出國報告(出國類別：其 他)

航空氣象發展協調會議、航空氣象業務協調聯繫暨航空氣象現代化作業系統強化及支援計畫協調會議報告書

服務機關：　交通部民用航空局
飛航服務總台
姓名職稱：　黃拔源 主任
陳順發 課長
高述國 主任氣象員
陳海根 主任氣象員

派赴國家：　美　國

出國期間：　95 年 9 月 23 日
至 10 月 2 日

報告日期：　95 年 11 月 29 日

航空氣象發展協調會議、航空氣象業務協調聯繫暨航空氣象現代化作業系統強化及支援計畫協調會議報告書

摘　要

交通部民用航空局為提升台北飛航情報區之航空氣象服務品質，提供符合國際規定及符合民航業界需求之航空氣象產品，於民國 86 年 7 月起推動航空氣象現代化計畫，由美國國家大氣研究大學聯盟所屬之美國國家大氣科學研究中心協助，於民國 91 年 7 月建置完成航空氣象現代化系統（AOAWS）。

由於當時受到預算經費限制，部份功能尚未完全涵括於 AOAWS 系統中，且科技發展迅速，為持續引進新的航空氣象預報及資料整合技術，經奉行政院核定，於民國 95 年起至 99 年進行為期五年的「航空氣象現代化作業系統強化及支援計畫」，以持續提升民航局航空氣象作業水準。

本次協調會議充分掌握航空氣象現代化作業系統強化及支援計畫美方本年度執行進度，其次就當前航空氣象服務實際作業需求與美方協調，美方亦能充分配合。另參訪觀摩美國目前最新航空氣象作業現況，希能提供國內航空氣象業務發展參考。

航空氣象發展協調會議、航空氣象業務協調聯繫暨航空氣象現代化作業系統強化及支援計畫協調會議報告書

目　次

壹、目的

交通部民用航空局(簡稱民航局)為提升台北飛航情報區之航空氣象服務品質，提供符合國際規定及符合民航業界需求之航空氣象產品，於民國 86 年 7 月起推動航空氣象現代化計畫，由美國國家大氣研究大學聯盟（University Corporation for Atmospheric Research；UCAR）所屬之美國國家大氣科學研究中心（National Center Atmospheric Research ; NCAR）協助，於民國 91 年 7 月建置完成航空氣象現代化系統（Advanced Operational Aviation Weather System ; AOAWS）。

由於當時受到預算經費限制，部份功能尚未完全涵括於AOAWS系統中，且科技發展迅速，為持續引進新的航空氣象預報及資料整合技術，經奉行政院核定，於民國 95 年起至 99 年進行為期五年的「航空氣象現代化作業系統強化及支援計畫」（Enhancement and Support Services For the Advanced Operational Aviation Weather System ; AOAWS-ES)，以持續提升民航局航空氣象作業水準。

為了解AOAWS-ES計畫實際執行進度及美國航空氣象作業現況，透過NCAR協助安排，行程主要包括與NCAR協商AOAWS-ES計畫中有關作業需求與功能、參觀Jeffco機場塔台作業、美國國家海洋暨大氣總署（National Oceanic and Atmospheric Administration；NOAA)，拜會美國航空氣象中心（Aviation Weather Center；AWC）討論民航局航空氣象預報員至該中心訓練事宜,參觀美國國家氣象局(National Weather Service;NWS)位於密蘇里州Pleasant Hill之EAX天氣預報中心(Weather Forecast Office；WFO)。

貳、過程

職等四人於民國95年9月23日搭乘下午四時四十分中華航空CI006

班機，於美西時間 9 月 23 日下午一時抵達美國洛杉磯機場，通關辦理好行李轉運及洛杉磯至丹佛轉機報到手續後，因為離登機時間尚有四小時空檔，一行五人趁機進行洛杉磯大眾運輸探索之旅。經搭乘市區巴士到洛杉磯聯合車站（Union Station），再搭乘地鐵紅線至Pershing Square站感受市區風光。晚上七點返回洛杉磯第三航站搭乘Frontier航空F9-407 班機前往丹佛，當地時間晚上十一時抵達丹佛國際機場，由NCAR Ms. Celia Chen及資策會于經理接機，凌晨抵達Boulder市Golden Buff旅館休息。

9 月 24 日適逢週日，Ms. Celia 的夫婿陳先生熱情帶領大家開車上山領略今年初雪，並到 Celia 家參觀她的別墅，及 Baseline Lake 湖畔風光。下午一行人至 Jeffco 機場，由 NCAR Research Applications Laboratory（RAL） Aviation Applications Program 計畫主管 Bruce Carmichael 駕駛四人座小飛機，進行近一小時的空中之旅。飛行期間除飽覽大 Boulder 區風光外，Bruce Carmichael 還詳盡介紹飛機性能、美國 General Aviation 現況，並在兩座無塔台機場進行跑道 Touch-Go 飛行。

9 月 25 日星期一上午九時至 NCAR Foothills Lab 拜會 RAL 副組長 Mr. Richard Wagoner，隨即展開協調會議，議程如附件一。首先由 RAL Weather Systems and Assessment Program 計畫主管 Bill Mahoney 介紹 NCAR 組織架構及 RAL 研發工作與成果，如附件二。接著由 Mike Dixon 簡報 AOAWS-ES 本年度工作進度如附件三，Aaron Bracekel 展示進階的爪哇語言基礎多元化氣象產品顯示系統（JMDS）目前開發成果，最後由 Jim Bresch 報告 AOAWS-ES 模式更新（Modeling Update）情形，如附件四。

下午二時三十分至 Jeffco 機場參觀 NCAR 所屬 Earth Observing Laboratory（EOL）Research Aviation Facility（RAF）的研究用飛機，RAF 目前有 C130 與 Gulf Stream 兩架氣象用研究飛機，能酬載 6000 磅研究儀器進行單次航程 6000 海浬、最高可飛抵 51,000 英尺高度接近對流層頂，進行風向、風速、溫溼度及大氣化學成份探測等的科學研究。

下午三時三十分至 Jeffco 機場塔台參觀，該機場為 General Aviation 之用，並無商業定期航班，許多飛行愛好者都以這個機場進行飛行訓練。塔台值班管制員三名，分為 Ground、Tower 及資料席。因為機場規模小，並無氣象觀測員，而是以 ASOS 自動觀測資料經 ATIS 廣播提供氣象資訊給飛行員。

9 月 26 日星期二上午九時繼續進行第二天的協調會議，先由 Cory Wolff 簡報美國聯邦航空總署（FAA）之積冰計畫（如附件五），然後 Dave Johnson 簡報閃電資料之飛航應用（如附件六）、Bob 簡報 FAA 之亂流計畫（如附件七）及 John Williams 簡報 FAA Nexrad 雷達亂流演算（如附件八），了解美國 FAA 目前航空氣象相關研究計畫。

上午十一時到 NCAR 的 Mesa 總部參觀其 Visualization Lab 所作的天氣數位模擬動畫，展示了各種天氣系統生成、發展、消散之三度空間立體分布。中午在 Mesa 餐廳用餐，並參觀對外界開放的相關大氣科學教育展示。

下午二時三十分返回 Foothills Lab 進行協調會議議題討論包括年度驗收日期、中正機場更名為桃園國際機場、網頁更新、多元化航空氣象產品（MDS）色階調整、NCAR 對中央氣象局高速電腦之使用、網頁版 MDS 防火牆之裝置、接收日本 CDF 資料之整合、MDS 顯著危害天氣（SIGNET）版面修正、世界區域預報資料（WAFS）之接收等，會議記錄

請見如附件九。NCAR 並說明目前氣象預報模式在預報落雷的困難性，如附件十。

9月27日星期三上午九時由NCAR安排參觀位於Boulder市的NOAA地球系統研究（Earth System Research Laboratory；ESRL）實驗室，分別由Fanthune Moeng介紹該實驗室各部門業務（如附件十一）、Tom LeFebvre進行地球科學球體（Science On a Sphere；SOS）展示、Greg Pratt介紹火山灰預報工具(Volcanic Ash Coordination Tool；VACT)、Russ Chadwick 介紹 NOAA 剖風儀分佈及使用情形，讓我們了解 NOAA 目前在大氣科學的研究現況。另外並參觀同一棟大樓內的 NWS Denver WFO(BOU)，由Bob Glancy介紹該中心預報作業狀況。NWS在美國有122個WFO，BOU負責科羅拉多州東北與北部之區域天氣預報及機場航空氣象預報。

下午三時二十五分搭乘聯合航空 UA362 於傍晚六時抵達堪薩斯市，由 AWC 前副主任 James H. Henderson 接送至 Homestead Studio Suites飯店住宿。

9 月 28 日星期四參訪AWC，由AWC主任Jack May介紹NOAA’s Aviation Weather Center的組織及業務，如附件十二。AWC係NOAA/NWS/NCEP（National Centers for Environmental Prediction）轄下九個中心之一，負責整個美國地區航空氣象天氣預報與顯著天氣報告編發，AWC亦為美國世界天氣預報中心（the U.S. World Area Forcast Center，WAFC)，對全世界發布國際顯著天氣SIGMET與供應國際顯著天氣圖SIGWX。

9月29日星期五上午八時三十分赴AWC繼續第二天的拜會討論。由於AWC為全球兩個WAFC之一，負責發布供應國際SIGMET與SIGWX，因此

很希望得到世界各地氣象預報中心對其發布SIGMET與SIGWX之意見回饋。會中我方建議AWC申請民航局航空氣象服務網（Aeronautical Meteorological Service Page；AMSP　http://aoaws.caa.gov.tw）帳號，進而取得飛航服務總台台北航空氣象中心每六小時製作之Taipei FIR區域SFC-10,000FT，10,000FT-25,000FT顯著天氣圖，以供AWC製作國際SIGWX之參考。該中心副主任並已於10月初來函申請，並取得航空氣象服務網帳號。

會中並就今年七月飛航服務總台兩名至該中心接受訓練學員的訓練情形，以及未來訓練計畫進行討論。我方除了感謝AWC與Henderson所提供的航空氣象訓練安排外，也很高興能夠透過訓練建立台美雙方航空氣象作業溝通管道。另外AWC也允諾與NCAR協助民航局接收WAFS系統資料，建立WAFS經由Internet FTP站取得的備援方案。

下午一時抵達美國氣象局（National Weather Service）位於密蘇里州Pleasant Hill之EAX天氣預報中心，由Suzanne Fortin介紹該中心作業（如附件十三），Richard D. Webber介紹NWS派駐於Kansas City航路管制中心（Air Route Traffic Control Center；ARTCC）之氣象服務中心（Center Weather Service Unit；CWSU）之作業（如附件十四），最後由值班預報員上機展示利用Aviation Forecast Preparation System（AvnFPS）進行機場預報編報作業。

Pleasant Hill WFO（EAX）負責密蘇里州及堪薩斯州44個郡的天氣警報與預報，航空氣象預報作業包括：

1. 機場天氣預報（TAF）；每天例行四次，使用AvnFPS進行編發負責區域內機場天預報作業。

2. Transcribed Weather Broadcasts（TWEBs）：經由 Automated Flight Service Station Briefers 提供 General Aviation 的飛行員堪薩斯市當地及航路上 50 海浬寬度氣象預報資訊。

美國本土的 20 個（ARTCC）均配置有由氣象人員負責的 CWSU，於日間空中交通繁忙期間提供氣象諮詢、預報及建議天氣預報簡報給管制員，希望能降低天氣因素對飛航安全與效率之影響。並編發以下兩項天氣報告電碼：

1. Center Weather Advisories (CWA)：

CWA 範例：ZKC5 CWA 042335　ZKC CWA 501 VALID UNTIL 050000 45SSW MKC　TORNADO REPORTED 45SSW MKC OR 10S IXD MOV FROM 25025KT.　…THIS IS ADDN INFO TO CONVECTIVE SIGMET 27C…

2. Meteorological Impact Statements (MIS)：

MIS 範例：ZKC MIS 01 VALID 261845-270300　..FOR ATC PLANNING PURPOSES ONLY..　E PWE-OKC LINE AND W IRK-SGF LINE¡KSCT TS DVLPG 21Z-23Z FORMING A SCT-BKN NE-SW LINE¡KSOME TS SEV WITH TOPS ABV FL450.　TS MOV E AND CONT AFT 03Z.

9 月 30 日星期六上午九時，由 Henderson 安排參觀 Leavenworth 小鎮及密蘇里河風光。下午三時至堪薩斯機場搭乘美國航空 AA607 班機中停芝加哥歐海爾國際機場，於晚上十時抵達洛杉磯國際機場。

10 月 1 日凌晨一時搭乘中華航空 CI007 班機，於台北時間 10 月 2 日清晨六時抵達台灣桃園國際機場。

參、心得

一、AOAWS-ES 計畫協調會議：

本局航空氣象現代化作業系統及後續強化支援計畫，係由NCAR之RAL與 MMM（Mesoscale and Microscale Meteorology）兩個單位進行研發及建置工作。過去NCAR之研究經費主要來自美國國家科學基金會，其所屬各單位大部份偏重於學術性之研究，並將其研究成果提供美國國內大氣科學相關領域之團體或機構運用。近年來因該基金會能支援NCAR之經費日益短絀，NCAR轉而接受作業單位之委託進行專案研究或作業系統之研發。雖然NCAR擁有相當多優秀之各類氣象專長之科學家,但其對於航空氣象服務相關系統之研發，仍需實際作業單位研提作業需求。經NCAR相關人員簡報AOAWS-ES計畫執行情形及展示JMDS研發成果,大致符合該計畫第九號執行辦法進度，另就當前本總台實際作業需求與NCAR協調，NCAR亦能充分配合。

二、重視大氣科學教育之宣導及推廣：

NCAR之MESA LAB及NOAA之地球系統研究實驗室提供許多大氣科學教育相關之展示，開放一般民眾參觀。如NCAR對各類天氣系統之三度空間模擬及NOAA整合全球觀測資料所展示大氣與海洋之球體影像，栩栩如生、令人印象深刻。

三、航空氣象資料之供應：

美國之航空氣象服務係分別由AWC、WFO、CWSU等單位提供，其中AWC提供之產品，在美國本土部份包括顯著天氣資訊SIGMET、對流顯著天氣資訊SIGMET、低空顯著天氣資訊AIRMET、區域預報Area Forecasts、整合對流天氣預報CCFP、低層顯著天氣預報圖等，另AWC亦為美國世界天氣預報中心（the U.S. World Area Forcast Center，WAFC)，所發布之航空氣象資訊包括全球顯著天氣資訊SIGMET、全球顯著天氣預報圖SIGWX、熱帶飛航天氣報告Tropical Aviation WX及供應國際飛行手摺International Flight

Folders)。各WFO除負責特定地區之各類天氣服務外，尚需提供特定民航機場之機場預報（TAF）。另CWSU則提供ARTCC氣象諮詢、預報、危害天氣警告及與航空氣象有關之協調等。

美國所有之航空氣象服務雖由NWS所屬之各單位提供，但許多與航空氣象有關之系統均由FAA贊助經費研發，其所提供之產品亦均須符合FAA之規定。由於美國幅員遼闊，除民用航空大眾運輸需求外，普通航空業及私人飛行盛行，因此其對航空氣象產品之供應，甚為多元及多樣化，甚值國內航空氣象現代化強化及支援計畫未來研提作業需求時參考。

四、航空氣象作業電腦化：

AWC與WFO其作業都已經進入無紙化電腦作業，各席位上系統完成整合，預報員所需各種預報資訊與觀測報告都已經整合至網路連線資料庫中。包括預報產品編製過程中氣候資料庫即時輔助功能、完成後傳送至使用單位、預報結果進入資料庫自動校驗考核及預報更正監控警示功能等，甚值本局於規劃航空氣象業務時參考。

肆、結語與建議

一、持續派員至美國接受航空氣象專業訓練：

美國之航空氣象作業係由FAA全力支援，並委託NCAR及NOAA等單位進行研究及開發系統，使其航空氣象服務在國際上能夠居於領先地位，如目前NOAA正進行之飛航天氣測試平台即屬於FAA Aviation Weather Research Program（AWRP）計畫，包括ADDS（Aviation Digital Data Service）網頁更新實驗、即時校驗系統、積冰預報及數值預報中有關對流之預報等。

由於科技發展日新月異，為跟上國際航空氣象發展腳步，了解先進國家航空氣象作業發展確有其必要性，希能持續派員至NCAR或AWC等單位進行航空氣象專業等訓練，以持續提升航空氣象服務水準，擴大航空氣象人員國際視野，使航空氣象作業與國際接軌。

二、建立機場天氣預報（TAF）監控警示及氣候資訊查詢系統：

美國 NWS 將各機場之觀測資料建立資料庫，即時提供各機場之氣候資訊，WFO 之氣象人員除利用傳統之天氣圖表、衛星雲圖、雷達回波等外，尚可參考該項氣候資訊及數值模式預報編發 TAF。為方便國內民航機場天氣守視人員編發更精確之 TAF 及能適時修正 TAF，未來可參考 WFO 之作業方式，建立各機場之 TAF 監控警示系統，並利用國內各民航機場之過去歷年觀測資料，建立各機場之氣候資訊查詢系統。

附件一：協調會議議程

DRAFT AGENDA
Taiwan Civil Aeronautics Administration (CAA) and
Institute for Information Industry (III) Visiting NCAR
September 25-26, 2006

<u>September 25, 2006</u> (FL-2 RM 3099)

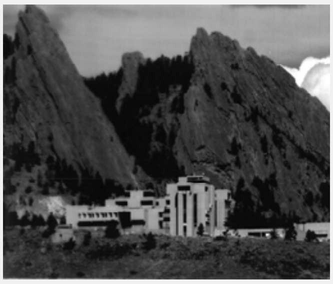
08:30 – 09:00	Refreshments
09:00 – 09:30	Visit with Rich Wagoner
09:30 – 10:00	NCAR/RAL Overview (Bill)
10:00 – 10:30	AOAWS-ES Version-5 Overview (Mike)
10:30 – 10:45	Break
10:45 – 11:20	JMDS Demo (Aaron)
11:20 - 12:00	AOAWS-ES Modeling Update (Jim)
12:00 – 14:00	Luncheon
14:00 – 14:30	Boulder – Jeffco
14:30 – 15:30	RAF: HIAPER Tour (Dick Friesen)
15:30 – 16:30	BJC ATCT Tour (Liz Meyer)

<u>September 26, 2006 (FL-2 Rm 3107)</u>

08:30 – 09:00	Refreshments
09:00 – 09:20	FAA Icing Program Overview (Cory Wolff)
09:20 – 09:40	Aviation Applications of Total Lightning Data (Dave Johnson)
09:40 – 10:00	FAA Turbulence Program Overview (Bob/Jamie)
10:00 – 10:20	Break
10:20 – 11:00	FAA Nexrad Turbulence Detection Algorithm (John Williams)
11:00 – 11:30	NCAR Shuttle: FL - ML
11:30 – 12:30	Mesa Lab: Visualization Lab Demo (Tim Scheitlin)
12:30 – 13:30	Lunch (ML cafeteria)
13:30 – 14:00	NCAR Shuttle: ML - FL
14:30 – 16:30	AOAWS-ES Project Discussions

附件二：NCAR/RAL介紹

Overview of NCAR and Research Applications Laboratory

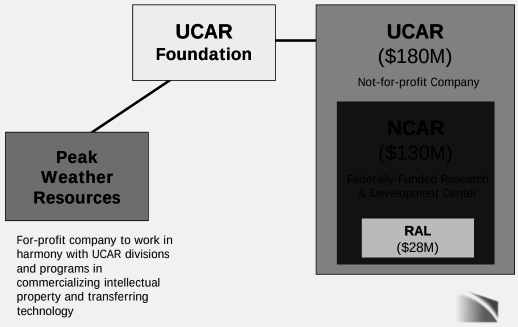


The NCAR Mesa Laboratory

Boulder, Colorado

NCAR

UCAR Organization



NCAR

National Center for Atmospheric Research (NCAR)

- Federally Funded Research & Development Center
- Academic orientation
- Administered by consortium of 68 Ph.D.-granting North American universities through the University Corporation for Atmospheric Research (UCAR)
- UCAR International Affiliates: A group of 33 international institutions with strong connections to UCAR/NCAR

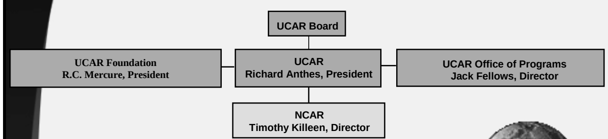
NCAR

International Affiliates - Asia

- Central Weather Bureau
- National Taiwan University
- National Central University (Taiwan)
- City University of Hong Kong
- Hong Kong University of Science & Technology
- Institute of Atmospheric Physics, Chinese Academy of Sciences
- Korea Meteorological Administration
- Malaysia Meteorological Service
- Manila Observatory
- Meteorological Research Institute – Japan
- Peking University
- Seoul University
- University of Tokyo

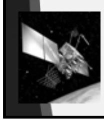
NCAR

NCAR Organization



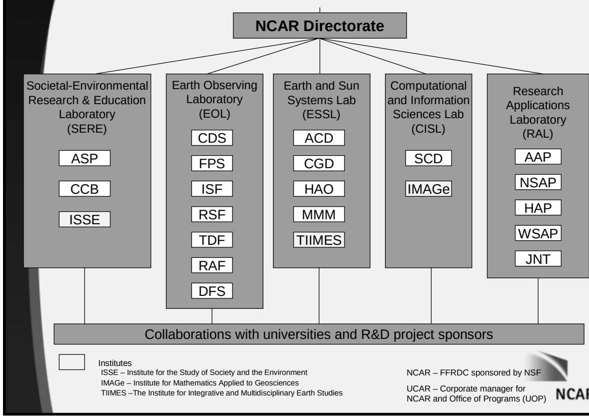
NCAR Laboratories

- **Computational & Information Systems Lab (CISL)**
- **Earth Observing Lab (EOL)**
- **Earth & Sun Systems Lab (ESSL)**
- **Research Applications Lab (RAL)**
- **Societal-Environmental Research and Education (SERE)**



NCAR

National Center for Atmospheric Research



NCAR

National Center for Atmospheric Research - RAL

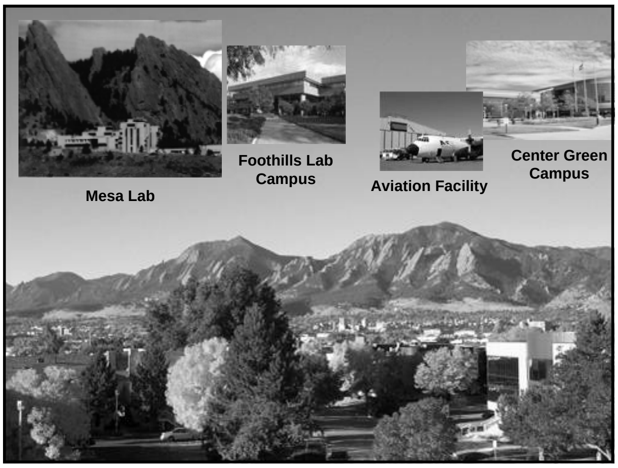
Research Applications Laboratory
Brant Foote, Director
Richard Wagoner, Deputy Director
Joanne Dunnebecke, Administrator

- **Aviation Applications Program** — *Bruce Carmichael*
- **Homeland Security Applications Program** — *Scott Swerdlin*
- **Hydrometeorology Applications Program** — *Roy Rasmussen*
- **Weather Systems and Assessment Program** — *Bill Mahoney*
- **Joint Numerical Testbed** — *Bob Gall*

Research Applications Laboratory (RAL)

- AAP
- NSAP
- HAP
- WSAP
- JNT

NCAR



Programs in:
Climate
Air chemistry
Solar physics
Weather research
Supercomputing
Research facilities
Technology Transfer

National Center for Atmospheric Research

NCAR

Research Applications Laboratory

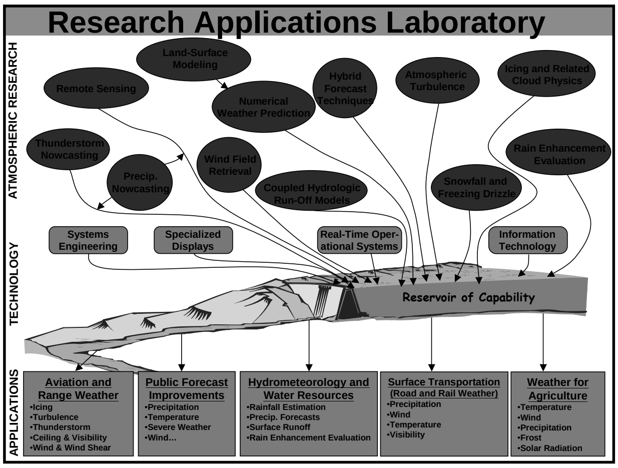
- RAL
  - One of five laboratories of NCAR
  - About 200 people, approximately half are atmospheric scientists, and half are engineers
- Mission
  - Transfer knowledge and technology to US government agencies, the private sector, and foreign governments

NCAR

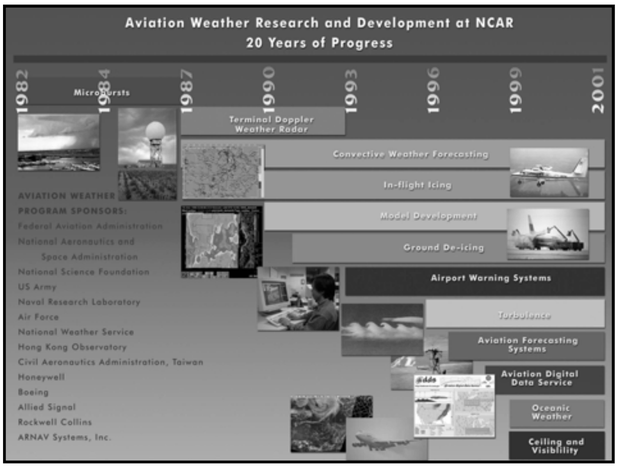
Nature of work in RAL

- On-going efforts in program development and national advocacy
- Understanding and developing user requirements
- Atmospheric research
- Engineering development
- Demonstration, testing, and evaluation of capability
- Technology Transfer, per se, including the deployment of turn-key systems
- Education and training

NCAR



Research Samples

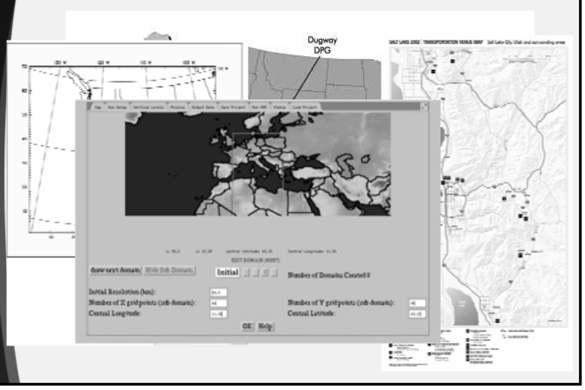


Decision Support Systems

Users	Phenomena/Application
Air Traffic Control	Thunderstorms Turbulence In-Flight Icing
Pilots & Airlines	Thunderstorms Turbulence In-Flight Icing Winds/Temp Aloft Aircraft Deicing
Army Test Range Specialists	Plume Dispersion Test Planning Test Operations/Evaluation
Highway Maintenance Supervisors	Snow, Ice, Rain, Mixed Road Condition Treatment Guidance
Global Military Operations	Tactical Weather Prediction
Water Resource Managers	Flooding, Water Management
Wildland Fire Managers	Winds, humidity, fire behavior, etc
Energy	Short and Mid-Term Predictions (Temp, Winds, Precipitation, etc)

FAA Aviation Digital Data Service

Army Test & Evaluation Command Advanced Weather System

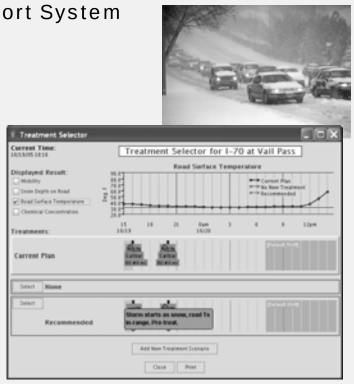


Homeland Security – First Responder Decision Support Systems

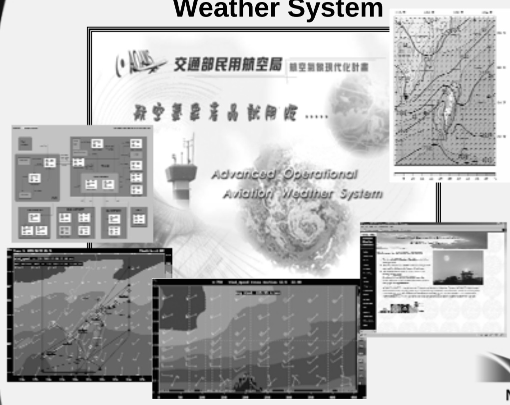
Required Information:

- **Weather observations**
  - **surface winds**
  - **surface temperatures**
  - **stability**
  - **radar winds**
  - **agent type**
- **High resolution models**
- **Plume dispersion**
- **Urban scale data**

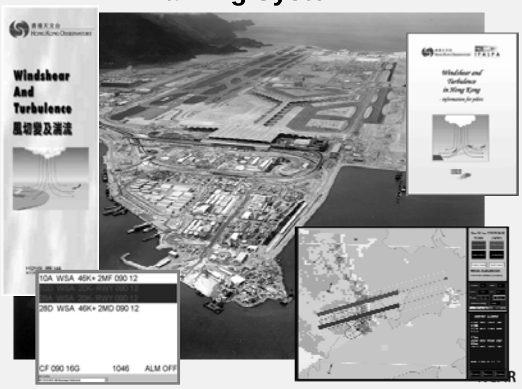
FHWA Winter Road Maintenance Decsion Support System



Taiwan Advanced Operational Aviation Weather System



Hong Kong Windshear and Turbulence Warning System



New Emphases

- Surface transportation weather program
  - Road Weather
  - Railroad Weather
- Fire Weather
- Homeland Security
- Energy Sector
- Economic impacts of weather w.r.t. USWRP
- Hydrometeorological applications
- 2-6 hr forecast (nowcast), warm and cold seasons

Recent Honors

- 2003: NASA "Turning Goals into Reality" – Aircraft Turbulence
- 2003: UCAR Scientific and Technical Advancement Award, Taiwan Advanced Operational Aviation Weather System
- 2002: FAA "Excellence in Aviation Research" – Aviation Weather
- 2002: NWA Aviation Weather Award
- 2002: NASA "Turning Goals into Reality" – In-flight Icing
- 2001: NASA "Turning Goals into Reality" – In-flight Icing
- 2001: UCAR Scientific and Technical Advancement Award, 4DWX
- 2000: UCAR Outstanding Publication Award, Snowfall Conditions/Rate (Rasmussen et al.)
- 1999: FAA Technology Advancement Award – Aircraft Deicing
- 1999: UCAR Scientific and Technical Advancement Award, Aviation Digital Data Service (ADDS)
- 1998: Air Traffic Magazine – Windshear & Turbulence
- 1989: Aviation Week & Space Technology - Windshear

CAA/III/NCAR meeting

Advanced Operational Aviation Weather System Enhanced (AOAWS-ES)

Version 5 System Engineering
Upgrade development

Mike Dixon

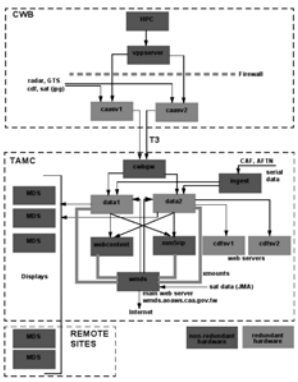
NCAR

Boulder CO
September 2006

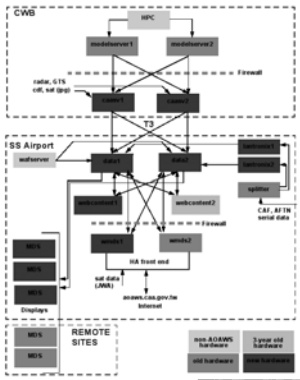
2006 systems development and upgrade tasks

- Systems development and upgrades - $126K
  - TITAN : $60K
  - Data and systems integration : $41K
  - Hardware replacement : $25K
- Other
  - Support and maintenance : $142K
  - JMDS : $244K
  - MM5/WRF : $333K
  - Project management : $130K

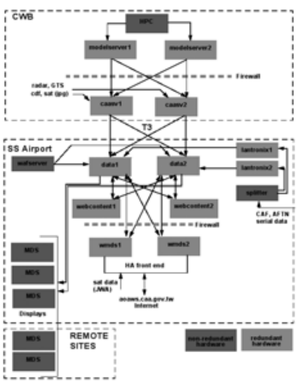
Version 4 host diagram



Version 5 host upgrades



Version 5 host redundancy



Server redundancy

- After the hardware upgrade, all servers in the system will have redundancy.
- At the web server end, a LINUX High-Availability Front End (HA) system will be installed. This technology is used by the FAA for the ADDS web server.
- The two web servers share an internet address. A heart-beat is passed between the two servers, either using a serial connection or dedicated second ethernet connection.
- One server assumes the primary role and accepts internet connections.
- If this server has problems the heartbeat will stop.
- The secondary server will then assume the public internet address and serve data to client.

Main web site address

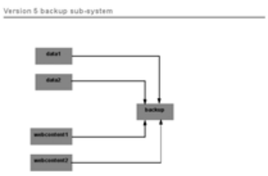
- The main web address to the wmds now is:
  - wmds.aoaws.caa.gov.tw
- The CAA would like to change this address to:
  - aoaws.caa.gov.tw
- NCAR recommends using the new address for the High-availability front-end (HA) pair of web servers.

WMDS firewall issues

- The CAA has installed a new firewall between the WMDS web server and the rest of the AOAWS system.
- The purpose of the firewall is to improve network security.
- A problem exists because in the existing AOAWS there are cross-mounts from the WMDS to data1, data2, mm5rip and webcontent. Cross-mounts cannot exist through a secure firewall.
- As a short-term solution, a second network card in the WMDS allows access to the rest of the AOAWS system.
- The CAA would like to make the system more secure by removing the second network card.
- NCAR is working on a solution to push all data to the WMDS hosts so that the cross-mounts will not be needed.

New data archive strategy

- The old tape-drive backup system will be replaced by DVD writers.
- Compressed tar files will be created on the data servers and webcontent hosts.
- The tar files will be copied across to the backup host.
- The tar files will automatically be written to DVD on a pre-determined schedule.
- The CAA will need to ensure that new blank DVDs are in place in the DVD writers before each backup.

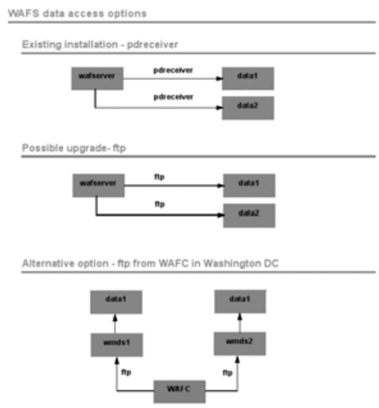


Host name changes for 2007

Hostname / Alias	Comment
cwb-modelserver1	Same host as cwb-vppserver – old hardware
cwb-modelserver2	New host role using old hardware
cwb-caasv1	Replacement hardware – HP server
cwb-caasv2	Replacement hardware – HP server
tamc-data1	Replacement hardware – HP server
tamc-data2	Replacement hardware – HP server
tamc-webcontent1	New host hardware – HP server
tamc-webcontent2	Same as tamc-webcontent
tamc-lantronix1	Serial-to-TCP converter
tamc-lantronix2	Serial-to-TCP converter
tamc-wmds1	New host hardware – HP server
tamc-wmds2	Same host as wmds
aoaws.caa.gov.tw	HA front end web address

WAFS data access

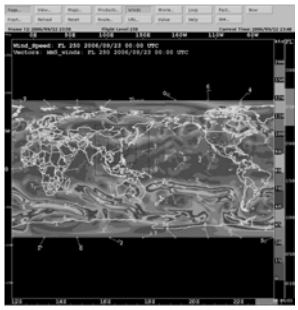
- CAA and III set up WAFS data ingest from wafserver onto data1 using the pdreceive utility.
- This will be duplicated on data2.
- However, there are reliability issues with pdreceive. Sometimes files are missed. Perhaps this is because it uses UDP broadcast for the data.
- Possible alternative options are:
  - Use ftp to push data from wafserver to data1 and data2.
  - Use ftp to pull data from WAFC in Washington DC.
- NCAR has demonstrated the ability to pull GRIB data from the WAFC using ftp.
- It is not yet known whether BUFR data is available via ftp.



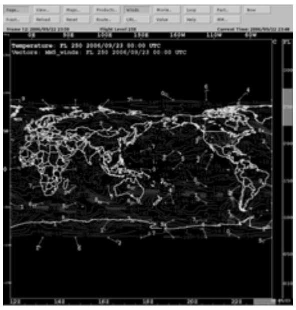
WAFS GRIB data

- GRIB data is being decoded from the WAFS system at TAMC.
- The GRIB data arrives in multiple files, one file per (a) time, (b) height, (c) data field and (d) geographical sectors.
- There are 8 geographical sectors in the global data.
- The individual files are combined into a single MDV file for each forecast time.
- The resulting data covers the full globe.
- Fields available on the MDS are:
  - Winds
  - Temperature
  - Relative humidity

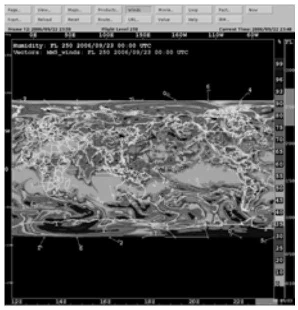
WAFS global winds



WAFS global temperature



WAFS global humidity



GRIB pressure levels available

Pressure level	Flight level	Data from CAA WAFS receiver	Data from WAFC
1000	SL	Yes	Yes
850	FL045	Yes	Yes
700	FL095	Yes	Yes
600	FL130	Yes	Yes
500	FL175	Yes	Yes
400	FL230	Yes	Yes
300	FL295	Yes	Yes
250	FL335	No	Yes
200	FL380	No	Yes
150	FL440	No	Yes
100	FL500	No	Yes
70	FL600	No	Yes

2006 TITAN tasks

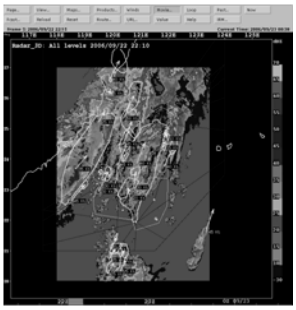
- Upgrade TITAN for use with CWB 3-D radar data
- Configure TITAN for storm tracking on CWB data
- Distribute TITAN products to MDS hosts
- Configure MDS to display TITAN forecasts

Also, TITAN products will be available on the JMDS.

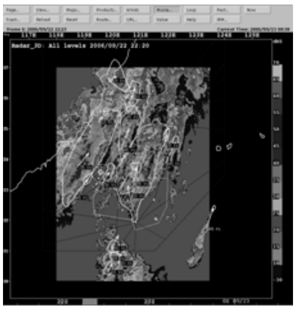
TITAN storm tracks

- The TITAN storm tracking sub-system has been installed and tested on the data servers, data1 and data2.
- TITAN operates on the 3-D radar mosaic obtained from the Central Weather Bureau.
- This data arrives every 10 minutes.
- Storm tracks and forecasts will be displayed on the MDS and JMDS.
- Forecasts are shown as a vector, to indicate speed and direction.
- A forecast polygon shows the forecast storm size and shape.
- Forecast speed is shown in knots.

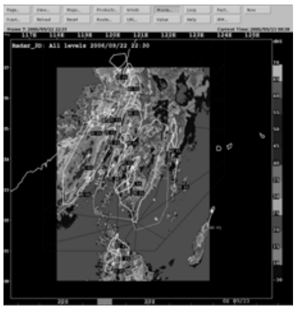
TITAN example – frame 1



TITAN example – frame 2

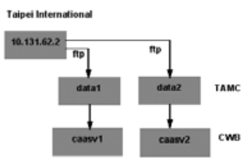


TITAN example – frame 3



Radar data from Taipei International

- With the help of the CAA, III and NCAR set up ftp-based acquisition of the radar data from the radar at the Taipei international airport.
- This data is then distributed to the CWB for inclusion into the 3D radar mosaic.



ICAO pre-flight and in-flight documents

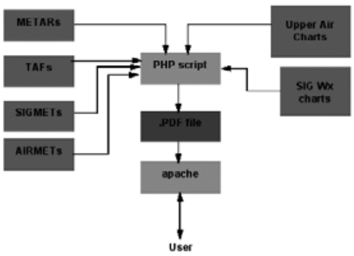
- The requirements are specified in ICAO Annex 3, Chapter 9: Service for operators and flight crew members.
- The service is provided to international flights from the host country to the next destination.
- Products are supplied pertinent to the planned flight route, including alternates.
- Typical product requirements include:
  - Upper-air winds/temps.
  - METARs
  - TAFs
  - SIGMETs and AIRMETs
  - Volcanic ash advisories
  - SIG Weather charts

FAA international flight folder program

- The FAA fulfils the ICAO requirement using the international flight folder program, based at AWC in Kansas City.
  - http://aviationweather.gov/iffdp/
- Jim Henderson was the manager for the flight folder program. Jim will be hosting the CAA for their visit to the AWC, and will be happy to discuss details of the program with the CAA.
- The FAA currently uses a fax-based system to send the flight folder information to users.
- However, is seems that with the advance of the internet and on-line access, it may be better to consider compiling the information into a pdf files for on-line delivery.

FAA Flight Folder Page

Delivering flight planning information via the web



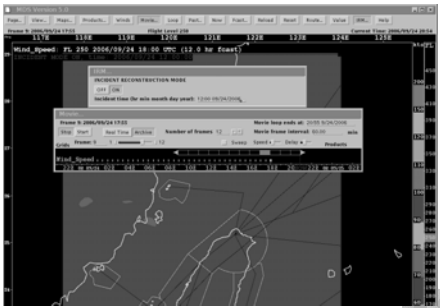
MDS enhancements – for discussion with CAA

- IRM – Incident Reconstruction Mode.
  - Allows the user to enter an 'incident time'. Only data stored on the disk at or before this time will be displayed. Data stored after this time will be ignored.
- Added 'forecast' label to data as applicable, to show the forecast lead time of model data.
- Added the capability to specify a time margin on a field-by-field basis. For example, we can set radar data to expire after 30 minutes, satellite data to expire after 1 hour and model data to expire after 3 hours.
- Fixed bug related to frame time and the display of SIGMET and AIRMET products.

MDS – IRM off

MDS – IRM on

MDS – IRM on - 2



Thank you

附件四：AOAWS-ES模式更新報告

AOAWS-ES Modeling Update

Dr. Jim Bresch
Mesoscale and Microscale Meteorology Division
National Center for Atmospheric Research
25 September 2006

I. Current status of AOAWS modeling

II. The WRF Model in AOAWS-ES

III. Modeling-related tasks in AOAWS-ES

Taiwan CAA / III Briefing, Boulder 2006/09/25

I. AOAWS modeling status

Background: Initial Phase Modeling

- Development & implementation of real-time MM5 modeling system (1998-2002)

- Implementation of 3DVAR

- Creation of web-based model display system

- Creation of forecast products tailored to CAA forecaster needs

- Tuning MM5 for optimal performance over East Asia

- Provision of model output for MDS and WMDS including input for the turbulence and icing forecast algorithms.

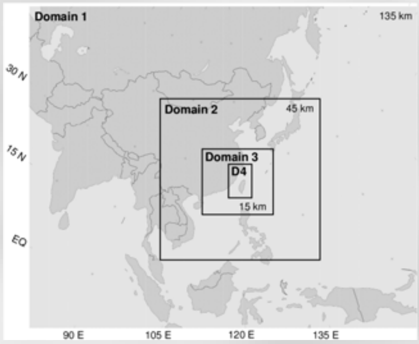
Taiwan CAA / III Briefing, Boulder 2006/09/25

CAA AOAWS MM5 Forecasts

- AOAWS MM5 Site: **http:// aoaws.caa.gov.tw / staff/model/**
  - User-selectable product list
- Runs
  - 4 forecasts/ day
  - Initializations: 00, 06, 12, 18 UTC
  - Forecast length: Domains 1 and 2: 48 h
    Domain 3: 24 h
    Domain 4: 12 h

Taiwan CAA / III Briefing, Boulder 2006/09/25

AOAWS MM5 Configuration



Taiwan CAA / III Briefing, Boulder 2006/09/25

II. The WRF Model in AOAWS-ES

Goals

- Make the AOAWS forecasting system state-of-the-art: WRF
- Update and improve the AOAWS data assimilation system: WRFVAR
- Add additional data sources to WRFVAR (satellite, radar, mesonets)
- Create a unified WRF system for CAA and CWB
- Add a real-time verification capability
- Optimize WRF's performance over East Asia and the Taipei FIR

Taiwan CAA / III Briefing, Boulder 2006/09/25

WRF Development Partners

WRF— A collaborative development effort

- **NCAR**
- U.S. National Centers for Environmental Prediction (NCEP)
- U.S. Federal Aviation Administration (**FAA**)
- U.S. Air Force Weather Agency (AFWA)
- U.S. Navy— Naval Research Laboratory
- NOAA Earth System Research Laboratory (ESRL)
- Oklahoma University

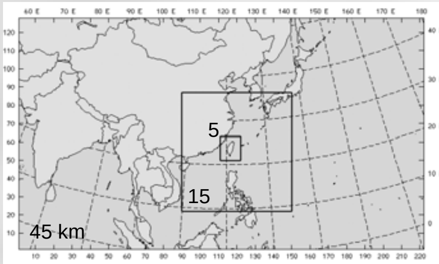
Taiwan CAA / III Briefing, Boulder 2006/09/25

WRF/ARW User Participation

	9/13/06 Registered Users	June 2006 Workshop Participants
Principal Partners		
NCAR	123	44
NCEP	22	4
ESRL	26	17
AFWA	21	5
Navy	17	2
U.S. Universities (132)	863	47
U.S. Government Labs	306	18
Private Sector	435	22
Foreign	2398	44
	-------	-------
Total	4211	203
Institutions represented		101
Foreign countries represented	82	17

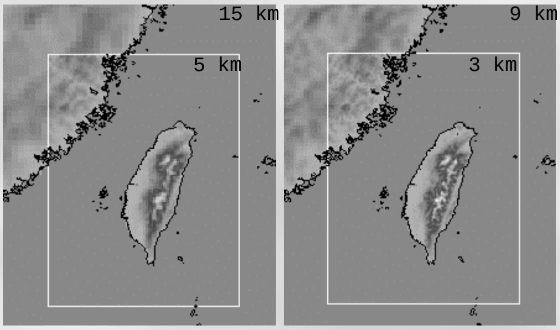
1902 active subscribers to wrf-news@ucar.edu

CWB NFS Domains



84-hour forecasts, twice per day, 6-hour update cycle.
CWB replaces NFS with WRF, July 2007.
27/9/3 km replaces 45/15/5, January 2009.

WRF topography



July 2007 January 2009

III. MMM Tasks in AOAWS-ES

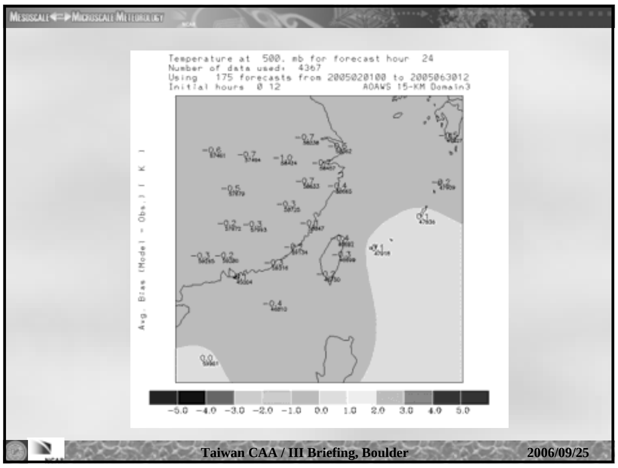
- Port AOAWS MM5 system from VPP5000 to IBM
  (completed. Operational since 1 August 2006)
- Update and improve WRFVAR
  (updated to version 2.1)
- Add additional data sources to model initialization
  such as satellite radiances, radar, GPS soundings…
  (added Quikscat winds and mesonet obs)

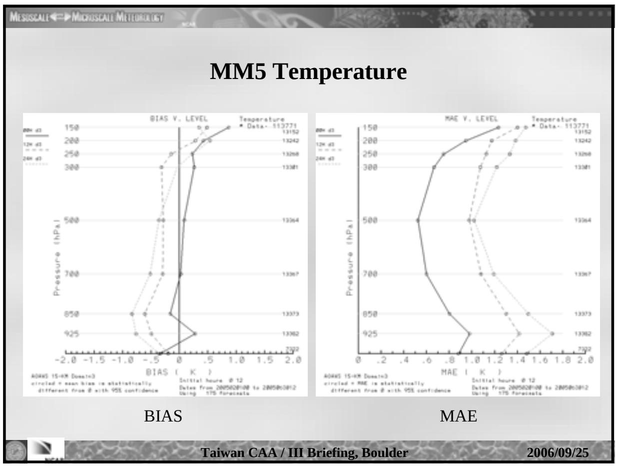
WRFVAR Observation types

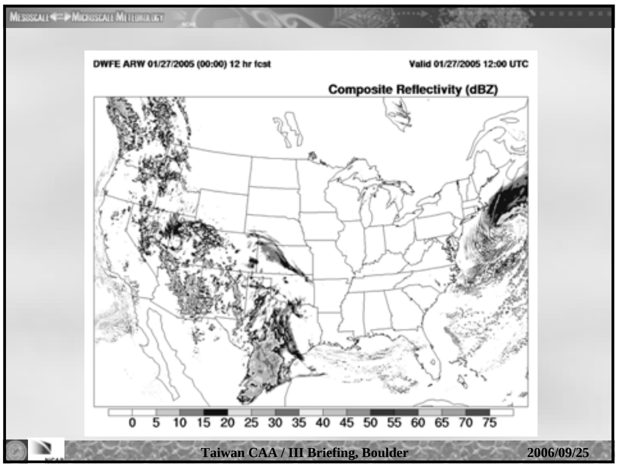
- ✓ *Surface— SYNOP, METAR, SHIP, BUOY*
- ✓ *Upper air— TEMP, PIBAL, AIREP, ACARS*
- ✓ *COSMIC GPS refractivity*
- ✓ *Ground-based GPS Total Precipitable Water (TPW)*
- ✓ *Satellite radiances (e.g., AMSU, SSM/I)*
- ✓ *Radar reflectivity, radial velocity*
- ✓ *Satellite soundings (e.g., AIRS, ATOVS)*
- ✓ *Satellite cloud-track winds and AMVs (e.g., SATOBS, MODIS)*
- ✓ *SSM/I oceanic surface wind speed and TPW*
- ✓ *Quikscat oceanic surface winds*
- ✓ *Wind profiler data*

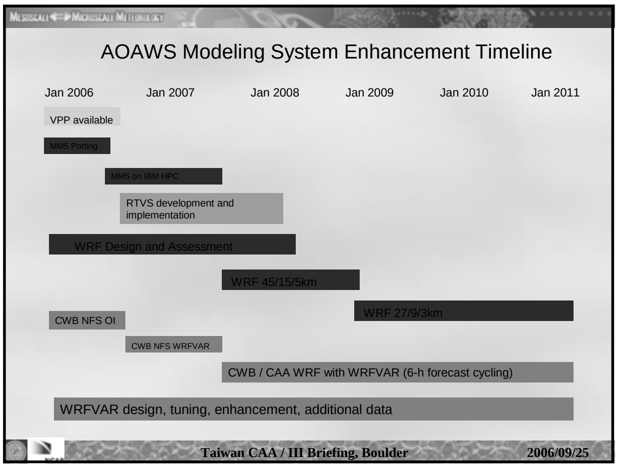
III. MMM Tasks in AOAWS-ES

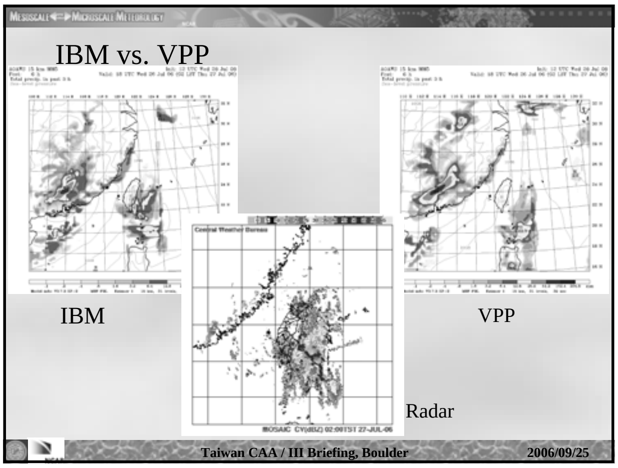
- Implement a real-time verification system
  (in progress)
- Assist in the development and test CWB's implementation of WRF
  (in progress)
- Enhance model display system
  (future work)

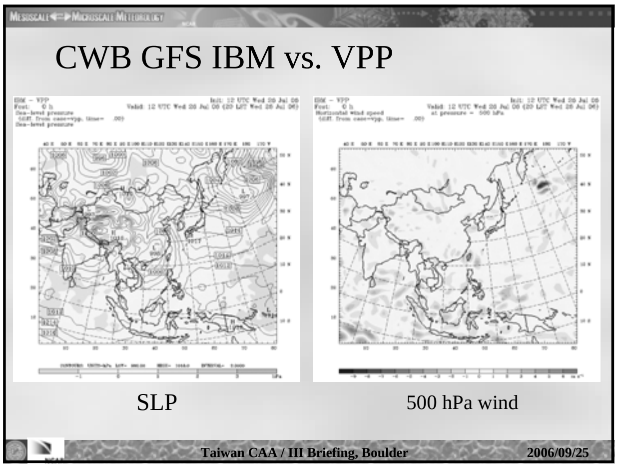

Temperature at 500. mb for forecast hour 24
Number of data used: 4367
Using 175 forecasts from 2005020100 to 2005063012
Initial hours 0 12
AOAWS 15-KM Domain3
Avg. Bias (Model - Obs.) (K)
Taiwan CAA / III Briefing, Boulder
2006/09/25


MM5 Temperature
BIAS
MAE
Taiwan CAA / III Briefing, Boulder
2006/09/25


DWFE ARW 01/27/2005 (00:00) 12 hr fcst
Valid 01/27/2005 12:00 UTC
Composite Reflectivity (dBZ)
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75
Taiwan CAA / III Briefing, Boulder
2006/09/25


AOAWS Modeling System Enhancement Timeline
Jan 2006
Jan 2007
Jan 2008
Jan 2009
Jan 2010
Jan 2011
VPP available
MM5 Porting
MM5 on IBM HPC
RTVS development and implementation
WRF Design and Assessment
WRF 45/15/5km
WRF 27/9/3km
CWB NFS OI
CWB NFS WRFVAR
CWB / CAA WRF with WRFVAR (6-h forecast cycling)
WRFVAR design, tuning, enhancement, additional data
Taiwan CAA / III Briefing, Boulder
2006/09/25


IBM vs. VPP
IBM
VPP
Radar
Taiwan CAA / III Briefing, Boulder
2006/09/25


CWB GFS IBM vs. VPP
SLP
500 hPa wind
Taiwan CAA / III Briefing, Boulder
2006/09/25

附件五：FAA之積冰計畫簡介

NCAR

FAA Icing Program Overview

Cory A. Wolff
26 September 2006

National Center for Atmospheric Research

RAL's Icing Work

- Started in late 1980's
  - History of incidents, accidents
  - Continues today
  - Study weather features
- Weather projects (1990-now)
  - Aircraft - cloud character, effects
  - Radars, satellite, models
  - Diagnosis & forecast techniques
  - Universities, NASA, international

NCAR

Icing Algorithm Development

- Icing forecasting techniques
  - Find the right kinds of clouds for icing
- Manual to automated - learn & apply
  - Computer models
  - Evolution of icing algorithms
    - T & RH (1992-1993)
    - Incorporate surface observations (1995)
    - Satellite icing product (1996)
    - Integrated Icing Diagnosis and Forecast Algorithms (1997-99)
      - "CIP" (Current Icing Product)
      - "FIP" (Forecast Icing Product)
- What are we trying to find?

NCAR

Icing: In search of….

Supercooled Liquid Water
  Where is it likely to be?
  How likely is it to be there?
  How much of it is likely to be present?
Droplet sizes & terminology

Cloud (small) droplets	FZDZ	FZRA

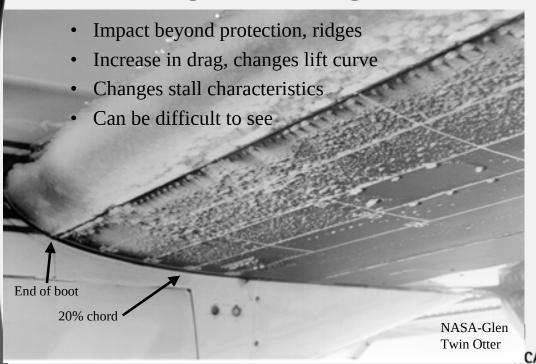
1 10 40/50 100 400/500 1000
Droplet diameter (microns)

Supercooled Large Drops
  FZDZ and/or FZRA **aloft**

NCAR

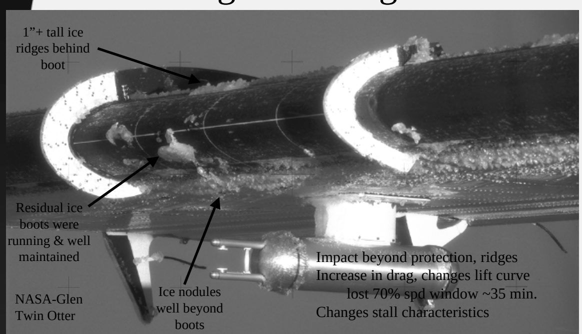
SLD Icing - Freezing Drizzle

- Impact beyond protection, ridges
- Increase in drag, changes lift curve
- Changes stall characteristics
- Can be difficult to see



NCAR

SLD Icing - Freezing Rain



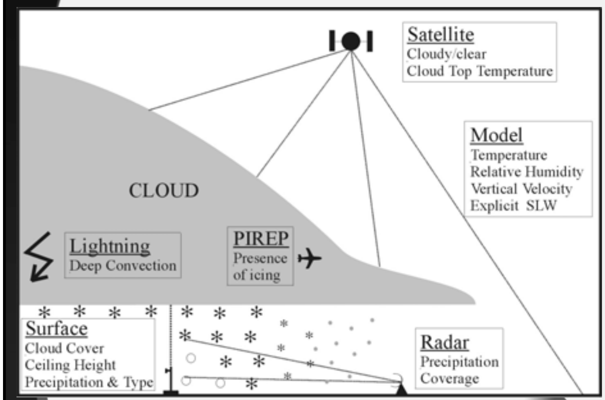
Beyond certification envelope - aircraft and deicing equipment are not certified for flight in FZDZ or FZRA

NCAR

Current Icing Product (CIP)

- Gridded, hourly, 3-D *diagnosis* of icing probability, SLD potential, and icing severity
- Uses information from 6 data sources
  - Rapid Update Cycle Model (20 km): T, RH, VV, SLW
  - GOES-11 and -12 Satellite (1 km visible, 4 km IR, others)
  - Surface Observations (variable)
  - National radar mosaic (~1 km)
  - Pilot reports of icing (variable)
  - Lightning strike data (variable)
- Physically-based, situational approach
  - Apply information differently, appropriately

NCAR

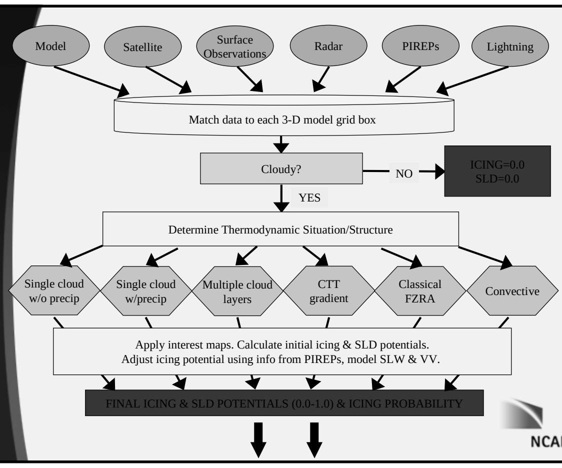


NCAR

How CIP Finds & Describes Icing

- Hourly analysis
  - 20km horizontal spacing, 1000ft vertical spacing
- Integrates information from many sources
  - Each provides information that must be used in context
  - Observations: Satellite, Radar, METARs, PIREPs, lightning
  - Weather models: Temperature, RH, Vertical Velocity…
- Find clouds and precipitation
  - Clear areas and altitudes above/below clouds/precip = no icing
  - Inside clouds & precipitation
    - Examine the characteristics & determine icing parameters
    - How likely is it that there is icing? ICING PROBABILITY (0-85%)
    - How likely is it that SLD is present? SLD POTENTIAL (0-100)
    - How "bad" do the conditions appear to be? ICING SEVERITY
      - Categories: None, Trace, Light, Moderate, Heavy
      - Based on accumulation rate, drop size and temperature
      - Maps to a mid-sized, straight-winged, prop aircraft

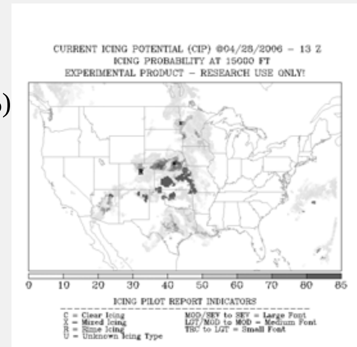
NCAR



NCAR

Icing Probability

Calibrated probability (0-85%) of the presence of icing inside the 20km by 20km by 1000ft thick box



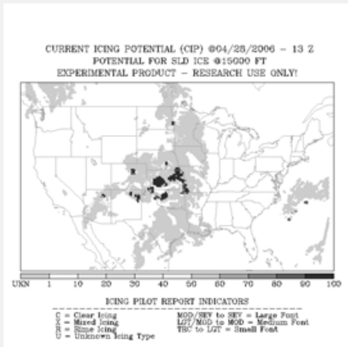
NCAR

SLD Potential

Uncalibrated likelihood (0-100) of the presence of SLD inside the box

Grey = icing, but no indication of SLD

High icing & SLD values in thunderstorms

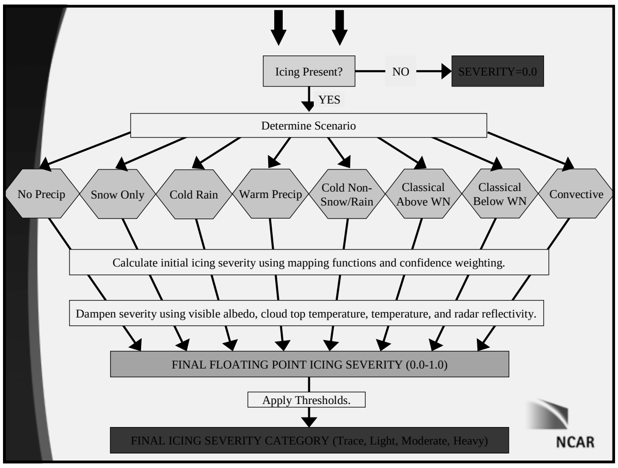


NCAR

Severity: Concept and Datasets

- CIP concept remains the same
  - Different datasets have something to offer
  - No one tells the whole story
  - Work best when applied situationally
    - Information can mean different things
      - Appropriate application via situational interest maps, weights
- Input Datasets
  - Exactly the same
    - Model, satellite, radar, surface obs, PIREPs, lightning
  - Some new fields and derivatives are used
    - Examples: Weighted severity from PIREPs
- New: weighting and confidence to get consensus
  - Based on experience, statistics, data quality

NCAR

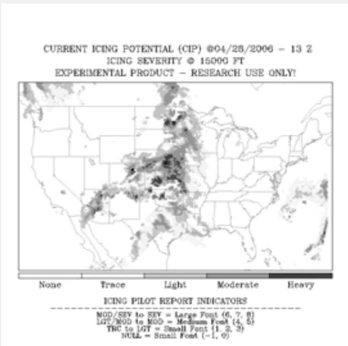


NCAR

Icing Severity

Expected severity of icing to be found inside the box

CATEGORICAL



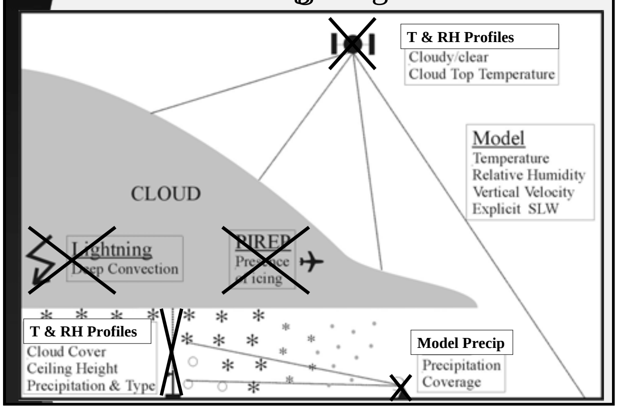
NCAR

Forecast Icing Product (FIP)

- Emulates CIP
  - Uses model fields as surrogates for observations
- Run on RUC grid (20 km)
  - 2 and 3 hour forecast every hour
  - 6, 9, and 12 hour forecasts every 3 hours
- Severity algorithm just added
  - Same concepts as CIP

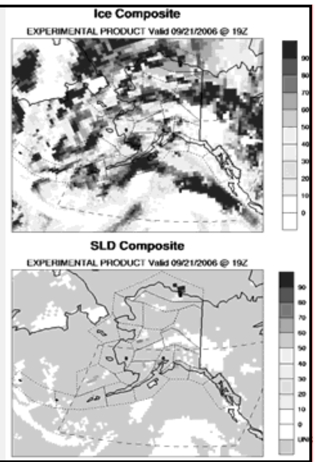
NCAR

CIP – Icing Diagnosis / FIP – Icing Forecast



Alaska

- CIP and FIP
- Same concepts, different model
- No severity yet

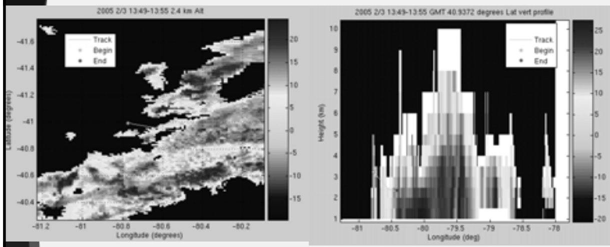


Future Plans

- CIP Severity operational in December
  - Pending FAA approval
- FIP Severity experimental in March 2007
  - Operational in August 2008
- New additions and upgrades

NCAR

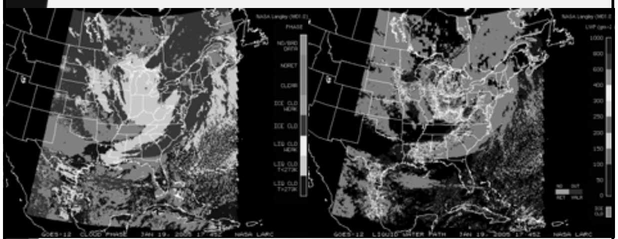
3-D Radar



- Produced by NSSL
- Smarter use of reflectivity field (currently uses radar mosaic)
- May help with layer and SLD identification

NCAR

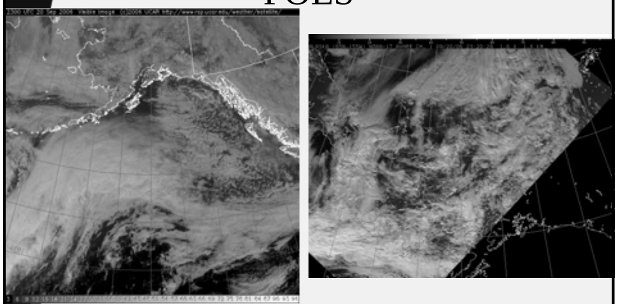
GOES Derived Cloud Products



- Produced by NASA Langley
- Proven to be useful in certain situations
- Cloud phase, water path, particle size, and cloud top height are being tested for use in CIP

NCAR

POES



- GOES data used as far north as Fairbanks
- POES gives high-res views of entire state
- Timing is an issue

NCAR

Current Products and More Information

- CIP – www.rap.ucar.edu/icing/cip
- FIP – www.rap.ucar.edu/icing/fip/newsev
- Alaska – www.rap.ucar.edu/icing/cipak
  - Links to FIP-AK as well
- Latest operational products can be found on ADDS – adds.aviationweather.gov/icing

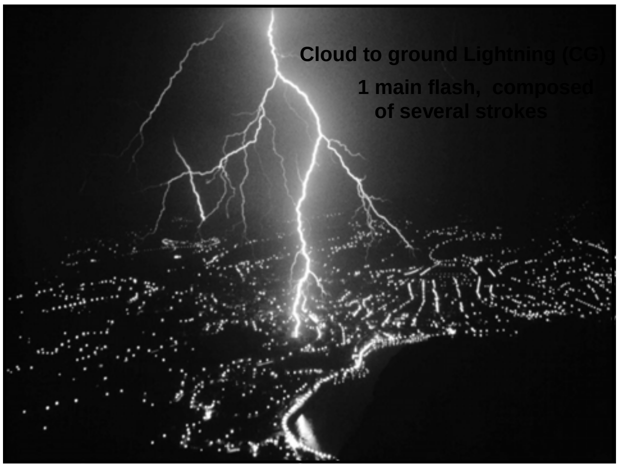
- Journal article on CIP by Bernstein, et. al
  - *Journal of Applied Meteorology* (July 2005)
- Conference paper on FIP by McDonough, et. al
  - 20th IIPS Conference (2004)
- Conference paper on CIP Severity by Bernstein, et. al
  - 12th ARAM Conference (2006)

NCAR

Total Lightning and Severe Weather

summary by
David Johnson
NCAR

based on a presentation by
Hugh Christian
Marshall Spaceflight Center

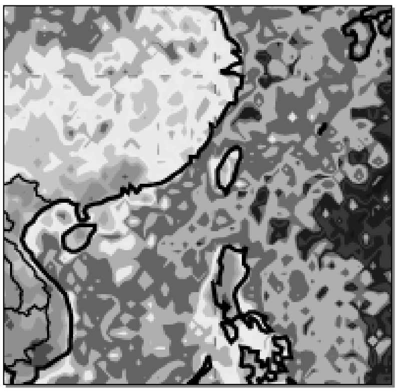


Within cloud Lightning (doesn't hit ground)

also called cloud-to-cloud (cc)

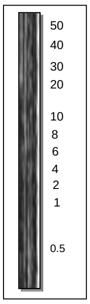
Total Lightning

Combination of
all cloud-to-ground flashes (CG)
+
all cloud-to-cloud (cc) and
within cloud flashes

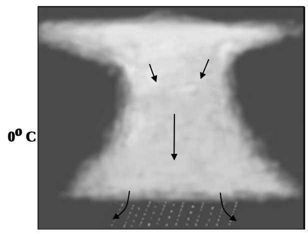


Total Lightning

Annual Lightning Flash Rate: flashes per square kilometer per year.

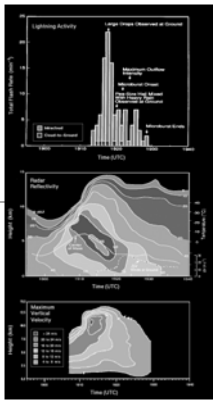


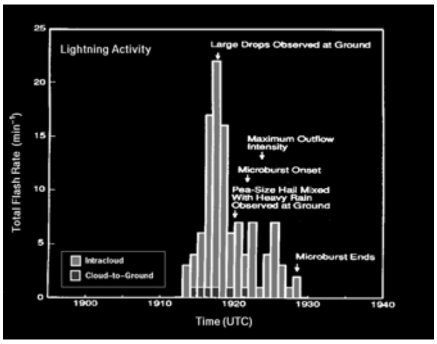
Multi-year NASA climatology based on lightning sensors in low earth orbit.



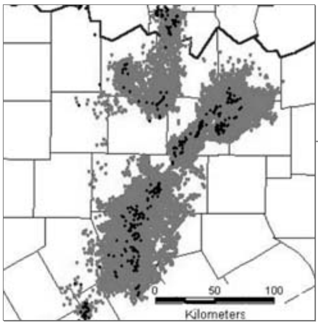
Lightning Connection to Thunderstorm Updraft, Storm Growth and Decay

- Total Lightning —responds to updraft velocity and concentration, phase, type of hydrometeors — integrated ***flux*** of particles
- WX Radar — responds to concentration, size, phase, and type of hydrometeors- integrated over small volumes





Mapping Individual Strokes



Cloud lightning (red) enhances CG detection (black) in mapping the storm's electrically active area.

Major Points for Severe Weather

Primary lightning signature is high flash rates and a "jump" in lightning activity.

Lightning flash rate is correlated storm intensity, higher rates imply a stronger storm.

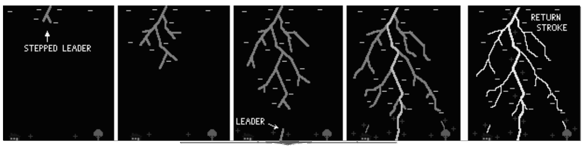
Evolution of the lightning activity follows the updraft. Increasing activity means the storm intensifying; decreasing activity means the updraft is weakening.

A jump in lightning activity is associated with a pulse in updraft intensity

These signatures, in conjunction with other observing systems can be used to:

Separate intensifying from weakening storms
Identify storms in process of going severe
Quickly determine the most intense storms in a complex system
Improved warning times
Reduced false alarms rates

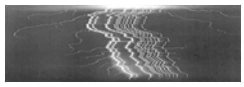
Structure of a Lightning Flash



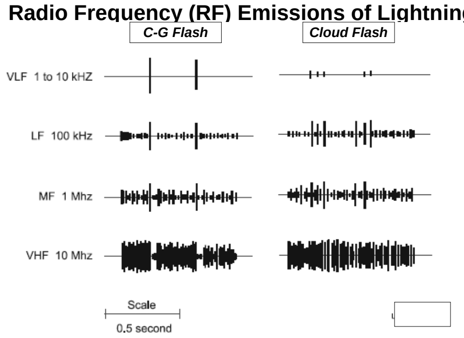
•Flash begins with development of multiple "stepped leaders"
•A strong "return stroke" follows after leaders reach the ground
•Multiple, separate return strokes along the same path

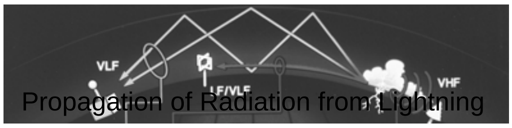
Classic Photograph of a Lightning Flash

Picture of a lightning flash made with a special lightning camera with film that moves rapidly during the exposure.
Stepped leaders are frozen, while the multiple return strokes show up as separate strokes that follow exactly the same path.



Radio Frequency (RF) Emissions of Lightning





Propagation of Radiation from Lightning

Main propagation mechanisms :

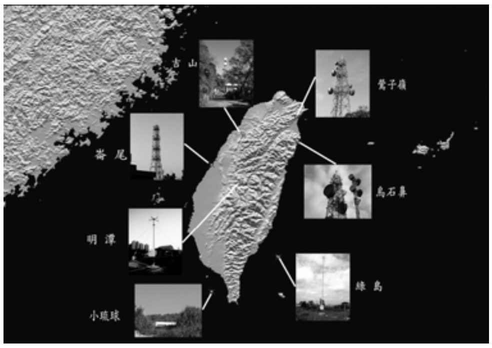
- **VLF : Earth- Ionosphere reflections (thousands km)**
- **LF : Ground wave propagation (300 – 600 km)**
- **VHF : Line of sight propagation (200-300 km)**

Total Lightning Detection Systems

Requires both VHF and LF detection.

VHF emissions are weaker and don't travel as far as LF or VLF emissions.

Total lightning networks need more sensors, and they need to be spaced closer together.



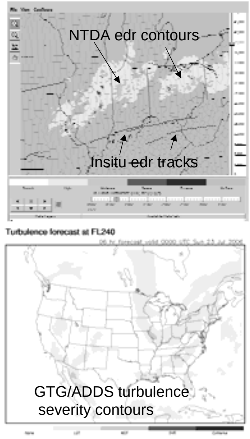
附件七：FAA之亂流計畫簡介

Turbulence – motivation(Bob)

- Statistics
  - CAST analysis (1983-1999) of NTSB "accident" data
    - ~70% of weather related injuries
    - 3 fatalities,176 serious, 544 minor injuries
  - Independent MCR Federal study of NTSB data 1983-1997
    - 665 cited turbulence as a cause or factor
      - 1,438 injuries
      - 609 fatalities (mainly GA)
  - These numbers are grossly underestimated due to NTSB reporting requirements!!
- Contributes to public perception that air travel is unsafe
  - Severe encounters (PIREPS) ~ 5,500/year
  - Actual numbers probably much higher….

FAA AWRP Turbulence PDT work areas

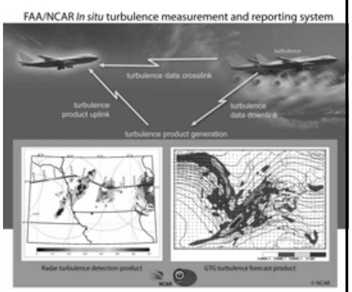
- **Develop/implement in situ turbulence observations of edr**
  - **UAL, SWA, Delta**
- **Develop/implement remotely sensed turbulence observations**
  - **NEXRAD Turbulence Detection Algorithm (NTDA)**
- **Develop turbulence nowcasting and forecasting systems**
  - **Graphical Turbulence Guidance (GTG) - CONUS**
  - **Global**



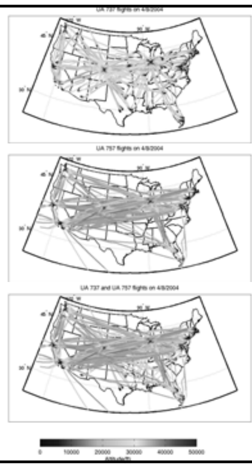
In situ turbulence measurement and reporting program

Goal: To augment/replace subjective PIREPs with objective and precise turbulence measurements

Features:
- Automatically computes/ records turbulence intensities
- Aircraft independent (eddy dissipation rate, EDR)
- Automatically downloads data periodically during flight using ACARS network
- Adopted as ICAO Standard



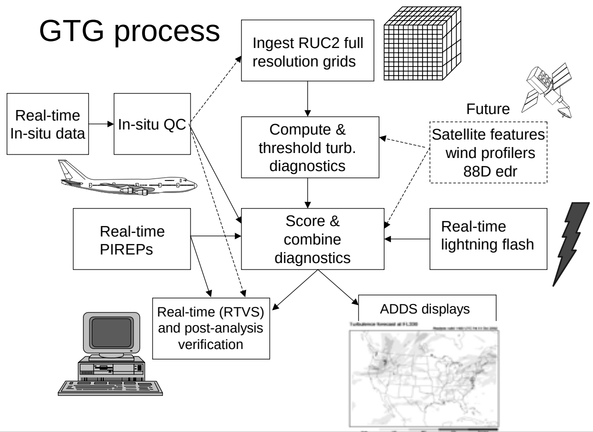
UAL *in situ* compared to pireps



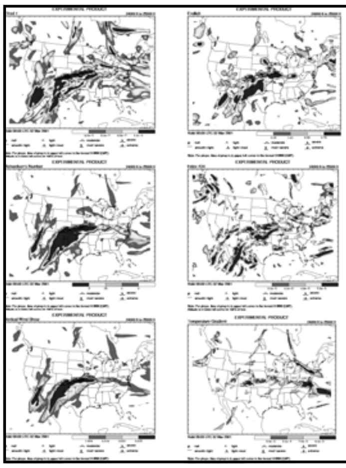
Turbulence PDT forecasting goals

- Completely automated – no human-in-the-loop
- "Operational", i.e., 24x7
- Rapid updates
- Easy to understand output for airline dispatchers, etc.
- Optimized statistical performance accuracy
  - Validated against selected case studies but…
  - overall performance judged on 1000s of cases
- Satisfy a set of NOAA/FAA performance criteria
  - AWTT process
  - Independent expert reviews
  - Independent quality assessment team
- Implemented in the Graphical Turbulence Guidance (GTG) forecast product

GTG process

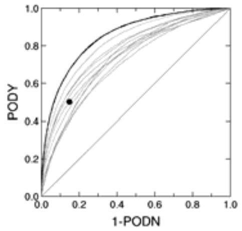


Example of merging diagnostics into GTG

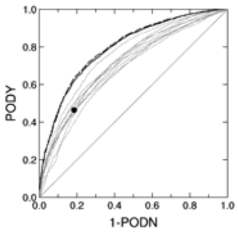


=>

GTG2 Statistical Performance

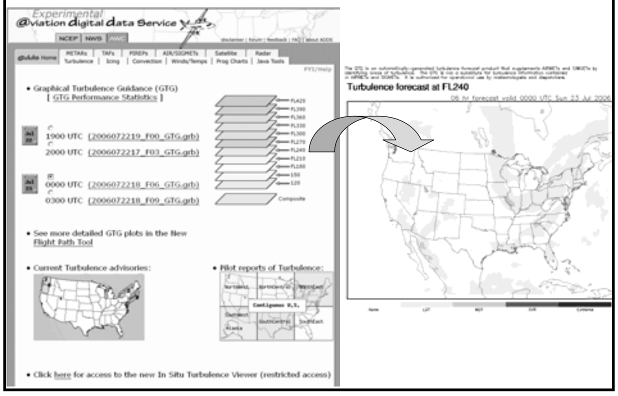


Individual diagnostics and the GTG2 PODY-PODN performance statistics (individual diagnostics as thin grey, GTG combination using dynamic weights as heavy black solid and GTG combination using climatological weights as heavy black dashed) derived from one year (2003) of 18 UTC 6-hour forecasts (valid 00 UTC) using 49,703 PIREPs, for upper-levels (FL200-FL460). For comparison, also shown is the no skill line as the diagonal, and the 2003 average AIRMET performance (with amendments) at upper-levels centered on 00 UTC.



Individual diagnostics and the GTG2 PODY-PODN performance statistics (individual diagnostics as thin grey, GTG combination using dynamic weights as heavy black solid line and GTG combination using climatological weights as heavy black dashed) derived from one year (2003) of 18 UTC 6-hour forecasts (valid 00 UTC) using 8,063 PIREPs, for mid-levels (FL100-FL200). For comparison, also shown is the no skill line as the diagonal, and the 2003 average AIRMET performance (with amendments) at mid-levels centered on 00 UTC.

GTG2 Experimental ADDS viewer



Projected GTG releases

Version	Capabilities	D3	D4	Op
GTG1	Upper levels RUC20	---	3/03	3/03
GTG2	Improved GTG1 Mid levels RUC13	11/04	11/05	2/06
GTG3	Improved GTG2 MWT 10 km RR WRF Text generation Uses in situ Probabilistic forecasts	11/07	11/08	2/09
GTG/TFO	Global - GFS	11/06	11/08	2/09
GTG4	Improved GTG3 out-of-cloud turb forecasts	11/08	11/09	2/10
GTGN	Rapid upates in-cloud turb nowcasts in situ GTG4 0-2 hr analyses	11/08	11/09	2/10
GTG5	Improved GTG4 Low levels	11/09	11/10	2/11
GTGAK	Alaska region	11/10	11/11	2/12

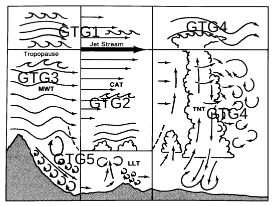
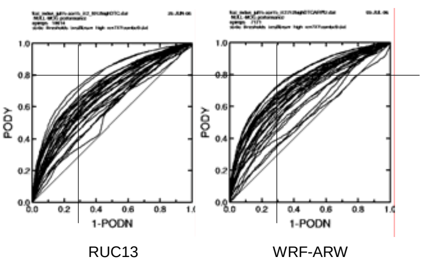


Figure 1-16. Aviation turbulence classifications. This figure is a pictorial summary of the turbulence-producing phenomena that may occur in each turbulence classification.

Null-mog POD curves – 12h forecast, all seasons, upper levels

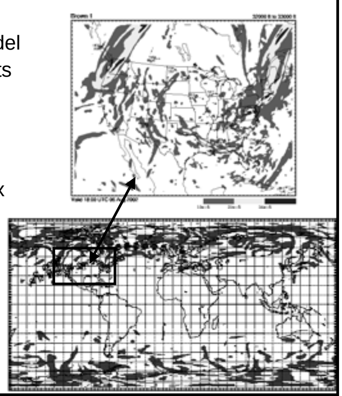


GTG Performance About the same for WRF vs. RUC

WRF still under development

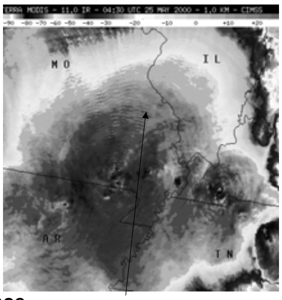
Global GTG

- Uses NOAA's GFS model
- Diagnoses and forecasts of CAT > FL200
- Experimental product should be available by early 2008
- Example: Brown's index at FL320
  06 Aug 2002 18Z
  - Upper: RUC20
  - Lower: GFS



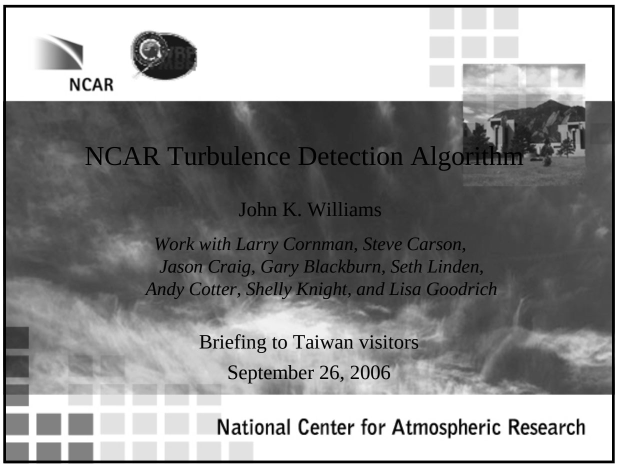
NASA Turbulence work areas

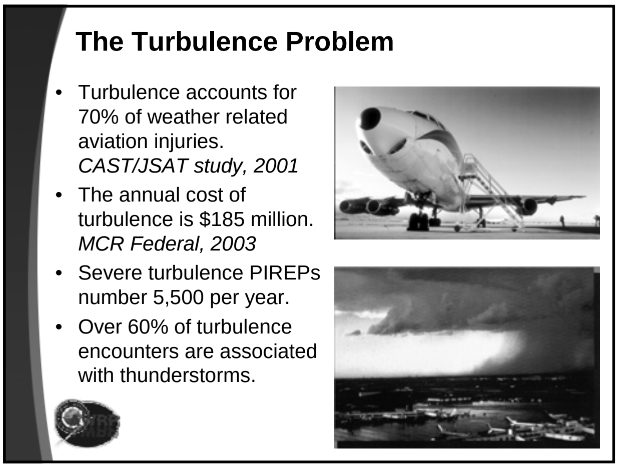
- Develop methods for identifying upper-level turbulent regions using satellite data
- Develop/implement automated convectively-induced turbulence (CIT) nowcast/forecast system
- Evaluate feasibility of forwarding-looking IR sensors to detect turbulence

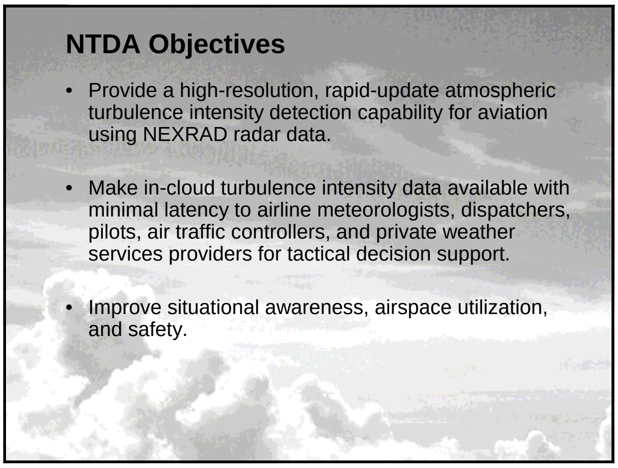


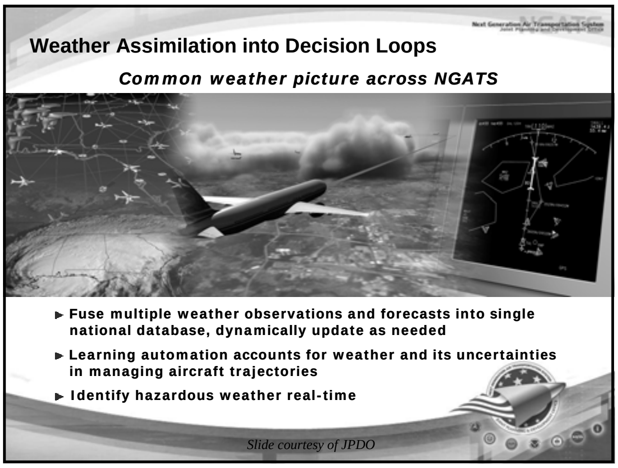
Convectively-induced gravity waves observed by MODIS

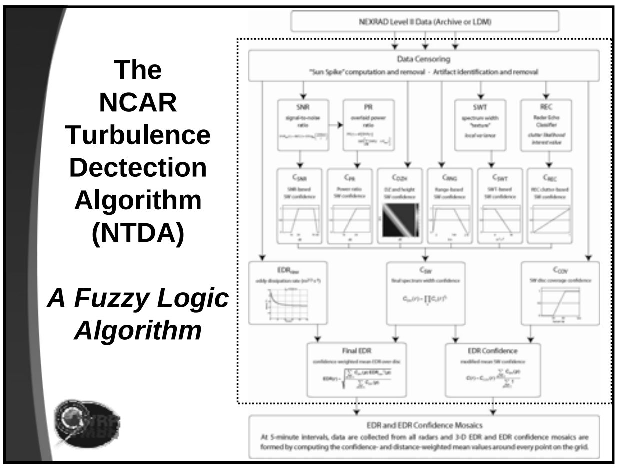
附件八：FAA Nexrad雷達亂流演算簡介

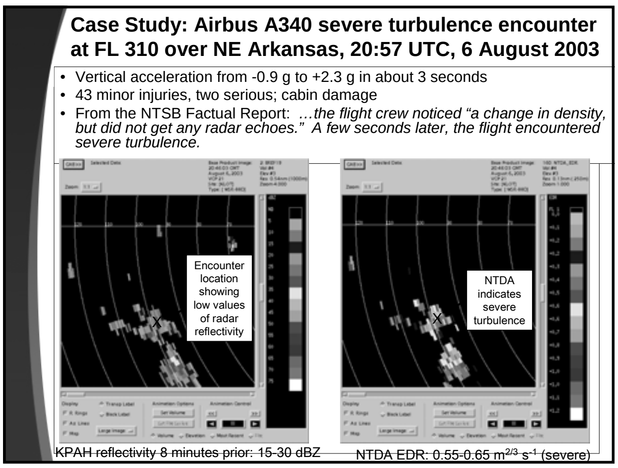












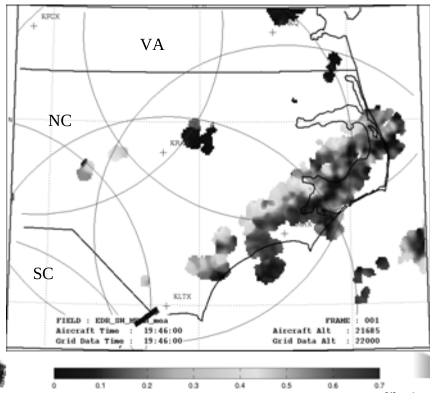
Field Program: NASA B-757 flight tests, 3 April – 18 May 2002

- 11 flights in and around thunderstorms over the south-eastern US
- 40 of the 55 turbulence encounter “events” were covered by archived Level II data. These data were processed using the NTDA.

The NASA Langley B-757 aircraft

NCAR

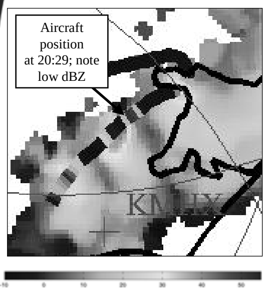
NASA B-757 Data: Overlay Animation



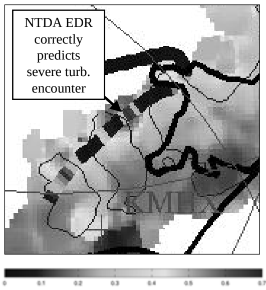
15 April 2002 NTDA EDR mosaic with *in situ* EDR overlay, $m^{2/3}$ s^{-1}

NCAR

Field Program: Overlay, revisited



Merged NEXRAD DZs, dBZ

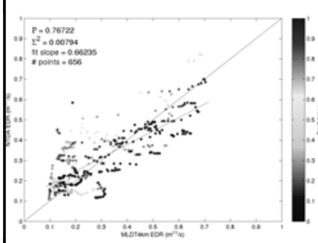


Merged NEXRAD NTDA EDRs, $m^{2/3}/s$

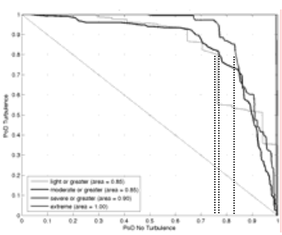
Mosaic overlay plot for 15 April 2002, grid time 20:27, aircraft time 20:29

NCAR

NASA B-757 Data : Comparison Results



NTDA EDR vs. aircraft EDR for all NASA flights (points colored by NTDA confidence)

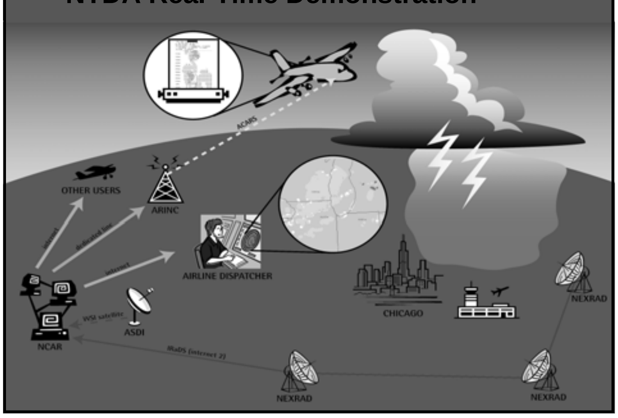


Corresponding ROC skill curves for EDR >0.1, >0.3, >0.5 and >0.7 $m^{2/3}/s$, resp.

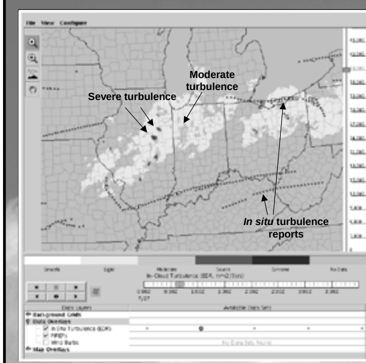
Comparisons for aircraft/radar measurement distance < 0.5 km and time difference < 60 s and NTDA confidence > 0.5

NCAR

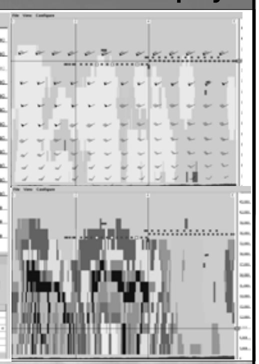
NTDA Real-Time Demonstration



NTDA Demo: Java Web-Accessible Display

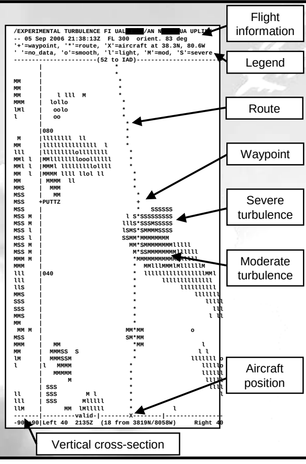


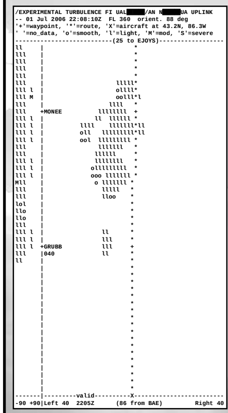
NTDA turbulence, 0040 UTC on 27 July 2005

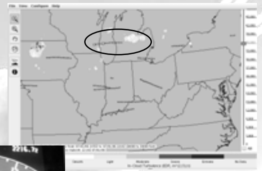


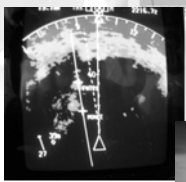
Vertical cross-sections of turb. and refl.

Custom Text-Based Turbulence Uplink Maps



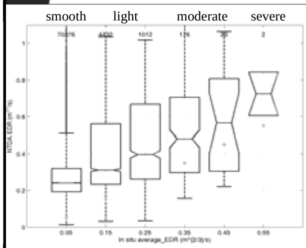

NTDA uplink message at 2208 UTC


NTDA turbulence display at 2210 UTC

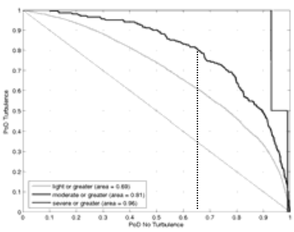

Radar at ~2215 UTC (deviation began at 2213)


View toward left at about 2215 UTC

NTDA Demo: Comparison Results



NTDA EDR vs. commercial aircraft 1-minute **median** *in situ* EDR


Corresponding ROC skill curves for EDR >0.1, >0.3, >0.5 $m^{2/3}/s$, resp.

5 June 2005 - 5 October 2005 comparisons for NTDA mosaic of 16 NEXRADs over the upper Midwest

NCAR

Summary and Plans

- **NEXRAD detection of in-cloud turbulence shows skill when compared to NTSB turbulence encounters and *in situ* reports from research and commercial flights.**
- **Near real-time delivery of the turbulence information to airline meteorologists, dispatchers, other users, and en-route pilots has been demonstrated.**
- **Plans**
  - **Spring, 2007: Deliver NTDA code to Radar Operations Center for inclusion in ORPG Build 10.0**
  - **Spring, 2008: NTDA operational on all NEXRADs**
  - **Spring, 2010: GTG-N on Experimental ADDS, using mosaic of NTDA EDRs for in-cloud turbulence**

Requirements: Cost-benefit studies

- "… turbulence-related costs to the airline community amount to over $100 million per year." *Source: NASA LaRC (http://tpaws.larc.nasa.gov/overview.htm)*
  - Injuries (compensation and missed work)
  - Damage to aircraft
  - Disruptions when aircraft are out-of-service for inspections and repairs
- "On an annual basis, Part 121 carriers experience…567.8 turbulence related injury events that result in 687.4 minor flight attendant injuries, 38.4 serious flight attendant injuries, 119.5 minor passenger injuries, and 17.1 serious passenger injuries" with a cost to airlines of between $30 and $60 million. *Source: P. Kauffmann and A. Sousa-Poza, 2001: "Market Assessment of Forward-Looking Turbulence Sensing Systems", NASA report CR-2001-210905.*
- For commercial (Part 121/129), air taxi (Part 135), and general aviation (GA, Part 91) between 1983-1997, turbulence contributed to 664 accidents leading to 609 fatalities (mostly GA), 239 serious and 584 minor injuries, for an estimated annual societal cost of $134 million. *Source: H. Eichenbaum, 2000: "Historical overview of turbulence accidents", MCR Federal, Inc, report TR-7100/023-1.* (A subsequent MCR report in 2003 updated this figure to $184.7M.)
- Pilots report 65,000 moderate-or-greater and 5,500 severe-or-greater encounters (PIREPs) per year.

Concept of Use: GTG Release Schedule

Version	Capabilities	D3	D4	Op
GTG1	Upper levels RUC20	---	3/03	3/03
GTG2	Improved GTG1 Mid levels RUC13 Text generation Uses in situ	11/04	05/06	8/06
GTG3	Improved GTG2 MWT 10 km RR WRF Probabilistic forecasts	11/07	11/08	2/09
GTG/TFO	Global - GFS	11/07	11/08	2/09
GTG4	Improved GTG3 near-cloud turb forecasts	11/08	11/09	2/10
GTGN	Rapid update in-cloud detection/nowcasts in situ EDR GTG4 0-2 hr analyses	11/08	11/09	2/10
GTG5	Improved GTG4 Low levels	11/09	11/10	2/11
GTGAK	Alaska region	11/10	11/11	2/12

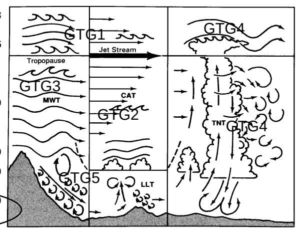
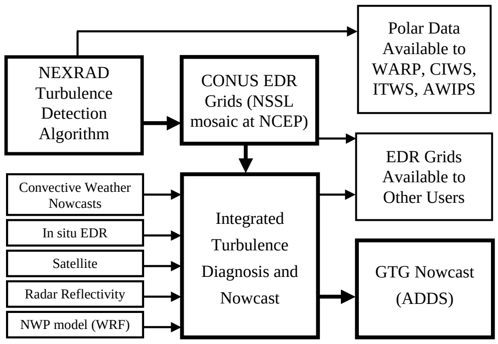


Figure 1-16. Aviation turbulence classifications. This figure is a pictorial summary of the turbulence-producing phenomena that may occur in each turbulence classification.

NCAR

Operational concept



GTG = Graphical Turbulence Guidance,
ADDS = Aviation Digital Data Service (see http://weather.aero)

NCAR

Radar Turbulence Detection Challenges

- Radars measure mostly horizontal wind fluctuations, but vertical have greatest effect on aircraft
- Convectively-induced turbulence may not be well-developed and may not satisfy theoretical models
- Ground-based scans are slow, have poor resolution at large distances (at 60 miles, 1° ≈ 1 mile), and have large gaps between sweeps at high angles
- Radar data are contaminated by non-atmospheric and measurement noise
- Radar spectrum width not extensively tested/tuned
- Turbulence is a statistical quantity—measurements must be averaged to be meaningful

NCAR

Standards for Evaluation

- Case studies: The detection algorithm should produce elevated EDR in the vicinity of in-cloud moderate-or-greater turbulence encounters (e.g., from NTSB accidents or incidents).
  - *Cases are few, and this standard does not assess overwarning.*
- Field program data: The detection algorithm should show good skill (high correlation, good PoDY-PoDN ROC curves) when compared with nearby in-cloud turbulence measurements from research aircraft.
  - *Data are scarce, and may not be representative of commercial flight conditions.*
- *In situ* EDR reports: The detection algorithm should show good skill when compared to nearby in-cloud *in situ* EDR reports from commercial aircraft.
  - *Current EDR reports have low temporal resolution (1 min), may not be well-calibrated, and do not represent random samples of the atmosphere.*
- If two methods show equal detection skill, the one with the greater area of coverage should be preferred.

NCAR

The End

NCAR

附件九：協調會議會議記錄

Issues raised at meeting on 9/26/2006

Participants: CAA, NCAR, III

1. Acceptance meeting date.
As previously discussed, the acceptance meeting for 2006 will take place on Thursday November 30 2006.

2. Change of name of CKS airport.
The name of the international airport has been changed to Taiwan Taoyuan International Airport, with the designation TTY.
NCAR and III will change the name in the various parts of the AOAWS, especially on the web pages.
The MDS hosts at TTY will be renamed to: ttyfis.mds1，ttywx.mds1，ttyrd.mds1
SysView will be updated accordingly.The host name change will be completed by the acceptance meeting.

3. Web server address.
The CAA pointed out that the main web server address is now aoaws.caa.gov.tw, instead of wmds.aoaws.caa.gov.tw.
The CAA requested that NCAR make changes to use the new web address. NCAR and III will work on making those changes. The goal is to have the change in place by the acceptance meeting.

4. Changes to RIP output - e.g. color scale changes.
NCAR would like to change some of the color scales on the model display output. It was agreed that NCAR would send example output of suggested changes to HG for approval prior to making the changes in the operational system.

5. NCAR account on HPC.
In order for NCAR to properly perform its work on WRFVAR, NCAR will need an realtime account on the HPC after the CWB starts running WRF. The CAA agreed this is necessary. NCAR will write a memorandum to the CAA detailing their request.

6. wmds firewall.

The CAA has installed a firewall between the web server and the rest of the AOAWS hosts. At present, a second ethernet card in wmds allows cross-mounts to data1, data2, mm5rip and webcontent.
The CAA requested that NCAR and III reconfigure the web content data so that the cross-mounts are no longer needed. NCAR and III will work on this and try to have this completed by the acceptance meeting.

7. CDF web page.
The CAA would like to merge the CDF web page with the wmds.
The following goals were agreed on:
(a) CDF printing will take place on data1 / data2. It is desirable that only a single copy of the images be printed.
(b) CDF ftp services and web pages will be moved to wmds.
NCAR and III will start working towards these goals.

8. SIGMET/AIRMET "SA" messages not being decoded by AOAWS.
The CAA reported that SA (blowing sand) messages were not being decoded for SIGMETs and AIRMETs.
NCAR has worked on fixing the problem. The bug fix has been installed on the field system. The CAA is requested to let NCAR know if they notice any problems with this fix.

9. SIGMET/AIRMET cancel not working correctly.
The CAA reported that SIGMET and AIRMET products were not being correctly cancelled on the AOAWS. Messages which had been cancelled were still showing up on the displays.
NCAR has worked to fix this problem, and the bug fix has been installed on the operational system in the field. The CAA is requested to let NCAR know if problems are noticed with this fix.

10. /var/www/staff on wmds.
The CAA maintains a staff directory on the wmds for documentation. Previously the CAA had requested that NCAR check this directory and its contents into CVS as a way of keeping it backed up.
NCAR does not feel this is a good idea since this is content which is not created or maintained by NCAR and the data sizes are quite large.
III and the CAA will work out a strategy for backing this material up.

11. WAFS ingest.
The WAFS data is currently received on data1 using the pdreceive application, which listens to UDP broadcasts from the WAFS downlink host. However, this seems to

have reliability issues and some files are missed.
The CAA WAFS contractor will, at some time in the future, start distribution of the data to data1 and data2 using ftp. When that occurs,   NCAR and III will modify the system to accommodate this change.
The CAA also requested NCAR's assistance in obtaining access to WAFS data via ftp from the WAFC hosts. This assistance would take the form of communicating with relevant agencies to make the CAA case for data access. NCAR agreed to supply this assistance.

12. Required bandwidth for HRIT satellite data.
The CAA needs to add internet bandwidth capability to allow ingest of the new JWA HRIT satellite data. It was proposed that an 8 Mbit/s ADSL line be installed for this purpose.
NCAR checked the HRIT data sizes on the JWA ftp site. It appears that a maximum of about 150 Mbytes of data must be downloaded every 30 minutes, during daylight hours when the visible data files are largest.
At 8 Mbit/sec, 150 Mbytes of data will take about 190 seconds for the transfer, Therefore, 8 MBit/sec of bandwidth appears adequate.

13. Display of global data in MDS / JMDS.
NCAR demonstrated the global winds/temperature/humidity products on the MDS and JMDS. The data is derived from WAFS grib files.
The CAA requested that NCAR add extra fields on the MDS and JMDS specifically to show the global products.
NCAR will add fields named:
 * WAFS Global wind speed， * WAFS Global temperature， * WAFS Global humidity

14. Missing data message - JMDS
The CAA requested that in the JMDS, if the height requested is too high, as in the global products above FL300, a message should be displayed indicating that the data is not available at the requested height.

15. TITAN reflectivity threshold documentation.
The CAA requested that NCAR add documentation to (a) the MDS user manual and (b) the wmds help pages, concerning the reflectivity threshold used by TITAN in identifying storms in radar data, and the scientific reason why this threshold was chosen.

16. CAF data via Telnet/TCP.
The CAA informed NCAR and III that it was satisfied with the reliability testing for obtaining the CAF METAR data via Telnet/TCP from a CAF server. The CAA

requested that this method become the main data access for CAF data.
NCAR and III will work on having this installed with version 5 before the acceptance meeting.
There is a redundancy issue with this. NCAR requests that the CAA check with the CAF about the possibility of the CAF running two telnet servers, one for the feed to data1 and one for the feed to data2. This is necessary because the telnet server allows only a single client.
Ideally these servers would be run on separate hosts at the CAF. However, it would also be reasonable to run two server applications on a single host at the CAF.
If this is not possible, NCAR recommends that the existing CAF serial data line be fed to a Lantronix serial-to-tcp converter, to supply the redundant data feed.

17. ICAO Annex 3 requirements for pre-flight and in-flight information.
The CAA reminded NCAR that IA#9 includes the following task:
"Evaluate the feasibility of upgrading the MDS and WMDS to comply with ICAO Annex-3 regulations and the automatic pre-flight information requirement."
NCAR will probably use the services of Jim Henderson (formerly of the FAA and AWC) to prepare a report on this item.

18. METAR messages with "SA" weather type (sand obscuration).
NCAR misunderstood the problem with decoding the SA weather type. NCAR thought this was in reference to SIGMETs, whereas the CAA had drawn NCAR's attention to a bug in the METAR decoder with respect to the SAweather type.
NCAR will work to fix the METAR SA bug.
As it turns out, the SIGMET decoder was also deficient with respect to the SA weather type, so it was good to get this fixed as well.

附件十：氣象預報模式預報落雷的困難性

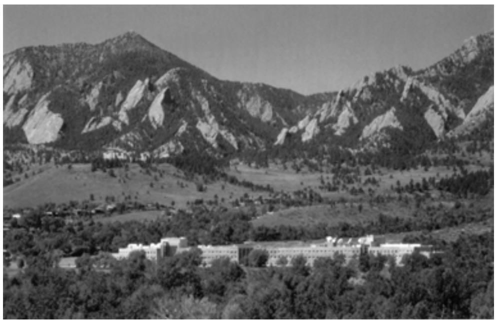
The numerical weather prediction models used in the AOAWS(MM5 and WRF) do not forecast lightning. While the models do forecast areas of convection, from which the possibility of lightning might be inferred, the scales of lightning are well below the grid scale (5 km) or effective resolution (> 10 km) of features that the model can represent.

It is not possible to predict specific locations and times where lightning will strike based on the model output. This is because of the lack of model resolution, imperfections in any model's simulation of convection and hydrometeor distribution, and the lack of sufficient theory or understanding of predicting specifically where lightning will occur.

The models could produce a crude probability of lightning within a grid box (25 km^2) over a given time window (for example, 3 hours) based on current scientific understanding. However, the investigation of questions about the formation of lightning is a matter of basic research that needs much work in order to begin to yield a predictive theory for lightning with sufficient accuracy for CAA's purposes.

附件十一：NOAA地球系統研究（ESRL）實驗室介紹

Earth System Research Laboratory

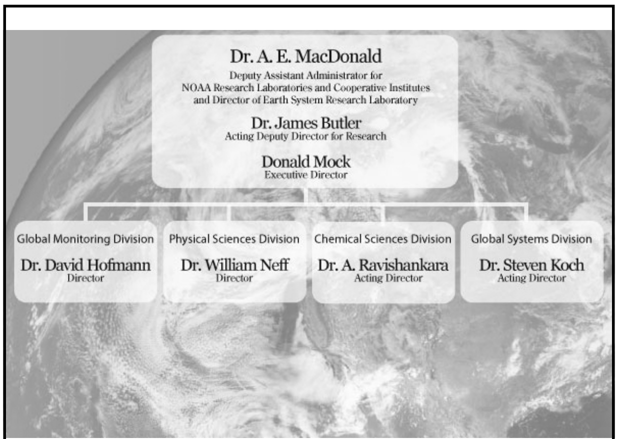


Mission:
To observe and understand the Earth system and to develop products through a commitment to research that will advance NOAA's environmental information and service on global-to-local scales.

Talk Summary

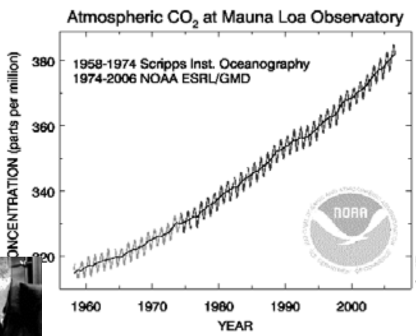
Earth System Research Laboratory

- **Global Monitoring Division (global carbon dioxide research, ozone depletion,)**
- **Physical Science Division (climate change)**
- **Chemical Science Division (air quality)**
- **Global Systems Division (formerly FSL)**

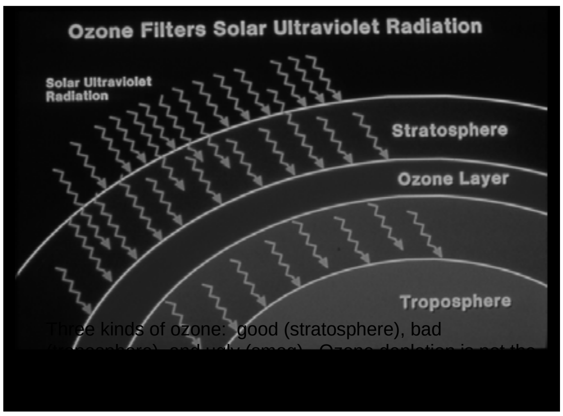


Global Monitoring Division

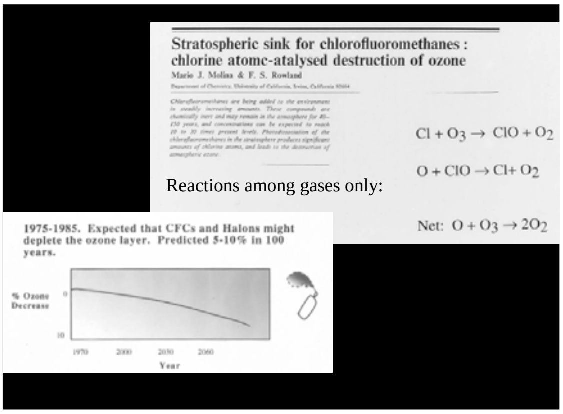
- Mission
  Monitor atmospheric gases, particles, and radiation across the globe to determine trends influencing climate changes, ozone depletion, and baseline air quality
- NOAA/ESRL is a world-leader in carbon dioxide monitoring and research
- Discovery of a major stratospheric ozone layer event over Antarctica in 1985



www.cmdl.noaa.gov/ccgg/trends/



Three kinds of ozone: good (stratosphere), bad


Stratospheric sink for chlorofluoromethanes : chlorine atomc-atalysed destruction of ozone

Mario J. Molina & F. S. Rowland

Reactions among gases only:

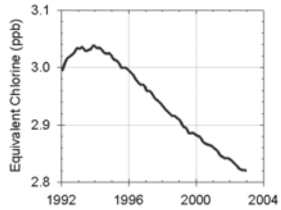
$Cl + O_3 \rightarrow ClO + O_2$

$O + ClO \rightarrow Cl + O_2$

Net: $O + O_3 \rightarrow 2O_2$

1975-1985. Expected that CFCs and Halons might deplete the ozone layer. Predicted 5-10% in 100 years.

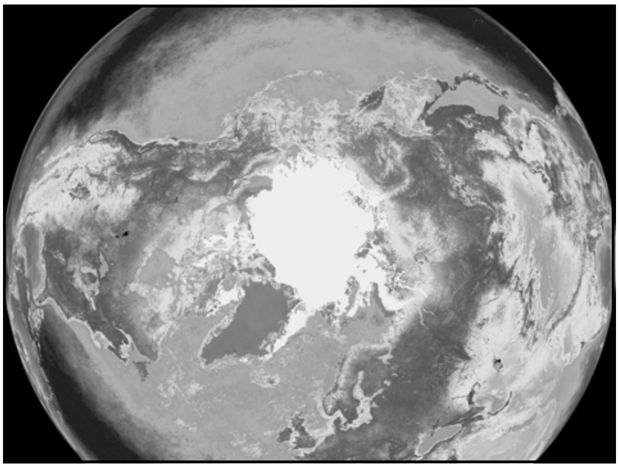
Ozone-Destroying CFCs are Declining
Ozone Layer Recovery expected by 2050



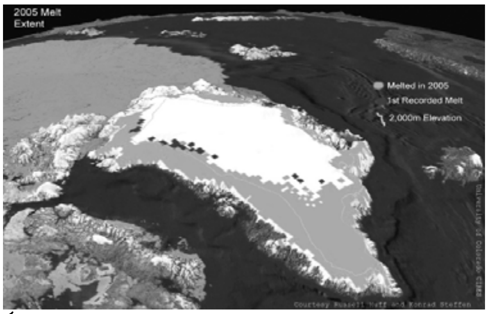
The quality of a prediction depends first on scientific study to understand the physical processes. Then – and only then – it can be correctly incorporated into analysis and prediction models.

Physical Science Division

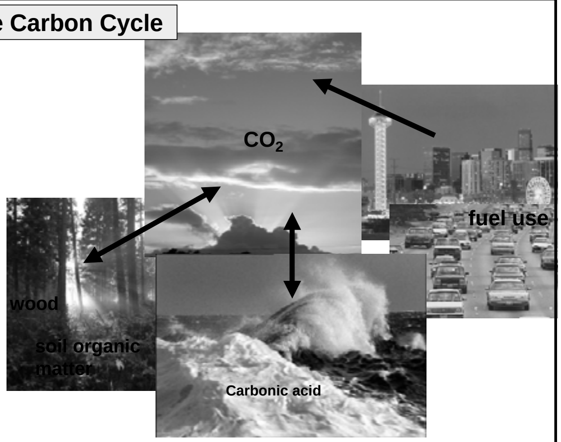
- Mission
  - *Address physical science questions of short- and long-term societal and policy relevance within NOAA's Climate and Weather and Water Goals*
- Regional weather and climate applications
- Cloud and Arctic research



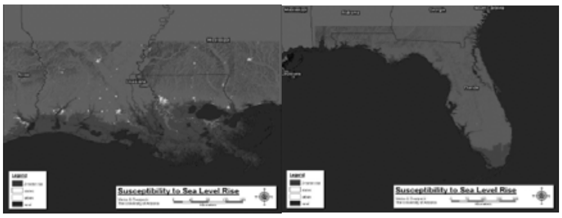
Increasing Greenland Melt



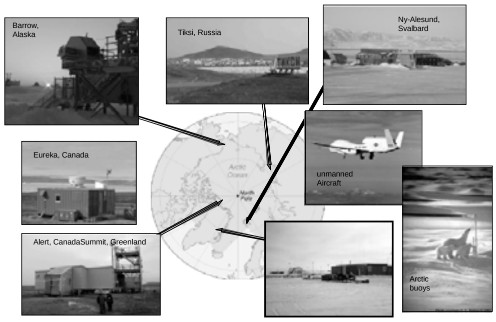
The Carbon Cycle



A rapid melt of Arctic ocean ice could increase the rate of Greenland ice melt. This chart from Overpeck shows a 2 meter sea level rise in red.



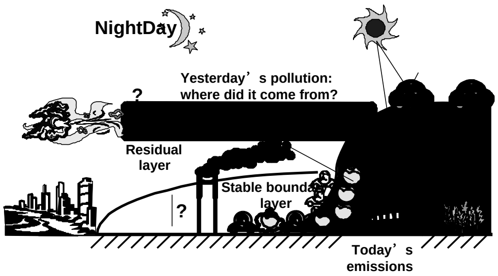
Building an Integrated Arctic Observation System



Chemical Science Division

- Mission
  - *Discover and understand the processes that govern the chemical reactions of Earth's atmosphere*
  - *Improve NOAA's capability to predict its behavior*
- Climate change
- Regional Air Chemistry
- Stratospheric ozone layer

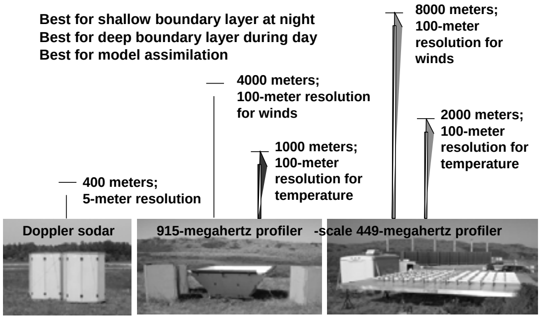
Regional Air Quality − The Problem



Vertical mixing: what is the depth of the boundary layer?
Horizontal transport: where does the wind move the pollution?

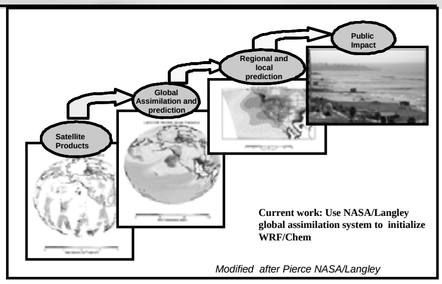
Regional Air Quality − ESRL Solutions

Best for shallow boundary layer at night
Best for deep boundary layer during day
Best for model assimilation



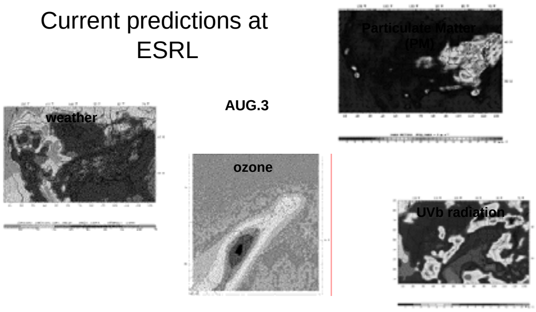
ESRL has successfully lead the development of a complex modeling system, used for state-of-the- art air quality and weather forecasting, and earth system research applications

Next step: from chemical data assimilation and global modeling to public impact



Part II: Examples of forecasting application

Current predictions at ESRL

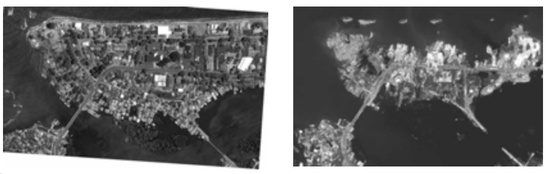


Global System Division (Forecast Systems Lab)

- Mission
  - *Develop systems that deliver global environmental information and forecast products ranging from short-term weather predictions to longer-term climate forecasts*
- System Development
- Observing Systems
- Modeling and data assimilation
- High performance computing
- Outreach (Technology Transfer to Taiwan)

Importance of Observing System Analysis

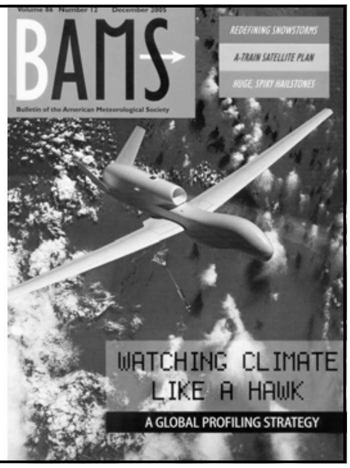
Observing systems are the foundation of better warnings and protection of the public from all types of disasters.

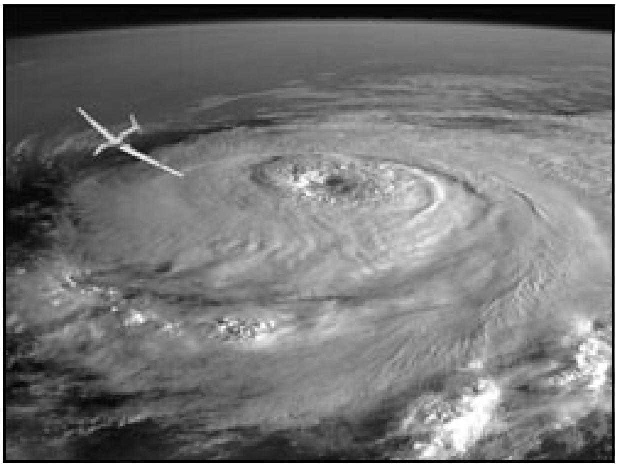


Before and after the Indian Ocean Tsunami

We are making significant progress in the program to develop Unmanned Aircraft Systems for NOAA use.

(BAMS, December 2005, by Sandy MacDonald, pp 1747-1764)





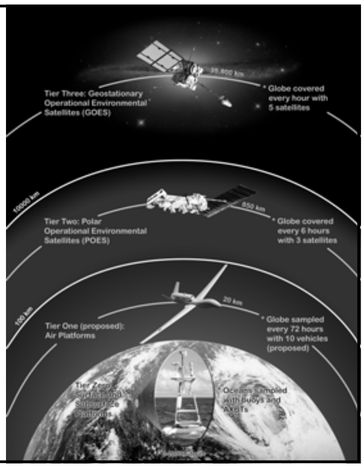
Integrated

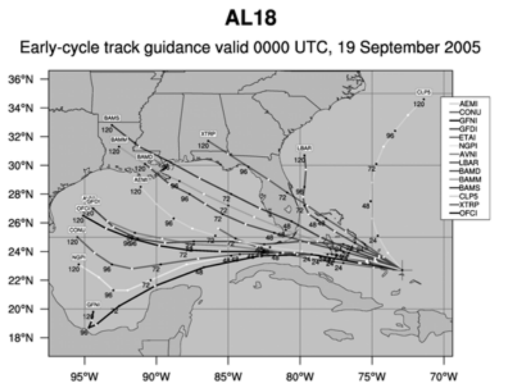
Global

Observing

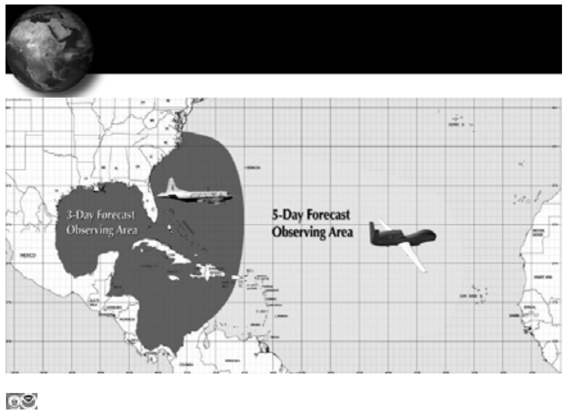
The strategic triad of global observing:

Satellites – UAVs – Surface

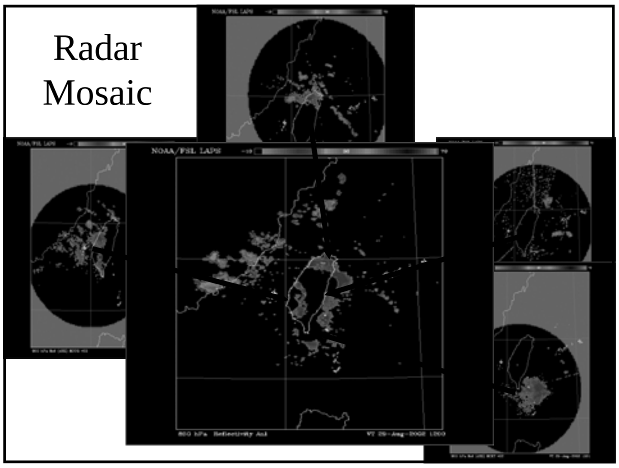




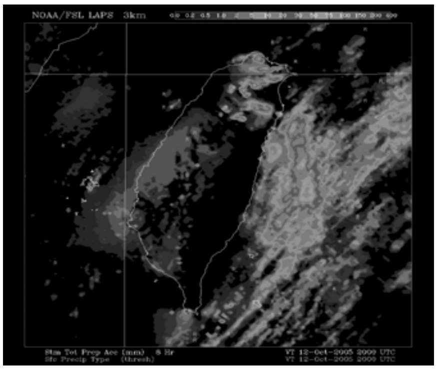
"According to our model, Hurricane Rita will make landfall at . . . "



Radar Mosaic

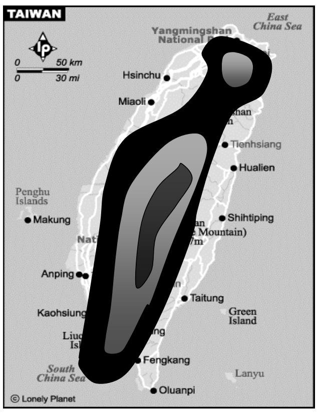


Precipitation Analysis



Precipitation Probability

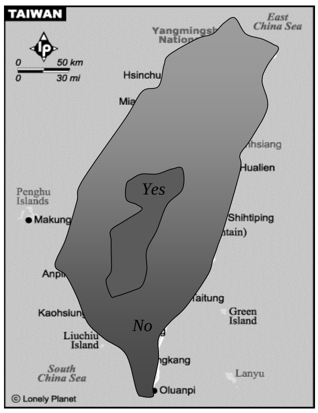
- User sets important threshold or precipitation rate
- Ex: Probability of > 100mm in 3-hrs for a specific time period



10-30 % *30-50%* *50-70%*

Decision Support for Heavy Rain Event

- User plugs decision model into probabilistic database
- Ex: Lower reservoir level? Yes-No



Yes *No*

STMAS (3DVAR surface analysis) Application to frontal detection (MIT-LL)

QuickTime?and a
Microsoft Video 1 decompressor
are needed to see this picture.

STMAS (3DVAR surface analysis) vs. Radar (MIT-LL)

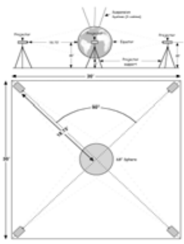
QuickTime?and a
Cinepak decompressor
are needed to see this picture.

SOS Planet Theater Display

Science On a Sphere

System Description

- Room size display system (10 m x 10 m)
- 68” (173 cm) sphere suspended from above
- Video projectors display images onto the outside of the sphere surface
- Computers warp and render the animations to display on the sphere
- Customizable system



Earth System Research Laboratory

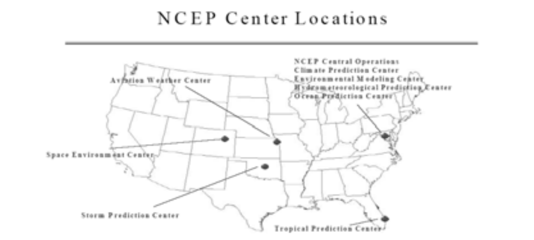
Observing, Understanding, and Predicting the Earth System

附件十二：美國航空氣象中心（AWC）簡介

NOAA's Aviation Weather Center

Briefing for
Taiwanese Aeronautical Meteorological Center (TAMC)
September 28, 2006

The AWC is One of Nine NCEP Centers



We share our facility with...

National Weather Service
Training Center

National Weather Service
Central Region Headquarters

Why Kansas City?

- 15 USC 313b (Pub. L. 102-588, title II, Sec. 222, Nov. 4, 1992, 106 Stat. 5119.)
- "The Administrator of the National Oceanic and Atmospheric Administration shall establish an Institute for Aviation Weather Prediction. The Institute shall provide forecasts, weather warnings, and other weather services to the United States aviation community. The Institute shall expand upon the activities of the aviation unit currently at the National Severe Storms Forecast Center in Kansas City, Missouri, and shall be established in the Kansas City Missouri area. The Administrator of the National Oceanic and Atmospheric Administration shall provide a full and fair opportunity for employees at the National Severe Storms Center to assume comparable duties and responsibilities within the Institute."

Aviation Weather Center Outcomes

- Outcomes
  - Safe, Secure, and seamless movement of goods and people in the U.S. transportation system.
  - Environmentally sound development and use of the U.S. transportation system

C/T Strategies AWC Activities

- "Develop and implement sophisticated assessment and prediction capabilities to support decisions on aviation, marine, and surface navigation efficiencies; coastal resource"

AWC Personnel

Program	Number
Administration	5
Domestic Operations Branch	25
International Operations Branch	13
Aviation Support Branch	11
Contractors	9
TOTAL	63

AWC Products

Domestic
- o SIGMET
- o Convective SIGMET
- o AIRMET
- o Area Forecasts
- o Low Level Significant Wx
- o Collaborative Convective Forecast Product (CCFP)

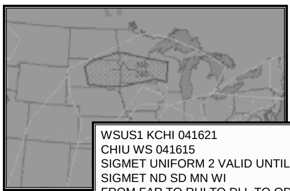
International
- o Mid-Level Significant Wx
- o High Level Significant Wx
- o International SIGMET
- o Tropical Aviation Wx
- o International Flight Folders

Supplementary
- o Graphical area Forecast
- o Graphical Turbulence Guidance
- o Current Icing Potential
- o Forecast Icing Potential
- o National Conv. Wx Diagnostic/Forecast

SIGMETs

(**SIG**nificant **MET**eorological Information)

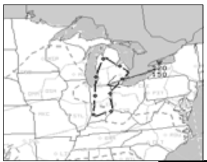
Weather potentially hazardous to all aircraft



WSUS1 KCHI 041621
CHIU WS 041615
SIGMET UNIFORM 2 VALID UNTIL 042015
SIGMET ND SD MN WI
FROM FAR TO RHI TO DLL TO ODI TO 30S FSD TO 65NW ANW TO DPR TO 60S BIS TO FAR
OCNL SEV TURB BTN FL240 AND FL390.
RPRTD BY BE40 AND LJ25. THIS UPDATES UNIFORM 1 AND EXTENDS AREA INTO WI.
CONDS CONTG BYD 2015Z.
JNR

- **Thunderstorms that affect aviation.**
- **Severe icing**
- **Severe or extreme turbulence**
- **Dust storms and sandstorms lowering visibility to < 3 miles**
- **Volcanic Ash**

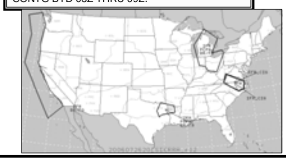
AIRMETs



Weather that may be hazardous to light aircraft:
- o Ceilings < 1000 feet and/or Visibility < 3 miles affecting ≥ 50% of an area
- o Extensive mountain obscuration
- o Moderate turbulence
- o Moderate icing
- o Sustained surface winds ≥ 30 knots
- o Freezing levels

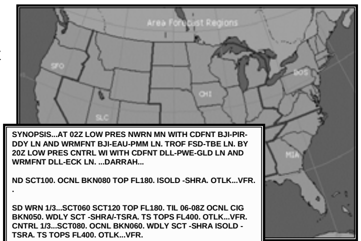
Issued for areas > 3,000 sq. miles

WAUS1 KBOS 042032
BOSS WA 042045
AIRMET SIERRA UPDT 6 FOR IFR AND MTN OBSCN VALID UNTIL 050300
AIRMET MTN OBSCN...ME NH VT NY PA MA MD WV VA
FROM 70NW PQI TO MLT TO CON TO HAR TO 30NW GSO TO HMV TO HNN TO JHW TO SYR TO MSS TO YSC TO 70NW PQI
MTNS OCNL OBSC IN CLDS/PCPN/BR. CONDS CONTG BYD 03Z THRU 09Z.



Area Forecasts

WEST CENTRAL EAST



- **Alphanumeric Product**
- **3 regions / 6 areas**
- **Issued every 8 hours**
- **12-hour forecast + 6-hour outlook**
- **VFR Conditions**
- **Cloud bases / coverage**
- **MVFR Conditions**
- **Weather**
- **Wind >20kts**

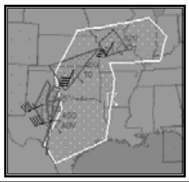
SYNOPSIS...AT 02Z LOW PRES NWRN MN WITH CDFNT BJI-PIR-DDY LN AND WRMFNT BJI-EAU-PMM LN. TROF FSD-TBE LN. BY 20Z LOW PRES CNTRL WI WITH CDFNT DLL-PWE-GLD LN AND WRMFNT DLL-ECK LN. ...DARRAH...

ND SCT100. OCNL BKN080 TOP FL180. ISOLD -SHRA. OTLK...VFR.
.

SD WRN 1/3...SCT060 SCT120 TOP FL180. TIL 06-08Z OCNL CIG BKN050. WDLY SCT -SHRA/-TSRA. TS TOPS FL400. OTLK...VFR.
CNTRL 1/3...SCT080. OCNL BKN060. WDLY SCT -SHRA ISOLD -TSRA. TS TOPS FL400. OTLK...VFR.
ERN 1/3...SCT100. BY 05-07Z OCNL BKN080 TOP 160. OTLK...VFR SHRA. .

NE PNHNDL...AGL SCT050. TIL 04-06Z ISOLD -SHRA/-TSRA. TS TOPS FL400. OTLK...VFR.
CNTRL AND E...AGL SCT040 BKN080 TOPS LYRD FL180. OCNL CIG OVC030. WDLY SCT -SHRA/-TSRA. TS TOPS FL450. TS POSS SEV.
CNTRL BY 06-08Z SCT030 OCNL CIG BKN020. CONDS SPRDG ACRS RMNDR BY 11-13Z. OTLK...VFR. .

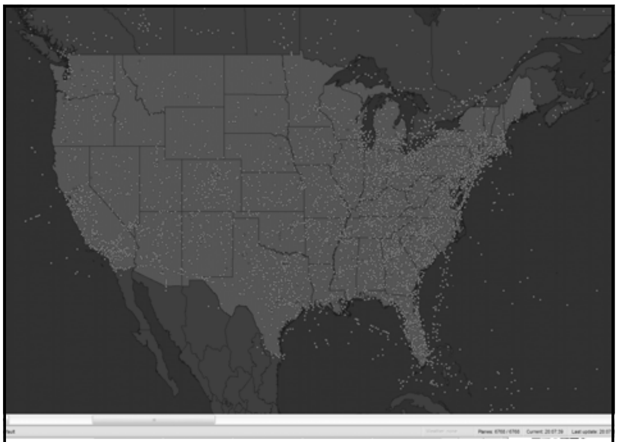
Convective SIGMET



- Convective SIGMET implies severe or greater turbulence, severe icing, and low level wind shear.
- Area of responsibility: CONUS plus coastal waters
- Issued Hourly / Valid for 2 hours

WSUS41 KMKC 041856
WSTC
SIGMET CONVECTIVE SIGMET 85C
VALID UNTIL 2055Z
TX OK
FROM 60SE GAG-50WSW SPS-60NE JCT-50SSE DLF INTSF LINE SEV TS 40 NM WIDE MOV FROM 25045KT. TOPS ABV FL450. TORNADOES...HAIL TO 2 IN...WIND GUSTS TO 80KT POSS.

OUTLOOK VALID 042055-050055
FROM ORD-FWA-LOU-SGF-LIT-LCH-LRD-50E DLF-30W ADM-GAG-OVR-ORD REF WW 22 23.
WST ISSUANCES EXPD.

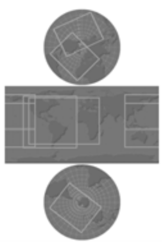


Collaborative Convective Forecast Product

- Sixth Season began March 1.
- Issued every 2 hours
- 2, 4, and 6 hour forecasts
- Used for Strategic traffic flow management decisions
- Collaboration among
  - *FAA*
  - *CWSUs Meteorologists*
  - *Airline Meteorologists*
  - *AWC Meteorologists*

International Forecasts

- World Area Forecast Center
- Meteorological Warning Office
- Gulf of Mexico and Caribbean
- International Flight Folders



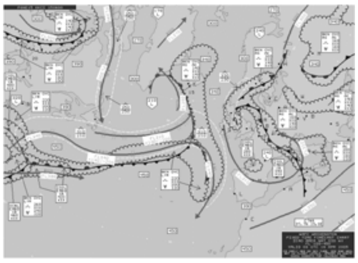
World Area Forecast Center

- World Area Forecast System
  - Developed by International Civil Aviation Organization (ICAO) and the World Meteorological Organization to impove the quality and consistency of enroute guidance provided for international aircraft operations.
  - Two Satellite Broadcasts
    - ISCS
    - SADIS

WAFS – ISCS Broadcast

- Supported by Two World Area Forecast Centers (WAFCs).
  - WAFC – Washington
    - ✓ Aviation Weather Center provides Significant Weather Charts
    - ✓ NCEP Central Operations Provides Wind and Temperature Grids Charts
    - ✓ NWS Telecommunications Gateway supports ISCS broadcast &
  - WAFC – London
    - ✓ Met Office -- Exeter

Mid Level Significant Wx

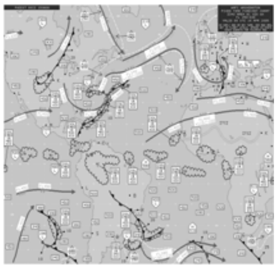


24 hr forecast issued at 00z, 06z, 12z, and 18z

FL100 – FL450

- **Thunderstorms**
- **Jet Stream**
- **Surface Fronts**
- **Mod – Severe Icing**
- **Mod – Severe Turbulence**
- **Tropical Cyclones**
- **Clouds**
- **Volcanic Eruptions**
- **Radioactive Releases**

High Level Significant Weather

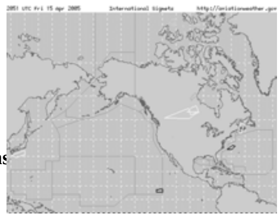


24 hour forecasts of:

- Jet Streams,
- Convection,
- Turbulence,
- Tropopause Heights
- Fronts
- Active Volcanoes
- Tropical Cyclones

- **Covers FL250 - FL600**
- **Issued every 6 hours**

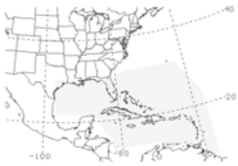
International SIGMET



- **Thunderstorms**
  - **Tornadoes**
  - **Lines of thunderstorms**
  - **Embedded thunderstorms**
  - **Large areas of thunderstorms**
  - **Large hail**
- **Tropical cyclone**
- **Severe icing**
- **Severe or extreme turbulence**
- **Dust storms and sandstorms**
- **Volcanic Ash**

**WSNT10 KKCI 051409
SIGA0J
TJZS SIGMET JULIETT 1 VALID 051405/052005 KKCI- SAN JUAN FIR VOLCANIC ASH FROM SOUFRIERE HILLS WI 20 NM EITHER SIDE OF LINE 1618N06300W 1550N06345W. TOPS TO FL070. ASH MOV SW 25KT. NC. BASED ON SATELLITE OBS AND LATEST ADVSRY. OUTLOOK 06/0205..NC. TANSEY**

Gulf of Mexico and Caribbean



- Cloud bases and coverage
- Cloud tops
- Visibility less than 6 miles
- Surface winds > 20 knots
- Convection
- Icing
- Turbulence
- Synoptic features.

Gulf of Mexico Area Forecasts

- Forecasts marine and aviation hazards
  - TPC & AWC Collaboration
- For Whom?
  - 4,000 OPERATING PLATFORMS
  - 30,000 PERSONNEL LIVING ON THE PLATFORMS
  - 600 HELICOPTERS
  - 1.7 MILLION FLIGHTS IN 1997
  - 60,000 SQUARE MILES
  - $250K PER HOUR IN CREW COST

International Flight Folder Documentation Program (IFFDP)

United States is responsible for:

Supplying operators and flight crews with meteorological information for scheduled int'l airline flights either departing or arriving from the US

Used for:
- dispatch planning
- flight crew pre-flight brief
- flight crew en-route brief

Aviation Support Branch

- Major Responsibilities
  - Automated Product Issuance
  - Product Delivery Services
  - Production Systems
  - Applied Research
  - Technical Training
  - Verification
  - Facilities

Primary Computer Equipment

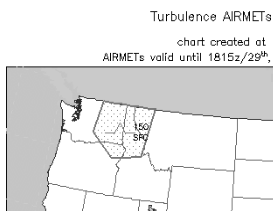
- N-AWIPS used mainly for product generation (domestic and international)
- AWIPS used for communications & domestic data access and display
- FAA Testbed for technical transfer of experimental products

International Visitors/Training

Graphical Forecasts for Aviation (GFA)

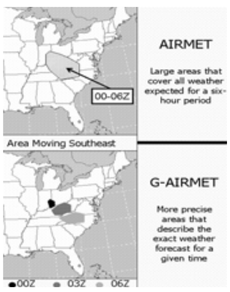
WAUS46 KKCI 290745 SFOT WA 290745 AIRMET TANGO UPDT 2 FOR TURB VALID UNTIL 291400 AIRMET

TURB...WA OR ID MT FROM 50SW YQL TO 30NW LKT TO BKE TO YKM TO 40SE YDC TO 50SW YQL OCNL MOD TURB BLW 150 DUE TO STG LOW/MID LVL WNDS. CONDS CONTG BYD 14Z THRU 20Z.

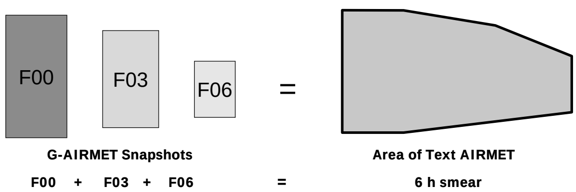


Snapshot vs. Smear Example

- A Weather hazard is moving and expanding from southwestern North Carolina and increasing in size.
- The graphic representation of the text AIRMET at the top is forced to encompass this entire region for the full six-hour forecast period.
- The G-AIRMET at the bottom is able to depict the precise position, size, and shape of the area at three distinct times within the same forecast period.



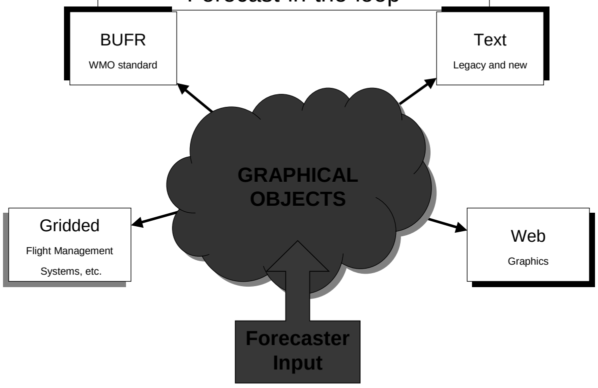
Snapshot vs. Smear



- **G-AIRMET production = AIRMET snapshots in time**
- **Snapshots turned into 6 hour smear**
- **6 h smear turned into Text AIRMET**
- **Very Similar to current forecaster practice**

Graphical Objects

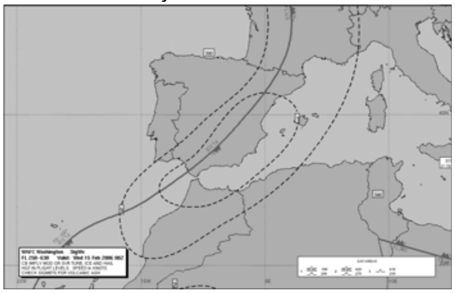
Forecast-in-the-loop



Similar BUFR Products Today

World Area Forecast System

Twenty-four hour forecasts



Graphical Forecast for Aviation

Demonstration of GFA (local)

Demonstration of GFA (live internet)

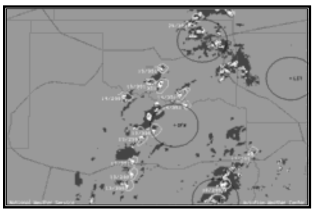
Applied Research

- Partner with FAA's Aviation Weather Research Program (AWRP)
- Aviation Weather Technology Transfer (AWTT) process
  - o Disciplined technology transfer process
  - o Joint FAA and NWS approval board
  - o User Meetings
- AWC responsible with implementation of research as operational products

National Convective Weather Forecast (NCWF)

- **Operational since Fall 2001**
- **NCWD: Current Convective Hazards**
- **NCWF: 1 hour extrapolation forecasts of thunderstorm hazard locations**
- **Incorporates WSR-88D, echo top, and lightning data**
- **Forecasts are determined by applying a stratiform-convective partitioner and elliptical filter to the hazard detection field**

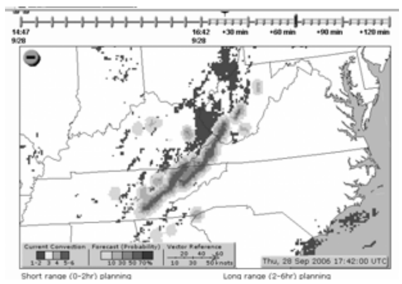
Does well w/ mature, large-scale systems. Not as well with isolated or short-lived systems.



NCWF-2 Upgrade will include thunderstorm probability out to 2 hours

NCWF-2

http://www.weather.aero/convection/



Current Icing Products (CIP)

- **Operating as Current Icing <u>Potential</u> since spring 2002**
- **Three gridded icing characteristics produced hourly:**
  - **Hourly diagnosis of icing intensity:**
    - **Heavy, Moderate, Light, Trace**
    - **Probability of any icing severity**
    - **Probability of Supercooled Liquid Droplets (SLD)**
- **20 km resolution**
- **Every 1,000 feet through FL300. Also Composite.**
- **Displays can combine fields**

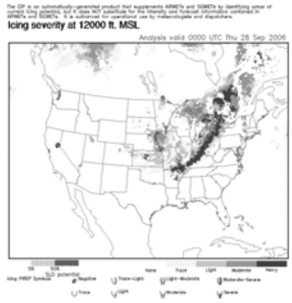
CIP Severity & Probability

CIP Display Combinations

Conditional Probability

CIP Display Combinations

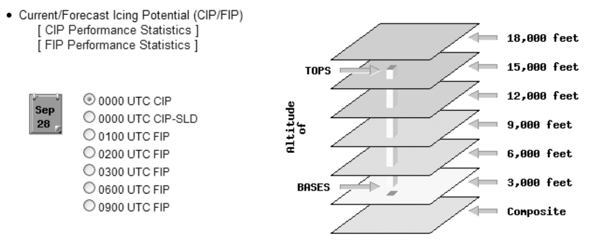
SLD & Severity with SLD



Forecast Icing Potential (FIP)

- **Operational since winter 2004**
- **Gridded Forecast of Potential Icing**
- **High resolution product (RUC 20 km)**
- **Incorporates RUC model to produce interest maps for:**
  - **Temperature**
  - **Cloud top temperature**
  - **Relative Humidity**
  - **Vertical Velocity**
  - **Precipitation Rate**
- **Does <u>Not</u> represent Icing Severity**

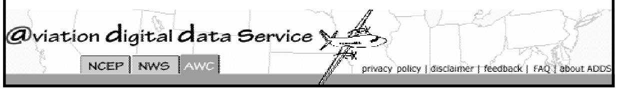
FIP Display on ADDS



- **Operational since spring 2003**
- **Automated Product showing Location and Intensity of Turbulence**
- **Incorporates RUC 20 km, lightning data, and PIREPs to map turbulence intensity**
- **Assigns weighting functions to several operationally verified algorithms and combines them to produce the GTG product**

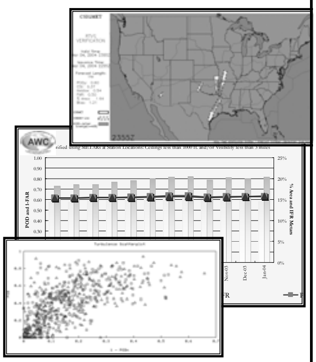
ADDS

- Aviation Digital Data Service (ADDS)
- Developed by NCAR (AWRP funding)
- Operational 2003
- http://adds.aviationweather.gov



RTVS

- Real-Time Verification System (RTVS)
- Developed by FSL
  - o AWRP funding
- Provides Verification of AWC Products
  - o AIRMETs, SIGMETs, CCFP and Automated Products
  - o No verification for FA and Graphical Products
- Technology Transfer to NWH



Aviation Weather Center

附件十三：密蘇里州EAX天氣預報中心簡介

National Weather Service Forecast Office Pleasant Hill Forecast Operations

Dave Beusterien
Meteorologist

Suzanne Fortin
Science and Operations Officer

Overview

- Who we are and what we do
  - National Presence
  - Local Office
- Aviation Services
  - Forecasts by NWS Pleasant Hill
  - National

NWS WFO Pleasant Hill

- **One of 122 WFOs across the U.S. and its territories.**
- **Warnings and forecasts for 44 counties in KS and MO**
- **24/7 operation**
- **At least 1 Meteorologist on at all times**
- **Rotating shifts for operational meteorologists and weather technicians**

NWS Pleasant Hill - Staffing

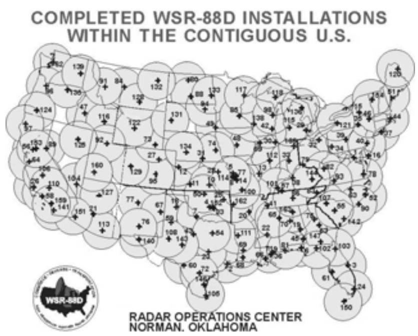
1 Meteorologist-in-Charge
1 Administrative Assistant
1 Warning Coordination Program Manager
1 Science and Training Program Manager
1 Information Technology Officer
1 Service Hydrologist
1 Observations Program Manager
10 Forecasters
2 Hydrometeorological Technicians
2 Meteorologist Interns (Forecasters in training)
1 Electronic Systems Analyst
2 Electronic Technicians

Who we are and what we do

- A Federal Government Agency
- Part of N.O.A.A. – National Oceanic & Atmospheric Administration
- Created by Congress for the Protection of Life and Property

Nationwide – Network of Radars

- 142 CONUS
- 17 OCONUS
- 159 TOTAL



Nationwide – Upper Air Network

- 92 locations in North America
- Monitoring the atmosphere to over 100,000 ft

Your Local NWS – Pleasant Hill

- Responsible for 44 counties
- Located in Pleasant Hill
- 24/7

NWS Pleasant Hill: Day-to-Day Operations

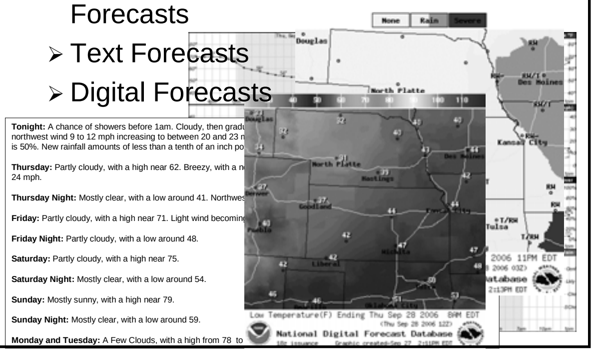
- Weather Forecasts (Day 1-7)
- Issue Watches & Warnings
- Data Collection and Dissemination
- Operate NOAA All-Hazards Weather Radio

Day-to-Day: Issuing Forecasts

- Daily Forecasts
  - Day 1-7
  - Graphical
  - Digital
  - Text
- Short Term
  - 1-6 hour forecast
- Hazardous Weather Outlook
  - Daily
  - Hazardous weather potential for the next 7 days
- Hazardous Weather Watches and Warnings
  - As needed
- Aviation
  - Terminal forecasts
  - Transcribed Weather Bulletins
  - No Airport Weather Warnings

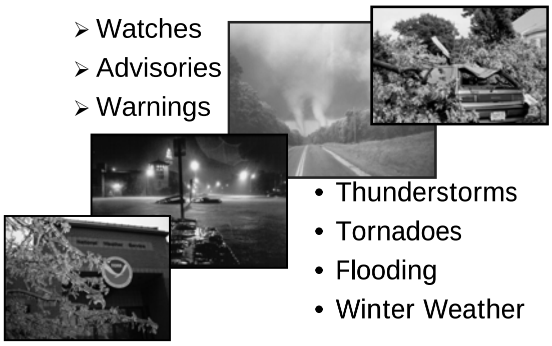
Day-to-Day Forecasts – Public Forecasts

- 7 Day Graphical Forecasts
- Text Forecasts
- Digital Forecasts



Day-to-Day: Issuing Watches & Warnings

- Watches
- Advisories
- Warnings

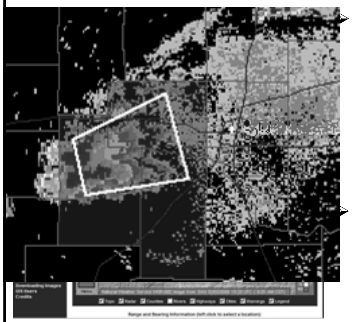


- Thunderstorms
- Tornadoes
- Flooding
- Winter Weather

Each NWS Office Provides:

- Advisories
- Watches

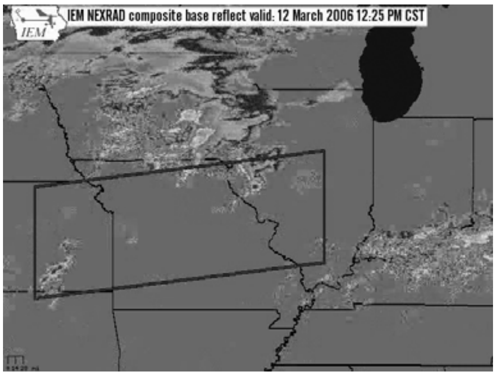
Each Office Provides: Severe Weather Warnings



Watches/Warnings link on all NWS front pages

- **Severe Weather Warnings**
  - **Polygons displayed with radar data.**
    - **Yellow = Severe Thunderstorm Warning**
    - **Red = Tornado Warning**
    - **Green = Flash Flood Warning**
- **Significant Weather Alert**
  - **Issued by NWS Pleasant Hill and NWS Springfield**
    - **For storms with hail less than 1" in diameter**
    - **To serve as a "heads-up"**

March 12 radar imagery



National Weather Service Aviation Forecasts

NWS Pleasant Hill Aviation Forecasts

- Terminal Forecasts (TAFs)
  - Downtown Kansas City (MKC), Kansas City International (MCI) and St. Joseph Rosencranz (STJ)
- Transcribed Weather Broadcasts (TWEBs)
  - MKC Vicinity
  - MKC to Burlington, Iowa Route
  - MKC to Tulsa, Oklahoma Route
- Airport Weather Warnings
  - KCI and SZL issue their own

Terminal Forecasts

- **Terminal Aerodrome Forecast (TAF):** A forecast of expected meteorological conditions significant to aviation at an airport (terminal) for a specified time period. The U.S. definition of a terminal is the area within five (5) statute miles (SM) of the center of an airport's runway complex.

Terminal Forecasts

- Issued 4 times a day and updated as needed
- Cover a 24 hour period
- Focus on “critical TAF period” of 2 to 6 hours from time of issuance

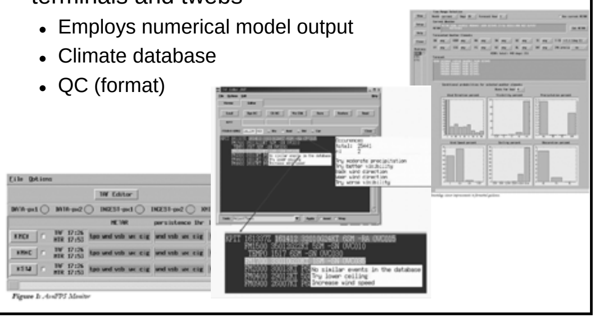
Terminal Forecasts

Example of an actual TAF issued by NWS Pleasant Hill for MCI, Kansas City International Airport:

KMCI 161136Z 161212 04015KT 4SM -FZRA BR OVC009
TEMPO 1214 1SM TS FZRASN BR OVC005CB
FM1500 04015G25KT 3/4SM -SN BR OVC006
FM1900 35020G30KT 3SM -SN BLSN BR SCT006 OVC012
FM0000 32025G35KT 6SM -SN BLSN BR OVC020
FM0500 31018G28KT P6SM OVC025=

Terminal Forecast Preparation

- AVNFPS 3.1 for monitoring and generation of terminals and twebs
  - Employs numerical model output
  - Climate database
  - QC (format)



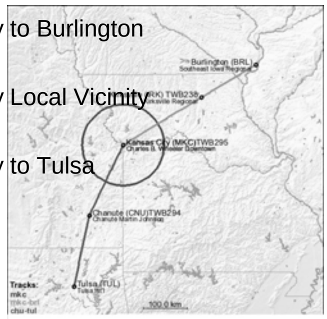
TWEBs
Transcribed Weather Broadcasts

TWEBs

- Used by Automated Flight Service Station Briefers to provide local, detailed information to General Aviation Pilots.
- Made available to pilots through continuous, recorded aviation weather sources

TWEBs Issued by NWS Pleasant Hill

- TWB 238 Kansas City to Burlington
- TWB 295 Kansas City Local Vicinity
- TWB 294 Kansas City to Tulsa



NWS Pleasant Hill TWEBs

- TWEB Local Vicinity Forecast
  - Aviation weather forecast valid for a 12-hour period and covering an area with a radius of 50 nm, which may contain several airports.
  - An amended TWEB Local Vicinity Forecast may be valid for less than a 12-hour period
- TWEB Route forecast
  - 50 nm wide corridor forecast including:
    - Sustained surface winds 25 kts or greater
    - Visibility, weather and obstructions to visibility
    - Sky conditions including coverage, ceilings and cloud heights and tops
    - Nonconvective low level wind shear
  - Valid for a 12 hour period – amendments may be shorter

TWEB Forecasts Example

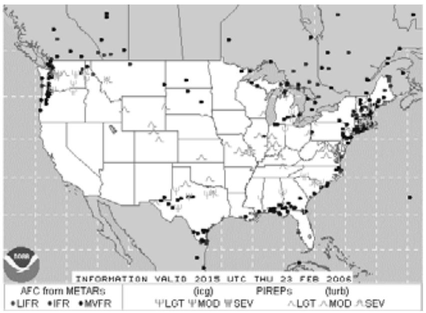
295 TWEB 170214 KMKC LCL VCNTY. ALL HGTS AGL EXC TOPS. 4SM -SN BR OVC030…07Z P6SM OVC060.

NWS Aviation Forecasts: National

TAF sites across North America

NWS Aviation Forecasts: National

Sigmets, Airmets and other forecasts critical to aviation issued by the NWS Aviation Weather Center



www.aviationweather.gov

NWS Pleasant Hill:

Data and Forecasts:

- Phone 816**-540-6021**

All Information:

- Internet **weather.gov/kc**

All Information PLUS alert capability:

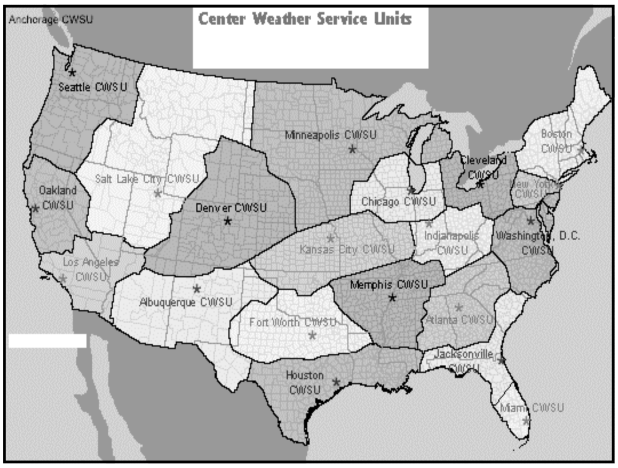
- NOAA All-Hazards Radio

Thank You!

E-mail:
dave.beusterien@noaa.gov

An Introduction to The Kansas City Center Weather Service Unit

Richard D. Webber
Meteorologist
Kansas City CWSU



Purpose of the CWSU

- To provide meteorological consultation, forecasts and advice to managers and staff within the ARTCC and other supported FAA facilities.
- To provide advisories of hazardous weather conditions for airborne aircraft

Staffing

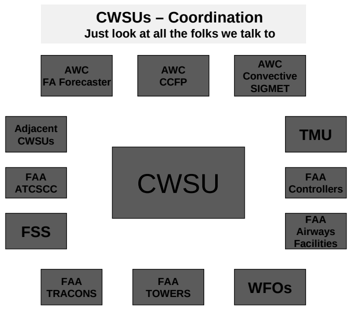
- Meteorologist-in-Charge (GS-13)
- 3 Meteorologists (GS-12)

Hours of Operation

- Hours determined by each ARTCC
- 16 hours a day/7 days a week
- ZKC hours 0530-2130 Central Time
  - Winter hours 0530-2100 (October 1-March 31)
  - Morning Shift 0530-1330
  - Evening Shift 1330-2130 (Summer)
    1300-2100 (Winter)

Duties

- Provide weather forecasts and briefings to FAA personnel.
- Issue Center Weather Advisories (CWA) and Meteorological Impact Statements (MIS).
- Lots of Coordination
  - WFOs for TAFs
  - AWC for SIGMETS/AIRMETS/CWAs.
  - Collaborative Convective Forecast Product (CCFP).
  - Adjacent CWSUs for forecast compatibility.



Traffic Management Unit - TMU

- Plan and Implement Air Traffic Routes over ZKC.
  - Based on CWSU Meteorologist Input.
  - Based on CCFP.
  - Coordinate with ATCSCC
  - Coordinate with other TMUs
  - Coordinate with other FAA Facilities
  - Coordinate with Military.

Traffic Management Unit - TMU

-Monitor Individual Sectors.

-Implement Traffic Restrictions

  -Miles in Trail

  -Ground Stop

Command Center – ATCSCC

- Located in Herndon, Virginia.
- Plan and Implement National Air Traffic Routes.
- Based heavily on CCFP.
- Coordinate with Center TMUs.
- Coordinate Internationally.
- Coordinate with Military.

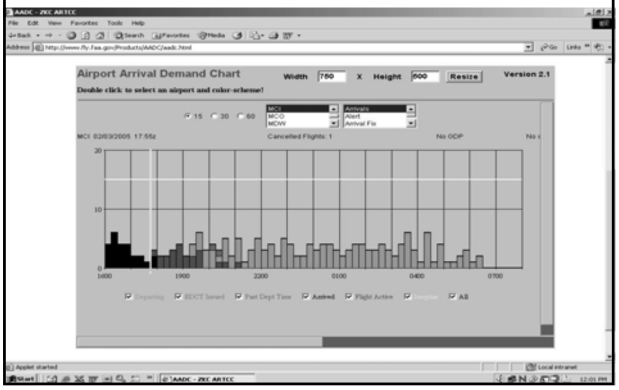
TAF Coordination with WFOs

- 20-30 minutes prior to scheduled TAF
  - 1730Z and 2330Z
- Non Scheduled Coordination
  - When TAF needs amending.
- Coordination by telephone.
  - CWSU calls WFOs for scheduled coordination…
    - If airport coordination criteria is met.
    - If CWSU Met feels coordination is needed.
  - WFO calls CWSU for scheduled coordination…
    - If CWSU does not call and…
    - WFO met feels coordination is needed.

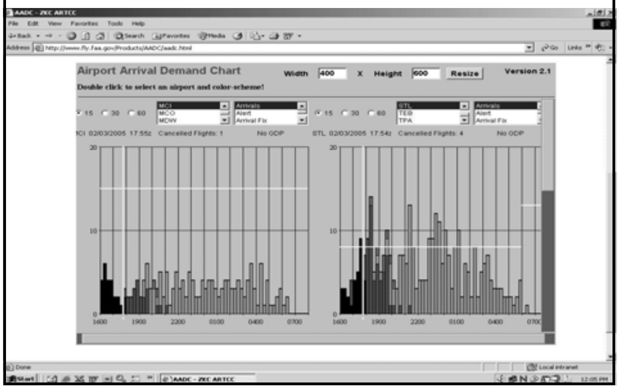
TAF Coordination for STL

TAF Coordination for MCI

MCI Arrivals

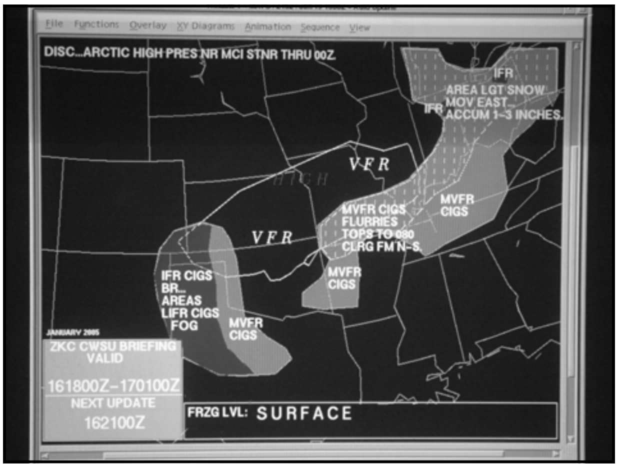


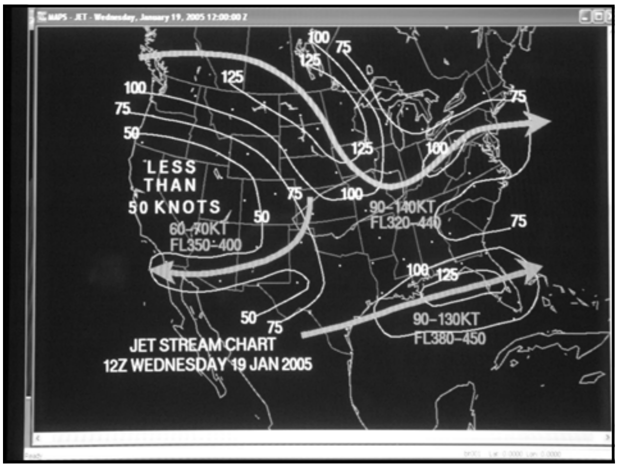
MCI vs. STL Arrivals



Duties

- Create graphic products for briefings
- Collect and disseminate PIREPS.
- Provide meteorological training to FAA controllers.





Center Weather Advisories

- Issued for:
  - Turbulence of Moderate Intensity or Greater
  - Icing of Moderate Intensity or Greater
  - IFR conditions
  - Convective Weather
  - Volcanic Ash
  - Miscellaneous

Center Weather Advisories

- Issued
  - For areas NOT covered by an AIRMET, SIGMET or Convective SIGMET.
  - As a supplement to an existing SIGMET, AIRMET or Convective SIGMET to provide additional information.

Center Weather Advisories

ZKC1 UCWA 251805 ZKC CWA 101 VAILD UNTIL 251900 FROM PWE TO 25SW ICT DVLPG LINE SEV TS…20NM WIDE…MOV FROM 28025KT…TOPS ABV FL450. HAIL TO 1 INCH…WIND GUST 50 KT POSS.

Center Weather Advisories

ZKC2 CWA 300100 ZKC CWA 203 VALID UNTIL 300300 FROM IRK TO BUM TO PWE TO IRK AREA FRQ MOD OCNL SEV TURB FL310-370. SEV TURB REPORTED BY DC10 OVR MCI AT FL350. CONDS MOV EAST AND CONT AFT 03Z. ..THIS IS ADDN INFO TO AIRMET TANGO.. ..NO UPDTS AVBL AFT 30/0300Z..

Center Weather Advisories

ZKC5 CWA 042335 ZKC CWA 501 VALID UNTIL 050000 45SSW MKC TORNADO REPORTED 45SSW MKC OR 10S IXD MOV FROM 25025KT. …THIS IS ADDN INFO TO CONVECTIVE SIGMET 27C…

Meteorological Impact Statements

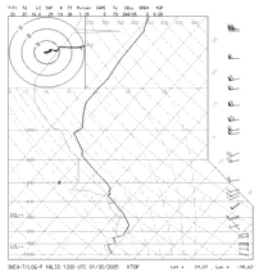
- Issued when weather conditions within the Kansas City ARTCC area are expected to adversely impact the flow of air traffic.
- A non-scheduled product.
- Valid up to 12 hours from issuance time.
- A forecast product.

Meteorological Impact Statements

ZKC MIS 01 VALID 261845-270300 ..FOR ATC PLANNING PURPOSES ONLY.. E PWE-OKC LINE AND W IRK-SGF LINE…SCT TS DVLPG 21Z-23Z FORMING A SCT-BKN NE-SW LINE…SOME TS SEV WITH TOPS ABV FL450. TS MOV E AND CONT AFT 03Z.

Forecast Challenges

- Thunderstorms
- Hub forecasts
- Turbulence and Icing
- Location of Jet Stream
- Forecasting for a large area.



Equipment

- Weather and Radar Processor (WARP)
- AWIPS Workstation
- Aeronautical Information System (AIS)
- Integrated Terminal Weather System
- Corridor Integrated Weather System
- Internet