Technical Memo

Subject: Preparation of 2022 Wildland Fire Emissions for the 2022 Collaborative Emissions Modeling Platform (Beta version)

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To: State/Local/Tribal/Federal Agencies and other interested parties

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This memo is meant to provide a summary of activity data, modeling tools, and supporting data used to generate the beta version the year 2022. This beta version used activity data from 29 different state agencies, 2 tribes, and numerous federal/national activity datasets. These submitted activity datasets included wildfire, prescribed (including pile burns), and agricultural burns. Pile burns emissions have been included for the first time in an emissions modeling platform. See Pile burn section later in this memo. Agricultural burn emissions have also been provided. As of April 2024, emissions data and other summaries for the beta version are available at: https://gaftp.epa.gov/Air/emismod/2022/v1/draft/fires/ . There will be a 30 day review period where agencies can submit comments/questions/feedback on the emissions. After the 30 day review, comments will be addressed where possible, changes made the inventory and the final 2022 version 1 inventory posted. If you don't already have access to the 2022 Comments SharePoint site to submit a comment, email emissionsmodeling@epa.gov requesting an invite to the SharePoint to get access.

Activity Data

National datasets of wildland fire activity were timely obtained as inputs for calculating daily estimates of acres burned. The sources of the 2022 national input data are listed below.

- **Incident Status Summary reports (ICS-209)** daily incident report data
  - Derived from the 2022 SIT ACCESS DB available at the FAMWEB website: https://famit.nwcg.gov/applications/FAMWeb
  - Wildfires taken from SIT209_HISTORY_INCIDENTS table
- **Wildland Fire Interagency Geospatial Services (WFIGS) Group Fire Perimeter data**
  - Shapefiles acquired from: https://data-nifc.opendata.arcgis.com/datasets/nifc::wfigs-current-interagency-fire-perimeters/about
  - Mainly wildfires
- **NOAA HMS (Hazard Mapping System)** satellite detections
  - Initially retrieved as text from: https://www.ospo.noaa.gov/Products/land/hms.html#data
  - Wildland areas separated from agricultural areas using the Cropland Data Layer (CDL) and 240m resolution LandFire v2.2.0 landcover with Fuel Characteristic Classification System (FCCS) version 4 fuel beds

        - Note the resolution changed since draft version from 120m to 240m to capture more agricultural burns near bodies of water
- **Forest Service Activity Tracking System (FACTS)**
    - Hazardous Fuel Treatment Activity data
    - 2022 shapefiles used in beta version
    - Wildfires and Prescribed burns (including pile burns)
- **Department of Interior (DOI)** fire activity data
    - Sent by DOI via direct communication
    - Prescribed burns only on DOI lands
    - Included pile burn activity

The type of activity data submitted by states and tribes varied greatly. We only had 4 states with activity in the draft version, so a great amount of activity was added in the beta version. Table 1 provides a brief description of the type of data received and used in the beta version.

Table 1. Activity data submitted by state or tribal agencies for the 2022 fire inventory

SLT	Wildfire	Prescribed burns	RX includes pile burns	Ag burns
Arizona	No	Yes	Yes	No
Arkansas	Yes	Yes	Yes	Yes
California	Yes	Yes	Yes	No
Coeur d'Alene Tribe	No	No	No	Yes
Colorado	No	Yes	Yes	No
Connecticut	Yes	Yes	No	No
Delaware	No	Yes	No	Yes
Florida	Yes	Yes	Yes	Yes
Georgia	Yes	Yes	No	Yes
Idaho	No	No	No	Yes
Iowa	Yes	Yes	Yes	No
Kansas	No	Yes	No	No
Maine	Yes	Yes	No	No
Maryland	Yes	Yes	Yes	No
Minnesota	No	Yes	No	No
Missouri	No	Yes	No	Yes
Montana	No	Yes	Yes	No
Nevada	No	Yes	Yes	No
New Jersey	Yes	Yes	No	No
New Mexico	Yes	Yes	No	No
Nez Perce Tribe	No	Yes	Yes	Yes
North Carolina	Yes	Yes	No	No
North Dakota	No	Yes	No	No
Oklahoma	No	Yes	No	No
Oregon	Yes	Yes	Yes	No
Pennsylvania	Yes	Yes	No	No
South Carolina	Yes	Yes	Yes	Yes

Texas	Yes	Yes	No	No
Utah	No	Yes	Yes	No
Washington	No	Yes	Yes	Yes
Wyoming	Yes	Yes	Yes	No

The amount of activity submitted and data completeness by each state varied greatly as well. In some cases, EPA communicated with a state to get corrections or clarifications on fire activity submitted. EPA made every attempt to use the submitted activity.

Modeling Tools and Other Supporting Data

Input activity data was processed and reconciled using a modified python-based SmartFire2 to generate daily fire acres by location and type (RX/WF).

Python SmartFire2 output was processed through the BlueSky Pipeline (BSP) version is 4.2.14 containing CONSUME version 5.0.2 to calculate emissions estimates for the daily fires. The BSP uses a series of modular steps to create the final product. These modules are listed below.

- **Fuel Characteristic Classification System (FCCS)** used 120m horizontal resolution, 2022-compatible Landfire v2.2.0 remap landcover raster data and FCCS v4 fuel bed cross reference information to get the FCCS fuel bed by fire location.
- **CONSUME** version 5.0.2 was used in conjunction with the FCCS v4 fuel loading to calculate biomass consumption by phase.
- **Smoke Emissions Reference Application (SERA)** emissions factors were applied to the consumption to get total daily emissions by fire. These emissions factors were updated since the draft version.

The BSP output was post-processed to create the 2022 inventory.

- The fire locations were geocoded using the 2020 TIGER county boundaries to verify and update the county FIPS for each fire. Fires with locations over water were dropped.
- Fire emissions were apportioned to flaming and smoldering SCCs so that all emissions associated with the flaming and smoldering phases go to the flaming SCC and all emissions associated with the residual phase is put into the smoldering SCC.
- Crop Residue emissions were computed in a new BSP agricultural burn module: Using 2022 HMS detects that were identified as crop residue, acres burned for all crops (except sugarcane) were estimated using the field size by state Table. Emissions were estimated as the product of area burned, combustion completeness, fuel loading and emission factors. A state acres/HMS detect was estimated for sugarcane instead of the field size by state.
- HAPs emissions factors applied are as shown in section 7 of our 2017 NEI TSD (https://www.epa.gov/sites/default/files/2021-02/documents/nei2017_tsd_full_jan2021.pdf)
- All questions/comments should be addressed to Jeff Vukovich(Vukovich.Jeffrey@epa.gov)

Pile Burns

As mentioned earlier, this is the first time that a pile burn emissions methodology has been applied. No previous NEIs by EPA have included a method for these types of burns. This methodology was presented in late 2023 along with draft pile burn emissions for a few states that had specific pile burn activity datasets. Some feedback from states was received and implemented when possible. The beta

version pile burn emissions are available here:
https://gaftp.epa.gov/Air/emismod/2022/v1/draft/fires/pile_burns/

The data at this website consists of the SMOKE-ready FF10 formatted emissions files that have all the pile burns included. The FF10 files begin with "ptinv" and "ptday". There are also specific csv files for certain states and national activity datasets that give more details on how emissions were estimated. Arizona(az), Arkansas(ar), Florida(fl), Nez Perce tribe(np), Oregon(or: 2 files), Washington (wa: 2 files) and Wyoming(wy) csv files are for state-submitted activity that had more detailed information besides acres burned. This detailed information consisted of number of piles, dimensions of piles, machine or hand piles, tons burned, and other data. The USFS FACTS (facts csv file) had pile burn information that was also more detailed than just acres. As seen in Table 1 above in the Activity section, other states submitted pile burn activity as well as the Department of Interior. These data consisted of only acres burns or treated so the same methodology was used for of these fires and put into the US pile burn csv file (begins with "us"). When reviewing this data please keep in mind that in some cases pile burns for your state can be in different csv files. For example, pile burns conducted by FACTS or DOI in your state may be their separate csv file. EPA looks forward to further feedback from agencies on pile burn emissions.

Flint Hills and Midwest "grass or ditch" fires

Every year the Flint Hills area in eastern Kansas and in northeastern Oklahoma has prescribed fire activity from roughly mid-February through April. The time period varies a little each year. The dominant fuel consumed is grasslands and the amount varies from 1 to almost 3 million acres each year. Like previous years, EPA received specific acres burned by county for year 2022 and used the HMS satellite detects to allocate the acres spatially and temporally. Specific emissions factors for Flint Hills grasses were used, when possible, to estimate the emissions. This Flint Hills process is completed outside of the BlueSky Pipeline due to the nature of the activity data available. There is a separate fireloc file for these Flint Hills burns here:
https://gaftp.epa.gov/Air/emismod/2022/v1/draft/fires/2022FireLoc_FlintHils.csv

It is not clearly known if corn and soybean fields are burned each year due to lack of benefits in doing so. Therefore, for the midwest and some surrounding states the assumption that ditch fires are used to burn the grasses/weeds/etc around the corn and soybean fields has been used outside of BlueSky Pipeline. HMS detects that have not reconciled with any of the data mentioned in the Activity section above and have been identified as corn or soybeans field are generally treated as grassland burns. Also note, an overwhelming majority of these burns are assumed to be prescribed burns. There are small wildfires assumed in the months of October and November. There is a separate fireloc file for these burns here:
https://gaftp.epa.gov/Air/emismod/2022/v1/draft/fires/2022FireLoc_MidwestGrass.csv

The states that had corn and soybeans fields where this assumption was made are listed in Table 2. If a state listed below has questions about this process, please let Jeff Vukovich (Vukovich.Jeffrey@epa.gov).

Table 2. States where assumptions were made for fires identified at or near corn and soybeans fields

Arkansas
Illinois
Indiana
Iowa
Kansas
Kentucky
Michigan
Minnesota
Missouri
Nebraska
Ohio
Oklahoma
Tennessee
Wisconsin