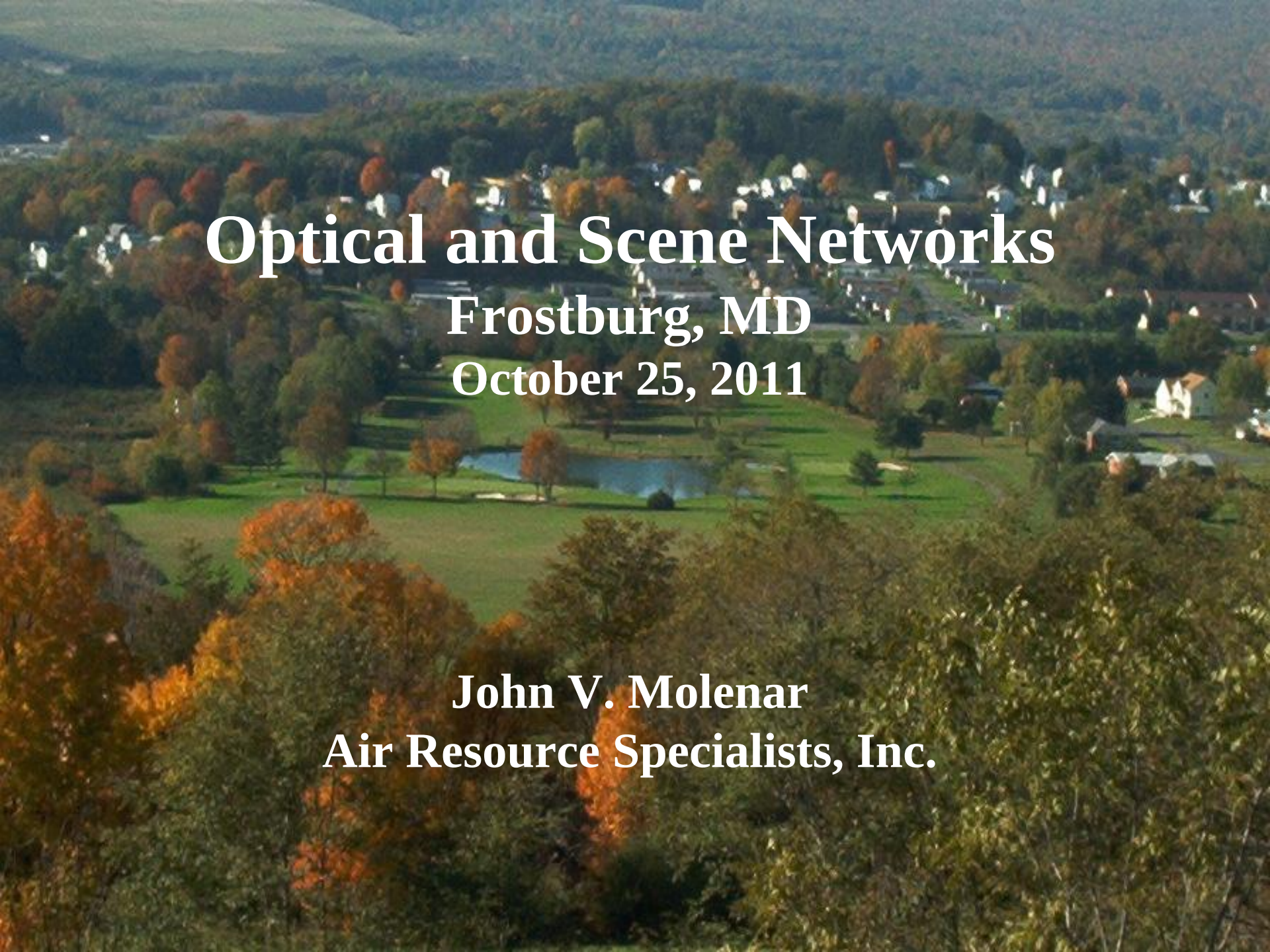


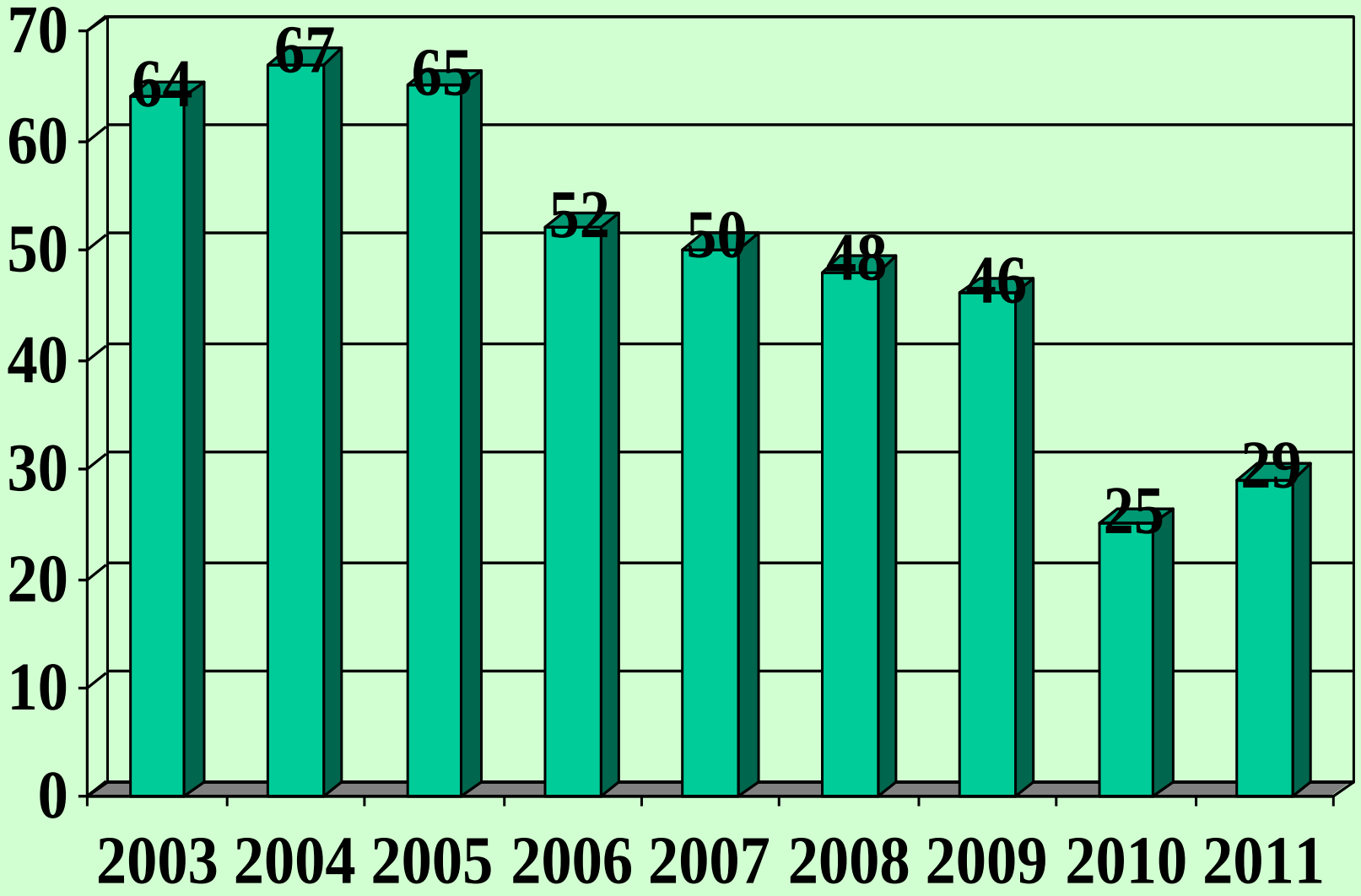
# Optical and Scene Networks

## Frostburg, MD

## October 25, 2011

**John V. Molenar**
**Air Resource Specialists, Inc.**

# Number of Optical Monitors



# Optical & Webcam Networks: 10/18/2011

| Network | Transmissometers | | Nephelometers | | Webcams and Exhibits |
|---|---|---|---|---|---|
| | Remote | Urban | Remote | Urban | |
| Arizona (4) +1 | - | 1 (+1) | 0 | 3 | 4 (-1) |
| NPS (13) +1 | - | - | 12 (+1) | 1 | 18 |
| Wyoming (4) +1 | - | - | 4 (+1) | - | 17 |
| Colorado (4) | - | 2 | - | 2 | 2 |
| USFS (1) -1 | 1 (-1) | - | - | - | 20 |
| Nevada (2) +2 (Clark County) | - | 2 (+2) | - | - | 2 |
| CENRAP (0) | - | - | 0 | - | - |
| SCDEQ (1) | - | - | 1 | - | - |
| Midwest Hazecam (0) | - | - | - | - | 8 |
| CAMNET (0) | - | - | - | - | 10 |
| | | | | | |
| Totals (29) +4 | 1 (-1) | 5 (+3) | 17 (+2) | 6 | 81 (-1) |

# NGN LED Nephelometer

Mie theory can be used to calculate the scattering coefficient of spherical particles at any wavelength of light. The relationship of aerosol scattering ($b_{sp}$) with the wavelength of incident light ($\lambda$) can be approximated using the Aerosol Angstrom Coefficient $\alpha$ as follows:

$$\frac{b_{sp}(\lambda_1)}{b_{sp}(\lambda_2)} = \left(\frac{\lambda_2}{\lambda_1}\right)^{\alpha}$$

where: $\alpha$ is the Angstrom exponent

$\lambda$ = wavelength of incident radiation

$b_{sp}(\lambda_1)$ = aerosol scattering coefficient at $\lambda_1$

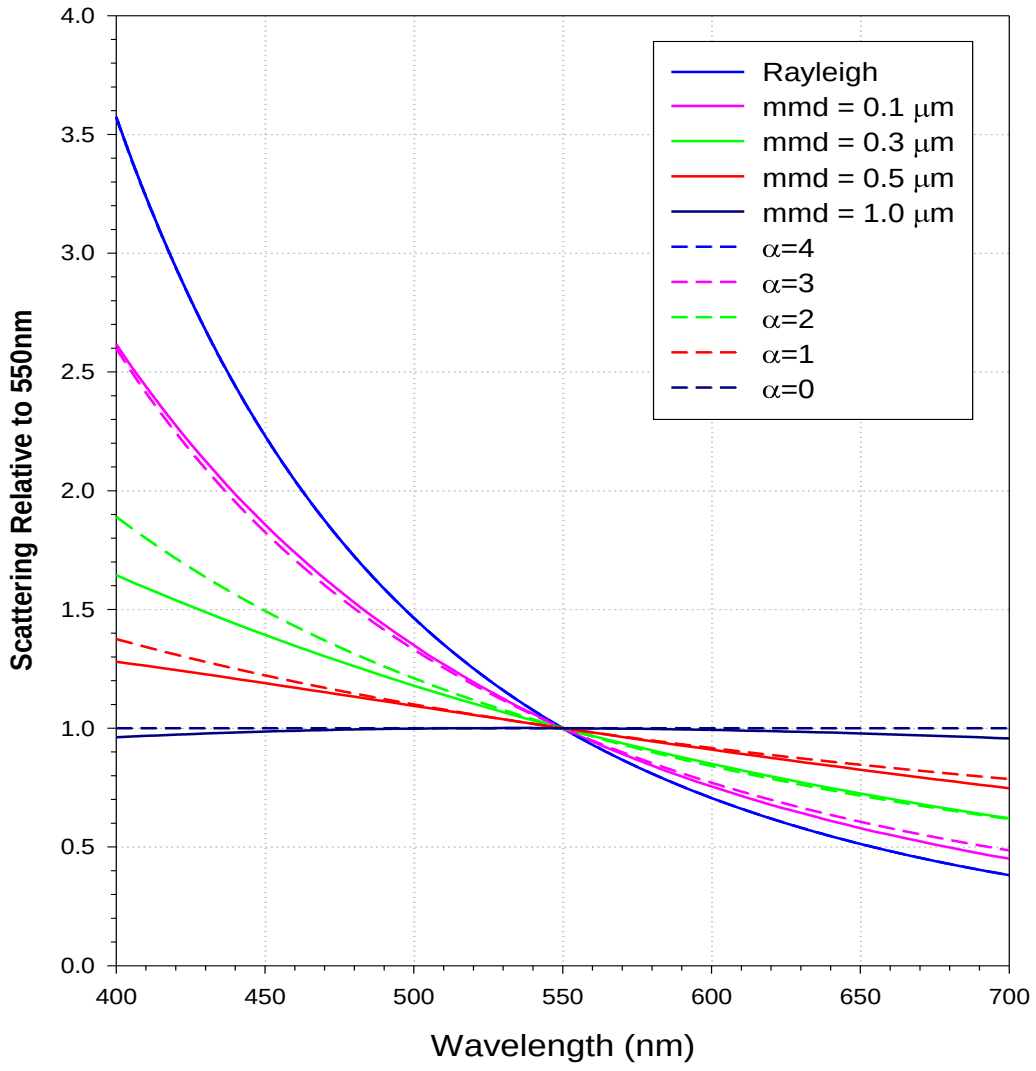
$b_{sp}(\lambda_2)$ = aerosol scattering coefficient at $\lambda_2$

# NGN LED Nephelometer

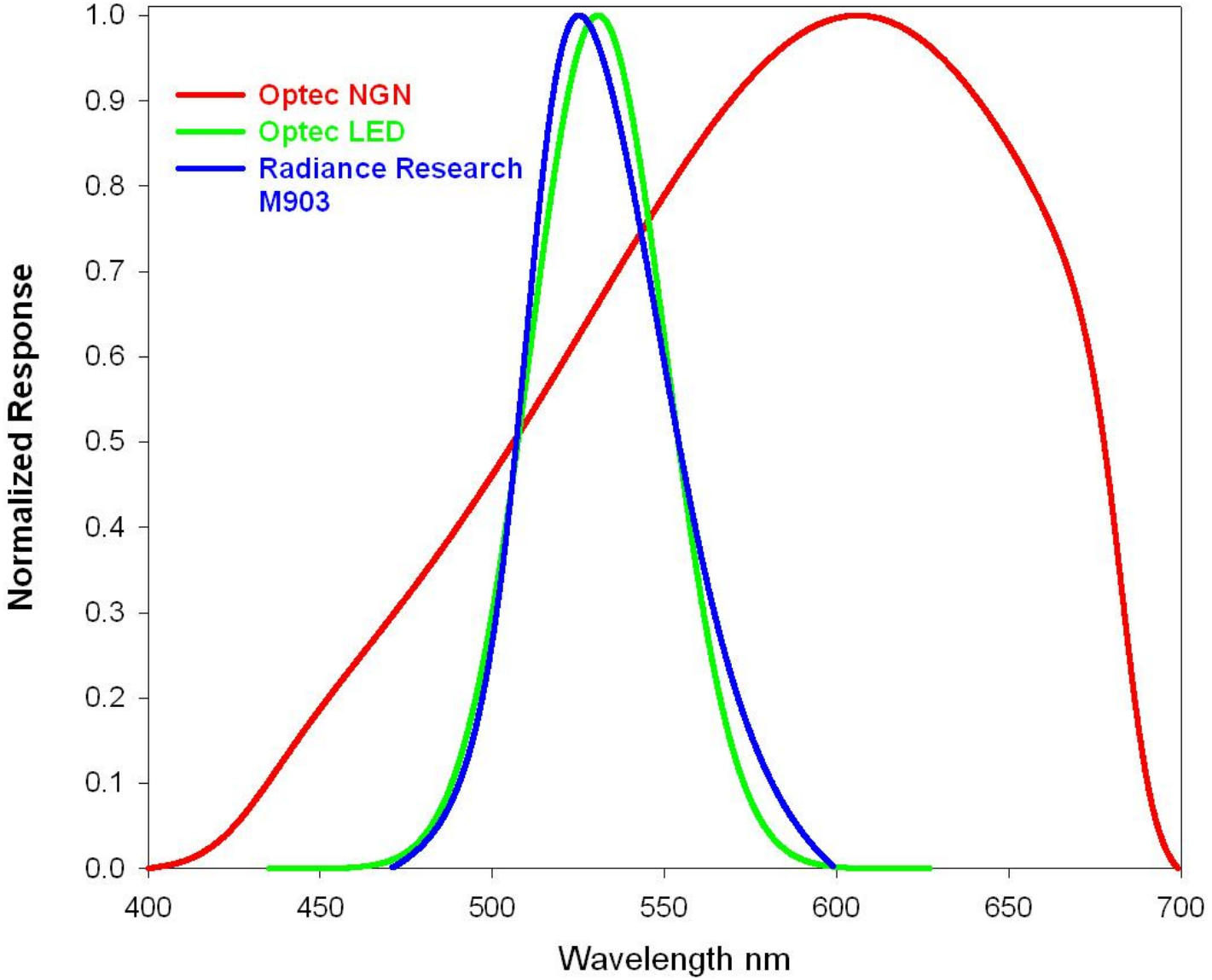
For Rayleigh scattering, where the diameter of gas molecules is much less than the incident wavelength, $\alpha$ is exactly equal to 4.

For aerosols, $\alpha$ varies between 0 and 3, depending on the size of the aerosol. Large aerosols have $\alpha = 0$, with no wavelength dependence of aerosol scattering (this is why fogs and clouds are white). For very small aerosols, $\alpha$ approaches 3.

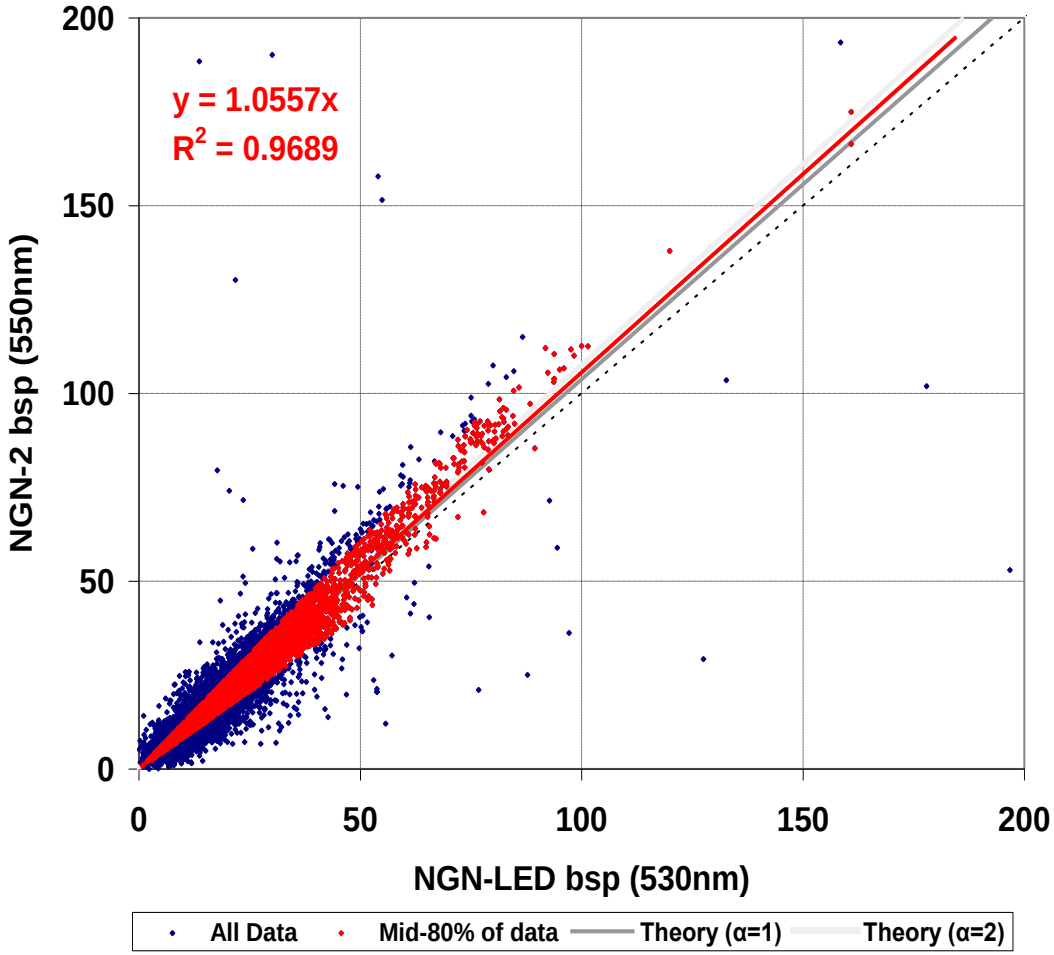
Thus the wavelength dependence of ambient aerosols is a function of the mix between fine and coarse aerosols and their respective size distributions.




Wavelength dependence of Rayleigh and aerosol scattering (relative to 550nm) modeled with MIE theory with lognormal aerosol size distributions of various mass mean diameters (mmd), geometric sigma = 1.75, and index of refraction = 1.52 $\pm$ 0.006*i* and various Angstrom coefficients ($\alpha$).




Normalized wavelength dependent response of Optec NGN, Optec LED, and Radiance Research M903 integrating nephelometers.




Comparison between NGN-2 (incandescent light source) and NGN-LED (LED light source for 5-minute data collected at ARS headquarters in Fort Collins, Colorado. Red data excludes the largest and smallest 10% of differences between the nephelometers.

# SOPs/TIs

**All Nephelometer, Transmissometer, and Scene SOPs and TIs are current. Updates are being made for the LED nephelometers and transmissometers.**

**All documents receive a yearly review (and update if necessary) during their anniversary month.**

**A QAPP and QMP for the optical network are scheduled to be developed early next spring.**

# Optical Data

**Nephelometer data through 06/30/2011 delivered to NPS/CIRA on 9/30/2011**

**Transmissometer data (2 USFS sites - Bridger & San Gorgonio) through 12/31/2010 delivered to NPS/CIRA on 7/31/2011**

# NPS Webcam Network and Web Site Upgrades

**November 2008: Start of partnership between NPS and Olympus to upgrade and support 16 site webcam network**

**Oct 2010 – Oct 2011: Shenandoah, Hawaii Volcanoes and Grand Tetons added to network.**

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**Network Operations (NPS-Olympus Partnership funded to October 2011)**

- Technical support, backup equipment, communications, archive
- Annual agreements. Third and final agreement ended October 1, 2011

**Network Upgrades**

- Backup digital SLRs (E420) supplied by Olympus available to network
- Dial-up connections being replaced with cellular, DSL or DOI network where possible (Sequoia, Olympic, Point Reyes complete, Mount Rainier, Theodore Roosevelt planned)
- Camera control software updated to support new camera settings and additional camera models (ie. Canon Rebel series)

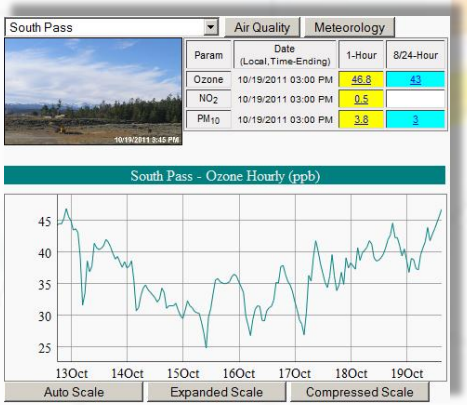
**Web Site Upgrades (NPS-ARD funded)**

- NPS-ARD redesigned web site went live early Summer 2010
- Continuing improvements to image and web site content creation software
- NPS-ARD developing online archive of all digital images captured since network inception

National Park Service photo captured by Olympus camera

# Air Quality Apps

**ARS has developed AQ applications for mobile devices (iOS, Android, web application) to…**




Display images and monitoring data


Present time lapse video

AQDB Data Collection Status 10/19/2011 16:06

| PollAbbr | MinAgo | PollGroup | LastTime |
|---|---|---|---|
| AFTC | 0 | A | 10/19/2011 16:06 |
| BASI | 57 | A | 10/19/2011 15:09 |
| BLIS | 711 | A | 10/19/2011 04:15 |
| BOULDER | 56 | B | 10/19/2011 15:10 |
| BRSO-TR | 649 | A | 10/19/2011 05:17 |
| BRSOanlg | 653 | A | 10/19/2011 05:13 |
| BRSOdig | 651 | A | 10/19/2011 05:15 |
| BU | 51 | A | 10/19/2011 15:15 |
| CAMP | 54 | D | 10/19/2011 15:11 |
| CAMT | 57 | B | 10/19/2011 15:09 |
| CASP-SR | 102930 | A | 08/09/2011 04:36 |
| CAVE2 | 44 | B | 10/19/2011 15:22 |
| CHEY-SC | 471 | D | 10/19/2011 08:15 |
| CHEY-SC1H | 3 | D | 10/19/2011 16:03 |
| CHEY1min | 660 | D | 10/19/2011 05:06 |
| CHEYBAM | 48 | A | 10/19/2011 15:18 |
| CHEY_5min | 602 | D | 10/19/2011 06:03 |
| CLHA | 743 | A | 10/19/2011 03:43 |

Summarize data collection status

**… and is developing tools to support technicians during site visits, control the digital camera software, and others.**

# NPS WebCam Stats 2010 – Pages

| Rank | Park | Visits | Daily Average |
|---|---|---|---|
| 1 | Great Smoky Mountains NP – Look Rock | 1,049,629 | 2,875 |
| 2 | Great Smoky Mountains NP- Purchase Knob | 989,207 | 2,710 |
| 3 | Grand Canyon NP | 713,282 | 1,954 |
| 4 | Washington DC Mall | 458,641 | 1,256 |
| 5 | Mount Rainier NP | 314,214 | 860 |
| 6 | Yosemite NP | 304,980 | 835 |
| 7 | Point Reyes NS | 298,642 | 818 |
| 8 | Denali NP | 275,277 | 754 |
| 9 | Sequoia-Kings Canyon NP | 242,934 | 665 |
| 10 | Olympic NP | 235,699 | 645 |
| 11 | North Cascades NP | 200,128 | 548 |
| 12 | Theodore Roosevelt NP | 194,169 | 531 |
| 13 | Mammoth Cave NP | 181,456 | 497 |
| 14 | Acadia NP | 151,206 | 414 |
| 15 | Joshua Tree NP | 131,399 | 359 |
| 16 | Big Bend NP | 113,447 | 310 |
| Total | | **5,854,310** | |

# NPS WebCam Stats 2011 – Pages

| Rank | Park (through September) | Visits | Daily Average |
|---|---|---|---|
| 1 | Great Smoky Mountains NP- Purchase Knob | 681,944 | 2,497 |
| 2 | Great Smoky Mountains NP – Look Rock | 629,371 | 2,305 |
| 3 | Grand Canyon NP | 593,324 | 2,173 |
| 4 | Denali NP | 313,047 | 1,146 |
| 5 | Point Reyes NS | 306,321 | 1,122 |
| 6 | Mount Rainier NP | 237,378 | 869 |
| 7 | Washington DC Mall | 223,171 | 817 |
| 8 | Yosemite NP | 222,928 | 816 |
| 9 | Sequoia-Kings Canyon NP | 203,321 | 744 |
| 10 | Olympic NP | 206,906 | 757 |
| 11 | Theodore Roosevelt NP | 177,087 | 648 |
| 12 | Mammoth Cave NP | 159,011 | 582 |
| 13 | North Cascades NP | 154,939 | 567 |
| 14 | Acadia NP | 129,939 | 475 |
| 15 | Joshua Tree NP | 120,930 | 442 |
| 16 | Big Bend NP | 104,797 | 383 |
| 17 | Shenandoah NP (partial year) | 94,209 | 440 |
| 18 | Hawai'i Volcanoes NP (partial year) | 89,652 | 418 |
| Total | | **4,648,275** | |

# NPS WebCam Stats 2010 – Images

| Rank | Park | Visits | Daily Average |
|---|---|---|---|
| 1 | Grand Canyon NP | 5,513,308 | 15,104 |
| 2 | Washington DC Mall | 3,582,097 | 9,813 |
| 3 | Yosemite NP | 2,625,212 | 7,192 |
| 4 | Great Smoky Mountains NP – Look Rock | 2,395,724 | 6,563 |
| 5 | Great Smoky Mountains NP- Purchase Knob | 1,915,396 | 6,247 |
| 6 | Denali NP | 1,691,545 | 4,634 |
| 7 | Point Reyes NS | 1,279,765 | 3,506 |
| 8 | Mount Rainier NP | 1,003,833 | 2,750 |
| 9 | Sequoia-Kings Canyon NP | 980,787 | 2,687 |
| 10 | North Cascades NP | 956,254 | 2,619 |
| 11 | Olympic NP | 775,836 | 2,125 |
| 12 | Joshua Tree NP | 770,172 | 2,110 |
| 13 | Big Bend NP | 433,118 | 1,186 |
| 14 | Acadia NP | 337,035 | 923 |
| 15 | Mammoth Cave NP | 330,207 | 904 |
| 16 | Theodore Roosevelt NP | 286,343 | 784 |
| Total | | **24,876,632** | |

# NPS WebCam Stats 2011 – Images

| Rank | Park (through September) | Visits | Daily Average |
|---|---|---|---|
| 1 | Washington DC Mall | 3,878,488 | 14,206 |
| 2 | Denali NP | 3,062,455 | 11,217 |
| 3 | Grand Canyon NP | 2,974,359 | 10,895 |
| 4 | Yosemite NP | 1,868,085 | 6,842 |
| 5 | Great Smoky Mountains NP – Look Rock | 1,474,419 | 5,400 |
| 6 | Great Smoky Mountains NP- Purchase Knob | 1,176,852 | 4,310 |
| 7 | Mount Rainier NP | 808,486 | 2,961 |
| 8 | Point Reyes NS | 680,585 | 2,492 |
| 9 | North Cascades NP | 608,131 | 2,227 |
| 10 | Olympic NP | 606,114 | 2,220 |
| 11 | Sequoia-Kings Canyon NP | 583,520 | 2,137 |
| 12 | Joshua Tree NP | 434,853 | 1,592 |
| 13 | Big Bend NP | 323,857 | 1,186 |
| 14 | Mammoth Cave NP | 272,651 | 998 |
| 15 | Acadia NP | 244,578 | 895 |
| 16 | Theodore Roosevelt NP | 244,260 | 894 |
| 17 | Hawai'i Volcanoes NP (partial year) | 95,225 | 444 |
| 18 | Shenandoah NP (partial year) | 94,019 | 439 |
| Total | | **19,430,937** | |

# NPS WebCam Stats
# 2009-2011 Monthly Summary

| Month | Website Visits | | | Photo Image Visits | | |
|---|---|---|---|---|---|---|
| | 2009 | 2010 | 2011 | 2009 | 2010 | 2011 |
| January | 423,592 | 497,426 | 635,072 | 1,602,728 | 2,235,619 | 2,627,308 |
| February | 836,985 | 1,009,559 | 1,091,066 | 3,652,493 | 4,505,939 | 4,664,766 |
| March* | 1,202,527 | 1,419,421 | 1,632,456 | 5,091,840 | 6,443,573 | 6,881,466 |
| April | 1,577,339 | 1,747,984 | 2,111,351 | 6,702,290 | 8,015,434 | 8,929,934 |
| May | 2,001,911 | 2,063,060 | 2,578,673 | 8,452,863 | 9,691,592 | 10,982,118 |
| June | 2,443,450 | 2,434,570 | 3,083,566 | 10,211,663 | 11,356,549 | 13,043,055 |
| July | 2,933,161 | 2,829,481 | 3,595,792 | 12,288,564 | 13,071,579 | 15,128,221 |
| August | 3,419,521 | 3,205,055 | 4,127,909 | 14,376,499 | 14,622,513 | 17,331,827 |
| September | 3,967,545 | 3,602,399 | 4,648,275 | 16,677,020 | 16,207,915 | 19,430,937 |
| October | 4,691,947 | 4,716,806 | | 19,485,978 | 20,791,543 | |
| November | 5,069,455 | 5,205,742 | | 21,487,351 | 22,585,463 | |
| December | 5,490,459 | 5,854,310 | | 23,217,908 | 24,876,632 | |