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**	10/8/14
REPORTING PERIOD	**From:** September 1, 2014 **To:** September 30, 2014	**REPORT #**	4

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

- SMARTFire data from Susan O'Neil (U.S. Forest Service) has been obtained for 2012 and may serve as an additional resource for fire detection.

- A GIS expert, Kevin Sampson, from NCAR, has been appointed for a limited period to begin updates of the fire point and land cover processing. Initial plans have been formulated and programming activities have begun.

- Dr. Wiedinmyer is currently working with a colleague at the National Aeronautics and Space Administration (NASA) to produce a FINN-ready file from the Visible Infrared Imaging Radiometer Suite (VIIRS) fire products for 2012. These data support fire detection and characterization of burned area.

- The team has merged the Popescu et al. (2011) and National Agricultural Statistical Service Crop Data Layer (CDL). Preliminary results are shown below. Figure 1 shows the Popescu land cover characterization obtained from TCEQ. The spatial resolution is 30 m with Lambert Conformal projection parameters shown in Table 1. Figure 2 is the CDL 2012 raster file with Albers Equal Area Conical projection parameters shown in Table 2. The CDL raster was reprojected to match the Popescu raster using the ArcGIS “Resample” tool with the “nearest” algorithm to determine pixel values. The snap raster feature was enabled to align pixels of the two rasters. Areas classified as agricultural were identified for each land cover dataset. For the Popescu database these included Class 8 (herbaceous cultivated) and 17 (cultivated woody vegetation). For the CDL database, these included identifiers 1 to 99 and 200 to 255. Each pixel was examined to determine if one or both of datasets identify it as agricultural. Green pixels in Figure 3 represent regions considered by both datasets to be agricultural, while blue and red pixels indicate areas that are identified as agricultural by only one dataset. In order to merge the two datasets, pixels that were identified as agricultural in the CDL, applied the CDL characterization, regardless of the Popescu et al. classification. For pixels identified as agricultural in the Popescu et al. database but not in the CDL (blue pixels), the CDL’s non- agricultural characterization was substituted. All other pixels remained the same as in the Popescu et al. database. Note that the CDL data layer was not available for Mexico. The merged raster is shown as Figure 4. In order to include all land cover types into single byte (256) in Figure 4, the CDL's non-agricultural land cover types (100-199) are rearranged into 150-199 and Popescu's land cover types, originally 1-36, are stored in 101 to 136.

Figure 1. Popescu et al. (2011) land cover characterization.

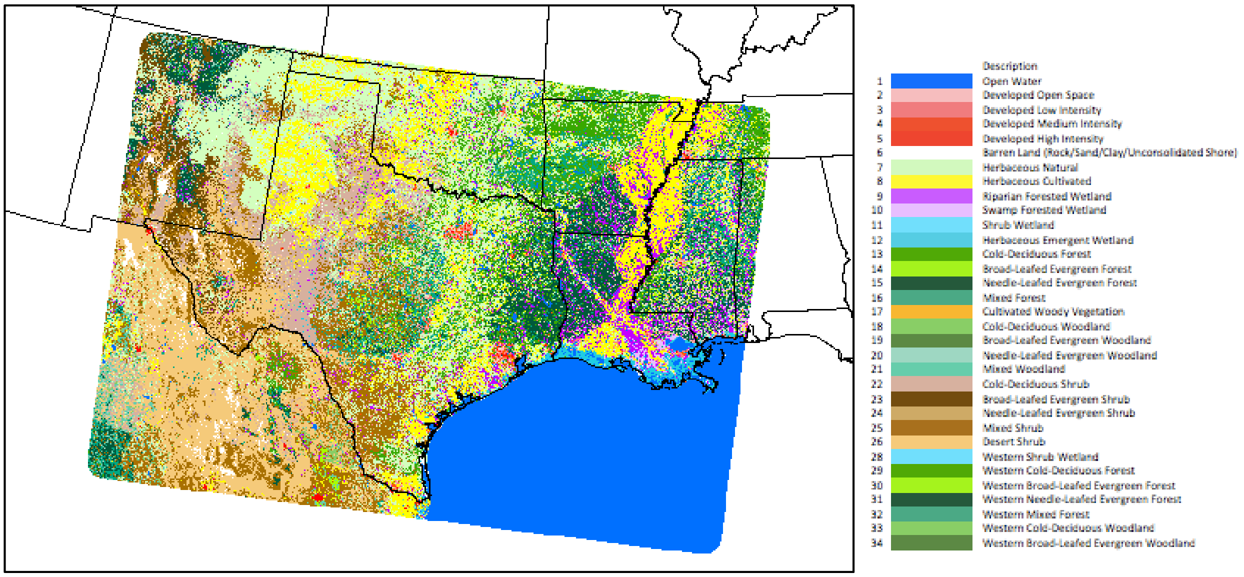
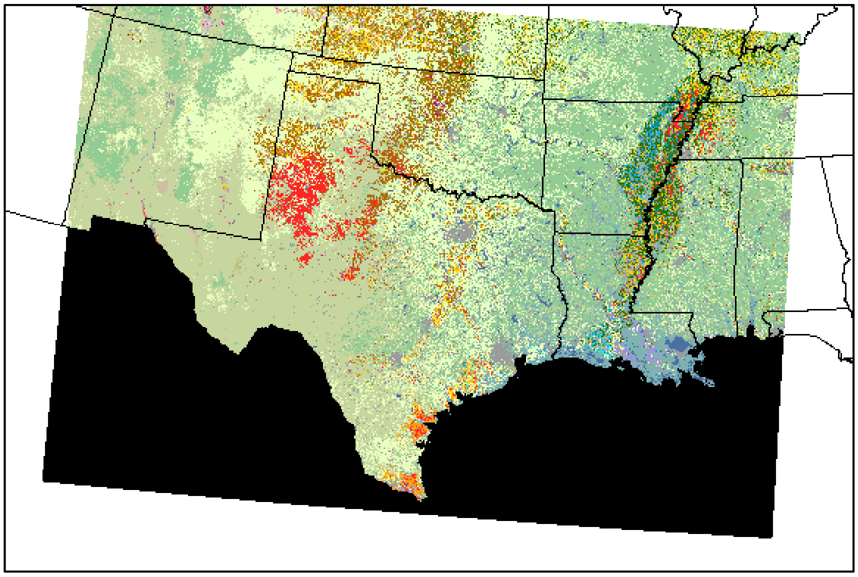


Figure 2. National Agricultural Statistical Service 2012 Crop Data Layer.



		Class_Name
1	🟨	Corn
2	🟥	Cotton
3	🟦	Rice
4	🟧	Sorghum
5	🟩	Soybeans
6	🟨	Sunflower
10	🟩	Peanuts
11	🟩	Tobacco
12	🟨	Sweet Corn
13		Pop or Orn Corn
14	🟦	Mint
21	🟪	Barley
22	🟫	Durum Wheat
23	🟫	Spring Wheat
24	🟫	Winter Wheat
25	🟪	Other Small Grains
26	🟩	Dbl Crop WinWht/Soybeans
27	🟪	Rye
28	🟪	Oats
29	🟪	Millet
30	🟪	Speltz
31	🟨	Canola
32	🟦	Flaxseed
33	🟨	Safflower
34	🟨	Rape Seed
35	🟩	Mustard
36	🟪	Alfalfa
37	🟩	Other Hay/Non Alfalfa
38	🟩	Camelina
39	🟪	Buckwheat
41	🟪	Sugarbeets
42	🟥	Dry Beans
43	🟫	Potatoes
44	🟩	Other Crops
45	🟪	Sugarcane
46	🟫	Sweet Potatoes
47	🟥	Misc Vegs & Fruits
48		Watermelons
49	🟨	Onions
50	🟥	Cucumbers
51	🟩	Chick Peas
52	🟩	Lentils
53	🟩	Peas
54	🟧	Tomatoes
55	🟥	Caneberries
56	🟩	Hops
57	🟦	Herbs
58	🟪	Clover/Wildflowers
59	🟩	Sod/Grass Seed
60	🟩	Switchgrass
61	🟫	Fallow/Idle Cropland
63	🟩	Forest
64	🟩	Shrubland
65	🟫	Barren
66	🟪	Cherries
67	🟪	Peaches
68	🟥	Apples
69	🟪	Grapes
70	🟦	Christmas Trees
71	🟫	Other Tree Crops
72	🟨	Citrus
74	🟫	Pecans
75	🟩	Almonds
76	🟫	Walnuts
77	🟫	Pears
81	⬜	Clouds/No Data
82	⬛	Developed
83	🟦	Water
87	🟦	Wetlands
88	⬜	Nonag/Undefined
92	🟦	Aquaculture

		Class_Name
111	🟦	Open Water
112	⬜	Perennial Ice/Snow
121	⬛	Developed/Open Space
122		Developed/Low Intensity
123		Developed/Med Intensity
124		Developed/High Intensity
131	🟫	Barren
141	🟩	Deciduous Forest
142		Evergreen Forest
143		Mixed Forest
152	🟩	Shrubland
176	🟨	Grassland/Pasture
190	🟦	Woody Wetlands
195		Herbaceous Wetlands
204	🟩	Pistachios
205	🟪	Triticale
206	🟥	Carrots
207		Asparagus
208		Garlic
209		Cantaloupes
210	🟪	Prunes
211	🟩	Olives
212	🟧	Oranges
213	🟥	Honeydew Melons
214		Broccoli
216		Peppers
217	🟫	Pomegranates
218	🟪	Nectarines
219	🟥	Greens
220	🟪	Plums
221	🟥	Strawberries
222		Squash
223	🟪	Apricots
224	🟩	Vetch
225	🟨	Dbl Crop WinWht/Corn
226		Dbl Crop Oats/Corn
227	🟥	Lettuce
229		Pumpkins
230	🟫	Dbl Crop Lettuce/Durum Wht
231	🟥	Dbl Crop Lettuce/Cantaloupe
232	🟥	Dbl Crop Lettuce/Cotton
233	🟪	Dbl Crop Lettuce/Barley
234	🟧	Dbl Crop Durum Wht/Sorghum
235		Dbl Crop Barley/Sorghum
236	🟫	Dbl Crop WinWht/Sorghum
237	🟨	Dbl Crop Barley/Corn
238	🟫	Dbl Crop WinWht/Cotton
239	🟩	Dbl Crop Soybeans/Cotton
240		Dbl Crop Soybeans/Oats
241	🟨	Dbl Crop Corn/Soybeans
242	🟦	Blueberries
243	🟥	Cabbage
244		Cauliflower
245		Celery
246		Radishes
247		Turnips
248		Eggplants
249		Gourds
250		Cranberries
254	🟩	Dbl Crop Barley/Soybeans

Figure 3. Contingency of agricultural versus non-agricultural land between the Popescu et al. and National Agricultural Statistical Service Crop Data Layer rasters.

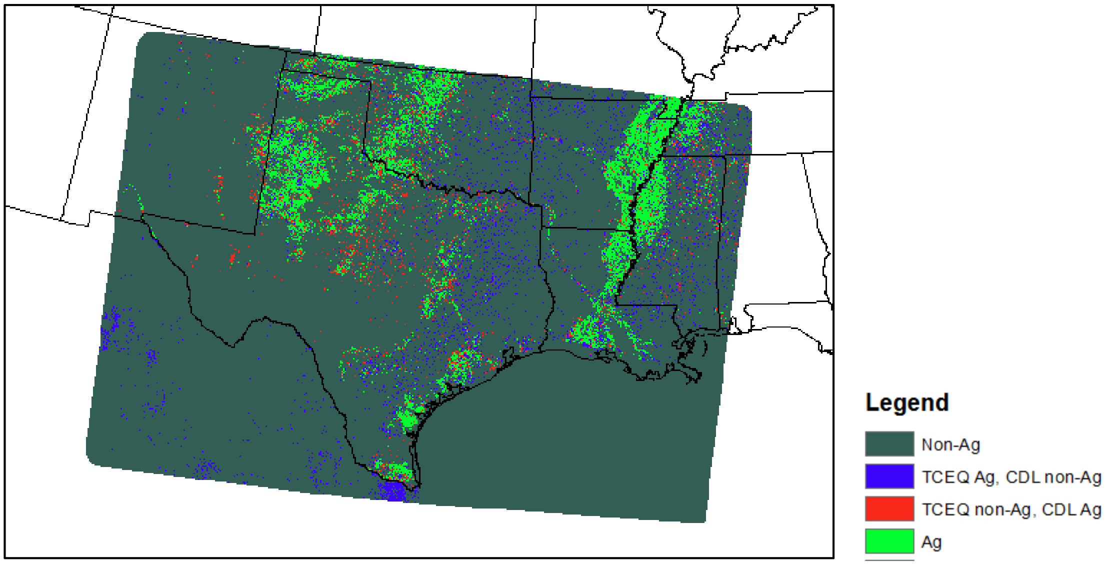
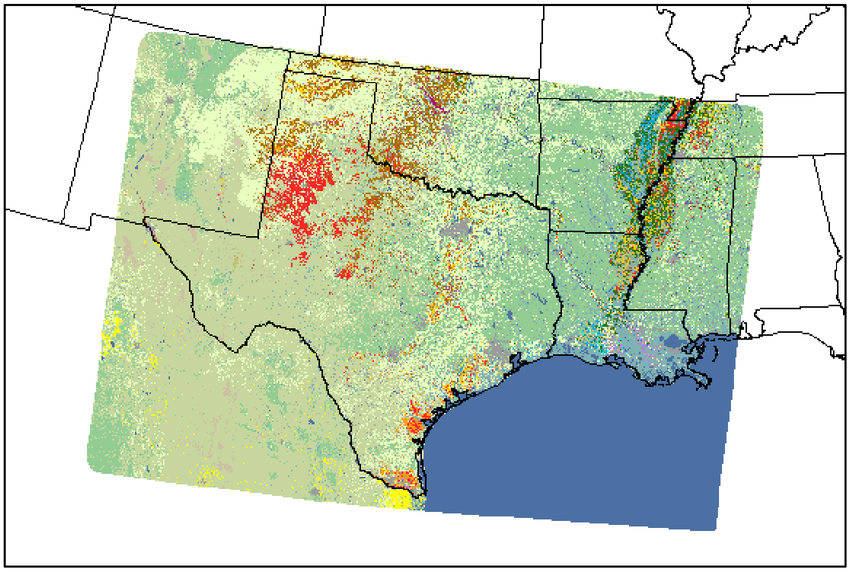


Figure 4. Merged land cover mapping.



		Class_Name			Class_Name
1	🟨	Corn [c]	101	🟦	Open Water [t]
2	🟥	Cotton [c]	102	⬜	Developed Open Space [t]
3	🟦	Rice [c]	103	⬜	Developed Low Intensity [t]
4	🟧	Sorghum [c]	104	⬜	Developed Medium Intensity [t]
5	🟩	Soybeans [c]	105	⬜	Developed High Intensity [t]
6	🟨	Sunflower [c]	106	🟫	Barren Land (Rock/Sand/Clay/Unconsolidated Shore) [t]

10	🟩	Peanuts [c]
11	🟩	Tobacco [c]
12	🟧	Sweet Corn [c]
13	🟧	Pop or Orn Corn [c]
14	🟦	Mint [c]
21	🟪	Barley [c]
22	🟫	Durum Wheat [c]
23	🟨	Spring Wheat [c]
24	🟫	Winter Wheat [c]
25	🟪	Other Small Grains [c]
26	🟩	Dbl Crop WinWht/Soybeans [c]
27	🟪	Rye [c]
28	🟪	Oats [c]
29	🟪	Millet [c]
30	🟪	Speltz [c]
31	🟨	Canola [c]
32	🟦	Flaxseed [c]
33	🟨	Safflower [c]
34	🟨	Rape Seed [c]
35	🟩	Mustard [c]
36	🟪	Alfalfa [c]
37	🟩	Other Hay/Non Alfalfa [c]
38	🟩	Camelina [c]
39	🟪	Buckwheat [c]
41	🟪	Sugarbeets [c]
42	🟥	Dry Beans [c]
43	🟫	Potatoes [c]
44	🟩	Other Crops [c]
45	🟪	Sugarcane [c]
46	🟫	Sweet Potatoes [c]
47	🟥	Misc Vegs & Fruits [c]
48	🟥	Watermelons [c]
49	🟨	Onions [c]
50	🟥	Cucumbers [c]
51	🟩	Chick Peas [c]
52	🟩	Lentils [c]
53	🟩	Peas [c]
54	🟧	Tomatoes [c]
55	🟥	Caneberries [c]
56	🟩	Hops [c]
57	🟦	Herbs [c]
58	🟪	Clover/Wildflowers [c]
59	🟩	Sod/Grass Seed [c]
60	🟩	Switchgrass [c]
107	🟨	Herbaceous Natural [t]
108	🟨	Herbaceous Cultivated [t]
109	🟦	Riparian Forested Wetland [t]
110	🟦	Swamp Forested Wetland [t]
111	🟦	Shrub Wetland [t]
112	🟦	Herbaceous Emergent Wetland [t]
113	🟩	Cold-Deciduous Forest [t]
114	🟩	Broad-Leafed Evergreen Forest [t]
115	🟩	Needle-Leafed Evergreen Forest [t]
116	🟩	Mixed Forest [t]
117	🟧	Cultivated Woody Vegetation [t]
118	🟩	Cold-Deciduous Woodland [t]
119	🟩	Broad-Leafed Evergreen Woodland [t]
120	🟩	Needle-Leafed Evergreen Woodland [t]
121	🟩	Mixed Woodland [t]
122	🟩	Cold-Deciduous Shrub [t]
123	🟩	Broad-Leafed Evergreen Shrub [t]
124	🟩	Needle-Leafed Evergreen Shrub [t]
125	🟩	Mixed Shrub [t]
126	🟩	Desert Shrub [t]
127	🟦	Western Swamp Forested Wetland [t]
128	🟦	Western Shrub Wetland [t]
129	🟩	Western Cold-Deciduous Forest [t]
130	🟩	Western Broad-Leafed Evergreen Forest [t]
131	🟩	Western Needle-Leafed Evergreen Forest [t]
132	🟩	Western Mixed Forest [t]
133	🟩	Western Cold-Deciduous Woodland [t]
134	🟩	Western Broad-Leafed Evergreen Woodland [t]
135	🟩	Western Needle-Leafed Evergreen Woodland [t]
136	🟩	Western Mixed Woodland [t]
156	🟦	Open Water [n]
157	⬜	Perennial Ice/Snow [n]
161	⬜	Developed/Open Space [n]
162	⬜	Developed/Low Intensity [n]
163	⬜	Developed/Med Intensity [n]
164	⬜	Developed/High Intensity [n]
166	🟫	Barren [n]
171	🟩	Deciduous Forest [n]
172	🟩	Evergreen Forest [n]
173	🟩	Mixed Forest [n]
177	🟩	Shrubland [n]
186	🟨	Grassland/Pasture [n]
196	🟦	Woody Wetlands [n]
197	🟦	Herbaceous Wetlands [n]

61	🟫	Fallow/Idle Cropland [c]
63	🟩	Forest [c]
64	🟩	Shrubland [c]
65	🟫	Barren [c]
66	🟪	Cherries [c]
67	🟥	Peaches [c]
68	🟥	Apples [c]
69	🟪	Grapes [c]
70	🟩	Christmas Trees [c]
71	🟫	Other Tree Crops [c]
72	🟨	Citrus [c]
74	🟫	Pecans [c]
75	🟩	Almonds [c]
76	🟨	Walnuts [c]
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81	⬜	Clouds/No Data [c]
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83	🟦	Water [c]
87	🟦	Wetlands [c]
88	🟩	Nonag/Undefined [c]
92	🟦	Aquaculture [c]

204	🟩	Pistachios [c]
205	🟪	Triticale [c]
206	🟥	Carrots [c]
207	🟥	Asparagus [c]
208	🟥	Garlic [c]
209	🟥	Cantaloupes [c]
210	🟥	Prunes [c]
211	🟩	Olives [c]
212	🟧	Oranges [c]
213	🟥	Honeydew Melons [c]
214	🟥	Broccoli [c]
216	🟥	Peppers [c]
217	🟫	Pomegranates [c]
218	🟥	Nectarines [c]
219	🟥	Greens [c]
220	🟥	Plums [c]
221	🟥	Strawberries [c]
222	🟥	Squash [c]
223	🟥	Apricots [c]
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227	🟥	Lettuce [c]
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230	🟫	Dbl Crop Lettuce/Durum Wht [c]
231	🟥	Dbl Crop Lettuce/Cantaloupe [c]
232	🟥	Dbl Crop Lettuce/Cotton [c]
233	🟪	Dbl Crop Lettuce/Barley [c]
234	🟧	Dbl Crop Durum Wht/Sorghum [c]
235	🟧	Dbl Crop Barley/Sorghum [c]
236	🟫	Dbl Crop WinWht/Sorghum [c]
237	🟨	Dbl Crop Barley/Corn [c]
238	🟫	Dbl Crop WinWht/Cotton [c]
239	🟩	Dbl Crop Soybeans/Cotton [c]
240	🟩	Dbl Crop Soybeans/Oats [c]
241	🟨	Dbl Crop Corn/Soybeans [c]
242	🟦	Blueberries [c]
243	🟥	Cabbage [c]
244	🟥	Cauliflower [c]
245	🟥	Celery [c]
246	🟥	Radishes [c]
247	🟥	Turnips [c]
248	🟥	Eggplants [c]
249	🟥	Gourds [c]

250	🟥	Cranberries [c]
254	🟩	Dbl Crop Barley/Soybeans [c]

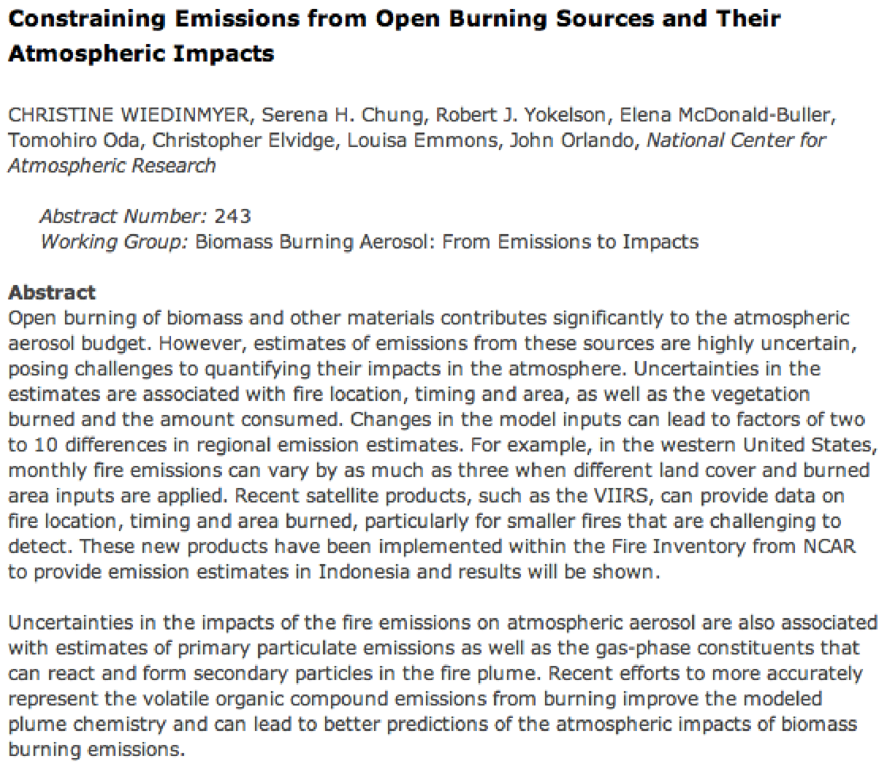
Table 1. Popescu et al. (2011) raster file spatial reference.

Reference spheroid	Sphere, radius = 6370997 m
Projection	Lambert Conformal Conic
Central Meridian	-90 deg
Standard Parallel	30 deg and 60 deg
Latitude of origin	40 deg

Table 2. National Agricultural Statistical Service Crop Data Layer raster file spatial reference.

Reference spheroid	NAD 1983
Projection	Albers Conical Equal Area
Central Meridian	-96 deg
Standard Parallel	29.5 deg and 49.5 deg
Latitude of origin	23 deg

Dr. Wiedinmyer is developing a presentation that includes some of the fire emissions work in Texas for an invited presentation at American Association for Aerosol Research 33rd Annual Conference in Orlando during October 20-24, 2014. The abstract is presented below.



Constraining Emissions from Open Burning Sources and Their Atmospheric Impacts

CHRISTINE WIEDINMYER, Serena H. Chung, Robert J. Yokelson, Elena McDonald-Buller, Tomohiro Oda, Christopher Elvidge, Louisa Emmons, John Orlando, *National Center for Atmospheric Research*

Abstract Number: 243
Working Group: Biomass Burning Aerosol: From Emissions to Impacts

Abstract
Open burning of biomass and other materials contributes significantly to the atmospheric aerosol budget. However, estimates of emissions from these sources are highly uncertain, posing challenges to quantifying their impacts in the atmosphere. Uncertainties in the estimates are associated with fire location, timing and area, as well as the vegetation burned and the amount consumed. Changes in the model inputs can lead to factors of two to 10 differences in regional emission estimates. For example, in the western United States, monthly fire emissions can vary by as much as three when different land cover and burned area inputs are applied. Recent satellite products, such as the VIIRS, can provide data on fire location, timing and area burned, particularly for smaller fires that are challenging to detect. These new products have been implemented within the Fire Inventory from NCAR to provide emission estimates in Indonesia and results will be shown.

Uncertainties in the impacts of the fire emissions on atmospheric aerosol are also associated with estimates of primary particulate emissions as well as the gas-phase constituents that can react and form secondary particles in the fire plume. Recent efforts to more accurately represent the volatile organic compound emissions from burning improve the modeled plume chemistry and can lead to better predictions of the atmospheric impacts of biomass burning emissions.

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:

Principal Investigator: Elena McDonald-Buller