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CONCEPTUAL MODEL FOR FIRE DATA PROJECT - CORE SCIENCE TEAM MEETING #1

DATE: February 1, 2021

TIME: 3:00-5:00pm MST

LOCATION: Zoom Meeting Room

ATTENDEES: Matt Mavko, Tom Moore, Dave Randall, Klaus Scott, Farren Herron-Thorpe, Andrew Kirsch, Mark Fitch, Sara Strachan, Anny Huang, Sarika Kulkarni, Jeremy Avise, Mark Hixson, Robert Kotchenruther, Lyndsey Boyle

	AGENDA ITEMS	PRESENTER	TIME ALLOTTED
1	Welcome, self-introductions	Tom Moore	10 Minutes
2	Purpose of CST and project – timeline/outcomes	Dave Randall	10 Minutes
3	Core Science Team-building roundtable	Tom Moore (facilitator)	25 Minutes
4	Breakdown of building the Conceptual Model of Fire Data	Matt Mavko	10 Minutes
5	Core Science Team roundtable open discussion	Matt Mavko (facilitator)	25 Minutes
6	Next Steps and Meetings	Tom Moore	10 Minutes

	NEW ACTION ITEMS	RESPONSIBLE	DUE DATE
1	Create a bullet list of all fire data you use. E.g. types of Fire EIs you create, what types of data fields do you need, and where you get data from (create case study examples)	Core Science Team	February 16th
2	Identify SMEs in the field; potentially on emission factors and best practices/definitions of when to use which. Susan O'Neil was suggested for EFs.	Core Science Team	February 16th
3	What data can be brought together in a warehouse to make your job more efficient?	Core Science Team	February 16th
4	Send suggestions, future edits, and additions to the Whitepaper to Tom [Tom will send whitepaper in Word format so folks can leave comments/revisions]	Core Science Team	February 16th
5	Air Sciences will follow up with notes, questions, reading materials or action items for folks	Air Sciences/WRAP	February 16th
6	Air Sciences will further develop the model to include different levels and scales	Air Sciences/WRAP	February 16th
7	Identify the best existing fire activity/emissions resource	All	February 16

	NEW ACTION ITEMS	RESPONSIBLE	DUE DATE
8	Identify the regional extent and starting year for this project	Air Sciences/WRAP	February 16

	UPCOMING MEETINGS	DATE AND TIME
1	Core Science Team Meeting #2	February 16, 2021, 3:00-5:00 PM MST
2	Core Science Team Meeting #3	March 1, 2021, 3:00-5:00 PM MST
3	Core Science Team Meeting #4	March 29, 2021, 3:00-5:00 PM MST

	FIRE DATABASES & RESOURCES DISCUSSED	LINK
1	SPECIATE	https://www.epa.gov/air-emissions-modeling/speciate
2	IRWIN	https://www.forestsandrangelands.gov/WFIT/applications/IRWIN/index.shtml
3	FFT (Fuel and Fire Tools) FCCS (Fuel Characteristics Classification System) CONSUME	https://www.fs.usda.gov/pnw/tools/fuel-and-fire-tools-fft [includes FCCS and CONSUME now]
4	LF (LandFire)	https://www.landfire.gov/fccs.php
5	FINN (Fire INventory from NCAR)	https://www2.acom.ucar.edu/modeling/finn-fire-inventory-ncar
6	CALFIRE	https://www.fire.ca.gov/
7	InForm	https://in-form-nifc.hub.arcgis.com/
8	GEOMAC [no longer supported]	https://www.geomac.gov/
9	BlueSky Playground	https://tools.airfire.org/playground/v3/emissionsinputs.php
10	MODIS	https://fsapps.nwcg.gov/afm/activefiremaps.php
11	FOFEM (First Order Fire Effects Model)	https://www.firelab.org/project/fofem-fire-effects-model
12	NEI (National Emissions Inventory)	https://www.epa.gov/air-emissions-inventories/national-emissions-inventory-nei

Meeting Notes

Pre-Meeting Discussion

- Objective of the Core Science Team is to produce a spec sheet of data requirements needed to produce an annual fire EI for the WRAP states. The overall objective of the project is to put in place the components (data sources, calculation methods, metadata standards) needed to produce an annual fire EI, and a distribution mechanism for the output. (Sara)
- Expand the scope to include methods that aren't based on the Acres/Consumption/EFs assumption. Having a pathway for pile burn permits (Tons burned/Combustion Completeness/EFs) and HMS-only detects (FRP/EFs) would also be valuable.

Fundamentally they all have activity data, scaling factor, and pathway specific EFs; but would differ in their data elements and calculation pathway. (Farren)

Core Science Team

- **Klaus Scott,** CARB, Background in Emission Inventory for fires
- **Andy Kirsch,** National Park Service, Geospatial analyst
- **Sara Strachan,** Idaho DEQ, Senior Analyst in Tech Services, GIS and remote sensing, wildfire response
- **Farren Herron-Thorpe,** Washington State Department of Ecology, Background in remote sensing and air quality modeling, calculating fire emissions in BlueSky, and emission Inventory work and forecasting

Outline and Overview (Dave Randall)

- We are trying to answer the question of "What do Primary Stakeholders need on a sustainable, long-term, cost-effective basis?
    - Essential fire emission inventory products and services that are based on a consistent set of standards for quality and metadata.
- The objective of the core science team (CST) is to develop a spec sheet to produce and annual fire EI for the WRAP states. To put in place the components needed to produce an annual fire EI (data sources, calculation methods, metadata standards), and a distribution mechanism for the output
- 3 Core Principals
    - Fire does not have a rigorous data quality standards and metadata requirements for EIs like other source categories do
    - Stakeholders have a critical need for these fire EI products and services
    - The fire EI products and services need **long-term** support for consistency and continuity
- The CST will develop a detailed and technically annotated list of the essential fire inventory products and services for Primary Stakeholders
- Identify a technical barrier free path to develop the essential fire EI products and services that will be accessible for the long-term
- History of WRAP's Fire EIs
    - July 1996 wildfire EI – model spin up and performance (one month)
        - Basic EI equation: Activity (acres x fuel loading) x EF
    - WRAP Annual 2002 Phase 1 & 2 Fire EIs (regional modeling for RH SIPs)
        - Added Fire Growth per Day, Smoldering
    - Annual 2014 Base Year Fire EI (5-Year period "representative year")
        - Used gridded fuel beds
        - Used CMAQ's plume rise algorithm

- Quantitative Approach to Determine EI Levels Based on Data Uncertainty of Data Element Categories
    - Table 1 from Whitepaper
    - The EI Level denotes the amount of effort required to get input data (Level 3 meaning best quality, but hardest to obtain potentially)
    - If uncertainty values are too hard to determine, we can deal with relative uncertainty
    - CST will determine an essential EI Level (quality) that the conceptual model must deliver; a minimum level of quality that must be met
- Project & Timeline overview
    - CST Virtual Meetings: 3 or so meetings over the next couple of months
        - Informed by input from Subject Matter Experts (SMEs) along the way. Identify, evaluate, and qualify data elements necessary for the fire EI
    - Draft the Conceptual Model for Fire EI
    - Identify options for a distribution mechanism for the Conceptual Model
    - Stakeholders Virtual Meetings (2)
        - Refine the Conceptual Model
        - Supports ways to resolve technical barriers to the Conceptual Model
        - Refine the options to deliver and sustainably support the Conceptual Model
    - **Looking for immediate input from CST; identify SMEs**

Core Team-building Discussion (facilitated by Tom Moore)

- Guiding Questions
    - Are there subject matter experts we should bring in?
    - Are there lessons learned that we should consider?
    - Are there experiences we are missing?
    - What are your initial thoughts in this endeavor?
- Klaus Scott
    - Have been using off-the-shelf activity data, modeling tools to get the work done in CA, like the GeoMAC system [no longer exists]
    - CA has pretty good in-state data from forestry department & spatial science unit with a geoscience dataset on wildfire and prescribed burning
    - Fuel maps (FCCS) [Fuel Characteristics Classification System]
        - LANDFIRE (LF) products [includes FCCS grids and a disturbance grid]
    - Fuel Moisture
    - Grid map products from U of Idaho
    - Disturbance datasets
    - Greenhouse Gas inventory
    - FINN (Fire INventory from NCAR) products for regions near other states

    - Wildfire mapping datasets are usually good quality – CALFIRE releases fire map in April for the past year
    - Prescribed burning is a little less quality because it varies by land-owner (publicly-owned lands are usually more detailed than burns done on privately-owned land)
    - Most of Fire EI work is historical & retrospective, not typically done for wildfires currently happening
    - Different type of Fire EI for fires that are currently active
        - Would need fire perimeter data
    - Interested in a **Regional-scale Fire EI** due to downwind emissions from other states
- Andy Kirsch
    - Fire perimeter data – variation in the quality of data
    - Remote sensing data we can get more than once per day, but it is usually not as accurate
    - Can get surveyed data from folks in the field that is much more accurate but not as often (about once a day)
    - Size of fires & fuel products; some fuels are not picked up as well as others (lighter fuels vs heavier fuels)
        - Some of the lighter fuels are not picked-up by heat detects
        - MODIS can be used in a grid nature but spatial resolution is usually not fine enough; it can be helpful in places without access like in Alaska
        - Satellite-based anomaly detection
    - Improve upon GEOMAC data (no longer used) for an annual basis
    - Would be great to have a single source for current year data and historical data
    - Fire reporting team does not keep track of metadata for remote sensing data
    - As the fire progresses, there is access to incrementally improved data
        - Operational, more frequent than daily, perimeter data gets stored and later gets archived
        - Once the fire is over, the manager for the fire unit will finalize the Final Fire Perimeter
- Mark Fitch
    - Mapping perimeters with unburned islands would be useful
    - CALFIRE only shows final fire perimeter
- Sara Strachan
    - Experience in working with exceptional events
    - There is a need for activity type to be divided between wildfire and prescribed burns and agricultural/rangeland burning
    - We do not produce annual fire EIs in Idaho
        - If we are working on a SIP, we do put a lot of work in a specific area
    - Uses NEI but quality of data is a concern
    - BlueSky provides a regional snapshot of time period emissions

    - Would be interested in a **Regional-scale Fire EI due to downwind emissions from other states** (Idaho is a downwind state)
    - Has knowledge and experience in gathering current vegetation data
    - Fuels data are available, good quality, and ready for use but are outdated
    - FRP data – certain satellites are better for location and others are better for heat signatures; sometimes using a combination of satellites will get you the best product
    - Potentially bring in SMEs on emission factors, which are the best one to use and how to evaluate their quality
    - Susan O'Neill has a new website that has compiled newest Emission Factors
    - SME in Montana may be a good resource (no name given)
- Farren Herron-Thorpe
    - Should we look at it more like the SPECIATE database?
    - Maybe we do not bother to calculate emissions; instead, provide a list of emission factors with detail about them
    - Raw activity data is more useful than a final product that has been manipulated
    - Show an example of data flow and methodology
    - Prescribed burn and Ag fire
        - Are we using remote sensing data or just permit data?
        - Are there weather conditions to consider?
        - Are we just doing WRAP states?
    - Input data varies from state to state or across country
    - Reconciling multiple data sources
        - Hourly data – might be not worth chasing. Use start and end time only
        - Get perimeter data
        - Include plume rise and data needed for plume calculation
    - Are we are trying to have something to continuously roll out on an annual basis? Need to determine starting year
    - Need to define regional/spatial scale as well
    - Is available to help with data needs

Breakdown of building the Conceptual Model of Fire Data (Matt Mavko)

- Table 2 from Whitepaper
- Work done for the CONSUME (fuel consumption model) has a probability-based fuels database
- As you move from left to right in the table; we move to more complexity and potential accuracy
    - More complex data elements do not necessarily improve answers though
- What are our chosen metrics for our domain?
    - Event Information – Time and Space

    - Activity Information – metadata about the burn; acres, burn type, burn class, fuel type
    - Consumption and Emissions – Fuel amount and Multipliers
- Will need to work through combination/configuration of parameters selected
    - Can we tease apart the product vs what the product delivered so that we are not dependent on software/resources?
- Identify certainty associated with each level
- Identify a certain level of quality needed for EI; Can we produce that annually? How big of a lag do the datasets have?
    - Datasets may not be available until a while after the burn
- Need to keep investigating to see what is possible and cost-effective in a timely manner
- This table is a first stab/example of the types of parameters but is not yet flushed out

Feedback from Core Team

- Farren Herron-Thorpe
    - Maybe there are separate tables for pile burns or other non-acre based fires?
    - Table 2 includes a lot of data – there may be fires where we do not have data for each category
    - Should we make a simple pathway? And then a more complex pathway?
- Matt Mavko
    - We may need to create some sort of baseline for minimum data needed for EI
    - Can we have prebuilt spatial layers with information (land-owner, land-use type, vegetation, etc.)?
        - Needs to account for seasonal – HMS detects in ag land in July or September could be wildfire (Farren)
    - Will need to interpret HMS detects to get what likely happened there. e.g. Burn piles vs understory burns
- Sara Strachan
    - Perhaps we think of the final product as different modules
        - Perhaps a data warehouse to store dataset options (Tom Moore)
    - There are instances when doing EI where we just need acres affected
    - Need to account for all small-scale and large-scale applications and needs
    - The table can be used to help folks get the best EI possible with the data and time-constraints they have
- Andy Kirsch
    - In agreement with having a data warehouse with pros and cons about each one for stakeholders to understand
    - End date has been notoriously difficult to pin down; some agencies are hesitant to declare the fire out

    - Growth Cessation Date: When the fire stops growing. Trying to capture the date when the fire stops growing/was the largest. 2020 is the first year trying to get this data [How do we account for continued burning in the perimeter?]
- Klaus Scott
    - In agreement with the data warehouse approach
    - Somewhere easily accessible so that adjacent states can easily access
    - Detail on metadata for each dataset
    - Would add Fuel Moisture to the table
    - Have had difficulty pinning down the fire end-date; usually is the date it was contained
        - Barrier to accurate dire activity data: Managers do not declare fire "out" because of operational/incident funding sources stop.
    - Would like to have more information on smoldering emissions. How long to extend emissions from smoldering?
    - For our EI products consider the following **fire life stages:** start date, growth, contained, growth cessation date, out, smoldering
    - Maybe there is room for machine learning to tell us if a burn is prescribed or not
    - Maybe we should develop land use parameter? Mixed land use vs forest?
        - EPA is trying to better understand Toxics associated with combustible structures [Is this within our scope?]
    - Need to make decision for our products wrt Wildland-Urban Interface fuel models (that could include ag (e.g. vineyards, orchards), structures, toxics).
    - Model should account for **regional and temporal (seasonal) profiles** to assess remote sensing data/fire detects and assign events to WF or Rx fire. Profiles could change from year to year depending on drought conditions.
- Mark Fitch
    - Caution surrounding double counting fires. E.g. fires get named two different names by different jurisdictions
    - Consider: How do you handle EIs when fires merge?
- Andy Kirsch
    - IRWIN – system for fires to eliminate risks for double counting
        - Flag second fire that comes in with similar geo location and information
        - Mark the duplicates as invalid
    - Double-counting has been an issue for historical data and have been working to minimize for years
    - Fires that merge together
        - Incidents are managed together as a complex
        - Should include a metadata field to identify fires as a complex
        - Incident category – users would mark as a complex
        - Being tracked in IRWIN currently and this past year
    - Would be nice to include Fire Names in a database