2017 National Emissions Inventory

Summary of Quality Assurance Information

This document provides an overall summary of the quality system and associated documentation for the 2017 National Emissions Inventory. The quality approach consists of both automated quality assurance checks (see Section 1) and manual quality assurance steps (Section 2).

1 Quality assurance and control of incoming data from other agencies

Quality assurance (QA) and control of incoming data to Emissions Inventory System (EIS) that is used to compile the emissions inventory data from state, local, tribal (SLT) agencies, and other data sources. These checks are automated and are performed when data is uploaded to the EIS. If problems are found, then the data are not loaded into the EIS and the data submitter is notified to correct and resubmit the data. These checks are run on both the data SLTs submit as well as data EPA loads to EIS. A list of checks is available on the 2017 NEI website as part of the documentation[1]. In addition, the EPA provided a QA list[2] to SLT agencies as part of the 2017 NEI Process. That list provided recommended quality assurance checks for SLTs to perform in advance of submitting their data to EIS.

2 Manual quality assurance

In addition to automatic checks of electronic data, EPA staff and contractors take additional steps to review the data used in the NEI. These checks have expanded over the years, most recently resulting in the 2017 NEI.

2.1 Point source quality assurance checks

Point source emissions are emissions at facilities with specific latitude/longitude locations. This part of the NEI is a composite of SLT-submitted data and EPA-generated data to use when SLT data are not available. One reason that SLT data may not be available is that hazardous air pollutants (HAPs) are voluntarily reported, and thus some states and pollutants are not reported to EIS. The 2017 NEI Technical Support Document[3] (TSD) Section 3 describes the additional data sets used, the creation and review of those datasets, and the quality assurance process for the data.

Contractors support EPA for emissions estimates from airports and rail yards. Three QAPPs[4,5,6] cover the work done to support airports while one contractor QAPP[6] covers work to support rail yards. This work corresponds to Section 3.2 of the 2017 NEI TSD for airports and Section 3.3 of the TSD for rail yards.

2.2 Nonpoint source quality assurance

Nonpoint emissions are compiled as a county total of emissions because the sources are too numerous or too small individually to compile as point sources. Examples of nonpoint emissions sources include residential wood combustion and agricultural dust from fields.

The NEI program develops emissions estimation tools, collects emissions data from SLTs, makes national datasets of county-specific default emissions, and compiles all the datasets into the final inventory. The emissions estimation tools are developed by contractors, and the quality assurance is done by them as part of those contracts. The following provides a list of quality assurance project plans for these projects that have led to the 2017 NEI:

For Wagon Wheel tool development and use by the contractor for generating 2017 EPA county-specific default emissions, there are six relevant QAPPs.[6, 7, 8, 9, 10,11]

For the Oil and Gas tool development and use by the contractor to generate 2017 EPA county-specific default emissions, there is a QAPP[12] and a final report[13] on the tool. In addition, a memorandum[14] is available that summarizes the contractor's analysis of some of the data for use as input to the tool. Finally, the 2017 NEI TSD[3] Section 4.17.3.6 describes QA findings for the oil and gas nonpoint sector.

A contractor also generated commercial marine vessel emissions for 2017, and that work was covered by three project QAPPs.[4,5,6] As noted in the TSD, additional documentation[15,16] is available about the commercial marine vessel emissions method and how it was implemented for the largest "C1" vessels as well as the smaller "C2" and "C3" vessels.

The contractor also supported EPA on locomotive emissions for 2017, which is covered in project QAPPs.[6] An additional brief statement on locomotive QA is available in the 2017 NEI TSD[3] in Section 4.22.4.

Biogenic emissions were also created by a contractor. Quality documentation[17] for the contract is available. This work corresponds to Section 4.6 of the 2017 NEI TSD[3].

In addition, EPA staff create estimates for specific emissions sectors. Each of these has documentation available about the quality planning relevant for that work.

- Fertilizer application – Office of Research and Development (ORD) QAPP D-CED-0030089
- Agricultural fires – ORD QAPP D-CED-0030089

The SLT-submitted data must be merged with the EPA data, selecting the best available information for each county, sector, and pollutant. For 2017 nonpoint development EPA employed new techniques for the selection process to help ensure high quality information. These techniques help to ensure that the selection uses the SLT data that was submitted, doesn't duplicate emissions when merging with EPA data, and makes sure to avoid double counting of emissions due to pollutant grouping. These techniques are described in Section 4.1.4 of the 2017 NEI TSD[3]. The TSD also describes the EPA approach to avoid missing particulate matter (PM) and HAP data in Sections 4.1.5 and 4.1.6 of the TSD, respectively.

Prior to release, EPA staff generate maps for review and run many comparisons of the data to other data sources. The following is a list of checks done by EPA staff prior to releasing the final data. The checks are repeated after corrections are made based on any unacceptable findings.

1. Compare inventories across versions and years.
    a. Create summaries at the national, state, and county levels, as well as separate summaries for Puerto Rico, U.S. Virgin Islands, Alaska, and Hawaii. Compare the following datasets for all pollutants:
        - 2017 NEI selection
        - Previous triennial NEI selection (2014v2),
        - Previous/draft version of 2017
        - 2017 EPA estimated nonpoint emissions
        - 2017 SLT-submitted nonpoint emissions
    b. Flag the following for review/correction:

- Unexpected pollutants that appear in the 2017 NEI selection but not in other datasets.
- Expected pollutants that were not in the 2017 NEI selection.
- Where emissions for any given state-county FIPS and pollutant appear/disappear between datasets without an expected change.

2. Create relative ranking of 2017 NEI selection vs. 2014v2 selection by pollutant at the county/SCC and county/sector levels. Compare relative ranking across the two datasets.
    a. Calculate a rank delta. For example, if county "x" for residential wood combustion from fireplaces was ranked 150 in 2014 but 100 in 2017, the delta would be +50
    b. Calculate a rank ratio. From the previous example, the ratio would be 150/100=1.5.
    c. Sorted by raw delta and the ratio.
    d. Evaluate any significant changes in rank. The larger emitters matter more, for example #1 from #10 (ratio=10) is more interesting than #2000 vs #2010.
    e. Make sure significant rank changes can be explained based on the expected changes from those sectors in 2017 as compared to 2014v2.
3. Calculate and compare VOC versus summed VOC-HAP totals by county and SCC.
    a. Filter results to identify records with VOC sum of zero but a VOC-HAP sum greater than zero.
    b. For all cases with a difference of 1 ton or more, set VOC equal to the VOC-HAP total.
4. Identify outliers:
    a. Using the summaries from check 1 above, compare the 2017 NEI selection to the 2017 EPA estimated nonpoint emissions. Identify records with 50% difference or more in either direction. Limit this evaluation to CAPs > 10 tpy, HAPs > 1 tpy, and Hg, Cr, Pb > 0.1 tpy at the county/SCC resolution.
    b. Make sure that all differences can be explained by expected methods differences between what was included in the selection (i.e., from a SLT-submission) and the EPA emissions estimate.
5. Visual checks for unexpected boundaries:
    a. Create emission density maps (emissions/area) and compare the 2017 NEI selection to the 2014v2 and to the 2017 EPA-estimated emissions. Create these for selected important sector/pollutant combinations for CAPs and limited HAPs.
    b. Review the maps visually. Look for abrupt changes at boundaries of states, which suggests that there is a consistency issue. Make sure that those consistency issues are understood.
6. Code checks
    a. Confirm that all state/county codes are valid
    b. Confirm that all SCCs are valid.
    c. Confirm that all agencies are included in the dataset
7. Check that in-flight Lead emissions are included only for FIPS codes with the county ID of 777 as intended.
8. Consistency check between SLT's nonpoint survey responses and what they submitted
    a. Export the detailed nonpoint survey from EIS and merge it with the list of SLT-submitted Wagon Wheel input templates to check for consistency.

i. If SLT indicated that they do not have a sector, but then submitted an input template for the sector, we followed up with the state to make sure whether to include their input template or ignore it.
ii. If SLT indicated that they do not have a sector, confirm that EPA did not back fill for that sector.
iii. If SLT did not accept EPA estimates but did not submit an input template, we followed up to make sure SLT intentions were known and implemented accordingly.
iv. If SLT selected "Supplement only at reported locations" but failed to submit any emissions for any location, we followed up to ensure appropriate coverage using either SLT or EPA estimates, as clarified by the SLT.

Additional information about quality assurance of agricultural fires is included in Section 4.12.3.5 of the 2017 NEI TSD[3], which describes QA findings describes of remaining known quality issues for that sector.

2.3 Mobile source quality assurance

Nonroad and onroad mobile emissions estimation is a collaboration between the states and the EPA. For all states except California, EPA uses the MOVES model to estimate emissions from these source categories. The MOVES model is developed by the Office of Transportation and Air Quality (OTAQ) using thorough quality assurance processes (that we do not attempt to compile here). More information on how EPA uses the MOVES model to estimate emissions is available in Sections 5 and 6 of the 2017 NEI TSD[3].

When SLTs compile their MOVES input data for EPA, one additional QA step added in the 2017 NEI process was that states must run a MOVES input QA Tool on their data prior to sending it to the EPA. This QA is documented in Section 6.5.2 of the 2017 NEI TSD[3]. The QA Tool script generates a QA Report that verifies all table contents meet range, naming convention, format and other checks. The report confirms that each CDB contains the appropriate number of tables and that the values within those tables are valid.

Two EPA contractors are involved in helping EPA collect the input data from SLTs, create the national input data, run the MOVES model, perform QA, and provide EIS input files to the EPA. EPA staff load the data from the EIS input files to EIS, and EIS performs automated QA checks as noted above in Section 1.

Contractor QAPP documents[4,5,6] cover the work done to create MOVES inputs and to run MOVES to create emission factors, which corresponds to Section 6.7 through 6.8.8 of the 2017 NEI TSD[3].

A separate contractor runs SMOKE-MOVES, and the quality management document[17] for that work corresponds to Sections 6.8.8 through 6.8.10 of the 2017 NEI TSD[3].

In addition to this information, Section 6.9 of the 2017 NEI TSD[3] provides a summary of the quality assurance for onroad sources.

EPA staff performed QA at two different stages. Prior to running MOVES, EPA staff performed QA on the activity inputs, which included comparing activity values (e.g., vehicle miles traveled a vehicle population) to prior years. Both absolute and percent differences were examined through both spreadsheet and graphing analyses. Discrepancies were noted and explored for their reasonableness and any unreasonable differences were address. After running MOVES and SMOKE-MOVES, EPA staff

performed QA on the emission outputs. QA included comparing pollutants to prior years, both through spreadsheet analysis and maps. Maps of emissions show geographical differences between model run years. Again, absolute and percent differences are examined, discrepancies are examined for their reasonableness, and any issues identified are addressed prior to finalizing emissions. If issues are unable to be addressed, they are included as part of the documentation.

2.4 Event (Fires) quality assurance

EPA developed most of the 2017 wildfire and prescribed fire emissions data. The process of EPA developing the fire emissions for states other than Georgia and Washington has several steps as described in the 2017 NEI TSD[3] Section 7. All contractor work described in the steps below is covered under the contractor quality management document[17].

1. EPA contractor creates draft activity data (e.g., fire location, duration, fuels) based on default datasets and runs the fire models (BlueSky/SmartFire) to create draft fire emissions. The draft default activity data are based on a combination of post-processed satellite images and national databases of fire activity. EPA staff reviews the draft data prior to the next step.

2. EPA provides the draft default activity and emissions for states to review and comment. States send comments, activity data that pertains to their local conditions, and additional model inputs.

3. The contractor incorporates the state comments and state activity data and reruns the BlueSky/SmartFire model. As part of this effort, the contractor works with state and EPA staff to make sure that the activity data can be used properly by the BlueSky/SmartFire model. The modeling uses a combination of state-submitted activity data where provided and EPA default activity data for states that did not submit the activity data.

4. The contractor generates final emissions estimates, and the EPA provides those for review and comment by states. The contractor addresses the comments before going to the next step.

5. The contractor applies PM speciation factors to the PM2.5 emissions to include additional pollutants. The contractor transfers the data to the EPA.

EPA staff loaded the resulting data into EIS.

For 2017, only Georgia and Washington state submitted emissions. The EPA provided these states HAP emission factors that they use to ensure national consistency in the approach for HAP emissions from fires. EPA staff merged the final EPA data with the data from Georgia and Washington. EPA staff completed final QA prior to release, which is described in the 2017 NEI TSD[3] Section 7.4.

3 References

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