Monthly Technical Report

PROJECT TITLE	Development and Evaluation of an Interactive Sub-Grid Cloud Framework for the CAMx Photochemical Model	**PROJECT #**	14-025
PROJECT PARTICIPANTS	ENVIRON International Corporation Texas A&M University	**DATE SUBMITTED**	4/3/15
REPORTING PERIOD	**From:** March 1, 2015 **To:** March 31, 2015	**REPORT #**	10

A Financial Status Report (FSR) and Invoice will be submitted separately from each of the Project Participants reflecting charges for this Reporting Period. I understand that the FSR and Invoice are due to the AQRP by the 15th of the month following the reporting period shown above.

Detailed Accomplishments by Task

This project was initiated on May 21, 2014. This report documents progress during the month of March 2015.

Task 1: Preparation and Software Design

This task was completed in August.

Tasks 2 and 3: Implementation of a Sub-Grid Convective Model in CAMx

These tasks were completed in October.

Task 4: Model Evaluation

TAMU completed installation of the ENVIRON-modified versions of WRF and CAMx and completed test runs of both models to confirm that everything was working properly. TAMU ran WRF for all three test cases using the standard TCEQ configuration for WRF (except for the omission of the 4-km nest). Initial CAMx runs have also been completed using inputs from two of the WRF runs. ENVIRON and TAMU are discussing modeling progress via regularly scheduled conference calls every 2 weeks.

Preliminary Analysis

Snapshots from each of the three model runs are shown on the next pages, along with images of Level II NEXRAD radar observations. In general, the model simulations from all three cases have much less convection than observed, and what convection is simulated by WRF is generally in the wrong place. However, it is likely that WRF-reported "radar reflectively" is internally diagnosed only from resolved convection generated by the microphysics scheme, and does not include contributions from sub-grid convection. The team is considering other analysis methods that account for both forms of convection.

Data Collected

No additional data were collected by the project team.

Identify Problems or Issues Encountered and Proposed Solutions or Adjustments

Assessment of the performance of the WRF/CAMx convective processor will be challenging if the convection simulated by the model does not correspond to the convection that produced the redistribution of pollutants detected by aircraft. None of the three model runs are satisfactory in this regard. This is concerning, especially since TAMU has already created successful model runs for Case 1 for other purposes using higher resolution grids and a different convective parameterization from Kain-Fritsch (K-F).

TAMU is now testing WRF with alternative configurations while at a minimum maintaining the use of K-F. Superior results have been achieved through elimination of the data nudging employed in the TCEQ configuration, and additional tests with alternative boundary layer and microphysics schemes are underway in order to find a configuration that produces a spatial and temporal pattern of convection that's reasonably consistent with the observations.

Goals and Anticipated Issues for the Succeeding Reporting Period

TAMU will identify a successful model configuration for WRF and create benchmark runs for WRF and CAMx for the DISCOVER-AQ and START08 testing and evaluation episode. TAMU intends to begin performance testing of the modified CAMx scheme by the end of the next reporting period.

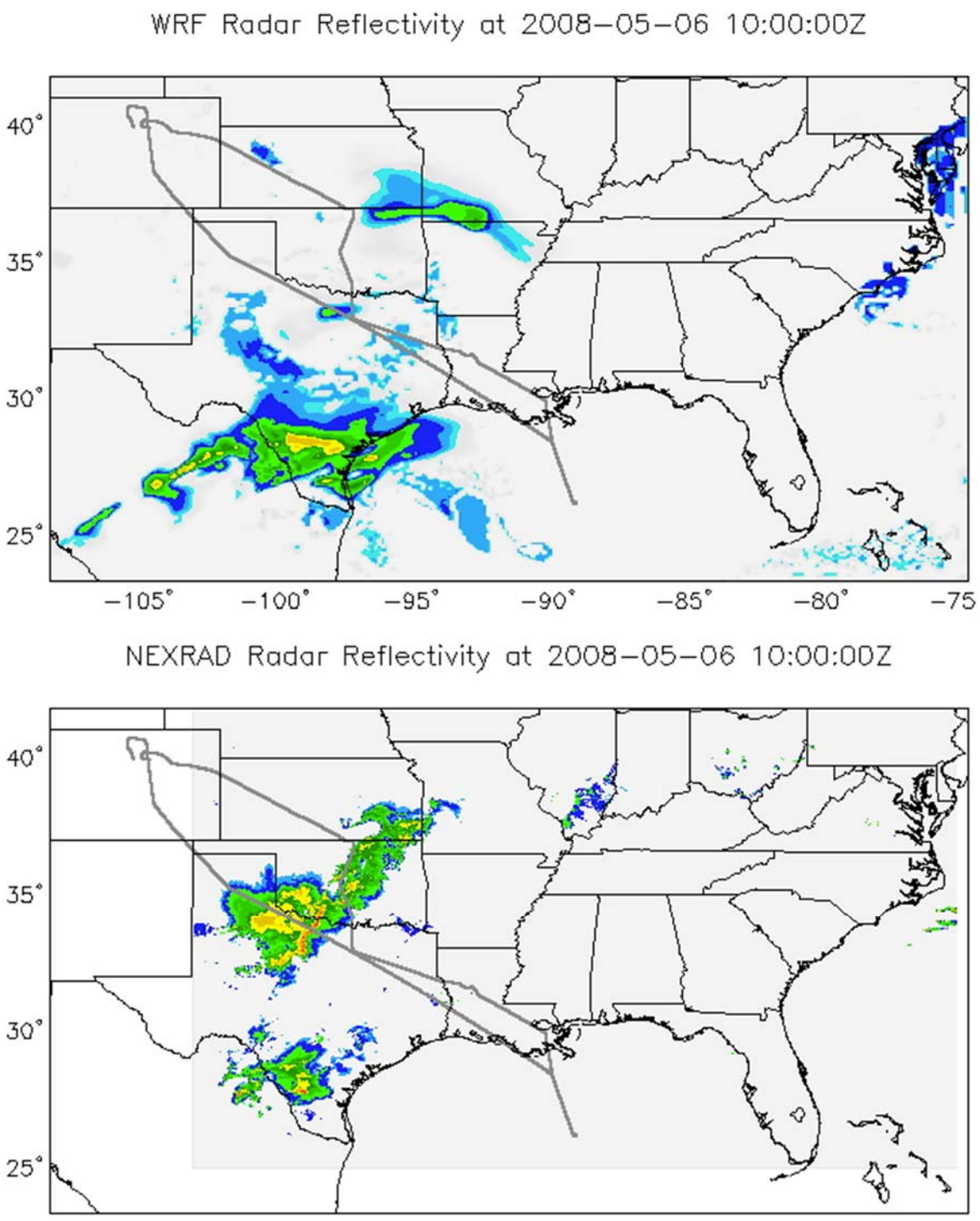

Figure 1: Calculated reflectivity from WRF simulation of Case 1 (top) and verifying radar composite (bottom). The aircraft track is shown in the thick gray line. The aircraft sampled air in the upper troposphere, some of which originated at low levels within the squall line along the Red River.

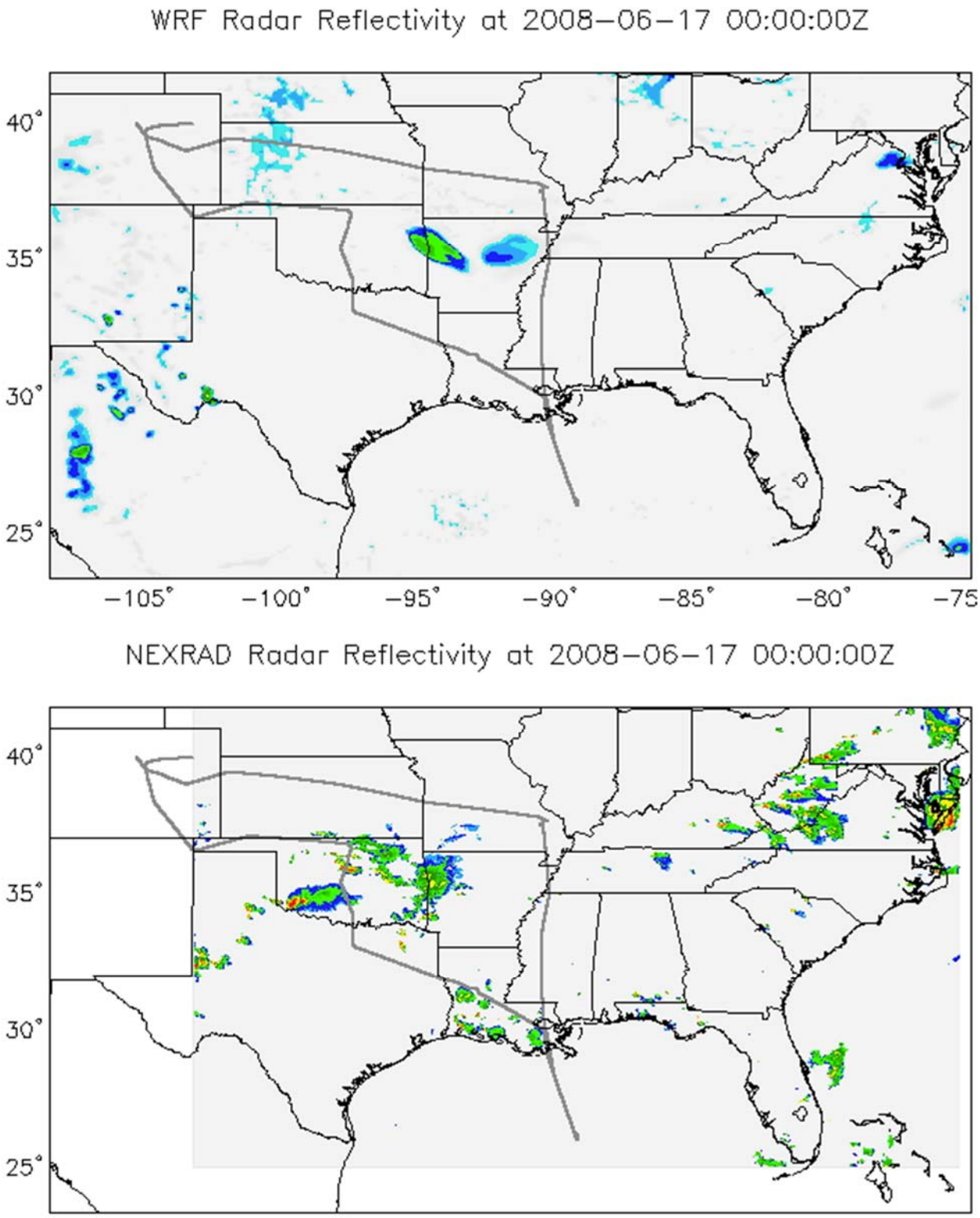

Figure 2: Calculated reflectivity from WRF simulation of Case 2 (top) and verifying radar composite (bottom). The aircraft track is shown in the thick gray line. The event featured intense, mostly single-cell convection with the aircraft sampling the thunderstorm environment.

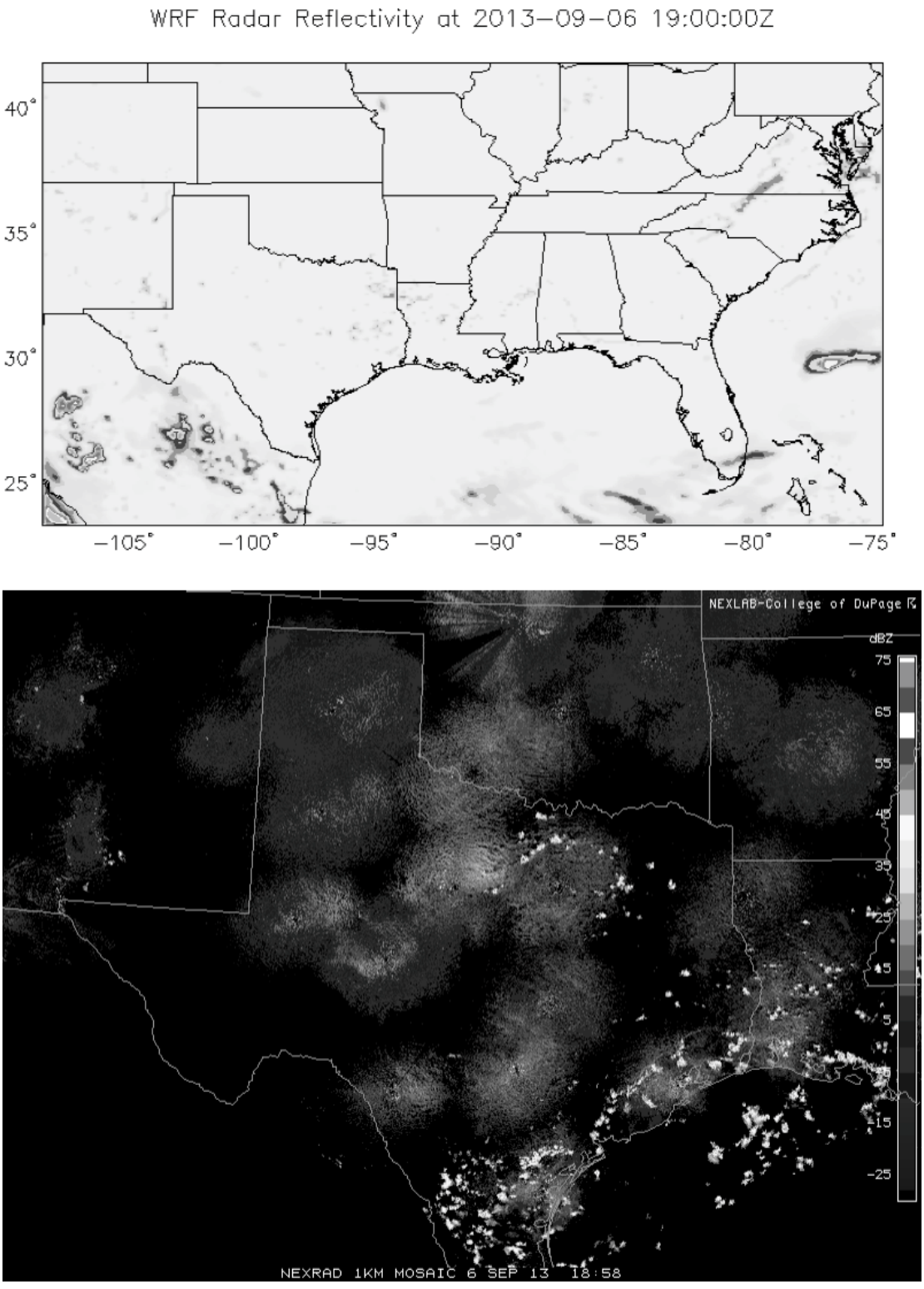

Figure 3: Calculated reflectivity from WRF simulation of Case 3 (top) and verifying radar composite (bottom). Aircraft operations in southeast Texas during DISCOVR-AQ sampled the isolated weak to moderate convective activity along the coastal plain.

Detailed Analysis of the Progress of the Task Order to Date

Progress on Task 1 (software design) was completed in August. Task 2 (implementation of a sub-grid convective model in CAMx) and Task 3 (implementation of chemistry and wet deposition) was completed in October. Task 4 (model evaluation) began in February as a result of delays related to our inability to solve technical issues with EPA's latest "multi-scale" version of the WRF Kain-Fritsch scheme. Task 4 is expected to be completed in late May.

The project remains on budget, but the schedule is roughly one month behind. Project completion and delivery of the final AQRP-reviewed report is scheduled for June 30, 2015.

Submitted to AQRP by: _Chris Emery_____

Principal Investigator: __Chris Emery_____