



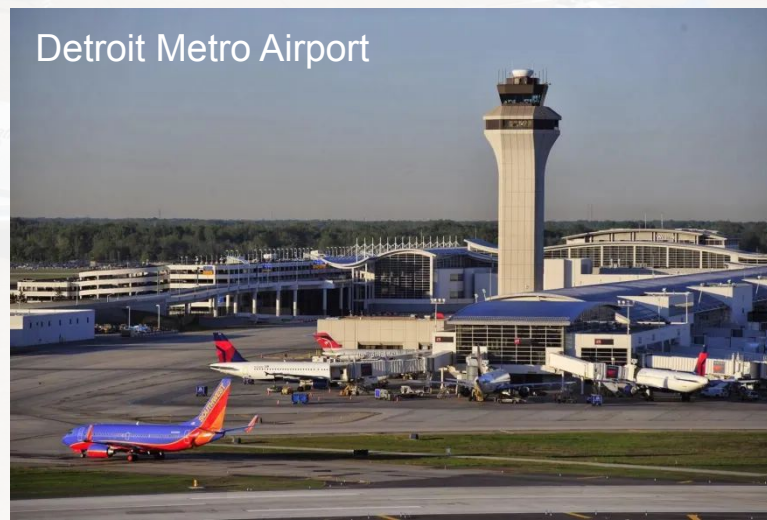
Integration of Probabilistic Meteorological Data for Aviation Related IDSS Briefings



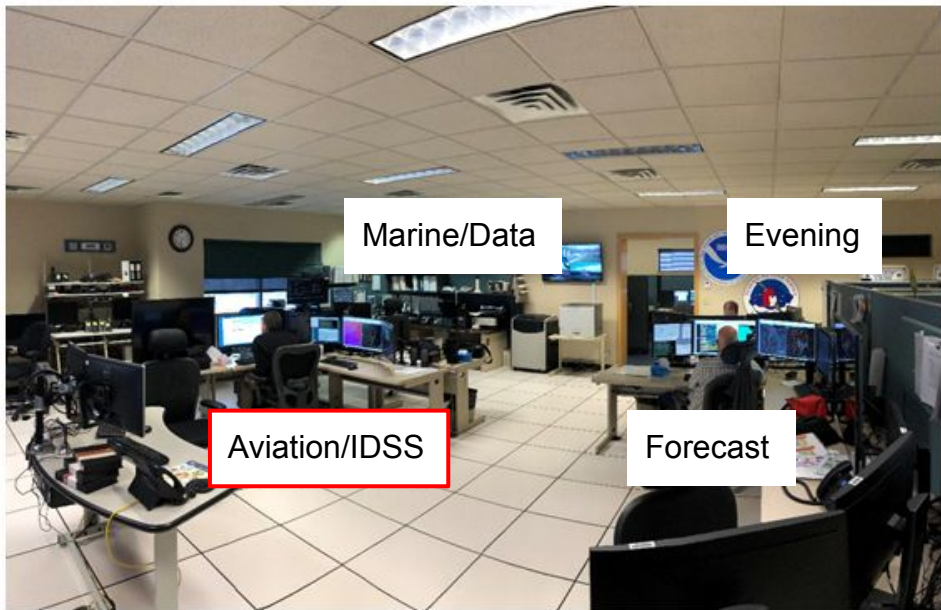
Kevin Kacan, NWS Detroit Meteorologist

Agenda

- Overview
- IDSS Tools
- D21 Support
- WCAA Support
- Best Practices
- Additional Probabilistic Data
- Takeaways



Overview: WFO Detroit Aviation & IDSS



- Near/Short/Long Term Forecast Desk
 - Gridded Forecast Database (NDFD)
 - Text/Tabular Public Forecast Products
 - Area Forecast Discussion (AFD)
 - Long-Fuse Watches, Warnings, & Advisories (WWA)
 - Excluding Marine
- Aviation/IDSS Desk
 - TAFs
 - Aviation AFD
 - Short-Fuse WWA
 - Terrestrial & Marine Convection
 - IDSS (excluding Marine)
- Marine/Data Collection
 - Observation Data Collection
 - Upper Air, COOP, Rivers
 - Climate & Hydrometeorological Text/Tabular Products
 - Text-Based Marine Forecast Products
 - Marine IDSS
 - Public, Media, & Spotter Phone Calls



Overview: WFO Detroit Aviation & IDSS

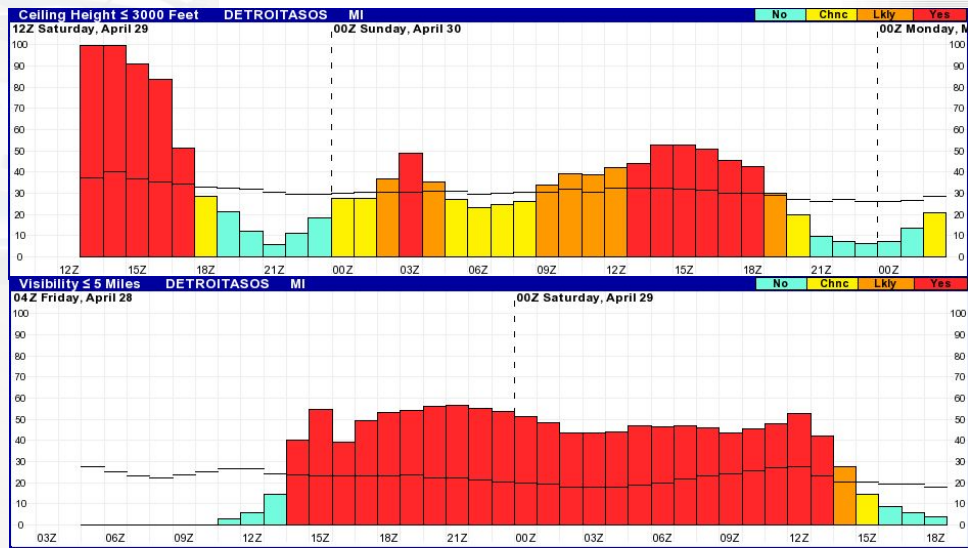
- WFO Detroit (DTX) has two major aviation-related IDSS responsibilities that are part of routine shift duties (seasonal dependence)
 - D21 Briefing Slide for CWSU/ARTCC Cleveland (ZOB) and DTW Tower/TRACON
 - Wayne County Airport Authority (WCAA) Briefing Slide for Detroit Metro & Willow Run Airfield Operations
- Deterministic and probabilistic datasets used to provide a narrative discussion and annotated graphical representation of anticipated meteorological conditions
- Feedback from decision makers regarding these briefings has been positive as their dependence continues to increase

IDSS Tools: LAMP Data

- GLAMP Probabilities and Thresholds for Flight Categories
- Probability (and Conditional Probability) of MVFR, IFR, or LIFR Ceiling or Visibility at a terminal
 - Conditional Example: Likelihood that if a ceiling develops, it will be a MVFR ceiling, should precipitation occur
- Solid black lines indicate the threshold value at each hour
- Colors represent the difference (using 10% thresholds) between the probability and the threshold required to make a categorical forecast

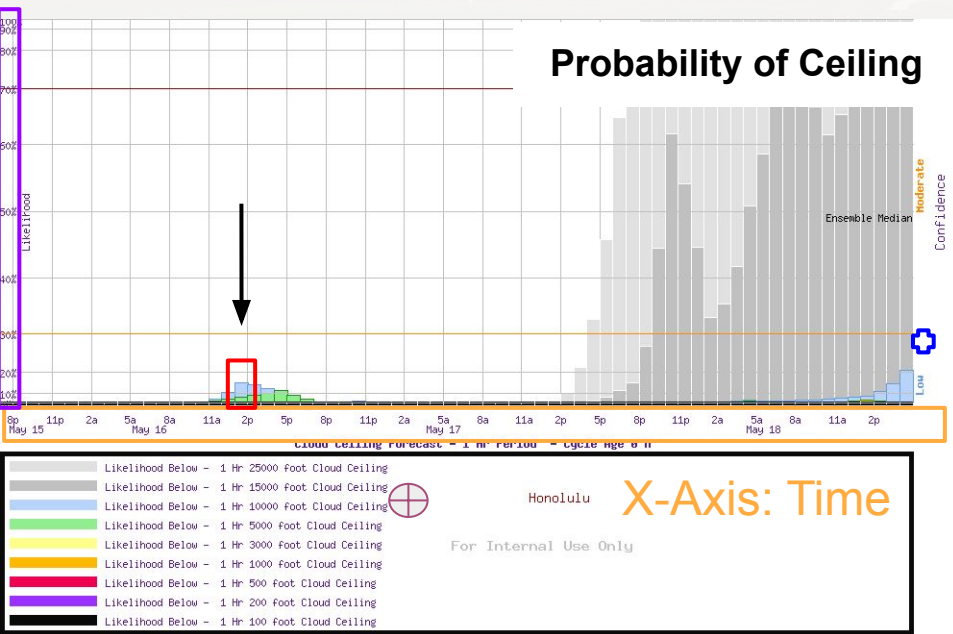
Uncertainty Plot	Threshold Plot		
	LIFR	IFR	MVFR
Ceiling Height	< 500 ft. <input type="radio"/>	< 1000 ft. <input type="radio"/>	≤ 3000 ft. <input checked="" type="radio"/>
Conditional Ceiling Height	< 500 ft. <input type="radio"/>	< 1000 ft. <input type="radio"/>	≤ 3000 ft. <input type="radio"/>
Visibility	< 1 mi. <input type="radio"/>	< 3 mi. <input type="radio"/>	≤ 5 mi. <input type="radio"/>
Conditional Visibility	< 1 mi. <input type="radio"/>	< 3 mi. <input type="radio"/>	≤ 5 mi. <input type="radio"/>
Probability of Precip Occurrence <input type="radio"/>			
Probability of Freezing <input type="radio"/>		Prob. of Freezing or Snow <input type="radio"/>	

Submit KDTW
-OR-
Select State ▼



IDSS Tools: Local Probabilistic Data

Y-Axis: Probability

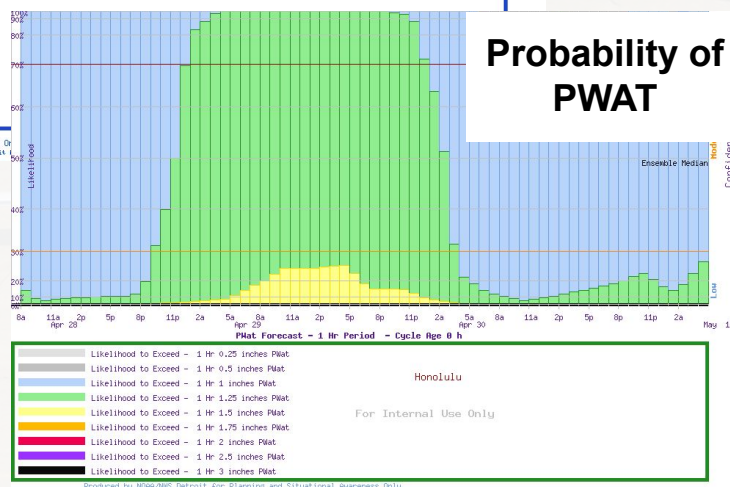
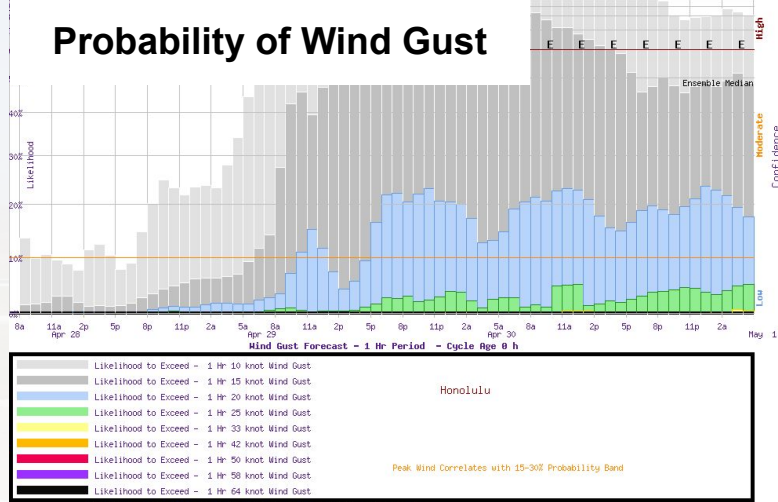
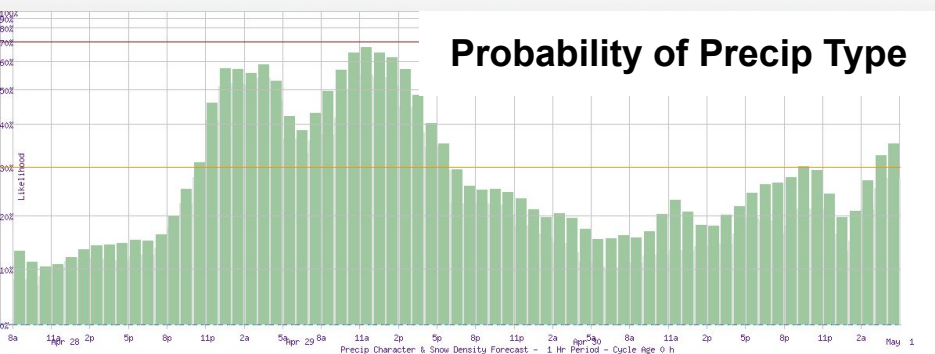


- Ensemble approach to probabilistic forecasting utilizing model soundings
- Dataset includes GFS, GEFS, NAM, NAM Nest, RAP, HRRR, & SREF
- Time-lagged component includes previous model runs to improve output stability through moving average calculations
- Time-centered options for 3, 6, 12, & 24 hour probabilities
 - Uses model data x hours before and x hours after the time-center
- Uniform threshold values for each parameter
- Probability confidence level cutoffs vary between variables
 - Low Confidence: 30% cutoff for Cloud Ceiling, compared to 10% for Gusts

→ Between 1 and 2 PM, the probability of achieving a 10 kft ceiling is ~16% and the probability of achieving a 5 kft ceiling is ~7%



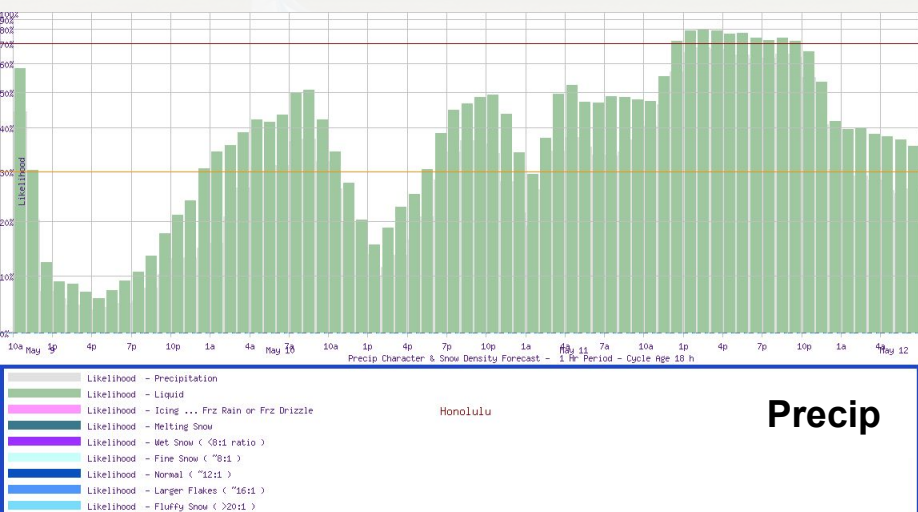
IDSS Tools: Local Probs



Ceiling	QPF	(SB)CAPE
Visibility	PWAT	MLCAPE
Inversion Base Height	Wind	MUCAPE
	Gusts	Convection

IDSS Tools: Local Probabilistic Data

18 Hour Change in Probability

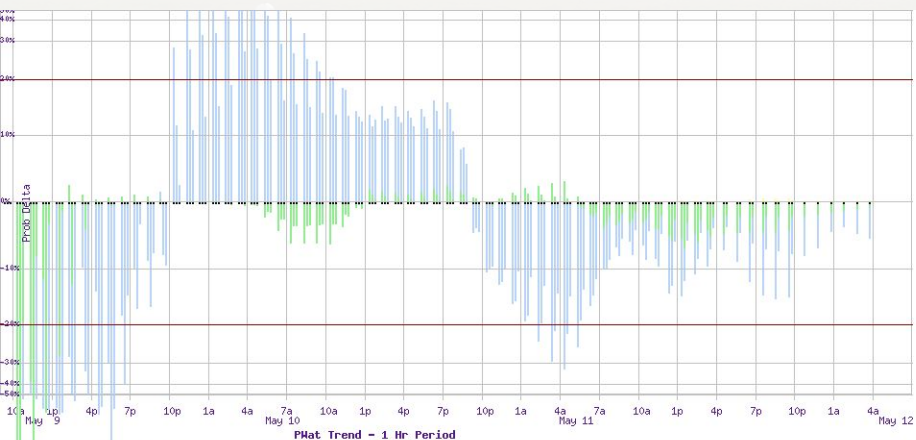


Produced by NWR/NWS Detroit for Planning and Situational Awareness Only
Version: 2022-03-09 11:53 The Filtered Explicit Weighted Time Lag Ensemble Population Percentages

- GIFs showing the time-matched probabilities from the previous 18 hours, 12 hours, 6 hours, and current
- Demonstrates shifts in the NWP solution space
 - Identify differences in magnitude
 - Shows adjustments in on-set time, duration, and end time
- Available for each variable within the first 72 hours
- Not included in briefing graphics

IDSS Tools: Local Probabilistic Data

18 Hour Probability Trend

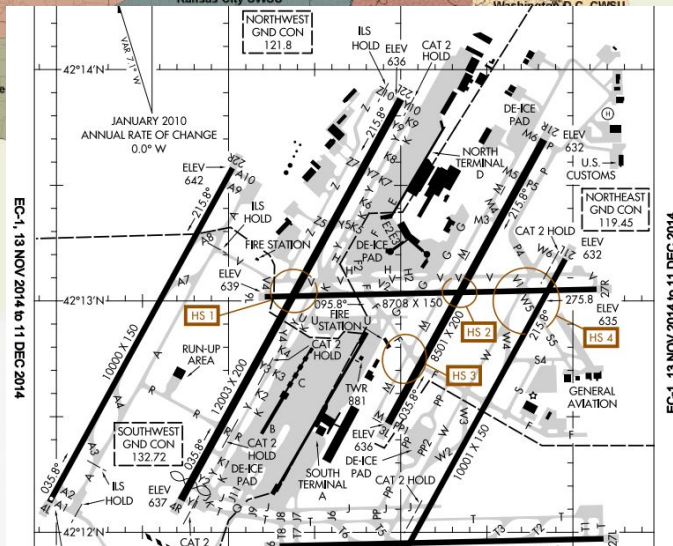
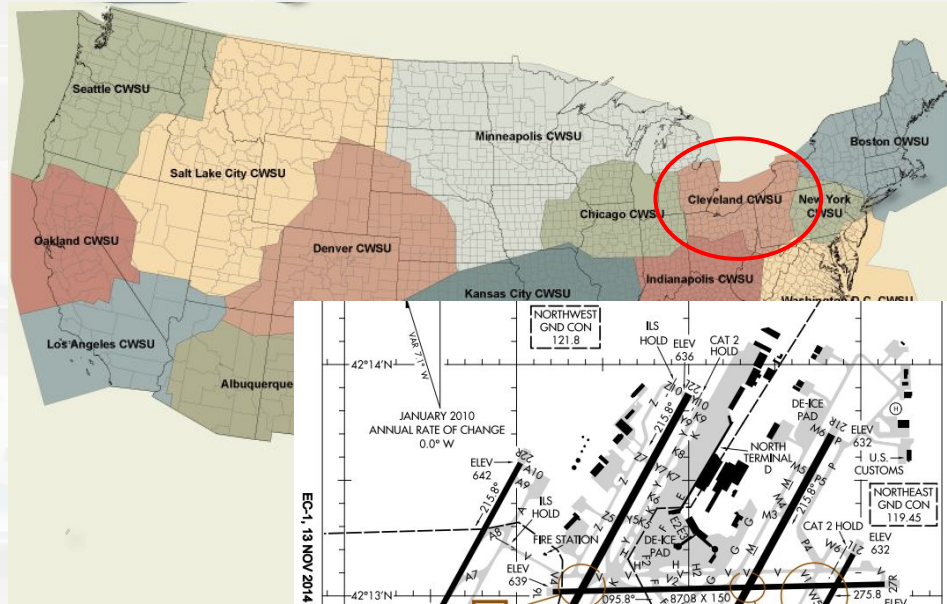


Produced by NOAA/NWS Detroit for Planning and Situational Awareness Only
 created 2020/05/10 10:23
 Time Filtered Explicit Weighted Time Lag Ensemble Population Percentage

- Static images showing the time-matched probabilities from the previous 18 hours, 12 hours, 6 hours, and current
 - Based on percent difference
 - Better accentuates the difference of more recent runs where magnitude changers are smaller
 - Separation of threshold values
- Available for each variable within the first 72 hours
- Not included in briefing graphics

D21 Support: Briefing Overview

- Tailed briefing slide for CWSU/ARTCC Cleveland (ZOB)
 - CWSU Meteorologists
 - ZOB Traffic Management Unit (TMU)
 - DTW TRACON/Tower
- Forecast Parameters
 - Dense Fog & Low Ceilings
 - Ceilings below 5000 feet (Cat F)
 - Winds/Crosswinds
 - Especially NW or SE
 - Can close 4 of 6 runways
 - Thunderstorms
 - Orientation, Intensity, Mode
 - Winter Precipitation



EC-1, 13 NOV 2014 to 11 DEC 2014

EC-1, 13 NOV 2014 to 11 DEC 2014

D21 Support: Briefing Overview

- Forecast summary highlights

- Confidence
- Nuance
- Challenges
- Significant Weather Elements

- Graphics/charts are used to provide a visual reference of meteorological data to support the forecast summary

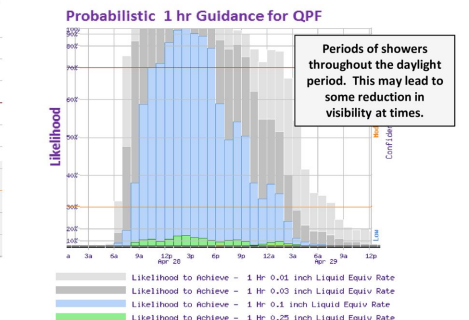
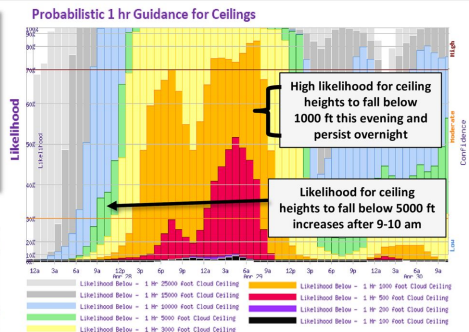
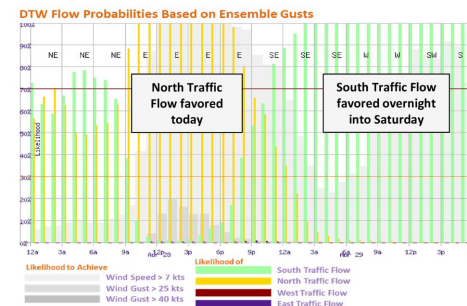
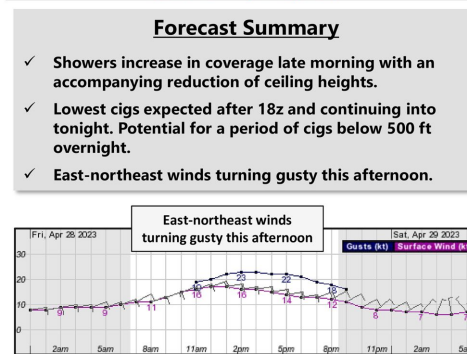
- Annotated graphics provide more context than just listing probabilities

- Issued by 5 AM daily

Discussion Date: 1000 UTC – April 28, 2023

Next Discussion: 1000 UTC – April 29, 2023

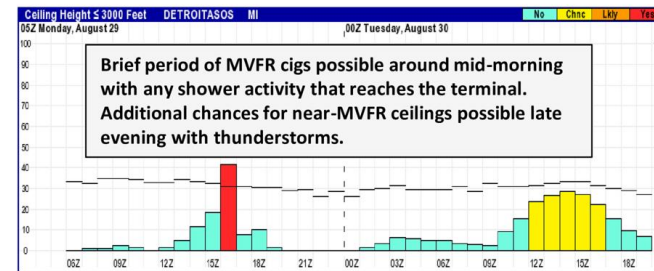
This slide does not receive intermediate updates.
Information on in-flight icing and turbulence is not included, but can be found at <https://www.weather.gov/ob/>





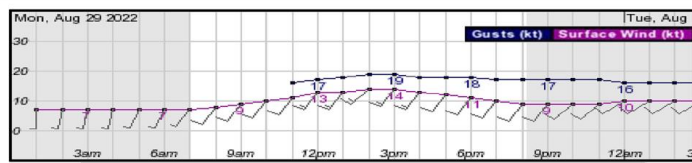
Forecast Summary Bullets

- ### Forecast Summary
- ✓ Generally low VFR ceilings today with periods of MVFR cigs possible tied to rain activity. Primary periods for that is mid-morning and late evening.
 - ✓ Two main windows for rain chances over DTW today. 1st is this morning with showers (perhaps a thunderstorm or two in the area) focused between 7am-Noon. 2nd window is this evening between roughly 7PM-Midnight. This period has the greatest potential for thunderstorm activity including stronger storms.
 - ✓ SW winds increase after midday with peak afternoon/evening gusts (outside of t-storms) up around 20kts.



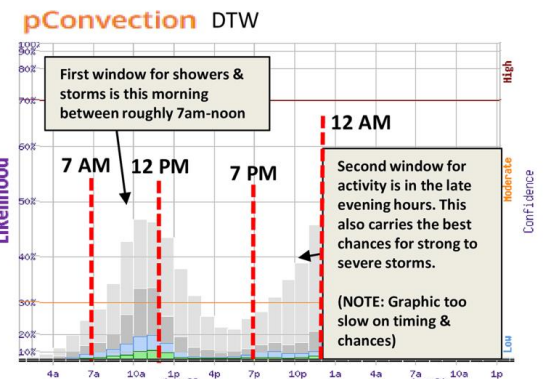
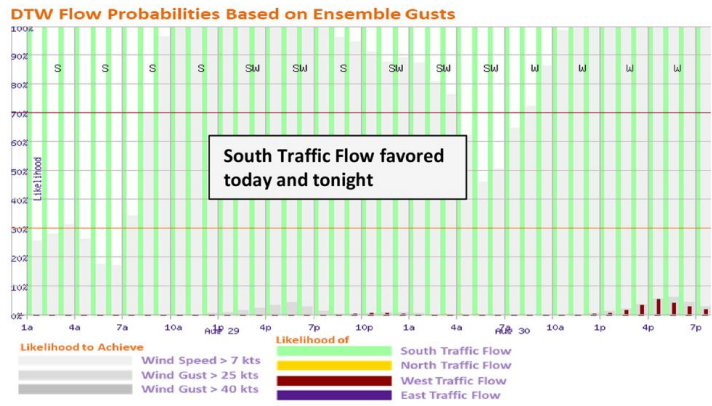
GLAMP MVFR Ceiling Probs

NDFD Winds & Gusts



Southwesterly winds increase into the afternoon-evening with peak gusts up around 20kts.

DTW Traffic Flow Probabilities



- Likelihood to Achieve - 3 Hr 0.01 inch Convective Liquid Equiv Rate
- Likelihood to Achieve - 3 Hr 0.03 inch Convective Liquid Equiv Rate
- Likelihood to Achieve - 3 Hr 0.1 inch Convective Liquid Equiv Rate
- Likelihood to Achieve - 3 Hr 0.25 inch Convective Liquid Equiv Rate
- Likelihood to Achieve - 3 Hr 0.5 inch Convective Liquid Equiv Rate
- Likelihood to Achieve - 3 Hr 0.75 inch Convective Liquid Equiv Rate
- Likelihood to Achieve - 3 Hr 1 inch Convective Liquid Equiv Rate
- Likelihood to Achieve - 3 Hr 2 inch Convective Liquid Equiv Rate
- Likelihood to Achieve - 3 Hr 3 inch Convective Liquid Equiv Rate

Thunder Probability



D21 Support: Briefing Applications

Local forecast by "City, St" or ZIP code
Enter local Location Help

News Headlines

- NOAA Lake Erie Harmful Algal Bloom Forecast
- Expert Forecast Opinion
- Just One In-Person and One Virtual Skywarn Spotter Training Class Left on the Schedule for Spring 2023

D21 Tracon Decision Support

Weather.gov > Detroit/Pontiac, MI > D21 Tracon Decision Support

Detroit/Pontiac, MI
Weather Forecast Office

Recent Changes: added probabilistic Ceiling and Visibility

CWSU ZOB Pre-Duty Weather Briefing
Prepared: 5/9/2023 12:02 Valid for 12 Hours
Pilot reports requested.

THUNDERSTORMS NONE	ICE NONE	CIGS/VIS ALL LRS NO CIG AOR 990
TURBULENCE PTCHY MOD FL180-420	ALT ALT ↑	ALTIMETER ASL 29.92
ICING S PA/W/M/D VSL LST 180-FL200 ENDG 19Z	DTW DTW	VFR: WHD NE BKT 01Z NEARLY CALM

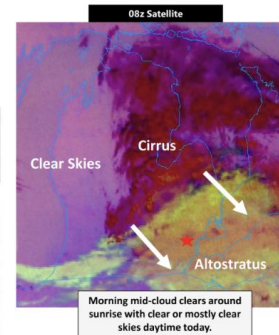
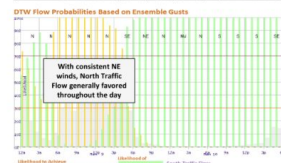
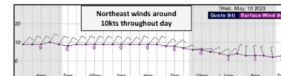
Overview	Discussion	TAFs	Wind	Gust	DTW Flow	DTW Flow (Gust)	Cig/Vis	Convection	Snow
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Discussion Date: 1000 UTC - May 9, 2023
Next Discussion: 1000 UTC - May 10, 2023

This slide does not receive intermediate updates. Information on in-flight icing and turbulence is not included, but can be found at <http://www.weather.gov/cuba/>

Forecast Summary

- Morning VFR mid-cloud clears around daybreak with clear or mostly clear skies for the rest of the day.
- Northeast winds around 10kts today.
- No precip through the midweek period.



- Used as an initial briefing for some CWSU meteorologists at the start of their morning shifts
 - Shifts begin at 5 AM
 - First pre-duty briefing due by 545 AM
 - Controllers' shifts begin at 6 AM
- TMU references the briefings, especially for winter weather
- Briefing slide is linked to two aviation support web portals
 - D21 TRACON dashboard includes access to several DTX probabilistic graphs
 - CWSU's tower briefing dashboard

D21 Support: Briefing Challenges

- Balancing DTX's IDSS role without overstepping the CWSU's role
 - Direct support to the TMU and staff at DTW TRACON/Tower
 - Face-to-face/on-the-spot briefings to air traffic controller
- Briefing slide is meant as a supplemental tool for CWSU meteorologists
 - By no means are CWSU staff members required to align their FAA support with DTX's D21 Briefing slide
- Only one slide per day, therefore the slide's value decreases with time, especially by afternoon/evening
 - Forecast summary often becomes obsolete wrt convection or highly variable low ceilings
 - Probabilities can become unrepresentative of latest adjustments
 - Satellite imagery quickly becomes outdated

The screenshot shows the National Weather Service website for the DTX D21 TRACON Decision Support page. The page includes a navigation menu with links for HOME, FORECAST, PAST WEATHER, SAFETY, INFORMATION, EDUCATION, NEWS, SEARCH, and ABOUT. A local forecast for 'City, ST, or ZIP code' is displayed, with a search box and a 'Go' button. A headline reads 'Sweating Heat in the West; Alaska Ice Jam and Snowmelt Flooding', followed by a brief summary and a 'Read More >' link. The page is titled 'PDWB_DTW' and identifies the user as 'Cleveland CWSU' (Center Weather Service Unit). A 'PRE-DUTY CONTROLLER WEATHER BRIEFING' section is visible, containing a map of the region and a 'Discussion Summary' box. The summary includes:

- ✓ VFR high cloud will continue to stream through the airspace until late this evening with ceilings situated above FL150.
- ✓ Prevailing winds from 40° range between 10 and 15 knots with gust component holding below 20 knots.
- ✓ North Traffic Flow expected today amidst modest wind from 40° before speeds diminish overnight.

 Other sections include 'Cloud Cover' (High-Based VFR), 'Gust Probabilities', 'DTW Flow Probabilities Based on Ensemble Gusts' (showing North and South Traffic Flow), and 'Hourly Winds'. A footer note states 'Full NWS DTX D21 TRACON Decision Support page' and provides a link to the CWSU ZOB homepage.

WCAA Support: Briefing Overview



WCAA snow removal ops from February 2015 Winter Storm producing 16.7" of snowfall over 2 days

- Participate in pre-season winter preparedness workshops, presenting on winter meteorology
- Tailored briefing slide for Wayne County Airport Authority (WCAA) Detroit Metro & Willow Run Airfield Operations
- Combination of graphics/charts, annotations, and forecast narrative through the period of events
- Issued as-needed; usually twice daily with impending winter weather
 - Deadlines: 5 AM & 2 PM
- WCAA's Primary Goal: Keep runways maintained and treated to prevent delays or cancellations
 - Reported millions of dollars in annual savings due to improved efficiency in staffing and materials usage
 - No known FAA fines for winter mishaps since support started during the 2015-2016 winter season

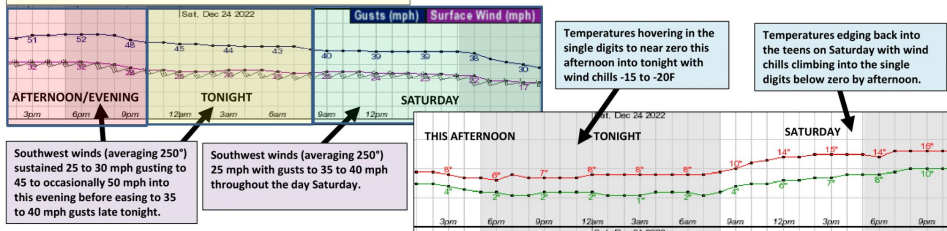
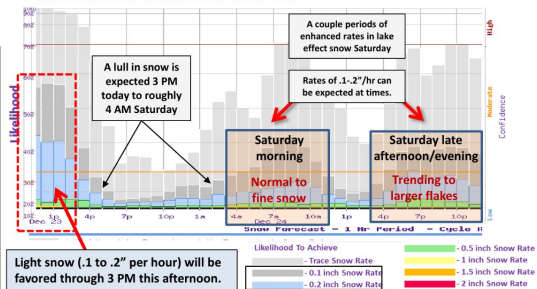
WCAA Support: Briefing Overview

WCAA Briefing Slide December 23, 2022 11:15 AM
 On-duty forecaster number 248-625-4139 / www.weather.gov/dtx/wcaagroundops

Narrative – This afternoon into Saturday

- Southwest winds (250°) will gust to 45 to occasionally 50 mph this afternoon into this evening, then ease off to gusts of 35-40 mph tonight into Saturday. **Recent trends have been for slightly lower peak gusts today.**
- Occasional light snow will taper off to flurries by 3pm as snow shifts north. Additional accumulations less than an inch, but with continued blowing and drifting snow.
- A lull in snow is expected from mid afternoon into tonight before lake effect activity bring a renewed chance of enhanced snowfall at times from Saturday morning into Saturday evening.
- Several additional inches of dry to powdery snow accumulation will be possible, but confidence is low.

Probabilistic 1 hr Guidance for Snow Rate



● Issuance Criteria

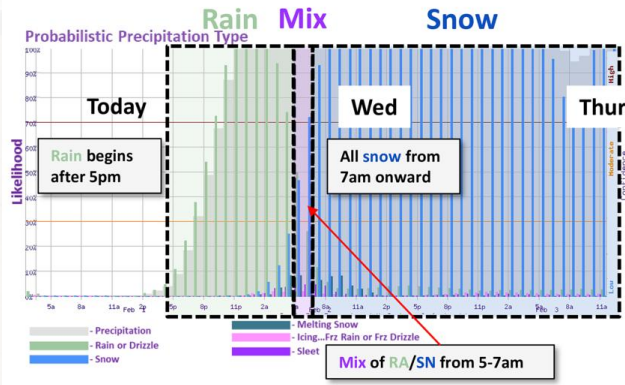
- Potential for accumulating snow or ice on runways within the next 72 hours
- Outlooked potential for Winter Weather Advisory, Watch, or Warning type of event beyond 72 hours
- Uncertainty in precipitation type or timing uncertainties
- Weekend sensitivity for WCAA staffing
- Any request from WCAA

● Additional Considerations

- Start/end time of snowfall
- Freezing rain proximity and rates
- Blowing/drifting snow
- Snow-Liquid Ratios

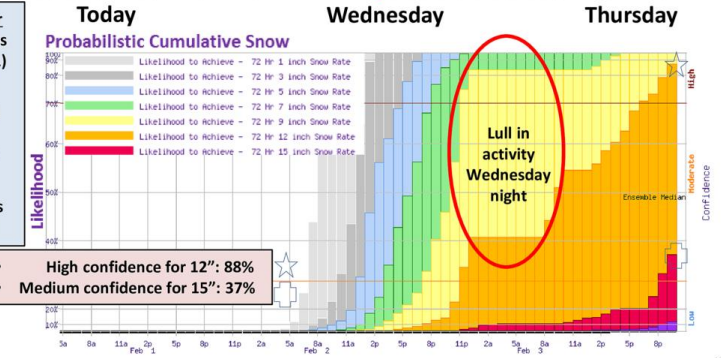
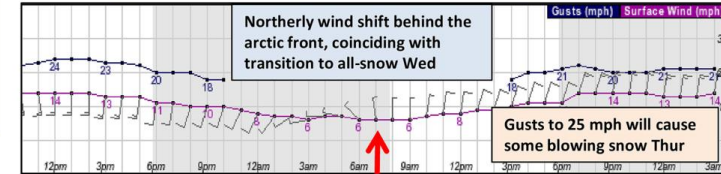
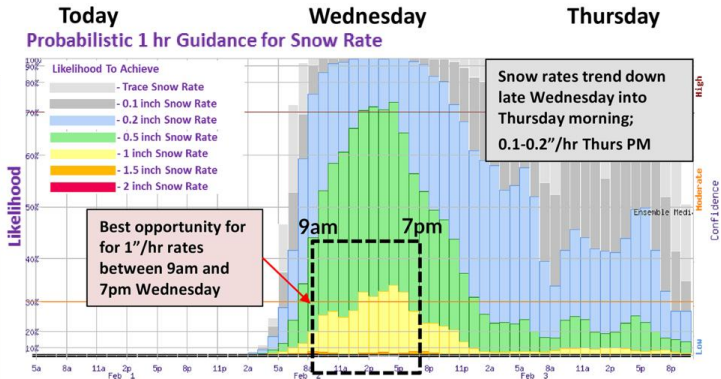
Forecast Narrative Bullets

- Narrative**
- Confidence remains high for a **significant snowfall event Wednesday morning through late Thursday evening.**
 - Total snowfall of **10-14"** likely by 11pm Thursday, with a chance for as much as 16" of accumulating snow within a 48 hour period.
 - Rain begins after 5pm Tuesday, then transitions to all snow by 7am Wednesday with snowfall rates up to 1"/hr during the daylight hours
 - The first 7-9" associated with an arctic frontal passage will be on the ground by 1am Thursday, followed by a brief lull early Thursday morning as snow rates drop until midday.
 - Expect another 3-5" on Thursday with rates near 1/2"/hr during the evening as a distant low pressure system makes its closest approach.
 - North-northeast winds gust to 25 mph with drier snow character Thursday poses a threat for blowing/drifting snow.



Snow Character
 Snow starts off as large flakes (14:1) Wednesday AM
 Becomes normal Wednesday afternoon (12:1)
 Predominantly large fluffy flakes Thursday (16:1)

All precip types in the column for each hour must add up to the total probability of precipitation (gray bar)



Snowfall Rates Probs

NDFD Winds

Total Snow Accum Probs

WCAA Support: Briefing Applications - User Thresholds

Event Level	Type	Depth	Duration	Rwys Open/Clearing
Blue	Dry/Wet Snow	< 1"	12 hr period	Monitor & Assess
Green	Dry Snow	1 to < 5"	12 hr period	3/1
	Wet Snow	1 to < 5"	12 hr period	3/1
	Freezing precip			3/1
Yellow	Dry Snow	4" – 7"	12 hr period	2 or 3/1
	Wet Snow	3" – 5"	12 hr period	2 or 3/1
	Freezing precip			2 or 3/1
Orange	Dry Snow	7"+	12 hr period	1/1
	Wet Snow	5"+	12 hr period	1/1
	Freezing precip			1/1

- Snowfall

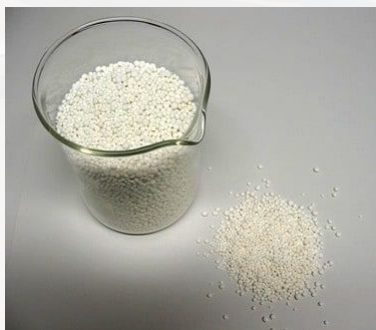
- Amounts/Depth
- Character/SLR
- Rates/Intensity
- Duration

- Freezing Rain

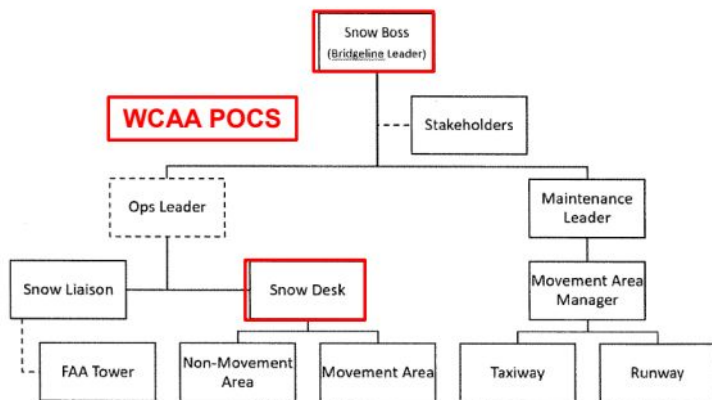
- Temperature: Raindrop, Pavement, & Air
- Freezing Rain Rate
 - ≥ 0.05 in/hr on glaze washes away chemical and has shut down the airfield

- Pilot Reports

- Nil Breaking Conditions



WCAA Support: Briefing Applications - User Response



- Pre-Event Coordination Webinars

- Internal and External Webinars
- DTX meteorologists review the slide information and add any new forecast updates; ends with Q&A
- WCAA personnel discuss potential treatment strategies and staffing plans based on DTX's forecast during the webinar and latest slide info
- WCAA might distribute briefing slides to a larger partner audience
 - FAA, ground crew supervisors, and airline managers (Delta hub)

- WCAA Snow Desk

- Goal is to limit runway closures, maximize resources, and avoid being caught off-guard by utilizing DTX's IDSS and observed conditions
- Open communication lines for airport leads
- Really try to avoid Orange events where AARs become highly constrained
- Relay forecast updates from DTX via all-hands email messages and internal dashboard





WCAA Support: Briefing Challenges

- **Pre-Event Coordination Webinars**
 - Microsoft Teams & NOAA IT Policy
 - Repetition when forecast narrative remains fairly consistent
 - 830 or 9 AM briefing times can occur shortly after shift changes
- **Balancing Technical Language**
 - To a non-meteorologist audience
- **Forecaster Fatigue**
 - Large winter IDSS responsibility at DTX besides WCAA briefings (e.g. MDOT, headline decisions)
 - Multi-day events or frequent subsequent minor events
- **Minor Events**
 - Low confidence in timing or very low-impact events that could be easily conveyed through text
- **Unexpected Event Outcomes**
 - Model shortcomings when high-end events that don't verify
 - Spend multiple days messaging the wrong outcome
- **Unconventional Requests**
 - Live Snowfall Rates

WCAA Support: Expansion of Support - Convection

All,

All severe weather threats are in play. The overall environmental conditions remain supportive of both significant large hail (2"+) and strong tornadoes (EF2+) for southeast Michigan. An enhanced risk for severe thunderstorms remains in place. Please review attachment.

Confidence has increased that the most likely time window for severe weather is between 11 AM and 4 PM.

Uncertainty continues to exist with regards to the coverage or how widespread the severe threat will be across Southeast Michigan. Ongoing showers and thunderstorms this morning may impact the amount of instability later today across the region.

Storm motion for thunderstorms will be to the northeast at 50-60 mph.

This system has the potential to be extremely hazardous. Ensure you have a way to monitor NWS for advisories, watches and warnings as some of the details may not come into focus until just prior to the event. Be prepared to seek shelter immediately when warnings are issued for your location.

Further updates will be provided as we get closer to the arriving weather system.

If you have any questions, feel free to contact me anytime.

We have a **severe weather event** predicted by National Weather Service (NWS) starting today; please see attached slide from earlier this morning. Here's the information that was talked about at our meeting with the NWS:

- National Weather Service forecast:
 - Sustained SW winds 23-30 mph with potential gusting up to 60 mph.
 - At times winds may shift to the west causing crosswind operations.
 - The window for the Severe Weather will be 12:00pm to 3:00pm.
 - 1"+ diameter hail is possible.
 - Heavy downpours of rain will be limited by the speed of this storm.
 - This evening a localized cold front will move through around 8:00pm.
 - The airfield will be ready should crosswind operations be needed.

- All information is being disseminated airport wide.

That's it for now. Please reach out if you have any questions. Thank you.

- Prompted by an early season SPC Enhanced Risk and distribution of general partner IDSS convective hazards briefing materials
- WCAA redistributed/rehashed NWS Detroit outlook messages to airfield maintenance personnel
- Hosted two Pre-Event Planning Webinars for convection
- WCAA requested heads-up notifications before lightning reaches the airfield





Best Practices

- Ask questions during the planning process to understand the partner's needs
- Participate in event reviews to discern how the forecast information is applied
 - Post-Event Lesson: Crosswinds with enough dewpoint depression can lead to evaporative cooling and worsen runway conditions
- Encourage forecast staff to leverage meteorological expertise and make probabilistic data/graphic selections that best support the forecast message
- Tailor forecaster reference materials to include information on how partners actually use their briefing slides
- Point out probabilistic data that is not representative of the overall forecast narrative
- Annotate, Annotate, Annotate



Additional Probabilistic Data

1. NBM/GEFS Map Viewer

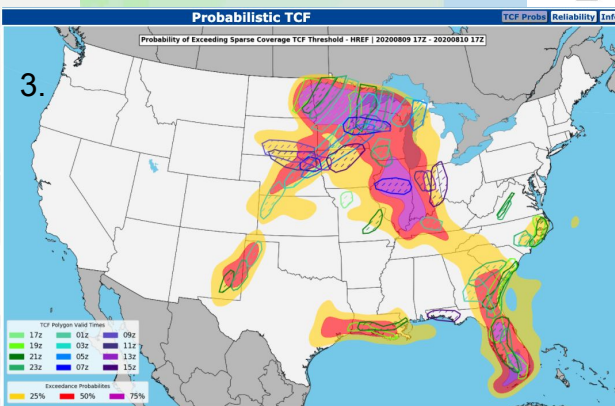
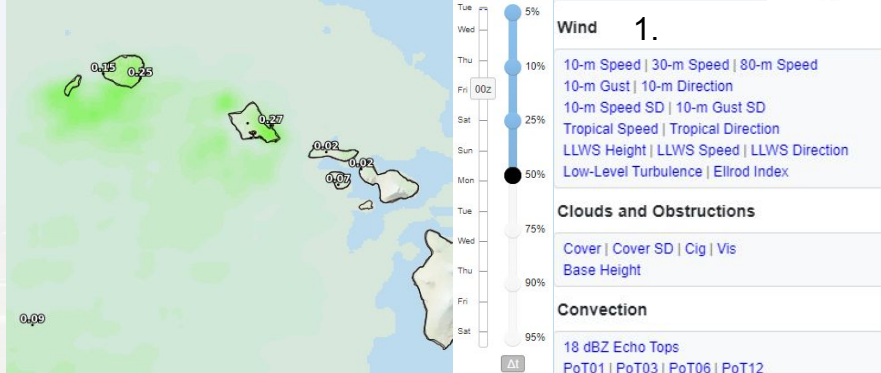
- Requires NOAA login credentials

2. NBM/GEFS Point Data Viewer

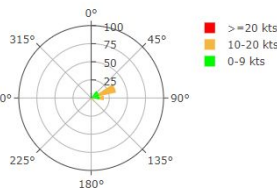
- Requires NOAA login credentials

3. AWC - Coming Soon??

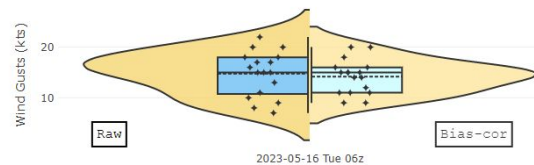
- Past AWC testbed experiments included probabilistic TCFs
- AWC testbed experiment conducted May 15-18 used new aviation probabilistic guidance with user/partner groups



NBM v4.1 Components 10-m Wind Speed Distribution (%)



2.





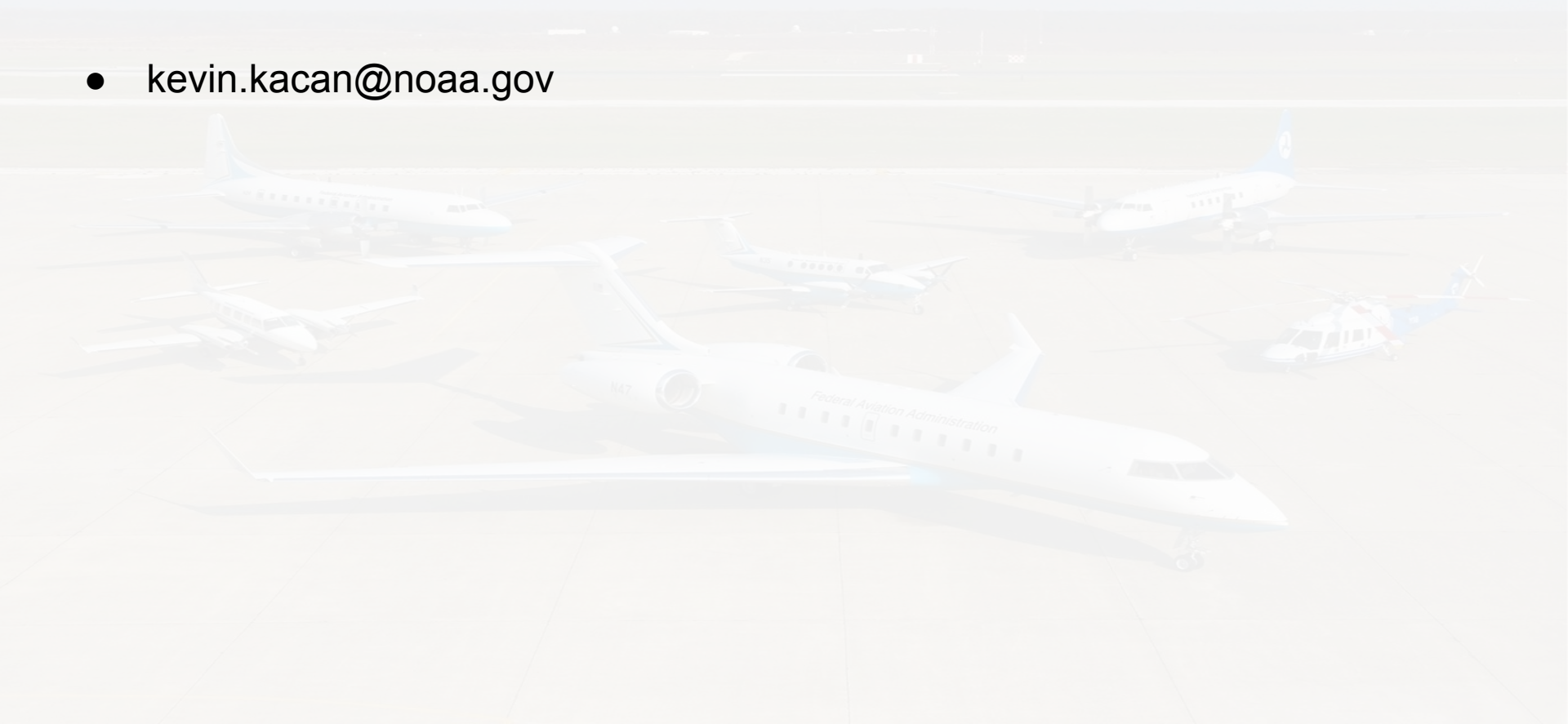
Takeaways

- Some NWS partners prefer probabilistic-based briefing information for the broader context than what text-based deterministic formats can provide
- Knowledge of meteorological processes and statistics varies greatly between users groups which is why it is so important to annotate probabilistic data
- Sometimes the weather just "wins"
 - 6:1 snow ratios with thundersnow produced a wet/heavy 6 inches of snow in 3 hrs this past March; unavoidable runway closures lead to a 3 hour ground stop at DTW
- Should partners gain a dependence on briefings, additional requests may arise beyond pre-arranged services which could lead to workload imbalances



Questions?

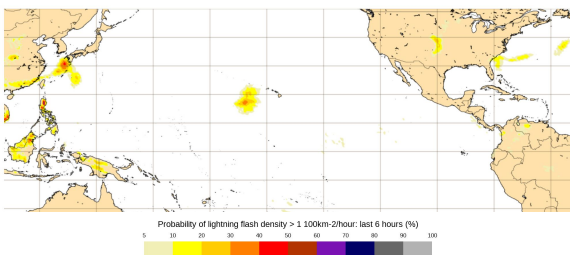
- kevin.kacan@noaa.gov



Alternative Probabilistic Resources: ENS

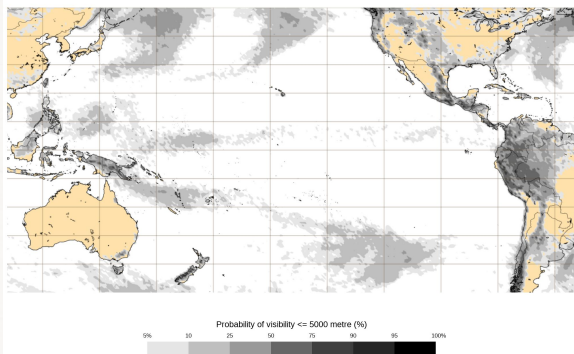
Probabilities: lightning flash density

Base time: Tue 16 May 2023 00 UTC Valid time: Thu 18 May 2023 12 UTC (+60h) Area: Equatorial Pacific Event threshold : 1



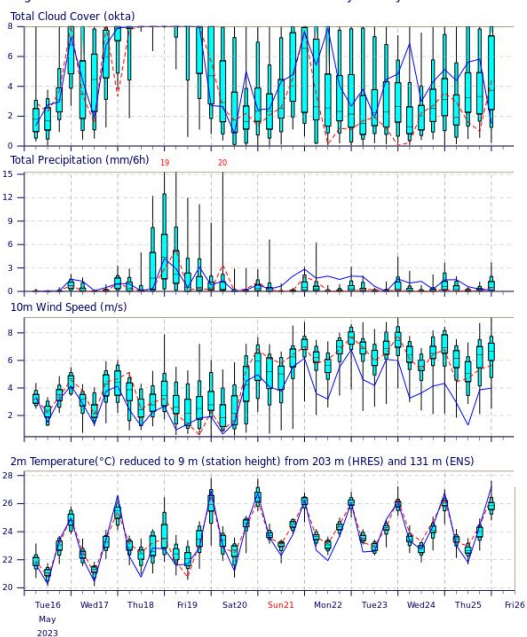
Probabilities: visibility

Base time: Tue 16 May 2023 00 UTC Valid time: Wed 24 May 2023 12 UTC (+24h) Area: Equatorial Pacific Event threshold : 5000

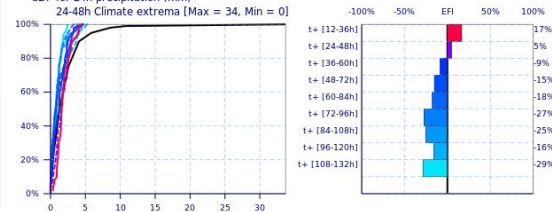


ENS Meteogram

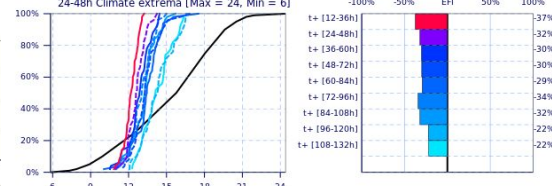
Honolulu 21.44°N 157.87°W (ENS land point) 9 m
High Resolution Forecast and ENS Distribution Tuesday 16 May 2023 00 UTC



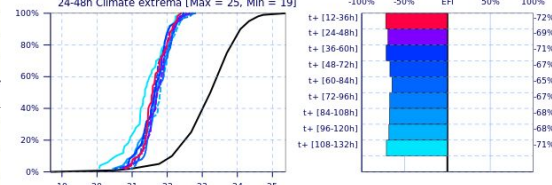
Forecast and M-Climate cumulative distribution functions with EFI values
21.44°N 157.87°W
Valid for 24 hours from Tuesday 16 May 2023 00 UTC to Wednesday 17 May 2023 00 UTC
CDF for 24h precipitation (mm)



CDF for 24h maximum wind gust (m/s)
24-48h Climate extrema [Max = 24, Min = 6]



CDF for 24h mean 2m temperature (°C)
24-48h Climate extrema [Max = 25, Min = 19]



M-Climate: this stands for Model Climate. It is a function of lead time, date (+/-15days), and model version. It is derived by rerunning all member ensemble over the last 20 years twice a week (1980 realisations). M-Climate is always from the same model version as the displayed ENS data. On this page only the 24-48 lead M-Climate is displayed.