A Hybrid Nowcasting System: Results and Challenges

Joseph P. Koval
The Weather Channel
Atlanta, GA, USA

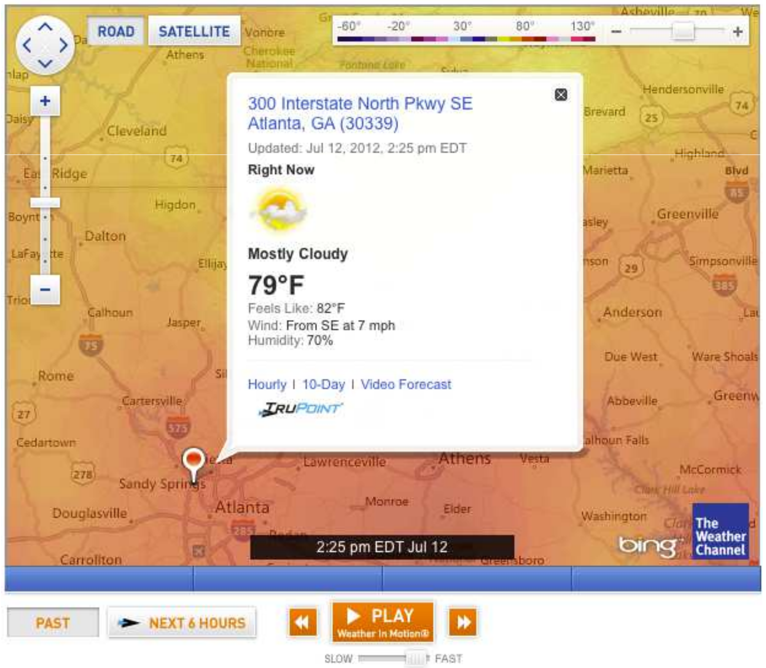
Todd Hutchinson
Weather Services International
Andover, MA, USA

Statement of Problem when developing Trupoint (2006)

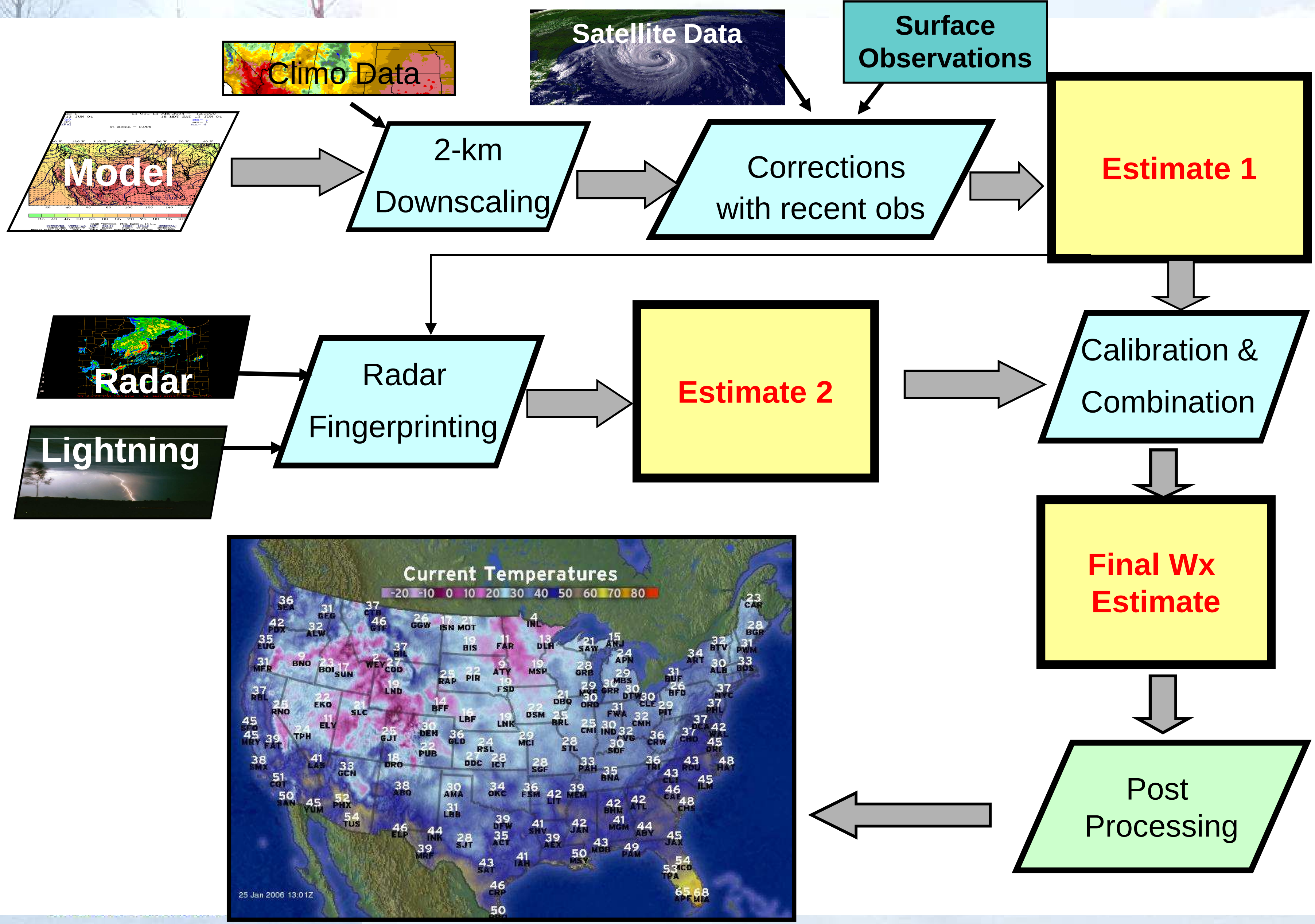
- Consumers demand personally-relevant weather forecasts
- There is a desire for more precise short term forecast information
- We know a lot more about the weather over the next few hours than we communicate
- Update cycle of Nowcasting guidance is outpacing the human forecaster's ability to be in the loop with the forecasting process on a national scale
- Resolution and update cycle will only become finer in the future

We already have Trupoint Currents

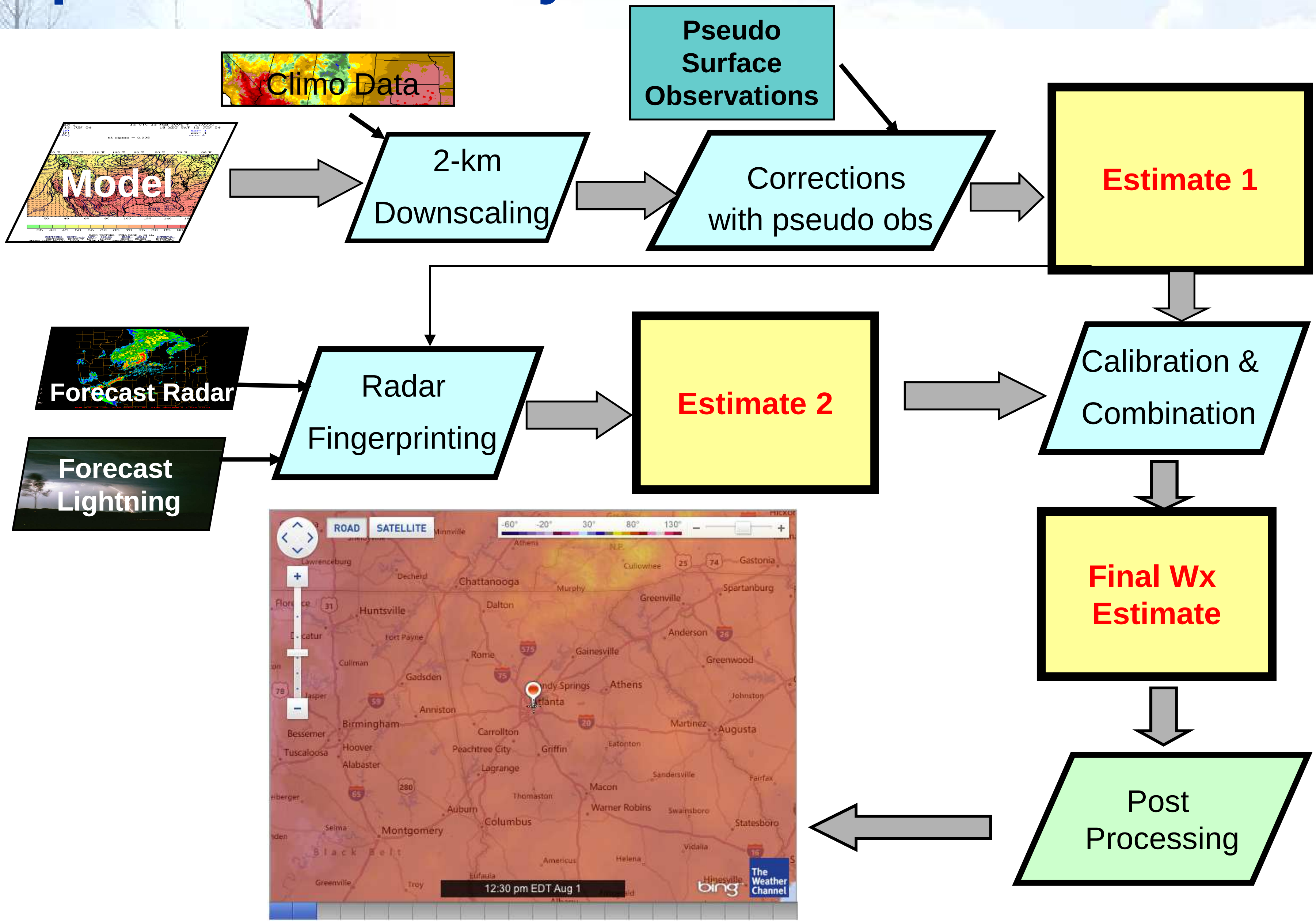
- An observation system that combines observations, model, radar, lightning and other observation data to produce high resolution current conditions



Trupoint Current Condition System

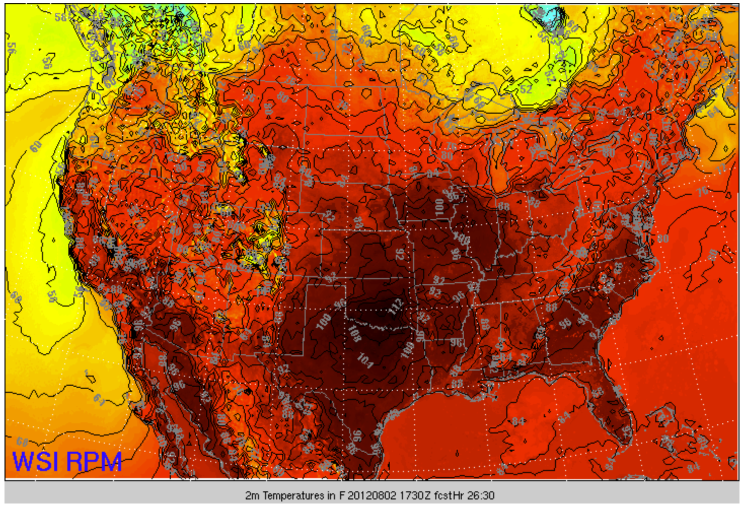


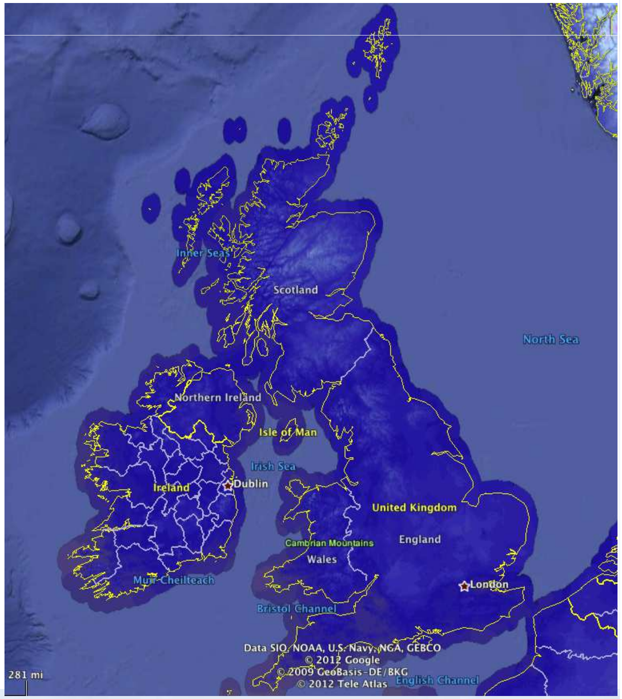
Trupoint Forecast System



Trupoint Forecast Inputs – Method 1

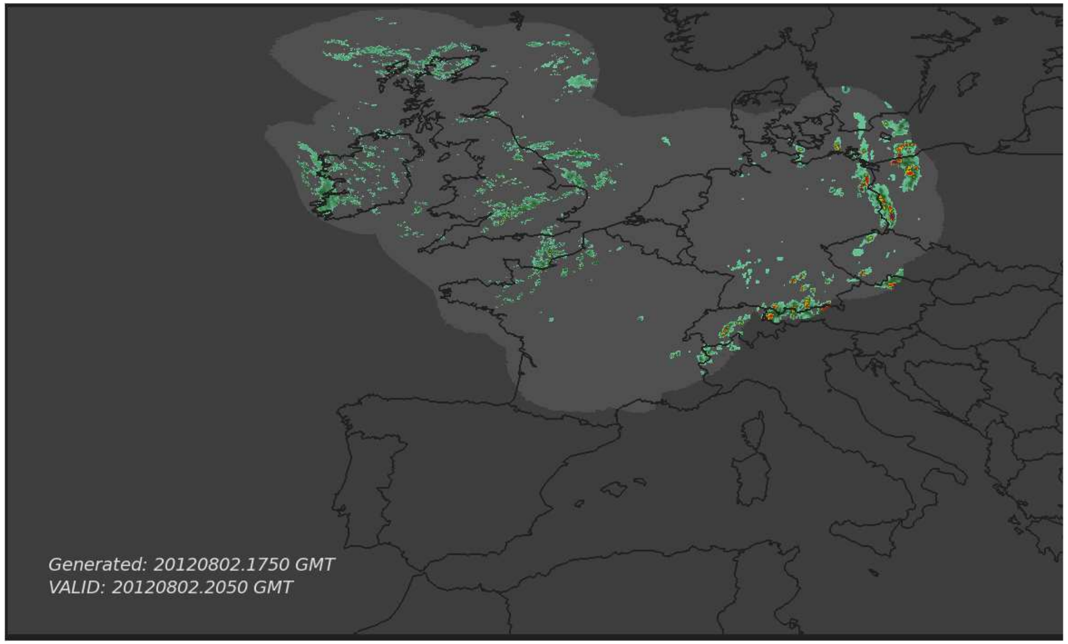
- Numerical Model Forecasts
  - 13 km NCEP RAP in CONUS
  - 4 km WSI RPM in Europe
- Gridded climatology
  - Oregon State PRISM data in CONUS
  - Proprietary gridded climatology in Europe
- Pseudo-observations
  - Forward error corrected traditional forecasts
  - Based on bias-corrected TWCC human-intervened "traditional forecast"
  - Higher skill for temperature, dewpoint, wind forecasts compared to individual model forecasts





Trupoint Forecast Inputs – Method 2

- Radar Advection product
  - WDT MAPLE in CONUS
  - Cell Identification/Lagrangian technique in Europe
- Lightning density forecast
  - Model-based solution derived from Thunderstorm Potential Index (TPI) (Knapp et al, 2006)



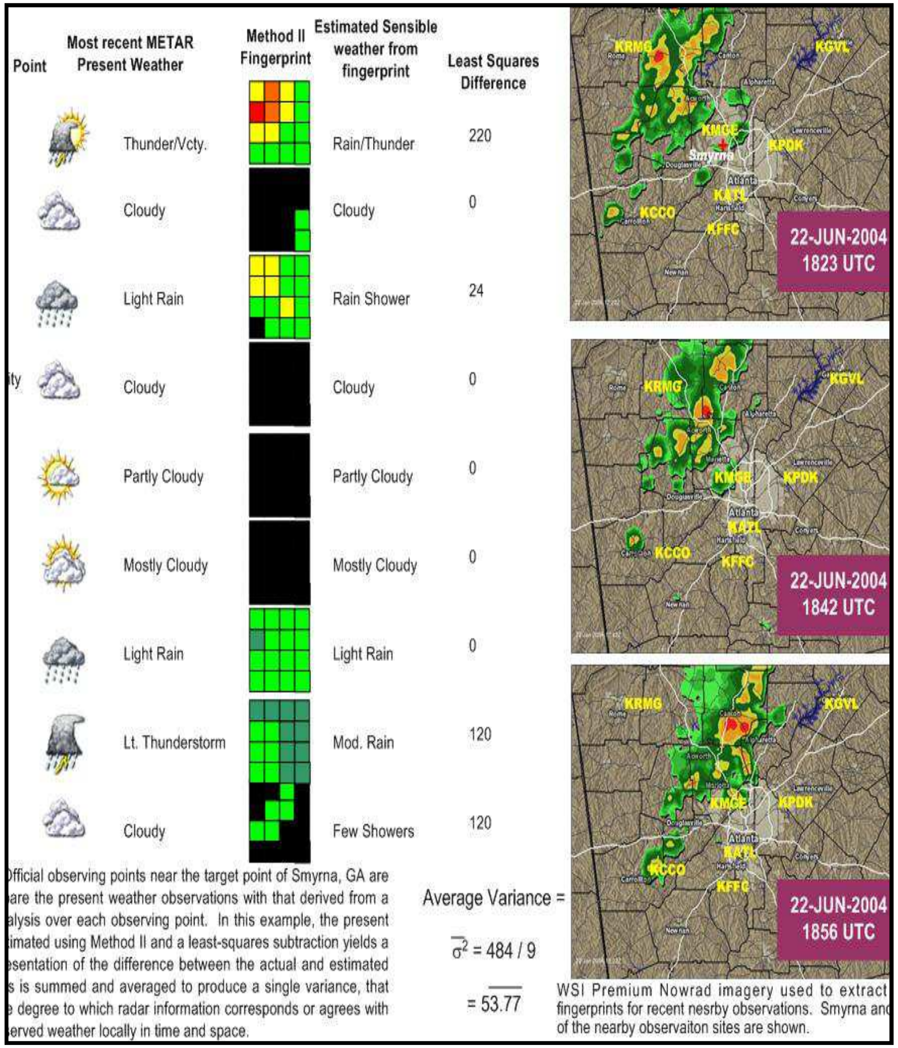
Method 2: Radar Fingerprinting and Calibration

- Focuses on ascertaining “sensible weather” using advected radar and lightning

- Assisted by output from Method 1

- Coverage, reflectivity around target point are converted to precipitation rate, then probability of precipitation

- Determine sensible weather and probability of precipitation based on the nearby radar reflectivity pattern



Trupoint Forecast – Future Radar Calibration

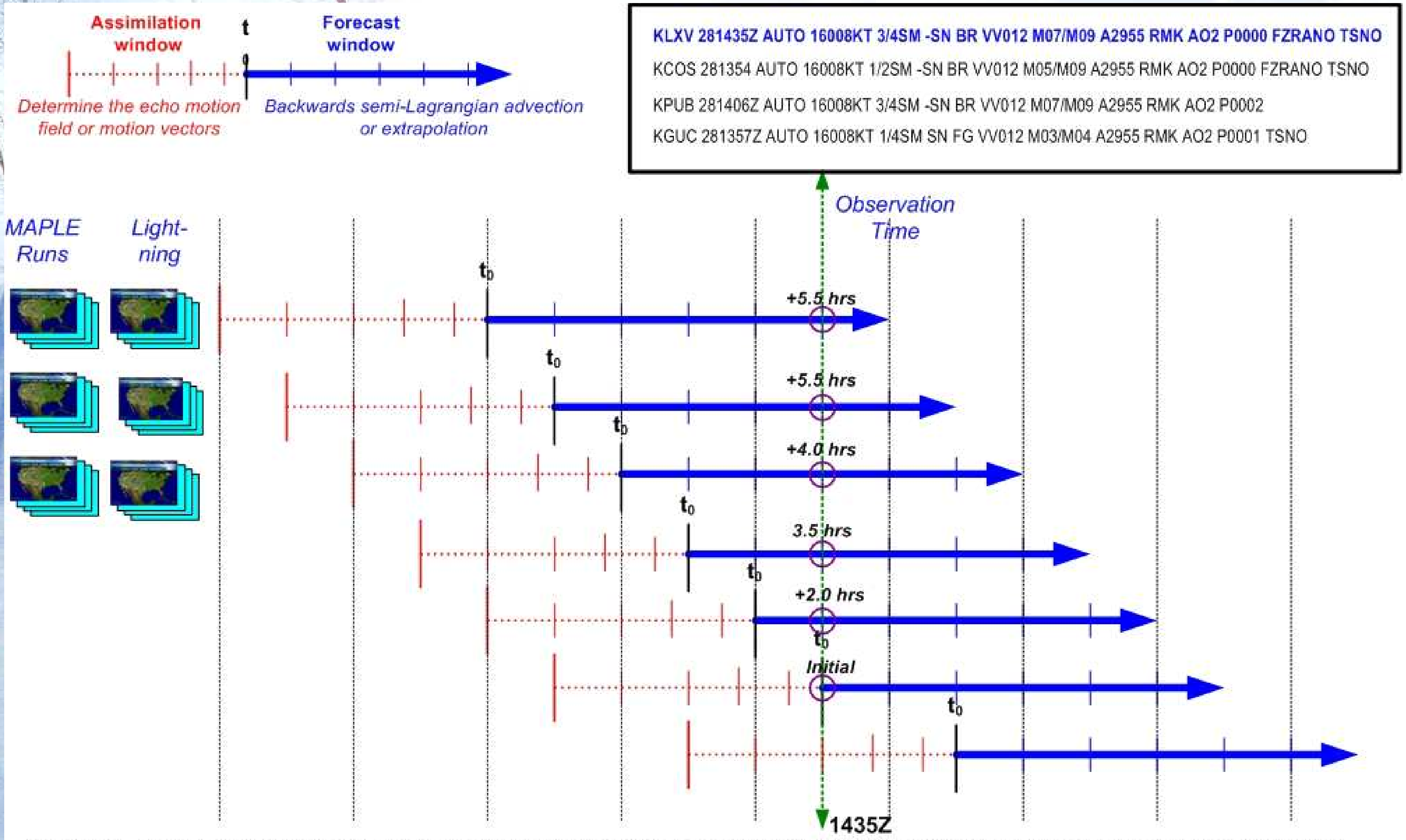
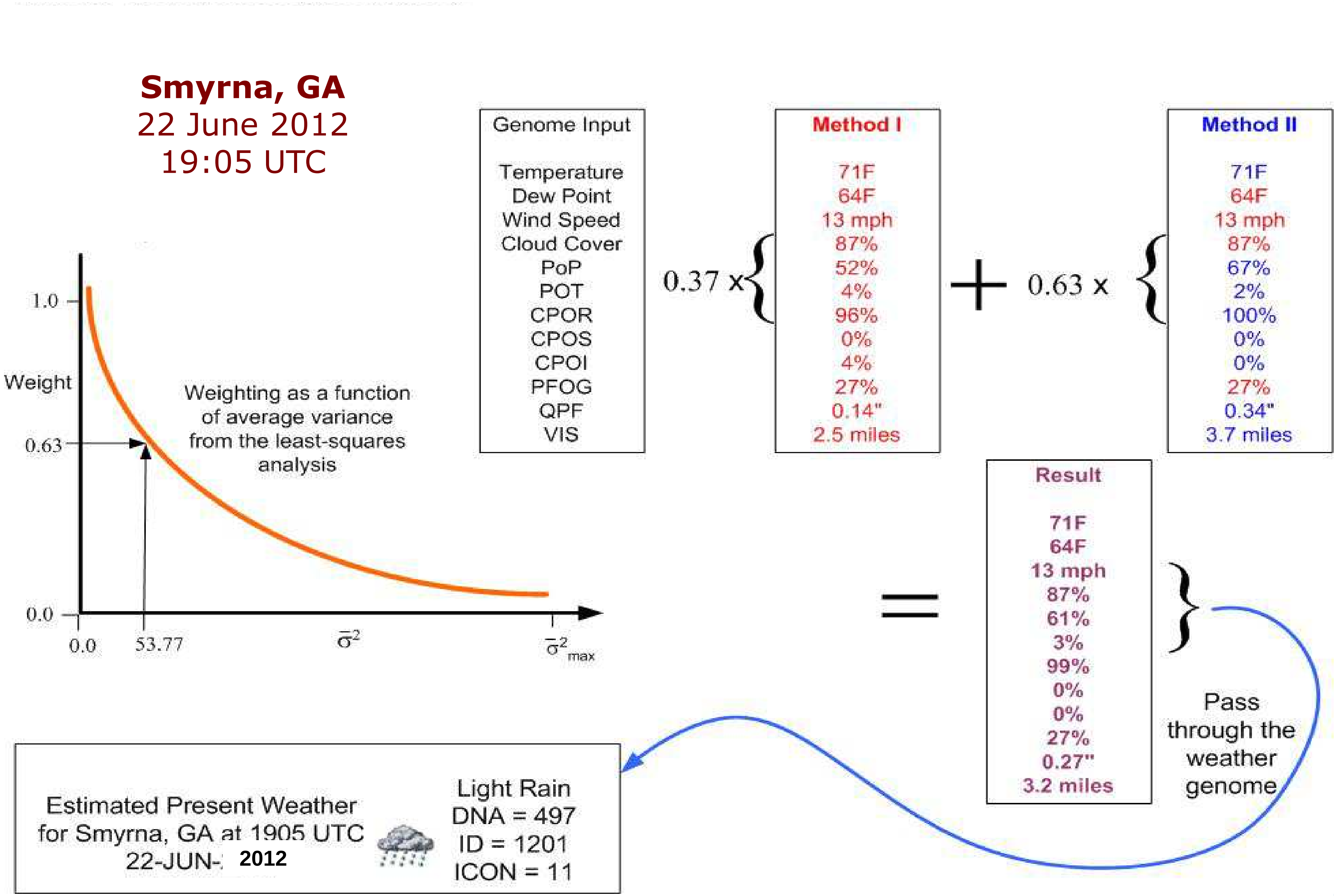


Figure 1.6 – The HiRAD:FastForward Calibrator uses information from MAPLE and lightning prediction to estimate present weather at reported observation points in the CONUS. It is the arrival of a valid METAR that triggers calibration to occur. In this example, KLXV reports at 1435Z and the Calibrator selects MAPLE and lightning imagery as close as possible to this observation time across all stored forecast sets. In each case, the Calibrator will compare its own internal estimate of present weather against the incoming METAR report; using sensible weather scoring, it will assign a variance or error to each comparison event. From this systematic comparison between observed and predicted, average error statistics will emerge as a function of forecast valid time and location.

Combining Method 1 and 2 (original design):



Trupoint Forecast – Calibration Challenges

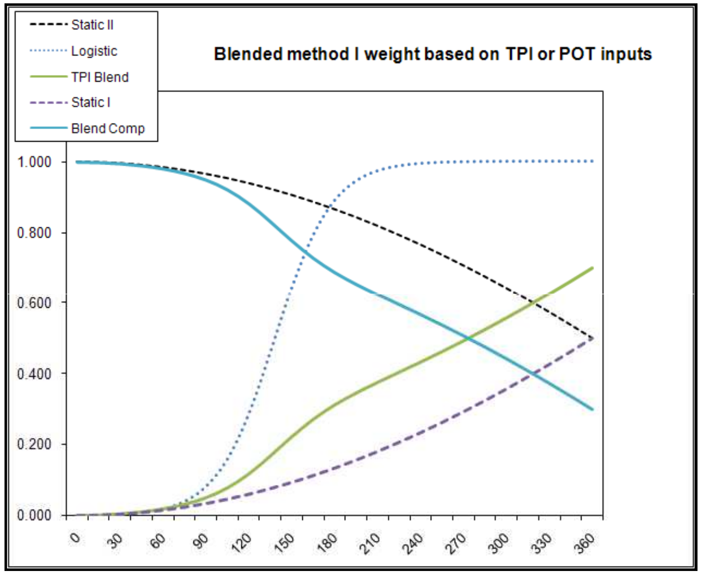
- In original system, blending between forecast radar and model forecast for precipitation entirely based on local calibration results
- Worked well in some cases (“steady state stratiform” precipitation events, preventing virga in forecast radar from driving false alarms)
- But in cases of initiation (precipitation developing in place), calibration resulted in severe dry biases, as dry radar solution was favored for too long because of previous good calibration scores
- “Summertime diurnal convection cases”

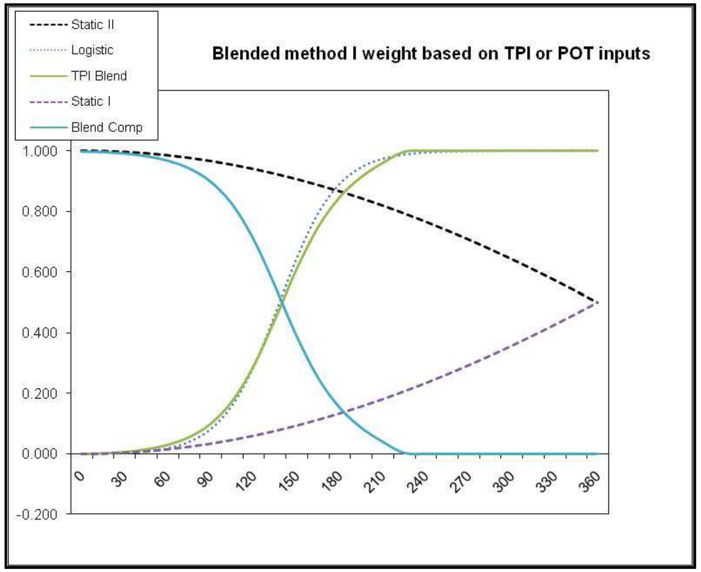
Trupoint Forecast – Modified Blending Technique

- We concluded blending technique based on radar calibration alone was not satisfactory
- Modified blending technique is based on a measure of the instability of local atmosphere
- The more unstable, the earlier the transition from radar to model-based precipitation forecast
- Logistic curve, so transition occurs in short order
- Calibration still plays a role, but only 15% of the weight is placed on calibration
- Improved threat scores by approximately .1 through modifications to blending technique

Trupoint Forecast – Modified Blending Technique

Weight of Method I and Method II are a strong function of local forecasts of instability (probability of thunder)



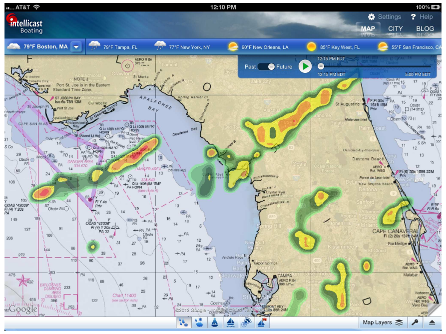


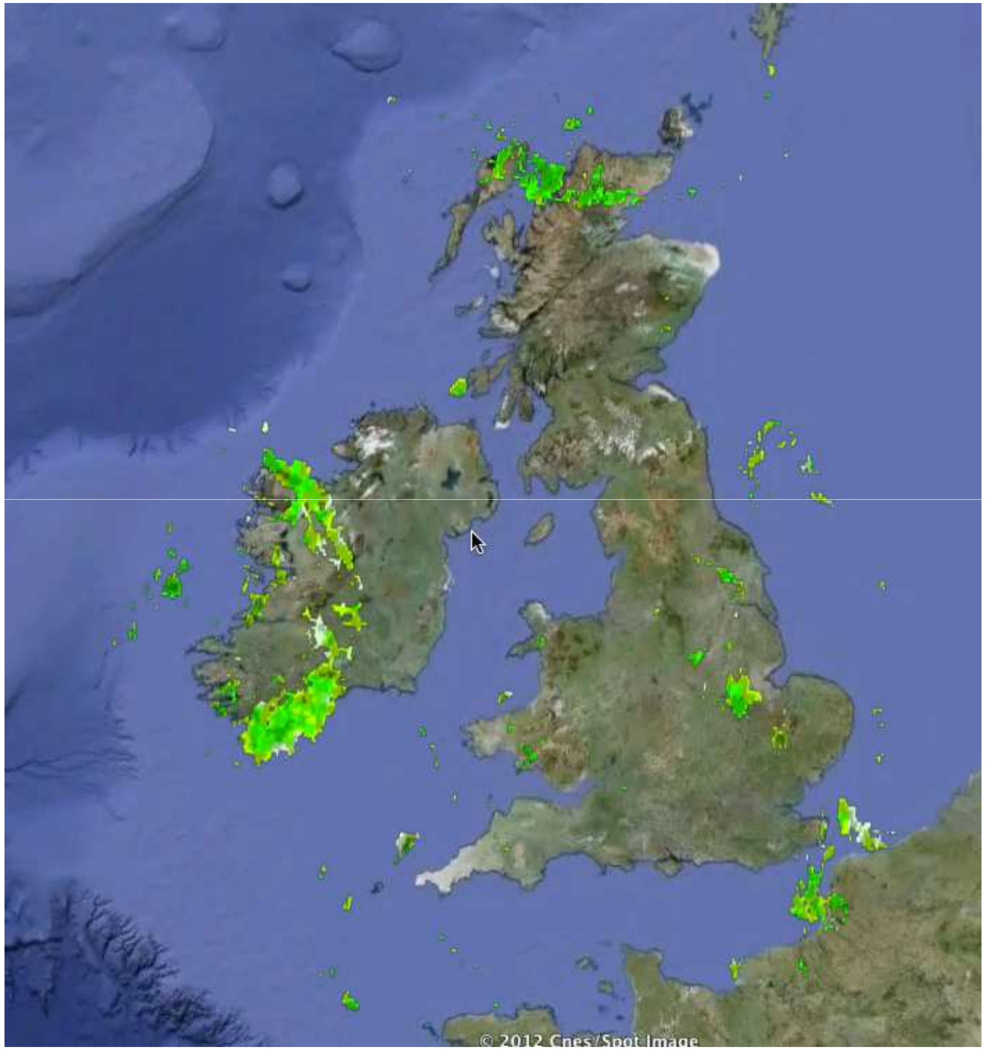
L.H.S. is with POT of 20%. R.H.S. is with 80%

Trupoint Forecast – The Operational System

- Runs for CONUS and the British Isles
- 44 Dell Servers run 104 tiles and 24 time steps 2x hourly (CONUS)
- 2 Dell Servers run 16 tiles and 24 time steps 2x hourly (British Isles)
- Altair PBS scheduler
- 5 km resolution
- Mainly an automated system (at least for precipitation/QPF)
- Delivered as point and gridded data
  - Derived products include Nowcast text forecasts and Onset-Offset products
  - Used on all TWCC platforms and for 2012 London Olympics coverage

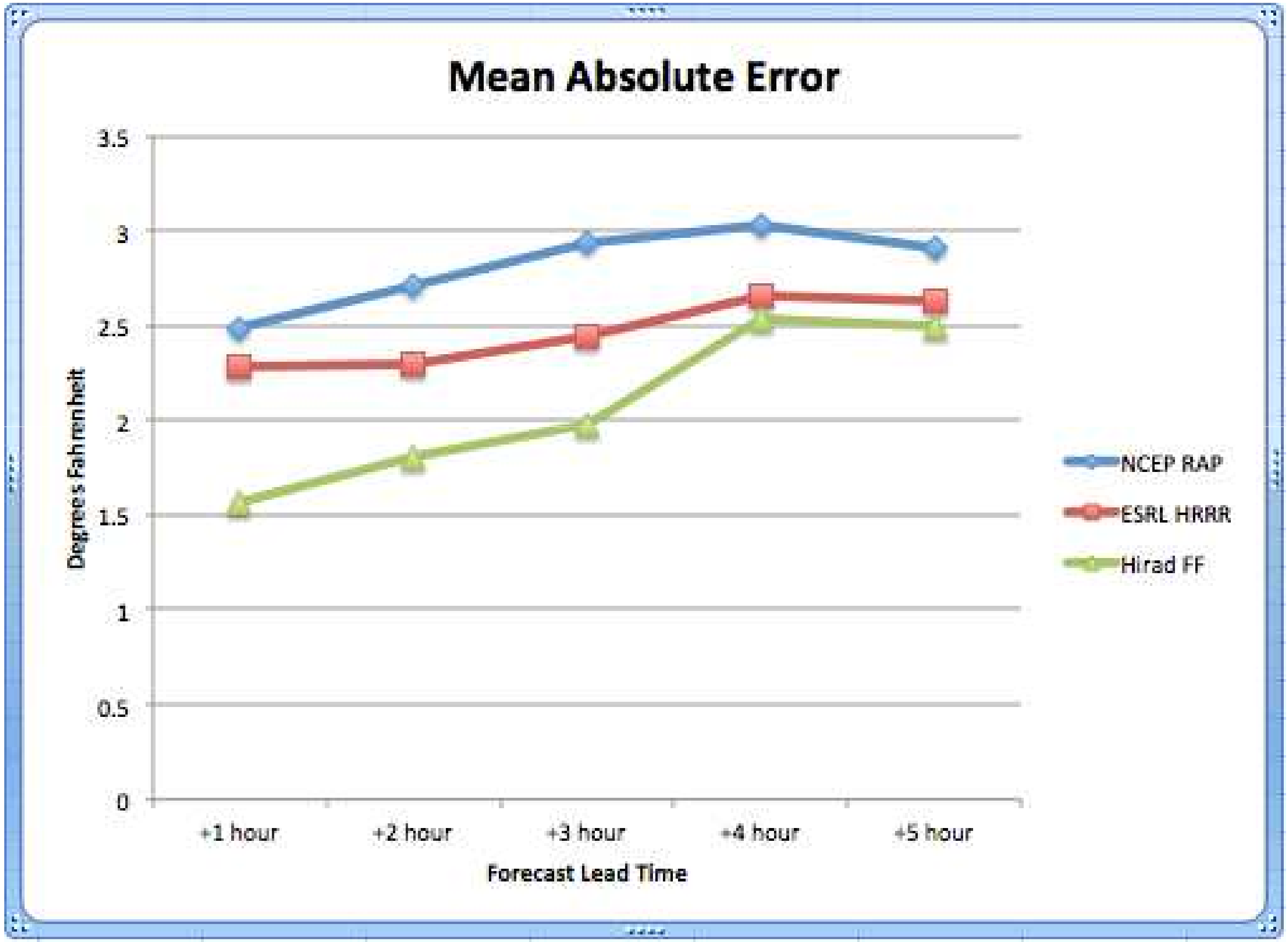
Sample Trupoint Products





Trupoint Forecast – Temperature Verification

June 6, 2012 CONUS 2-meter temperature verification, 6Z cycle



Results are representative of the sample

Trupoint Forecast Verification Highlights

- Precipitation
  - Threat score/bias equal to or slightly better in skill than advected radar and model forecast inputs alone
  - But threat score doesn't tell whole story
    - Convective forecasting, particularly initiation in weak forcing environments, is still a frustrating challenge during the 0 – 6 hour Nowcast period
    - At times, radar forecast and model forecast of precipitation location, particularly convection, is out of sync – "two squall lines, one appearing right in front of the other"
    - Results can be too deterministic in low coverage convection cases
    - Struggle with discontinuities between forecast and obs at time = 0
      - "It's raining, but we say it's partly cloudy"
- Temperature forecasts typically superior to any one model alone by .1 to .5 deg F due to bias-corrected ensemble

Trupoint Forecast Next Steps

- Improve handling of convective initiation in precipitation forecasts
  - Investigate satellite-based convective initiation algorithms
  - Use time lagged model/forecast radar ensembles instead of single cycle to improve probability of detection, decrease determinism when atmosphere is convective and weakly forced
- Improve forward error correction
  - Increase influence of current observations on 0 to 1 hour forecast
- Decide what role human forecasters play in severe weather situations

Obrigado!