

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	12/2/14
REPORTING PERIOD	From: November 1, 2014 To: November 30, 2014	REPORT #	6

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 AQR 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 November 2014.

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

Work was completed on CAMx modifications to incorporate a Cloud-in-Grid (CiG) module, which includes convective cloud mixing using data ingested from WRF, wet scavenging within the cloud and in the “ambient” fraction of the grid column, and aqueous PM chemistry within the cloud and the ambient fractions. Additional functional testing on a sample WRF/CAMx dataset was completed, as described below.

We contacted EPA on the status of their latest version of WRF, which includes a new “multi-scale” Kain-Fritsch (MSKF) module that allows for sub-grid convective treatment down to grid scales of 1 km. This will be important for CAMx/CiG, which is anticipated to be run on nested 36/12/4 km grids over Texas. Code delivery has been delayed as EPA is addressing bugs related to running MSKF on nested grids. EPA is unclear on when the WRF code will be made available, but based on EPA’s response we expect to receive it in December.

Task 4: Model Evaluation

A team status call was held in early November among ENVIRON and Texas A&M (TAMU) managers and staff. Topics included the schedule for transfer of modeling codes and datasets from ENVIRON to TAMU and the acquisition of measurement data from the 2013 Houston DISCOVER-AQ and 2008 START08 field campaigns. The team decided to hold model code/data transfer until the latest version of the EPA version of WRF (MSKF) was made available to the project.

Preliminary Analysis

ENVIRON continued basic functional testing of the CAMx CiG module. CAMx was run for a single day in June 2013 on a single 36 km grid, driven by meteorological fields developed from WRF version 3.6.1 (as described in the September progress report). Model configuration, emissions, and initial/boundary conditions were taken from previous projects conducted for TCEQ. CAMx was run in 3 modes with the CiG option turned on: (1) with no parallelization; (2) with Open-MP (OMP) shared-memory parallelization; and (3) with Message Passing Interface (MPI) distributed-memory parallelization. Testing resulted in a decision to explicitly include a convective time-scale in the CAMx CiG, which can be easily output from the WRF K-F scheme in a gridded format. The addition of code to output K-F time-scales from WRF is being held until we acquire the WRF MSKF code from EPA.

CAMx tests with both single processor and OMP parallelization verified that identical results are achieved with 1 and 8 CPUs, with consistent speed improvements as the original CAMx code with OMP. Testing with MPI parallelization resulted in minor differences from the single-processor and OMP cases. This was tracked to an area of the code that was not related to the new CiG implementation (a problem in the original code), which when identified was easily fixed. MPI speed improvements were found to be consistent with the original CAMx code.

Data Collected

Collection of field study measurements from DISOVER-AQ and START08 began.

Identify Problems or Issues Encountered and Proposed Solutions or Adjustments

No problems or issues were encountered during the reporting period.

Goals and Anticipated Issues for the Succeeding Reporting Period

We anticipate obtaining the latest version of WRF/MSKF from EPA developers in December. This delay may affect the project schedule by about 1 month. We will add necessary K-F entrainment/detrainment flux output fields to support the new CAMx convection routine and perform basic testing. Delivery of updated WRF and CAMx codes to TAMU is expected to occur in December or January. We do not anticipate other major technical, budget or schedule issues.

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) were started in August and completed in October; additional testing using the EPA's MSKF version of WRF is anticipated to begin in December. Task 4 (model evaluation) is expected to begin in January.

The project remains on schedule and budget for completion and delivery of the final AQRP-reviewed report by the AQRP contract end date of June 30, 2015.

Submitted to AQRP by: Chris Emery

Principal Investigator: Chris Emery