Balancing Radar Data Assimilation with a nested Digital Filter Initialization

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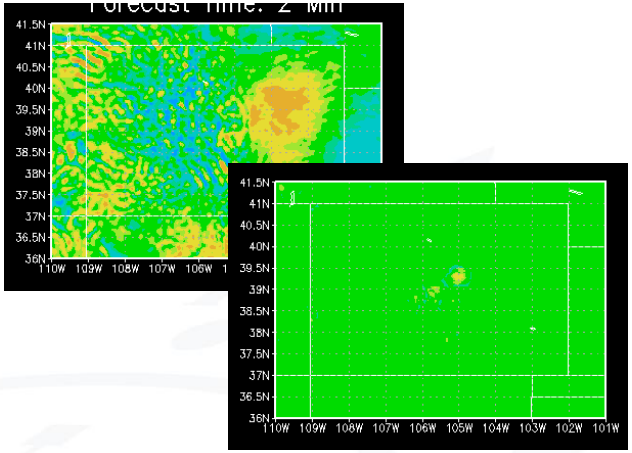
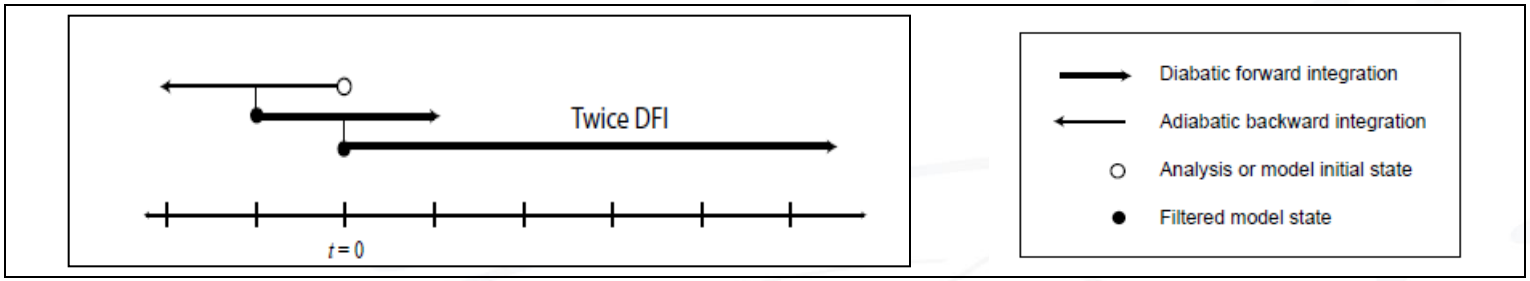
Agenda

- Nesting Capability in the WRF Digital Filter Initialization
  - Implementation
  - Results
- Radar Data Assimilation
  - ADAS Cloud Analysis
  - Experiment Setup
  - Statistical Results
  - Case Study
- Summary



Nested DFI Implementation Background

- Digital Filter Initialization (DFI) included since WRF3.0
  - filter results from a backward integration
  - filter results from a forward integration
  - more balanced initialization, reducing ‘spin-up’

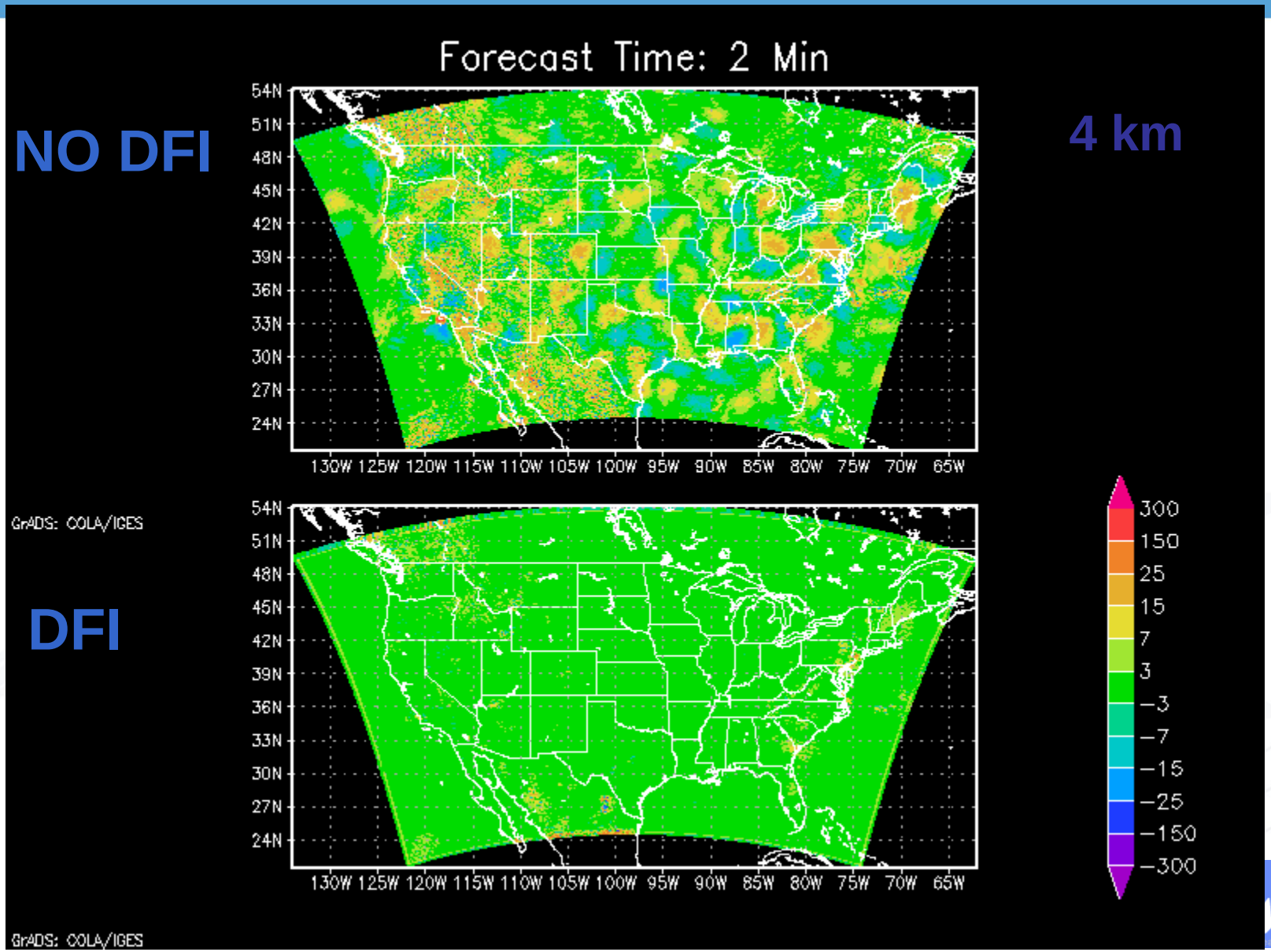


  - Limitation: No nesting
- We had a nesting requirement and were looking to better balance radar assimilated analyses
- This update adds DFI capability for nested runs
  - To be included in WRF 3.3 (March 2011), possibly WRF3.2.1 (August)

Nested DFI Implementation Details

- Most code changes simply add nesting ‘loops’ to existing DFI functions
- Uninitialized variables (vertical motion, etc.) caused imbalances in initial backward integration, so,
- Added a single forward step followed by a single backward step to assure initialization of fields

Nested DFI Results – mu dif per step



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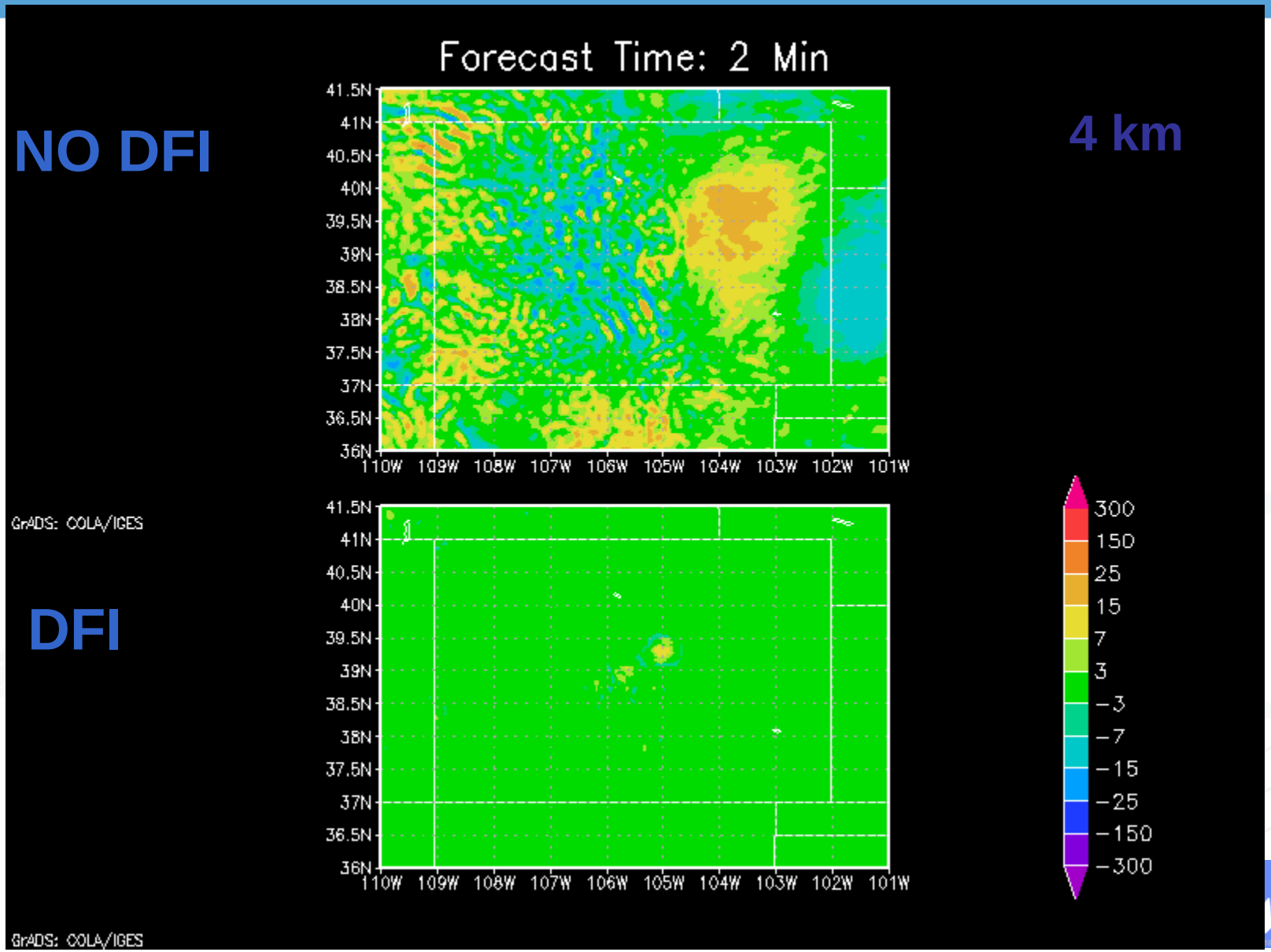
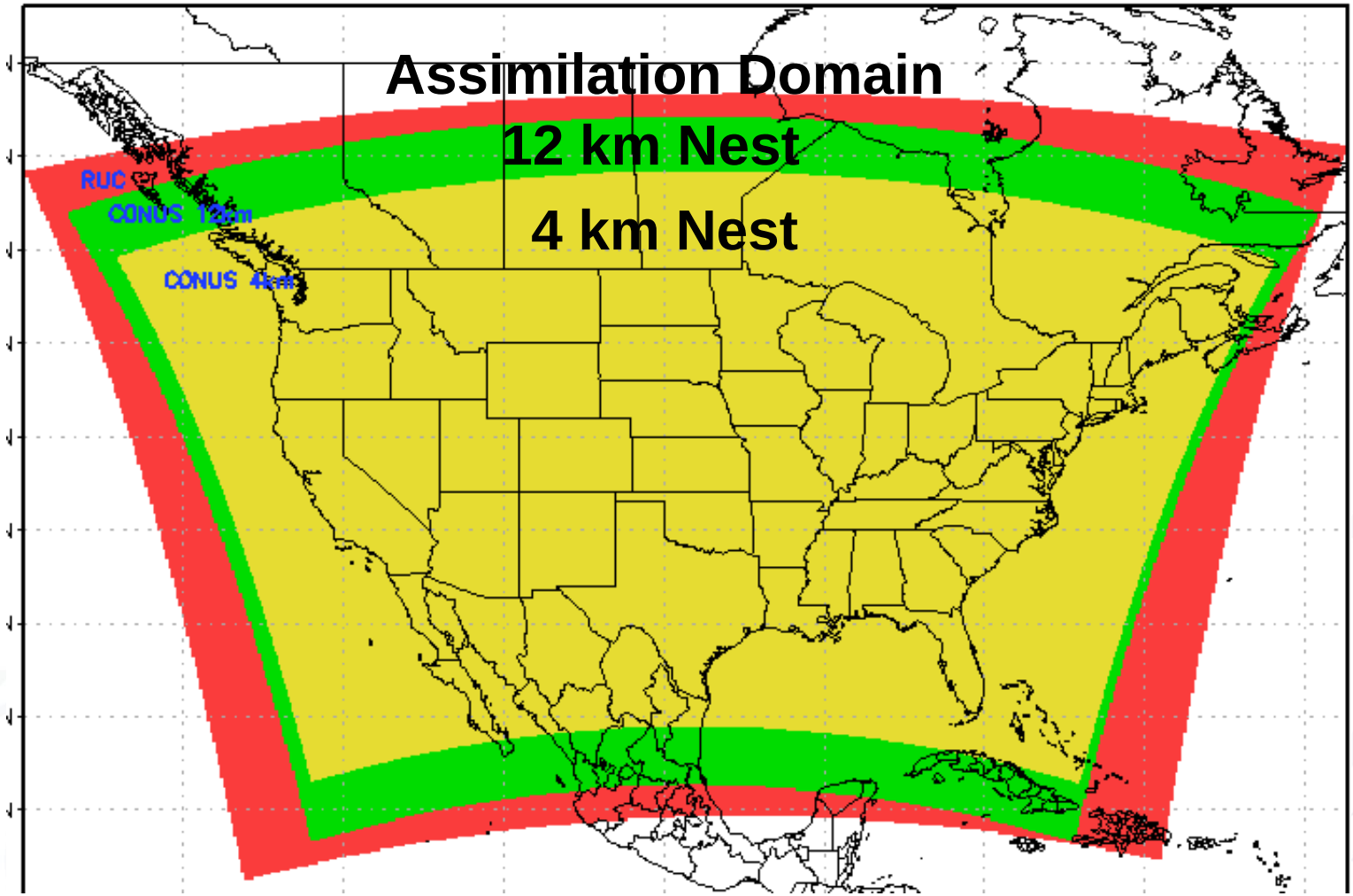


Radar DA – ADAS Cloud Analysis

- infer cloud, rain, ice, snow mixing ratios and cloud type from 3-D reflectivity
- Vertical motion based upon cloud type
- Temperature adjusted using a moist adiabatic profile based upon presence of cloud water, ice and assumed entrainment
- Removal of anomalous propagation from reflectivity

Experiment Setup - Domain



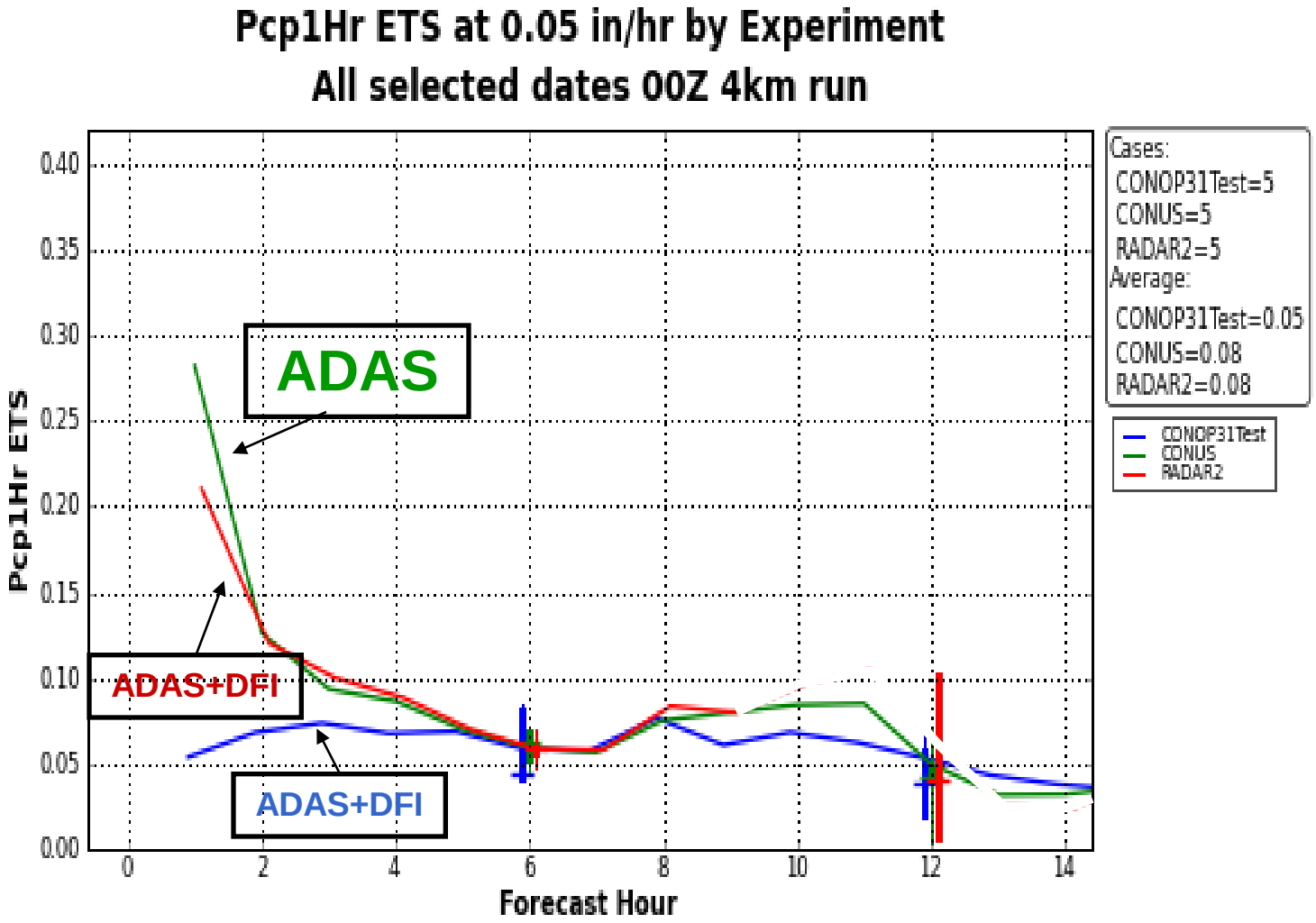
Experiment Setup – Model Details

- WRF-ARW version 3.1
- Feedback from 4 km to 12 km nest
- Kain-Fritsch convection on 12km grid
- WSM-5 Microphysics
- RUC 13 km isentropic for background analysis
- GFS 1-degree for boundary conditions
- Experiments:
  - Control: WPS
    - 15 hr fcsts
  - Exp 1: Radar DA using ADAS
    - 15 hr fcsts
  - Exp 2: Radar DA plus DFI
    - 1-hour back, 30 min fwd
    - 9 hr forecasts

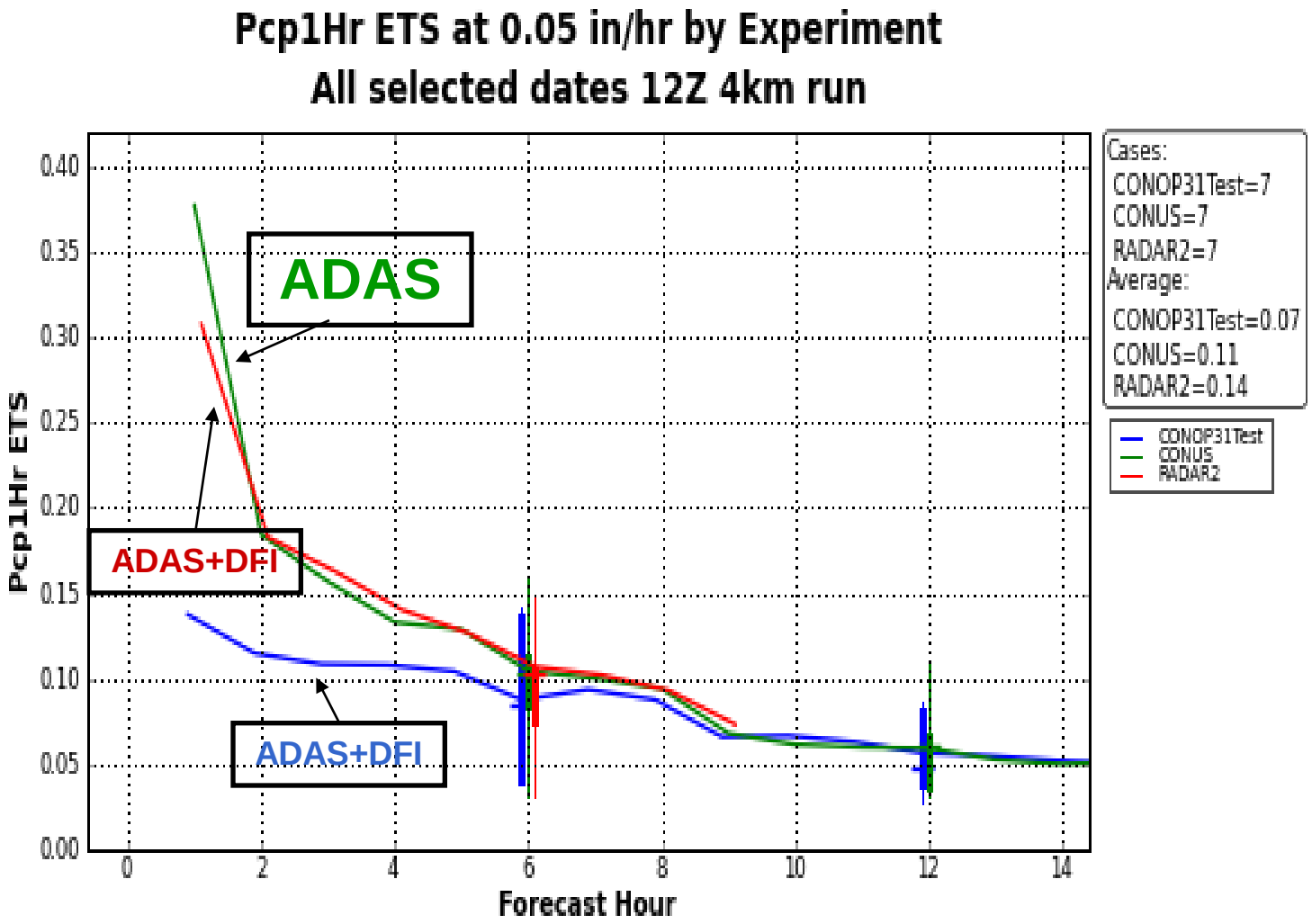
Verification

- 12 cases from August and September 2009
- Equitable threat scores of 1-hour accumulated precip
  - 1 hour NCEP Stage IV used as truth
- Scores combined by weighting by number of observed points in each case
- Results for 0.05 in / hr (1.27 mm/hr)

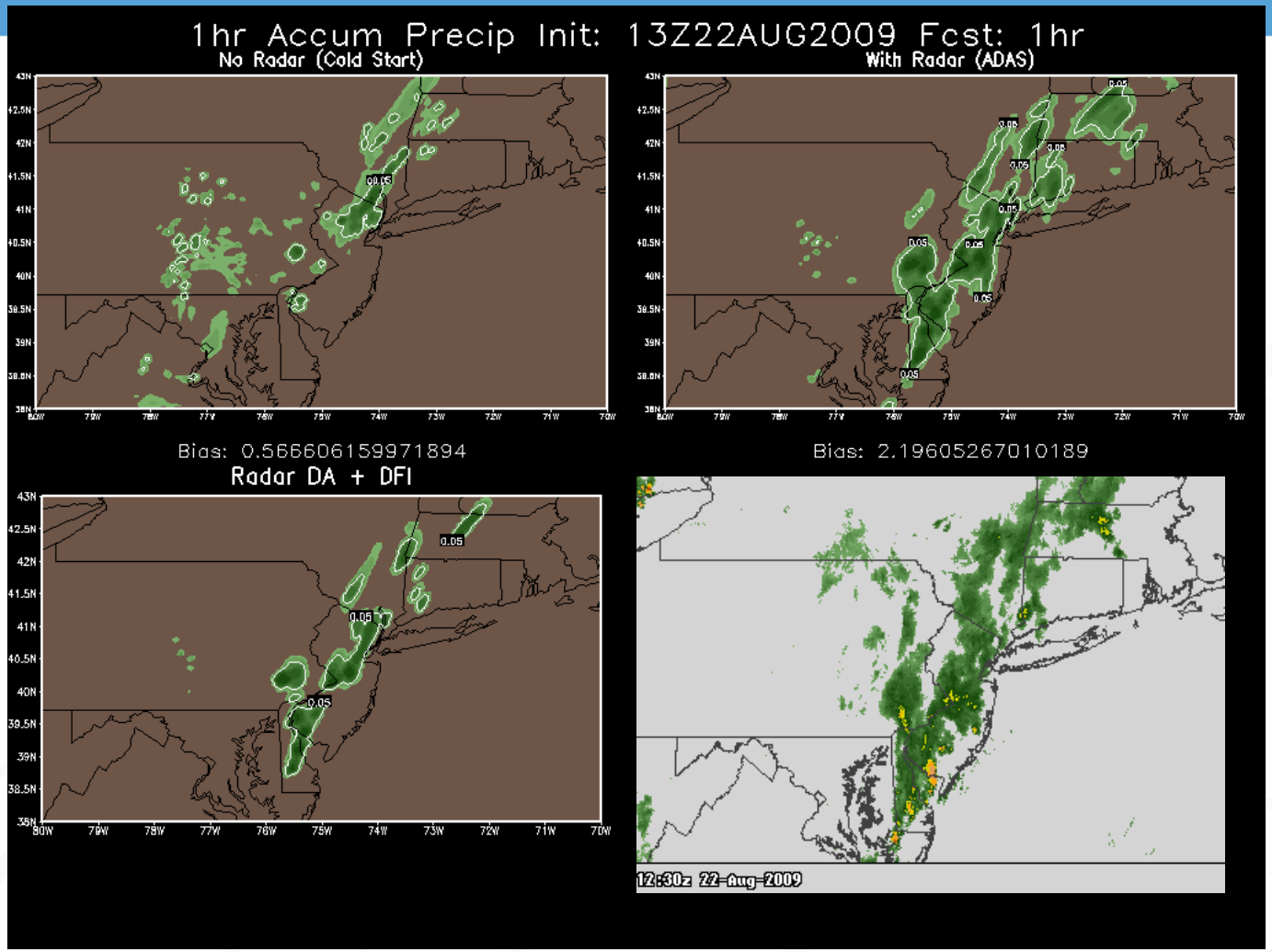
Statistical Results – 00 UTC runs (5)



Statistical Results – 12 UTC runs (8)



Precip Bias – Case Study



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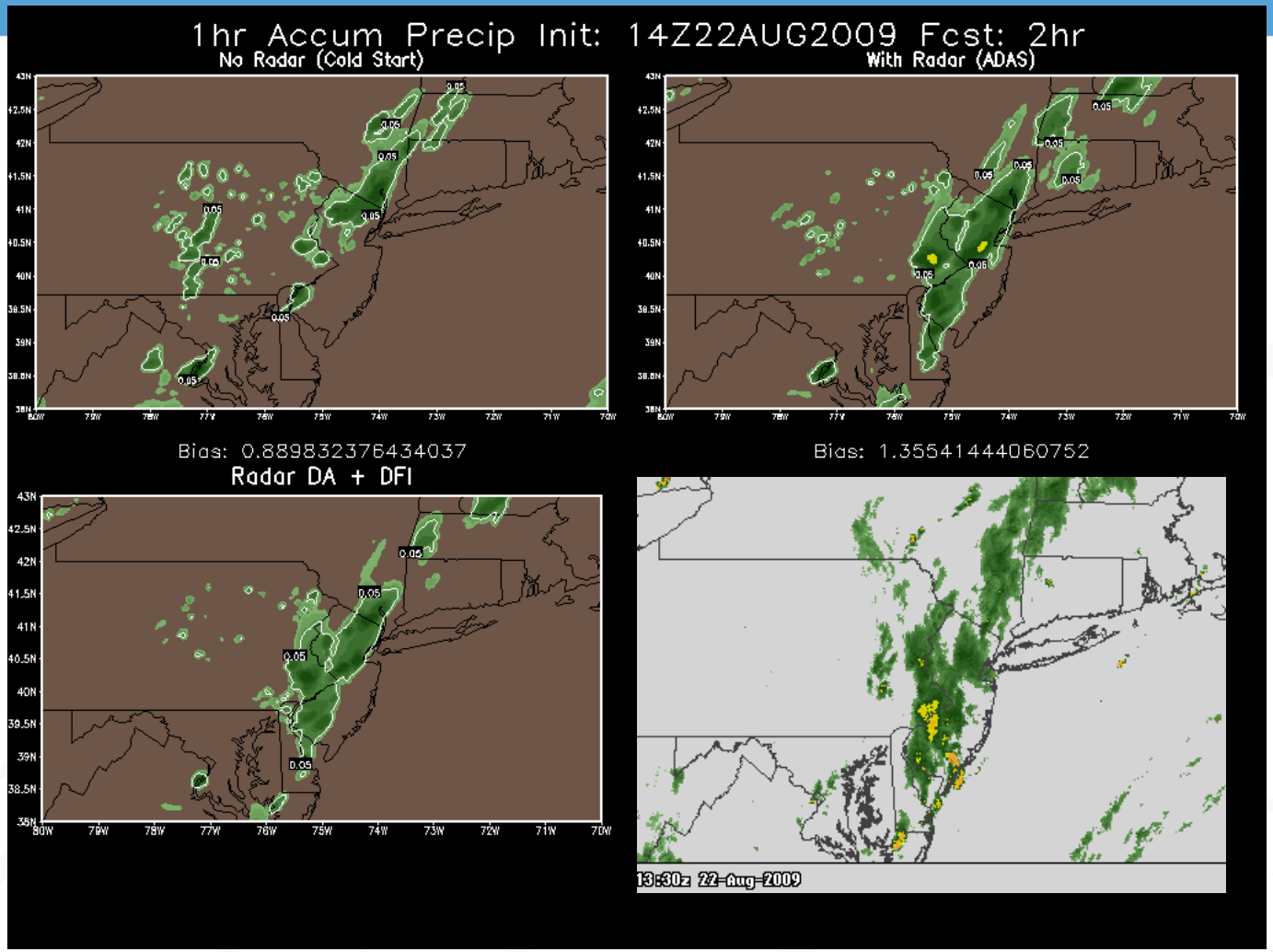

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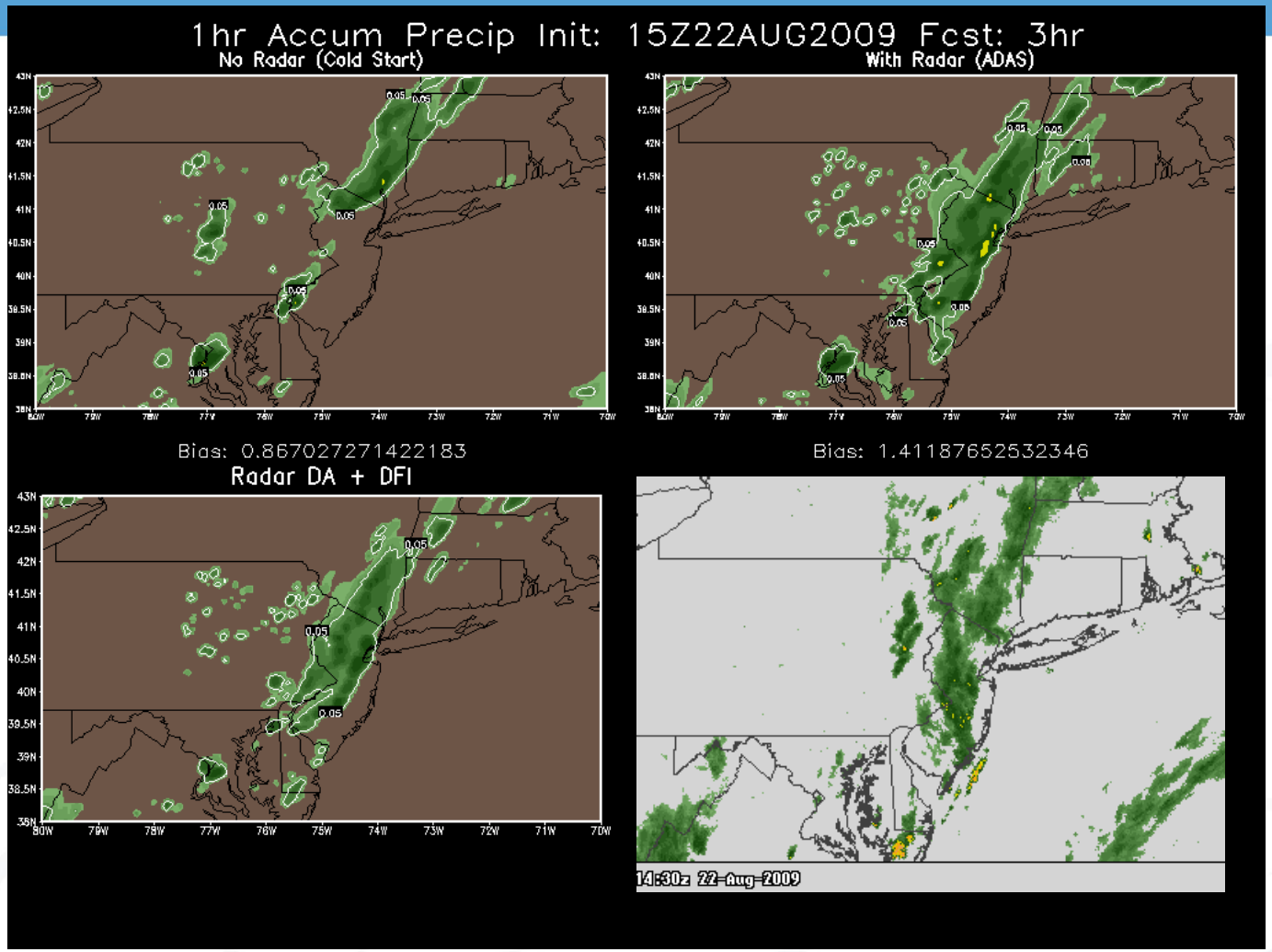

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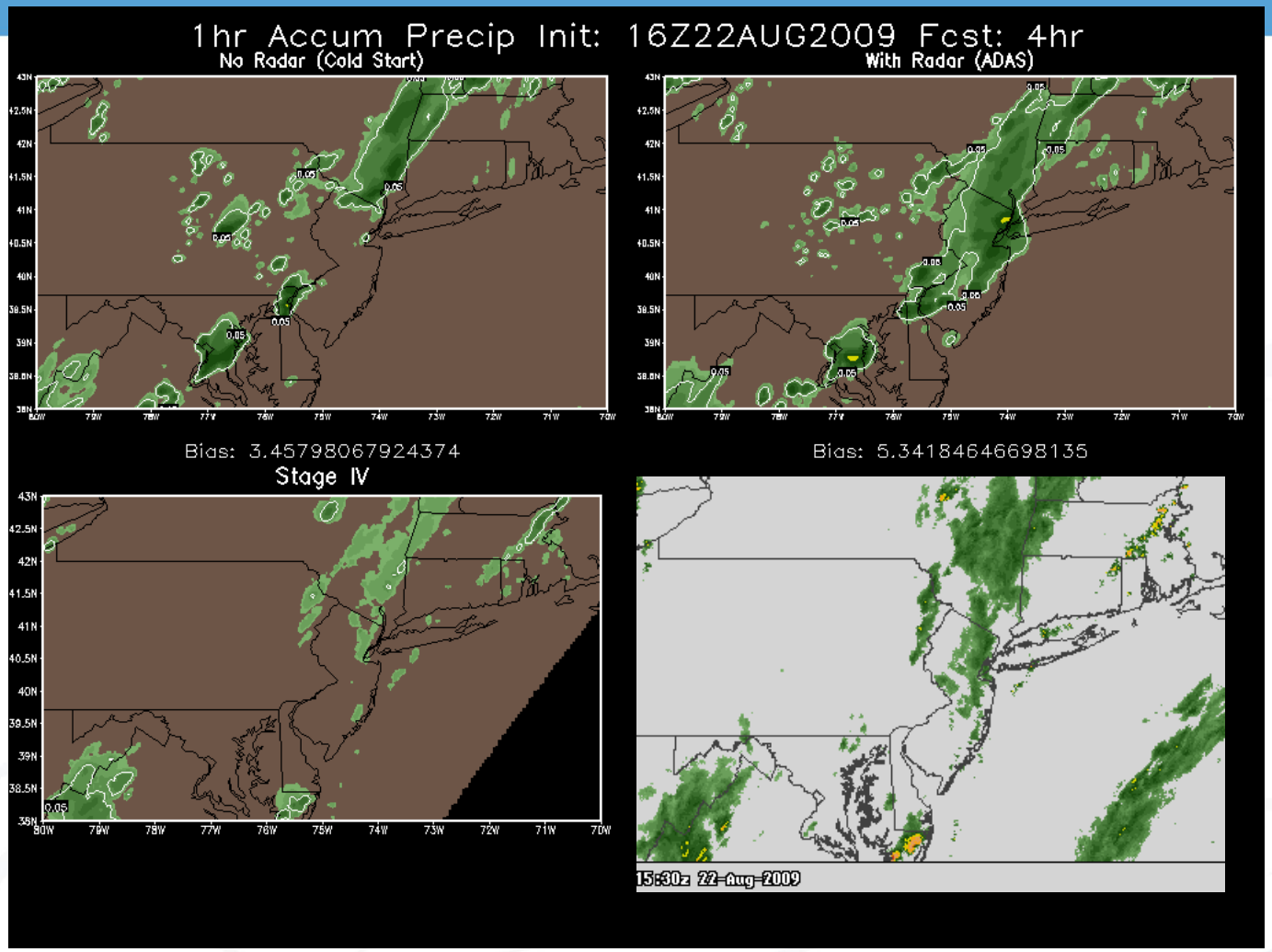

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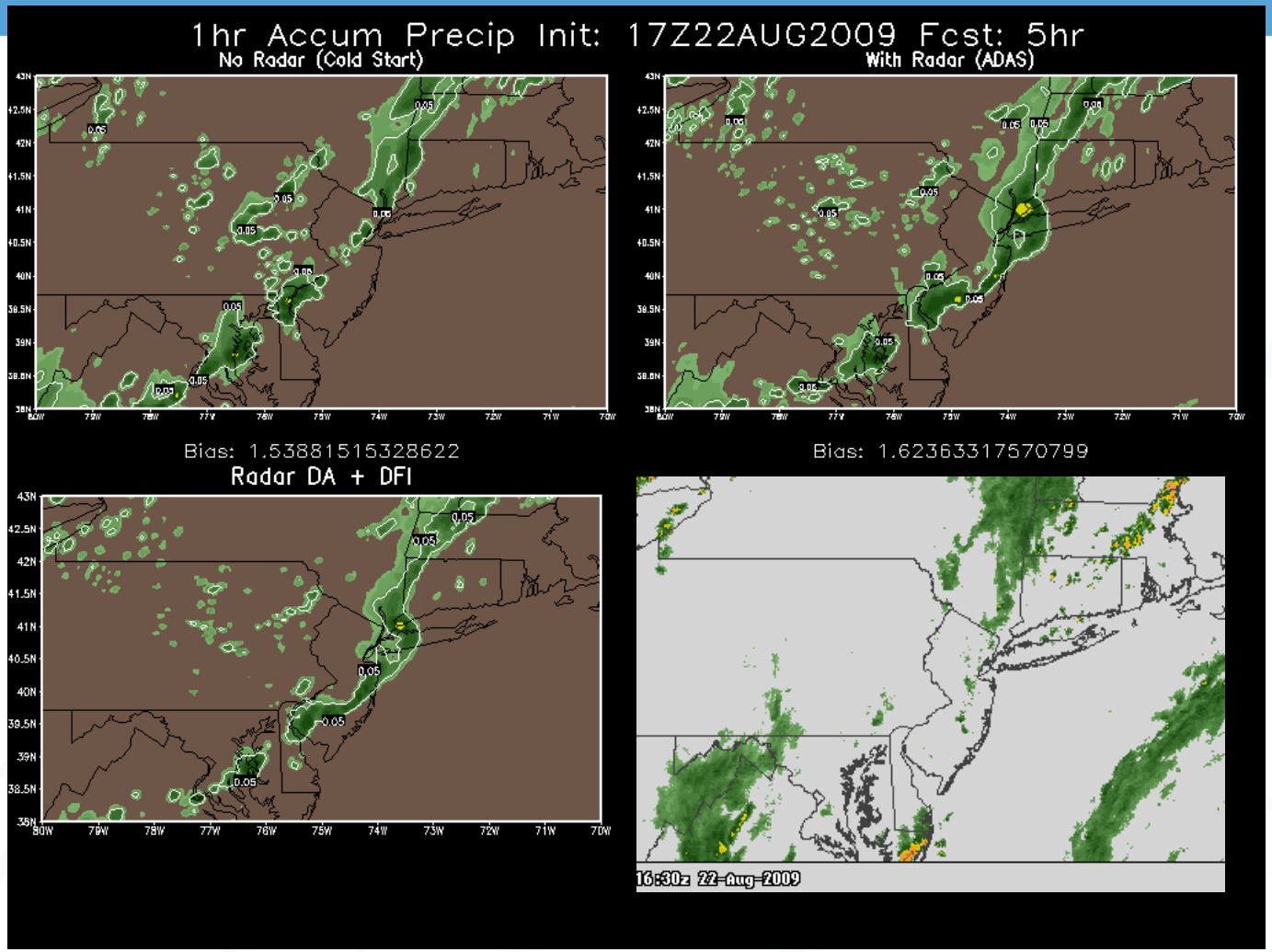

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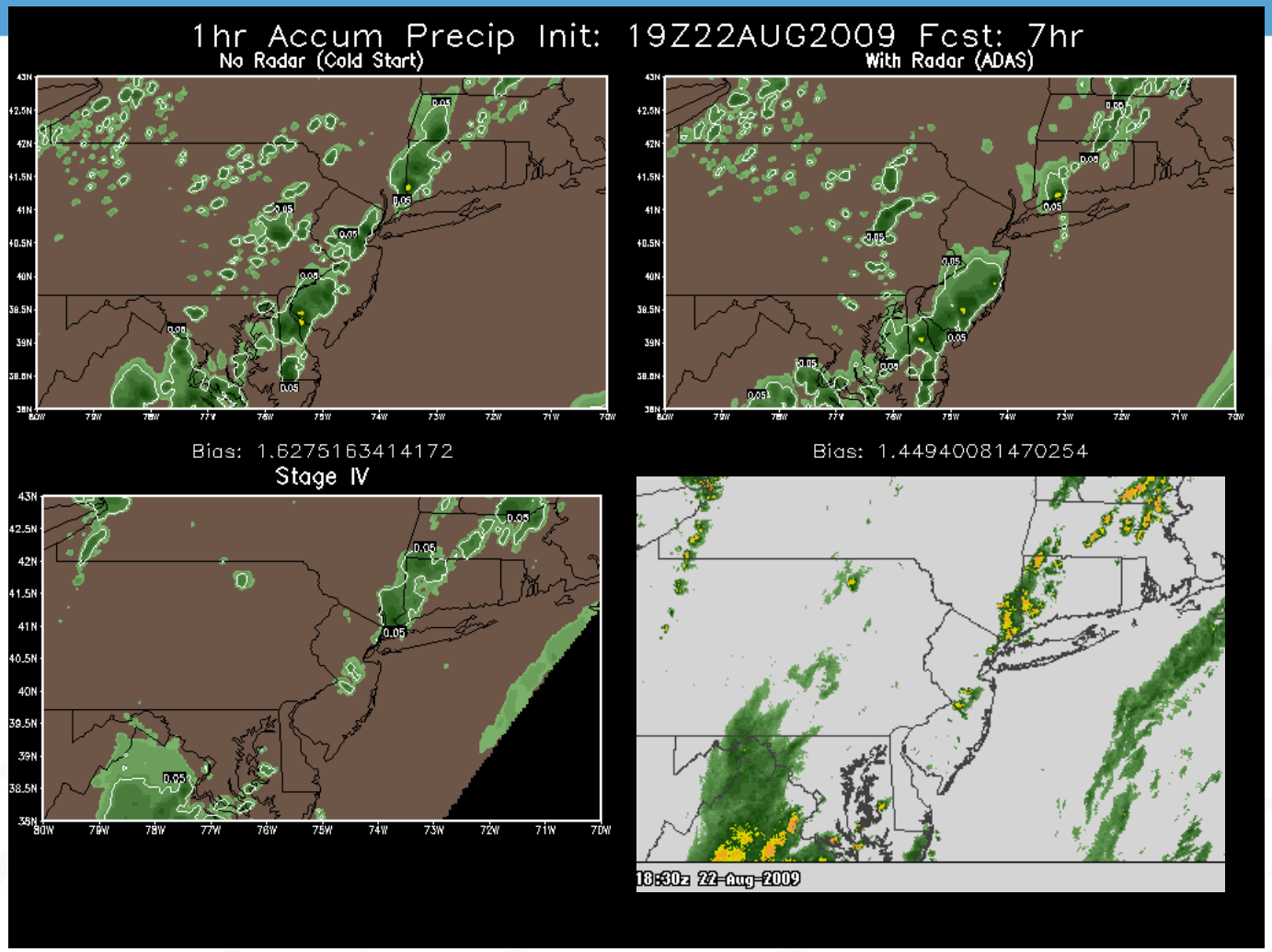

Summary

- Nested implementation of DFI to be integrated in WRF 3.2.1 or 3.3
- Assimilation of radar data (ADAS cloud analysis) improves precipitation skill scores in the first 6-8 forecast hours
- Use of digital filter provides additional balance to analysis
  - However, filter may remove some signals at analysis time