

US EPA ARCHIVE DOCUMENT

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TO: Tom Pace, U.S. EPA
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SUBJECT: Temporal Allocation Factors for Wildland Fires - Revised

Seasonal and diurnal temporal allocation factors were developed to support regional modeling of emissions from wildland fires. Separate sets of factors were developed for wildfires and prescribed fires, for each state. In addition, separate seasonal factors were developed for each year from 1999 through 2002, and for an average year. Insufficient data were available to determine whether the day of the week has a systematic impact on wildland fire emissions.

The seasonal and diurnal allocation factors are provided in two separate Excel files, with formats as shown in Tables 1 and 2. The following sections discuss the data sources and methodologies used to develop these factors.

Table 1. Format of the Seasonal Allocation Factor File	
Field	Description
State	State postal code
Fire type	PF = prescribed fire, WF = wildfire
Year	1999, 2000, 2001, 2002, or "Avg" (average)
Jan, Feb, Mar...	Fraction of annual fire activity estimated to occur during the given month
Acre/yr	Total acres burned in the given year, or average burned per year for multiyear averages
Source	Database used to develop the factors, or source of defaults
Years	Years covered by a multiyear average (e.g. 1970-2002)

Table 1. Format of the Diurnal Allocation Factor File	
Field	Description
State	State postal code
Fire type	PF = prescribed fire, WF = wildfire
Hr_1, Hr_2, Hr_24	Fraction of daily fire emissions estimated to occur during the given hour (counting from midnight)

Seasonal Allocation Factors

Seasonal allocation factors for wildland fire were developed using a number of different national and state-level fire incident databases for past years. The following are brief descriptions of the databases that were used:

- DOI database – Lists dates, sizes, and locations of wild and prescribed fire incidents on federal lands dating from prior to 1970 through 2002. Although the database includes fields for both the discovery date and the date that a fire was brought under control, the control date is often left blank.¹
- DRI database – Compiled by Desert Research Institute (DRI), largely from the DOI database. Extensive quality assurance was performed for locations of wildfires, but this database does not cover prescribed fires.²
- ICS-209 – A compilation by the U.S. Forest Service of Incident Status Summary report forms for wild and prescribed fires. This database mainly covers fires on federal land, although fires on state, and private lands can also be included. Unlike other databases, the ICS-209 database gives day-to-day information on fire size.³
- VISTAS – Database of wildfire, prescribed fire, agricultural burning, and land clearing for ten southeastern states – Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, West Virginia⁴
- NC – Databases of wild and prescribed fires on state and private lands in North Carolina.^{5, 6} (Used as a default for DC and Louisiana prescribed fires. VISTAS data were used for North Carolina.)
- IN – Database of wild and prescribed fires on state and private lands in Indiana⁷
- OK – Database of wild and prescribed fires on state and private lands in Oklahoma⁸

In general, seasonal (monthly) allocation factors were calculated using the following equation:

$$MF_m = \sum_{i, m}(A_i) / \sum_{i, a}(A_i)$$

where:

MF_m =	Allocation factor for month, m
$\sum_{i, m}$ =	Sum over all fire incidents, i, in month, m
A_i =	Area of fire i
$\sum_{i, a}$ =	Sum over all fire incidents, i, in year, a

This calculation was performed separately for wildfires and prescribed fires, and for each state and year that was analyzed. We did not combine the federal databases, but instead used the database which provided the most comprehensive information for each state and year. In North Carolina, Indiana, and Oklahoma, the federal and state databases were combined to give total fire activity. In other states, the seasonal patterns of fires on federal lands were assumed to be representative of all fires in the state, unless very little fire activity was reported on federal lands in the state.

The federal databases – DOI, DRI, and ICS-209 – are believed to provide a good picture of the seasonal distribution of burning in the western U.S., especially for wildfires. In the eastern U.S., the federal databases provide a less comprehensive picture because fires on state and private lands become more important. However, resources were not available to compile and analyze fire incident databases for all of the eastern states. Therefore, default seasonal factors were needed for many of the eastern states. If data were lacking for a given state and year, the first choice was to use the average seasonal factors for the given state and for the appropriate fire type (wild or prescribed). If no data were available for prescribed or wildfires in a given state, default factors for a nearby state were used.

Diurnal Factors

Hourly allocation factors were calculated using the Emission Production Model (EPM), which was developed by the U.S. Forest Service.⁹ EPM estimates hourly emissions from an individual fire, and from subsequent smoldering. We ran EPM for wildfires and prescribed fires in different forest types, using the classification system developed under the National Fire Danger Rating System (NFDRS). EPM was run for multiple days, and the second day was used to develop diurnal factors. By the second day, the model had reached a stable diurnal pattern.

Hourly allocation factors for a given state were calculated by taking the average allocation factors for all NFDRS categories found in the state. These averages were weighted by the distribution of land among the various NFDRS categories and the relative fuel consumption in the different NFDRS categories. The following equation was used:

$$HF_{a,i} = \sum_N (H_{N,i} \times F_N \times C_N) / \sum_N (F_N \times C_N)$$

where:

$HF_{a,i}$	=	Average hourly allocation factor for hour, i, in the given state
\sum_N	=	Sum over all NFDRS categories, N, in the state
$H_{N,i}$	=	Hourly allocation factor for NFDRS category, N
F_N	=	Fraction of wildland in the state in NFDRS category, N
C_N	=	Fuel consumed per acre burned within NFDRS category, N

References

1. Fire History Database. U.S. Department of Interior, Contact: Susan Goodman.
2. Brown, Timothy, Beth Hall, Charlene Mohrle, and Hauss Reinbold. *Coarse Assessment of Federal Wildland Fire Occurrence Data*. CEFA Report 02-04, prepared by Desert Research Institute, Reno, Nevada, for the National Wildfire Coordinating Group.
3. USDA Forest Service Fire Applications Support – 209 Program: Incident Status Summary, Form ICS-209. <http://famweb.nwcg.gov/>
4. Database of burning in the VISTAS Region. Provided to Tom Pace, U.S. Environmental Protection Agency by Pat Brewer, VISTAS. November 2003.
5. *Burning Summary Accomplishments* (Prescribed Burns). North Carolina Division of Forest Resources, Forest Management Development Section, Contact: Joann Hocutt, 919-773-2162 x243.
6. *Forestry Fire Tracking System* (Wildfires). North Carolina Division of Forest Resources, Forest Management Development Section, Contact: Ciscelia Greer, 919-773-2162 x231
7. Wildland Fire Reports 01/01/00 to 05/05/03. Indiana Department of Natural Resources, Fire Headquarters from Rural and Volunteer Fire Departments in Indiana, Contact: Crystal Hunt, cmhunt@scican.net.
8. New Fire Reports, 050101. Oklahoma Forestry Services, Contact: Pat McDowell, patrick@oda.state.ok.us.
9. Emissions Production Model (EPM). U.S. Forest Service, Pacific Northwest. <http://www.fs.fed.us/pnw/fera/sue/epm.html>