出國報告(出國類別：實習)

臺美氣象預報系統發展技術合作
赴美國國家海洋暨大氣總署
全球系統實驗室(NOAA GSL)
參訪及預報技術交流

服務機關：交通部 中央氣象署 預報中心
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派赴國家/地區：美國 / 波德 (Boulder)
出國期間：113 年 6 月 13 日 至 113 年 10 月 14 日
報告日期：114 年 1 月 14 日

摘要

AWIPS2 系統(第 2 代先進交談是天氣處理系統)為當前美國國家氣象局(National Weather System，NWS)所使用的天氣預報展示介面平台，此系統整合D2D、GFE、Hazard Service 等子系統。本次赴美研習針對精進精緻化預報、災害性天氣發布流程及學習天氣圖繪圖系統操作等議題，訪問美國國家海洋暨大氣總署(National Oceanic and Atmospheric Administration，NOAA)全球系統實驗室(Global System Laboratory，GSL)共計 4 個月。於訪問期間學習 AWIPS2 單機版(Standalone)安裝、繪製天氣圖工具(Product Generator，PGen)及災害性天氣服務系統(Hazard Service)，深入瞭解各項工具的實作及相關文件並參與兩場由 GSL 主辦的年度會議(GSL AI summit 及 2024 GSL Retreat)，藉由 GSL 於會中分享當前 AI 研究及技術開發，了解未來 GSL 將如何應用 AI 技術來產製以及呈現天氣預報產品的方式。

本次參訪主要是與 GSL 內 WIDS (Weather Informatics and Decision Support Division)部門底下的 WISE (Weather Information Systems Evolution)交流，透過長期與 NOAA GSL 的技術交流，本署增強了天氣預報展示以及災害性天氣發布能力。建議本署持續與美方互相交流預報技術及災害性天氣展示，強化本署氣象測報技術。

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一、 目的

第 2 代先進交談式天氣處理系統 (Advanced Weather Interactive Processing System 2，AWIPS 2) 為當前美國國家海洋暨大氣總署 (National Oceanic and Atmospheric Administration，NOAA)下國家氣象局(National Weather System，NWS) 於各天氣預報中心 (Forecast Office) 主要進行天氣預報、特報發布之系統。AWIPS 2 系統中主要包含天氣觀測及模式預報展示介面的 D2D、天氣預報編輯及發佈介面的 GFE、警特報編輯及發布的 Hazard Service。

中央氣象署(以下簡稱本署)為配合精緻化預報發展、原繪製天氣圖系統(WCE)汰換、天氣預報指引自動化以及系統面方便開發者使用及測試新工具，規劃本次參訪以及技術交流。希望透過此次參訪學習如何安裝 AWIPS2 Standalone (單機版) 、最新 Hazard Service 功能及操作流程、實作並操作 AWIPS2 內 PGen 功能(繪製天氣圖)以及了解 National Blending Model 概念。

二、 過程

1. 113 年 6 月 13 日：搭機赴美。

由桃園機場先至東京，因原航班被臨時取消，原東京(Tokyo)飛丹佛(Denver)的航班改由東京至舊金山(San Francisco)、舊金山至丹佛，最後與當地時間 6 月 13 日傍晚抵達丹佛並搭車前往波德市(Boulder)。

2. 6 月 14 日至 6 月 30 日：工作準備週。

赴 NOAA/GSL 報到，與 Jebb Steward 科長、Nathan Hardin 科長以及 David Tomalak 資深系統工程師見面，開始熟悉 NOAA/GSL 工作環境以及工作所需之設備及支援並與 Nathan Hardin 討論並說明當前本署對於 AWIPS 2 使用的現況及未來預期的發展。

3. 7 月 1 日至 8 月 31 日：建立 VLab 工作平台、AWIPS 2 單機版及參與 GSL AI 高峰會。

與 Nathan Hardin 及 Dave Tomalak 討論如何建置雙邊合作工作平台，最終採用將本署主要合作科室共 10 人加入 NOAA Vlab 平台，另於 NOAA GSL 提供的筆電安裝 AWIPS 2 23.4.1 版本的單機版本(Standalone)。受邀參加 GSL AI summit(高峰會)，由 Jebb Stewart 科長主辦邀請 GSL 各部門以及訪問學者共同參加 AI 技術發展研習並與美國國家颶風中心(National Hurricane Center，NHC)的 Wallace Hogsett 討論及分享本署預報中心所研發針對颱風強度及結構的 AI 預報。

4. 9 月 1 日至 9 月 30 日：參與 GSL 年會、PGen 操作及自動化預報指引。

受邀參加 GSL 年度進修活動，與 GSL 同仁討論當前 AI 在天氣預報上的應用；實作 PGen 繪圖功能及了解天氣圖產製流程，學習並了解自動化預報指引模式(NBM)產製概念及前驅物。

5. 10 月 1 日至 10 月 12 日：參訪 NWS Forecast Office 及學習 Hazard Service。

事前收集本署預報中心同仁提問，與 NWS 資深預報員 Paul Schlatter 交流預報工作經驗及實務操作流程。請 Dave Tomalak 資深系統工程師協助安裝新版本 Hazard Service 並於本機上實習製作災害性天氣特報發布及產製流程，本次實習期間工作內容如附件(一)所示。

6. 10 月 13 日至 10 月 14 日：搭機返臺。

由波德市(Boulder)搭車前往丹佛(Denver)國際機場並於舊金山(San Francisco)國際機場轉機後於臺灣時間 10 月 14 日傍晚抵達桃園國際機場。

三、 成果

(一) 在美報告「CWA’ s Goal of visiting NOAA GSL 2024」

此行在美國實習期間主要由 GSL 內 WIDS (Weather Informatics and Decision Support Division)部門底下的 WISE (Weather Information Systems Evolution) Nathan Hardin 科長作為我在美國的聯絡人，於抵達後與 Nathan Hardin 科長及本署預報中心同仁安排一次線上會議，討論並說明本次本署參訪 GSL 主要的目的以及想要學習的目標。會議中主要說明當前本署更新 AWIPS 2 版本的現況、未來預計發展的規劃以及雙邊如何在線上合作並共享開發的程式。相關會議簡報僅擷取部分如圖 1、圖 2 所示，詳細的報告投影片內容如附件(二)。

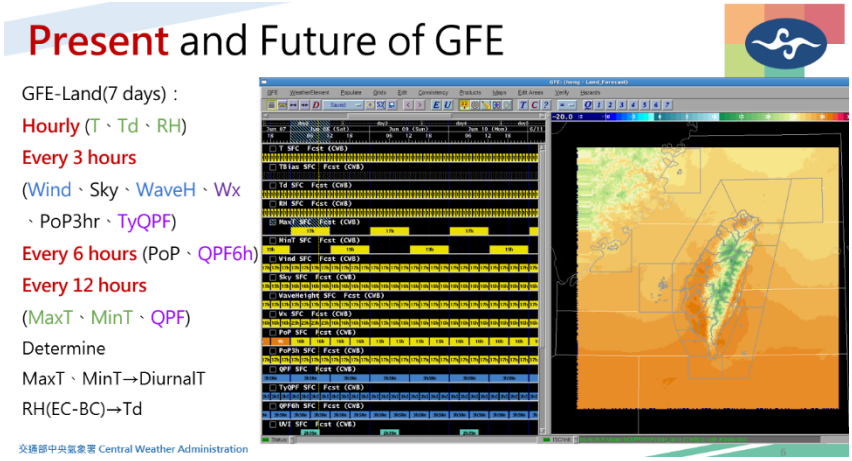


圖 1、 當前本署天氣預報編輯系統現況

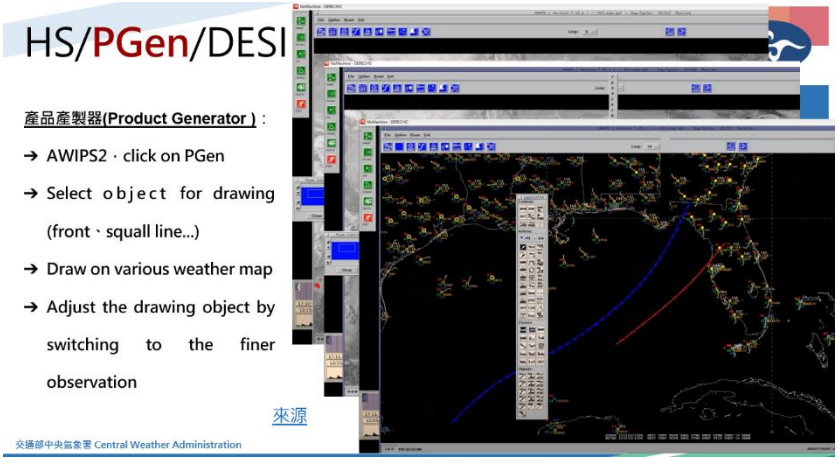


圖 2、 說明此次參訪目標

預期透過與美方 GSL 討論，可以更順利讓雙邊建立合作平台並提供未來更即時地諮詢協助。

(二) 在美報告「Typhoon Forecast in CWA, Taiwan」

訪美期間透過Nathan Hardin科長認識National Hurricane Center (NHC)的 Wallace Hogsett 科學首席(Science and Operation Officer)，並一同與Taylor Trodgen 科員(前 NHC 員工)開會介紹本署預報中心對於颱風預報技術的開發，以凱米颱風(2024)為例說明此次本署預報中心對於凱米颱風的風力、雨量及路徑的預報能力。另外也針對 AI 產品進行交流討論，會中 Wallace Hogsett 科學首席對於本署開發的 AI 颱風強度及結構分析相當感興趣，並希望未來 NHC 有機會可以與 CWA 交流合作。相關會議投影片節錄如圖 3、圖 4 所示，詳細報告投影片如附件(三)。

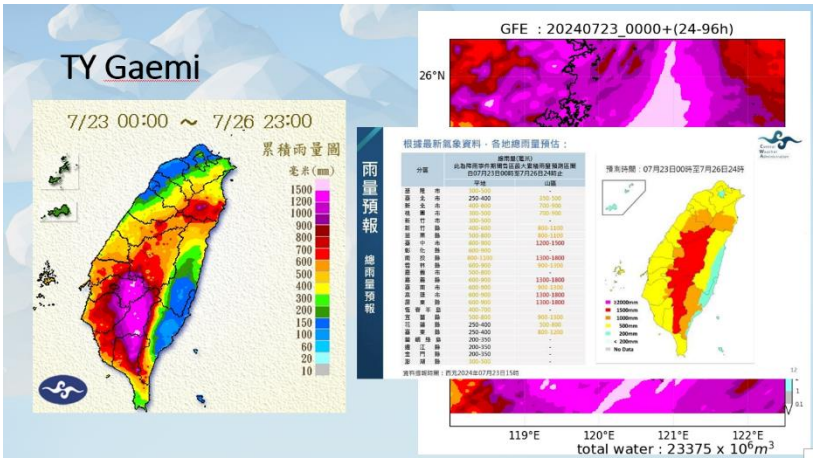


圖 3 、本署預報中心對凱米颱風(2024)雨量預報的掌握

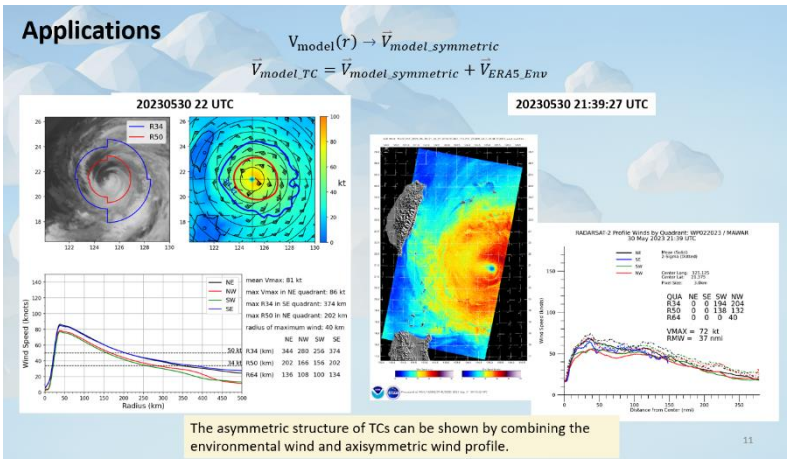


圖 4、 介紹本署預報中心現有的颱風 AI 結構技術

(三) 虛擬實驗室(VLab)帳號申請、開通

虛擬實驗室(VLab)為 NOAA 員工使用的開放工作及交流平台，為加強本署與 GSL 合作夥伴雙邊技術開發交流，此次請 Hardin Nathan 科長及 David Tomalak 資深系統工程師協助申請本署預報中心、數值資訊組同仁共 10 人帳號，提供我方可以登入查看相關文件並於線上平台討論程式開發議題。此項工作於訪美期間開通完畢，且上述本署同仁皆進行過測試可以使用。

VLab 內除可以進行雙邊程式或版本交流合作外，亦可查詢 AWIPS 2 內建功能並部分有教學、實作的文件可以參考，供本署合作夥伴了解當前系統開發的狀況。另當有版本更新或是新軟體開發時，亦可透過 VLab 查詢當前版本與前一版的差異及軟體使用方式。

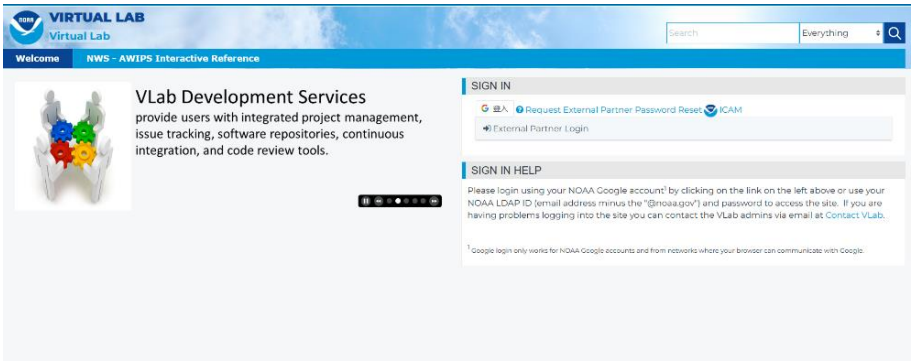


圖 5、 VLab 登入介面，外部合作夥伴使用 External Partner Login

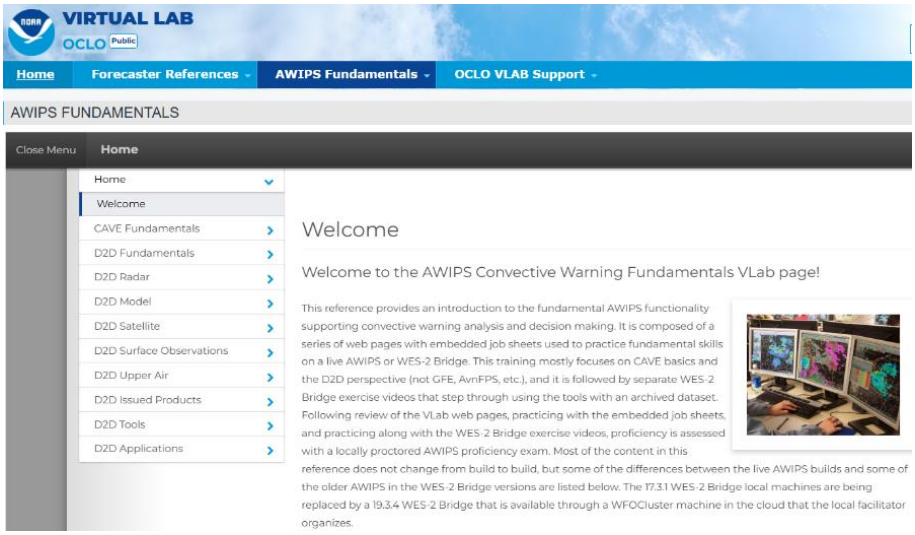


圖 6、AWIPS 團隊於 VLab 討論區

(四) 第 2 代先進交談式天氣處理系統(AWIPS 2) 單機版(Standalone)安裝

AWIPS 2 系統目前以分散式的方式安裝於本署內不同主機，並進行架接使用。為使系統及模組開發者於本機上即可進行模組開發，通常以單機版進行開發、測試後再推往正式機，因此此次實習期間請 David Tomalak 資深系統工程師協助安裝 AWIPS 2 單機版(Standalone)於個人筆電上並記錄安裝過程及相關檔案提供給署內其他開發者使用。本次安裝的版本為 23.4.1，為目前本署內使用的 23.2.1 的更新版但兩版本之間差異不大，並不影響開發者使用。當時安裝的筆電作業系統為 Redhat8 Enterprise Linux，記憶體為 30.8GB、處理器為 Inter -i9-10885H、CPU 為 2.4GHz * 16，顯卡為 Quadro RTX 3000/PCIe/SSE2 GNOME Version 3.32.2，OS system 64-bit 硬碟為 1TB。相關操作流程以及步驟詳見附錄，安裝完成的樣子如圖 7。

安裝的步驟大致包含新增群組及使用者名稱、修改 repo 設定檔、打包安裝流程檔、安裝相依性副程式、透過流程檔安裝 AWIPS2 單機版、移除並重新安裝 CAVE、新增資料庫，更新 edex 環境變數。詳細的步驟以及指令如附錄(四)所示。

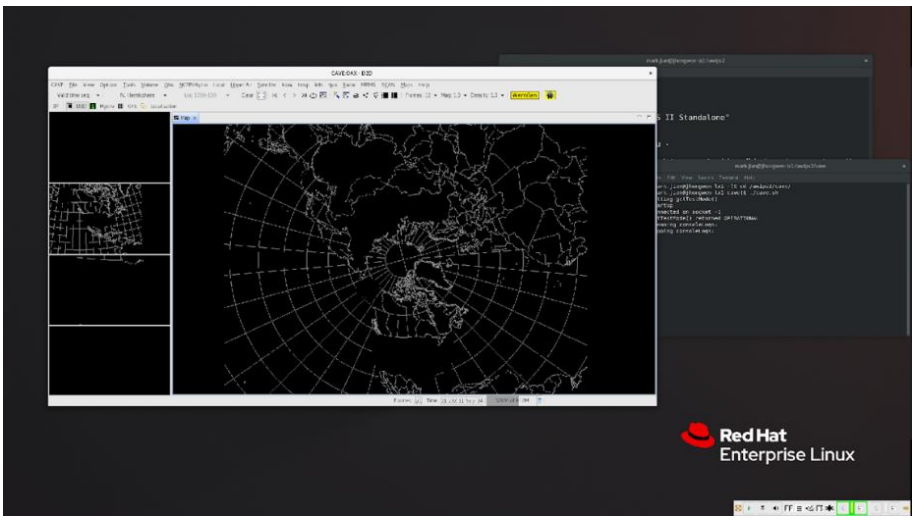


圖 7、 AWIPS2 23.4.1 單機版(Standalone) 安裝完成後開啟的畫面

(五) 第 2 代先進交談式天氣處理系統(AWIPS 2) 繪圖產品產出器(Product Generator，PGEN)實作及教學文件

Product Generator(PGEN)為一個在 AWIPS 2 中 D2D 以及 GFE 下繪製天氣符號的工具(Tools)，目前美國氣象局(NWS)各天氣預報中心(WFO)使用這個工具繪製天氣圖資包含航空天氣的 Significant Meteorological Information (SIGMET)以及地面分析天氣圖。從 AWIPS 2 20.3 版本之後，PGEN 變成是標配(Default)的安裝工具，此後的版本都可以直接在 Tools 的標籤下直接開啟 PGEN 使用。於出國實習期間使用單機版(AWIPS 2 23.4.1)試圖操作 PGEN 相關繪圖功能，並手工繪製地面分析天氣圖如圖 9 所示，並於實習結束後於本署內安裝的 AWIPS 2 23.2.1 版本開啟並繪製基本天氣要素如圖 10。

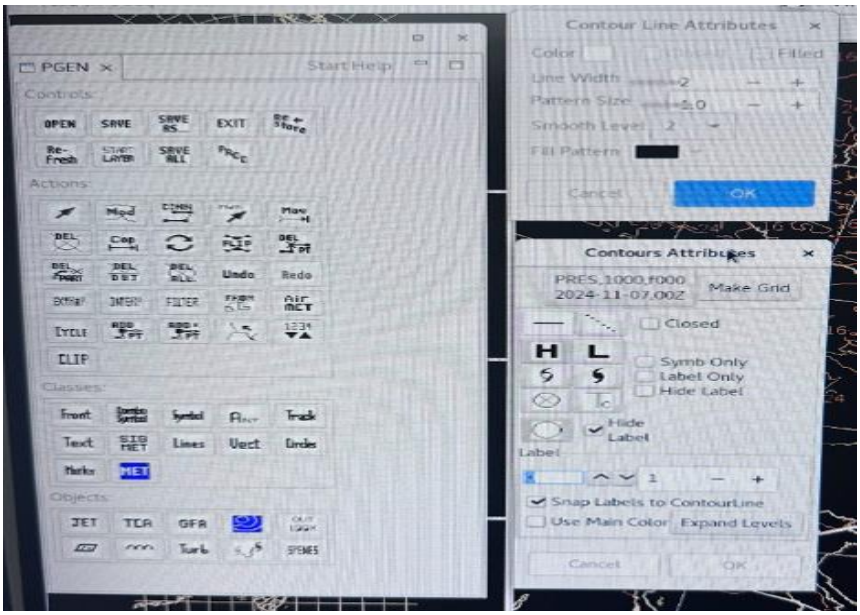


圖 8、 PGen 內建天氣圖示及繪圖功能

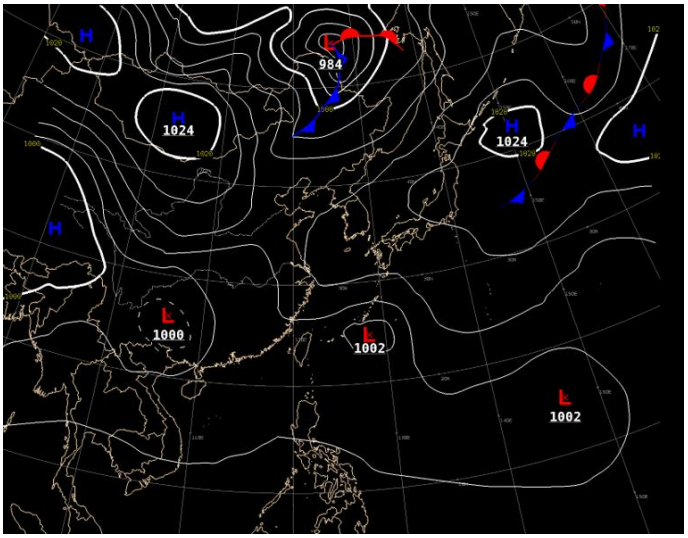


圖 9、 利用 AWIPS 2 23.4.1 版中的 PGen 繪製地面天氣圖

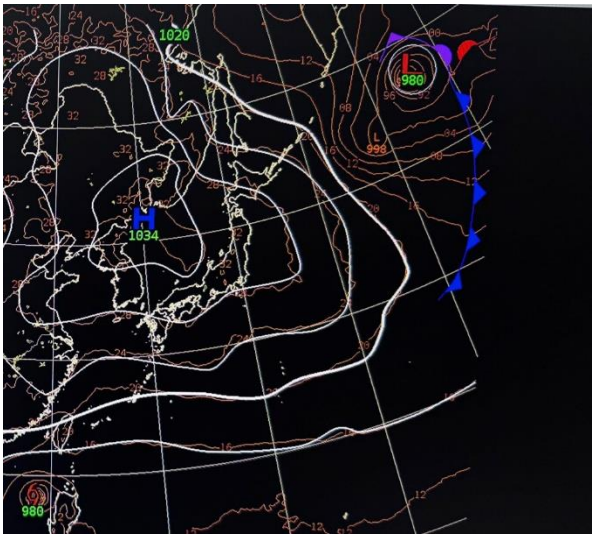


圖 10、利用本署當前 AWIPS 2 23.2.1 版中的 PGen 繪製地面天氣圖

(六) 災害性天氣服務(Hazard Service，HS)實作及教學文件

Hazard Service 為 AWIPS 2 內功能強大的模組，透過改善以及簡化災害工作流程如智慧工具的使用、半自動化選取區域等功能提升警報發布的效率。本署於 111 年冬季及 112 年夏季開始使用該功能發布鄉鎮化的低溫特報以及高溫資訊。為加強 CWA 以及 GSL 雙方技術交流以及能取得 HS 正式的教學說明，此行請 Nathan Hardin 科長安排每周 GSL 內固定會議了解當前 HS 技術發展的現況，另外請 Dave Tomalak 資深系統工程師協助安裝 HS 於單機版主機供實際操作，並提供 GSL 內對於 HS 教育訓練的文件讓 CWA 參考，下圖 11、圖 12 擷取自 GSL 提供的 HS 教育訓練投影片 。

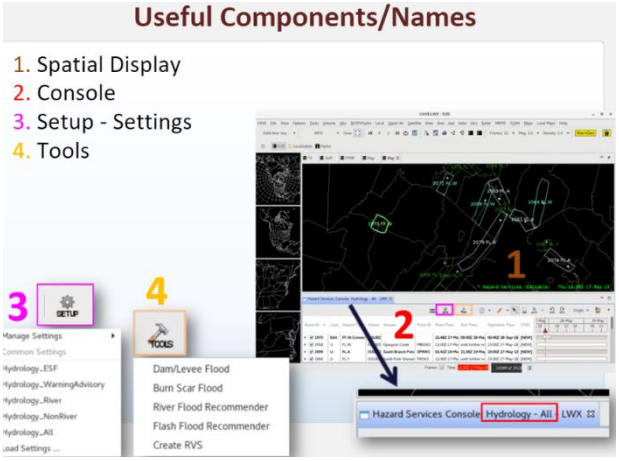


圖 11、 HS 開啟及操作步驟說明(1：現有災害天氣範圍、2：災害天氣事件狀態列表、3：操作設定、4：災害天氣建議工具)

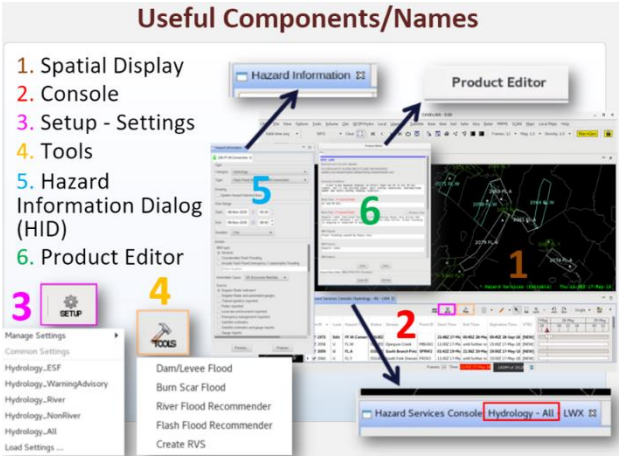


圖 12、 HS 操作步驟說明(5：災害天氣資訊調整、6：災害天氣特報產製)

(七) 全美混合模式(National Blending Model，NBM)使用文件

全美混合模式(NBM)是目前美國氣象局主要依賴的一周天氣預報指引，此指引提供各項天氣要素未來一周逐小時的預報指引，其中包含溫度、露點溫度、定量降雨預報、降雨機率預報、10 米風速風向、雲量、能見度、閃電機率預報及海面的示性波高。該指引是由不同尺度的天氣預報模式或指引進行混合，包含全球、區域、高解析、系集以及統計預報，經過地面分析場的回歸校正後，依據個別模式每日的預報表現給予不同權重進行未來一周逐時預報的混合基礎，如圖 13 所示。

因此，若要在本署開發建置自動化產製的天氣預報指引會需要三大要素，包含穩定輸出不同尺度下的天氣預報模型、良好的地面分析場作為校驗預報的基礎以及混合方式的選取與計算。隨著各種不同尺度甚至是 AI 預報模式的發展，擁有穩定輸出的天氣預報模型不算太難，但良好的地面分析場以及混合方式的選取是比較需要研究以及發展的方向。美方目前是依自己研發的地面分析場(Unrestricted Mesoscale Analysis，URMA)作為 NBM 校驗的基礎，並以各模式往後每日預報的平均絕對誤差(Mean Absolute Error，MAE)作為混合預報的權重依據。其中美方對於每日逐時更新的 URMA 或 RTMA(Real-Time Mesoscale Analysis)有公開在下方網頁。

(https://www.emc.ncep.noaa.gov/mmb/rtma/prod/URMA/)

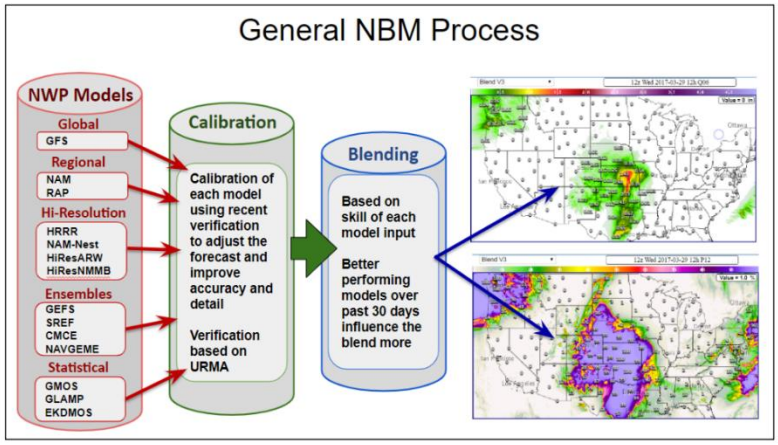


圖 13、 NBM 預報產製流程示意圖

(八) AWIPS 2 預報一致性工具 Forecast Builder 使用文件

Forecast Builder 為 NWS 各氣象預報中心作業常使用的預報調整工具，其依據氣象上各種物理性質給予合理且一致性的天氣種類(Wx，如降雨、雪、雨夾雪、凍雨)預報格點(圖 14 所示)。根據 David Tomalak 資深系統工程師的說法，此軟體工具可以直接安裝在當前本署所使用的 AWIPS2 23.2.1 版本中提供給預報員簡單操作天氣型態編輯的工具，詳細關於 Forecast Builder 的介紹與發展文件如附件(五)所示。

在 NWS 天氣預報中心，Forecast Builder 藉由使用 NBM、RTMA 等模式及觀測資料協助判斷該預報網格的天氣種類。此判斷的依據會需要使用到模式或觀測高層大氣的資料作為參考(Top-Down Methodology)，並依據大氣物理過程於不同溫度給予不同降雪型態可能發生的機率(如圖 15 所示)，以提供 GFE 內天氣種類的預報，有關於 Forecast Builder 操作說明以及 NWS 內訓練預報員使用的計畫如附件(六)所示。實務上，預報員藉由此工具可以產出天氣種類預報的初步預報(First Guess)，再經由自身預報經驗進行種類的調整以更符合當地氣候特色。

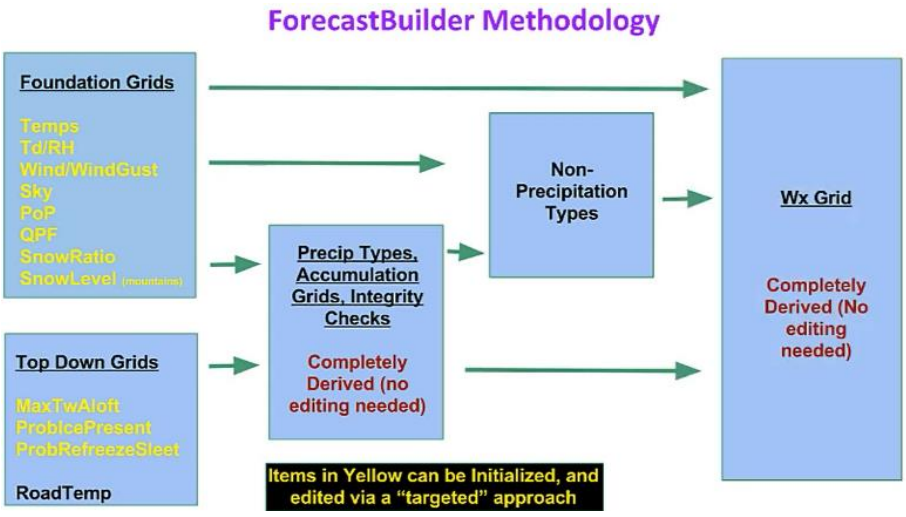


圖 14、 Forecast Builder 產製天氣種類預報流程圖

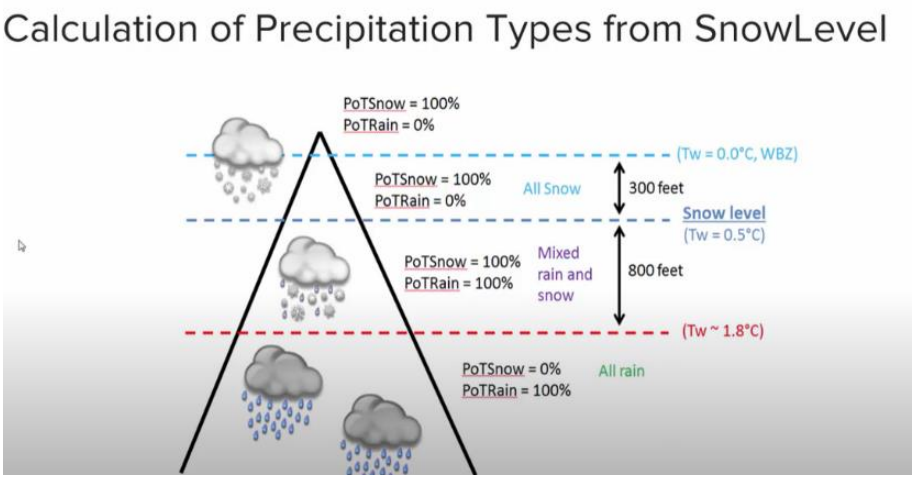


圖 15、 依據不同高度、濕球溫度(Tw)及雪線(Snow Level)決定不同降水種類機率

(九) 參加 2024 GSL AI summit (高峰會)

因近年 AI 技術發展快速，GSL 也針對 AI 如何改善天氣預警的議題於 GSL 內部舉辦高峰會討論當前掌握的技術以及未來如何精進，本次受 Nathan Hardin 科長以及 Jebb Stewart 科長(主辦)邀請，一同參與於 2024/08/22 在 NOAA GSL 舉行的 GSL AI summit。會中邀請 GSL 各部門如 AVID(Assimilation and Verification Innovation Division)、EPAD(Earth Prediction Advancement Division)、WIDS(Weather Informatics and Decision Support Division)以及 ITS(Information & Technology Services Division)說明當前 AI 技術使用狀況。此次訪問的部門(WIDS)提及利用 CNN 及雷達資料校正登陸墨西哥灣颶風的定量降水預報(QPF)，此部分的研究也與本署有密切合作(圖 16 所示)。

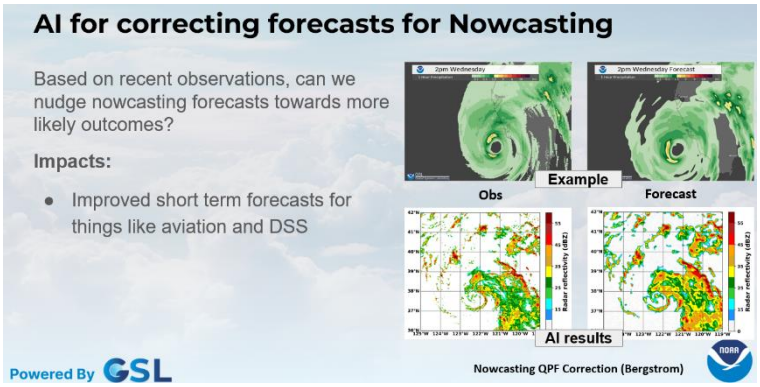


圖 16、 WIDS 當前針對登陸颶風進行 AI QPF 校正雨量

圖 17、 GSL 主席 Jennifer Mahoney 於會議中說明 GSL 未來在 AI 發展的目標

(十) 參加 2024 年度 GSL Retreat(進修)活動

本次實習期間恰巧遇到 NOAA GSL 年度進修活動，經由 Nathan Hardin 科長邀請一同與整個 GSL 團隊參加位於科羅拉多大學(Colorado University) 永續能源及環境學系(Sustainability, Energy, and Environment Community，SECC)所舉辦的 GSL 年度 Retreat(進修)活動。此活動為期兩天(2024/09/10 - 2024/09/11)，要在會議內介紹 GSL 成立的目標、新成員的加入、新增設的工作項目、未來持續發展的目標以及各部門近期發展的工作和成員之間的交流。

GSL 主要以改善模式預報、發展預報決策工具、視覺化天氣預報系統以及使用高效能的運算技術支援全美的天氣預報。其中 GSL 底下包含四大部門包含 AVID、EPAD、WIDS 以及 ITS。此次實習的單位是 WIDS 底下關於 AWIPS 2 及 HS 開發的單位(Weather Information Systems Evolution，WISE)，目前 WISE 正在將原 WarnGen 功能移植到 HS 內整合成 Convective Hazard Service，並試圖將 HS 獨立於原 AWIPS 2 系統，目的在於讓更多的防災夥伴可以使用 HS 而不用一定要同時安裝 AWIPS 2 系統。

圖 18、 於 GSL Retreat 活動中與 GSL 成員合影留念

(十一)　參訪 NOAA NWS Weather Forecast Office in Boulder (波德預報中心)

透過 Nathan Hardin 科長的介紹於 10 月 2 日與波德預報中心資深預報員(Science and Operation Officer) Paul Schlatter 討論本署以及美國預報中心如何產製作業化的天氣預報。參訪前，事先與本署內預報中心的同仁蒐集並線上開會討論想要詢問的問題，主題包含預報流程、災害性天氣預報及警示、極短期天氣監測以及 A2 系統面相關問題。會議中與 Paul Schlatter 針對各式主題討論彼此之間天氣預報作業上的差異以及可以互相交流及學習之處。

圖 19、 與 Paul Schlatter 討論雙邊天氣預報作業方式。

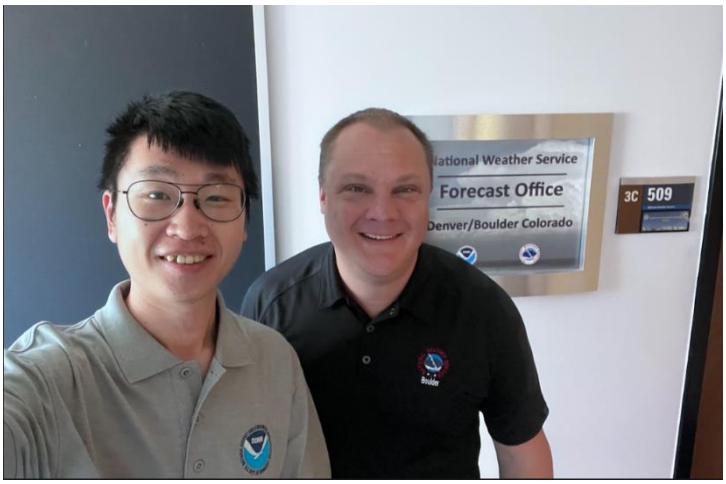


圖 20、 合影於 NWS 於 Boulder 的天氣預報辦公室。

四、 心得與建議

這次出國參訪 NOAA GSL 的經歷讓我收穫良多，不僅是 NOAA GSL 各部門分工精確且有效率，同時也透過小組每周固定開會 1 小時，討論當前遇到的狀況、預計解決的方式以及前一週的生活分享，通過這樣的會議加強小組內各成員的連結以及參與感。此外，與 GSL 合作夥伴們交流時也能感受到各夥伴都對於自己手上處理的專案相當自豪且有信心，並積極想要分享及互相交流。因此，在訪問期間經常可以聽其他專案的夥伴分享個別專案的進度與經驗分享。

對於此次交流的主題，主要都是 AWIPS 2 系統上如何安裝以及工具該怎麼使用，雖然相對比較枯燥但透過 David Tomalak 資深系統工程師不厭其煩地帶領與教學，才讓我可以儘早上手並有能力與大家分享本署氣象預報發布以及展示災害性天氣警報。經過此次的訪問，認識到許多 GSL 內的合作夥伴，並透過他們分享各自掌握的技術與工具，了解如何更有效率及視覺化天氣預報及展示災害性天氣警報。

綜合本次參訪的建議如下：

本次參訪地點位於 NOAA 屬於美國政府部門，並由於 NOAA, Boulder 同一個腹地內有 NIST (National Institute of Standards and Technology)，因此申請進入 NOAA 辦公會需要較多流程，建議可以儘早申請相關文件加速流程進行。另外，此行參訪 NOAA GSL 時有發現他們與學界的合作相當密切，除有共同合作的研究外，還有提供一些學生進入 GSL 實習的機會。最後由於 NOAA, Boulder 位於 Colorado 州 ，除 Colorado University (CU Boulder) 有氣象相關學系外，鄰近的 Colorado State University (CSU)的大氣系也是相當有名，有不少雷達或是中尺度對流專長的教授可以交流，因此建議本署除與 NOAA GSL 持續交流天氣預報經驗以及災害性天氣警報展示外，下次再度訪問時也可以一同拓展與美國學術研究界交流的機會，進而增加本署科研能力。

五、 參考資料

NOAA GSL (https://gsl.noaa.gov/who/organization)

VLab (https://vlab.noaa.gov/web/)

Vlab AWIPS (https://vlab.noaa.gov/web/oclo/awipsfundamentals)

Vlab NBM (https://vlab.noaa.gov/web/mdl/home)

VLab Forecast Builder (https://vlab.noaa.gov/web/forecastbuilder)

六、 附錄

(一) 2024 CWA 參訪工作內容

CWA AWIPS II 2024 INSTALL, TRAINING REFERENCE

Overview: This reference reviews many of training and discussions Mark and I went through this summer. I also included a SPEC/Installation plan for a distributed RH8 23.4.1 system. I followed this reference to install/upgrade our distributed VM upgrade to RH8 23.4.1.

NWS Status with RH8 23.4.1 (10/8/24)

- The NWS extended its RH7 Enterprise support through March 2025.
- Issues with HCI slowed down the rollout this summer. Most of these have been resolved.
- AWIPS II RH8 23.4.1 has been installed at all 5 regional offices.
- Operational Beta (about 8 NWS offices) is expected to start in early November.
- These 8 or so offices will test the updated software for a few months. If all goes well, AWIPS II RH8 23.4.1 installations will deploy at the remaining NWS offices in early 2025.
- GSL has several RH8 systems, including one distributed VM solution which has been stable, so this is good news.

VLAB ACCESS

- All CWA users should have access to VLAB. If this is not the case, then please let me know.

ForecastBuilder Specific Items

Overview: ForecasterBuilder is a crowd sourced GFE tool-set that provides a baseline of scientific tools and procedures. ForecastBuilder provides a consistent starting point for all NWS offices. The National Blend of Models (NBM) serves as a foundation for the extended forecast periods.

- ForecastBuilder - VLAB Link
  - Modification needed for CWA
- ForecastBuilder - Introduction/Installation
- ForecastBuilder Training Plan (Good Training and Overview)
- ForecastBuilder Quick Start Slides

National Blend of Models

Overview: The National GFE SmarInits Config (NIC) is a set of nationally science-based GFE SmartInits. All NWS offices utilize the same set of GFE Smartinits for their office. This effort results in a consistent and scientifically driven base. SmartInits are updated for the National Blend of Models.

- NationalBlend of Models - VLAB Link
  - Modification needed for CWA
- National Inits Config (NIC) - VLAB Link
  - Modification needed for CWA

PGEN/Hazard Services Tutorials and Training

Overview: Organized below are PGEN and HS reference sheets for CWA.

PGEN Tutorials

- CWA-PGEN Reference
- CWA PGEN Job Sheets
- GSL PGEN Focal Point Reference

Hazard Services VLAB training

- Main Hazard Services VLAB page
- HS Convective YouTube Training
- HS Initial Training

AWIPS II GraphiDSS

Overview: awips2-graphidss has been baselined into AWIPS starting with 21.4.1. GraphiDSS is designed to easily create and draw forecast graphics within the AWIPS RedHat environment of any forecast grid located within your office's GFE database and ISC database. Any grid can be made into a graphic, including numeric and discrete grids (such as weather and hazards). GraphiDSS leverages the Data Access Framework to pull and visualize data from AWIPS and GFE. Even if GraphiDSS is not used at CWA, I believe this application will be beneficial to CWA as a template.

- GraphiDSS VLAB / Reference

Himawari Updates from NESDIS

Overview: The attached tarball contains common_static and cave_static SITE level overrides for the Himawari Satellite data. These updates were made by NESDIS. They contain updated RGM Recipies/menus. CWA may have to adjust these files some, but hopefully they will provide a good starting point

- himawari_common_static.tar.gz - untar in /awips2/edex/data/utility/common_static/site/CWA
- himawari_cave_static.tar.gz - untar in /aiwps2/edex/data/utility/cave_static/site/CWA

ECMWF Compression Ingest issue Workaround

Overview: At times we have seen changes with ECMWF compression. The LINUX utility wgrib2 can provide a short term work around for data ingest:

Use WGRIB2 Utility:

1) wgrib2 IN.grb -set_grib_type c3 -grib_out OUT.grb

Make Script: /usr/local/ldm/decoders/adjustECMWF.sh (Note: Below is a sample script. Modify as needed**)**

```
Make sure all std out from this script also goes to the log file
exec 2>>/usr/local/ldm//logs/adjustECMWF.log 1>&2

# Store the original productid but prepend with a distribution-matching
# prefix of ZZHH00. This new product-id will be used in the pqinsert below
productId=ZZHH00.$1

# Completely read std in and store in temp and unique file name. If you
# do not do this, LDM hangs! That is to say, the entire file needs to be
# read through end-of-file and cat is the easiest way to do that.
cat > /tmp/temp.grib2.$$

# Here's the wgrib2 command to change the process-id (from 83) to 254
/bin/wgrib2 /tmp/grib2.$$ -set_grib_type c3 -grib_out /tmp/out.grib2.$$

# Insert the patched grib file back into the LDM queue.
pqinsert -vl /usr/local/ldm/var/logs/hrrrOverrideProcessId.log -p $productId -f
FSL2 /tmp/out.grib2.$$

# Clean up temporary files
rm -f /tmp/temp.grib2.$$
rm -f /tmp/out.grib2.$$

# Exit gracefully
exit 0
```

LDM PQACT ENTRIES

```
###################################
##   -- ECMWF Compression Modification--
###################################
## (Incoming Product ID: ECMWF product)
```

```
##
ANY    ^(ECMWF Pattern Match goes here.*)
       PIPE    -close  /usr/local/ldm/decoders/adjustECMWF.sh \1
#
# Push the inserted file thru -edex
FSL2    ^(ECMWF Pattern Match goes here.*)
       FILE    -overwrite -log -close -edex    /awips2/edex/data/manual/\1.grib2
```

CWA REDHAT 8 VM SPECS/INSTALLATION PLAN

Overview: The document below provides a NWS SPECS for a VM RH8 AWIPS II distributed system. In this reference I highlight the servers that are required along with AWIPS II group packages required for each server. I copied the CPU and Disk Spaces specs from an NWS configuration. I plan to build on this document for CWA.

- CWA - AWIPS II VM RH8 SPECS/ INSTALLATION PLAN
- CWA - AWIPS II Cloud Stand Alone and Container Instructions

(二) CWA’s Goal of visiting NOAA GSL 2024 投影片

Goal of Visit to GSL 2024

2024.06.28

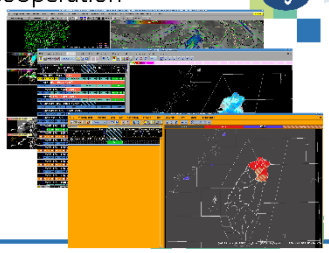
Weather Forecast Center Jian, Hong-Wen

Outline

- Origin of the cooperation
- Present and future of GFE
- Develop Smart tool and Ensemble method
- BC/BOI-verify to National Blending Model (automatic forecast)
- Forecast element in AWIPS2
- Visit the weather forecast operational office
- Hazard Service/Product Generator/DESI

Origin of The Cooperation

- In order to impement the latest and mature skil of weather forecas: and to improve the regional forecas: ab lity, CWA cooperate with NOAA and import the AWIPS to our operational weather forecast.
- AWIPS 1(WINS) → AWIPS 2



Origin of The Cooperation

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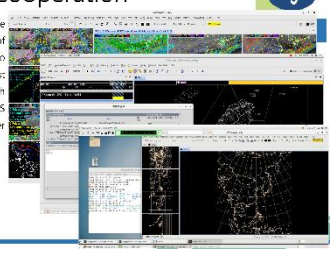


Present and Future of GFE

GFE-Land(7 days) :

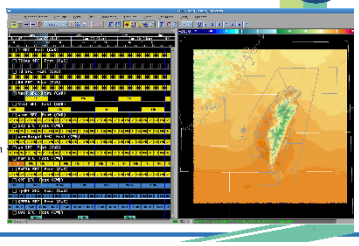
Hourly (T、Td、RH)

Every 3 hours

(Wind、Sky、WaveH、Wx、PoP3hr、TyQPF、WaveD、WaveP、CurDir、CurSpd、StnP、SRad) Auto

Every 6 hours (PoP、QPF6h、UVI)

Every 12 hours (MaxT、MinT、QPF)



Present and Future of GFE

GFE-Land(7 days) :

Hourly (T、Td、RH)

Every 3 hours

(Wind、Sky、WaveH、Wx、PoP3hr、TyQPF)

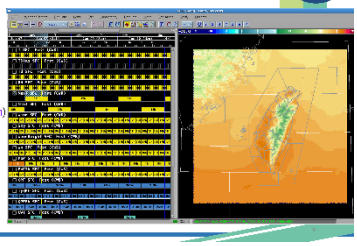
Every 6 hours (PoP、QPF6h)

Every 12 hours

(MaxT、MinT、QPF)

Determine MaxT、MinT -DiurnalT

RH(EC-BC)→Td



Present and Future of GFE

GFE-Land(7 days) :

Hourly (T、Td、RH)

Every 3 hours

(Wind、Sky、WaveH、Wx、PoP3hr、TyQPF)

Every 6 hours (PoP、QPF6h)

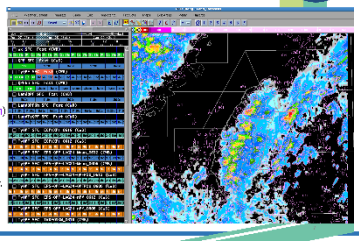
Every 12 hours

(MaxT、MinT、QPF)

Decide TyQPF(model blend)

Based on concept of forecaster, Edit the TyQPF

→Edit Wx → 6、12hrs QPF



Present and Future of GFE

GFE-Land(7 days) :

Hourly (T、Td、RH)

Every 3 hours

(Wind、Sky、WaveH、Wx、PoP3hr、TyQPF)

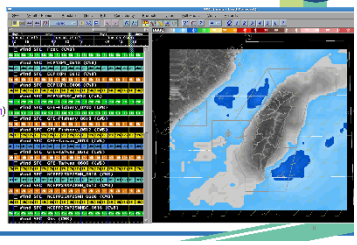
Every 6 hours (PoP、QPF6h)

Every 12 hours

(MaxT、MinT、QPF)

Edit Wind from GFE-Marine

Edit WaveH with NWW3



Present and Future of GFE

GFE-Land(7 days) :

Hourly (T、Td、RH)

Every 3 hours

(Wind、Sky、WaveH、Wx、PoP3hr、TyQPF)

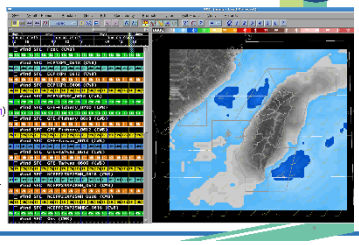
Every 6 hours (PoP、QPF6h)

Every 12 hours

(MaxT、MinT、QPF)

Edit sky with EC、NCEP

Edit PoP with EPS-LAG24 or EPS-Latest

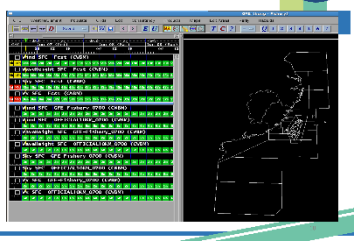


Present and Future of GFE

GFE-Martine(7 days) :

Every 3 hours

(Wind、Sky、WaveH、Wx)



Present and Future of GFE

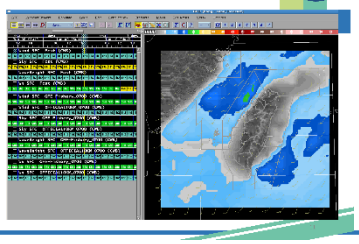
GFE-Martine(7 days) :

Every 3 hours

(Wind、Sky、WaveH、Wx)

Edit Wind (model blend)

Edit WaveH with NWW3



Present and Future of GFE

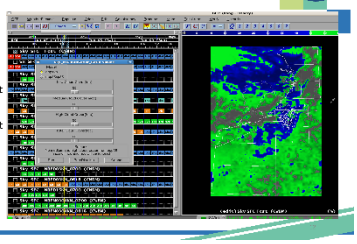
GFE-Martine(7 days) :

Every 3 hours

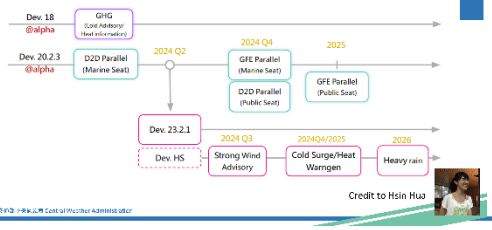
(Wind、Sky、WaveH、Wx)

Edit TyQPF(ECP25)→convert Wx

Edit Sky with EC and smart tool



Present and Future of GFE



Credit to Hsin Hua

Present and Future of GFE

米源

Domain will be lager

Origin

Lon 117.78-123.52

Lat 21.48-26.72

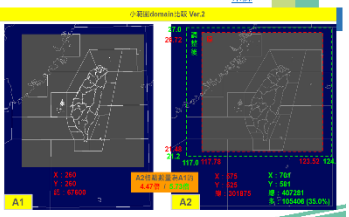
New

Lon 117.0-124.0

Lat 21.2-27.0

Forecast length 7→14 days

Arrangement for each forecast parameter



Develop Smart Tool and Ensemble Method

米源

Develop Smart Tool and Ensemble Method

米源

ModelBlend_Wind

MaxMinT_Ensemble Tool

Model_Blend_V3

QPF_EnsembleTool

QPF_ModelBlend

TyQPF_NowcastingARMOR

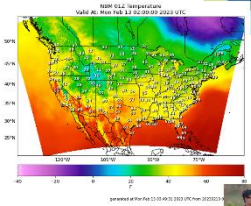
CalcModelRainfallTotalV2

Prototype of Auto Forecast (NBM)

Produce guidance from multiple calibrated models

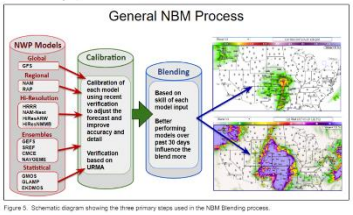
Guidance initially design to solve discontinuous boundary

Forecasters base on the NBM and then adjust some detail before issue prodoct



Credit to Steve Liu

Prototype of Auto Forecast ---Process



米源

Different kinds of Model

Calibration (BC)

Blend model based on previous 30 days (less MAE)

Prototype of Auto Forecast ---Product

Hourly QPF

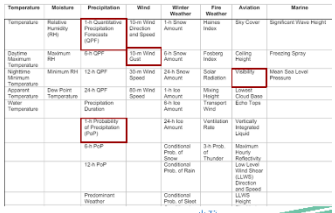
Hourly PoP

Gust

Visibility

Probability of serve weather

Provide the First Guess of Weather Forecast



米源

Forecast Element in AWIPS2

GFE Land(14 days) :

Hourly (T、Td、RH、Wind、Sky、WaveH、Wx、TyQPF、GUST)

Every 3hours

(PoP3hr、WaveD、WaveP、CurDir、CurSpd、StnP、SRad)

Every 6hours (PoP、QPF6h、UVI)

Every 12hours (MaxT、MinT、QPF)

VIS (?)

GFE-Martine(14days) :

Hourly

(Wind、Sky、WaveH、Wx)

Visit Forecast Operational Office

●A2已經上線

Credit to Steve Liu

(GSL)

預報作業室參訪

Credit to Steve Liu

➢ 組成：
- ✓ forecaster
- ✓ lead forecaster
- ✓ managers

➢ 輪值：
- ✓ 24小時3班制
- ✓ 一班3人
- ✓ 副測人員協助人力

➢ 任務：
- ✓ 天氣預報及警報
- ✓ 大災、颱生天地
- ✓ 資料蒐集

Edit process when using NBM based guidance and smart tool

HS/PGen/DESI

預警資訊整合發布(Hazard Services)：

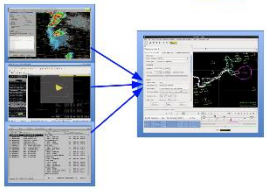
→ Combine WarnGen、River Pro and GHG

→ Issue different kinds of Warnings、Watches、Advisories and produce associated info/product

WarnGen (<1 hour)

Graphical Hazard Generator (Hours, Days)

RiverPro (Days)



HS/PGen/DESI

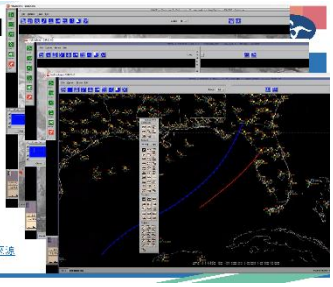
產品產製器(Product Generator)：

→ AWIPS2、click on PGen

→ Select object for drawing (front、squall line...)

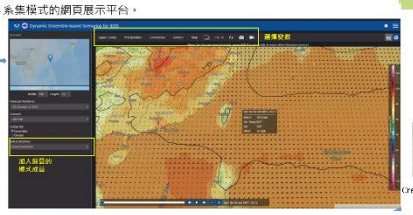
→ Draw on various weather map

→ Adjust the drawing object by switching to the finer observation



HS/PGen/DESI

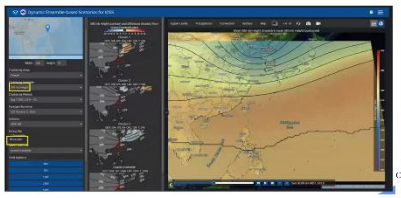
► 系集模式的網頁展示平台。



Credit to Steve Hu

HS/PGen/DESI

► 群落運算。



Credit to Steve Hu

HS/PGen/DESI

► 影響開始的時間(降雨超過0.05inch的第一個時間)。

Credit to Steve Hu

Summary

Goal :

- ➔ Hourly Forecast in AWIPS2 (Arrange every parameters)
- ➔ Learn NBM How to produce "First Guess" forecast data
- ➔ Ensemble tool and share with NOAA Forecaster
- ➔ HS process and experience sharing
- ➔ PGEN leaning and evaluation for the next generation weather map
- ➔ How to apply for / use VLab account (Better sharing with each other, CWA and GSL)

Summary

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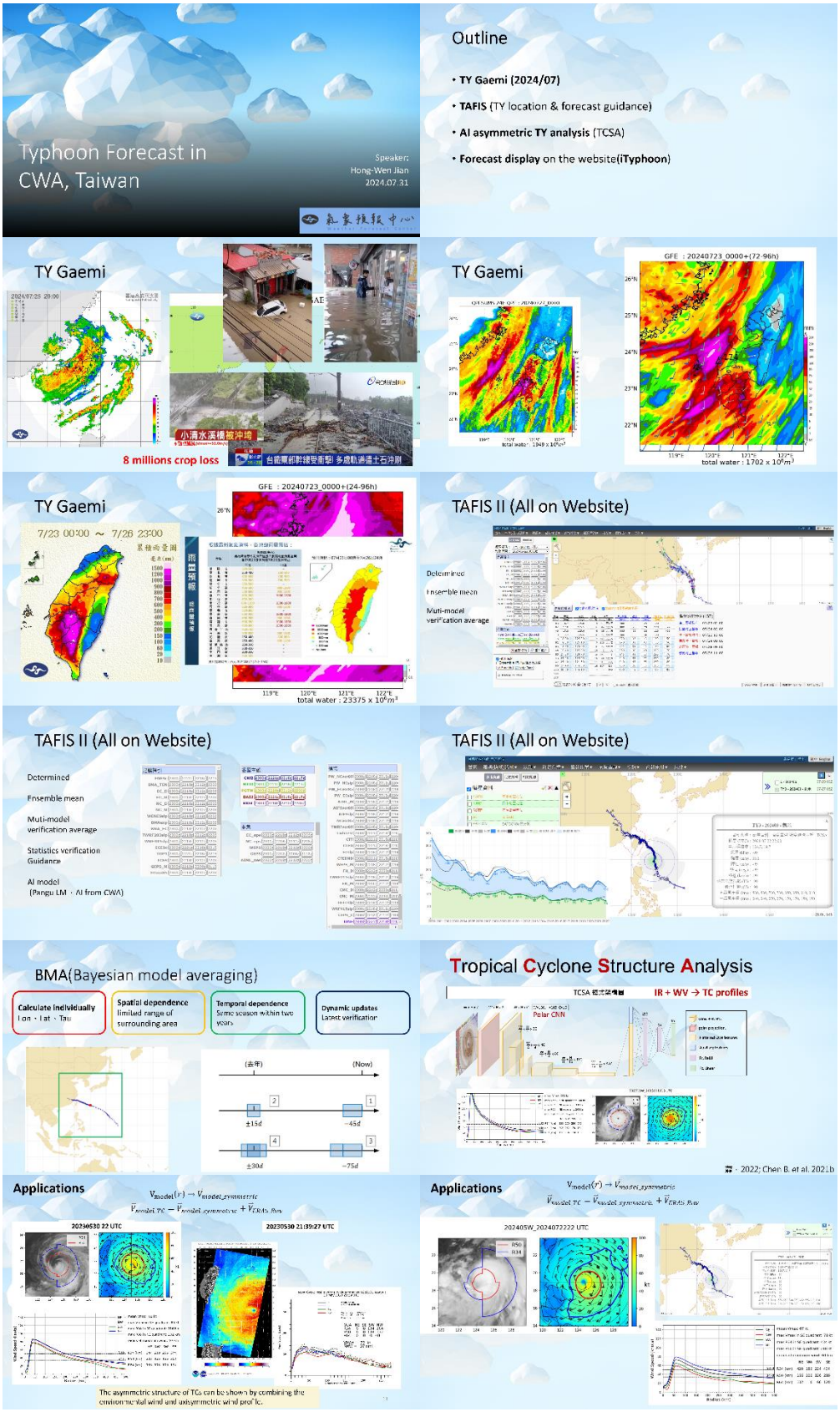
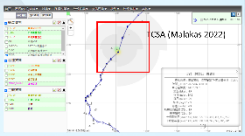
Thank you

(三) Typhoon Forecast in CWA, Taiwan 投影片

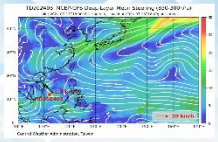


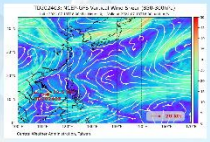
DLTC and TCSA applied in CWB TAFIS*

	ADT	SATCON	DLTC	TCSA
	Advanced Dvorak Technique	The SATellite Consensus	Deep-learning for Tropical Cyclone	Tropical Cyclone Structure Analysis
Source	CWB satellite center	JTWC of Western Pacific	Work Natural Taiwan Chi.	
Update freq.	30min	30min	30min	60min
Fix	Auto	Auto	Auto	Auto
Max Wind	√	√	√	√
Pressure	√	√		
Time	√			
Center	√			
Radius of 30 kt				√
Radius of 50~60 kt				√
Remark	Unavailable over land			Experiment in Taiwan



Analysis for wind shear and steering flow after filtering TY





Method for filtering TY

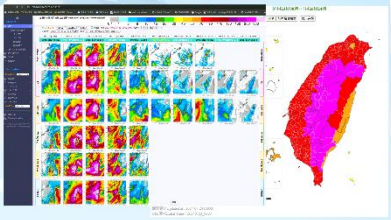
1. For a given TY center, project its vorticity and divergence onto the polar coordinated.
2. Minus the vor & div of TY with symmetric radius of 500km to get the surrounding vor and div.
3. Solve the stream function and potential velocity to rebuild the wind field.

Layer:
850 & 300 (hPa)
850 & 200 (hPa)
850 & 500 (hPa)
500 & 200 (hPa)
1000 & 700 (hPa)

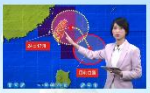
Arrow shows : Mean steering flow and wind shear within TY radius of 500km

Forecast display on the website(iTyphoon)

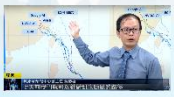
Based on QPF from GFE iTyphoon display forecast visually for each city in Taiwan



Thanks for your attention



We look forward to cooperating with NHC



(四) AWIPS2 Standalone 安裝流程

STANDALONE INSTALLATION INSTRUCTIONS

Update Steps (Update to a newer AWIPS II build)

- dnf group remove “AWIPS II Standalone”
- rm -rf /awips2/cave
- update /etc/yum.repos.d/awips2.repo to include new patch
- dnf group install “AWIPS II Standalone”

Create group fxalpha and user awips (If not present)

- groupadd fxalpha
- grep fxalpha /etc/group (note the groupPID number)
- useradd -d /home/user -g groupPID -s /bin/bash awips

Create sudoers file for focal point users (ie awips)

- Add /etc/sudoers.d/awips

  Cmnd_Alias AWIPS_SERVICES = /usr/bin/systemctl status edex_camel@ingest.service, /usr/bin/systemctl start edex_camel@ingest.service, /usr/bin/systemctl stop edex_camel@ingest.service, \
  /usr/bin/systemctl status edex_camel@ingestDat.service, /usr/bin/systemctl start edex_camel@ingestDat.service, /usr/bin/systemctl stop edex_camel@ingestDat.service, \
  /usr/bin/systemctl status edex_camel@ingestGrib.service, /usr/bin/systemctl start edex_camel@ingestGrib.service, /usr/bin/systemctl stop edex_camel@ingestGrib.service, \
  /usr/bin/systemctl status edex_camel@request.service, /usr/bin/systemctl start edex_camel@request.service, /usr/bin/systemctl stop edex_camel@request.service, \
  /usr/bin/systemctl status postgresql@awips.service, /usr/bin/systemctl start postgresql@awips.service, /usr/bin/systemctl stop postgresql@awips.service, \
  /usr/bin/systemctl status qpidd, /usr/bin/systemctl start qpidd, /usr/bin/systemctl stop qpidd, \
  /usr/bin/systemctl status httpd-pypies, /usr/bin/systemctl start httpd-pypies, /usr/bin/systemctl stop httpd-pypies, \
  /usr/bin/systemctl status ldmcp, /usr/bin/systemctl start ldmcp, /usr/bin/systemctl stop ldmcp, \

/bin/vim, /usr/local/ldm/etc/pqact.conf

awips ALL=(ALL) NOPASSWD:AWIPS_SERVICES

Install libqhull and libqhull_r (ALMA8)

- enable repo for almalinux-powertools (install libqhull)
- dnf install libqhull libqhull_r

Install postgresql-server

- NOTE: By default, alma8 comes with psqogresql-server version 10 set by default. Since AWIPS II 23.4.1 requires version 12+, we need to enable version 12.
  - **dnf module list posgresql** (list the postgres modules currently included with alma8)
  - **dnf module enable postgresql:12** (enable version 12)
  - **dnf module list postgresql** (version 12 should have an e). Since only one stream can be enabled at a time, the e setting trumps the d (default)
- **dnf install posgresql-server postgresql-upgrade postgresql-contrib**

Setup and Configure AWIPS II repo's

- Download awipsii_build.tar.gz to install location (ie /install-awips/awipsinstall)
- Modify /etc/yum.repos.d/awips2.repo and update file path location of the repo
- If needed, cd into each repo and recreate the comps.xml file
  - ex: cd ../repo/noarch
  - createrepo -g ../comps.xml .

Install AWIPS II

- yum clean all
- dnf group list
  - Make sure "AWIPS II Standalone" is one of the options
- dnf groupinstall "AWIPS II Standalone"
- dnf install awips2-python* -y
- dnf install awips2-localapps-environment

Remove and re-install cave packages

- dnf remove awips2-cave awips2-cave-wrapper awips2-cave-gfeclient awips2-gfesuite awips2-alertviz
- cd /awips2
- rm -rf cave
- rm -rf alertviz

- dnf install awips2-cave awips2-cave-wrapper awips2-gfesuite awips2-alertviz

Install PolicyCoreUtils

- dnf install policycoreutils-python-utils
- dnf install nss-tools

Update /awips2/database/data/pg_hba.conf

- ifconfig and note the (ipaddress) for your instance
- Replease default ip address with your ipaddress subnet from about
- hostssl all all ipaddress cert clientcert=1
- hostnossl all all ipaddress md5
- Add localhost
- hostssl all all localhost cert clientcert=1
- hostnossl all all localhost md5

Set SELINUX to Permissive for Postgres to work

- setenforce 0
- cd /etc/sysconfig/selinux
    - Change:
        - SELINUX=enforcing
        - SELINUX=permissive

Create the extra databases needed by AWIPS

- export PGHOST=/tmp;
- createdb -U awipsadmin hd_ob92oax;
- createdb -U awipsadmin dc_ob92oax;
- createdb -U awipsadmin dc_ob7oax

Install extra packages (if available)

- dnf install awips2-common-base awips2-common-foss
- dnf install awips2-localization-OAX

Install GraphiDSS Package

- yum install awips2-graphidss

Install certs

- install qpidcerts
- install guestcerts

Update /awips2/edex/bin/setup.env

- Add export SITE_IDENTIFIER=${AW_SITE_IDENTIFIER}
- Add **export DATASTORE_PROVIDER=pypies** after:
  - **export BROKER_HTTP=8180**
- Comment out line DATASTORE_PROVIDER=ignite

Setup EDEX Services for RH8

- /usr/bin/systemctl enable postgresql@awips.service
- /usr/bin/systemctl enable edex_camel@request.service
- /usr/bin/systemctl enable edex_camel@ingest.service
- /usr/bin/systemctl enable edex_camel@ingestGrib.service
- /usr/bin/systemctl enable httpd-pypies
- /usr/bin/systemctl enable qpidd
- /usr/bin/systemctl disable edex_camel@ingestDat.service
- /usr/bin/systemctl disable edex_rcm.service
- /usr/bin/systemctl disable ignite@production.service
- /usr/bin/systemctl stop ignite@production.service
- /usr/bin/systemctl stop edex_rcm.service

(五) Forecast Builder 介紹及版更文件

Latest release: 11.3 (issued September 30, 2024)

Training for Versions 11.3

No specific training for this version - for overall training reference the ForecastBuilder Training Plan

NBM-SnowLevel method training was updated for winter 2024-2025 (linked on training plan).

NBM method winter "one-pagers" had minor updates (linked on training plan).

Updates for version 11.3

- Adds Heatrisk to grid keys to publish list in all conus regional configurations
- A bug in the calculation of MaxWBGTRisk was corrected
- The callSmartToolFB code now allows local smart tools to operate on weather elements without erasing them first.
- Fix for Td not interpolating when 2 users working simultaneously and locked grids
- Fix for NudgeTSnow button bug
- Fix for SnowLevel & ProbIcePresent methodology and SnowAmtPreSL grids bug
- Minor Changes
    - Aviation finalize function sets visibility to 6 not 5 when PotHaze is forecast.
    - T conversion to C use 5/9 instead of .556 to address some rounding issues
    - Fixes warning message in procedure to say something else when diurnal T Check is run and there is a warning (it said tool failed when it had not)
    - Adds SJU to marine offices
    - Changes Potsmoke/Haze tool threshold to new EPA standard of 9 from 12. Set smoke to start at 9 in the GUI so that Haze is optional. Smoke value of 9 is locally configurable.
- NBM-SnowLevel method related updates
    - Fixes Edit area function toggle for initializing WxTypes when default p-type method set to NBM SnowLevel. (Acted as if no edit area is there.)
    - Fix for FB cron not populating/creating MinSnowElev.
    - For NBM SnowLevel methodology, add varDict["MinSnowElevGUI"]=True/False option for site configuration, which enables/disables the 10th/25th percentile pop-up box option during the populate step (False defaults to 10th percentile).

Past ForecastBuilder Version Information found in Appendix C

Introduction to ForecastBuilder

ForecastBuilder serves as a crowdsourced developed tool for GFE to:

- Provide a common tool set, thus establishing a baseline of scientific and technical expertise at all offices utilizing the program. In turn this makes service backup and operating GFE at any office easier.
- Give ability to populate a common starting point
- Give structure to the gridded forecasting process, which in turn provides a solid foundation for IDSS.
- Share scientific and technical expertise across the NWS

ForecastBuilder is built in python and numpy, and while it and its dependencies are installed on the SITE level, the construct follows BASE -> Region -> Office (similar to text formatters). In Localization Perspective -> GFE -> Utilities, you can find Baseline configurations stored in ForecastBuilderNationalConfig, Regional configurations in the ForecastBuilderRegionalConfig, and Office configuration in the ForecastBuilderConfig. See the configuration section on how to configure ForecastBuilder for your office.

If you encounter any bugs, please open a ticket on the SCP VLAB site.

To see a step by step overview on how ForecastBuilder works, looks and feels, check out the Quick Start Guide.

Install Instructions - Version 11 series

This is a normal install that will take most sites upgrading from version 11.2, 5-10 minutes at most.

1. Log into a LX workstation using your regular user account, then open a terminal

2. Switch to the user you typically use for svn commands.
3. umask 002
4. For testing releases:
    a. First time checkout:
        i. svn checkout https://vlab.noaa.gov/svn/nwsscp/Gfe/Apps/ForecastBuilder/trunk /localapps/install/scp/Gfe/Apps/ForecastBuilderTest
        ii. cd /localapps/install/scp/Gfe/Apps/ForecastBuilderTest
    b. Updates:
        i. cd /localapps/install/scp/Gfe/Apps/ForecastBuilderTest
        ii. svn update
5. For official releases:
    a. First time checkout:
        i. svn checkout https://vlab.noaa.gov/svn/nwsscp/Gfe/Apps/ForecastBuilder/tags/latest_stable /localapps/install/scp/Gfe/Apps/ForecastBuilder
        ii. cd /localapps/install/scp/Gfe/Apps/ForecastBuilder
    b. Updates:
        i. cd /localapps/install/scp/Gfe/Apps/ForecastBuilder
        ii. svn update
6. cd install_scripts
7. ./install_ForecastBuilder.sh

    The install script will update all ForecastBuilder components and remove any legacy modules (e.g. those titled with PoT*). The script will also detect if a previous EXP version was installed and ask if you would like to remove them.

    a. If you are testing:
        i. cd /localapps/install/scp/Gfe/Apps/ForecastBuilder/install_scripts
        ii. ./install_ForecastBuilder.sh -t
        iii. If you want to install to the user level, type 'n' at the first prompt ("Install to SITE?")

8. This step requires system admin privileges (ITO/ESA). Ensures all users caveData cache updates to the latest ForecastBuilder version.
    a. ssh to dv1
    b. cd /localapps/install/scp/Gfe/Apps/ForecastBuilder/install_scripts/
    c. sudo -E ./remove_FBcaveData.sh and with the opening question make sure your site ID is set correctly.
    d. exit
9. QPF CFP: If your office is NOT in CR or WR and would like the WPC QPF automatically populated into your forecast database (545Z and 1745Z are chosen as the QPF usually arrives by 0530/1730Z but sometimes comes in a few minutes later):
    a. ssh to pv2

b. sudo vi /etc/cron.d/a2SITEpv2cron
c. Add:
   45 5,17 * * * gfecron /localapps/runtime/bin/RunForecastBuilder.sh QPF
d. Save

10. ForecastBuilderConfig adjustments
    a. **Recall you can** reference the ForecastBuilder Configuration section below for adjusting any configuration items for ForecastBuilder.
    b. **Important configuration items from recent releases**:
        i. **For v 11.3:** If you are an office wanting to run the NBM precipitation type with SnowLevel Percentiles as Guardrails technique (recommended for Mountain areas), in your ForecastBuilderConfig file set:

           varDict["Default PType Method"] = "NBM SnowLevel"

11. **For offices using SnowLevel and would like to practice/play with NBM as the p-type method (coordinate with SOO)**:
    a. **./install_ForecastBuilder.sh -t**
    b. The -t switch will install all ForecastBuilder files as _EXP, allowing the original ForecastBuilder version to remain.
    c. Via Localization perspective -> GFE -> Utilities, copy your configuration information from ForecastBuilderConfig to ForecastBuilderConfig_EXP. Also make sure in the config file to set:
       varDict["Default PType Method"] = "NBM SnowLevel"

12. **If this was a first time install:**
    a. Open CAVE -> Localization Perspective
    b. Under GFE -> Config Files, open your "siteGfeConfig" file
    c. Ensure you have the following default ColorTable information added. You'll notice some are left blank. If you do not have a color table for these, then you can use "Gridded Data"
        i. SnowAmt_defaultColorTable =
        ii. IceAccum_defaultColorTable =
        iii. SleetAmt_defaultColorTable =
        iv. PotBlowingSnow_defaultColorTable = "PotBlowingSnow"

    d. Search for MissingDataMode in your "siteGfeConfig" file. **If it is set to "Create," comment it out.** This setting of "Create" will cause Hazard grids, precipitating and non precipitating type grids to interpolate when ForecastBuilder reads them in. For other tools that require this setting, there is an option under the GFE menu to temporarily set the setting to "Create." An AWIPS request change has been submitted to resolve this issue.

13. Setting up the cron (depends on local and/or regional policy)
    You will need to have a role to write to and restart crons to complete this step
    a. ssh to pv2
    b. cd /localapps/install/scp/Gfe/Apps/ForecastBuilder/config
    c. Copy the contents of a2SITEpx2cron.RunForecastBuilder.tmp to your pv2 a2SITEpv2cron
        i. You may need to adjust the timing to meet your local/regional needs. **NOTE: The default timing already meets CR & WR grid initialization policies.** Please see this tab in the Configuration spreadsheet for more information
14. Ensure forecasters restart their CAVEs that have GFE open
15. Coordinate with SOO - set up pseudo WES program, see instructions in Appendix D
16. Ensure to upload your GFE configuration to the Central Server via the IFPS Service Backup GUI
17. Done.

If you encounter any bugs, please open a ticket on the SCP VLAB site.

Appendix A - Configuration

There are three general themes to the configuration:

1. Utilizes python coding and dictionaries.
2. A dictionary named varDict. This dictionary contains settings for variables that affect both the GUI, Fire Weather and other grid policies.
3. Another dictionary named gridDef. gridDef overrides the default options of the parameters in ForecastBuilder, and gridDef is used to define gridDict. gridDict passes the information about each parameter (grid) throughout the procedure. gridDef/gridDict is also used by fire weather in FB.

Important Notes to keep in mind when doing configuration:

1. If you modify either the varDict or gridDef section, please remove the "pass" statement line at the end of that section.
2. Local configuration changes can induce grid consistency issues
3. For more in-depth configuration and examples, you can reference ForecastBuilderRegionalConfig and the "configure_ForecastBuilder" function in ForecastBuilderUtility

See this spreadsheet to help configure ForecastBuilder, this supplement for Fire Weather, and GHWO grid configuration if your office does this. You will also want to check out the gridDef section below.

Option	Possible Values	What it does
smoothFactor	EditArea, Factor	On populating grids, smooths inside of a specified edit area by a specified smooth factor. This was made to smooth out NBM T, Td, MaxT, MinT bias over lakes. Example below
smoothFactor Example (in ForecastBuilderConfig gridDef section): for grids in ["T" ," Td" ,MaxT" ," MinT"]: gridDef["%s" %grids," smoothFactor" ," EditArea"] = "NBMLakes" (Any EditArea) gridDef["%s" %grids," smoothFactor" ," Factor"] = "10"		

Appendix B - Sample ForecastBuilder Configuration for Fire Weather

La Crosse:

```
    if var == "varDict":
        ######### ARX Fire Weather configs
##############################################################################
##############################
        varDict["Parms to Load in Analyze/Adjust"].extend(["Haines", "MixHgt",
```

```
"TransWind", "VentRate"])
        varDict["Include Fire"] = True # If your office would like to create FireWx grids
as part of ForecastBuilder
        varDict["Possible-Fire Wx: Calculate from GFE/D2D grids?"].extend(["LAL",
"HoursOfSun", "MixHgtAve", "TransWindAve", "VentRateAve", "Wetflag", "Curing",
"CuringAg",  "GFDI", "GFDIAg", "Vent From Sounding Data"])
        varDict["Fire Wx:Calculate from GFE/D2D grids?"].extend(["LAL",
"HoursOfSun", "MixHgtAve", "TransWindAve", "VentRateAve", "Wetflag", "Curing",
"CuringAg","GFDI", "GFDIAg"])
        varDict["Additional Fire Weather Parms to Possibly Populate in Step
2"].extend(["Haines"])
        varDict["Additional Grids to Load for Fire Weather"] = ["Mixing Height",
"Transport Wind", "Ventilation", "Wetflag", "FireRisk", "RFTI", "Curing", "CuringAg",
"MaxT", "MinT", "T", "Td", "PoP", "RH", "MaxRH", "MinRH", "Sky", "Wx", "Hazards",
"QPF06", "Haines"]
        #
        # GHWO override for the Fire Wx Risk based on sub-regional RFW criteria
        #
        varDict["HBFireWx"]["Criteria"] = [
            # Group 1
            [
            [None, 999],  # For T < 120F
             [ # First column is the wind criteria (Uses >+ and <)
              [    0, 20, 25, 35, 45, 101], # First row is RH Criteria (Uses >= and <)
              [  2.2,  1,  1,  0,  0,   0], # Always assumes values less than first RH and
speed criteria is 0
              [  4.3,  1,  1,  1,  0,   0],
              [  8.7,  2,  2,  1,  0,   0],
              [ 13.0,  2,  2,  1,  1,   0],
              [ 17.4,  3,  3,  2,  1,   1],
              [999.0,  4,  3,  2,  1,   1]
             ],
             None   # Entire Grid
            #],
            ]
            ]

        varDict["Transport Wind Speed at least Surface Wind Speed"] = True


        varDict["Fire Button List"].append(["MixHgtAve",["self._FBUtility",
"callSmartToolFB", ["MixHgtAve", "MixHgtAve",  "varlgridDict", "varlvarDict"]]])
        varDict["Fire Button List"].append(["TransWindAve",["self._FBUtility",
"callSmartToolFB", ["TransWindAve", "TransWindAve",  "varlgridDict", "varlvarDict"]]])
```

```
        varDict["Fire Button List"].append(["VentRateAve",["self._FBUtility",
"callSmartToolFB", ["VentRateAve", "VentRateAve",  "var|gridDict", "var|varDict"]]])
        varDict["Fire Button List"].append(["Wetflag",["self._FBUtility",
"callSmartToolFB", ["Wetflag", "Wetflag",  "var|gridDict", "var|varDict"]]])
        varDict["Fire Button List"].append(["Curing",["self._FBUtility",
"callSmartToolFB", ["Curing", "Curing",  "var|gridDict", "var|varDict"]]])
        varDict["Fire Button List"].append(["CuringAg",["self._FBUtility",
"callSmartToolFB", ["CuringAg", "CuringAg",  "var|gridDict", "var|varDict"]]])

        varDict["GridKeys for Fire Button Dict"]["MixHgtAve"] = "MixHgtAve"
        varDict["GridKeys for Fire Button Dict"]["TransWindAve"] = "TransWindAve"
        varDict["GridKeys for Fire Button Dict"]["VentRateAve"] = "VentRateAve"
        varDict["GridKeys for Fire Button Dict"]["Wetflag"] = "Wetflag"
        varDict["GridKeys for Fire Button Dict"]["Curing"] = "Curing"
        varDict["GridKeys for Fire Button Dict"]["CuringAg"] = "CuringAg"


        ###### End ARX Fire Wx Configs
##########################################################################
########################
        #pass

    elif var == "gridDef":
        ######### ARX Fire Weather configs
##########################################################################
##########
       # Section Below is NBM populated grids
        gridDef["Haines","maxTime"] = "Day 3"
        gridDef["Haines","smoothFactor","Factor"] = "20"

        # The addition below smooths the mixing height grid from NBM population for an
edit area
        # named NBMColdPools. The mixing height is falsely lower in the NBM due to
the URMA bias
        # correction applied over larger water bodies / lakes and wider rivers/.

        gridDef["Mixing Height","smoothFactor", "Factor"] = "10"
        gridDef["Mixing Height","smoothFactor", "EditArea"] = "NBMColdPools"

        # Grids below are calculated from existing GFE grids.
        gridDef["LAL","LALPotThunderList"] = [15,25,40,55]
        gridDef["LAL","maxTime"] = "Day 3"

        gridDef["HoursOfSun","gridName"] = "HrsOfSun"
```

```
        gridDef["HoursOfSun","maxTime"] = "Day 3"

        # These calcs use pre-existing smartTools
        gridDef["MixHgtAve","maxTime"] = gridDef["LAL","maxTime"]
        gridDef["TransWindAve","maxTime"] = gridDef["LAL","maxTime"]
        gridDef["VentRateAve","maxTime"] = gridDef["LAL","maxTime"]
        gridDef["Wetflag","maxTime"] = "Day 2"
        gridDef["Curing","maxTime"] = "Day 3"
        gridDef["CuringAg","maxTime"] = "Day 3"

        # Calcs done using FB code
        gridDef["GFDI","maxTime"] = gridDef["LAL","maxTime"]
        gridDef["GFDIAg","maxTime"] = gridDef["LAL","maxTime"]

        ######### End ARX Fire Weather configs ############################
        #pass
```

Salt Lake City:

```
############## Start varDict Entries ####################
        varDict["Fire Button List"].append(["CWR",["self._FBUtility", "callSmartToolFB",
["CWR", "CWR_fm_Fcst", "varlgridDict", "varlvarDict"]]])
        varDict["Fire Button List"].append(["LAL",["self._FBUtility", "callSmartToolFB",
["LAL", "LAL_fm_Wx", "varlgridDict", "varlvarDict"]]])
        varDict["Fire Button List"].append(["Free Wind",["self._FBUtility",
"callSmartToolFB", ["FreeWind", "FreeWind", "varlgridDict", "varlvarDict"]]])
        varDict["Fire Button List"].append(["Mixing Height",["self._FBUtility",
"callSmartToolFB", ["MixHgt", "MixHgt_from_NBM_and_GJT", "varlgridDict",
"varlvarDict"]]])
        varDict["Fire Button List"].append(["Mixing Height MSL",["self._FBUtility",
"callSmartToolFB", ["MixHgtMSL", "MixHgtMSL", "varlgridDict", "varlvarDict"]]])
        varDict["Fire Button List"].append(["Transport Wind",["self._FBUtility",
"callSmartToolFB", ["TransWind", "TransWind_from_NBM_and_GJT", "varlgridDict",
"varlvarDict"]]])
        varDict["Fire Button List"].append(["Clearing Index",["self._FBUtility",
"callSmartToolFB", ["CLRIndx", "CLRIndxFromFB", "varlgridDict", "varlvarDict"]]])
        varDict["Fire Button List"].append(["Haines",["self._FBUtility",
"callSmartToolFB", ["Haines", "HainesFromNBM", "varlgridDict", "varlvarDict"]]])

        varDict["GridKeys for Fire Button Dict"] = {
            "CWR":"CWR", "LAL":"LAL", "Mixing Height":"MixHgt",
"Haines":"Haines", "Free Wind":"FreeWind",
            "Mixing Height MSL": "MixHgtMSL", "Transport Wind":"TransWind",
"Clearing Index":"CLRIndx"
```

```
        }
############## End varDict Entries ####################

############## Start gridDict Entries ####################
        # Handle fire weather grids
         gridDef["CWR","gridDefinition"] = [[-24, 12*3600,12*3600]]
         gridDef["CWR","SmartTool"] = "CWR_fm_Fcst"
         gridDef["CWR","maxTime"] = 96
         gridDef["LAL","gridDefinition"] = [[-24, 6*3600,6*3600]]
         gridDef["LAL","SmartTool"] = "LAL_fm_Wx"
         gridDef["LAL","maxTime"] = 150
         gridDef["LAL","combineIdenticalGrids"] = False
         gridDef["FreeWind","gridDefinition"] = [[0, 6*3600,6*3600]]
         gridDef["FreeWind","SmartTool"] = "FreeWind"
         gridDef["FreeWind","maxTime"] = 96
         gridDef["MixHgt","gridDefinition"] = [[-24, 6*3600,6*3600]]
         gridDef["MixHgt","SmartTool"] = "MixHgt_from_NBM_and_GJT"
         gridDef["MixHgtMSL","gridDefinition"] = [[-24, 6*3600,6*3600]]
         gridDef["MixHgtMSL","SmartTool"] = "MixHgtMSL"
         gridDef["TransWind","gridDefinition"] = [[-24, 6*3600,6*3600]]
         gridDef["TransWind","SmartTool"] = "TransWind_from_NBM_and_GJT"
         gridDef["CLRIndx","gridDefinition"] = [[-24, 6*3600,6*3600]]
         gridDef["CLRIndx","SmartTool"] = "CLRIndxFromFB"
         gridDef["Haines","SmartTool"] = "HainesFromNBM"
############## End gridDict Entries ####################
```

Nashville:

```
        varDict["Additional Fire Weather Parms to Possibly Populate in Step 2"] =
["Haines", "MixHgt", "TransWind", "VentRate"]
        varDict["Possible-Fire Wx: Calculate from GFE/D2D grids?"].extend(["LAL",
"Wind20ft", "ADI", "LDSI", "LVORI"])
        varDict["Fire Wx:Calculate from GFE/D2D grids?"].extend(["LAL", "Wind20ft",
"ADI", "LDSI", "LVORI","FireCheck"])
        varDict["Fire Button List"].append(["LDSI", ["self._FBUtility",
"callSmartToolFB", ["LDSI", "LDSI_TOOL", "var|gridDict", "var|varDict"]]])
        varDict["GridKeys for Fire Button Dict"]["LDSI"] = ["LDSI"]
        varDict["Fire Button List"].append(["LVORI", ["self._FBUtility",
"callSmartToolFB", ["LVORI", "LVORI_Tool", "var|gridDict", "var|varDict"]]])
        varDict["GridKeys for Fire Button Dict"]["LVORI"] = ["LVORI"]
        varDict["Fire Button List"].append(["LAL",["self._FBUtility", "callSmartToolFB",
["LAL", "LAL_tool", "var|gridDict", "var|varDict"]]])
        varDict["GridKeys for Fire Button Dict"]["LAL"] = ["LAL"]
```

```
        varDict["Fire Button List"].append(["ADI", ["self._FBUtility",
"callSmartToolFB", ["ADI", "ADI_Tool", "varlgridDict", "varlvarDict"]]])
        varDict["GridKeys for Fire Button Dict"]["ADI"] = ["ADI"]
        varDict["Fire Button List"].append(["FireCheck", ["self._FBUtility",
"callProcedureFB", ["FireCheck", None, "varlvarDict[\"Master Time Range\"]", None]]])
        varDict["Additional Grids to Load for Fire Weather"] = ["Haines", "MixHgt",
"TransWind", "VentRate", "Td", "MinRH", "Wind", "QPF", "FireWxPotential"]

        varDict["Fire Weather Grids to Save and Publish"] = ["Haines", "MixHgt",
"TransWind", "VentRate", "Wind20ft", "LAL", "ADI", "LDSI", "LVORI"]
        varDict["Grid Keys to Publish"].extend(["Haines", "MixHgt", "TransWind",
"VentRate"])
```

Appendix C - Update history

Version 11.2 (no training needed for forecasters)

Version 11.1 and 11.1.4 (no training needed for forecasters)

Version 10.8 and 10.8.1 (no training needed for forecasters)

Version 10.7 and ForecastBuilder v10.7 Training for Forecasters

Version 10.6 and 10.6.1 and ForecastBuilder v10.6 Training for Forecasters

Version 10.5 and 10.5.1 and ForecastBuilder V10.5 Training for Forecasters

Version 10.4 (all training contained within the Training Plan)

Version 10.3 (no training needed for forecasters)

Version 10.2 and ForecastBuilder V10.2 Training for Forecasters

Version 10.1 (no training needed for forecasters)

Version 10.0 and ForecastBuilder V10.0 Training for Forecasters

Version 9.0 and ForecastBuilder V9.0 Training for Forecasters

Version 8.1 (no training needed for forecasters)

Version 8.0 and ForecastBuilder V8.0 Training for Forecasters

Version 7.4 and ForecastBuilder V7.4 Training for Forecasters

Version 7.3 and ForecastBuilder V7.3 Training for Forecasters

Version 7.2 and ForecastBuilder V7.2 Training for Forecasters

Appendix D - "pseudo WES" case instructions

To save off a case of NBM data:

1. Open a terminal window and ssh dv1
2. cd /data/local
3. mkdir tmp
4. chmod 777 tmp
5. cd /localapps/install/nwsscp/Gfe/Apps/ForecastBuilder/bin/
    a. Note the scp in the directory path may be nwsscp. This all depends on how ForecastBuilder was checked out.
6. For NBM data run: ./caseNBMExport.sh <upper case Site ID>
   (e.g. ./caseNBMExport.sh OUN)
7. For NBMEXP data run: ./caseNBMEXPExport.sh <upper case Site ID>
   (e.g. ./caseNBMEXPExport.sh OUN)
8. What the scripts do in steps 6 and 7:
    a. This script will save a 5 day forecast from the singleton NBM database in GFE, grabbing the following parameters:

       MaxT, MinT, T, Td, Wind, WindGust, PoP6, PoP01, PoP, QPF, QPF1, SnowRatio, SnowLevel, SnowAmt, IceAccum, PotFreezingRain, PotRain, PotSleet and PotSnow

    b. The output of the script will go to a directory /data/local/tmp
    c. When you are ready to restore the case into Practice mode, copy it over to /data/local/PoWTcases (see next section below)

To restore a case into Practice Mode:

1. Please ensure you have completed the ForecastBuilder install instructions
2. Steps 3 through 7 are for setup and should only need to be completed once, unless alerted to in the ForecastBuilder install instructions.
3. cd /data/local/
4. mkdir PoWTcases
5. chmod 777 PoWTcases
6. cd /localapps/install/scp/Gfe/Apps/ForecastBuilder/archiveCases
7. cp * /data/local/PoWTcases
8. cd /data/local/PoWTcases
9. ls -ltar

    a. Note the provided cases. One is FWD. The other is a late season event in EAX from 2020 Apr 3. You may have more files if you had saved off some from the previous section
    b. There are additional NBM p-type cases available in this Google Drive link. Feel free to download these, move over to AWIPS and place in /data/local/PoWTcases
10. If needed based on WFO ID in the file name, start up a service backup for one of the sites listed in 9a. All you need is the configuration, not the Forecast Grids. Proceed once this has completed
11. Back in the terminal, run ./extractPoWTcase.py <case file name without the tar gz or .nc> <date/time>
    a. The program will take a bit and extract the data to the Practice Forecast database of the site
    b. The <date/time> argument in YYYYMMDDHH format allows you to plop the data into the forecast. For example, if today is 2022 Aug 24 and you want to put the data at 12Z type 2022082412. Use 12Z for most cases unless specified otherwise.
12. Type /awips2/cave/cave.sh -mode PRACTICE -perspective GFE -site <Site ID of case file name>
    a. This will start up a Practice GFE for the site. You should see several fields populated (MaxT, MinT, QPF, SnowAmt, SnowRatio, PotFreezingRain for example) for the next 5 days. This was the NBM data saved off by the site.
    b. With ForecastBuilder, DO NOT populate any data in the Foundation Grids step. THIS WILL OVERWRITE with current NBM data.
13. If you had opened up Service Backup, be sure to exit cleanly upon finishing looking at the case.

(六) Forecast Builder 訓練計畫(含影片連結)

FY24 CLC Curriculum for Non-SnowLevel Sites & SnowLevel Sites

FY23 CLC curriculum

New training highlighted in yellow

Notes:

- *Presentations are available by clicking on the links above the module descriptions*
- *Don't forget the ForecastBuilder Quick Start Guide is always available for quick reference!*
- *Questions? E-mail nws.forecastbuilder@noaa.gov*

The audience for each video is:

A - Recommended for all forecasters (no changes since initial release on 2022 Sep 1)
B - Recommended for all forecasters using NBM Probability of Weather Type method
C - Recommended for all forecasters using SnowLevel Weather Type method (no changes exist for winter 2023-2024)
N - Recommended for all NEW forecasters, but optional for experienced users
O - Optional based on office configurations and operational needs

Part 1: Introduction	Time	Video Link	Speaker	Audience
Vision and Mission of ForecastBuilder *The beginning module about ForecastBuilder, detailing its vision, mission, goals and various support groups behind the application.*	3 min	SciShare	Andrew Just (CRH STI)	A
What is the NDFD forecast? *To most effectively utilize ForecastBuilder, it is important to understand what the NDFD forecast represents. This module goes into detail on the NDFD and the migration to probabilistic.*	8 min	SciShare	Michael Dutter (AKQ)	A

Part 2: Knobology of ForecastBuilder	Time	Video Link	Speaker	Audience
Main GUI overview *Describes all the various items when you start up ForecastBuilder such as time range to choose and the left toolbar menu*	8 min	SciShare	Eleanor Dhuyvetter (EPZ)	N
Population Step *An overview of the Population Step in ForecastBuilder*	4 min	SciShare	Patrick Ayd (DLH)	N
What is EditRetention and how do I use it with examples *Learn about the ability to retain edits when the ForecastBuilder cron runs, which is particularly helpful in steep terrain areas under stagnant patterns.*	10 min	SciShare	Monica Traphagan (SLC)	O
Analyze/Adjust step *Detailed information about the Analyze and Adjust step in ForecastBuilder, including the various tools available such as WxPreview.*	10 min	SciShare	William Iwasko (LUB)	N
Deriving hourly temperature and relative humidity *ForecastBuilder has its own method to derive hourly temperature and RH with several benefits, as well as a few gotchas.*	10 min	SciShare	Ted Ryan (FWD)	A
Integrity checks *Overview of all the Integrity Checks in ForecastBuilder, including grids that get created during that step*	3 min	SciShare	Justin Titus (SGF)	N
Warm-season Precip Types (Updated Presentation but content similar to recording) *Creating precipitation types in the warm season, including thunder* Warm season jobsheet activity *(~30 min to complete)*	11 min	SciShare	Matthew Day (OUN)	B

Courtesy: Ted Ryan				
Non-Precipitation Types *A look at the numerous Non-Precipitation types ForecastBuilder can create, along with behind the scenes information into how the various tools work.* *PotDryThunder addendum* *Courtesy: David Church*	13 Min	SciShare	Patrick Ayd (DLH)	N
Wx Step How ForecastBuilder builds a Wx grid *This module describes how the Wx grid gets built, utilizing the development of a pizza as an analogy. The Wx grid creation follows directive 10-503 which often causes the grid to become "messy", especially in mixed winter precipitation.*	8 min	SciShare	Geoffrey Heidelberg-er (HUN)	N

Part 3: Winter Operations with ForecastBuilder	Time	Video Link	Speaker	Audience *(winter wx WFOs only)*
Understanding Microphysical processes on precipitation type *Before we look at how to interact with precipitation type, snow or ice accumulation with ForecastBuilder, we need to have a solid foundation about precipitation type. This module will cover that along with the need to think probabilistically.*	15 min	SciShare	Dan Baumgardt (ARX)	A
NBM V4.1 Winter Training A review of past NBM versions in creating precipitation type, followed by what's new with V4.1 for winter	8 min	FDTD Video	Andrew Just (CRH STI)	A
Non SnowLevel Sites: Utilizing ForecastBuilder and NBM data to efficiently create precipitation type and snow/ice accumulation	45 min	Part 1 Part 2	Ted Ryan (FWD)	B

Part 3: Winter Operations with ForecastBuilder	Time	Video Link	Speaker	Audience *(winter wx WFOs only)*
ForecastBuilder v10.8 - Winter Precip Types Forecaster Reference "One Pager" for NBM p-type for Non SnowLevel Sites *Courtesy: Ted Ryan and Patrick Ayd*				
SnowLevel Sites: Utilizing ForecastBuilder and NBM data, including SnowLevel Percentiles, to efficiently create precipitation type and snow/ice accumulation Forecaster Reference "One Pager" for NBM p-type and SnowLevel as Guardrails *Courtesy: Ted Ryan, Ed Townsend and Patrick Ayd*	60 min	Part 1 Part 2	Ted Ryan (FWD)	B
Job sheets for working with ForecastBuilder and NBM precipitation types NOTE: These work best for Non SnowLevel Sites. Those for SnowLevel Sites are in development.	Refer to each job sheet	*Eastern Region Science Training Page*	Mike Dutter (AKQ), Todd Foisy (CAR), Michael Jurewicz (CTP), Justin Arnott (GYX), Matt Strauser (CAR)	B
Utilizing Only SnowLevel to Create Precipitation Type *ForecastBuilder provides offices with sharp terrain the ability to utilize*	15 min	SciShare	David Church (SLC)	C

Part 3: Winter Operations with ForecastBuilder	Time	Video Link	Speaker	Audience *(winter wx WFOs only)*
SnowLevel to derive p-type. Learn about those tools. Forecaster Reference "One Pager" for Freezing Rain / Drizzle *Courtesy: Kathy Torgerson and Paul Wolyn*				
Utilizing Only SnowLevel: Creation of snow and ice accumulations *Details how snow and ice accumulation, along with other accumulation grids, are derived in ForecastBuilder* - ***updated Jan 7 2024***	12 min	SciShare	Andrew Just (CRH STI)	B

Other Winter Training References:

FRAM Ice Accumulation One Pager
Courtesy: Brian Barjenbruch

Road Temperature Impacts in ForecastBuilder
Courtesy: Andrew Just

The remaining training material is Optional based on a site's configuration/operational needs.

Part 4: Aviation Operations with ForecastBuilder	Time	Video Link	Speaker	Audience (DAS WFOs only)
Digital Aviation Services with ForecastBuilder *An introduction on how to perform Digital Aviation Services with ForecastBuilder, along with the various internal consistency checks provided*	12 min	SciShare	Dylan Lusk (FFC)	O

Part 5: Marine Operations with ForecastBuilder (TBD)	Time	Video Link	Speaker	Audience
Populating Marine grids and other considerations				

Part 6: Tropical Operations with ForecastBuilder	Time	Video Link	Speaker	Audience
Demonstration on the Tropical Workflow *An overview on how to work through the tropical process with ForecastBuilder* ForecastBuilder Tropical Reference "One pager"	15 min	*Not coming until 2024*	Ted Ryan (FWD)	O

Part 7: Fire Weather Operations with ForecastBuilder (TBD)	Time	Video	Speaker	Audience
Populating Fire Weather Grids and other considerations			Brian Curran / Eleanor Dhuyvetter	

Other Modules of Interest	Time	Video Link	Speaker	Audience
More on NBM MaxT, MinT and T *There are various nuances about MaxT, MinT and T that impact ForecastBuilder and you the forecaster. Hear more in this module.*	3 min	SciShare	Patrick Ayd (DLH)	O
Considerations of utilizing percentile data (TBD)			Andrew Just	

(七) 參訪 Boulder 預報中心