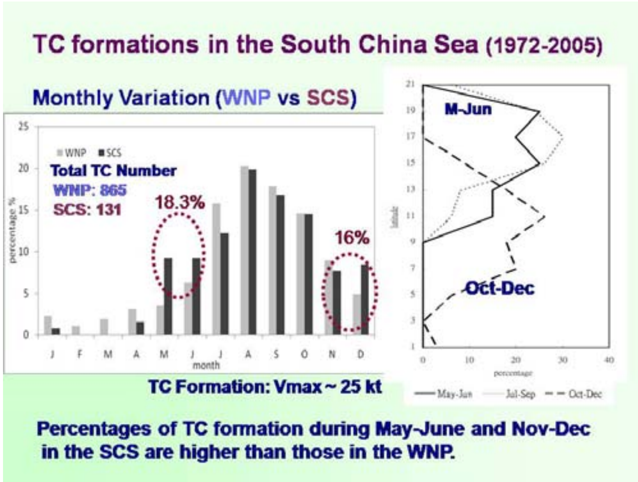
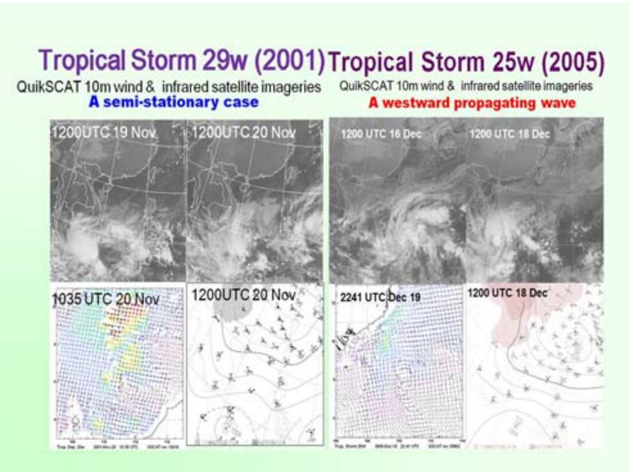
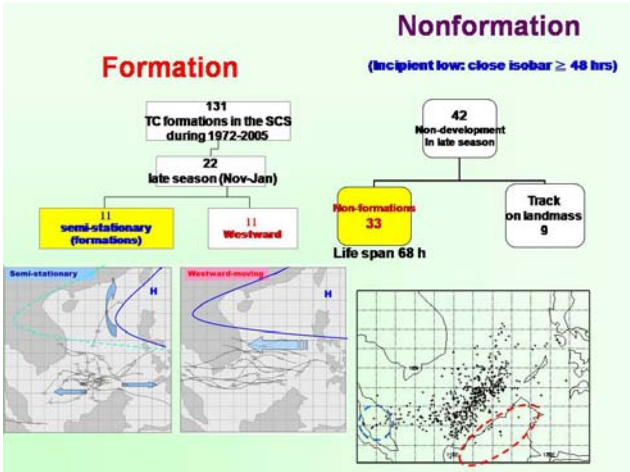
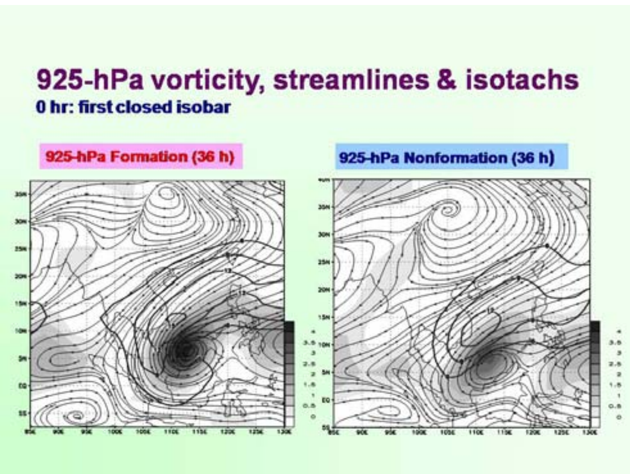
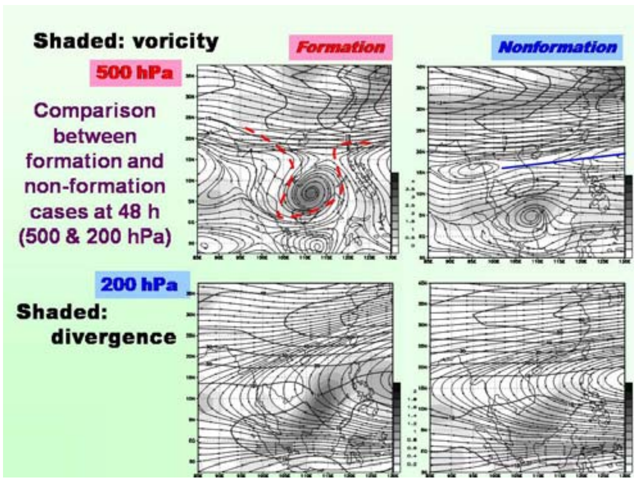


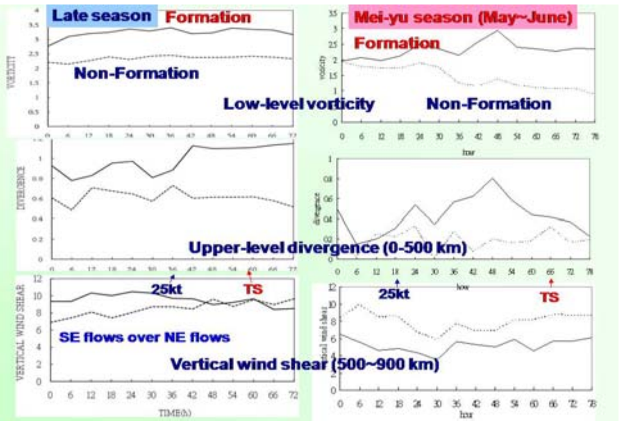


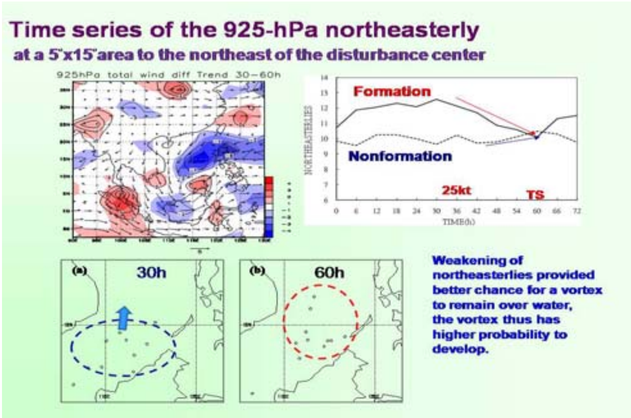


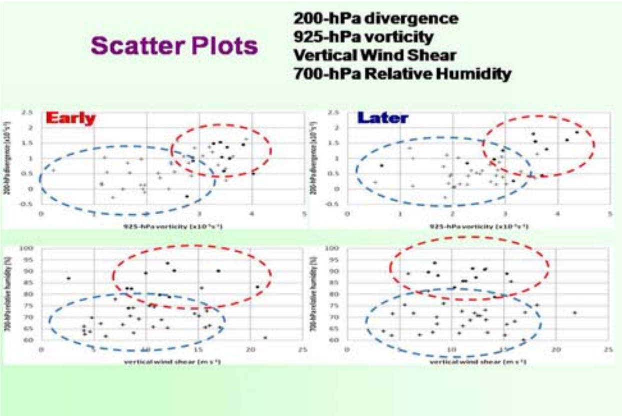


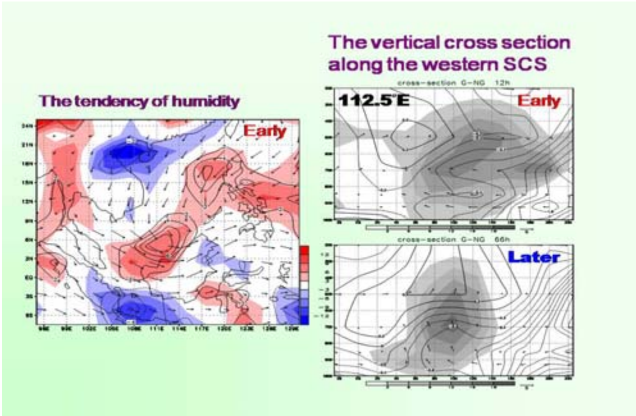












Summary

Percentage of incipient lows that develop to TC intensity

Early season (Mei-yu front) : 64.7% (11/17)

Late season (Borneo vortex) : 25% (11/44)

(Incipient low: close isobar > 48 hrs)

Average max intensity

43 kt (Mei-yu) vs. 45 kt (Late season)

~ much weaker than that of WNP

Average time from 25 kt to TS

Mei-yu : 47 hrs (weak and slow-developing)

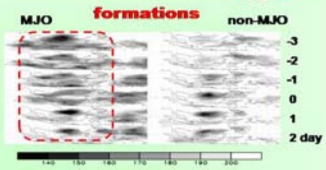
Late season: 28.3 hrs (weak but faster-developing)

WNP (winter): 36.4 hrs

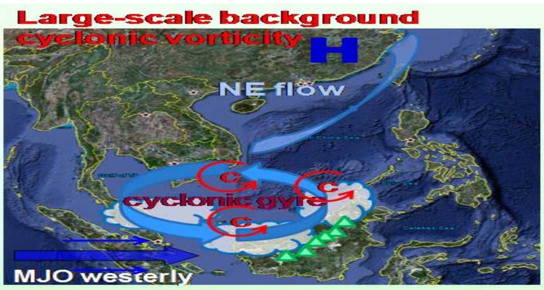
The TC formation probability with the MJO and non-MJO

MJO triggers more convections – higher chance for more incipient vortices to form.

	no MJO	MJO
no vortex	2373	361
vortex	109	40
% of total days	4.4%	10%



The probability for an incipient vortex to form a TC is higher during the non-MJO phase.



MJO westerly triggers more convections and many incipient vortex formations

↓

Many vortices or cloud clusters are not necessarily favorable for an incipient vortex to organize a TC.

↓

Therefore the probability of an incipient vortex to become a TC is higher during the non-MJO phase. SCS TC formation in the late season is more like a stochastic process.

Incipient formation

Stronger NE flow

More air-sea interaction

Later formation

NE flow decreasing

↓

Decreasing VWS

&

Avoid the vortex from moving to the landmass cold and dry air suppressing convection