2023 National Emissions Inventory Wildland fires and Agricultural burns: Kickoff meeting

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Outline

- Planned changes in 2023NEI and summary of Tools used to generate 2023NEI fire emissions
- 2023 Wildfire season summary
- Draft (or alpha) version of inventory
- SLT activity received and to be used in beta version
- Review NEI timeline and next steps

Terminology/Acronyms

- WF = Wildfires
- RX = Prescribed burns
  - PB = Pile burns
- AG = Agricultural burns
- pySF2 = modified python SmartFire2
- BSP = BlueSky Pipeline framework
- EF = Emissions Factor
- NIFC = National Interagency Fire Center

Fire inventory tools used

- Modified python-based SmartFire version 2 (pySF2)
  - Uses satellite detects, federal and SLT fire activity information
  - Uses weighting factors and other parameters to reconcile fire activity with satellite detects
  - Assigns fire type, latitude-longitude, daily acres burned
  - Provides reference information (e.g., source of activity used)
- BlueSky Pipeline (BSP) framework system
  - Take the pySF2 output (daily acres burned)
  - Assigns fuels burned
  - Estimates consumption and emissions

Planned changes in 2023NEI: High-level summary

- Wildland fires
  - Smoke Emissions Reference Application (SERA) emissions factors used instead of Fire Emission Production Simulator (FEPSv2)
  - New SCCs by vegetation region (Boreal, Eastern, Western, Grassland)
    - Modeling enhancements and quality assurance
  - All HMS detects input into the activity reconciliation process in python-SmartFire2 (change in processing of HMS detects)
- Prescribed burns
  - Adding pile burn methodology; emissions computed outside of BlueSky Pipeline
- Agricultural burns
  - Adding specific SCC for ditch burns on or very near agricultural lands (moved from prescribed burn SCC)
  - Agricultural burn emissions computed in updated BlueSky Pipeline

BlueSky Pipeline changes for 2023NEI

Bluesky Pipeline (BSP)

- US Forest Service has significantly updated the Bluesky Framework and named the new system "Bluesky Pipeline"
- It is open source at https://github.com/pnwairfire/bluesky
- Currently, BSP version 4.2.13 used at EPA
- BSP has both SERA and FEPSv2 emissions factors available
- FEPSv2 factors vary by combustion phase only, limited pollutants
- SERA factors can vary by phase, fire type, region, fuel type and more pollutants

Smoke Emissions Reference Application (SERA)

- SERA is a searchable online database coordinated by the US Forest Service and University of Washington
- Consists of existing peer-reviewed emission factors (EFs) of 276 known air pollutants
- Database enables the analysis and summaries of existing EFs, and creation of average EFs to be used in decision support tools for smoke management, including BSP
- EPA has been using SERA-generated fire inventories in air quality modeling applications for various years 2016-2019, 2021 and 2022
- Other EFs: Non-Methane Organic Compound (NMOC) and HAP EFs are coming from the reference values in Urbanski 2014

https://depts.washington.edu/nwfire/sera/index.php

SMOKE EMISSIONS REFERENCE APPLICATION (SERA)

Emission Factors by Pollutant | Smoke Emissions References

Filter summaries by:

☐ Include outliers

Combustion Phase
- ☐ Flaming
- ☐ Residual smoldering
- ☐ Smoldering
- ☐ Unspecified

Burn Type
- ☐ Broadcast Rx (Field)
- ☐ Other (Lab)
- ☐ Pile burn (Field)
- ☐ Pile burn (Lab)
- ☐ Wildfire (Field)

Platform*
- ☐ Aerostat
- ☐ Airborne
- ☐ Ground
- ☐ Tower

Region
- ☐ North
- ☐ Southeast
- ☐ West

Vegetation Type
- ☐ Conifer forest
- ☐ Grassland
- ☐ Hardwood forest
- ☐ Mixedwood forest
- ☐ Organic soil
- ☐ Other
- ☐ Shrubland

EPA Pollutant Category
- ☐ Air Toxin (TOX)
- ☐ Critical Air Pollutant (CAP)
- ☐ Greenhouse Gas (GHG)
- ☐ Hazardous Air Pollutant (HAP)
- ☐ Ozone Depleting Substance (OZD)
- ☐ Ozone Precursor (OZP)
- ☐ Persistent Bioaccumulative Toxic (PBT)

Slash
- ◉ Exclude (default)
- ○ Include
- ○ Slash-only

▶ **Advanced search**

Use checkboxes in the table below to further limit output to selected pollutants.

Apply filter | Reset

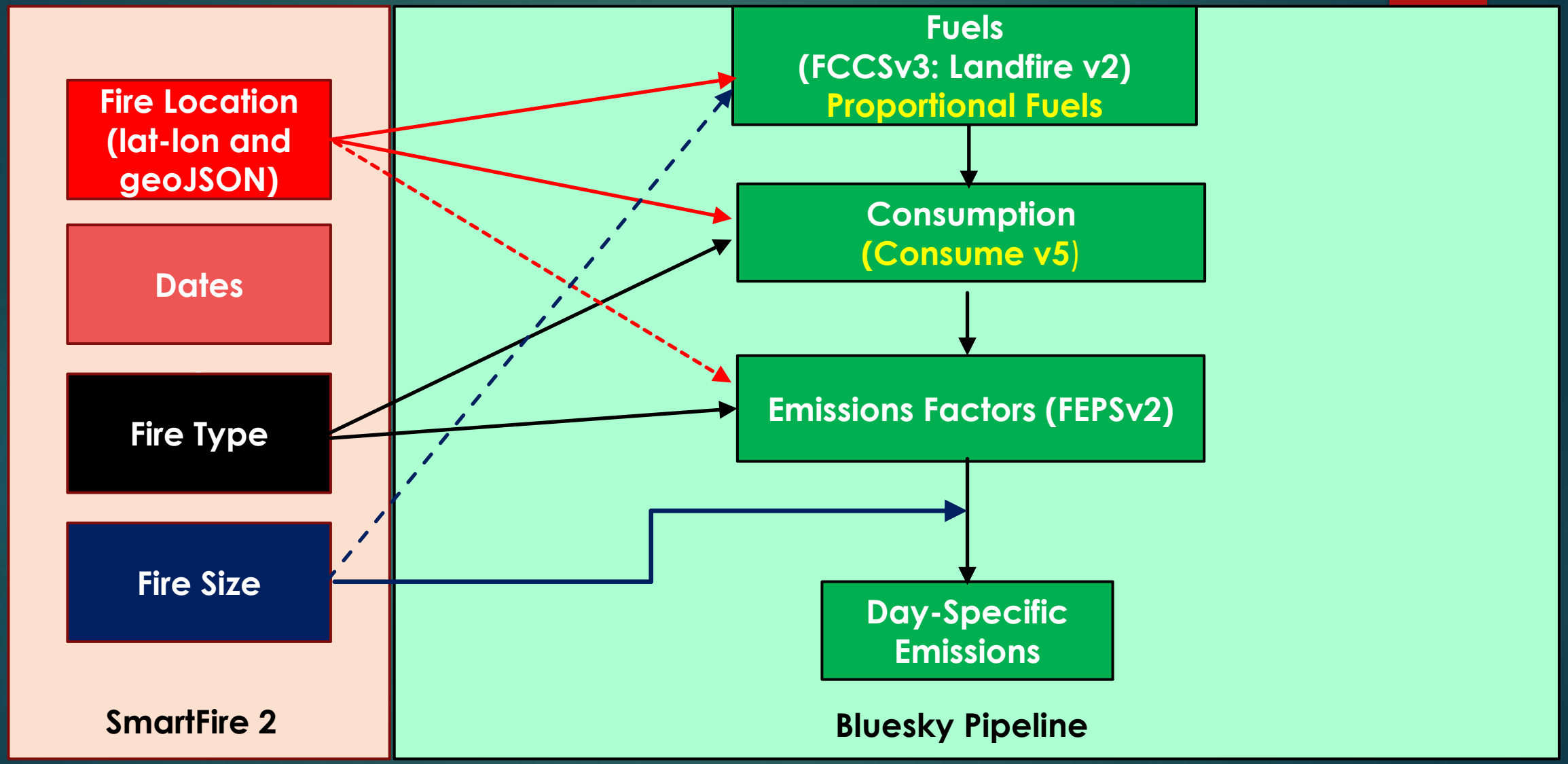
**Platform applies only to field burns (i.e., broadcast Rx, pile burn, or wildfire). Lab burn + platform will yield 0 records.*

Download this summary table | Download source EFs for this summary table

Emission Factor Summaries: Showing all 279 pollutants, across all categories (excluding outliers and slash)

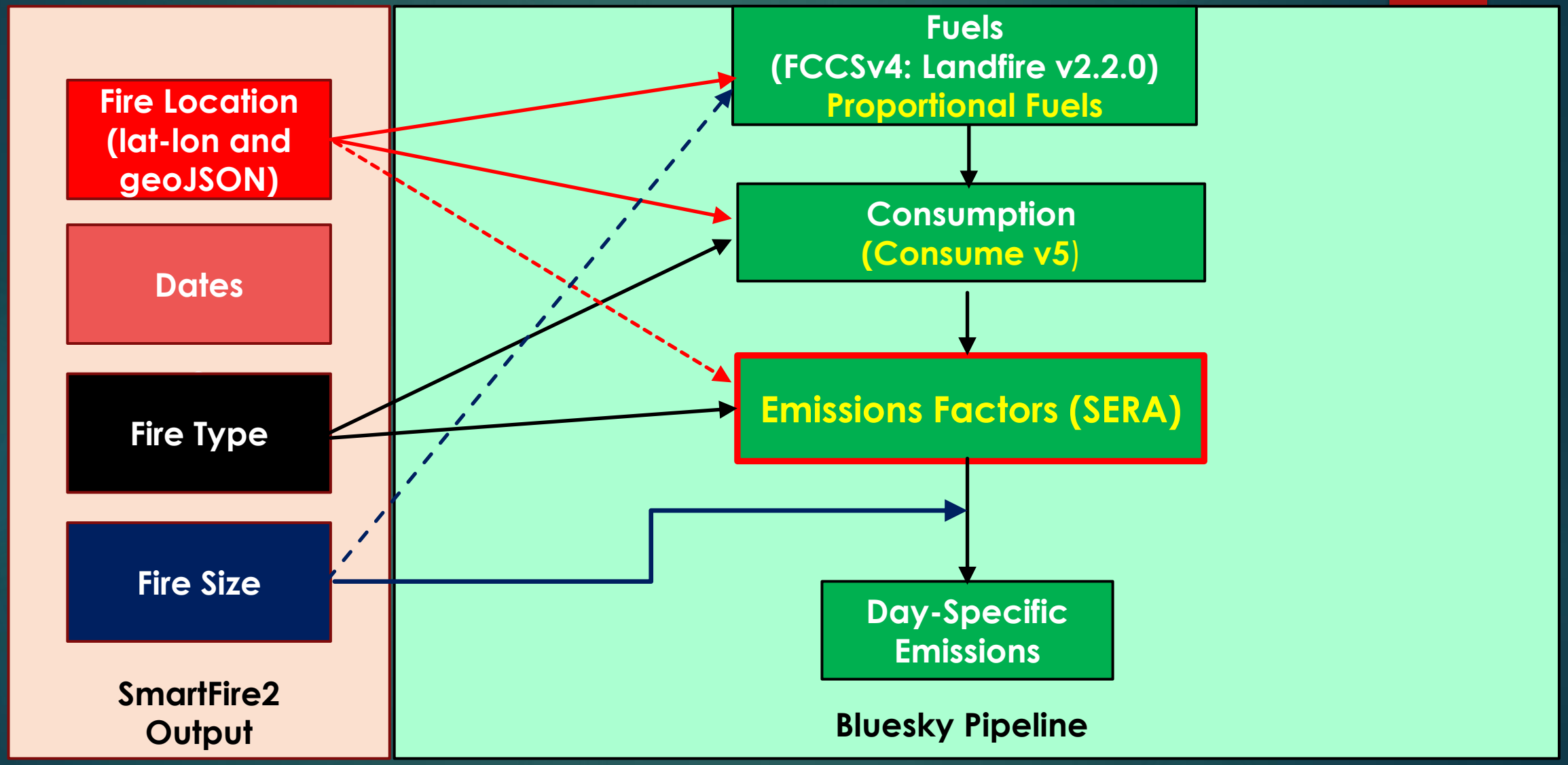
	Pollutant	Formula	Pollutant Category	Molecular Wt	Count	EF (g/kg) Mean	EF (g/kg) SD	MCE (0-1) Mean	MCE (0-1) SD
Primary Gases/Aerosols									
☐	ammonia	NH_3	inorganic gases	17.031	199	1.386	1.445	0.910	0.059
☐	carbon dioxide	CO_2	inorganic gases	44.009	599	1,605.958	154.744	0.906	0.047
☐	carbon monoxide	CO	inorganic gases	28.01	658	98.678	49.264	0.901	0.056
☐	methane	CH_4		16.043	481	4.657	3.456	0.904	0.047
☐	nitric oxide	NO	nitrogen oxides	30.006	186	2.148	1.600	0.928	0.038

2020NEI Bluesky Pipeline modules



FCCS = Fuel Characteristic Classification System

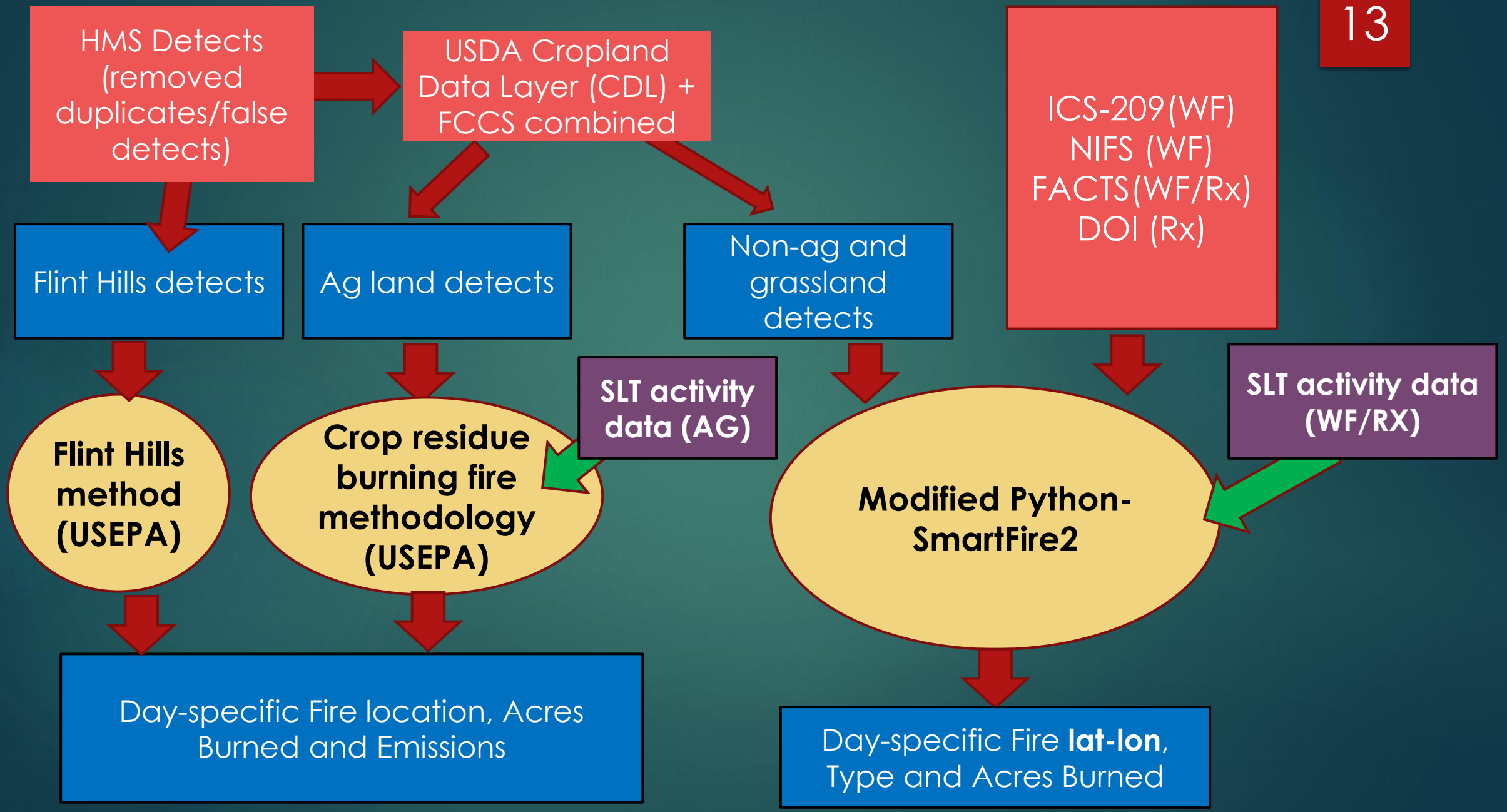
2023NEI Bluesky Pipeline modules



FCCS = Fuel Characteristic Classification System SERA=Smoke Emissions Reference Application

Data processing changes in 2023NEI

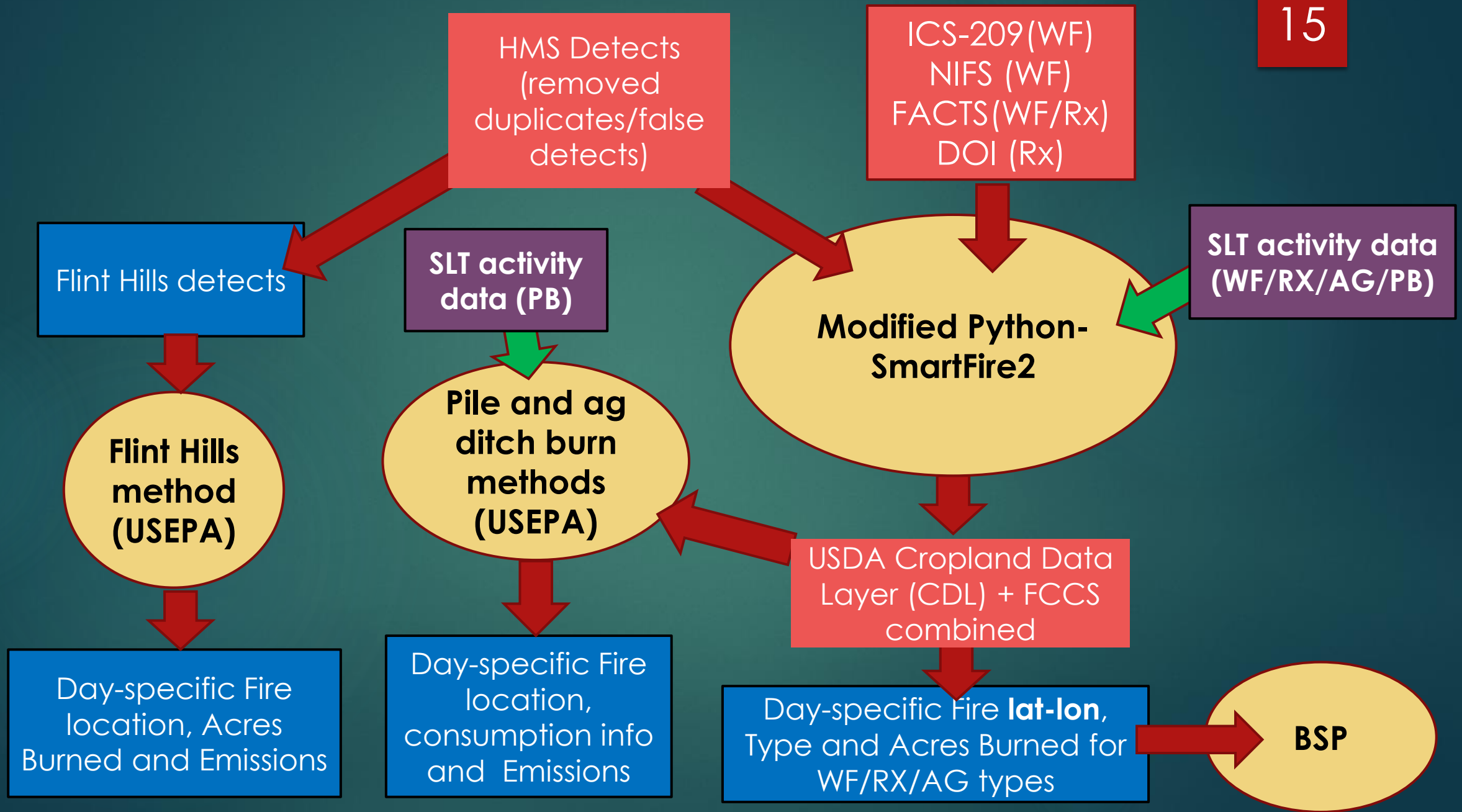
Python-SMARTFIRE2 + other burns processing for 2020 NEI



Application of cropland shapefile in fires processing

- Used to identify agricultural burns when SLT data not available or incomplete
- Done before python-SmartFire2 since 2011NEI
  - Results in double counting situations
    - Wildfires over agricultural lands
    - Prescribed burns near agricultural lands
- Applying cropland shapefile after python-SmartFire2 in 2023NEI
  - Should reduce double counting
  - Allow for better characterization (more HMS detects) to allocate fire emissions spatially and temporally

Python-SMARTFIRE2 + other burns processing for 2023 NEI



New SCCS for fires in 2023NEI

New wildfire SCCs for 2023NEI

SCC	scc level three	scc level four
2810070001	Boreal Forest Wildfires	Smoldering + Flaming
2810070002	Boreal Forest Wildfires	CWD Residual Smoldering
2810070003	Boreal Forest Wildfires	Duff Residual Smoldering
2810071001	Eastern Forest Wildfires	Smoldering + Flaming
2810071002	Eastern Forest Wildfires	CWD Residual Smoldering
2810071003	Eastern Forest Wildfires	Duff Residual Smoldering
2810072001	Grassland Wildfires	Smoldering + Flaming
2810073001	Shrubland Wildfires	Smoldering + Flaming
2810073002	Shrubland Wildfires	CWD Residual Smoldering
2810073003	Shrubland Wildfires	Duff Residual Smoldering
2810074001	Western Forest Wildfires	Smoldering + Flaming
2810074002	Western Forest Wildfires	CWD Residual Smoldering
2810074003	Western Forest Wildfires	Duff Residual Smoldering

Duff is a layer of dead plant material on the forest floor that can burn in wildfires. It's made up of partially decayed organic matter like leaves, twigs, needles, bark, and root

CWD: Coarse woody debris

New SCCs will allow for fire-type and fuel bed specific speciation

New prescribed burn SCCs for 2023NEI

SCC	scc level three	scc level four
2810080001	Boreal Forest Prescribed Burning	Smoldering + Flaming
2810080002	Boreal Forest Prescribed Burning	CWD Residual Smoldering
2810080003	Boreal Forest Prescribed Burning	Duff Residual Smoldering
2810081001	Eastern Forest Prescribed Burning	Smoldering + Flaming
2810081002	Eastern Forest Prescribed Burning	CWD Residual Smoldering
2810081003	Eastern Forest Prescribed Burning	Duff Residual Smoldering
2810082001	Grassland Prescribed Burning	Smoldering + Flaming
2810083001	Shrubland Prescribed Burning	Smoldering + Flaming
2810083002	Shrubland Prescribed Burning	CWD Residual Smoldering
2810083003	Shrubland Prescribed Burning	Duff Residual Smoldering
2810084001	Western Forest Prescribed Burning	Smoldering + Flaming
2810084002	Western Forest Prescribed Burning	CWD Residual Smoldering
2810084003	Western Forest Prescribed Burning	Duff Residual Smoldering

Duff is a layer of dead plant material on the forest floor that can burn in wildfires. It's made up of partially decayed organic matter like leaves, twigs, needles, bark, and root

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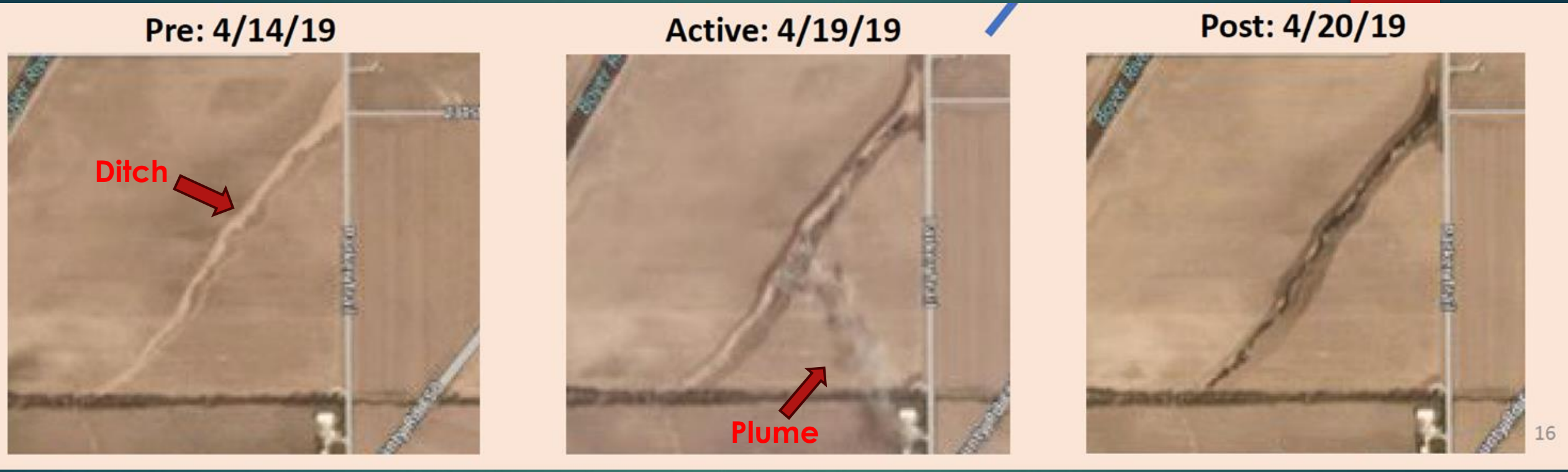
New SCCs will allow for fire-type and fuel bed specific speciation

Agricultural ditch burns: Example

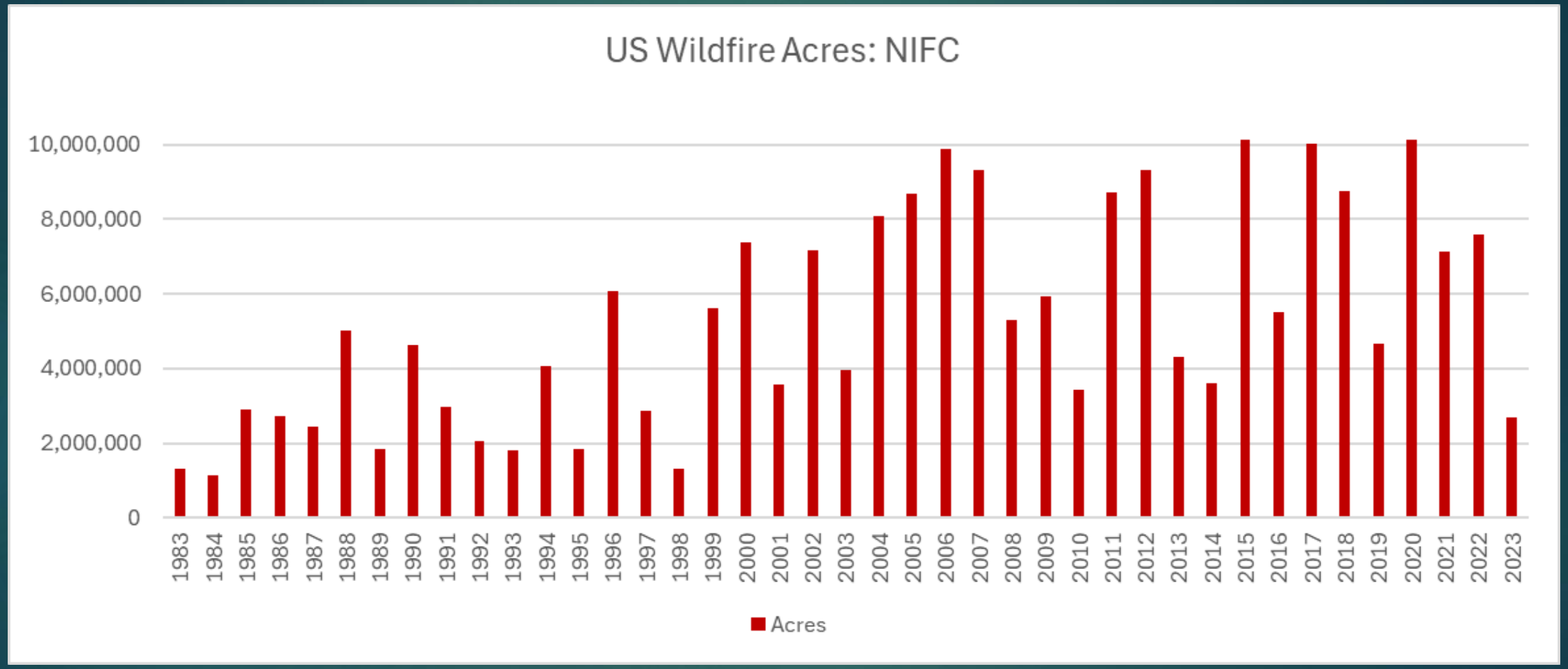


- Midwest region conducts ditch burns on or near corn and soybean fields
- New SCC 2801540000 to be used in 2023NEI for these type of agricultural land ditch burns
- Was using a prescribed burn SCC in 2020NEI

Pile burn methodology added to 2023NEI (James Beidler slides)

2023 Wildfire season summary

2023 Wildfire season: Low activity



USA total acres burned for 2023 was about 2.7M

Top 10 Wildfires: Year 2023

Name	State	Start Date	Last Repo	Size In Acres
Smith River Complex	CA	16-Aug	15-Nov	95,107
York	CA	28-Jul	19-Aug	93,078
Newell Road	WA	21-Jul	30-Jul	60,551
Pass	NM	21-May	31-Aug	59,833
Anderson Complex	AK	29-Jul	24-Aug	58,933
Delta	AK	25-Jul	31-Aug	57,395
Clear Creek Complex	AK	27-Jul	17-Aug	52,966
2023 SRF Lightning Complex	CA	17-Aug	24-Oct	50,198
Pogo Mine Road	AK	25-Jul	23-Aug	48,792
Cooksley	NE	18-Apr	18-Apr	40,000

Top 10 States: Year 2023 Wildfire acres burned

Source NIFC

Agency	# Fires - Human	Acres - Human	# Fires - Lightning	Acres - Lightning	# Fires - Total	Acres - Total
California	6,746	143,265	618	189,458	7,364	332,722
Alaska	170	738	176	313,539	346	314,276
New Mexico	587	25,864	432	186,514	1,019	212,378
Texas	6,708	172,550	394	37,714	7,102	210,264
Oregon	1,394	108,848	585	93,188	1,979	202,035
Arizona	1,306	75,823	531	112,660	1,837	188,483
Nebraska	511	178,933	58	1,800	569	180,733
Oklahoma	1,580	162,490	0	0	1,580	162,489
Washington	1,411	124,772	296	26,545	1,707	151,316
Montana	1,258	35,753	404	87,380	1,662	123,133

2023 draft (alpha) version

Planned changes in 2023NEI that are in 2023 draft (alpha) version are in yellow

- Wildland fires
  - Smoke Emissions Reference Application (SERA) emissions factors used instead of Fire Emission Production Simulator (FEPSv2)
  - New SCCs by vegetation region (Boreal, Eastern, Western, Grassland)
    - Modeling enhancements and QA
  - All HMS detects input into the activity reconciliation process in python-SmartFire2
- Prescribed burns
  - Adding pile burn methodology; emissions computed outside of BlueSky Pipeline
- Agricultural burns
  - Adding specific SCC for ditch burns on or very near agricultural lands (moved from prescribed burn SCC)
  - Agricultural burn emissions computed in updated BlueSky Pipeline

Activity data used: Federal agencies

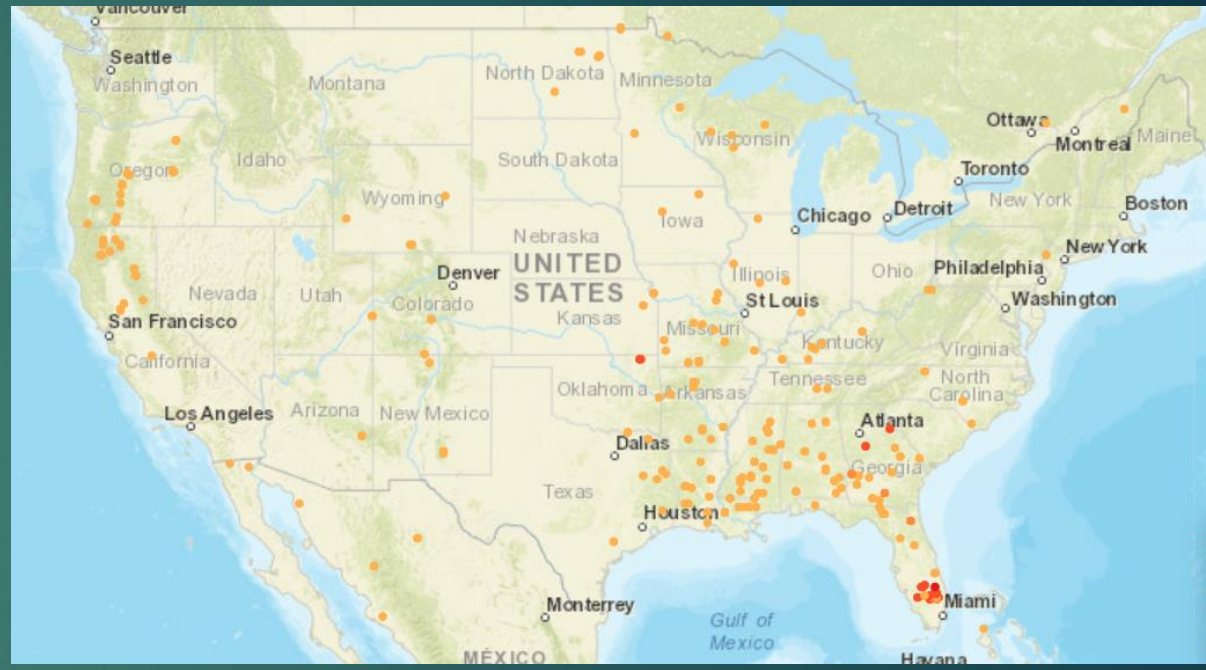
- **NOAA HMS (Hazard Mapping System)** satellite detection
  - https://www.ospo.noaa.gov/Products/land/hms.html
- Incident Status Summary reports (**ICS-209**) daily incident report data
  - https://famit.nwcg.gov/applications/FAMWeb
  - Mainly wildfires
- Wildland Fire Interagency Geospatial Services (**WFIGS**) Group Fire Perimeter data
  - Shapefiles acquired from: https://data-nifc.opendata.arcgis.com/datasets/nifc::wfigscurrent-interagency-fire-perimeters/about
  - Mainly wildfires
- US Forest Service Activity Tracking System (**FACTS**)
  - Hazardous Fuel Treatment Activity data for 2023
  - Wildfires and Prescribed burns
- Department of Interior (DOI) fire activity data from National Fire Plan Operations and Reporting System (**NFPORS**)
  - Obtained via DOI's RESTful GIS service
  - Prescribed burns only on DOI lands

Activity data used: State agencies

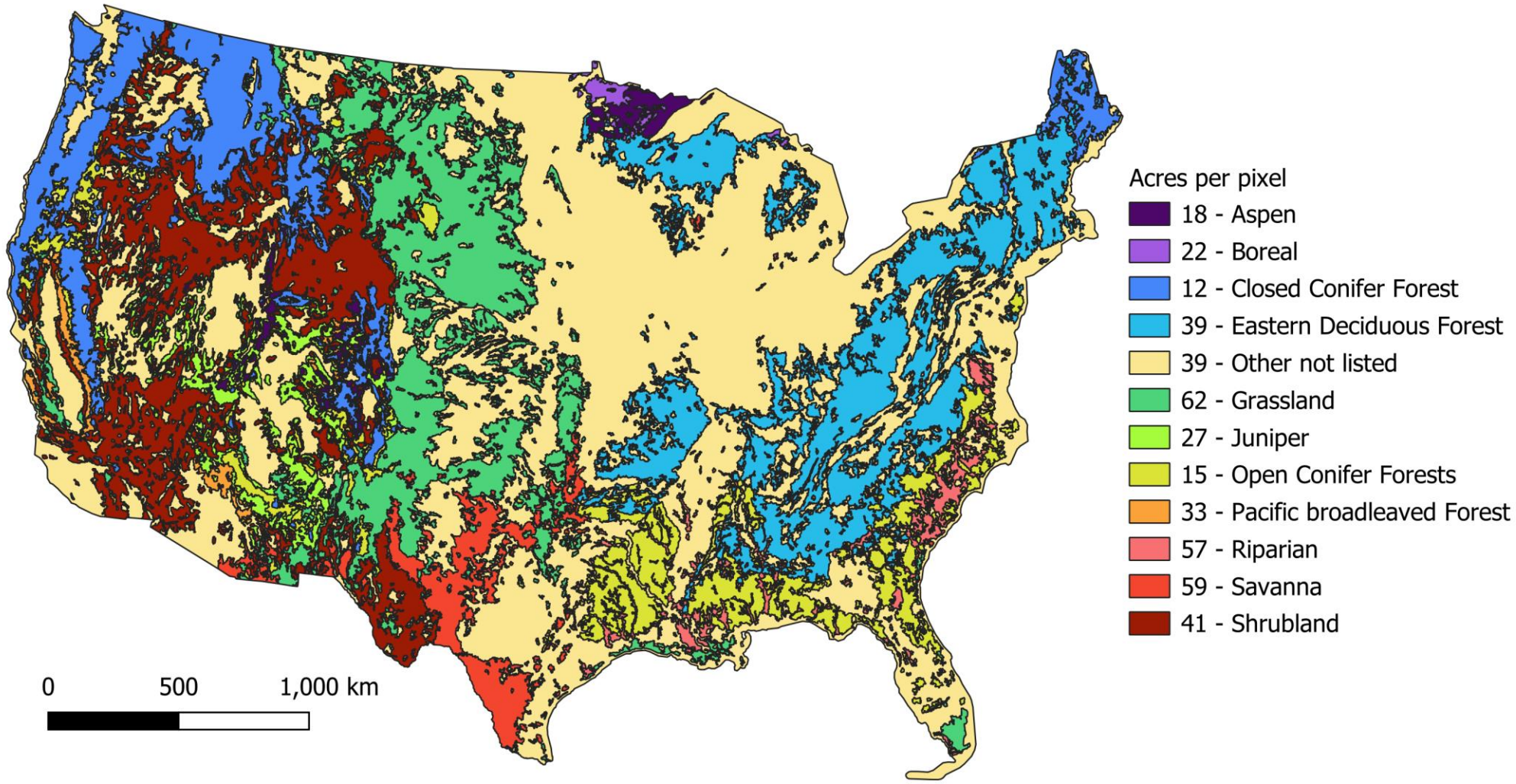
- California
  - Air Resources Board (CARB) Prescribed Fire Information Reporting System (PFIRS)
    - Prescribed burns only
  - The Department of Forestry and Fire Protection (CAL FIRE)
    - Wildfire activity via GIS shapefile
  - CalMAPPER
    - GIS application for capturing forest and fuels management projects and associated activities across programs within CAL FIRE
    - Prescribed burns only

Hazard Mapping System fire detects

- Total US detects for the year 2023 ~ 730K detects
- After applying the USDA Cropland Data Layer, about 580,000 detects were labeled as wildland fire and ~ 128,000 detects determined to be on agricultural lands
- About 22,700 detects determined as taking place during annual Flint Hills prescribed burns (more info on this later in ppt)



Default acres per HMS pixel/detect

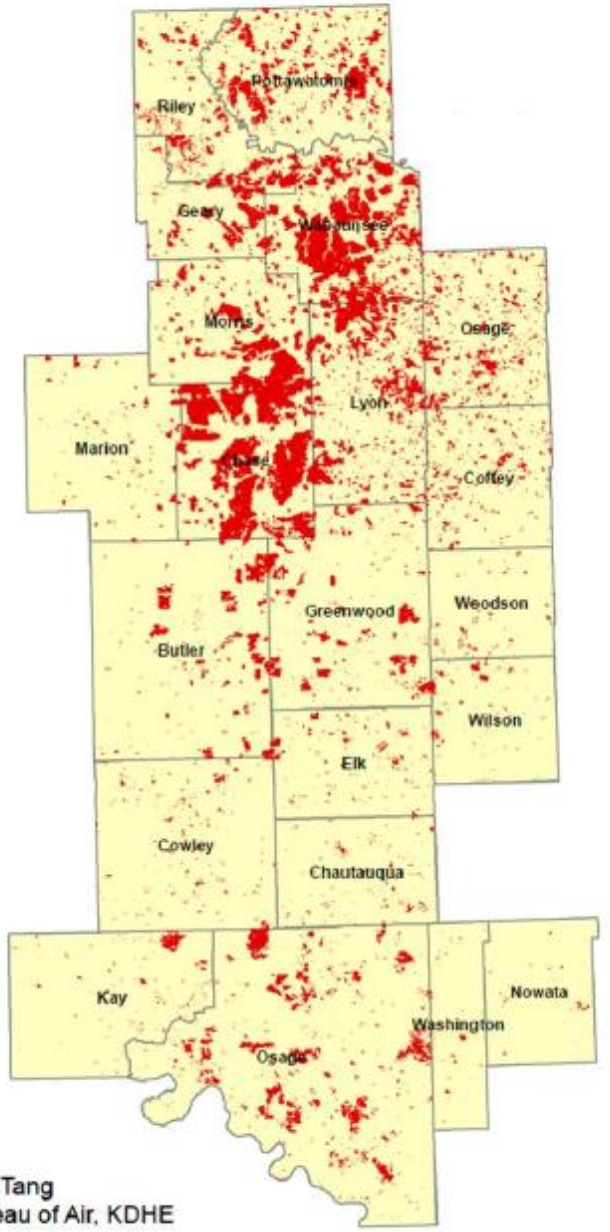


When we don't have actual documented fire activity and have to rely solely on HMS detect

Estimating Area Burned Flint Hills Prescribed Burning Spring 2023

- Calculate emissions outside of BSP
- Use all "Grass" HMS detects in these counties for the time of the prescribed Burning
- Calculate per county acres per HMS detect for this time period. Typically range ~ 50 -160 acres per detect
- 2023 Total number of Flint Hills Detects is about 22,700 in alpha version
- Use SERA grass emission factors to estimate pollutants except PM2.5
- PM2.5 from measurements in Flint Hills Amara Holder: 12.68 g/kg
- Wildfires did occur in Osage County, Oklahoma during this time!

Flint Hills Acreage Burned (February 3 – May 1, 2023)



Yao Tang
Bureau of Air, KDHE

County	Acres Burned
Butler	52,418
Chase	238,693
Chautauqua	7,645
Coffey	26,178
Cowley	13,112
Elk	14,301
Geary	38,147
Greenwood	54,704
Lyon	115,091
Marion	16,047
Morris	81,268
Osage (KS)	51,167
Pottawatomie	94,597
Riley	56,326
Wabaunsee	196,421
Wilson	9,653
Woodson	6,162
Nowata (OK)	1,961
Osage (OK)	111,478
Washington (OK)	2,595
Kay (OK)	12,649
Total	1,200,613

CONUS 2023 alpha version totals

	ACRESBURNED	PM2.5 (tons)
WF	2,087,049	504,447
RX w/o FHills	11,442,664	1,162,573
FlintHills	1,200,613	24,586
Total RX	12,643,277	1,187,159
TOTAL CONUS	14,730,326	1,691,606

- NIFC CONUS total WF acres for 2023 = 2.38M
- National Association of State Foresters estimates about 9.4M of RX acres in USA in 2020
- NASF report:
  - https://www.stateforesters.org/wp-content/uploads/2023/01/2021-National-Rx-Fire-Use-Report_FINAL.pdf

Crop Reside Burns 2023

- Number of HMS detects and average crop field size by state used to get daily acres burned
  - About 128K HMS detects in 2023 alpha version
- Sugarcane: use area harvested from USDA or LSU (Louisiana); use HMS detects to estimate acres/detect by state; use emission factors (from SPECIATE for PM2.5/VOC) to estimate emissions for Texas, Florida and Louisiana
- Crops Module added to Bluesky Pipeline that uses daily acres burned information as input and generate consumption estimates and applies emission factors to get resulting daily emissions for each burn
- 2023alpha
  - 4.77M acres
  - Additional 345K acres involved in Midwest ditch burns

What information is in the 2023NEI draft(alpha) emissions release?

- Wildfire and Prescribed Burns
  - Fire locations files
  - FCCS (fuel-bed) cross-reference table
  - Including CAPs and HAPs
- Ag fires
  - Comma delimited file, summary
  - Including CAPs and HAPs
- Technical memo
- Memo and data above posted: https://gaftp.epa.gov/Air/nei/2023/doc/supporting_data/events/draft/

2023NEI beta version plans

Planned changes in 2023NEI: Beta version

- Wildland fires
  - Smoke Emissions Reference Application (SERA) emissions factors used instead of Fire Emission Production Simulator (FEPSv2)
  - New SCCs by vegetation region (Boreal, Eastern, Western, Grassland)
    - Modeling enhancements and QA
  - All HMS detects input into the activity reconciliation process in python-SmartFire2
- Prescribed burns
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  - Adding specific SCC for ditch burns on or very near agricultural lands (moved from prescribed burn SCC)
  - Agricultural burn emissions computed in updated BlueSky Pipeline

State/Local/Tribal fire activity data to be used in 2023 beta version

State	RX	WF	AG	PB
Alaska	Yes	Yes	No	No
Arizona	Yes	No	No	Yes
Arkansas	Yes	Yes	Yes	Yes
California	Yes	Yes	No	Yes
Colorado	Yes	No	No	Yes
Connecticut	Yes	Yes	No	No
Delaware	Yes	No	Yes	No
Florida	Yes	Yes	Yes	Yes
Georgia	Yes	Yes	Yes	Yes
Idaho	Yes	No	Yes	Yes
Iowa	Yes	Yes	No	No
Kansas	Yes	No	No	No
Maine	No	Yes	No	No
Maryland	Yes	Yes	No	No
Minnesota	Yes	No	No	No
Mississippi	Yes	No	Yes	No
Missouri	No	Yes, but unable to use	No	No
Montana	Yes	No	No	Yes
Nevada	Yes	Yes	No	Yes
New Jersey	Yes	Yes	Unable to use	No
New Mexico	Yes	Yes	No	Yes
Nez Perce Tribe	Yes	No	Yes	Yes
North Carolina	Yes	Yes	Yes	No
North Dakota	Yes	No	No	Yes
Oklahoma	Yes	No	No	No
Oregon	Yes	No	No	Yes
Pennsylvania	Yes	Yes	No	No
South Carolina	Yes	Yes	Yes	No
Texas	Yes	Yes	No	No
Utah	Yes	No	No	Yes
Virginia	Yes	Yes	No	No
Washington	Yes	No	No	Yes
Wyoming	Yes	Yes	No	Yes

States where we have no activity data

States	States
Alabama	New Hampshire
Illinois	New York
Indiana	Ohio
Kentucky	Rhode Island
Louisiana	South Dakota
Massachusetts	Tennessee
Michigan	Vermont
Missouri (trying)	West Virginia
Nebraska	Wisconsin

Hawaii did provide information on Maui Wildland-Urban Interface (WUI) fire

NEI key dates and Next Steps

- By March 15, 2025: 2023 beta version emissions released for SLT/others to review
  - Will provide technical memo and instructions on how to make comments
  - Summaries will be made available including daily, point to annual-county level reports
- Late March/early April: NEI Workgroup meeting #2
- By May 1, 2025: SLT/others comments on beta version are due
- By Aug 1, 2025: Final 2023 emissions released to SLT/others to review
  - Memo and summaries just like beta version release
  - Anticipating only minor tweak changes after this date
- August/September : NEI Workgroup meeting #3
- By Oct 1, 2025: 2023NEI fires release in EIS
  - Sum up to county and by month for NEI to submit as a nonpoint category
- By Mar 31, 2026: Full public release of entire 2023

Any questions about 2023NEI fires please contact

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Extra Slides

Wildfire month assumptions in python-SmartFire2

- Wildfire month assumptions
  - AZ/CA/NV/NM: Jun-Aug
  - OR/WA/ID/MT/CO/UT/WY: Jul-Sep
- 2023 beta guestimate on HMS detects
  - Raw detects: 8196303
  - After anthro-filter applied: 8162414
  - After duplicates removed: 5198442
  - After non-US (FIPS=99999) records removed: 731207
  - After Flint Hills removed: 701794 (input into pySF2)