Incorporation of Federal Land Manager Estimates of Prescribed Burning into Emission Projections Developed for the VISTAS Regional Planning Organization

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ABSTRACT

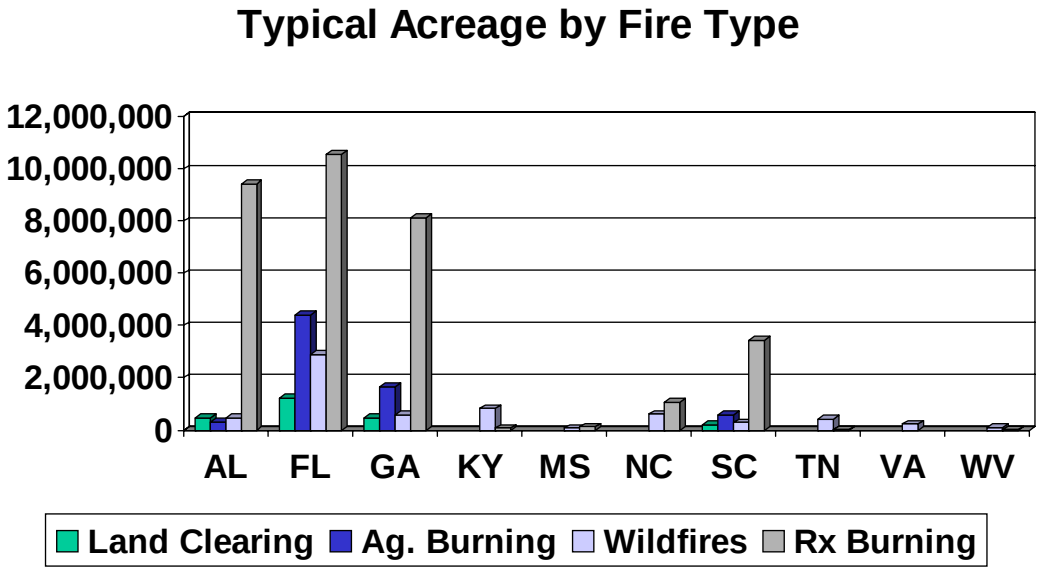
In recent years the importance of wild and prescribed fires to visibility improvement has been widely recognized by air quality regulators and scientists. One of the primary items that air quality regulators and scientists have been working to try and understand is how to balance the usage of prescribed fire as a tool of Federal Land Managers (FLMs) to assist in restoration of habitats and control of wildfires. One of the primary issues related to prescribed burning is how to incorporate projected increases in the number of acres burned with the Clean Air Act Amendments visibility projection goals. This paper discusses the approach used by the Visibility Improvement State and Tribal Association of the Southeast (VISTAS) Regional Planning Organization (RPO) to incorporate projected increases in prescribed fire acres burned by the U.S. Fish and Wildlife Service and the USDA Forest Service. Due to the nature of the data available, slightly different approaches were used in incorporating the data from each agency into the 2009 and 2018 emission projections prepared for VISTAS. Both methods are discussed in this paper.

INTRODUCTION

For some time now, estimates of projected emissions from wild and prescribed fires have been desired to assist in developing adequate regional haze implementation plans. However, typically, the projected emissions have not adequately captured proposed increases in prescribed burning. Future increases in prescribed burning have typically been forecast by Federal Land Managers (FLM) as a result of required burning to maintain and restore habitats and to decrease the incidence of wildfire by removing potential fuel source build ups.

One of the major reasons that prescribed fire increases are so important for the southeastern U.S. is because prescribed fire is the major fire component in that region when "typical" year data were evaluated. Figure 1 shows the "typical" year VISTAS fire acreage by State and by fire sector. This figure illustrates that in the southeastern U.S., prescribed fire is the largest component of fire. Thus uncertainty in future levels of prescribed fire represents a major uncertainty in the VISTAS fire projections for 2009 and 2018. As seen in Figure 1, the highest incidence of prescribed fire is in the southern tier of states: AL, FL, GA, MS and SC where pine forest are traditionally managed by prescribed fire.

Figure 1. State-level Acres Burned as Submitted by FWS with 2002 VISTAS Typical Acreage



MACTEC, working under contract with the Visibility Improvement State and Tribal Association of the Southeast (VISTAS) Regional Planning Organization (RPO) had developed preliminary

base year and typical year estimates for wildfires, prescribed burning, agricultural burning and burning to clear land of debris. For the typical year estimates, MACTEC had developed a method that used historic averages in acres burned to determine a multiplication factor used with the 2002 base year inventory to provide a "typical" year estimate from fires burned. The approach assumed that fuel types and loading remained the same as for the 2002 base year but that the acreages changed to those found from historic averages. A minimum of three years data was required to develop the historic average acreage for a particular fire type.

Just prior to release of version 3.1 of the VISTAS inventory, several Federal agencies indicated that they had plans for increased prescribed fire burning in future years and that the "typical" fire inventory would likely not adequately capture those increases (memo from Bill Jackson and Cindy Huber, U.S. Forest Service, August 13, 2004). However data were not readily available to incorporate those changes up through VISTAS Base F inventory. As a consequence MACTEC submitted a request to all FLMs in the VISTAS region to provide data for making revisions to the "typical" prescribed fire inventory to produce 2009 and 2018 specific projections. MACTEC worked with FLMs to acquire the data necessary to produce those inventories in time for inclusion in the VISTAS Base G fire inventory. The 2009 and 2018 projections developed using the method described below are being used by VISTAS as the 2009 and 2018 base case inventories for all States except FL. For FL the supplied data from the FLMs is not being used as FL felt that their data adequately reflected current and future prescribed burning practices. The baseline for these 2009 and 2018 projections is the "typical" 2002 base prescribed fire emission inventory.

DATA SUBMITTED

Updated information on the number of acres planned to be burned in 2009 and 2018 were solicited from FLMs in the VISTAS region. Only two agencies submitted data to MACTEC for use in producing 2009 and 2018 specific projections: The Forest Service (FS) and the Fish and Wildlife Service (FWS). FWS submitted annual acreage data by National Wildlife Refuge (NWR) and county with estimates of maximum planned acres burned per day for each NWR. FS provided fire-by-fire acreage estimates based on mapping projected burning acreage to current 2002 prescribed fire days.

The differences in the submittals along with other data issues required MACTEC to use two different methods to project the 2009 and 2018 prescribed fire emissions from FWS and FS lands. The two methods used are described below.

METHODS

One of the biggest issues in preparing the projection was how best to incorporate the data provided by the two agencies. As indicated above, FWS submitted annual acreage data by NWR

and county with estimates of the average number of acres burned per day for each NWR, and FS provided fire-by-fire acreage estimates based on mapping projected burning acreage to current 2002 prescribed fire days.

To understand some of the issues associated with incorporating FLM data into the projections some background on the "typical" and actual fire inventories is required. When MACTEC created the fire inventories, prescribed fire data were submitted by States and Federal agencies. However if a State identified that they had an inclusive prescribed fire permitting program that included all prescribed fires on State, private and Federal lands, then any FLM data submitted for that State was not included in the fire estimates to avoid double counting. Under that scenario, since the State data included all land ownership types, MACTEC felt that the State data represented a superset of any submitted FLM data. In States without a prescribed fire permit program, acreage burned data submitted by both State and Federal agencies were included in the data used to calculate emissions.

During the initial data submittal, FWS did not supply acreage burned data. Thus the 2002 actual and "typical" inventories did not contain any known FWS acreage other than what may have been included in the State submittals for States that had prescribed fire permit programs. Unfortunately none of the State submittals identified the land owner for the VISTAS States.

Thus one of the biggest issues facing MACTEC was how to include the FWS data. Since FWS had not submitted data for VISTAS original base year preparation process, there was no known FWS data in the 2002 actual or "typical" inventories specifically associated with FWS prescribed fires. Thus MACTEC had to develop a method that could use the county level data submitted by FWS.

In addition, despite the fact that the FS submitted fire-by-fire data for the 2002 actual inventory and had mapped the projections to current burn days in the 2002 actual inventory, MACTEC could not do a simple replacement of those records with the 2009/2018 projections. This situation was also created due to the prescribed fire permitting programs run by several of the VISTAS States. To avoid double counting, only State data was used in those States for the 2002 actual inventory. Thus there were no Federal data in those States since the Federal data could have potentially duplicated State-supplied prescribed fire data. In VISTAS States without permit programs, the FS supplied data for 2002 was used and those records were marked in the database. Thus for those States, the FS supplied 2009/2018 data could be directly substituted for the 2002 data.

The method used by MACTEC to include the FS data applied a county level data approach for FS data where a State had a prescribed fire permitting program and a fire-by-fire replacement for

FS data in States without permit programs. MACTEC used a county level approach for all of the FWS data. The approach used for each data set is discussed below.

Assumptions for All Methods

There were several underlying assumptions in developing the alternative projections using the FLM supplied acreages. First, as with the typical year projections, fuel loading, fuel quality and availability were assumed to be the same for all year. Thus the projected acres and consequent emission estimates were solely affected by the change in acreage. Since the purpose of this exercise was to ascertain the differences in modeled air quality, VISTAS and MACTEC felt that such an assumption best tested the consequences of increased burning in future years. Second, despite the fact that the primary purpose for prescribed burning on Federal lands is habitat maintenance, decreases in the number and intensity of wildfires are also put forth as reasons to increase prescribed burning. MACTEC and VISTAS consulted with both the FS and FWS to see if there were available data to support a consequent reduction in wildfire acres burned due to increases in the prescribed fire acreages. No information could be found in the time frame allocated for investigation to support a decrease in wildfire acres burned in future years. Thus the estimates provided here look solely at changes in prescribed burning. Finally, MACTEC assumed that if there was burning on a particular day in the 2002 base year, then that day was considered to have correct conditions for burning in developing assigned days for burning in the methods described below.

FWS Methodology

For the FWS data, MACTEC summed the annual acres burned supplied by the FWS across all NWRs in a county. We then subtracted out 2002 acreage for that county from the FWS projected acreage annual total to avoid double counting. The remaining acreage was then multiplied by 0.8 to account for blackened acres instead of the total perimeter acres that were reported. The revised total additional FWS acreage was then added to the total county “typical” acreage to determine future acreage burned for either 2009 or 2018. MACTEC then allocated the increased acreage to current modeling days. The average daily acres burned data provided by FWS per NWR/county was used to allocate the acreage to the correct number of days required to burn all of the acres. Guidance supplied by FWS indicated that up to three times the average daily acres burned could potentially be allocated to any one day. Thus if the estimated acreage per day were 100 acres then up to 300 acres could actually be allocated to a particular day. This approach (use of up to three times the average daily acres burned) was used if there were an insufficient number of 2002 modeling days available to account for all of the acreage increase. MACTEC used an incremental approach to using the increase above the base average daily acres. First we used twice the average daily acreage if that was sufficient to completely allocate the increased acreage over the total number of days available. If that wasn’t sufficient then we used three times the

average daily acres burned to allocate the acreage. We applied the highest increases to days in the database that already had the highest acreage burned since we felt those days were most likely to represent days with representative conditions for conducting prescribed burns. Table 1 shows the acreage submitted by State from the FWS for NWRs in each VISTAS State compared to the base year 2002 data.

Table 1. State-level Acres Burned as Submitted by FWS with 2002 VISTAS Typical Acreage

State	VISTAS 2002 Typical	2002	2009	2018
AL	858,652	356	5,370	5,920
FL	960,850	59,333	69,547	68,547
GA	738,204	10,245	22,460	22,460
MS	10,645	10,031	16,300	19,800
NC	97,896	15,799	22,900	31,500
SC	311,526	17,294	18,000	18,000

FS Methodology

The approach used by MACTEC for the FS was slightly different. For States that had permit programs, we used a similar approach to the FWS county level approach. First we summed the FS data at county level, we then added that value to the typical acreage and then we allocated the acres to current modeling days. The mapping to current modeling days was performed by Bill Jackson of the USFS and provided to MACTEC. For States that did not have a prescribed fire permit program, MACTEC simply replaced the current fire-by-fire records in the database with fire-by-fire records from the FS and recalculated emissions based on fuel model and fuel loading. We also applied the same 0.8 correction for blackened acres applied to all FS supplied acreage as the supplied values represented perimeter acres.

An additional problem with developing year-specific prescribed fire projections was how to adequately capture the temporal profile for those fires. In the 2002 actual fire inventory, fires occur on the days provided by State/FLM agencies. In the 2002 “typical” year inventory, fire acreage increased or decreased from acreage on the same fire days as were in the 2002 actual

inventory, since the acres were simply increased for each day based on a multiplier used to convert from actual to typical.

When prescribed fires acreage was added to a future year, MACTEC added acreage to individual fire days proportional to the annual increase (e.g., if acreage on a day is 10 percent of annual, add 10 percent of projected increase to that same day).

Table 2 shows how the FWS data for Okefenokee NWR were allocated for 2009 for Clinch County (Okefenokee NWR is located in four different counties). You can see that the total additional acreage for the Clinch County portion of Okefenokee NWR was 1,956 acres. Two hundred eighty (280) acres were the estimated average daily acres burned for that NWR/county combination according to the data supplied by the FWS. Thus to allocate the entire 1,956 acres would require almost 7 burn days (1,956 divided by 280). However only 5 burn days were found for Clinch County in the 2002 actual fire database. Thus we allocated twice the average acreage to the burn day with the most acres burned in the 2002 actual fire database (since our method allowed us to increase the average daily acres burned up to three times the recommended level). Thus the first burn day received 560 acres and all others received 280 except the final day which received 276 to make the total equal to the required 1,956 acres. The table also indicates that the increased acres burned provided increases of from 10-48 percent in the acres burned on the individual burn days and an average of approximately 14 percent for the year as a whole.

Table 2. Example allocation of FWS acres for Okefenokee NWR burning in Clinch County.

CLINCH COUNTY	3/1/2002	4/1/2002	2/1/2002	1/1/2002	11/1/2002	12/1/2002	Total Annual
Acres (typical)	3,757	2,612	1,996	1,801	616	472	11,764
Add on FWS Projection	560	280	280	280	280	276	1,956
Total	4,316	2,891	2,276	2,080	895	747	13,720
Percent Increase	14.9%	10.7%	14.0%	15.6%	45.5%	58.5%	14.3%

Figure 2 shows the increases for prescribed burning in the four counties that comprise the Okefenokee NWR area (which also includes FS land). In this figure you can see the additional acreage added for the burn days from FWS and the individual day increases caused by projected increases in prescribed burning based on FS data. It should be noted that while the emissions represent 2009, all fire event dates listed are for 2002 to match up with the base year meteorology used in modeling exercises.

Figure 2. Prescribed Fire Projection for Okefenokee NWR for 2009.

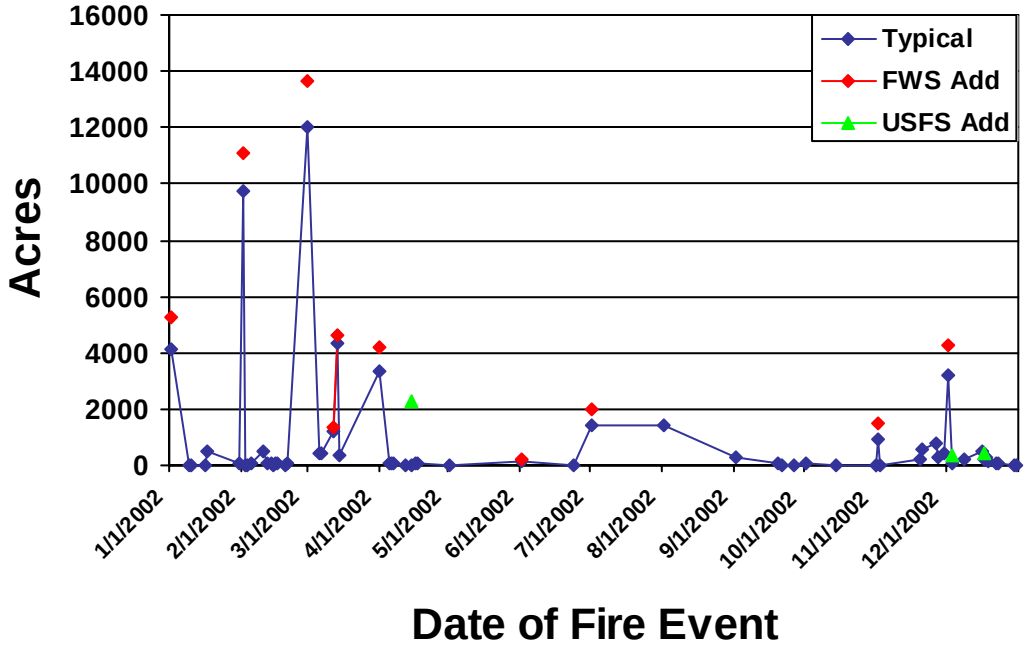
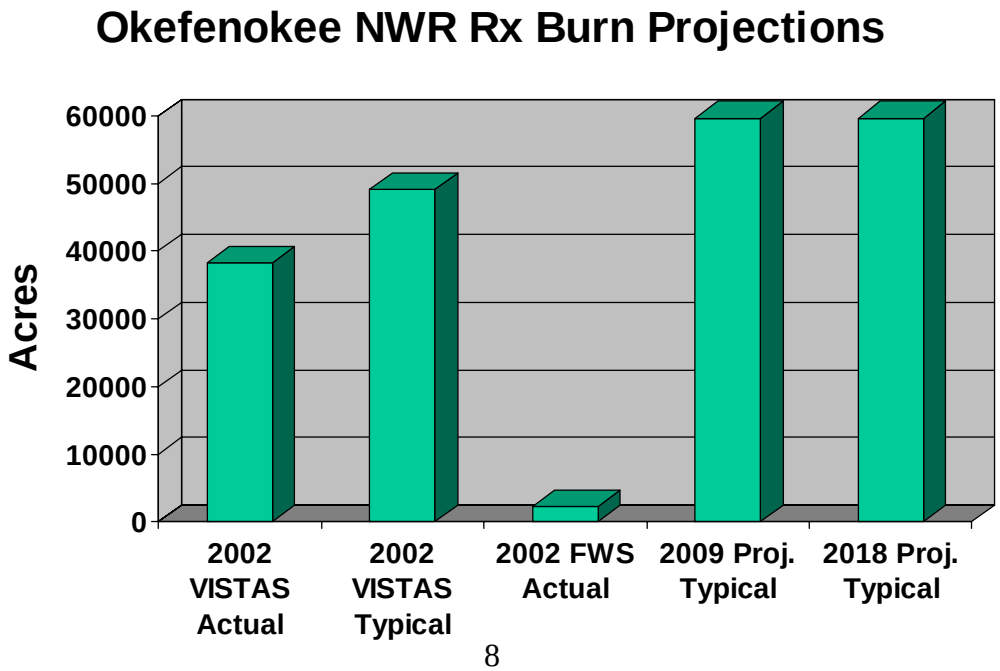


Figure 3 shows the results for the acreage for all four counties that have part of the Okefenokee NWR located in them. Figure 3 also shows the previous values for those counties for both the 2002 actual and typical fire years. For previous projections, the typical year value would have been used to represent the 2009/2018 fire years.

Figure 3. Differences between typical and FLM provided acreages for future year projections for the four counties associated with Okefenokee NWR.



RESULTS

The changes associated with the increased acreage burned associated with prescribed fires on FWS and FS lands for prescribed fires and for all burning are shown in Figures 4 and 5.

Figure 4. Differences in prescribed burning acreages after application of FLM adjustments for 2009 and 2018 when compared to the 2002 typical year acreage estimates.

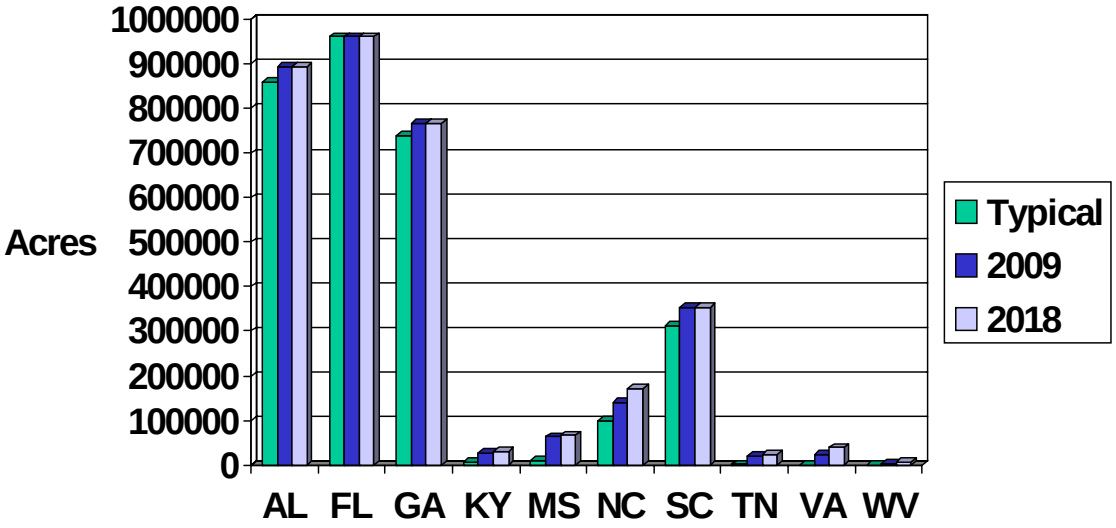


Figure 5. Differences in total burning acreages after application of FLM prescribed burning adjustments for 2009 and 2018 when compared to the 2002 typical year acreage estimates.

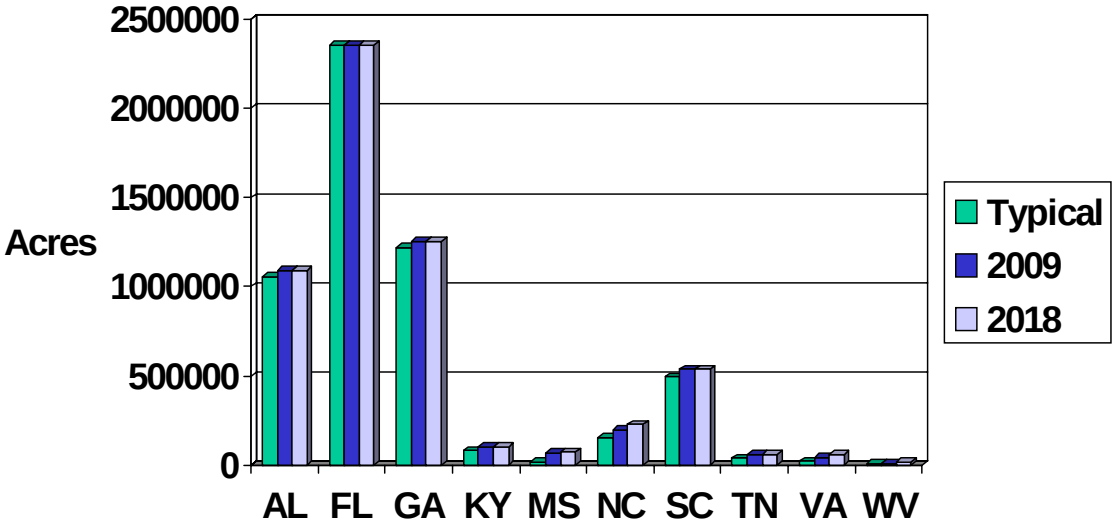


Table 3 (depicted graphically in Figure 6) shows that the revised acreages burned on FLM managed lands typically resulted in only a modest increase in PM-2.5 emissions in most States. No change is depicted in FL since the FLM data were not used in FL at FL Division of Forestry request. Figure 7 shows the change in PM-2.5 emissions after the FLM data were applied from all fire types.

Table 3. Change in PM-2.5 emissions resulting from FLM changes in prescribed fire acreage burned estimates (all values in tons).

	AL	FL	GA	KY	MS	NC	SC	TN	VA	WV
Typical	34,820	44,826	37,231	176	953	3,150	14,587	18	0	1
2009	36,550	44,826	38,635	752	3,772	5,176	17,031	623	710	109
2018	36,616	44,826	38,635	876	3,929	6,427	17,031	747	1,193	198

Figure 6. PM-2.5 prescribed fire emissions after FWS and FS revised projections compared to typical year estimates.

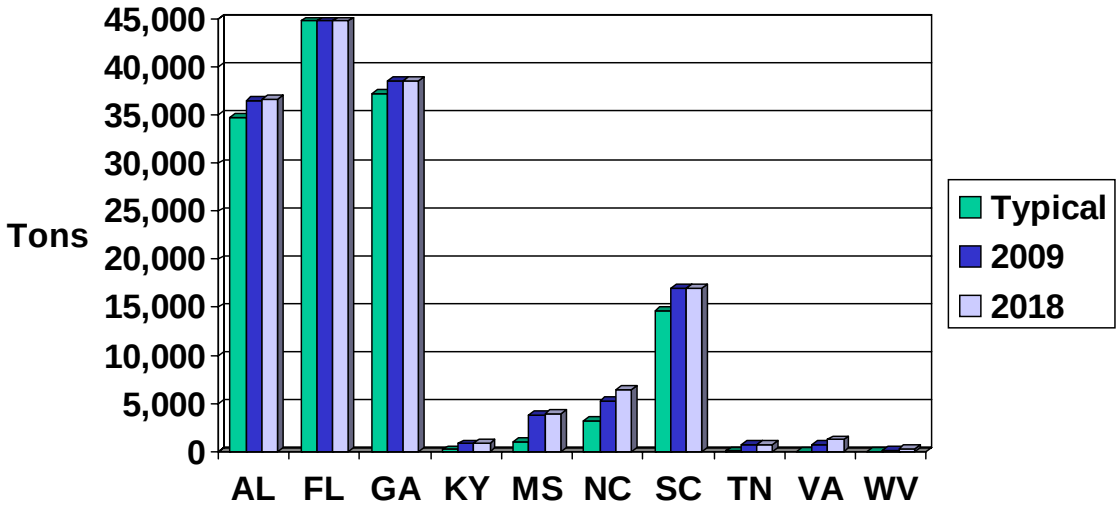
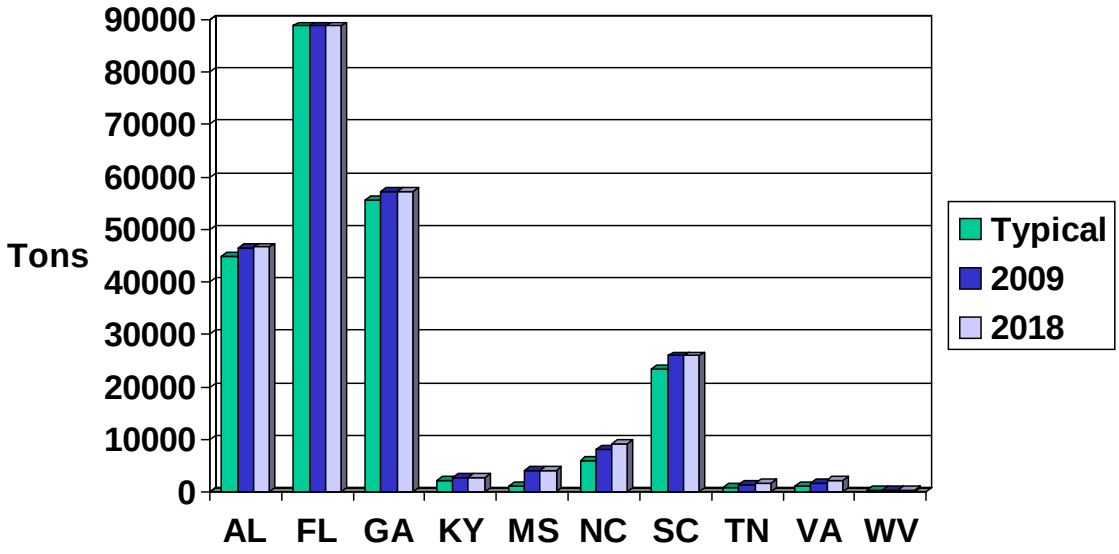


Figure 7. PM-2.5 emissions from all fire types after FWS and FS revised projections compared to typical year estimates.



CONCLUSIONS

In the southeastern U.S., prescribed fire emissions are an important part of total fire emissions. Thus proposed increases in prescribed burning on Federal and other land types are important to capture in evaluating projected emissions for regional planning with respect to regional haze and PM SIPs. This paper has proposed a method for capturing increased future year emissions for burning on Federal lands from two FLMs: FWS and FS. However in looking at ways of capturing these increases, differences in the way that data are reported and handled by both State divisions of forestry and by FLMs can cause difficulties in assimilating these data into projected emission inventories. States have differing levels of reporting of fire activity. Consistent reporting of individual fires with information on start and end date, location (latitude and longitude), land owner (private, Federal, State), fuel type, acreage blackened, and acreage burned would facilitate improvement of the fire inventory for VISTAS and other States.