Strawman for Source Apportionment of Nitrogen in the Chesapeake Bay Using the CMAQ-ISAM Model

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Recent advances in the CMAQ Airshed Model have allowed updated and improved estimates of the transport and fate of atmospheric emissions of oxidized nitrogen (NOx) and ammonium (NH_4^+). The analysis centers on the question, "For a nitrogen emission source from different regions in the Chesapeake watershed, what is the fraction that is deposited to regions, States, or to a point?"

Table 1, Example of an area and source sector matrix for emissions using CMAQ's Integrated Source Apportionment Model option. Note, that each area x sector sources would be tracked for each emission species, e.g. NO_x, NH_3, etc.

	Manure Poultry (MP)	Manure Other (MO)	Fertilizer (F)	Mobile on road (MR)	Mobile off road (OR)	EGU	Other Points Sources (OP)
DE	DE_MP	DE_MO	DE_F	DE_MR	DE_OR	DE_EGU	DE_OP
MD	MD_MP	MD_MO	MD_F	MD_MR	MD_OR	MD_EGU	MD_OP
NY	NY_MP	NY_MO	NY_F	NY_MR	NY_OR	NY_EGU	NY_OP
PA	PA_MP	PA_MO	PA_F	PA_MR	PA_OR	PA_EGU	PA_OP
VA	VA_MP	VA_MO	VA_F	VA_MR	VA_OR	VA_EGU	VA_OP
WV	WV_MP	WV_MO	WV_F	WV_MR	WV_OR	WV_EGU	WV_OP

The following outlines the research and analysis plan.

1. Oxidized (NOx) and reduced (NH4) nitrogen from eight emission sources will be traced. They are: 1) electric generating units (EGUs), 2) mobile sources, 3) off-road sources, 4) poultry manures, 5) other animal manures, 6) ammonia from fertilizer, 7) marine sources and 8) all other sources. We need to limit emission sources to eight because otherwise the run times of the tracer analysis will become untenable. The first seven emission sources generally have some prospect of being managed or have been managed in the past.

2. The regions generating the sources are shown in Figure 1. Each region will include from emissions each of the eight tagged sectors, e.g., state or region contribution of NOx and ammonia from EGUs, etc. Using geographic source regions allows a better assessment of deposition changes from each source area receiving management actions and is the recommended approach.

3. An alternative approach that can be applied is the source regions of the six CBP States (Figure 2). This approach allows for an assessment of the deposition from each state and

sector to each receiving area of a region, State, or point. For example, if a CBP State were to put controls on an emission source throughout the State, such as EGUs then this could be the preferred emission source approach. Either a regional or a State source approach can be applied but not both because of resource limitations.

4. Deposition will be a time series of model output of deposition on a CMAQ grid scale of 12 km by 12 km. Post-processing will allow the output to be provided by 1) CBP States and DC, and/or 2) major CBP basins, and/or 3) seasons of deposition. The estimated deposition to the whole CBP State, to the portion of the CBP State in the Chesapeake Bay (CB) watershed, and deposition to the Chesapeake airshed outside the CB watershed will be provided.

5. The year 2016 year will be used because of the two years available with recent emissions (2015 and 2016), it has a more average hydrology throughout the CB watershed*. Also, 2016 has better emission estimates as it was a National Emission Inventory (NEI) development year. Both 2015 or 2016 are also years that we'll be able to better assess and constrain the model estimates with through remote sensed satellite observations of NO_2 and NH_4^+.

* 2015 Climatology - https://www.ncdc.noaa.gov/temp-and-precip/us-maps/12/201512#us-maps-select
* 2016 Climatology - https://www.ncdc.noaa.gov/temp-and-precip/us-maps/12/201612#us-maps-select

Figure 1. Nitrogen emission source by region.

Regions / AirShed
Location
- Mtn Upper Susq
- Mid Mtn
- Lower Mtn
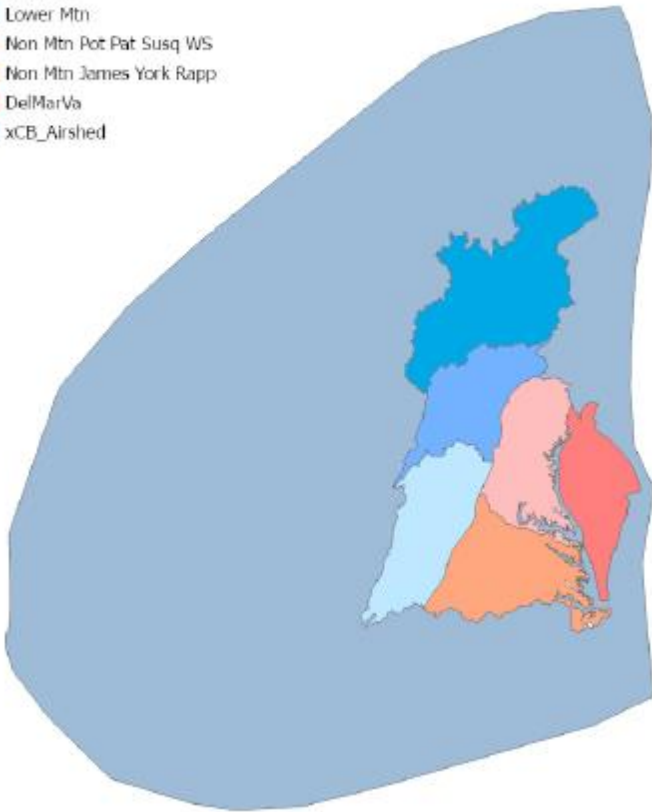- Non Mtn Pot Pat Susq WS
- Non Mtn James York Rapp
- DelMarVa
- xCB_Airshed

Figure 2. Nitrogen emission source by State.

States / Airshed
Location
- Delaware
- District of Columbia
- Maryland
- New York
- Pennsylvania
- Virginia
- West Virginia
- xC8_Airshed