

Modeling for SO₂ designations

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OAQPS/AQAD/AQMG

2011 Regional/State/Local Modelers
Workshop

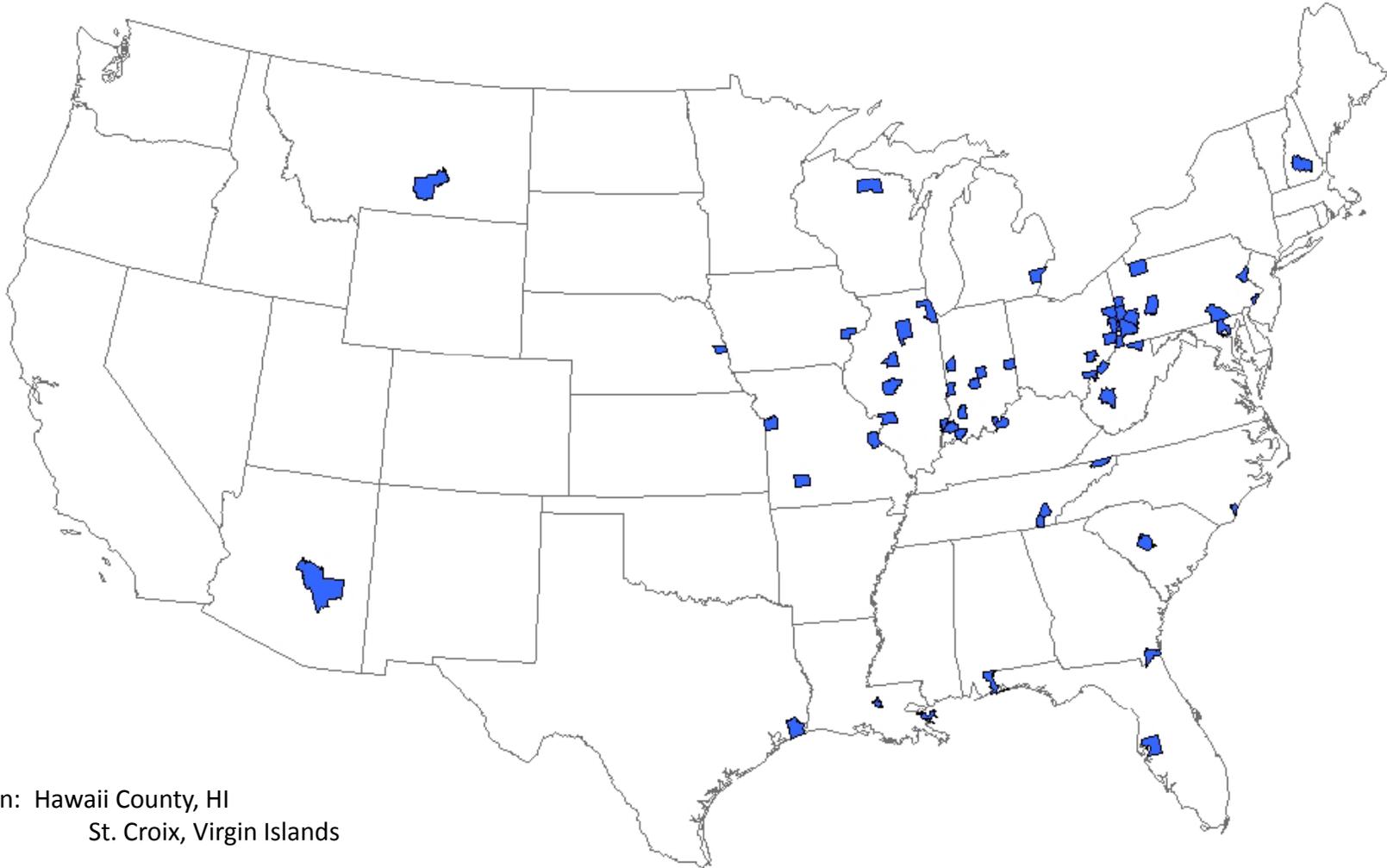
SO₂ NAAQS

- SO₂ NAAQS revised June 2010
- Standard is 75 ppb based on 3-year average of the 99th percentile of the annual distribution of 1-hour daily maximum concentrations

SO₂ NAAQS

- EPA anticipates an analytic approach that uses both air quality monitoring and modeling for determining compliance with the new SO₂ NAAQS
 - Consistent with EPA's historic practices for SO₂ NAAQS implementation
 - Single monitor may generally not be adequate to fully characterize ambient SO₂ concentrations around SO₂ stationary sources
- Refined dispersion modeling is able to fully characterize SO₂ air quality impact from modeled sources
 - Overcomes limitations of an approach based solely on monitoring
- In a few, exceptional circumstances, monitoring data alone might be determined a reliable indicator of compliance with the 1-hour SO₂ NAAQS.

2007-2009 monitored counties violating SO₂ NAAQS



Not shown: Hawaii County, HI
St. Croix, Virgin Islands

60 of 249 counties violate the standard

Designations Guidance

- Designations guidance issued in March 24, 2011 Steve Page memo “Area Designations for the 2010 Revised Primary Sulfur Dioxide National Ambient Air Quality Standards”
 - Defines three possible designation scenarios
 - Five factors for informing area boundaries
 - Modeling guidance to inform area boundaries

SO₂ Designations

- Nonattainment
 - Area where monitoring data **or** an appropriate modeling analysis indicates a violation
- Attainment
 - Area has no monitored violations **and** which has an appropriate modeling analysis and any other relevant information demonstrating no violations
- Unclassifiable
 - Area has no monitored violations and lacks an appropriate modeling analysis or other appropriate information sufficient to support an alternate designation

Designation Factors

1. Air quality data
 - Most recent 3 years of data to determine design value for comparison to standard
2. Emissions related data
 - Location and potential contribution to ambient SO₂ concentrations
 - Examine allowable emissions
3. Meteorology
 - How weather conditions affect plume of sources contributing to ambient SO₂ concentrations
4. Geography/topography
 - How physical features of the land affect SO₂ distribution
5. Jurisdictional boundaries
 - Use jurisdictional boundaries for providing boundaries

SO₂ Designations Modeling Guidance

- Modeling guidance to inform process, as appropriate
 - Modeling for nonattainment boundaries
 - Demonstrate attainment in areas without violating monitor
- Topics included:
 - Model selection = AERMOD as EPA preferred near-field dispersion model
 - Modeling domain and sources to model
 - Source inputs including use of maximum allowable emissions or federally enforceable permit limits
 - Meteorological inputs
 - Inclusion of monitored background concentrations
 - Use of modeling in nonattainment or attainment boundary determination
 - Documentation requirements

Model Selection

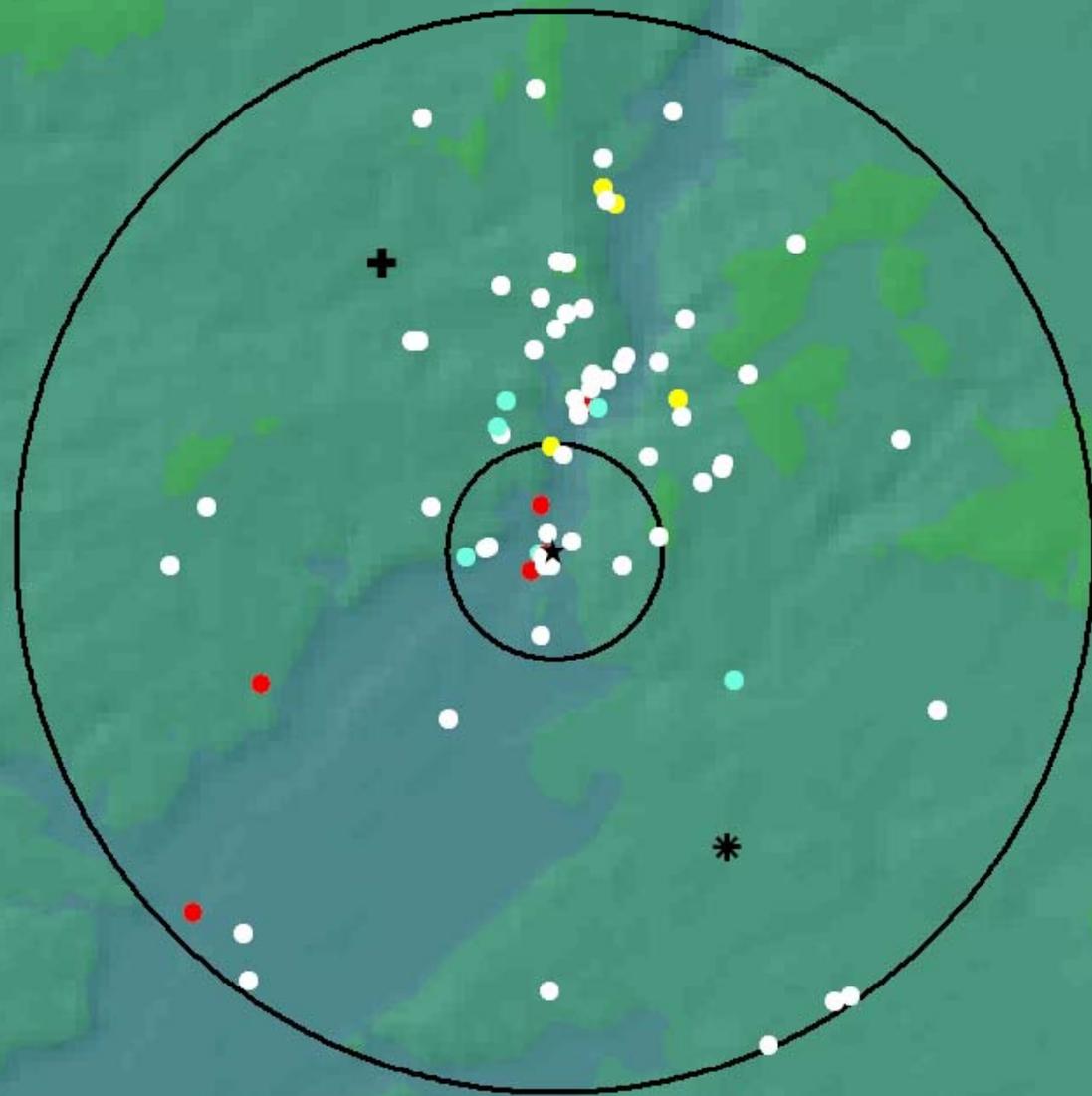
- AERMOD is EPA's preferred near-field dispersion model for regulatory applications
- As part of its promulgation, AERMOD modeling system has been evaluated using SO₂ releases and shows good performance for 1-hour SO₂ modeling
- Use of alternative model must meet criteria of alternative models as outlined in App. W (Section 3.2)

Modeling Domain

- If area contains violating monitor, center domain on violating monitor
- In absence of violating monitor, center domain on dominant source or sources
- Reasonable to initially focus on large emitters, i.e. 100 tpy (allowables or federally enforceable permits)
 - Do not ignore smaller emitters, especially short stacks or sources in complex terrain
- Determine if any sources can be represented by background monitor concentrations
- Use of screening modeling to determine inclusion of sources in refined modeling

Emissions (tons/year)

- ≤ 1
- 2 - 10
- 11 - 100
- > 100



02.55 10 15 20
Kilometers

Emissions

- Emissions inputs will be maximum allowable emissions, federally enforceable limits or potential emissions (in absence of allowables)
 - Source parameters should be reflective of these emission levels
- Use maximum short-term emission rate as calculated in Section 8.1 of Appendix W (Table 8-2)
- Existing inventories should be adequate starting point (per August 23, 2010 memo)

Emissions calculations

TABLE 8-1.—MODEL EMISSION INPUT DATA FOR POINT SOURCES ¹

Averaging time	Emission limit (#/MMBtu) ²	×	Operating level (MMBtu/hr) ²	×	Operating factor (e.g., hr/yr, hr/day)
Stationary Point Source(s) Subject to SIP Emission Limit(s) Evaluation for Compliance with Ambient Standards (Including Areawide Demonstrations)					
Annual & quarterly	Maximum allowable emission limit or federally enforceable permit limit.		Actual or design capacity (whichever is greater), or federally enforceable permit condition.		Actual operating factor averaged over most recent 2 years. ³
Short term	Maximum allowable emission limit or federally enforceable permit limit.		Actual or design capacity (whichever is greater), or federally enforceable permit condition. ⁴		Continuous operation, i.e., all hours of each time period under consideration (for all hours of the meteorological data base). ⁵
Nearby Source(s)^{6 7}					
Same input requirements as for stationary point source(s) above.					
Other Source(s)⁷					
If modeled (subsection 8.2.3), input data requirements are defined below.					
Annual & quarterly	Maximum allowable emission limit or federally enforceable permit limit. ⁶		Annual level when actually operating, averaged over the most recent 2 years. ³		Actual operating factor averaged over the most recent 2 years. ³
Short term	Maximum allowable emission limit or federally enforceable permit limit. ⁶		Annual level when actually operating, averaged over the most recent 2 years. ³		Continuous operation, i.e., all hours of each time period under consideration (for all hours of the meteorological data base). ⁵

¹ The model input data requirements shown on this table apply to stationary source control strategies for STATE IMPLEMENTATION PLANS. For purposes of emissions trading, new source review, or prevention of significant deterioration, other model input criteria may apply. Refer to the policy and guidance for these programs to establish the input data.

GEP and Stack Height

- Model minimum of actual stack height or GEP
- If modeling at GEP, use other actual stack parameters (temperature, diameter, exit velocity)
- If stack height below GEP downwash must be considered

Meteorological Data

- Five years of representative NWS data or at least one year of site-specific data
- 3-year averaging time for monitored design values does not preempt the use of five years of NWS data
 - Do not need to calculate rolling 3-year averages
 - Five year average unbiased estimate

Background Concentrations

- Maximum 1-hour monitored concentration
 - August 23, 2010 memo “Applicability of Appendix W Modeling Guidance for the 1-hour SO₂ National Ambient Air Quality Standard”
 - May be overly conservative
- Monitored design values added to modeled design values
- Temporally varying concentrations based on 99th percentile monitored concentrations by hour of day and season added to modeled design values.

Calculating design values

- At each receptor:
 1. For each modeled day, determine maximum 1-hour total (from all modeled sources + background) concentration
 - Results in 365 concentrations per year (366 for leap year)
 2. For each modeled year, determine 4th highest of the 365 (366) hourly concentrations
 - If modeling 5 years of data, results in 5 concentrations
 3. If modeling 5 years, average concentrations from step 2 to calculate design value
- Among all receptors, determine if any design values exceed NAAQS

Source contributions to design values

- A source group's contribution to the 5-year design value at a receptor is:
 - The multi-year average of the source group's concentrations corresponding to the same dates and hours as the 4th highest daily 1-hour maximum concentrations (from all sources) used to calculate the design values.

Design value example

Date (YYMMDDHH)	TOTAL	SOURCE 1	SOURCE 2	SOURCE 3	SOURCE 4
05080101	200.1	155.1	25.1	1.5	18.4
06073105	201.5	157.4	26.2	0.5	17.4
07080403	207.1	161.5	20.5	2.1	23.0
08072705	197.1	159.2	23.1	1.7	13.1
09080104	198.1	155.3	22.6	2.0	18.2
5-YEAR AVG.	200.8	157.7	23.5	1.6	18.0

↑
Design value

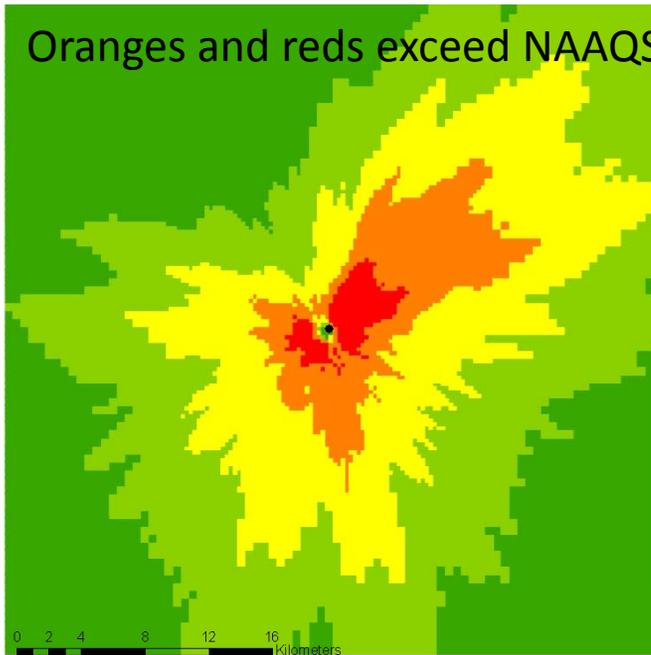
Source contributions to design value

Concentrations in $\mu\text{g}/\text{m}^3$

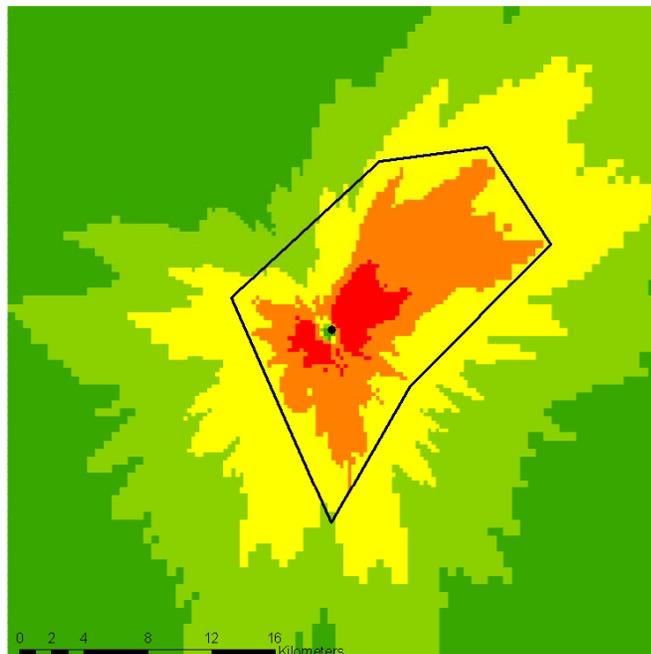
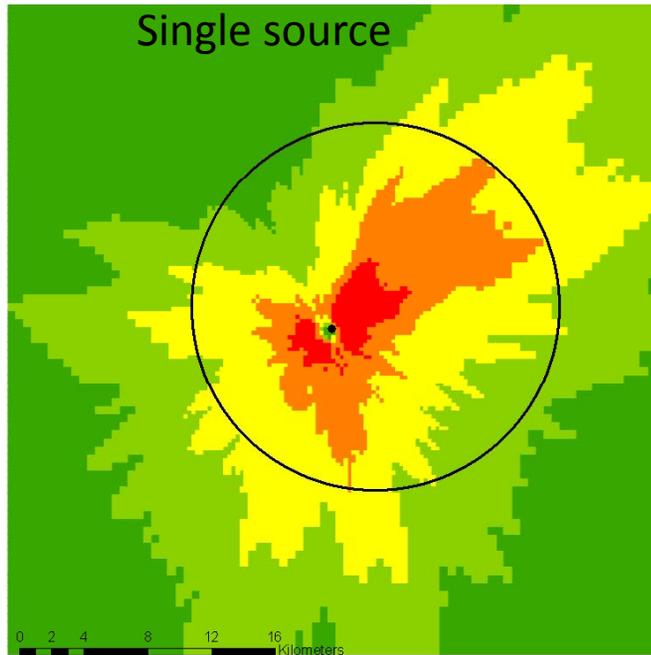
Use of Modeling for Designations

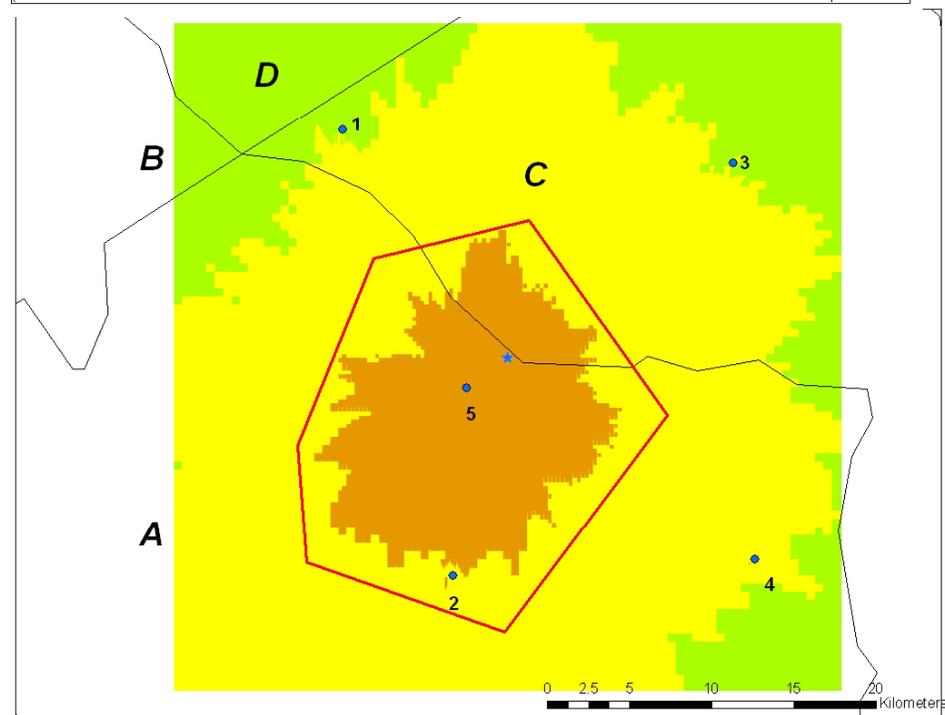
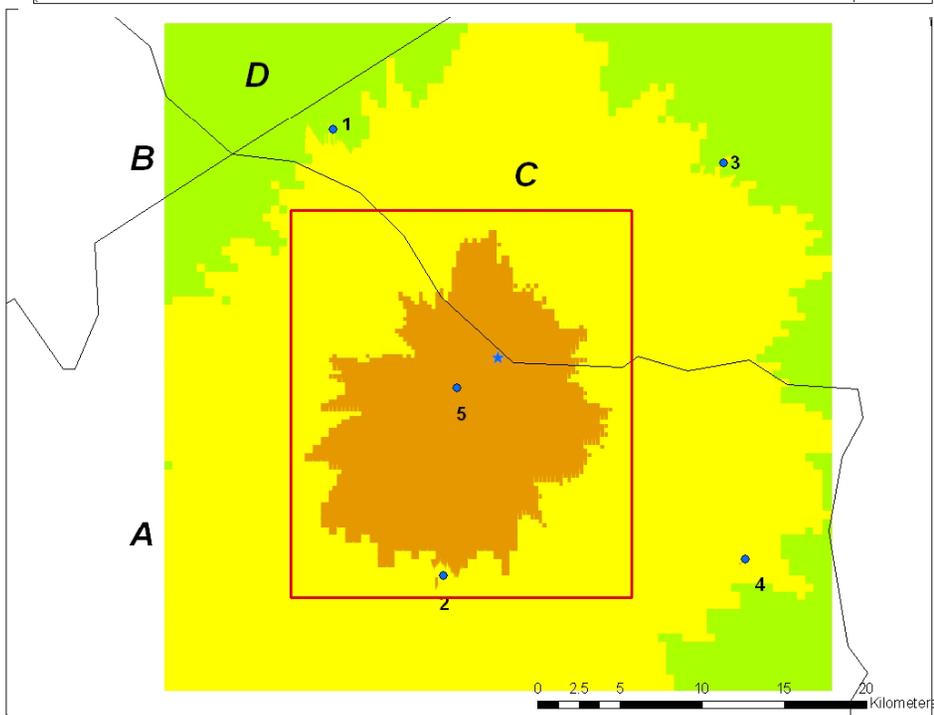
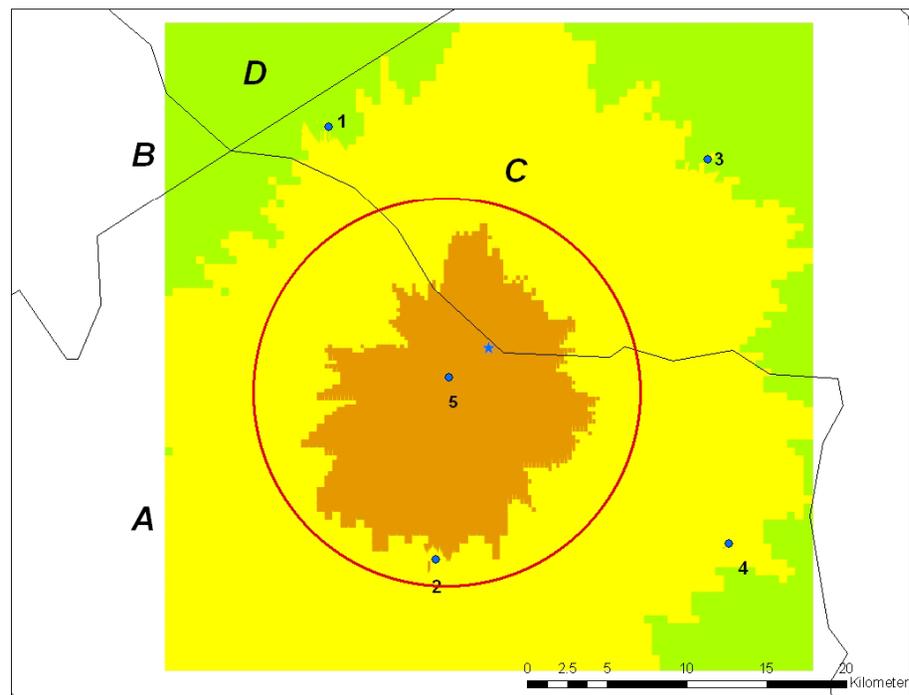
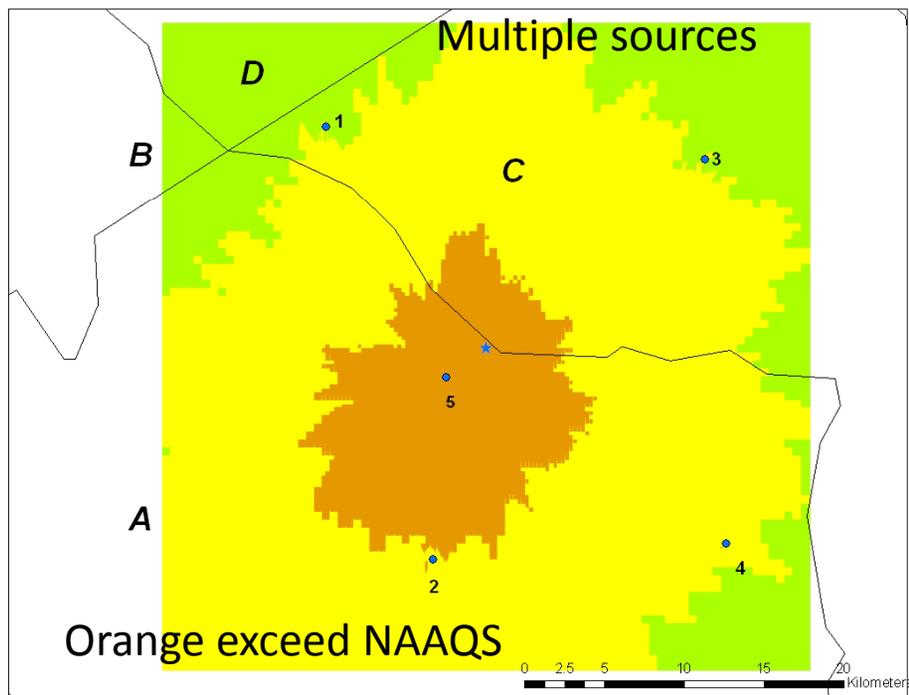
- For an area containing a violating monitor, modeling can be used to inform decisions on the nonattainment boundary
- For an area without a violating monitor, modeling can be used as evidence of an area's attainment status and also inform decisions on the appropriate (attainment or nonattainment boundary)

Oranges and reds exceed NAAQS



Single source





Relevant guidance documents

- Appendix W
- “Applicability of Appendix W Modeling Guidance for the 1-hour SO₂ NAAQS” August 23, 2010 memorandum
- “Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO₂ National Ambient Air Quality Standard” March 1, 2011– provides additional guidance regarding NO₂ permit modeling and also relevant to SO₂
- “Area designations for the 2010 Revised Primary Sulfur Dioxide National Ambient Air Quality Standards” March 24, 2011
- AERMOD Implementation Guide
- AERMOD, AERMAP, AERMET, AERMINUTE, AERSCREEN, AERSURFACE user’s guides

Questions?