

## What is SPECIATE?

- Database containing the speciation profiles from specific source types for both volatile organic compounds (VOCs) as well as particulate matter (PM) emissions
- Allows total VOC and PM<sub>2.5</sub> to be speciated into chemical components for photochemical modeling
- Each speciation profile is cross-referenced to an emissions inventory source by Source Classification Code (SCC), by pollutant, and potentially by region
- Used for policy, planning and research purposes

## Objective

Needs assessment to determine what the highest priority is for new and/or improved emission profiles for photochemical modeling applications.

### Project Goals

1. To determine which profiles are most prominent in the EPA 2014 modeling platform based on VOC emitted mass, VOC reactivity, and PM<sub>2.5</sub> emitted mass
2. To prioritize a running list of papers and reports that have been identified, but not yet added to SPECIATE
3. To identify gaps in the current literature in order to encourage research groups to measure speciation from sources that will be the most beneficial to the US EPA's modeling and policy efforts

### Steps Taken

- Step 1:** Identify most used profiles → Ranked profiles by total mass assigned in EPA's most recent 2014 modeling platform
- Step 2:** Conduct in depth evaluation → **Profile analysis criteria:** Top 90% of PM<sub>2.5</sub> emissions (by mass) and top 65% of VOC emissions (by mass) → Further examinations: quality of profile, age, appropriateness, region
- Step 3:** Rank-order profiles by highest priority for updates to profiles or updates to SCC-mapping

## Study Regions

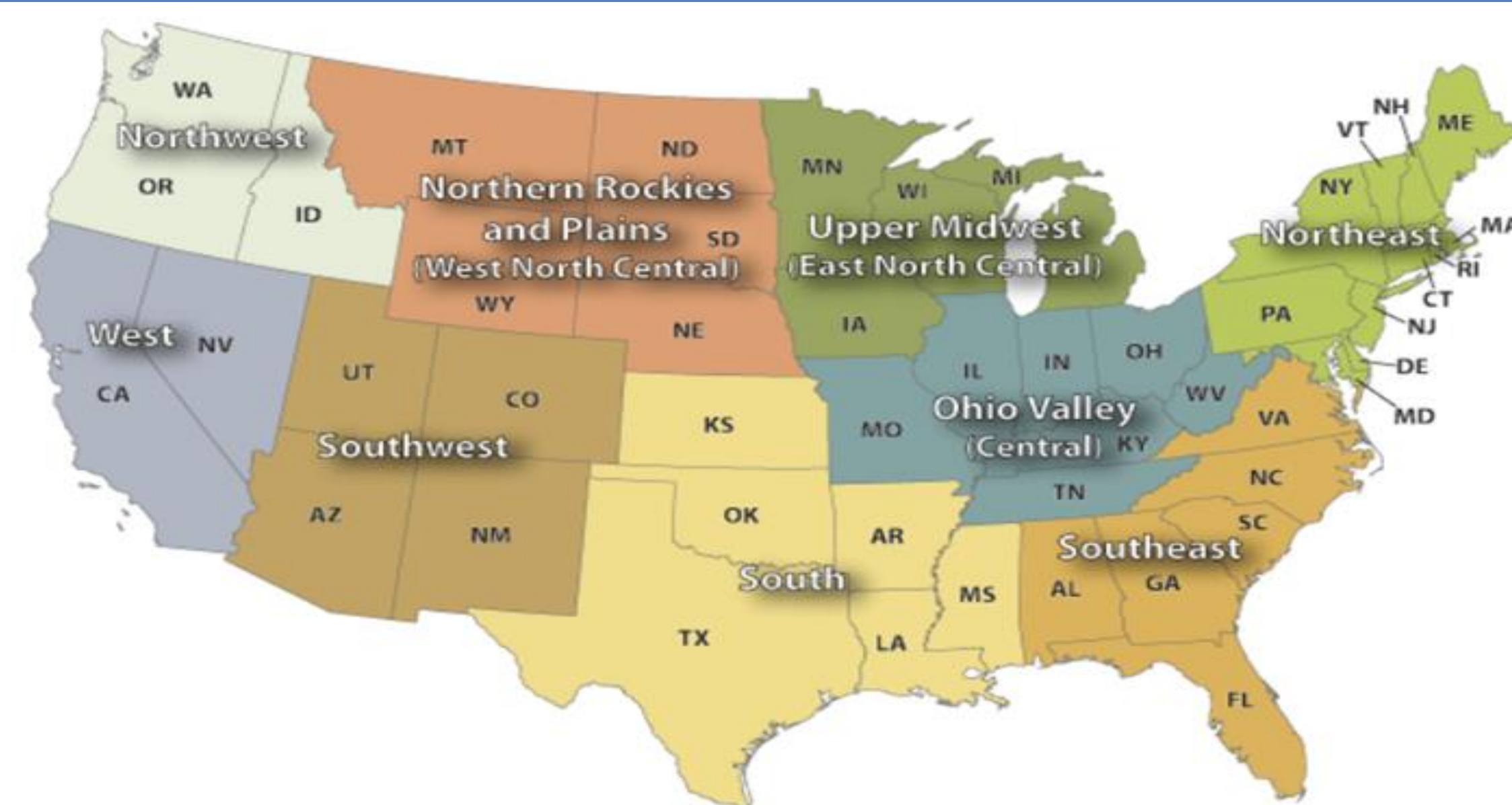


Figure 1. NOAA Climate Regions [Source: <https://www.ncdc.noaa.gov/monitoring-references/maps/us-climate-regions.php>]

Focusing on 3 regions for this presentation:

- Southeast
- Southwest
- Northeast

## Most Prominent Profiles By Emissions Mass

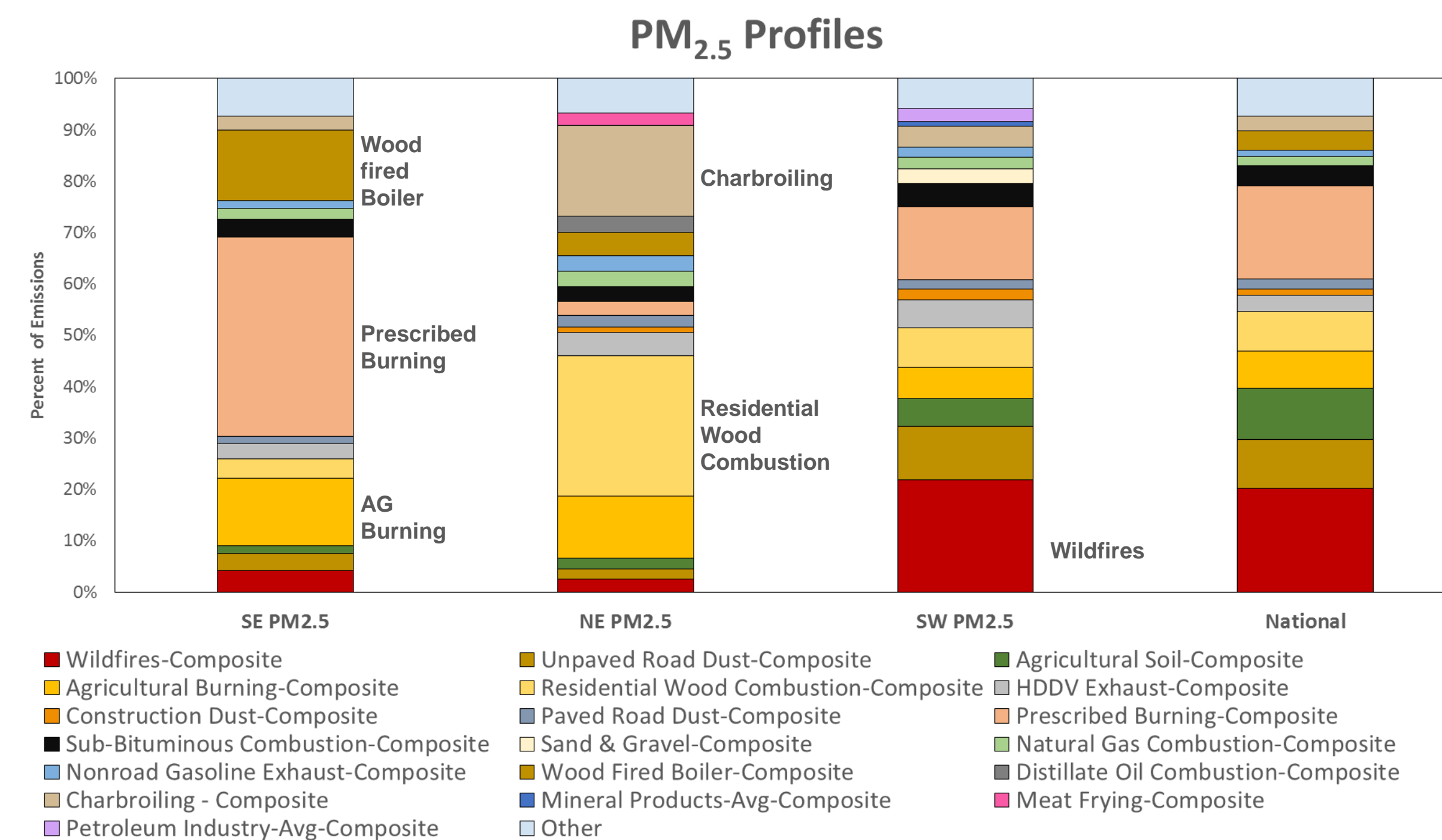


Figure 2. Top ~93% PM<sub>2.5</sub> profiles by emission mass on a national scale compared with top profiles on a regional scale for the Southeast, Northeast and Southwest US.

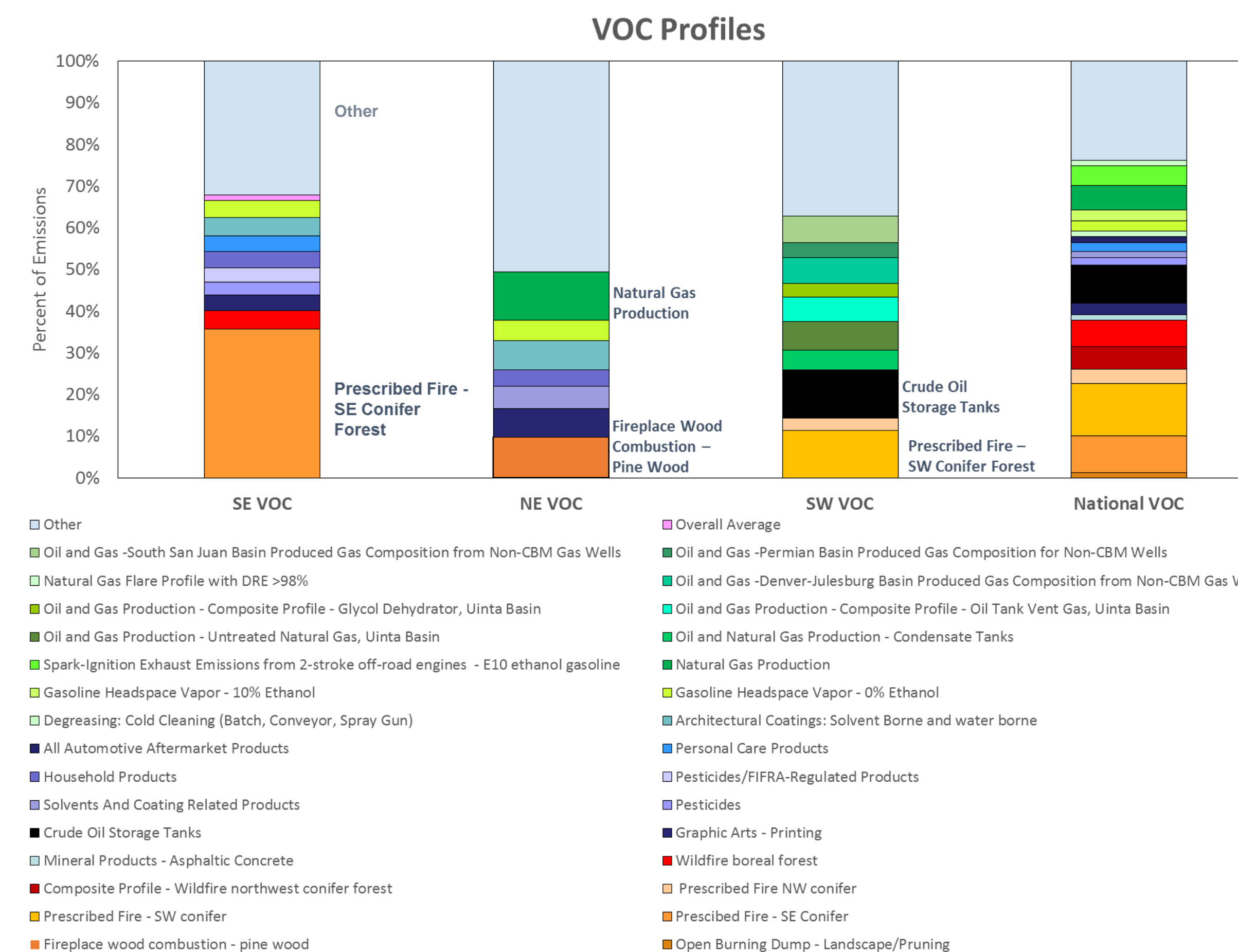


Figure 3. Top ~65% of VOC profiles by emission mass on a national scale compared with top profiles on a regional scale for the Southeast, Northeast and Southwest US.

## Prioritization of Profiles - Methodology

| Criteria   | Points assigned |   |
|--|-----------------|---|
| Age  | Old             | 1 |
|  | New             | 0 |
|  | Medium          | 1 |
| Reliability of Reference   | Low             | 2 |
|  | Medium          | 1 |
|  | High            | 0 |
| SCC issue? (e.g. mismatch between sources tested and SCC assigned in modeling platform)                | No              | 0 |
|  | Major           | 1 |
|  | Minor           | 2 |
| Maximum % weight among regions (emissions assigned to profile within region/total emissions in region) | > 12%           | 4 |
|  | 8-12%           | 3 |
|  | 4-8%            | 2 |
| Known error in data?   | < 4%            | 1 |
|  | No              | 0 |
|  | Yes             | 2 |
| Study region applicable?   | Yes             | 0 |
|  | No              | 1 |

Table 1. Priority ranking system for the criteria of interest. Profiles are ranked based on the criteria in order to assess priority of individual profiles.

## Prioritization of Profiles – Preliminary Results

### PM<sub>2.5</sub> Priority Ranking

| Profile | Profile Name                            | Score | Ranking |
|---------|---|-------|---------|
| 91102   | Wildfires – Composite                   | 9     | 1       |
| 91103   | Agricultural Burning – Composite        | 9     | 1       |
| 91106   | HDDV Exhaust – Composite                | 7     | 2       |
| 91110   | Sub-Bituminous Combustion – Combustion  | 7     | 3       |
| 91113   | Nonroad Gasoline Exhaust – Composite    | 7     | 3       |
| 91109   | Prescribed Burning – Composite          | 7     | 3       |
| 91101   | Agricultural Soil – Composite           | 6     | 4       |
| 91112   | Natural Gas Combustion – Composite      | 5     | 5       |
| 91108   | Paved Road Dust – Composite             | 4     | 6       |
| 91100   | Unpaved Road Dust – Composite           | 4     | 6       |
| 91105   | Residential Wood Combustion – Composite | 3     | 7       |
| 91116   | Charbroiling – Composite                | 3     | 7       |

Table 2. Priority ranking for PM<sub>2.5</sub> source profiles in need of updates.

### VOC Priority Ranking

| Profile | Profile Name   | Score | Ranking |
|---------|--|-------|---------|
| 0121    | Open Burning Dump – Landscape/Pruning                                | 6     | 1       |
| 4642    | Fireplace Wood Combustion – Pine Wood                                | 5     | 2       |
| 2487    | Composite of 7 Emission Profiles from Crude Oil Storage Tanks – 1993 | 5     | 2       |
| 8949    | Natural Gas Production   | 5     | 2       |
| 95421   | Composite Profile – Prescribed Fire Southeast Conifer Forest         | 5     | 2       |
| 3145    | Consumer Products Composite: Pesticides/FIFRA-Regulated Products     | 4     | 3       |
| 3146    | Consumer Products Composite: Household Products                      | 4     | 3       |
| 3147    | Consumer Products Composite: Personal Care Products                  | 4     | 3       |
| 95425   | Composite Profile – Wildfire Boreal Forest                           | 4     | 3       |
| 95422   | Composite Profile- Prescribed Fire Southwest Conifer Forest          | 4     | 3       |
| 1191    | Graphic Arts – Printing  | 3     | 4       |

Table 3. Priority ranking for VOC source profiles in need of updates.

### Findings on High Priority Profiles

- Many profiles used for both PM<sub>2.5</sub> and VOC are derived from fairly old measurements and are not applied to the appropriate SCCs
- Wildfire and prescribed burning profiles currently do not distinguish between smoldering and flaming phases of fire
- Profile 91102 (Wildfire –Composite) included measurements from fencepost burning
- Profile 91103 (Agricultural Burning – Composite) only representative of crops in the west but is applied nationally
- Profile 0121 (Open Burning Dump –Landscape/Pruning) is applied to some inappropriate SCCs (i.e. trash burning)

## Future Directions

### Future Directions

- Expand study regions to each NOAA Climate region and conduct analysis again
- Add VOC reactivity analysis
- For each region, continue project:
  - Step 4:** Determine if there are existing SPECIATE profiles in other versions that may be better than what is currently being used, or if a composite of existing SPECIATE profiles may be better [There are currently profiles created in SPECIATE that are not being applied in the modeling framework]
  - Step 5:** Browse the current literature, including the existing reference list, to identify existing profiles that could satisfy needs identified in step 3 and recommend that those receive high priority for inclusion into SPECIATE
  - Step 6:** Communicate with research community (journal article/presentations at conference, etc.) about high-priority sources for which no appropriate profiles exist in the literature

### Acknowledgements

The authors would like to acknowledge the SPECIATE work group, the air quality modeling group, the emission inventory and analysis group, the measurement policy group, the EPA Air, Climate, and Energy program, and the NC State air quality research group.