# The 2017 National Emission Inventory for Crop Residue Burning

United States Environmental Protection Agency

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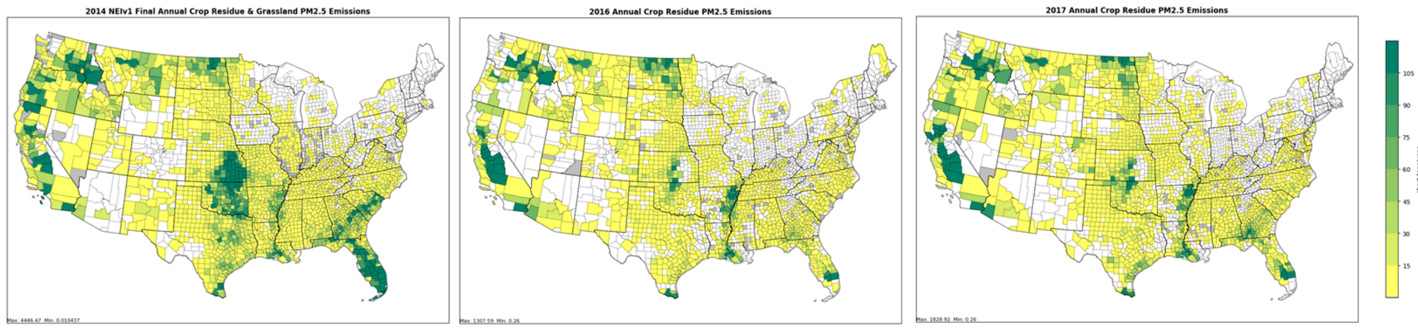
## Background

- Biomass burning is an important contributor to the degradation of air quality because of its impact on ozone, particulate matter and Hazardous Air Pollutants (HAPS).
- Crop residue burning has been a challenge to characterize in previous emission inventories because states are not required to report this source. Many states do not have information on this emission source and reporting by states is often sporadic and inconsistent.
- Many midwestern states disagree with the remote sensing observations of crop residue fires occurring over corn and soybean fields. Southeastern states suggest that there are more fires than detected by remote observation.
- A more robust method for estimating emissions from this source has been implemented in the 2014 NEI and now is improved for 2016 modeling platform and the 2017 NEI.
- HAP emission factors inconsistent with VOC emission factors in the 2002,2005,2008,2011,2014 NEIs.

## Comparison of 2014, 2016 and 2017 $PM_{2.5}$ estimates




Notes: 2014 includes both grasslands and crop residue; 2016 and 2017 are crop residue only; GA submitted data for 2016 but EPA estimates are shown

Totals are lower in FL&GA for 2016&2017 because 2014 includes state submitted data and 2016&2017 do not; 2017 increases because VIIRS and GOES-R became operational and report more detections

## Evolution of Crop Residue Emission NEI Methods

| Year | Type | $PM_{2.5}$ (Tons/Yr) | Notes |
|---|---|---|---|
| 2002 | NEI | 224,684 | 23 states reported only; no satellite information used |
| 2005 | NEI | | not updated |
| 2008 | NEI | 49,653 | fire detections used 1 field size, all emission factors mapped to 1 SCC |
| 2011 | NEI | 141,184 | Combines satellite-based procedure (changes in land surfaces over 8 day periods) from McCarty (2011) with updates from states |
| 2014 | NEI | 64,994 | Pouliot et al (2017) method; final version 1 with state data |
| 2014 | NEI | 19,623 | Pouliot et al. (2017) without grasslands |
| 2016 | Beta platform | 23,633 | 2014 method with limited state data without grasslands |
| 2017 | NEI draft | 32,802 | Draft for states to review without grasslands |

## Comparison of Satellite Detections by Year

| | 2014 | 2016 | 2017 |
|---|---|---|---|
| Total Number of Detections | 368,621 | 338,783 | 756,850 |
| Detections outside of the lower 48 states | 196,875 | 106,312 | 317,261 |
| VIIRS detections removed in 2016 only | 0 | 16,578 | 0 |
| Filtered because of snow covered areas | 6,701 | 4,113 | 7,214 |
| Filtered in the midwest | 3,855 | 6,622 | 10,456 |
| Filtered because of duplication | 5,243 | 8,348 | 24,885 |
| Detections that were not agricultural and used for Wildfire and Prescribed Fires | 108,203 | 133,218 | 306,874 |
| Replaced with State submitted data from Idaho | 0 | 821 | 0 |
| Grasslands | 22,699 | 31,362 | 50,380 |
| Actual Number used for Emission Estimates for Crop Residue Burning | 25,030 | 31,409 | 39,780 |

## 2016 Method

- Incremental update to Pouliot et al. (2017) method
- Grassland/Pasture no longer part of ag burning; included in prescribed/wildfire
- No double counting with other parts of the fire inventory: wildfire & prescribed fire
- State review of data with additional filtering shown in table
- Crop residue emissions: day-specific, county level, by crop type emission inventory (except for Washington State)
- State specific inputs replace EPA estimates in ID, KS, WA; (GA planned)

## 2017 Method

- Same as 2016 Method except emission factor table update
- State specific inputs will be incorporated in upcoming NEI review process

## Summary

- 2016 and 2017 for crop residue used data from multiple sources and addressed some of the shortcomings in previous methods for this sector
- Grasslands which were included in 2014 are now separated out in 2016 and 2017 because grasslands fires may be wildfires that need to be reconciled with other data sources in SMARTFIRE
- Revised Emission Factors to improve consistency between HAP and CAP inventories.

## 2017 Crop Residue Burning Emission Factor Table for $PM_{2.5}$, VOC, and selected HAPs

| Source Classification Code | Crop Type | $PM_{2.5}$ | VOC | formaldehyde | acetaldehyde | n-hexane | benzene | 1,3-butadiene | toluene | m&p-xylene | styrene | o-xylene |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | g/kg | g/kg | g/kg | g/kg | g/kg | g/kg | g/kg | g/kg | g/kg | g/kg | g/kg |
| 2801500150 | corn | 4.97 [a,c] | 9.24 | 0.513 | 0.761 | 0.086 | 0.114 | 0.081 | 0.085 | 0.024 | 0.013 | 0.009 |
| 2801500262 | wheat | 4.03 [a,c] | 9.34 [e] | 0.678 [e] | 0.550 [e] | 0.157 [e] | 0.110 [e] | 0.064 [e] | 0.047 [e] | 0.012 [e] | 0.009 [e] | 0.008 [e] |
| 2801500141 | soybean | 6.19 [a,c] | 9.24 | 0.513 | 0.761 | 0.086 | 0.114 | 0.081 | 0.085 | 0.024 | 0.013 | 0.009 |
| 2801500160 | cotton | 6.19 [a,c] | 9.24 | 0.513 | 0.761 | 0.086 | 0.114 | 0.081 | 0.085 | 0.024 | 0.013 | 0.009 |
| 2801500171 | fallow | 6.16 [a,c] | 9.24 | 0.513 | 0.761 | 0.086 | 0.114 | 0.081 | 0.085 | 0.024 | 0.013 | 0.009 |
| 2801500220 | rice | 2.36 [a,c] | 9.13 [e] | 0.348 [e] | 0.972 [e] | 0.016 [e] | 0.117 [e] | 0.098 [e] | 0.123 [e] | 0.035 [e] | 0.016 [e] | 0.011 [e] |
| 2801500250 | sugarcane | 4.35 [a,c] | 1.84 [d] | 0.150 [b] | 0.045 [b] | 0.000 [b] | 0.017 [b] | 0.000 [b] | 0.005 [b] | 0.001 [b] | 0.000 [b] | 0.000 [b] |
| 2801500142 | lentils | 6.16 [a,c] | 9.24 | 0.513 | 0.761 | 0.086 | 0.114 | 0.081 | 0.085 | 0.024 | 0.013 | 0.009 |
| 2801500000 | Other crops | 11.61 [a,c] | 9.24 | 0.513 | 0.761 | 0.086 | 0.114 | 0.081 | 0.085 | 0.024 | 0.013 | 0.009 |

[a] McCarty (2011);[b] Hall et al. (2012);[c] Pouliot et al. (2017);[d] Schreuder and Mavko (2010)

[e] Hays personal communication (2018) and Hays et al. (2005)

Note: Emission factors without a footnote were derived from an average of wheat and rice factors.

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## References

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