



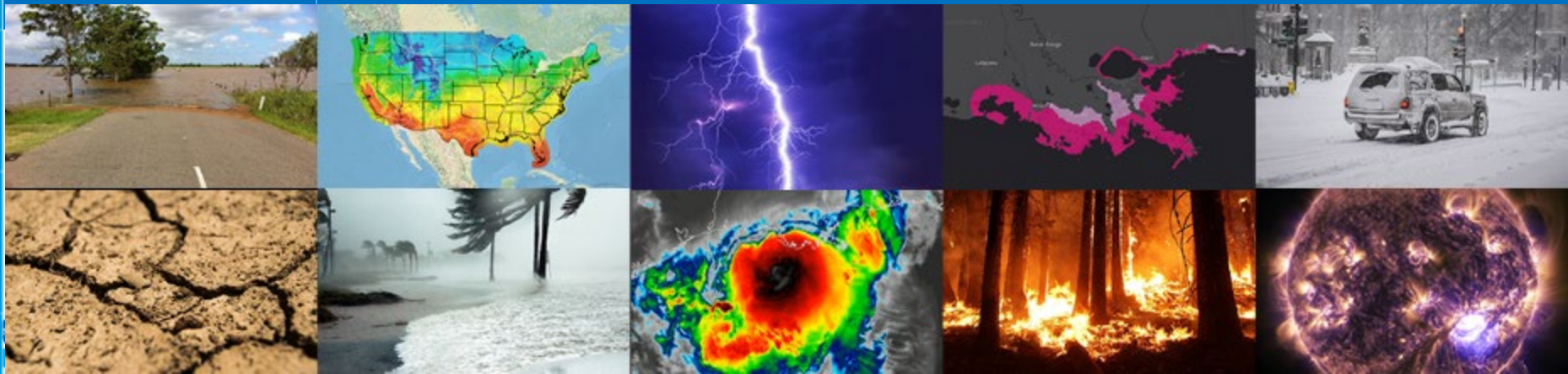
**NATIONAL
WEATHER
SERVICE**

Updates on Improvements to Aviation Guidance in the Localized Aviation MOS Program (LAMP)*

Tenth Southwest Aviation Weather Safety Workshop (SAWS)
April 21, 2023

Presenters: Phil Shafer and Judy Ghirardelli, NWS/MDL

* Disclaimer: Portions of this research is in response to requirements and funding by the Federal Aviation Administration (FAA). The views expressed are those of the authors and do not necessarily represent the official policy or position of the FAA.





Outline

1. LAMP Background
2. Tour of Web Products
3. LAMP/GLMP v2.5 Upgrades
4. FAA Aviation Weather Research Program (AWRP)-funded work:
 - a. 15-minute LAMP/GLMP
 - b. Onset/cessation of flight categories
 - c. Gridded ceiling height analysis at SFO
5. Summary/Future Work

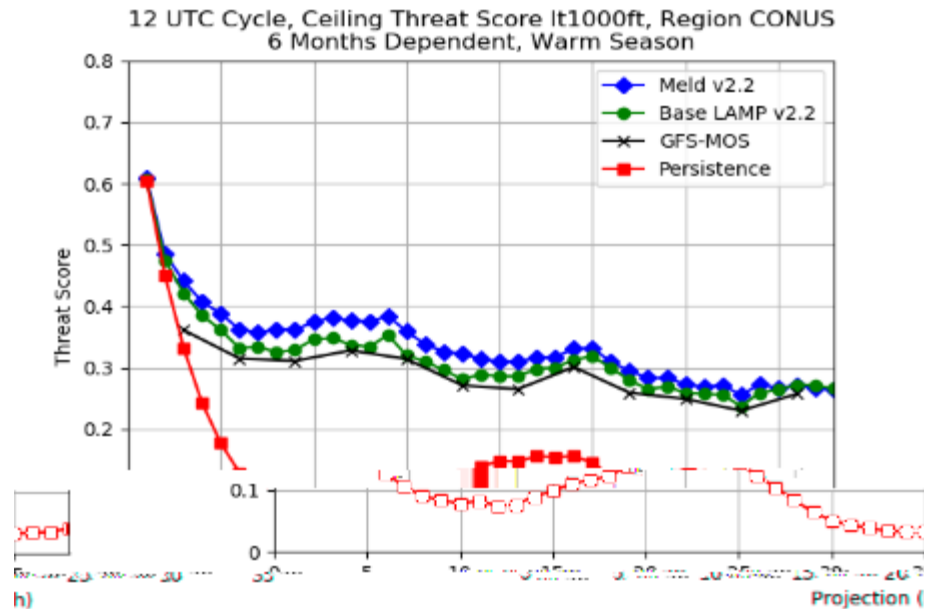


1. LAMP Background



LAMP Background: What is LAMP?

- What is LAMP? LAMP is a statistical system that uses observations, MOS output, and model output to provide guidance for aviation forecasting.
- LAMP acts as an update to MOS - bridges the gap between the observations and the MOS forecast.
- LAMP guidance covers the short-range period of 1-25 hours (38 hours for some elements).
- Runs every hour in NWS operations (every 15 minutes out to 3 hours for ceiling and visibility).
- LAMP supports the National Blend of models (NBM).



LAMP Background: Guidance Details

- LAMP provides station-oriented guidance for:
 - All LAMP forecast elements, ~2010 stations
 - CONUS, Alaska, Hawaii, Puerto Rico
- Gridded LAMP provides gridded guidance for:
 - Lightning & Convection
 - Temperature & Dewpoint
 - Wind Speed & Direction
 - Ceiling Height & Visibility
 - Sky Cover
 - Probability of Precipitation
- Available:
 - At NWS WFOs in AWIPS
 - Via NCEP NOMADS
 - Via website: <https://vlab.noaa.gov/mdl/lamp>

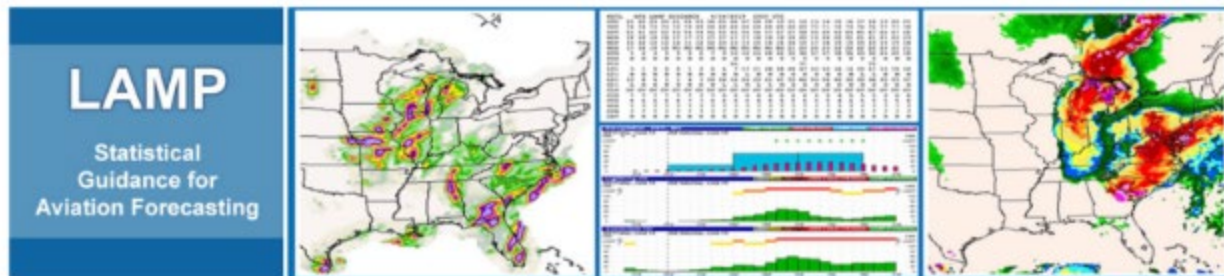
- Temperature and dewpoint
- Wind speed, direction, and gusts
- Probability of precipitation (on hr)
- Probability of measurable precipitation (1-, 6- and 12-h)
- Precipitation type
- Precipitation characteristics
- Lightning/Convection
- Ceiling height
- Conditional ceiling height
- Opaque sky cover
- Visibility
- Conditional visibility
- Obstruction to vision



2. Tour of LAMP Web Products



LAMP Web Page: <https://vlab.noaa.gov/web/mdl/lamp>



NWS OSTI / MDL / Projects / Localized Aviation MOS Program

As of February 2022, the LAMP pages hosted on the weather.gov server will be transitioning to the NOAA Virtual Lab (home page: <https://vlab.noaa.gov/web/mdl/lamp>). Please discontinue use of the LAMP weather.gov pages and instead use the LAMP VLab pages. All links to live data still go to the nws.noaa.gov server, so any bookmarks you have to live data should be unaffected by this change, which only impacts the static, informational LAMP webpages.

Please see [here](#) for more information about this transition.

Note: While we are transitioning our web pages, all of the products below link to product pages on the old system. Products on those pages are up-to-date, but links on those pages may go to old information or may be broken. Thank you for your patience!

The **Localized Aviation MOS Program** (LAMP) is a statistical system which provides forecast guidance for sensible weather elements. LAMP updates MOS on an hourly basis, is run on NOAA/NWS/NCEP Weather and Climate Operational Supercomputer Systems (WCSS) computers and disseminated centrally from NCEP, and provides guidance for over 1600 stations as well as gridded observation and forecast guidance on the NDFD CONUS 2.5-km grid out to 25 hours.

LAMP

- LAMP Update and Info +
- Station-based LAMP +
- Gridded LAMP
- Experimental LAMP
- LAMP Data Availability
- LAMP Documentation +
- Archived Products +
- LAMP Verification +
- LAMP Mailing List



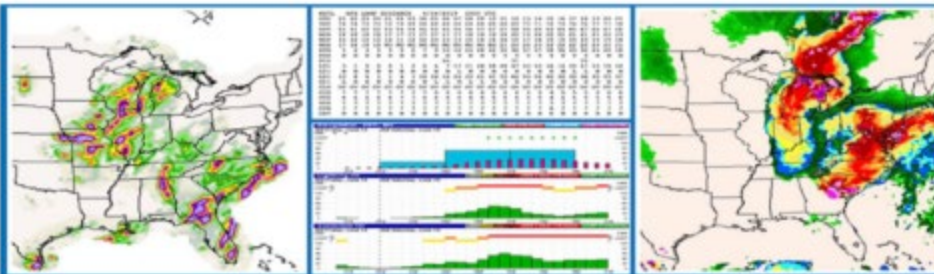
LAMP Web Page: <https://vlab.noaa.gov/web/mdl/lamp>

MDL The Meteorological Development Laboratory

HOME ABOUT MDL PROJECTS PEOPLE PUBLICATIONS

LAMP

Statistical
Guidance for
Aviation Forecasting



NWS OSTI / MDL / Projects / Localized Aviation MOS Program

As of February 2022, the LAMP pages hosted on the weather.gov server will be transitioning to the NOAA Virtual Lab (home page: <https://vlab.noaa.gov/web/mdl/lamp>). Please discontinue use of the LAMP weather.gov pages and instead use the LAMP VLab pages. All links to live data still go to the nws.noaa.gov server, so any bookmarks you have to live data should be unaffected by this change, which only impacts the static, informational LAMP webpages.

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Please note:
LAMP guidance
data are
operational but
webpages and
images are not
operational and
not guaranteed
to be available
24x7

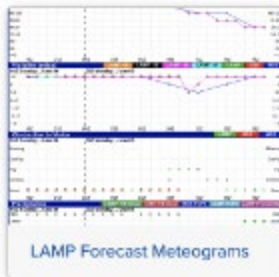
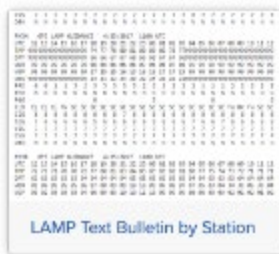


NATIONAL WEATHER SERVICE

Building a Weather-Ready Nation // 8

LAMP Web Page: <https://vlab.noaa.gov/web/mdl/lamp>

Click here to find real-time station-based forecast guidance



LAMP

LAMP Update and Info

Station-based LAMP

Gridded LAMP

Experimental LAMP

LAMP Data Availability

LAMP Documentation

Archived Products

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LAMP Mailing List



LAMP Web Page: <https://vlab.noaa.gov/web/mdl/lamp>

KPHX	PHOENIX				ASOS				GFS LAMP				GUIDANCE				6/05/2019				2100 UTC				
UTC	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22
TMP	99	100	100	99	99	97	95	93	91	89	87	86	84	82	81	79	81	84	87	90	93	95	97	99	100
DPT	37	36	36	35	35	35	36	37	37	38	39	40	41	42	42	42	42	41	40	39	39	38	37	36	36
WDR	27	27	27	27	27	27	26	25	25	27	28	31	30	14	12	11	11	11	14	24	25	27	26	26	27
WSP	11	12	11	13	13	11	10	08	08	08	05	05	04	04	05	05	06	06	06	06	06	06	07	09	08
WGS	18	19	18	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	16
PPO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PCO	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
P06									0						0						0				
LP1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LC1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
CP1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
CC1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
CLD	FW	FW	FW	FW	FW	FW	CL	CL	CL	CL	CL	CL	CL	CL	FW	FW	FW	FW	FW	FW	FW	FW	FW	FW	FW
CIG	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
CCG	8	8	8	8	8	7	7	7	8	7	7	7	8	8	7	7	8	8	8	8	8	8	8	8	8
VIS	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
CVS	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
OBV	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

Click here to find LAMP text bulletins

LAMP

LAMP Update and Info +

Station-based LAMP +

Gridded LAMP

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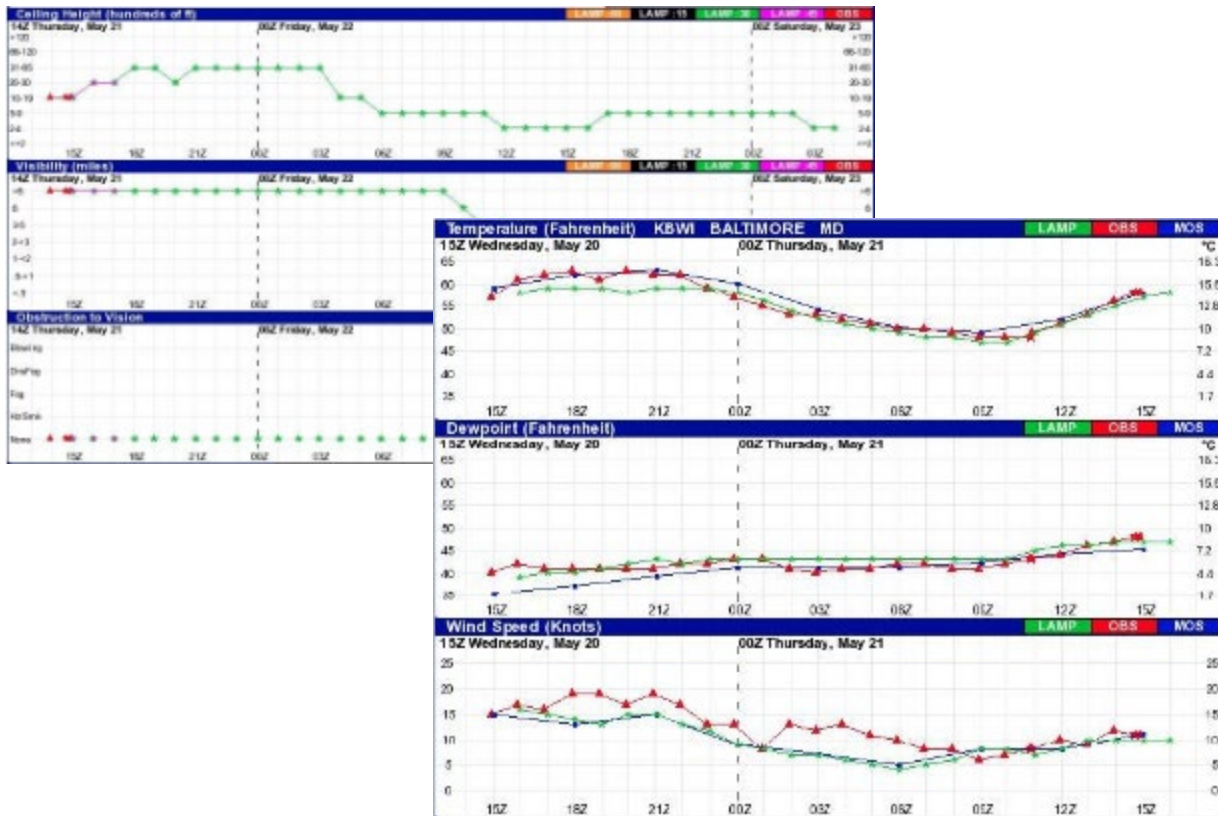
Archived Products +

LAMP Verification +

LAMP Mailing List



LAMP Web Page: <https://vlab.noaa.gov/web/mdl/lamp>



Click here for meteograms which display future guidance and past guidance with verifying observations

LAMP

LAMP Update and Info

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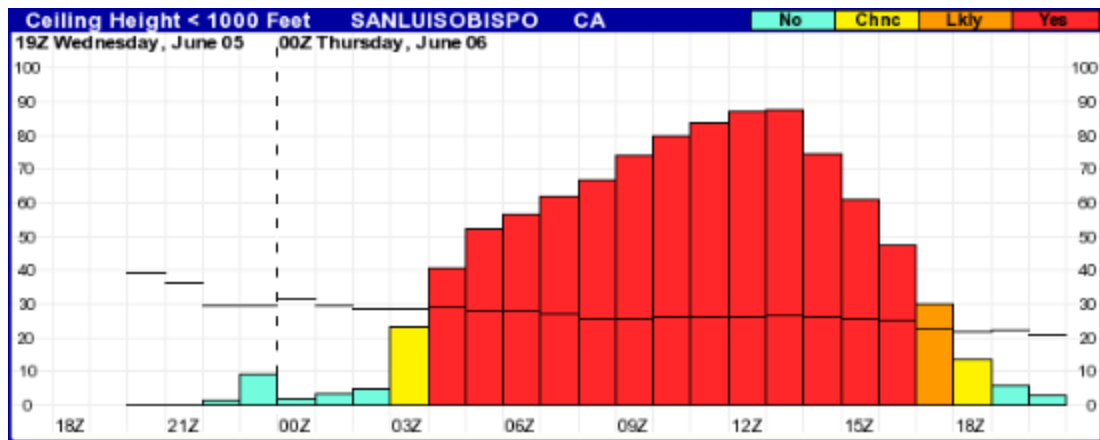
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Probabilities (bars) and thresholds
(lines) KSBP
Ceiling height < 1,000 feet

Click here for LAMP
Probability and
Threshold Plots

LAMP

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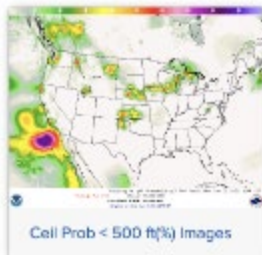
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LAMP Web Page: <https://vlab.noaa.gov/web/mdl/lamp>

Download Gridded LAMP GRIB2 Data below (Information on Gridded LAMP GRIB2 Data)

This data applies to the CONUS Region and is of the GRIB format.



Click here to find real-time gridded forecast guidance

LAMP

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Instructions for joining LAMP Mail List

Please email nws.lamp@noaa.gov :

- If you have questions or to report a problem.
- To request to be added to our email list for notifications so that you will be aware of changes to LAMP webpages or other LAMP products.

Click here to join our mailing list

LAMP

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3. LAMP/GLMP V2.5 Upgrades



LMP/GLMP V2.5 Upgrades: Temperature, Dewpoint, Winds

V2.5.0 highlights include:

1. Updated station-based temperature (T), dewpoint (Td), wind speed, wind direction, and wind gust guidance to incorporate the HRRR and updated GFS MOS and extend to 38 hours for input to NBM.
1. Re-tuned Gridded LAMP (GLMP) T, Td, and wind guidance to incorporate the updated station guidance.
1. Station additions/removals: 335 LAMP stations are being added and 33 stations are being removed in response to those stations being added or removed from GFS MOS.

SCHEDULED FOR IMPLEMENTATION IN SPRING 2023

LMP/GLMP V2.5 Upgrades: Temperature, Dewpoint, Winds

- V2.5.0 highlights:

Operational LAMP v2.4
LAV 1-25 h bulletin

Experimental LAMP v2.5
LAV 1-25 h bulletin

KEDW	GFS	LAMP	GUIDANCE	12/16/2022	1230 UTC																				
UTC	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13
TMP	999999	26	30	35	39	42	46	49	51	53	52	48	44	42	999999	999999	999999	999999	999999	999999	999999	999999	999999	999999	999999
DPT	999999	24	25	26	26	26	25	26	25	24	24	25	23	25	999999	999999	999999	999999	999999	999999	999999	999999	999999	999999	999999
WDR	99	99	03	05	06	06	07	07	06	07	08	07	07	08	09	05	34	31	99	99	99	99	99	99	99
WSP	99	99	02	02	02	04	04	05	06	05	05	04	03	03	03	04	04	04	99	99	99	99	99	99	99
WGS	999999	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
PFO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PCO	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
P01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
P06																									
LP1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LC1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
CP1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CC1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
POZ	4	5	5	5	4	3	2	2	1	1	1	1	1	1	2	1	1	1	2	2	3	2	3	3	3
POS	71	69	68	61	48	36	31	24	22	14	8	5	4	7	12	19	28	36	43	48	49	54	58	61	61
TYP	S	S	S	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R	S	S	S	S	S	S	S
CLD	OV	OV	OV	BK	SC	FW	SC	FW	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	FW	FW	FW	FW	FW	FW	FW
CIG	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
CGG	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
VIS	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
CVS	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
OBV	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

KEDW	GFS	LAMP	GUIDANCE	12/16/2022	1230 UTC																				
UTC	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13
TMP	28	28	27	29	33	39	45	47	48	50	51	50	46	42	37	36	34	34	32	31	30	27	26	25	25
DPT	25	24	23	25	25	26	24	24	22	21	21	21	22	19	20	19	19	19	18	18	17	16	15	14	15
WDR	36	35	35	03	03	03	05	06	07	07	07	07	08	07	03	01	36	02	36	36	33	33	34	32	32
WSP	02	03	02	02	01	02	04	06	06	06	06	05	06	04	03	04	04	06	04	04	04	03	02	02	03
WGS	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
PFO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PCO	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
P01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PC1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
P06																									
LP1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LC1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
CP1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CC1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
POZ	4	5	5	6	4	3	2	2	1	1	1	1	1	2	1	1	1	2	2	3	2	3	3	4	4
POS	71	69	68	63	53	46	38	29	22	14	8	5	4	7	12	19	28	36	43	48	49	54	58	61	61
TYP	S	S	S	S	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R	S	S	S	S	S	S
CLD	OV	OV	OV	BK	SC	FW	SC	FW	SC	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	FW	FW	FW	FW	FW	FW
CIG	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
CGG	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
VIS	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
CVS	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
OBV	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

Many stations that had missing T/Td/Wind guidance for some or all projections in operational LAMP now have guidance in v2.5 LAMP.

LMP/GLMP V2.5 Upgrades: Temperature, Dewpoint, Winds

- V2.5.0 highlights:

Operational LAMP v2.4 LEV 26-38 h bulletin

KBWI	GFS	LAMP	GUIDANCE	12/12/2022	1230	UTC
DT /DEC	13			/DEC	14	
HR	26	27	28	29	30	31 32 33 34 35 36 37 38
UTC	14	15	16	17	18	19 20 21 22 23 00 01 02
P01	0	0	0	0	0	0 0 0 0 0 0 0 0
PC1	N	N	N	N	N	N N N N N N N N
P06						0 0
CLD	CL	CL	CL	CL	CL	CL CL CL CL CL CL CL
CIG	8	8	8	8	8	8 8 8 8 8 8 8 8
CCG	8	8	8	8	8	8 8 8 8 8 8 8 8
VIS	7	7	7	7	7	7 7 7 7 7 7 7 7
CVS	7	7	7	7	7	7 7 7 7 7 7 7 6
OBV	N	N	N	N	N	N N N N N N N N

Guidance for temperature, dewpoint, wind speed, wind direction, and wind gust now available in extended LEV bulletin

Experimental LAMP v2.5 LEV 26-38 h bulletin

KBWI	GFS	LAMP	GUIDANCE	12/12/2022	1230	UTC
DT /DEC	13			/DEC	14	
HR	26	27	28	29	30	31 32 33 34 35 36 37 38
UTC	14	15	16	17	18	19 20 21 22 23 00 01 02
TMP	34	37	39	41	42	43 43 43 40 37 35 34 32
DPT	19	17	16	15	14	14 14 13 13 14 15 16 17
WDR	34	35	33	32	31	32 32 33 33 33 33 32 33
WSP	04	06	06	07	06	06 06 05 04 03 02 01 01
WGS	NG	NG	NG	NG	NG	NG NG NG NG NG NG NG NG
P01	0	0	0	0	0	0 0 0 0 0 0 0 0
PC1	N	N	N	N	N	N N N N N N N N
P06						0 0
CLD	CL	CL	CL	CL	CL	CL CL CL CL CL CL CL
CIG	8	8	8	8	8	8 8 8 8 8 8 8 8
CCG	8	8	8	8	8	8 8 8 8 8 8 8 8
VIS	7	7	7	7	7	7 7 7 7 7 7 7 7
CVS	7	7	7	7	7	7 7 7 7 7 7 7 7
OBV	N	N	N	N	N	N N N N N N N N

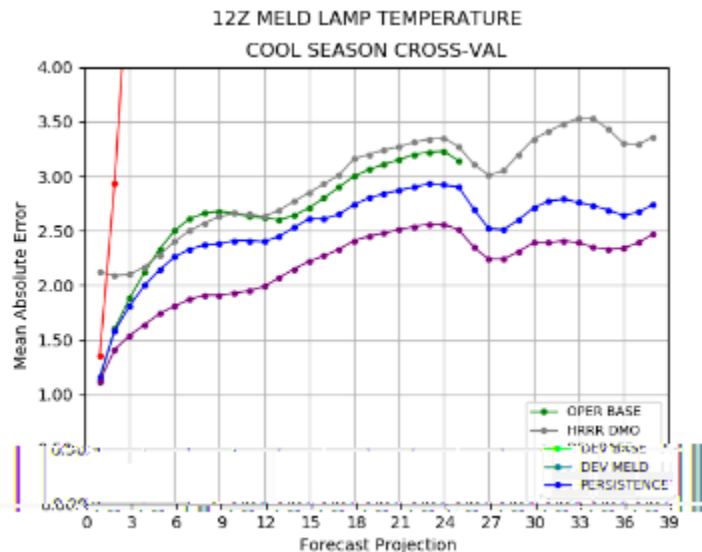
LMP/GLMP V2.5 Upgrades: Temperature, Dewpoint, Winds

- Verification details
 - Development period:
 - T/Td: July 2018 - Dec 2021
 - Winds: July 2017 - June 2021
 - K-fold cross-validation sample:
 - T/Td: July 2018 - Dec 2021 (3.5 cool, 3.5 warm)
 - Winds: July 2018 - June 2021 (3 cool, 3 warm)
- ~2310 stations verified
- Results for 1200 UTC cycle are shown (other cycles similar)

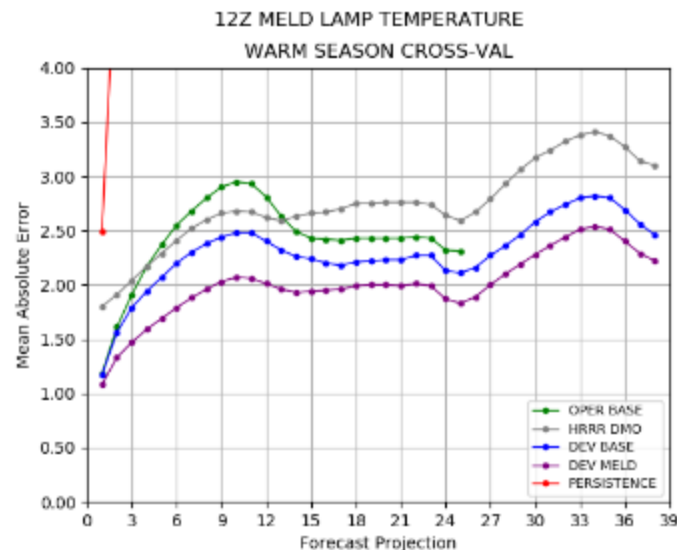
LAMP Meld (V2.5) Independent Verification

1-38 h Temperature MAE 12 UTC cycle

Cool Season



Warm Season

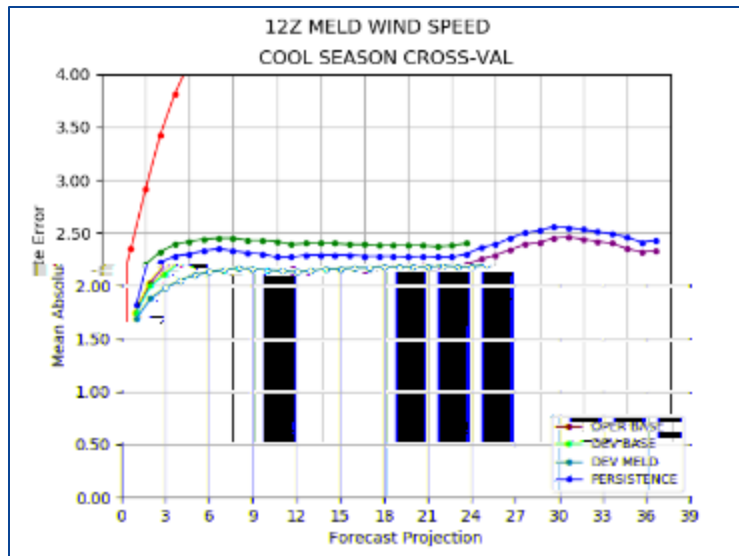


LAMP Meld (purple) shows improvement over Base LAMP (blue) and Oper LAMP (green) and HRRR (gray)

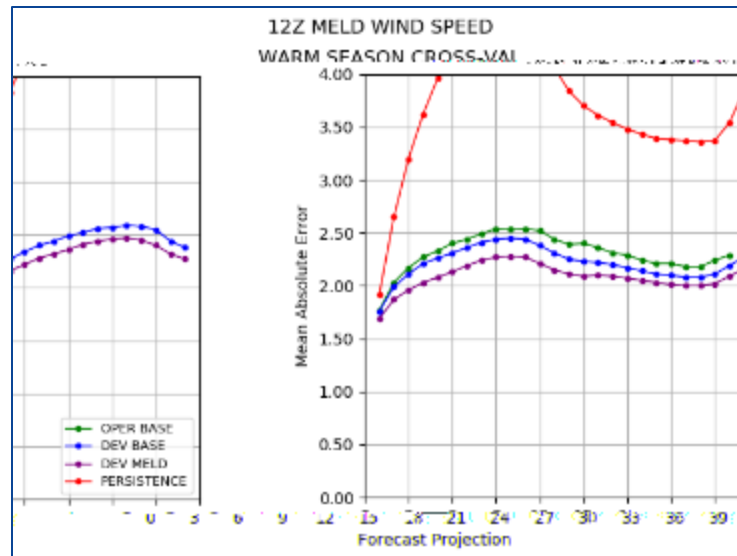
LAMP Meld (V2.5) Independent Verification

1-38 h Wind Speed MAE 12 UTC cycle

Cool Season

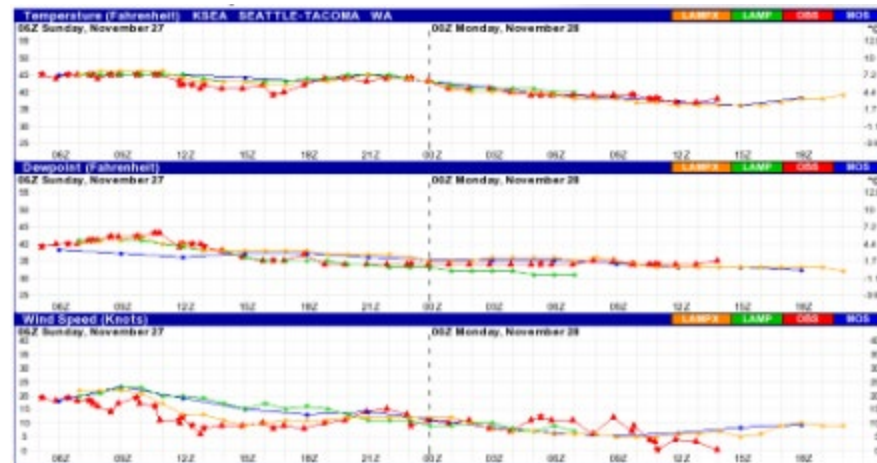
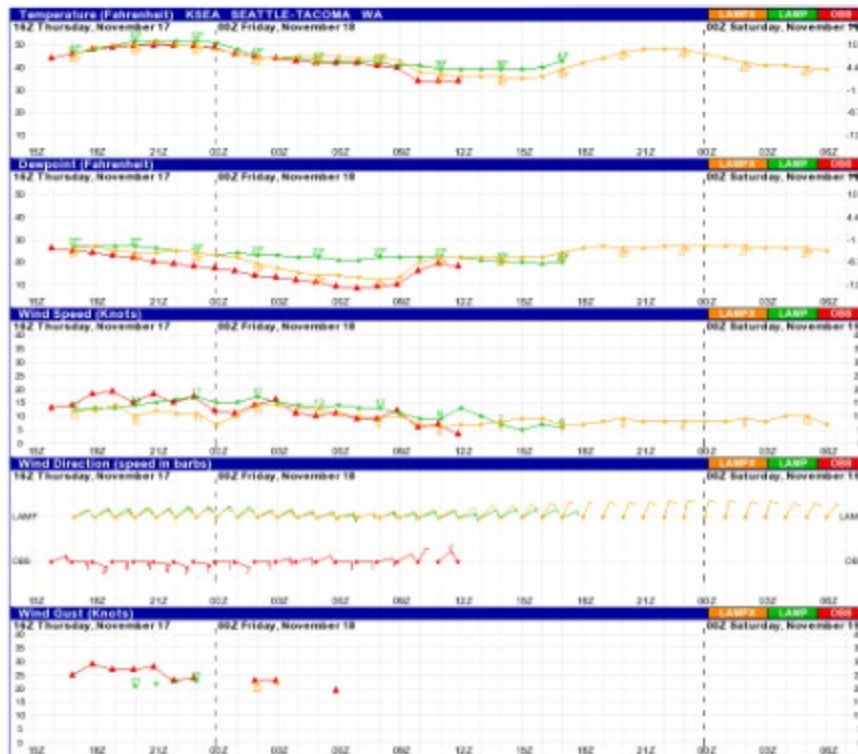


Warm Season

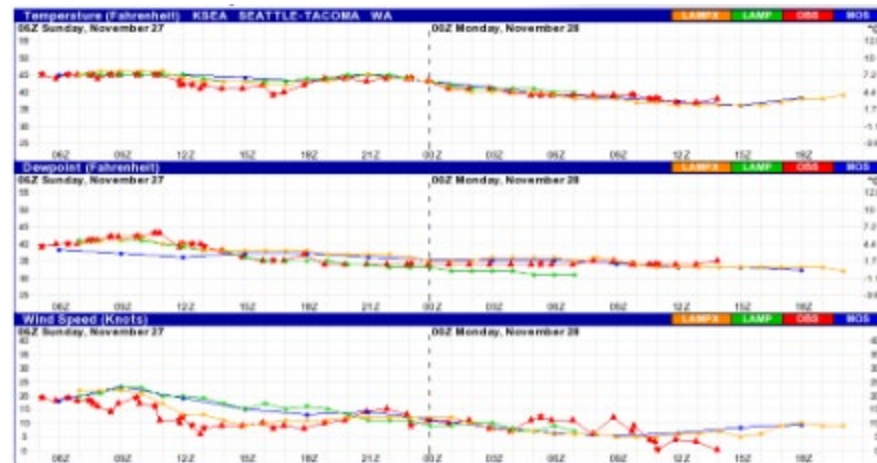
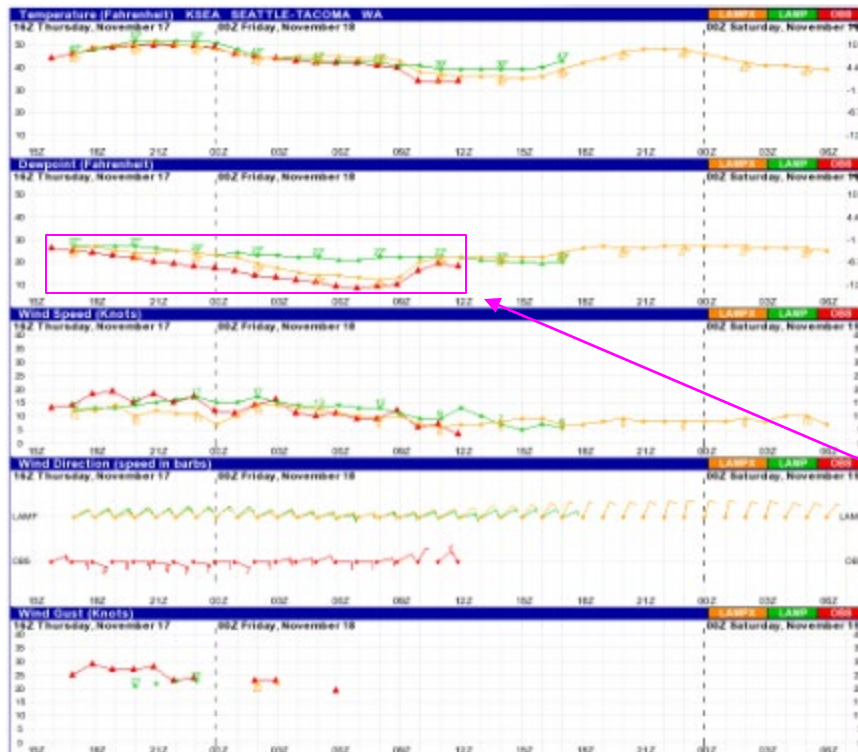


LAMP Meld (purple) shows improvement over Base LAMP (blue) and Oper LAMP (green)

LMP/GLMP V2.5 Upgrades: Temperature, Dewpoint, Winds

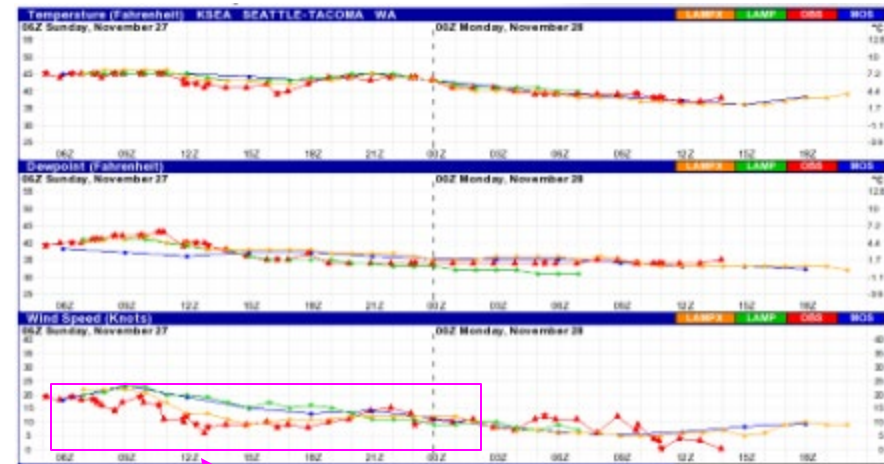
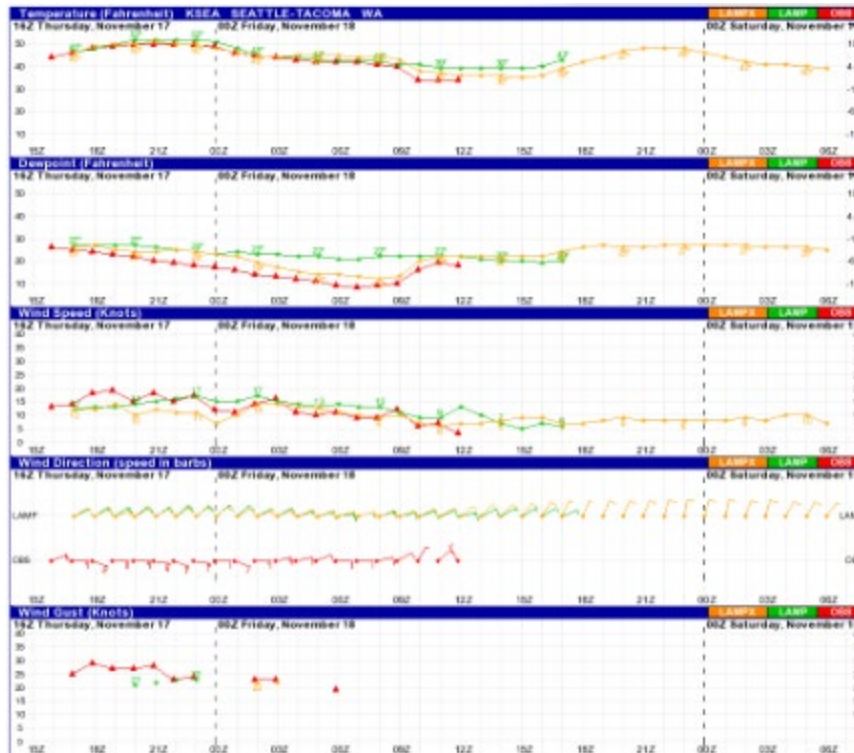


LMP/GLMP V2.5 Upgrades: Temperature, Dewpoint, Winds



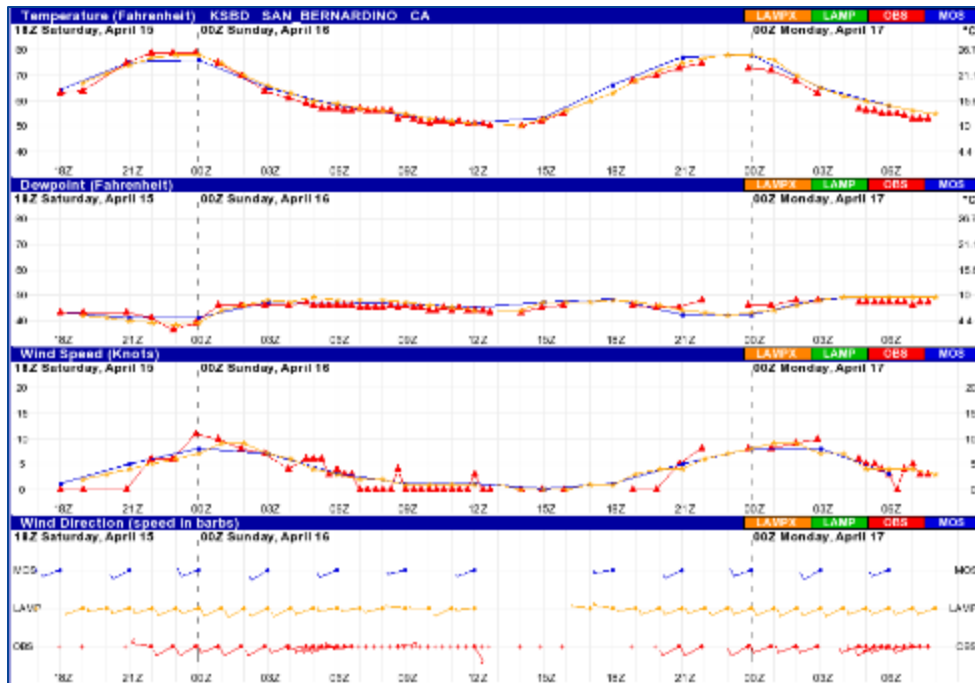
Example of improved dewpoint guidance
- likely due to influence from the HRRR

LMP/GLMP V2.5 Upgrades: Temperature, Dewpoint, Winds



Example of improved wind speed guidance - likely due to influence from the HRRR

LMP/GLMP V2.5 Upgrades: Temperature, Dewpoint, Winds



Example of new LAMP
Temperature/Dewpoint/Wind guidance
(shown as the **orange** line) at a station
(KSBG - San Bernardino, CA) that did not
have this guidance before this upgrade

LMP/GLMP V2.5 Upgrades: Temperature, Dewpoint, Winds

- V2.5.0 highlights:

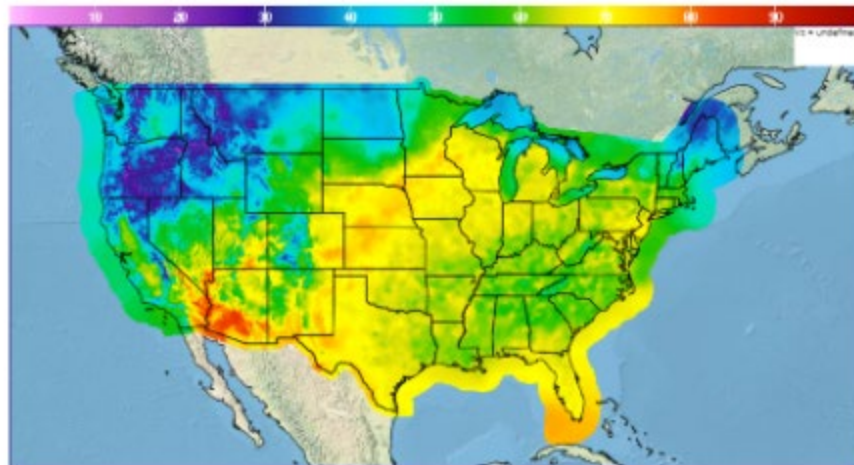
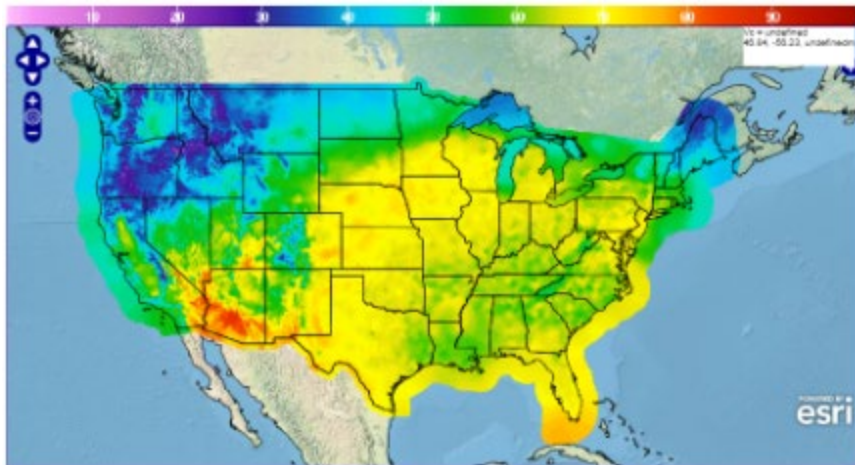
2. Gridded LAMP for CONUS has been re-tuned to incorporate the updated stn guidance.

- Meld station guidance that incorporates the HRRR is analyzed
- Addition of 335 new stations to GLMP analysis
- Removal of 33 stations that no longer have MOS guidance

v2.4

Temperature

v2.5



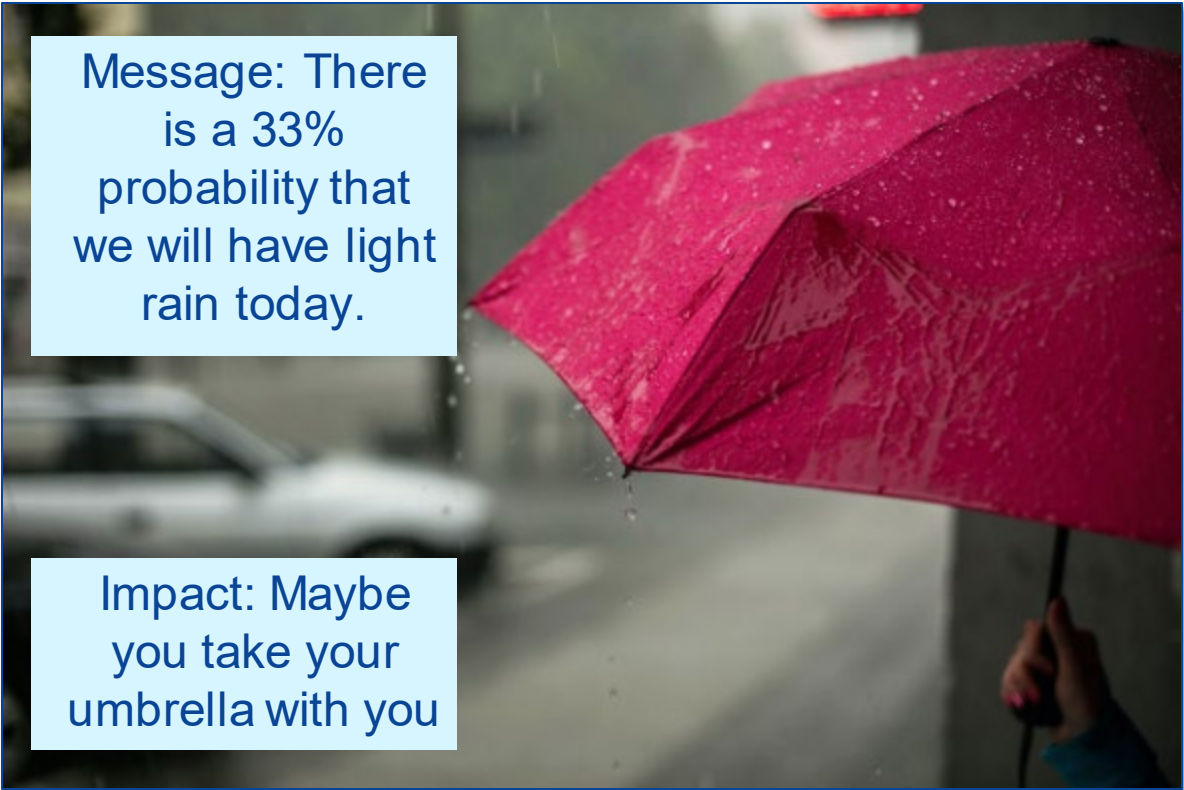
4. FAA AWRP Work



Why Probabilities Matter

- Probabilistic information can help provide Impact-based Decision Support Services (IDSS) for decision makers
 - “...forecasts possess no intrinsic value. They acquire value through their ability to influence the decisions made by users of the forecasts.” - Murphy, A. H. (1993). What Is a Good Forecast? An Essay on the Nature of Goodness in Weather Forecasting, *Weather and Forecasting*, 8(2), 281-293. Retrieved Dec 23, 2022, from https://journals.ametsoc.org/view/journals/wefo/8/2/1520-0434_1993_008_0281_wiagfa_2_0_co_2.xml

Why Probabilities Matter – Low Impact



Message: There is a 33% probability that we will have light rain today.

Impact: Maybe you take your umbrella with you



Why Probabilities Matter – High Impact

There is a 33% probability that the ceiling of this room will fall in today.

Impact: No one would be here!!



Why Probabilities Matter – For C&V

- Per NTSB data from 2011-2020: “The proportion of Part 91 accidents that resulted in a fatality was 18%; while **fatal IMC* accidents averaged 64%**” – Don Eick, NTSB Senior Meteorologist**
 - Statistically calibrated probabilities of ceiling height and visibility below critical levels are important to indicate risk and to influence decisions
- **NWS Director Ken Graham’s “Ken’s Ten”** Priorities and Action Strategies for the Future include “Probabilistic IDSS/Hazard Services”

* IMC = Instrument Meteorological Conditions

** Source: July 13, 2022 presentation at the NCAR Aviation Weather Technical Exchange Meeting, Boulder, CA





4a. LAMP/Gridded LAMP 15-minute High Impact Weather for Ceiling & Visibility





15-minute LAMP/GLMP out to 6 hours

- Project funded by FAA Aviation Weather Research Program (AWRP) for Clouds & Visibility to increase the temporal resolution of Gridded LAMP ceiling height and visibility (C&V) guidance from 1 hour to 15 minutes in the first 6 hours of the forecast period.
- Helicopter Emergency Medical Services (HEMS) operators use the NWS Aviation Weather Center (AWC) HEMS Tool* which uses GLMP data to update every 15 mins with latest observational data and forecast data.
 - Providing updated GLMP guidance for C&V every 15 mins for 15-min periods (instead of valid at the top of the hour) will help fill gap in the HEMS tool.
- Will be available at CONUS stations and on the CONUS grid
- High Impact Weather (HIW) C/V Predictand is defined as **lowest C/V observed over a 15-minute period** ending at HH:14, HH:29, HH:44, and HH:59.

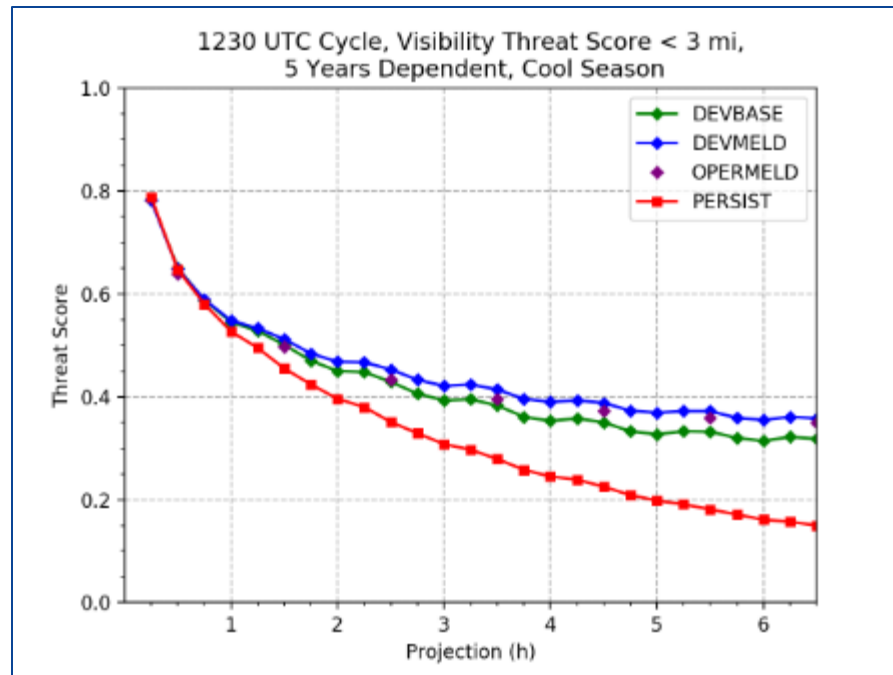
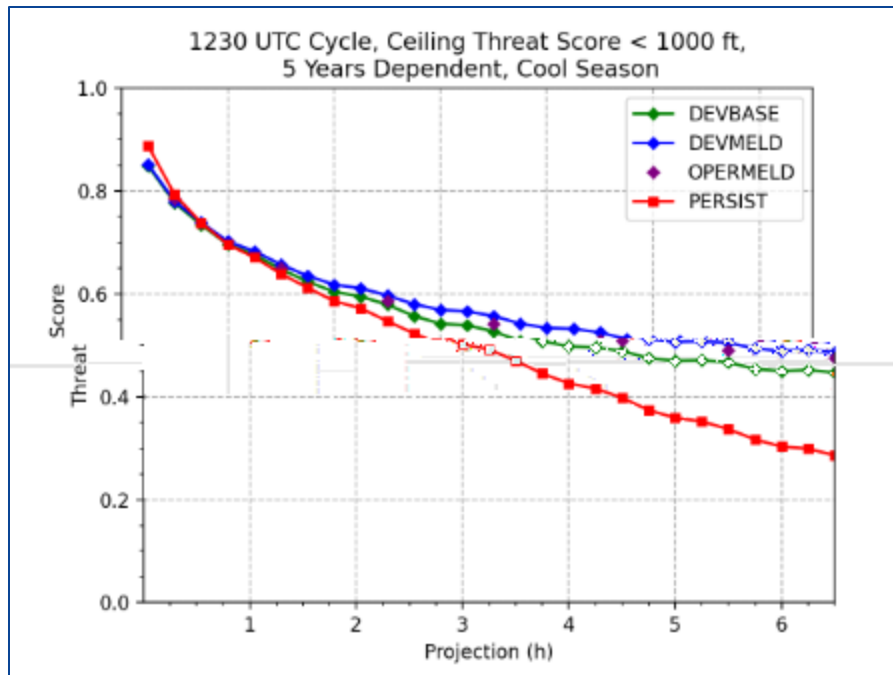
*The HEMS tool is planned to be renamed as the Graphical Forecast - Low Altitude (GFA-LA)



15-min Verification: Cool Season

Ceiling < 1,000 ft

Visibility < 3 miles



New 15-minute station-based LAMP Meld guidance (blue) shows improvement over the new LAMP Base guidance (green), operational hourly Meld (purple), and persistence (red)





4b. LAMP onset/cessation guidance for the Core 30 Airports



LAMP onset/cessation products

- Project funded by FAA AWRP for Clouds & Visibility to create onset/cessation guidance products for use by Traffic Flow Managers. Specific options developed include:
 - A **text product** similar to the operational LAMP text bulletin that displays:
 - Flight Categories (not currently shown in any LAMP text products)
 - Onset/Cessation of various Flight Categories
 - Probabilities of Ceiling Height and Visibility (currently only shown in LAMP BUFR messages and on LAMP website) corresponding to various Flight Categories
 - A **Webpage product** option

Summary of Options

- Numeric Flight Categories / Probabilities
- Letter Flight Categories / Probabilities

FLT	5	4	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	3	3	3	3	3	3	4	4	5	5	
FLT	V	M	V	M	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	M	I	I	I	I	I	I	M	M	V	V
CP1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	2	2	3	3	4	4	3	2	1	0	0	0	1	1	1	1	1	1	1	0	1		
CP2	3	5	1	0	0	1	0	0	0	2	4	4	4	5	6	7	8	9	10	13	14	16	16	11	5	10	6	4	8	14	17	15	14	14	13	9	5	6	
CP3	5	10	1	3	6	5	0	0	1	2	5	6	6	7	9	10	12	11	11	14	17	19	16	11	5	13	15	18	26	35	44	39	35	30	25	17	10	10	
CP4	18	43	35	44	37	34	32	33	32	30	16	15	15	14	13	12	13	11	12	14	17	19	18	14	9	16	22	29	43	58	72	67	65	62	50	38	26	21	
VP1	0	0	0	1	1	1	0	1	1	0	0	0	0	1	1	2	2	2	3	4	5	6	8	6	2	1	1	1	1	1	2	2	2	2	1	1	1	1	
VP2	1	1	1	2	1	1	0	2	1	1	2	1	2	3	3	3	5	5	5	8	9	11	12	11	5	3	3	3	2	3	4	5	5	4	4	3	3	3	
VP3	1	1	1	2	2	1	0	2	2	3	4	4	4	5	5	5	6	7	8	11	13	16	18	17	9	9	11	12	12	15	19	19	15	12	9	6	5	5	
VP4	1	1	1	2	2	1	0	2	3	5	6	7	6	7	7	8	9	11	12	16	19	24	27	23	15	16	19	20	22	26	31	30	23	19	15	12	9	8	
CPVL	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	2	2	3	3	4	4	3	2	1	0	0	0	1	1	1	1	1	1	1	1	0	1	
CPL	3	5	1	0	0	1	0	0	0	2	4	4	4	5	6	7	8	9	10	13	14	16	16	11	5	10	6	4	8	14	17	15	14	14	13	9	5	6	
CPI	5	10	1	3	6	5	0	0	1	2	5	6	6	7	9	10	12	11	11	14	17	19	16	11	5	13	15	18	26	35	44	39	35	30	25	17	10	10	
CPM	18	43	35	44	37	34	32	33	32	30	16	15	15	14	13	12	13	11	12	14	17	19	18	14	9	16	22	29	43	58	72	67	65	62	50	38	26	21	
VPVL	0	0	0	1	1	1	0	1	1	0	0	0	0	1	1	2	2	2	3	4	5	6	8	6	2	1	1	1	1	1	2	2	2	2	1	1	1	1	
VPL	1	1	1	2	1	1	0	2	1	1	2	1	2	3	3	3	5	5	5	8	9	11	12	11	5	3	3	3	2	3	4	5	5	4	4	3	3	3	
VPI	1	1	1	2	2	1	0	2	2	3	4	4	4	5	5	5	6	7	8	11	13	16	18	17	9	9	11	12	12	15	19	19	15	12	9	6	5	5	
VPM	1	1	1	2	2	1	0	2	3	5	6	7	6	7	7	8	9	11	12	16	19	24	27	23	15	16	19	20	22	26	31	30	23	19	15	12	9	8	



Summary of Options (continued)



- One text bulletin out to 38 hours, OR
- Two text bulletins (01 - 25 hours & 26 - 38 hours)
- 3-space columns (consistent with operational LAMP text bulletins), OR
- 4-space columns (more readable, especially with 100% probabilities)



CP4 100 95 68 87 91 87 85100100 99100 88 77 86 77 75 58 53 46 48 48 48 47 44 41 46 53 58 63 66 66 63 57 52 47 41 35 39 (3-space)



CP4 100 95 68 87 91 87 85 100 100 99 100 88 77 86 77 75 58 53 46 48 48 48 47 44 41 46 53 58 63 66 66 63 57 52 47 41 35 39 (4-space)



- Display Flight Categories with dashes
- Display Flight Categories with 1s

[illegible]

3 spaces, all projections (cumulative probs)

KATL ATLANTA ASOS GFS LAMP 1430 UTC 1/05/2022

UTC	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04
FLT	5	4	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	4	3	3	3	3	3	3	4	4	5	5
VFR	--/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/
MVF		+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/	+-/
IFR																																						
LIF																																						
VLI																																						
CIG	8	5	8	5	6	6	6	6	6	8	8	8	8	8	8	8	8	8	8	8	8	8	7	6	6	6	6	5	3	3	3	3	3	3	4	5	6	7
VIS	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	6	7	7	7	7	7	7	5	5	7	7	7	7	7	7	
CP1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	2	3	3	4	4	3	2	1	0	0	0	1	1	1	1	1	1	1	0	1
CP2	3	5	1	0	0	1	0	0	0	2	4	4	4	5	6	7	8	9	10	13	14	16	16	11	5	10	6	4	8	14	17	15	14	14	13	9	5	6
CP3	5	10	1	3	6	5	0	0	1	2	5	6	6	7	9	10	12	11	11	14	17	19	16	11	5	13	15	18	26	35	44	39	35	30	25	17	10	10
CP4	18	43	35	44	37	34	32	33	32	30	16	15	15	14	13	12	13	11	12	14	17	19	18	14	9	16	22	29	43	58	72	67	65	62	50	38	26	21
VP1	0	0	0	1	1	1	0	1	1	0	0	0	0	1	1	2	2	2	3	4	5	6	8	6	2	1	1	1	1	1	2	2	2	2	1	1	1	1
VP2	1	1	1	2	1	1	0	2	1	1	2	1	2	3	3	3	5	5	5	8	9	11	12	11	5	3	3	3	2	3	4	5	5	4	4	3	3	3
VP3	1	1	1	2	2	1	0	2	2	3	4	4	4	5	5	5	6	7	8	11	13	16	18	17	9	9	11	12	12	15	19	19	15	12	9	6	5	5
VP4	1	1	1	2	2	1	0	2	3	5	6	7	6	7	7	8	9	11	12	16	19	24	27	23	15	16	19	20	22	26	31	30	23	19	15	12	9	8

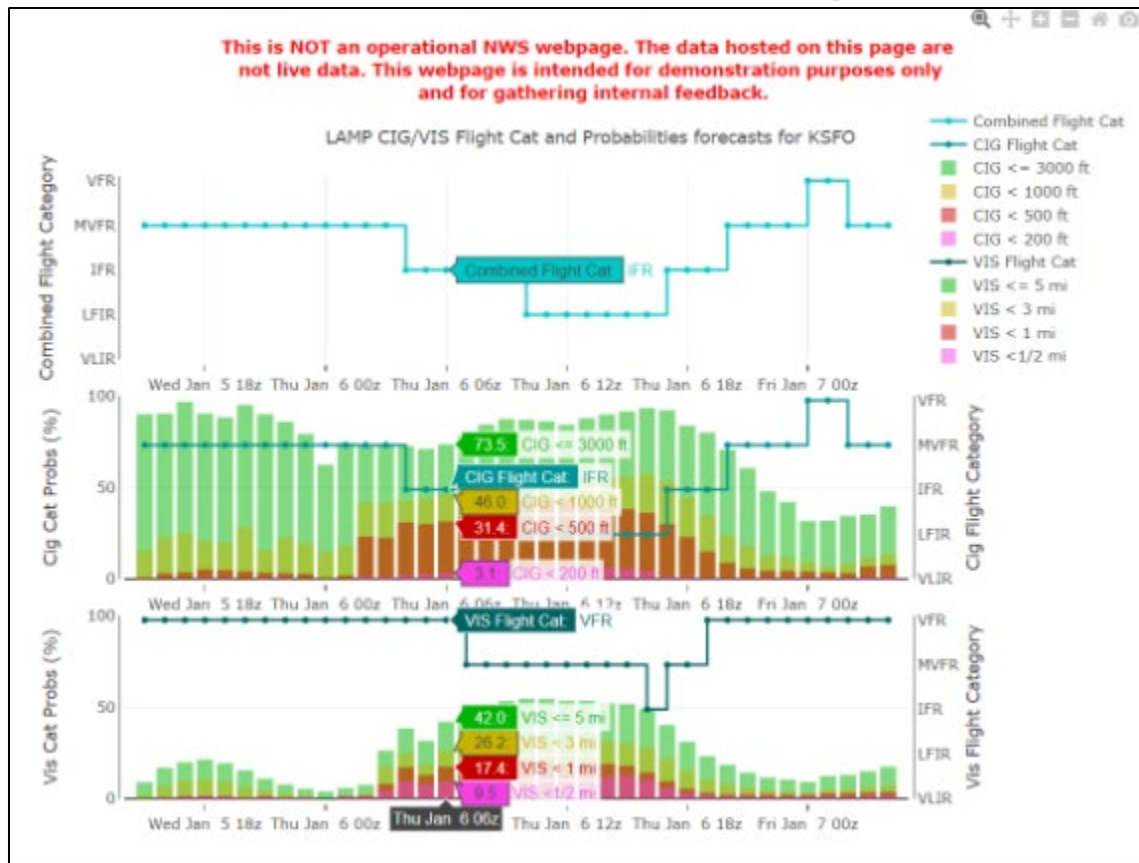


Bulletin on onset/cessation times

KSFO	SAN FRANCISCO	GFS LAMP 1430 UTC	1/05/2022
VFR	07/0000 – 07/0100		
MVF	05/1500 – 06/0300	06/2000 – 06/2300	07/0200 –
IFR	06/0400 – 06/0900	06/1700 – 06/1900	
LIF	06/1000 – 06/1600		



Example Prototype Web Page

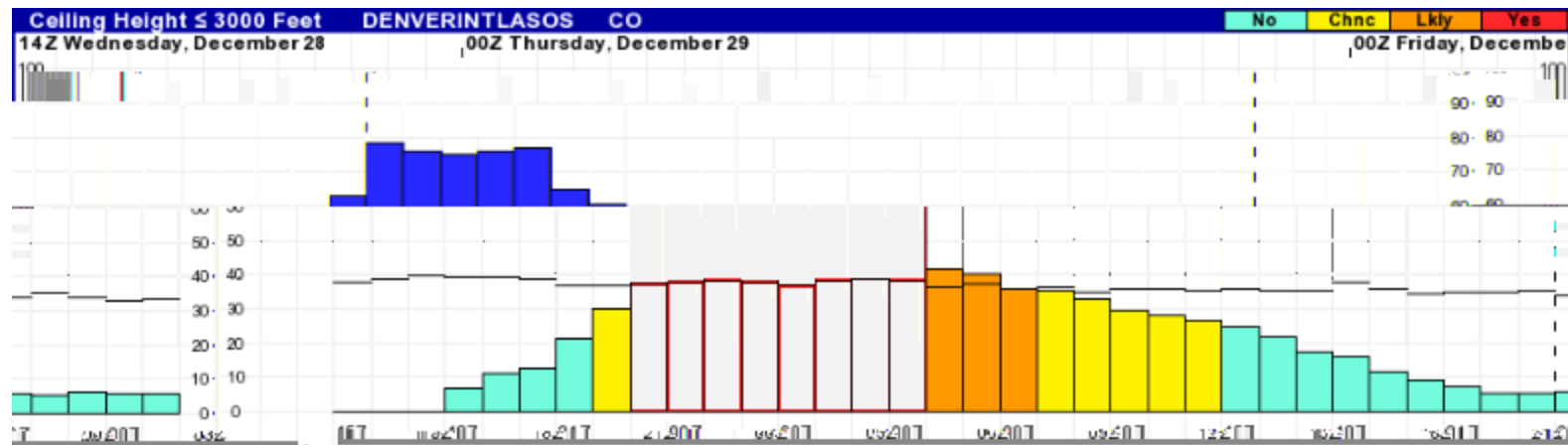


Time series plots of combined flight category (top), cumulative ceiling height probabilities (middle), and cumulative visibility probabilities (bottom)

Feedback Received

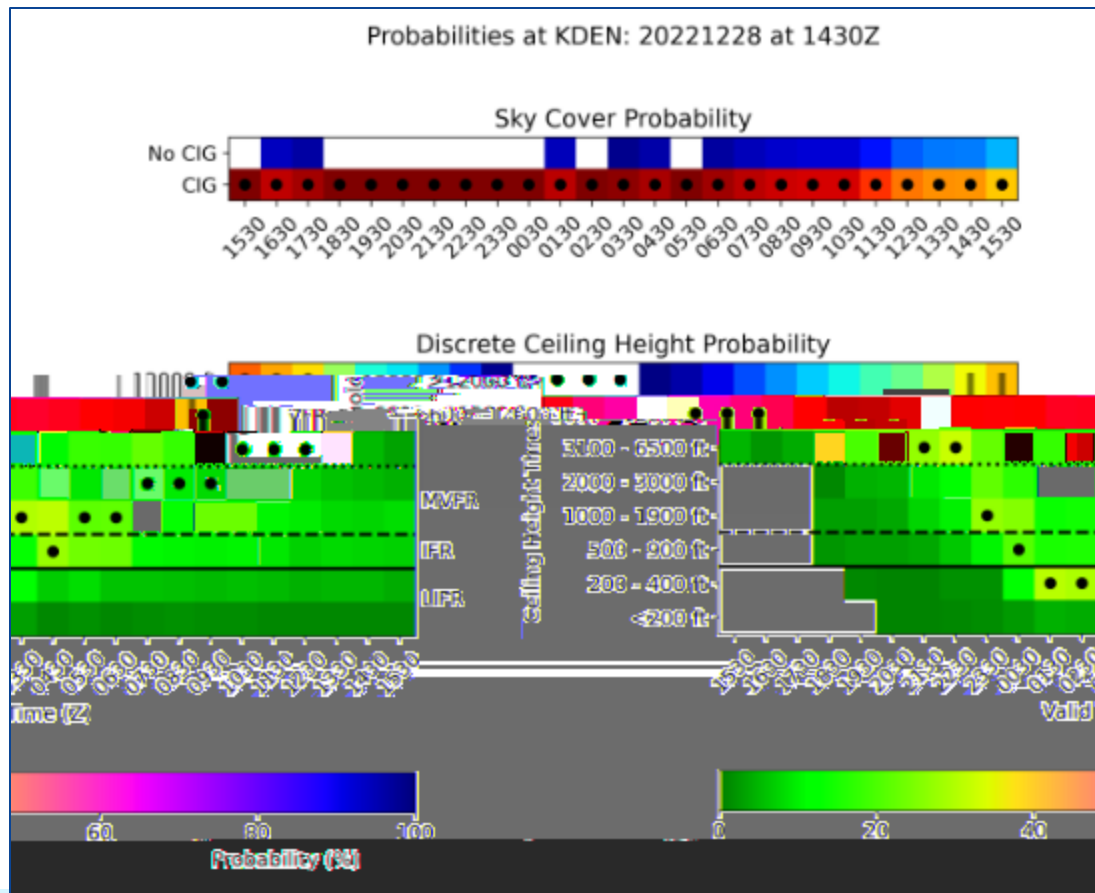
- Presented the text and web options to small group of FAA and requested feedback
- A common takeaway from the feedback received was the indicated **need for airport-specific thresholds for C&V at Core 30 airports** and not so much the traditional Flight Categories:
- It was also apparent that what meteorologists want may differ from what Traffic Flow Managers want:
 - “I won’t use the text products.”
 - “I like the initial range of options, particularly with respect to the more simplistic text options.”
 - “Not much to dislike! As long as we consider that there are two distinct audiences here.”

Current Probability Images $\leq 3,000$ ft



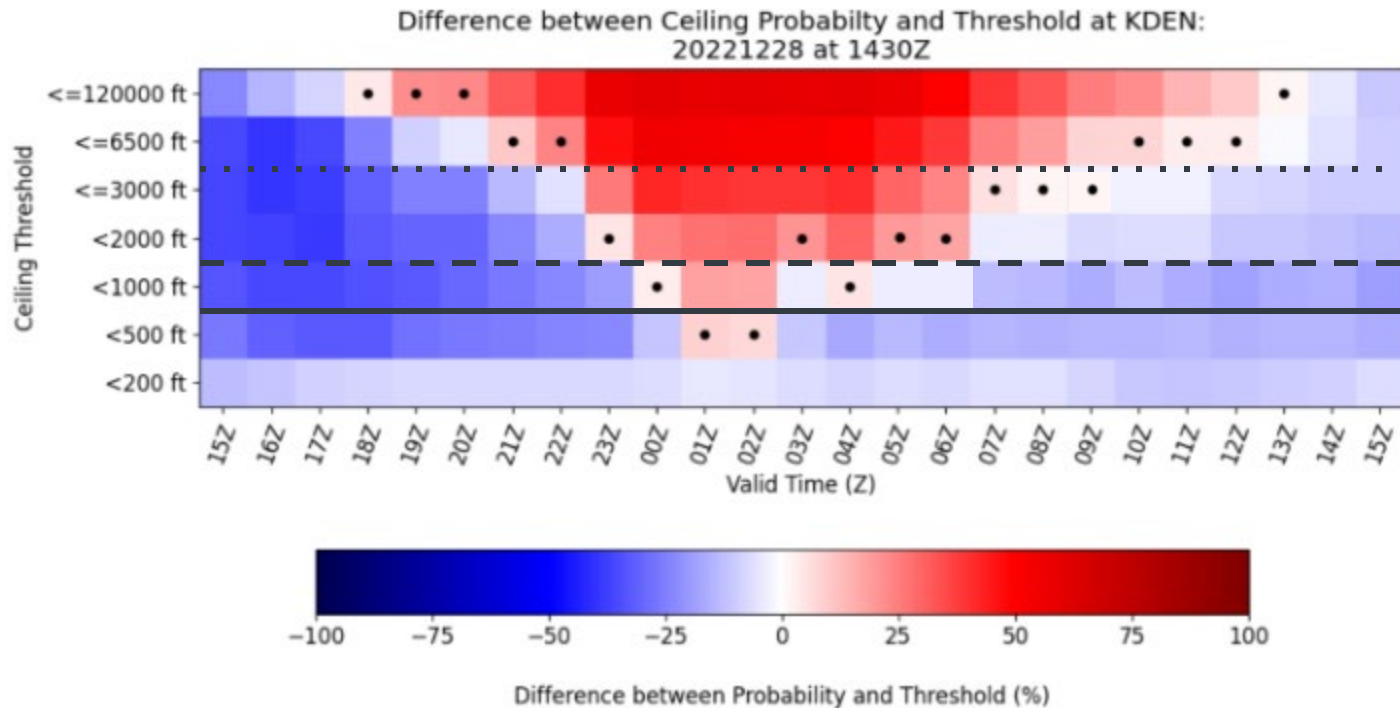
Additional Graphical Options (Probabilities)

New Images being considered – Probabilities by category





Additional Graphical Options (Prob - Thresholds)



New Images being considered
(Probability – Threshold) **differences** by category



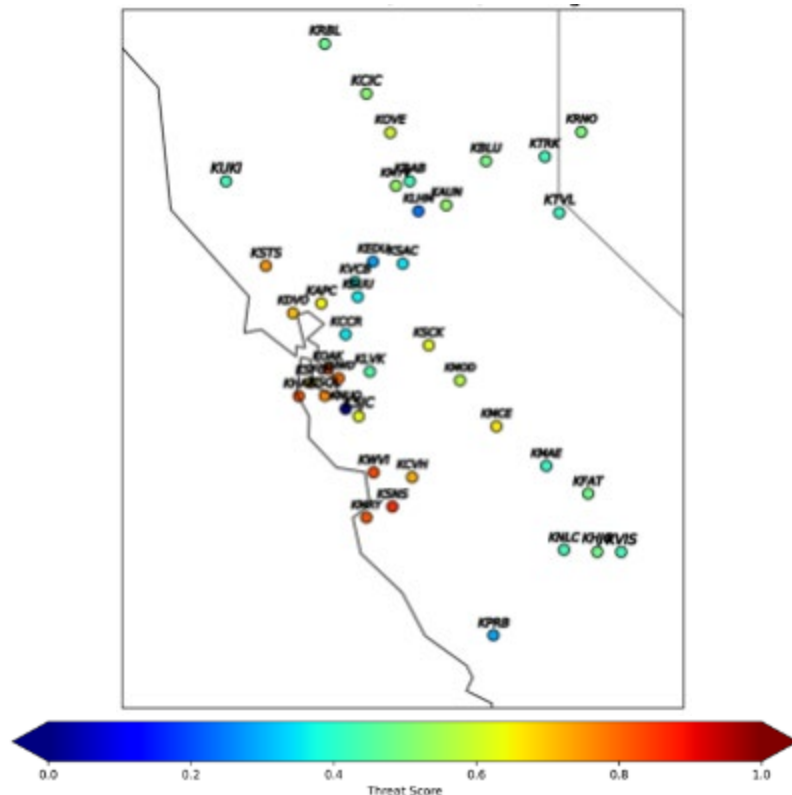


4c. Prototype of High Resolution Gridded Ceiling Height Observations at San Francisco

Gridded Ceiling Height Obs over SFO

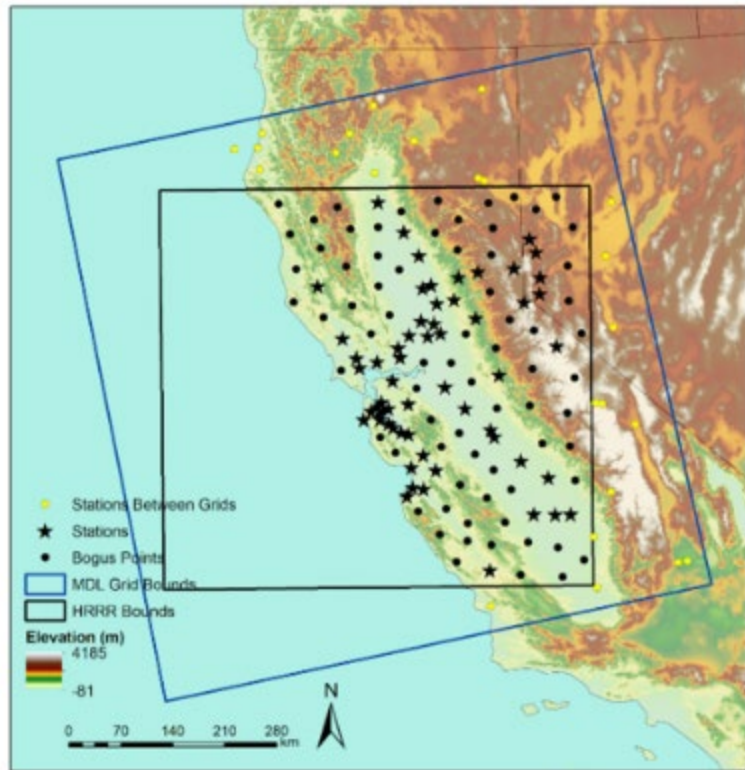
- Project funded by FAA AWRP for Clouds & Visibility to create a prototype of high resolution gridded observations of ceiling height over the San Francisco Airport region:
 - Station ceiling height observations are analyzed at 1.25-km resolution, with HRRR ceiling used over water (Ocean, Bay).
 - Analysis leverages “pseudo-observations” (pseudo-obs) of ceiling height to help inform what is happening in between the METAR stations:
 - o “Smart predictor” informed by a [Random Forest model](#).
 - o Applied at strategically-placed “bogus” points where METAR coverage is sparse.

Random Forest “Smart” Predictor



- Random Forest model uses observations from closest three stations to predict the occurrence of a ceiling (defined by $\leq 12,000$ ft).
- Provides probability (regressor) and binary yes/no (classifier) output as predictor in pseudo-ob equations.
- Threat scores generally highest where events occur most frequently (Bay area stations), and lower for inland stations.

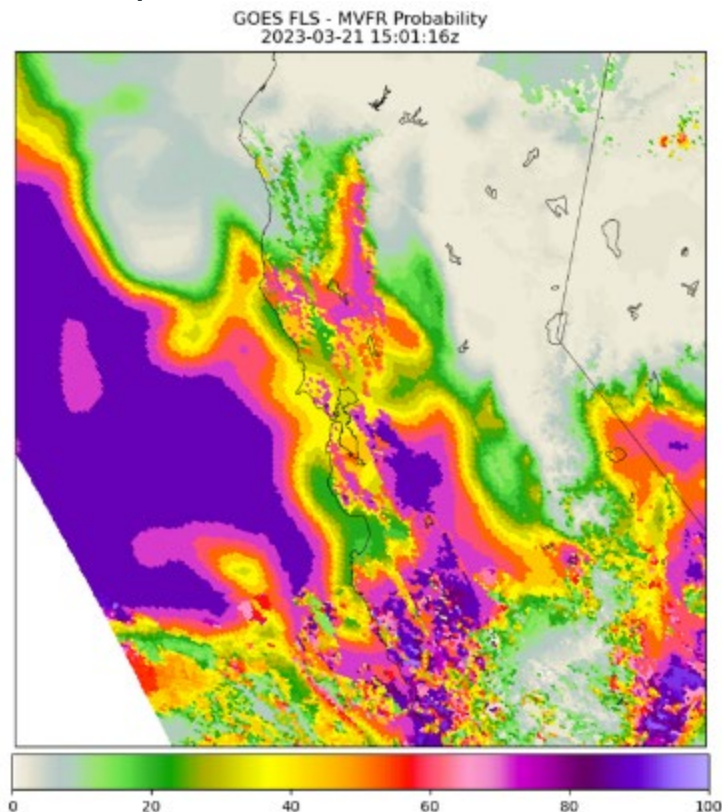
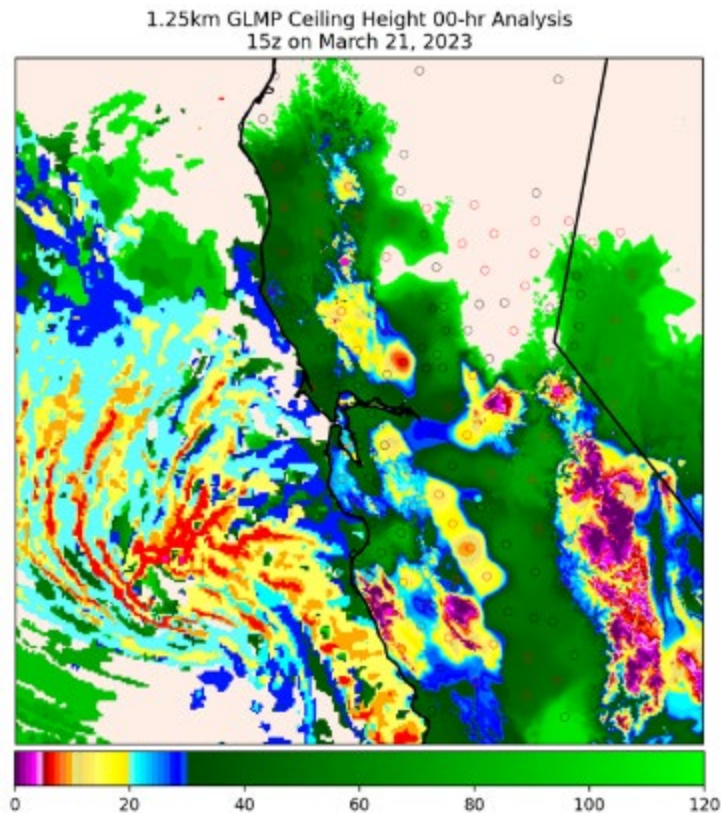
Pseudo-Obs Development: Forecasting the Observation



- Predictors include sub-hourly HRRR variables, HRRR-derived climatology, radar data, and Random Forest “smart” predictor.
- Equations for “stratus season” (May through September) and non-stratus season.
- Equations applied at bogus points to help inform what is going on between the METARs.
- Then analyzed METAR obs and Pseudo-ob → Gridded LAMP ceiling obs

Gridded Ceiling Observations

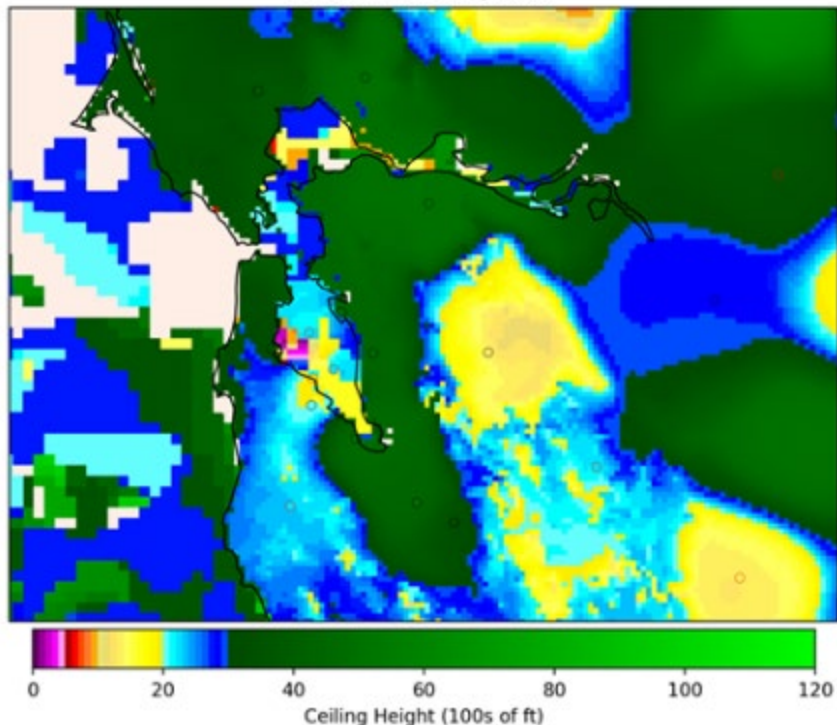
Full domain example



Gridded LAMP Ceiling Observations

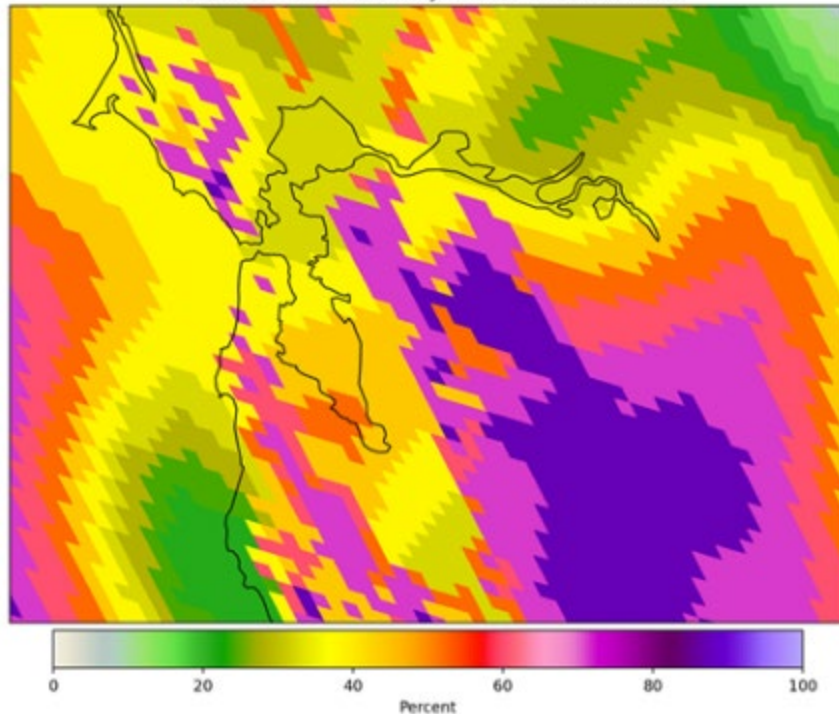
Ceiling Height Analyses (1.25 km) for **1500 UTC**, March 21, 2023

1.25km GLMP Ceiling Height 00-hr Analysis
15z on March 21, 2023



GOES Fog & Low Stratus Product

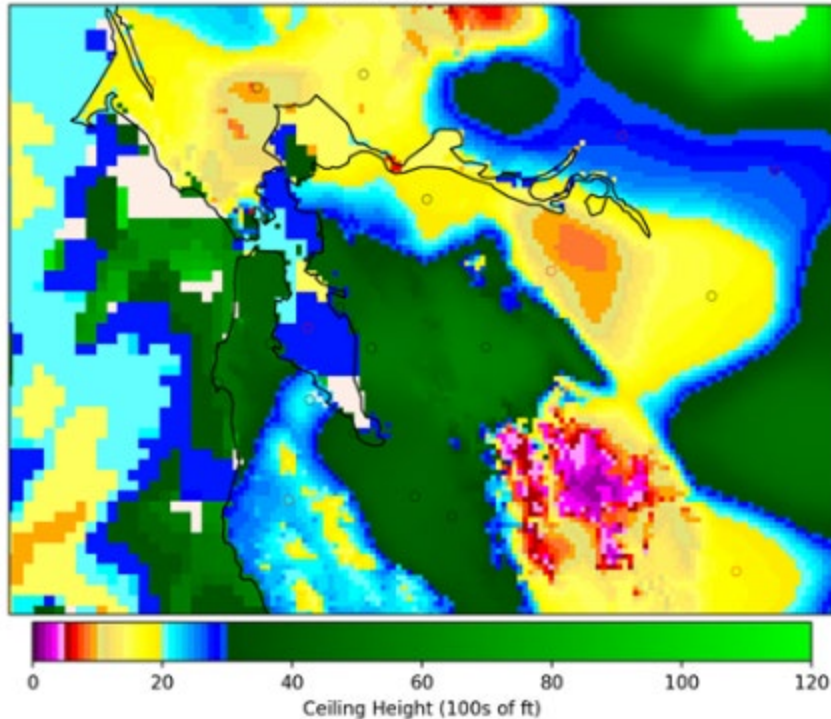
GOES FLS - MVFR Probability on 2023-03-21 15:01:16z



Gridded LAMP Ceiling Observations

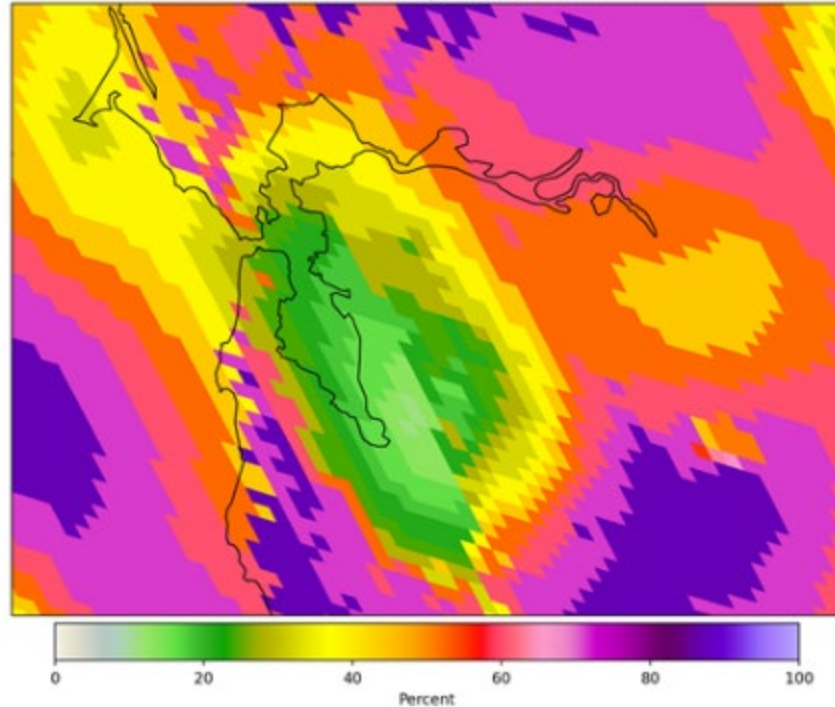
Ceiling Height Analyses (1.25 km) for **1700 UTC**, March 21, 2023

1.25km GLMP Ceiling Height 00-hr Analysis
17z on March 21, 2023



GOES Fog & Low Stratus Product

GOES FLS - MVFR Probability on 2023-03-21 17:01:16z



Gridded Ceiling Obs Subjective Verification

Web camera images looking over Bay



1500 UTC



1700 UTC

Summary

- LAMP/GLMP v2.5 (T/Td/Winds): scheduled implementation **May 2023**
- 15-min LAMP/GLMP: LAMP C&V guidance valid at 15-min timesteps, to be produced every 15 minutes, out to 6 hours
 - **Tentative code handoff in Spring 2024 with implementation in Summer 2024**
- Onset/cessation: text bulletins and new web graphics showing probabilistic and flight category guidance
 - MDL/Aviation Weather Center (AWC)/FAA Aviation Weather Demonstration and Evaluation Team (AWDE) **user demonstration from late Fall 2023 – early winter 2024.**
- Gridded ceiling height analysis at SFO:
 - MDL/AWC/FAA AWDE **user demonstration from May 2023 – Fall 2023.**

Phil.Shafer@noaa.gov
Judy.Ghirardelli@noaa.gov

Thank you!

<https://vlab.noaa.gov/web/mdl/lamp>

