

Emission Estimation (Follow-up to New Orleans Fire Workshop)

Conference Call on 5/27/04

Participants: Roger Ottmar, Bill Battye, Sam Sandberg, Pete Lahm, Megan Schuster, Elizabeth Reinhardt, Bruce Bayle, David Holloman (for Randy Strait), Mark Janssen, Bill Barnard, Annette Sharp, Greg Stella.

FOFEM – FOFEM was developed by Elizabeth Reinhardt at the USFS Missoula Fire Lab. It is used to estimate both fuel consumption and fire emissions using blackened fire area, fuel loading & moisture conditions for prescribed and wildfires. Its not linked to fuel maps or fuel moisture databases such as NFDRS so this data must be input by the user or alternatively the user may use built-in default assumptions. Also, it does not estimate emissions from piles. FOFEM includes the “Burnup” module which estimates both flaming & smoldering over a 2 hr period for PM10 & PM2.5, CO CO2, CH4, NOx & NO2. Elizabeth noted that other emission species can be added. Burnup calculations are made by time steps and flaming and smoldering can occur simultaneously. Since it only tracks fires for a few hours, it doesn’t handle stumps.

No major changes to FOFEM are planned, but Elizabeth is willing to work on it as needs arise. Version 5.2 is available as a .dll, is written in C++ and can be run in batch mode. FOFEM is available at: <http://fire.org/nav.mas?pages=fofem&mode=1>

Consume – Consume was developed by Roger Ottmar at the USFS Seattle Research Station. It is used to estimate fuel consumption using user input blackened fire area. It can access NFDRS or FCC fuel maps to obtain fuel loading. The user can input fuel moisture or Consume can draw it from the real time NFDRS fuel moisture database. It can also calculate fuel moisture, if the user supplies a fire location (Lat/Long), maximum and minimum temperature and RH & hours of measurable precipitation duration for 21 days prior to fire. This moisture calculation procedure is the same as used for the NFDRS database of fuel moistures. Consume can estimate fuel consumption from piles, but the user must provide the pile characteristics. It splits the consumption into flaming vs smoldering and applies different emission factors for each. It does not estimate the duration of flaming vs. smoldering - FEPS or EPM does that.

Consume 2.1 is written in VB but Consume 3.0 (due out in April 2005) will be written in VBNet/Java. Underlying data tables are in Access. Consume could be set up to work in batch mode and Roger will explore that with his programmer.

Emission Factors – EF’s are being summarized by Ron Babbitt at the Missoula Fire Lab. Bill Battye also has some emissions information resulting from collaboration with Bob Yokelson in April, 2004. Roger & Elizabeth agreed to collaborate to ensure they are using the same emissions factors. It’s presumed that FEPS will collaborate as well.

Fuel Condition Classification (FCC) system – is a system of describing fuel conditions and loadings. It follows the old fuels photo series which is still useful for on site fuel surveys. The old FCC system contained only a limited number of condition classes but it has been replaced by a much more extensive set of FCCs. The USFS Seattle Research Station is developing a FCC fuels map at 1 km resolution to augment the NFDRS maps.

FEPS – The Fire Emissions Production System (FEPS) was developed by Sam Sandberg to replace the Emissions Production Model (EPM). FEPS estimates fire emissions, loft and drift for each fire on an hourly basis. It improves on EPM and the integrated Consume/EPM system in BlueSky by accounting for smoldering that occurs during a 3rd through 72nd hour of a fire. FEPS calculates fuel consumption internally, but can alternatively accept fuel consumption input which can imported from either Consume or FOFEM. Its currently being tested in Visual Basic (VB) but, to make it platform independent, Sam plans to rewrite it in C++ with a projected end date of early winter. Sam considers the VB version ready to use now. It doesn't work in batch mode but a user interface could easily be added to allow it to be batch processed. Sam will check with his programmer on this.

Sam & Roger suggested that FEPS could easily be run for 200 -300 condition sets (combinations of e.g., fuel beds, moistures, lighting patterns, atmospheric stability) that could be distilled to a lookup table estimate of consumption per acre of fire in a particular location.

Agricultural Burning – Sam feels its relatively simple to map agricultural fuels & incorporate those into FEPS. Roger & Sam need a list of agricultural ground covers that are burned & where these crop types are grown. Annette feels the agriculture community can provide better technical information on fuel loading & EF's. She feels the overall capabilities of the emission estimation tools and their potential to configure them to estimate fire emissions should be presented to the AAQTF in July. Sam concurs with Annette that agricultural burning should be integrated into the tools and architecture used for wildland fire emissions estimation. Annette mentioned Sue Ferguson or Al Reibau as possible presenters. She feels that the AAQTF contacts may result in some funding leads. She has discussed the possibility of such a presentation with Elvis Graves.

EC/R Approach for MWRPO – EC/R used the following fire-by fire approach to emission estimation for the Midwest RPO. EC/R noted that they are not entirely comfortable with the input data they've been able to obtain:

EC/R obtained fuels information from fire incident reports, if available. If not, CSEM is used to look up a NFDRS code. This fuels information was then refined by comparing NFDRS with USFS Photo Series, information from the old FCC system & BELD3. They then created a set of "representative fires" and assigned each fire in their database to one of these "representative fire" types. Fuel consumption was then estimated using FOFEM. FOFEM was selected over Consume because EC/R believed it had better treatment of residual smoldering & NOx emission factors built in. They did not run it in batch mode because weren't running a lot of cases.

Since EC/R's emissions estimation approach was based on a reasonable approach (considering resources, the availability of fuel maps & models and the nature of fires in the Midwest), Mark Janssen doesn't see much incremental benefit to implementing the lookup table approach that Sam & Roger outlined. However, he does see a big advantage to pursuing the C++ version of FEPS & the FCC maps, seeing those as important tools for the future.

DRAFT Conclusions from 5/27/04 call

FOFEM 5.2, Consume 2.1 and EPM are all ready to use now, subject to the limitations discussed above. CSEM can be used to access NFDRS fuel codes for specific locations and the USFS Photo Series and FCC documents can be helpful to cross-check the NFDRS codes. The contacts are: FOFEM Elizabeth Reinhardt – 406-329-4760 ereinhardt@fs.fed.us; Consume and Photo Series – Roger Ottmar – 206-732-7826 rottmar@fs.fed.us, FEPS Sam Sandberg – 541-750-7265 dsandberg@fs.fed.us, CSEM – Bill Battye 919-484-0222 battye.bill@ecrweb.com.

FEPS is very useful and its conversion to a platform-independent language should be accelerated. Consume 3.0 will likewise be very useful. Sandberg & Ottmar feel that a lookup table to give emissions for a range of moisture ranges, fuel types, ignition patterns and atmospheric stabilities would be relatively simple to produce. Several participants felt it would be useful, both to potentially improve emission estimates for large fires (most useful in the southeast and east), to compare against other estimation methods and to give a quick and easy-to-use tool, especially useful to non-fire experts, pending integration of Consume 3.0 w/ Burnup, FOFEM, FEPS and FCC maps into process-based emission tools, projected to occur in about 1 year.

Adding batch processing capability to both FEPS (VB version) & Consume 2.1/EPM seems to be worthwhile and straightforward, but no firm commitments were made pending consultation with the programmers. Note, FOFEM is already batch-capable.

The group seemed to feel that it is a good idea to incorporate agricultural emissions estimation capability to the same tools & architecture as used for wildland fires and that agriculture should be added to the fuels maps. Annette Sharp will pursue via discussions with the AAQTF & EPA.