Emissions from Prescribed Burning of Timber Slash Piles in Oregon

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History of Pile Burning

- Polyethylene (PE, black plastic) used to keep piles dry for burning in rain or snow.
- PE was to be removed prior to burning.
- PE inconvenient to remove so left on piles and burned – illegally.
- Smoke Management Review Committee commissions study (2003) to evaluate available literature to determine emission hazards from burning PE.

- Smoke Management rule change allowed maximum 100 sq ft, 4 mil size PE covering. Waiver for using multiple sheets allowed. 2008.

Previous Studies – PE Covered Piles

1. Lab study burning low-density PE (LDPE) of various mass ratios (0, 0.25%, 2.5%) with manzanita wood in a 2-kg mixture. Significant findings:
    - "LDPE does not add additional toxic compounds to burning wood."
    - "Inclusion of small proportions of low-density polyethylene in piled silvicultural debris does not appear to significantly change the emissions produced when low-moisture-content wood is burned."

2. Literature Review report. Significant findings:
    - "No studies have assessed emissions from silvicultural piles with and without a PE covering."
    - "No evidence that unique classes of chemicals are, or should be found in emissions from burning PE, in comparison to burning wood debris."

1. Hosseini et al. 2014. Effect of Low-density Polyethylene on Smoke Emissions from Burning of Simulated Debris Piles. Journal of the Air & Waste Management Association.
2. Wrobel and Reinhardt. 2003. Review of Potential Air Emissions from Burning Polyethylene Plastic Sheeting with Pile Forest Debris. URS Corporation, Seattle, WA.

Field Study Need

- Smoke Management Review Committee (2012-13) considers allowing using greater thickness and larger size of PE on piles.
- Building large piles and burning in strong winds necessitate allowing a larger size and greater thickness of PE than the current rule allows.
- Review Committee subcommittee determines based on landowner and land manager input that up to 60 percent of the pile needs covering for sufficient combustion to completely burn. Up to 400 sq ft, 6 mil PE size/thickness recommended.
- Department of Environmental Quality did not favor greater thickness or greater size committee recommendation of PE unless a field study demonstrated additional PE did not contribute significant additional emissions, and showed an emission benefit over burning wet, uncovered piles.

Field Study Goal

Characterize and compare emissions from burning large woody biomass piles, including:

- dry polyethylene (PE) covered piles
- dry uncovered piles
- wet piles

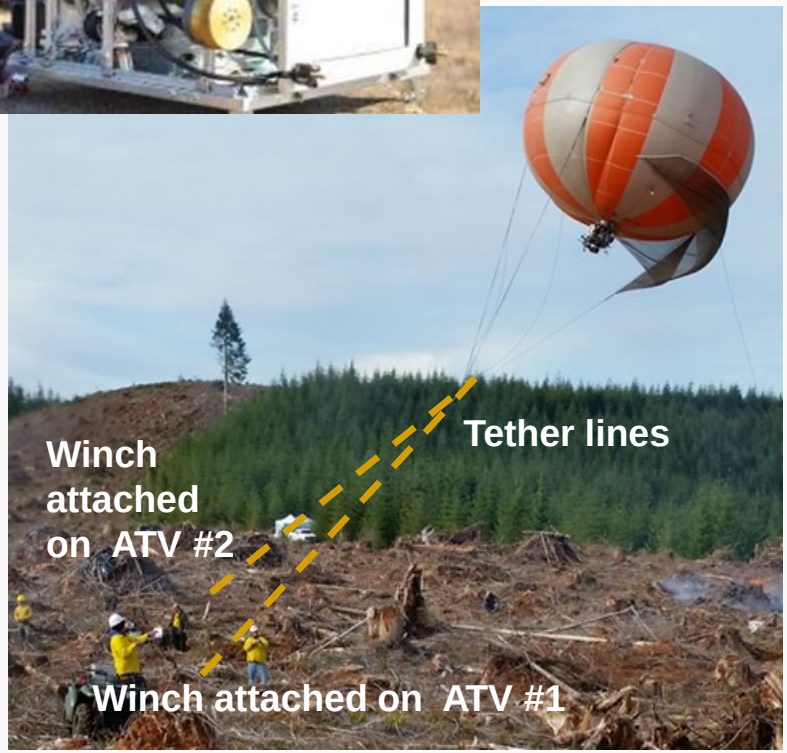
Test Matrix

Test Day	Test Order, Type, PE Size
Day 1	Burn 1: WET 01
	Burn 2: DRY, PE 6.1 × 6.1 m, 0.15 mm (20 × 20 feet, 6 mil)
Day 2	Burn 3: WET 02
	Burn 4: DRY, uncovered
	Burn 5: DRY, PE 3 × 3 m, 0.15 mm (10 × 10 feet, 6 mil)
Day 3	Burn 6: WET 03
	Burn 7: DRY, uncovered
	Burn 8: DRY, PE 3 × 3 m, 0.10 mm (10 × 10 feet, 4 mil)
	Burn 9: DRY, uncovered
Day 4	Burn 10: DRY, PE 6.1 × 6.1 m, 0.15 mm (20 × 20 feet, 6 mil)
	Burn 11: DRY, PE 3 × 3 m, 0.15 mm (10 × 10 feet, 6 mil)

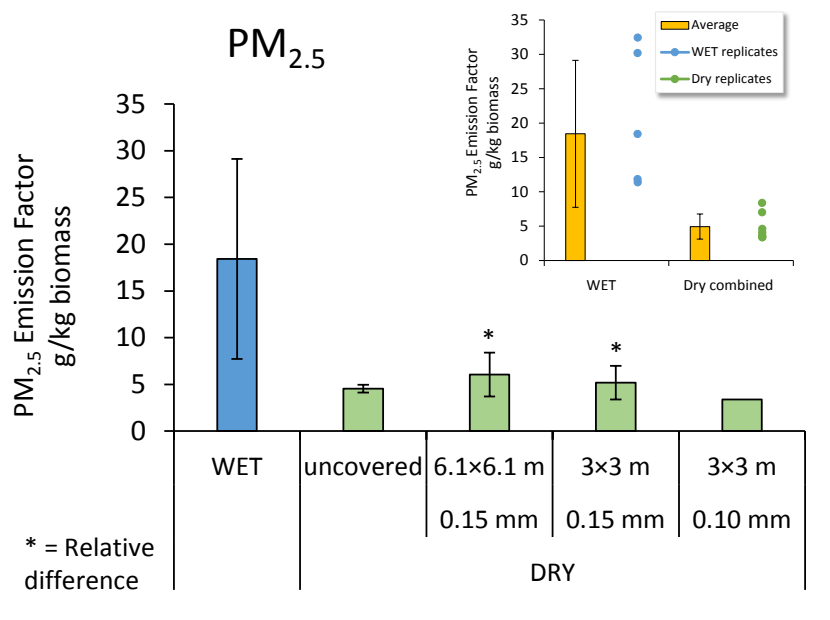
Aerostat Based Sampling Method

The "Flyer"

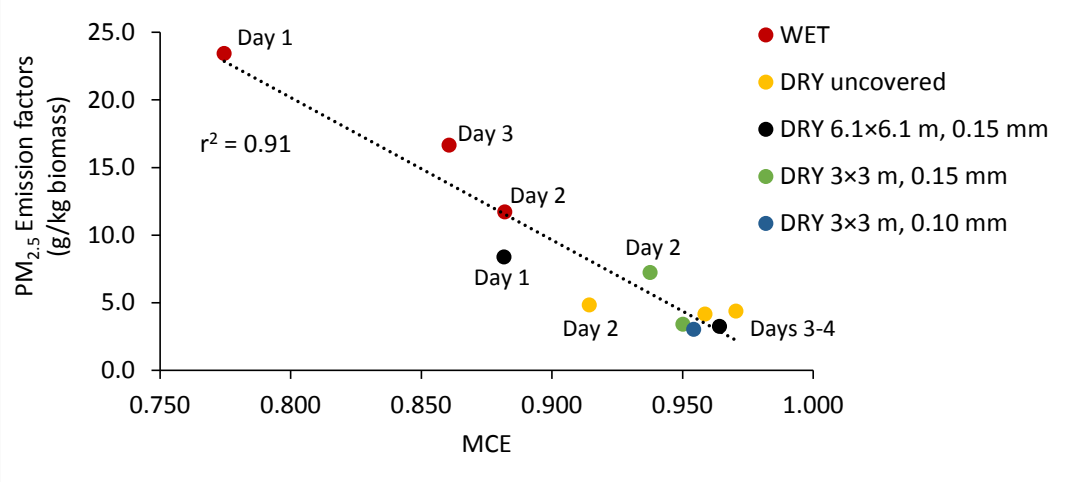
- CO_2 and CO continuously
- PM by filter $PM_{2.5}$
- Continuous $PM_{2.5}$
- Semi-Volatile Organic Compounds (SVOCs)
  - PCDD/PCDF/PAH
- Volatile Organic Compounds (VOCs)
  - SUMMA Canister
- Black carbon (BC) and UVPM
  - MicroAethalometer
- Elemental Carbon (EC), Organic Carbon (OC)
- Total weight ~ 21 kg (46 lb)
- Onboard computer with data transmission
- GPS



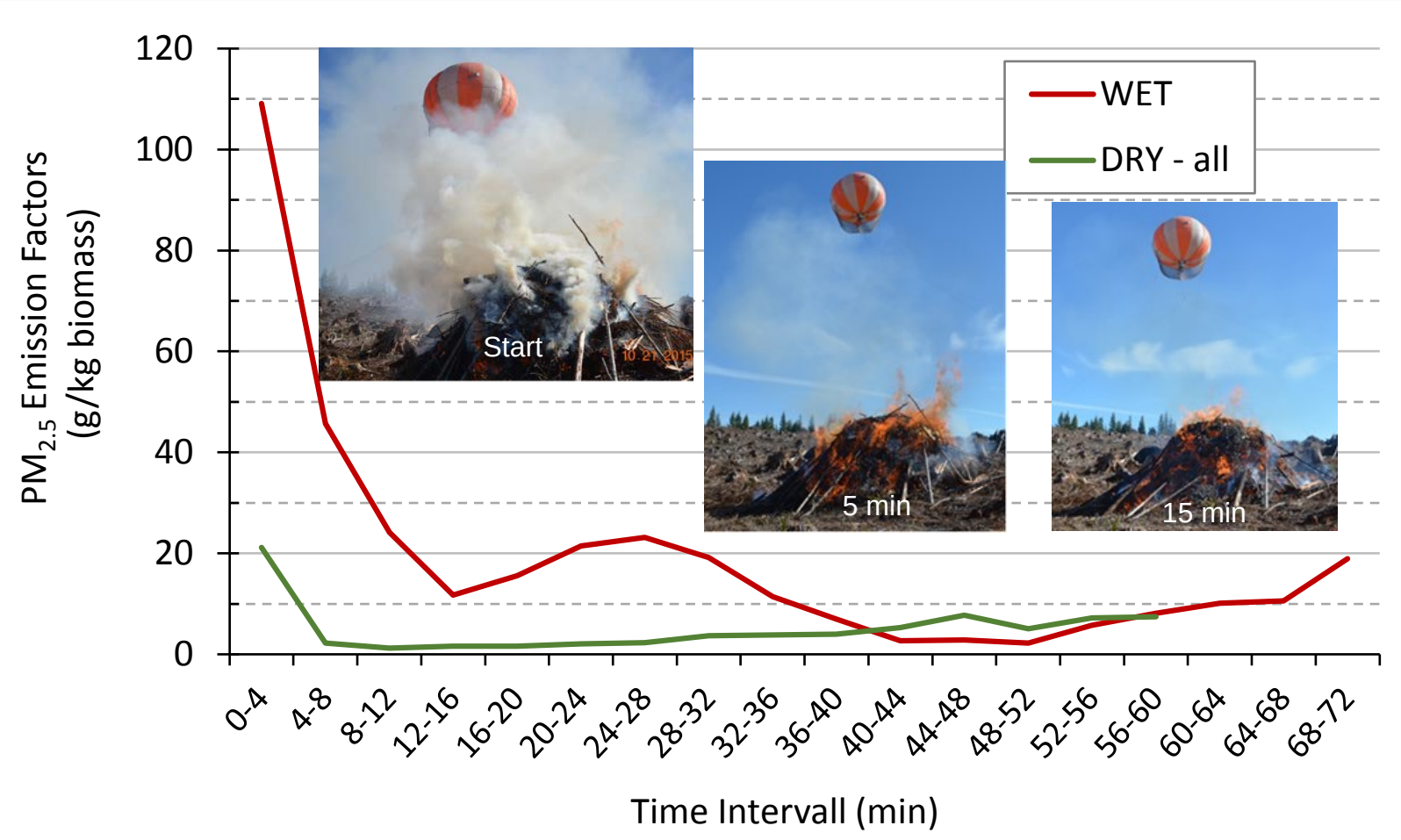
$PM_{2.5}$



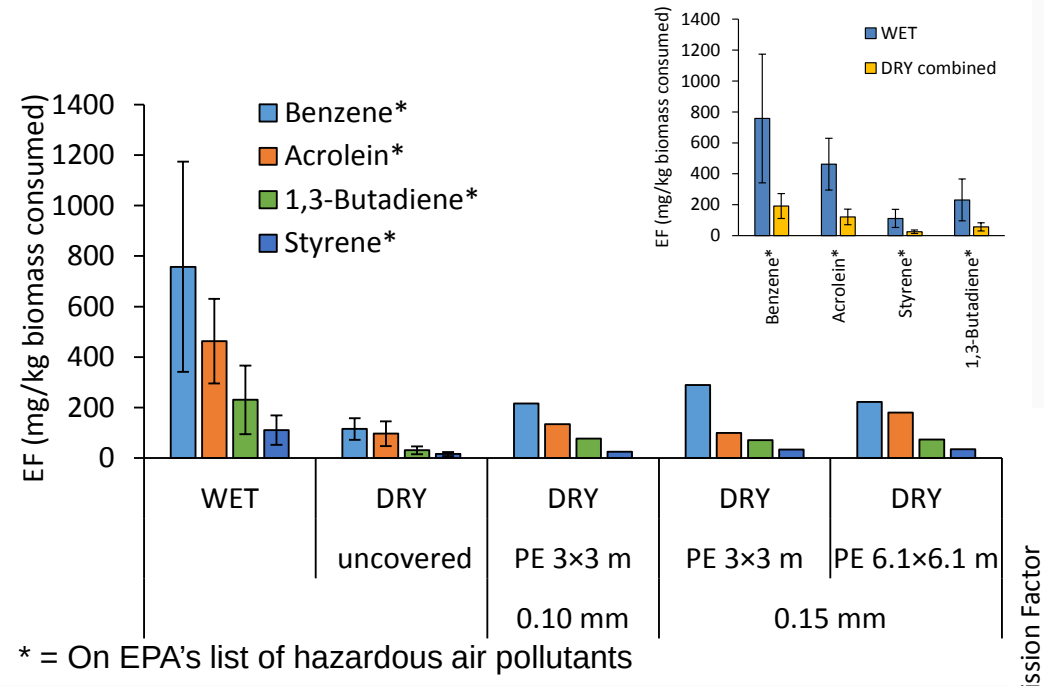
- No difference between PE size or thickness covered piles
- No difference between PE covered or uncovered dry piles
- Difference between wet and dry piles
- Increased EF with decreased MCE



$PM_{2.5}$


120
100
80
60
40
20
0
PM2.5 Emission Factors (g/kg biomass)
WET
DRY - all
Start
5 min
15 min
0-4
4-8
8-12
12-16
16-20
20-24
24-28
28-32
32-36
36-40
40-44
44-48
48-52
52-56
56-60
60-64
64-68
68-72
Time Intervall (min)

VOCs



* = On EPA's list of hazardous air pollutants

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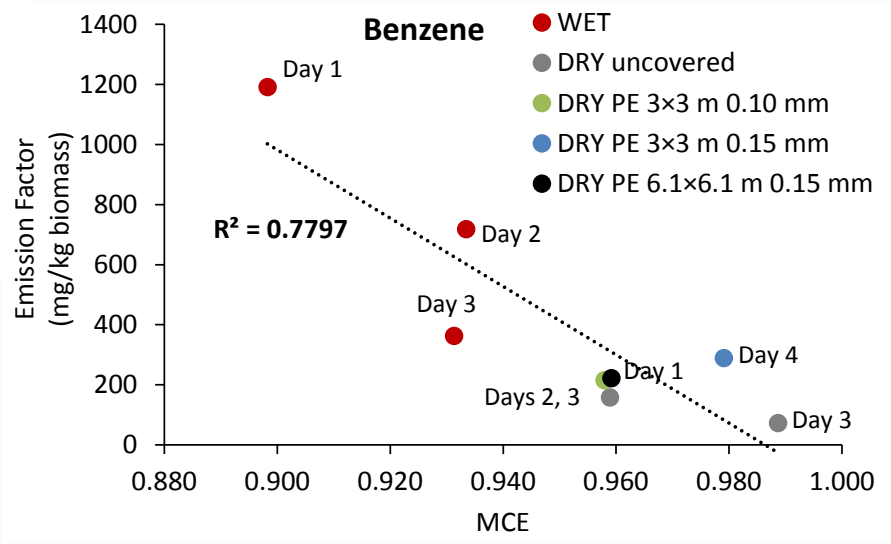
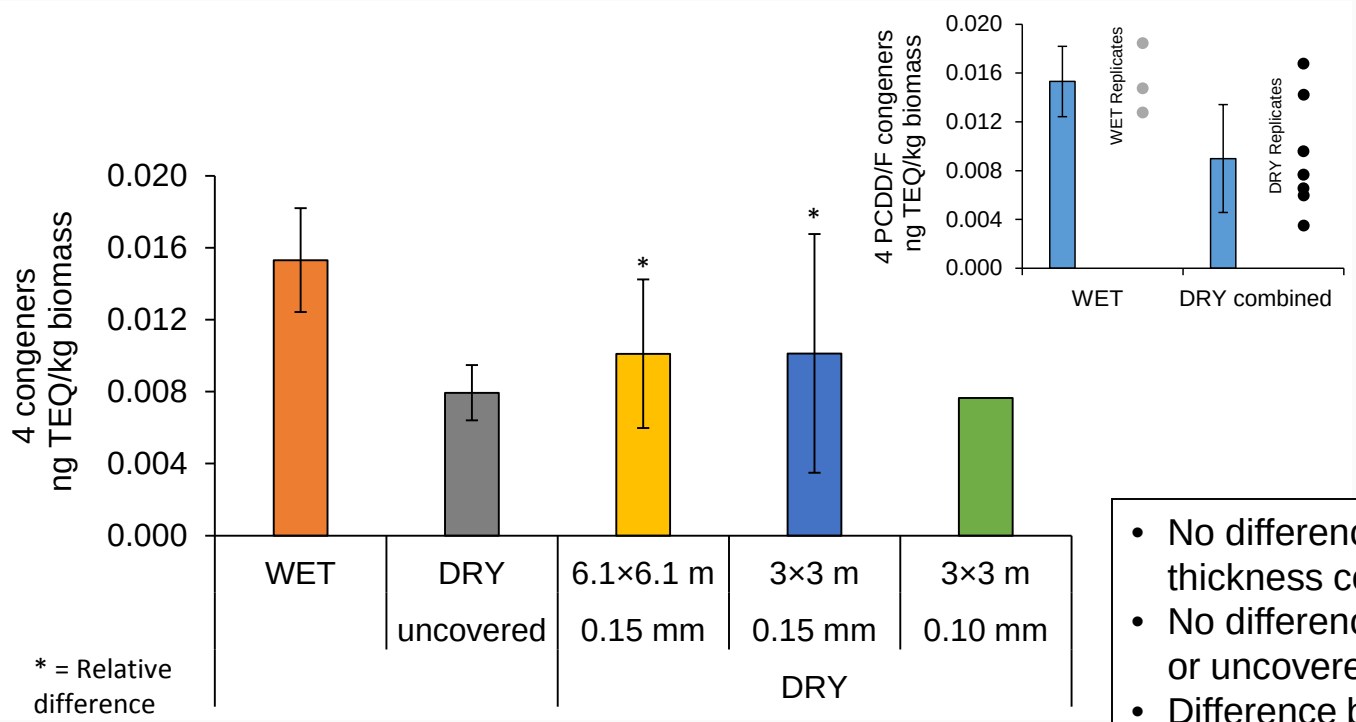
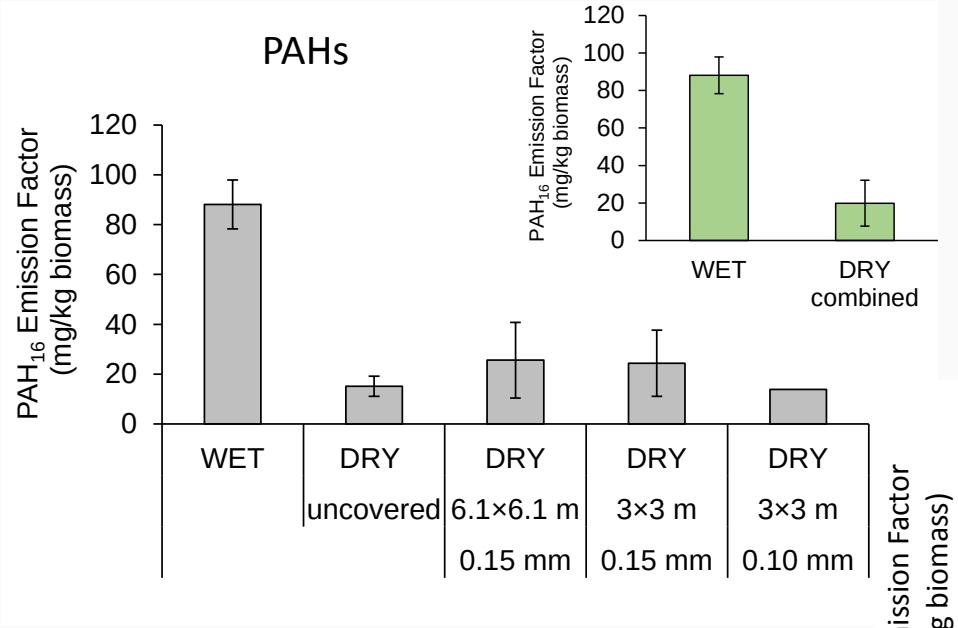


PCDD/PCDF



- No difference between PE size or thickness covered piles
- No difference between PE covered or uncovered dry piles
- Difference between wet and dry uncovered piles

PAHs



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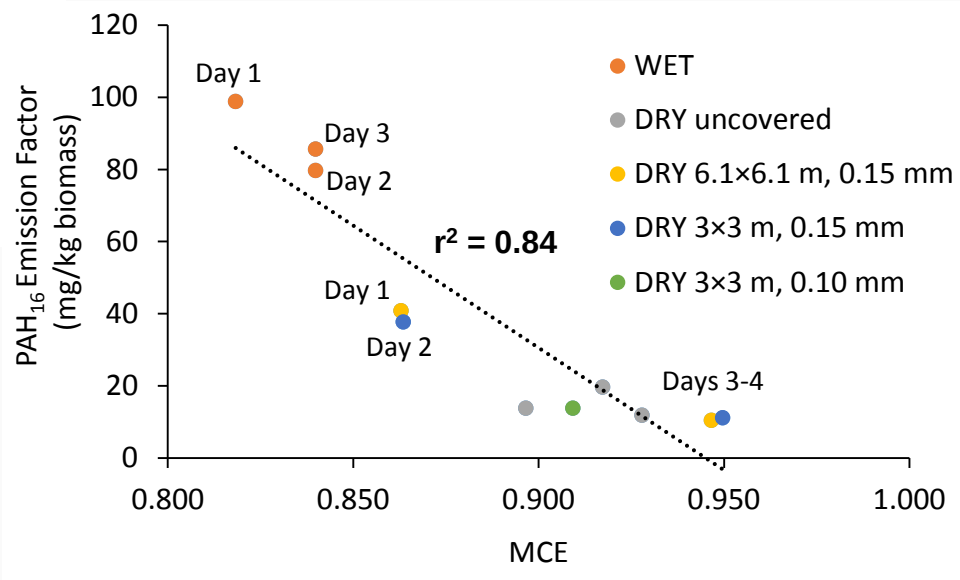

Summary

- Variation of PE cover size and thickness showed no statistically significant difference in emission factor for any of the pollutants
- Wet piles showed higher emission factors for $PM_{2.5}$, PAHs, VOCs, and PCDDs/PCDFs
- Emission levels negatively correlated with combustion quality
- Results suggest that use of PE as a biomass pile cover results in lower emission factors than those from piles exposed to moisture, reducing pollutant levels during pile burns

Publication

Johanna Aurell, Brian K. Gullett, Dennis Tabor, Nick Yonker. **Emissions from prescribed burning of timber slash piles in Oregon**. *Atmospheric Environment*

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- Thank you for Listening!