DEMONSTRATION OF THE NCAR'S AutoNowCaster (ANC) SYSTEM AT NOAA/NWS/MDL

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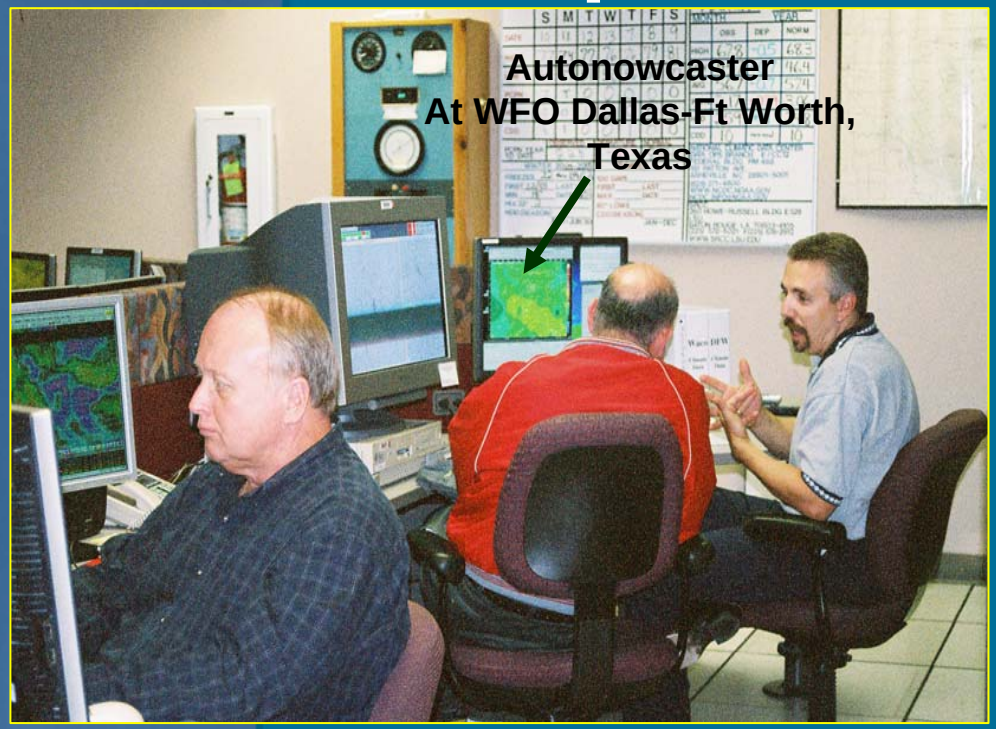
Objective

- Objectives (from User Requirements)
  - Forecasting convection initiation
  - Identification, monitoring and tracking of existing thunderstorms including tracking their life cycle (e.g. growth and decay
- Applications
  - Provide Forecaster guidance
  - Provide Short-term Automated Gridded Thunderstorm products for Aviation Users

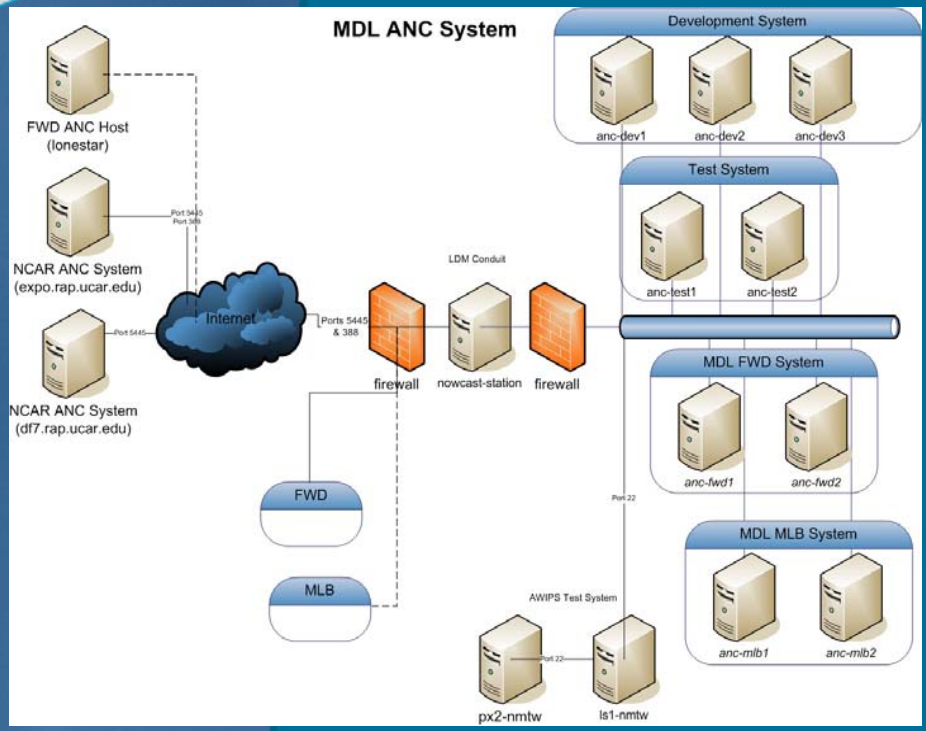
A collaborative effort to bring the AutoNowCaster (ANC) system into NWS operations:

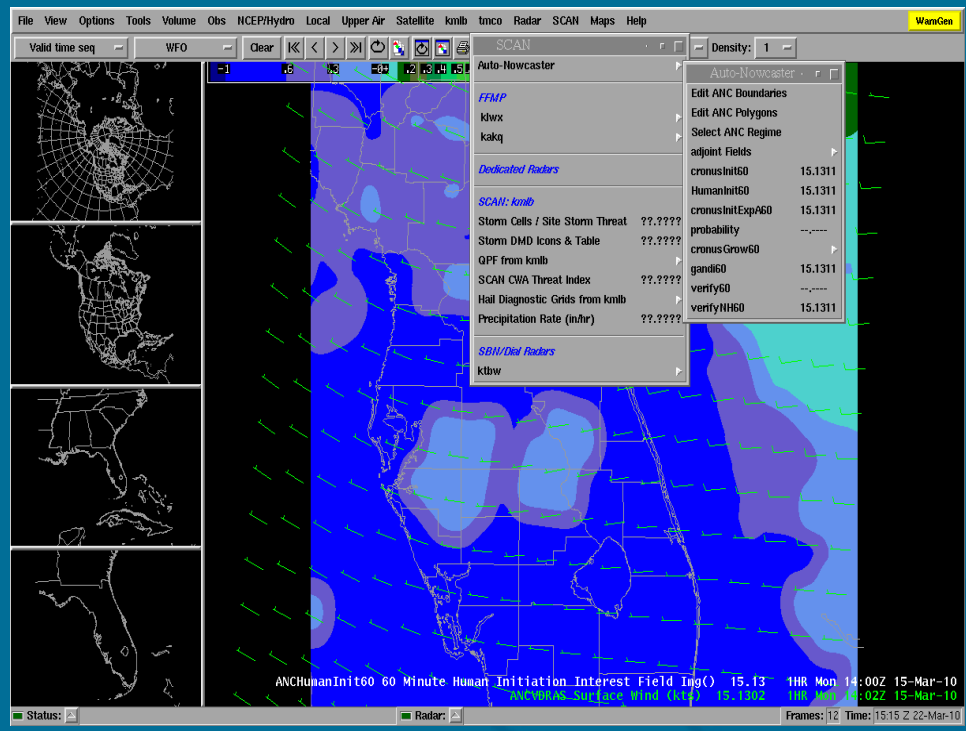


- NCAR provides software engineering and science expertise support to MDL for ANC implementation.
- MDL integrates ANC into the NWS' AWIPS[1] system.
- Forecasters interact with ANC by providing convergence boundary locations and setting convective regimes for which ANC will run.

[1]The Advanced Weather Interactive Processing System (AWIPS) is a communications and forecaster workstation system that supports forecast operations in all 122 Weather Forecast Offices (WFOs) in the United States.

MDL's Prototype of Autonowcaster System Network Configuration





MDL's ANC Network Configuration

ANC AWIPS Forecaster Interface

Each regional system may cover several Weather Forecast Offices (WFOs)

Why are thunderstorm nowcasts important for NWS operations?

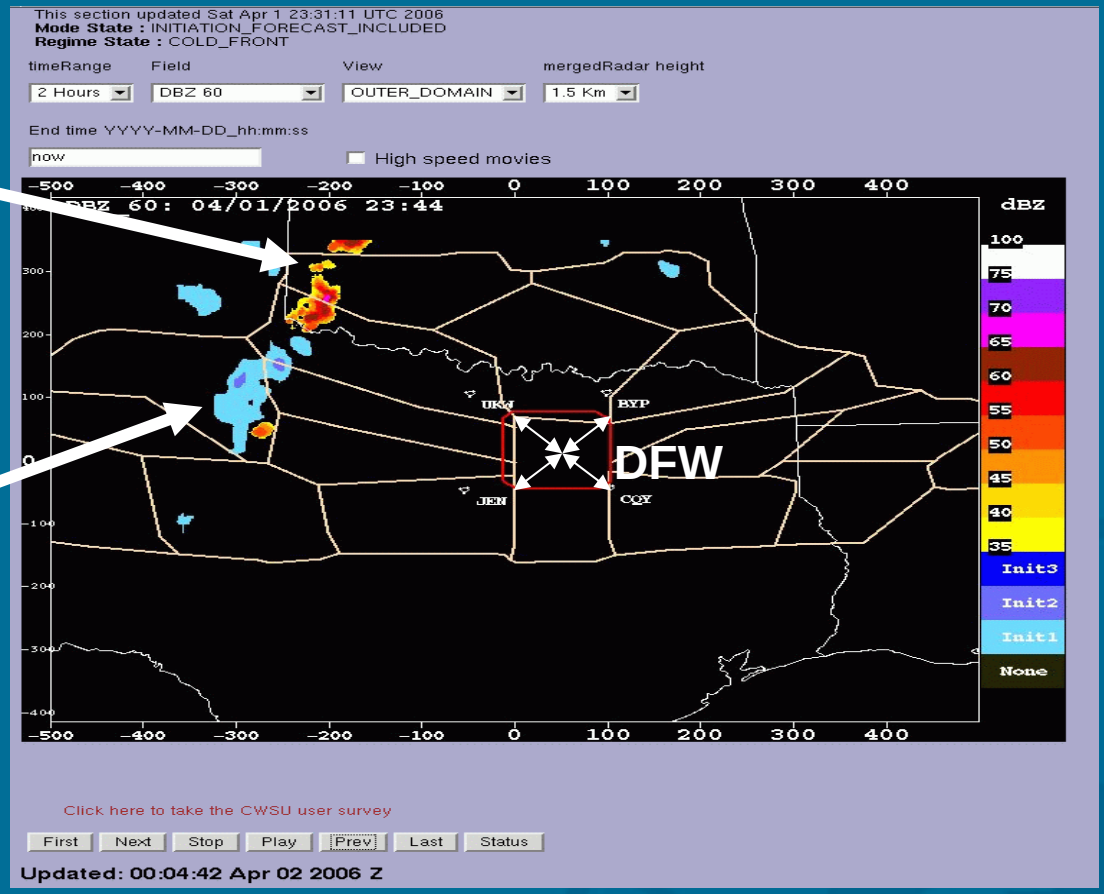
- High quality nowcasts of thunderstorms have the potential to be a tremendous benefit to the general public.

- Timely and accurate thunderstorm nowcasts can be a key factor in improved decision making for both in-route and terminal air traffic control

Using the Autonowcaster system, NWS forecasters can provide guidance to air traffic controllers about the short term likelihood of thunderstorms occurring near any of four airport navigation points.

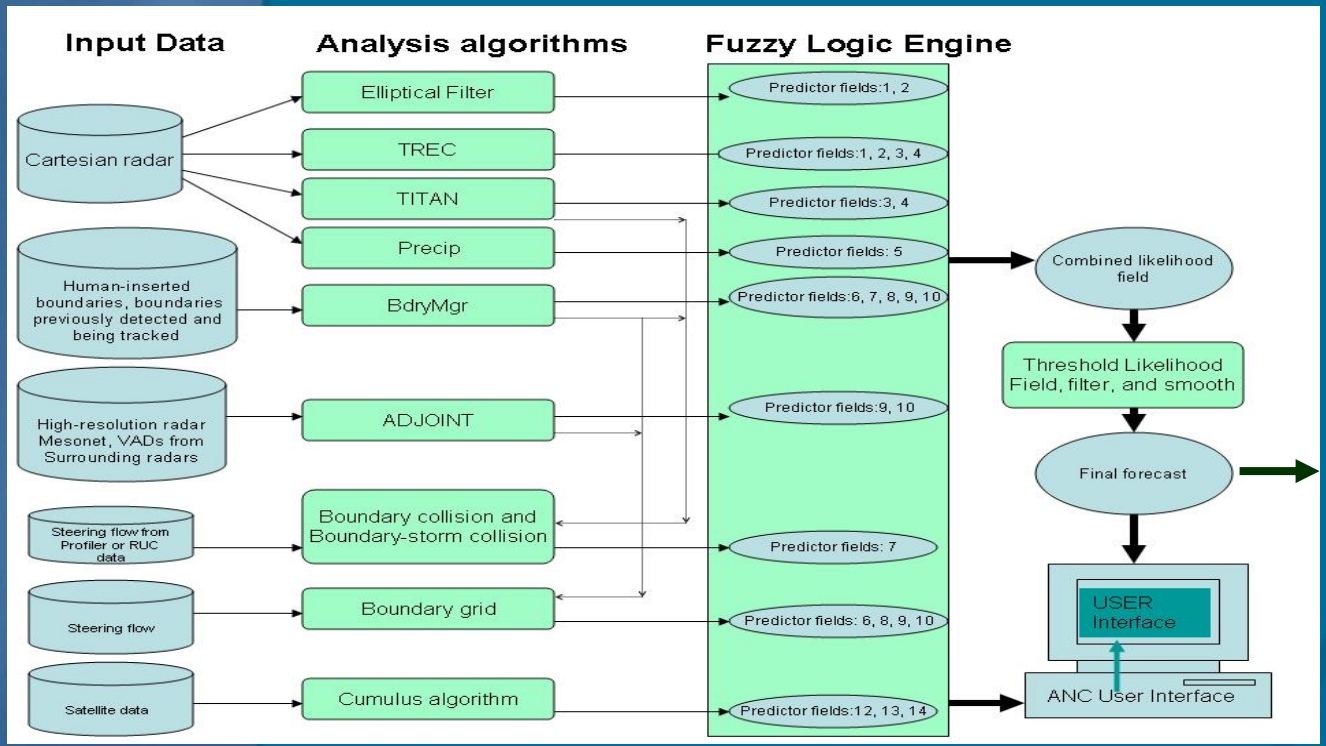
Orange and Red Areas: Growth/Decay of existing thunderstorms

Blue Areas: Autonowcaster thunderstorm initiation nowcasts



Overview of the Autonowcaster System

- Rapid refresh (5mins) short-term (0-1hour) forecasts of thunderstorm initiation, growth and decay.
- Uses fuzzy logic to combine observations, NWP and forecaster input to generate nowcasts.



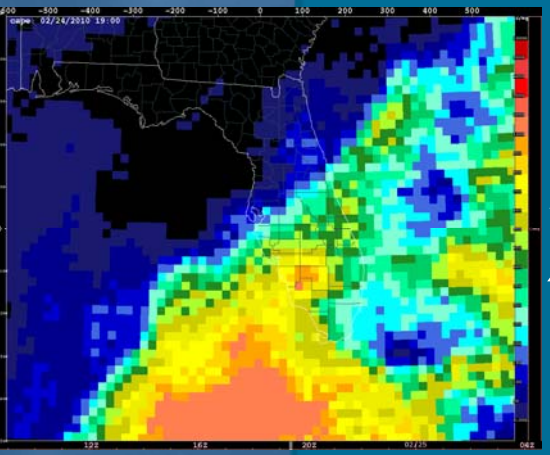
- Growth/Decay of existing echoes
- Initiation likelihood

Fuzzy Logic Algorithm: Combines Likelihood Fields to forecast Storm Initiation

- **Environmental conditions (Numerical Model):**
  - Frontal forcing (Hybrid Levels)
  - CAPE(900-700mb MAX)
  - CIN (975 – 900mb MEA
  - RH (875 – 725mb MEAN)
- **Boundary-layer**
  - Convergence/vertical
  - shear along boundary
  - Colliding boundaries
  - Vertical velocity along boundary
  - Boundary-relative steering flow
  - New storms along boundary
- **Clouds (from satellite data)**
  - Clear sky or cumulus clouds
  - Cloud growth observed with cloud top cooling rate

Fuzzy Logic Alogorithm

- Fuzzy Logic ingests predictor fields and applies a membership function to the field values to produce individual interest maps.



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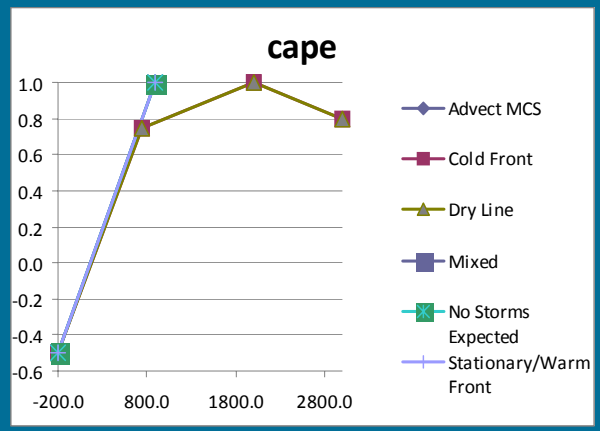

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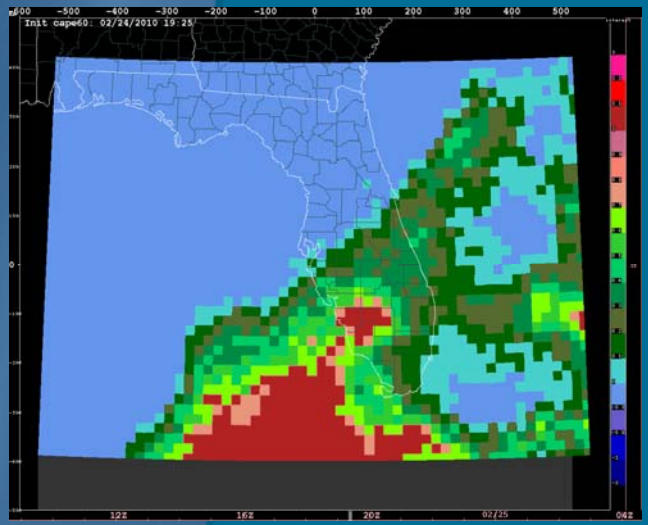
Fuzzy Logic

- Each Interest map is then multiplied by a weight



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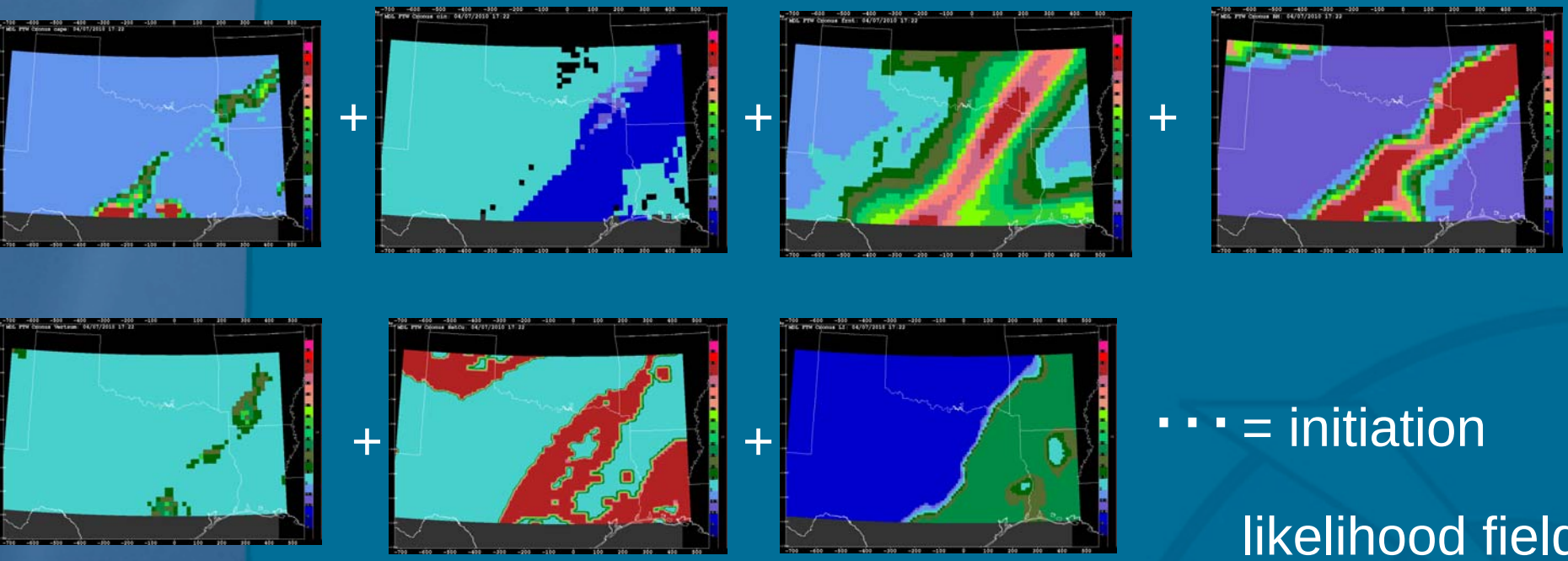
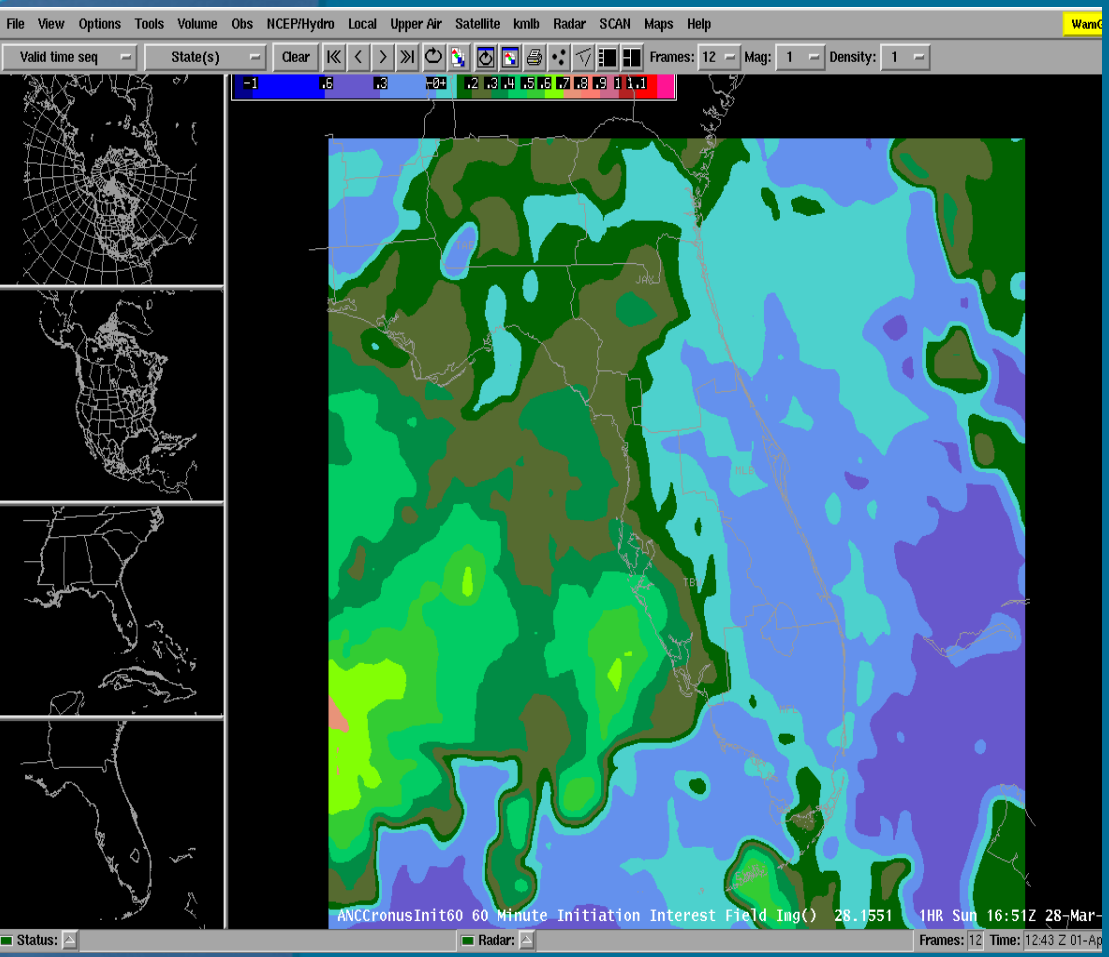
Fuzzy Logic

- All the weighted interest maps are then summed to produce the Init60 field



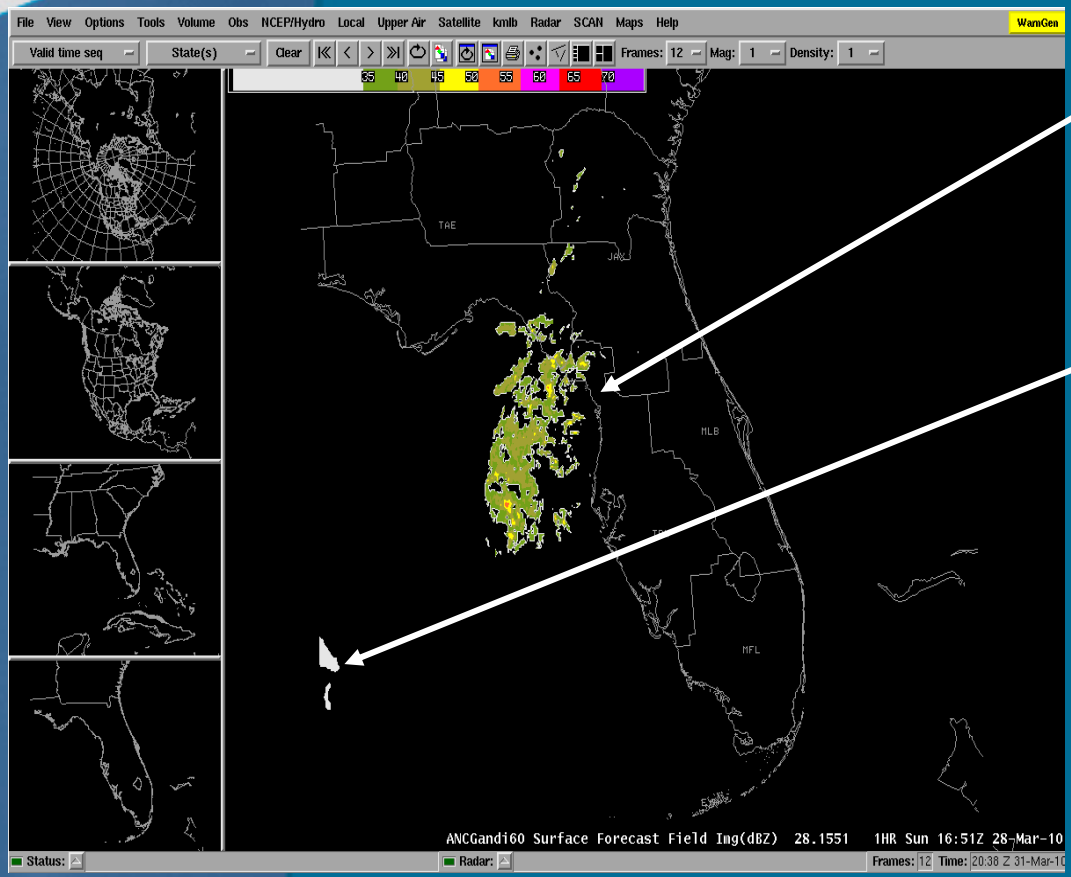
· · · = initiation likelihood field

60 Minutes Storm Initiation likelihood



- Fuzzy logic output for likelihood for initiation at 60min.
- Blue regions – Little chance of storm development
- Warmer colors indicate higher likelihoods
- Values of .7 and higher (salmon/red) interpreted as threshold for storm initiation at 60mins.

Nowcast Final: Combined Growth/Decay and Initiation likelihood field



- Colors are Growth/Decay of existing echoes.
- Gray is 60 mins initiation likelihood
- Existing echoes been filtered to remove stratiform precipitation

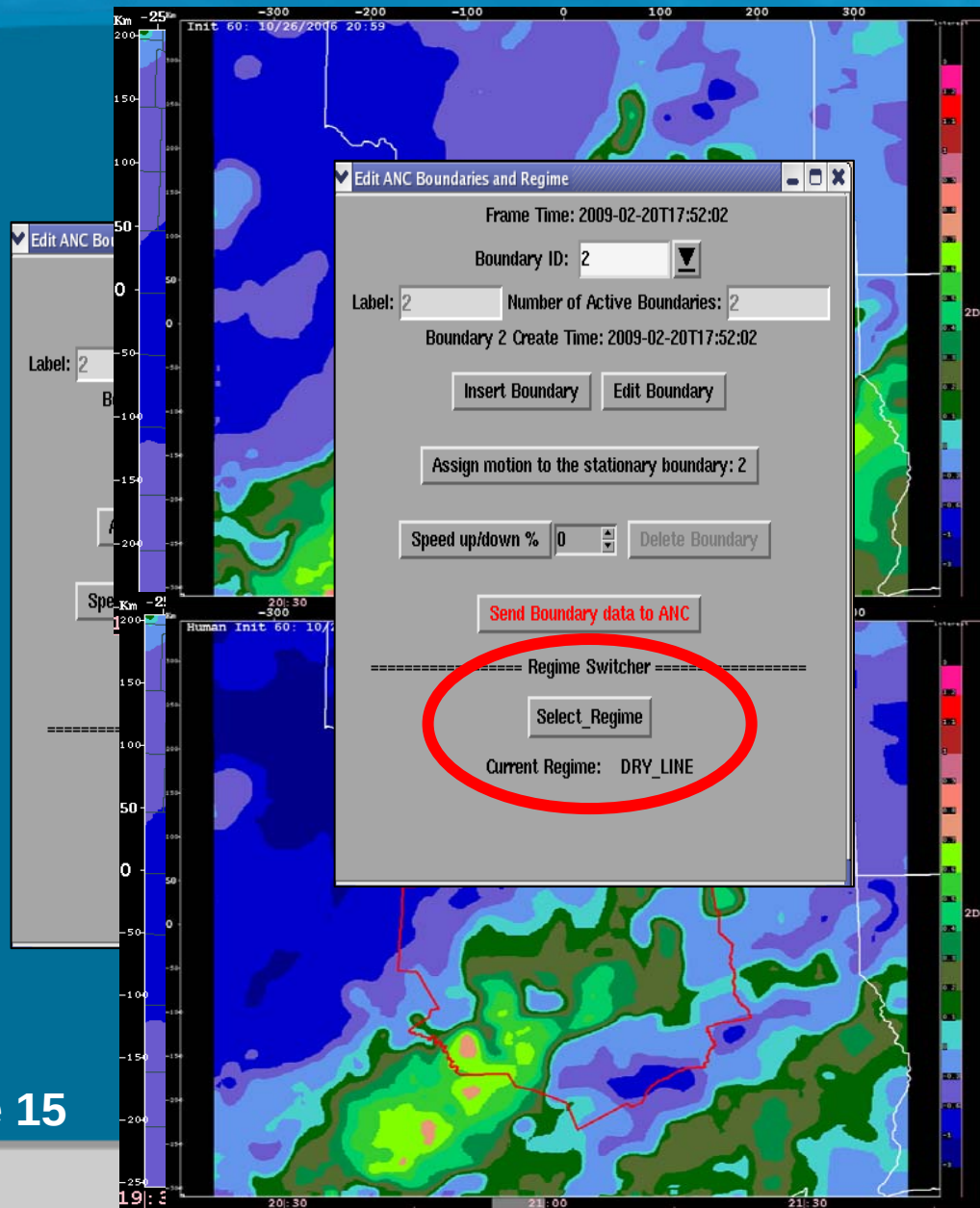
Role of the forecaster in an automated thunderstorm nowcast system

- It is extremely difficult to design an automatic system that consistently identifies the boundary layer convergence lines and/or fronts.

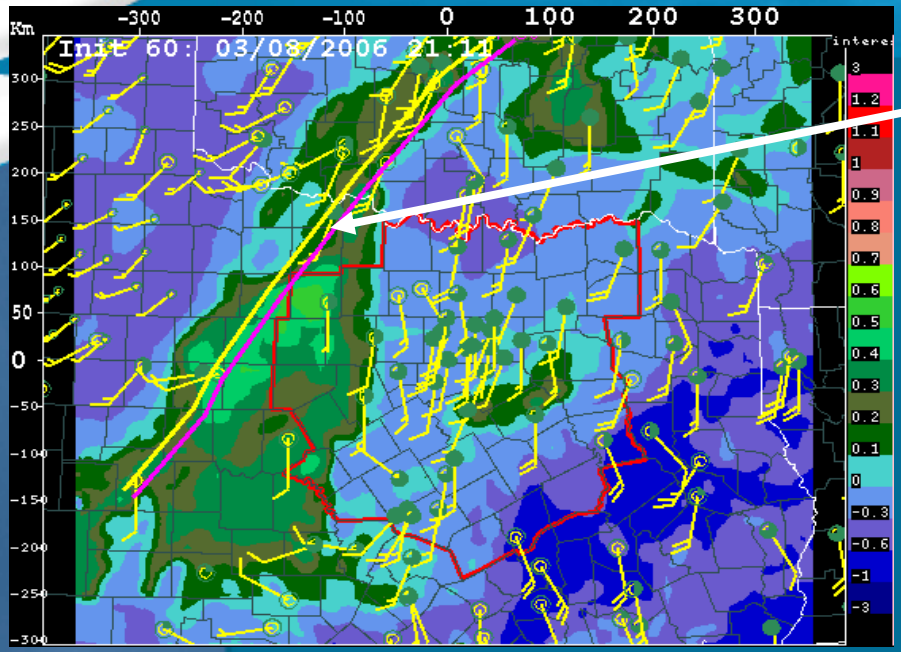
- On other hand, forecasters are remarkably good at quickly identifying and tracking these lines

Forecaster's Interaction

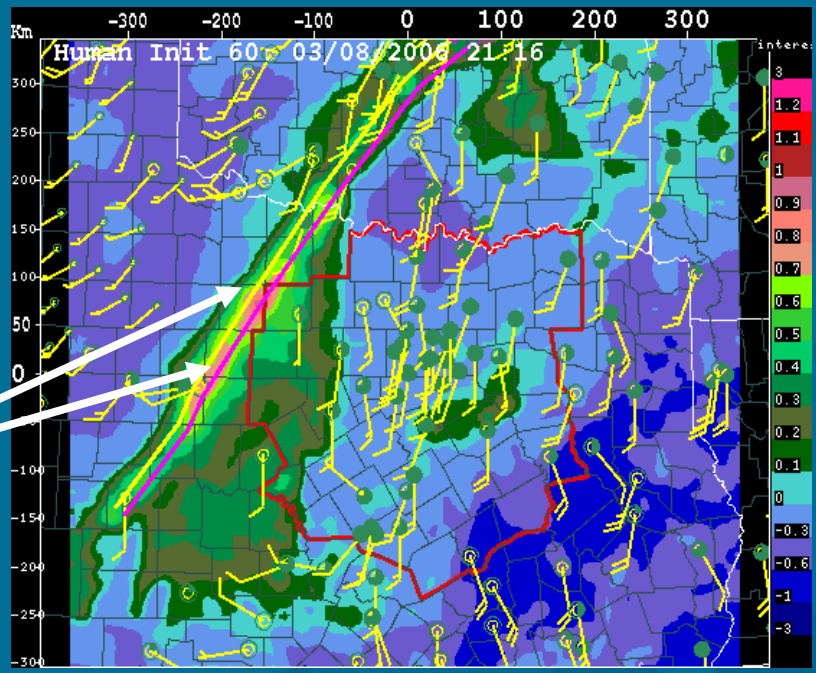
- Enter the location of surface boundaries across the forecast area
- Monitor the initiation likelihood field and makes adjustments as necessary (Polygon tool)
- Init Field Nudging
- Sets regime of convection that is the most appropriate for the day and puts ANC to that regime



Impact of Human entered boundary



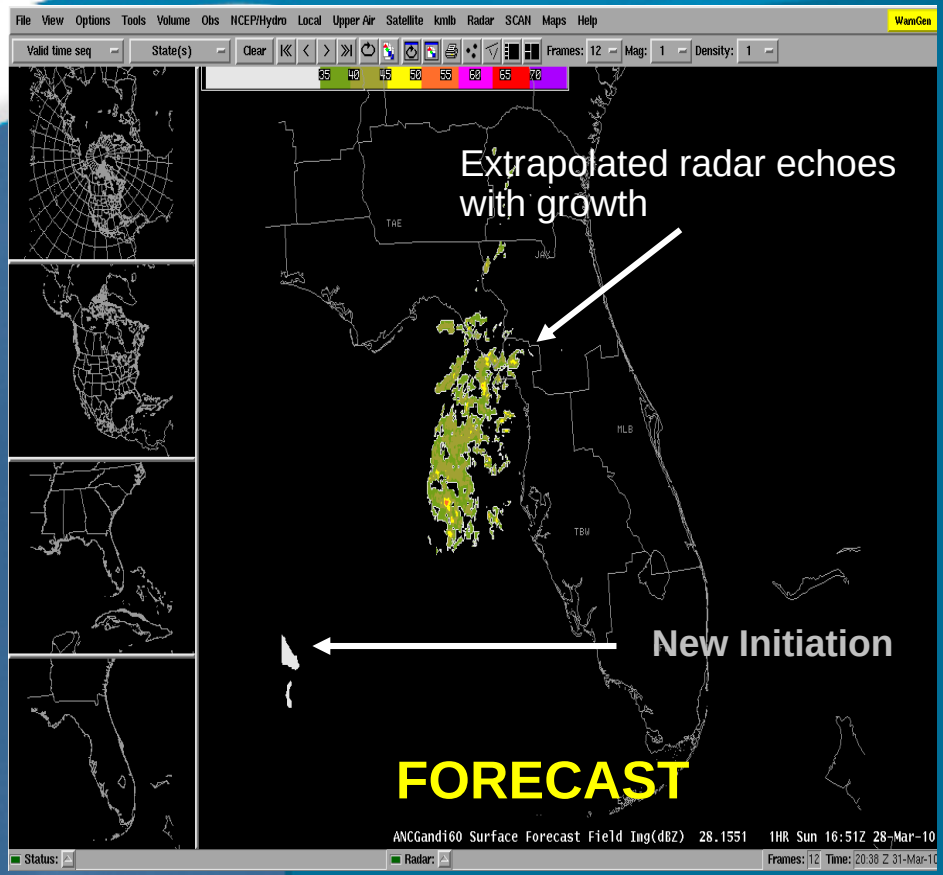
Human has inserted a moving boundary that is ingested into upstream algorithms

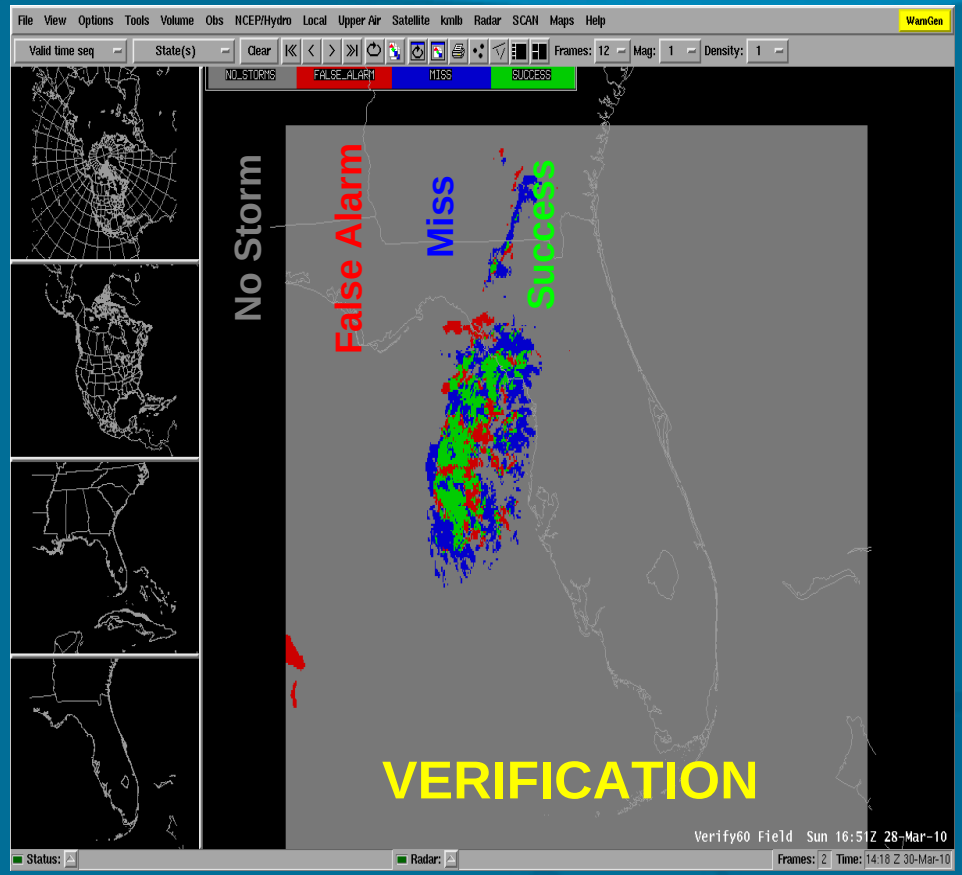


5 min later impact of human-entered boundary:

- **interest field is increased near boundary**
- **reddish areas are where new storms are expected in 60 min**

Example of the System performance





Thunderstorm activities across the Gulf of Mexico on March 28, 2010: (a) dBZ echoes with growth with ANC new initiation field (white polygons) at forecast times of 15:51 UTC and (b) real time validation field at 16:51 UTC with radar observation used as truth.

AutoNowCaster Perspective For NextGen[1] and Beyond

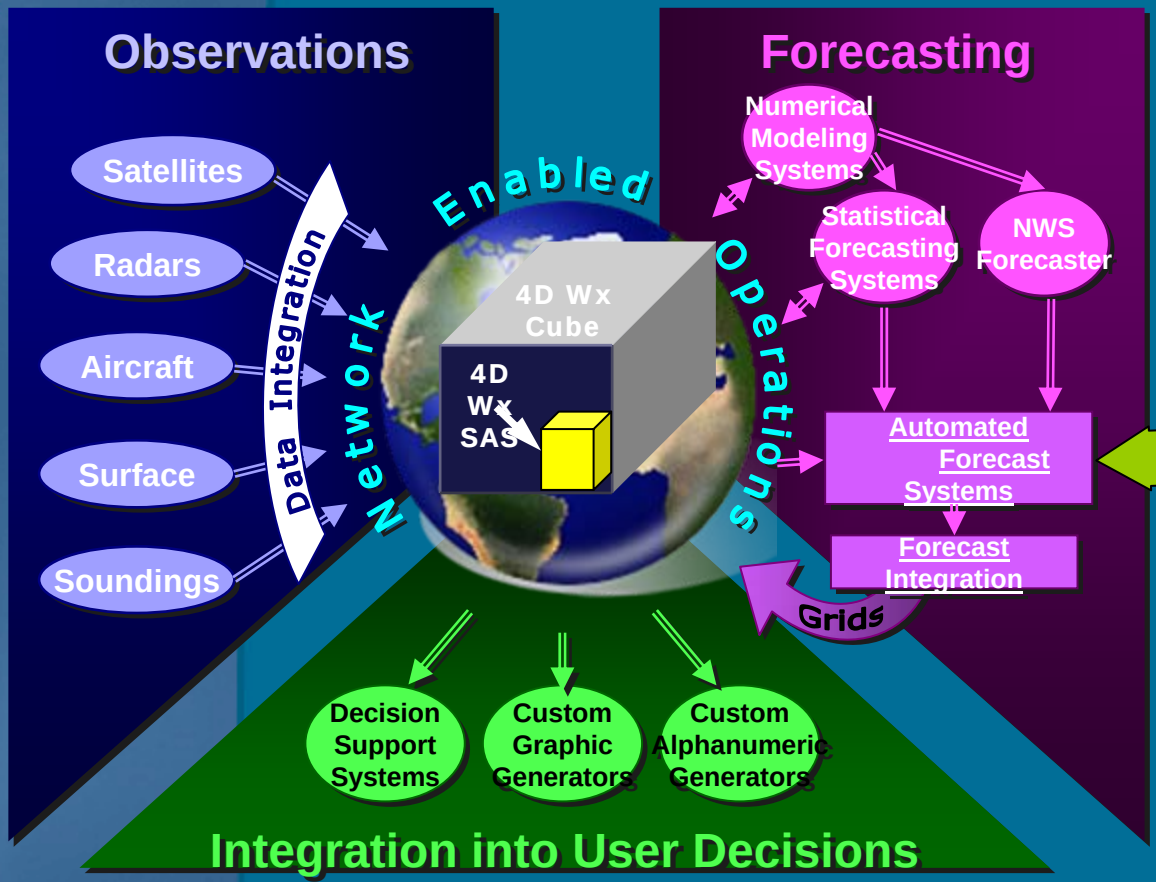
- Autonowcaster becomes the primary nowcasting technology used in NWS to provide rapidly updating gridded nowcasts to populate the WIDB[2] (aka 4-D Cube).
- NWS WFOs use in-house expertise to optimize their ANC system to support to NextGen[1] as well as local High Impact Events.
- Acts as a test bed for mesoscale meteorology conceptual models as applied to operational nowcasting

[1]Next Generation Air Transportation System

[2] Weather Information Database

The FAA NextGen 4-D Weather Cube:

Provides a common weather picture for the National Air Space by 2025



AutoNowCaster

CONCLUSIONS

1. NWS forecasters can properly and consistently enter in boundaries into the Autonowcaster system in a way that improves the overall performance of the system

2. NWS Forecasters interaction is limited. They do not have to constantly “babysit” the automated system

3. It is anticipated that when fully implemented in AWIPS, the Autonowcaster will provide useful guidance that will improve NWS support of aviation and short-term warnings and nowcasts of thunderstorms to the public