International Emissions Inventory Conference

August 14, 2012

Tampa, FL

Comparative Fire Emissions Analysis: The DEASCO$_3$ Project and the EPA 2008 NEI

The Grand Canyon Visibility Transport Commission

- Fire is essential in the West
- Historic land management, climate have altered (worsened) fire events
- Fire is an episodic contributor to visibility-impairing aerosols
- All types of fire (not just large wildfires) are important

"Modeling indicates that, at certain times, increased visibility impairment from fire is likely to exceed the potential visibility improvements associated with other GCVTC recommendations"

The Grand Canyon Visibility Transport Commission

- All planned fire events (Rx and agricultural) must be addressed as part of a visibility protection strategy.
- Require all fire programs to incorporate smoke effects in planning and application.
- Implement a consistent emissions tracking system for wildfire, Rx and Ag burning.

"Modeling indicates that, at certain times, increased visibility impairment from fire is likely to exceed the potential visibility improvements associated with other GCVTC recommendations"

Fire Emissions Joint Forum (FEJF)

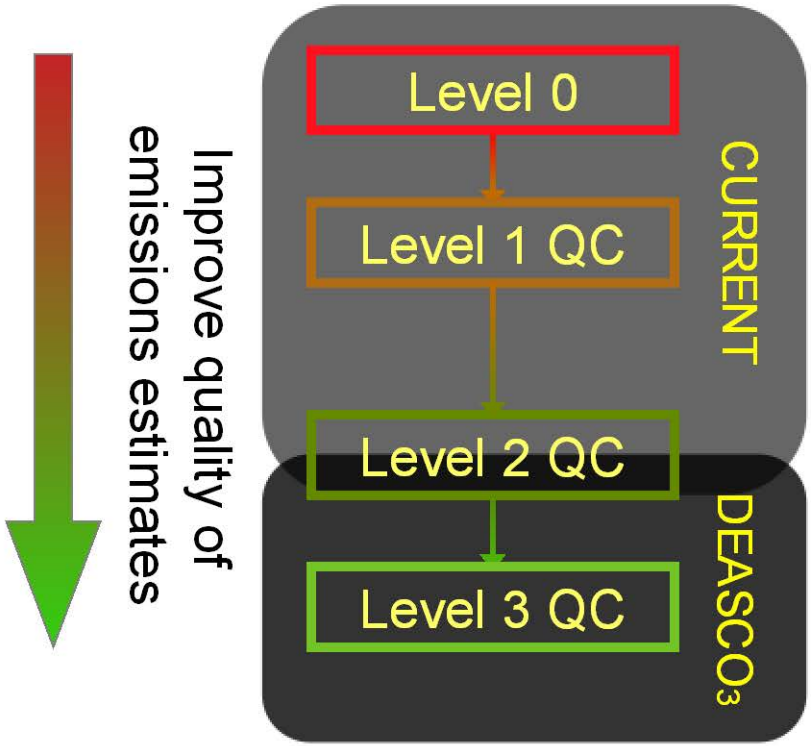
Formed to support the WRAP in implementing the recommendations of the GCVTC

Key Subject Matter Areas of the FEJF

1. Smoke Management Programs (SMPs)
   - Evaluate and enhance capabilities of SMPs to incorporate the addressing of smoke effects into prescribed fire programs.
2. Fire Categorization (Natural vs. Anthropogenic fire types)
   - Critical to interpret regional modeling results and to develop emission reduction strategies that improve visibility.
3. Fire emissions/assessment
   - Improve methods to gather/utilize fire activity data, estimate fuel loading and consumption, estimate emissions, and characterize fire emissions in regional modeling analyses. For use in retrospective air quality analyses (i.e., SIP-grade emission inventories).
   - Develop and implement a ***Fire Tracking System***: for real-time use by SMPs for regional coordination AND to produce SIP-grade emission inventories for retrospective air quality analyses.

Fire Emissions Tracking System

- Storage device for fire activity data
- Real-time information tool for SMPs
- Portal for all fire activity/emissions within WRAP modeling domain.

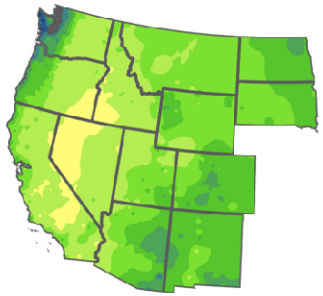


Source	WF	WFU	RX	AG	NFR	Last Submit	Domain
ICS-209	○	○	-	-	-	01/17/12	WRAP CONUS
AK	☑	☑	☑	N.D.	N.D.	11/23/11	State/Federal > 40 ac
AZ	-	-	☑	N.D.	N.D.	01/18/12	State-Wide
CA - PFIRS	-	-	☑	N.D.	N.D.	10/13/10	State-Wide
CO	-	-	○	N.D.	N.D.	04/07/12	State-Wide
Idaho DEQ	-	-	-	☑	-	04/12/12	State-Wide
MT - Agriculture	-	-	-	N.D.	-	No Data	State-Wide
MT/ID Airshed Grp.	-	-	○	-	N.D.	01/17/12	State/Federal Lands
ND	-	-	☑	N.D.	N.D.	06/27/11	State-Wide
NM	-	☑	☑	☑	☑	04/12/12	State-Wide
NV	-	-	N.D.	N.D.	N.D.	No Data	State-Wide
OR - Dept. of Forestry	-	-	☑	-	N.D.	12/14/11	Federal/State/Private
OR - Agriculture	-	-	-	N.D.	-	No Data	State-Wide
SD	-	-	☑	N.D.	N.D.	04/09/12	State-Wide
UT	-	-	N.D.	N.D.	N.D.	No Data	State-Wide
WA - DNR	-	-	☑	-	-	01/17/12	State-Wide
WA - Dept. of Ecology	-	-	-	☑	N.D.	01/17/12	State-Wide
WY	-	-	☑	N.D.	N.D.	04/09/12	State-Wide
Nez Perce Tribe	-	-	☑	○	N.D.	04/12/12	Nez Perce Tribal Land

Activity Data

Loading

Moisture

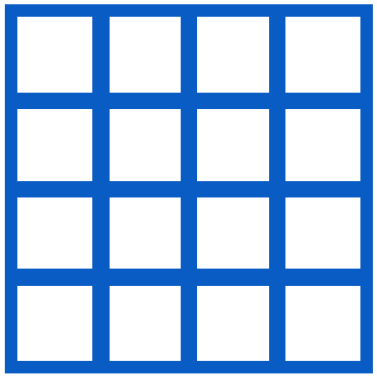


Emissions Model

FETS

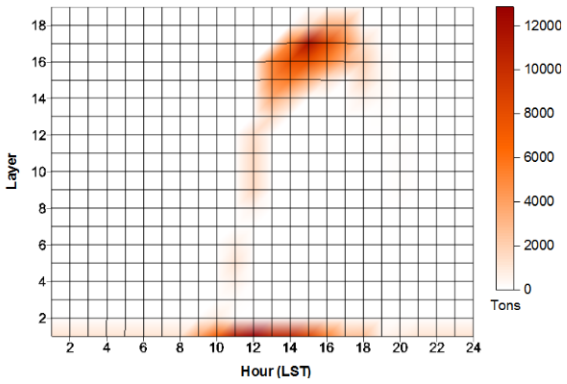
DEASCO$_3$

distribute emissions



Chemical Profiles

Loft emissions



Ozone and PM Fire Impacts

Deterministic and Empirical Assessment of Smoke's Contribution to Ozone (DEASCO3)

Activities

- Analysis of complex relationship between fires and elevated Ozone
- Describe how fires contribute to ambient Ozone concentrations
- National emission inventory development for wildland and agricultural fires in 2002-08
- Photochemical grid modeling with fire emissions source apportionment

Deliverables

- Online tool for FLMs to access results
- Collaborative review and analysis by NPS and USFS air program staff
- Documentation and summary reports of methods and results
- Evaluation of contributions to Ozone NAAQS violations and exceptional events

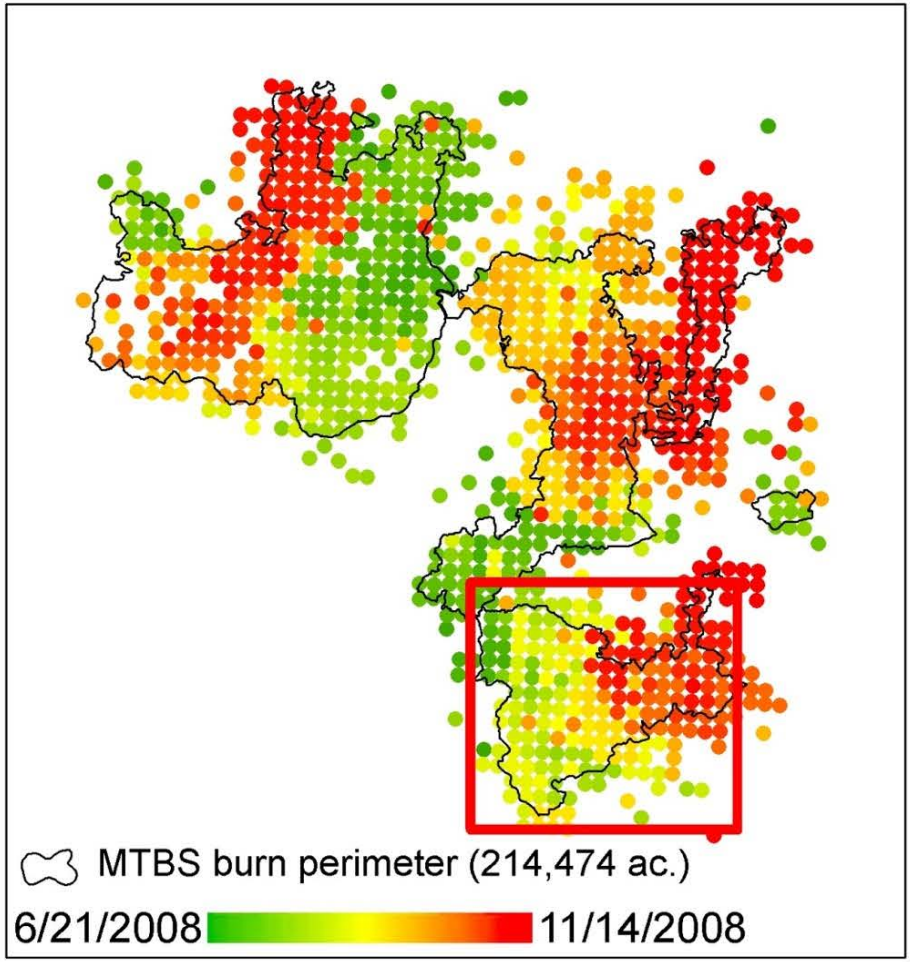
Particulate Matter Deterministic & Empirical Tagging & Assessment of Impacts on Levels (PMDETAIL)

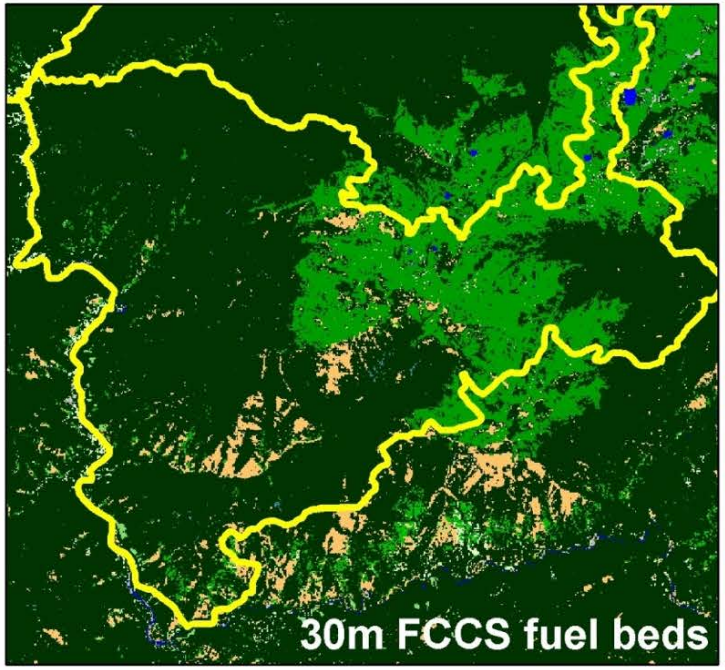
Activities

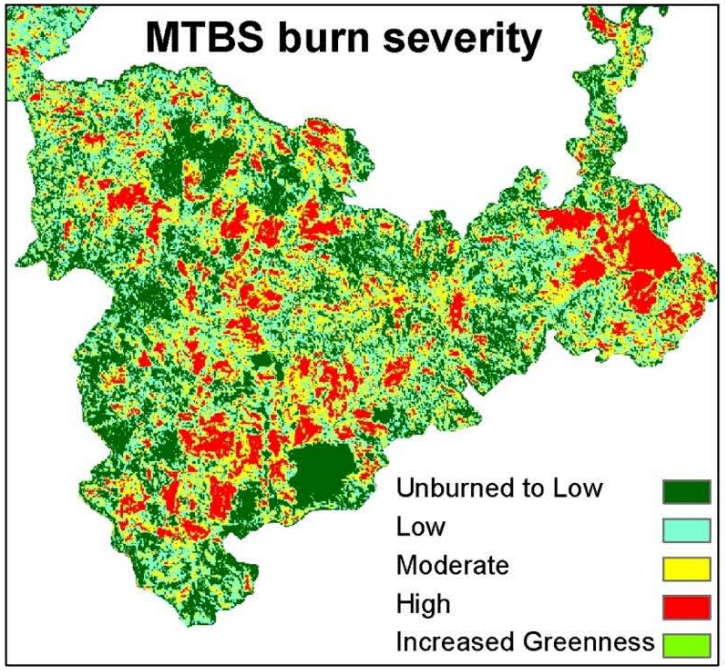
- Analysis of complex relationship between fires and elevated PM
- Describe how fires contribute to ambient PM concentrations
- National emission inventory development for wildland and agricultural fire for 2002-08-11
- Uses special additional emission inventory methods and ambient filter-based markers to track secondary organic aerosol formation and fire contributions to monitored PM
- Photochemical grid modeling with fire emissions source apportionment

Deliverables

- Online tool for FLMs to access results
- Collaborative review and analysis by NPS and USFS air program staff
- Carnegie-Mellon and Colorado State Universities' experts on air quality monitoring and modeling added to team
- Documentation and summary reports of methods / results
- Evaluation of contributions to PM NAAQS violations and exceptional events





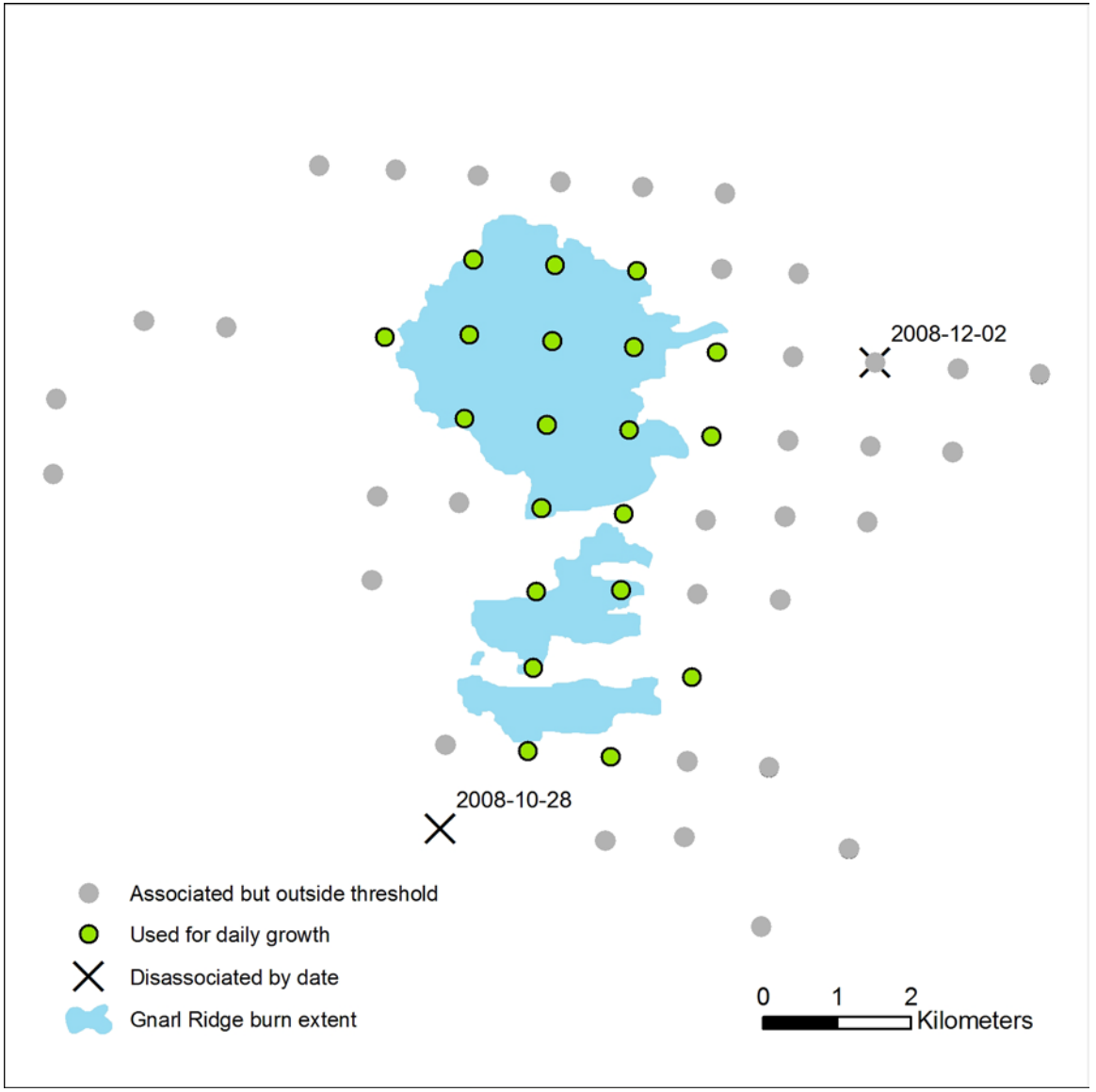


- Acres constrained by perimeter
- Daily growth & composite fuel loading
- Consumption scaled by severity

Data source / Processing step	2008 NEIv2	DEASCO$_3$
Ground-based Reports	ICS-209; FACTS	FETS (incl. ICS-209)
Satellite-based Data	HMS; MTBS	HMS; MTBS
Daily growth for large fires	SF2 algorithm; scale acres with MTBS	Associate HMS with MTBS. Burns not covered default to FETS.
Satellite data classification	Rx climatology, remainder WF	Reconcile with FETS; proximity; ownership
Satellite data size	Burn statistics by veg type from MTBS burn perimeters.	Avg size of nearby FETS burns; method for remainder undetermined.
Fuel Loading data	FCCS 1-km	FCCS-Landfire 30m
Fuel loading assignment	Not specified	Partition frequency of FCCS classes over burned area
Duff moisture	Based on 1000-hr moisture	Default value of 50%
Fuel moisture	Nearest WIMS station	Nearest WIMS station
Precipitation	Not specified	Grid cell within 6 km ≥0.25in from NWS precip analysis.
Canopy consumption	CONSUME defaults	MTBS severity
Shrubland blackened	Not specified	MTBS severity
Duff consumption	Max 20 t/ac in West, 5 t/ac in East for prescribed burns.	Default
Emission Factors	FEPS	CONSUME

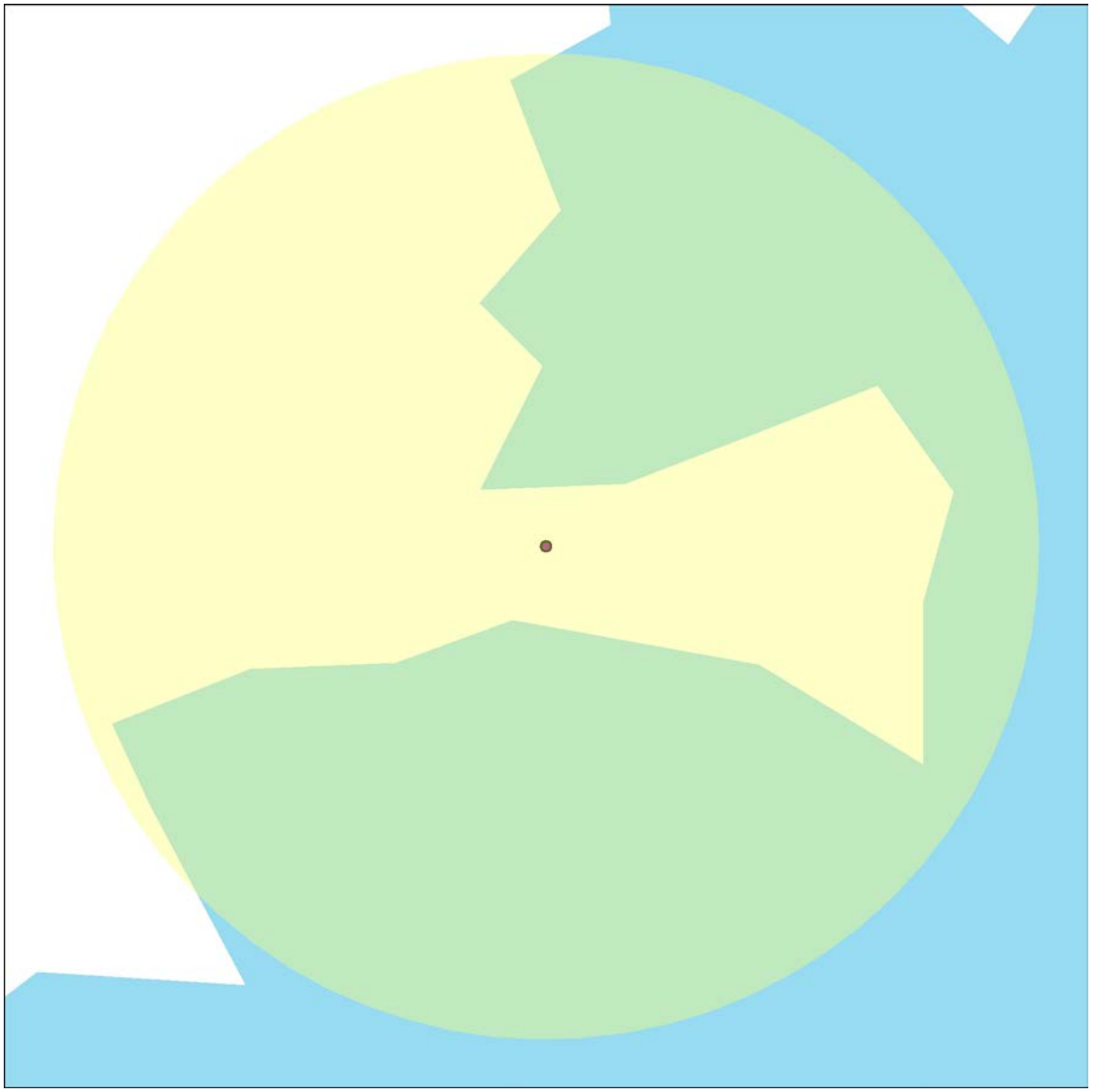
MTBS-HMS fire growth Pattern Identification

1. HMS detections are associated with an MTBS burn by proximity, then by timing
2. “isolated” detections, in space or time, are disassociated (black X’s)
3. Detections within 0.5km of the perimeter are used for daily growth (green circles)
4. All other detections are “associated” but do not count toward emissions or activity



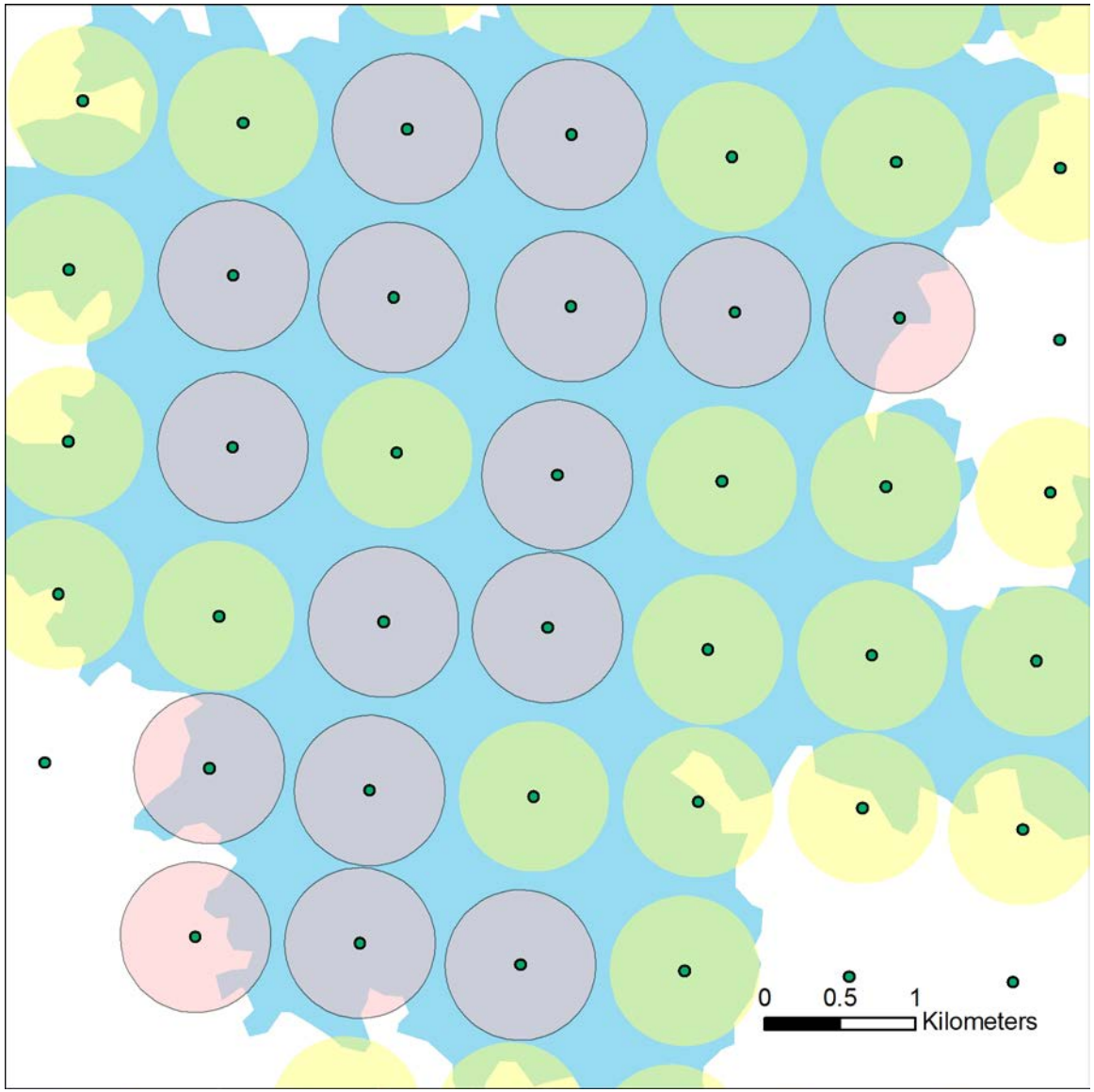
MTBS-HMS fire growth Pattern Identification

5. HMS detection (dot)
6. Detection buffer, 0.5km (yellow)
7. MTBS burn area (blue)
8. Area burned (green)
9. Area burned is used to identify frequency of vegetation types and burn severity



MTBS-HMS fire growth Pattern Identification

10. Daily Growth determined by date of HMS detections (purple, outlined circles)
11. MTBS area is divided by sum of HMS-MTBS intersections to determine scalar
12. Total daily acres burned are scaled to match MTBS area



Classification of remaining HMS Data

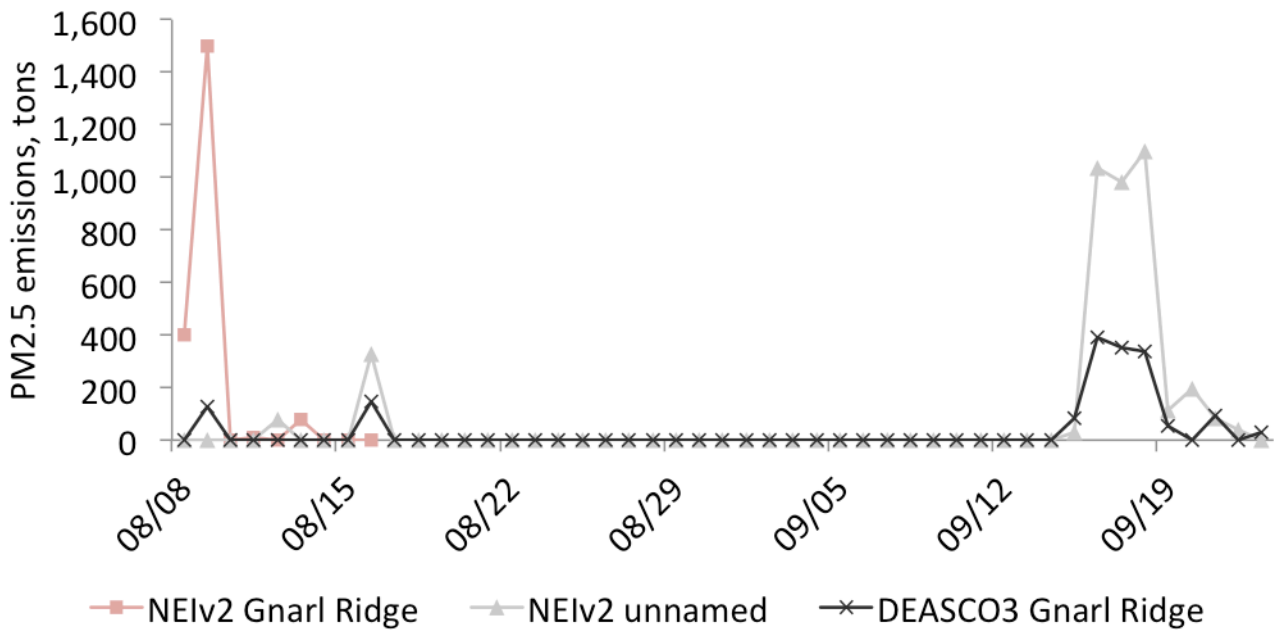
- Associate with ground-based reports based on proximity
  - Uncertainty of detection overlaps uncertainty of ground report
  - multiple detections do not influence size of ground report
- Search nearby in space in time, use median size and most frequent burn type.
  - +/- 2 weeks
  - within 50km
- Use permit records, monthly burned area totals to “train” detection size and type
- In areas with no reporting, use land ownership and vegetation type (SF2 or FINN)
  - Private land: Rx
  - Fed land or unknown: WF

Gnarl Ridge Fire Oregon

- Ignited in August 2008
- Lull in burning activity of several weeks
- Common wildfire size range (3,000 acres)

- NEIv2 method identifies additional burns
  - matches wildfire acres with MTBS
  - All wildfire burning in August

- $DEASCO_3$ method attributes all HMS data to wildfire
  - Misses some burn days
  - distributes acres across Aug-Sep

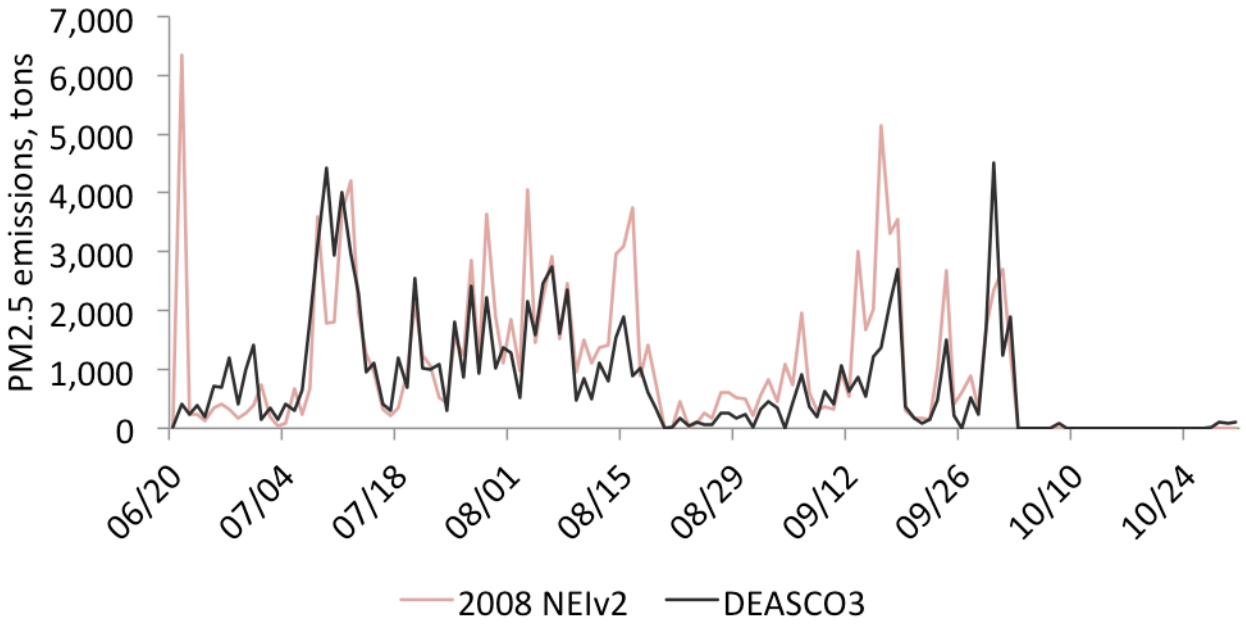


Inventory	Events	Total Area, Acres	PM2.5, tons	# burn days
NEIv2	31	10,494 (3,502)	6,008 (1,985)	16
$DEASCO_3$	1	3,497	1,614	10

Panther-Bear Wallow California

- Ignited in Late June 2008
- Burned continuously through September
- Complex of several wildfires (200,000+ acres)

- Pattern of activity similar across both inventories
  - NEIv2 attributes all of Bear Wallow to one day (6/21)
  - $DEASCO_3$ identifies burning into Nov.
- NEIv2 has 30% higher emissions
  - Differing patterns of vegetation
  - NEIv2 has higher canopy consumption

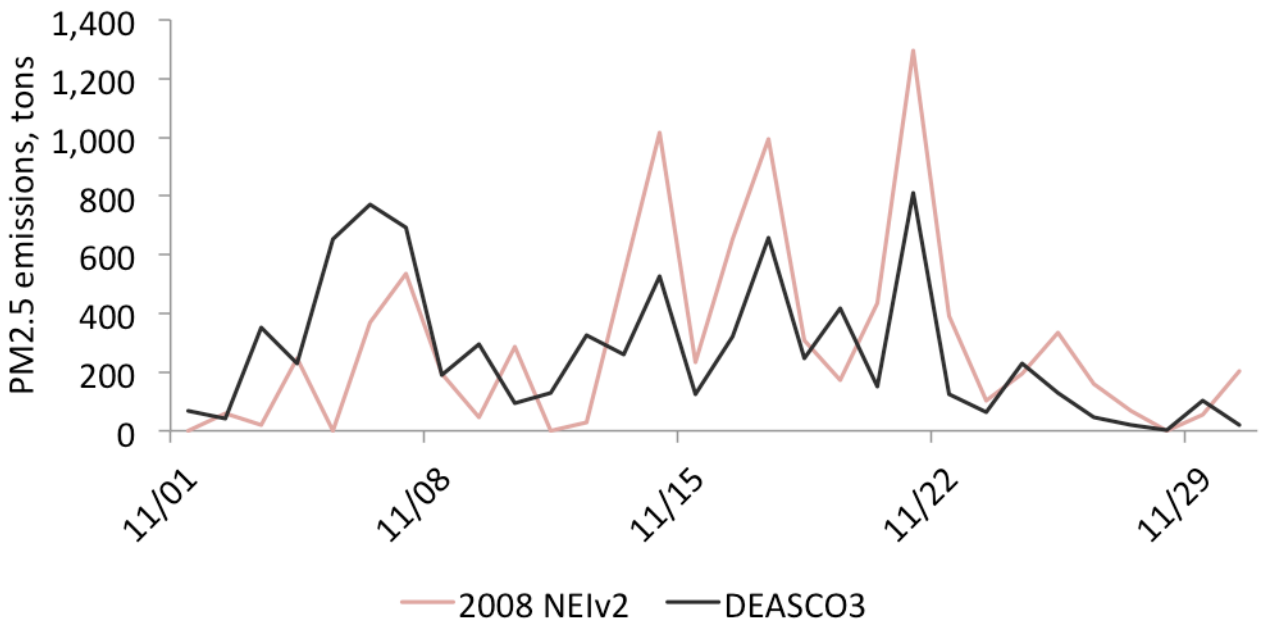


Inventory	Events	Total Area, Acres	PM2.5, tons	# burn days
NEIv2	2	227,388	133,515	103
$DEASCO_3$	5	227,560	105,568	109

Prescribed Burning, Nov. Southwest Oregon

- Region has active Rx season in autumn
- Frequent private burning is not tracked by SMP
- Much of the tracked burns are large slash piles

- $DEASCO_3$ inventory uses FETS, resulting in 50% more events then NEIv2.
- 79 HMS events overlapped FETS data
- NEI reports 37% more acres burned, 10% more emissions
  - Inventories show similar pattern of vegetation
  - Difference in emission rates come from moisture and consumption parameters.



Inventory	Events	Total Area, Acres	PM2.5, tons	# burn days
NEIv2	523	41,089	8,932	26
$DEASCO_3$	797	29,962	8,094	30

Implications

- Analysis of opportunity
- Temporal differences in activity and emissions
- Methodological differences in spatial analysis
  - how events are “lumped”
  - how a fire grows
- The two approaches may be appropriate for different applications
  - Air quality planning
  - Exceptional events
  - Year-to-year trends