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**	9/5/14
REPORTING PERIOD	**From:** August 1, 2014 **To:** 9/5/2014	**REPORT #**	3

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

Dr. Kimura traveled to the National Center for Atmospheric Research in Boulder, Colorado for intensive work on the project with Dr. Wiedinmyer.

Together they evaluated different fire detection and products for characterizing burned area, which are described below.

1. Monitoring Trends in Burn Severity (MTBS): The primary objective of this database is to support national analysis of burn severity trends (http://www.mtbs.gov/nationalregional/burnedarea.html). Burn Severity Mosaics and Burned Area Perimeters files for 2012 were downloaded from http://www.mtbs.gov/nationalregional/download.html. The MTBS product only identifies fires that exceed 1000 acres in the western United States, including Texas. During 2012, there were 20 fires points meeting this criterion in Texas with a total acreage burned of 106, 350 acres. There were significant fires in other areas of the western United States.

2. Visible Infrared Imaging Radiometer Suite (VIIRS) fire products. The VIIRS sensor was launched aboard the Suomi National Polar-orbiting Partnership (NPP) satellite on October 28th, 2011; fire detections began on January 18th, 2012. The VIIRS active fires product for 2012 was obtained from the U.S. Forest Service's Remote Sensing Applications Center (USFS RSAC) through http://activefiremaps.fs.fed.us/data_viirs/fireptdata/viirsfire_2012_na.htm. The file contains fire data for May 5th through December 31st, 2012. Dr. Wiedinmyer has requested the separate VIIRS Nightfire product for 2012 and expects to receive it next week.

3. Wildland Fire Emissions Information System (WFEIS) from Michigan Tech Research Institute is a web interface that includes burned area maps, fuel loadings, and fuel consumption models to estimate fire fuel consumption and emissions for the continental United States and Alaska (http://wfeis.mtri.org/calculator). It includes multiple data options for burned area including the MOderate Resolution Imaging Spectroradiometer (MODIS) MCD64A1, MTBS, Landsat Daily,

SmartFire 2011 National Emissions Inventory (NEI), and Agricultural NEI in hdf tile format. At this time, WFEIS only has data for 2000-2011.

4. Dr. Wiedinmyer contacted Sean Raffuse of Sonoma Technology, Inc. (STI) regarding SmartFire. SmartFire is not available for 2012, but it could be produced under contract.

5. The Hazard Mapping System (HMS) Fire and Smoke Product (reference for example, http://www.arb.ca.gov/smp/progdev/iasc/2013prezo/noaa.pdf) was requested from Mark Ruminski of the National Oceanic and Atmospheric Administration (NOAA).

6. The Western Regional Air Partnership Fire Emissions Tracking System (FETS) includes the western United States but not Texas (http://wrapfets.org/).

7. National Interagency Fire Center (NIFC) has reported annual area burned for 2012 (http://www.predictiveservices.nifc.gov/intelligence/2012_statssumm/2012Stats&Summ.html). Fire locations are not included, but this product could be useful as a comparison to FINN estimates of area burned in Texas.

Dr. Wiedinmyer and Dr. Kimura did a preliminary comparison of the MTBS, VIIRS AF, and MODIS Rapid Response product detections of large fires in Texas during 2012. Interestingly, the VIIRS AF product missed a number of fires that were detected by the MODIS RR. Because MTBS has a size constraint on fires that are reported (>1000 acres), at this time the team is moving forward with the MODIS RR product for 2012 but will continue to review the evolution of the VIIRS algorithms and products and review other requested databases as they are received. Dr. Wiedinmyer and Dr. Kimura downloaded the 2012 MODIS Rapid Response data for North America from USFS RSAC (http://activefiremaps.fs.fed.us/data/fireptdata/modisfire_2012_na.htm).

During the month of August, Dr. Kimura has continued working with the *U.S. Department of Agriculture (USDA), National Agricultural Statistical Service (NASS) Cropland Data Layer (CDL): http://nassgeodata.gmu.edu/CropScape/*, described in the July monthly report. During his visit with Dr. Wiedinmyer, they merged and processed the CDL data with land use/land cover data from *Popescu et al.* (*http://m.tceq.texas.gov/assets/public/implementation/air/am/contracts/reports/oth/5820564593FY0925-20110419-tamu-expension_tx_lulc_arboreal_vegetation.pdf*), which is currently used by the TCEQ for emissions inventory and air quality modeling activities, for the 12-km domain. For the rest of the continental United States, Dr. Wiedinmyer and Dr. Kimura merged and processed land cover data from the Fuel Characteristic Classification System (FCCS) with the CDL data to obtain a map with 1-km resolution as an alternative to the global land use/land cover database.

Dr. Wiedinmyer and Dr. Kimura also developed fuel loading estimates from the FCCS. For all fuel types, fuel loadings were characterized as either “TREE” (woody) or “HERB” (herbaceous). For the 12-km domain, CDL data were reprojected and resampled to overlay the FCCS. The TCEQ land cover map was overlaid on the FCCS categories, and the fraction of each FCCS category was determined. Using these fractional estimates, the weighted average of “TREE” and “HERB” fuel loadings for each TCEQ land cover was applied. For areas identified in the CDL as croplands, fuel loadings from McCarty et al. (2012) and Agaki et al. 2011 were applied. For the remaining continental United States, fuel loadings were applied according to FCCS land cover category. The same strategy for croplands was used as in the 12-km domain. For the remainder of the domain, FCCS classes were categorized according to the generic land cover codes of the MODIS Land Cover Type Product (LCT) or the Food and Agriculture Organization (FAO) of the United Nations’ Global Land Cover-SHARE (GLC-SHARE) product. The average fractions of the “TREE” and “HERB” categories were determined and fuel loadings assigned to the LCT and GLC classes.

Dr. Wiedinmyer and Dr. Kimura also began updates to the FINN emission factors. Dr. Jessica McCarty of the University of Louisville was contacted and is anticipated to provide agricultural burning emissions for 2012 within the next week. Dr. Wiedinmyer and Dr. Kimura have defined 15 generic land use/land cover types for FINN that are being mapped to all explicit land cover codes from the FCCS, CDL, LCT, and GLC databases. Emission factors (CO, NOx, NMOC, NH_3, SO_2, $PM_{2.5}$, OC, BC) were assigned to each of these generic codes. New emission factors were taken from Akagi et al. (2011), Akagi et al. (2014), FINNv1, unpublished data from FLAME-4 (Stockwell and Yokelson), unpublished data from the Studies of Emissions and Atmospheric Composition, Clouds and Climate Coupling by Regional Surveys (*SEAC4RS*) campaign (Liu and Huey), and McCarty et al. (2012).

The updated FINN model for North America has been named FINNv15NA. A summary of changes from FINNv1.5 include regional land cover data for the 12-km domain from the TCEQ, FCCS/CDL data for the continental United States, and global data elsewhere; four fuel loading databases (TCEQ, FCCS/CDL, GLC, LCT); updated emissions factors; improvements in the input and output files, new combustion efficiencies for forests, shrublands, and croplands; and removal of the dependency on the vegetation Continuous Fields (VCF) product to identify the density of vegetation at active fire locations.

Dr. Kimura and Dr. Wiedinmyer met with Kevin Sampson (GIS expertise) of NCAR to discuss potential future improvements in the model processing and to develop new approaches to remove duplicate fire detections and to assign more reasonable estimates of assumed area burned based on pixel size at different latitudes.

Preliminary Analysis (*Include graphs and tables as necessary.)*
As described above.

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

Identify Problems or Issues Encountered and Proposed Solutions or Adjustments
None this period.

Goals and Anticipated Issues for the Succeeding Reporting Period
The team will continue to pursue several goals, including the incorporation of new emission factors and fuel loadings for croplands and potential improvements in the model processing and approaches for fire detection and estimates of area burned, as discussed with Mr. Sampson. A series of sensitivity studies are anticipated that will compare the new version of FINN to previous versions and the individual effects of land cover, emissions factors, and are burned assumptions.

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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