INSITE – AN IDSS TOOL FOR AVIATION

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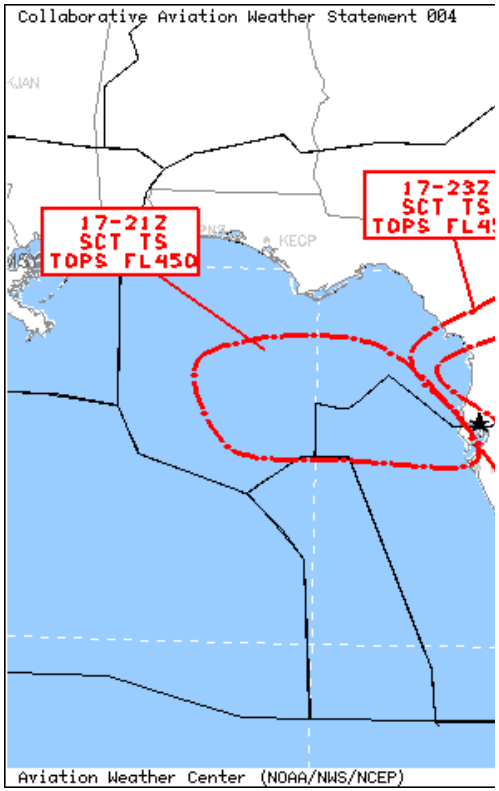
VLab Forum

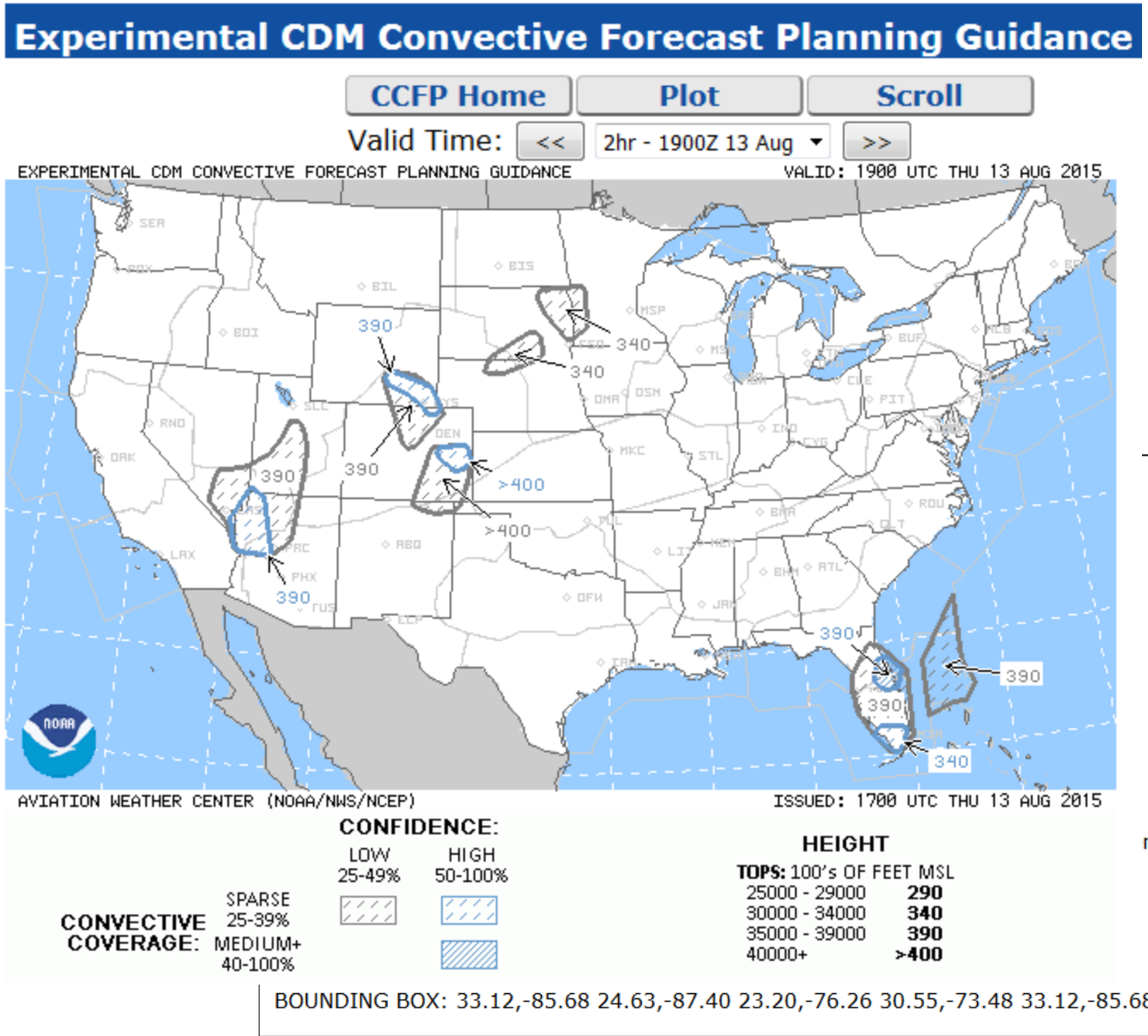
17 February 2016

Forecast Impact and Quality Assessment Section

- Mission: Advance the understanding and use of weather information through impact-based assessments and targeted information delivery to benefit decision making in response to high-impact weather events
- Sponsors
  - NWS: NextGen Program and Aviation and Space Weather Services Branch
  - FAA: Aviation Weather Research Program (QA PDT)
- Activities
  - Independent quality assessments
  - Verification in operational context
  - Technologies

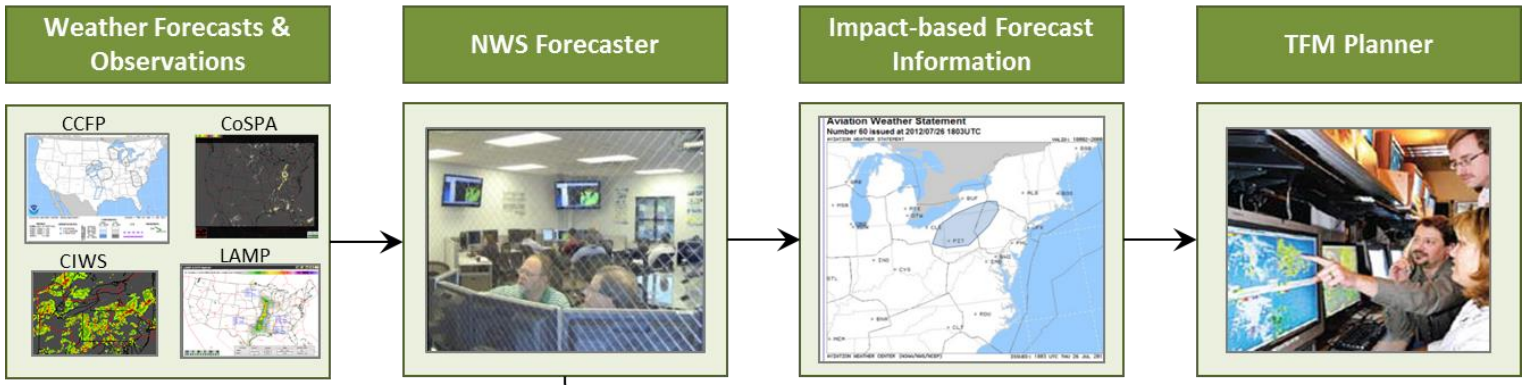
Collaborative Aviation Weather Statement (CAWS)





INSITE

- Development sponsored by NWS NextGen Program
  - Aligned with NWS Weather Ready Nation initiative of Impact-based Decision Support Services

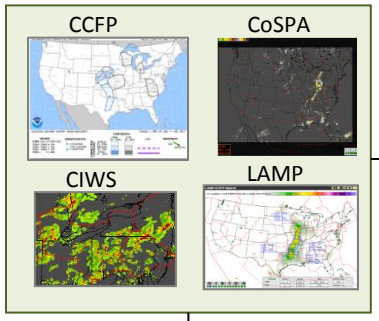


Key Forecaster Responsibilities

- 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

Weather Forecasts & Observations



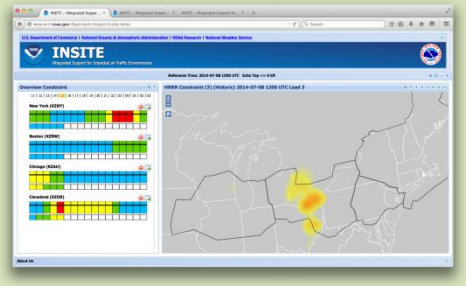
NWS Forecaster

Impact-based Forecast Information

TFM Planner

A weather decision service for common situational awareness and forecast preparation

INSITE



Weather Forecasts, Observations

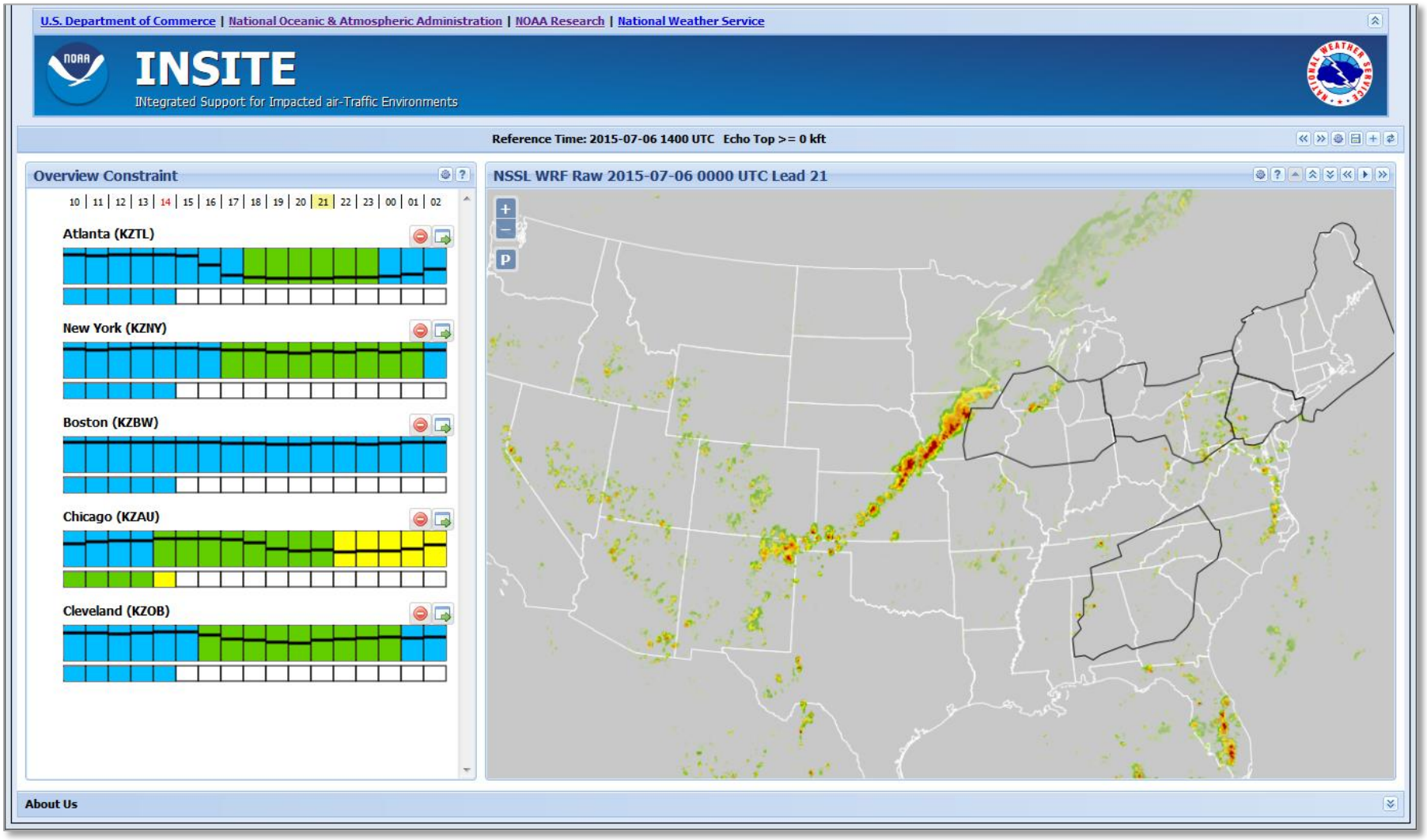
Decision Criteria Traffic Flow Information

INSITE: INtegrated Support for Impacted air Traffic Environments

INSITE Features

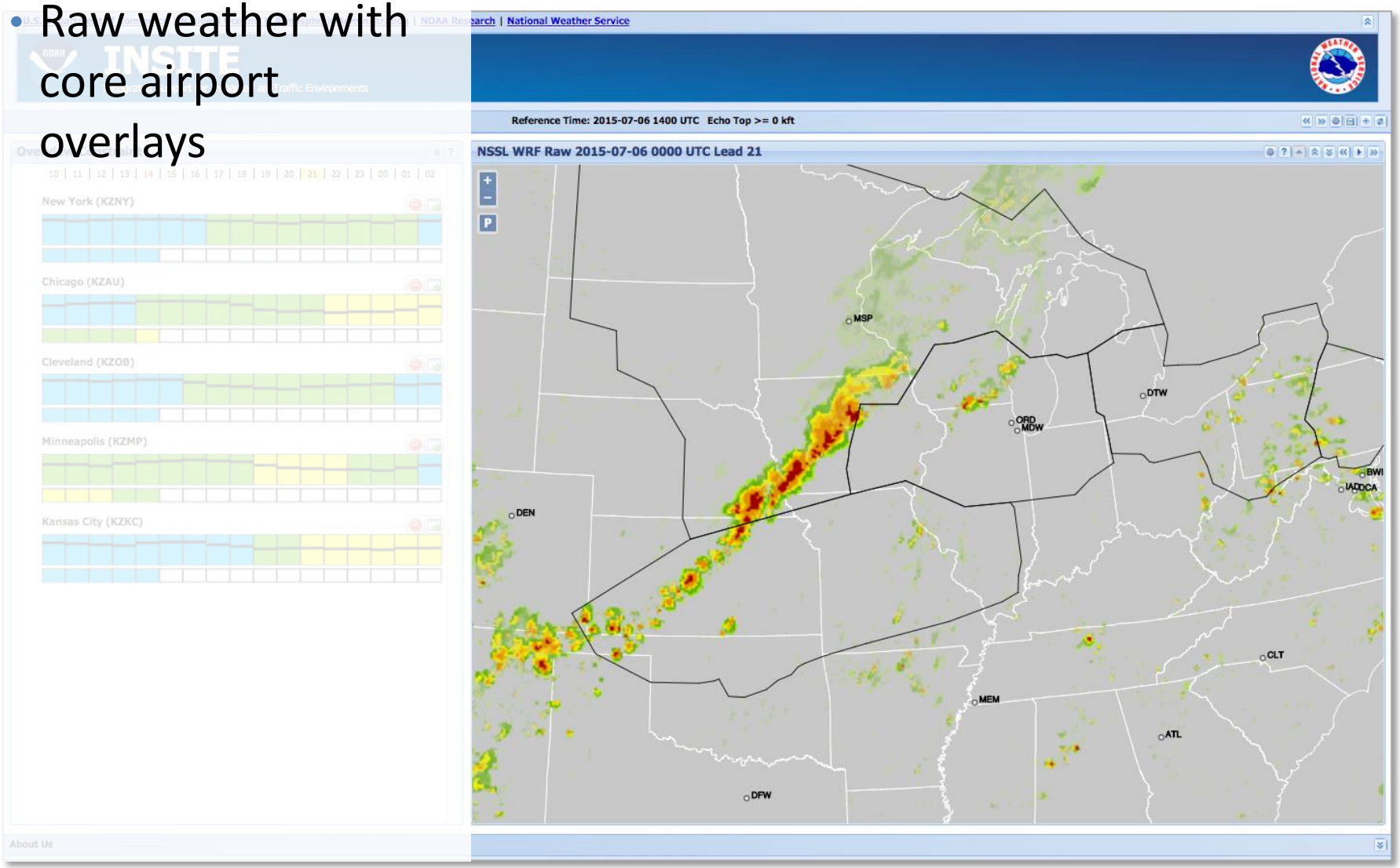
- Features support forecaster identification of convective weather potentially impactful to air traffic
- Several convective forecast products, plus observations
- Overlays of routes and Control Centers (ARTCCs)
- Airspace constraint fields (Flow Constraint Index) derived from blend of weather and traffic data
- Confidence information for forecast constraint
- Displays of both raw weather and constraint fields
- 'Synthesis' product, where different forecast products are blended into a single forecast of constraint using performance information
- Summary constraint information for regions of interest (default ARTCCs or user-drawn)
  - Drill-down capabilities to identify potential impacts to related routes or ARTCCs
- Historical playback feature to review past events

INSITE – Main Page



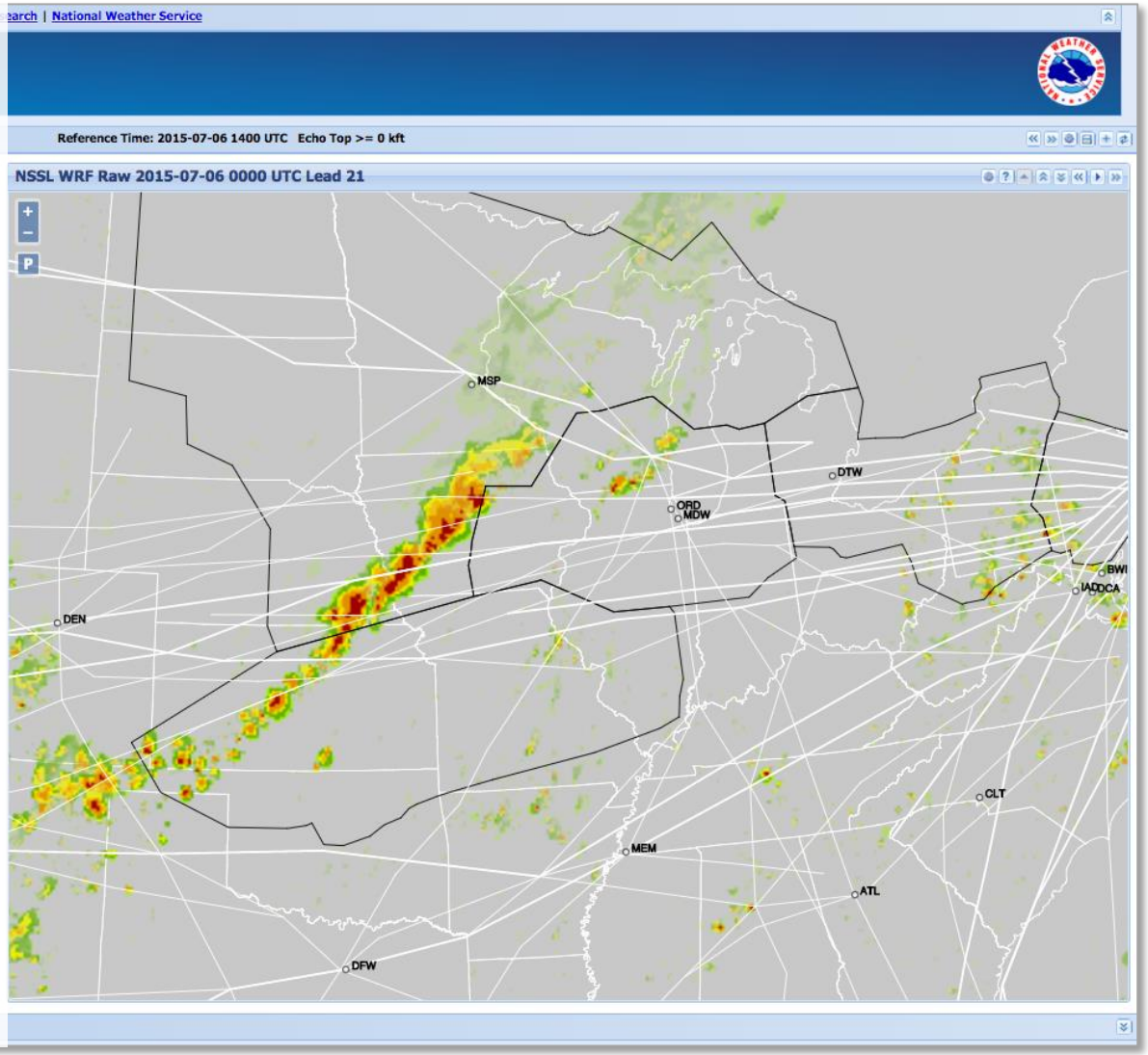
INSITE

- Raw weather with core airport overlays



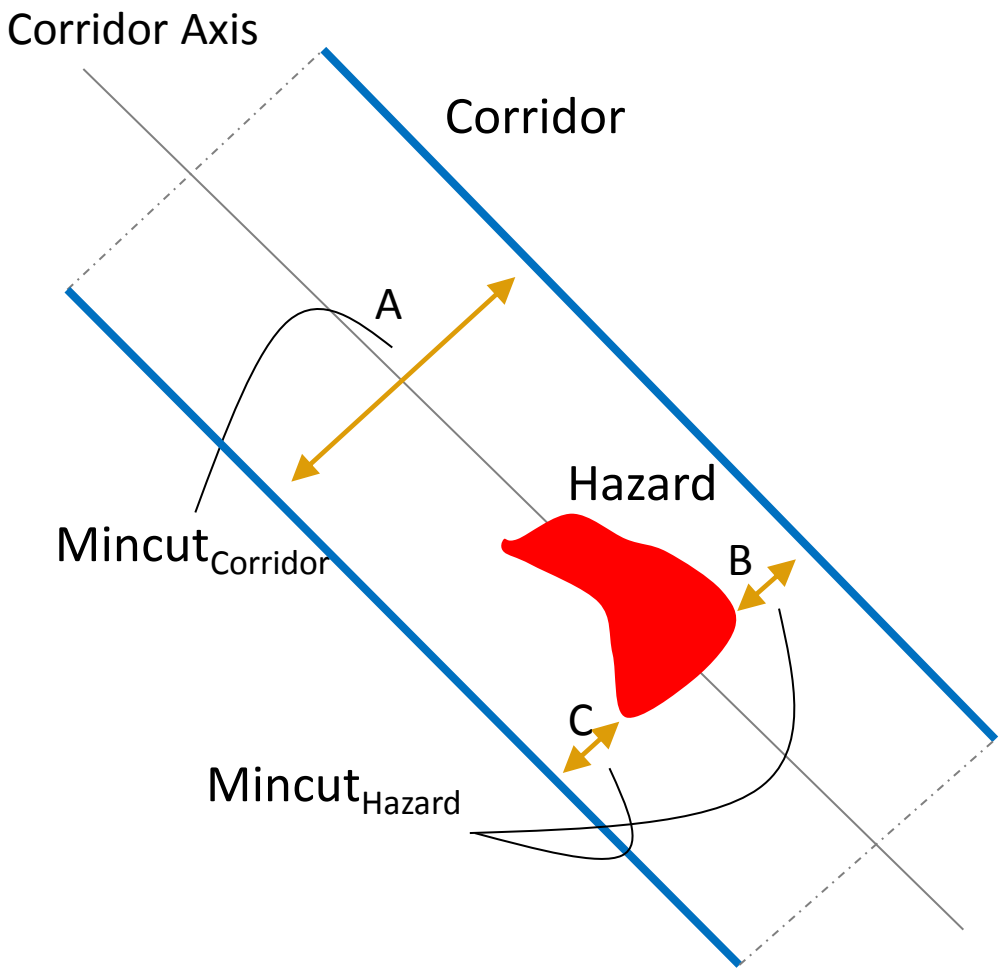
INSITE

- Raw weather graphics and route overlays indicate this line of convection could be impactful to East-West traffic
- INSITE provides a metric that is a quantitative measure of how much impact is likely

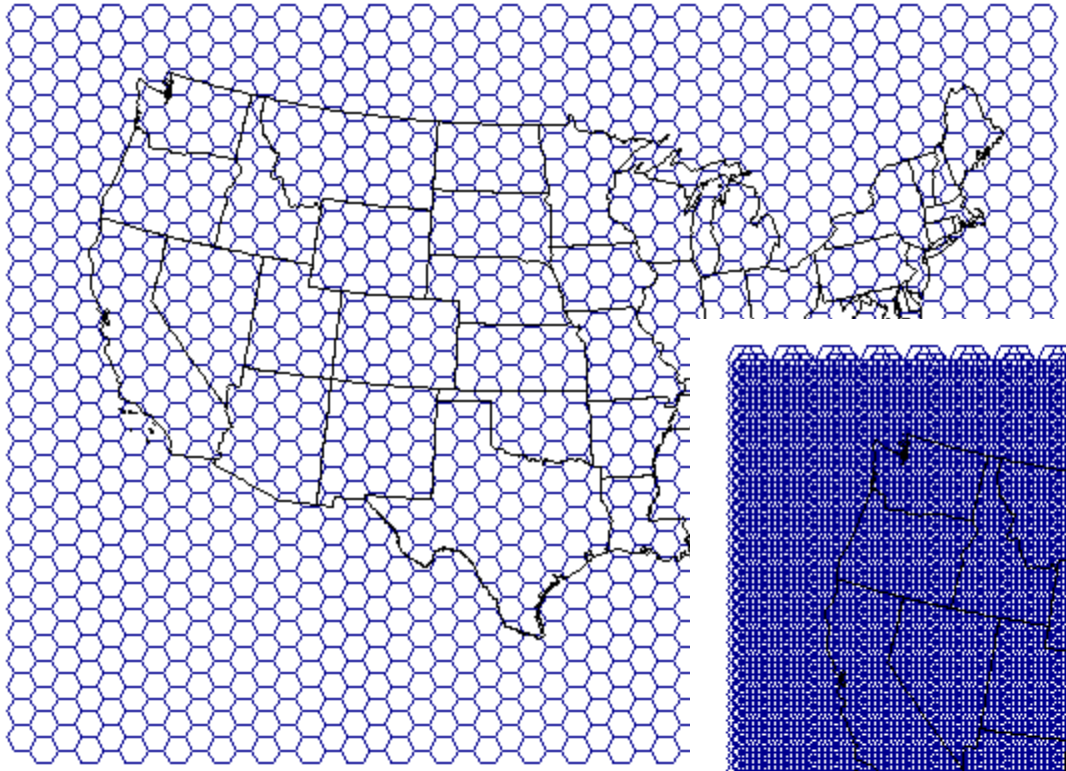


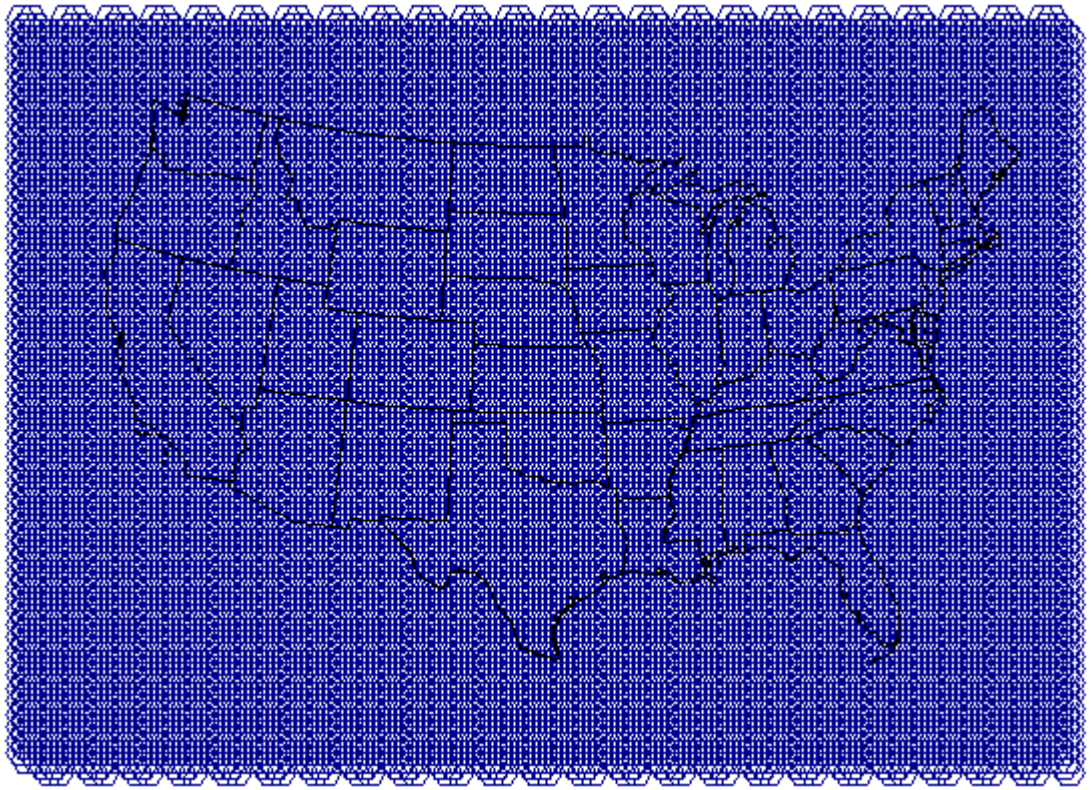
Flow Constraint Index (FCI)

- 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 $1- (Mincut_{Hazard}/Mincut_{Corridor})$
- 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)

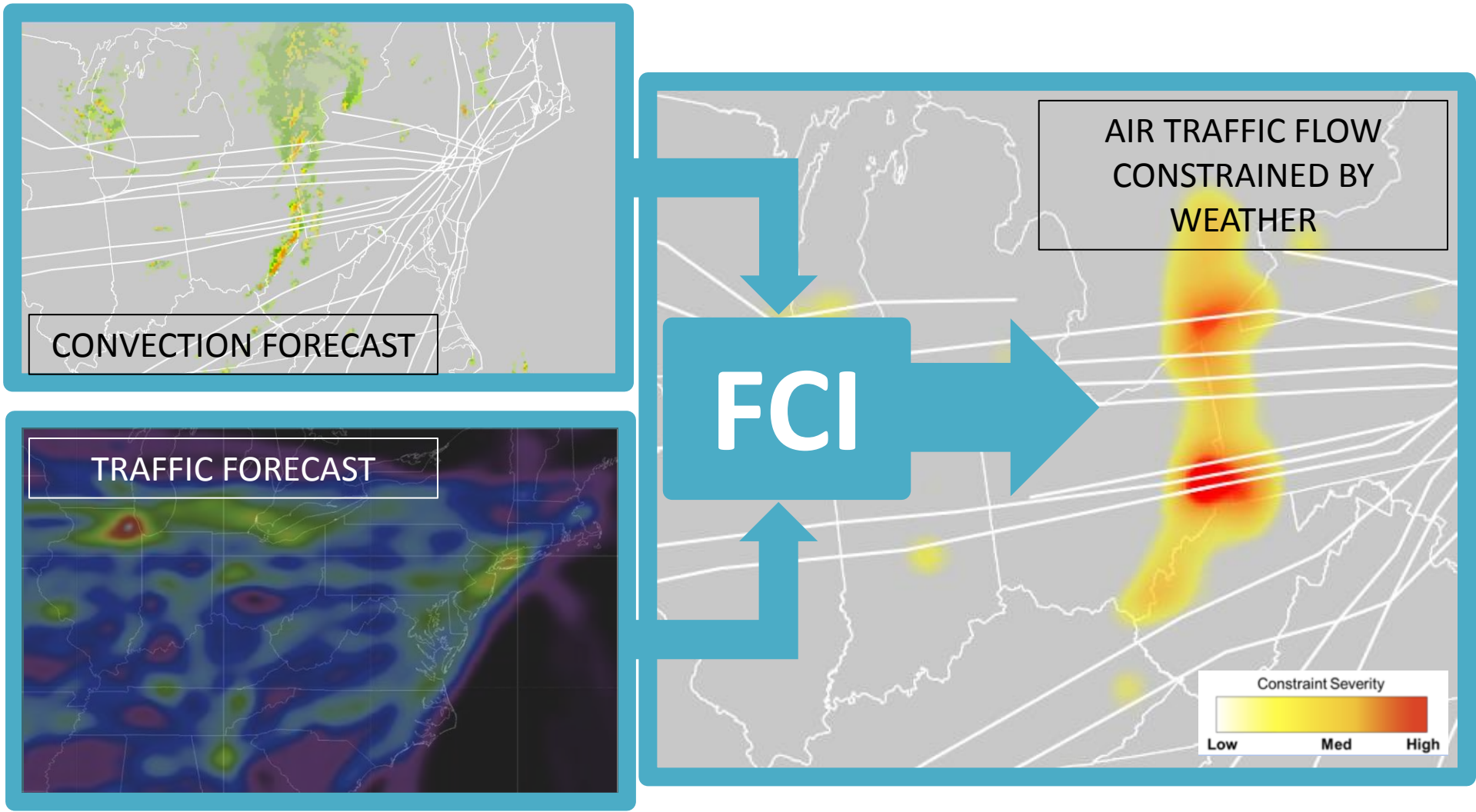


FCI Hexagonal Grid



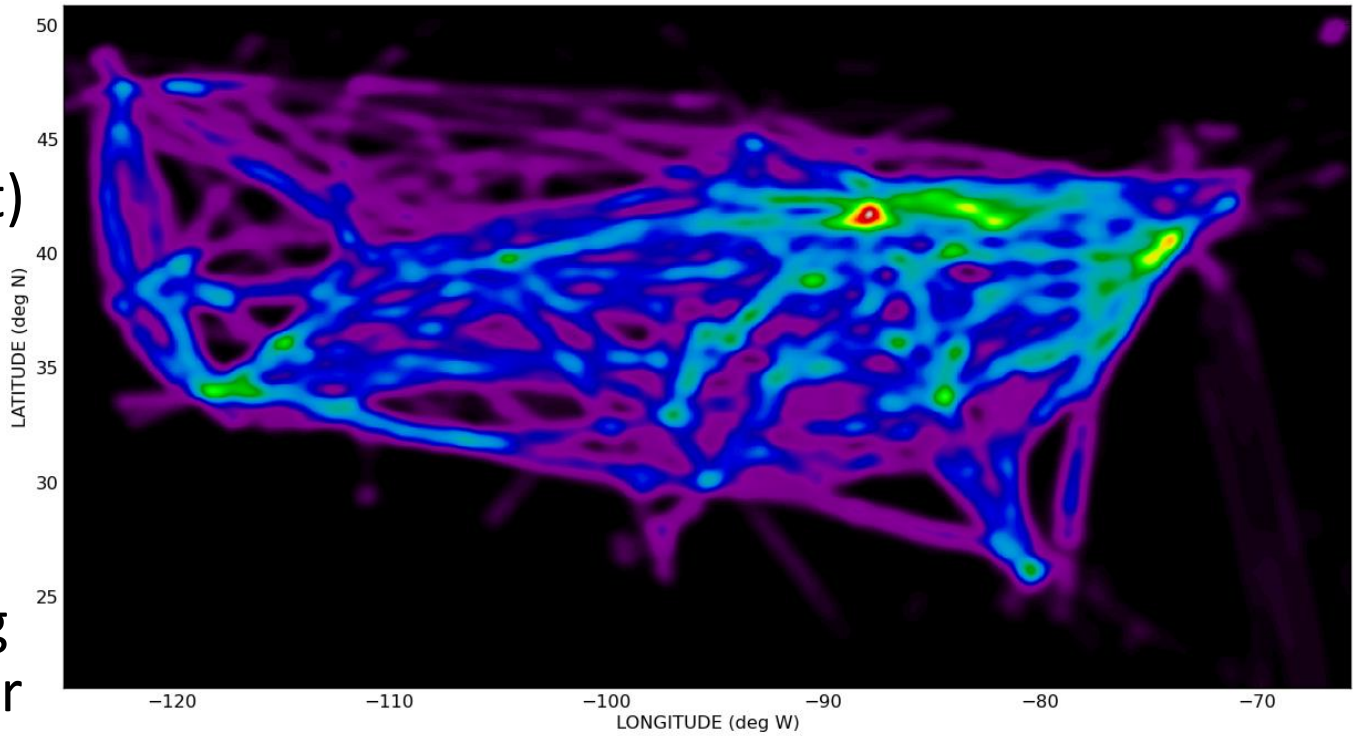


FCI Example in INSITE



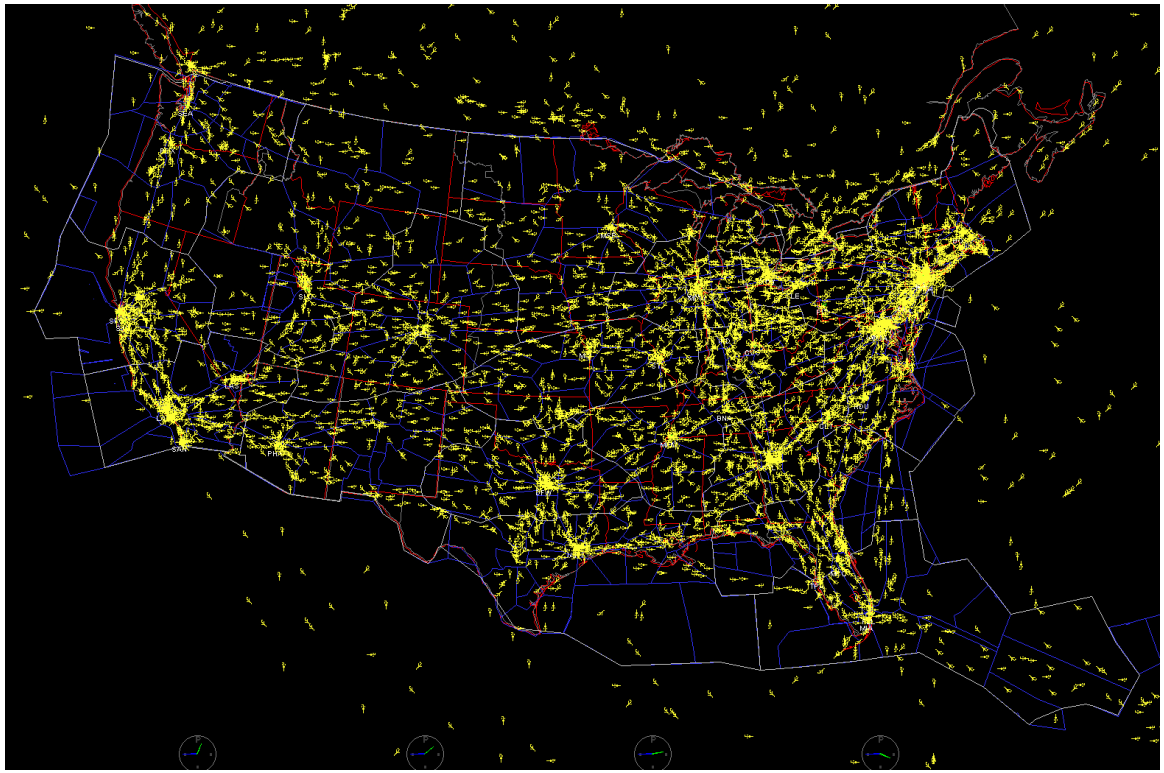
FCI Traffic Weighting – Historic Data

- ASDI Data from 2014 convective season (May-Sept)
- Flights corresponding to major carriers, operating at OEP 35 airports
- Data representing ‘ideal scenario’ for standard routes
  - Clear air days
  - First flight plan
- Traffic density stratified by day of week and hour of day



FCI Traffic Weighting – Current Data

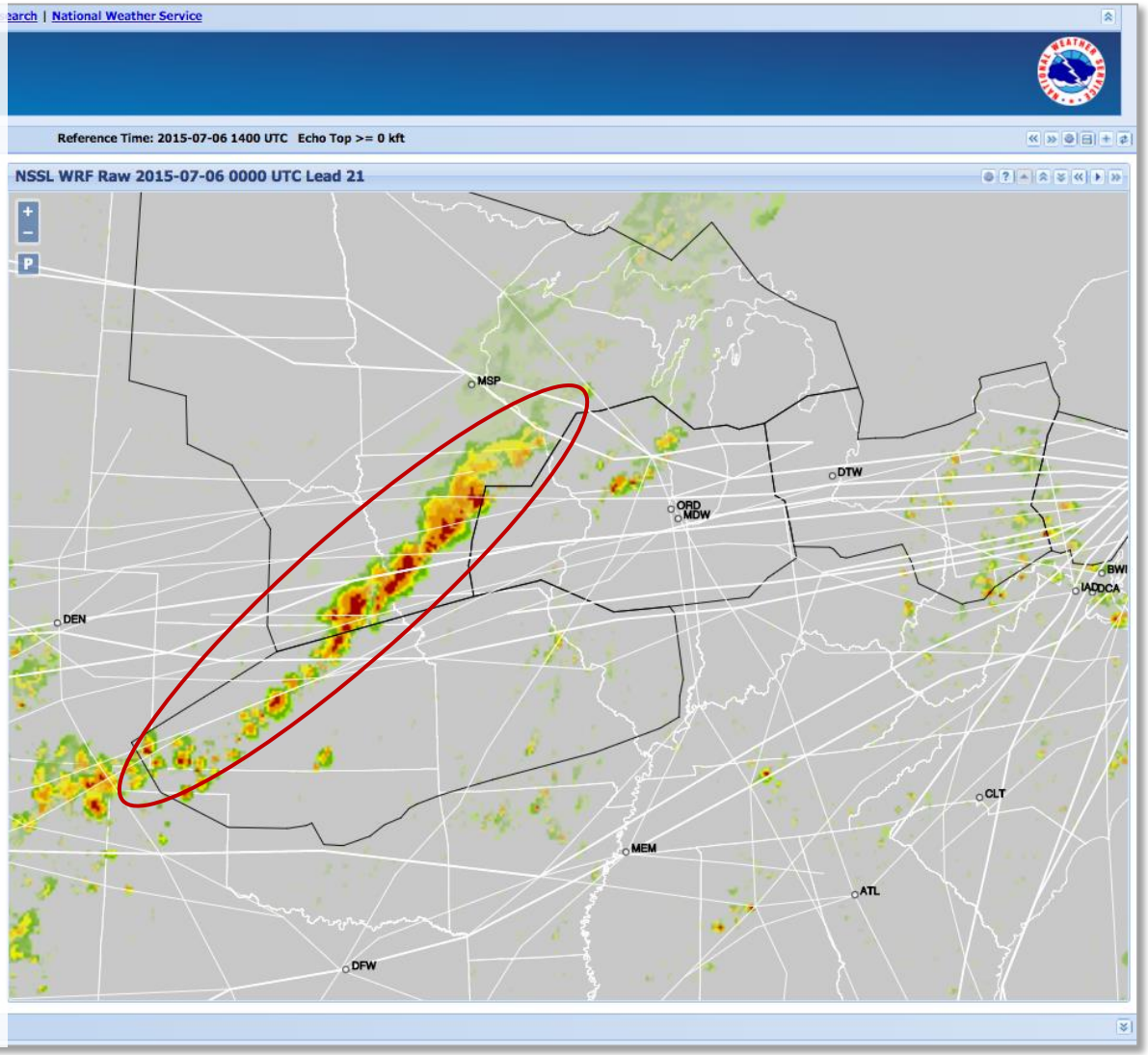
- Ingest real time air traffic from the ASDI data set
- Determine the set of most recent flight plans, planned aircraft locations
- Incorporate 'planned' traffic density into the FCI



A FACET snapshot of air traffic over the United States on July 10, 2006, at 2:45 p.m. EST.
Image Credit: NASA Ames Research Center

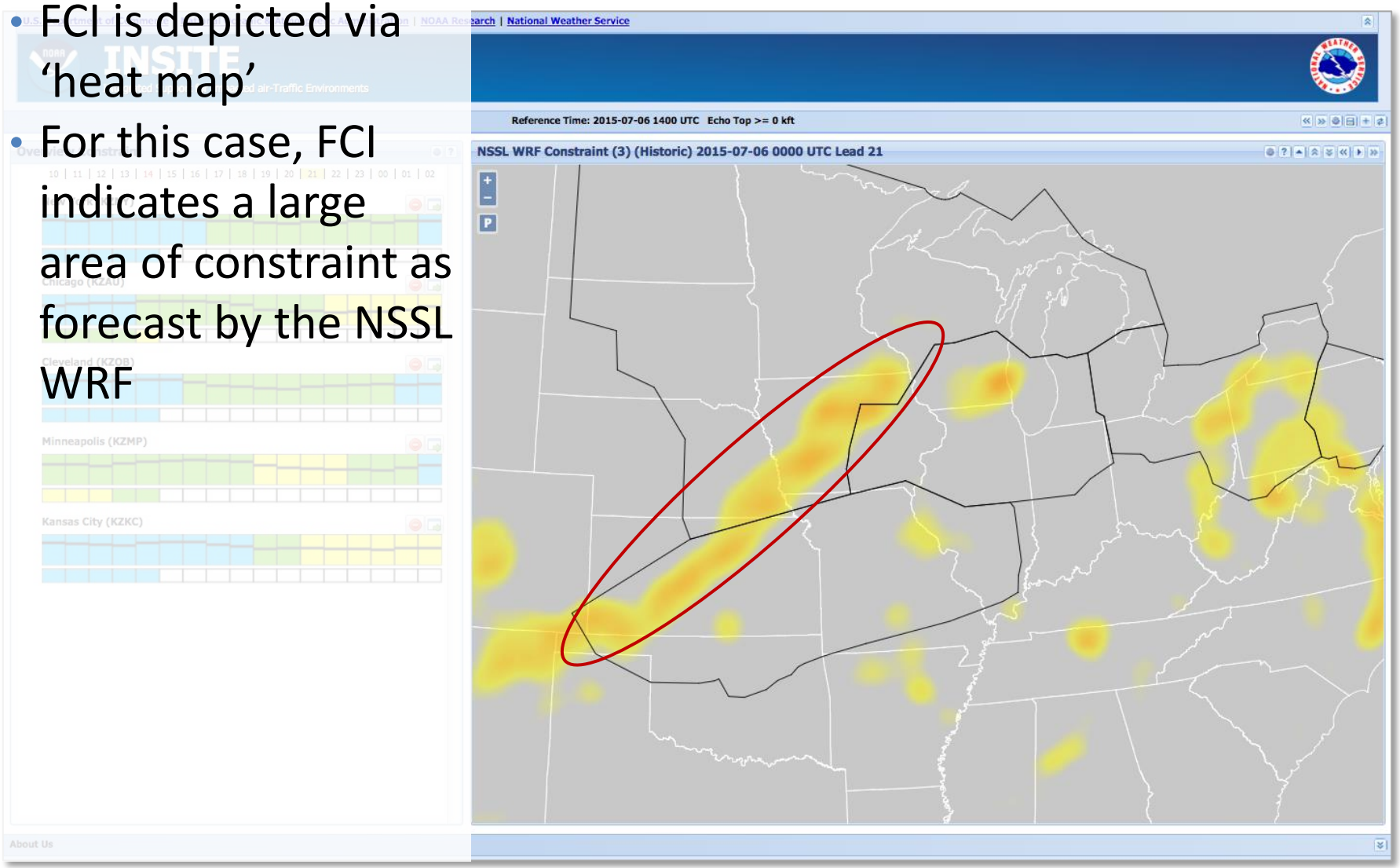
INSITE

- Raw weather graphics and route overlays indicate this line of convection could be impactful
- INSITE provides a metric that is a quantitative measure of how much impact is likely



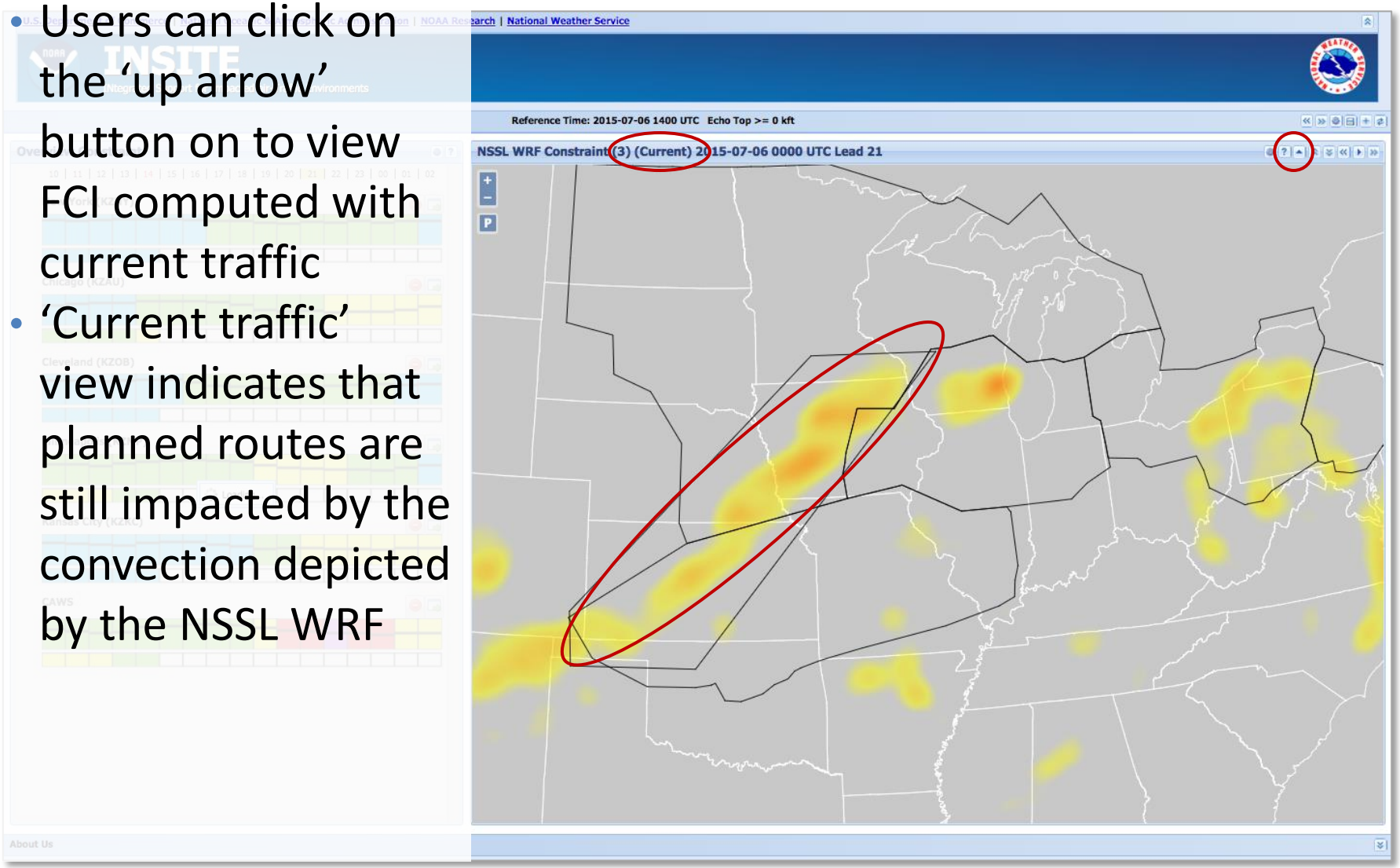
FCI in INSITE – Our Case

- FCI is depicted via 'heat map'
- For this case, FCI indicates a large area of constraint as forecast by the NSSL WRF



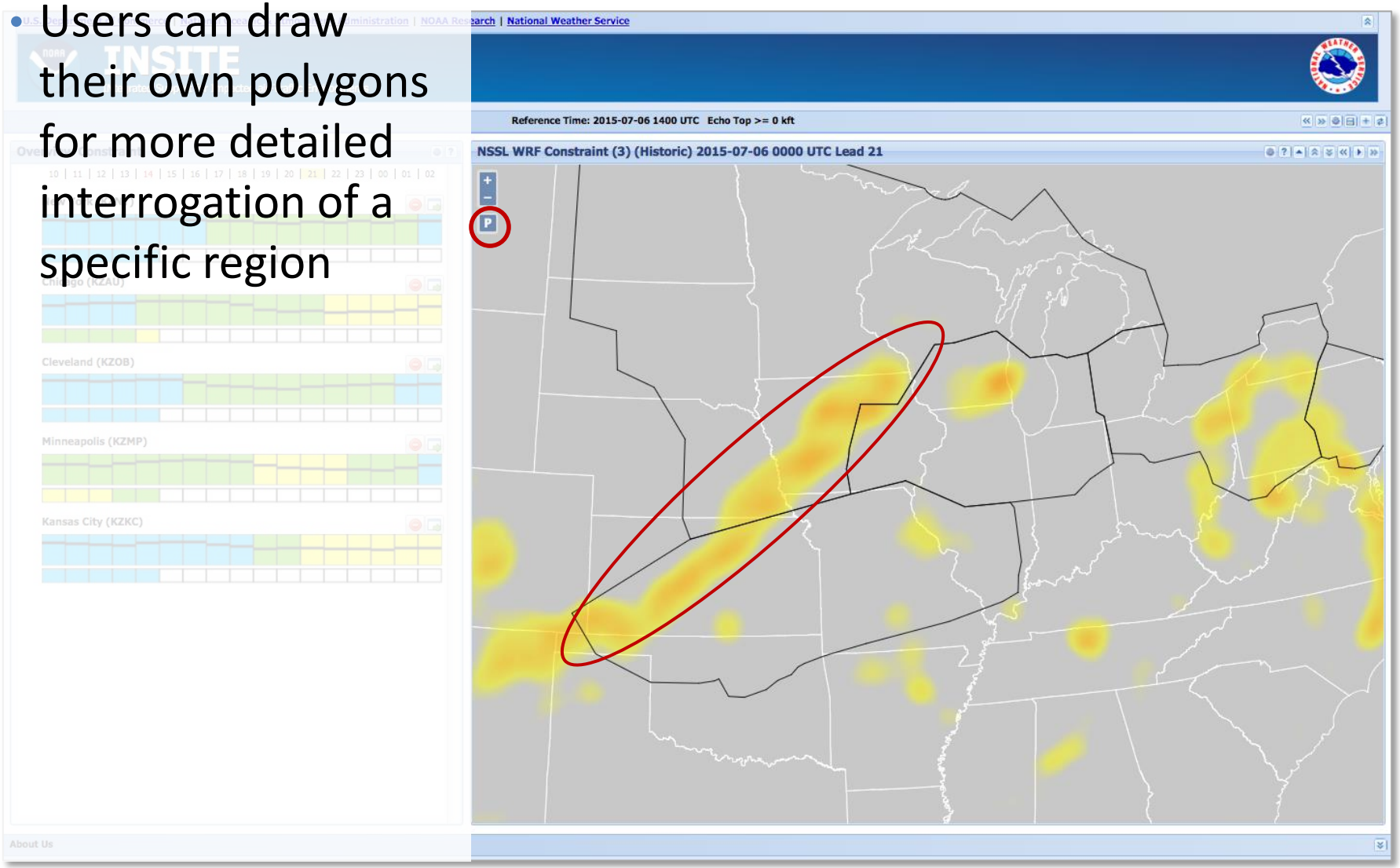
FCI in INSITE – Our Case

- Users can click on the ‘up arrow’ button on to view FCI computed with current traffic
- ‘Current traffic’ view indicates that planned routes are still impacted by the convection depicted by the NSSL WRF

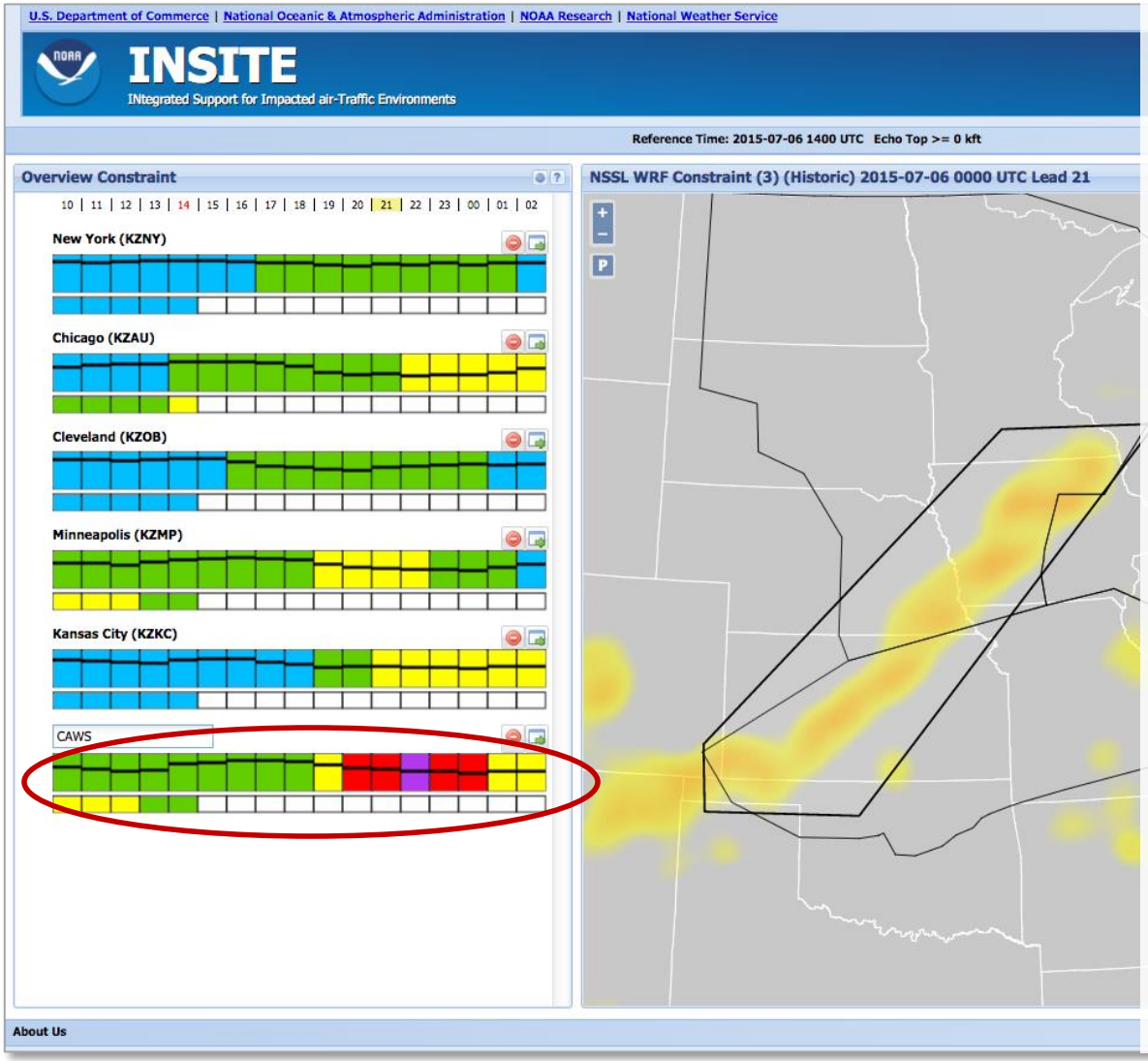


FCI in INSITE – Areas of Interest

- Users can draw their own polygons for more detailed interrogation of a specific region

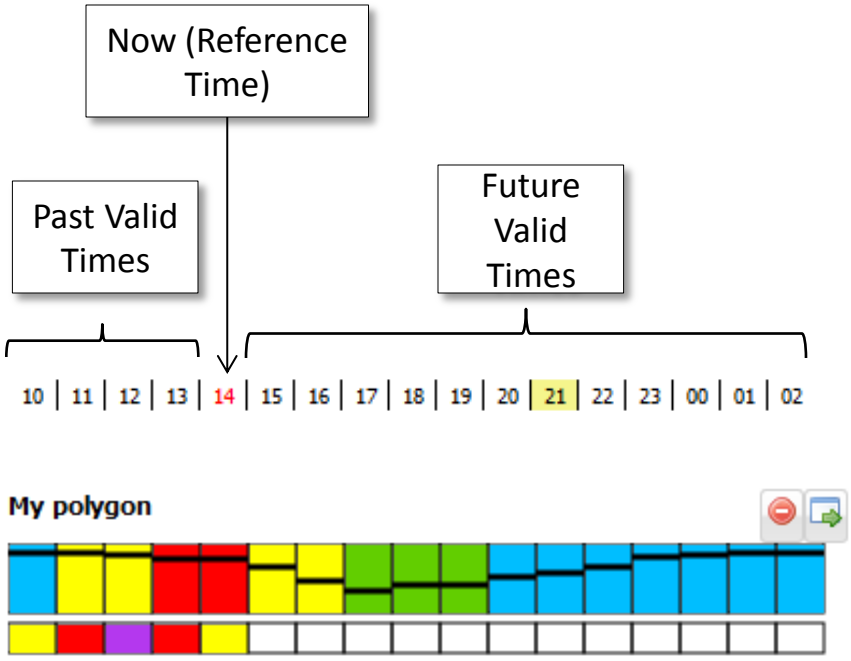


FCI – Summary Information

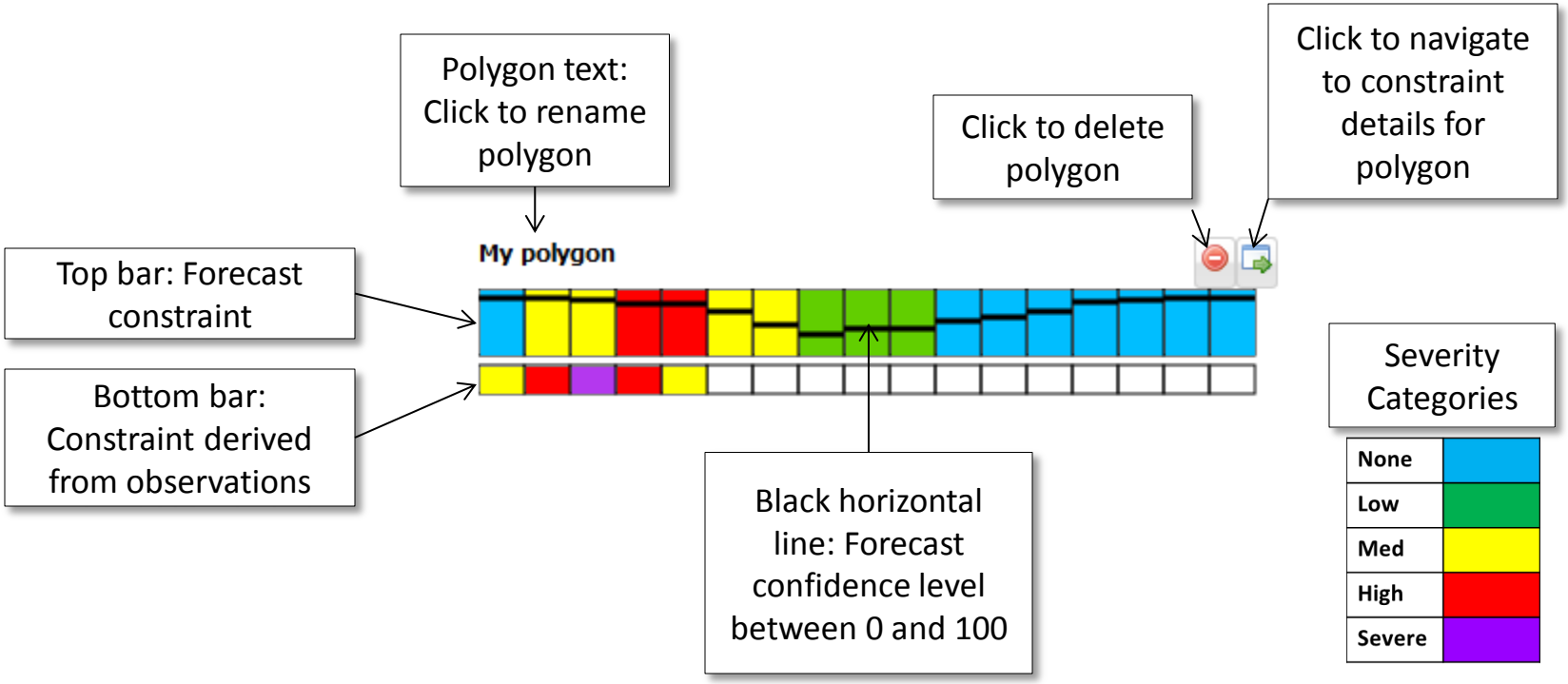


- Bar charts on far left are time series of constraint as identified by FCI
- Each bar corresponds to a polygon drawn on the geographical map

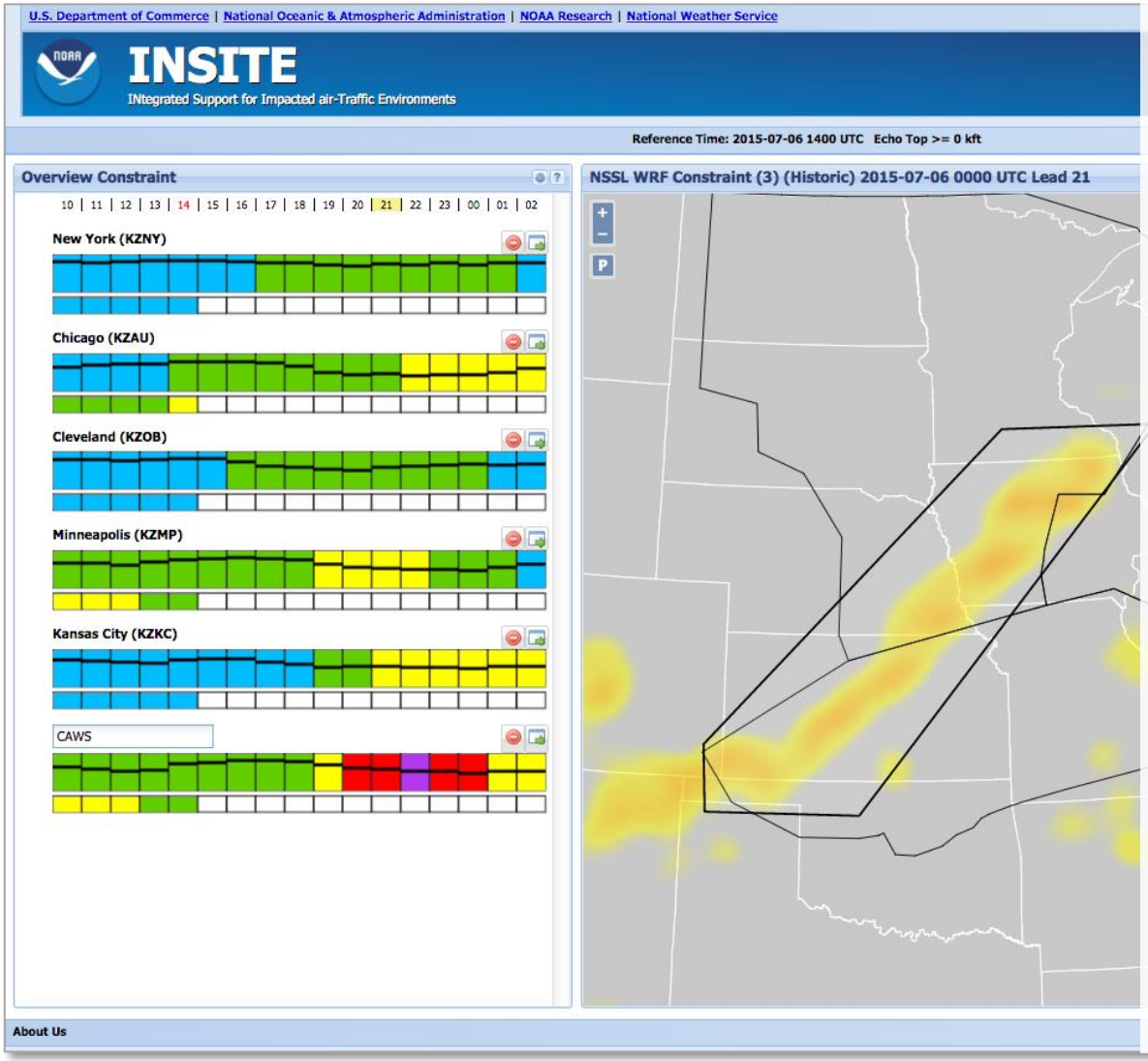
Constraint and Confidence Bars (CC-Bars)



Constraint and Confidence Bars (CC-Bars)



Constraint and Confidence bars



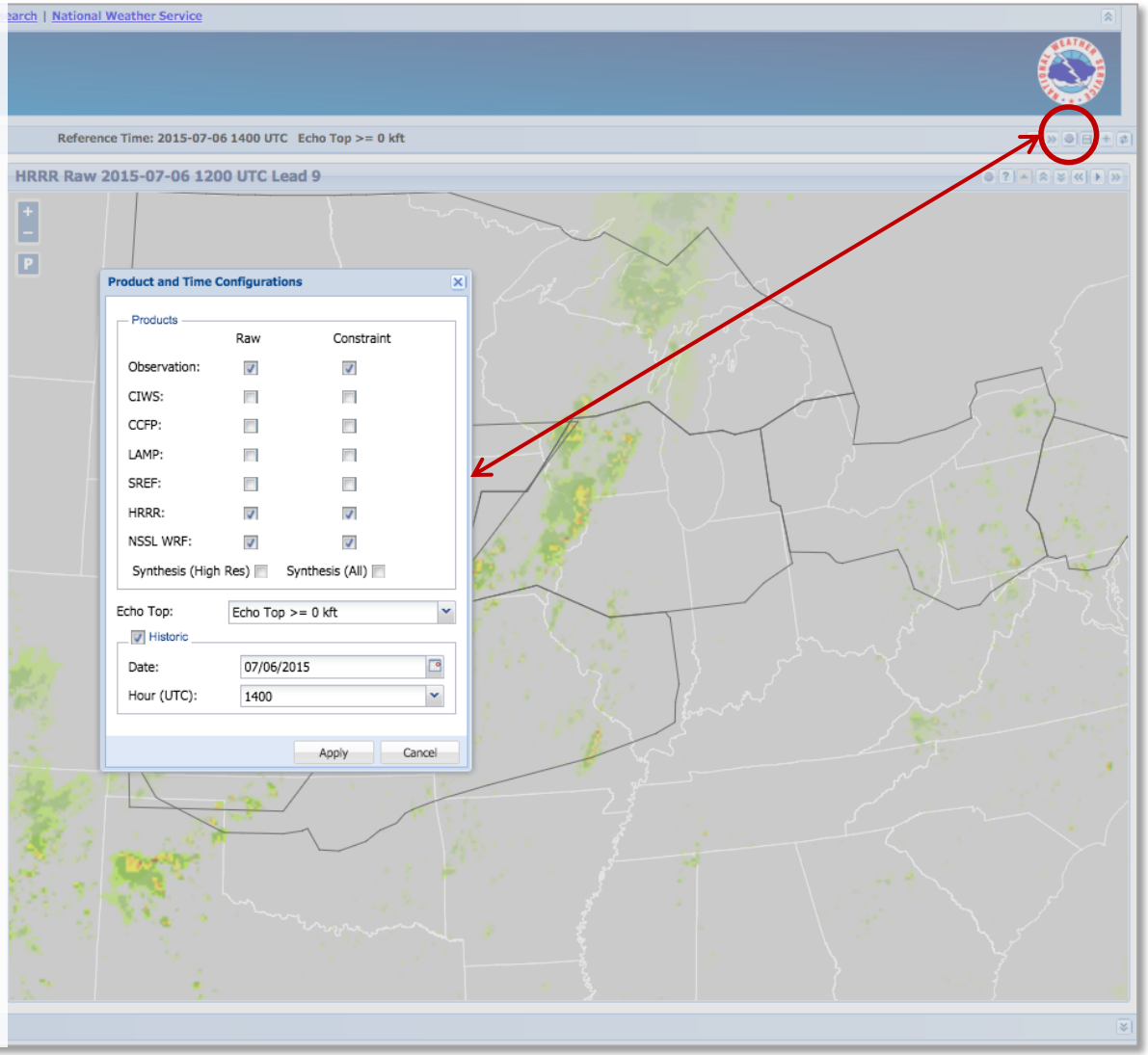
Constraint and Confidence (or Consistency) bars (CC bars) are provided on the left side

Confidence Information

- Confidence is based on long-term historical performance of the forecast products, and also includes a prolonged forecast latency penalty

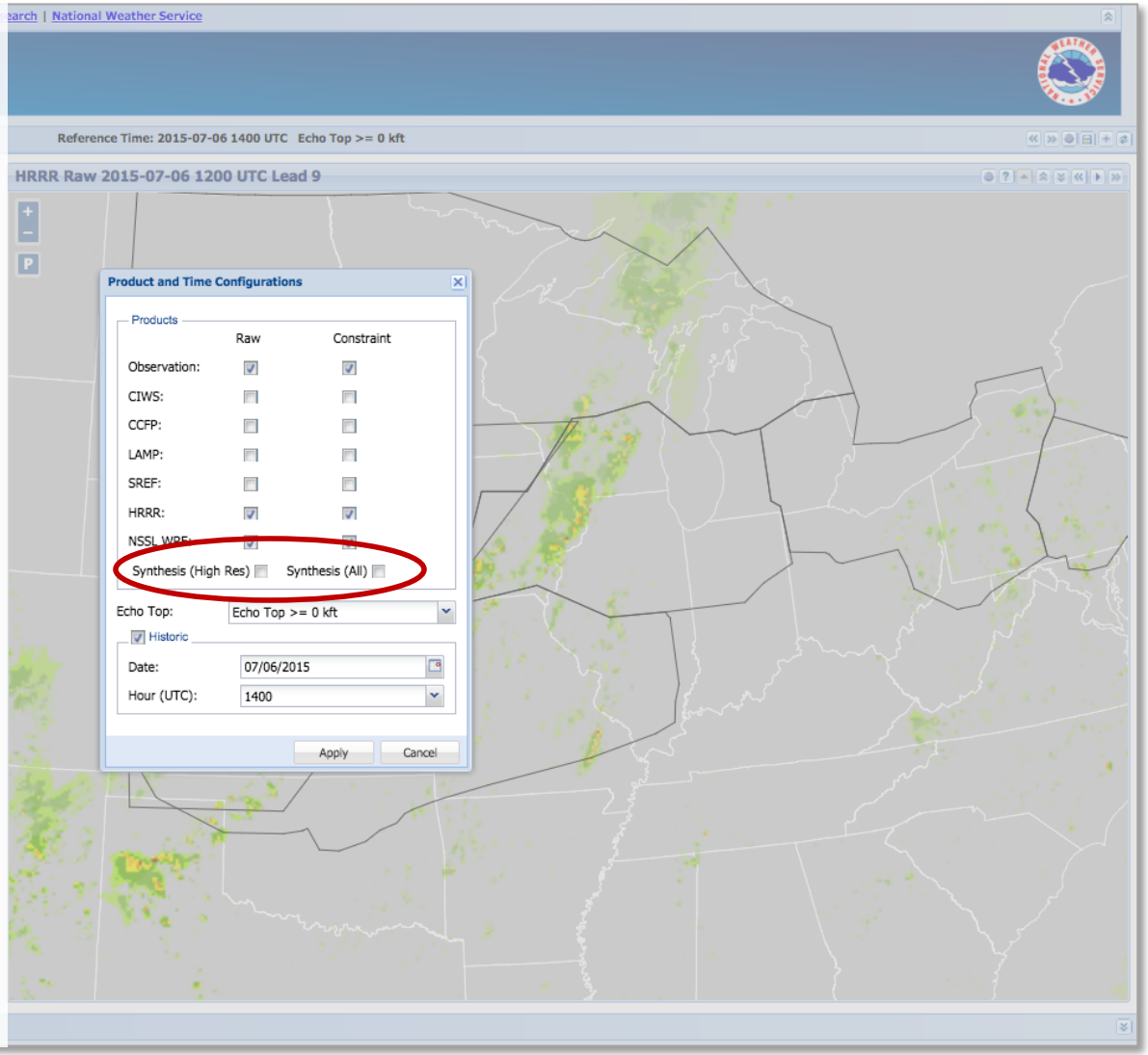
Products Featured in INSITE

- INSITE products:
  - HRRR
  - NSSL WRF
  - SREF
  - LAMP
  - CCFP
  - CIWS
- Raw product or derived constraint (FCI)

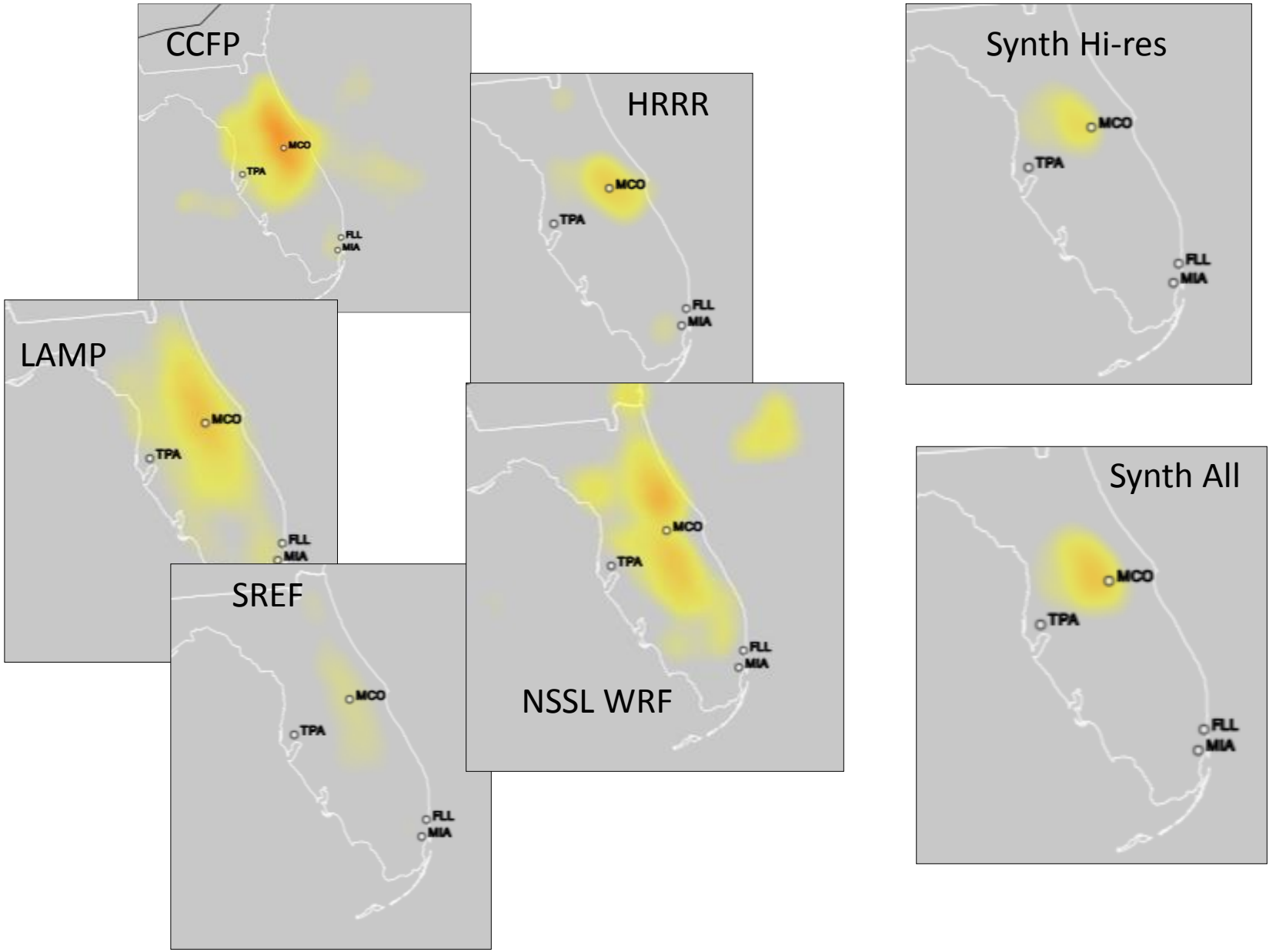


Synthesis Product

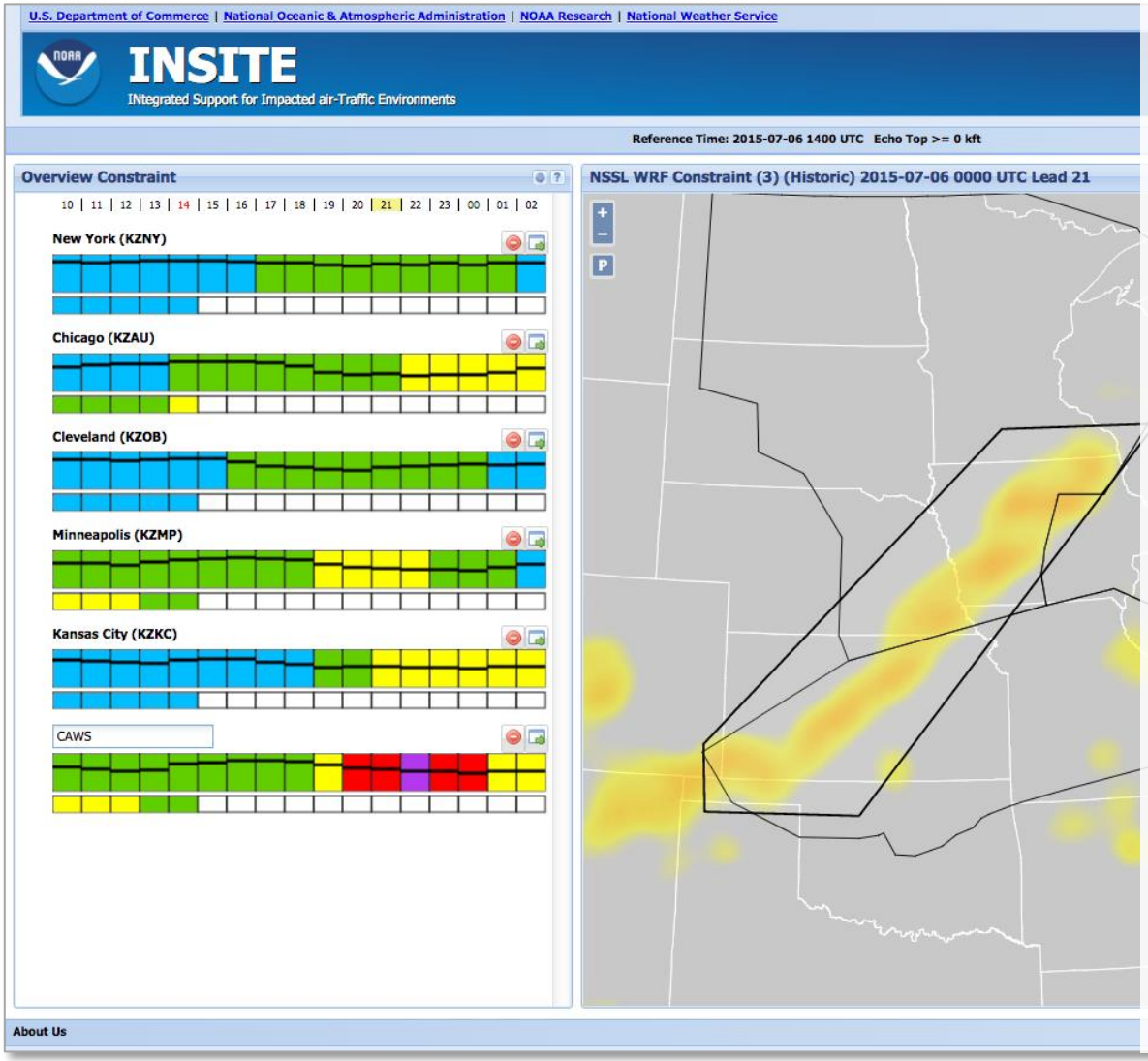
- The synthesis is a blend of the individual FCI'ed products
  - All
  - High-res only
- Product weights based on historical performance, inter-model consistency



Synthesis


CCFP
MCO
TPA
FLL
MIA
HRRR
MCO
TPA
FLL
MIA
Synth Hi-res
MCO
TPA
FLL
MIA
LAMP
MCO
TPA
FLL
MIA
SREF
MCO
TPA
FLL
MIA
NSSL WRF
MCO
TPA
FLL
MIA
Synth All
MCO
TPA
FLL
MIA

Constraint and Confidence bars

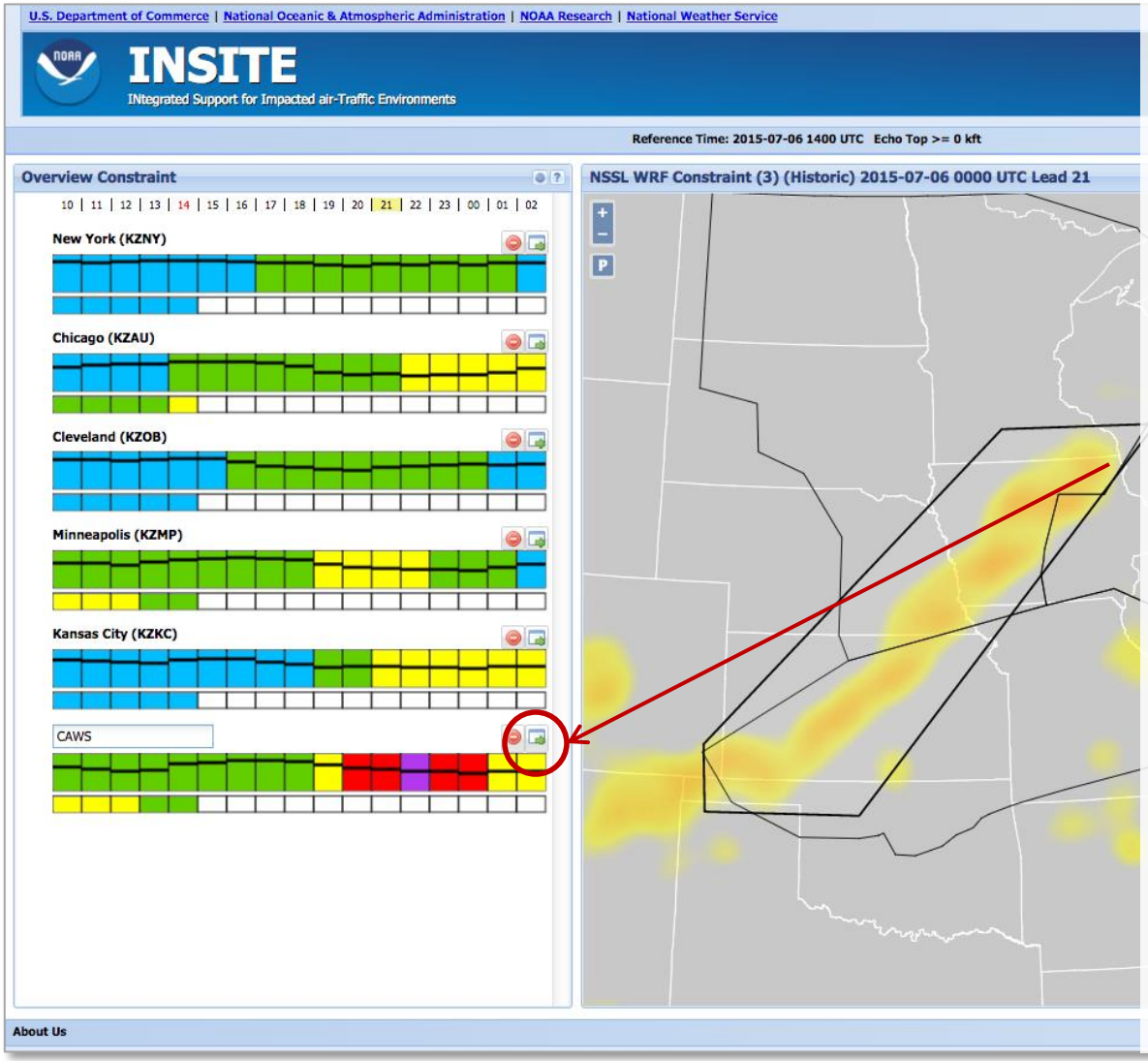


Constraint and Confidence (or Consistency) bars (CC bars) are provided on the left side

Confidence Information

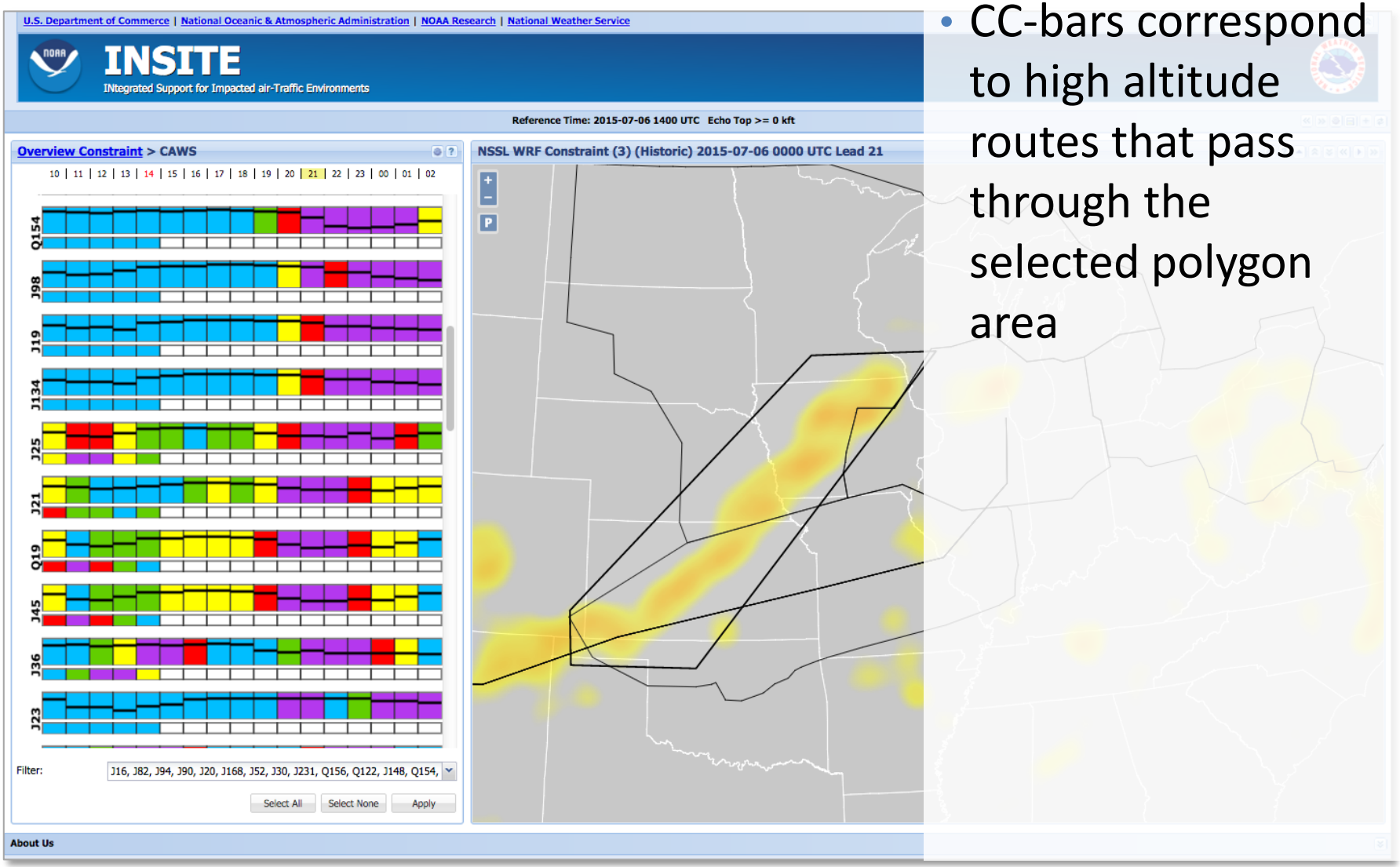
- Confidence is based on long-term historical performance of the forecast products, and also includes a prolonged forecast latency penalty
- For synthesis product, horizontal line is grey and indicates level of consistency between constituent forecasts

Further Regional Interrogation



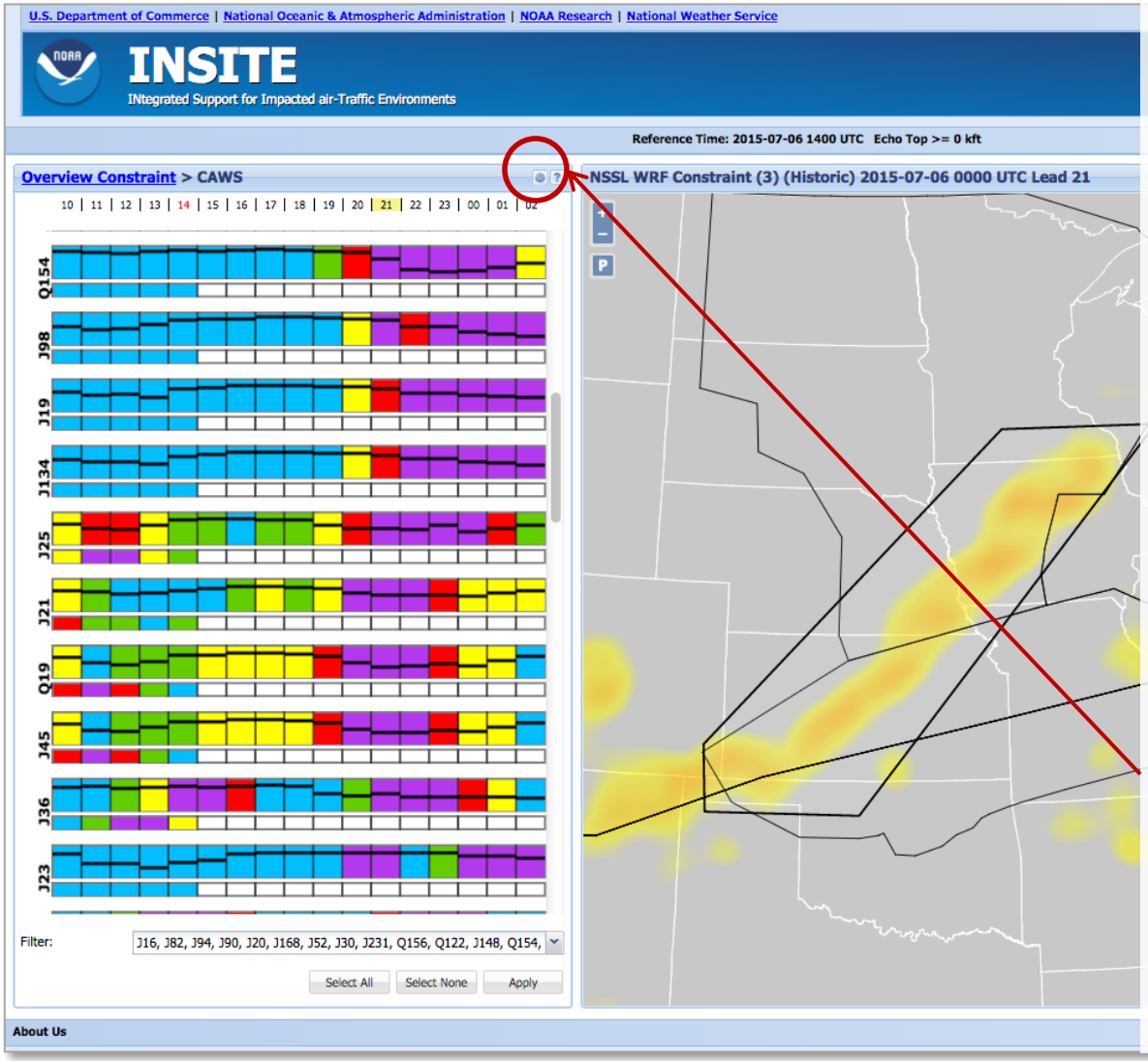
- Clicking on the ‘green arrow’ icon above the CC-bar navigates the user to more detailed information about the corresponding polygon

NAS Elements Within a Polygon/Area



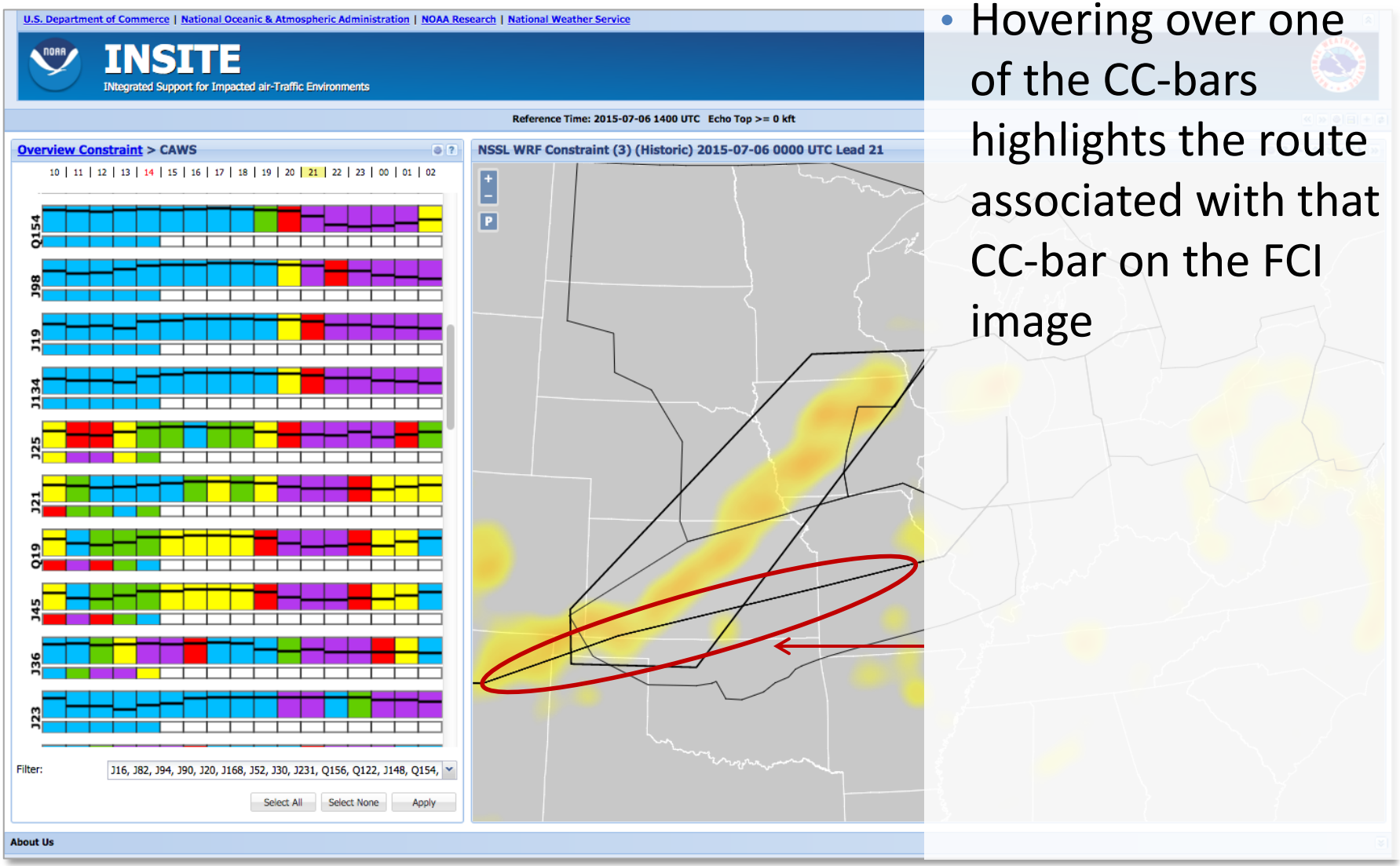
- CC-bars correspond to high altitude routes that pass through the selected polygon area

NAS Elements Within a Polygon/Area



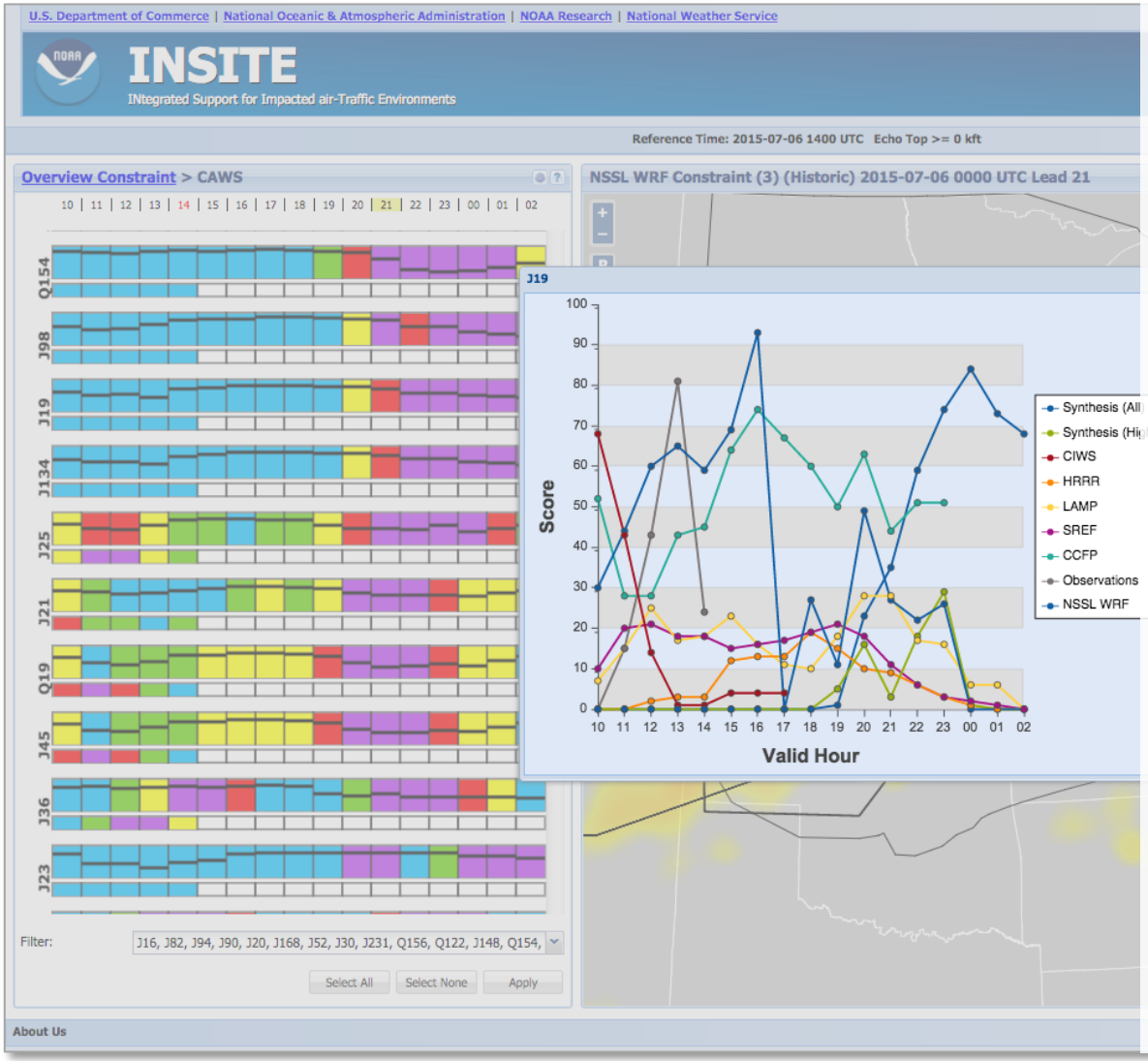
- Routes are listed by rank, with the most impacted at the top of the list, the least impacted at the bottom of the list
- Impact, as used to rank the routes, is for future times only
- Intersecting ARTCCs are also viewable, using the gear symbol

NAS elements within a polygon/area



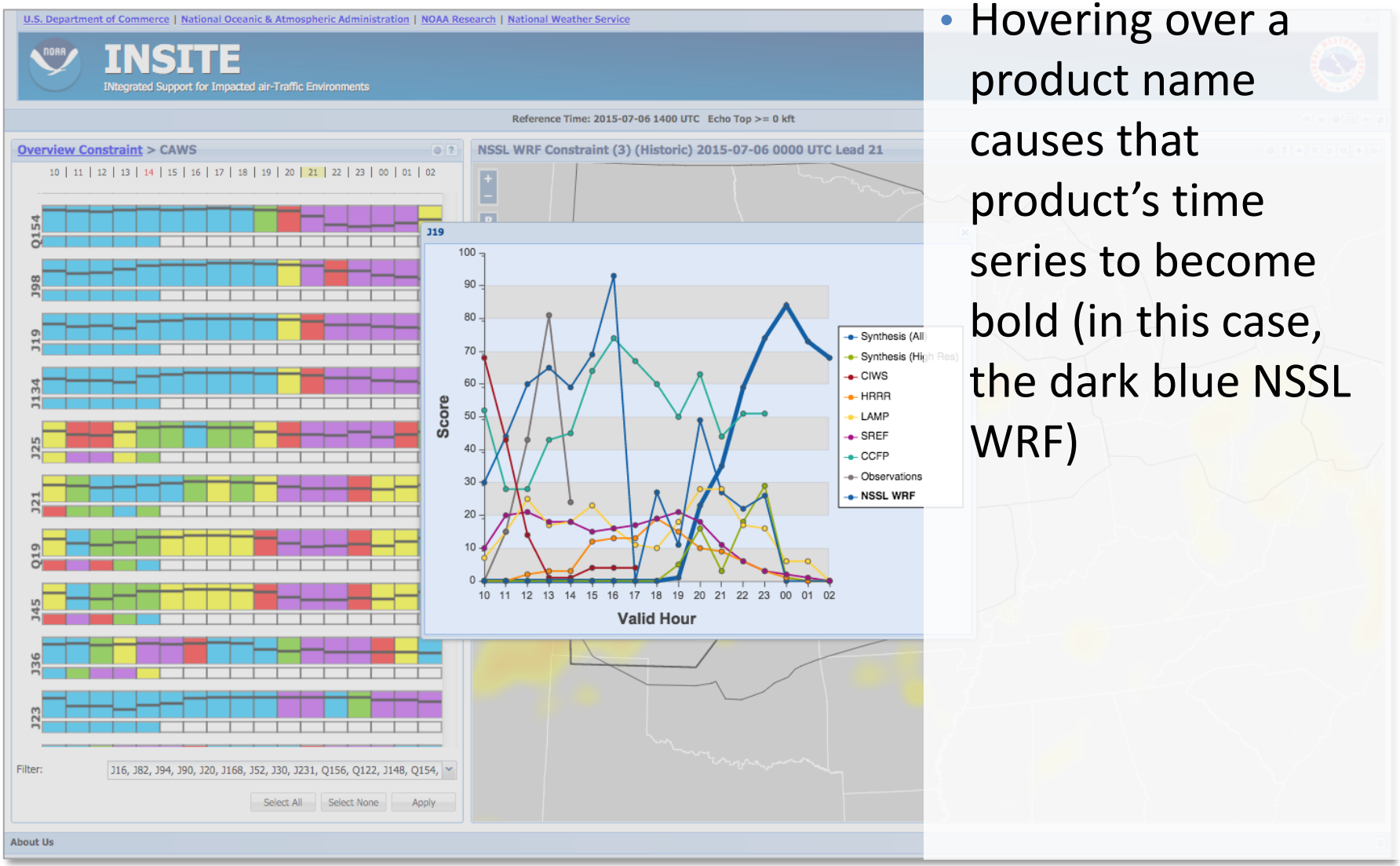
- Hovering over one of the CC-bars highlights the route associated with that CC-bar on the FCI image

NAS elements within a polygon/area



- Clicking on one of the CC-bars brings up a time series of the FCI values from all products for the time period from 4 hours before to 12 hours after the reference time

NAS elements within a polygon/area



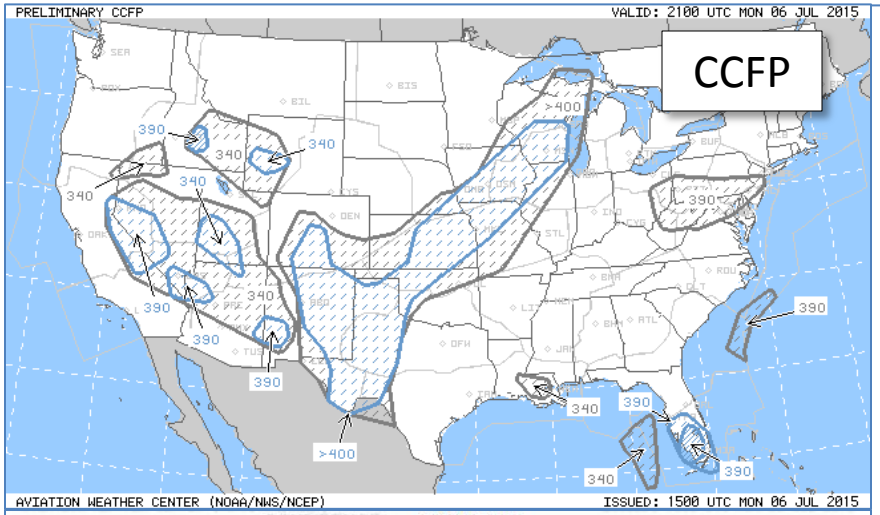
- Hovering over a product name causes that product's time series to become bold (in this case, the dark blue NSSL WRF)

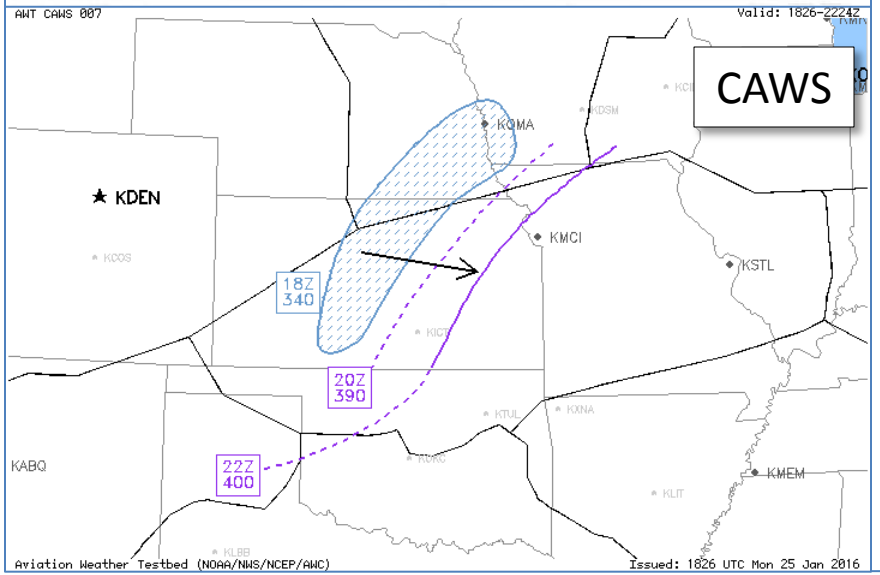
Use Case

INSITE Operational Scenario Steps

Identify potential areas of air-traffic constraints in area of responsibility	Compare potential areas of air-traffic constraints with other model guidance	Narrow down area of interest using polygon drawing tool	Identify geographic areas with constraints above moderate severity threshold	Identify potential time of onset and cessation	Adjust forecast based upon model trends using confidence in CC bars	Adjust forecast based upon model consistency in CC bars	Use these areas of constraints as first guess impact areas in CAWS

Collaborative Aviation Weather Statement (CAWS)





Collaborative Aviation Weather Statement 003
NWS Aviation Weather Center Kansas City MO
1450 UTC Mon 06 Jul 2015

Weather: Thunderstorms
Valid: 1800-2200Z

ARTCCs affected: ZFW, ZKC, ZMP
Terminals affected:

CCFP: 15Z - Coverage too low

SUMMARY: Thunderstorms expected to develop across ZKC by 18Z and intensify into a line by 20-22Z.

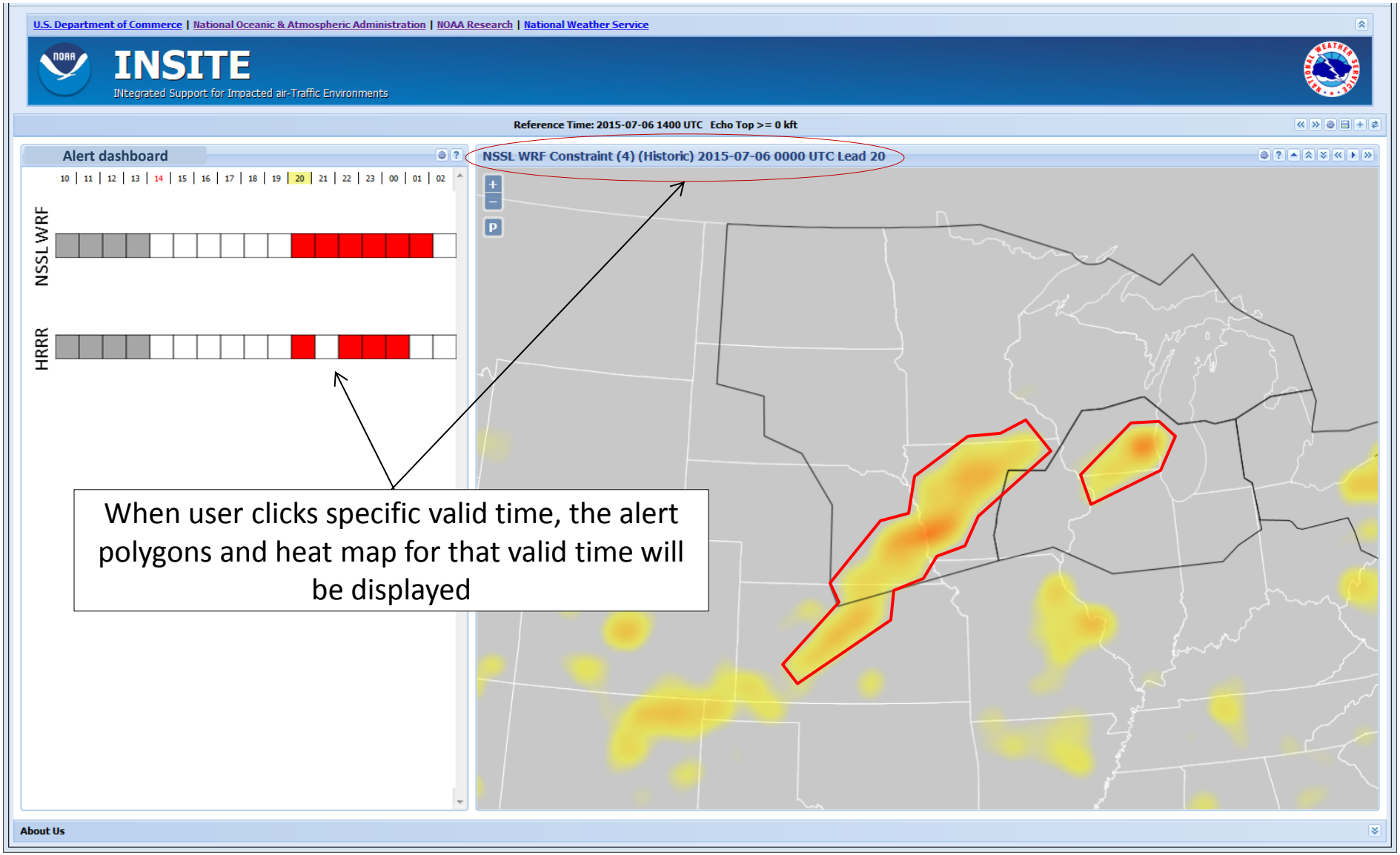
DISCUSSION: Current storms across N KS/SE Neb will intensify after 18Z and form a broken line by 20Z and a significant solid line by 22Z with tops FL400+. Further south across the panhandle TX and W OK a broken line should begin to form around 22Z.

An additional CAWS may be needed as the storms pushes eastward.

INSITE v4

- Funding organization: NWS NextGen Program
- INSITE 4 to be released late May 2016, available for OB/CAWS activities
  - Addition of MRMS analyses
  - Switch from AWC SREF product to NCEP/NCO SREF product
  - Numerous UI updates (such as black background, improved product navigation, more help info)
  - New “Alert” feature – system identification of areas that are in excess of a given FCI value

INSITE Alert Feature – Mockup



Transition to NWS Operations

- Operational host: IDP
- IOC
  - INSITE v4
    - Switch to all operational NWS products (replace CIWS with MRMS, NSSL-WRF with HiRes NMM/ARW runs)
  - May 2017
- Where in the process?
  - Have begun the necessary coordination with IDP
  - Initial design review
  - Technical documentation

Contacts

- Feedback and questions on INSITE and its use are welcomed
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  - Missy Petty melissa.a.petty@noaa.gov
- NOAA/NWS contact:
  - Jamie Vavra jamie.vavra@noaa.gov