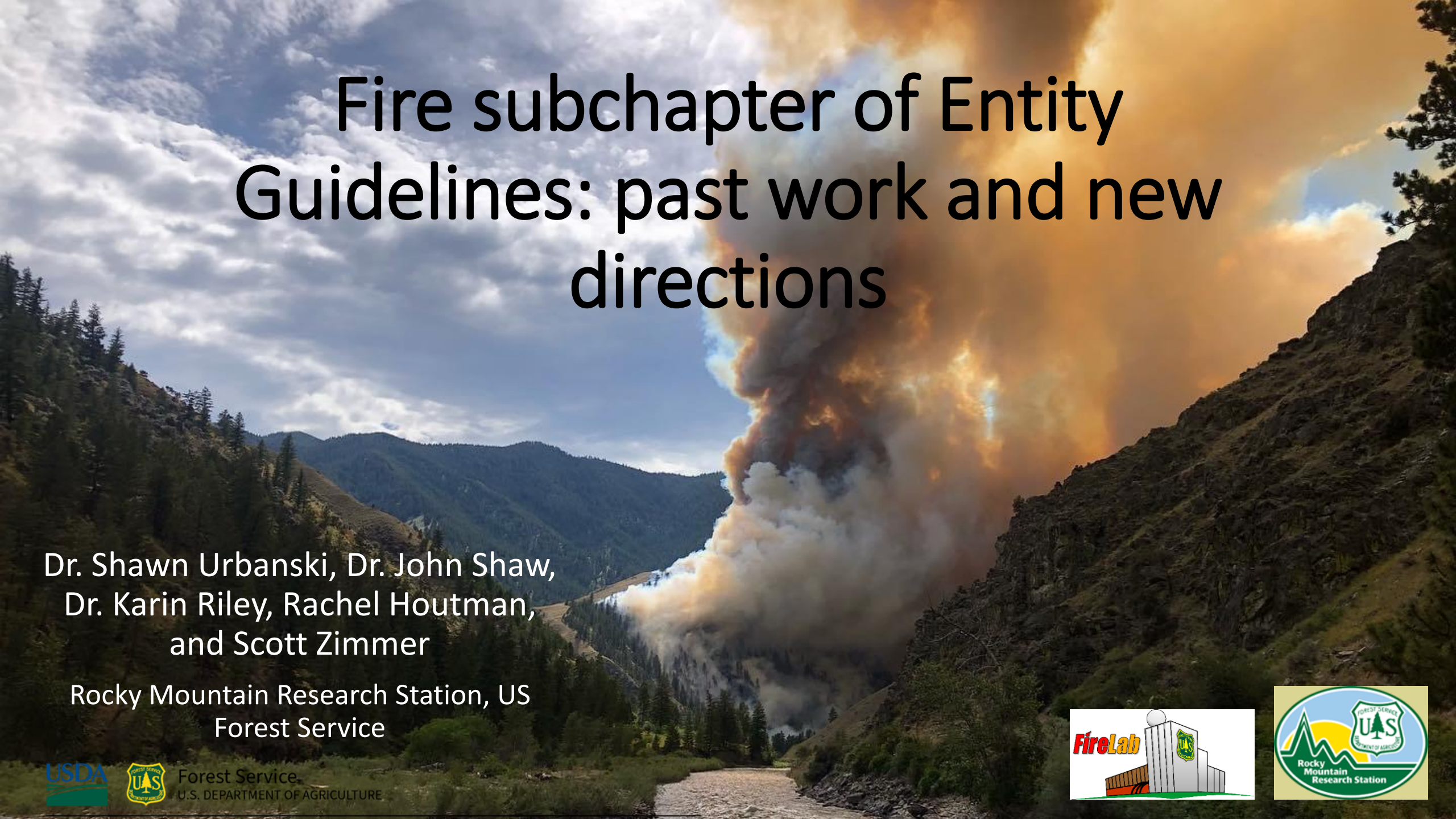
Fire subchapter of Entity Guidelines: past work and new directions



Dr. Shawn Urbanski, Dr. John Shaw, Dr. Karin Riley, Rachel Houtman, and Scott Zimmer

Rocky Mountain Research Station, US Forest Service

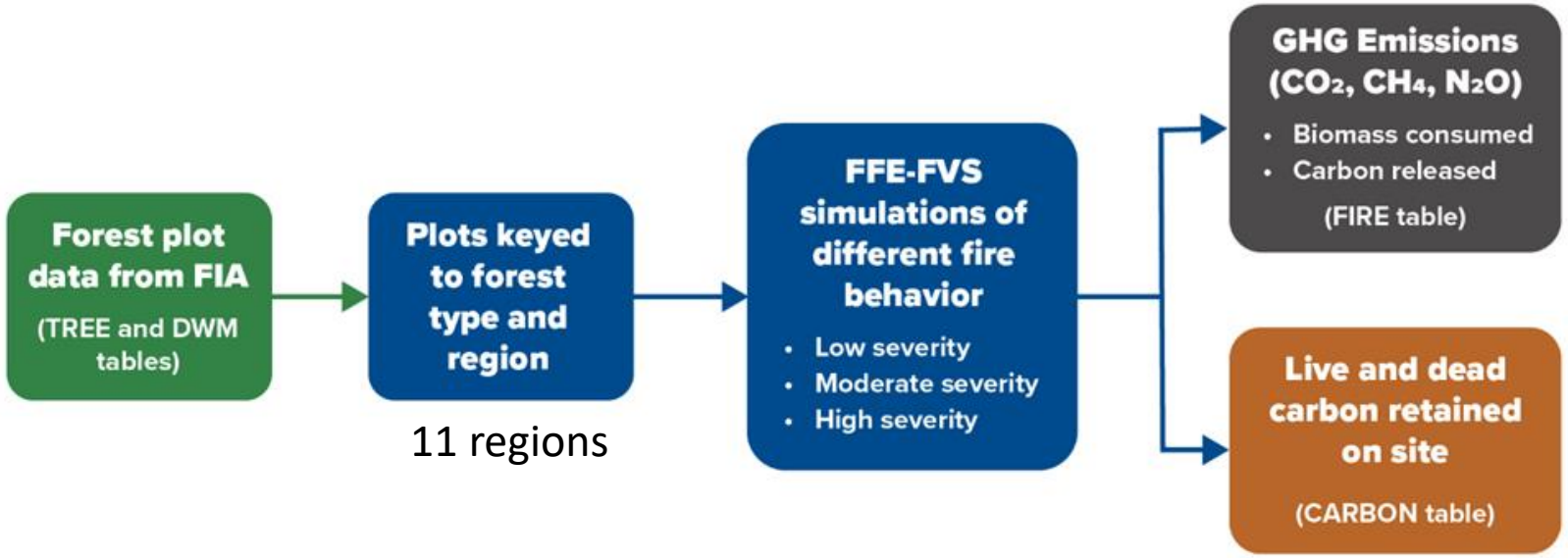
USDA Forest Service
U.S. DEPARTMENT OF AGRICULTURE

Level 1 approach from 2022 update of the USDA's 2014 report *Quantifying Greenhouse Gas Fluxes in Agriculture and Forestry: Methods for Entity-Scale Inventory*

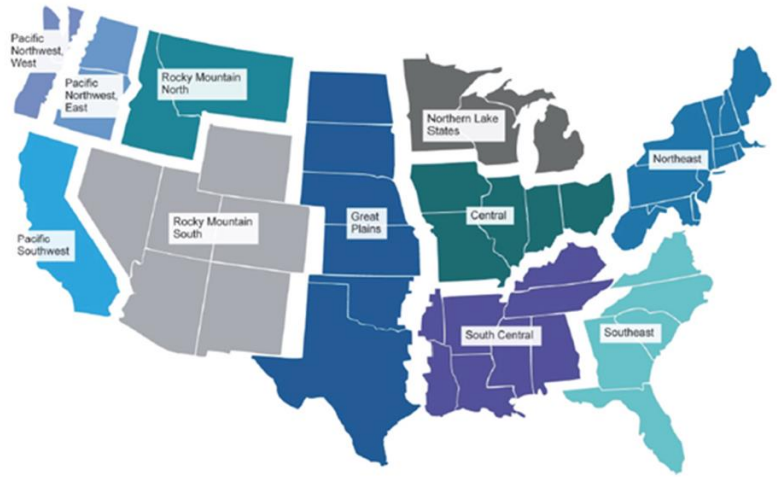
- Objective: provide methods and guidance on estimating greenhouse gas (GHG) emissions and carbon removals associated with entity-level activities in managed forest systems, including wildfire and prescribed fire.
- Timeline for *fire subchapter* completion was 3-4 months, and approach was thus simple
- Our contribution was limited to direct GHG emissions from consumption of live and dead fuels

2022 Level 1 method summary for fire

- Leveraged field data from Forest Inventory and Analysis (FIA) to establish pre-fire pools
- Two main sectors that produce smoke emissions:
  - **Litter, duff, and down dead wood biomass: DWM (Downed Woody Material)** Table
  - **Live and dead trees: TREE** Table — records of individual tree species, diameter, height and status (live or dead)

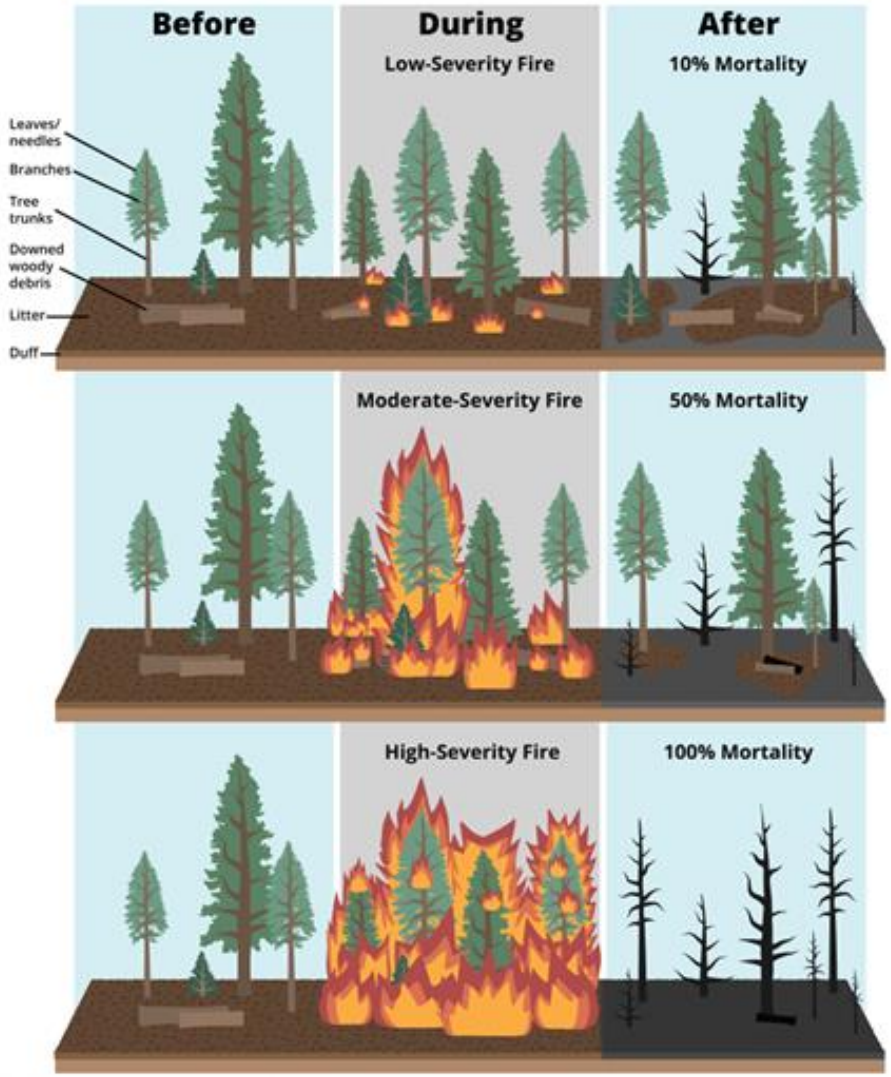


- GHG emissions (CO2-eq) calculated as product of fuel consumption and emission factors



2022 Level 1 method summary for fire

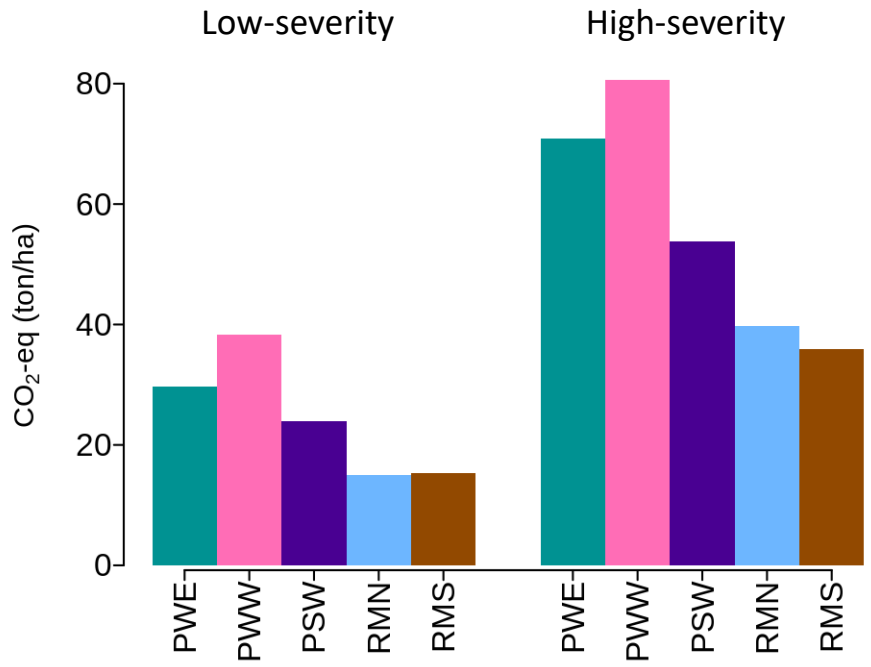
- Ran FFE-FVS for 49,000 FIA plots for the 5 fire schemes = 245,000 runs
- Extract simulation results satisfying fire severity categories, sometimes tuning burn conditions to meet the severity criteria
- Aggregate runs by fire severity, forest type group, and region



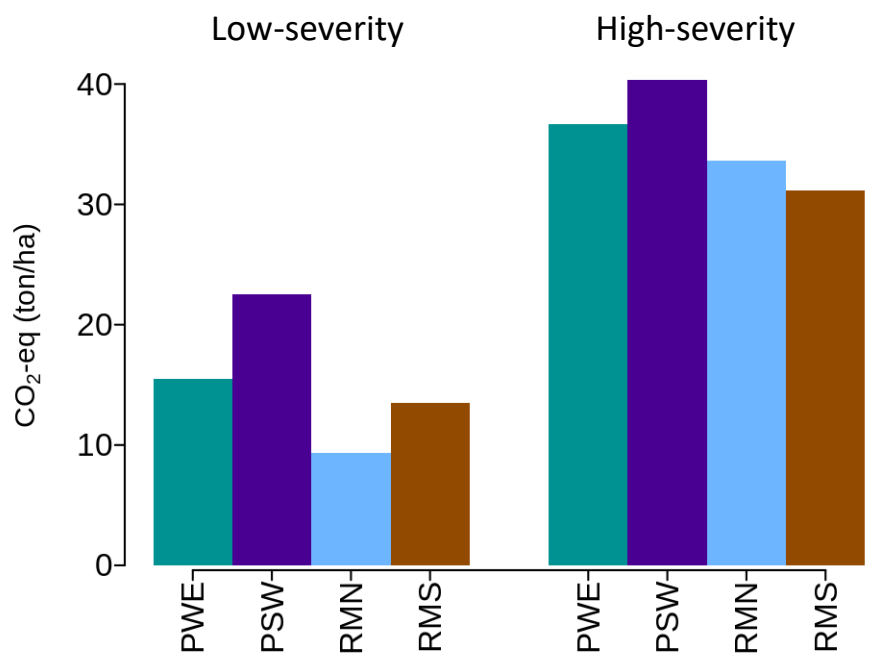
Fire Activity	Description
Low-severity wildfire/prescribed fire	< 20% tree mortality
Moderate-severity wildfire	40–60% tree mortality
High-severity wildfire	>90% tree mortality

2022 Level 1 results for fire: variation across forest type and region

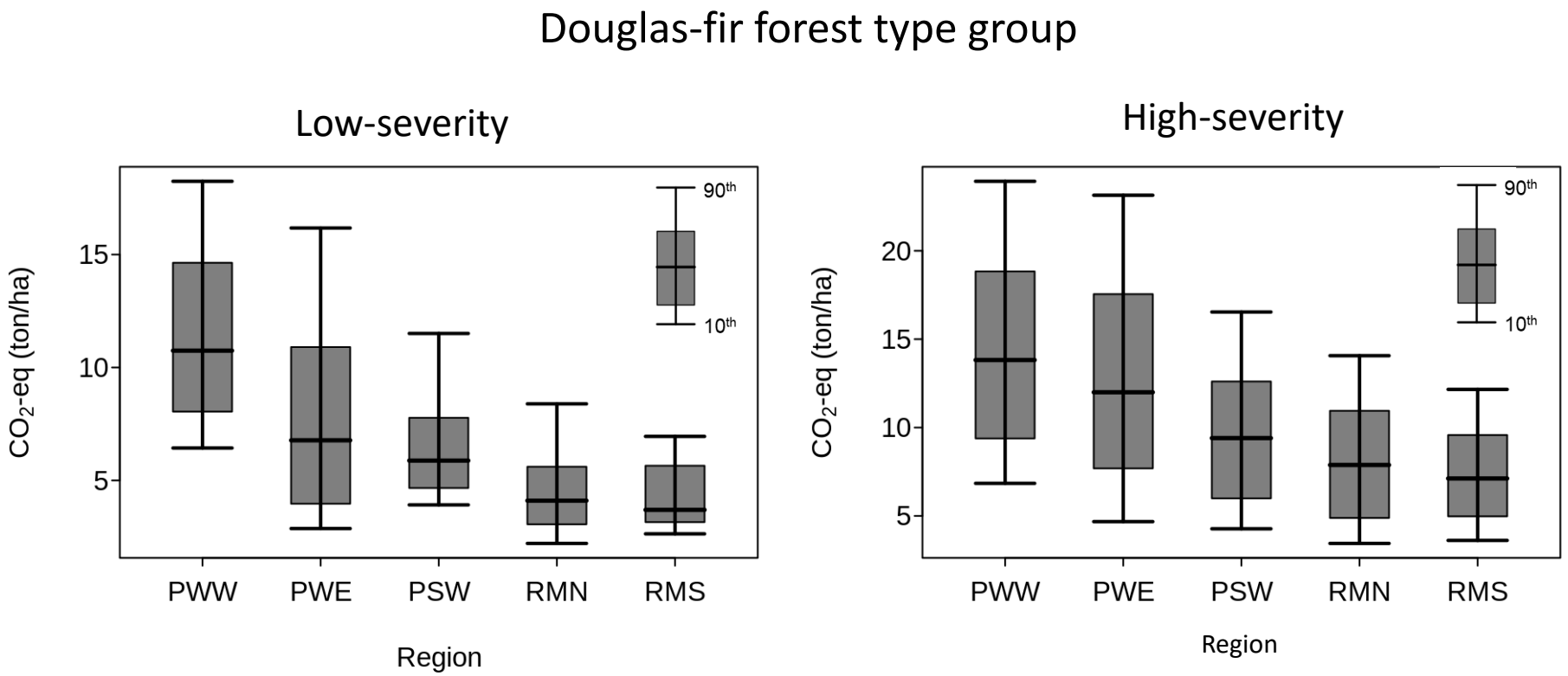
Douglas-fir forest type group



Ponderosa pine forest type group

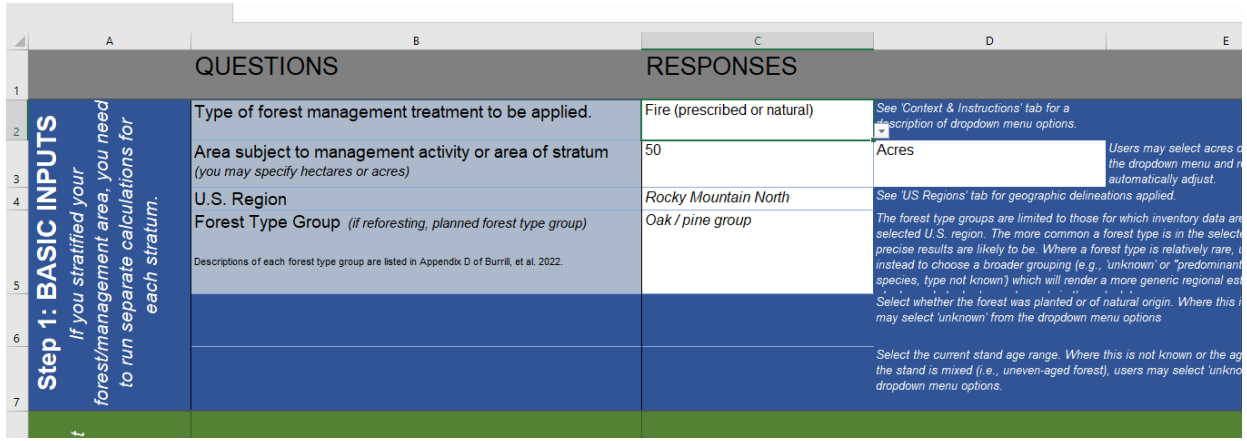


2022 Level 1 results for fire: uncertainty and variability



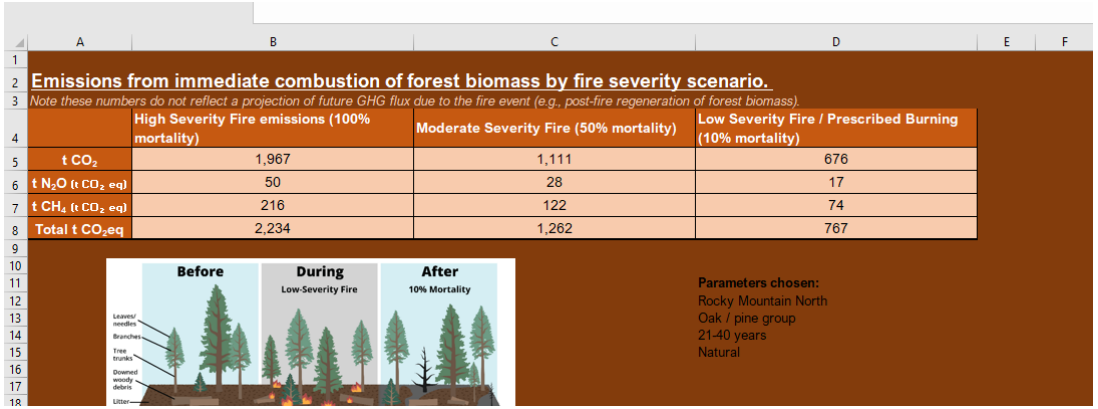
2022 Level 1 results for fire: how to use Excel workbook

USER INPUT



	QUESTIONS	RESPONSES	
Step 1: BASIC INPUTS *If you stratified your forest/management area, you need to run separate calculations for each stratum.*	Type of forest management treatment to be applied.	Fire (prescribed or natural)	*See 'Context & Instructions' tab for a description of dropdown menu options.*
	Area subject to management activity or area of stratum *(you may specify hectares or acres)*	50	Acres *Users may select acres or the dropdown menu and automatically adjust.*
	U.S. Region	*Rocky Mountain North*	*See 'US Regions' tab for geographic delineations applied.*
	Forest Type Group *(if reforesting, planned forest type group)*	*Oak / pine group*	*The forest type groups are limited to those for which inventory data are selected U.S. region. The more common a forest type is in the selected precise results are likely to be. Where a forest type is relatively rare, instead to choose a broader grouping (e.g., 'unknown' or "predominant species, type not known') which will render a more generic regional est*
	Descriptions of each forest type group are listed in Appendix D of Burrill, et al. 2022.		*Select whether the forest was planted or of natural origin. Where this i may select 'unknown' from the dropdown menu options*
			Select the current stand age range. Where this is not known or the ag the stand is mixed (i.e., uneven-aged forest), users may select 'unkno dropdown menu options.

RESULTS



Emissions from immediate combustion of forest biomass by fire severity scenario.

Note these numbers do not reflect a projection of future GHG flux due to the fire event (e.g., post-fire regeneration of forest biomass).

	High Severity Fire emissions (100% mortality)	Moderate Severity Fire (50% mortality)	Low Severity Fire / Prescribed Burning (10% mortality)
t CO_2	1,967	1,111	676
t N_2O (t CO_2 eq)	50	28	17
t CH_4 (t CO_2 eq)	216	122	74
Total t CO_2eq	2,234	1,262	767

Parameters chosen:
Rocky Mountain North
Oak / pine group
21-40 years
Natural

- Type of forest management treatment – 'Fire (prescribed or natural)'
- U.S. Region (from drop-down menu)
- Forest Type Group (from drop-down menu)
- Planted or natural forest origin
- Age class

- Tons of CO_2, N_2O, and CH_4 as CO_2-eq
- Reported mean for low, moderate and high severity fire

USDA Forest Service
U.S. DEPARTMENT OF AGRICULTURE

Excel Workbook created by Andy Lister, USDA Forest Service

Main advantages of the approach

- Tractable during short time limit for project
- Leverages field data
- Grouping by forest type, region, and severity allows some amount of specificity, as well as comparisons across these factors

Gaps

- Limited to *direct* GHG emissions from consumption of live and dead fuels and did not consider post-fire carbon fluxes:
  - Decay of trees killed by fire
  - Forest regeneration
  - Avoided wildfire emissions following fuel treatment via prescribed fire
- Did not compare treated and untreated stands
- Did not consider fire risk (i.e. probability of burning at various intensities)
- Was not explicitly spatial and did not allow summary by an Area of Interest or property boundary

Author contact:
Dr. Shawn Urbanski: shawn.p.Urbanski@usda.gov
Dr. John Shaw: john.d.shaw@usda.gov
Dr. Karin Riley: karin.l.riley@usda.gov
Rachel Houtman: rachel.houtman@usda.gov