CASAC Perspectives* on EPA NAAQS Staff Paper

Rich Poirot, VT DEC, OTC Meeting, Providence, RI, 6/6/07

* Disclaimer: One small state's perspective only

CASAC is one of Several Advisory Committees convened under and supported by the EPA Science Advisory Board

Clean Air Scientific Advisory Committee

Enabling Legislation

Clean Air Act (CAA) Amendments of 1977 (Public Law 95-95)

42 USC Sec. 4209 (d)(2)(A)

The Administrator shall appoint an independent scientific review committee composed of seven members including at least

one member of the National Academy of Sciences,

one physician, and

one person representing State air pollution control agencies.

Clean Air Scientific Advisory Committee (CASAC)

Dr. Rogene Henderson, **CHAIR**, Scientist Emeritus, Lovelace Respiratory Research Institute, Albuquerque, NM

Dr. Douglas Crawford-Brown, Director, Carolina Environmental Program; University of North Carolina at Chapel Hill, Chapel Hill, NC

Dr. Armistead (Ted) Russell, Georgia Power Distinguished Professor of Environmental Engineering, Georgia Institute of Technology, Atlanta, GA

Dr. Ellis Cowling, University Distinguished Professor-at-Large, Colleges of Natural Resources and Agriculture and Life Sciences, North Carolina State U., Raleigh, NC

Dr. James Crapo, Professor, Department of Medicine, National Jewish Medical and Research Center, Denver, CO

Dr. Frank Speizer, Edward Kass Professor of Medicine, Channing Laboratory, Harvard Medical School, Boston, MA

Mr. Richard Poirot, Environmental Analyst, Air Pollution Control Division, Dept. of Environ. Cons., VT Agency of Natural Resources, Waterbury, VT

Additional Members of CASAC Ozone Review Panel

1. **Dr. John Balmes (M.D.)**, University of California, San Francisco (CA)
2. **Dr. William (Jim) Gauderman**, University of Southern California (CA)
3. **Dr. Henry Gong (M.D.)**, University of Southern California (CA)
4. **Dr. Paul J. Hanson**, Oak Ridge National Laboratory (TN)
5. **Dr. Jack Harkema**, Michigan State University (MI)
6. **Dr. Philip Hopke**, Clarkson University (NY)
7. **Dr. Michael T. Kleinman**, University of California, Irvine (CA)
8. **Dr. Allan Legge**, Biosphere Solutions (Canada)
9. **Dr. Mort Lippmann**, New York University (NY)
10. **Dr. Maria Morandi**, University of Texas, Houston (TX)
11. **Dr. Charles Plopper**, University of California, Davis (CA)
12. **Dr. Armistead (Ted) G. Russell**, Georgia Institute of Technology (GA)
13. **Dr. Elizabeth A. (Lianne) Sheppard**, University of Washington (WA)
14. **Dr. James S. Ultman**, Pennsylvania State University (PA)
15. **Dr. Sverre Vedal (M.D.)**, University of Washington School of Medicine (WA)
16. **Dr. James V. Zidek**, University of British Columbia (Canada)

CASAC Duties (from 1977 CAA Amendments):

Shall **Review** Primary and Secondary NAAQS and underlying Scientific Criteria (Every 5 Years)

Shall **Recommend** to the Administrator any new national ambient air quality standards and revisions of existing criteria and standards as may be appropriate

Shall also **Advise** the Administrator of areas in which additional knowledge is required to appraise the adequacy and basis of existing, new, or revised national ambient air quality standards,

Describe the research efforts necessary to provide the required information,

Advise the Administrator on the relative contribution to air pollution concentrations of natural as well as anthropogenic activity, and

Advise the Administrator of any adverse public health, welfare, social, economic, or energy effects which may result from various strategies for attainment and maintenance of such national ambient air quality standards.

Primary Standards "shall be ambient air quality standards the attainment and maintenance of which in the judgment of the Administrator, based on such criteria and allowing an adequate margin of safety, are requisite to protect the public health." (CAA § 109 (b) (1))

To be attained in 5 Years , with extensions of up to 15-20 years for Severe to Extreme Ozone non-attainment

Secondary Standards "shall specify a level of air quality the attainment and maintenance of which in the judgment of the Administrator, based on such criteria, is requisite to protect the public welfare from any known or anticipated adverse effects associated with the presence of such air pollutant in the ambient air." (CAA § 109 (b) (2))

To be attained as Expeditiously as Practicable (No set date)

"All language referring to **effects on welfare** includes, but is not limited to, effects on soils, water, crops, vegetation, man-made materials, animals, wildlife, weather, visibility, and climate, damage to and deterioration of property, and hazards to transportation, as well as effects on economic values and on personal comfort and well-being, whether caused by transformation, conversion, or combination with other air pollutants." (CAA § 302 (h))

* added in 1990 Amendments

Recent NAAQS Reviews (final & ongoing)

Particulate Matter NAAQS Review (Final, but CASAC Letters disagree with Proposed & Final Primary & 2ndary NAAQS)

Ozone NAAQS Review (Final Staff Paper but CASAC Letter disagrees with upper bounds of Proposed Primary & 2ndary NAAQS)

Lead NAAQS Review (Final CD & 1st Draft "Staff Paper" & Risk Assessment, CASAC Recommends Substantially Lower NAAQS)

SO2 and NO2 NAAQS Reviews (Just started with separate Panels for Primary & Secondary NAAQS)

Particulate Matter NAAQS Review (About to start again with Science Workshops this summer)

From CASAC 9/29/06 (PM) letter to Administrator Johnson:

"In summary, the Agency has rejected the CASAC's expert scientific advice with regard to lowering the level of the annual primary fine particle ($PM_{2.5}$) standard and establishing a new coarse particle ($PM_{10-2.5}$) standard — both of which are consistent with the recommendations of the nationally-recognized science, medical and public health groups such as those cited above — and, in addition, EPA has not followed our advice in setting a separate secondary $PM_{2.5}$ standard.

We note that, since the CASAC's inception in the late 1970s, the Agency has always accepted the Committee's scientific advice with regard to final NAAQS decisions. In view of this, we question whether you have appropriately given full consideration to CASAC's expert scientific advice — obtained through open, public processes — in your final decisions on the PM NAAQS."

Proposed Ozone Standard Ranges

Primary – 3 yr Average of 4th highest 8-hour daily Max

Current Standard: 0.08 ppm (rounded 0.084)

CASAC: 0.060 to 0.070 ppm

EPA Staff: 0.060 to "somewhat below 0.080"

Secondary – 3 Month 12-hour W126 (weighted sum)

Current Standard (same as primary)

CASAC: 7 to 15 ppm-h

EPA Staff: 7 to 21 ppm-h

From CASAC 3/27/07 Letter on EPA Final Ozone Staff paper:

“**Reiterating** what was stated in the CASAC’s previous letter to you on this review (EPA-CASAC-07-001), **Ozone Panel members were unanimous in recommending that the level of the current primary ozone standard should be lowered from 0.08 ppm to no greater than 0.070 ppm.”**

“The Ozone Panel agrees with EPA Staff recommendations that the lowest bound of the range within which a seasonal **W126 welfare-based (secondary) ozone standard** should be considered is 7.5 ppm-hrs; however, it ***does not* agree with Staff’s recommendations that the upper bound of the range should be as high as 21 ppm-hours**. Rather, the Panel recommends that the **upper bound of the range considered should be no higher than 15 ppm-hour**…”

Ozone health effects overview: “Pyramid of effects”

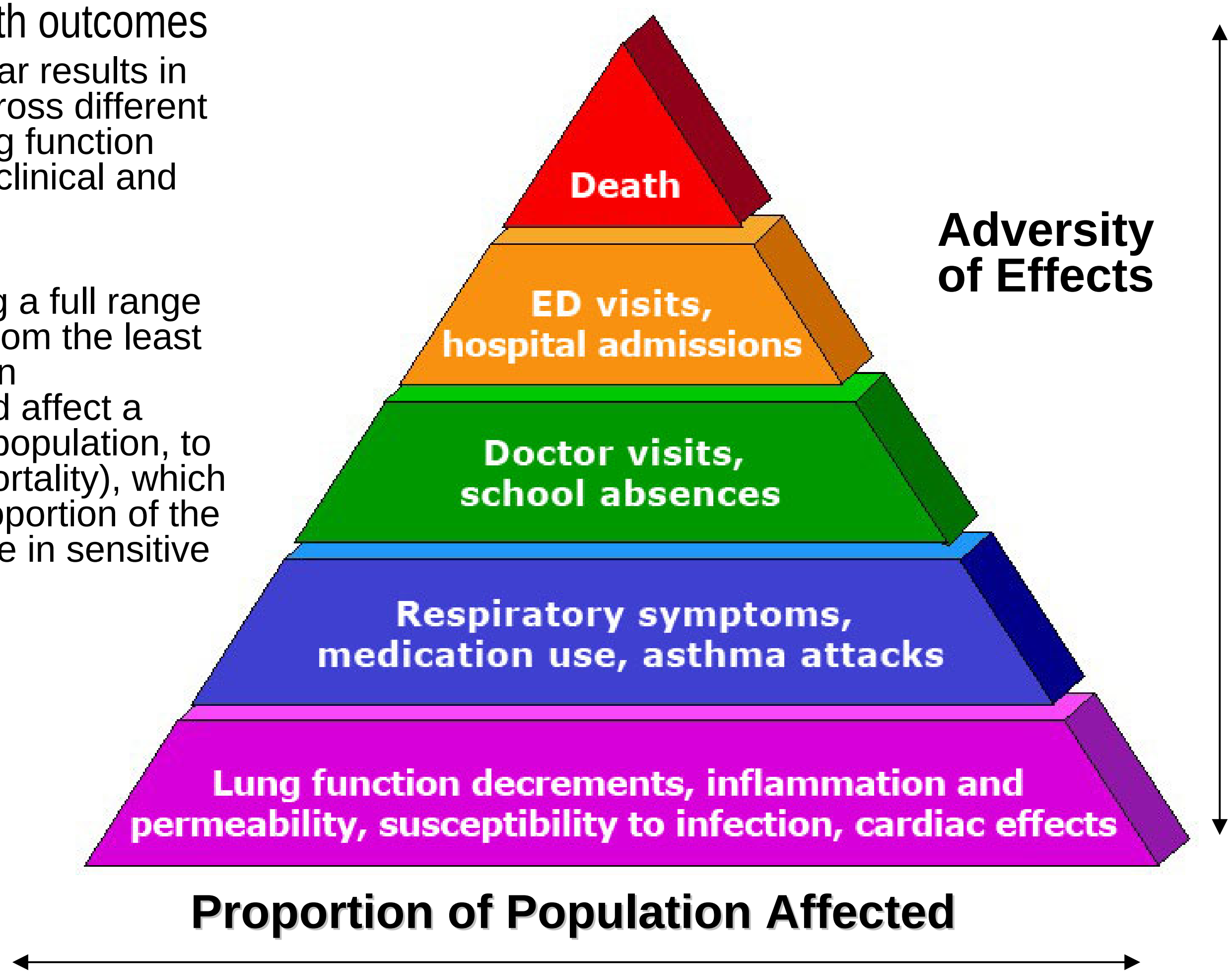
- Consistent and coherent effects seen across a wide range of health outcomes
  - Consistent effects -- similar results in different locations and across different types of studies (e.g., lung function effects in animal, human clinical and epidemiology studies)
  - Coherent effects -- finding a full range of related health effects from the least serious (e.g., lung function decrements), which would affect a greater proportion of the population, to the most serious (e.g., mortality), which would affect a smaller proportion of the population (primarily those in sensitive groups)

Sensitive groups include:

Asthmatic children and other people with lung disease

All children and older adults, especially people active outdoors

Outdoor workers



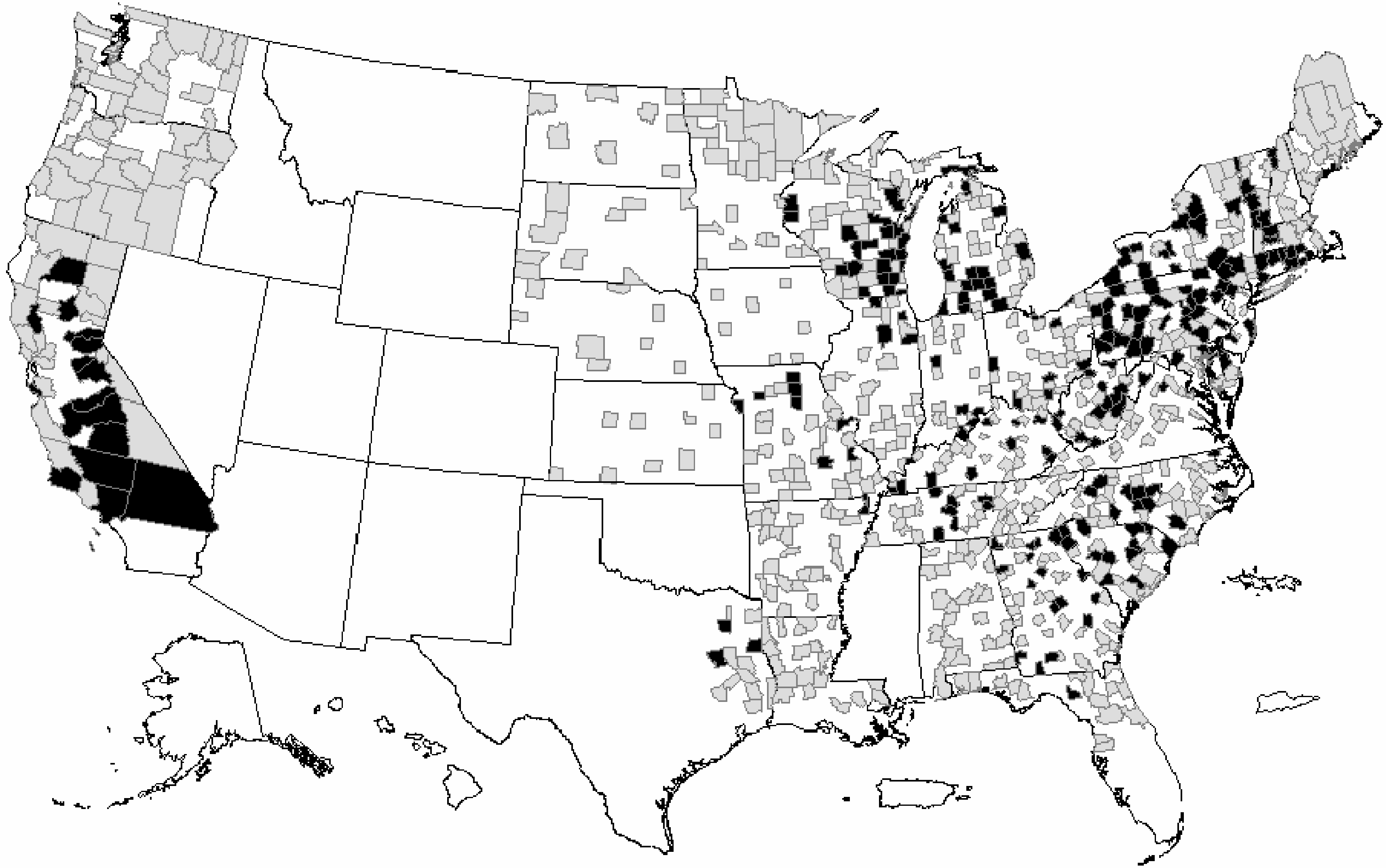
Clinical Studies

- Controlled human exposure studies provide clearest and most compelling evidence for an array of health effects caused by O_3 exposures, including:
  - Lung function decrements
  - Respiratory symptoms (e.g., pain on deep inspiration, cough, shortness of breath)
  - Biomarkers of lung injury including inflammation, increased airway permeability, and increased susceptibility to respiratory infection
  - Increased airway responsiveness (airway hyperreactivity)
- Lung function decrements and respiratory symptoms (e.g., pain on deep inspiration, shortness of breath, cough) observed in healthy adults at O_3 levels as low as 0.060 ppm (6.6-hr exposures under moderate exertion)
- All biomarkers of lung injury, including lung inflammation, as well as increased airway responsiveness, observed in healthy young adults at O_3 levels as low as 0.080 ppm (6.6-hr exposures under moderate exertion)
- Evidence indicates that people with asthma, especially children, experience more serious effects. Thus, studies of healthy subjects likely underestimate O_3-related effects on asthmatics and other sensitive groups.
- Levels at which these types of effects are judged to be adverse are drawn from principles published by the American Thoracic Society and reviewed by CASAC

Epidemiologic Studies

- Numerous epidemiologic studies, including important new multi-city studies as well as field and panel studies, add to previous evidence of O_3-related respiratory morbidity effects (lung function decrements, symptoms, hospital admissions, emergency department visits)
  - Effects evaluated in outdoor workers, athletes, the elderly, hikers, school children, and asthmatics
  - Provide evidence of new health outcomes, including asthma medication use, school absenteeism, and cardiac-related effects
  - Evidence indicates that people with asthma, especially children, experience more serious effects including larger lung function decrements, increased respiratory symptoms, increased airway responsiveness, and greater inflammatory responses
- Large multi-city studies and three meta-analyses provide evidence of a robust association between ambient O_3 and mortality
- Observed effects supported by new animal toxicological studies that provide new information regarding mechanisms of actions and biological plausibility
- Effects observed especially in the warm season
- Report effects at levels well below the level of the current standard
- No clear evidence regarding threshold: if a population threshold does exist, likely well below level of current standard and possibly within range of background concentrations

Is Foliar Injury Present or Absent?, 2002



Foliar Injury Absent Present

In 1997 Ozone NAAQS Review, EPA Considered (but rejected) a seasonal cumulative 3-month 12-hr SUM06 Secondary Ozone Standard of 25 ppm-hr

SUM06 ranges agreed on by Vegetation Effects Experts at 1997 consensus-building workshop on the need for a long-term cumulative secondary O3 standard:

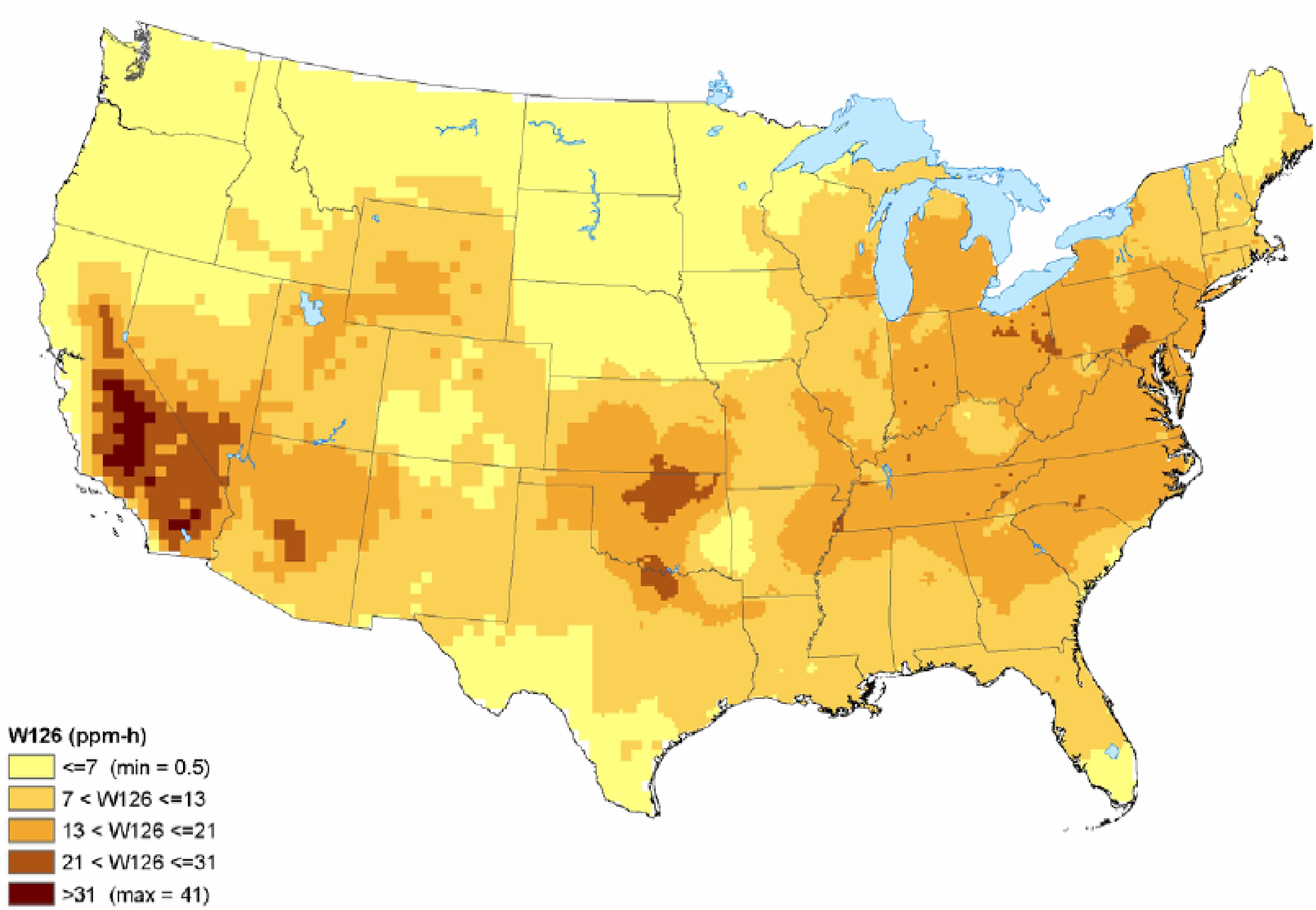
foliar injury to natural ecosystems	8 to 12 ppm-hr
growth effects to tree seedlings in natural forest stands	10 to 15 ppm-hr
growth effects to tree seedlings and saplings in plantations	12 to 16 ppm-hr
yield reductions in agricultural crops	15 to 20 ppm-hr

From: Heck, W. W.; Cowling, E. B. (1997) The need for a long term cumulative secondary ozone standard – an ecological perspective. EM (January): 23-33

Note: the above ranges are expressed in terms of protective levels of SUM06. "Equivalent" levels (IMHO) of W126 would be about 75% of SUM06.

CASAC Recommended Range was 10 to 20 ppm-h SUM06 or 7 to 15 ppm-h W126.

Estimated W126 Exposures (if current O.08 ppm 8-hour standard were attained)



Summer Seasonal 12-Hr. SUM06

Sum of all ozone concentrations >= 0.06 ppm

Aggregated over the maximum 3-month ozone season

But including only the 12 “Daylight” Hours

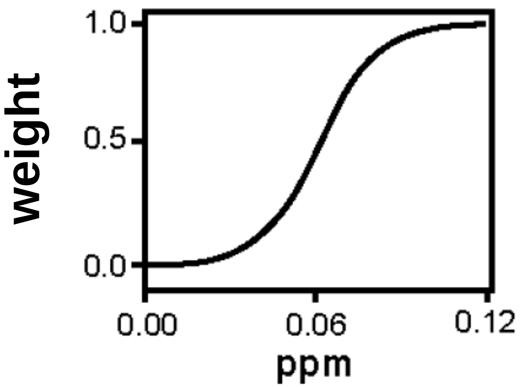
Summer Seasonal 12-Hr. W126

Same as above except all concentrations are used

And are weighted before summing,

Using a sigmoidal curve ($1/1+4403e^{-126C}$)

Understanding the W126 Form



Steps in calculating W126 value for a particular site:

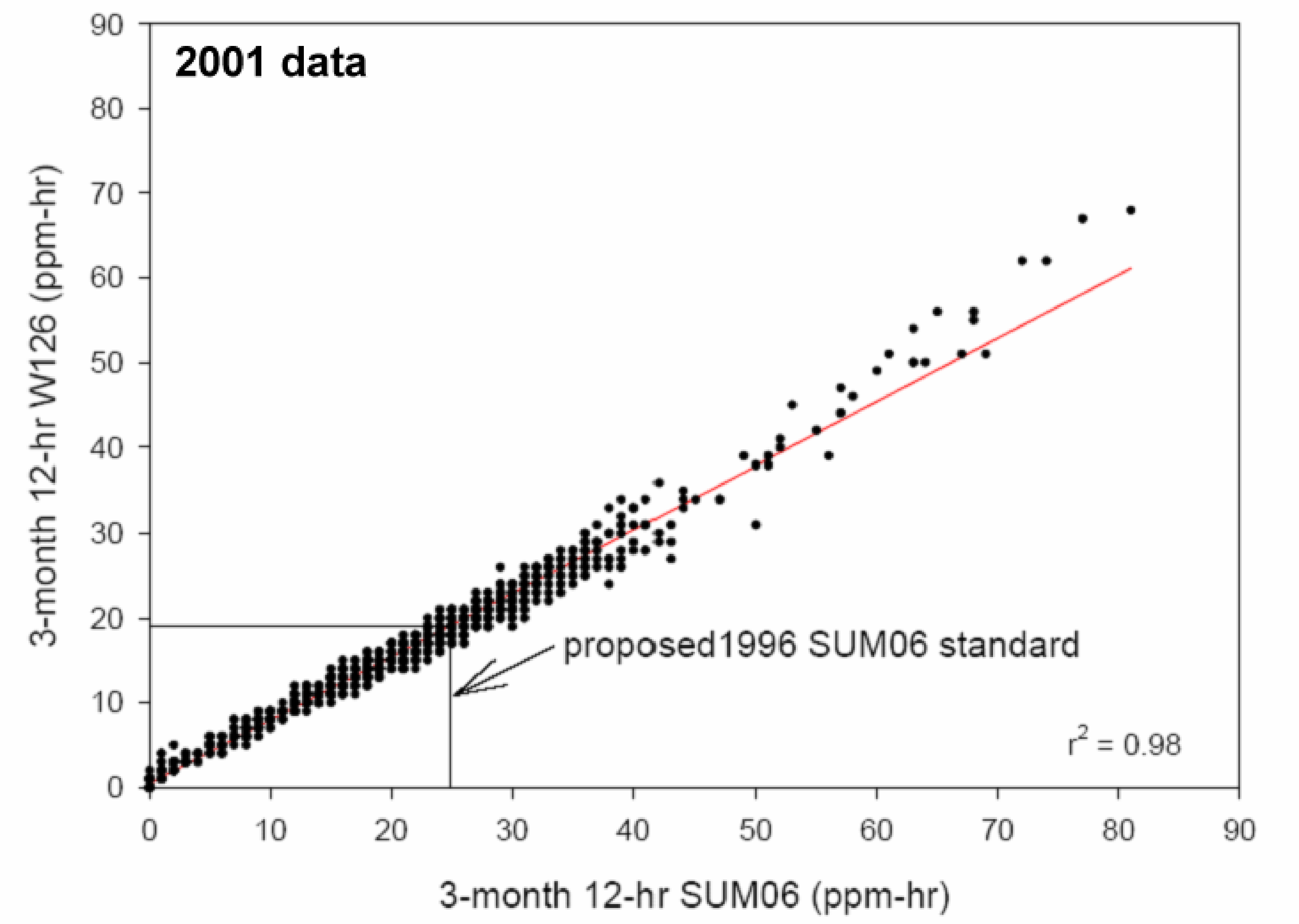
1. Measure hourly O_3 value
2. Weight hourly value based on concentration: lower concentrations receive less weight than higher concentrations
3. Add the weighted hourly values for each hour of a 12-hour daylight period (8 am – 8 pm) to calculate daily value for each day
4. Sum daily values over highest consecutive 3-month period in ozone season
5. W126 = Sum of all weighted daily O_3 values over highest consecutive 3-month period

Example of weighting over 5-hour period:

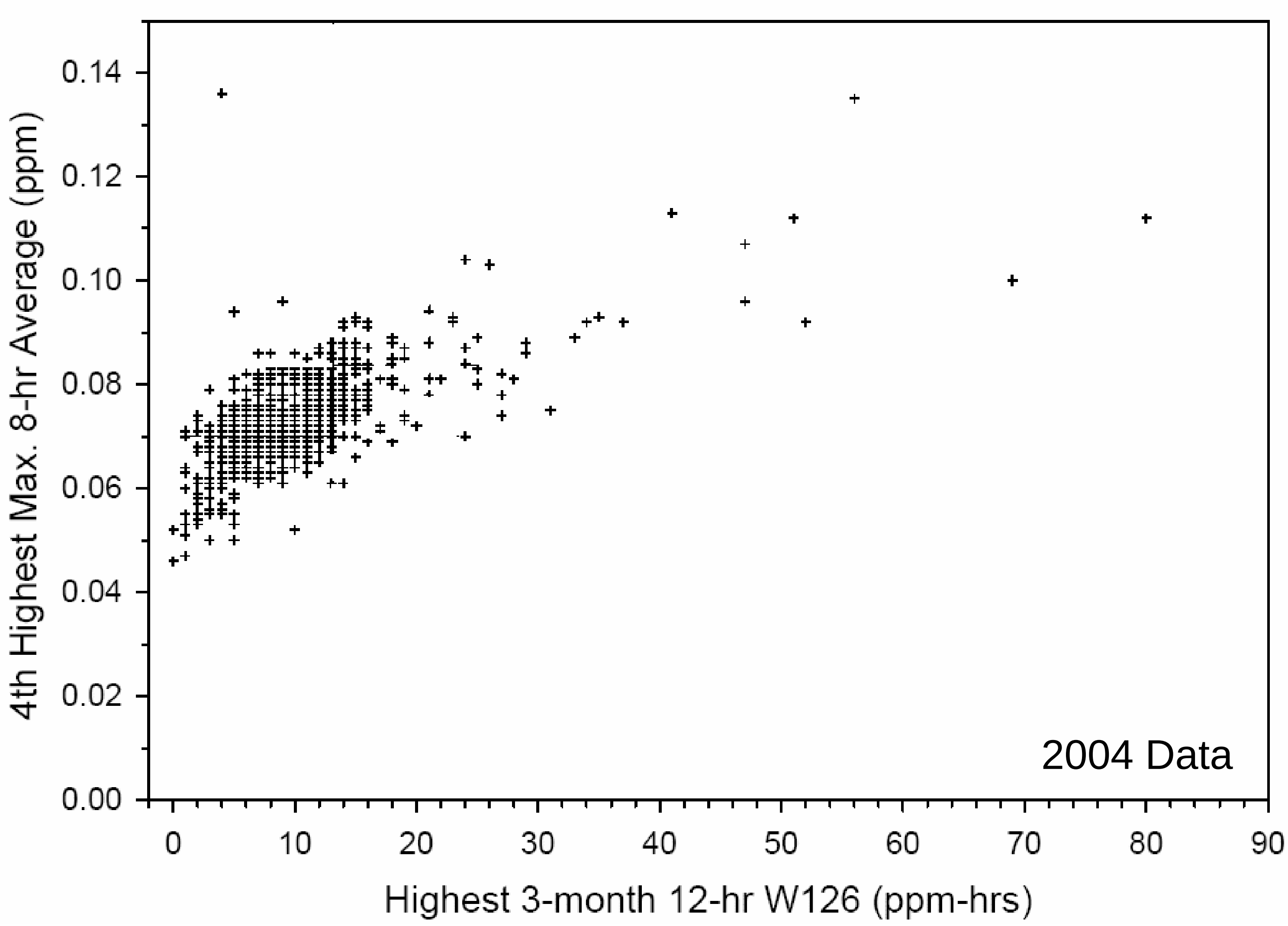
Hourly O_3 (ppm)	Weight	W126 (ppm-hrs)
0.03	0.01	0.00
0.05	0.11	0.01
0.06	0.30	0.02
0.08	0.84	0.07
0.10	1.0	0.10

Daily value = sum of values over 12 daylight hours

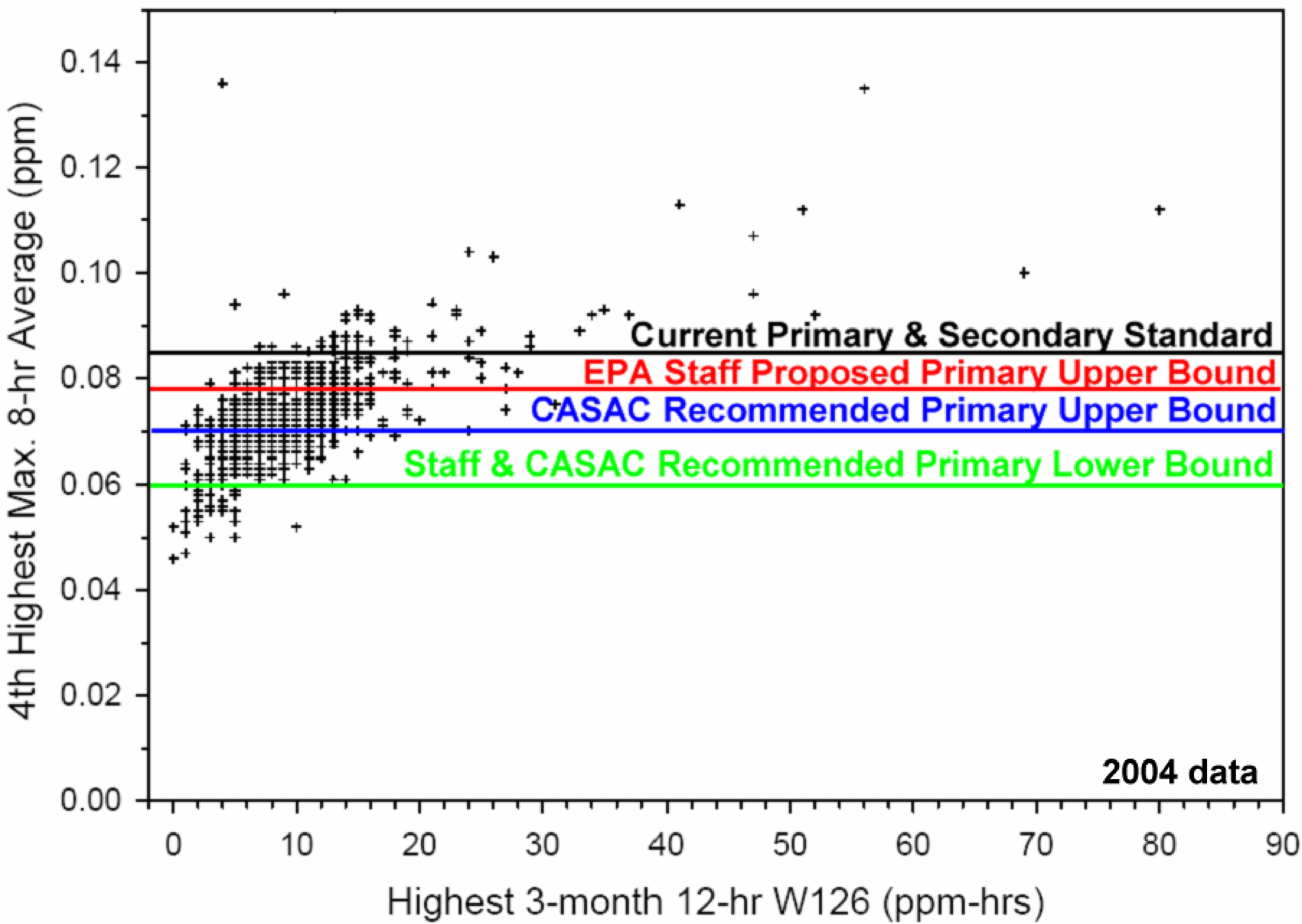
W126 is Highly Correlated with SUM06, Slope = about 0.75



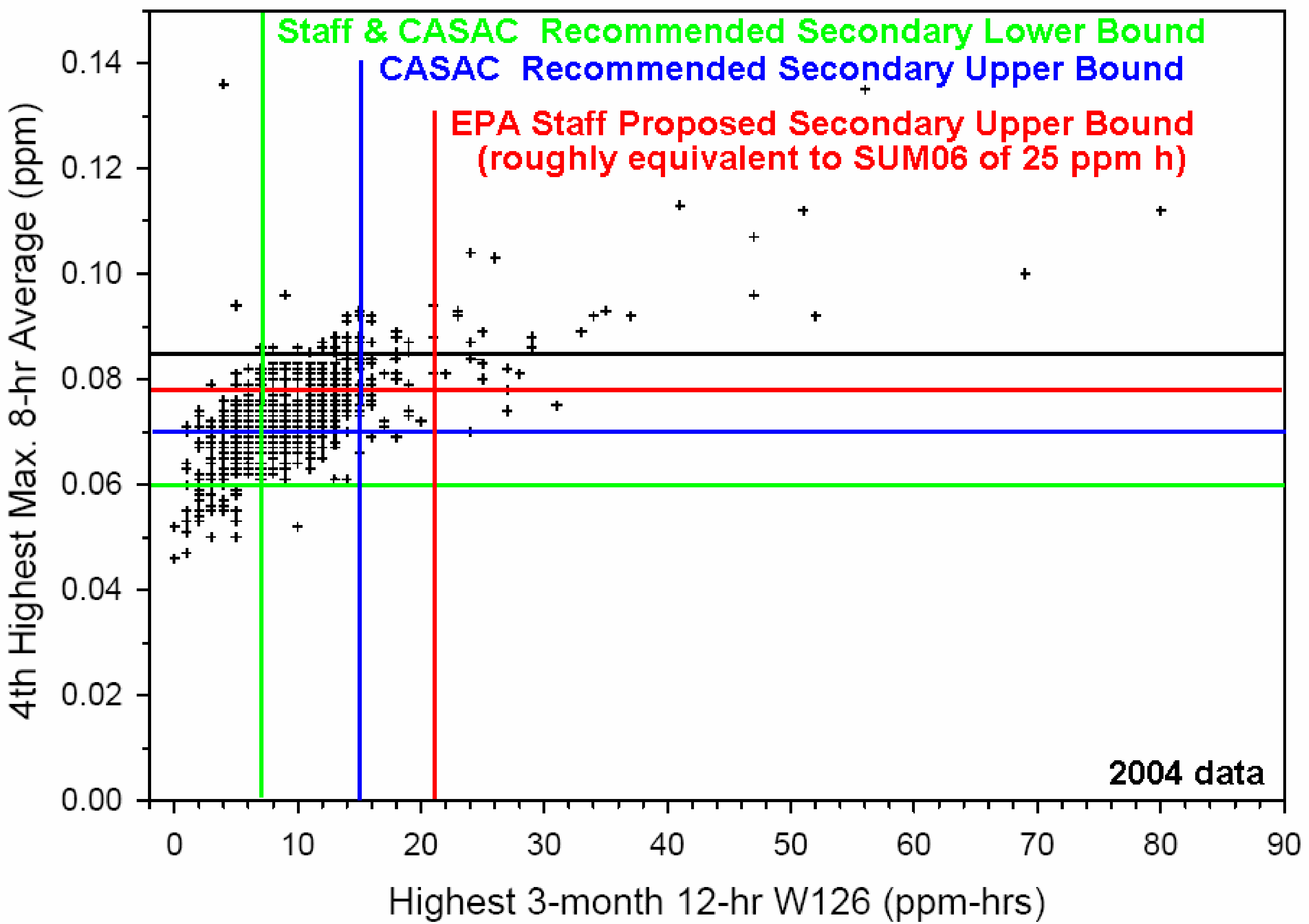
W126 Is Not Well Correlated with the 4th Highest 8-Hour Max (Hence the Clear Need for a Separate Secondary Standard)



* Note: W126 is a Seasonal Accumulation; No Need to Average over 3 Years

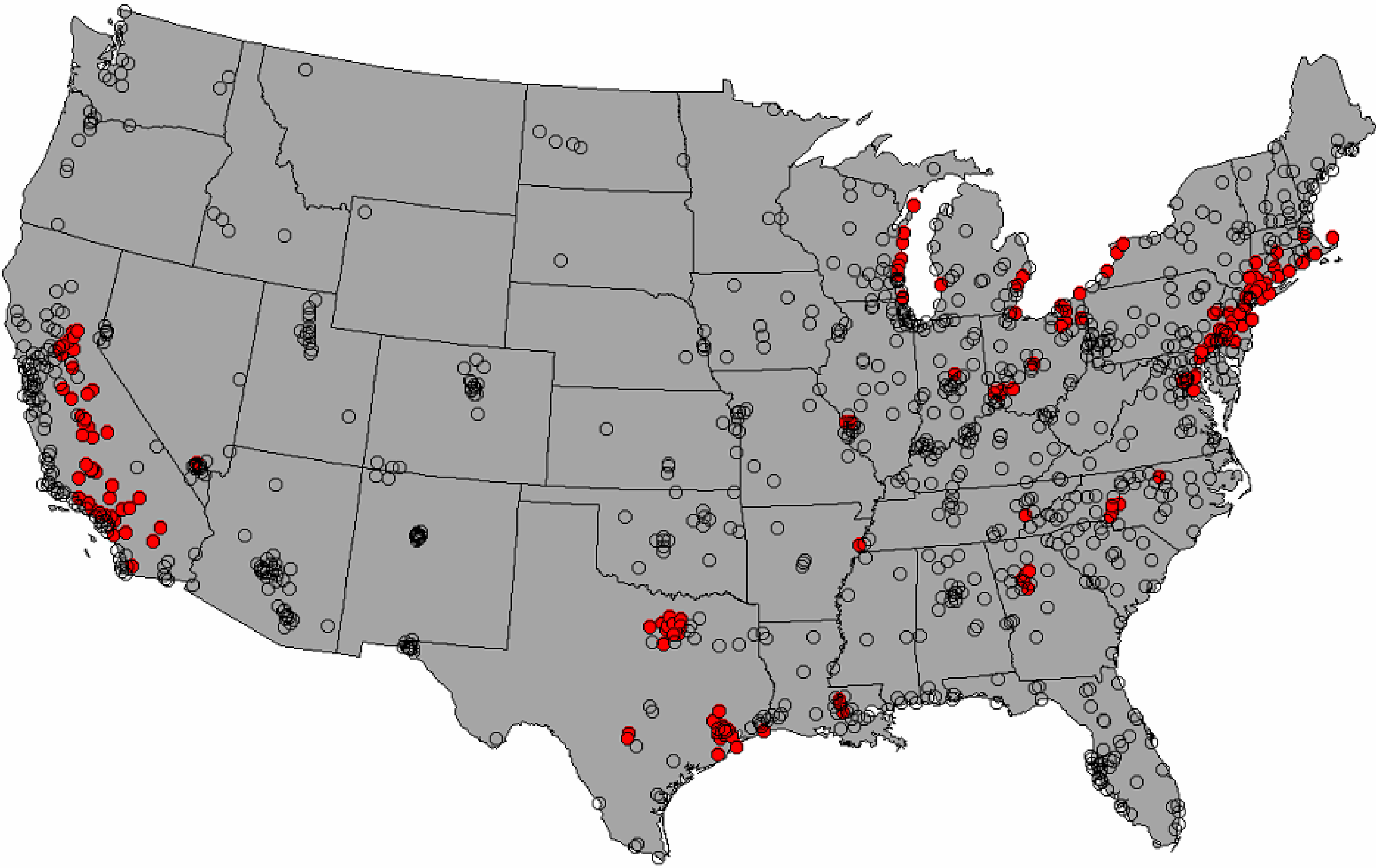


0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
4th Highest Max. 8-hr Average (ppm)
Current Primary & Secondary Standard
EPA Staff Proposed Primary Upper Bound
CASAC Recommended Primary Upper Bound
Staff & CASAC Recommended Primary Lower Bound
2004 data
0
10
20
30
40
50
60
70
80
90
Highest 3-month 12-hr W126 (ppm-hrs)

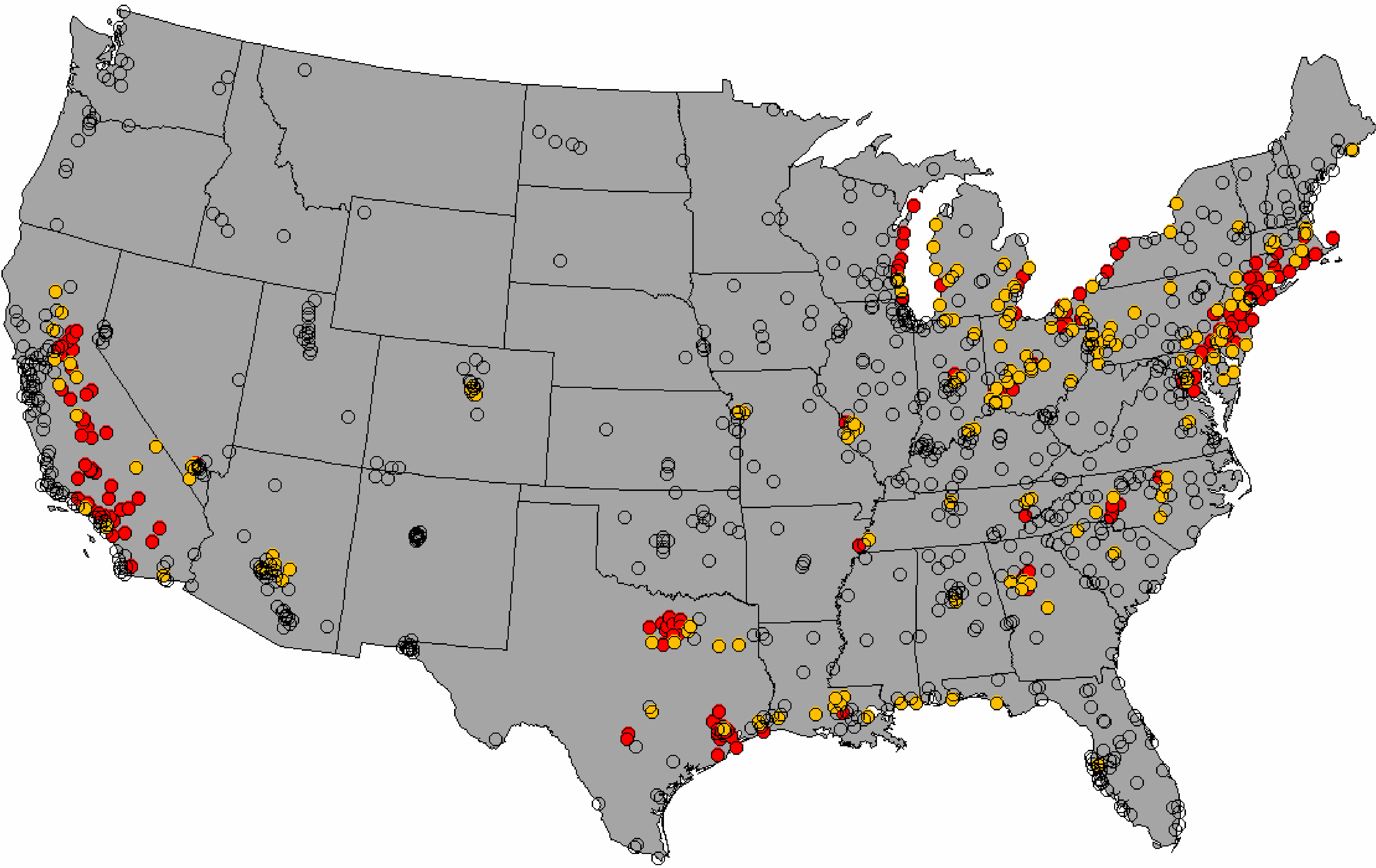

Staff & CASAC Recommended Secondary Lower Bound
CASAC Recommended Secondary Upper Bound
EPA Staff Proposed Secondary Upper Bound
(roughly equivalent to SUM06 of 25 ppm h)
2004 data
4th Highest Max. 8-hr Average (ppm)
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
Highest 3-month 12-hr W126 (ppm-hrs)
0
10
20
30
40
50
60
70
80
90

Sites with 2003-05 Ozone Design Values:

> 0.084 ppm

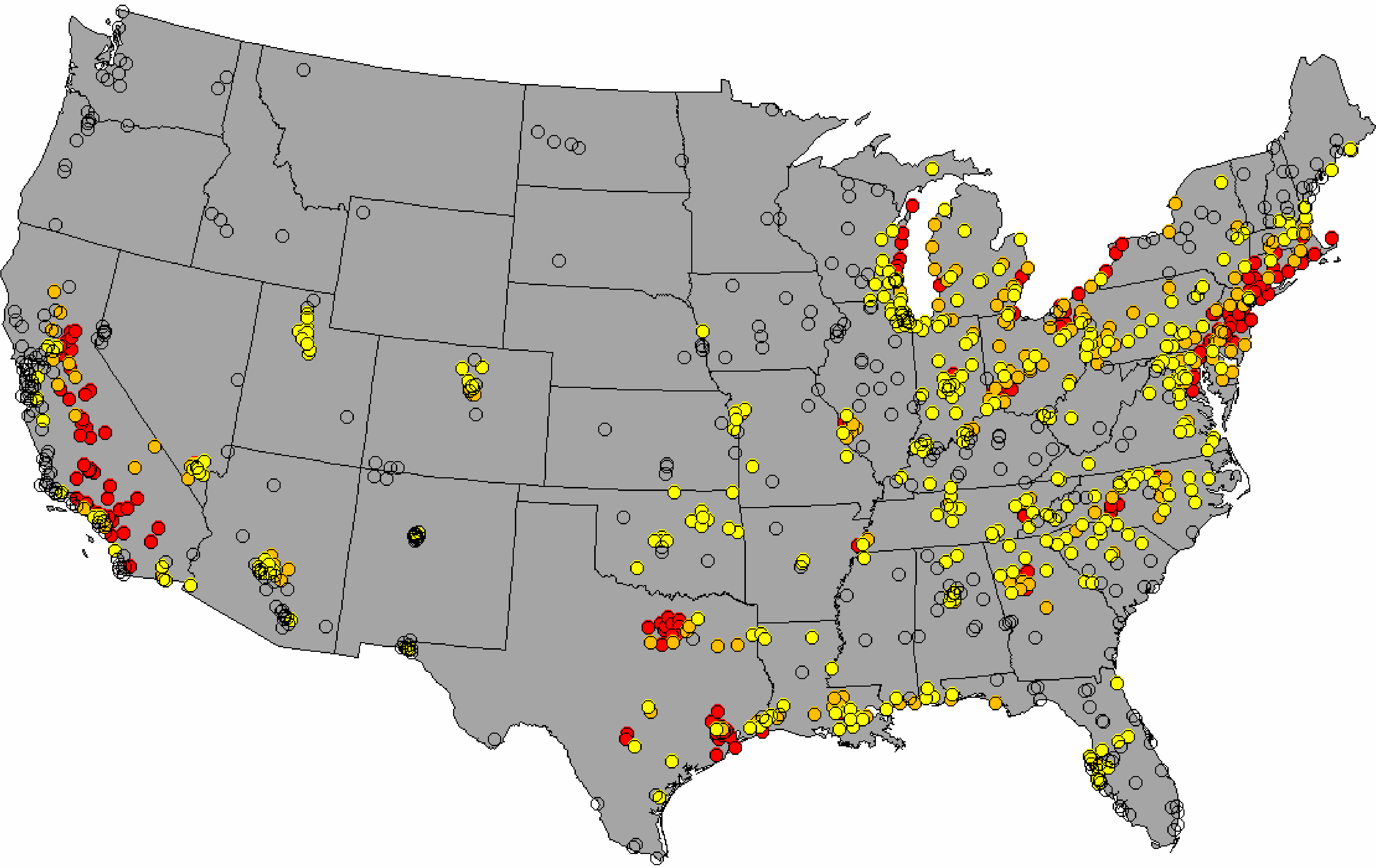


Sites with 2003-05 Ozone Design Values:
> 0.084 ppm, 0.081-0.084 ppm



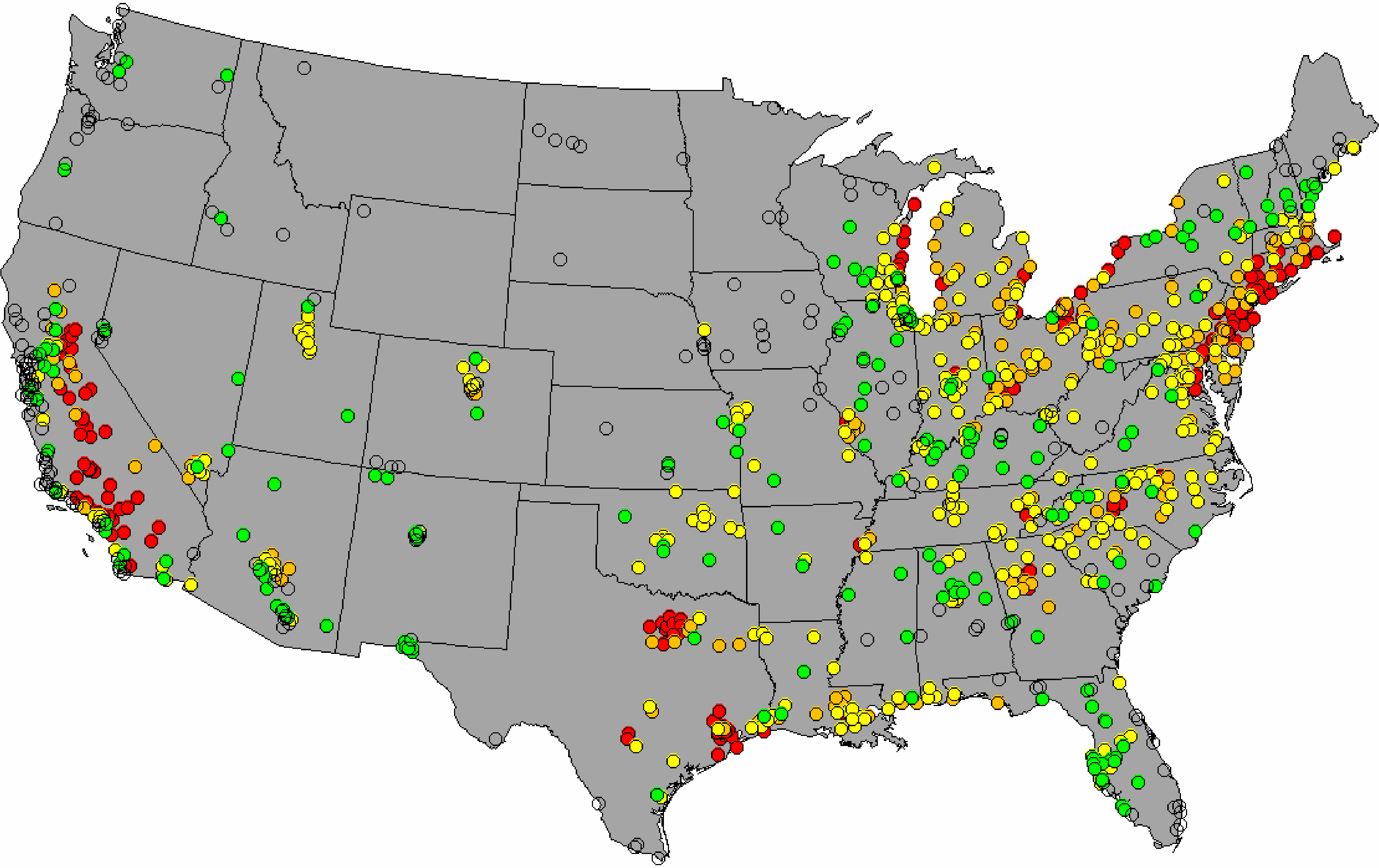
Sites with 2003-05 Ozone Design Values:

> 0.084 ppm, 0.081-0.084, 0.075-0.080 ppm



Sites with 2003-05 Ozone Design Values:

> 0.084 ppm, 0.081-0.084, 0.075-0.080, 0.071-0.074 ppm



Sites with 2003-05 Ozone Design Values:

> 0.084 ppm, 0.081-0.084, 0.075-0.080, 0.071-0.074, 0.061-0.070 ppm

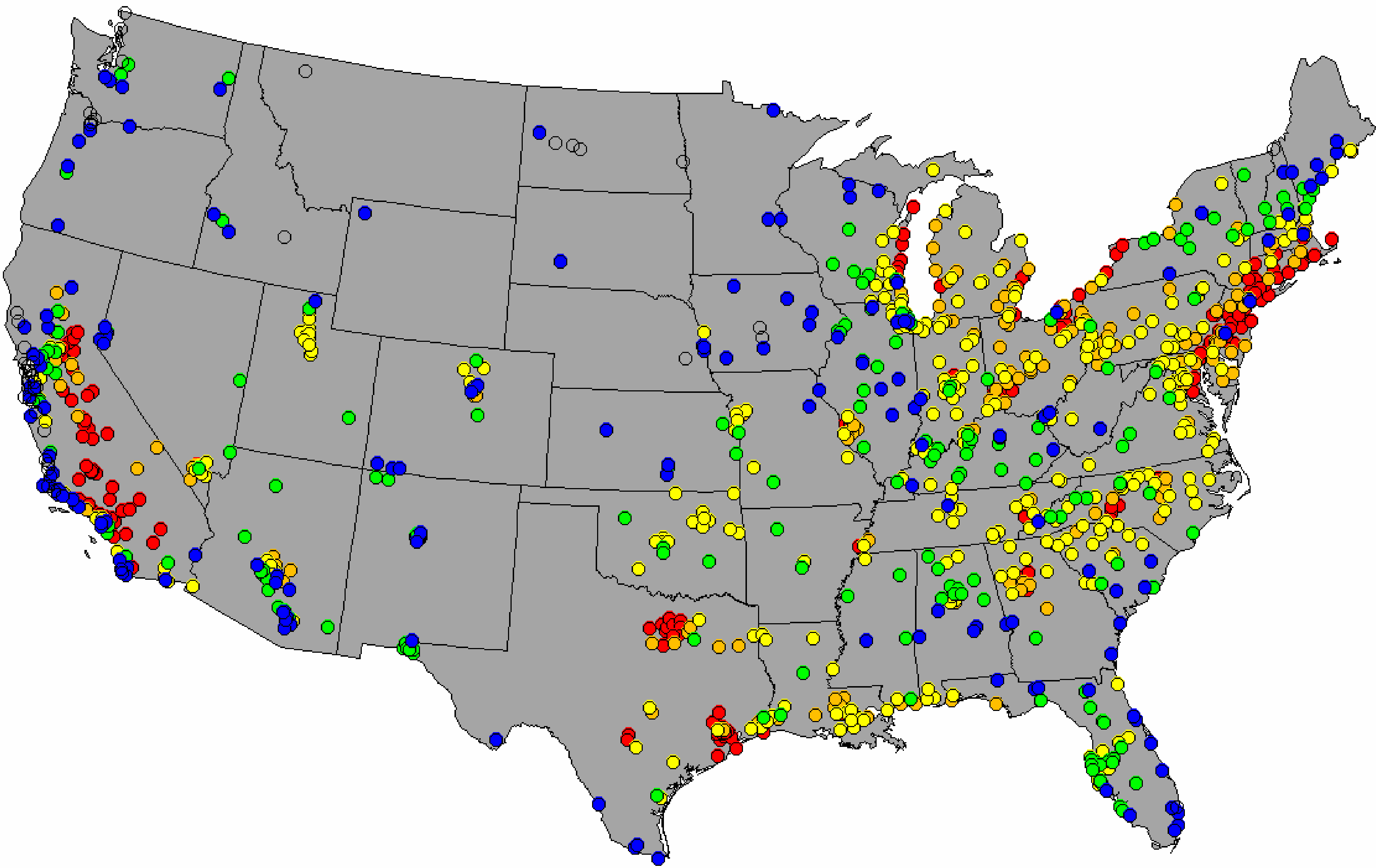
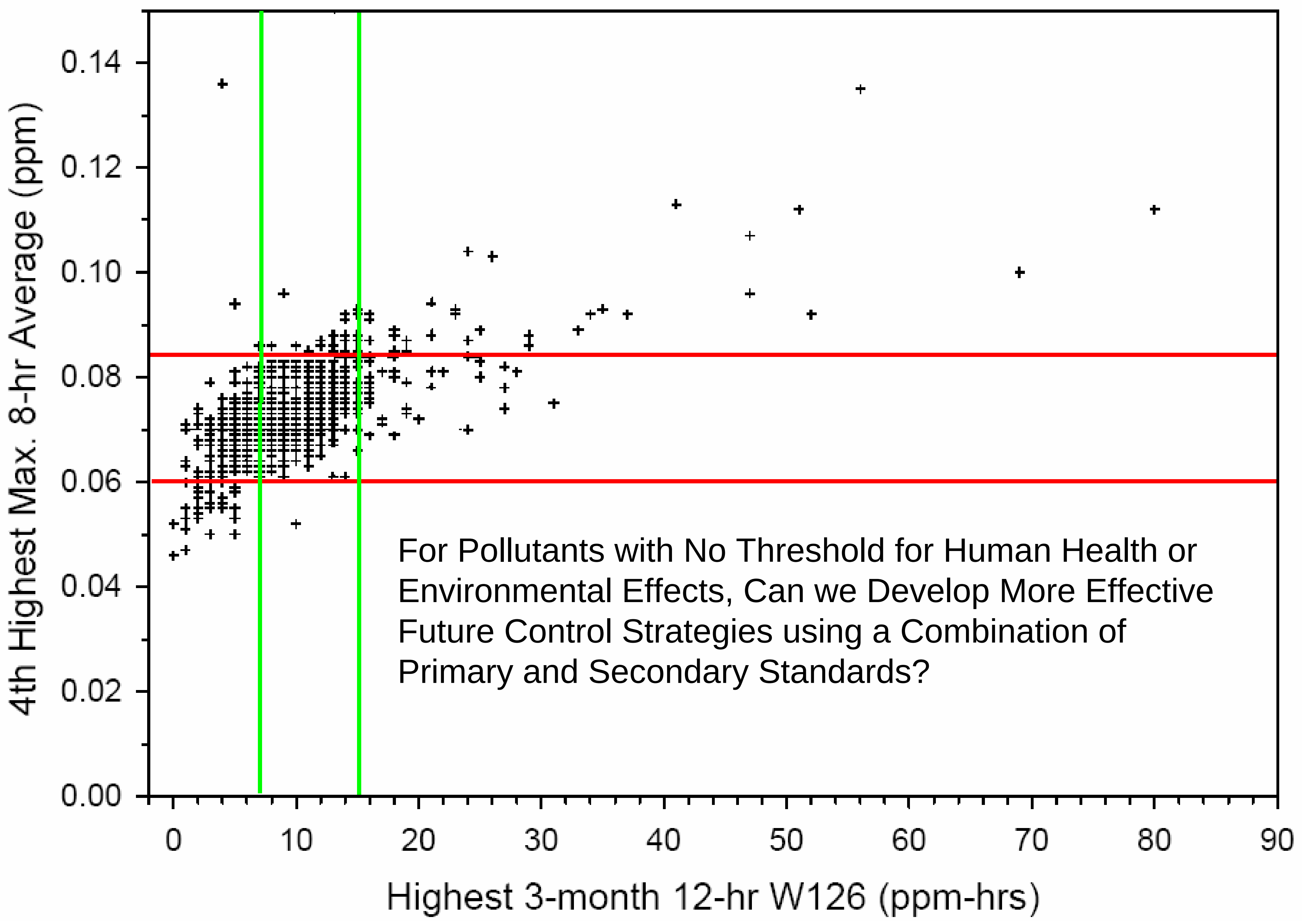


Table of Translated 8-Hour Design Values

Area Classification	CAA design value thresholds for 1-hour ozone (ppm)	8-hour ozone design value thresholds (ppm)	Attainment date
Marginal	≥0.121	≥0.085	3 years (2007)
Moderate	≥0.138	≥0.092	6 years (2010)
Serious	≥0.160	≥0.107	9 years (2013)
Severe-15	≥0.180	≥0.120	15 years (2019)
Severe-17	≥0.190	≥0.127	17 years (2021)
Extreme	≥0.280	≥0.187	20 years (2024)


4th Highest Max. 8-hr Average (ppm)
0.14
0.12
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0.08
0.06
0.04
0.02
0.00
0
10
20
30
40
50
60
70
80
90
Highest 3-month 12-hr W126 (ppm-hrs)
For Pollutants with No Threshold for Human Health or Environmental Effects, Can we Develop More Effective Future Control Strategies using a Combination of Primary and Secondary Standards?