Considerations on Combined $\text{NO}_x$-$\text{SO}_x$ Secondary National Ambient Air Quality Standards

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Acknowledgements and Disclaimer

• EPA’s Offices of research and Development and Air Quality Planning and Standards are largely responsible for all of the good ideas to be discussed here*, along with those of the CASAC NOx-SOx Secondary NAAQS Panel.

Though

• All of the opinions and misinterpretations presented are mine, unless noted otherwise, and should not be construed as being those of either EPA or the CASAC NOx-SOx Secondary NAAQS Panel.

#See yosemite.epa.gov/.../431c50dafeac39f18525757d00655674!OpenDocument&Date=2009-07-22 and Risk and Exposure Assessment for Review of the Secondary National Ambient Air Quality Standards for Oxides of Nitrogen and Oxides of Sulfur: 2nd Draft
Background (and important tidbits)

• EPA is reviewing the NOx and SOx NAAQS
  – New and different
    • Separating primary from secondary!
    • Combining secondary NOx and SOx reviews
      – A focused effort on identifying ecological effects and developing an ecologically-relevant standard
      – CASAC panel largely composed of ecological effects experts, atmospheric scientists and policy folks
  – Not new and different
    • Being driven by court order deadlines
      – Rule to be finished Oct. 19, 2010
        » NPR out Feb. 12, 2010
        » Very limited time to finish policy assessment
Old NAAQS Review Process

- Workshop on science-policy issues
- Integrated Plan: timeline and key policy-relevant scientific questions
  - Review by CASAC and the public
- Integrated Science Assessment: concise evaluation and synthesis of most policy-relevant studies
- CASAC review and public comment
- Risk/Exposure Assessment: concise, quantitative assessment focused on key results, observations and uncertainties
- Policy Assessment Document
  - Interagency review
- EPA proposed decision on standards
  - Public hearings and comments on proposal
  - Agency decision making and draft final notice
  - Interagency review
  - EPA final decision on standards

From projects.pechan.com/.../Ozone_workshop-the_NAAQS_Review_Process_10-29-08.pdf
Pieces of the Process and History

• EPA ORD develops Integrated Science Assessment
  – Identifies acidifying sulfur and nitrogen oxide deposition as the primary concern
  – CASAC reviewed, pushed strongly to
    • More comprehensively include impacts of reduced (and organic) nitrogen and non-atmospheric sources of reactive nitrogen to ecosystems
    • Recognize the combined effects of acidifying deposition
      – EPA responded

• EPA OAQPS develops the Risk and Exposure Assessment
  – CASAC reviewed, pushed strongly to
    • More comprehensively include impacts of reduced (and organic) nitrogen
    • Recognize the combined effects of acidifying deposition
      – EPA responded

• October 2008 ISA/REA Review meeting
  – OAQPS presented conceptual approach to having an ecologically-relevant set of standards that addressed the combined effects of NOx, SOx and reduced nitrogen deposition
Integrating Across Species Contribution to Aquatic and Terrestrial Acidification: A Proposed EPA Approach…

Indicator

ANC

Deposition Load

Atmospheric Concentrations

Total acidifying deposition

Acceptable depositional rate
Deposition from reduced N
Allowed NOx+SOx deposition

What is regulated

Physical

Regulatory

Concentration-Deposition Relationship

Dep_{NOx} – C_{SOx}

Current

Allowed

Dep_{NOx} – C_{NOx}
Applied to Nutrient Enrichment

- Indicator
  - ?
- Deposition Load
  - Total Nutrient Load
    - Allowable $R_n$ load
    - Non-atmospheric load
    - Allowed NOx deposition
- Atmospheric Concentrations
  - Deposition from reduced N
  - Concentration-Deposition Relationship

What is regulated

- Total Nutrient Load
  - Allowable $R_n$ load
  - Non-atmospheric load
  - Allowed NOx deposition
  - Deposition from reduced N
  - Concentration-Deposition Relationship
My thoughts on this...

Great!

Almost exactly what CASAC was looking for.

Let’s see how they flesh out the details.
Last Week…

• CASAC review of 2nd Draft REA, introduction to Policy Assessment concept (recall, ANPR is gone), but first
  – OAQPS has determined that due to the complexity and policy innovation of the proposed approach, and that they were unable to get additional time from the plaintiffs, they can not adequately develop ecologically meaningful standards
    • To meet statutory obligations and meet the court ordered deadline, limited policy options available
      – Retain current secondary standards
      – Revise current standards by making secondary standards identical to the primary standards
      – Revoke current secondary standards
      – Which should be recommended?
        » None are viewed as protective to sensitive ecosystems
  – Goal would be to continue with an accelerated next review
    • Build upon current ISA and REA
2nd Draft REA

- Significantly advanced from 1st draft
- Introduced their secondary NAAQS structure diagram:
- Further fleshed out the Critical Load Function (CFL) response curve:
- More focus on ecosystem services
Structure of an Ecologically-based Standard

1. Air Quality Indicator(s)
   Measured over a specified averaging time; expressed in terms of a specified statistic (form)

2. Variable/Fixed Factors: Atmospheric Landscape

3. Atmospheric Deposition Transformation Function

4. Deposition Metric

5. Variable/Fixed Factors: Ecological

6. Ecological Effect Function

7. Ecological Indicator
   Calculated over a specified averaging time; expressed in terms of a specified statistic (form) (Ecological Benchmark)

8. Factors related to Characterizing Adversity

9. Standard Level
   Value of ecological indicator judged to provide requisite degree of protection for a specific endpoint

10. To determine whether standard is met:
    Compare measured air quality indicator(s) in ambient air to the calculated combinations of air quality indicators such that the ecological indicator value is greater than or equal to the ecological benchmark
Target Ecological Concerns

- Four targeted effect areas, using case studies
  - Aquatic acidification
  - Terrestrial acidification
  - Aquatic (excess) nutrient enrichment
  - Terrestrial (excess) nutrient enrichment
- Initial focus on aquatic acidification
  - Viewed as a reasonable choice
  - ANC ecological indicator
  - Ecosystem services impacted
    - Rec. fishing
    - Biodiversity
Case/Considered Study Areas

2002 Simulated NO₂ Annual Concentration

n.b.: 1) Areas experience range of concentrations
2) Air/watersheds go well beyond sensitive ecosystem
3) Critical loads vary dramatically
Multipollutant Approach to an Ecologically-Relevant Acidification Standard

**Indicator**

- ANC

**What is regulated**

- Deposition Load
- Atmospheric Concentrations

**Physical**

- Concentration-Deposition Relationship
  - \( \text{Dep}_{\text{NOx}} - C_{\text{SOx}} \)
  - \( \text{Dep}_{\text{NOx}} - C_{\text{NOx}} \)

**Regulatory**

- Acceptable depositional rate
- Deposition from reduced N
- Allowed NOx+SOx deposition

**Total acidifying deposition**
Application of Critical Load Function: Terrestrial Acidification

Kane Experimental Forest Case Study Area

Accounting for reduced nitrogen load:

Risk and Exposure Assessment for Review of the Secondary National Ambient Air Quality Standards for Oxides of Nitrogen and Oxides of Sulfur: 2nd Draft
Many questions remain in each step, some really tough.
Thoughts

• CASAC generally likes the approach
  – Recognizes (as does EPA) many of the complexities are coming
    • Over what domain does one determine attainment?
    • What species are used as ambient indicators?
    • What about areas that are not adverse to or can benefit from additional deposition?
  – Interested in a non-concentration ambient air quality standard
    • Flux
      – My thought: measurement a major stumbling block and just replaces one modeled relationship with another, and we can be equally protective using concentrations
Just scratching the surface…

NO₂ Concentrations

Application area?

How do you account for varying concentrations and deposition velocities?

What is this in terms of [NO₂]?
What is this in terms of [NO₂] + [HNO₃] + [NO₃⁻] given the differing deposition velocities? Do we need to measure other forms of oxidized N?

How do you determine the deposition of reduced N? Do we need to measure NH₃? If so, how?

What is this in terms of [SO₂]? What is this in terms of [SO₂] + [SO₄²⁻] given the differing deposition velocities? Do we need to measure other forms of oxidized S?

What is this in terms of [NO₂]? What is this in terms of [NO₂] + [HNO₃] + [NO₃⁻] + … given the differing deposition velocities? Do we need to measure other forms of oxidized N?
Summary

- EPA developing foundation for multipollutant, multieffect NAAQS
  - Significant added complexities
  - Responsive to CASAC, National Research Council, SAB
- Separated review of NO\textsubscript{x} and SO\textsubscript{x} primary and secondary NAAQS reviews
  - Allows focus on relevant ecological endpoints (and maybe minimize likelihood of just setting the secondary equivalent to the primary)
- Court ordered deadline pushing to limit options
  - Which choice is best?
  - Eager to continue review building upon current ISA & REA
- Approach developed in REA and discussed as part of the Policy Assessment is viewed positively
  - Awaiting how they deal with complexities (October for next update)