Aviation Forecast Verification Tool (AFVT) for the Aviation Weather Testbed

Dana Strom
Tabitha Huntemann
Matthew Jin

August 17th, 2015

Introduction

MDL has been tasked by the NextGen program and Aviation and Space Weather Services Branch (ASWSB) to enhance verification capabilities for gridded forecasts from NDFD

Since 2012, MDL has developed the Aviation Forecast Verification Tool (AFVT) to:

- store forecasts and observations
- compute verification metrics
- depict the verification results via a web-based graphical user interface

Verification Types

Grid-to-point: Forecast / Guidance grid points verified at METAR stations using nearest neighbor approach. These points are verified using METARs and SPECIs disseminated by MADIS.

Grid-to-grid: Grid point by grid point verification of the forecast and guidance grids utilizing RTMA.

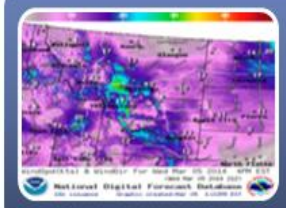
Verifiable Areas

AFVT provides verification results for gridded forecasts at various spatial scales

- Users can choose a domain from a menu or custom-define the domain

National Digital Forecast Database Verification

- Verification of Aviation Weather Elements
- Near-real time results



Verification of a Forecast for a Region

- NWS regions
- Air Route Traffic Control Center

Verification of a Forecast for a WFO

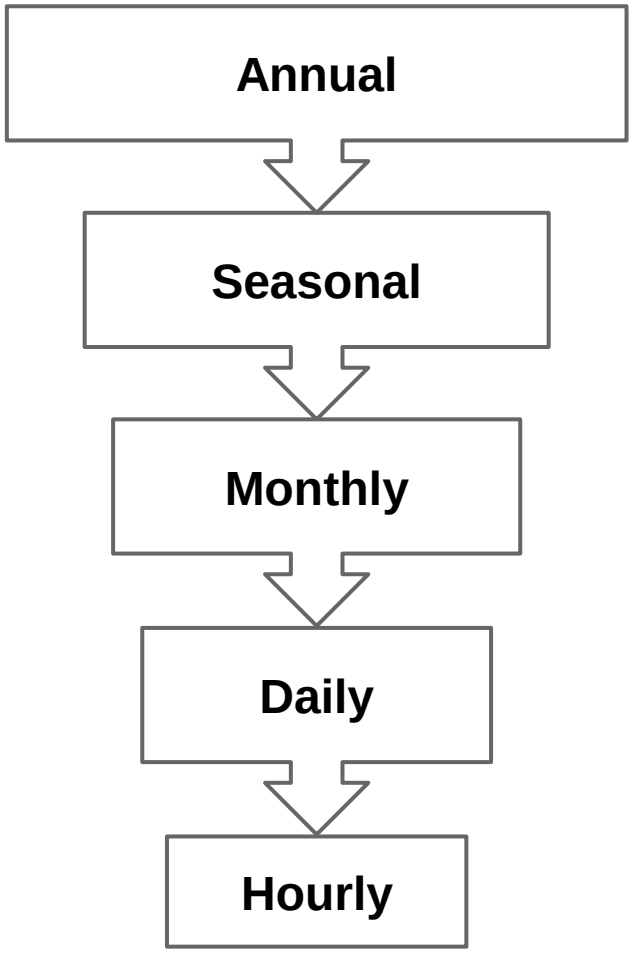
- User defined areas
- For one specified County Warning Area

Verification of a Forecast for an Airport or Point

- Core CONUS Airports
- User selected point locations

Optional Time Breakdowns

Results are displayed for the area and time range selected from the available historical record of data and can be viewed by year, season, month, day, or hour.



Data

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
Guidance/models	GLMP, GMOS
Grid-to-Grid	**Status**
Analyses	RTMA
NDFD forecasts	temperature, dew point, wind speed, wind direction, wind gust visibility, sky cover
NDFD issuances	00Z-23Z
NDFD projections	1-36 hours
Grid resolution	2.5 km
Guidance/models	GLMP, GMOS

Current Functionality

Grid-to-Point

- January 1, 2012 - July 31 2014, (Soon to be expanded to present).
- Flexible user-defined element thresholds
  - Example: Flight Category
- Graphical and text reports

Grid-to-Grid

- Grid-level raster display (maps), March 2015 - present
- Airport and WFO area aggregated stats (currently June 1, 2015 -present) with graphical and text reports.

Prototype User Access

Operational AFVT will be open to all NOAA users

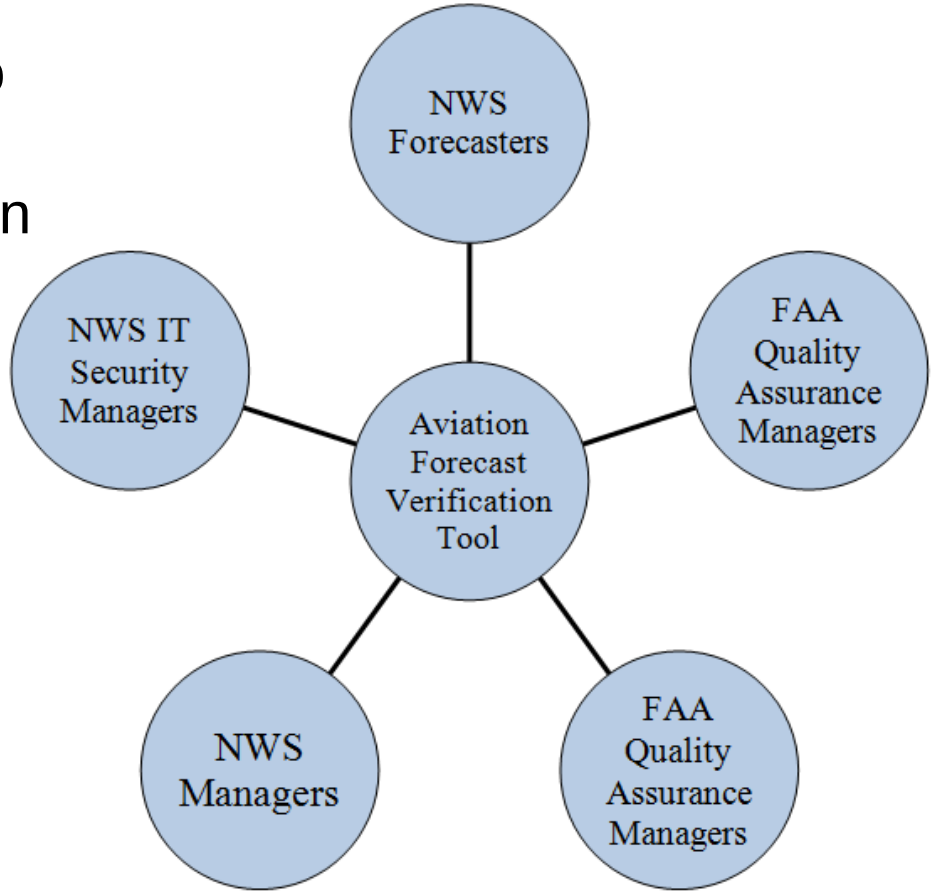
Prototype access being granted in phases to evaluation groups

- NWS HQ, Aviation Digital Services offices, and AWC

How to become an evaluator:

- Request access through Jamie Vavra (Jamie.Vavra@noaa.gov)
- Join the AFVT listserv

Must have NOAA LDAP credentials (NOAA email)



Intended users

Benefits of AFVT

NWS Managers use for resource planning

NWS forecasters use for continual improvement to their forecast process

NWS provides quality management system data to the FAA

Aviation and Space Weather Services Branch and NextGen Program uses for planning and evaluation of improvement to Aviation Services

NWS Managers use for performance management

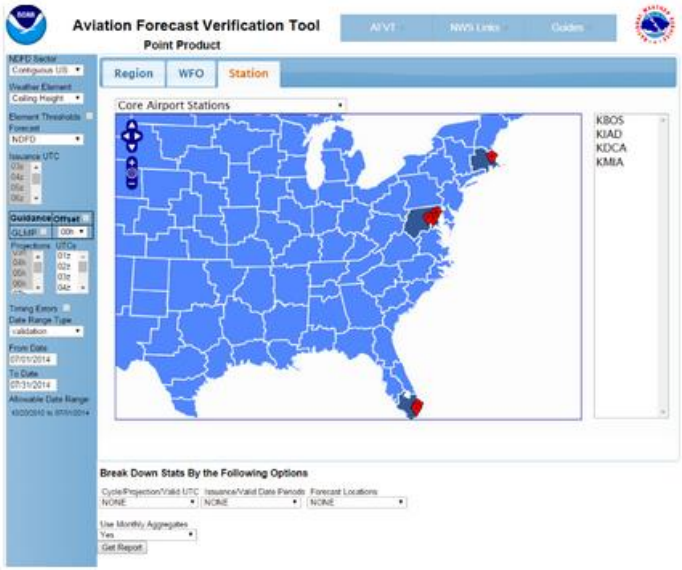
Guidance Product Developers use for continual improvement

Graphical User Interface

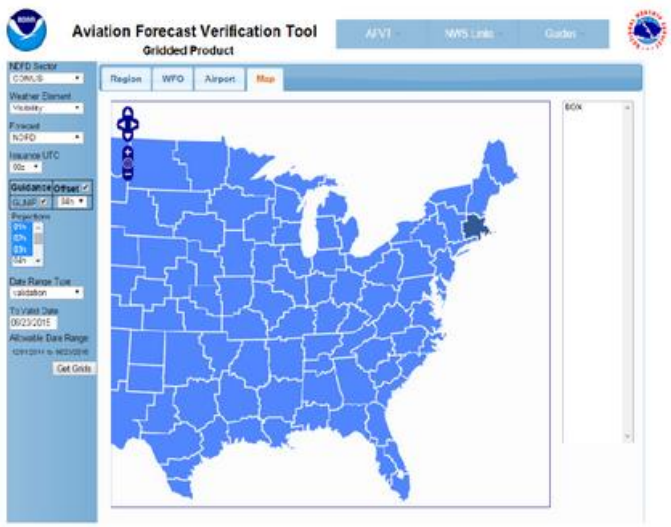
- Forecast and Guidance Models
  - NDFD
  - GLMP
  - GMOS
- Gridded Analysis Models
  - RTMA
- Weather Elements
  - Ceiling Height
  - Visibility
  - Flight Category
  - Sky Cover
  - Wind Speed
  - Wind Direction
  - Wind Gust
  - Temperature
  - Dew Point

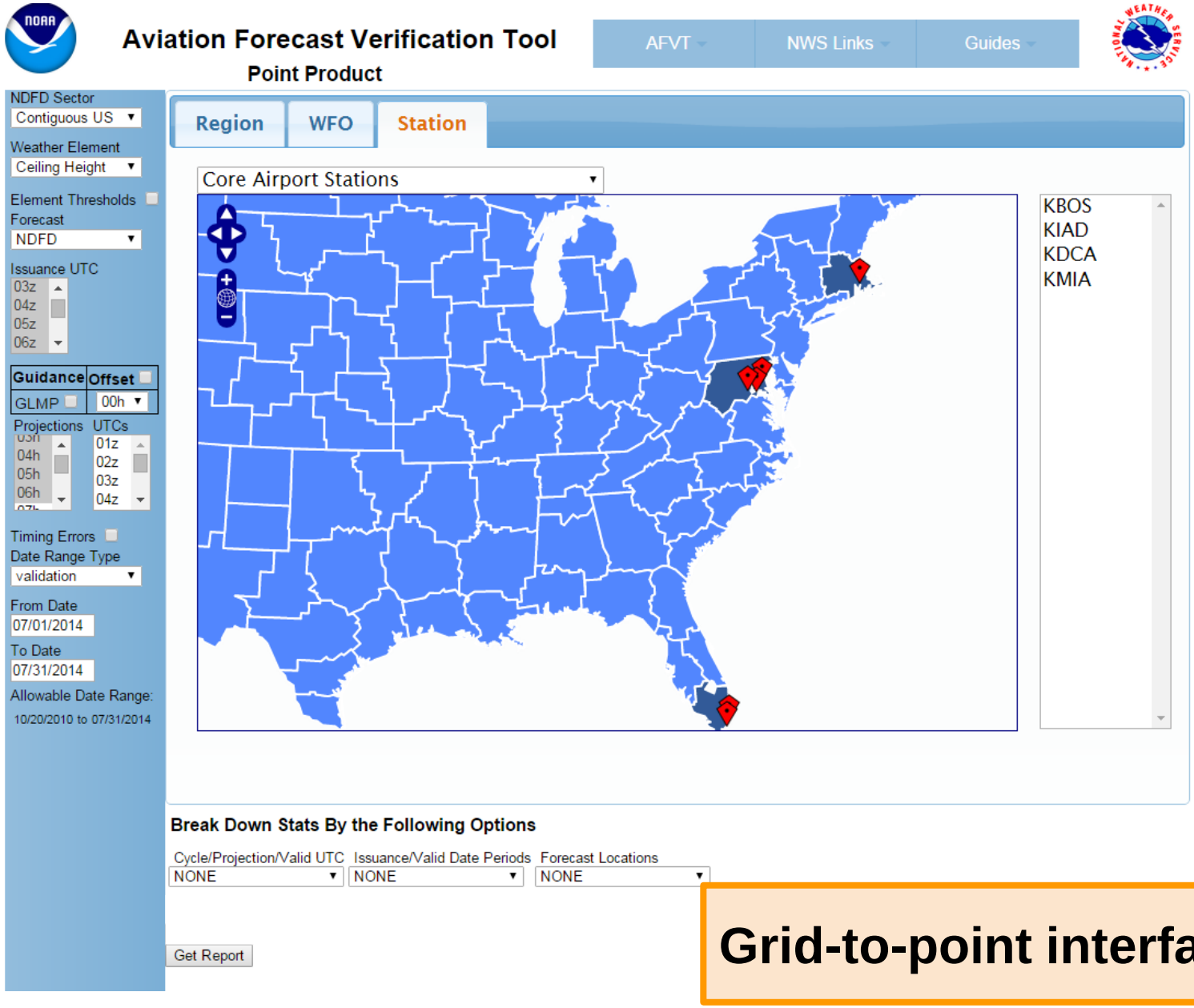
Aviation Forecast Verification Tool

Grid-to-Point Verification

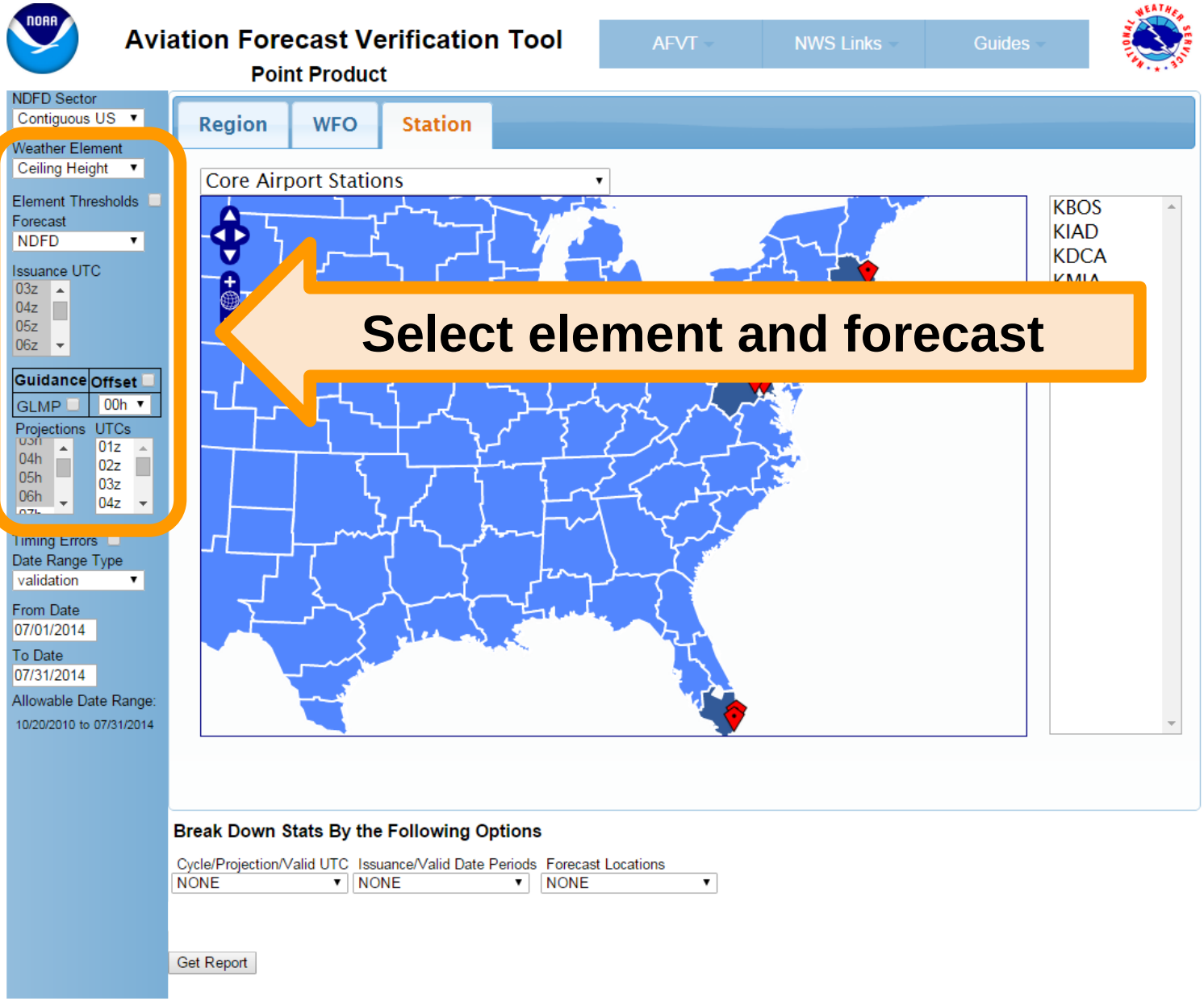


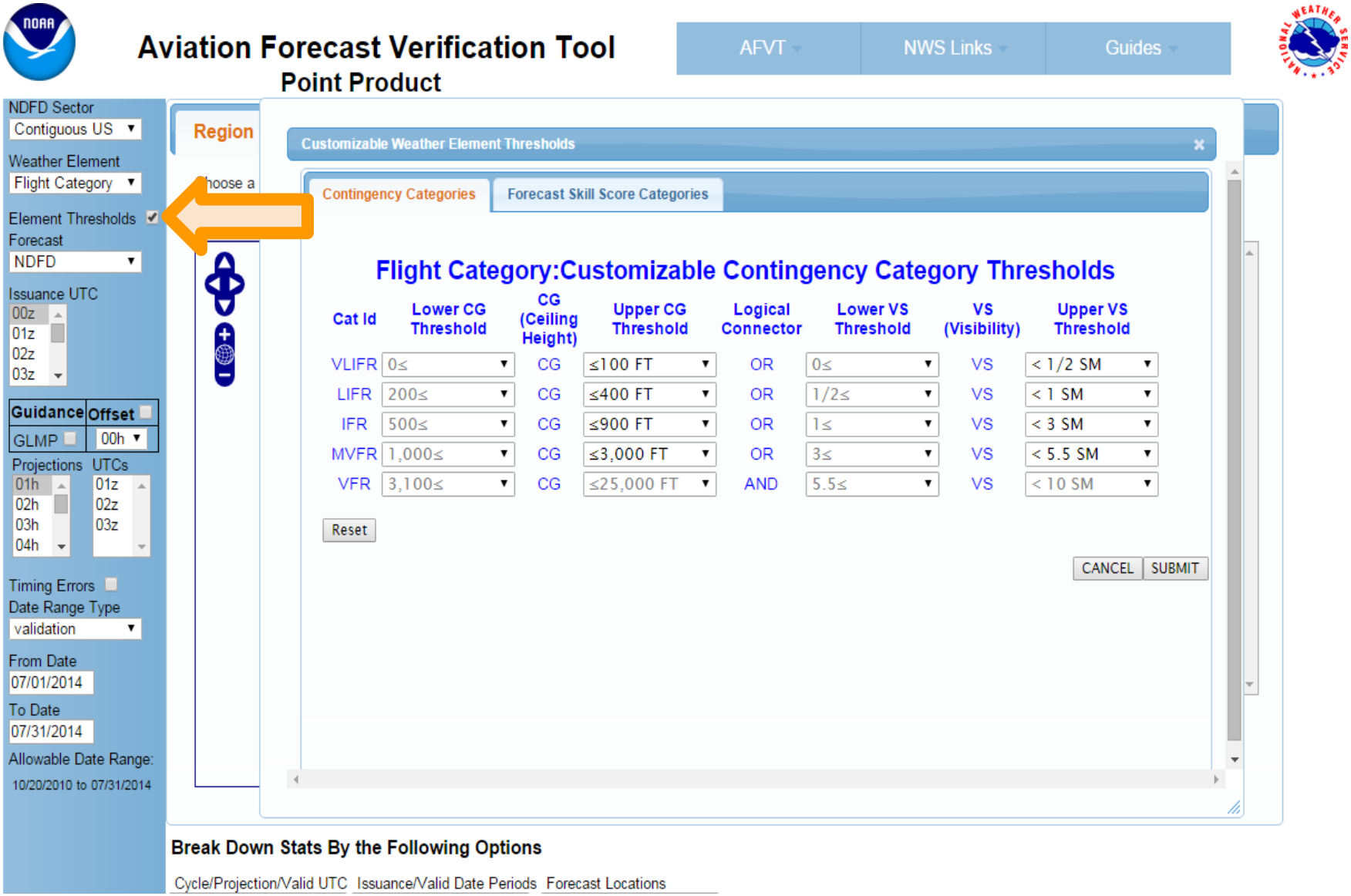
Grid-to-Grid Verification

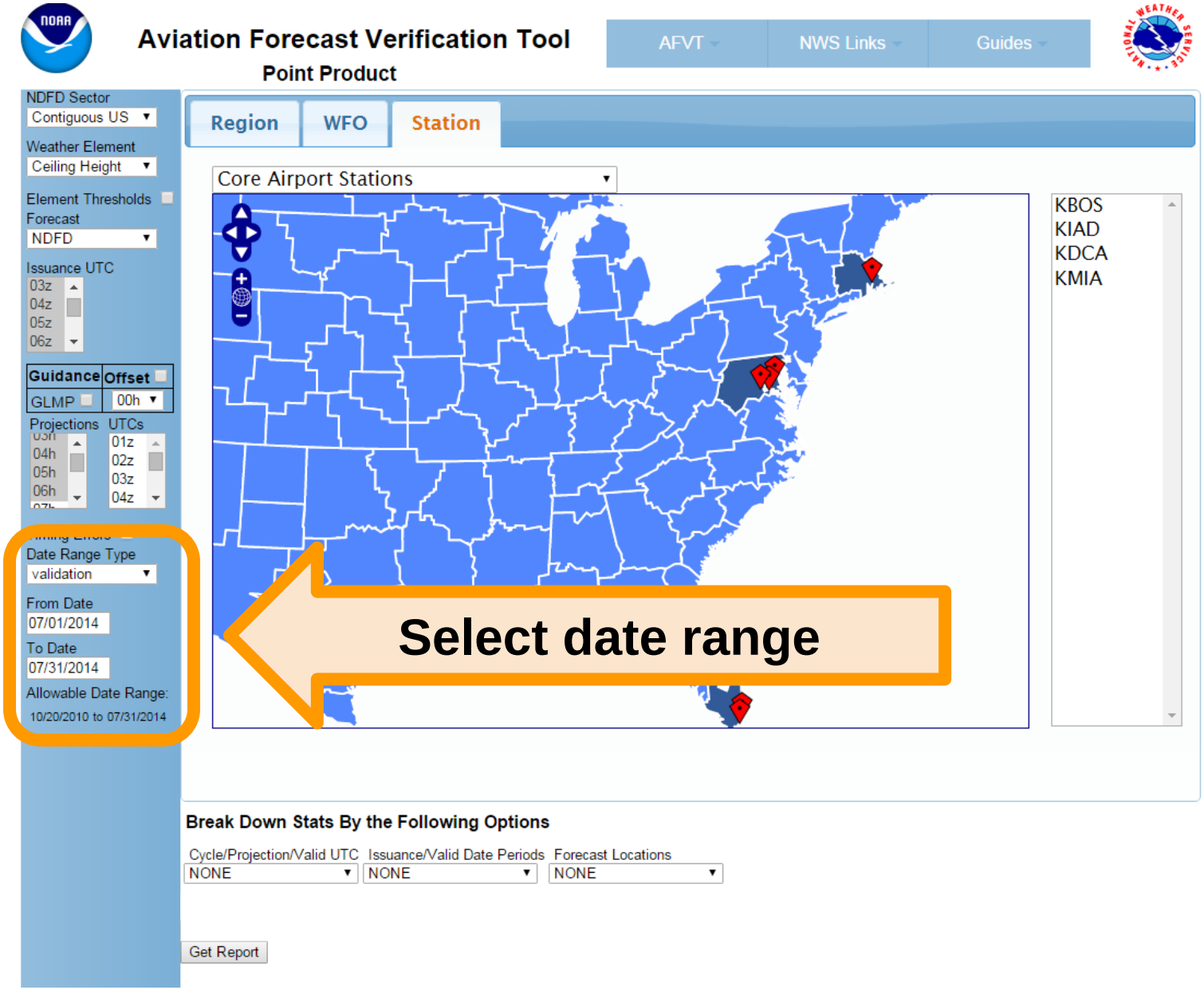


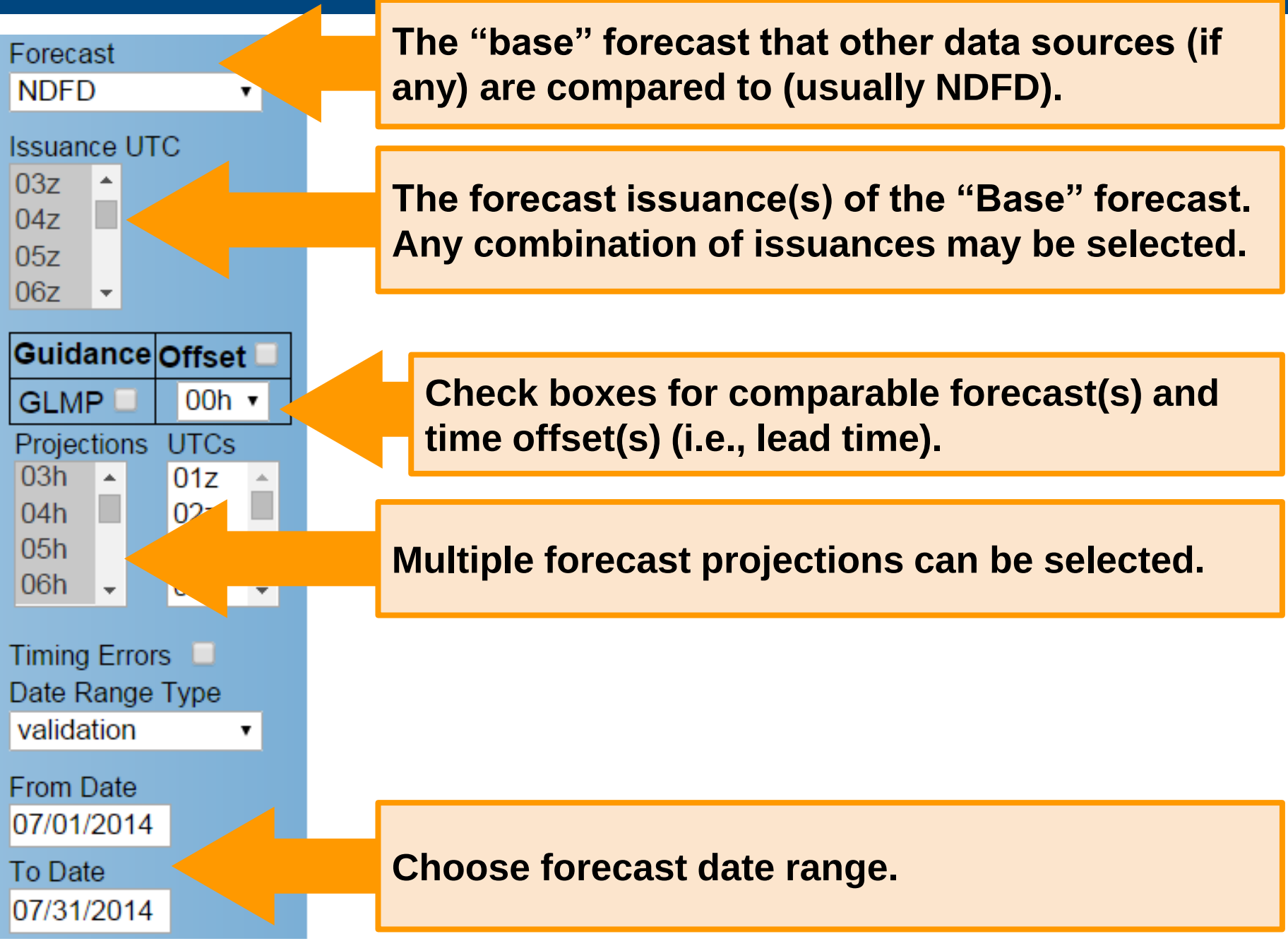


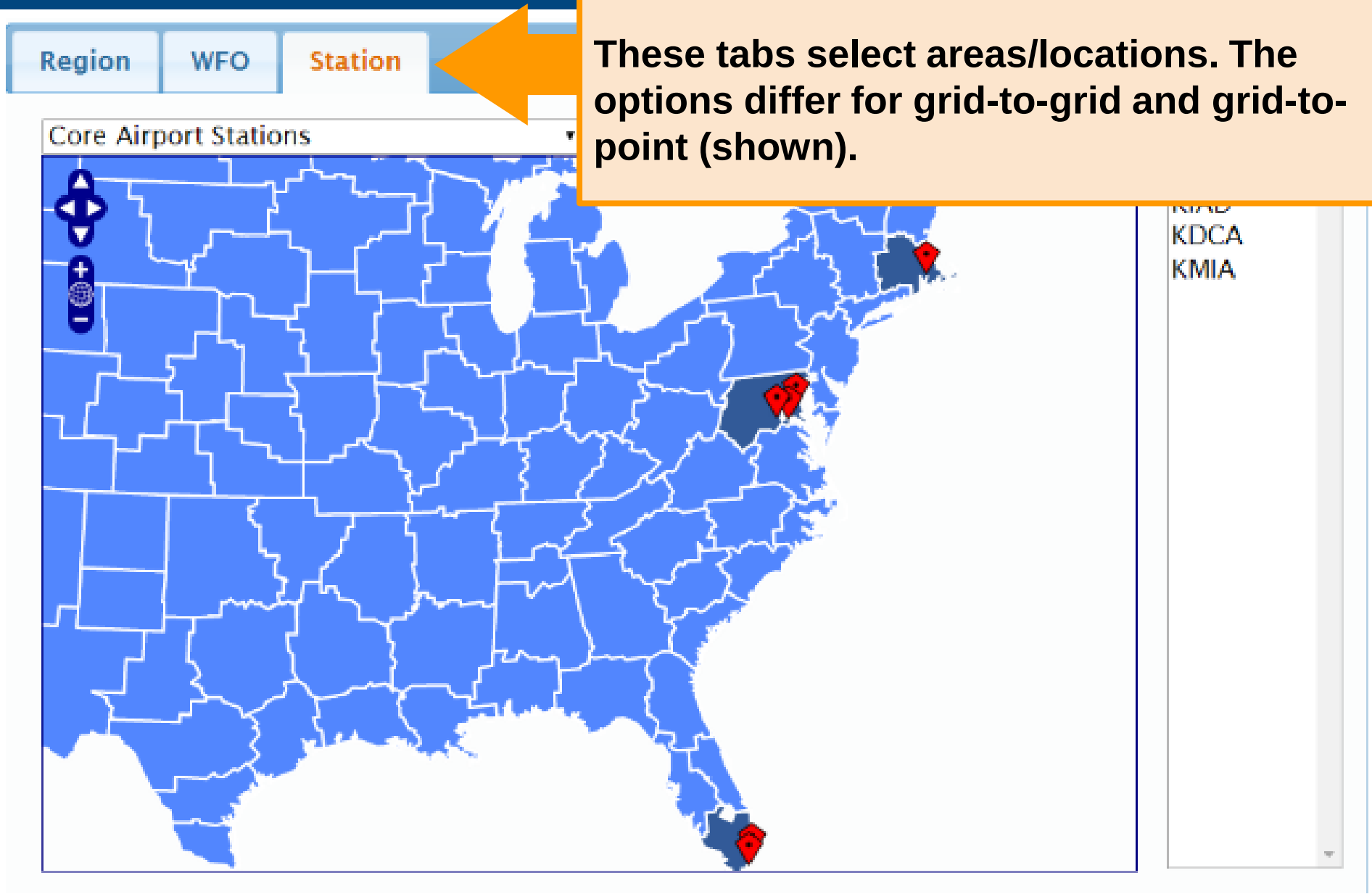
Grid-to-point interface

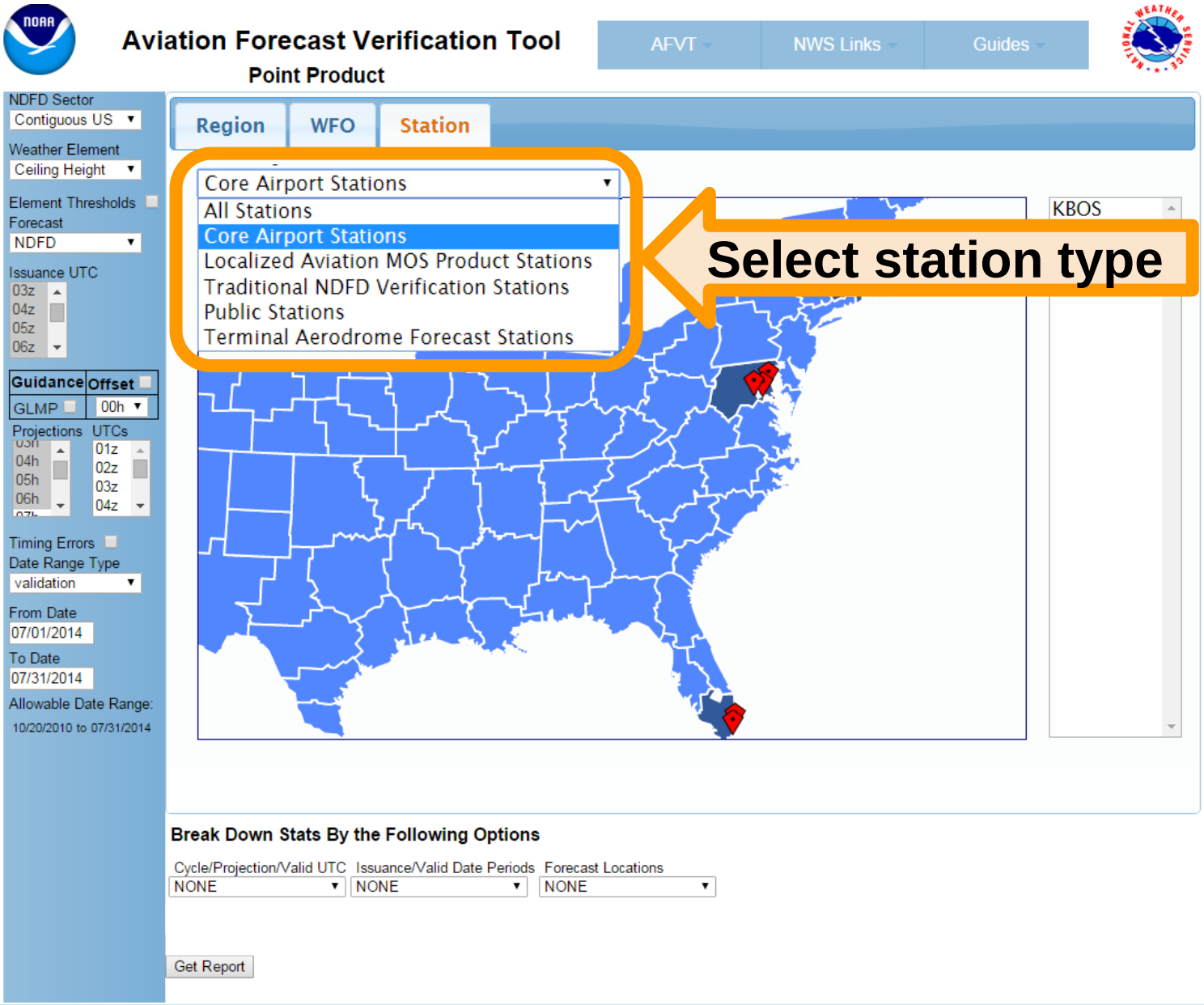

Aviation Forecast Verification Tool
Point Product
AFVT
NWS Links
Guides
NDFD Sector
Contiguous US
Weather Element
Ceiling Height
Element Thresholds
Forecast
NDFD
Issuance UTC
03z
04z
05z
06z
Guidance
Offset
GLMP
00h
Projections
UTCs
04h
05h
06h
01z
02z
03z
04z
Timing Errors
Date Range Type
validation
From Date
07/01/2014
To Date
07/31/2014
Allowable Date Range:
10/20/2010 to 07/31/2014
Region
WFO
Station
Core Airport Stations
KBOS
KIAD
KDCA
Select element and forecast
Break Down Stats By the Following Options
Cycle/Projection/Valid UTC
Issuance/Valid Date Periods
Forecast Locations
NONE
NONE
NONE
Get Report

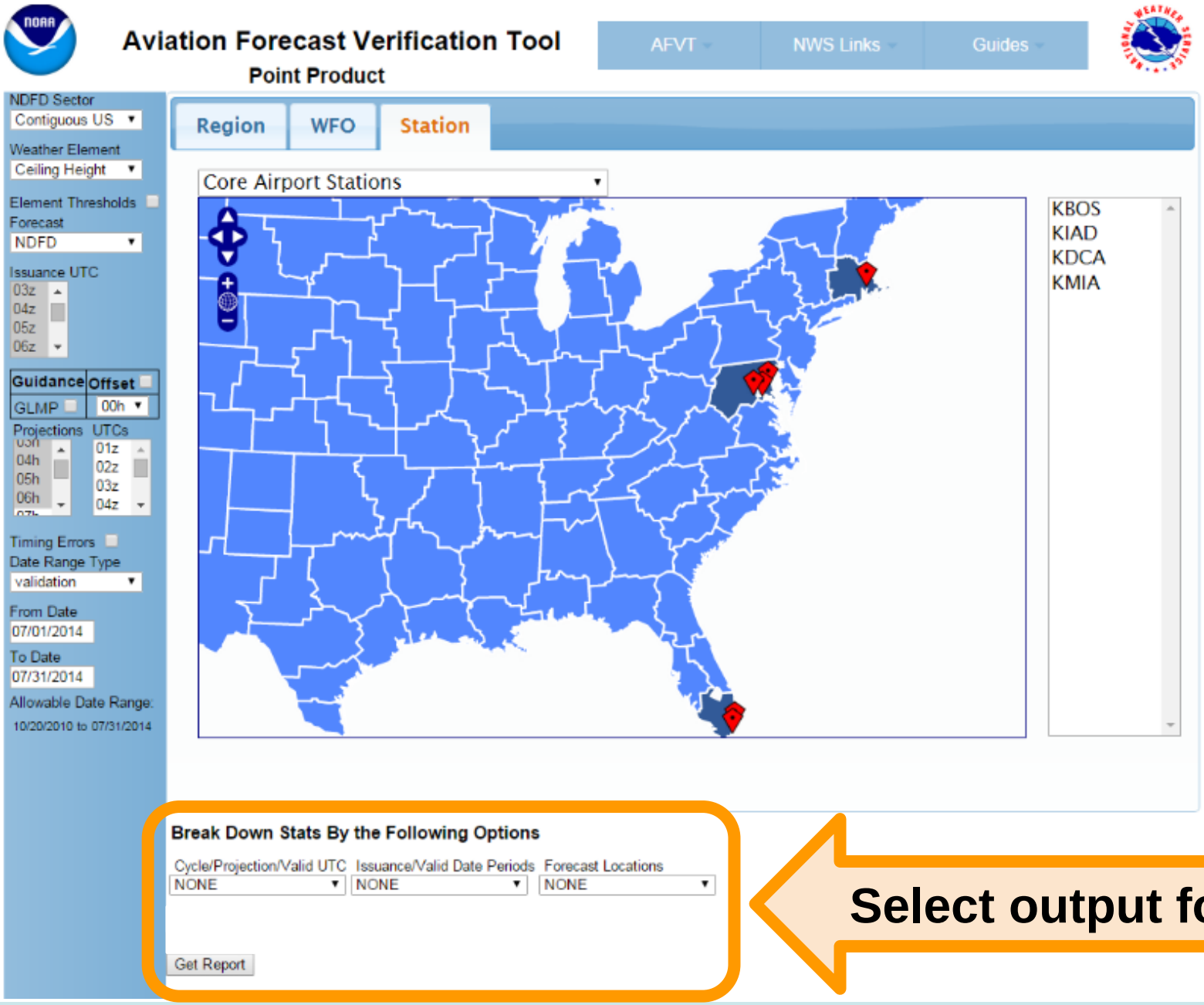

Aviation Forecast Verification Tool
Point Product
AFVT
NWS Links
Guides
NDFD Sector
Contiguous US
Weather Element
Flight Category
Element Thresholds
Forecast
NDFD
Issuance UTC
00z
01z
02z
03z
Guidance
Offset
GLMP
00h
Projections
UTCs
01h
02h
03h
04h
01z
02z
03z
Timing Errors
Date Range Type
validation
From Date
07/01/2014
To Date
07/31/2014
Allowable Date Range:
10/20/2010 to 07/31/2014
Region
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
Break Down Stats By the Following Options
Cycle/Projection/Valid UTC
Issuance/Valid Date Periods
Forecast Locations

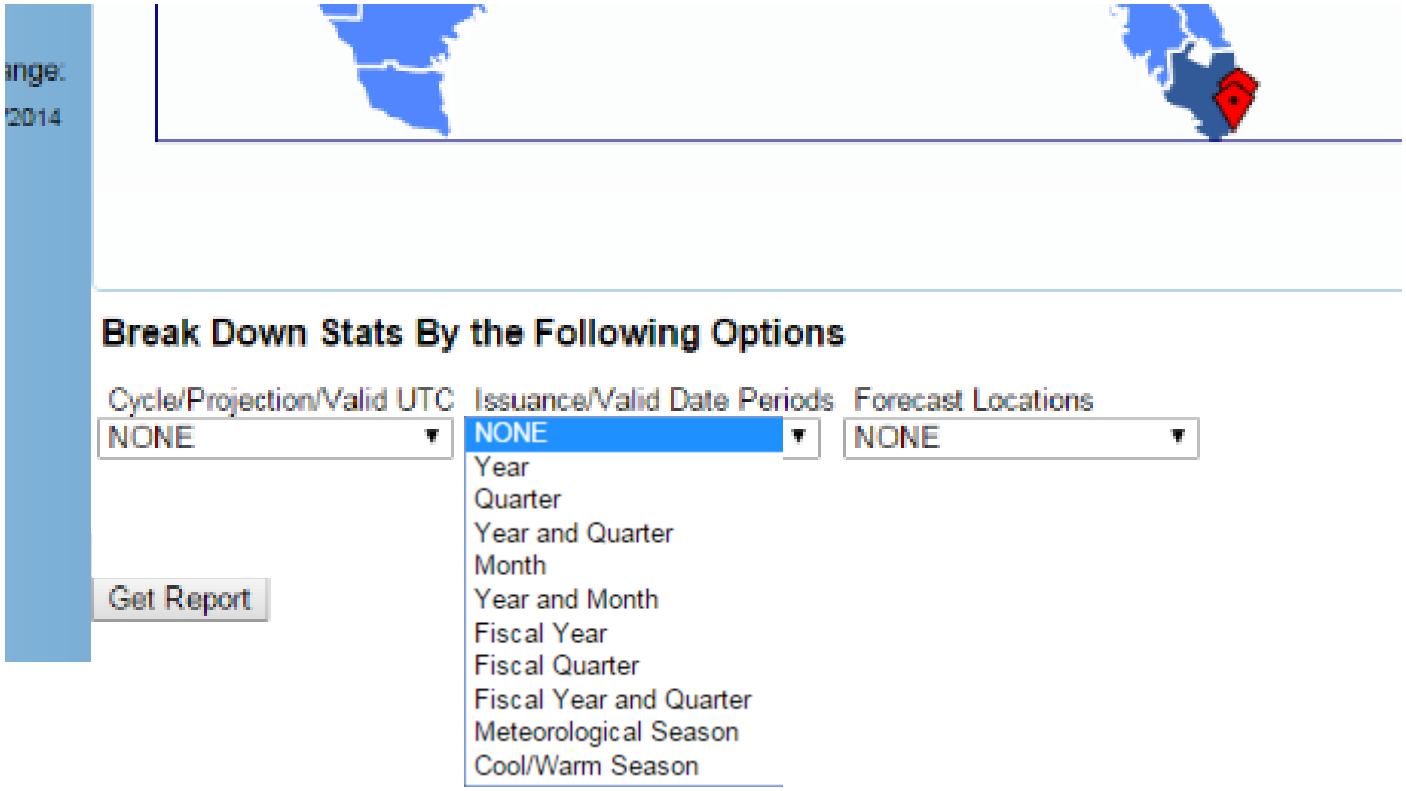

Aviation Forecast Verification Tool
Point Product
AFVT
NWS Links
Guides
NDFD Sector
Contiguous US
Weather Element
Ceiling Height
Element Thresholds
Forecast
NDFD
Issuance UTC
03z
04z
05z
06z
Guidance
Offset
GLMP
00h
Projections
UTCs
04h
05h
06h
01z
02z
03z
04z
Date Range Type
validation
From Date
07/01/2014
To Date
07/31/2014
Allowable Date Range:
10/20/2010 to 07/31/2014
Region
WFO
Station
Core Airport Stations
KBOS
KIAD
KDCA
KMIA
Select date range
Break Down Stats By the Following Options
Cycle/Projection/Valid UTC
Issuance/Valid Date Periods
Forecast Locations
NONE
NONE
NONE
Get Report


Forecast
NDFD
Issuance UTC
03z
04z
05z
06z
Guidance
Offset
GLMP
00h
Projections
UTCs
03h
04h
05h
06h
01z
Timing Errors
Date Range Type
validation
From Date
07/01/2014
To Date
07/31/2014
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.


Region
WFO
Station
These tabs select areas/locations. The options differ for grid-to-grid and grid-to-point (shown).
Core Airport Stations
KDCA
KMIA


Aviation Forecast Verification Tool
Point Product
AFVT
NWS Links
Guides
NDFD Sector
Contiguous US
Weather Element
Ceiling Height
Element Thresholds
Forecast
NDFD
Issuance UTC
03z
04z
05z
06z
Guidance
Offset
GLMP
00h
Projections
UTCs
04h
05h
06h
01z
02z
03z
04z
Timing Errors
Date Range Type
validation
From Date
07/01/2014
To Date
07/31/2014
Allowable Date Range:
10/20/2010 to 07/31/2014
Region
WFO
Station
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
KBOS
Break Down Stats By the Following Options
Cycle/Projection/Valid UTC
Issuance/Valid Date Periods
Forecast Locations
NONE
NONE
NONE
Get Report


Aviation Forecast Verification Tool
Point Product
AFVT
NWS Links
Guides
NDFD Sector
Contiguous US
Weather Element
Ceiling Height
Element Thresholds
Forecast
NDFD
Issuance UTC
03z
04z
05z
06z
Guidance
Offset
GLMP
00h
Projections
UTCs
04h
05h
06h
01z
02z
03z
04z
Timing Errors
Date Range Type
validation
From Date
07/01/2014
To Date
07/31/2014
Allowable Date Range:
10/20/2010 to 07/31/2014
Region
WFO
Station
Core Airport Stations
KBOS
KIAD
KDCA
KMIA
Break Down Stats By the Following Options
Cycle/Projection/Valid UTC
Issuance/Valid Date Periods
Forecast Locations
NONE
NONE
NONE
Get Report
Select output format



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

Aviation Forecast Verification Tool

Point Product

AFVT | NWS Links | Guides

NDFD Sector: Contiguous US

Weather Element: Ceiling Height

Element Thresholds

Forecast: NDFD

Issuance UTC: 07z 08z 09z 10z

Guidance: GLMP | Offset: 00h

Projections: 08h 09h 10h 11h | UTCs: 01z 02z 03z 04z

Timing Errors

Date Range Type: validation

From Date: 07/01/2014

To Date: 07/31/2014

Allowable Date Range: 10/20/2010 to 07/31/2014

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 LOCATIONS(STATION)	KBOS,KDCA,KIAD,KMIA
STATION TYPE	Core Airport Stations
STATS BROKEN DOWN BY	NONE

[Graphical Report] [Text Report]

Toggle Contingency Table Format (Count/Percent):

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

Show/Hide Scoring Matrix:

CONTINGENCY TABLE

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

CATEGORICAL BIAS

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
Bias	0.00	1.35	1.93	0.55	3.46	1.98

SCORING MATRIX

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
0 to 100	108.8142	16.5761	6.8668	2.4394	0.8978	-0.202
200 to 400	16.5761	16.7191	7.0099	2.5824	1.0409	-0.059
500 to 900	6.8668	7.0099	7.1549	2.7274	1.1859	0.085
1,000 to 1,900	2.4394	2.5824	2.7274	2.8751	1.3335	0.233
2,000 to 3,000	0.8978	1.0409	1.1859	1.3335	1.4909	0.390
3,100 to 6,500	-0.2025	-0.0594	0.0856	0.2332	0.3907	0.554
6,600 to 12,000	-0.7163	-0.5733	-0.4283	-0.2806	-0.1232	0.041
12,100 to 25,000	-1.0000	-0.8569	-0.7119	-0.5643	-0.4069	-0.242

GERRITY SKILL SCORE AND PERCENT CORRECT

Gerrity Skill Score

Percent Correct (%)

Pct Forecasts with Errors off by More Than One Category(%

Aviation Forecast Verification Tool

Point Product

AFVT | NWS Links | Guides

NDFD Sector: Contiguous US

Weather Element: Ceiling Height

Element Thresholds

Forecast: NDFD

Issuance UTC: 07z 08z 09z 10z

Guidance: GLMP | Offset: 00h

Projections: 08h 09h 10h 11h | UTCs: 01z 02z 03z 04z

Timing Errors

Date Range Type: validation

From Date: 07/01/2014

To Date: 07/31/2014

Allowable Date Range: 10/20/2010 to 07/31/2014

Grid-to-Point Aviation Forecast Verification Report

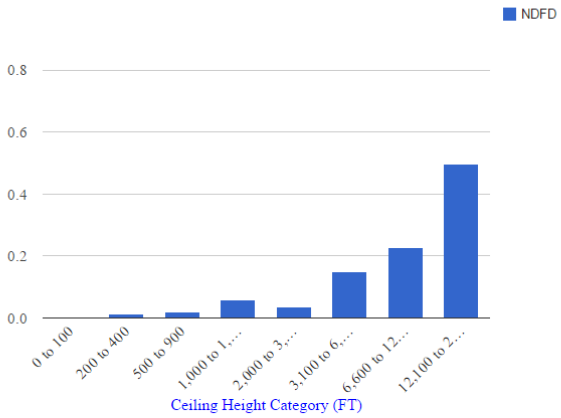
SUMMARY OF REQUEST

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 LOCATIONS(STATION)	KBOS,KDCA,KIAD,KMIA
STATION TYPE	Core Airport Stations
STATS BROKEN DOWN BY	NONE

[Graphical Report] [Text Report]

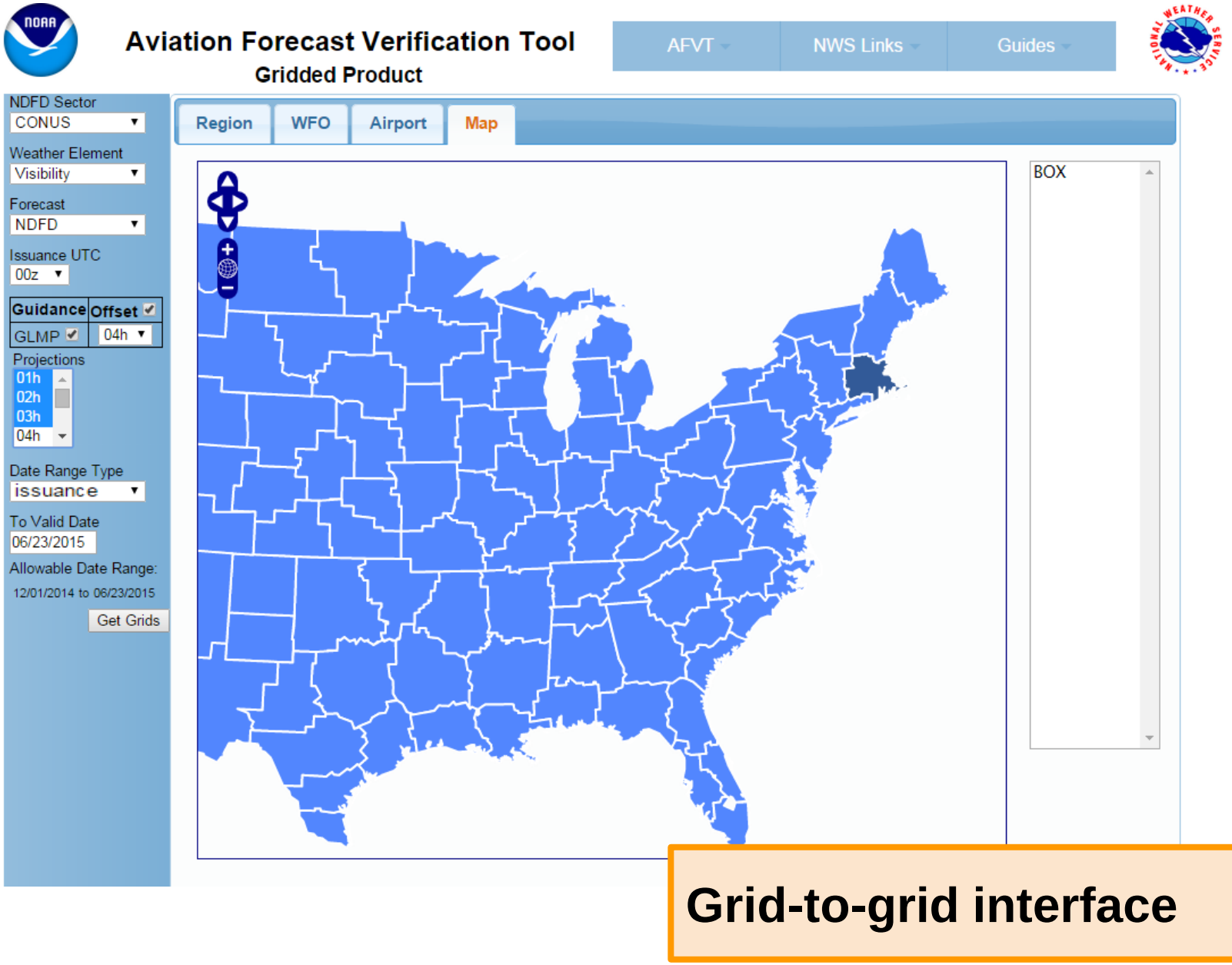
Select Stat(s): All Available Stats

Observed Frequency for Selected Sample



Categorical Forecast Bias

Results can be shown as text or graphics



Grid-to-grid interface

Aviation Forecast Verification Tool

Gridded Product

AFVT | NWS Links | Guides

NDFD Sector: CONUS

Weather Element: Visibility

Forecast: NDFD

Issuance UTC: 00z

Guidance	Offset
GLMP	04h

Projections: 01h, 02h, 03h, 04h

Date Range Type: issuance

To Valid Date: 06/13/2015

Allowable Date Range: 12/01/2014 to 06/23/2015

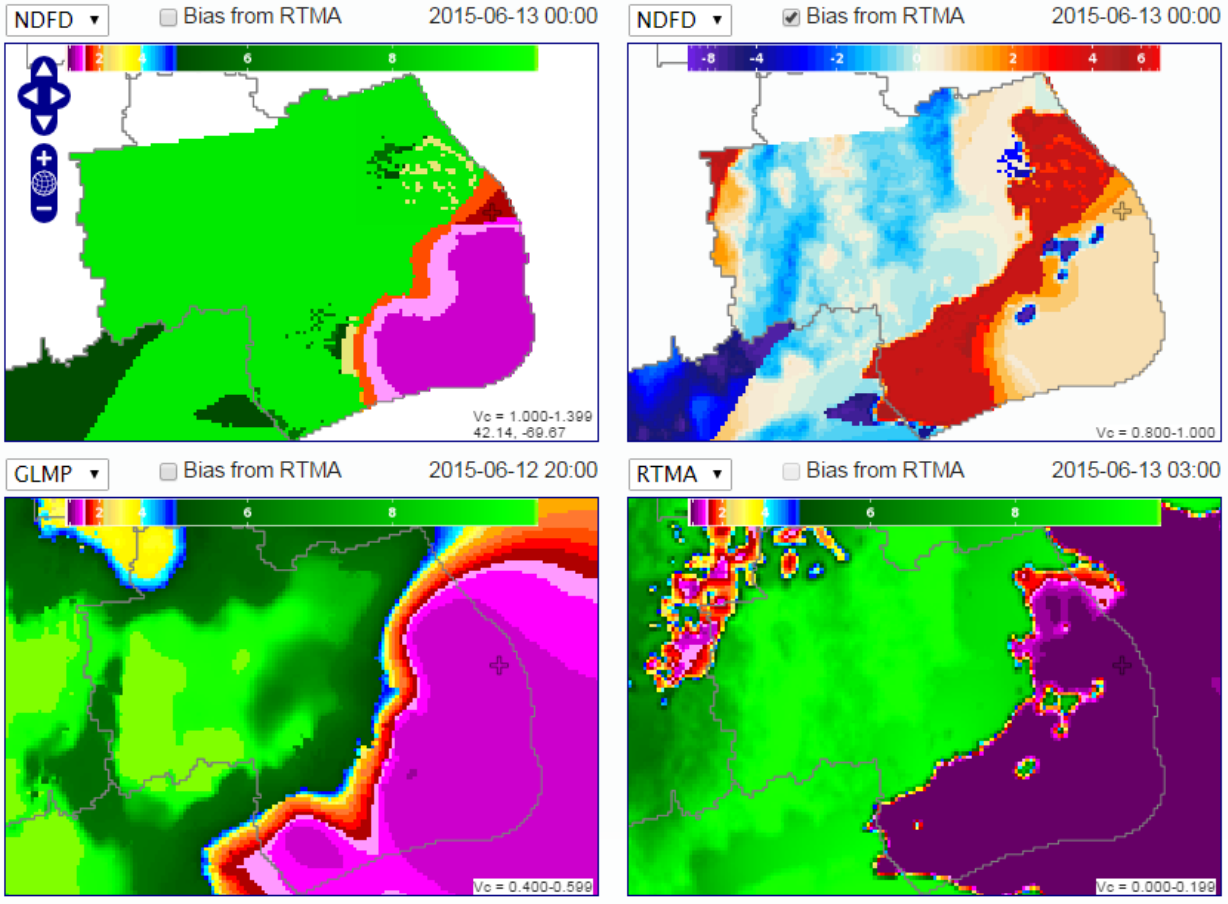
Get Grids

Region | WFO | Airport | Map

WFO:

1hr 2hr 3hr

Valid time: 2015-06-13 03:00



Live Demonstration

Long term point: NDFD visibility from Jan 1, 2014 to June 30, 2014 for Eastern Region. 0-6z issuances, first 12 hours for each forecast, issuance based.

Aggregated Gridpoints: Airport (75 NM radius around). Visibility, NDFD, 6Z, 1-12 projections, July 1 - 31. Dulles

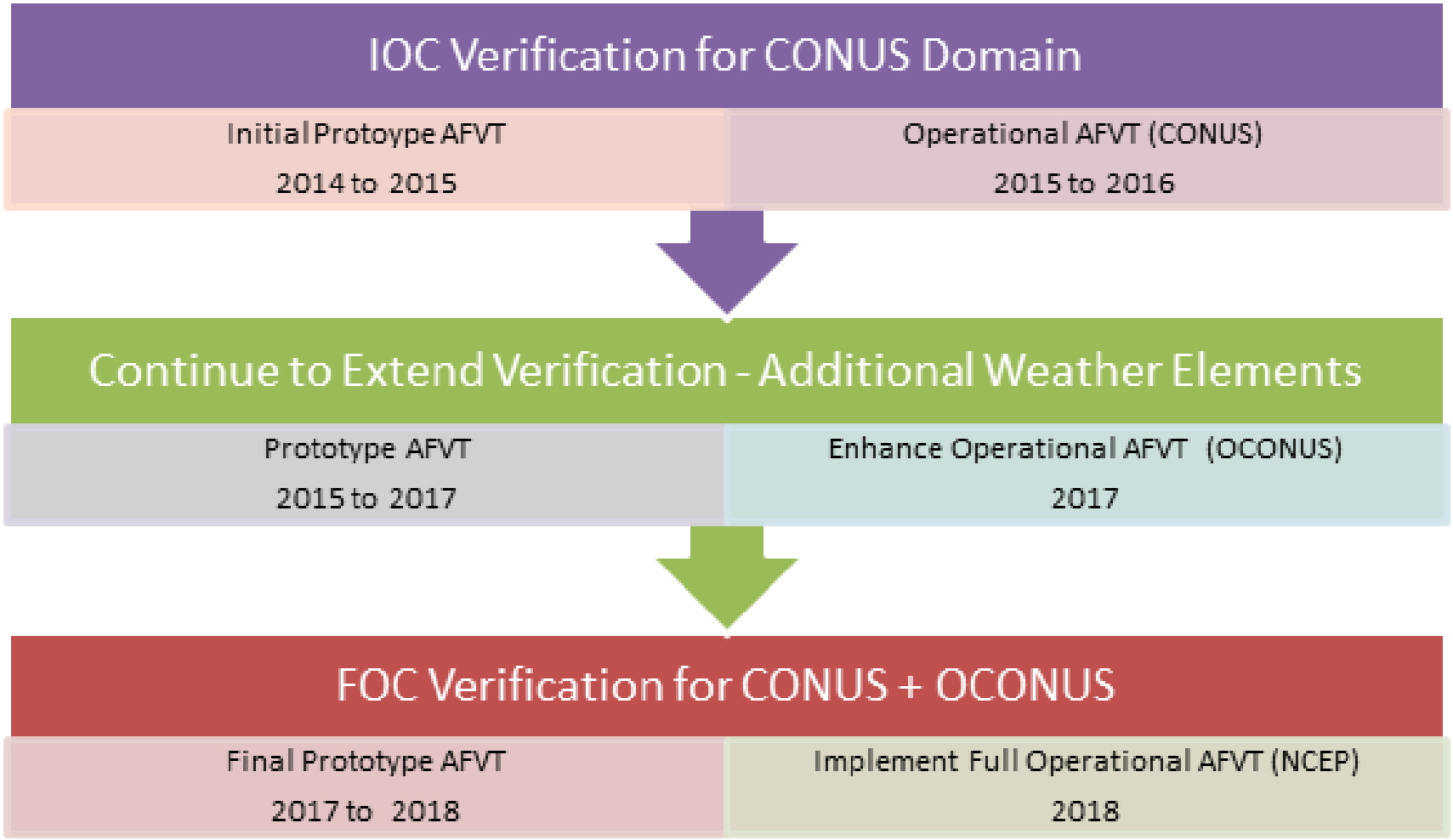
Gridded forecast case: May 9th - LWX, 9z issuance, 6hrs, vis. Shows very low visibility and cessation of the visibility. Forecasters hit low-vis spots.

Future plans

Development continues:

- Additional weather elements
- Expanding to Alaska, Hawaii, Puerto Rico, Guam
- Additional statistics and tools for gridded map product
  - Monthly grid point by grid point statistics
  - Error distribution charts
  - Time graphs from selections
- Transitioning to NWS operations in IDP
- Performance optimizations

AFVT Implementation in Integrated Dissemination Program (IDP)



Questions