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

William R. Barnard  
MACTEC Engineering and Consulting, Inc.  
wrbarnard@mactec.com

Pat Brewer  
VISTAS Technical Coordinator

Greg Stella  
Alpine Geophysics, LLC.
VISTAS Fire Emissions Development

- VISTAS Fire Workgroup convened in 2003 to oversee development of 2002 base year emission inventory
  - Fire Workgroup included Federal and State fire officials
- States and local agencies, National Park Service, and Forest Service provided 2002 acreage for wildfire, prescribed fire, agricultural burning, and land clearing categories
- Methods to calculate emissions from acreage and fuel type developed with Fire Workgroup
- Emissions developed on a fire-by-fire basis wherever data sufficient
VISTAS Base Year Fire Emissions

- Data solicited from Fire Workgroup on acreage, fuel loading/fuel characteristics, emission factors and other parameters necessary to estimate fire emissions
- Base year inventory provided to Fire Workgroup for review and comment prior to submittal for modeling
# Fire-by-Fire Data Submitted

<table>
<thead>
<tr>
<th>Fire Type</th>
<th>AL</th>
<th>FL</th>
<th>GA</th>
<th>KY</th>
<th>MS</th>
<th>NC</th>
<th>SC</th>
<th>TN</th>
<th>VA</th>
<th>WV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Clearing</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Ag Burning</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Wildfires</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Rx</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
VISTAS Fire Projections

- To project fire emissions, VISTAS developed a “typical” fire year to use with all projection modeling.
- Kept 2002 fuel loadings/characteristics and dates the same but used long term (greater than 3 years) data to develop “typical” annual burned acreage.
- Developed a ratio between 2002 and long term acreage to apply to each fire type.
- Multiplied the ratio times the 2002 acreage to obtain the “typical” year emissions.
How To Capture Increases In Rx Burning In Future Years?

- Federal agencies indicate that Rx burning in future years is likely to increase significantly.
- VISTAS will consider this as a “control strategy” scenario (e.g., does increased Rx burning affect regional haze?)
- How best to incorporate the data?
Why Are Future Rx Fire Increases Important In The SE U.S.?

Typical Acreage by Fire Type

- **Land Clearing**
- **Ag. Burning**
- **Wildfires**
- **Rx Burning**
Rx Future Year Data Submitted

- FWS and FS submitted data
- FWS – Annual acreage data by NWR/county with estimates of acres burned per day
- FS – fire-by-fire acreage estimates based on mapping projected burning acreage to current modeling days
Issues Related to Data Incorporation

• FWS did not submit data for VISTAS original base year preparation
  – Proposed method would use county level data for FWS data
• FS submitted data, but VISTAS can’t do a simple replacement
  – Some VISTAS States run a Rx fire permitting program
  – To avoid double counting, only State data were used in those States; FS records are marked in database for those States without a permit program
  – Proposed method would use county level data for FS data where a State Rx fire permitting program exists and fire-by-fire replacement for FS data in States without permit programs
• How to handle added acreage when there were no fires for a county/forest/NWR in 2002
State-level Acres Burned As Submitted by FWS with 2002 VISTAS Typical

<table>
<thead>
<tr>
<th>State</th>
<th>VISTAS 2002 Typical</th>
<th>2002</th>
<th>2009</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL</td>
<td>858,652</td>
<td>356</td>
<td>5,370</td>
<td>5,920</td>
</tr>
<tr>
<td>FL</td>
<td>960,850</td>
<td>59,333</td>
<td>69,547</td>
<td>68,547</td>
</tr>
<tr>
<td>GA</td>
<td>738,204</td>
<td>10,245</td>
<td>22,460</td>
<td>22,460</td>
</tr>
<tr>
<td>MS</td>
<td>10,645</td>
<td>10,031</td>
<td>16,300</td>
<td>19,800</td>
</tr>
<tr>
<td>NC</td>
<td>97,896</td>
<td>15,799</td>
<td>22,900</td>
<td>31,500</td>
</tr>
<tr>
<td>SC</td>
<td>311,526</td>
<td>17,294</td>
<td>18,000</td>
<td>18,000</td>
</tr>
</tbody>
</table>
FWS data - County level approach

- Sum annual acres burned for FWS across all NWRs in a county
- Subtract out 2002 acreage from projected acreage to avoid double counting.
- Multiply resultant acreage by 0.8 to account for blackened acres instead of total reported
- Add revised total FWS acreage provided to total county “typical” acreage to determine future acreage burned
- Allocate acreage increase to current modeling days
- Use average daily acres burned to allocate to the number of days
  - According to FWS guidance up to 3x average daily acres burned can be allocated to any one day. If insufficient number of days available, used either 2x or 3x average daily acres burned to allocate to the first couple of days.
FS Approach

• For States that have permit programs, use similar approach to FWS county level approach
  – Sum FS data at county level, add to typical and then allocate to modeling days based on mapping done by Bill Jackson, USFS
• For States that don’t have a permit program, replace current fire-by-fire records in database with fire-by-fire records from FS and recalculate emissions based on fuel model and fuel loading.
• 0.8 correction for blackened acres applied to all FS acres.
Annual Average Rx Fires - 4 Counties with Okefenokee NWR

- 2002 VISTAS Actual
- 2002 VISTAS Typical
- 2002 FWS Actual
- 2009 Proj. Typical
- 2018 Proj. Typical

4 Counties OKEF 4 Counties
How to capture temporal profile for fire?

- In 2002 actual fire inventory, fires occur on same days as state/FLM records.
- In 2002 “typical” year, fire acreage increased or decreased from acreage on fire days in 2002 actual inventory
- When adding Rx fire in future year, add acreage to individual fire days proportional to annual increase (days with the largest acres burned in 2002 typical received the largest fraction of acres in the allocation)
Monthly Fraction of Annual Prescribed Acres Burned - 2002 Actual Profile

Fraction of Annual Acres Burned

Month

Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec

VISTAS Prescribed Fire Data

MACTEC
Specific NWR/NF Fire Event Distribution

(Temporal Plot of Current Typical Acres Burned in 4 Counties Containing Okefenokee NWR)

Individual NWR/NF distribution used for future burn plans
### Okefenokee Example – 2009/2018 FWS data

<table>
<thead>
<tr>
<th>BAKER COUNTY</th>
<th>3/14/2002</th>
<th>3/12/2002</th>
<th>Total annual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acres (typical)</td>
<td>4315</td>
<td>1233</td>
<td>12,415</td>
</tr>
<tr>
<td>Add on FWS Projection</td>
<td>280</td>
<td>111.2</td>
<td>391.2</td>
</tr>
<tr>
<td>Total</td>
<td>4,595</td>
<td>1,344</td>
<td>12,806</td>
</tr>
<tr>
<td>Percent increase</td>
<td>6.5%</td>
<td>9.0%</td>
<td>3.2%</td>
</tr>
</tbody>
</table>

Total annual represents total annual acres for all days, not just days needed to allocate increased burning acreage.
Okefenokee Example – 2009/2018 FWS Data (cont’d)

<table>
<thead>
<tr>
<th>CHARLTON COUNTY</th>
<th>3/1/02</th>
<th>1/1/02</th>
<th>12/1/02</th>
<th>2/1/02</th>
<th>4/1/02</th>
<th>11/1/02</th>
<th>7/1/02</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acres (typical)</td>
<td>6,021</td>
<td>1,831</td>
<td>1,758</td>
<td>1,196</td>
<td>492</td>
<td>303</td>
<td>138</td>
<td>11,827</td>
</tr>
<tr>
<td>Add on FWS Projection</td>
<td>560</td>
<td>560</td>
<td>560</td>
<td>560</td>
<td>329.6</td>
<td>280</td>
<td>280</td>
<td>3,130</td>
</tr>
<tr>
<td>Total</td>
<td>6,581</td>
<td>2,391</td>
<td>2,318</td>
<td>1,756</td>
<td>822</td>
<td>583</td>
<td>418</td>
<td>14,957</td>
</tr>
<tr>
<td>Percent Increase</td>
<td>9.3%</td>
<td>30.6%</td>
<td>31.9%</td>
<td>46.8%</td>
<td>67.0%</td>
<td>92.4%</td>
<td>202.9%</td>
<td>26.5%</td>
</tr>
</tbody>
</table>

Total annual represents total annual acres for all days, not just days needed to allocate increased burning acreage.
**Okefenokee Example 2009/2018 FWS Data (cont’d)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Acres (typical)</td>
<td>3,757</td>
<td>2,612</td>
<td>1,996</td>
<td>1,801</td>
<td>616</td>
<td>472</td>
<td>11,764</td>
</tr>
<tr>
<td>Add on FWS Projection</td>
<td>560</td>
<td>280</td>
<td>280</td>
<td>280</td>
<td>280</td>
<td>276</td>
<td>1,956</td>
</tr>
<tr>
<td>Total</td>
<td>4,316</td>
<td>2,891</td>
<td>2,276</td>
<td>2,080</td>
<td>895</td>
<td>747</td>
<td>13,720</td>
</tr>
<tr>
<td>Percent Increase</td>
<td>14.9%</td>
<td>10.7%</td>
<td>14.0%</td>
<td>15.6%</td>
<td>45.5%</td>
<td>58.5%</td>
<td>14.3%</td>
</tr>
</tbody>
</table>

Total annual represents total annual acres for all days, not just days needed to allocate increased burning acreage.
## Okefenokee Example 2009/2018 FWS Data (cont’d)

<table>
<thead>
<tr>
<th>WARE COUNTY</th>
<th>2/1/02</th>
<th>3/1/02</th>
<th>7/1/02</th>
<th>12/1/02</th>
<th>1/1/02</th>
<th>4/1/02</th>
<th>6/1/02</th>
<th>Total Annual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acres (typical)</td>
<td>6,535</td>
<td>2,221.3</td>
<td>1,355.0</td>
<td>947.3</td>
<td>482.6</td>
<td>218.8</td>
<td>104.9</td>
<td>13,019</td>
</tr>
<tr>
<td>Add on FWS Projection</td>
<td>560</td>
<td>560</td>
<td>280</td>
<td>280</td>
<td>280</td>
<td>280</td>
<td>107.2</td>
<td>2,347.2</td>
</tr>
<tr>
<td>Total</td>
<td>7,095</td>
<td>2,781.3</td>
<td>1,635</td>
<td>1,227.3</td>
<td>762.6</td>
<td>498.8</td>
<td>212.1</td>
<td>15,366.2</td>
</tr>
<tr>
<td>Percent Increase</td>
<td>8.6%</td>
<td>25.2%</td>
<td>20.7%</td>
<td>29.6%</td>
<td>58.0%</td>
<td>128.0%</td>
<td>102.2%</td>
<td>15.3%</td>
</tr>
</tbody>
</table>

Total annual represents total annual acres for all days, not just days needed to allocate increased burning acreage.
Specific NWR/NF Fire Event Distribution
(Annual Temporal Plot of Acres Burned in Okefenokee NWR – 4 Counties)

Individual NWR/NF distribution used for future burn plans
Specific NWR/NF Fire Event Distribution
(Annual Temporal Plot of Acres Burned in Cape Romain NWR – 1 County)

Individual NWR/NF distribution used for future burn plans
Specific NWR/NF Fire Event Distribution
(Annual Temporal Plot of Acres Burned in Swan Quarter NWR – 1 County)

Individual NWR/NF distribution used for future burn plans
Specific NWR/NF Fire Event Distribution
(Annual Temporal Plot of Acres Burned in Cherokee NF – 7 Counties)

Individual NWR/NF distribution used for future burn plans
Rx Acreage by State

Acres

AL  FL  GA  KY  MS  NC  SC  TN  VA  WV

Typical
2009
2018

MACTEC
PM2.5 Rx Emissions After FWS and FS Rx Projections

Tons

- AL
- FL
- GA
- KY
- MS
- NC
- SC
- TN
- VA
- WV

Typical
2009
2018

MACTEC
PM2.5 Emissions for All Fire Types After FWS and FS Rx Projections
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.
• Developing a method to capture these increases in projected emission inventories can be difficult because of differences in the way that data are reported and handled by both State divisions of forestry and by FLMs which can cause difficulties in assimilating these data into projected emission inventories.
• 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.