Monthly Technical Report

(Due to AQRP Project Manager on the 8th day of the month following the last day of the reporting period.)

PROJECT TITLE	Targeted Improvements in the Fire INventory from NCAR (FINN) Model for Texas Air Quality Planning	**PROJECT #**	14-011
PROJECT PARTICIPANTS **(Enter all institutions with Task Orders for this Project)**	The University of Texas at Austin ENVIRON International Corporation	**DATE SUBMITTED**	8/14/15
REPORTING PERIOD	**From:** July 1, 2015 **To:** 8/14/2015	**REPORT #**	12

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

Task 1. Regional Land Cover Characterization

Processing of ArcGIS raster files for the global and U.S. national and regional land cover datasets has been completed as described in previous reports. These land cover products have been used alone or in combination in sensitivity studies with FINN v.2 to estimate emissions of carbon monoxide (CO), nitrogen oxides (NO_x), and fine particulate matter ($PM_{2.5}$) associated with fire events during 2012. FINN emission estimates for 2012 were generated for seven land cover scenarios:

Global:
Scenario 1 = MODIS LCT ONLY
Scenario 2 = GLC-SHARE ONLY
Scenario 3 = ESA ONLY

U.S. National:
Scenario 4 = FCCS in the continental US and MODIS LCT elsewhere
Scenario 5 = FCCS_CDL in the continental US and MODIS LCT elsewhere

Texas Regional:
Scenario 6 = TCEQ in the Texas regional domain, FCCS in the continental US, and MODIS LCT elsewhere
Scenario 7 = TCEQ_CDL in the Texas regional domain, FCCS in the continental US, and MODIS LCT elsewhere

The scenarios were designed with several objectives in mind. FINN is designed as a global model. As such, a global land cover data product provides a consistent default for global-scale climate and air quality models and in the absence of regional data. Thus, one objective was to evaluate alternatives to the MODIS global LCT product. Another objective was to evaluate the use of available regional datasets in place of the global land cover information. For example, the FCCS was a resource for fuelbed information that could be related to FINN land cover classes as an alternative to the MODIS LCT for the United

States. Simulations with and without the identification of key U.S. crop types were conducted to determine the spatial and seasonal effects of crop identification on FINN emission estimates. Finally, a key goal was to produce FINN simulations that could be used by the TCEQ in its 2012 air quality modeling, leveraging the regional land cover data available.

Task 2. Mapping of Croplands Data
This task has been completed.

Task 3. Estimation of Burned Area
This task has been completed.

Task 4. Sub-grid scale Partitioning of NO_x Emissions to NO_z in Fire Plumes
An approach has been developed to speciate FINN NO_x to NO_z compounds as a function of fire size relative to grid resolution and fire plume rise during the EPS3 fire processing chain. Ramboll ENVIRON is completing the development of the software code to support an optional NO_x partitioning algorithm. They will prepare an additional CAMx scenario using the TCEQ_CDL land cover representation, which we consider to have the most spatially resolved land cover for Texas and other states in the 12-km domain, with the NO_x partitioning algorithm implemented. Dr. McDonald-Buller's team will evaluate the effects of the NO_x partitioning on ozone predictions using CAMx.

Task 5. Comprehensive Air Quality Model with Extensions (CAMx) Sensitivity Studies
Daily FINNv2 fire emissions speciated to MOZART-4 were developed for the entirety of 2012 for the seven land cover scenarios listed above. Three selected FINNv2 scenarios (MODIS_LCT, ESA, TCEQ_CDL) have been prepared for the May-June 2012 modeling episode by speciating to the CB6r2 chemistry mechanism and converting to the CAMx input point source format using a suite of processors developed by Ramboll Environ. These processors are compatible with an updated version of the Emission Processing System (EPS v3.22) recently developed for the TCEQ (Jimenez and Yarwood, 2015). EPS3 was run using the following modules and associated pre/post-processors:

Name	Purpose
FIRESPEC	Windows and maps fire coordinates (latitude/longitude) to model domain projection, maps MOZART-4 species to CAMx CB6r2 compounds
GROUPPTS	Groups individual FINN pixel records into larger fire complexes according to a "Fire ID" now available in FINNv2 files
PREFIR	Reads pre-processed fire data and converts to EPS3 EMBR formats
CHMSPL	Speciates emissions (since this is already done in FIRESPEC, this just involves units conversion from tons/day to moles or grams/day)
TMPRL	Allocates emissions temporally to each hour of the day
PSTFIR	Allocates emissions vertically and outputs results in binary point source files
PTSMRG	Merges FINN fire point sources with TCEQ-developed anthropogenic point sources

A FINN file consists of daily emission estimates for each ~1 km^2 fire pixel. Chemical species include NOx, CO, SO_2, NH_3, various PM components, and NMOC allocated to MOZART-4 species. All gases are given in units of mol/day, while PM components are given in kg/day. Additional pertinent information includes the coordinates of each fire pixel (latitude/longitude), a "Fire ID" that indicates whether a particular fire pixel is part of a larger fire complex polygon, land cover type, and area burned (m^2). The FIRESPEC preprocessor removes fires outside of the CAMx 36 km domain and remaps the MOZART-4 species to CAMx CB6r2 species. GROUPPTS uses new information available in the FINNv2 files (Fire ID) to group individual fire points into a larger fire complex. This approach replaces the old GROUPPTS methodology used with FINNv1 that was based simply on finding fire points within 5 km of each other. PREFIR then formats the FINN data into emission binary record (EMBR) files for EPS3 processing.

PREFIR includes an option to combine individual fires if: (1) they are in the same grid cell; (2) share the same "county" designation and SCC code (to determine local time zone); and (3) share the same fire class assignment of a common fire complex.

The EPS3 TMPRL module applies a single diurnal profile in local time to all fires such that emissions are highest in the early afternoon and lowest at night (Figure 16). The time zone of each fire is assigned based on its longitude relative to 15 degree longitudinal zones. Any emissions allocated to the next date due to a time zone shift are assigned to the same hour of the current date to conserve daily total emissions mass per daily emissions file. The emissions are then shifted to the CAMx time zone to coincide with the other model inputs.

PSTFIR incorporates the WRAP methodology to vertically allocate fire emissions each hour. The aggregated daily area burned for each fire complex (determined in GROUPPTS) is used to classify each fire complex into one of five size bins. This approach replaces the old PSTFIRE methodology used with FINNv1 that classified fire size according to a linear regression between NO_x emissions and area burned. The fire size classification determines the fraction of emissions allocated to the CAMx surface layer and to the elevated plume, and defines the top and bottom heights of the elevated plume, for each hour of the day. A single point source is used to represent elevated emissions from each fire complex using the new EPS3/CAMx capability to define initial plume depth. This approach replaces the old methodology where multiple point sources were defined to inject elevated fire emissions into each CAMx layer spanning the plume depth.

The CAMx simulations are being initiated at the time of this report.

Data Collected *(Include raw and refine data.)*
As described above.

Identify Problems or Issues Encountered and Proposed Solutions or Adjustments
None encountered.

Goals and Anticipated Issues for the Succeeding Reporting Period
Priorities for the next month completing the planned CAMx simulations, as well as submitting the draft project report.

Detailed Analysis of the Progress of the Task Order to Date *(Discuss the Task Order schedule, progress being made toward goals of the Work Plan, explanation for any delays in completing tasks and/or project goals. Provide justification for any milestones completed more than one (1) month later than projected.)*
Ongoing.

Submitted to AQRP by:

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