

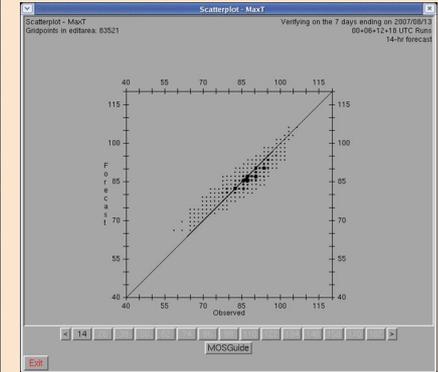
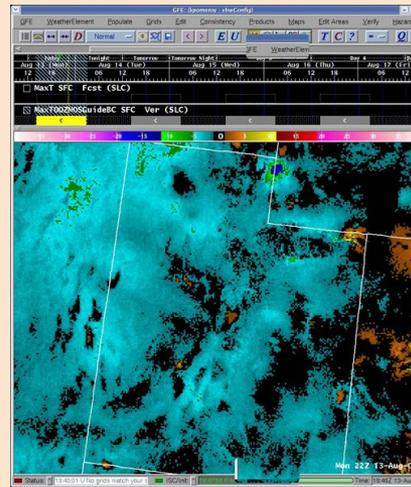
Aviation Forecast Verification Tool (AFVT)

**Virtual Lab Forum
November 16, 2016**

Tabitha Huntemann
Dana Strom
Steve Lanciani

Motivation

Create capabilities to provide near real-time verification results for national-scale gridded forecasts of importance to aviation operations



BOIVerify: verifies gridded forecasts
Limitation: locally maintained

Verification > Evaluation > Storm Data > Training > Data Tools > Resources > About > Repo

Home >> Verification >> Aviation >> Request

TAF Report Page

Element	Ceiling
TAF Type	Operational Impact (Scheduled Only)
Date Range	12/01/2015 TO 12/15/2015
Terminal	KCMH, KCVG, KDAY, KILN, KLCK, KLUK
Cycle Times	0000Z, 0600Z, 1200Z, 1800Z
Projections	>0 - 3, >3 - 6
Report Format	Hours Minutes Percent Frequency Toggle Legend

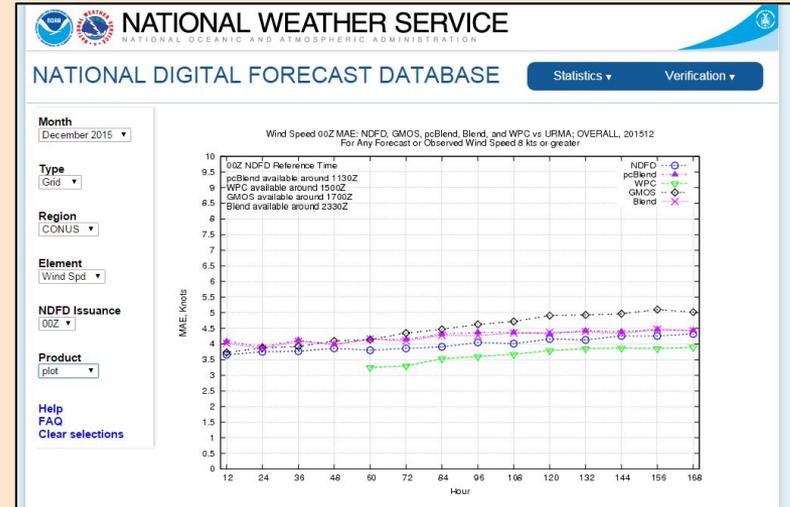
Hit
 1-Category Error
 2-Category Error
 3-Category Error
 4 or More Category Error

Show All Hide All

MULTICATEGORY CONTINGENCY TABLE WITH ASSOCIATED SCORES

OBS\FORCASTS	1	2	3	4	5	6	TOTAL
<200 (1)	486	173	12	0	0	73	744
200-400 (2)	152	1,150	411	0	29	460	2,202
500-900 (3)	3	227	805	14	27	60	1,136
1000-1900 (4)	0	55	209	730	484	67	1,545
2000-3000 (5)	0	6	75	912	1,990	397	3,300
>3000 (6)	118	150	171	1,557	2,441	11,769	16,206
TOTAL	759	1,761	1,683	3,213	4,971	12,826	25,213
BIAS	1.020	0.800	1.482	2.080	1.471	0.791	----

Stats on Demand: verification of alphanumeric products, TAF, warnings
Limitation: does not contain gridded verification



NDFD Verification: verification of gridded forecasts
Limitation: non-operational; not real-time

Aviation Forecast Verification Tool

- MDL is developing AFVT to:
 - store forecasts and observations
 - compute verification metrics
 - depict the verification results via a web-based graphical user interface
- This work is funded by STI and the Aviation and Space Weather Services Branch (ASWSB)

Benefits of AFVT

- Digital Aviation Services
 - NWS provides quality management system data to the FAA
 - ASWSB and STI use for planning and evaluation of improvement to Aviation Services
- Verification
 - NWS managers use for performance management and resource planning
 - NWS forecasters use for continual improvement to their forecast process
 - Guidance product developers use for continual improvement

Initial AFVT Functionality

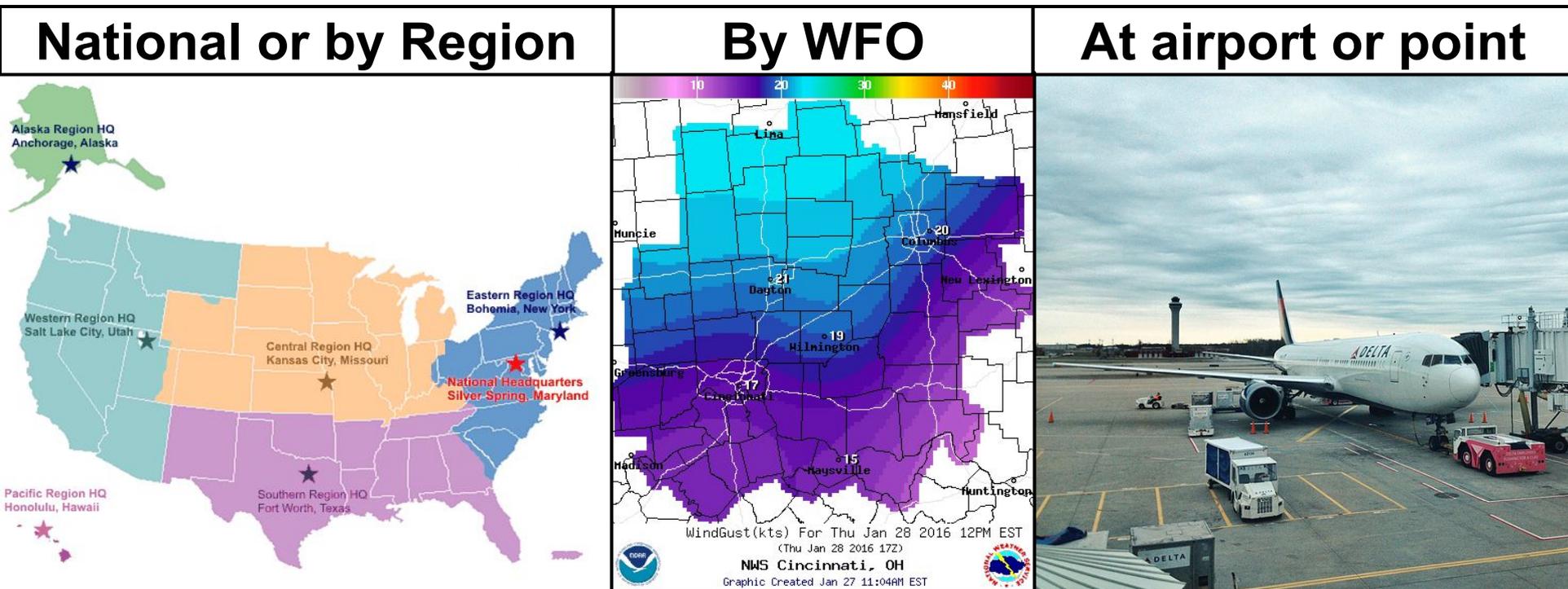
- Users access through a web-based GUI
 - Allows user to select element, time, and location of interest
 - Displays results as graphs, text, and maps
 - Results available in near real time
- Grid-to-point and grid-to-grid capabilities
- 4+ years of data (2012 - present)

- Prototype access is open to all NOAA users

Data Status

Grid-to-Point	Status
Observations	METAR / SPECI (MADIS)
NDFD forecasts	ceiling height, visibility, flight category, sky cover, temperature, dew point, relative humidity, wind speed, wind direction, wind gust
NDFD issuances	00Z-23Z
NDFD projections	1-36 hours
Grid resolution	2.5 km (CONUS)
Guidance/models	GLMP, GMOS
Grid-to-Grid	Status
Analysis	RTMA
NDFD forecasts	temperature, dew point, wind speed, wind direction, visibility, sky cover
NDFD issuances	00Z-23Z
NDFD projections	1-36 hours
Grid resolution	2.5 km (CONUS)
Guidance/models	GLMP, GMOS

Verifiable Areas in AFVT



Optional Time Breakdowns



Accessing AFVT

<https://veritas.nws.noaa.gov/afvt>

Aviation Forecast Verification Tool

AFVT | NWS Links | Guides

Aviation Forecast Verification Tool

Grid-to-Point Verification | Grid-to-Grid Verification

Forecast and Guidance Models
ROED
GLMR
GMAOS

Gridded Analysis Models
LEPS

Weather Elements
Ceiling Height
Visibility
Flight Category
Sky Cover
Wind Speed
Wind Direction
Wind Gust
Temperature
Dew Point

Login with NOAA LDAP credentials

Graphical User Interface



- Forecast and Guidance Models
 - NDFD
 - GLMP
 - GMOS
- Gridded Analysis Models
 - RTMA
- Weather Elements
 - Ceiling Height
 - Visibility
 - Flight Category
 - Sky Cover
 - Wind Speed
 - Wind Direction
 - Wind Gust
 - Temperature
 - Dew Point

Aviation Forecast Verification Tool

Grid-to-Point Verification

Grid-to-Grid Verification

Aviation Forecast Verification Tool
Point Product

Region: WFO Station

Core Airport Stations: KBOS, KJAD, KCOA, KMIA

NEED Sector: Comprehensive US

Weather Element: Ceiling Height

Element Thresholds: Forecast: NDFD

Issuance UTC: 00z, 06z, 12z, 18z

Guidance Offset: GLMP, On

Projections: UTC, 00z, 06z, 12z, 18z

Date Range Type: Validation

From Date: 07/23/2014

To Date: 07/31/2014

Allowable Date Range: 1800000 to 07/31/2014

Break Down Stats By the Following Options

Cycle/Projection/Valid UTC: Issuance/Valid Date Period: Forecast Locations: Include

Use Monthly Aggregates: Yes

Get Report

Aviation Forecast Verification Tool
Gridded Product

Region: WFO Airport Map

NEED Sector: COMUS

Weather Element: Visibility

Forecast: NDFD

Issuance UTC: 00z

Guidance Offset: GLMP, On

Projections: 00z, 06z, 12z, 18z

Date Range Type: Validation

To Valid Date: 08/23/2015

Allowable Date Range: 1800000 to 08/23/2015

Get Grids



Aviation Forecast Verification Tool Point Product

AFVT

NWS Links

Guides



NDFD Sector
Contiguous US

Weather Element
Ceiling Height

Element Thresholds
Highest Impact Ob Forecast
NDFD

Issuance UTC
00z
01z
02z
03z

Guidance Offset
GLMP 04h

Projections UTCs
03h 01z
04h 02z
05h 03z
06h 04z

Date Range Type
issuance

From Date
2016-10-01

To Date
2016-11-09

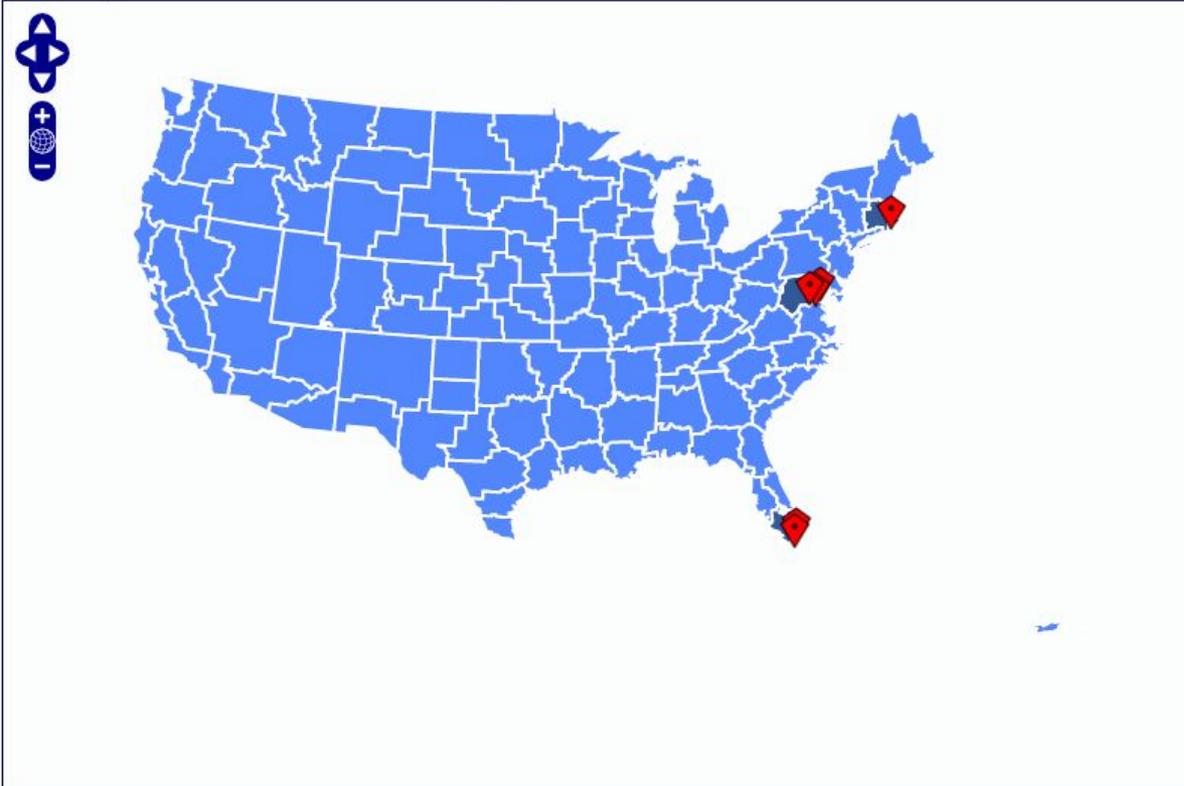
Allowable Date Range:
01/01/2012 to 11/08/2016

Get Report

Region WFO Station

Choose a desired station type and click on any WFO area to show available stations of the selected type. And click on any station to select/de-select it. Stats will be computed for the selected stations

Core Airport Stations



- KMIA
- KBOS
- KIAD
- KDCA
- KBWI

Break Down Stats By the Following Options

Cycle/Projection/Valid UTC Issuance/Valid Date Periods Forecast Locations
 NONE NONE NONE

Grid-to-point interface



Aviation Forecast Verification Tool

Point Product

AFVT

NWS Links

Guides



NDFD Sector
Contiguous US

Element Thresholds

Highest Impact Ob Forecast

NDFD

Issuance UTC
00z
01z
02z
03z

Guidance Offset
GLMP 04h

Projections UTCs
03h
04h
05h
06h
07h

Date Range Type
issuance

From Date
2016-10-01

To Date
2016-11-09

Allowable Date Range:
01/01/2012 to 11/08/2016

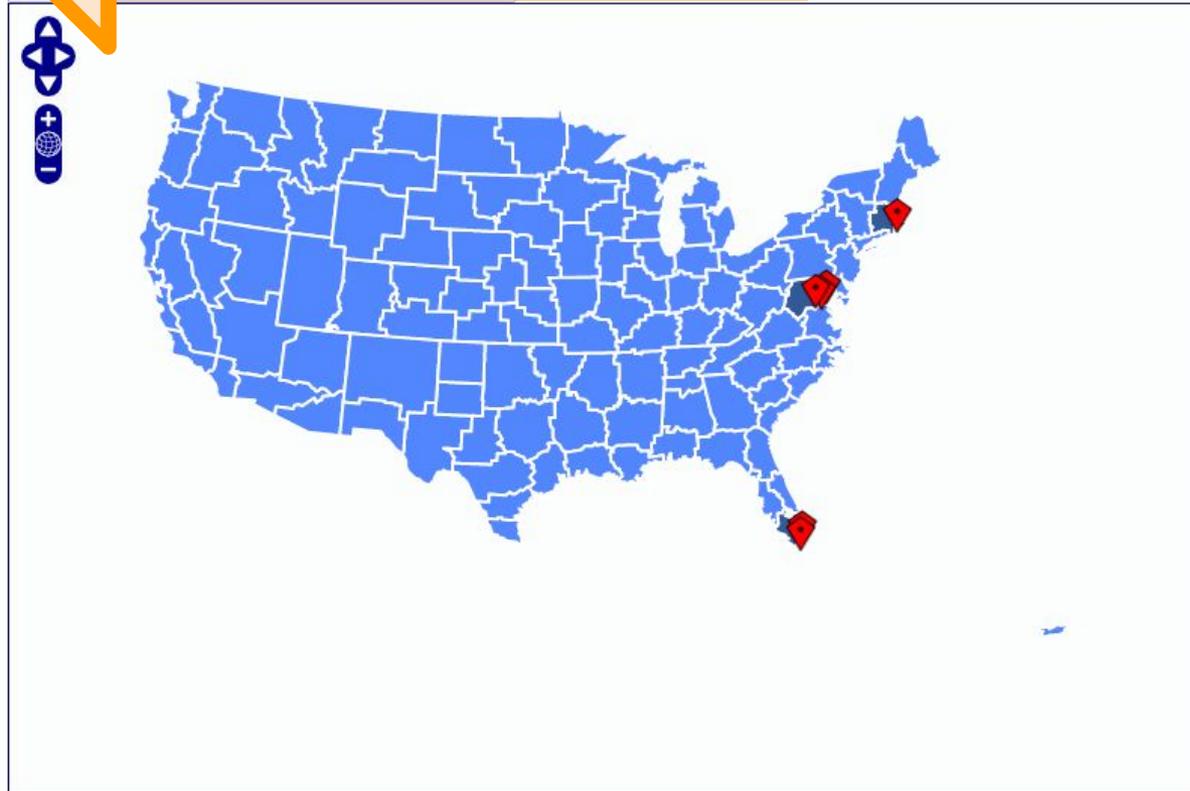
Get Report

Region: WFO Station

Ceiling Height



Select element



- KMIA
- KBOS
- KIAD
- KDCA
- KBWI

Break Down Stats By the Following Options

Cycle/Projection/Valid UTC Issuance/Valid Date Periods Forecast Locations

NONE NONE NONE



Aviation Forecast Verification Tool Point Product

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NDFD Sector
Contiguous US

Weather Element
Ceiling Height

Element Thresholds

Forecast
NDFD

Issuance UTC
00z
01z
02z
03z

Guidance Offset

GLMP 04h

Projections UTCs
03h 01z
04h 02z
05h 03z
05h 04z

data source type
issuance

From Date
2015-06-01

To Date
2015-06-18

Allowable Date Range:
01/01/2012 to 09/16/2016

Get Report

Region

Choose a
side a re



Customizable Weather Element Thresholds

Contingency Categories

Forecast Skill Score Categories

Flight Category: Customizable Contingency Category Thresholds

Cat Id	Lower CG Threshold	CG (Ceiling Height)	Upper CG Threshold	Logical Connector	Lower VS Threshold	VS (Visibility)	Upper VS Threshold
VLIFR	0≤	CG	≤100 FT	OR	0≤	VS	< 1/2 SM
LIFR	200≤	CG	≤400 FT	OR	1/2≤	VS	< 1 SM
IFR	500≤	CG	≤900 FT	OR	1≤	VS	< 3 SM
MVFR	1,000≤	CG	≤3,000 FT	OR	3≤	VS	< 5.5 SM
VFR	3,100≤	CG	≤25,000 FT	AND	5.5≤	VS	< 10 SM

Reset

CANCEL SUBMIT

Optional: select customizable element thresholds

Break Down Stats by the Following Options

Cycle/Projection/Valid UTC Issuance/Valid Date Periods Forecast Locations



NDFD Sector
Contiguous US

Weather Element
Ceiling Height

Element Thresholds

Highest Impact Ob Forecast ←

NDFD

Issuance UTC
00z
01z
02z
03z

Guidance Offset
GLMP 04h

Projections UTCs
03h 01z
04h 02z
05h 03z
06h 04z

Date Range Type
issuance

From Date
2016-10-01

To Date
2016-11-09

Allowable Date Range:
01/01/2012 to 11/08/2016

AFVT provides 2 station-based verification techniques:

- Top-of-the-hour observation (default)
- Highest-impact observation within the hour (to account for SPECIs)

Element(s)	High Impact
Ceiling height, visibility, flight category	Lowest value over hour
Wind speed, wind gust, dew point*, relative humidity* (*)=dependent on location/season	Highest value over hour
Temperature	Warm season: highest value Cool season: lowest value
Wind direction	Top of hour verification only - to be revisited



Aviation Forecast Verification Tool Point Product

AFVT

NWS Links

Guides



NDFD Sector
Contiguous US

Weather Element
Ceiling Height

Element Thresholds

Highest Impact Ob

Forecast
NDFD

Issuance UTC
00z
01z
02z
03z

Guidance	Offset
GLMP	04h

Projections	UTCs
03h	01z
04h	02z
05h	03z
06h	04z
07h	

Date Range Type
issuance

From Date
2016-10-01

To Date
2016-11-09

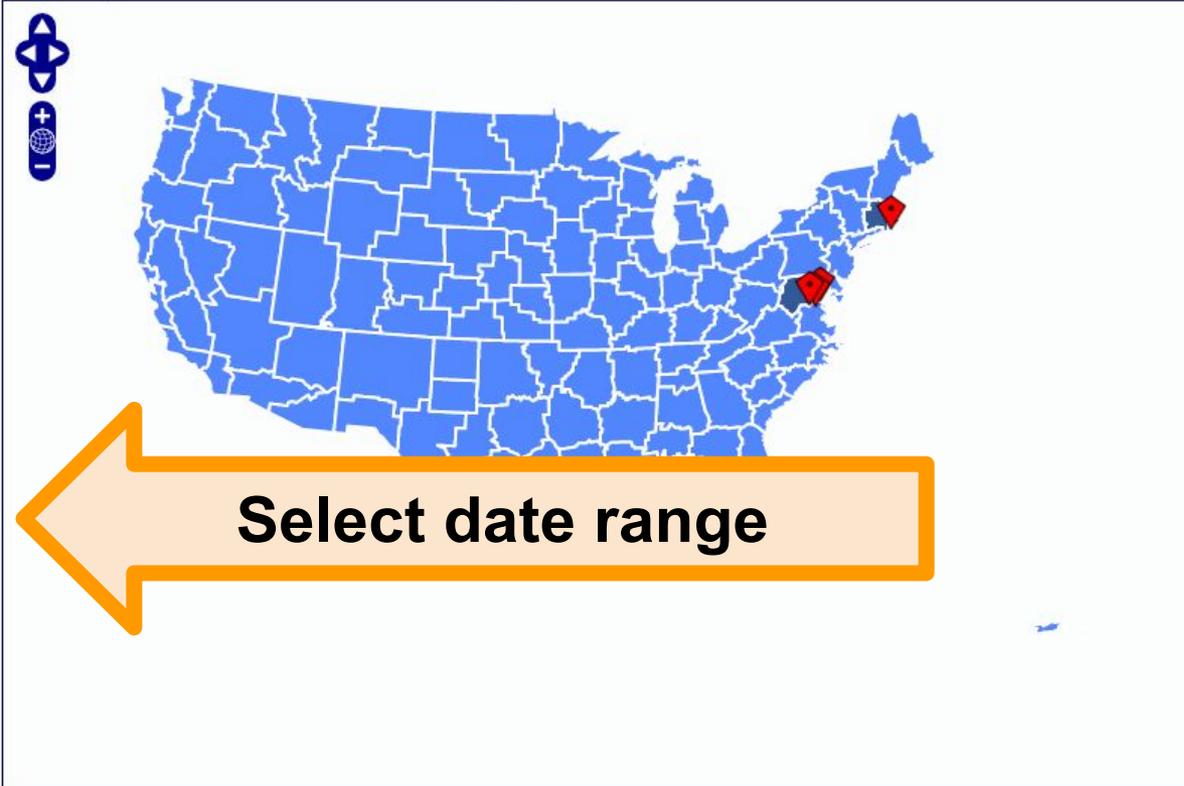
Allowable Date Range:
01/01/2012 to 11/08/2016

Get Report

Region WFO Station

Choose a desired station type and click on any WFO area to show available stations of the selected type. And click on any station to select/de-select it. Stats will be computed for the selected stations

Core Airport Stations



- KMIA
- KBOS
- KIAD
- KDCA
- KBWI

Break Down Stats By the Following Options

Cycle/Projection/Valid UTC	Issuance/Valid Date Periods	Forecast Locations
NONE	NONE	NONE

Forecast
NDFD

Issuance UTC
00z
01z
02z
03z

Guidance	Offset
<input type="checkbox"/> GLMP	04h

Projections UTCs
03h
04h
05h
06h
07h

Date Range Type
issuance

From Date
2016-10-01

To Date
2016-11-09

Allowable Date Range:
01/01/2012 to 11/08/2016

The “base” forecast that other data sources (if any) are compared to (usually NDFD).

The forecast issuance(s) of the “Base” forecast. Any combination of issuances may be selected.

Check boxes for comparable forecast(s) and time offset(s) (i.e., lead time).

Multiple forecast projections can be selected.

Choose forecast date range.



Aviation Forecast Verification Tool Point Product



NDFD Sector
Contiguous US

Weather Element
Ceiling Height

Element Thresholds
Highest Impact Ob Forecast
NDFD

Issuance UTC
00z
01z
02z
03z

Guidance Offset
GLMP 04h

Projections UTCs
04h 01z
05h 02z
06h 03z
07h 04z

Date Range Type
issuance

From Date
2016-10-01

To Date
2016-11-09

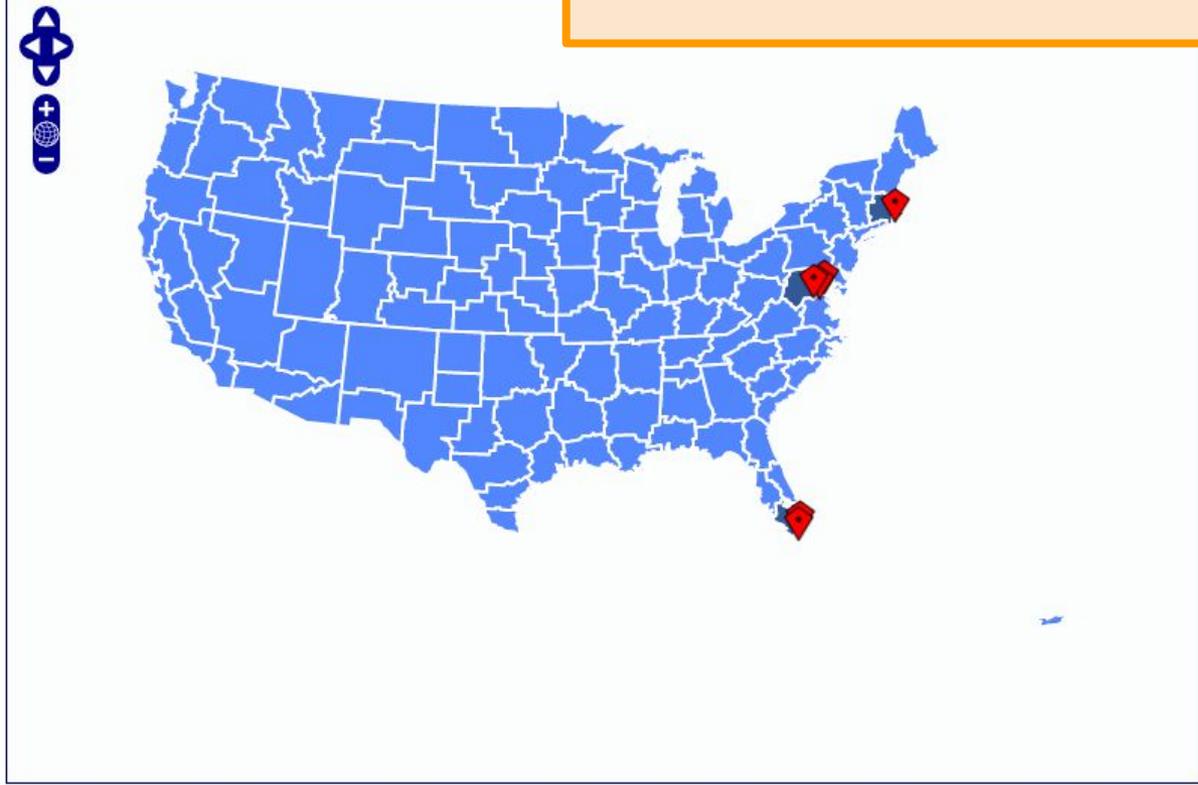
Allowable Date Range:
01/01/2012 to 11/08/2016

Get Report

Region WFO **Station**

Choose a desired station type and click on any WFO area to show select/de-select it. Stats will be computed for the selected station

Core Airport Stations



- KIAD
- KDCA
- KBWI

These tabs select areas/locations. The options differ for grid-to-point (shown) and grid-to-grid.

Break Down Stats By the Following Options

Cycle/Projection/Valid UTC Issuance/Valid Date Periods Forecast Locations
 NONE NONE NONE



Aviation Forecast Verification Tool

Point Product

AFVT

NWS Links

Guides



NDFD Sector
Contiguous US

Weather Element
Ceiling Height

Element Thresholds
Highest Impact Ob Forecast
NDFD

Issuance UTC
00z
01z
02z
03z

Guidance	Offset
GLMP	04h

Projections UTCs
03h
04h
05h
06h
07h

Date Range Type
issuance

From Date
2016-10-01

To Date
2016-11-09

Allowable Date Range:
01/01/2012 to 11/08/2016

Get Report

Region WFO **Station**

Choose a desired station type and click on any WFO area to show available stations of the selected type. And click on any station to select/de-select it. Stats will be computed for the selected stations

- Core Airport Stations
- All Stations
- Core Airport Stations**
- Localized Aviation MOS Product Stations
- Traditional NDFD Verification Stations
- Public Stations
- Terminal Aerodrome Forecast Stations

Select station type



KMIA
KBOS
KIAD
KDCA
KBWI

Pre-defined station lists contain commonly used subsets such as the Core 30 Airports, LAMP forecast sites, stations used in monthly NDFD verification, Stats-on-Demand public (PFM) sites, and TAF sites.

Break Down Stats By the Following Options

Cycle/Projection/Valid UTC	Issuance/Valid Date Periods	Forecast Locations
NONE	NONE	NONE



Aviation Forecast Verification Tool Point Product

AFVT

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NDFD Sector
Contiguous US

Weather Element
Ceiling Height

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Highest Impact Ob Forecast
NDFD

Issuance UTC
00z
01z
02z
03z

Guidance Offset
GLMP 04h

Projections UTCs
03h 01z
04h 02z
05h 03z
06h 04z

Date Range Type
issuance

From Date
2016-10-01

To Date
2016-11-09

Allowable Date Range:
01/01/2012 to 11/08/2016

Get Report

Region WFO Station

Choose a desired station type and click on any WFO area to show available stations of the selected type. And click on any station to select/de-select it. Stats will be computed for the selected stations

Core Airport Stations



- KMIA
- KBOS
- KIAD
- KDCA
- KBWI

Break Down Stats By the Following Options

Cycle/Projection/Valid UTC Issuance/Valid Date Periods Forecast Locations

NONE NONE NONE



Break Down Stats By the Following Options

Cycle/Projection/Valid UTC	Issuance/Valid Date Periods	Forecast Locations
NONE ▼	NONE ▼	NONE ▼
Year		
Quarter		
Year and Quarter		
Month		
Year and Month		
Fiscal Year		
Fiscal Quarter		
Fiscal Year and Quarter		
Meteorological Season		
Cool/Warm Season		

Optional selections: Scores can be grouped by cycles, projections, valid times, date periods, and/or locations.



Point Product

Grid-to-Point Aviation Forecast Verification Report

SUMMARY OF REQUEST
 ELEMENT/FORECAST/GUIDANCE(IssuanceOffset H) Ceiling Height/NDFD/
 FORECAST ISSUANCE CYCLES 0,1,2,3,4,5,6,7,8,9,10Z
 FORECAST PROJECTIONS 1,2,3,4,5,6,7,8,9,10,11H
 FORECAST TIMING ERROR RANGE(S) (in Min) [0,0]
 FORECAST VALID DATE RANGE 07/01/2014 to 07/31/2014
 FORECAST LOCATION(S)(STATION) KBOS,KDCA,KIAD,KMIA
 STATION TYPE Core Airport Stations
 STAT'S BROKEN DOWN BY NONE

[\[Graphical Report\]](#) [\[Text Report\]](#)Toggle Contingency Table Format (Count/Percent):

Highlight Contingency Table (from Green(implying Hits) to Red (implyin

Show/Hide Scoring Matrix: 

Point Product

Grid-to-Point Aviation Forecast Verification Report

SUMMARY OF REQUEST
 ELEMENT/FORECAST/GUIDANCE(IssuanceOffset H) Ceiling Height/NDFD/
 FORECAST ISSUANCE CYCLES 0,1,2,3,4,5,6,7,8,9,10Z
 FORECAST PROJECTIONS 1,2,3,4,5,6,7,8,9,10,11H
 FORECAST TIMING ERROR RANGE(S) (in Min) [0,0]
 FORECAST VALID DATE RANGE 07/01/2014 to 07/31/2014
 FORECAST LOCATION(S)(STATION) KBOS,KDCA,KIAD,KMIA
 STATION TYPE Core Airport Stations
 STAT'S BROKEN DOWN BY NONE

[\[Graphical Report\]](#) [\[Text Report\]](#)Select Stat(s):

OBS\FST(FT)	0 to 100	200 to 400	500 to 900	1,000 to 1,900	2,000 to 3,000	3,100 to 6,500
0 to 100	0	0	0	0	0	0
200 to 400	0	3	5	13	0	0
500 to 900	0	0	41	9	0	8
1,000 to 1,900	0	34	40	56	47	57
2,000 to 3,000	0	14	0	0	0	115
3,100 to 6,500	0	3	36	0	358	0
6,600 to 12,000	0	0	9	7	42	376
12,100 to 25,000	0	15	0	43	51	583
Subtotal	0	69	131	128	498	1,139

OBS CATEGORY(FT)	0 to 100	200 to 400	500 to 900	1,000 to 1,900	2,000 to 3,000	3,100 to 6,500
Bias	0.00	1.35	1.93	0.55	3.46	1.98

OBS\FST(FT)	0 to 100	200 to 400	500 to 900	1,000 to 1,900	2,000 to 3,000	3,100 to 6,500
0 to 100	108.8142	16.5761	6.8668	2.4394	0.8978	-0.2025
200 to 400	16.5761	16.7191	7.0099	2.5824	1.0409	-0.0594
500 to 900	6.8668	7.0099	7.1549	2.7274	1.1859	0.0856
1,000 to 1,900	2.4394	2.5824	2.7274	2.8751	1.3335	0.2332
2,000 to 3,000	0.8978	1.0409	1.1859	1.3335	1.4909	0.3907
3,100 to 6,500	-0.2025	-0.0594	0.0856	0.2332	0.3907	0.5548
6,600 to 12,000	-0.7163	-0.5733	-0.4283	-0.2806	-0.1232	0.0410
12,100 to 25,000	-1.0000	-0.8569	-0.7119	-0.5643	-0.4069	-0.2427

GERRITY SKILL SCORE AND PERCENT CORRECT
Gerrity Skill Score

%

Results can be shown as text or graphics

NDFD Sector
Contiguous US

Weather Element
Ceiling Height

Element Thresholds

Highest Impact Ob Forecast

Issuance UTC
03z
04z
05z
06z

Guidance Offset
GLMP 04h

Projections UTCs
01h 01z
02h 02z
03h 03z
04h 04z

Date Range Type
validation

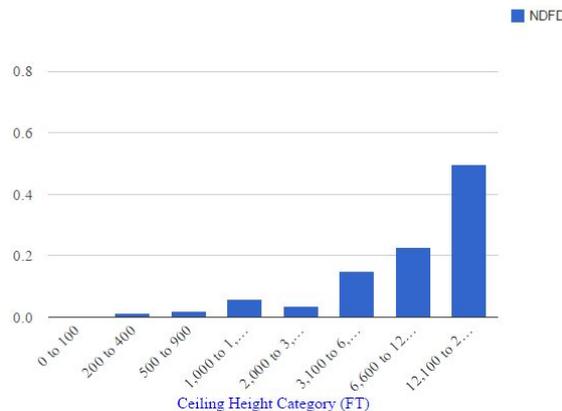
From Date
2014-07-01

To Date
2014-07-31

Allowable Date Range:
01/01/2012 to 11/11/2016

Get Report
Save Statistics As:
CSV IMG

Observed Frequency for Selected Sample



Categorical Forecast Bias





Aviation Forecast Verification Tool

Gridded Product

AFVT

NWS Links

Guides



NDFD Domain
CONUS

Weather Element
Visibility

Forecast
NDFD

Issuance UTC
18z

Guidance **Offset**

GLMP 01h

Projections
07h
08h
09h
10h

Date Range Type
issuance

Issuance Date
08/12/2015

Allowable Date Range:
02/01/2015 to 11/10/2016

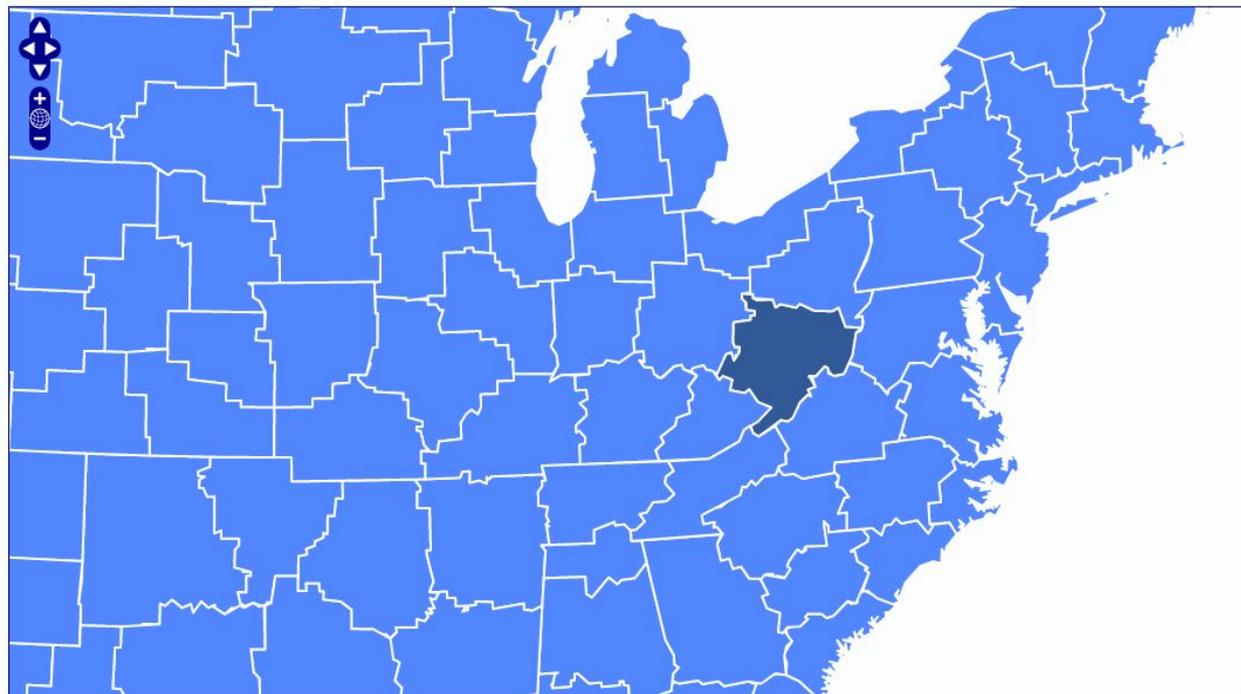
Get Grids

[WFO Key](#)

[ARTCC Key](#)

[Region Key](#)

Domain Region ARTCC **WFO**



RLX

Grid-to-grid interface



Aviation Forecast Verification Tool

Gridded Product

AFVT

NWS Links

Guides



NDFD Domain
CONUS

Weather Element
Visibility

Forecast
NDFD

Issuance UTC
18z

Guidance Offset

GLMP 01h

Projections
07h
08h
09h
10h

Date Range Type
issuance

Issuance Date
08/12/2015

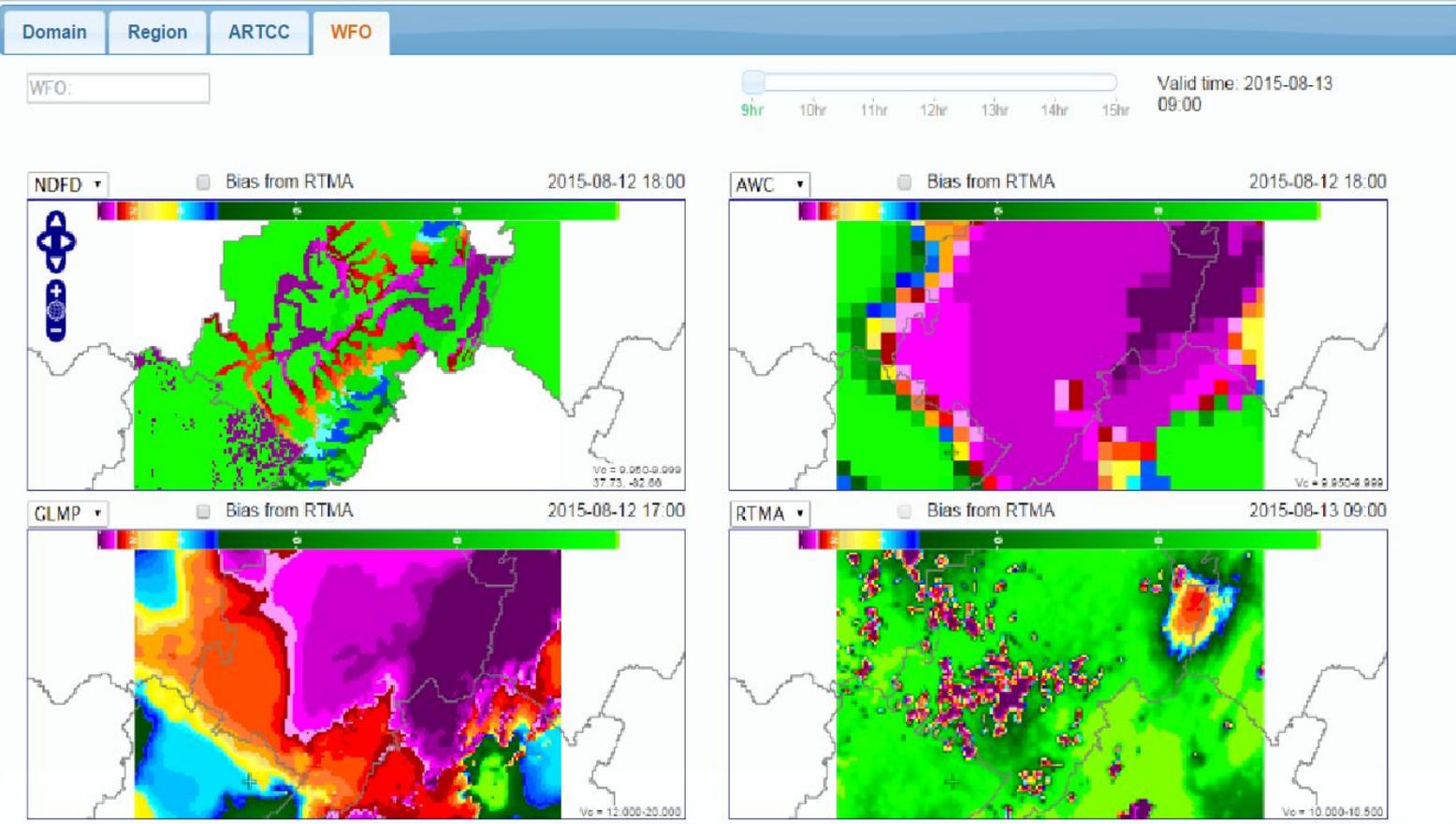
Allowable Date Range:
02/01/2015 to 11/09/2016

Get Grids

[WFO Key](#)

[ARTCC Key](#)

[Region Key](#)



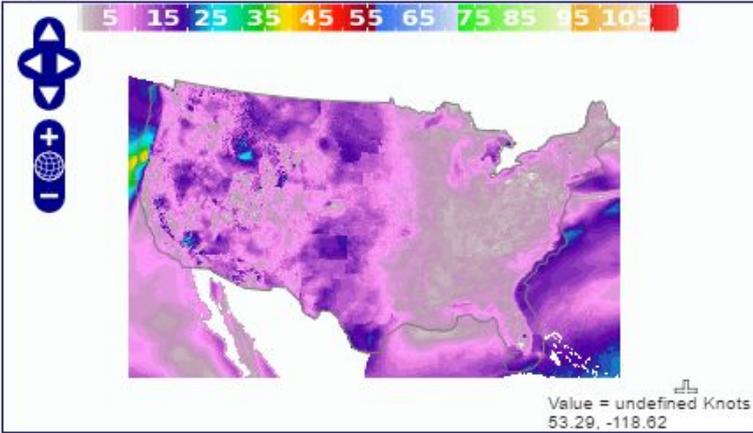
Change location

CO

Domain

NDFD Bias

Issuance Time: 2016-08-01 00:00



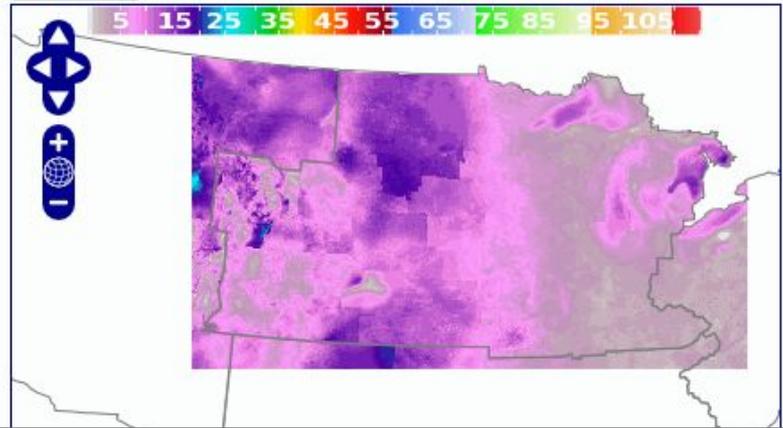
Change location

CR

Region

NDFD Bias

Issuance Time: 2016-08-01 00:00



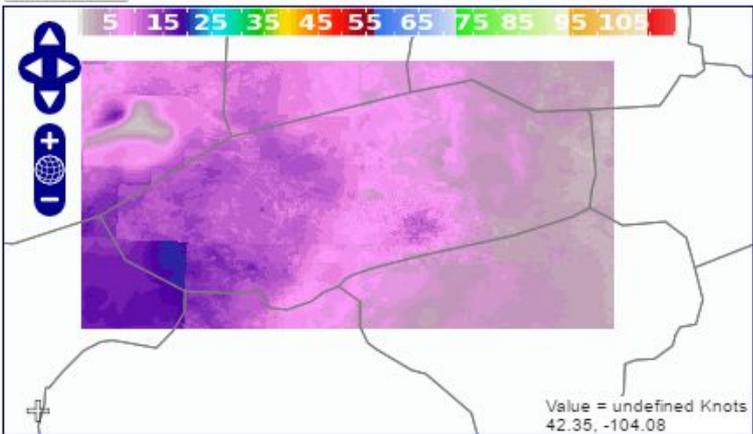
Change location

KANSAS_CITY

ARTCC

NDFD Bias

Issuance Time: 2016-08-01 00:00



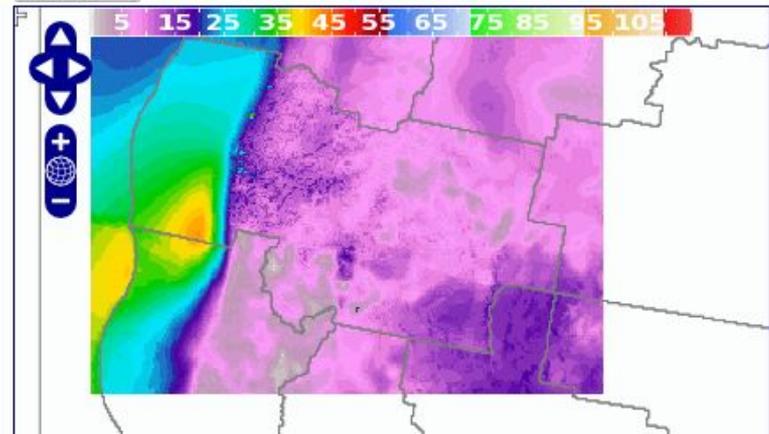
Change location

MFR

WFO

NDFD Bias

Issuance Time: 2016-08-01 00:00



Future Plans

- Additional statistics and tools for gridded map product
 - Monthly grid point by grid point statistics
 - Error distribution charts
 - Time graphs from selections
- Additional weather elements
- Expanding to OCONUS
- Adding National Blend of Models (NBM)
- Transitioning to NWS operations in IDP

Providing Feedback

- Feedback is important!
 - Ask questions and report issues
 - Make recommendations for future development
 - Ensure AFVT provides the key capabilities needed for aviation verification

- How to provide feedback
 - Join the [AFVT VLab community](#)
 - Join the AFVT mailing list
 - Contact Tabitha.Huntemann@noaa.gov for information

Questions?

Tabitha.Huntemann@noaa.gov