Nulled NEXRAD Radar Latency Research

This research is in response to requirements and funding by the Federal Aviation Administration (FAA). The views expressed are those of the authors and do not necessarily represent the official policy or position of the FAA.

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Problem

Radar images presented in the cockpit are often 15 minutes old ("latent")

*Cockpit weather information latency is attributable to a safety risk
of GA pilots making adverse weather avoidance decision
by interpreting the cockpit weather information as real time.*

Latency can be introduced at many steps along the delivery chain:

- Radar sweep cycle
- Transmission to NOAA
- Compositing and image generation
- Dissemination to FIS-B or vendor
- Datalink to aircraft
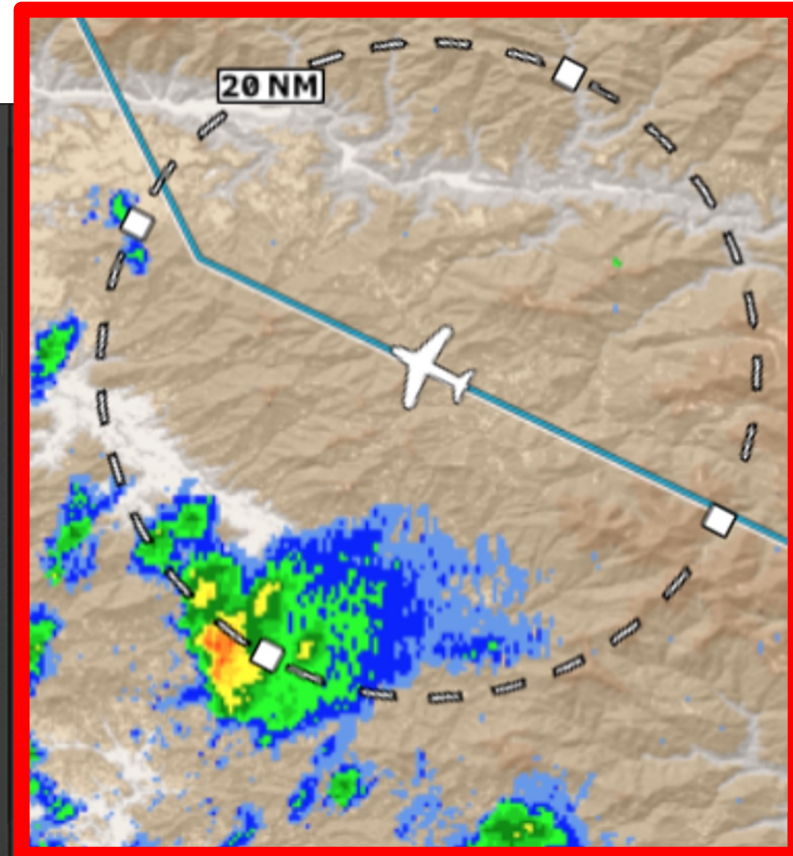- Update and rendering on avionics

Between the time when the radar observes convective weather and when a pilot views it, it may have:

- Moved 0.5 - 10 miles
- Grown
- Decayed
- Changed shape
- Changed intensity

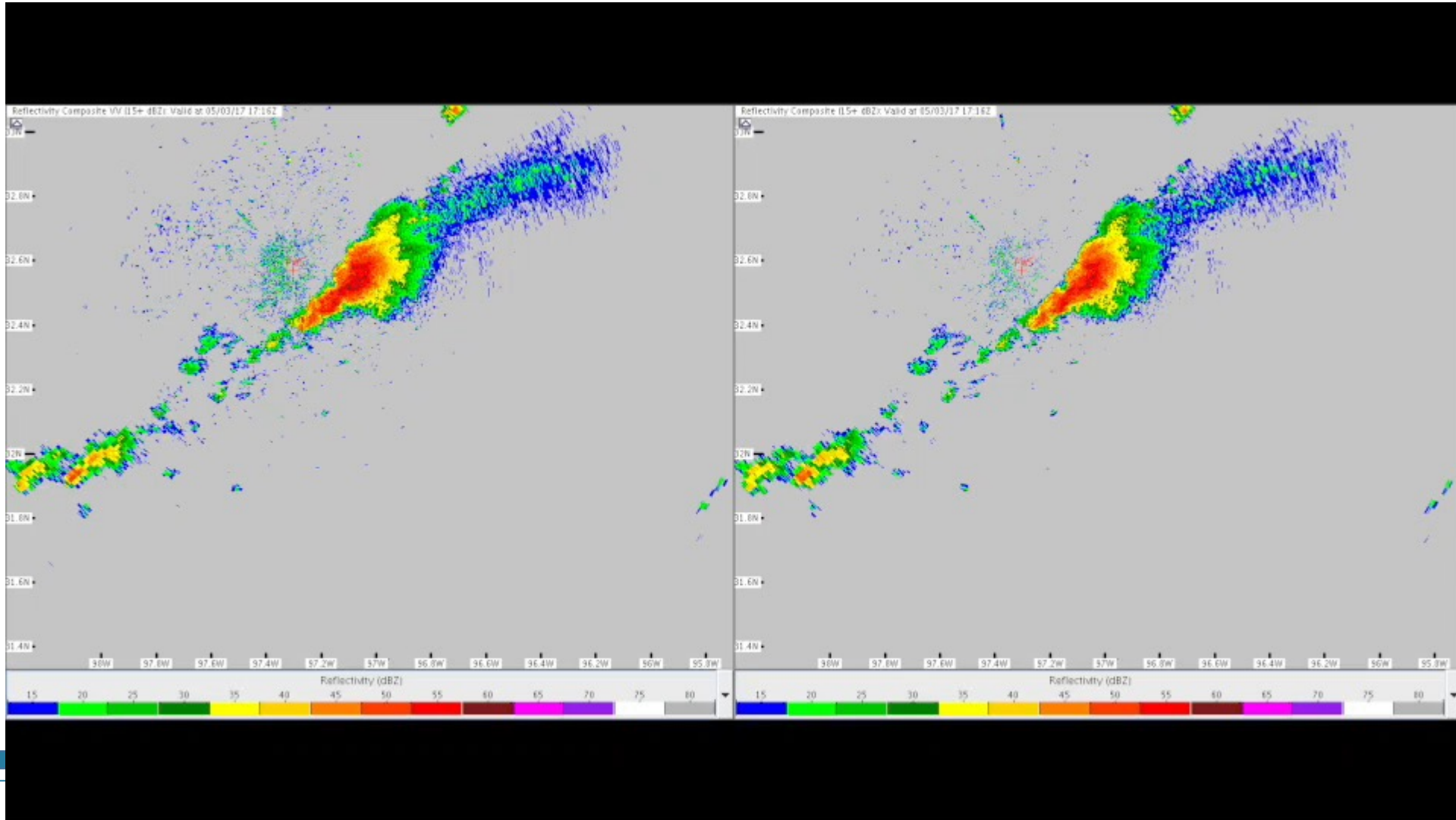# Single-cell, developing, thunderstorm
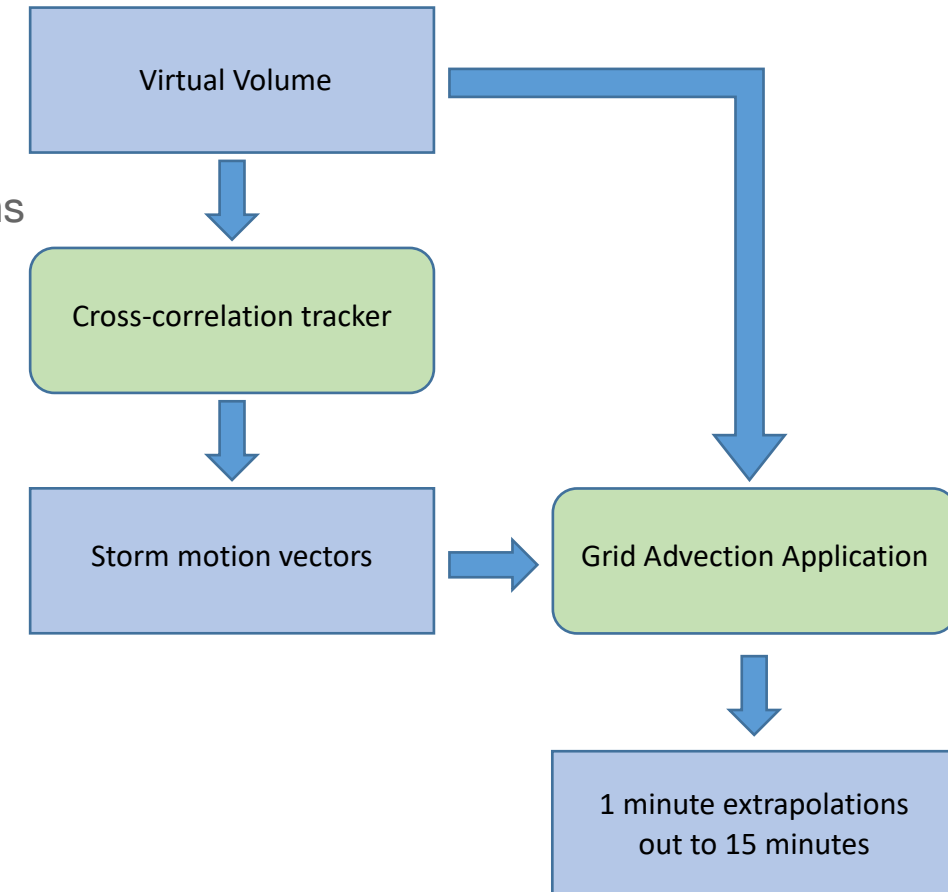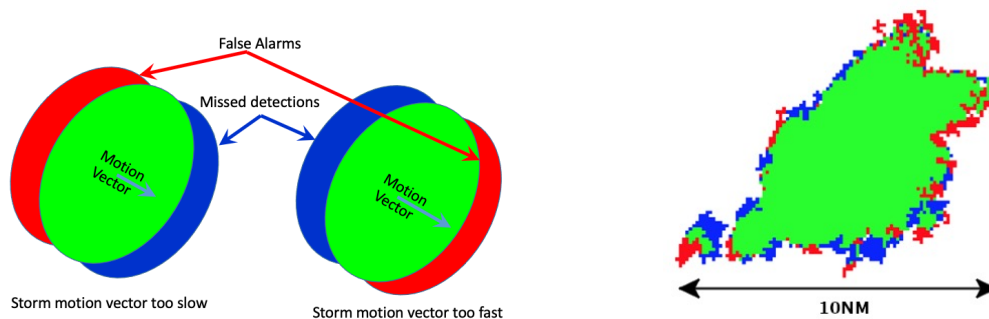## KSHV to KFWS - May 10, 2017 16:29CT
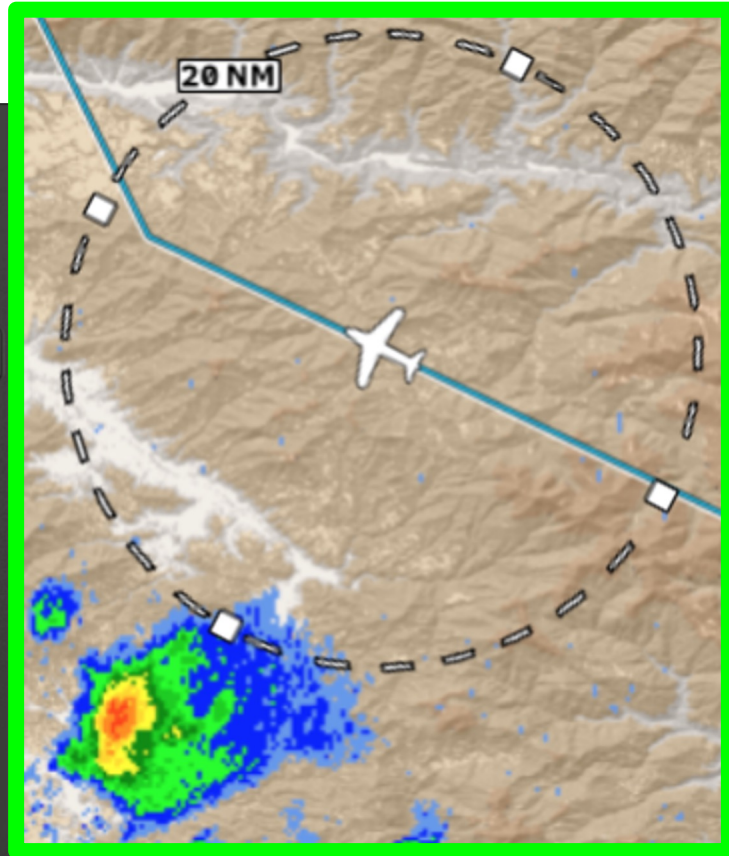
t-12 minutes

Actual

Reduce Radar Processing Latency

Radar scan angles (deg)

Null Latency with 1-15 Minute NowCast

- Extrapolation processing
  - Virtual Volume created
  - Compute gridded storm motion vectors
    - Cross-correlation tracker (CTREC) to correlate storm positions
    - Centroid locations of correlation "boxes" determines vector
  - Compute extrapolation nowcasts with Grid Advection
    - Input gridded storm motion vectors and Virtual Volume
    - Outputs nowcasts of 1 min extrapolations out to 15 min
- Growth/Decay via TITAN did not improve forecast
- Errors were on the order of 1.5 km over 15 minutes

Virtual Volume

Cross-correlation tracker

Storm motion vectors

Grid Advection Application

1 minute extrapolations out to 15 minutes

False Alarms

Missed detections

Motion Vector

Motion Vector

Storm motion vector too slow
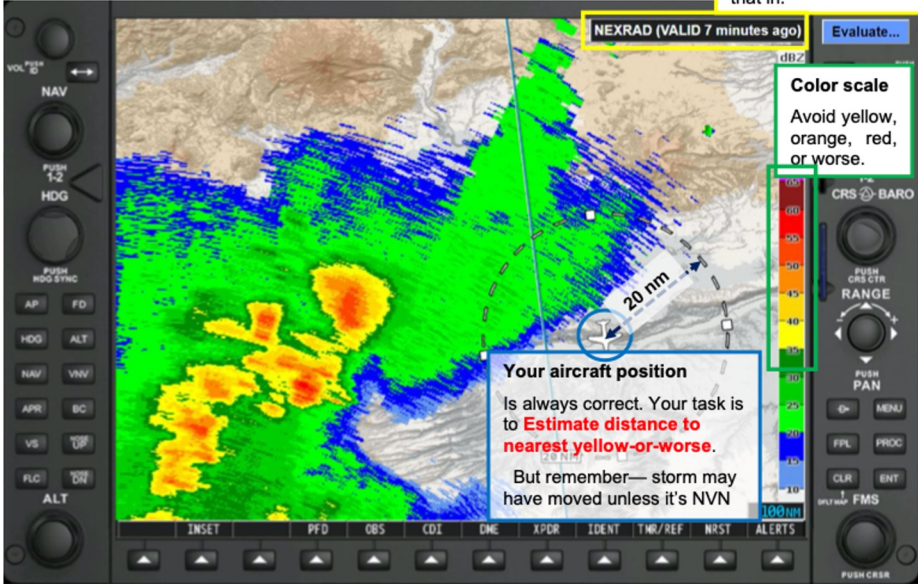
Storm motion vector too fast

10NM

Test Application and Study

- Prepared test design with CAMI
  - Part-task simulation with 27 scenarios
  - 2 Questions
    - How **far** do you think you are now?
    - How **confident** are you of your estimate?
  - 3 independent variables
    - **Latency**: 0 (NVN), 7, 11 minutes
    - **Storm Geometry**: "Fat," "Skinny," "Popcorn"
    - **Distance to Hazard**: 16, 20, 24 NM
  - 3 Dependent variables
    - **Accuracy** in judging actual distance (MCDTH)
    - **Speed** of making the judgement
    - **Confidence** in the accuracy of their judgment
- Remotely administered due to pandemic
- 30 participants of varying experience

Results

- Some disappointing conclusions
  - The Generalized Linear Mixed Model (GLMM) model had trouble finding statistical significance
  - There was no consistent effect from Latency on Speed or Confidence
  - There was a strong bimodal distribution to Accuracy (pilots equally over/under estimated MCDTH
- Main positive conclusion:

  Latency causes separation-distance estimates to vary more
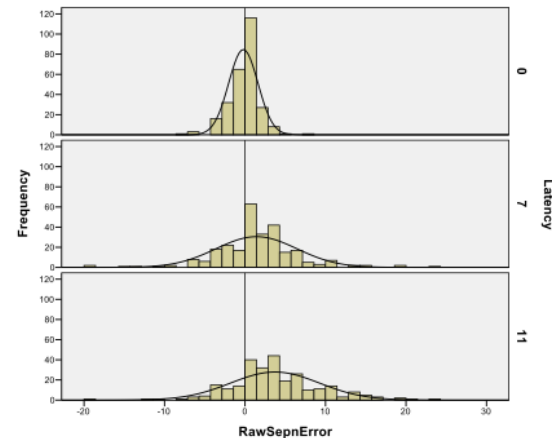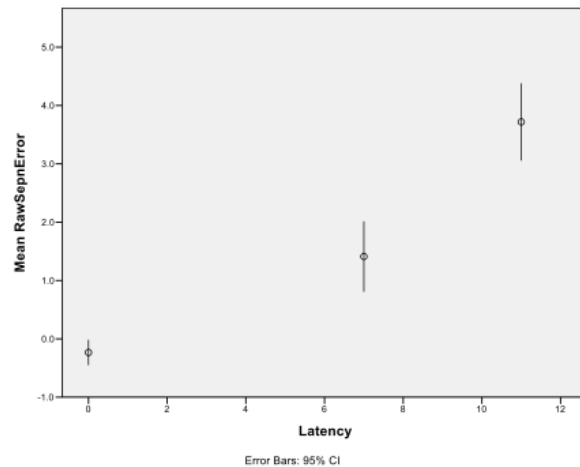
- Nulling radar latency holds promise, but more research is needed