Overview of Final Policy Assessment

Informational Briefing for CASAC
February 15, 2011

Projected Schedule for Completion of Review of NOx/SOx Secondary NAAQS

Actions to complete review	Projected schedule (court-ordered dates*)
1st draft Policy Assessment (PA)	late February 2010
CASAC review and public comment on 1st draft PA	April 2010
2nd draft PA	early September 2010
CASAC review and public comment on 2nd draft PA: CASAC Panel public meeting CASAC Panel teleconference CASAC teleconference to approve letter CASAC Panel meeting on final PA	 October 6-7, 2010 November 9-10, 2010 December 6, 2010 *February 15-16, 2011*
Final PA	early January 2011
Science/Options Pre-briefs and Options Selection	late January – early March 2011
Draft NPR; Workgroup review; FAR	February – mid-April 2011
Draft NPR to OMB (90 days)	mid-April 2011
Proposed rule (signature)	July 12, 2011*
Public comment period (90 days), public hearings	late July – late Oct 2011
Final rule (signature)	March 20, 2012*

NOx/SOx Secondary NAAQS Policy Assessment Team

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- OAQPS Ambient Standards Group Leader: Karen Martin

Overview

- Major adjustments from 2nd PA to Final PA
- Outline and Summary of Policy Assessment (PA)
  - Focus on chapter 7 – Elements of the standard

Major changes from 2nd PA to final PA

- Organizational
  - Chapter 7: linking all elements together; enabled by chapters 2 and 3….
  - Chapter 2: centralizing technical summaries of emissions through water quality
  - Chapter 3: centralizing biological effects
  - Spatial aggregation: simplified to ecoregion level III as a basis for demonstrating the area over which the standard is defined
  - Appendix C: supplementary ecoregion Atlas
- Uncertainty and evaluation
  - Appendix G: cumulative Monte Carlo like analysis
  - Transference ratio comparisons with observed data and Canadian AURAMS model
  - Addition of CMAQ comparisons to SEARCH SO_2 data
- Response behavior of the standard – section 7.5 and Appendix D
  - Prospective analyses using current and future year emission scenarios
  - Inferential accountability through linked (emission through water quality) trends in section 2.5

Policy Assessment: Table of Contents

Conceptual model of an aquatic acidification standard

Ecological effects and ecological indicator

Linking atmospheric oxides of S and N deposition to ecological indicator

Linking “allowable” deposition to “allowable” concentrations of ambient air indicators of oxides of N and S

This standard is designed to link aquatic acidification effects (ANC), to ambient air indicators through atmospheric deposition

$$\text{Aquatic Acidification Index (AAI)} = F_1 - F_2 - F_3\,[\text{NOy}] - F_4\,[\text{SOx}]$$

- **Form**: defined by AAI equation; factors F1 through F4 would be specified by EPA
- **Level**: the target AAI value that, in combination with the other elements of the standard, is judged to provide requisite protection
- **Indicators**: NOy and SOx to be measured by States to determine if the standard is met

These key elements are discussed on the following pages . . .

Ambient Air Indicators (section 7.1)

- Attributes
  - Association: does the ambient indicator reflect acidification potential?
  - And, can we measure it?
- Oxides of Sulfur
  - SOx, defined as the sum of:
    - sulfur dioxide gas, SO_2, and particulate sulfate, SO_4
    - SO_2 and SO_4 are measured separately
- Oxides of Nitrogen
  - NOy, defined as the sum of all reactive oxidized nitrogen species (e.g., NO_2, NO, HNO_3, p-NO_3,PAN,….)
  - One measurement that captures all species, but not information on each separate species
- Monitoring
  - Routine monitoring methods exist
  - Further discussion on monitoring methods and network design to be included in future implementation briefing

Form: $AAI = F_1 - F_2 - F_3 [NOy] - F_4 [SOx]$

section 7.2

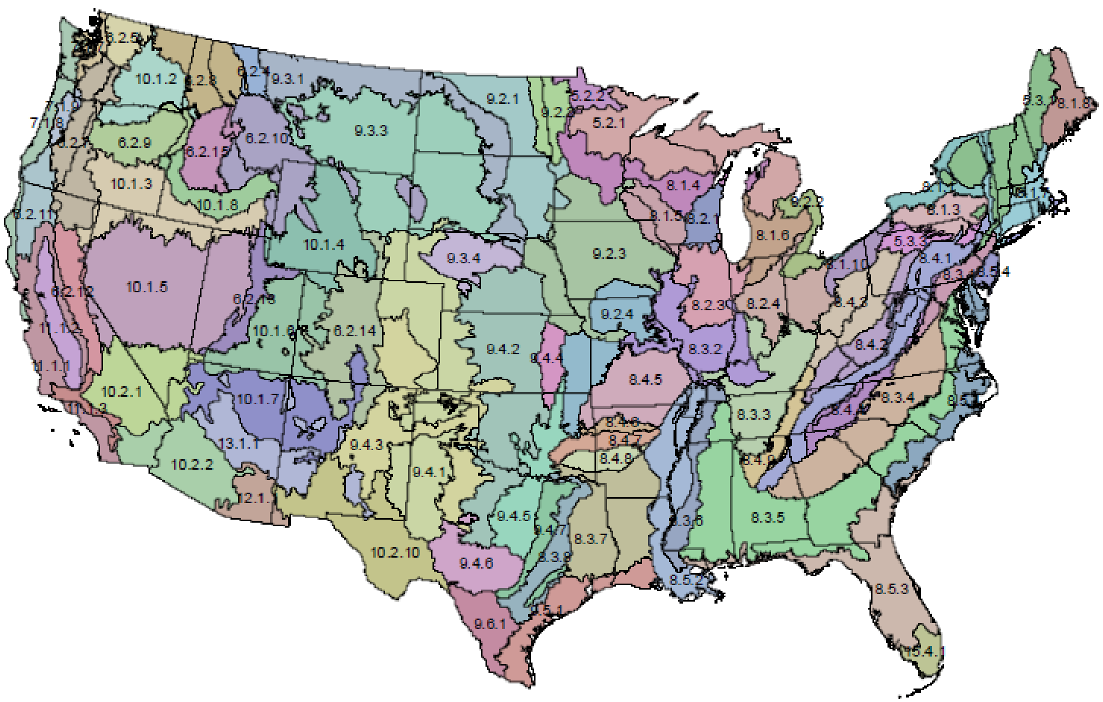
- Attributes
  - Association:
    - Links ecologically relevant effects to ambient air indicators through deposition
  - Consider:
    - Does the AAI and its components respond reasonably to changes associated with air management practice (e.g., emission changes) over time
    - Since value of each factor varies across the U.S., need to define appropriate spatial areas over which the factors are defined

Appropriate spatial areas, in terms of defined "ecoregions," are presented on the next 2 pages, followed by discussion of each of the components of the form, as listed below . . .

- Components of the form
  - Ecological indicator (relates directly to AAI)
  - F_1: natural ability of an ecosystem to neutralize nitrogen deposition
  - F_2: reduced nitrogen (ammonia gas and ammonium ion) deposition
  - F_3, F_4: factors that convert measured NOy and SOx in the ambient air to NOy and SOx deposition

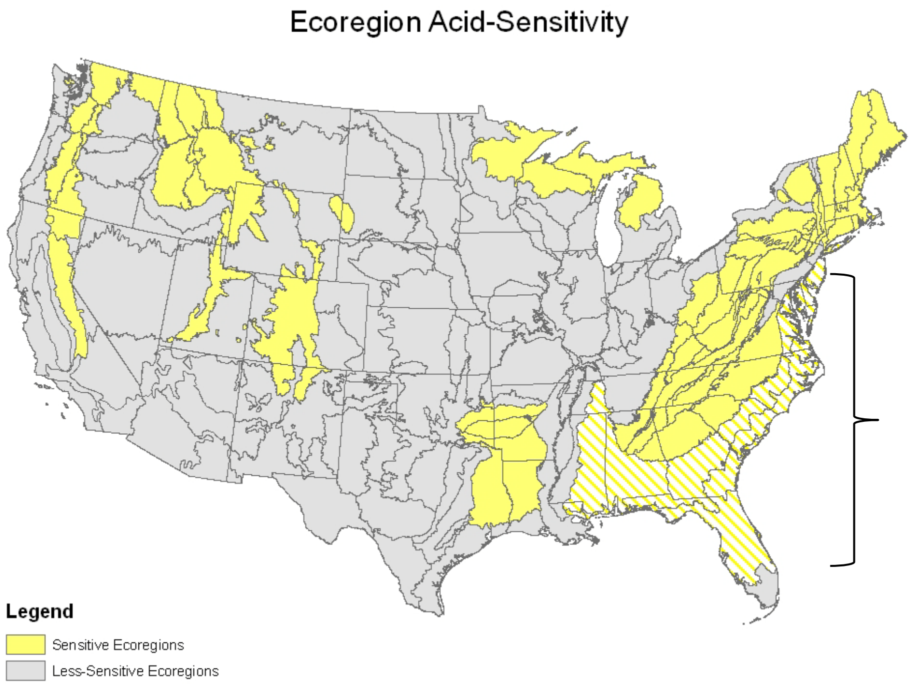
Form: Spatial aggregation approach section 7.2

- Omernik Ecoregion III classification scheme (developed in the 1980s by EPA) divides the U.S. into ecologically relevant regions (84 regions cover the continental U.S.)
  - Classification is based on common vegetation, geology, soils, and hydrological characteristics – all impact the components of the form defined in terms of an aquatic acidification index
  - Has the additional benefit of providing an appropriate structure for potential future secondary standards to address other deposition-related effects



Acid sensitive and non-sensitive Omernik Level III Ecoregions section 7.2

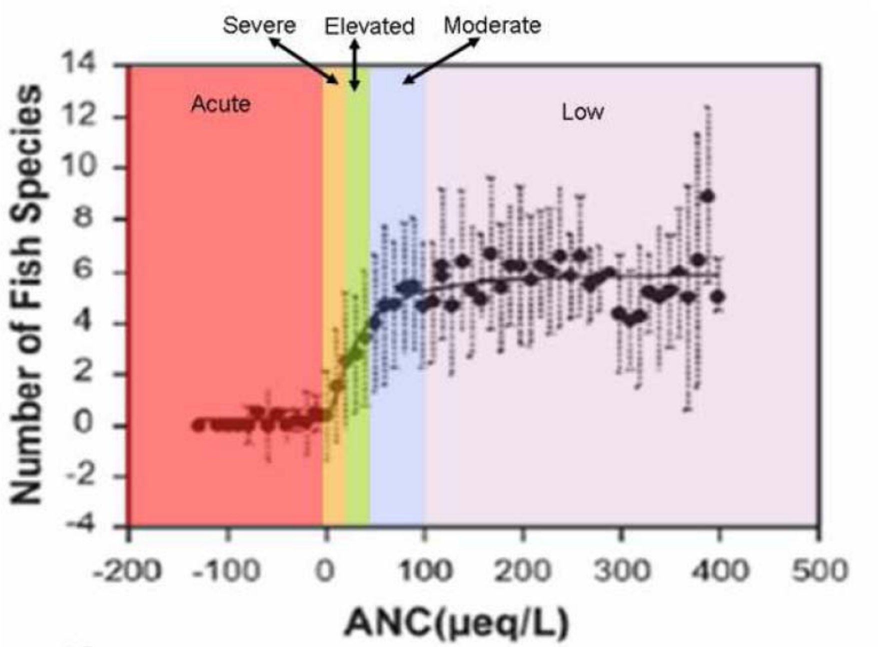
Categorizing ecoregions as relatively acid-sensitive (~29 areas) or non-sensitive (~55 areas) helps to focus standard on areas that will benefit most from reductions in NOy and SOx deposition



Revisit these coastal plains regions in section 7.5

Form: Ecological indicator section 7.2

- **Acid Neutralizing Capacity (ANC)** -- a measure of the capacity of an ecosystem to protect against acidifying deposition
  - Highly associated with effects of concern, including fish mortality and reduced aquatic species diversity
  - Supported by CASAC



Form: Spatial aggregation and factors F1 – F4

section 7.2

- Spatial variation of these factors across the U.S. is accounted for by dividing the country into ecologically relevant regions (i.e., Omernik ecoregions)
  - Each region has a unique set of factors, F1 – F4, that are calculated based on data from water bodies within each region and from CMAQ modeling
  - EPA would specify F values for each region and provide look-up tables
- For each of the factors, data averaged across the ecoregion is used
- To calculate F1, data from a "representative" water body is also used
  - A water body is selected within each ecoregion based on its relative acid sensitivity
  - For acid-sensitive regions, a percentile of the distribution of acid sensitivities across a region in the range of the 70th to 90th percentile is appropriate to consider
    - Selecting from within this range helps to target appropriate protection for the relatively more sensitive water bodies within such a region, while avoiding potential outliers at the extreme end of the distribution
  - For relatively non-acid-sensitive regions, appropriate to consider alternative approaches, such as the same range of percentiles, the median value, or the use of data averaged over all non-sensitive regions

Averaging Time section 7.3

- Staff concludes that consideration should be given to calculating average annual AAI values over 3-5 years
  - 3-5 years intended to account for interannual variability, especially that associated with precipitation

Level section 7.4

- Staff concludes that consideration should be given to a range of values from 20 – 75 μeq/L
  - Entire range affords protection from long-term, chronic aquatic acidification
  - Upper part of range affords:
    - Added protection for episodic acidification (e.g., spring snowmelt)
    - Shorter time frame for some water bodies to reach a target ANC
  - Upper end of range is a reasonable value since potential for additional protection at higher values is substantially more uncertain
  - Lower end of range is a reasonable value so as to protect against chronic effects that have been characterized as severe at lower ANC values

Interpretation of the standard

- **Standard would be met at a monitoring site** when measured values of NOy and SOx are such that the calculated value of the AAI, averaged over 3-5 years, is greater than or equal to the level of the standard, when using the ecoregion-specific factors F1- F4

- **Protection afforded** by such a standard is based on the **combination of the level and the percentile value** used to define the representative water body within a region for the purpose of calculating the term F1, in conjunction with all the other elements of the standard

Alternative Standards (section 7.5)

- Alternative standards encompassing combinations of level (20 – 75 μeq/l) and range (70th to 90th percentile) were assessed relative to the likelihood that acid sensitive ecoregions would not meet alternative standards.

Table 7-2. Summary of the number of acid sensitive ecoregions (out of 29) not likely to meet alternative standards based on a 2005 CMAQ simulation.

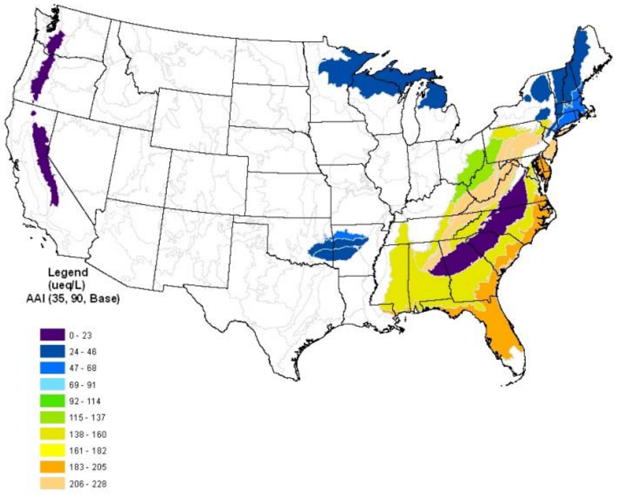
ANC (μeq/l)	Percentile	Number
20	70	8
	75	9
	80	10
	85	13
	90	19
35	70	9
	75	10
	80	14
	85	16
	90	19
50	70	11
	75	13
	80	16
	85	19
	90	22
75	70	15
	75	16
	80	19
	85	21
	90	25

Example maps of ecoregions not likely to meet alternative standards – current and future conditions

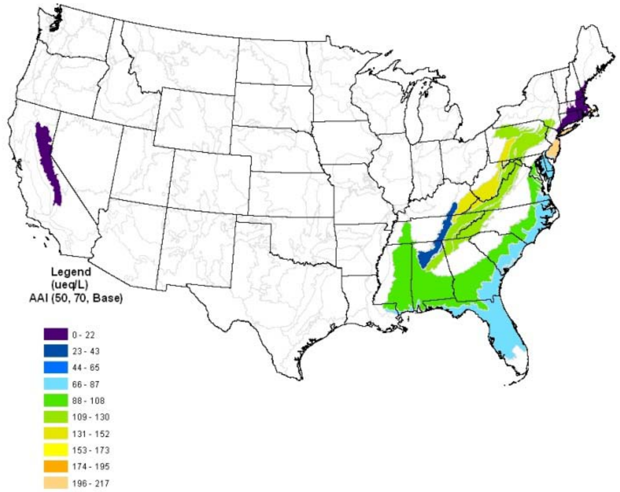
note: (1) acid sensitive areas identified; (2) most areas very responsive to reductions in Nox/SOx emissions; (3) persistence of Coastal Plains regions not responding to emission reductions

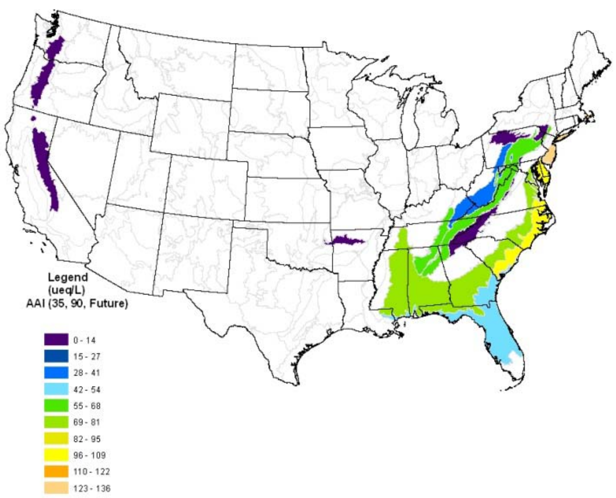
ANC 35, 90%

ANC 50, 70%

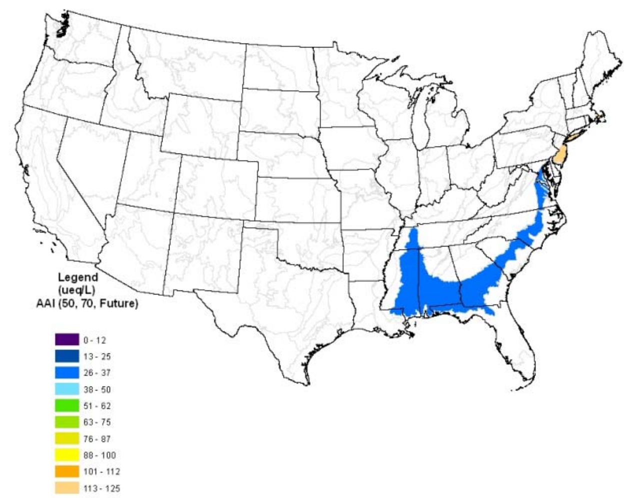


2005



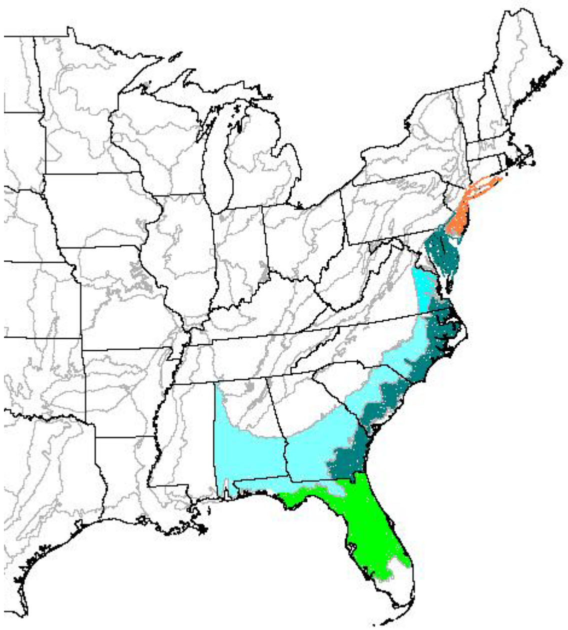


42% and 48% SOx, NOx reduction



Revisiting Coastal Plains

Coastal plains regions: southeastern plain (8.3.5), middle atlantic coastal plain (8.5.1), southern coastal plain (8.5.3), atlantic coastal pine barrens (8.5.4)



Consider these coastal plains regions as relatively non-acid sensitive, because:

- water chemistry indicates relatively high DOC levels and very low natural base cation production
- generally are not sensitive to changes in NOx and SOx emission reductions
- are relatively highly managed with respect to commercial/residential development and agricultural practices

Non-acid sensitive category could be assigned a standard critical load based on the median value of critical loads across all non-sensitive ecoregions, resulting in all non-sensitve areas likely to meet the standard

Uncertainty (section 7.6)

- General
  - Large body of scientific evidence and solid conceptual underpinning for linking:
    - Biological effects to ecological indicator (ANC)
    - N and S deposition to changes in ANC
    - Ambient NOy and SOx and deposition of NOy and SOx
- Linking across all components (from ANC to ambient concentrations) identifies specific areas of relatively high uncertainty
  - Critical load estimates
    - Natural base cation production
    - Neco – which will emerge as an important variable in western U.S. analyses and future assessments
  - Transference ratios
    - Embody uncertainties associated with characterizing ambient concentration and deposition patterns

Areas of research and enhancements

- Further assimilation of existing and collection of additional water chemistry data for development of national critical loads data base
- Expanded coverage of nitrogen and SOx observations in rural, acid-sensitive regions
- Dry deposition process improvements through observed flux gradient studies
- Adoption of NH_3 bi-directional flux, lightning-generated NOx in CMAQ
- Improved treatment of soil exchange processes to enhance characterization of natural base cation supply
- Linking atmospheric and aquatic modeling systems
- Improved characterization of organic nitrogen, relationship between dissolved organic carbon and changes in N and S deposition