ASIP and Use in State Modeling

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Georgia EPD – Air Protection Branch

2007 Region 4 Modelers Workshop

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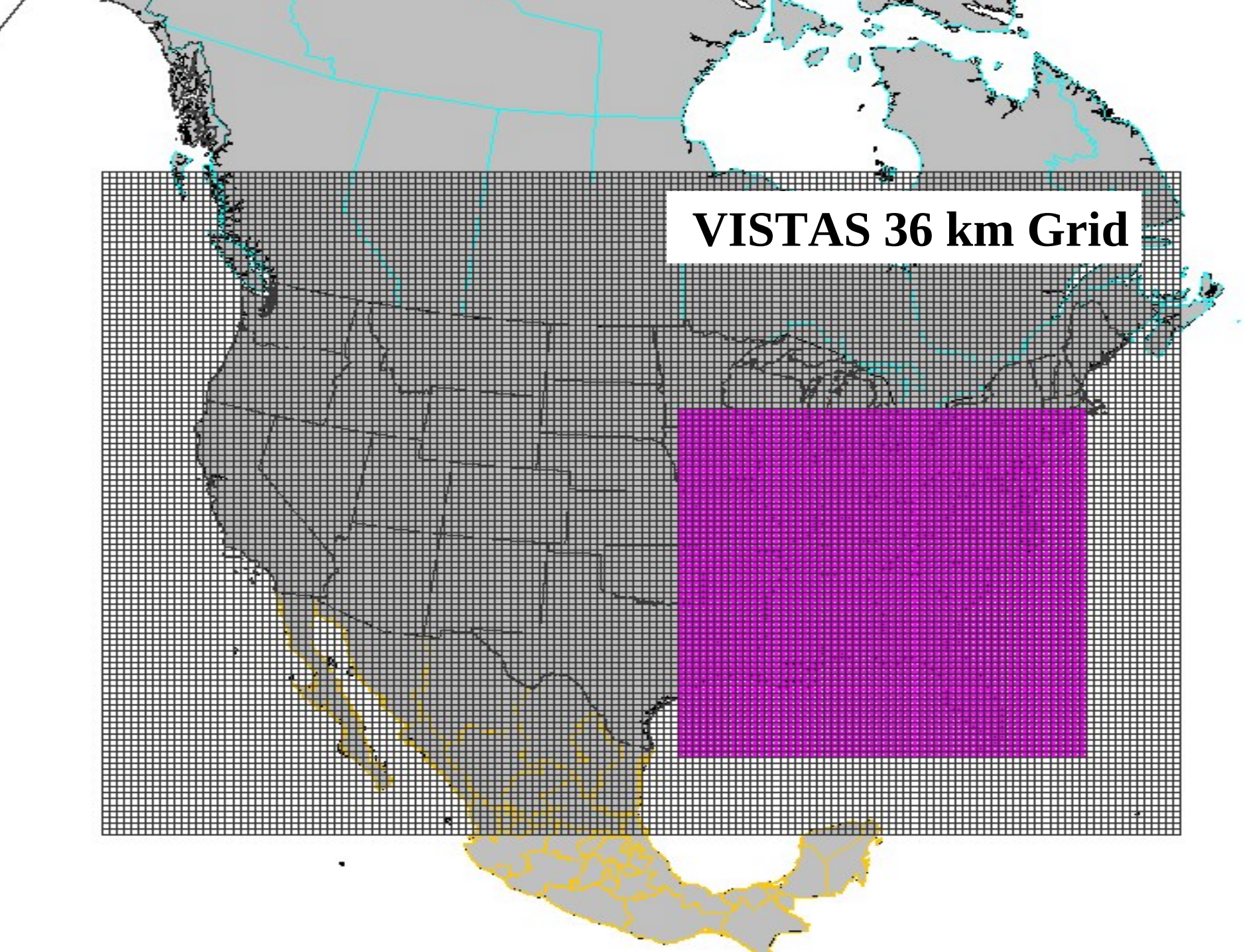
Outline

- Background Information
- ASIP 2009 Ozone Projections
- ASIP 2009 PM2.5 Projections
- Georgia Attainment Modeling
- Georgia Episodic Emission Sensitivities
- Next Steps

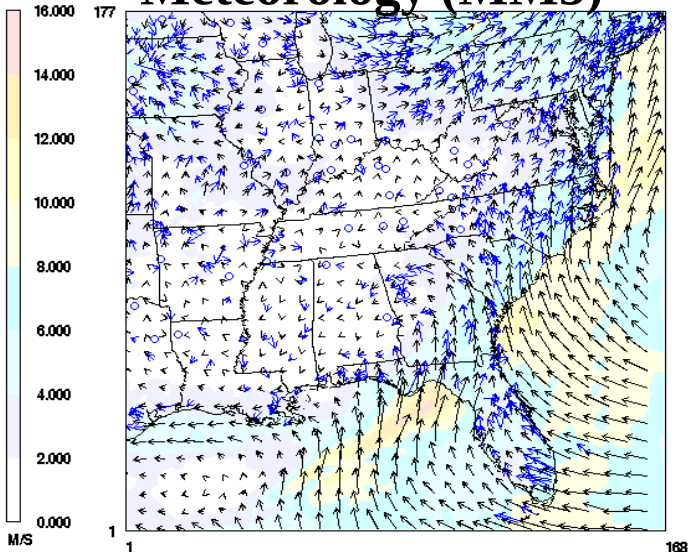
ASIP Modeling

- **A**ssociation for **S**outheastern **I**ntegrated **P**lanning
  - AL, GA, FL, MS, SC, NC, TN, KY, VA, WV
- Modeling Contractors
  - ENVIRON International Corporation
  - Alpine Geophysics, LLC
  - University of California at Riverside
- Annual Modeling for the Southeastern U.S. with the CMAQ Photochemical Grid Model at 36 and 12 km grid resolutions


VISTAS 36 km Grid

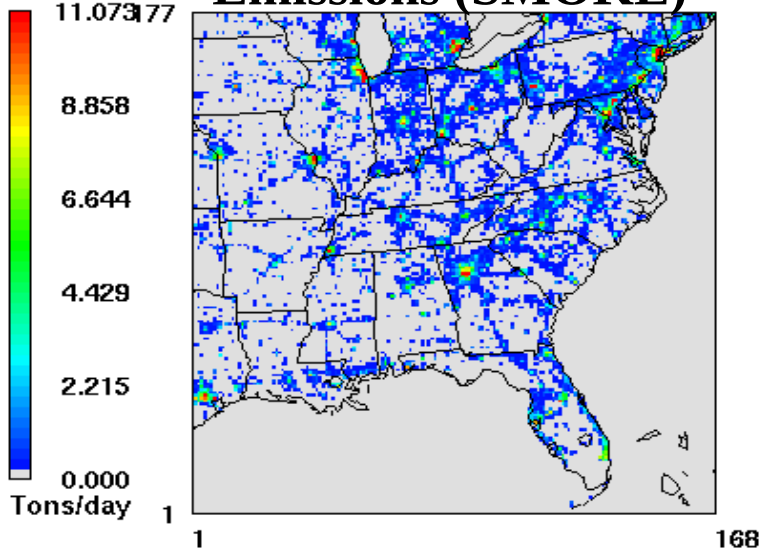
Atmospheric Modeling System

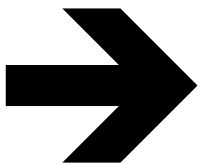
Meteorology (MM5)



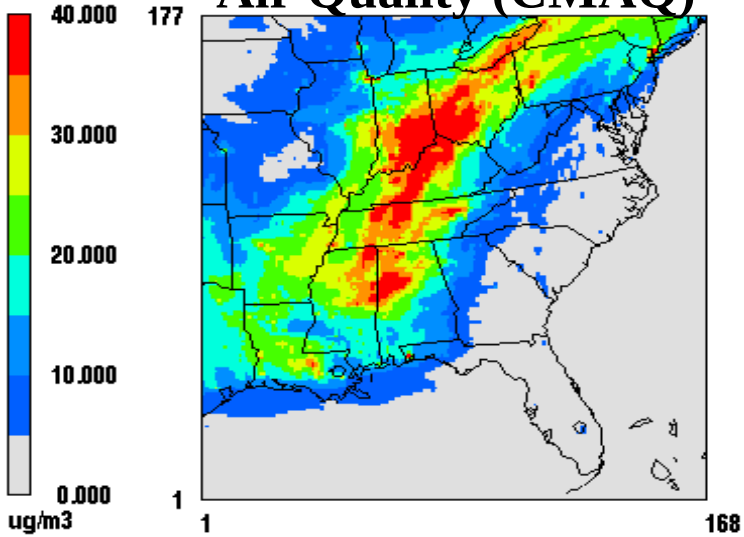
+

Emissions (SMOKE)

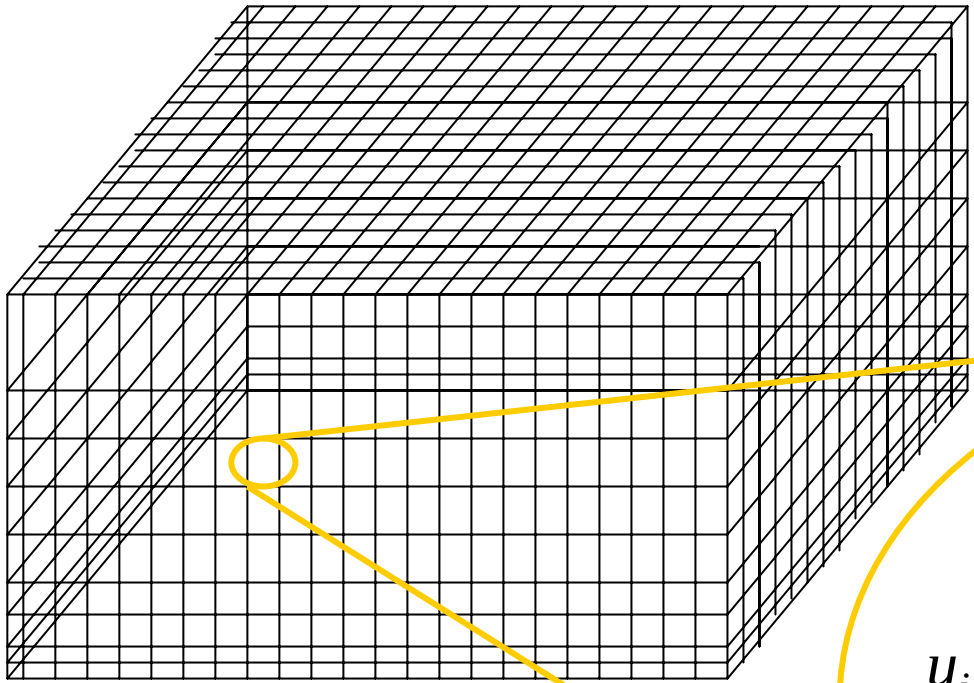




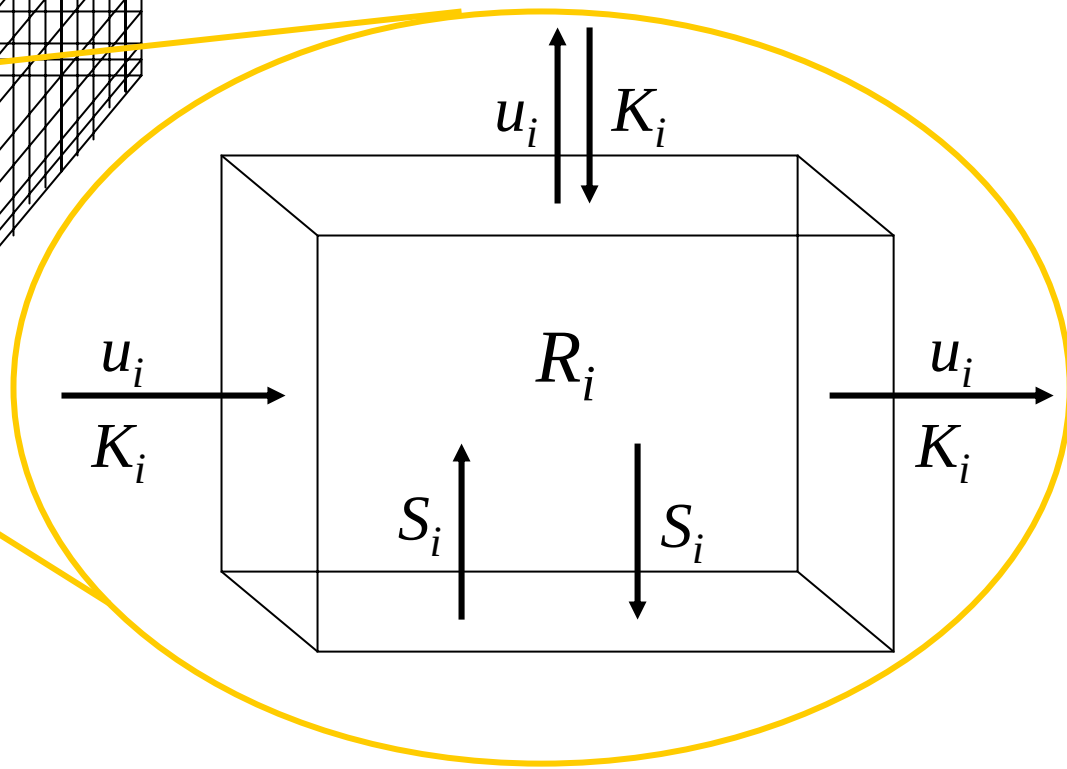
Air Quality (CMAQ)



CMAQ is a Grid-Based Model



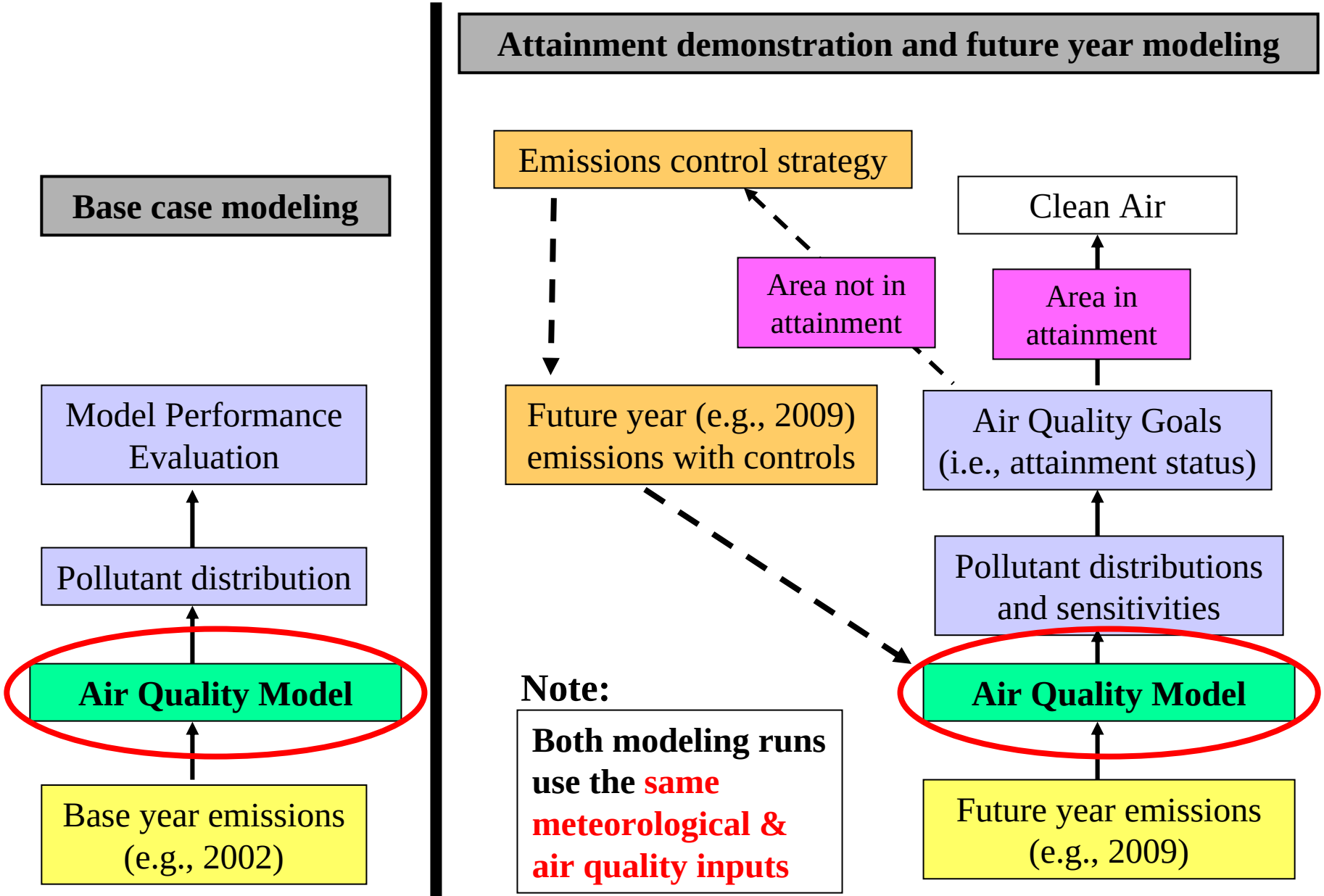
$$\frac{\partial c_i}{\partial t} + \nabla \cdot (\vec{u} c_i) = \nabla \cdot (\vec{K} \nabla c_i) + R_i + S_i$$



Model Outputs: Hourly pollutant concentrations for every grid cell in the domain

– Gases (ppm) and PM (μg/m³)

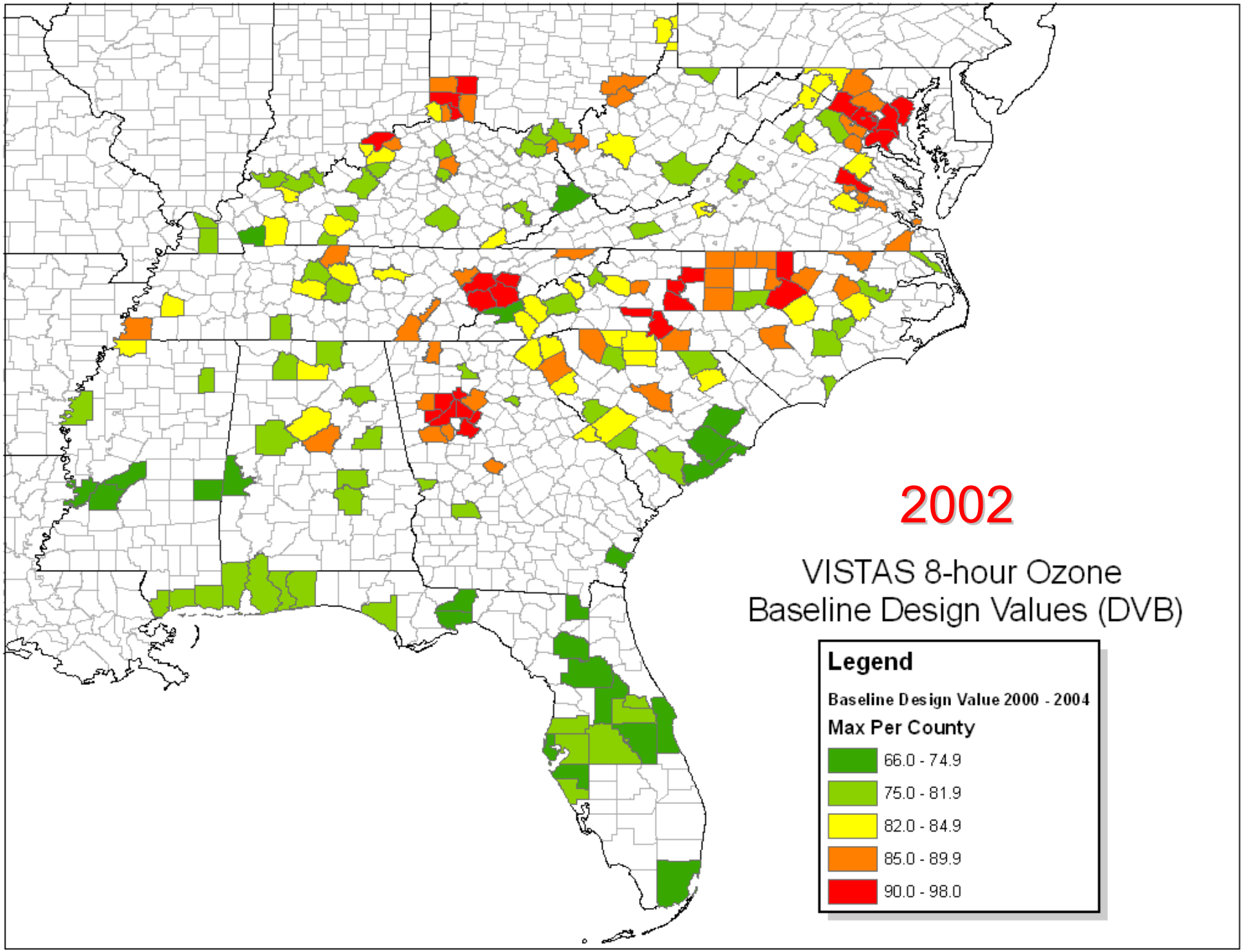
Demonstrating Attainment using AQ models

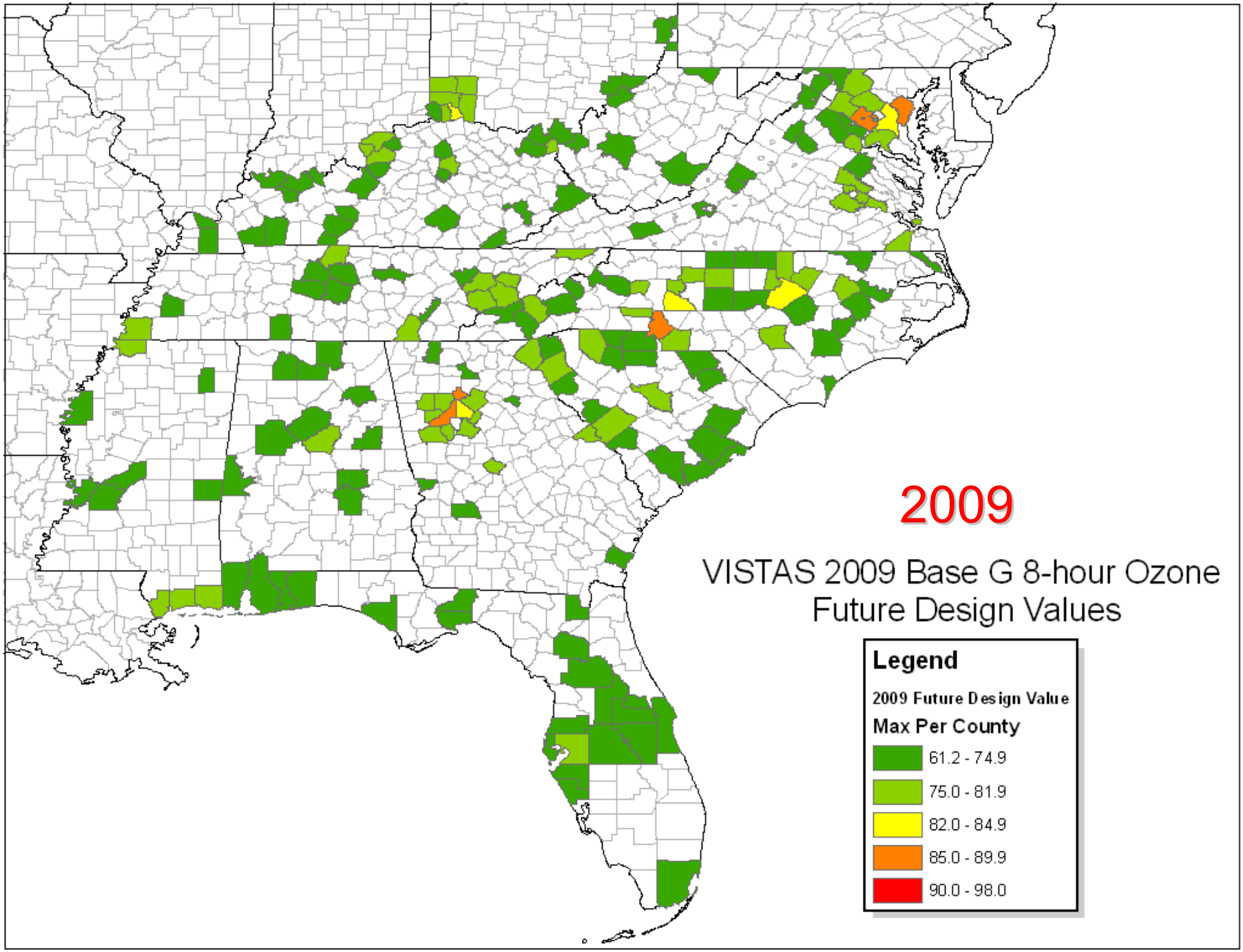


8-Hr Ozone and $PM_{2.5}$ Projections

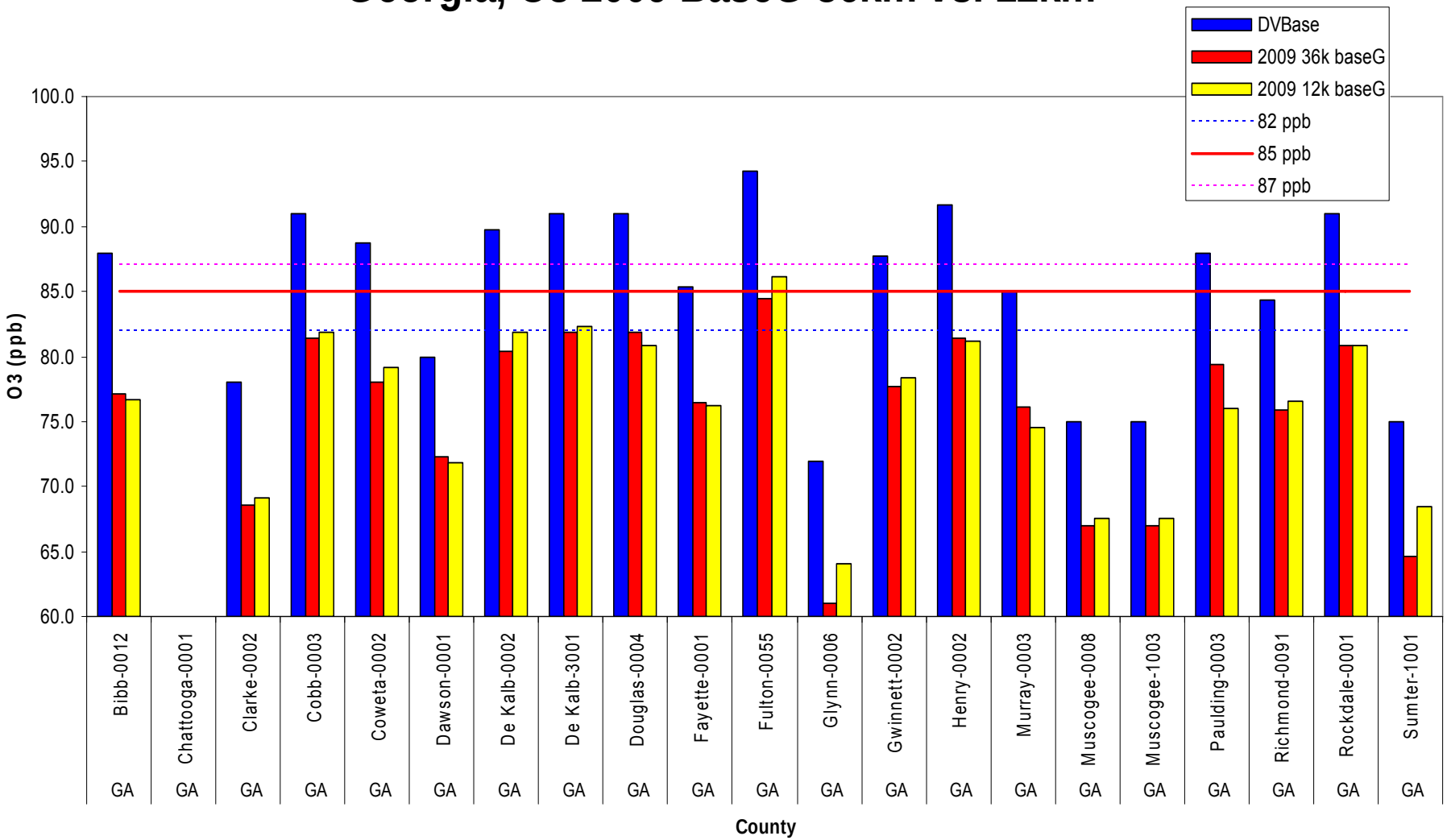
- EPA's *"Guidance on the Use of Models and Other Analysis for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5 and Regional Haze – Draft 3.2"* (September 2006)
  - 8-hour ozone use days with highest daily maximum value near monitor > threshold value
    - 85 ppb, sliding 85 ppb to 70 ppb with 10 day min
  - Annual $PM_{2.5}$ use Speciated Modeled Attainment Test (SMAT)

ASIP Modeling

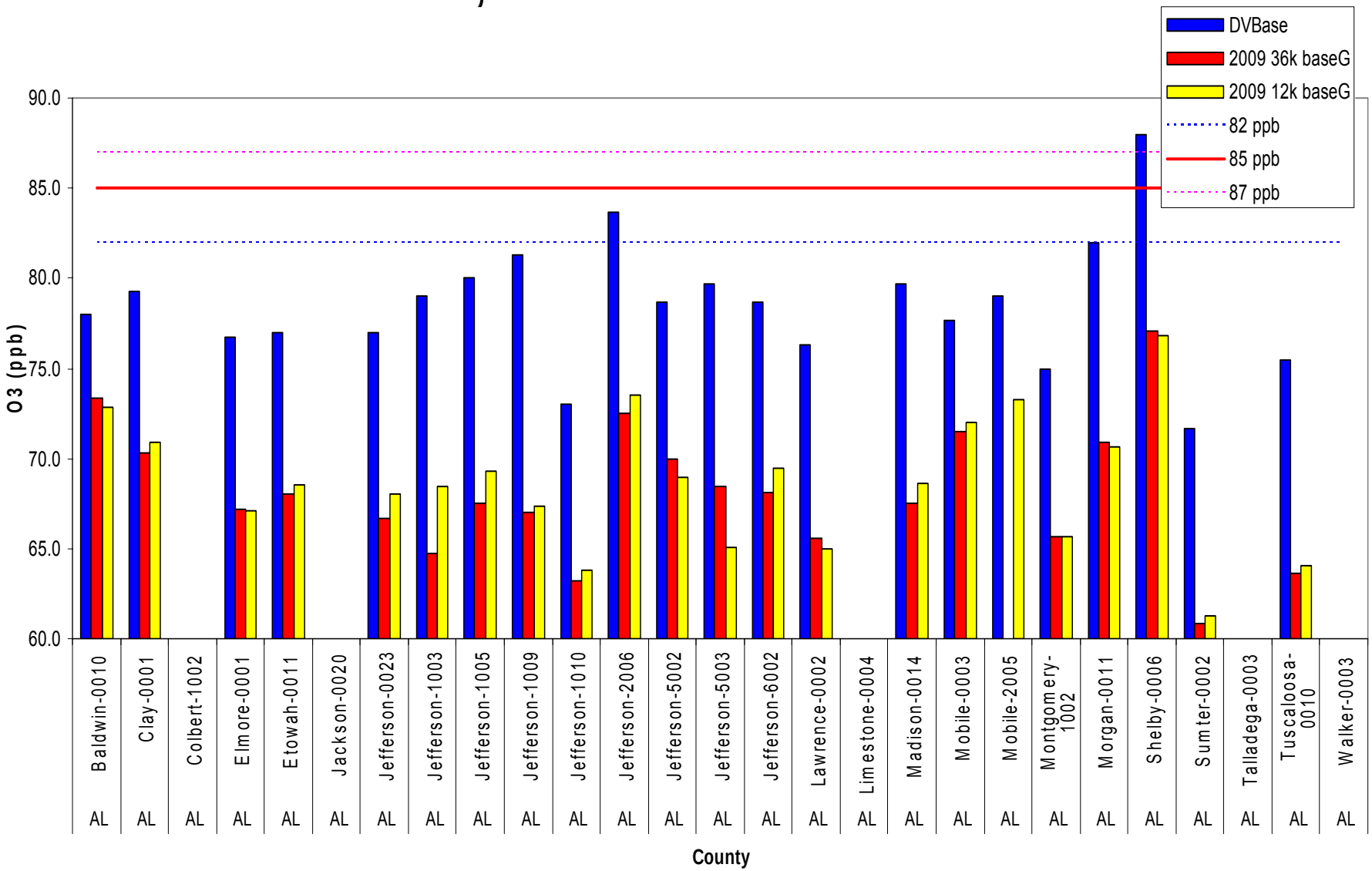

2002
VISTAS 8-hour Ozone
Baseline Design Values (DVB)
Legend
Baseline Design Value 2000 - 2004
Max Per County
66.0 - 74.9
75.0 - 81.9
82.0 - 84.9
85.0 - 89.9
90.0 - 98.0


2009
VISTAS 2009 Base G 8-hour Ozone
Future Design Values
Legend
2009 Future Design Value
Max Per County
61.2 - 74.9
75.0 - 81.9
82.0 - 84.9
85.0 - 89.9
90.0 - 98.0

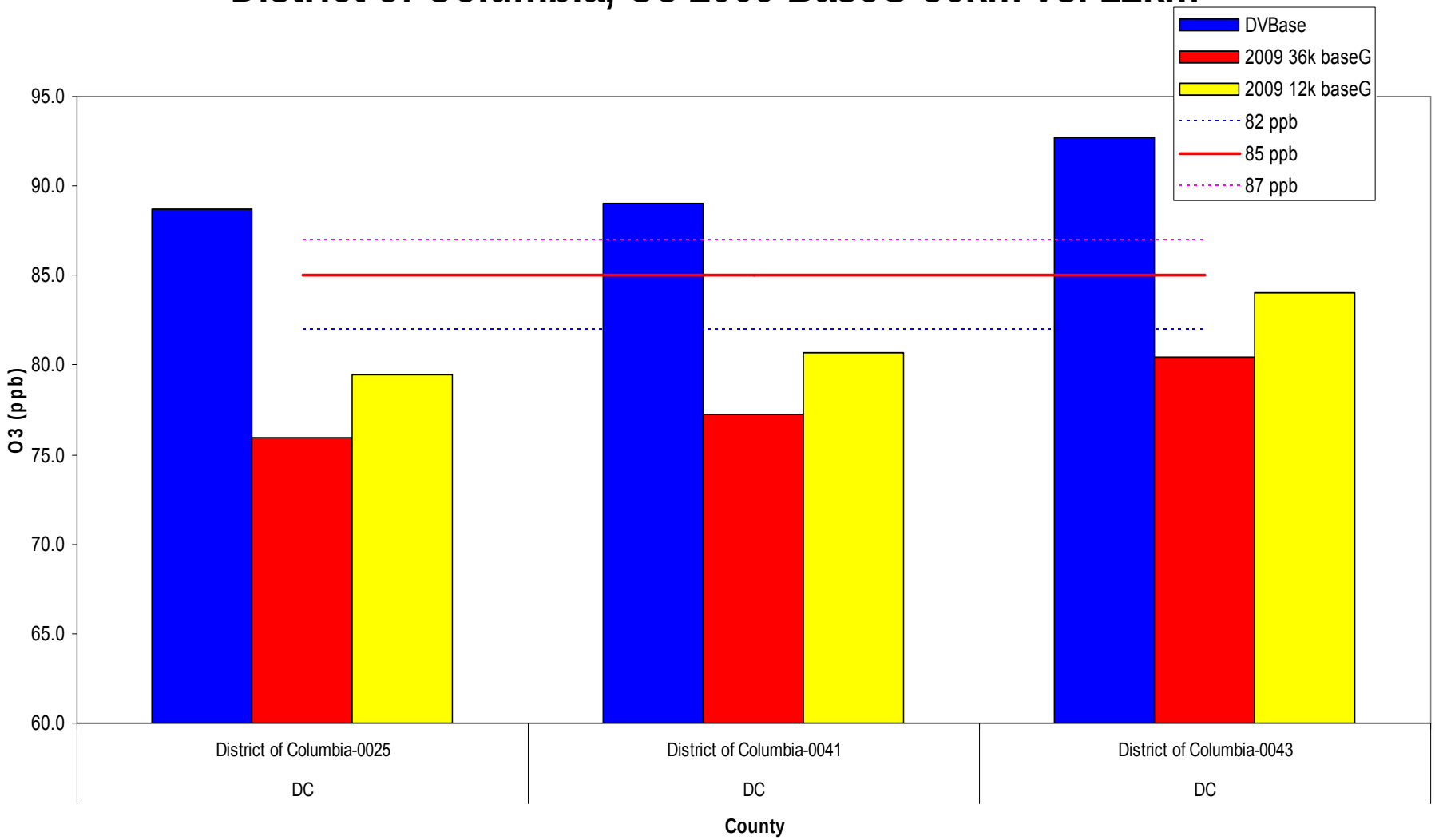
Georgia, O3 2009 BaseG 36km vs. 12km



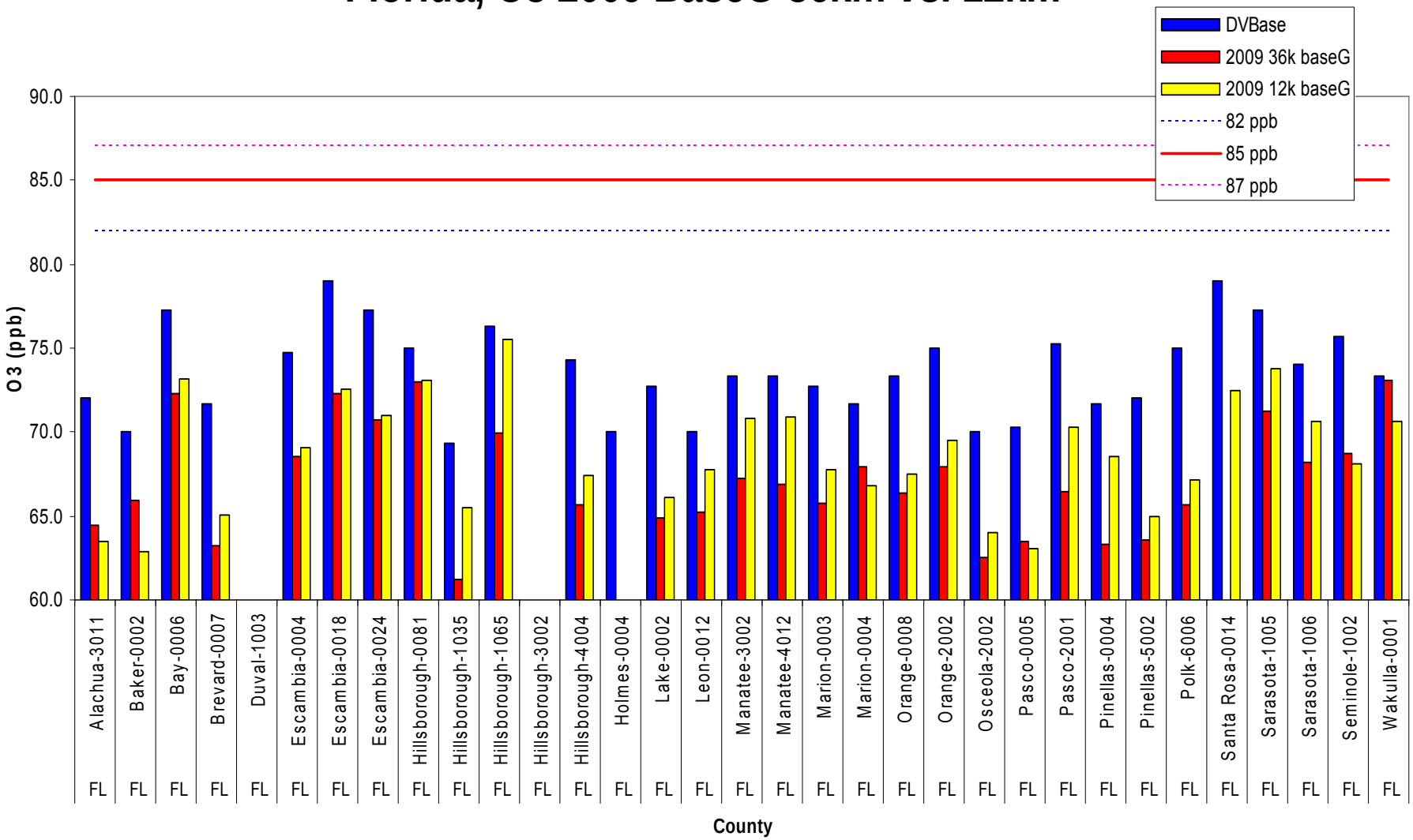
Alabama, O3 2009 BaseG 36km vs. 12km



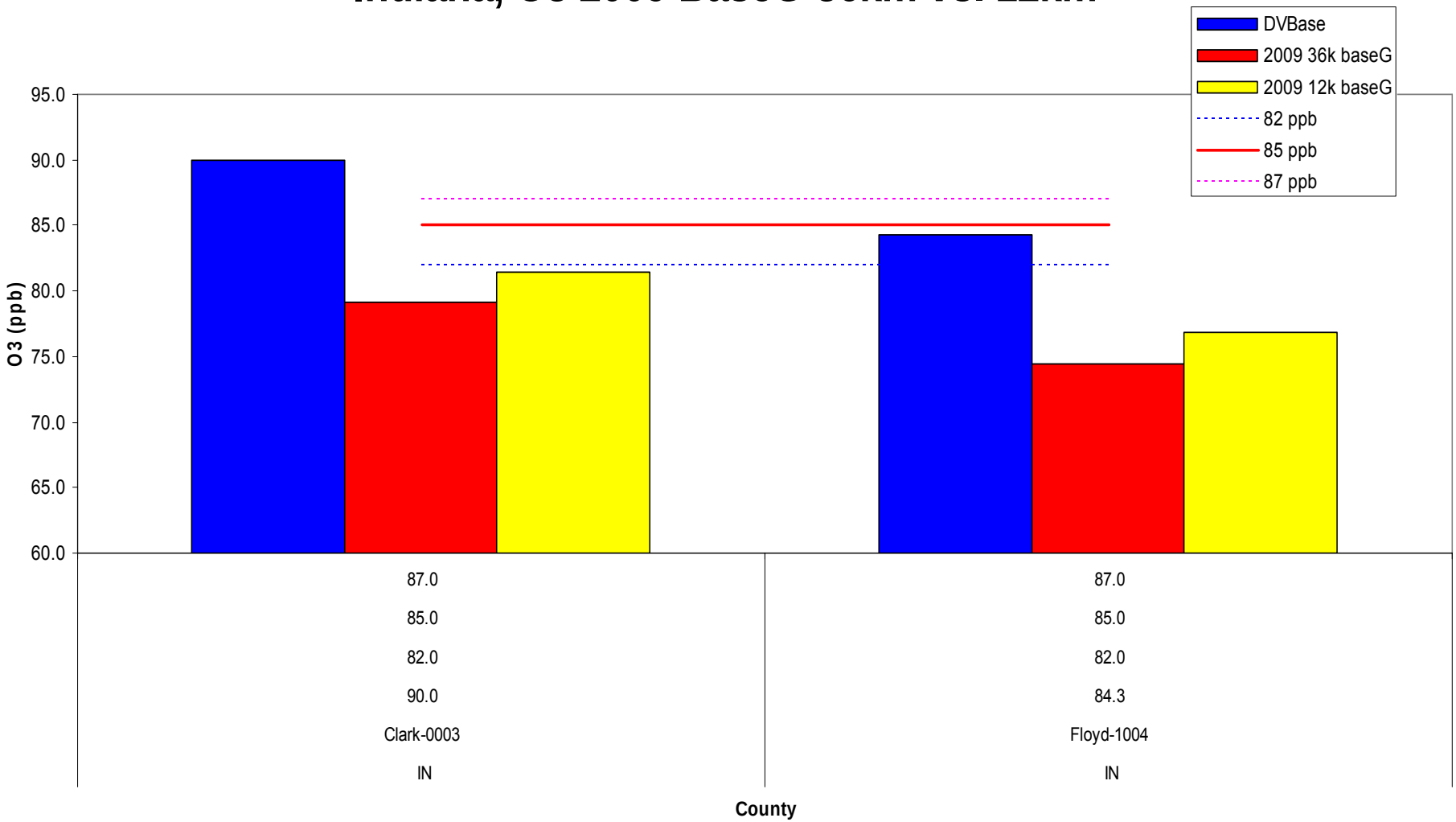
District of Columbia, O3 2009 BaseG 36km vs. 12km



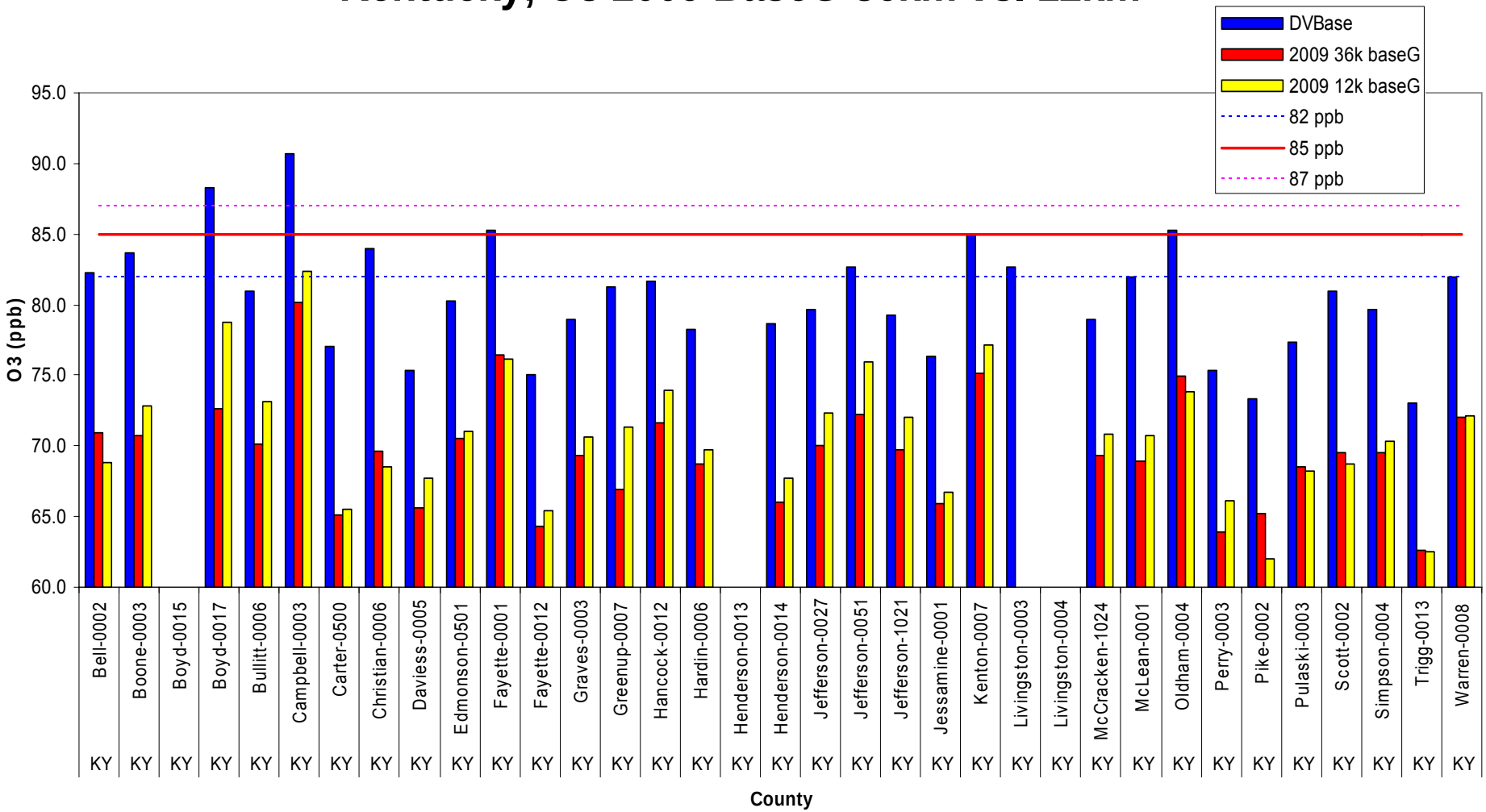
Florida, O3 2009 BaseG 36km vs. 12km



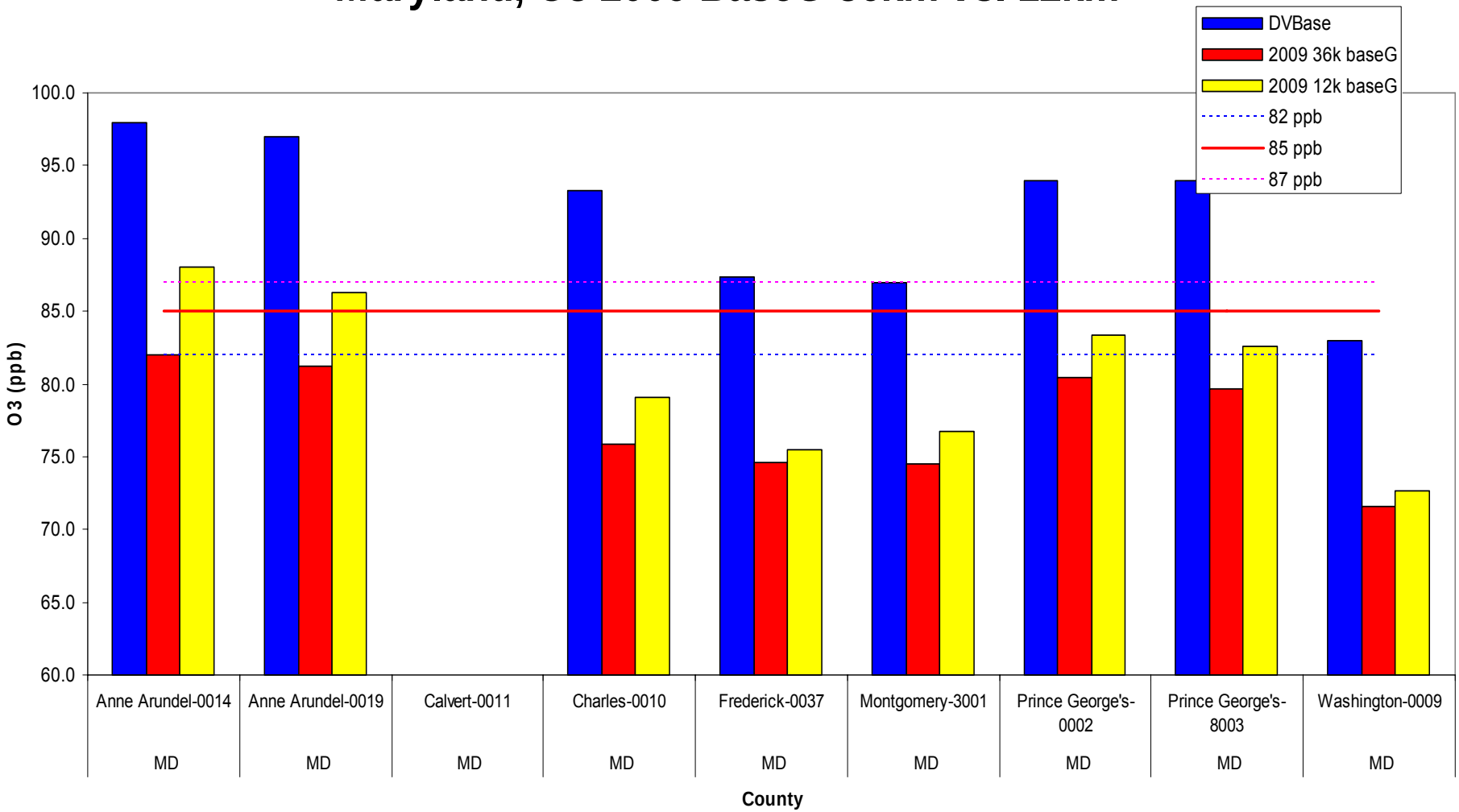
Indiana, O3 2009 BaseG 36km vs. 12km



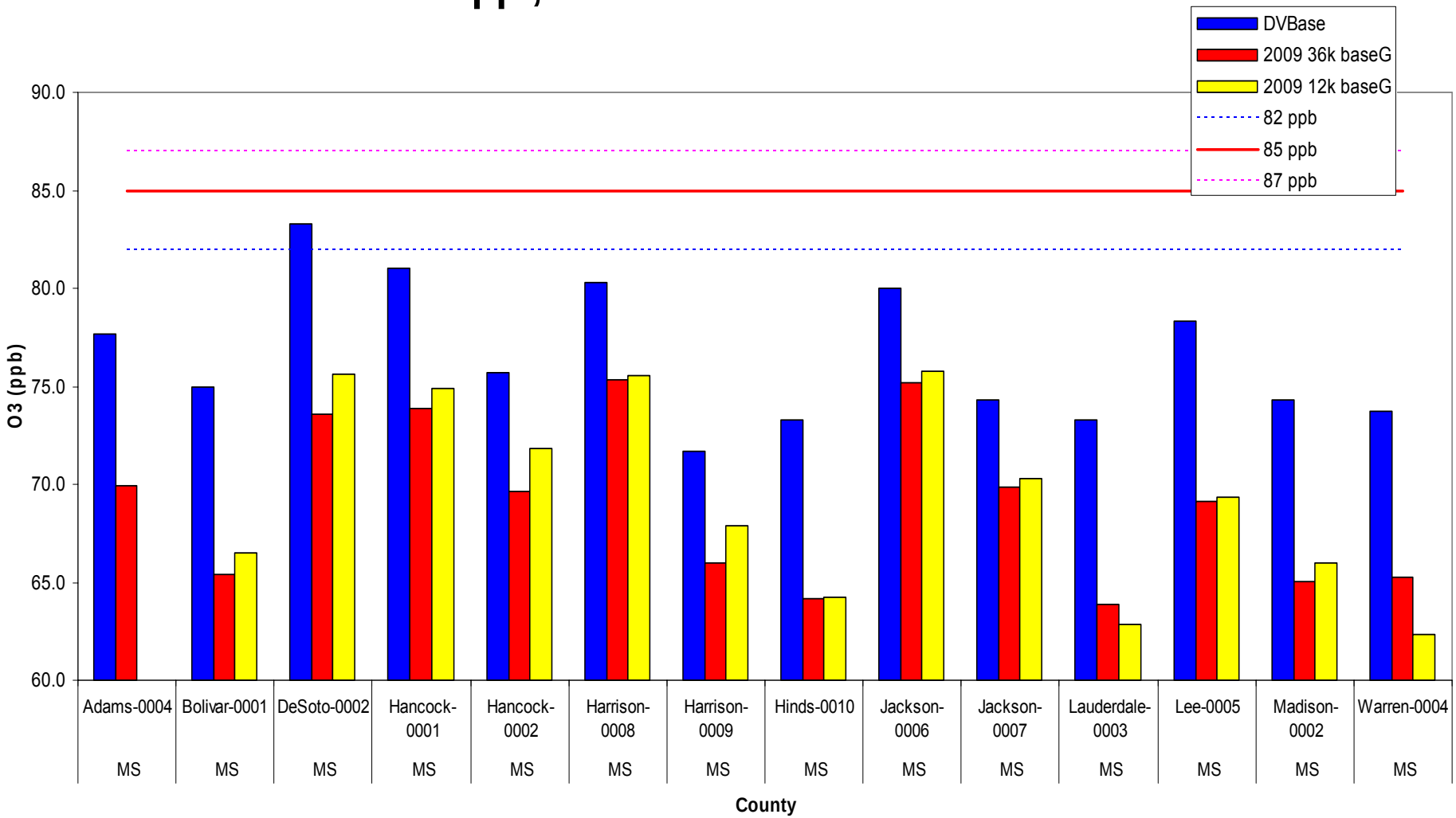
Kentucky, O3 2009 BaseG 36km vs. 12km



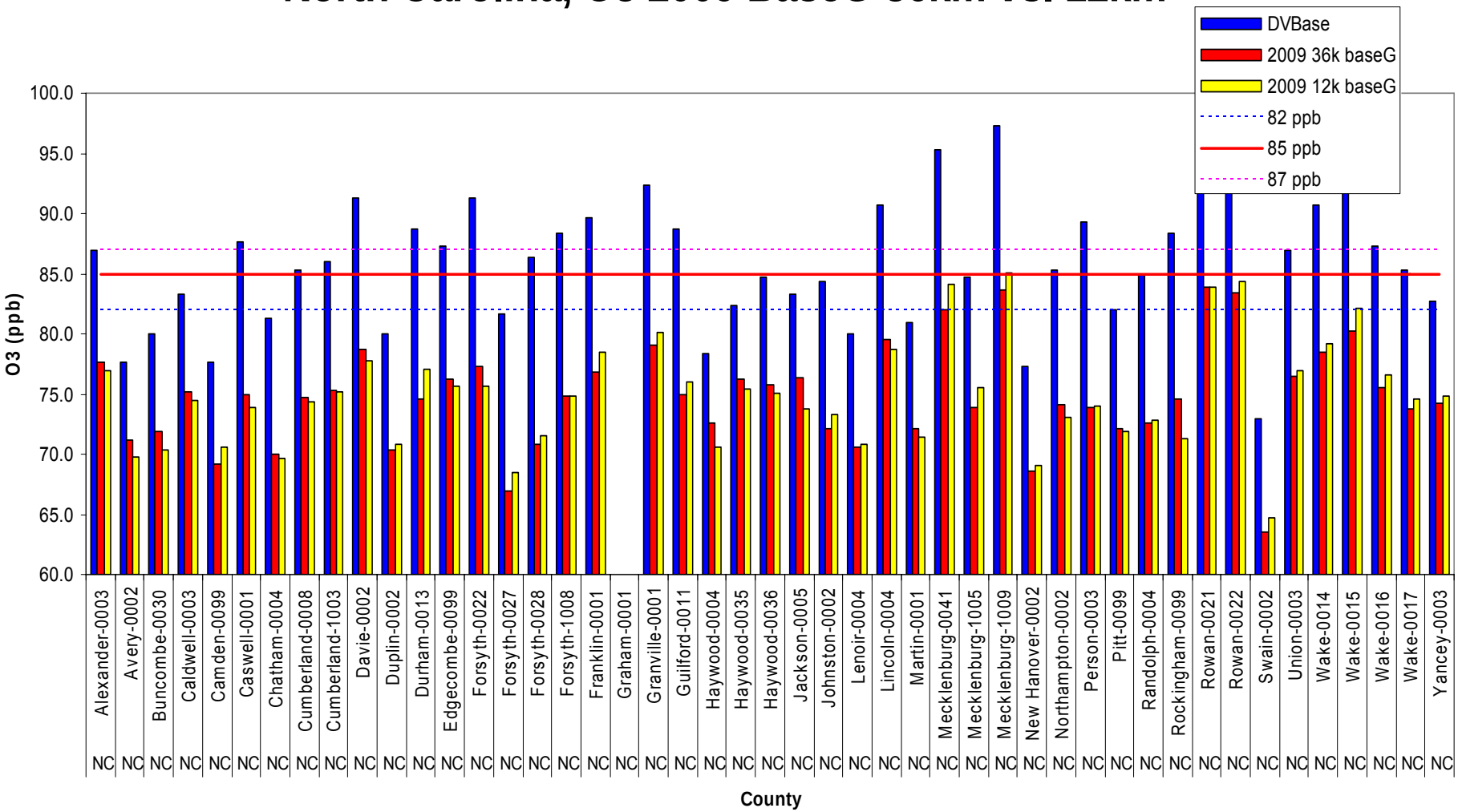
Maryland, O3 2009 BaseG 36km vs. 12km



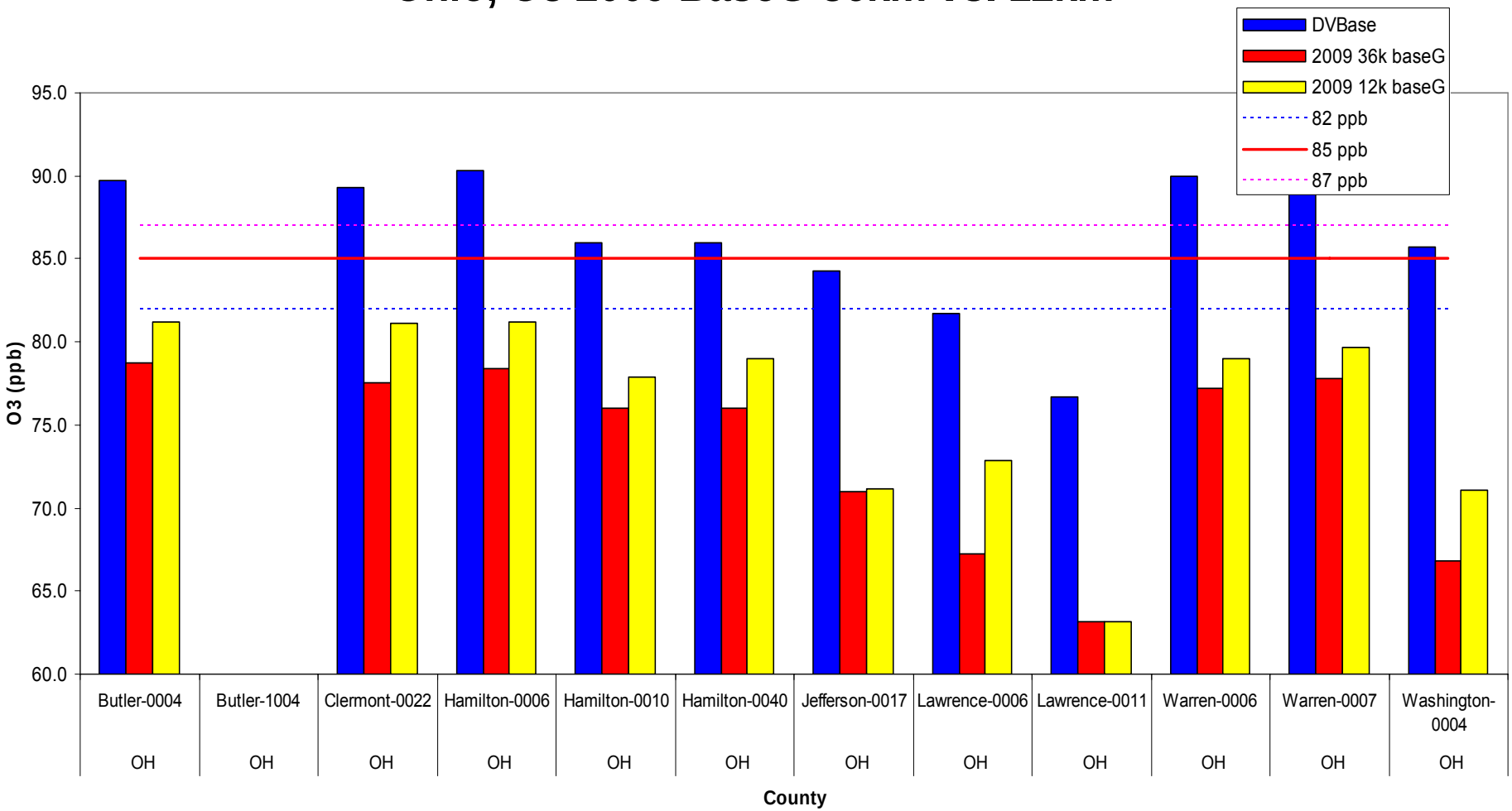
Mississippi, O3 2009 BaseG 36km vs. 12km



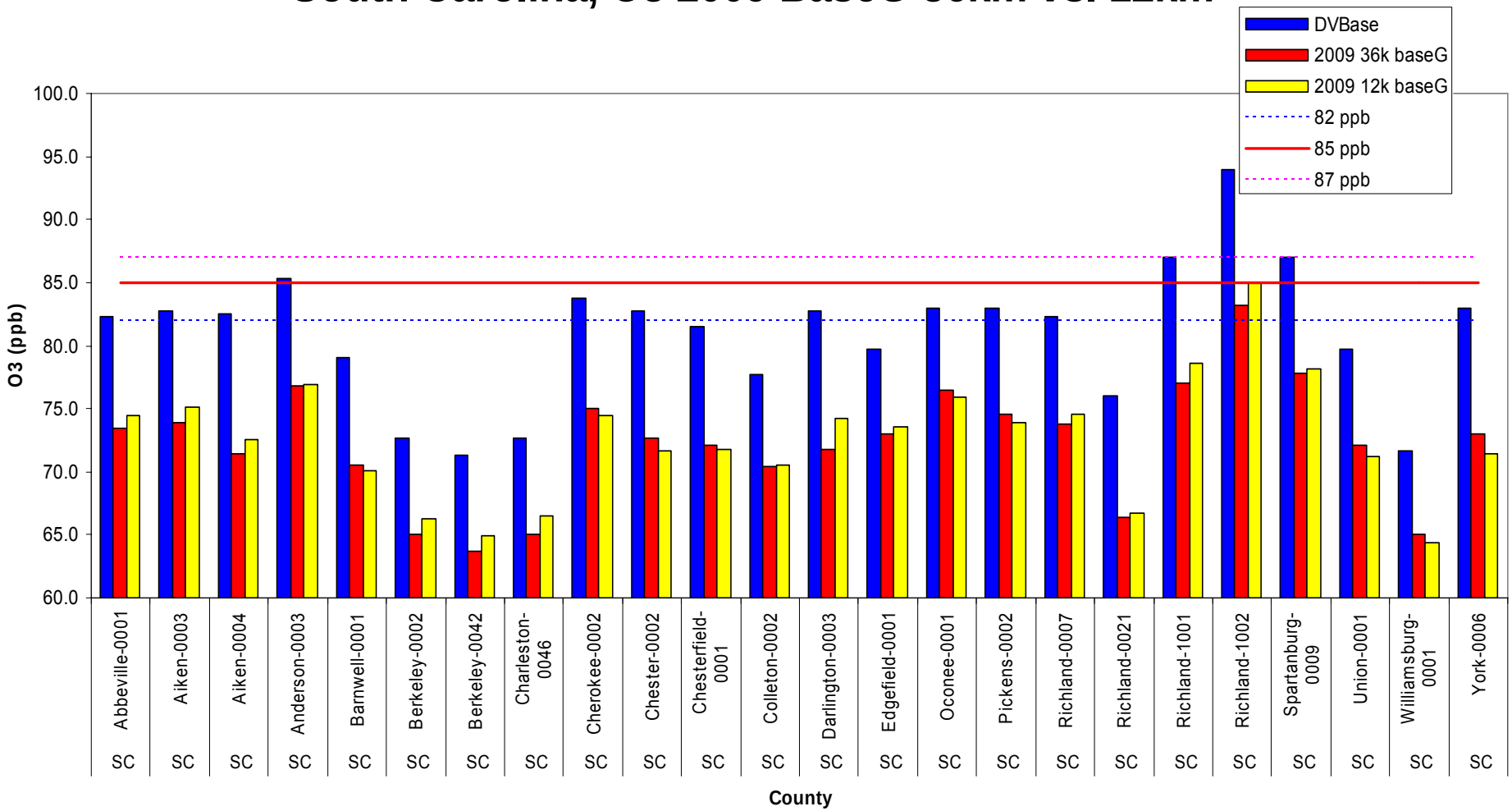
North Carolina, O3 2009 BaseG 36km vs. 12km



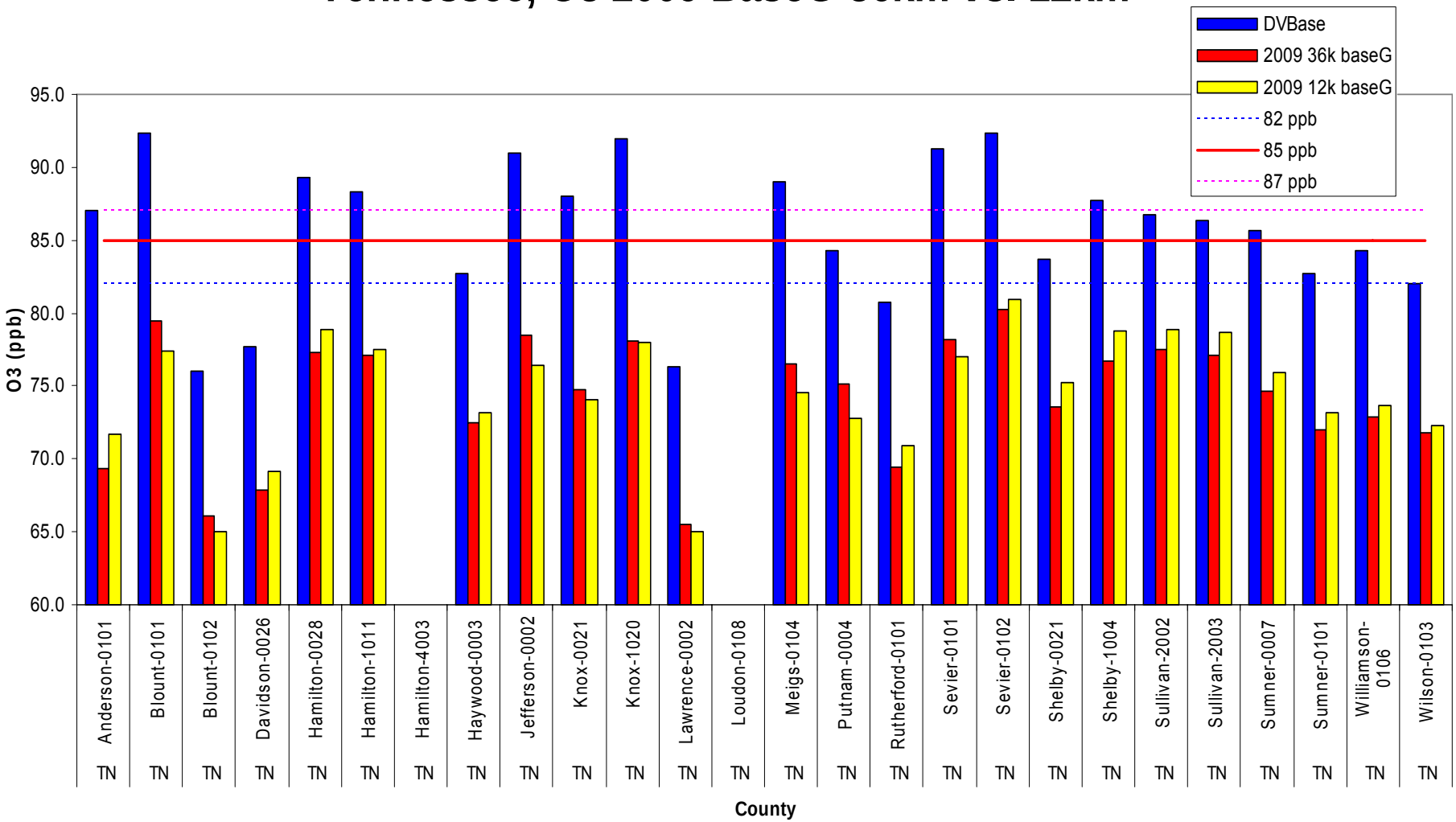
Ohio, O3 2009 BaseG 36km vs. 12km



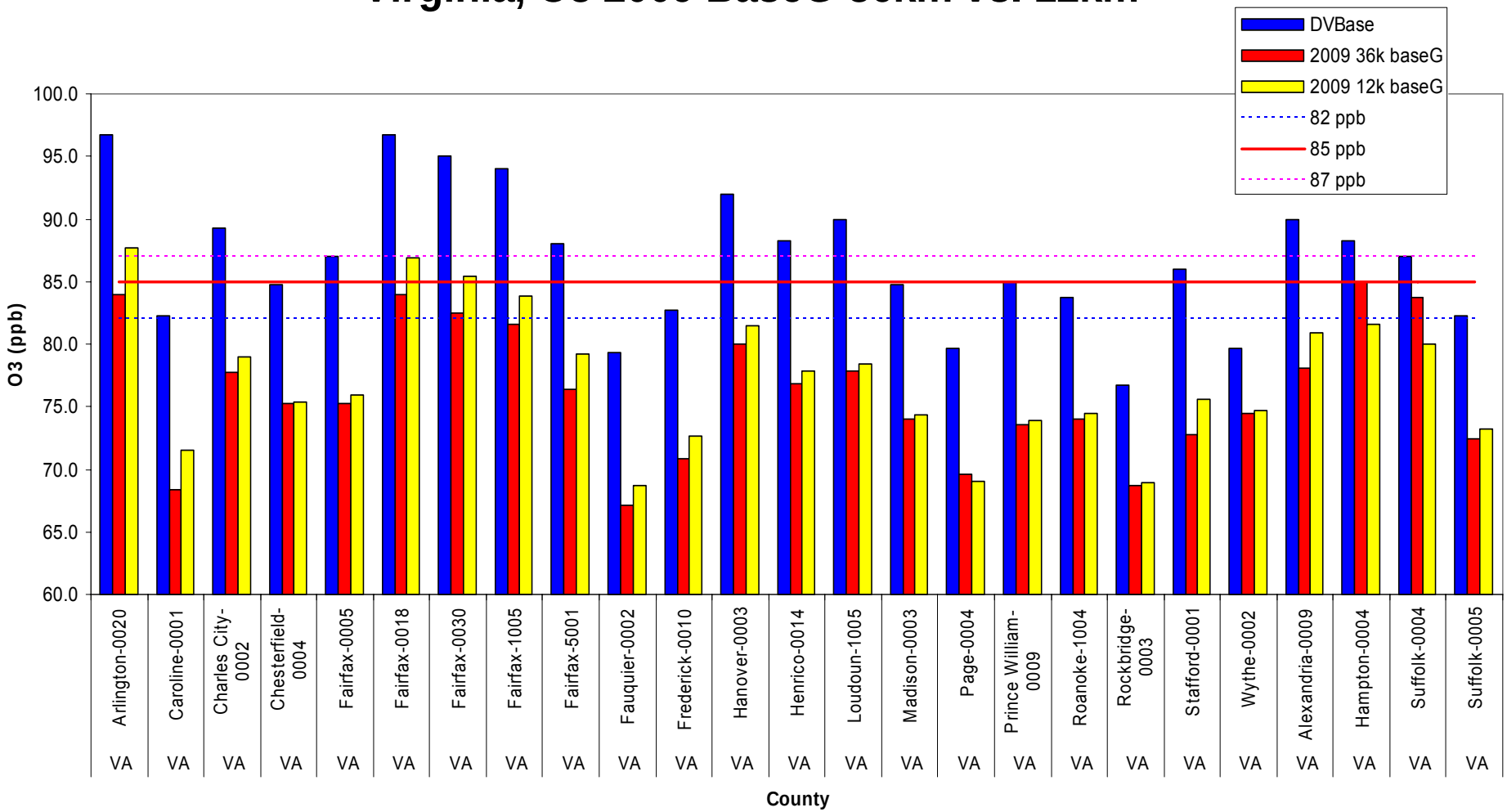
South Carolina, O3 2009 BaseG 36km vs. 12km



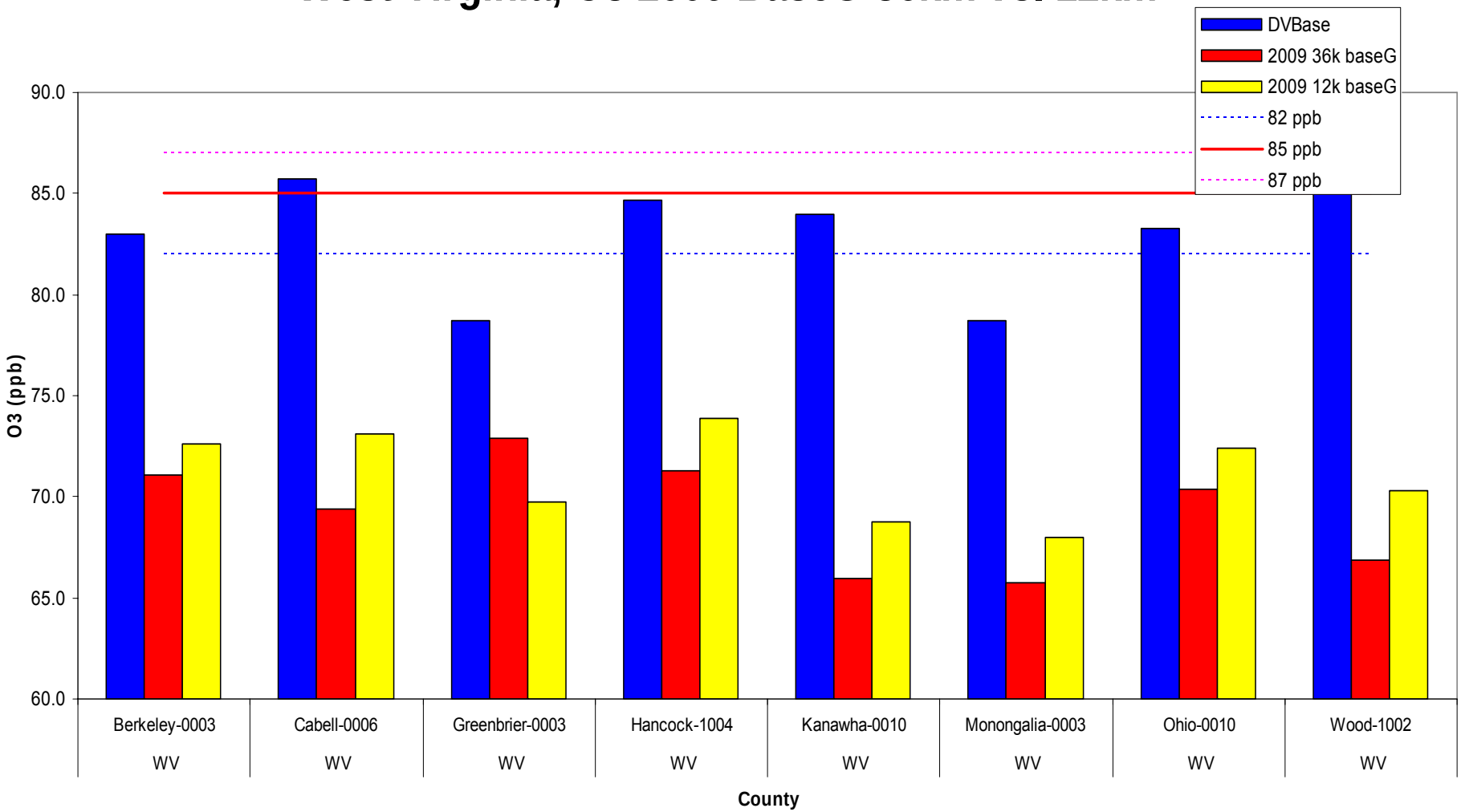
Tennessee, O3 2009 BaseG 36km vs. 12km



Virginia, O3 2009 BaseG 36km vs. 12km



West Virginia, O3 2009 BaseG 36km vs. 12km

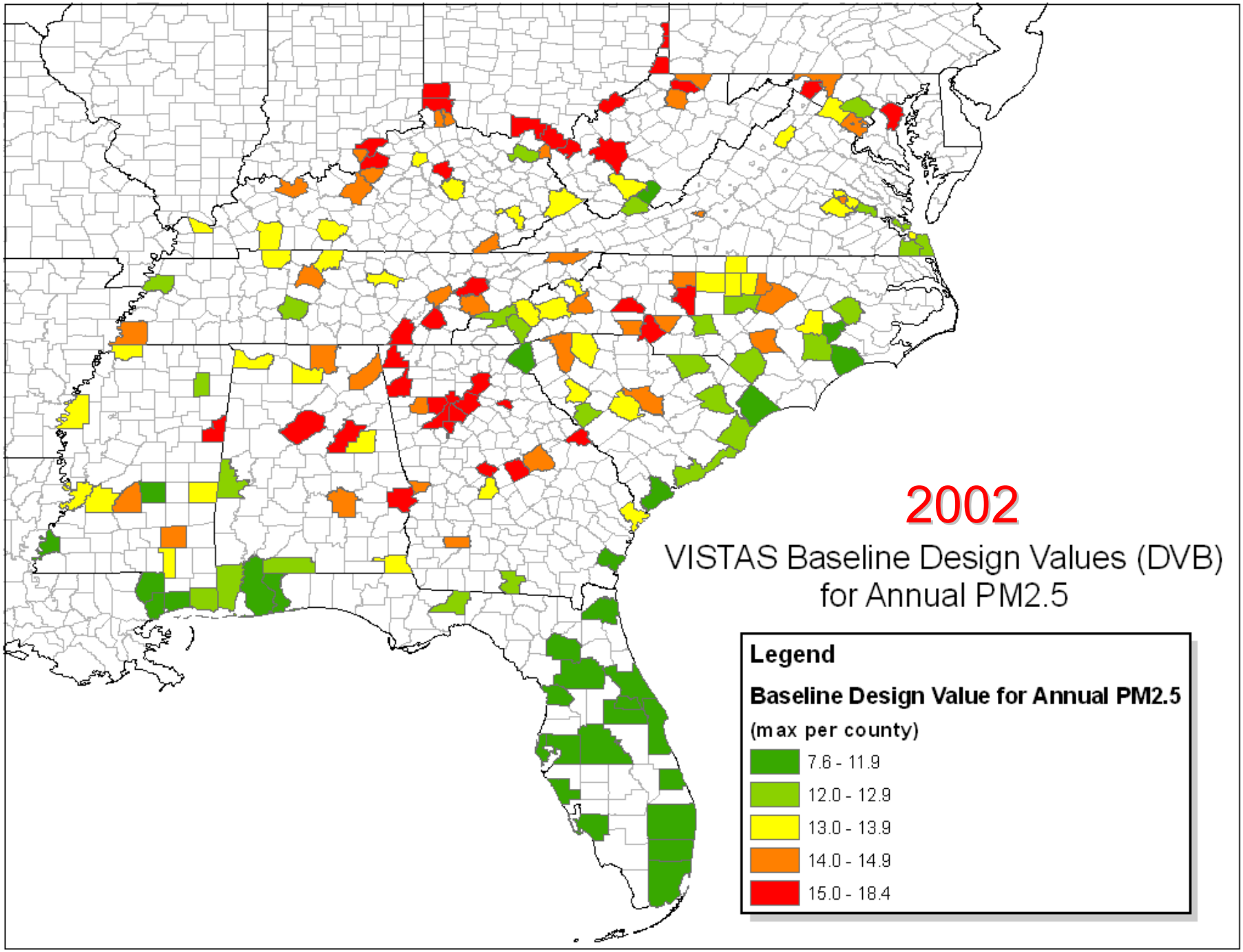


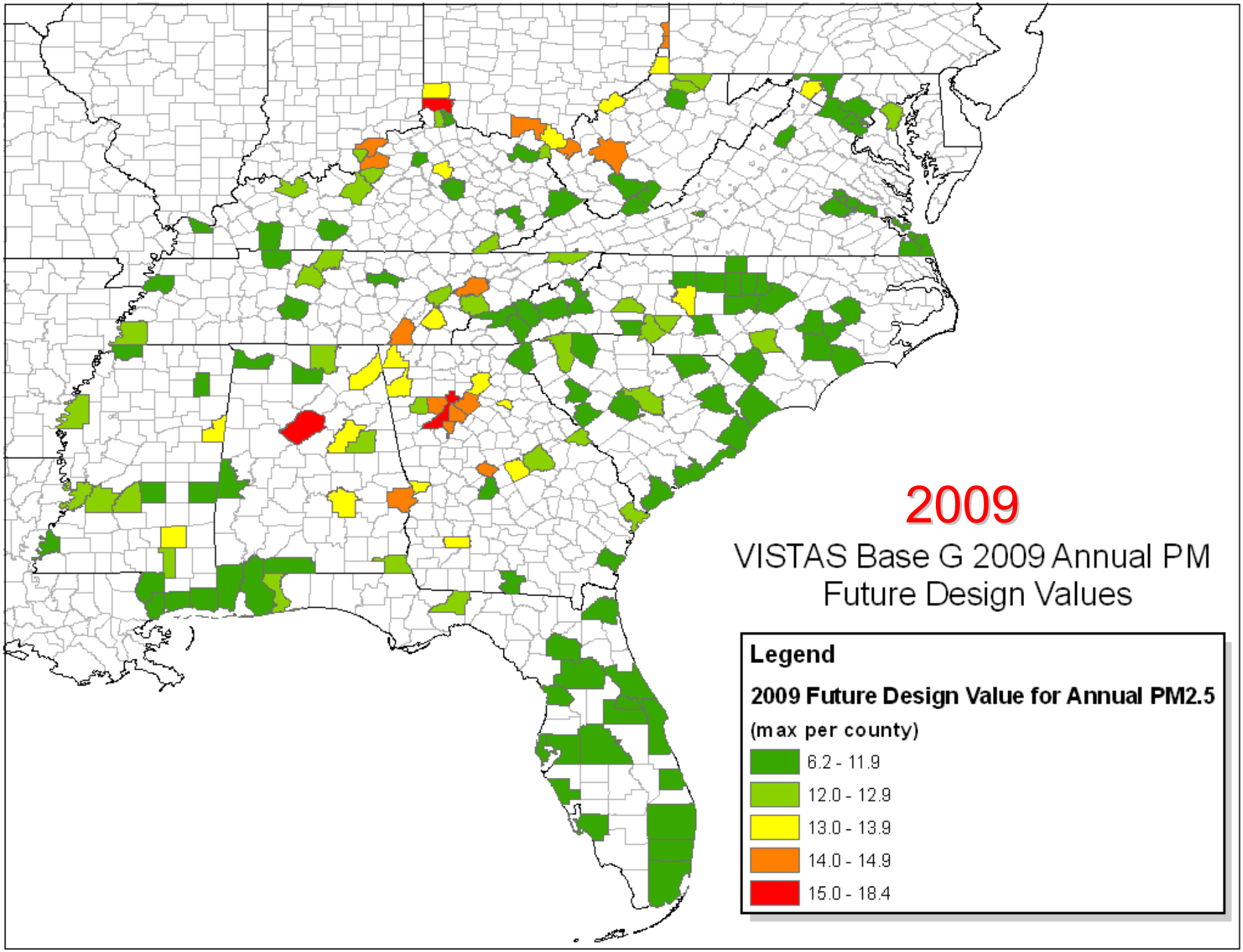
2009 Ozone Projections

- 85 ppb NAAQS
- Virginia
  - Arlington-0020 = 87.7 ppb
  - Fairfax-0018 = 86.9 ppb
  - Fairfax-0030 = 85.4 ppb
- Georgia
  - Fulton-0055 = 86.0 ppb
- North Carolina
  - Mecklenburg-1009 = 85.0 ppb
- 82 ppb to 87 ppb WOE Range

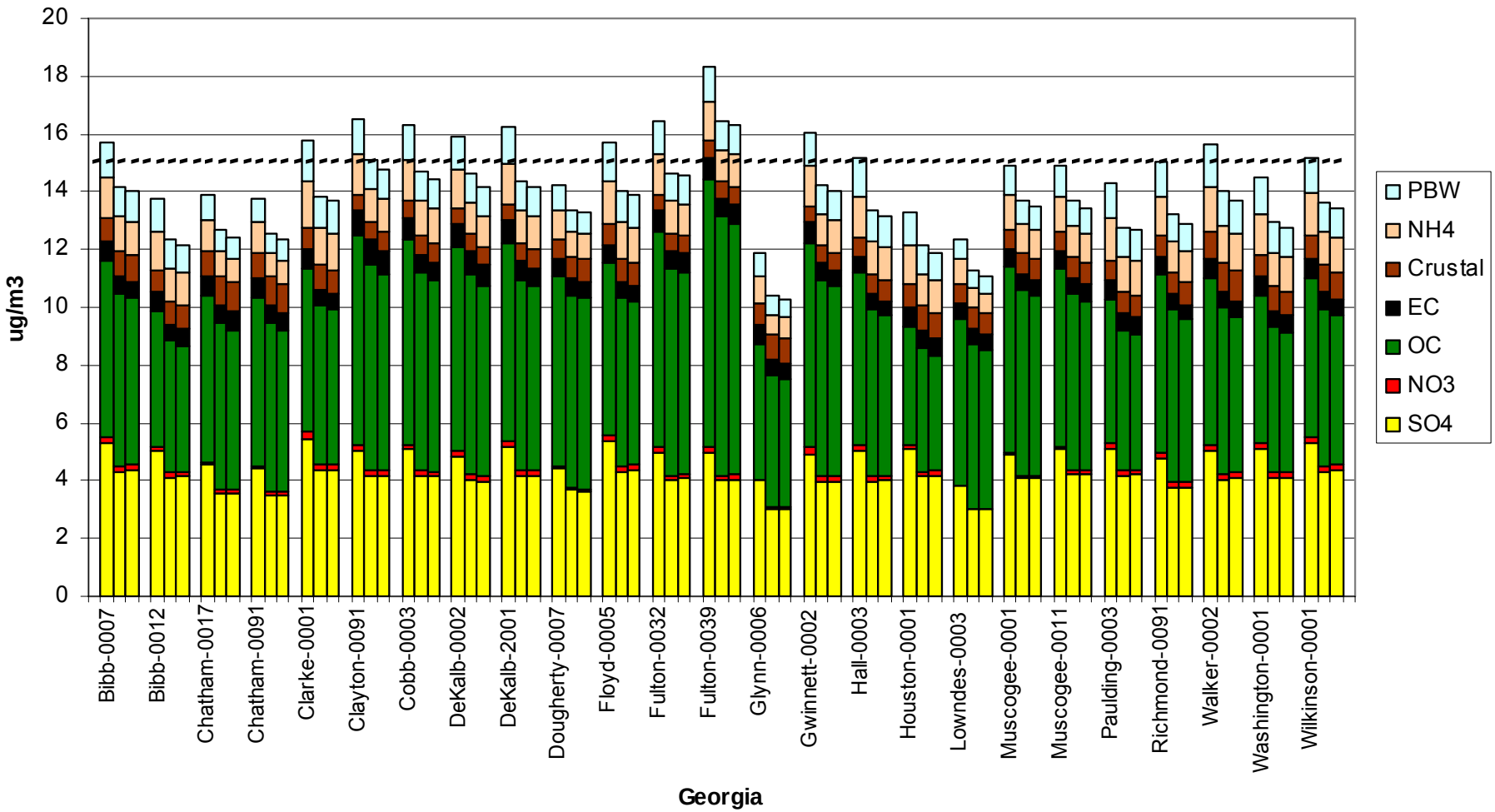
2009 12 km BaseG Ozone WOE

State	County	DVBase	2009 12K BaseG
MD	Anne Arundel-0014	98.0	88.0
VA	Arlington-0020	96.7	87.7
VA	Fairfax-0018	96.7	86.9
MD	Anne Arundel-0019	97.0	86.2
GA	Fulton-0055	94.3	86.0
VA	Fairfax-0030	95.0	85.4
NC	Mecklenburg-1009	97.3	85.0
NC	Rowan-0022	97.0	84.3
NC	Mecklenburg-0041	95.3	84.1
DC	District of Columbia-0043	92.7	84.0
NC	Rowan-0021	97.3	83.8
VA	Fairfax-1005	94.0	83.8
SC	Richland-1002	92.5	83.6
MD	Prince George's-0002	94.0	83.3
MD	Prince George's-8003	94.0	82.5
KY	Campbell-0003	90.7	82.3
GA	De Kalb-3001	91.0	82.2
NC	Wake-0015	92.7	82.1

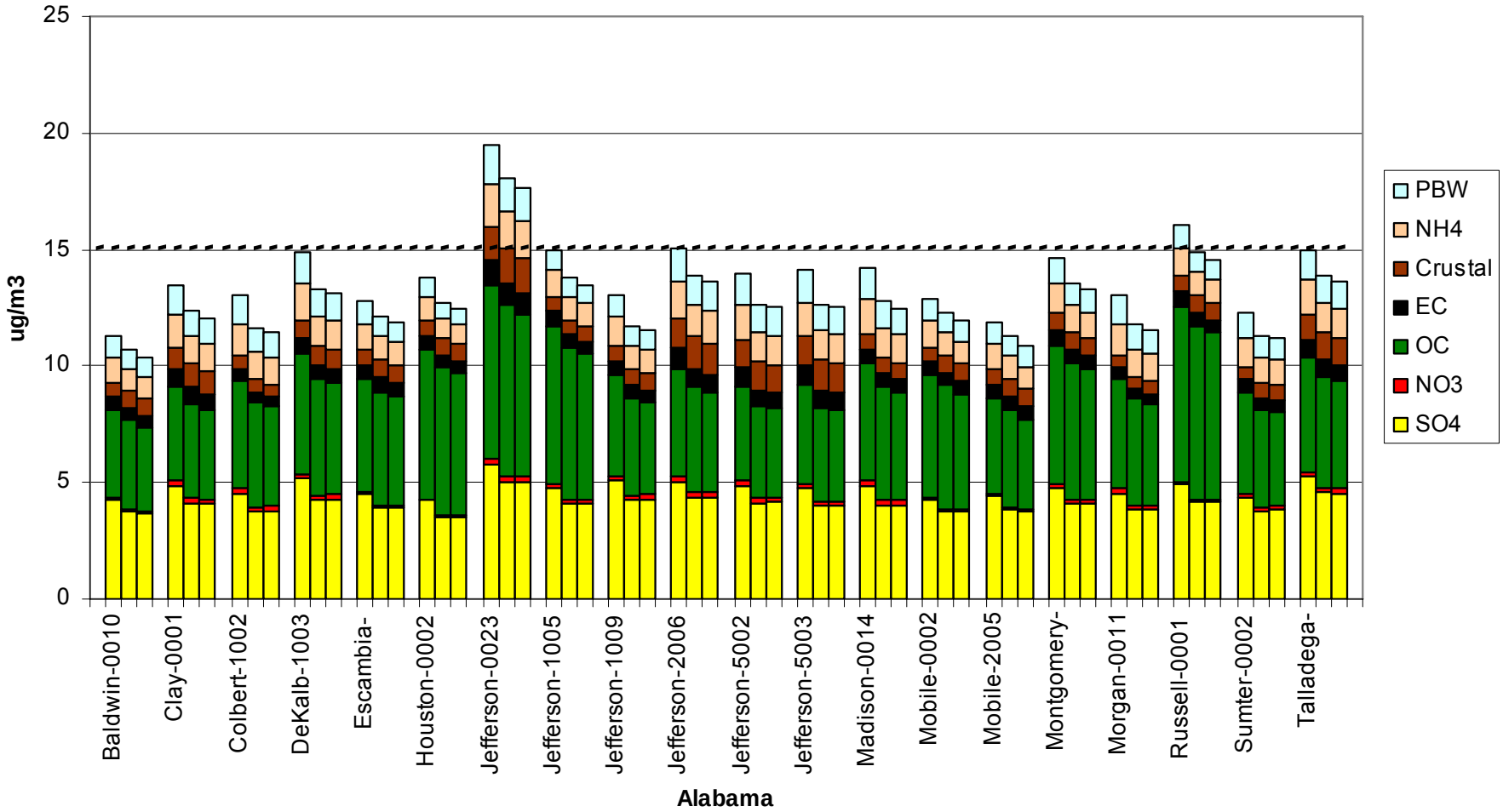

2002
VISTAS Baseline Design Values (DVB)
for Annual PM2.5
Legend
Baseline Design Value for Annual PM2.5
(max per county)
7.6 - 11.9
12.0 - 12.9
13.0 - 13.9
14.0 - 14.9
15.0 - 18.4


2009
VISTAS Base G 2009 Annual PM
Future Design Values
Legend
2009 Future Design Value for Annual PM2.5
(max per county)
6.2 - 11.9
12.0 - 12.9
13.0 - 13.9
14.0 - 14.9
15.0 - 18.4

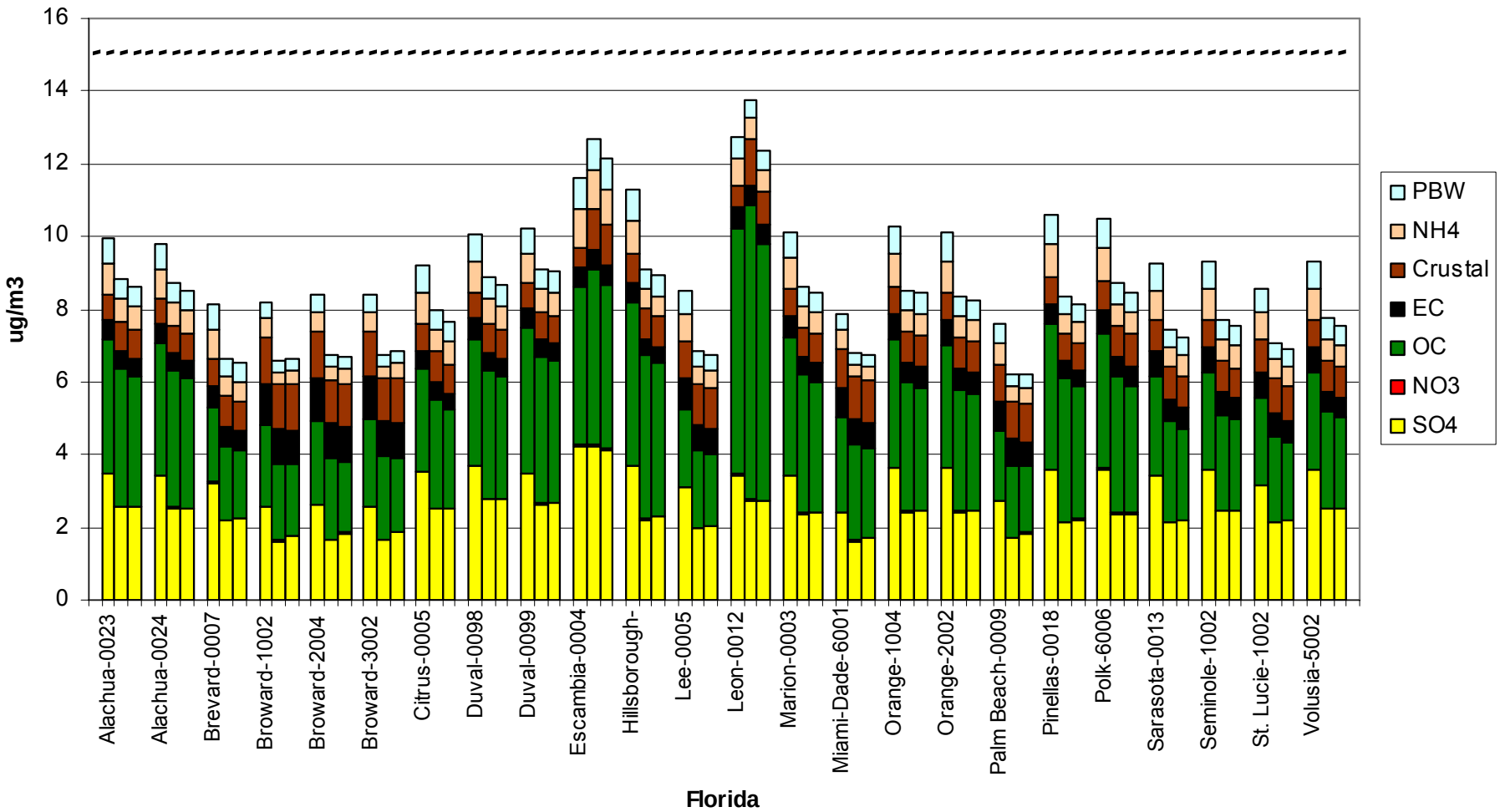
Georgia 2002 Design Value (Left) and 2009 base G 36km projected DVF (Middle) and 2009 base G 12km projected DVF (Right)



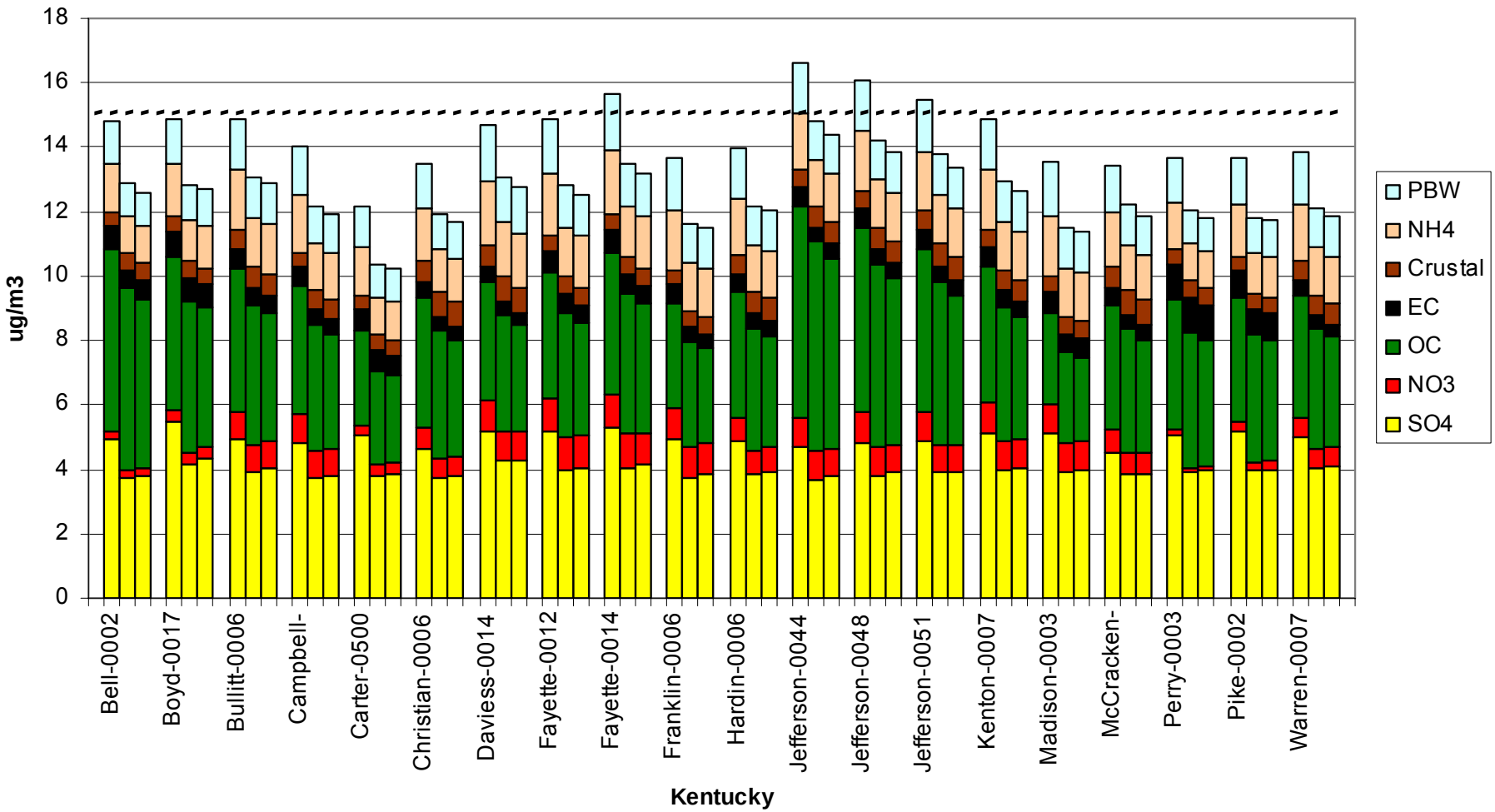
Alabama 2002 Design Value (Left) and 2009 base G 36km projected DVF (Middle) and 2009 base G 12km projected DVF (Right)



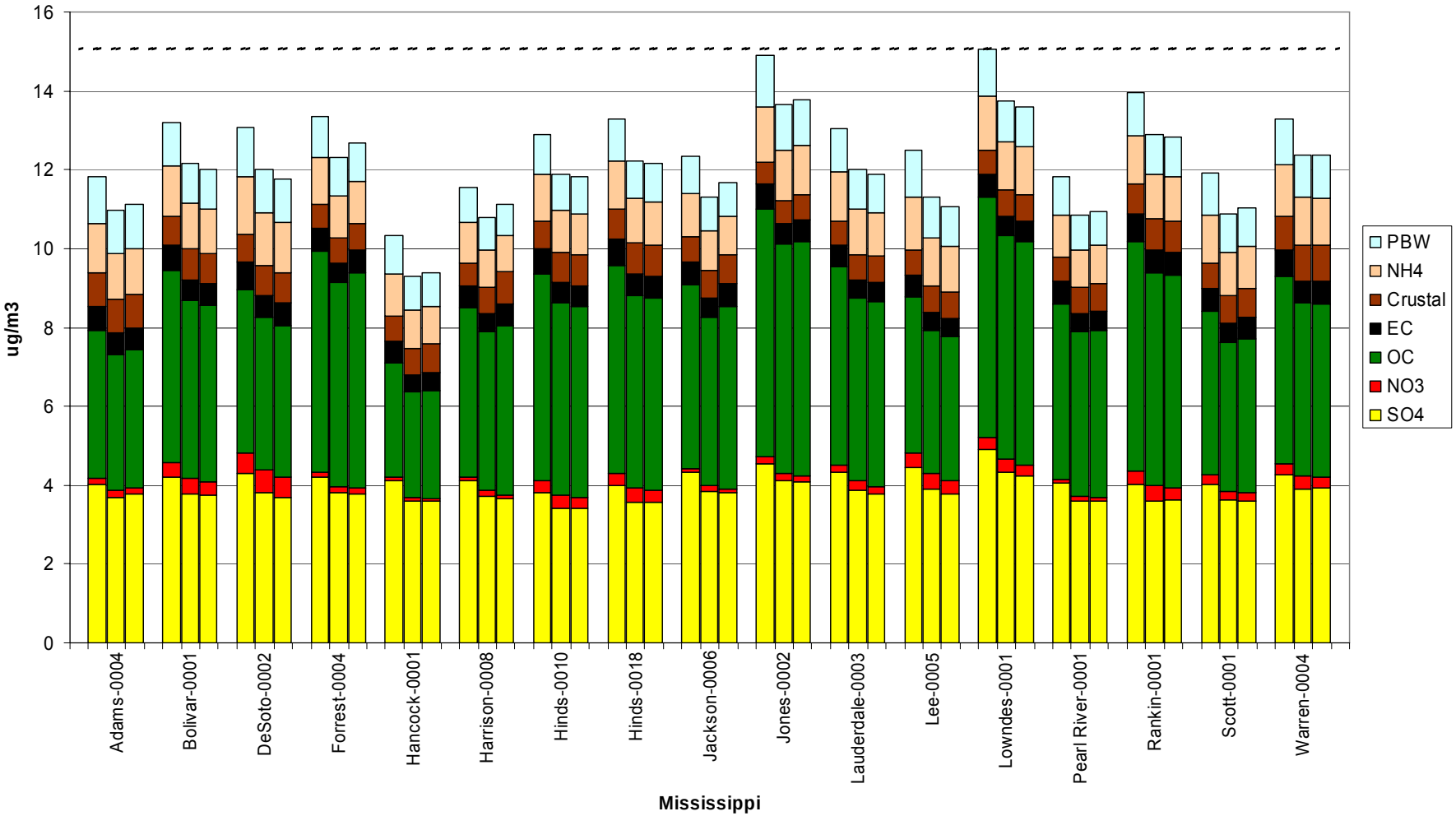
Florida 2002 Design Value (Left) and 2009 base G 36km projected DVF (Middle) and 2009 base G 12km projected DVF (Right)



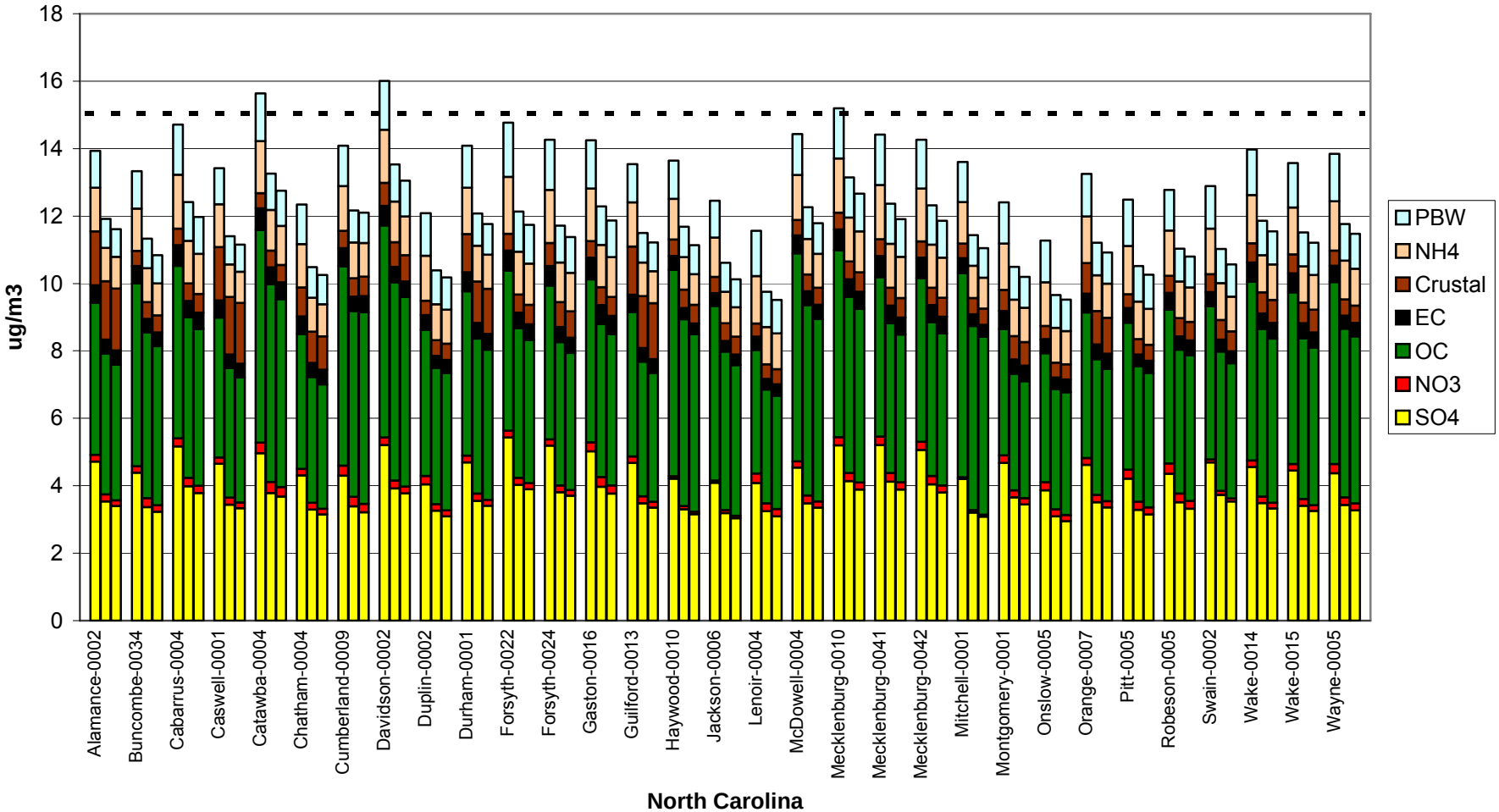
Kentucky 2002 Design Value (Left) and 2009 base G 36km projected DVF (Middle) and 2009 base G 12km projected DVF (Right)



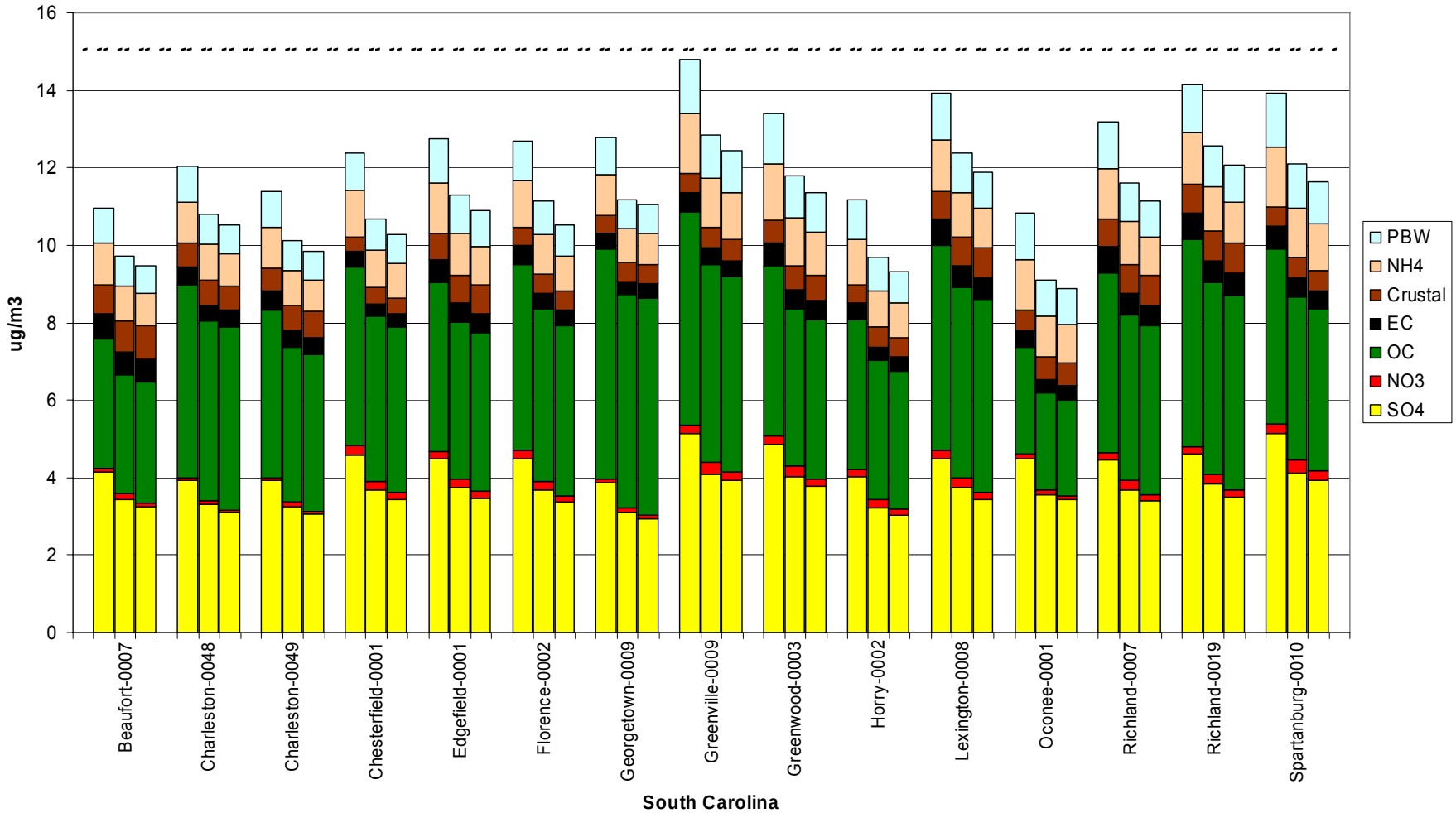
Mississippi 2002 Design Value (Left) and 2009 base f4a 12km projected DVF (Middle) and 2009 base G 12km projected DVF (Right)



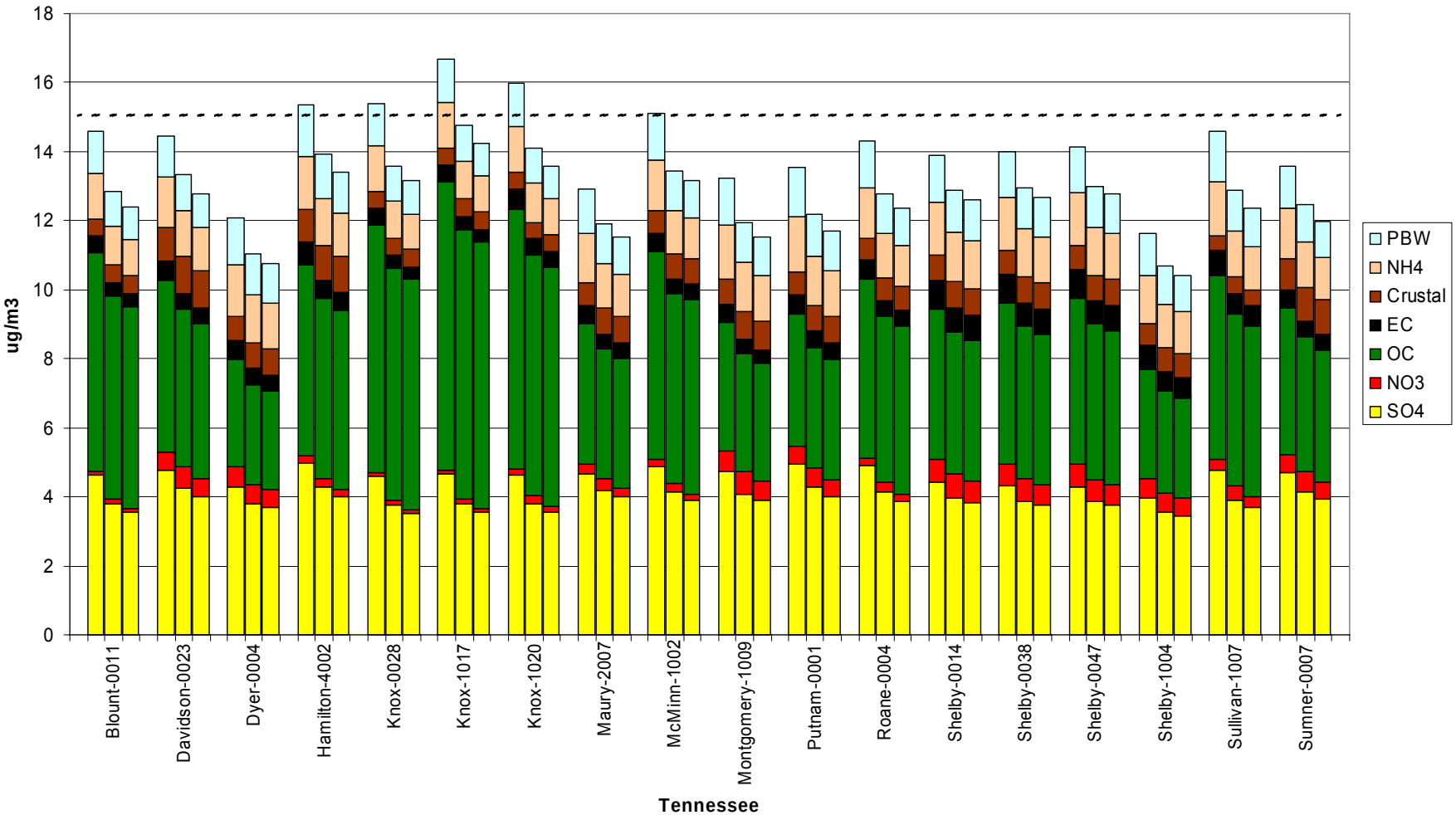
North Carolina 2002 Design Value (Left) and 2009 base f4a 12km projected DVF (Middle) and 2009 base G 12km projected DVF (Right)



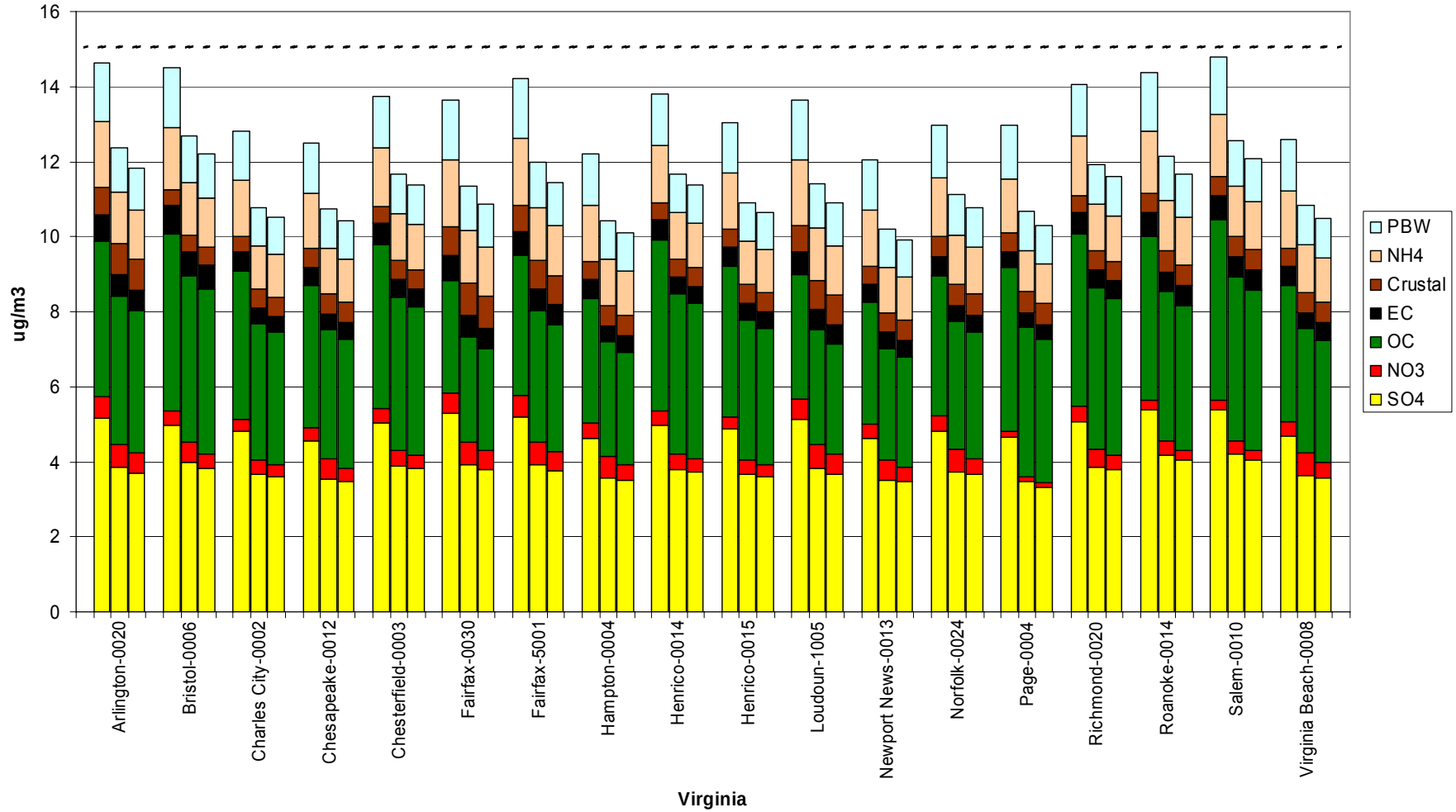
South Carolina 2002 Design Value (Left) and 2009 base f4a 12km projected DVF (Middle) and 2009 base G 12km projected DVF (Right)



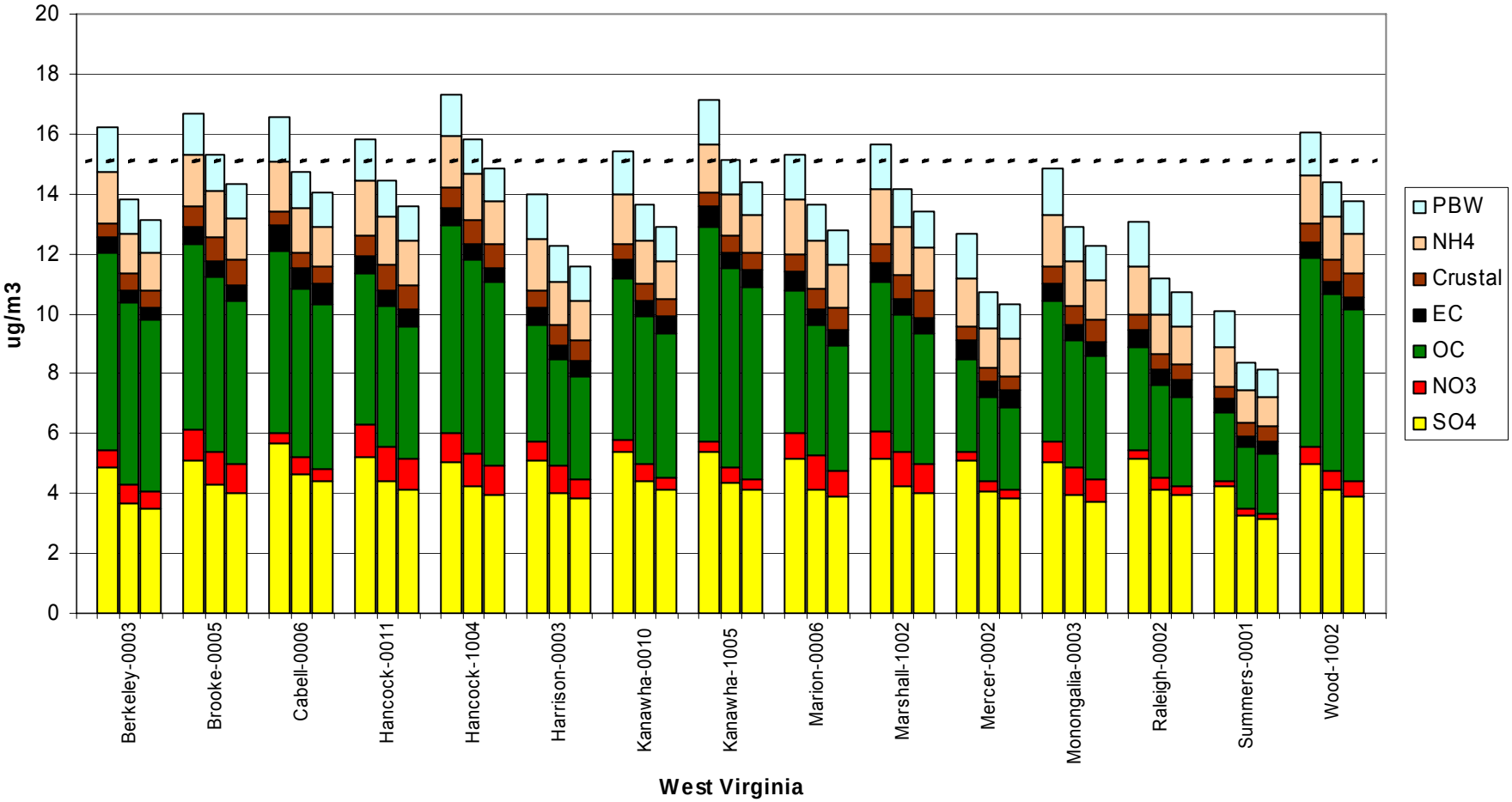
Tennessee 2002 Design Value (Left) and 2009 base f4a 12km projected DVF (Middle) and 2009 base G 12km projected DVF (Right)



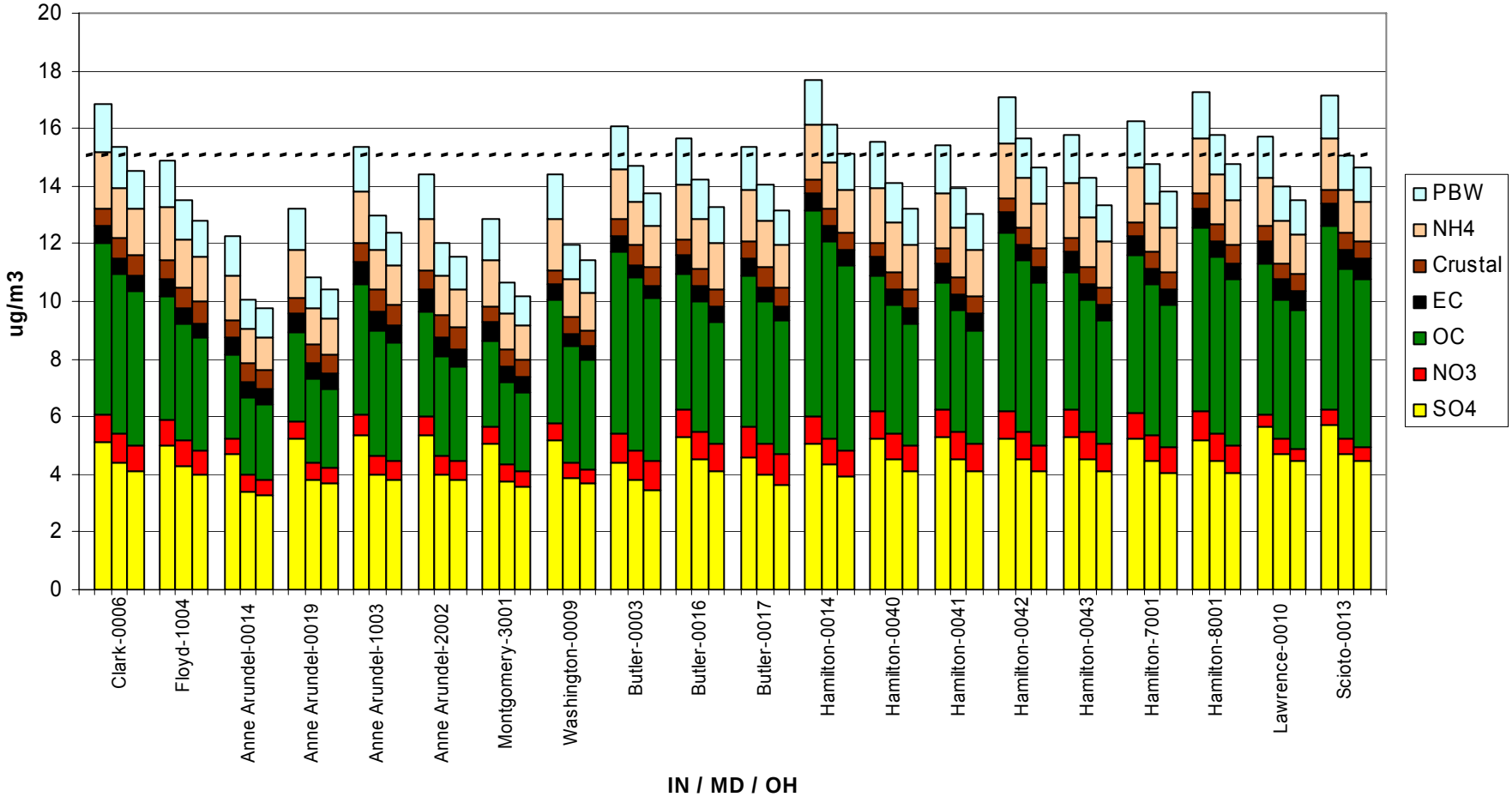
Virginia 2002 Design Value (Left) and 2009 base f4a 12km projected DVF (Middle) and 2009 base G 12km projected DVF (Right)



West Virginia 2002 Design Value (Left) and 2009 base f4a 12km projected DVF (Middle) and 2009 base G 12km projected DVF (Right)



IN / MD / OH 2002 Design Value (Left) and 2009 base f4a 12km projected DVF (Middle) and 2009 base G 12km projected DVF (Right)



2009 Annual $PM_{2.5}$ Projections

- 15 µg/m^3 NAAQS
  - Alabama
    - Jefferson NBHM = 17.7 µg/m^3
  - Georgia
    - Fulton = 16.3 µg/m^3
  - Ohio
    - Hamilton = 15.1 µg/m^3
- 14.5 to 15.5 µg/m^3 WOE Range

2009 Base G PM2.5 WOE

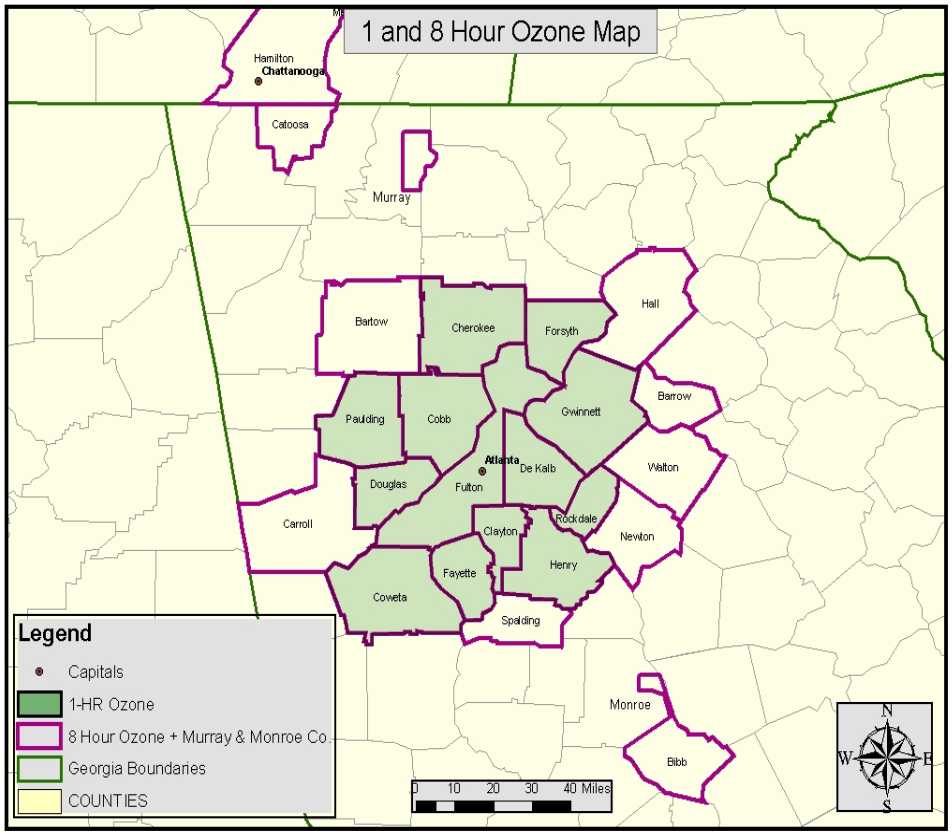
				2009g1a	
AIRS ID	State	County	00-04 DV CONC of PM	2009 36km CONC of PM	2009 12km CONC of PM
01-073-0023	AL	Jefferson	19.5	18.1	17.7
13-121-0039	GA	Fulton	18.3	16.4	16.3
39-061-0014	OH	Hamilton	17.7	15.7	15.1
54-029-1004	WV	Hancock	17.3	15.5	14.9
39-061-8001	OH	Hamilton	17.3	15.3	14.8
13-063-0091	GA	Clayton	16.5	15.1	14.8
39-061-0042	OH	Hamilton	17.1	15.1	14.7
39-145-0013	OH	Scioto	17.1	15.0	14.6
13-121-0032	GA	Fulton	16.5	14.6	14.6
01-113-0001	AL	Russell	16.1	14.9	14.6
18-019-0006	IN	Clark	16.8	14.9	14.5
54-039-1005	WV	Kanawha	17.1	14.7	14.4
13-067-0003	GA	Cobb	16.3	14.7	14.4
21-111-0044	KY	Jefferson	16.6	14.8	14.4
54-009-0005	WV	Brooke	16.7	14.9	14.3
47-093-1017	TN	Knox	16.7	14.7	14.3
13-089-2001	GA	DeKalb	16.2	14.4	14.2
13-089-0002	GA	DeKalb	15.9	14.6	14.1
54-011-0006	WV	Cabell	16.5	14.4	14.1
13-021-0007	GA	Bibb	15.7	14.2	14.0
13-135-0002	GA	Gwinnett	16.1	14.2	14.0
13-115-0005	GA	Floyd	15.7	14.0	13.9
21-111-0048	KY	Jefferson	16.1	14.2	13.9
39-061-7001	OH	Hamilton	16.3	14.3	13.8
54-107-1002	WV	Wood	16.1	14.2	13.8
39-017-0003	OH	Butler	16.1	14.3	13.8

GA EPD Modeling

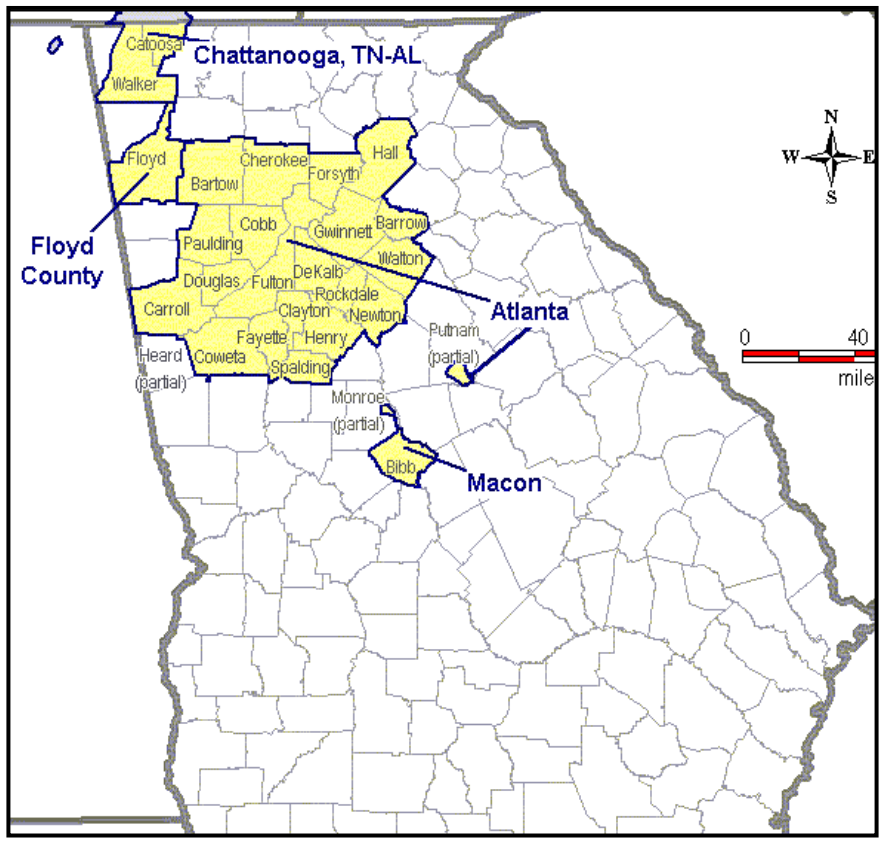
Non-Attainment in Georgia

- **8-hour ozone standard (85 ppb): Atlanta, Macon, Murray, Chattanooga (EAC)**
- **Annual $PM_{2.5}$ standard (15 μg/m^3): Atlanta, Macon, Floyd County, Chattanooga**

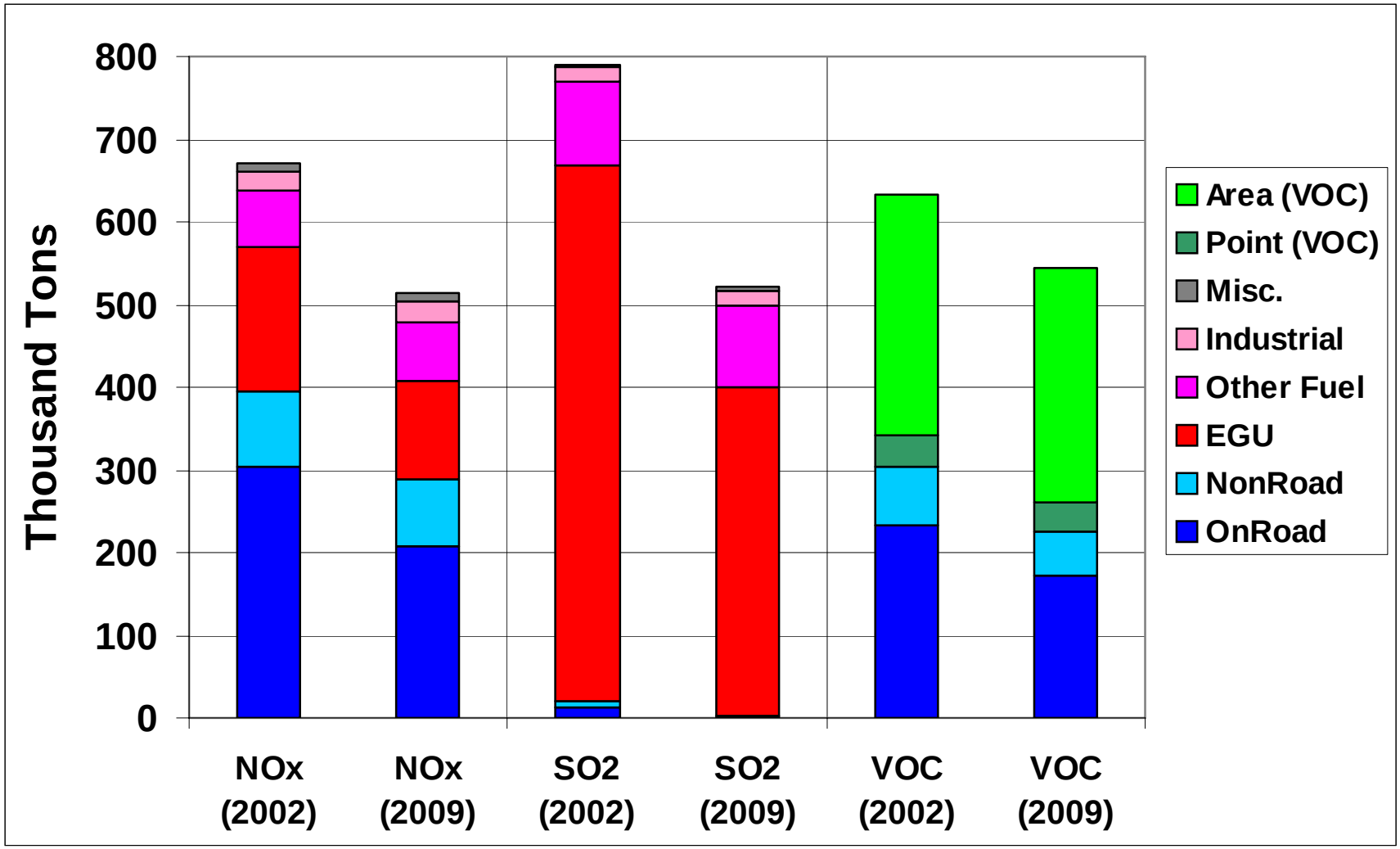
Ozone non-attainment areas



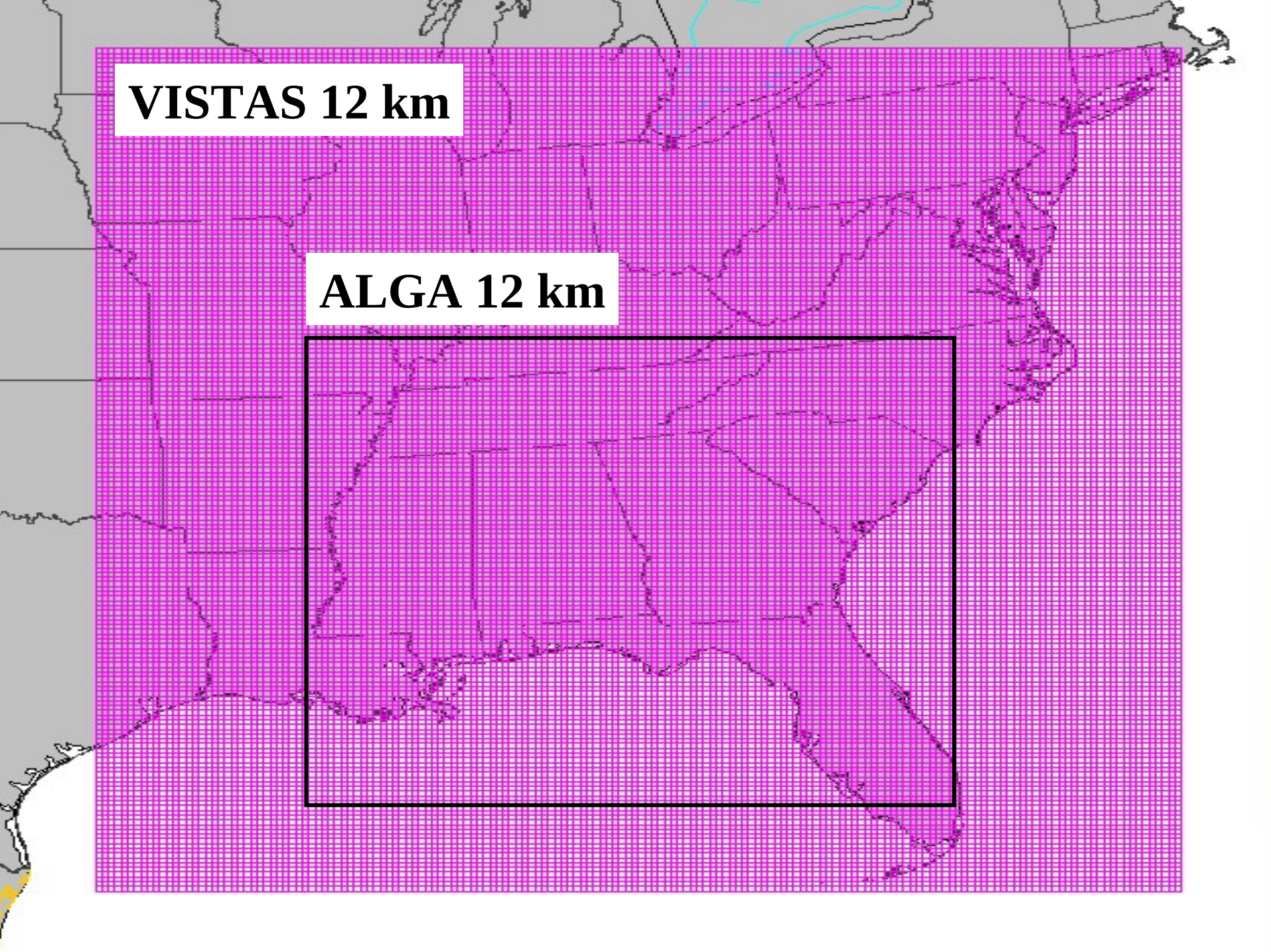
PM2.5 non-attainment areas



Future Emissions in Georgia

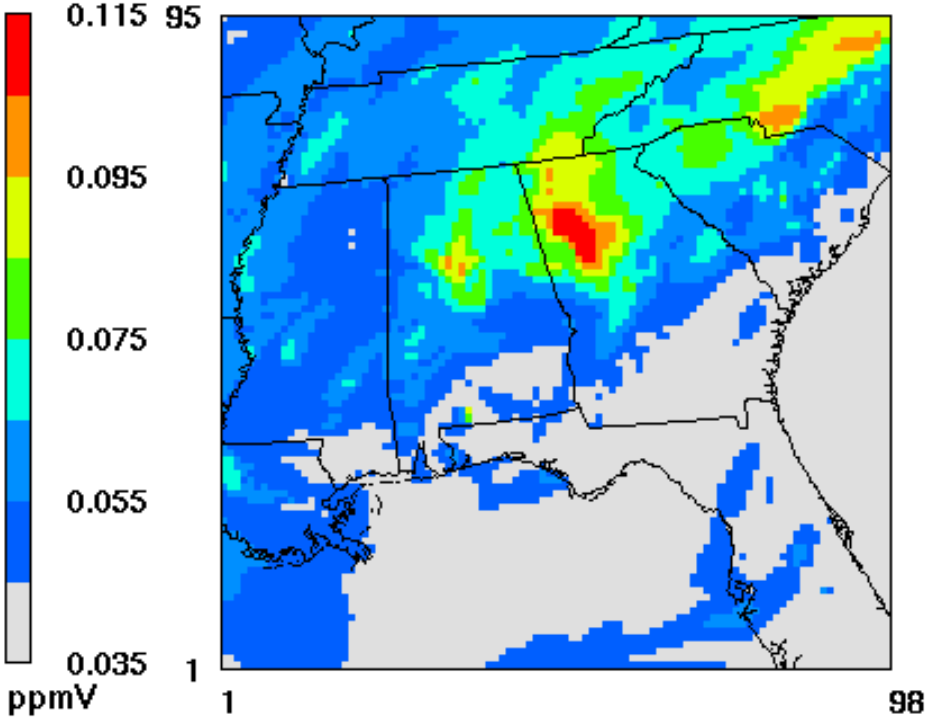


Reductions in NO_x and SO_2 $\Rightarrow$ reductions in ozone and sulfate $PM_{2.5}$

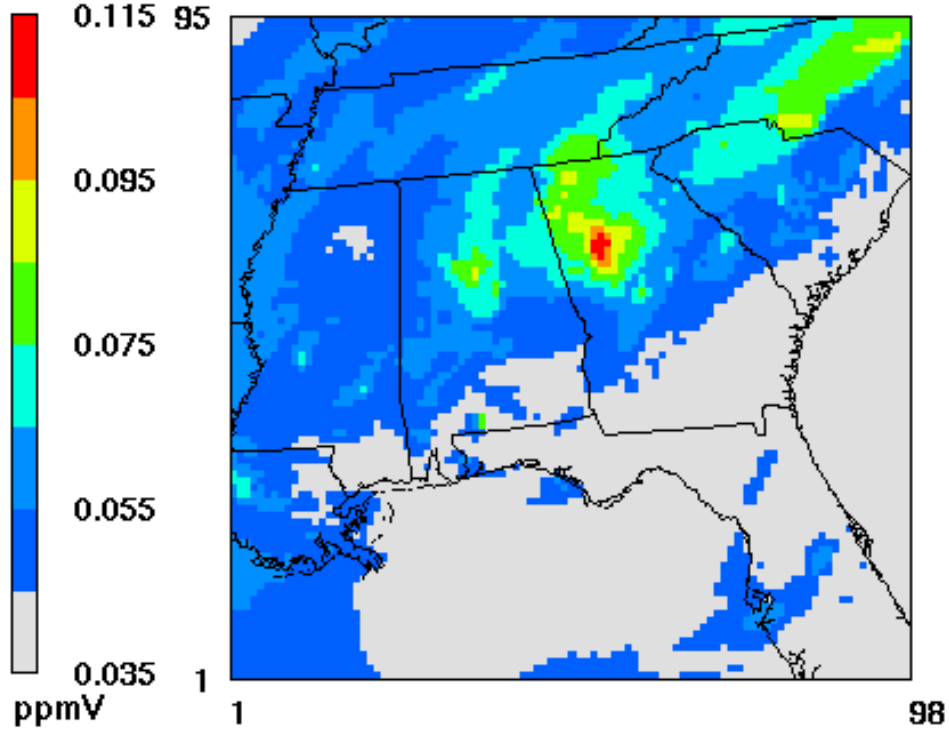

VISTAS 12 km
ALGA 12 km

Reductions in Ozone (2002 ➔ 2009)

Max 8-hour O3 on June 12, 2002
2002 Emissions

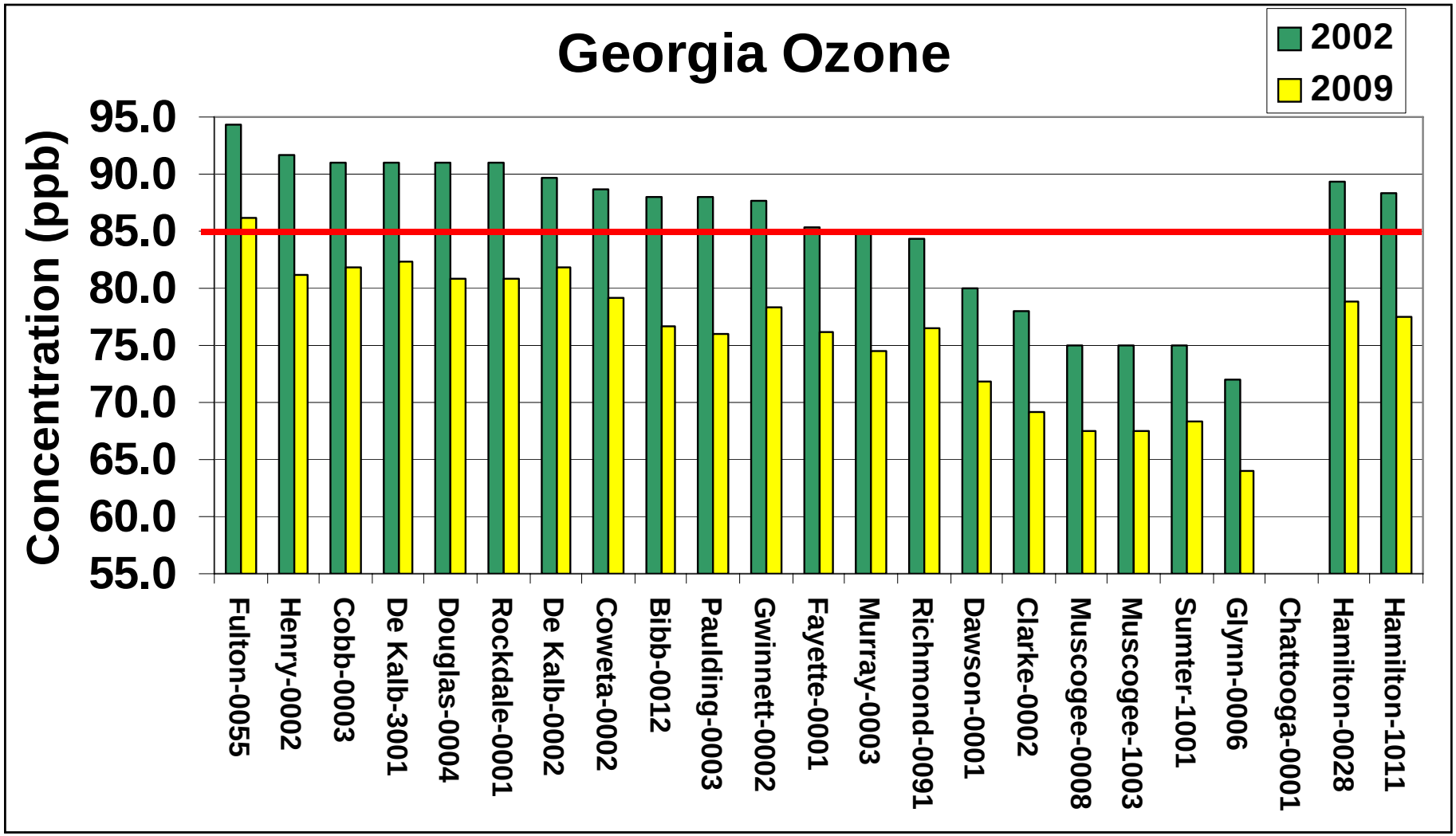


Max 8-hour O3 on June 12, 2002
2009 Emissions



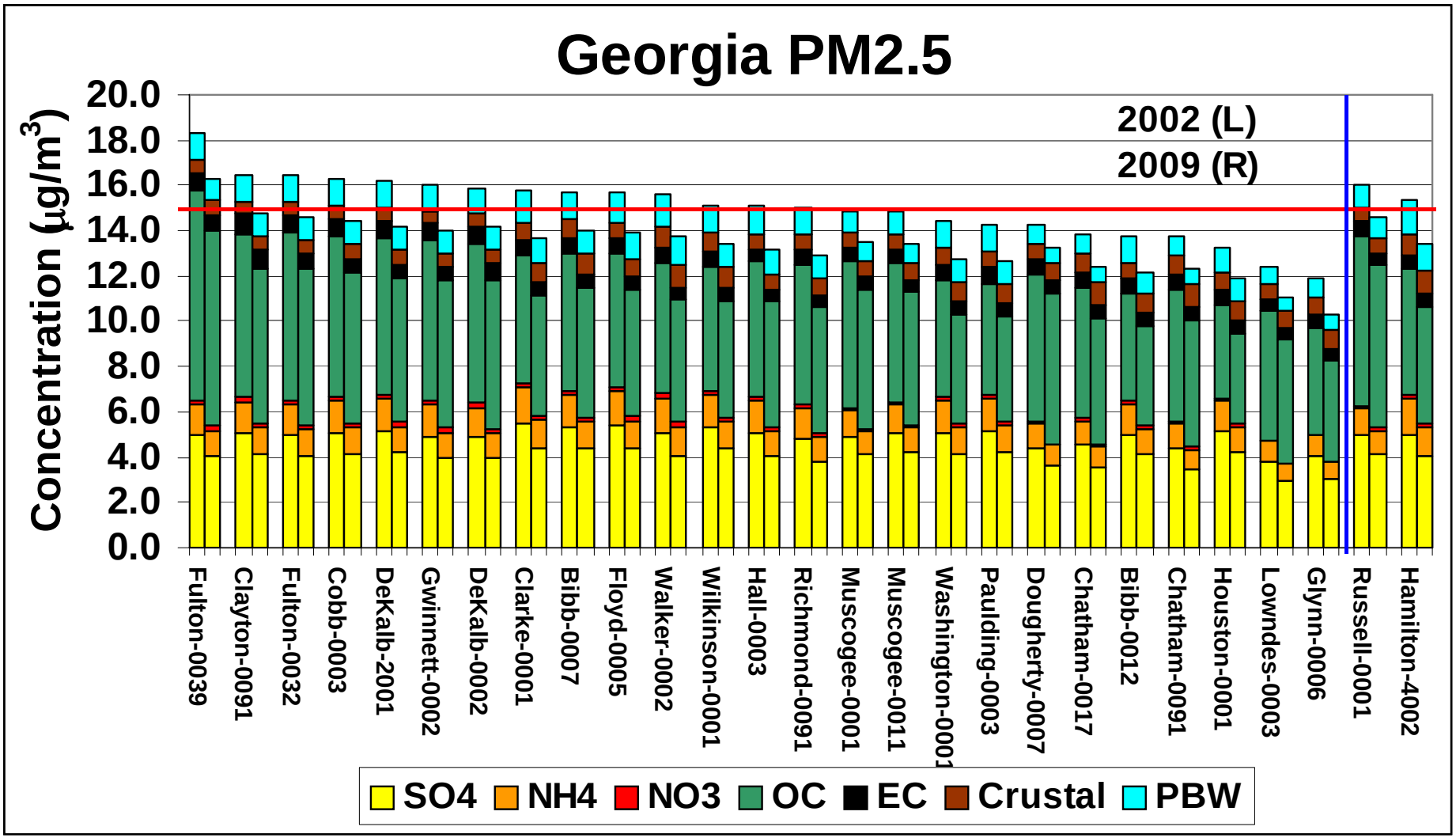
Future Ozone Concentrations

(BaseG emissions at 12km)



Future $PM_{2.5}$ Concentrations

(BaseG emissions at 12km)



Episodic Emission Sensitivities

- Sensitivity of ozone (ppb) and $PM_{2.5}$ ($\mu g/m^3$)
  - Summer Episode: **May 25 - June 25, 2002 (2009)**
  - Winter Episode: **Nov 19 - Dec 19, 2002 (2009)**
- Regional 10% Emission Reductions
  - Mobile (on-road/non-road), area, non-EGU
  - NOx, VOCs, SO_2, NH_3, and primary carbon (PC)
  - **Atlanta (full & sub)**, Macon (full & sub), Chattanooga (full & sub), Floyd County
- Point Emission Reductions
  - Additional SCRs (NO_x) and Scrubbers (SO_2) at seven largest Power Plants in Georgia

Ozone at Confederate Avenue

Sensitivity	Avg response (ppb)*	ppt/TPD reduction
10% Atlanta NO_x (20 counties)**	**1.36**	**35.7**
10% Atlanta NO_x (5 counties)**	**0.95**	**41.1**
10% Atlanta VOC (20 counties)**	0.08	1.5
10% Atlanta VOC (5 counties)**	0.07	2.2
Plant McDonough (2 SCRs)	**0.42**	**60.4**
Plant Scherer (4 SCRs)	**0.41**	**13.7**
Plant Branch (4 SCRs)	0.07	4.6
Plant Hammond (3 SCRs)	0.03	2.2
Plant Yates (7 SCRs)	0.11	9.9

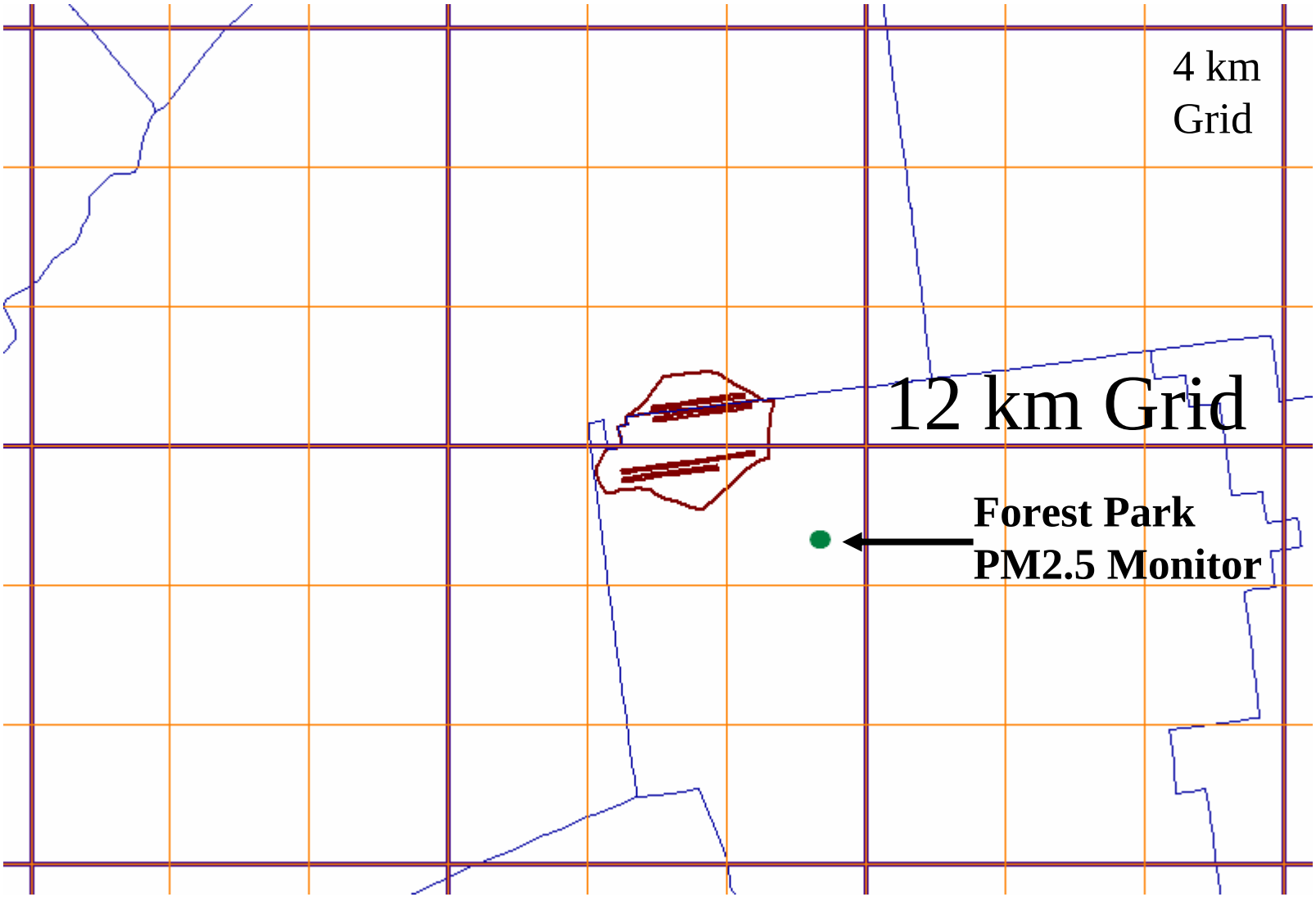
***Days where base case (2002) above 85 ppb**

****10% reduction from 2009 levels**

$PM_{2.5}$ at FS #8 (Fulton)

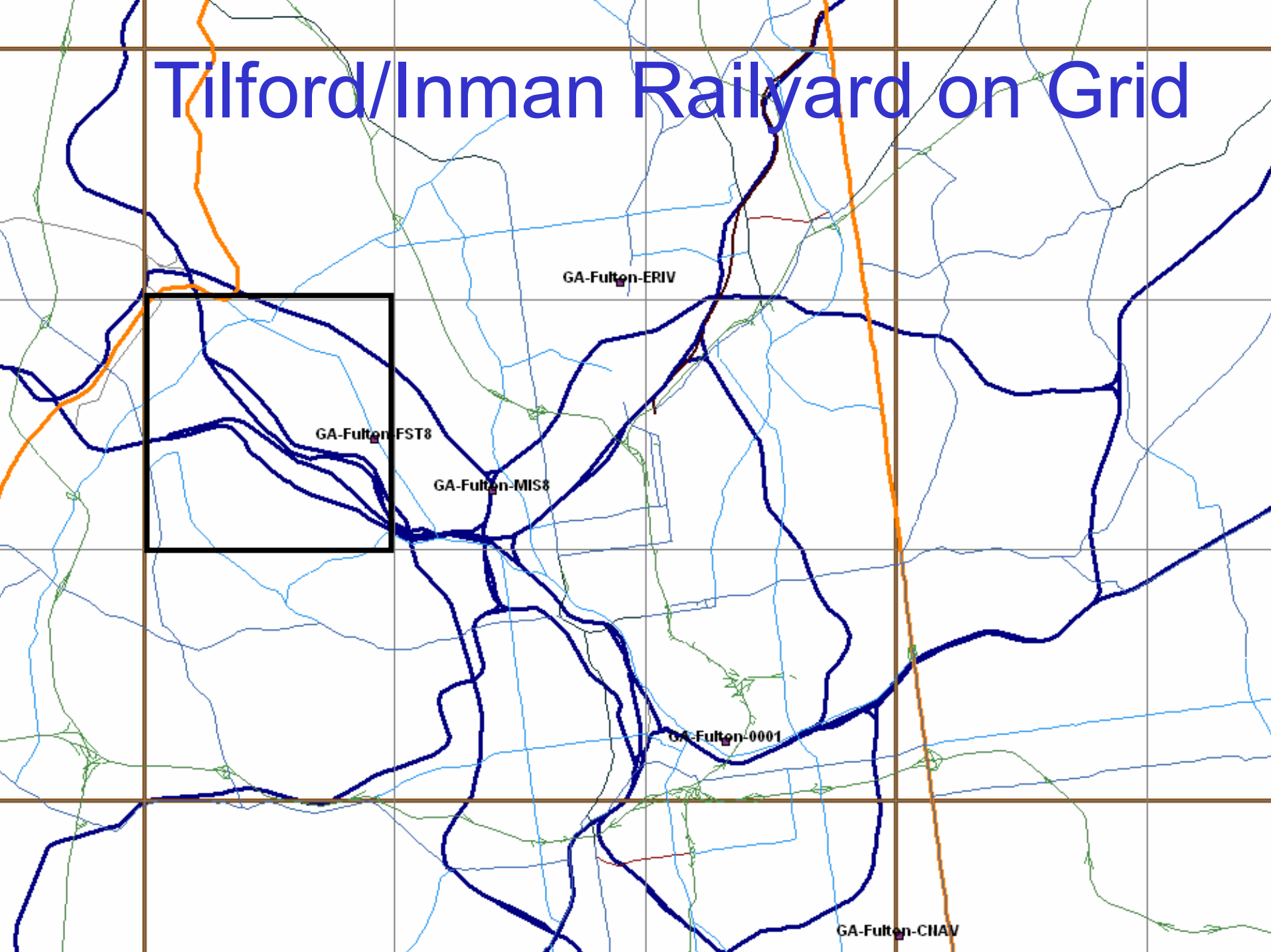
Sensitivity	Summer ($\mu g/m^3$)	Winter ($\mu g/m^3$)	Annual ($\mu g/m^3$)	Annual (ng/m^3/TPD)
10% Atlanta PC	0.19	0.36	**0.25**	85.7
10% Atlanta SO2	0.02	0.01	0.01	1.9
10% Atlanta NOx	0.03	-0.02	0.00	-0.09
10% Atlanta NH3	0.06	0.15	0.09	22.5
10% Atlanta VOCs	0.00	0.01	0.01	0.11
2 Scrubbers at Bowen	0.19	0.07	**0.091**	0.50
4 Scrubbers at Branch	0.15	0.03	**0.098**	0.63
2 Scrubbers at McDonough	0.11	0.07	**0.070**	1.39
4 Scrubbers at Scherer	0.38	0.04	**0.150**	0.56
1 Scrubbers at Wansley	0.09	0.06	0.044	0.44
2 Scrubbers at Yates	0.05	0.06	0.037	0.71

Hartsfield Airport on Grid



Railyard and Fire Station #8

Tilford/Inman Railyard on Grid



Next Steps for ASIP Modeling

- Correcting Errors in Emissions and BCs
  - Missing SOA species in BCs
  - Misallocation of fires in Georgia
- Redo 36 and 12 km Model Performance Evaluation and Attainment Demonstrations with BaseG2 Emissions
- Final Attainment Modeling after States Submit Control Strategies

Next Steps for GA EPD Modeling

- Annual Emission Sensitivity Modeling at 12 km grid resolution
  - NOx for Ozone
  - SO2 and Primary Carbon for PM2.5
  - Completed
- Seasonal Emission Sensitivity Modeling at 4 km grid resolution
  - NOx and VOCs for Ozone
- Local Scale Dispersion Modeling for Primary PM2.5 Emissions (next ppt)

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