出國報告(出國類別：其他)

出席「航空氣象現代化作業系統氣象技術增強計畫」協調會議出國報告書

服務機關：交通部民用航空局飛航服務總臺
姓名職稱：莊清堯 預報員
派赴國家：美國
出國期間：101 年 9 月 22 日~101 年 9 月 28 日
報告日期：101 年 11 月 21 日

列印

提 要 表

系統識別號：	C10103740
計畫名稱：	參加「航空氣象現代化作業系統氣象技術增強計畫」協調會議
報告名稱：	出席「航空氣象現代化作業系統氣象技術增強計畫」協調會議出國報告書
計畫主辦機關：	交通部民用航空局
出國人員：	姓名：莊清堯；服務機關：交通部民用航空局飛航服務總臺；服務單位：臺北航空氣象中心；職稱：預報員；官職等：委任(派)；E-MAIL 信箱：聯絡人 ufvejuan@gmail.com
前往地區：	美國
參訪機關：	美國國家大氣科學研究中心(NCAR)，美國航空氣象中心(AWC)
出國類別：	其他
出國期間：	民國101年09月22日 至 民國101年09月28日
報告日期：	民國101年11月22日
關鍵詞：	協調會議，美國國家大氣科學研究中心
報告書頁數：	77頁
報告內容摘要：	爲提昇臺北飛航情報區之航空氣象服務品質，提供符合民航業者需求之航空氣象產品，交通部民用航空局(以下簡稱民航局)自1997年 7月起推動航空氣象現代化計畫，與美國大氣研究大學聯盟(UCAR)合作建置航空氣象現代化作業系統(AOAWS)，並於2002年7月完成建置。然而，隨著氣象科技日新月異發展，爲持續引進新一代航空氣象預報及資料整合技術，民航局復自 2006年起至 2010年進行爲期5年之「航空氣象現代化作業系統強化及支援計畫」(AOAWS-ES)，透過前兩階段共10年之計畫，有效強化本區航空氣象服務品質。然而，隨著氣象科技的進步，爲持續增強AOAWS系統預報產品，達成產品高度客製化服務，民航局自2011年起執行爲期四年之「航空氣象現代化作業系統氣象技術增強計畫」(AOAWS-TE)，該計畫爲AOAWS系統第三階段計畫，期能透過與飛航安全及飛航效率有密切關係之天氣現象(如積冰、亂流偵測預報及機場低能見度及低雲冪天氣預報)技術的增強與檢測，提升並加強危害天氣資訊之航空氣象服務。爲有效管理及瞭解美方本年度工作執行情形，並討論明(2013)年新年度工作規畫，奉派於2012年9月22日至28日赴美國科羅拉多州博德市（Boulder）之國家大氣研究中心（NCAR）參加業務協調會議，並參訪位於密蘇里州堪薩斯市之美國航空氣象中心(AWC)及訓練中心，以瞭解美國航空氣象人員如何將AOAWS工中之積冰及亂流產品(運用於日常航空氣象作業之中，作爲規劃未來航空氣象作業之參考。
電子全文檔：	C10103740_01.pdf
出國報告審核表：	C10103740_A.doc
限閱與否：	否
專責人員姓名：	
專責人員電話：	

列印

目次

壹、目的 2

貳、過程 4

參、心得 24

肆、建議事項 27

伍、附錄 28

一、會議議程 28

二、會議討論議題 29

壹、 目的

爲提昇臺北飛航情報區(以下簡稱本區)之航空氣象服務品質，提供符合民航業者需求之航空氣象產品，交通部民用航空局(以下簡稱民航局)自 1997 年 7 月起推動航空氣象現代化計畫，與美國大氣研究大學聯盟(The University Corporation for Atmospheric Research, UCAR)合作建置航空氣象現代化作業系統(Advanced Operational Aviation Weather System, AOAWS)，並於 2002 年 7 月完成建置。然而，隨著氣象科技日新月異發展，爲持續引進新一代航空氣象預報及資料整合技術，民航局復自 2006 年起至 2010 年進行爲期 5 年之「航空氣象現代化作業系統強化及支援計畫」(The Advanced Operational Aviation Weather System Enhancement and Support， AOAWS-ES)，透過前述兩階段共 10 年之航空氣象現代化計畫，已明顯改善本區航空氣象預報準確率和飛航服務品質。

然而，隨著氣象科技的進步，爲持續增強 AOAWS 系統預報產品，達成產品高度客製化服務，民航局自 2011 年起執行爲期四年之「航空氣象現代化作業系統氣象技術增強計畫」(Technical Enhancement for the Advanced Operational Aviation Weather System， 以下簡稱 AOAWS-TE)，該計畫爲 AOAWS 系統第三階段計畫，期能透過與飛航安全及飛航效率有密切關係之天氣現象(如積冰、亂流偵測預報及機場低能見度及低雲冪天氣預報)技術的增強與檢測，提升並加強危害天氣資訊之航空氣象服務。

本(2012)年度爲 AOAWS 第 15 號執行辦法(Implementation Agreement No.15, IA#15)，係 AOAWS-TE 之第二年工作合約，年度工作項目包含(一)發展飛行中積冰診斷產品（CIP）；(二)開發及建置 NCAR 亂流偵測演算法產品（NTDA）；(三)強化機場雲冪高和能見度預報產品；(四)強化顯示系統；(五)AOAWS 資料系統更新、測試與整合；(六) AOAWS 系統強化、支援及維護；(七)教育訓練及(八)專案管理、行政協調及文件準備等八個主要項目。

爲有效管理及瞭解美方本年度工作執行情形，並討論明(2013)年新年度工作

規畫，職奉派於 2012 年 9 月 22 日至 28 日赴美國科羅拉多州博德市（Boulder）之國家大氣研究中心（NCAR）參加業務協調會議，並順道參訪位於美國密蘇里州堪薩斯市之美國航空氣象中心(AWC)及訓練中心，以瞭解美國航空氣象人員如何將 AOAWS 工作項目中之相關積冰及亂流產品(如 CIP 及 NTDA 等)運用於日常航空氣象作業之中，作爲規劃未來航空氣象作業之參考。

貳、 過程

本次出國案過程說明如下：

第一天 9月22日（六）

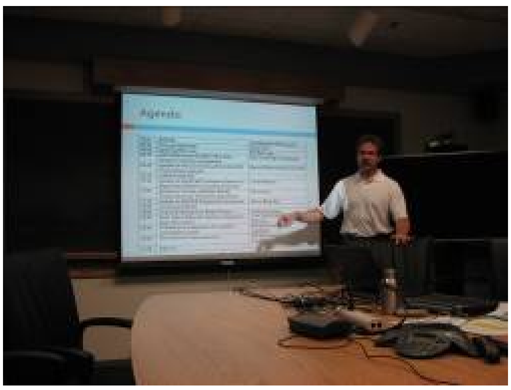
職與民用航空局航管組余技正曉鵬等2員，搭乘臺灣時間16:40長榮班機(BR12)由臺灣桃園國際機場前往美國洛杉磯。經過漫長的飛行航程之後，於洛杉磯時間9月22日15:55抵達，轉搭當日21:45美國航空班機至科羅拉多州丹佛國際機場。經過約2小時30分鐘的飛行，於丹佛時間9月23日凌晨01:00抵達，隨即搭車至博德市(Boulder)下榻旅館(Best Western Golden Buff)。

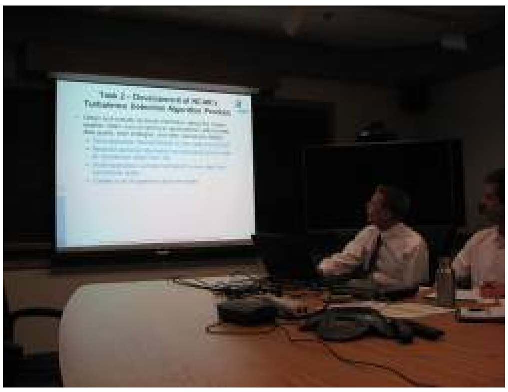
第二天 9月23日（日）

本日為美國當地週日，職於旅館複習整理臺灣所帶來之會議相關資料，為明日會議做好準備。在複習工作告一段落後，稍事休息以調整時差。

第三天 9月24日（一）

上午09:00-09:15於NCAR(FL-3 ROOM 2072)展開協調會議。首先，由AOAWS-TE計畫專案經理Mr. Bill Mahoney介紹與會人員，並說明本次會議安排方式及進行討論之議題，會議即順利開始。


圖一、Bill Mahoney主持會議


圖二、Gary Cunning進行簡報

上午09:15-09:45由Mr. Gary Cunning就IA#15之應辦事項及至目前為止執行進度進行簡報，內容摘要如下：

航空氣象現代化作業系統氣象技術增強計畫第15號執行辦法(AOAWS-TE IA#15)工作項目，共有八大工作項目，相關說明及執行細節如下：

一、工作項目#1–發展飛行中積冰診斷產品：

(一) 開發及提昇積冰產品之軟體，並整合及使用AOAWS資料來源，包括天氣研究與預報模式(WRF)、衛星及地面天氣觀測資料。

(二) 研究校準方法及完成校準程序。

(三) 進行積冰個案研究評估，以確保演算法能夠有效診斷積冰。

(四) 準備CIP產品開發報告於每月及每季之工作進度報告中。

二、工作項目#2–開發及建置NCAR亂流偵測演算法產品：

(一) 蒐集及評估臺灣氣象雷達之相關技術資訊，如技術文件、資料格式、資料品質、雷達掃瞄策略及其他作業細節。

(二) 蒐集臺灣都卜勒雷達樣本資料。

(三) 使用特定之臺灣都卜勒氣象雷達資料，發展及精進亂流偵測演算法。

(四) 測試亂流偵測演算法，確保其診斷功能。

(五) 進行建立AOAWS系統與臺灣雷達資料連結，並備份研發所需之雷達資料。

三、工作項目#3–強化機場雲冪高及能見度預報產品：

(一) 蒐集並處理民航局選定機場之檔案觀測資料和WRF模式資料。

(二) 應用統計方法和技術，發展模式和觀測資料之間的統計關係。

(三) 驗證和開發用於AOAWS作業上之最佳預報演算法。

(四) 在UCAR的測試環境中，測試修改後的雲冪高及能見度預報演算法。

(五) 整合新的演算法至AOAWS。

(六) 驗證機場雲冪高及能見度的預報能力。

四、工作項目#4-強化顯示系統：

(一) 遵循Jadite（Java Framework）顯示軟體架構進行新一代航空氣象產品顯示系統（JMDS）重新調整。

(二) 開始進行開發取代互動式資料顯示介面（CIDD）所需要之JMDS功能。

(三) 在UCAR測試環境中，開發及測試取代航空氣象產品顯示系統（MDS）主機之CIDD之新JMDS顯示設定功能。

(四) 修改JMDS及WMDS系統，以顯示CIP及NTDA產品，並在UCAR之AOAWS實驗室環境中執行測試。

(五) 在新的AWOS軟硬體安裝後，將馬祖北竿機場(RCMT)資料加入AWOS顯示系統。

五、工作項目#5-**AOAWS**資料系統更新、測試與整合：

(一) 支援民航局修復任何AOAWS資料系統的故障問題。

(二) 在世界區域預報系統（WAFS）系統轉換至全球網際網路檔案系統（WIFS）系統過程中，對AOAWS處理程序作必要的調整，並更新系統文件。

(三) 將衛星資料（MTSAT-2）由日本氣象協會(JWA)資料格式轉換成日本氣象廳(JMA)資料格式。

(四) 開發能夠處理JWA提供之衛星資料（EUMETSAT）的能力。此項工作包括這種新資料加入後所造成之AOAWS系統架構改變。

(五) 開發AOAWS系統程式碼，能夠整合包括新的及強化後之亂流與積冰產品之新資料形態；並且在UCAR的AOAWS測試環境中，測試這些程式碼。

六、工作項目#6-**AOAWS**系統強化、支援及維護：

(一) 協助AOAWS作業支援及維護工作，包括新的硬體安裝及網路配置變動。

(二) 當有AOAWS各式軟體發生問題時，提供問題及障礙排除之協助。

七、工作項目#7–教育訓練計畫：

(一) 資料來源及資料處理程序、網路設定及頻寬要求。

(二) 使用者顯示系統、系統運作及監控系統(包括SMD顯示)。

(三) 系統運作及監控系統(包括SMD顯示)、系統設定。

八、工作項目#8-專案管理、行政協調及文件準備：

(一) 執行例行專案管理，如規劃、預算分配、與團隊成員進行技術協商以及進度追蹤。

(二) 準備每月及每季的工作進度報告。

(三) 取得並檢視AOAWS-TE系統之使用者意見。

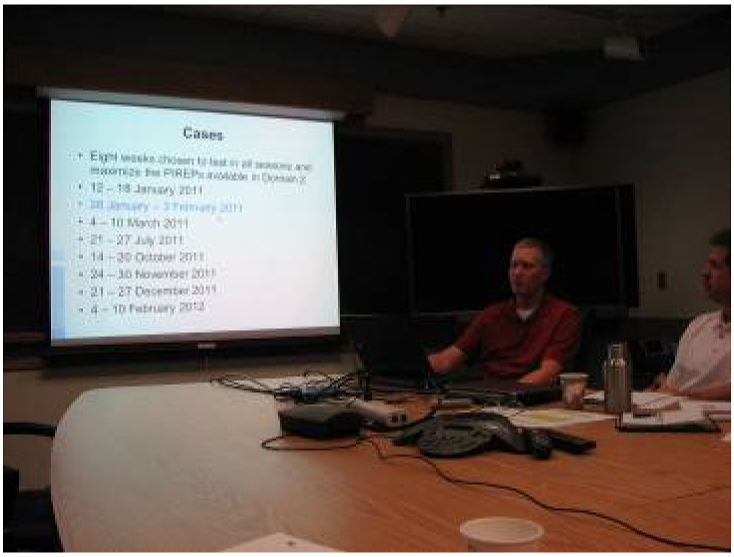
(四) 回覆例行性技術及資訊要求。

透過簡報及測試中系統，職已充分瞭解IA#15之所有工作項目已幾近完成，其餘工作項目(如使用者手冊及系統驗收版本安裝等等)持續由NCAR依合約所定期程辦理中，應可順利完成IA#15合約所訂之工作，並於今年度驗收日交付驗收。

上午09:45-10:15由Ms. Marcia K. Politovich進行「NCAR’s Icing Forecasting and Diagnosis Projects」簡報，主要係針對AOAWS-TE IA#15 Task#1: 發展飛行中積冰診斷產品之工作項目進一步說明，其介紹美國國家航空暨太空總署（NASA）所使用NIRSS(NASA Icing Remote Sensing System)系統，其透過多頻道輻射儀(radiometer)、X或K-Band垂直指向之雷達及雲冪儀(Ceilometer)等裝備，偵測機場附近積冰之狀況。另Mr. Cory A. Wolff，亦進行「Current Icing Product (CIP) Status」簡報，說明美國所使用WRF-RAP(CONUS)與臺灣使用之CWB-WRF之差異，包括模式執行頻率、輸出延遲及有效期間等。同時，亦說明NCAR團隊已利用8週針對美國地區模式輸出資料、地面及高空觀測資料、雷達資料、飛機報告與衛星資料，進行WRF-RAP與CWB-WRF校驗，期能找出差異，並發展適合本區之CIP演算法。

目前測試發現CWB-WRF受限於中央氣象局(CWB)高速電腦資源及資料同化程序，一天僅能提供4個run的模式資料，無法如同NCAR實驗室之WRF-RAP採每小時進行更新資料程序，但其CWB所產生的模式資料用於積冰預報之可用性及準確度，仍高於NCAR實驗室所用之WRF資料，因此在積冰所需的模式基礎資料上，本區航空氣象部分已佔有優勢。而CIP其餘所需的及時觀測資料部分包

含衛星、雷達、高空及地面觀測、閃電等等資料，其中本區所欠缺的是飛機報告資料(高空資料)，因此目前在研發此項工作時，NCAR將暫時使用美國東南角(佛羅里達州周邊)作爲研究開發系統範圍，配合美國日常接收的大量飛機報告，進行實驗室開發階段。而待今年驗收之後，NCAR團隊將依IA#16規劃於本區今年冬季及明年梅雨季時，由航機進行密集的飛行中積冰資料蒐集工作所得資料，經由校驗方式正式將此演算法依本區天氣特性進行適當之調整，以達到真正量身定做符合本區天氣特徵條件。相關工作本總臺已經於今年4月時開始著手規劃執行方式，預計於今年11月份經由教育訓練進行作業宣導，並於12月派員前往各國籍航空公司進行相關作業說明，爭取航空公司支持及全面性配合。



圖三 Cory A. Wolff說明CIP工作項目

上午10:15-10:30 Coffee/Tea break。

上午10:30-11:00由Mr. John Williams爲與會人員進行「Update on the NCAR Turbulence Detection Algorithm (NTDA) Product Development」簡報，首先介紹雲中亂流之即時偵測，提供了AOAWS系統有價值的新資料輸入，不僅能幫助駕駛員及飛航管制員，評估與天氣相關之飛航危害性，特別是在對流天氣發生期間，能增進飛航安全及空中流量。NCAR亂流偵測演算法(NTDA)，是一套設計以使用作業性都卜勒氣象雷達資料爲基礎之先進都卜勒氣象雷達亂流偵測演算法。本項技術是UCAR在美國聯邦航空管理局（FAA）航空天氣研究方案贊助下開發完

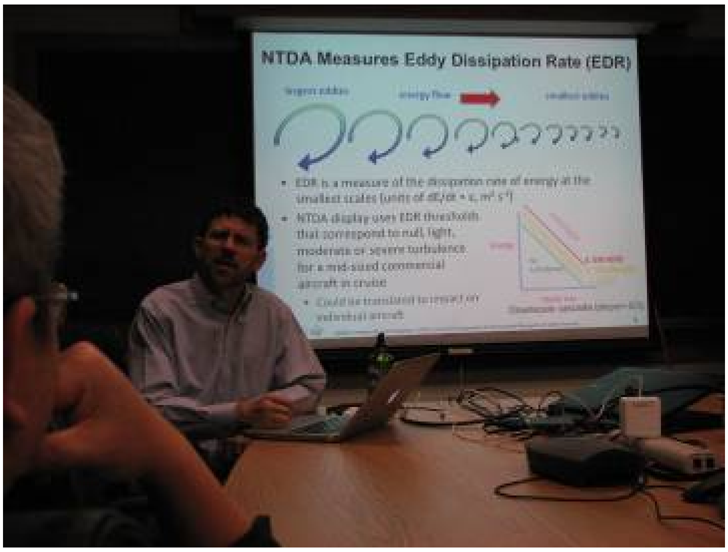
成，其原理是利用NEXRAD(S-band)都卜勒雷達偵測之回波場、徑向速度場及波譜寬度等資料，經過資料品質管制，並處理計算出與個別航空器機型無關之渦流消散率(EDR)。EDR可用以表示航空相關亂流強度的等級分類(例如輕度、中度或重度等)。

NTDA工作項目完成後共產生兩個產品並整合於現行作業中之AOAWS供使用者使用，分別為NTDA雷達回波整合(mosaic)產品以及NTDA亂流產品，目前臺北航空氣象中心雖已接收由中央氣象局所完成的雷達回波整合資料，但由於其有整合資料及產品傳輸的限制，因此本項資料偶有時間延遲情況，但在NTDA工作項目完成之後，AOAWS則利用已經接收到的中央氣象局雷達資料進行回波整合，經由資料在地製作並於在地顯示的方式，將可進一步提升雷達回波整合產品的可用性及參考性。另在NTDA亂流產品部分，由於目前AOAWS所使用的亂流產品演算法與美國FAA所使用的GTG2.5版本雷同，但本項演算法以模式資料為演算參考，其主要提供晴空亂流部分資訊，對於雲中亂流尚無法進行預報。在NTDA工作項目完成後，AOAWS將可提供晴空及雲中亂流之相關資料，航機更可透過產品瞭解最新的亂流區域變化，藉此提升本區飛航安全。

NTDA產品之開發、建置及測試時程將從2012年至2014年，臺北航空氣象中心已於今年初完成介接中央氣象局五分山、七股、花蓮及墾丁雷達站原始資料工作。NCAR為臺北航空氣象中心主動及快速的引入NTDA所需之雷達原始資料，表示感謝之意。特別在今年梅雨季及颱風季，NCAR利用所接收到的原始資料進行多項重要測試與資料演算法調校，此將大大有助NTDA工作項目於臺北飛航情報區的執行效能。

職詢問NCAR取自臺灣氣象雷達資訊之測試結果，簡報人員認為NCAR幾能正確解碼，現正進行調整和測試，以確保正式上線時，產品能夠符合預期效益。唯美方人員在解譯中央氣象局五分山雷達資料時，發現該雷達屬德系公司製作，資料格式與其他三個雷達資料不同，部分演算資料需要透過技術文件進行確定，確保演算資料完全正確，故希望我方協助提供氣象局雷達資料之報頭(Header)資

訊，以利其進行氣象資料進一步比對。



圖四、John Williams說明NTDA工作項目

上午11:00-11:30由Mr. Jim Cowie為與會人員進行「Enhancement of Airport Ceiling and Visibility Product」簡報，首先說明此工項係分析最新WRF模式系統設定所產生之資料，配合過去WRF模式輸出資料及本局選定之機場觀測資料，透過進行演算法運算，其結果利用於短時機場天氣預報。

過去AOAWS使用模式輸出統計預報 (Model Output Statics，MOS)資料進行機場之風場、能見度、雲組、溫度及氣壓預報。其原理為透過WRF模式產生之資料與過去及目前所得觀測資料進行比對及調校，將輸出的模式輸出資料調整為與現行機場天氣接近的數值後，進行後續時間的天氣預報。但過去所使用的比對及調整技術較為簡單，若遇到天氣劇變時，往往出現落後反應情況，導致資料可用度下降。

而本項工作在於使用強化後的後級統計方法處理，進行統計最佳化預報。其中，前述的後級統計方法包括資料探勘、隨機叢林法及其他適合之統計方法或技術，利用過去觀測資料在不同天氣系統的變化情況，配合當時所得之模式輸出資料，進行歷史時間序列資料進行調整，由於參考歷史資料後，可避免在天氣劇變時，資料無法立即反應快速變化之機場天氣要素數值，可有效提升預報資料的穩定度及可靠性。最後得到之演算法將取代現行簡單的統計方法。新技術也會被整

合至AOAWS系統內，以強化機場之風場、溫度、雲冪高及能見度之預報能力。

簡報者說明IA#15此工項之最新進度，以及針對臺灣10個民航機場低能見度及雲冪之測試結果，並說明因臺灣屬副熱帶海島型氣候，全年皆有受到顯著天氣系統影響的情況，經常出現天氣變化快速的情況，因而透過各種數學統計方式及技術後，發現很難以單一演算方式適用於所有臺北飛航情報區之機場天氣預報，且在同一機場之各項天氣要素預報也很難以單一演算方式適用。因此，NCAR利用不斷嘗試的方式，找出適合各機場之各項天氣要素的數學統計演算法，並與過去MOS輸出結果進行比對，至會議當天為止，統計運算結果已有了明顯的進步。本項工作項目將於2012年底上線。屆時臺北航空氣象中心將請預報員進行在不同天氣下之資料結果分析，並將結果交予NCAR參考。預計在2014年NCAR將對於AOAWS本項產品所蒐集到的使用者回饋意見，為本產品進行再次精進的調校。

上午11:30-中午12:00由Mr. Aaron Braeckel為與會人員進行「Display Update」簡報。JMDS將於今年進行重大的改變，其將由Java的Jade程式作業平臺(framework)改為Jadite的程式作業平臺。其原因除了Java公司已經推出程式作業平臺更新版本外，也為了以後系統需因應越來越多的使用者所提關於調整顯示畫面需求，JMDS轉植於新版的framework後，未來可直接設定其XML格式的設定檔，調整JMDS各項航空氣象產品的顯示方式。會中在展示未來JMDS之新面貌同時，經由短暫的示範操作，說明CIP、NTDA、歐洲衛星資料產品顯示方式及設計理念。新版JMDS程式碼將在2012年年底之前安裝於線上作業系統中。

另外今年臺北航空氣象中心已申請完成專屬總臺JMDS專用的Java憑證，預計將於今年底或明年初更換JMDS之Java憑證，不再使用NCAR開發用的Java憑證，此將使目前臺北飛航情報區航空氣象資訊服務的主力系統「JMDS」，資訊安全部分更添一分保障。

今年度新增民航機場（馬祖北竿）AWOS即時資料顯示等工項部分，臺北航空氣象中心已能運用去年前往NCAR受訓所學，自行辦理資料接收及轉化工作，最後由NCAR進行軟體及程序的確認及微調，本項目已於今年3月28日於航空氣

象服務網上線服務，並持續穩定運作。NCAR認為未來臺北航空氣象中心已具備自行辦理接下來其餘民航機場AWOS汰換後由設備硬體輸出後的接收資料、轉化乃至於利用總臺的Java憑證完成顯示介面調整的能力，此為臺北航空氣象中心的一大進步。

下午2:00-下午2:30由Ms.Cathy Kessinger介紹「Airport Bird Detection Radar Project」簡報，目前美國FAA使用設置於機場的高頻雷達，偵測機場周圍之移動物體，透過演算法判斷移動物體是否為鳥群，以及其可能移動的方向速度，用以提供航機起降是否受鳥群影響的預警資訊。會中透過投影片中的實際案例及影片，說明該系統對於避免航機鳥擊事件有著莫大的幫助，雖然目前仍有誤判的情況，但已為美國本土各大機場所使用。目前本區民航機場鳥擊事件較少，主因為各航空站航務單位定時巡場驅離鳥群，且於適當區域設置鳥群攔截網之故。因此本項介紹本區之需求性較低。

圖五、Cathy Kessinger進行簡報

下午2:30-3:30 NCAR由Dr. David Johnson進行「Wind Shear Detection Systems Upgrades-Open Discussion」之研討。主要係針對臺灣桃園及松山機場低空風切警告系統（LLWAS）站台遷移及硬體汰換設置等相關議題進行討論。首先，由職

針對先前美方對LLWAS系統各站台之遷移建議說明目前辦理情況及所遭遇之困難。說明如下：

(一)松山機場：經過去年度NCAR的評估，目前LLWAS明顯受到環境影響的站臺爲八號站(位於臺北市民權國中屋頂)，但由於松山機場位於都會區，周圍大樓林立，同時用地取得較爲不易，因此臺北航空氣象中心已奉總臺核准本站將留置原址，未來新LLWAS本站的演算法必須濾除受影響方向的風場，或另俟得標廠商選定更佳的移設地點。因此職利用此機會與NCAR討論八號站是否有更佳的移設地點做爲日後參考，NCAR指出該站的另一選擇爲靠近原站址南方的蓬萊國小或靜修女中屋頂(以上兩處地近寧夏夜市)。

以上資訊將納入未來松山機場LLWAS汰換案相關站點用地取得及移設腹案。而目前總臺辦理松山機場LLWAS用地取得工作，已幾近完成(保持原簽奉方案)。

(二)桃園機場：目前之LLWAS受到周圍環境影響之站臺有中央風塔、七號站及八號站。

中央風塔將移設至機場東北方海巡署海湖訓練基地中，本站已獲海巡署全力支持，僅剩設置方式需由雙方經過討論得到共識後決定。

七號站部分，原預計移設於機場西南方苗圃位置，但是桃園機場即將進行A3整建計畫，使得原預定地不可使用，故臺北航空氣象中心也簽奉總臺核准此站未來將保留原地，同樣以演算法調整捨棄受影響方向之風場資料。NCAR於會中認爲此站已無更佳的解決方式，總臺之處理方式合宜。

八號站預定地受到周圍機場捷運工程影響，用地部分需要進一步由總臺相關單位與高鐵局及桃園捷運公司進行共同會勘確定最後位置後，即可由總臺進一步接洽租約事宜。

松山及桃園機場LLWAS汰換案預計103年完成。

圖七、與David Johnson討論LLWAS辦理情況並交換意見

下午3:30-4:00 NCAR進行「ATM Weather Integration Task(IA#15 related) Discussion」簡報。由於天氣多變特性，天氣因素對忙碌密集之飛航作業造成衝擊且會增加航管系統使用者決策的複雜性，因此提供整合性航空危害天氣資訊予飛航管制人員是刻不容緩的。明年度IA#16其中一工項係瞭解使用者對於將危害天氣產品整合至飛航管理系統(Air Traffic Management System，以下簡稱ATMS)環境的需求，並發展初始之作業概念，以使飛航管制員、督導及管理者能夠給予機師及航路中位於顯著積冰、亂流及雷暴等危害天氣周圍之航機更好的指引。使用者需求及基本作業概念之發展將著重於臺北區域管制中心(Taipei Area Control Center，TACC)飛航管制員、督導及管理者之實際需要。AOAWS系統中危害天氣資訊產品，將是未來整合至ATMS可能資訊，包括來自雷雨辨認路徑追蹤與即時預報系統(Thunderstorm Identification, Tracking and Nowcasting，TITAN)之雷雨位置、NTDA之對流性亂流資訊及CIP之飛行中積冰產品資訊等。由於本局ATMS系統最近才剛建置完成，這些產品真正整合到ATMS系統還太早，因此本項工作並不包含相關產品之實際整合。

此項工作將包括成立一個任務小組，成員包括UCAR及CAA管理人員、飛航管制人員及可能之ATMS系統技術人員。該小組將研究及討論危害天氣資訊顯示於ATMS系統上之使用者需求及使用這些資訊以提昇飛行安全及飛航管理效率的作業概念的初步構想。

圖八、Bill Mahoney進行ATM Weather Integration Task Discussion簡報

下午4:00-5:30 進行「Discussion of open questions」IA#15及IA#16規劃進行討論，會議討論議題摘要如下：

一、2014年CWB將升級WRF之解析度(3公里/15公里)，範圍未定，同時未來WRF計畫增加預報時間長度，AOAWS系統將如何因應?

NCAR回覆：系統上各項產品，例如：ITFA、CIP、FIP及RIP等產品需進一步測試並改變，另WRF模式資料庫亦應一併調整，所牽涉的範圍相當大。2009年AOAWS曾為因應WRF模式解析度由原本45/15/5km調整為20/4km，NCAR為此進行相關調整工作耗時1年多方能完成的過去經驗，故變更WRF模式解析度將是重大工程，除前述相關產品必須隨之調整外，AOAWS系統會因為解析度調高而使負載將增加，其資料傳輸頻寬、硬碟空間及CPU應同步提昇。

職表示由於本項工作牽涉範圍甚巨，且中央氣象局之新網格點實際上線期程不甚明確，且預報效能是否與目前解析度有長足進步部分，皆屬於未知數。另中央氣象局已經表示目前解析度的WRF可在新模式高速運算電腦正式運轉後，納入即時的資料同化方式，此將使目前解析度的WRF模式準確率提升，因此提升WRF模式準確度似乎並非重要跟進項目。本議題將由本總臺、中央氣象局及NCAR經過審慎評估其效益後，決定是否跟進調整。

二、未來當衛星圖檔解析度及範圍調整時，AOAWS系統將如何因應?另外，在

MTSAT原始資料處理部分，如遇未來日本更新衛星時，AOAWS系統將如何調整?

NCAR回覆：衛星雲圖資料最重要的工作在於資料格式的轉化，所有資料需要轉化成MDV檔案，AOAWS系統才可以使用，因此相關程序應一併修正。本項工作需要有相當程式經驗及熟稔AOAWS系統架構的工程師方能勝任。

職表示目前日本之MTSAT-1R及MTSAT-2衛星，即將於2014年發射新氣象衛星且於2015年完成新舊衛星平行作業後退役，但因詳細時程及其他細節仍需待日本逐步提供相關精確資訊加以釐清。在日本提供明確資訊供總臺及NCAR進行評估前，尚有諸多變數，且AOAWS-TE執行時間至2014年年底為止，以目前總臺對於NCAR所提之資料轉化部分恐無法勝任，而導致新衛星資料接收處理時程可能發生疑慮。故本總臺將密切留意日本新氣象衛星發射時程及相關資訊，進而評估本項工作因應策略。

三、**有關JMDS及AWOS Display所需要之Java版本問題。未來當Java改版時，AOAWS系統將如何調整?**

NCAR回覆：NCAR目前在Windows及Linux-based的環境下執行Java 6及7均無異常現象，另臺北航空氣象中心中心日前所提Java由6.0升級至7.0導致JMDS及AWOS顯示系統無法執行情況，經NCAR測試後可能是網路或防火牆設定的問題所致。但NCAR表示Java不相容情況確實有可能發生，因此期將持續關注Java環境之開發，瞭解其是否仍保留向後相容之特性。另外在任何Java版本上線時，也有可能出現短暫不相容情況，這時需要建議JMDS及AWOS資料顯示介面使用者暫時保留在原本可以使用的Java執行環境(JRE； Java Runtime Environment)中，等待穩定版本釋出後，再行安裝升級。

職表示今年7月Java官方宣布Java 6.0升級至Java 7.0時，剛上線的Java 7.0版本確實導致JMDS及AWOS顯示介面出現問題，所幸Java官方很快的推出升級7版(Java 7.0 Updated 7)程式後，前述問題全數恢復正常。臺北航空氣象中心將持續並測試留意Java版本與前述系統相容性問題，並適時提供NCAR回饋意見。

四、綜合以上三點，NCAR是否可將上述可能涉及調整的部分，將目前處理程序參數化?未來AOAWS系統僅需針對參數調整即可?

NCAR回覆：目前AOAWS並無法利用參數方式設定系統，用以因應使用新的資料源輸入處理。但NCAR計畫撰寫為因應未來可預期之系統改變的一般標準處理程序，並提供一些指導，以使飛航服務總臺有能力面臨這些改變。另NCAR表示，將系統調整為設定檔方式變更處理不同資料格式的想法，牽涉到系統根本架構調整，影響程度甚大。NCAR將持續與本總臺討論本項議題後續及可行方案。

五、有關開發機場雲冪及能見度預報工作項目是否包含校驗版面?如果沒有，何時可以開發完成?

NCAR回覆：前述產品之校驗系統並未包含在IA#15的工項中。但NACR已經於開發本項產品時，已進行長時間的校驗，其結果報告可提供予本總臺參考。線上校驗版面設置可於2014年(IA#17)辦理。

職表示本產品相關校驗系統應符合航空作業需求，建議應有不同時間間距之校驗結果供作業參考，如校驗結果應供使用者視需要點選最近半小時、1小時、3小時、6小時、12小時、24小時、1周、1個月及更長等等時間間距的結果。詳細資訊將由職與臺北航空氣象中心進行充分討論後，將校驗版面藍本送NCAR進行設計規劃。

六、AMDAR資料何時可顯示於JMDS中？

NCAR回覆：民航局目前接收的AMDAR資料主要來自向中央氣象局介接的全球通訊線路(GTS)資料之中，今年中央氣象局已將接收到的GTS資料分成文字(text)檔及數位資料格式(bufr)檔，以方便本身及民航局使用。NCAR目前已經成功解譯text格式，並已納入AOAWS之Web Service中，但目前尚無查詢介面可查詢。NCAR計畫於2013年開始解譯bufr格式資料，並於該年4月AOAWS第12版更新時，將相關查詢及顯示介面納入系統，供使用者查詢使用。

七、有關本局飛航服務總臺所申請之Java Certificate，何時可運用於JMDS及AWOS DISPLAY中?

NCAR回覆：NCAR、資拓宏宇公司（IISI）及民航局將建立相關程序，使用飛航服務總臺所申請之Java Certificate，以替代現行由NCAR的Certificate。預計在今年底或明年初前述兩系統全面改用使用飛航服務總臺所申請的Java Certificate。本次更換憑證工作由於相關程序尚未建立，將由IISI協助辦理，臺北航空氣象中心將從旁學習。

八、**RCFG(南竿)機場AWOS系統也將於2013年11月驗收，請NCAR一併於2013年完成RCFG機場的AWOS Display。**

NCAR回覆：NCAR將俟南竿機場AWOS資料接收後，進行以今年馬祖北竿機場方式此項工作。由臺北航空氣象中心進行資料接收及轉化工作，並由NCAR進行相關程序確認並納入版本控管系統(CVS)。有關資料顯示介面可依同樣模式或由NCAR完成。另本項工作進行前，需由臺北航空氣象中心及IISI確定南竿機場資料輸出軟硬體設定以及資料輸出格式欄位已經完備。由於南竿AWOS之驗收時間與AOAWS第12版之安裝時程過近，所以此工項將於IA#16驗收會議後完成。

九、**今年度AOAWS驗收版本安裝時程，因牽涉到Debian6 64位元版本安裝，NCAR是否依然計畫於11月開始進行並且確定於驗收日前完成?**

NCAR回覆：為使年底驗收前系統穩定運作，NCAR將以Linux Debian6 32位元作業版本為今年系統驗收版本。由於作業系統版本並未更新，僅更新AOAWS版本，因此依原訂時程可完成。

職表示IA#15合約中並未規定Linux作業版本，因此本次NCAR為求系統穩定驗收順利，僅安裝今年度AOAWS驗收版本，並不違背合約精神。另查Linux作業系統已於今年7月~9月間完成Debian 6.0 32位元版本之安裝，目前為止穩定運作。請NCAR確實依照預定期程進行AOAWS驗收版本安裝。

十、今年驗收作業預計行程。

NCAR回覆：本次來臺參與飛航服務總臺驗收會議之成員有Mr. Bill Mahoney(12月4日抵臺)及Mr. Gary Cunning(12月3日抵臺)，驗收會議時間依IA#15合約表訂時間12月6日進行。驗收完成後，NCAR人員將於12月8日離臺。

十一、明年度的臺灣及美國所辦技術轉移訓練計畫時間。

NCAR回覆：明年度臺灣地區技術轉移訓練預定於2013年4月22日辦理，而舉辦於美國Colorado Boulder的技術轉移訓練預定於2013年9月9日進行。

臺北航空氣象中心將針對前述預定日期進行相關討論，由於目前距明年度技術轉移訓練時間尚久，待相關時程確定後在與NCAR進行相關課程等細節討論。

第四天　9月25日（二）

職與余技正曉鵬在Gary Cunning陪同下，依據原規劃行程，搭乘美國聯合航空UA571班機，由丹佛市前往位於密蘇里州（Missouri）之堪薩斯市（Kansas City），航班於當地時間約11時抵達。我們一行三人隨即驅車前往美國航空氣象中心（AWC）進行參訪。

上午11:30-下午3:00由Mr. Joe Bishop帶領我們拜會該中心之Director，Mr. Robert W. Maxson，並說明此次我們參訪的目的；Mr. Robert W. Maxson亦表達對我們的歡迎之意。

AWC隸屬於美國商業部國家海洋大氣總署（NOAA）美國國家氣象局（NWS）轄下之國家環境預報中心（NCEP），與AWC同位階另有其他八個中心。AWC主要係爲美國本土、阿拉斯加及夏威夷等地區之航空氣象服務之供應者，同時亦爲世界區域預報中心之一，與英國倫敦共同提供全球航路預報，且此二中心互爲備份。

依據ICAO第三號附約之規範，各締約國應指定主管機關安排氣象單位進行飛航所需航空氣象服務。其中，美國與倫敦爲世界區域預報中心，主要任務係提供有效、一致及高品質之航路顯著天氣預報圖（SIGWX）；其他各締約國不需再自行開發系統，可有效節省成本。各國僅需加強飛航情報區之低層顯著危害天氣、機場預報及觀測等工作。

因此，爲遂行前述之任務，各締約國需安排氣象辦公室，進行其飛航情報區之航路預報（SIGWX）、機場各項天氣預報（TAF、趨勢預報、起飛預報等）

及顯著危害天氣資訊（SIGMET、AIRMET）之發布，另亦須安排航空氣象臺進行航空氣象觀測作業，用以發布最新之機場天氣（METAR、SPECI）。

首先我們參觀AWC如何製作符合ICAO規範之全球顯著天氣圖，AWC以北緯20度分南北二半球區域，分別由二個席位人員製作後組合而成全球顯著天氣預報圖。製作過程中，席位人員會透過網路與各地之預報員討論該中心所製作之產品，並交換意見，必要時做適度之修正。職詢問值班人員，全球尺度的顯著危害天氣圖中積冰、亂流及噴射氣流等資訊對航機幫助很大，製作時是否有參考數值模式呢?值班人員告知，現在氣象人員有時過於相信數值模式，反而減少對各項危害天氣學理成因之分析，不利於掌握各項天氣之演變。此外，部分區域之天氣特性亦需透過經驗累積，方能勝任該項工作。

接著，我們瞭解AWC如何透過其責任區域的分布，進行作業席位的分配，分別為熱帶席、東、西及中部席位。其中，熱帶席的預報區域為墨西哥灣、加勒比海及東太平洋海域，主要係透過一天發布二次天氣概述，預報該區域海平面12,000以下之雷暴、對流SIGMET資訊，中度以上積冰與亂流、1000呎以下平均風大於25海浬、結冰高度等資訊，以利低空飛行之直昇機作業。另由東、西及中部席負責全美航空氣象產品之製作，包含定時發布之天氣預報概述、定時發布低空危害天氣資訊（AIRMET）、非對流性SIGMET及低層顯著天氣圖（Low Level SIGWX）等產品。其中，AIRMET資訊係發布美國國內45,000呎以下之危害天氣，包含中度積冰、結冰層高度、中度亂流、低空風切、山岳波及地面強風等資訊。AIRMET每6小時發布一次，三個席位同時發布，預報有效期間為6小時，並加上6小時未來的展望。此部分與我方作法，稍有不同，臺北飛航情報區係由臺北航空氣象中心依據實際天氣或預期將發生低空危害天氣時，不定期發布AIRMET，另並針對該天氣現象進行守視。

前述作業係在ICAO規範下所提供之航空氣象服務；惟美國境內幅員廣闊，每日空中航行量很大，部分樞紐機場(芝加哥、紐約)的航行決策受天氣因素影響很大。因此，AWC為期達飛行之最大效益，有一對流整合預報席人員，每2小時

製作航路整合式對流顯著天氣預報產品予飛航使用者。此產品發布前必須與美國各地氣象人員、航空公司氣象人員及區管中心之氣象服務席位人員，使用網路進行討論，並進行預報產品草圖之修正後，統一發布預報產品。本項作業係考量飛航作業之實際需求所研製，可有效掌握航情，並提供航班管理決策參考之用。臺北航空氣象中心去年應航空公司業務需求，考量航空公司飛航東亞航線使用資料便利性，除ICAO規範之預報產品外，亦提供地面至45,000之SIGWX之預報產品，深受航空公司讚許。

綜上所述，美國因其地理環境及天氣特性，將航空氣象預報作業依任務特性（世界區域預報中心）、區域特性（分東、西及中部預報席位）及使用者需求(全美航路對流顯著天氣整合)特性，除提供符合ICAO規範之航空氣象服務外，另兼顧飛航使用者之需求，提供所需之服務。

而ICAO所規範各機場應提供之機場預報（TAF）、趨勢預報（TREND TYPE）及起飛預報（TAKE-OFF）等預報，則由各地之天氣預報辦公室（WFO）來執行，並非AWC之業務職掌。

另外職於參訪時，詢問到目前CIP及NTDA於AWC作業上運用情況。當天AWC值班人員說明，CIP及NTDA皆爲目前用以判斷積冰及亂流的工具之一。CIP部分由於美國空中報告資料充裕，因此經過空中報告即時診斷後的結果，確實有相當的參考價值。特別在美國冬季遇到強烈寒流時，光由模式預報寒冷空氣移動的情況，不容易持續掌握其確切移動方向及速率，偶而天氣系統受制於另一個天氣系統，即時資料診斷便成爲相當重要的資訊修正及提供方式。而NTDA部分由於全美已經建構綿密的雷達網，且美國幅員廣闊，雷達掃瞄範圍不容易出現受阻情況，因此劇烈對流系統發展後，利用NTDA進行偵測，爲原本受到對流系統影響而縮小的空域，找到雲中但無亂流之區域，供航機使用。但預報員進行積冰或亂流預報時，不能光靠一種預報產品，而是要參考多種預報資料進行分析研判，如AWC進行積冰作業時也會參考實際探空資料得知高空溫度及水氣分佈情況，納入積冰預報參考資料之一；而亂流預報部分則利用多個數值模式結果，互相比

對參考，並且引進個人預報經驗，判斷積冰可能位置。目前CIP及NTDA的運作是直接呈現經過數個造成積冰或亂流天氣因子配合權重運算結果，但在實際作業上使用本項資料務必留意，因為目前結果是如何運算後加以顯示，就預報員來說是無法得知的，是否每個天氣系統都適用也無從得知。因此AWC當天值班人員一再強調，如果盡信單一產品進行預報將是相當危險的事情。

下午15:00-15:30由Gary Cunning帶領至下榻旅館，結束今天的參訪行程。

第五天　9月26日（三）

上午09：00-11：30本日依原定計畫參訪與AWC位於同一大樓之訓練中心。首先，由該中心工程及電子部門主管Mr. James H. Poole為我們說明航空氣象人員之訓練。美國航空氣象人員除依WMO之規定接受應有的學科教育外，於職前至該中心接受預報之訓練，由於該中心擁有豐富之訓練師資及支援，該中心會安排各種航空氣象訓練專業課程，並建立一系列之訓練檢查表，逐一瞭解訓練人員通過何項訓練課程。透過考核人員進行確認，作為日後預報員所具備能力之證明。

民航局下轄民航人員訓練所，專責辦理航空氣象訓練。航空訓練主要分為專業資格訓練（職前訓練及進階訓練）及專精複訓（年度複訓及業務熟悉訓練）兩大類。專業資格訓練完成且考核通過後，可從事航空觀測、預報及資訊管理等工作，並藉由各項專精複訓強化各航空氣象作業核心技能，提昇整體航空氣象人員之素質。

圖九、民航局余技正與AWC Mr. James H. Poole合影

下午4：00-6：13搭乘美國聯合航空UA 4528班機前往休士頓喬治布希國際機場。

下午9：50-10：24搭乘美國聯合航空UA 1166扳機前往洛杉磯國際機場。

第六天　9月27日（四）

於美國洛杉磯凌晨01:55轉搭乘長榮(BR15)班機回臺灣。

第七天　9月28日（五）

臺灣時間上午6:10抵達桃園機場。

參、 心得

一、 透過駐美國臺北經濟文化代表處(TECRO)與美國在臺協會(AIT) 間航空氣象現代化作業系統發展技術合作協議,民航局及美國大氣研究大學聯盟(UCAR)進行密切合作，迄今航空氣象現代化作業系統計畫已經執行 10 餘年，計畫進行期間由 UCAR 下屬機構美國國家大氣科學研究中心(NCAR)協助引入並開發適合臺北飛航情報區的航空氣象產品，目前本區的航空氣象服務已達到相當高的水準，並深獲使用者好評。

二、 即時積冰產品(CIP)，是以模式預報資料爲運算基礎，並納入即時的觀測資料進行資料修正調整,使得預報產品更加接近目前大氣情況。此爲 FAA 目前作業中使用相當先進的航空氣象產品,同時本項產品的引入使得本區之航空氣象預報由原本的 Forecast 進階爲 Nowcast 的另外一個里程碑。目前 NCAR 已經由臺北航空氣象中心取得足夠的資料，並針對本區空中報告可能不足的問題,進行系統實測與調整工作,以確保其於本區運作之系統效能。

三、 NCAR 的亂流偵測演算法(NTDA)，是一套設計以使用作業性都卜勒氣象雷達資料爲基礎的先進都卜勒氣象雷達亂流偵測演算法。本項技術是 UCAR 在 FAA 的航空天氣研究方案贊助下開發完成，利用 NEXRAD(S-band)都卜勒雷達偵測到的回波場、徑向速度場及波譜寬度等資料,經過資料品質管制,並處理計算出與個別航空器機型無關的渦流消散率(EDR)。

四、 有關強化機場雲幕高和能見度預報產品部分，NCAR 說明臺灣 10 個民航機場低能見度及雲幕之測試結果,得知臺灣機場有著天氣變化快速且劇烈情況,因此在數學統計方式下,出現不同機場需要不同的統計方式以及單

一機場不同的天氣要素也需要不同的統計方式的情況。爲此 NCAR 爲使今年驗收順利，將盡力持續進行相關調整，使得充分發揮本項工作效益，並預計在今年工作項目交付後，將於後年依據明年所蒐集到的使用者意見及個案研究結果進行精進工作。

五、 明年度IA#16之瞭解使用者對於將危害天氣產品整合至飛航管理系統(Air Traffic Management System，以下簡稱 ATMS)環境的需求，並發展初始的作業概念之工項部分，本項工作需要眾多不同單位的成員提供意見，而最理想方案是由本總臺成立任務小組，成員包括行政主管及相關決策人員、飛航管制、航空氣象及 ATMS 系統技術支援人員。

六、 美國因其地理環境及天氣特性，將航空氣象預報作業依任務（世界區域預報中心）、區域（分東、西及中部預報席位）及使用者需求(全美航路對流顯著天氣整合)等考量，除提供符合 ICAO 規範之航空氣象服務外，另兼顧飛航使用者之需求，提供客製化之服務。

七、 美國境內幅員廣闊，每日空中航行量很大，部分樞紐機場(芝加哥、紐約)的航行決策受天氣因素影響很大。因此，AWC 爲期達飛行之最大效益，有一對流整合預報席人員，每 2 小時製作航路整合式對流顯著天氣預報產品予飛航使用者。此產品發布前必須與美國各地氣象人員、航空公司氣象人員及區管中心之氣象服務席位人員，使用網路進行討論，並進行預報產品草圖之修正後，統一發布預報產品。本項作業係考量飛航作業之實際需求所研製，可有效掌握航情，並提供航班管理決策參考之用。臺北航空氣象中心亦有類似之作法，考量航空公司飛航東亞航線之需求，除 ICAO 規範之預報產品外，亦提供地面至 45,000 之 SIGWX 之預報產品，深受航空公司讚許。

八、 美國航空氣象人員除依 WMO 之規定接受應有的學科教育外，於職前至該中心接受預報之訓練，由於該中心擁有豐富之訓練師資及支援，該中心會安排各種航空氣象訓練專業課程，並建立一系列之訓練檢查表，逐一瞭

解訓練人員通過何項訓練課程。透過考核人員進行確認，作爲日後預報員所具備能力之證明。

肆、建議事項

一、 有關明年度 IA#16 瞭解使用者對於將危害天氣產品整合至飛航管理系統(ATMS)環境的需求，並發展初始的作業概念之工項部分，建請飛航業務室協助協調本總臺航管、航電、氣象之行政主管及相關人員，並請目前 ATM 軟硬體維護廠商一同組織工作小組，NCAR 計畫於今年度驗收會議後對小組成員進行簡報，使成員瞭解工作內容，俾使來年本項工作順利進行。

二、 有關強化機場雲冪高和能見度預報產品部分，為期該項產品符合本區航空氣象作業之效益，建議針對民航局所屬 10 個民航機場之低能見度及低雲冪產品，進行實際觀測結果及模式預報結果進行比對，並蒐集相關使用者意見，相關結果經彙整後送 NCAR 供 2014 年度產品精進參考。

三、 有關中央氣象局汰換模式運算高速電腦並計畫提高天氣研究與預報(WRF)模式解析度部分，其牽涉系統調整部分龐大，且高解析度部分效能及上線期程皆未定。另查中央氣象局於新模式高速運算電腦上線後，將於即時資料同化程序納入目前作業中 WRF 之模式資料，此將有效提升現行模式預報準確度，已可滿足現行航空氣象作業需求。建議由臺北航空氣象中心與中央氣象局密切連繫，留意本項議題後續，目前不需急於跟進。

四、 航空氣象現代化作業系統氣象技術增強計畫(AOAWS-TE)將於 2014 年年底結束，未來在 AOAWS-TE 結束後，航空氣象現代化作業系統將面臨系統維護等等事宜。建請臺北航空氣象中心儘速與 NCAR 及 IISI 討論未來合作策略及維護系統方式。俾利未來航空氣象現代化作業系統持續穩定運作並提供高品質之航空氣象資訊服務。

伍、附錄

一、會議議程

2012 UCAR-CAA AOAWS-TE Project Review Meeting Agenda

09/24/2012 Monday (FL-3 Room 2072)

Time	Activity	Host/Speaker/Participants
8:30	Pick-up from hotel	Celia Chen
9:00	Opening/welcome	Bill Mahoney
9:15	IA#15 status and AOAWS-TE System Version 11 and updates	Gary Cunning & Jim Cowie
9:45	Update on the Current Icing Potential (CIP) Product Development	Marcia & Cory Wolff
10:15	Coffee/Tea break	
10:30	Update on the NCAR Turbulent Detection Algorithm (NTDA) Product Development	John Williams
11:00	Update on Ceiling, Visibility, Wind, Temperature, etc. Prediction algorithms	Jim Cowie
11:30	Update on AOAWS Display Enhancement	Aaron Braeckel
14:00	Airport Bird Detection Radar Project	Cathy Kessinger
14:30	Wind Shear Detection Systems Upgrades-Open Discussion	CAA, Bill Mahoney , David Johnson
15:30	ATM Weather Integration Task(IA#15 related) Discussion	Bill Mahoney, Tenny Lindholm
16:00	Discussion of open questions	Bill Mahoney, Gary Cunning, Jim Cowie
17:00	Adjourn	

9/25/2012 Tuesday

Time	Activity	Host/Speaker/Participants
Morning	Travel to Kansas City, Missouri(fly)	Gary Cunning+CAA
Afternoon	Visit NWS-Aviation Weather Center	Matt Strahan, Joe Bishop

9/26/2012 Wednesday

Time	Activity	Host/Speaker/Participants
Morning	**Visit NWS-Training center**	Matt Strahan, Joe Bishop
Afternoon	**Depart for Taiwan**	

二、會議討論議題

AOAWS-TE Program Review Meeting Notes
Boulder Meeting
24 September 2012

1. 2014 年 CWB 將升級 WRF 之解析度(3 公里/15 公里)，範圍未定，同時未來 WRF 計畫增加預報時間長度，未來民航局自行處理將有可能遇到什麼問題?(請 NCAR 提出想法與建議)

   The CWB plans to upgrade WRF resolution to 3/15KM, with TBD domain and planed increase the length of forecast time, in 2014. What possible problems might CAA face in the future after CAA takes over the system and these changes occurs? (Please provide ideas and suggestions.)

   NCAR Response:

   - ITFA will have to be re-tuned and possibly modified
   - Instances of Wrf2Mdv will have to be modified
   - CIP and FIP will have to be tested, retuned and verified
   - RIP and model display web pages will have to be tested, possibly modified
   - If the WRF data fields change and/or forecast lead times, then additional system work will be required
   - Overall load on AOAWS will increase, which may require increases in bandwidth, disk space, memory or CPU

2. 未來如遇到衛星圖檔解析度及範圍調整，民航局自行做可能遇到

什麼問題?另外在 MTSAT 原始資料處理部分，如遇到未來日本汰換衛星時，民航局如果自行做又可能遇到什麼問題?(請 NCAR 提出想法與建議)

What possible problems might CAA face when/if satellite data resolution and domain changes in the future after CAA takes over the system? Also, what to do when/if Japan replaces its satellites and MTSAT data processing procedure changes. (Please provide ideas and suggestions.)

NCAR Response:

- Reformatting to MDV will still work
- File format change will be a problem and some software engineering will be required to adapt the AOAWS to these changes
- NCAR can't provide much advice without additional information

3. 有關 JMDS 及 AWOS Display 所需要的 Java 版本問題。未來如遇到 Java 改版，民航局應如何因應使其於新的 JRE 中執行?(請 NCAR 提出想法與建議)

This is a question about Java used by JMDS and AWOS display. What will CAA need to do in order to replace/install a new

Java version in JRE? (Please provide ideas and suggestions.)

NCAR Response:

- NCAR could not reproduce problem with Java 6 & 7 on Windows- and Linux-based hardware.
- Additional information from TAMC indicated that perhaps this is a networking or firewall configuration problem
- NCAR will have to watch for additional indications that the problem still exists
- We will monitor future developments of the Java environment to see if they will remain 'backwards' compatible. There is some uncertainty with how Oracle will move ahead with future Java developments. This is an issue for the entire Java community

4. 綜合以上 2,3,4 三點，NCAR 是否未來可將以上可能涉及調整的部分，將目前處理程序參數化? 未來民航局僅需針對參數調整即可因應，請問本項提議可行性?

Will it be possible for NCAR to set up some system configuration files to take care of future system changes mentioned in the above 3 questions. If so then the CAA will be able to adjust parameters according to the system changes when need. (Please provide ideas and suggestions.)

NCAR Response:

- NCAR can create general procedures based on anticipated scenarios that can provide guidance when these changes occur
- NCAR cannot create a set of configurations files without specific details

5. 有關民航局所申請的 Java Certificate，何時可運用於 JMDS 及 AWOS DISPLAY 中?

When can CAA use the Java certificate in the JMDS and AWOS displays?

NCAR Response:

- NCAR, IISI, and the CAA will develop a procedure to use the CAA Java certificate when signing AOAWS display jar files that will replace the current practice of using NCAR's certificate. Execution of the procedure will become the responsibility of the CAA with support from IISI.

6. 有關機場雲冪及能見度工作項目是否包含校驗版面?如果沒有，何時可以開發完成?

Does the airport ceiling and visibility product include verification? If not, when can it be developed?

NCAR Response:

- A verification system is not part of included work for IA #15, but the data that are used in this process can be used for verification
- Therefore, a verification product can be created from the tools created to perform analyses
- If requested, NCAR will develop a ‘real-time’ verification capability for this product system as part of IA #17

7. 預定 AMDAR 資料何時可顯示於 JMDS 中？

When can the AMDAR data be displayed on JMDS.

NCAR Response:

- AMDAR data will be available on JMDS with first release of AOAWS version 12 in April 2013
- The BUFR decoding must be completed to accomplish this task
- Work will not begin until start of IA#16 because of timing, staff availability and budget

8. RCFG(南竿)機場 AWOS 系統也將於 2013 年 11 月驗收，請 NCAR 一併於 2013 年完成 RCFG 機場的 AWOS Display。

The RCFG airport’s AWOS will be installed in November 2013. We will need NCAR to add the AWOS display for RCFG in 2013.

NCAR Response:

- NCAR will ensure resources are available to complete task, but it will be added after the Acceptance Meeting
- TAMC and IISI performed large portion of work to add RCMT
- The November date may conflict with final AOAWS 12 install; therefore, we will move this activity to after the IA #16 Acceptance Meeting
- There may be four new ‘AWOS’ stations added in 2013 for a total of ten

9. 今年度 AOAWS 驗收版本安裝時程，因牽涉到 Debian6 64 位元版本安裝，請問 NCAR 是否依然計畫於 11 月開始進行並且確定於驗收日前完成?

The AOAWS IA 15 system final version installation may take longer due to the Debian6 64bits version installation. Will NCAR start the installation process in November as planned and finish the installation before the acceptance meeting?

NCAR Response:

- The final release during IA#15 (version 11.1) will be 32-bit

- The work to install and test the 64-bit release will take some time
- The 64-bit Debian version is scheduled to be part of first AOAWS 12 release in April 2013.

10. 今年的驗收日(何時抵台?成員?以及行程?)

We need to identify the IA#15 acceptance meeting dates.(When will the team arrive? Who are coming? And other schedule/plans?)

NCAR Response:

- Bill Mahoney and Gary Cunning will attend the Acceptance Meeting
- Thursday, 6 December date (as listed in IA#15) will work for NCAR
- Gary Cunning will arrive on Monday, 3 December
- Bill Mahoney will arrive on Tuesday, 4 December
- Bill and Gary will plan to depart Taiwan on Saturday, 8 December

11. 明年度的訓練(預計台灣及美國分別何時?)

Next year’s training programs (any tentative schedule for Taiwan and Boulder training programs?)

NCAR Response:

- NCAR proposes that the first training session at TAMC occur during the week of 22 April 2013
- This week would coincide with the first ATMS (IA#16 Task #3) user group meeting
- NCAR proposes that the second training session in Boulder begin on 9 September 2013
  - The CAA indicated that the length of second training will be 3 weeks (12 or 13 working days (depending on the training schedule details) with two CAA trainees.

ADVANCED OPERATIONAL AVIATION WEATHER SYSTEM – TECHNICAL ENHANCEMENTS (AOAWS-TE)

Fall Project Review Meeting
24 September, 2012

Bill Mahoney

Welcome Friends and Colleagues

CAA

- Ching-Yao Chuang (C.Y.)
- Show-Perng Yu (Samuel)
- Hsin-Mou Chen

IISI (International Integrated Systems, Inc.)

- Cheyin Liao
- Ryan Lai
- Shiow-Ming Deng

Agenda

Time	Activity	Host/Speaker/Participants
08:30	Pick-up from hotel	Celia Chen
09:00	Opening/Welcome	Bill Mahoney
09:15	IA#15 Status and AOAWS-TE System Version 11 review and updates	Gary Cunning & Jim Cowie
09:45	Update on the Current Icing Potential (CIP) Product Development	Marcia Politovich & Cory Wolff
10:15	Coffee/Tea Break	
10:30	Update on the NCAR Turbulence Detection Algorithm (NTDA) Product Development	John Williams
11:00	Update on Ceiling, Visibility, Winds, Temperature, etc. Prediction algorithms	Jim Cowie
11:30	Update on AOAWS Display Enhancements	Aaron Braeckel
12:00	Luncheon (offsite)	
14:00	Airport Bird Detection Radar Project	Cathy Kessinger
14:30	Wind Shear Detection Systems Upgrades – Open Discussion	CAA, David Johnson, and Bill Mahoney
15:30	ATM Weather Integration Task (IA#15 related) Discussion	Bill Mahoney & Tenny Lindholm
16:00	Discussion of open questions	Bill Mahoney, Gary Cunning & Jim Cowie
17:00	Adjourn	

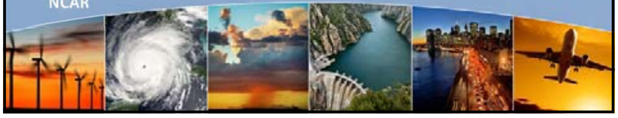
AOAWS IA#15 Status Update

2012 UCAR-CAAAOAWS-TE Project Meeting

Gary Cunning & Jim Cowie

24 September 2012

NCAR



IA#15 Status

- Review IA#15 tasks
- Status of active tasks
- Schedule

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IA#15 Tasks

- Development of In-Flight Icing Diagnosis Product
- Development of NCAR's Turbulence Detection Algorithm Product
- Enhance Airport Ceiling & Visibility Prediction Product
- Display System Enhancements
- AOAWS Data systems Upgrades, Testing, and Integration
- AOAWS Implementation Support and Maintenance
- Conduct Training Program
- Project Management, Administration, and Documentation Preparation

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Task 1 – Development of In-Flight Icing Diagnosis Product

- Develop and refine the CIP software to operate using the AOAWS data sources including the Weather Research and Forecasting (WRF) model output, satellite, and surface weather observations
- Investigate calibration methodologies and performing the initial calibration process
- Evaluate icing case studies to ensure the algorithm is performing appropriately
- Prepare CIP development progress reports that will be included in the monthly and quarterly reports

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Task 1 – Development of In-Flight Icing Diagnosis Product

- Develop and refine the CIP software to operate using the AOAWS data sources including the Weather Research and Forecasting (WRF) model output, satellite, and surface weather observations
  - Held planning meeting
  - Modified derived_model_fields to include graupel field from model

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Task 1 – Development of In-Flight Icing Diagnosis Product

- Develop and refine the CIP software to operate using the AOAWS data sources including the Weather Research and Forecasting (WRF) model output, satellite, and surface weather observations
  - Held planning meeting
  - Modified derived_model_fields to include graupel field from model
  - Refactored model processing to allow CIP and FIP to share data
  - Added satellite channels needed by CIP
  - All inputs for CIP are available

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Task 1 – Development of In-Flight Icing Diagnosis Product

NCAR

- Investigate calibration methodologies and performing the initial calibration process
  - Prepared note on methodologies used in past
  - Prepared note on information gathering and sample questionnaires
  - Received list of questions from TAMC

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Task 1 – Development of In-Flight Icing Diagnosis Product

NCAR

- Investigate calibration methodologies and performing the initial calibration process
  - Prepared note on methodologies used in past
  - Prepared note on information gathering and sample questionnaires
  - Received list of questions from TAMC
  - Answered list of questions
  - Plan to conduct survey during winter, with a possible second survey during 2013 Mei-Yu season
  - Use case studies to compare differences between WRF-RAP and CWB-WRF over CONUS

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Task 1 – Development of In-Flight Icing Diagnosis Product

NCAR

- Evaluate icing case studies to ensure the algorithm is performing appropriately
  - Created CWB-like version of WRF (CWB-WRF) to run over CONUS
  - Ran model over a week period for a set of case studies
  - Used CWB-WRF and WRF-RAP model results to analyze effect of run cycles and file latencies on CIP
  - Compared CIP & FIP output from CWB-WRF and WRF-RAP models

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Task 1 – Development of In-Flight Icing Diagnosis Product

NCAR

- Evaluate icing case studies to ensure the algorithm is performing appropriately
  - Created CWB-like version of WRF (CWB-WRF) to run over CONUS
  - Ran model over a week period for a set of case studies
  - Used CWB-WRF and WRF-RAP model results to analyze effect of run cycles and file latencies on CIP
  - Compared CIP & FIP output from CWB-WRF and WRF-RAP models
  - Completed 8 two-week CWB-WRF over CONUS runs
  - Begun preparing other CIP inputs
  - Created plan to evaluate CIP's performance with reduced inputs for AOAWS.

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Task 1 – Development of In-Flight Icing Diagnosis Product

NCAR

- Prepare CIP development progress reports that will be included in the monthly and quarterly reports
  - Presented analysis and results in first quarter progress report.

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Task 1 – Development of In-Flight Icing Diagnosis Product

NCAR

- Prepare CIP development progress reports that will be included in the monthly and quarterly reports
  - Presented analysis and results in first quarter progress report.
  - Will present additional results in fourth quarter progress report

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Task 1 – Development of In-Flight Icing Diagnosis Product

NCAR

- Activity for remainder of year
  - Complete calibration study (1.2)
  - Complete preparation other CIP inputs (1.3)
  - Begin to process seven CIP configurations for one week from first case study (1.3)
  - Submit a fourth quarter progress report (1.4)

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Task 2 – Development of NCAR's Turbulence Detection Algorithm Product

NCAR

- Obtain and evaluate technical information about the Taiwan weather radars such as technical specifications, data formats, data quality, scan strategies, and other operational details
- Obtain sample Taiwan Doppler radar datasets
- Develop and refine the turbulence detection algorithm to utilize Doppler weather radar data from selected Taiwan doppler weather radars
- Begin to test the turbulence detection algorithm to ensure it is functioning as designed
- Begin to establish AOAWS related connections to the radar data in Taiwan and archiving data for research and development
- Evaluate the processing requirements for running the NTDA algorithm within the AOAWS environment
- Prepare NTDA development progress reports that will be included in the monthly and quarterly report

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Task 2 – Development of NCAR's Turbulence Detection Algorithm Product

NCAR

- Obtain and evaluate technical information about the Taiwan weather radars such as technical specifications, data formats, data quality, scan strategies, and other operational details.
  - Used application Nexrad2Netcdf to view data from RCWF
  - Received technical information and decoding source code for Gematronik radars from IISI
  - Wrote application Gematronik2Netcdf to view data from Gematronik radars
  - Created a list of questions about the radars

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Task 2 – Development of NCAR's Turbulence Detection Algorithm Product

NCAR

- Obtain and evaluate technical information about the Taiwan weather radars such as technical specifications, data formats, data quality, scan strategies, and other operational details.
  - Used application Nexrad2Netcdf to view data from RCWF
  - Received technical information and decoding source code for Gematronik radars from IISI
  - Wrote application Gematronik2Netcdf to view data from Gematronik radars
  - Created a list of questions about the radars
  - Met with Dr. Shih-Yun Chou at CWB and received answers to questions
  - Compiling a new list of questions

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Task 2 – Development of NCAR's Turbulence Detection Algorithm Product

NCAR

- Obtain sample Taiwan Doppler radar datasets
  - Received sample data from all four radars from IISI

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Task 2 – Development of NCAR's Turbulence Detection Algorithm Product

NCAR

- Develop and refine the turbulence detection algorithm to utilize Doppler weather radar data from selected Taiwan doppler weather radars
  - Developed algorithm to determine radar constant
  - Investigated impact of clutter on spectrum width estimates
  - Installed data ingest, processing, and product generation on development computer in Boulder lab
  - Developed technique to gather radar field statistics over long time periods

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Task 2 – Development of NCAR's Turbulence Detection Algorithm Product

NCAR

- Begin to test the turbulence detection algorithm to ensure it is functioning as designed
  - Reviewed radar data in near-real-time with an interest in identifying thunderstorms

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Task 2 – Development of NCAR's Turbulence Detection Algorithm Product

NCAR

- Begin to test the turbulence detection algorithm to ensure it is functioning as designed
  - Reviewed radar data in near-real-time with an interest in identifying thunderstorms
  - Identified several issues related to clutter filtering, radar operational modes and environment.
  - Collected and analyzed reflectivity data from Typhoon Saola

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Task 2 – Development of NCAR's Turbulence Detection Algorithm Product

NCAR

- Begin to establish AOAWS related connections to the radar data in Taiwan and archiving data for research and development
  - TAMC took lead in gaining approval to access data from CWB
  - TAMC requested IMC open networking firewall so files can be distributed back to Boulder
  - IISI established connection between CWB and AOAWS computers
  - UCAR configured AOAWS to distribute files and create archive in Boulder

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Task 2 – Development of NCAR's Turbulence Detection Algorithm Product

NCAR

- Begin to establish AOAWS related connections to the radar data in Taiwan and archiving data for research and development
  - TAMC took lead in gaining approval to access data from CWB
  - TAMC requested IMC open networking firewall so files can be distributed back to Boulder
  - IISI established connection between CWB and AOAWS computers
  - UCAR configured AOAWS to distribute files and create archive in Boulder
  - Exploring receiving radar data in smaller packets

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Task 2 – Development of NCAR's Turbulence Detection Algorithm Product

NCAR

- Evaluate the processing requirements for running the NTDA algorithm within the AOAWS environment
  - Performance of NTDA being monitored on development lab hardware. Final results will not be available until all CIP, FIP and NTDA applications are running on tamc-algorithm1/2 in Boulder lab.

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Task 2 – Development of NCAR's Turbulence Detection Algorithm Product

NCAR

- Prepare NTDA development progress reports that will be included in the monthly and quarterly report
  - Presented analysis and results in first and second quarter progress reports

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Task 2 – Development of NCAR's Turbulence Detection Algorithm Product

NCAR

- Prepare NTDA development progress reports that will be included in the monthly and quarterly report
  - Presented analysis and results in first and second quarter progress reports
  - Will present additional results in fourth quarter progress report

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Task 2 – Development of NCAR's Turbulence Detection Algorithm Product

NCAR

- Activity for remainder of year
  - Continue tasks to develop and refine turbulence detection algorithm (2.3)
  - Continue tasks to test turbulence detection algorithm (2.4)
  - Continue to monitor processing resources used by NTDA (2.6)
  - Submit fourth quarter progress report (2.7)

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Task 3 – Enhance Airport Ceiling & Visibility Prediction Product

NCAR

- Obtain and process historical METAR and WRF model data for CAA selected airports
- Apply statistical methods and techniques to develop statistical relationships between model and observational data
- Verify the best approaches and developing algorithms for use in the operational AOAWS
- Test the revised ceiling and visibility algorithm in the UCAR test environment
- Integrate the revised algorithm code into the AOAWS
- Verify the performance of the ceiling and visibility predictions

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Task 3 – Enhance Airport Ceiling & Visibility Prediction Product

NCAR

- Obtain and process historical METAR and WRF model data for CAA selected airports
  - Created a growing archive in Boulder of SPDB input, intermediate and output from MOS applications using AOAWS file distribution.
  - Wrote file converter for regression input data for Cubist/c5.0 data mining format

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Task 3 – Enhance Airport Ceiling & Visibility Prediction Product

NCAR

- Obtain and process historical METAR and WRF model data for CAA selected airports
  - Created a growing archive in Boulder of SPDB input, intermediate and output from MOS applications using AOAWS file distribution.
  - Wrote file converter for regression input data for Cubist/c5.0 data mining format
  - Modified existing MOS applications to run in a playback mode and produce diagnostic output
  - Moved data to NCAR HPSS for long term storage

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Task 3 – Enhance Airport Ceiling & Visibility Prediction Product

NCAR

- Apply statistical methods and techniques to develop statistical relationships between model and observational data
  - Preformed Cubist runs to test conversion code
  - Built stand-alone test environment to run the existing MOS applications in Boulder lab
  - Generating output in formats used by statistical tools under consideration

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Task 3 – Enhance Airport Ceiling & Visibility Prediction Product

- Apply statistical methods and techniques to develop statistical relationships between model and observational data
  - Preformed Cubist runs to test conversion code
  - Built stand-alone test environment to run the existing MOS applications in Boulder lab
  - Generating output in formats used by statistical tools under consideration
  - Wrote software for flight category for ceiling and visibility data
  - Compared results from the application of multi-linear regression, cubist regression tree and random forest methodologies.
  - Wrote software to evaluate RMSE performance for the three techniques

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Task 3 – Enhance Airport Ceiling & Visibility Prediction Product

- Verify the best approaches and developing algorithms for use in the operational AOAWS
  - An approach to current technique with new ones was formulated.

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Task 3 – Enhance Airport Ceiling & Visibility Prediction Product

- Verify the best approaches and developing algorithms for use in the operational AOAWS
  - An approach to current technique with new ones was formulated.
  - Implemented a persistence-based adjustment using recent METAR observations
  - Investigated conversion from SPDB to HTML with MosSpdb2Html to see how triggering occurred. Changed timing so that updates occur every 5 minutes

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Task 3 – Enhance Airport Ceiling & Visibility Prediction Product

- Verify the performance of the ceiling and visibility predictions
  - Developed script to RMSE performance of raw forecasts with forecasts adjusted with recent METARs.
  - Analysis of testing led to discovery of several bugs in original adjustment step

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Task 3 – Enhance Airport Ceiling & Visibility Prediction Product

- Activity for remainder of year
  - Test revised ceiling and visibility algorithm (3.4)
  - Integrate revised algorithm into AOAWS (3.5)
  - Submit report on findings.

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Task 4 – Display System Enhancements

- Re-engineer JMDS to follow the Jadite framework
- Begin development of the JMDS functionality needed to replace CIDD when it is used headless to create images for the WMDS web pages
- Create and test in the UCAR lab environment new JMDS configurations to replace CIDD on MDS hosts
- Modify JMDS and WMDS to display CIP and NTDA products. Perform testing in the UCAR AOAWS lab environment
- Add RCMT to the AWOS Display after the installation of new AWOS hardware
- Support the operational versions of the JMDS, WMDS, SMD, and AWOS systems
- Respond to user feedback and, as appropriate, provide and develop enhancements to address issues raised by the users as resources permit

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Task 4 – Display System Enhancements

- Re-engineer JMDS to follow the Jadite framework
  - Conducted initial planning meetings
  - Began work on the conversion of JMDS to Jadeite
  - Worked on converting MDV layers
  - Worked on converting SPDB layers
  - Included debugging and testing

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Task 4 – Display System Enhancements

- Re-engineer JMDS to follow the Jadite framework
  - Conducted initial planning meetings
  - Began work on the conversion of JMDS to Jadeite
  - Worked on converting MDV layers
  - Worked on converting SPDB layers
  - Included debugging and testing
  - Completed Jadite conversion for several tools
  - Investigated use of JavaFX and JFreeChart in time series tool
  - Implemented new color palette generation technique

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Task 4 – Display System Enhancements

- Begin development of the JMDS functionality needed to replace CIDD when it is used headless to create images for the WMDS web pages
  - Added initial capability to JMDS to render images in PNG file format
  - Introduced tags to JMDS configuration file define image generation

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Task 4 – Display System Enhancements

- Create and test in the UCAR lab environment new JMDS configurations to replace CIDD on MDS hosts
  - Modified JMDS and configuration so specified tools and sub-windows appear at startup

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Task 4 – Display System Enhancements

- Modify JMDS and WMDS to display CIP and NTDA products. Perform testing in the UCAR AOAWS lab environment
  - Created JMDS configuration file to show NTDA results from development server in Boulder lab

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Task 4 – Display System Enhancements

- Add RCMT to the AWOS Display after the installation of new AWOS hardware
  - Released AWOS Display 11, with RCMT

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Task 4 – Display System Enhancements

NCAR

- Support the operational versions of the JMDS, WMDS, SMD, and AWOS systems
  - Updated SysView diagrams for WIFS, RCMT AWOS and radar file distribution
  - Updated WRF Model web page on WMDS

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Task 4 – Display System Enhancements

NCAR

- Support the operational versions of the JMDS, WMDS, SMD, and AWOS systems
  - Updated SysView diagrams for WIFS, RCMT AWOS and radar file distribution
  - Updated WRF Model web page on WMDS
  - Investigated late METARs on AWOS display
  - Updated Sysview diagrams to match changes introduced by code cleanup and architecture changes

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Task 4 – Display System Enhancements

NCAR

- Respond to user feedback and, as appropriate, provide and develop enhancements to address issues raised by the users as resources permit
  - Responded to a TAMC request for more information about Java security certificates

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Task 4 – Display System Enhancements

NCAR

- Respond to user feedback and, as appropriate, provide and develop enhancements to address issues raised by the users as resources permit
  - Responded to a TAMC request for more information about Java security certificates
  - Responded to a TAMC request to look in to problems running JMDS under Java 7

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Task 4 – Display System Enhancements

NCAR

- Activity for remainder of year
  - Add new satellite data
  - Test JMDS 11
  - Create JMDS 11 release
  - Update JMDS manual
  - Continue with CIDD replacement as time allows

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Task 5 – AOAWS Data systems Upgrades, Testing, and Integration

NCAR

- Support TECRO's designated representative, CAA, in troubleshooting any problems associated with the AOAWS data system on Taiwan
- Transition from WAFS to WIFS, making necessary adjustments to AOAWS processing and updating system documentation
- Transition from JWA format of MTSAT2 data to the JMA format, which includes any AOAWS architecture and system documentation updates
- Develop capability to process EUMETSAT satellite data provided by the JWA. This includes any AOAWS architecture changes precipitated by the inclusion of this new data set. System monitoring and documentation will also be updated
- Develop code to integrate new data types into the AOAWS including new and enhanced turbulence and icing product datasets and testing the code in the UCAR AOAWS test environment

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Task 5 – AOAWS Data systems Upgrades, Testing, and Integration

NCAR

- Provide assistance to the CAA, to ensure that the necessary data links, hardware, and network capacity are identified and available as AOAWS upgrades are implemented at CAA facilities
- Refine AOAWS system operator manuals in PDF format suitable for both printing and on-line browsing. Provide a link to the manuals from suitable AOAWS web pages

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Task 5 – AOAWS Data systems Upgrades, Testing, and Integration

NCAR

- Support TECRO's designated representative, CAA, in troubleshooting any problems associated with the AOAWS data system on Taiwan
  - Investigating short periods where current METARs and AWOS data were not available on tamc-wmds1

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Task 5 – AOAWS Data systems Upgrades, Testing, and Integration

NCAR

- Support TECRO's designated representative, CAA, in troubleshooting any problems associated with the AOAWS data system on Taiwan
  - Investigating short periods where current METARs and AWOS data were not available on tamc-wmds1
  - Investigated late-arriving METARs causing their datasets to turn red on Sysview. Modified Metar2Spdb configuration.

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Task 5 – AOAWS Data systems Upgrades, Testing, and Integration

NCAR

- Transition from WAFS to WIFS, making necessary adjustments to AOAWS processing and updating system documentation
  - Developed scripts to retrieve WAFS data from the WIFS server
  - Modified AOAWS infrastructure to utilize products
  - Tested in Boulder lab
  - Installed on operational tamc-data2
  - Discussed options with TAMC on how to transition to GRIB2 files for AISS when GRIB1 files are removed from the WIFS server

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Task 5 – AOAWS Data systems Upgrades, Testing, and Integration

NCAR

- Transition from WAFS to WIFS, making necessary adjustments to AOAWS processing and updating system documentation
  - Developed scripts to retrieve WAFS data from the WIFS server
  - Modified AOAWS infrastructure to utilize products
  - Tested in Boulder lab
  - Installed on operational tamc-data2
  - Discussed options with TAMC on how to transition to GRIB2 files for AISS when GRIB1 files are removed from the WIFS server
  - Modified AISS ftp role to use WIFS feed
  - Created script to force GRIB files to be resent to AISS ftp server

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Task 5 – AOAWS Data systems Upgrades, Testing, and Integration

NCAR

- Transition from JWA format of MTSAT2 data to the JMA format, which includes any AOAWS architecture and system documentation updates
  - Wrote application JmaMtSatHRIT2Mdv to convert JMA to MDV format
  - Tested on sample files

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Task 5 – AOAWS Data systems Upgrades, Testing, and Integration

NCAR

- Transition from JWA format of MTSAT2 data to the JMA format, which includes any AOAWS architecture and system documentation updates
  - Wrote application JmaMtSatHRIT2Mdv to convert JMA to MDV format
  - Tested on sample files
  - Created real-time simulation of JWA data
  - Integrated applications in Boulder lab

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Task 5 – AOAWS Data systems Upgrades, Testing, and Integration

NCAR

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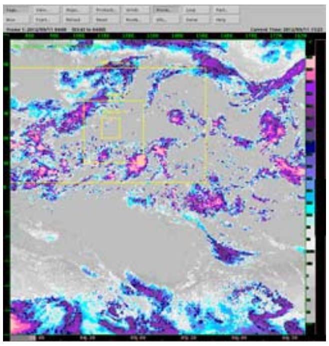
Task 5 – AOAWS Data systems Upgrades, Testing, and Integration

NCAR

Old HRIT IR



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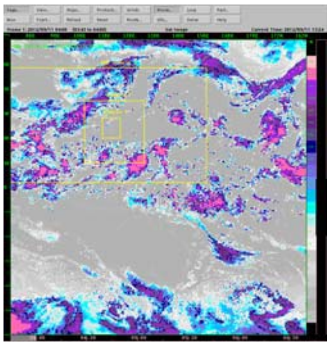
Task 5 – AOAWS Data systems Upgrades, Testing, and Integration

NCAR

New HRIT IR



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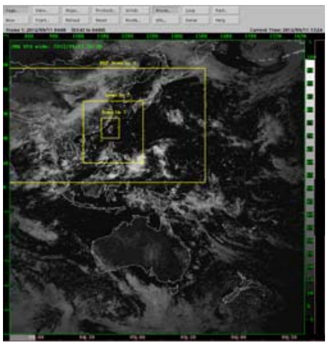
Task 5 – AOAWS Data systems Upgrades, Testing, and Integration

NCAR

Old HRIT VIS



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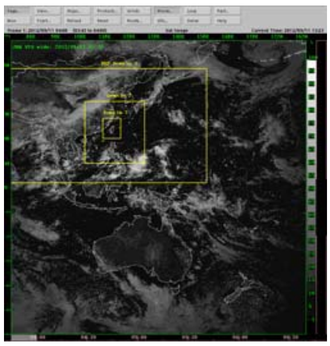
Task 5 – AOAWS Data systems Upgrades, Testing, and Integration

NCAR

New HRIT VIS



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Task 5 – AOAWS Data systems Upgrades, Testing, and Integration

- Develop capability to process EUMETSAT satellite data provided by the JWA. This includes any AOAWS architecture changes precipitated by the inclusion of this new data set. System monitoring and documentation will also be updated
  - Wrote MeteosatBin2Mdv to convert the EUMETSAT binary files to the MDV format
  - Tested on sample data
  - Created real-time simulation of EUMETSAT data
  - Integrated applications in Boulder lab

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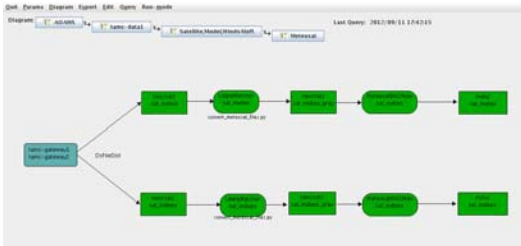
Task 5 – AOAWS Data systems Upgrades, Testing, and Integration



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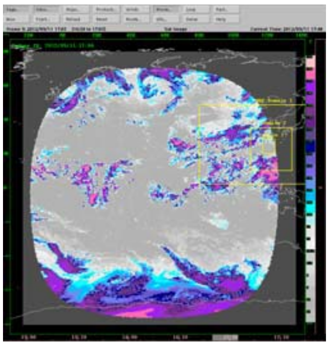
Task 5 – AOAWS Data systems Upgrades, Testing, and Integration

Meteosat
Indian Ocean



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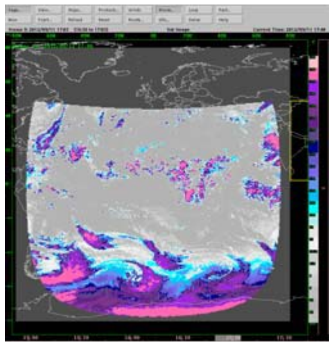
Task 5 – AOAWS Data systems Upgrades, Testing, and Integration

Meteosat



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Task 5 – AOAWS Data systems Upgrades, Testing, and Integration

- Develop code to integrate new data types into the AOAWS including new and enhanced turbulence and icing product datasets and testing the code in the UCAR AOAWS test environment
  - Investigated AMDARs
  - Began writing Amdar2Spdb application to convert ASCII and BUFR formatted messages to SPDB.
  - Modified AOAWS to processing RCMT AWOS files and convert to SPDB format.
  - Added text data service role, called text_server, to AOAWS
  - Added ability to print XML-formatted SIGMETs to SpdbQuery

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Task 5 – AOAWS Data systems Upgrades, Testing, and Integration

- Develop code to integrate new data types into the AOAWS including new and enhanced turbulence and icing product datasets and testing the code in the UCAR AOAWS test environment
  - Investigated AMDARs
  - Began writing Amdar2Spdb application to convert ASCII and BUFR formatted messages to SPDB.
  - Modified AOAWS to processing RCMT AWOS files and convert to SPDB format.
  - Added text data service role, called text_server, to AOAWS
  - Added ability to print XML-formatted SIGMETs to SpdbQuery
  - Identified and tested BUFR decoding library using TAMC supplied AMDAR messages
  - Tested processing of global satellite composite

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Task 5 – AOAWS Data systems Upgrades, Testing, and Integration

NCAR

- Provide assistance to the CAA, to ensure that the necessary data links, hardware, and network capacity are identified and available as AOAWS upgrades are implemented at CAA facilities
  - Turned tamc-service into a gateway for AOAWS files to transferred to Boulder, with assitance of TAMC
  - Established the transfer of radar files from CWB, with the assistance of IISI and TAMC

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Task 5 – AOAWS Data systems Upgrades, Testing, and Integration

NCAR

- Provide assistance to the CAA, to ensure that the necessary data links, hardware, and network capacity are identified and available as AOAWS upgrades are implemented at CAA facilities
  - Turned tamc-service into a gateway for AOAWS files to transferred to Boulder, with assitance of TAMC
  - Established the transfer of radar files from CWB, with the assistance of IISI and TAMC

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Task 5 – AOAWS Data systems Upgrades, Testing, and Integration

NCAR

- Activity for remainder of year
  - Continue and support and troubleshoot AOAWS
  - Update operators manual
  - Continue work on Amdar2spdb as time allows

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Task 6 – AOAWS Implementation Support and Maintenance

NCAR

- Provide general assistance to TECRO's designated representative, CAA, in supporting and operating the AOAWS including assisting the CAA with any AOAWS related new hardware installation and network configuration changes
- Provide assistance to the CAA in troubleshooting problems with various versions of the AOAWS, if and when they occur
- Support and maintain the installed operational version of the AOAWS
- Install, test, and support upgraded versions of the AOAWS
- Correct AOAWS defects that arise from the upgrades

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Task 6 – AOAWS Implementation Support and Maintenance

NCAR

- Provide general assistance to TECRO's designated representative, CAA, in supporting and operating the AOAWS including assisting the CAA with any AOAWS related new hardware installation and network configuration changes
  - Collected hardware information on AOAWS hosts
  - Installed 32-bit Debian 6 on the operational computers
  - Installed Opsview

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Task 6 – AOAWS Implementation Support and Maintenance

NCAR

- Provide general assistance to TECRO's designated representative, CAA, in supporting and operating the AOAWS including assisting the CAA with any AOAWS related new hardware installation and network configuration changes
  - Collected hardware information on AOAWS hosts
  - Installed 32-bit Debian 6 on the following operational computers
  - Installed Opsview
  - Set up tamc-gateway1/2 and tamc-algorithm1/2

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Task 6 – AOAWS Implementation Support and Maintenance

NCAR

- Provide assistance to the CAA in troubleshooting problems with various versions of the AOAWS, if and when they occur
  - Corrected failing disk on tamc-archive1
  - Corrected failing network adapter
  - Diagnosed and fixed high load problem on tamc-caasv2 that stalled the AOAWS 11.0 installation

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Task 6 – AOAWS Implementation Support and Maintenance

NCAR

- Provide assistance to the CAA in troubleshooting problems with various versions of the AOAWS, if and when they occur
  - Corrected failing disk on tamc-archive1
  - Corrected failing network adapter
  - Diagnosed and fixed high load problem on tamc-caasv2 that stalled the AOAWS 11.0 installation
  - Corrected additional hardware and system problems

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Task 6 – AOAWS Implementation Support and Maintenance

NCAR

- Support and maintain the installed operational version of the AOAWS
  - Performed general system maintenance and monitoring report

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Task 6 – AOAWS Implementation Support and Maintenance

NCAR

- Install, test, and support upgraded versions of the AOAWS
  - Created AOAWS 11.0 distribution
    - Debian 2.6 (squeeze) 32-bit port
    - WIFS processing
    - Amdar2Spdb
    - WMDS text server role
    - AWOS 11 Display (RCMT)
    - CWB radar file transfer and distribution
    - XML-formatted SIGMETs
    - Model display web page updates
  - Installed AOAWS 11.0

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Task 6 – AOAWS Implementation Support and Maintenance

NCAR

- Install, test, and support upgraded versions of the AOAWS
  - Performed code clean up
  - Added tamc-gateway1/2 and tamc-algorithm1/2 hosts to AOAWS
  - Improved the checkout, build and release preparation processes
  - Set up Boulder lab hardware
  - Separated simulation components from AOAWS code base
  - Created aoaws-sim host to drive simulation
  - Created Debian 32-bit version of AOAWS 11.1
  - Created Debian 64-bit version of AOAWS 11.1
  - Installed both versions of AOAWS 11.1 in lab

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Task 6 – AOAWS Implementation Support and Maintenance

NCAR

- Install, test, and support upgraded versions of the AOAWS
  - Code clean up
    - Performed on source code, scripts, configuration files, and data directories
    - Removed several hundred scripts and configuration files
    - Removed several hundred unused data directories
    - Removed more than twenty applications

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Task 6 – AOAWS Implementation Support and Maintenance

- Install, test, and support upgraded versions of the AOAWS
  - AOAWS 11.1 release
    - Removed old host types
    - Added new host types
    - Removed lab simulation components from AOAWS.
    - Moved FIP processing to the algorithm host type
    - Moved all file retrieval processing to the gateway host type
    - Moved all WRF model format conversion (MDV and SPDB) to the modelserver host type.
    - Moved all RIP image conversion to caasv host type
    - Added JMA-formatted MTSAT file processing
    - Added EUMETSAT file processing

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Task 6 – AOAWS Implementation Support and Maintenance

- Activity for remainder of year
  - Continue test and fix problems
  - Create AOAWS 11.1 installation plan
  - Install AOAWS 11.1 on operational hardware

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Task 7 – Conduct Training Program

- Prepare a training program plan designed to educate CAA staff on scientific and technical aspects of the AOAWS system
- Create training materials designed to educate CAA staff on scientific and technical aspects of the AOAWS system
- Conduct training programs designed to educate CAA staff on scientific and technical aspects of the AOAWS system

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Task 8 – Project Management, Administration, and Documentation Preparation

- Carry out general project management, such as planning, budgeting, technical consultations with team members, and tracking progress
- Prepare monthly and quarterly progress reports
- Obtain and review user feedback on the AOAWS-TE system
- Respond to routine technical and information requests from CAA
- Participate in AOAWS-TE related meetings

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Schedule

- Installations
  - AOAWS 11.1 Install: 5 November
- Meetings
  - Acceptance meeting: 6 December

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Questions

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Current Icing Product (CIP) Status

Cory A. Wolff
Annual AOAWS-TE Project Review Meeting
NCAR, Boulder, CO
24 September 2012

CWB-WRF and WRF-RAP

Model Lag Time

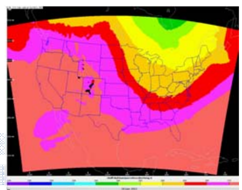
- CWB WRF
  - Run every 6 hours
  - 5 hour latency
  - 5 – 10 hour forecasts to be used in CIP
- WRF-RAP (CONUS)
  - Run every hour
  - 1 hour latency
  - 3 hour forecasts used in CIP
    - Could use shorter forecast but concern exists about model "spin up" of moisture fields

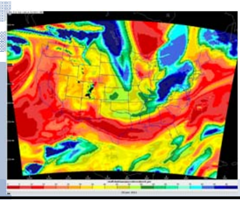
Hour	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
L=5																								
00Z						f05	f06	f07	f08	f09	f10													
06Z												f05	f06	f07	f08	f09	f10							
12Z																		f05	f06	f07	f08	f09	f10	
18Z	f06	f07	f08	f09	f10																			f05
L=4																								
00Z					f04	f05	f06	f07	f08	f09														
06Z											f04	f05	f06	f07	f08	f09								
12Z																	f04	f05	f06	f07	f08	f09		
18Z	f06	f07	f08	f09																			f04	f05
L=3																								
00Z				f03	f04	f05	f06	f07	f08															
06Z										f03	f04	f05	f06	f07	f08									
12Z																f03	f04	f05	f06	f07	f08			
18Z	f06	f07	f08																			f03	f04	f05
L=2																								
00Z			f02	f03	f04	f05	f06	f07																
06Z									f02	f03	f04	f05	f06	f07										
12Z															f02	f03	f04	f05	f06	f07				
18Z	f06	f07																			f02	f03	f04	f05
L=1																								
00Z		f01	f02	f03	f04	f05	f06																	
06Z								f01	f02	f03	f04	f05	f06											
12Z														f01	f02	f03	f04	f05	f06					
18Z	f06																			f01	f02	f03	f04	f05

CWB-WRF

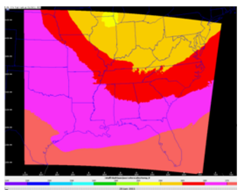
- Run over CONUS
  - Same configuration as that used by CWB
    - No data assimilation – GFS initialized
  - Two domains
    - Outer (20 km): Closely matches WRF-RAP
    - Inner (4 km): Southeast U.S. is a surrogate for Taiwan

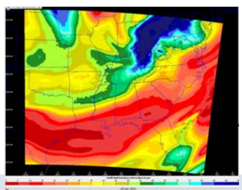
Domain 1



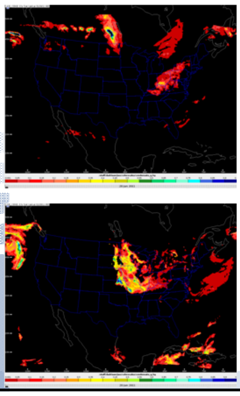


Domain 2

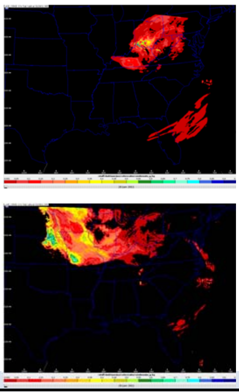




Domain 1



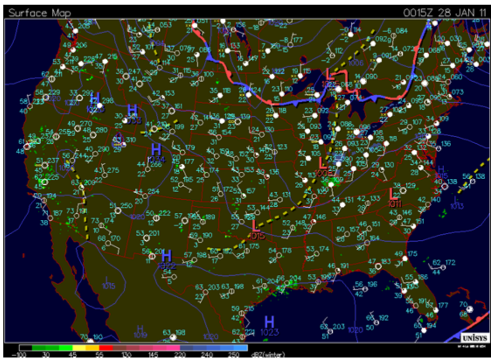
Domain 2



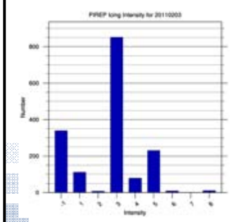
Cases

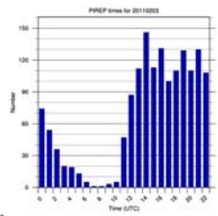
- Eight weeks chosen to test in all seasons and maximize the PIREPs available in Domain 2
- 12 – 18 January 2011
- 28 January – 3 February 2011
- 4 – 10 March 2011
- 21 – 27 July 2011
- 14 – 20 October 2011
- 24 – 30 November 2011
- 21 – 27 December 2011
- 4 – 10 February 2012

28 January – 3 February 2011

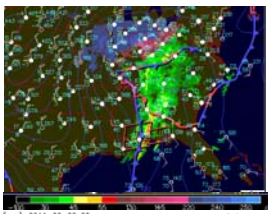


PIREPs



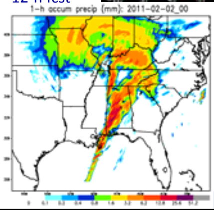


Model and Observation Comparison

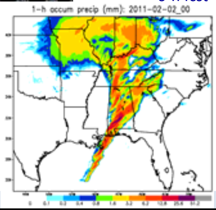


2011-02-02-00

12-h fcst

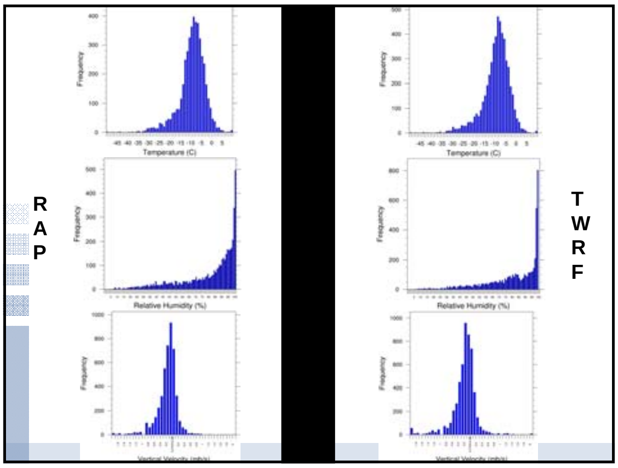


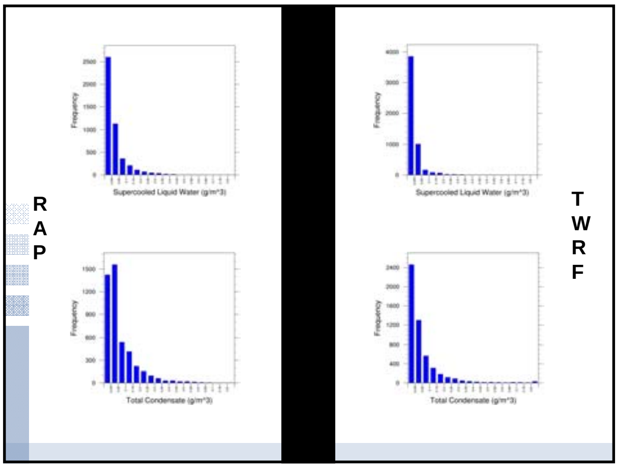
6-h fcst



Model Field Distributions

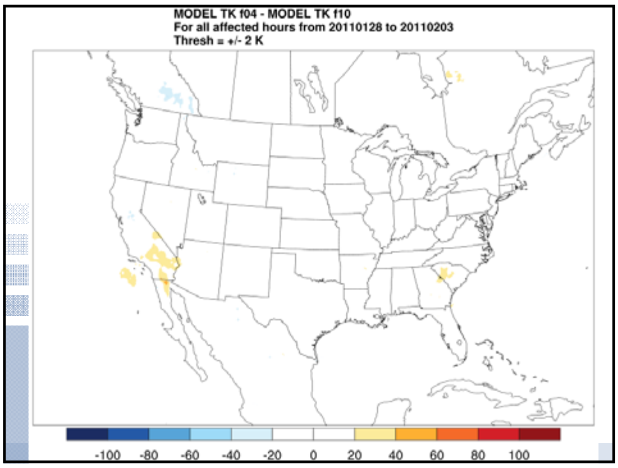
- Positive icing PIREPs matched to nearest model grid point
  - Useful for shaping interest maps and showing differences in how models forecast the fields of interest for icing

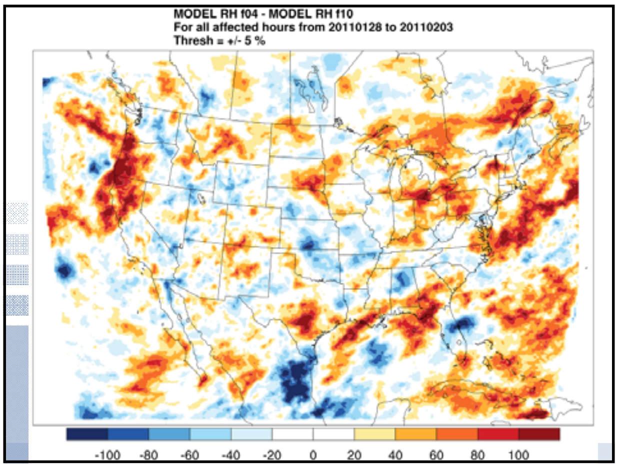


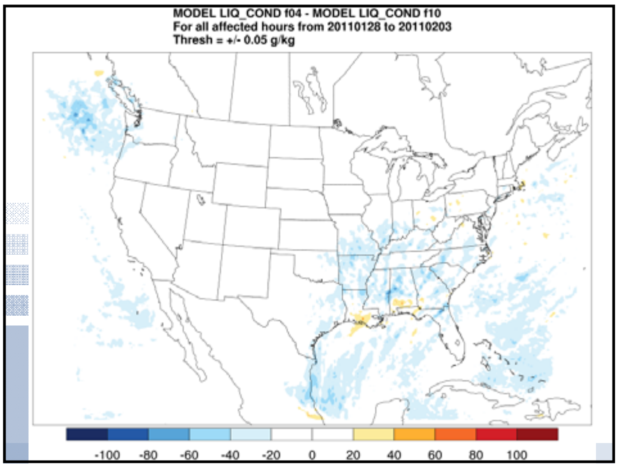


Difference Fields

- Calculate differences between forecast times for each earlier hour
  - 10 hour forecast → 4 hour forecast
  - 9 hour forecast → 3 hour forecast
  - 8 hour forecast → 2 hour forecast
  - 7 hour forecast → 1 hour forecast
- Instead of looking at many difference images (7 days, 4 runs per day, 37 levels = over 1000 images) we counted the differences that were outside predefined thresholds
- Can also limit based on altitude, region, forecast valid time, etc.







TCIP and CIP-RAP

NATIONAL CENTER FOR ATMOSPHERIC RESEARCH

CIP Configurations (CONUS)

1. WRF-RAP runs with a three-hour forecast used at each hour.
2. WRF-RAP runs using 5 – 10 hour forecasts each hour.
3. CWB-WRF runs on domain 1 using 5 – 10 hour forecasts each hour.
4. CWB-WRF runs on domain 2 using 5 – 10 hour forecasts.
5. CWB-WRF runs on domain 1 without PIREP input.
6. CWB-WRF runs on domain 2 without PIREP input.
7. CWB-WRF runs on domain 2 without PIREP and radar input.

Configurations (CONUS)

1. WRF-RAP runs with a three-hour forecast used at each hour. COMPLETED
2. WRF-RAP runs using 5 – 10 hour forecasts each hour.
3. CWB-WRF runs on domain 1 using 5 – 10 hour forecasts each hour.
4. CWB-WRF runs on domain 2 using 5 – 10 hour forecasts.
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7. CWB-WRF runs on domain 2 without PIREP and radar input.

Configurations (CONUS)

1. WRF-RAP runs with a three-hour forecast used at each hour. COMPLETED
2. WRF-RAP runs using 5 – 10 hour forecasts each hour. IN PROGRESS
3. CWB-WRF runs on domain 1 using 5 – 10 hour forecasts each hour. IN PROGRESS
4. CWB-WRF runs on domain 2 using 5 – 10 hour forecasts.
5. ~~CWB-WRF runs on domain 1 without PIREP input.~~
6. ~~CWB-WRF runs on domain 2 without PIREP input.~~
7. CWB-WRF runs on domain 1 without PIREP and radar input.
8. CWB-WRF runs on domain 2 without PIREP and radar input.

CIP on Domain 2

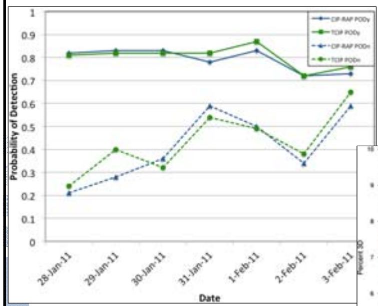
- New version of CIP algorithm
- Upgrades
  - "Scientist" code to "engineered" code
    - Better design with more modules and classes
  - Inflexible to adaptable
    - New models and datasets
    - Many of the inner workings have been parameterized
  - Data-driven
    - Will run when certain new datasets (likely model and satellite) become available

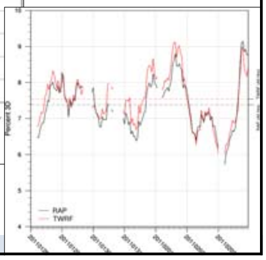
CIP Evaluation

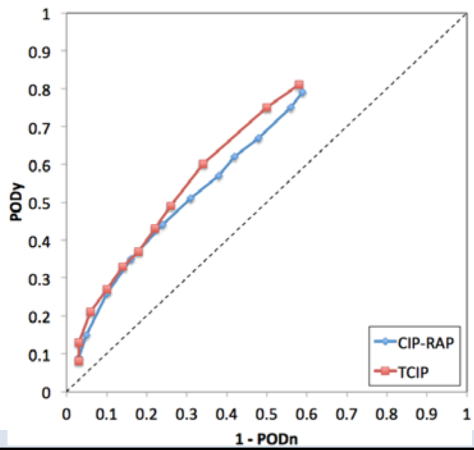
- 28 January – 3 February 2011
- Simple Statistics
  - Probability of detecting icing events (PODy)
  - Probability of detecting non-icing events (PODn)
  - Percent of grid covered by icing

	PODy	PODn	% Volume
TCIP	0.81	0.42	7.54
CIP-RAP	0.79	0.41	7.38

POD and Volume Charts







Future Work

- Fall
  - Complete full evaluation of one of the cases
    - All configurations
    - Model validation
    - Algorithm verification
- 2013
  - Complete evaluation of all cases
  - Implement CIP
  - Calibration and verification in Taiwan

Calibration and Verification

- Solicitation of PIREPs to get more data
  - We have found these to work well in small doses
  - Need to choose the right time for getting icing conditions
    - MayYu season?
- Questionnaires developed for various groups
  - Pilots
  - Traffic control
  - Dispatchers
  - Meteorologists

Example Questions

Pilot Questionnaire

Date:
Takeoff time:
Takeoff location:
Landing time:
Landing location:

Aircraft type:
Cruise altitude(s):

Did you experience icing conditions? Yes No

If yes, please continue.
Time of icing conditions:
Location of icing conditions:
Altitude of icing conditions:
Icing severity: ____None ____Trace ____Light ____Moderate ____Severe

Were the icing conditions forecasted correctly? Yes No

Do you have any other comments about the icing during this flight?

Dispatcher or Traffic Controller Questionnaire
To be filled out after talking with a pilot during flight.
Leave a question blank if that information wasn't solicited.

Date:
Time:

Are there icing conditions? Yes No
Aircraft type:
Aircraft location:
Aircraft altitude:
Pilot reported intensity: ____None ____Trace ____Light ____Moderate ____Severe

Comments on this encounter:

Meteorologist Questionnaire
To be filled out if icing is forecast, observed, or considered for a region.

Date:
Region of interest:
Altitudes of interest:
Forecast valid time:
Was an AIRMET issued? Yes No
Was a SIGMET issued? Yes No
AIRMET or SIGMET ID:
Was icing reported? Yes No
Time:
Location:

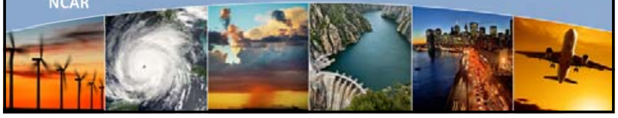
Briefly describe the reason why icing was forecast:

Update on the NCAR Turbulence Detection Algorithm (NTDA) Product Development

John Williams, Greg Meymaris

2012 UCAR-CAA AOAWS-TE Project Review Meeting
September 24, 2012

NCAR

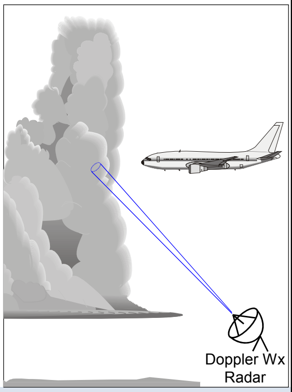


NCAR Turbulence Detection Algorithm (NTDA)

Objectives:

•Utilize Doppler weather radar data to provide remote, high-resolution, rapid-update atmospheric turbulence intensity measurements.

•Provide measurements with minimal latency to serve users and improve tactical situational awareness, airspace utilization, and safety.



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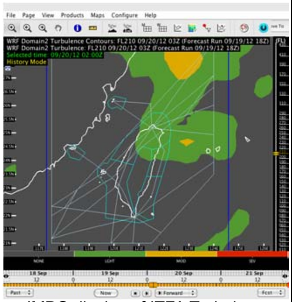
NTDA vs. ITFA Turbulence

- ITFA (aka GTG) is an NWP model-based turbulence *forecast* product
- NTDA is a Doppler radar-based turbulence *detection* product.
  - No predictive capability
  - Observes turbulence in radar scan when cloud is present and the signal is free of contamination



JMDS display of ITFA Turbulence, 9/20/12 02:00 Z, FL 210

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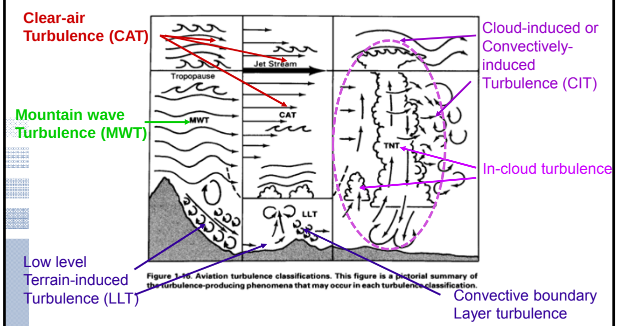
Sources of Turbulence



Graphic source: P. Lester, "Turbulence – A new perspective for pilots," Jeppesen, 1994

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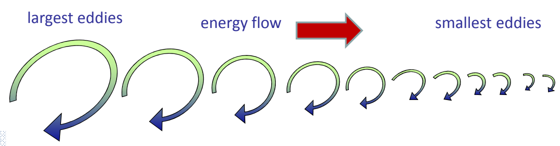
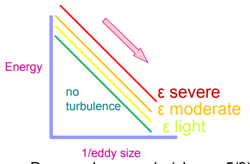
NTDA Measures Eddy Dissipation Rate (EDR)



- EDR is a measure of the dissipation rate of energy at the smallest scales (units of $dE/dt = \varepsilon$, $m^2\ s^{-3}$)
- NTDA display uses EDR thresholds that correspond to null, light, moderate or severe turbulence for a mid-sized commercial aircraft in cruise
  - Could be translated to impact on individual aircraft



Downscale cascade (slope=-5/3)

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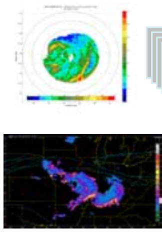
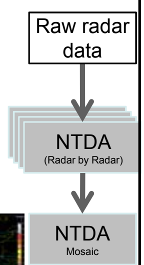
NTDA System Components

- NTDA processing
  - Runs radar by radar, producing EDR and confidence on a polar coordinate grid for each sweep.
- NTDA mosaic
  - Merges data from multiple radars to produce 3D grids of EDR and "confidence"
  - dBZ is also mosaicked for diagnostic purposes





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Taiwan NTDA Accomplishments to Date

- Established a real-time feed of Taiwan radar data to NCAR
- Wrote and tested software for data ingest and pre-processing
- Created, implemented and tested algorithms for estimating required quantities not present in the radar metadata
- Implemented a prototype real-time system:
  - Data ingest
  - NTDA processing
  - 3-D mosaic
  - Display

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E.g., Estimating Missing Radar Metadata

- NTDA makes significant use of metadata including radar operating characteristics, but these are not all available for all 4 radars
  - Radar constant (to compute signal-to-noise ratio, SNR) on Gematronik radars estimated via reflectivity
    - May cause some under-estimates of SNR, reducing coverage, but effect should be minimal
  - Number of pulses per beam (used to help assess quality) on RCWF estimated via pulse repetition time, scan type, and antenna rotation rate

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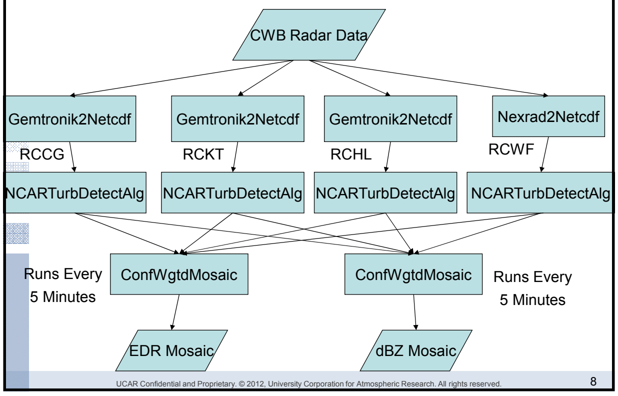
Prototype Taiwan NTDA Data Flow



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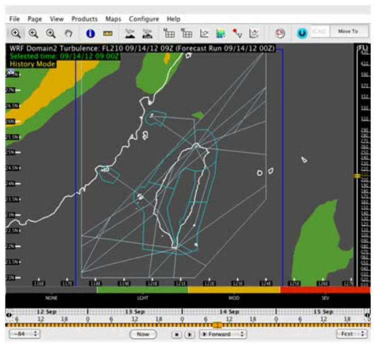
Prototype Display Case Study



JMDS display of ITFA Turbulence, 9/14/12 9:00 Z, FL 210

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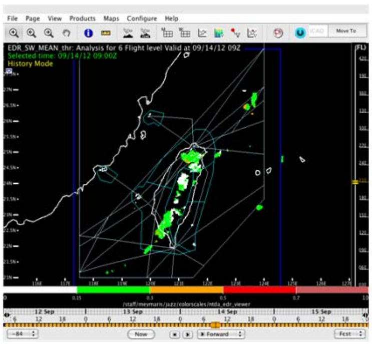
Prototype Display Case Study



JMDS display of prototype NTDA Turbulence, 9/14/12 9:00 Z, FL 210

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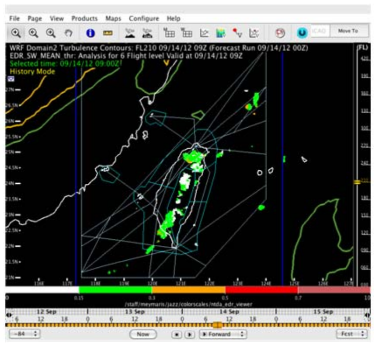
Prototype Display Case Study



JMDS display of NTDA + ITFA contours, 9/14/12 9:00 Z, FL 210

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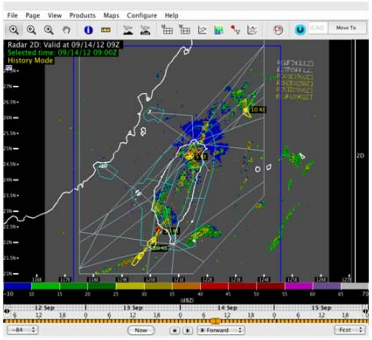
Prototype Display Case Study



JMDS display of 2D Radar, 9/14/12 9:00 Z, FL 210

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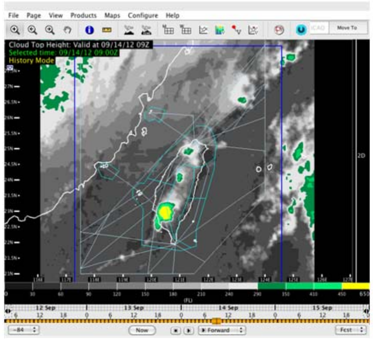
Prototype Display Case Study



JMDS display of Cloud Top Height, 9/14/12 9:00 Z, FL 210

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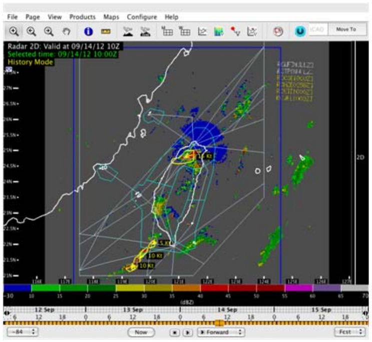
Prototype Display Case Study



JMDS display of 2D Radar, 9/14/12 10:00 Z, FL 210

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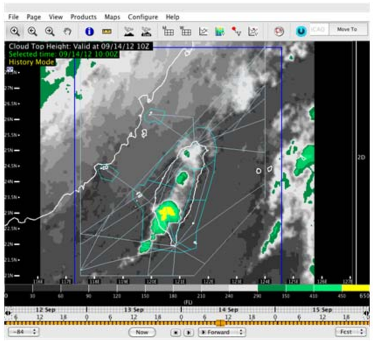
Prototype Display Case Study



JMDS display of Cloud Top Height, 9/14/12 10:00 Z, FL 210

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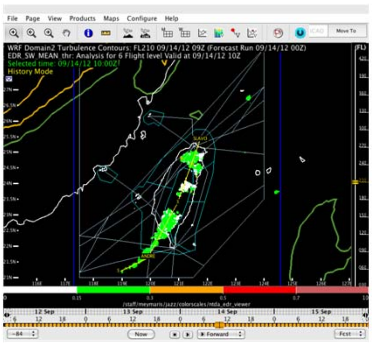
Prototype Display Case Study



JMDS display of NTDA + ITFA contours, 9/14/12 10:00 Z, FL 210

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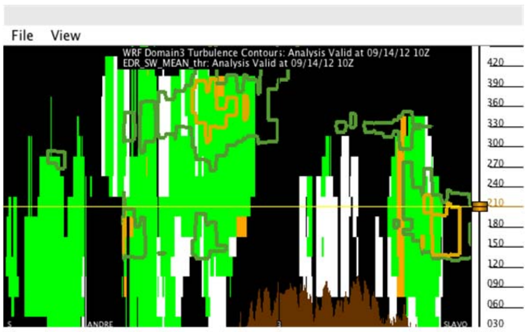
Prototype Display Case Study



JMDS cross-section display of NTDA + ITFA contours, 9/14/12 10:00 Z, FL 210

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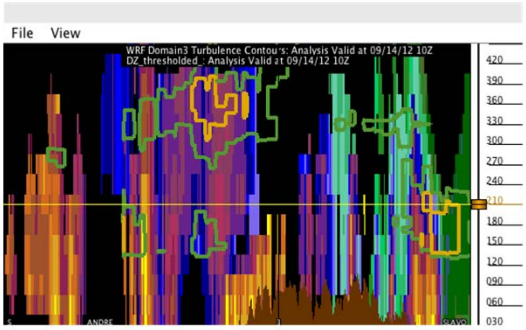
Prototype Display Case Study



JMDS cross-section display of dBZ + ITFA contours, 9/14/12 10:00 Z, FL 210

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18

2012 Tasks for Development and Implementation of NCAR's Turbulence Detection Algorithm Product

1. [>90%] Obtain and evaluate technical information about the Taiwan weather radars such as technical specifications, data formats, data quality, scan strategies, and other operational details
2. [>90%] Obtain sample Taiwan Doppler radar datasets
3. [60%] Develop and refine the turbulence detection algorithm to utilize Doppler weather radar data from selected Taiwan Doppler weather radars
4. [40%] Begin to test the turbulence detection algorithm to ensure it is functioning as designed
5. [>90%] Begin to establish AOAWS related connections to the radar data in Taiwan and archiving data for research and development
6. [30%] Evaluate the processing requirements for running the NTDA algorithm within the AOAWS environment
7. [65%] Prepare NTDA development progress reports that will be included in the monthly and quarterly report

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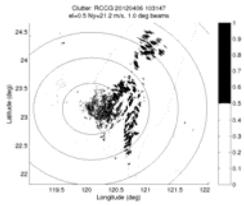
NTDA QC: Mitigating Clutter Contamination

- Clutter and overlaid clutter affect spectrum width measurements, so NTDA censors affected locations
  - RCWF: Dynamic clutter map not available
  - RCCG: Clutter filter applied everywhere, but some clutter still visible
  - RCKT & RCHL: Clutter filter not applied
- Radar Echo Classifier (REC) will be tuned to detect anomalous propagation (AP) and unfiltered clutter
- Static "worst-case" clutter maps will be developed for radars where clutter filtering is applied based on data analysis
- An algorithm may be needed for sea clutter mitigation



Clutter detected using REC on RCCG, 20120406 10:31:47 UTC, 0.5°

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20

NTDA QC: Radio-Frequency Interference

- RFI often affects spectrum width measurements, so regions where RFI is experienced should be censored
- RFI is not a problem in the US, so a new algorithm for detecting it is needed
  - Approach: identify radial artifacts in reflectivity, velocity and spectrum width data, and censor affected locations

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NTDA QC: Birds and Insects

- Birds and insects can affect spectrum width measurements, so NTDA confidence values are lowered in suspect locations
- The current NTDA QC algorithm uses an interest map with a reflectivity threshold that varies with altitude above ground
  - This threshold will need to be tuned for Taiwan
  - Alternatively, a more sophisticated algorithm may be developed to take into account other characteristics of the radar echoes

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NTDA Tuning and Verification

- Radar simulations will be performed to characterize spectrum width accuracy for various radars, operational modes, and signal-to-noise ratio values
- Spectrum width to EDR translation tables will be updated
- In the absence of aircraft turbulence observations, tuning and verification will be performed via case studies and statistical comparisons of NTDA output from adjacent radars

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23

Radar Data Transfer Latency

- Currently, Taiwan radar data are being assembled into volumes and sent to NCAR
- For Gematronik radars, the max time gap seen so far is 6¼ min.
- For the NEXRAD radar (RCWF), the time gap is about 5½ min.
- Including transmission latency, data may be close to 7 minutes old or more when received, and therefore up to 12 minutes old by the NTDA mosaic valid time.
- Receiving data for each elevation sweep as soon as it is completed, or in smaller chunks, would reduce the NTDA product latency and increase its tactical value.

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Development Approach and Priorities

- Taiwan NTDA is following a rapid-prototype development approach
  - Incremental improvements are developed, tested, and added to the real-time system
  - The prototype real-time system runs continuously
- We plan to prioritize optimizing Taiwan NTDA performance for altitudes > FL200 (20,000 ft)
- Taiwan NTDA data for lower levels may initially be omitted or have less than optimal coverage

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Summary

- Excellent progress has been made on Taiwan NTDA system development
  - Information about Taiwan radars has been obtained, and ingest of real-time Taiwan radar data established
  - Algorithms have been developed to estimate missing metadata, allowing NTDA to run
  - A prototype Taiwan NTDA system is running in real-time at NCAR, with display via a prototype JMDS
- Several tuning steps and scientific challenges remain, including mitigating clutter / clutter filter contamination
- A rapid-prototype development approach will continue to make incremental improvements, prioritizing accuracy and coverage at upper flight levels.

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Questions?

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NCAR

Backup slides

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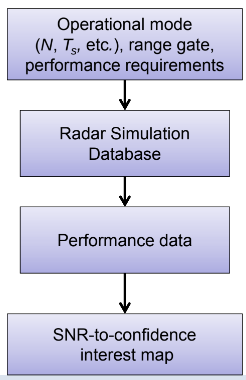
NTDA Adaptive SNR Quality Control

- Compute maps "on the fly" based on exact operational mode
  - Uses metadata that accompanies the radar sweep data
- Many future radar changes (e.g., new SW estimation methods) may now be handled via simulation database update



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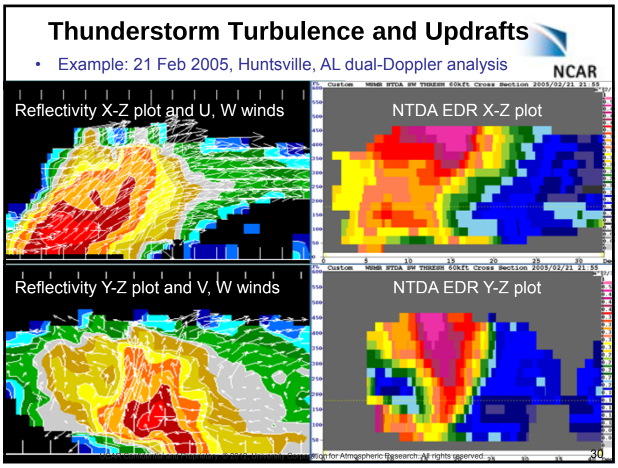

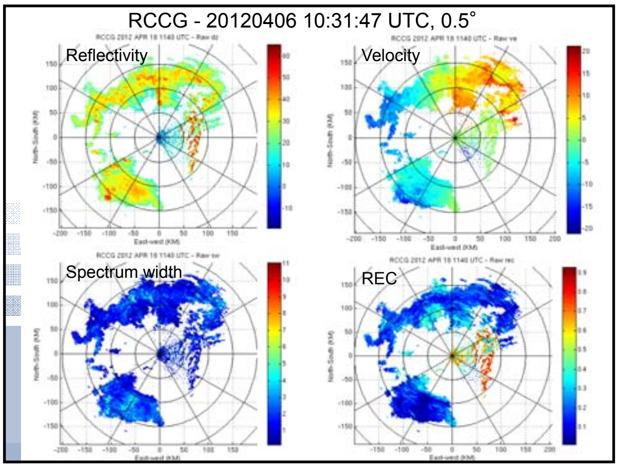

Turbulence Intensity

- Based on verbal pilot reports of turbulence (PIREPs)
- Mainly qualitative and subjective
  - "light"
  - "moderate"
  - "severe"
  - "extreme"
- Aircraft-dependent relationship to atmospheric turbulence

11/22/2012

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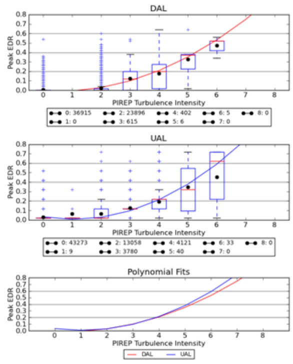
PIREP-*Insitu* EDR Comparisons



Based on 60,000 UAL757 matches, 50,000 DAL737 matches

"Light"=0.03 $m^{2/3}s^{-1}$

"Moderate"=0.21 $m^{2/3}s^{-1}$

"Severe"=0.56 $m^{2/3}s^{-1}$

These are lower than ICAO "standard" thresholds

"None" < 0.1 $m^{2/3}s^{-1}$

"Light" 0.1-0.3 $m^{2/3}s^{-1}$

"Moderate" 0.3-0.5 $m^{2/3}s^{-1}$

"Severe" > 0.5 $m^{2/3}s^{-1}$

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NCAR

NCAR's Icing Forecasting and Diagnosis Projects

Marcia K. Politovich

AAP Deputy Director for Science

For: Taiwan CAA

Annual AOAWS-TE Project Review Meeting

NCAR, Boulder, CO

24 Sept 2012

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Icing = frozen water on the airframe or in the engine

NCAR

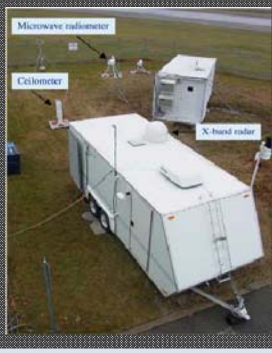
Icing – by Hazard

NCAR

- InFlight Icing
  - Detection & Diagnosis
  - Forecast
- Ground Icing
  - Decision support systems
  - Improved measurements
- Engine Icing
  - Diagnosis

NIRSS: NASA Icing Remote Sensing System

NCAR



NIRSS goal: Detect icing conditions in the airport terminal area with inexpensive, off-the-shelf technologies

- Multi-channel radiometer
- X- or K_a band vertically-pointing radar
- Ceilometer

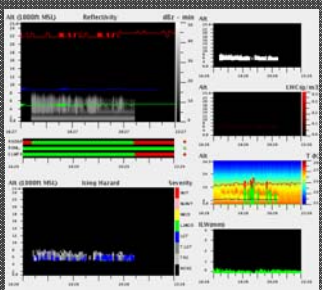
NIRSS Display

NCAR

Radar reflectivity

Instrument status

* Icing Hazard



Radar cloud bounds

Liquid water content

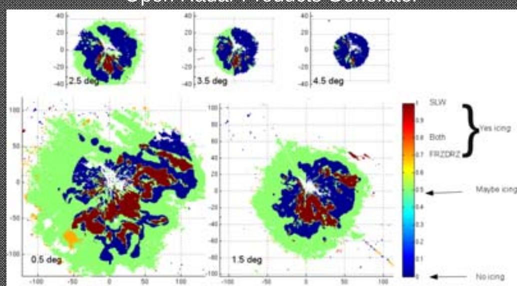
Radiometer T profile

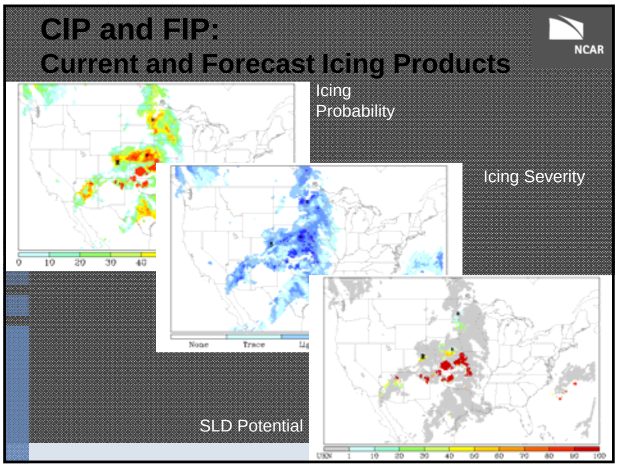
Radiometer integrated liquid water

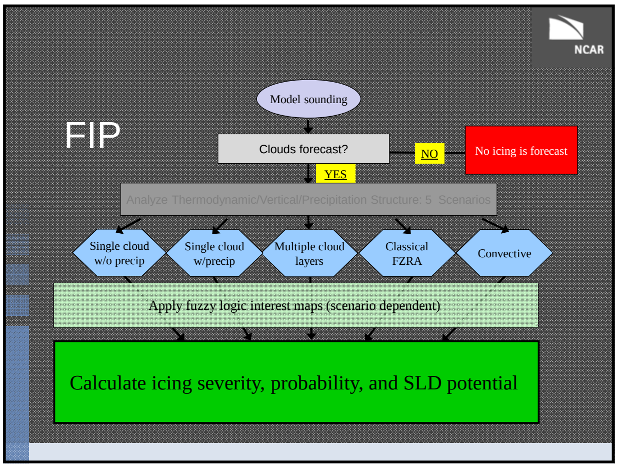
IHL: Icing Hazard Level

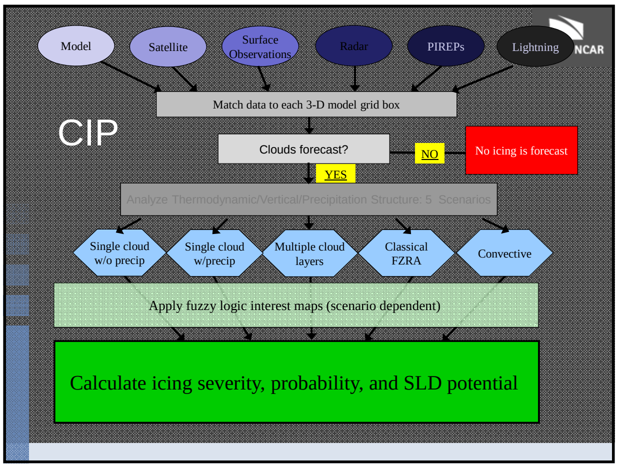
NCAR

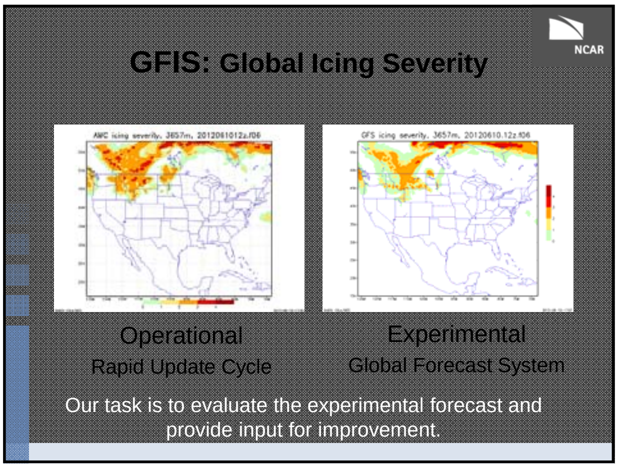
NEXRAD-based icing detection system intended for Open Radar Products Generator

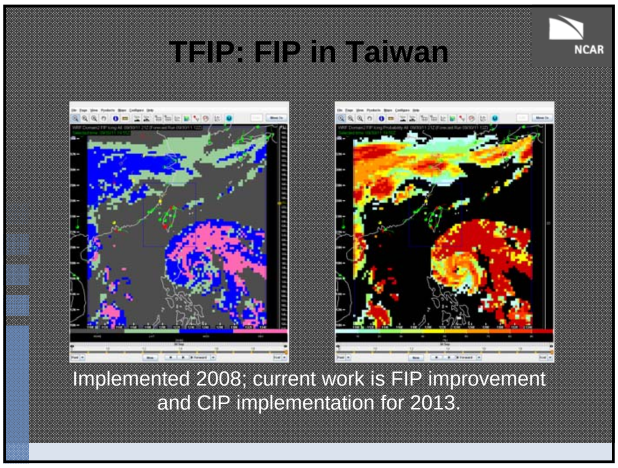



CIP and FIP:
Current and Forecast Icing Products
NCAR
Icing
Probability
Icing Severity
SLD Potential


NCAR
FIP
Model sounding
Clouds forecast?
NO
No icing is forecast
YES
Analyze Thermodynamic/Vertical/Precipitation Structure: 5 Scenarios
Single cloud w/o precip
Single cloud w/precip
Multiple cloud layers
Classical FZRA
Convective
Apply fuzzy logic interest maps (scenario dependent)
Calculate icing severity, probability, and SLD potential


Model
Satellite
Surface Observations
Radar
PIREPs
Lightning
NCAR
Match data to each 3-D model grid box
CIP
Clouds forecast?
NO
No icing is forecast
YES
Analyze Thermodynamic/Vertical/Precipitation Structure: 5 Scenarios
Single cloud w/o precip
Single cloud w/precip
Multiple cloud layers
Classical FZRA
Convective
Apply fuzzy logic interest maps (scenario dependent)
Calculate icing severity, probability, and SLD potential


NCAR
GFIS: Global Icing Severity
Operational
Rapid Update Cycle
Experimental
Global Forecast System
Our task is to evaluate the experimental forecast and provide input for improvement.

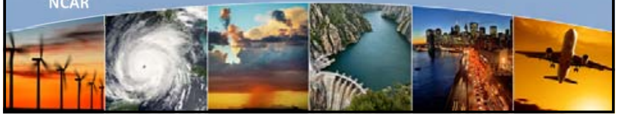

NCAR
TFIP: FIP in Taiwan
Implemented 2008; current work is FIP improvement and CIP implementation for 2013.

2012 UCAR-CAA AOAWS-TE Project Review

Enhancement of Airport Ceiling and Visibility Product

Jim Cowie
Julia Pearson, Gerry Weiner, Paul Prestopnik
24 September 2012

NCAR



Task 3
Enhance Ceiling & Visibility Prediction Product

Task Goal

- Develop and implement an upgraded product based on WRF and METAR data, using artificial intelligence methods and techniques.
- Improve forecasts of ceiling, visibility, temperature, RH, pressure, U, V-wind components

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Task 3
Enhance Ceiling & Visibility Prediction Product

Development Steps

- Collect historical dataset for testing
- Create playback system in lab
- Choose statistical methods for testing
- Perform tests and compare methods
- Select optimal approach
- Develop and test new code
- Implement code into AOAWS

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Task 3
Enhance Ceiling & Visibility Prediction Product

Testing Dataset

- WRF & METAR data at 10 airport forecast points
- Historical data collected (Dec 2011 – Jan 2012)
- Collection of operational data (Feb 2012 – now)
- Current linear regression uses 60 days history
- In June we had enough data for testing
- Forecast scoring sample size: 350 per site (200 for locations closed at night)

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Enhance Ceiling & Visibility Prediction Product

Playback System

- Playback system developed in NCAR lab
- Loop over days; Feb - May
- MosCalibration run once per “day” to generate data used by other methods (all techniques use same data)
- Cubist (regression tree) and Random Forest training
- Apply “model” to make forecasts for that day
- Increment one day, retrain, make new forecasts, etc

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Enhance Ceiling & Visibility Prediction Product

Scoring & Results

- Linear regression (current method), Cubist, Random Forest methods compared
- RMSE used as metric
- T, RH, Ceiling, Visibility (not shown: U, V, SLP)
- Lead times out to f18
- Results for all sites averaged together, 3 “main” sites (RCTP, RCSS, RCKS) together, and each site (not shown)

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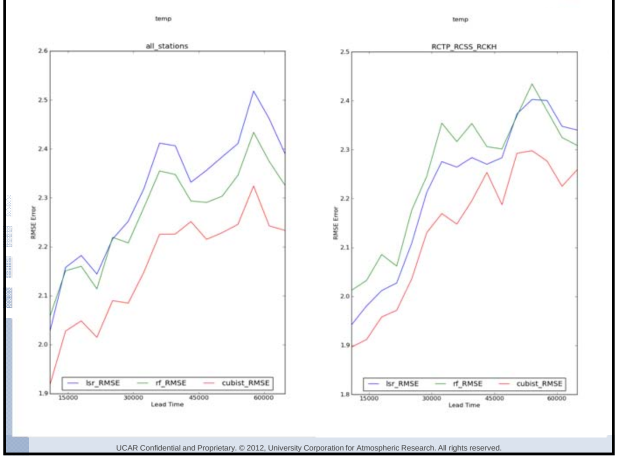

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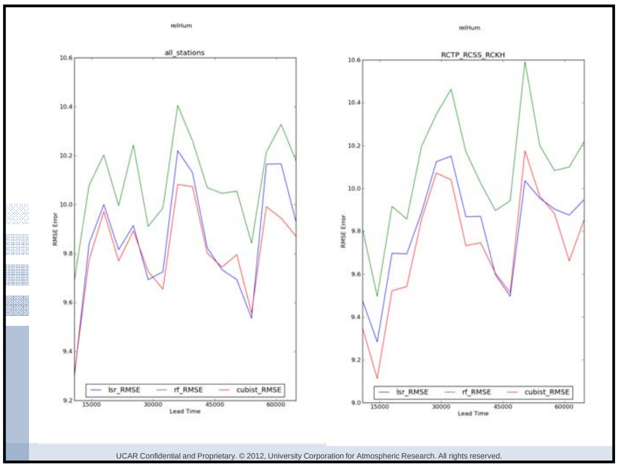

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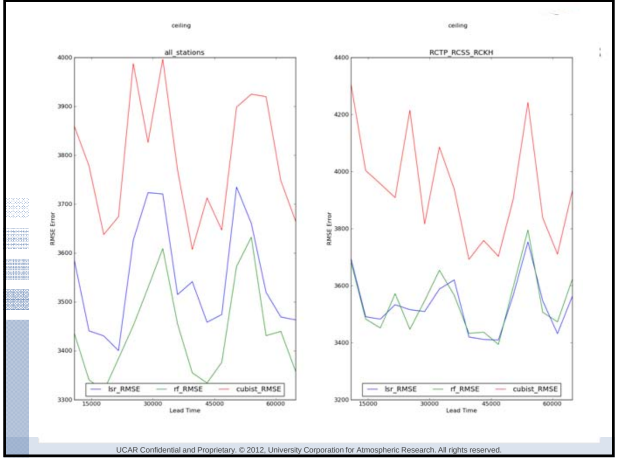

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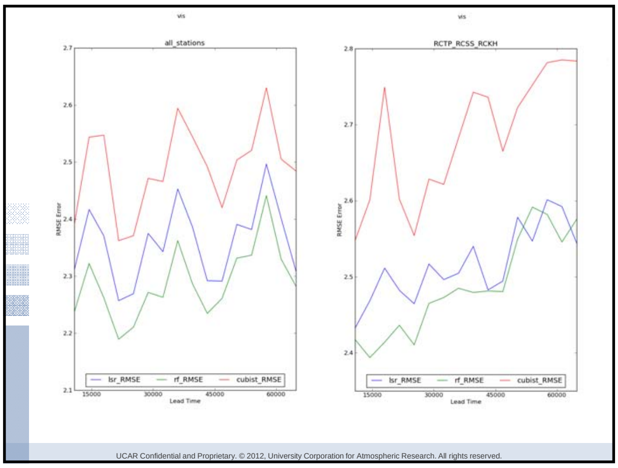

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Task 3

Enhance Ceiling & Visibility Prediction Product

NCAR

Conclusions

- Linear regression is very competitive
- No one method improves forecasts for all variables
- Replacing linear regression with Cubist or Random Forest would require engineering work but not improve all forecasts
- May still look at these methods or other linear regression improvements in IA#17
- Add verification system in IA#17

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Task 3

Enhance Ceiling & Visibility Prediction Product

NCAR

Other Conclusions

- Can we improve existing MOS technique?
- Yes, we found some things that will improve the forecasts.
- MosFcastAdjust – adjustment to METAR
- MosSpdb2Html – update frequency

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Enhance Ceiling & Visibility Prediction Product

MosFcastAdjust Modifications

- Existing technique adjusts forecast to METAR or SPECI using error difference all the way to f18
- This is hurting the skill of the forecasts after the first few hours
- We can apply a correction that decays linearly with forecast time (goes to 0 correction at f12 for example)
- Also tried a ‘sigmoid’ correction decay (not shown)
- Here are some results of this.

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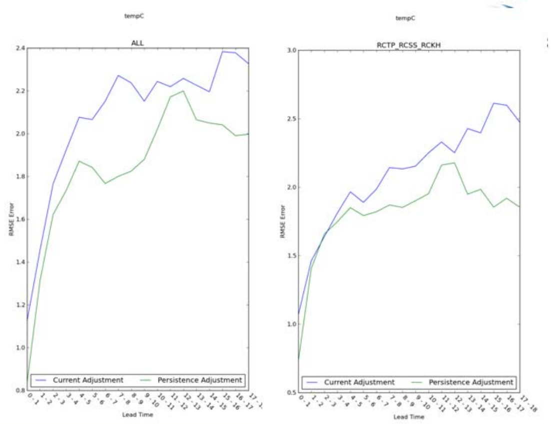

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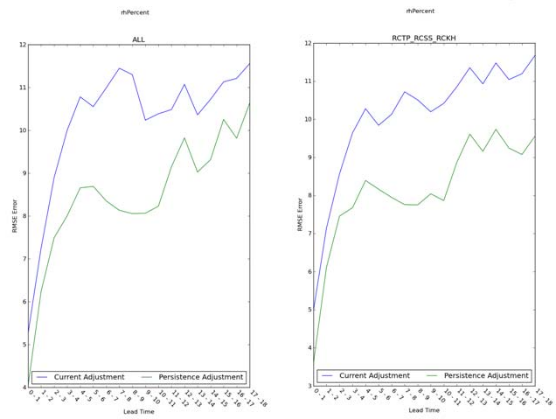

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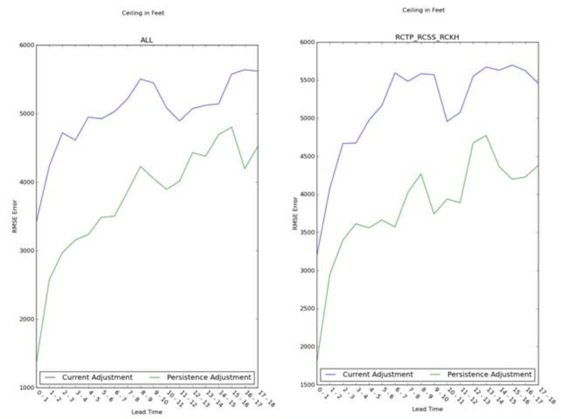

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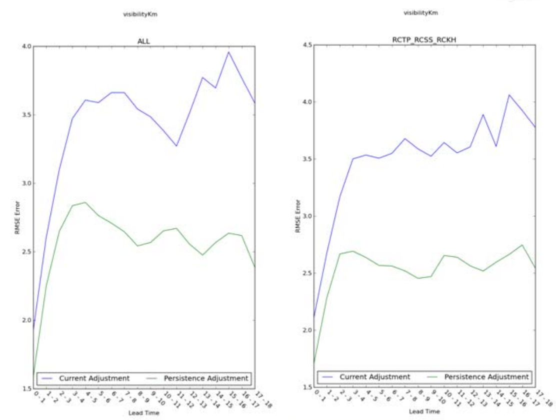

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Enhance Ceiling & Visibility Prediction Product

MosSpdb2Html Modifications

- This step creates the HTML pages for viewing from the adjusted MOS forecasts
- Not data driven
- Delay of viewable data caused by update schedule
- Change update schedule to be more frequent

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Remaining Work

- Install in NCAR lab
- Determine final configurations
- Lead-time adjustment extent (6,9,12 hr?)
- HTML update rate (1, 2, 5 minute?)
- Provide updates in next AOAWS release
- Provide progress report in Q3 report

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NCAR

Questions?

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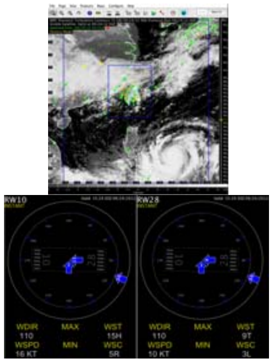
Display Update

Aaron Braeckel

National Center for Atmospheric Research

Overview

- Java 7
- TAMC Certificates
- JMDS
  - Tasks
  - Progress
  - Demo
- AWOS Display
  - Progress
  - RCFG (2013)



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Java 7

NCAR-observed issue
- Minor Exception. Does not effect display functions

TAMC-observed issue(s)
- Connection reset (fixed)
- Other issues?

Overall: Java 7 is not expected to cause issues. No significant issues observed

Certificates

Certificate Change
- Tested support for a changed certificate
- Switch is possible at any time, but involves ISI or TAMC to do the signing (NCAR provides JARs)
  - Separate build infrastructure (jarsigner)?
- Unclear requirement

JMDS 11 Work

- Simplified Configuration (Jadeite)
- User Interface Improvements
- Performance/Infrastructure Improvements
- MDS Replacement
  - MDS hardware/OS configuration
  - Image generation (finished next year)

JMDS 10 Layer Configuration

```
<DataLayerView
  id = "xsectPathLayer_view"
  className = "edu.ucar.rap.jade.view.DataLayerView"
  layerId = "xsectPathLayer"
  visible = "true">
  <CustomConfigSettings isCSGroupInitialized = "true">
    <CustomConfigSetting objectId = "cs_polylineColor">
      <SelectedValues>
        <SelectedValue>Yellow</SelectedValue>
      </SelectedValues>
    </CustomConfigSetting>
    <CustomConfigSetting objectId = "cs_pathLabelBackgroundColor">
      <SelectedValues>
        <SelectedValue>Black</SelectedValue>
      </SelectedValues>
    </CustomConfigSetting>
  </CustomConfigSettings>
  <DataLayerRenderer
    id = "xsectPathRend"
    className = "edu.ucar.rap.jade.view.renderer.XSectPathRenderer"/>
</DataLayerView>

<PostRenderer id="dl_status_renderer" className="edu.ucar.rap.aoaws.apps.jmds.JMDSStatusRenderer"
              timeControllerId="time_controller" paintLocation="NORTHWEST" >
  <CustomConfigSettings isCSGroupInitialized="true">
    <CustomConfigSetting objectId="cs_showLargeMessageOnError">
      <SelectedValues>
        <SelectedValue>true</SelectedValue>
      </SelectedValues>
    </CustomConfigSetting>
  </CustomConfigSettings>
</PostRenderer>
```

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New Configuration (Jadeite)

- No Java class names
- Limited cross-referencing
- Improved documentation
- User-focused

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MDS Replacement

MDS Host Differences
- Open windows (visibility, size and location)
- Raw text windows (raw METAR, TAF, AIREP, etc.)
  - Required in JMDS 11?

Image generation for WMDS
- Planning
- Implementation
- System Integration (scripts, configurations, bug fixes, etc.)

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JMDS 11

2012 Training version

Remaining Work:
- Time Series conversion
- METAR Time History conversion
- UI Improvements
- Testing

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JMDS 11 Image Generation

Config File and Demo

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AWOS Display

AWOS Display 11

Release Date: Feb 2012

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Summary

remember

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Advanced Operational Aviation Weather System (AOAWS)

Task #3

Air Traffic Management System (ATMS) Weather Integration Needs and Operational Concept Analysis

24 September 2012

National Center for Atmospheric Research (NCAR)
Research Applications Laboratory

ATMS Weather Integration

Ultimate Goal

- Improve aviation safety and air traffic system efficiency by having better information about hazardous weather conditions.

ATMS Weather Integration

Task Objective

- To explore and capture user needs, develop operational concepts, and discuss anticipated benefits derived from integrating selected AOAWS products into the TACC environment


Taipei Area Control Center (TACC)

ATMS Weather Integration

TACC Environment

- Traffic Management Unit
- Terminal Radar Approach Control
- Enroute Air Traffic Control
- Controllers
- Supervisors


Taipei Area Control Center (TACC)

ATMS Weather Integration

Candidate AOAWS Weather Products

- Airspace impacted by turbulence
  - GTG/ITFA (predicted)
  - NTDA (diagnosed)

- Airspace impacted by thunderstorms
  - Radar mosaic and TITAN
- Airspace impacted by icing
  - CIP (diagnosed)
  - FIP (predicted)

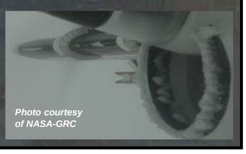
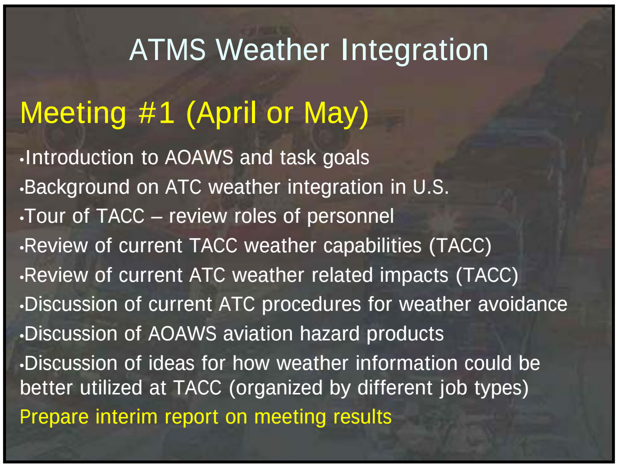


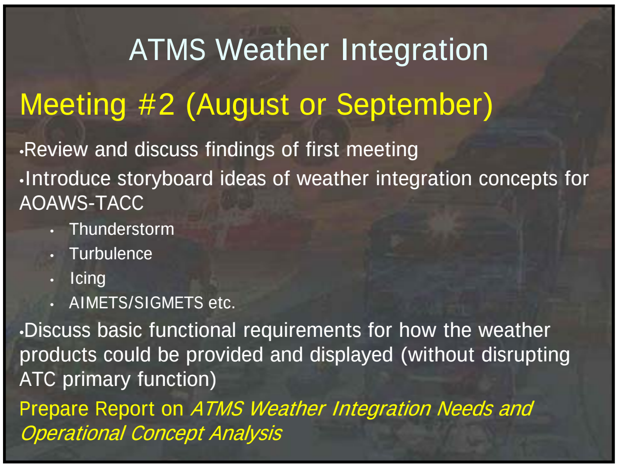
Photo courtesy of NASA-GRC

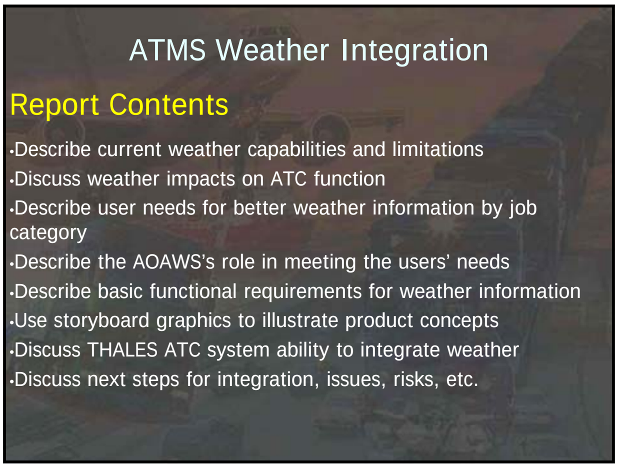
ATMS Weather Integration

Process

- Establish small Working Group
  - ~ 6 TACC personnel (from different job categories)
  - TAMC
  - IISI (1 to 2) and NCAR (1 to 2)
- NCAR will travel to Taiwan to participate in two meetings
  - April or May 2013 and August or September 2013


ATMS Weather Integration
Meeting #1 (April or May)
•Introduction to AOAWS and task goals
•Background on ATC weather integration in U.S.
•Tour of TACC – review roles of personnel
•Review of current TACC weather capabilities (TACC)
•Review of current ATC weather related impacts (TACC)
•Discussion of current ATC procedures for weather avoidance
•Discussion of AOAWS aviation hazard products
•Discussion of ideas for how weather information could be better utilized at TACC (organized by different job types)
Prepare interim report on meeting results


ATMS Weather Integration
Meeting #2 (August or September)
•Review and discuss findings of first meeting
•Introduce storyboard ideas of weather integration concepts for AOAWS-TACC
• Thunderstorm
• Turbulence
• Icing
• AIMETS/SIGMETS etc.
•Discuss basic functional requirements for how the weather products could be provided and displayed (without disrupting ATC primary function)
Prepare Report on *ATMS Weather Integration Needs and Operational Concept Analysis*


ATMS Weather Integration
Report Contents
•Describe current weather capabilities and limitations
•Discuss weather impacts on ATC function
•Describe user needs for better weather information by job category
•Describe the AOAWS's role in meeting the users' needs
•Describe basic functional requirements for weather information
•Use storyboard graphics to illustrate product concepts
•Discuss THALES ATC system ability to integrate weather
•Discuss next steps for integration, issues, risks, etc.

Task #7 :ATMS Product Integration

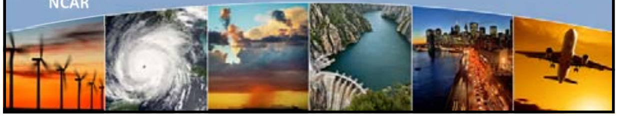
Objective: Integrate aviation weather hazard products into air traffic display systems

- Conduct user requirements and operational concept documents
- Design products
- Develop interface specifications with MITRE and THALES
- Export select AOAWS products to ATMS
- Document capability

2012 UCAR-CAA
AOAWS-TE Project Review

Issue Discussion

24 September 2012



1: 2014 WRF Domain Change

The CWB plans to upgrade WRF resolution to 3/15KM, with TBD domain and planed increase the length of forecast time, in 2014. What possible problems might CAA face in the future after CAA takes over the system and these changes occurs?

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1: 2014 WRF Domain Change

- ITFA will have to be re-tuned and possibly modified.
- Instances of Wrf2Mdv will have to be modified.
- CIP and FIP will have to be tested and verified.
- RIP and model display web pages will have to be tested, possibly modified.
- Overall load on AOAWS will increase, which may require increases in bandwidth, disk space, memory or CPU.

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2: How will CAA handle Satellite Change?

What possible problems might CAA face when/if Satellite data resolution and domain changes in the future after CAA takes over the system? Also, what to do when/if Japan replaces its satellites and MTSAT data processing procedure changes.

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2: How will CAA handle Satellite Change?

- Reformatting to MDV will still work.
- File format change will be a problem.
- NCAR can't provide much advice without more information.

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3: How will CAA manage new Java JRE?

This is a question about Java used by JMDS and AWOS display. What will CAA need to do in order to replace/install a new Java version in JRE?

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3: How will CAA manage new Java JRE?

NCAR

- NCAR could not reproduce problem with Java 6 & 7 on Windows- and Linux-based hardware.
- Additional information from TAMC indicated a networking or firewall configuration problem.
- Discuss further during display update.

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4: Can NCAR create configuration changes prior to changes

NCAR

Will it be possible for NCAR to set up some system configuration files to take care of future system changes mentioned in the above 3 questions? If so then the CAA will be able to adjust parameters according to the system changes when need. Or, the other option will be for CAA to sign a small maintenance contract with NCAR to take care of system adjustments for new AOAWS data ingests in the future.

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4: Can NCAR create configuration changes prior to changes

NCAR

- NCAR can create general procedures based on anticipated scenarios that can provide guidance when these changes occur.
- NCAR cannot create a set of configurations files without specific details.
- NCAR is open to discussing a maintenance contract.

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5: When can CAA use Java certificate?

NCAR

When can CAA use the Java certificate in the JMDS and AWOS displays?

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5: When can CAA use Java certificate?

NCAR

- More clarification is needed.
- This will be discussed during display update.

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6: Does new C&V work include verification?

NCAR

Does the airport ceiling and visibility product include verification? If not, when can it be developed?

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6: Does new C&V work include verification?

- A verification system is not part of included work for IA #15.
- One can be created from the tools created to perform analyses.
- Adding verification system can be part of IA #17

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7: View AMDAR Data

When can the AMDAR data be displayed on JMDS?

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7: View AMDAR Data

- AMDAR data will be available on JMDS with first release of AOAWS 12 in April 2013.
- The BUFR decoding must be completed too.
- Work will not begin until start of IA#16 because of timing, staff availability and budget.

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8: Add RCFG AWOS

The RCFG airport's AWOS will be installed in November 2013. We will need NCAR to add the AWOS display for RCFG in 2013.

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8: Add RCFG AWOS

- NCAR will ensure resource are available to complete task.
- TAMC and IISI performed large portion of work to add RCMT.
- The November date may conflict with final AOAWS 12 install.
- Move start to after the IA #16 Acceptance Meeting.

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9: Final AOAWS 11 Install

The AOAWS IA 15 system final version installation may take longer due to the Debian6 64bits version installation. Should the system installation starts earlier or will IISI take care of certain preparations?

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9: Final AOAWS 11 Install

- The final release (11.1) will be 32-bit.
- The work to install and test release will take time.
- The 64-bit Debian version is scheduled to be part of first AOAWS 12 release in April.

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10: Acceptance Meeting Plan

We need to identify the IA#15 acceptance meeting dates. (When will the team arrive? Who are coming? And other schedule/plans?)

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10: Acceptance Meeting Plan

- Bill Mahoney and Gary Cunning will attend Acceptance Meeting.
- 6 December date will work.
- Gary will arrive on 12/3.
- Bill will arrive on 12/3 or 12/4, depending on current obligations.
- Bill and Gary will leave on 12/8.

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11: IA #16 Training

Next year's training programs (any tentative schedule for Taiwan and Boulder training programs?)

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11: IA #16 Training

- Tentative first training session at TAMC to begin week of 22 April.
- Date picked to coincide with ATMS user group meetings.
- Tentative second training session in Boulder to begin 9 September.
- Length of second training is two weeks.

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