

# Review of the O<sub>3</sub> NAAQS: Second Draft Welfare Risk and Exposure Assessment (REA)

Clean Air Scientific Advisory Committee Meeting  
CASAC Ozone Panel  
March 25-27, 2014





# Overarching Changes Since 1<sup>st</sup> Draft Welfare REA

- Restructuring of document to better integrate ecosystem function changes and ecosystem services
- Focus on scenarios of just meeting existing and alternative O<sub>3</sub> standard levels
- Use of CMAQ-HDDM based approach to adjust distributions of O<sub>3</sub> concentrations to just meet existing and alternative O<sub>3</sub> standard levels
- Incorporated more comprehensive uncertainty characterization



# Structure of 2<sup>st</sup> Draft Welfare REA

Chapter 1: Introduction

Chapter 2: Framework

Chapter 3: Scope

Chapter 4: Air Quality Considerations

Chapter 5: O<sub>3</sub> Risk to Ecosystem Services

Chapter 6: Biomass Loss

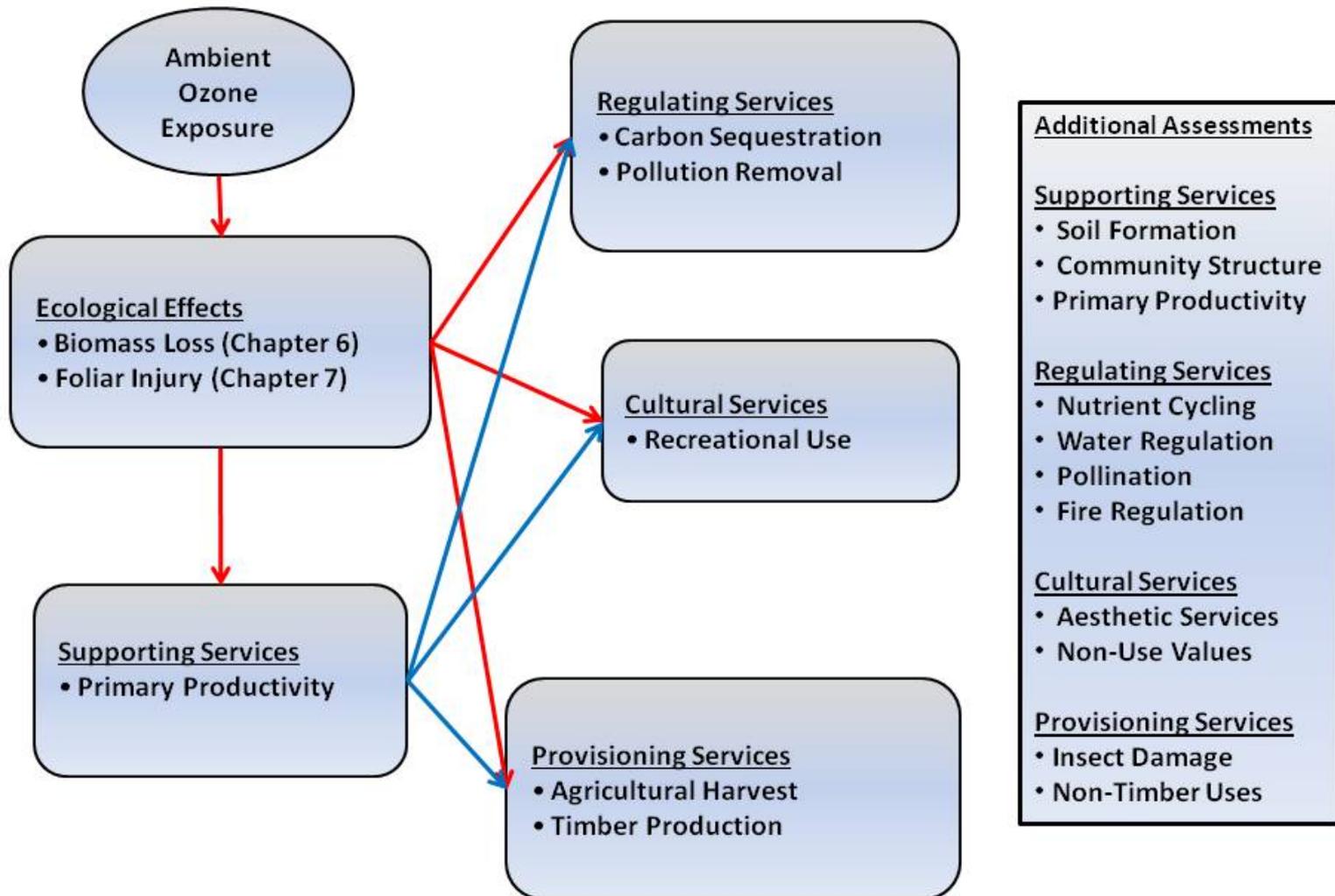
Chapter 7: Visible Foliar Injury

Chapter 8: Synthesis of Results

Chapter 9: References



# Overview of REA Design

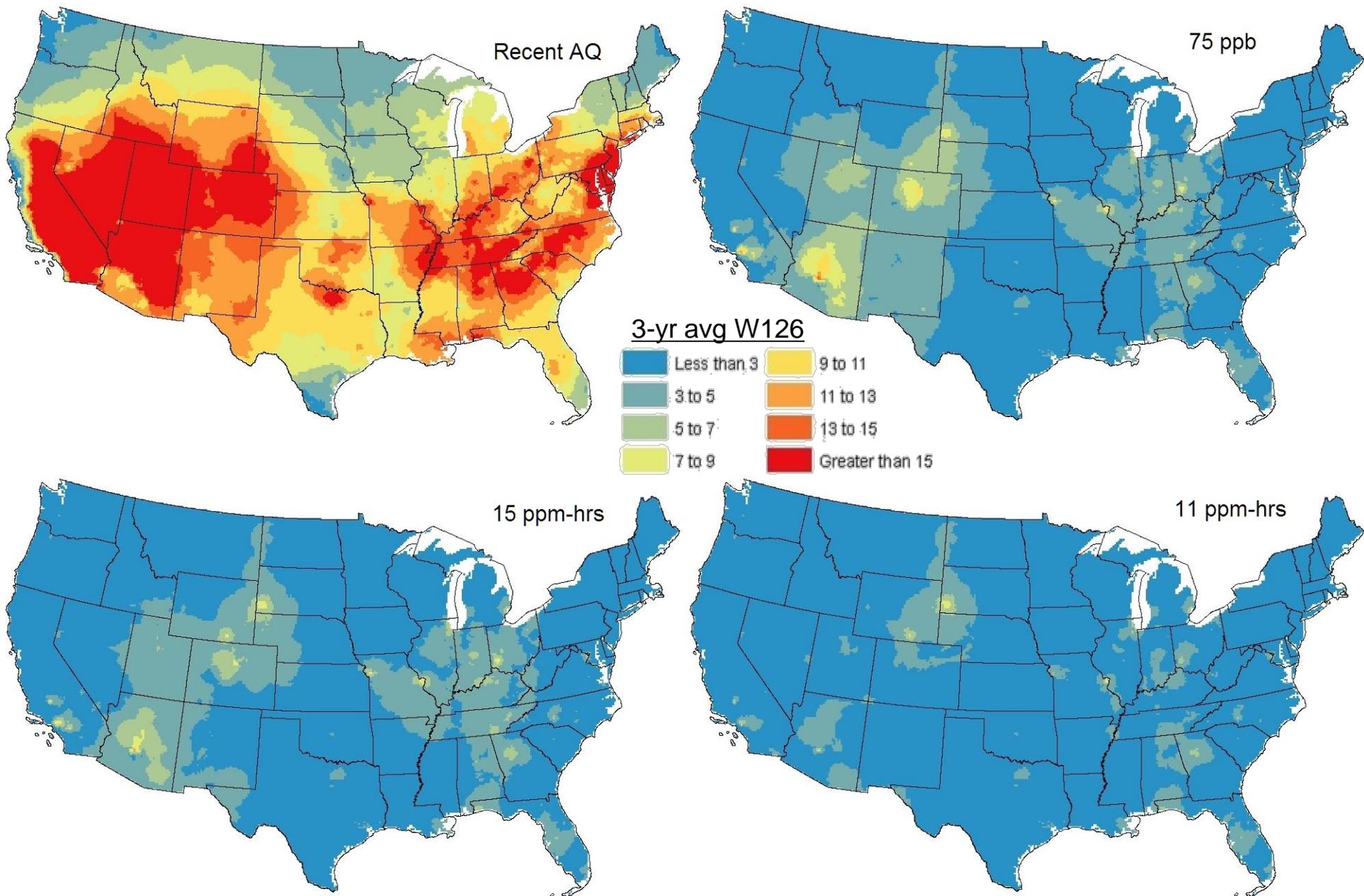




# Air Quality Characterization: Methodology

- Recent Air Quality (2006-2008)
  - Interpolation of monitored W126 concentrations using Voronoi Neighbor Averaging (VNA)
    - 3-year average W126 concentrations interpolated to 12 km x 12 km grid covering the contiguous U.S.
- Adjusted Air Quality
  - Model-based adjustment methodology, using CMAQ-HDDM
  - Adjusted 2006-2008 air quality data to meet the current standard (75 ppb), and potential alternative standards of W126 with levels of 15, 11, and 7 ppm-hrs
    - Adjustments based on “across-the-board” reductions in U.S. anthropogenic NO<sub>x</sub> emissions
    - Adjustments were applied independently to 9 regions covering the contiguous U.S.
    - Hourly ozone concentrations adjusted at all monitor locations in each region based on emissions reduction required for the highest monitor (This brings most monitors below the target standard level.)
    - Air quality was adjusted to meet the current standard (75 ppb) before adjusting to meet the potential alternative W126 standards. (In some cases, meeting the current standard brought regions below the alternative W126 standard, and no further adjustments were required.)
    - National-scale surfaces of W126 based on adjusted air quality created using VNA
- Changes from the 1st draft welfare REA
  - Interpolation of monitored W126 concentrations replaced monitor/model data fusion using eVNA for creating national-scale W126 surfaces
  - Model-based adjustment methodology replaced quadratic rollback. Model-based adjustment:
    - More realistically captures spatially and temporally varying O<sub>3</sub> response that can occur from reductions in precursor emissions
    - Estimates both increases and decreases in hourly O<sub>3</sub> concentrations

# National W126 Surfaces at Various Standard Levels





# Ecosystem Services

- **Methodology**

- Ecological effects are explicitly linked with associated ecosystem services
- Where feasible, quantitative estimates of changes in ecosystem services are provided
- For additional ecosystem services, semi-quantitative GIS assessments of potential for O<sub>3</sub> impacts are provided
- Where insufficient data is available for quantification, qualitative discussions of the magnitude and significance of potentially affected ecosystem services are included

- **Changes from 1<sup>st</sup> Draft REA**

- Includes a more comprehensive description of the overall ecosystem services framework and how the components of this assessment fit into that framework
- Includes a semi-quantitative assessment of risk associated with the combined effects of elevated O<sub>3</sub>, bark beetle, and fire risk
- Includes qualitative discussion of additional ecosystem services affected by O<sub>3</sub> that were not quantifiable



# Relative Biomass Loss: Methodology

- Individual Species Analyses
  - Evaluated 12 tree species and 10 crop species
  - Calculated W126 values associated with alternative percent biomass losses
  - Generated national relative biomass loss (RBL) surfaces for each species for recent O<sub>3</sub> and after meeting existing standard and alternative W126 levels
- Ecosystem Level Analyses (Weighted RBL Values)
  - Used modeled basal area from the Forest Health Technology Enterprise Team (FHTET) to weight the RBL values of individual tree species
  - The weighted RBL values were summed across species to calculate a weighted-RBL that included all 12 species
  - Summarized the data nationally by geographic regions and across Class I areas
- Ecosystem Services
  - Estimated commercial timber and agricultural impacts using FASOM-GHG sector model for recent O<sub>3</sub> and after meeting existing standard and alternative W126 levels
  - Calculated changes in producer and consumer welfare
  - Changes in yields and welfare are provided at the national, regional, and state and county level
  - Changes in carbon storage are also estimated for forestry and agriculture
  - Estimates of changes in carbon storage and air pollution removal by urban forests are provided for 5 urban case study areas using the i-Tree modeling system



# Relative Biomass Loss: Changes from 1<sup>st</sup> Draft

- Individual Species Analyses
  - Included 1 additional tree species (Loblolly Pine)
  - Added assessment of crop yields to main document
  - Compared the effect of compounding individual year's RBL values to using average values
- Ecosystem Level Analyses
  - Replaced "importance value" analysis with basal area weighted RBL values
- Ecosystem Services Analyses
  - Added agriculture crop analysis to main body
  - County level relative yield loss (RYL) values for crop species in appendix
  - Added i-Tree analysis
- Uncertainty
  - Semi-quantitatively assessed the uncertainty in relating seedling C-R functions to adult trees
  - Quantitatively assessed the effect of within species variability on estimated W126 levels associated with varying levels of biomass loss
  - Included qualitative assessment of other uncertainties associated with the RBL analyses



# Visible Foliar Injury: Methodology

- National Scale Assessment of Basal Area
  - Summarized the percent cover of 15 sensitive tree species in relation to recent (2006 to 2008) O<sub>3</sub> conditions
- Forest Health Monitoring (FHM) Data
  - Analyzed the relationship of FHM foliar injury data (2006 – 2010) to O<sub>3</sub> and moisture
  - Performed a cumulative analysis assessing the relationship of O<sub>3</sub> to the proportion of sites with foliar injury
- National Park Risk Screening-level Assessment
  - Used FHM data to calculate benchmark values of W126
  - Assessed 214 National Parks (42 with monitors) using varying combinations of moisture and O<sub>3</sub>
- National-scale Qualitative Treatment for Recreation
- Case Study Analysis
  - Assessed Great Smoky Mountains, Rocky Mountain and Sequoia/Kings National Parks
    - Included assessment of foliar injury benchmarks and the percent cover of O<sub>3</sub> sensitive species within vegetation communities
    - Assessed visitor activities and spending to estimate the impacted ecosystem services



# Visible Foliar Injury: Changes from 1<sup>st</sup> Draft

- New FHM analysis
- Foliar injury screening-level assessment
  - Expanded analysis to include non-monitored parks
  - Focused on W126 alone rather than other metrics
  - Derived W126 benchmarks from FHM data rather than biomass loss
  - Incorporated soil moisture quantitatively into 5 of the 6 benchmark scenarios
  - Determined the number of years that a park exceed benchmarks rather than classifying results as high, moderate, or low risk



# Synthesis: Changes from 1<sup>st</sup> Draft

- In response to CASAC's comments, expanded discussion on synthesis of results of assessments
  - Summarized national- and case study-scale analyses
  - Considering various benchmarks for biomass loss and foliar injury, reviewed national- and case study-scale analyses to identify any patterns or trends in risk and risk reduction between geographic areas or across years or alternative standards
  - Included discussion on representativeness of vegetation species, geographic regions, and timeframes
- Included discussion of key limitations and uncertainties, along with individual discussions of uncertainties in air quality, biomass loss, and foliar injury analyses
- Provided general conclusions on remaining O<sub>3</sub> exposure-related welfare risk and risk reductions



# Welfare REA Team

## OAQPS Team

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## Other Acknowledgments

Tyler Fox

Neil Frank

Liz Naess

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