# **INSITE: IDSS for Aviation Weather**

NOAA/OAR/ESRL/GSD/ Forecast Impact and Quality Assessment Section 8 June 2019

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## Impact-based Decision Support (or IDSS)



#### **Key Forecaster Responsibilities**

- Maintain continuous awareness of meteorological conditions as they pertain to aviation decisions
- Determine accuracy and confidence in existing weather predictions as they pertain to aviation decisions
- Update forecast as needed to support aviation decisions

#### **Impact-based Decision Support**



\*INSITE: INtegrated Support for Impacted air Traffic Environments

## Flow Constraint Index (FCI)



#### • Hexagonal Grid with 80 x 40 nmi corridors

- Approximates width of jet routes
- Captures sensitivity to orientation of hazard
- Allows FCI aggregation over any desired region (e.g., ARTCCs, potential TCF polygons)



## Flow Constraint Index (FCI)

- Blue lines: Corridor boundaries.
- Red area: Area of hazardous weather.
- Arrow A: Distance across corridor in absence of hazards.
- Arrows B and C: Distance across the available airspace around a hazard.
- Flow constraint is ...
  - 1- (Mincut<sub>Hazard</sub>/Mincut<sub>Corridor</sub>)
- Apply weighting scheme (traffic density)
- FCI of 1.0 corresponds to most constrained, 0.0 corresponds to none.
- Can compute FCI for any type of forecast (probabilistic, deterministic)



## **FCI in INSITE**



## Why Use INSITE?



06/8/19

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INSITE INtegrated Support for Impacted air-Traffic Environments		
Auto Update 🕅	Reference Time: 05/20/2019 🚨 2300 🕋 🐼 泌	Traffic density selection
Overview Constraint	HRRR Constraint 2019-05-20 2000 UTC Lead 3	frame defisity selection
Alert Dashboard ARTCCs - Help	$\frown$	Historical Traffic         Local Normalized         Legend
	Provide the second seco	HRR Constrain CIWS Constrain
	Airway Overlays Other Overlays Product Navigation Placement	





# August 8, 2018 Case



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#### Observations 2018-08-09 0600 UTC Lead 0



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#### **INSITE Activities**

- Web application available to anybody.
- Constraint fields can be made available to CWSUs on AWIPS workstations.
  - Currently at 2 CWSU offices (ZKC and ZDC).
  - Supported by AWC.
  - AWIPS (Advanced Weather Interactive Processing Systems)
- Ongoing work to transfer INSITE to NWS operations so it is available on all AWIPS workstations.
- Working on integrating INSITE constraint fields into WAVE (Weather Archive and Visualization Environment).



# **Extra Slides**

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#### **INSITE 101**

- Images of observations or forecasts of convection, and their derived constraint, are provided for visualizing evolving weather impacts
- Forecasts and observations are converted into airspace constraints using a technique known as the Flow Constraint Index (FCI), weighted by traffic density
- Confidence in the forecast constraint is provided
- Differing forecast solutions are blended using forecast performance information (synthesis)
- Users are able to investigate constraint for specific regions of interest

## Flow Constraint Index (FCI)

- For INSITE, the flow is through a grid of hexagons, passing through each hexagon in one of three directions.
- This flow constraint is multiplied by the expected air traffic along the corridor.
- The FCI is the product of weather and traffic information.



## **Constraint (Heat) Maps**



#### **Constraint and Confidence**



## Constraint and Confidence (or Consistency) bars (CC bars) are provided on the left side

#### **Constraint information**

- Colored boxes represent summary airspace constraint over a specific region at a particular time
  - Top row: airspace constraint derived from the selected forecast product
  - Bottom row: constraint derived from observations
- Reference hour is in red (13 UTC) and represents the 'current' time
  - Observation information is provided up to and including reference time
  - Forecast information (out to 12 hours) is derived from:
    - the most recent forecast available as of the reference time, for valid times after the reference time
    - the shortest lead time forecast valid at the indicated hour, for valid times up to and including the reference time.

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#### **Constraint and Confidence**

#### U.S. Department of Commerce | National Oceanic & Atmospheric Administration | NOAA Research | | SITE Ntegrated Support for Impacted air-Traffic Environments Auto Update **Overview Constraint** Alert Dashboard ARTCCs - Help Valid Hour (UTC) 19 20 21 22 23 00 01 02 03 04 05 06 07 08 09 10 11 Details Kansas City (KZKC) Oetails Fort Worth (KZFW) Details Minneapolis (KZMP) Oetails Chicago (KZAU) Oetails Denver (KZDV) Details Albuquerque (KZAB)

#### **Confidence Information**

- Embedded within each of forecast constraint boxes is a dark horizontal line (range = 0 to 1) which
  - For the individual forecast products, indicates the <u>level of</u> <u>confidence</u> in the forecast
  - For the synthesis product, indicates the <u>level of agreement</u> (consistency) between the constituent forecasts
- Confidence is based on long-term historical performance of the forecast products, and also includes a prolonged forecast latency penalty

#### **Synthesis Product**



- Synthesis is a blended view of constraint due to convective weather
- Each of the individual forecasts is converted to constraint using FCI
- Weights and calibrations are applied using statistical considerations such as historical performance and intermodel consistency
- There are two synthesis products

## **Constraint and Consistency**

# Voltage Valid Hour (UTC) 19 20 21 22 23 00 01 02 03 04 05 06 07 08 09 10 11 Kansas City (KZKC)

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For the synthesis product, Constraint and *Consistency* (vs. Confidence) information is provided via CC bars:

- Constraint information is similar to that of the individual forecast products
- Consistency is based on agreement between the constituent forecast products (as measured by their own predictions of constraint).
- The consistency is shown as a black line within the colored forecast bar.
- Example: if one of the 6 forecasts has high constraint, and high confidence, and the other 5 have low constraint and low confidence, the synthesis will have high constraint and low consistency.

#### **Current or Historical Traffic**

- Heat maps based on current traffic can provide information as to the location and onset of convective weather that impacts air traffic
- Heat maps based on current traffic will, after air traffic management actions are taken, show lesser FCI.
- Heat maps based on historical traffic can provide information as to when traffic can return to normal.