Review of the O_3 NAAQS: First Draft Welfare Risk and Exposure Assessment (REA)

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Structure of 1st Draft Welfare REA

Chapter 1: Introduction

Chapter 2: Conceptual Framework

Chapter 3: Scope

Chapter 4: Air Quality Considerations

Chapter 5: Ecological Effects

Chapter 6: Ozone Risk to Ecosystem Services

Chapter 7: Synthesis

Chapter 4: Air Quality Considerations

- W126 National-scale "Fused Surface"
  - Recent Air Quality
    - 2006-2008 W126 concentrations, calculated from ozone monitor data, were fused with 2007 CMAQ 12 km W126 modeled concentrations using the enhanced Voronoi Neighbor Averaging (eVNA) technique
      - Monitor data provided the absolute W126 values
      - Modeled data determined the gradient between monitors

Chapter 4: Air Quality Considerations

- W126 National-scale "Fused Surface"
  - Rollback to just meeting the Current 8-hr Standard
    - Recent air quality data was adjusted to simulate just meeting the current standard (i.e. 75 ppb) using Quadratic rollback approach
      - Monitors were grouped together throughout the US
      - If at least one monitor in a group had a design value (2006-2008) above 75 ppb, the monitors were rolled back
      - W126 values were calculated from the adjusted monitor ozone concentrations
      - The adjusted W126 values were used to generate a fused spatial surface

Air Quality “Fused Surfaces” for W126

Chapter 5: Ecological Effects

- Causal
  - Visible foliar injury, reduced vegetation growth, reduced productivity in terrestrial ecosystems, reduced yield and quality of agricultural crops, alteration of below-ground biogeochemical cycles
  - Reduced vegetation growth and visible foliar injury assessed quantitatively
- Likely to be Causal
  - Reduced carbon sequestration, Alteration of terrestrial ecosystem water cycling, Alteration of terrestrial community composition
- Concentration-Response Functions
  - Reduced vegetation growth (Relative Biomass Loss)

Chapter 5: Relative Biomass Loss

- This analysis was completed as part of the last review and was updated in this review with recent air quality data
- 11 tree species with Concentration-Response (C-R) functions
  - C-R functions for reduced growth were calculated as Relative Biomass Loss (RBL), comparing growth under varying ozone exposures to a baseline W126 of 0 ppm-hrs
  - 1 new species from the last review (*Eastern cottonwood*)
  - Species ranges were based on published U.S. Forest Service data
  - Ranges for eastern species were updated based on Forest Inventory Analysis data
- Analyses included assessment of absolute RBL values and the proportional change in RBL between exposure scenarios

Chapter 5: Abundance-Weighted Biomass Loss

- Abundance data from the U.S. Forest Service, collected as part of the Forest Inventory Analysis Program, were used to weight the Relative Biomass Loss (RBL) values for each tree species
- This was intended to scale the RBL values to assess potential effects at an ecosystem level
- Federal Class I and designated Critical Habitat Areas were used as geographic endpoints for analysis
- Analyses were limited by data availability (8 eastern species were included)
- Absolute weighted biomass loss values are difficult to interpret, so the focus of this analysis was on the proportional change between exposure scenarios

Chapter 5: National Park Case Study Areas

- Great Smoky Mountains, Rocky Mountain, and Sequoia/Kings Canyon National Parks
  - Great Smokey Mountains was analyzed in this draft
- Abundance values were based on USGS/NPS vegetation mapping
  - Abundance data were used to weight the relative biomass loss values
- Ozone exposure estimates were based on the national fused-surface described in Chapter 4

Chapter 5: Visible Foliar Injury

- This is an incomplete analysis in this draft
- For the 2nd draft this will include ozone monitoring data from the U.S. Forest Service Forest Health Monitoring program
  - This analysis will also include moisture data
- The National Park's ozone sensitive species list was used to assess overall cover of ozone sensitive tree species in the eastern U.S. based on U.S. Forest Service FIA data
- This draft includes a draft screening level assessment visible foliar injury risk in National Parks updating a study by Kohut (2007)

Chapter 6: Ecosystem Services Assessment

- The Ecosystem Services Framework used in this draft is based on the Millennium Ecosystem Assessment
- Quantitative assessments of services were included when possible (e.g. Carbon sequestration and pollution removal)
- For many services quantitative assessment of the incremental impact of changes in ozone exposure were not feasible
  - Qualitative assessments of these services were presented as a means of providing context for the scope and magnitude of the potentially affected services

Chapter 6: National Scale Assessment

Regulating Services
Benefits obtained through regulation of ecosystem processes

Climate regulation*
Water regulation
Fire regulation
Pollination

Provisioning Services
Products obtained from ecosystems

Food*
Timber*
Nontimber forest products

Cultural Services
Nonmaterial benefits obtained from ecosystems

Nonuse
Aesthetic
Recreation and ecotourism
Educational

Supporting Services
Services necessary for the production of all other services

Net primary productivity
Community composition

Services marked with an * were assessed in this draft.

Chapter 6: National Scale Assessment

- Forest and Agriculture Services Optimization Model-Green House Gas (FASOM-GHG) model for commercial forestry and agriculture
  - Quantifies incremental effects of ozone induced biomass loss on timber and agricultural markets
  - Addresses climate regulation in the form of changes in carbon storage
- Modelling included the 11 tree species with C-R functions analyzed in Chapter 5 as well as agricultural species identified in the ISA
  - These species were as proxies for other species in the model to account for trade-offs assessed in the model

Chapter 6: Urban Case Studies

- iTree model
  - Run in collaboration with the U.S. Forest Service
  - Estimates ozone induced biomass loss effects on carbon sequestration and pollution removal in urban systems
  - Results modeled in: Atlanta, Baltimore, Syracuse, Chicago Region, Tennessee (urban areas)
- 8 eastern tree species with C-R functions
  - Most areas had only 2-3 of these species present
- iTree does not include trade-offs between species, so only changes in species with C-R functions were modeled

Chapter 7: Summary of Key Points

- Biomass Loss
  - The magnitude and shape of the RBL C-R functions varied significantly between species, but on average there was a 30% reduction in biomass loss when O_3 concentrations were adjust to just meet the current standard
- Visible Foliar Injury
  - In some areas of the eastern U.S. O_3 sensitive tree species make up ~80% of the tree cover
- Ecosystem Services
  - FASOM estimated the average yield reduction for commercial timber was 5.2%
  - iTree estimates for urban forest services included reductions in C sequestration and pollution removal

Potential Updates for the Second Draft

- New model runs for FASOMGHG and iTree for alternate standards
- Include uncertainty analyses
- More quantitative treatment of fire and bark beetle risk in relation to ozone exposure levels
- Exploring the use of PnET to assess changes in net primary productivity and water cycling
- Complete national park case studies