



Bridging the gap between air quality science and management: The AQAST experience

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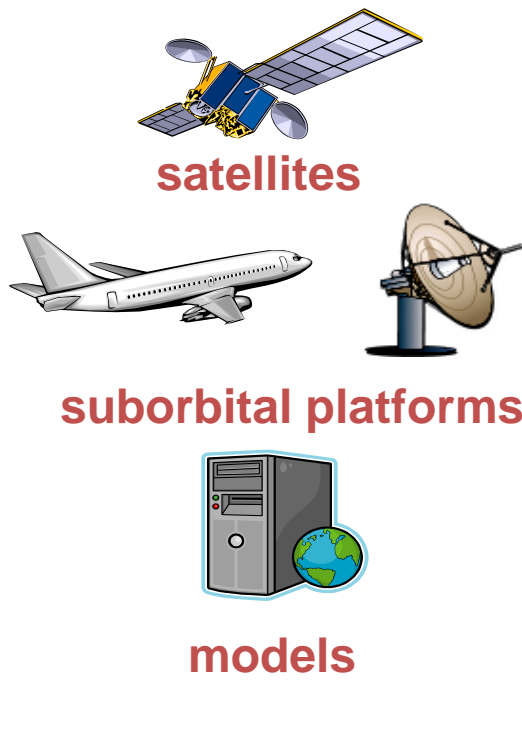


<http://tinyurl.com/obamaNO2>



NASA Air Quality Applied Sciences Team

Earth Science Serving Air Quality Management Needs



AQAST

Pollution monitoring
Exposure assessment
AQ forecasting
Source attribution
Quantifying emissions
Natural & foreign influences
AQ processes
Climate-AQ interactions

AQAST members

- **Daniel Jacob (leader)**, Loretta Mickley (Harvard)
- **Tracey Holloway (deputy leader)**, Steve Ackerman (U. Wisconsin); Bart Sponseller (Wisconsin DNR)
- **Greg Carmichael** (U. Iowa)
- **Dan Cohan** (Rice U.)
- **Russ Dickerson** (U. Maryland)
- **Bryan Duncan**, Yasuko Yoshida, Melanie Follette-Cook (NASA/GSFC); Jennifer Olson (NASA/LaRC)
- **David Edwards** (NCAR)
- **Arlene Fiore** (Columbia Univ.); Meiyun Lin (Princeton)
- **Jack Fishman**, Ben de Foy (Saint Louis U.)
- **Daven Henze**, Jana Milford (U. Colorado)
- **Edward Hyer**, Jeff Reid, Doug Westphal, Kim Richardson (NRL)
- **Pius Lee**, Tianfeng Chai (NOAA/NESDIS)
- **Yang Liu**, Matthew Strickland (Emory U.), Bin Yu (UC Berkeley)
- **Richard McNider**, Arastoo Biazar (U. Alabama – Huntsville)
- **Brad Pierce** (NOAA/NESDIS)
- **Ted Russell**, Yongtao Hu, Talat Odman (Georgia Tech); Lorraine Remer (NASA/GSFC)
- **David Streets** (Argonne)
- **Jim Szykman** (EPA/ORD/NERL)
- **Anne Thompson**, William Ryan, Suellen Haupt (Penn State U.)



Why was ACAST Unique?

All ACAST projects **connect** Earth Science and air quality management:

- Pursue science to support air quality management
- Collaborate with partners in air quality management
- Expand relationships through meetings, online tools, newsletters

ACAST has **flexibility** in how it allocates its resources

- Members can adjust work plans to meet evolving air quality needs
- Multi-member “Tiger Teams” compete for funding to address strategic problems requiring coordinated activity
- ACAST is self-organizing and can respond **quickly** to demands

ACAST supports two types of projects:

- **Investigator Projects** – core funding to individual members
- **Tiger Team Projects** – collaborations between ACAST members with supplementary funding to address urgent air quality management needs

**Quick, collaborative, flexible,
responsive to the needs of the AQ
community**



www.aqast.org

AQAST and Beyond



- Late 2009 – AQAST Solicitation
- March 2010 – AQAST applications due
- March 2011 – AQAST membership announced
- 2011-2016 – 5 year AQAST duration
- Late 2015 – H-AQAST Solicitation
- March 2016 – H-AQAST applications due
- Now – AQAST work wrapping up or complete
- July 22, 2016 – H-AQAST team announced
- 2016 – 2019 – 3 year H-AQAST duration

H-AQAST members



- Tracey Holloway (Team Lead, UW-Madison)
- Bryan Duncan (NASA GSFC)
- Arlene Fiore (Columbia University)
- Frank Freedman (San Jose State University)
- Daven Henze (University of Colorado, Boulder)
- Jeremy Hess (University of Washington, Seattle)
- Yang Liu (Emory University)
- Jessica Neu (NASA Jet Propulsion Laboratory)
- Susan O'Neill (USDA Forest Service)
- Ted Russell (Georgia Tech)
- Daniel Tong (George Mason University)
- Jason West (UNC-Chapel Hill)
- Mark Zondlo (Princeton University)

Air Quality
Managers

Public

NASA

Media/Pre
ss



Understanding Your Audience

1 Who are they?

Who are you trying to engage? Teachers? Doctors? Relatives? A broader, more general audience? *What prior knowledge (if any) might they have regarding your topic?*

2 Why are they here?

What do they hope to learn from you, as an expert? How will this impact their lives or inspire their curiosity? Are they coming with an open mind, preconceptions, or an agenda?

3 Why should they care?

What does your audience value? What keeps them awake at night? *How is your work important to them?* Remind them that we are all in this together, and demonstrate that you empathize with their needs, both as a scientist and as a person.

4 What will you send them away with?

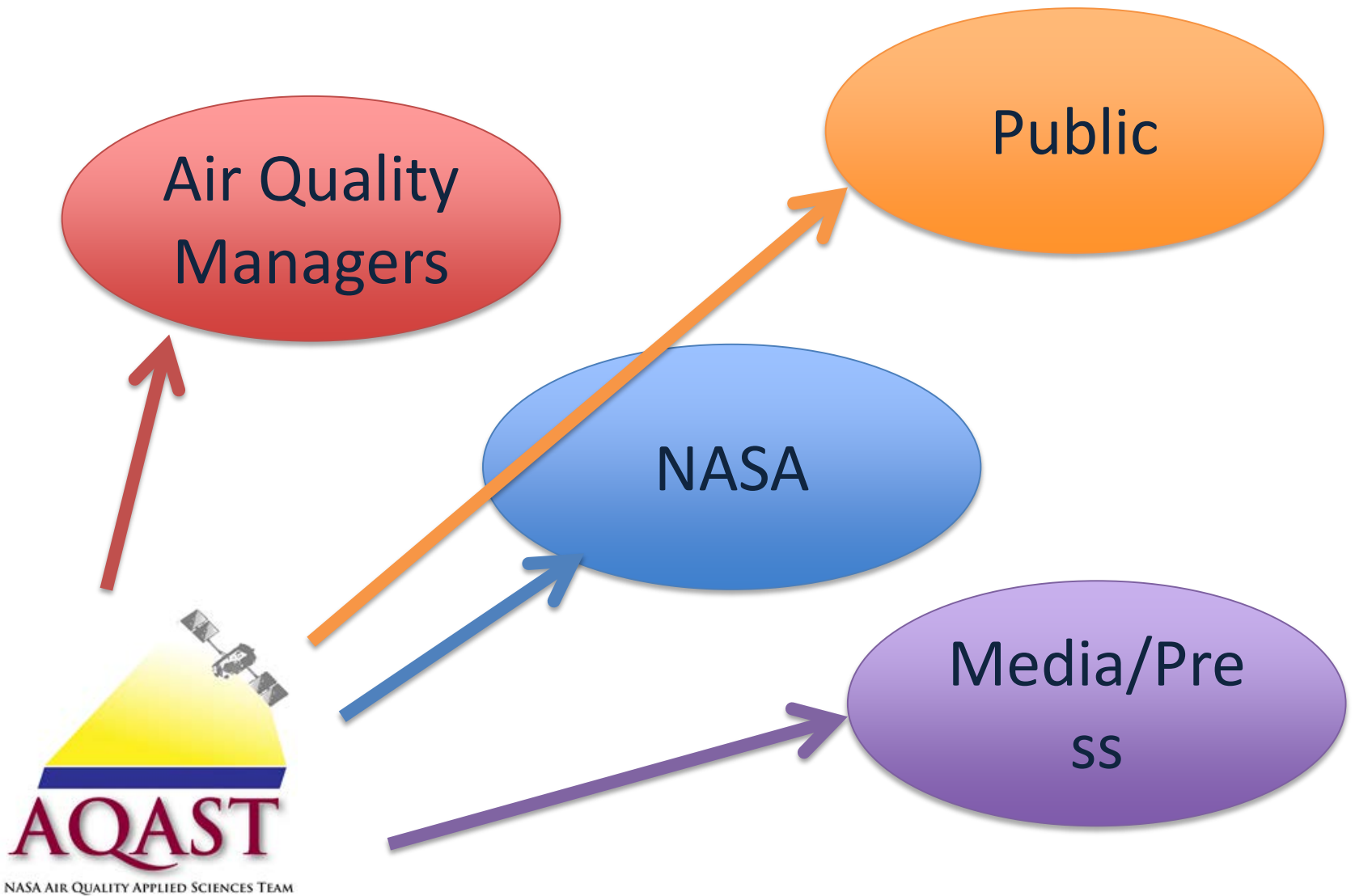
Can you leave them with a good dinner conversation topic? An action item they can share with friends? Word-of-mouth is still an effective communication strategy.

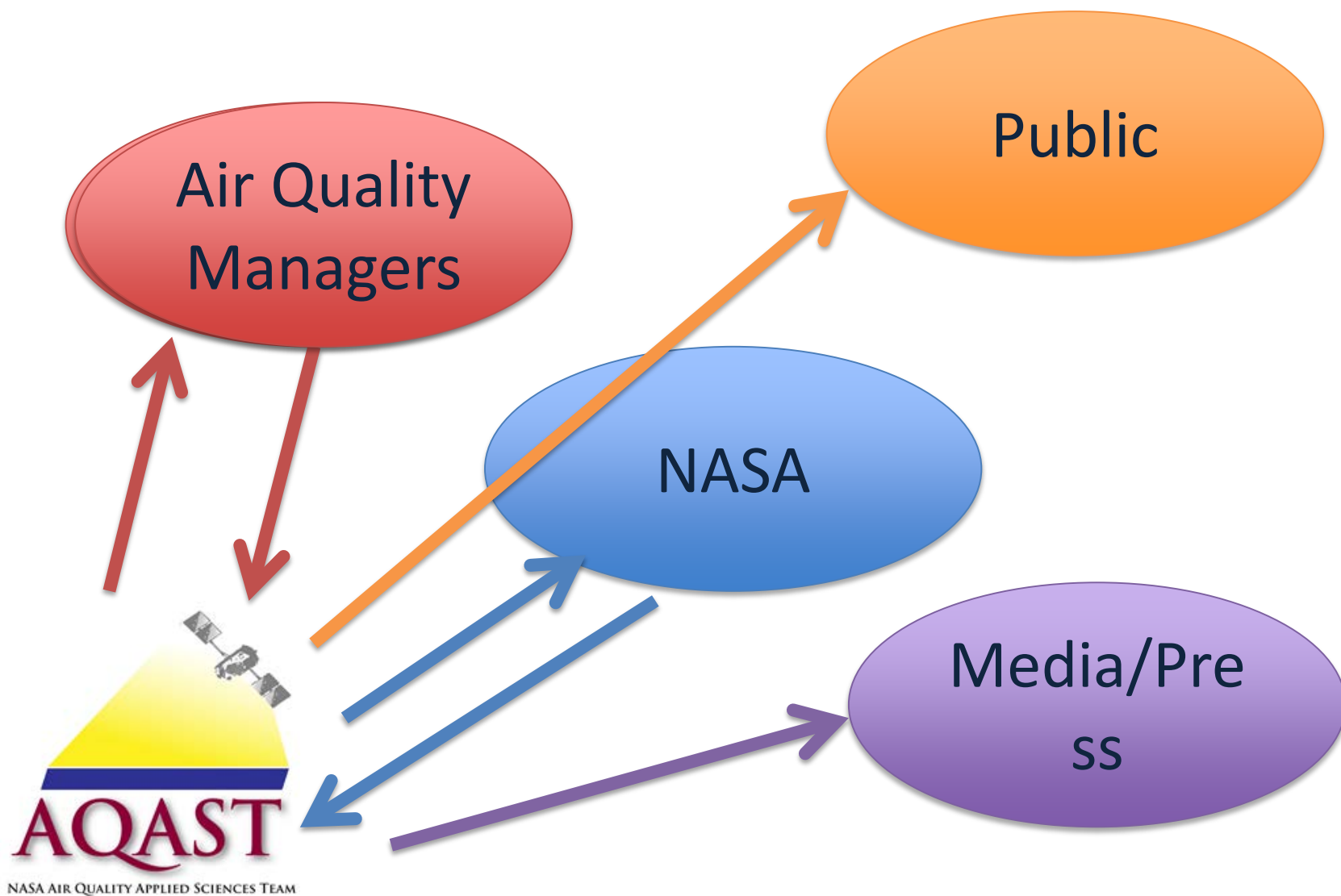
5 How can you best reach them?

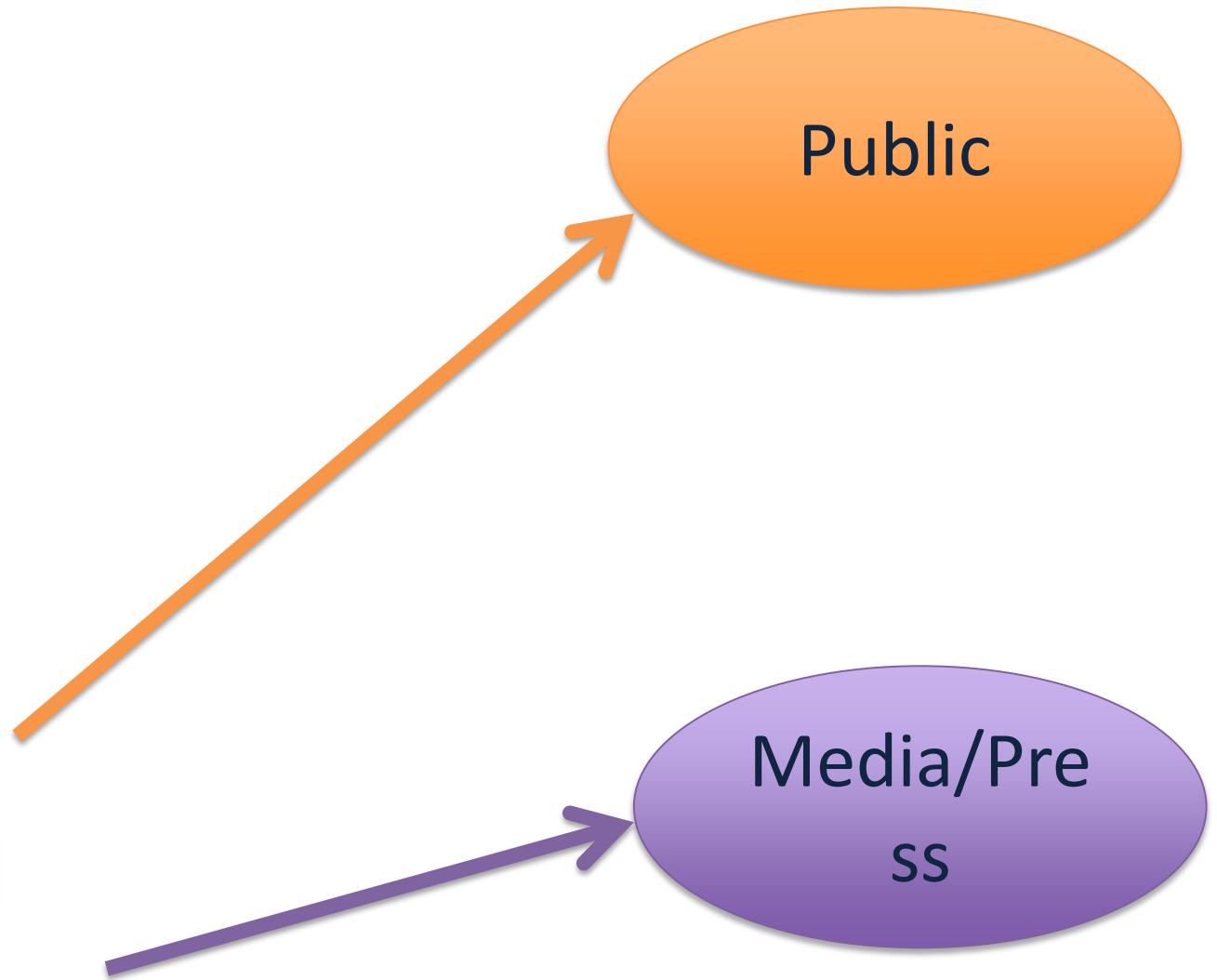
People vary in how they receive information. How might you best connect with your audience? Are there images or stories they might identify with?

6 What might they be resistant to hear?

Remember, everyone has opinions. Be aware of concepts, ideas, and action items that may cause your audience to dismiss or downplay your take-home messages.







Engaging with the Public

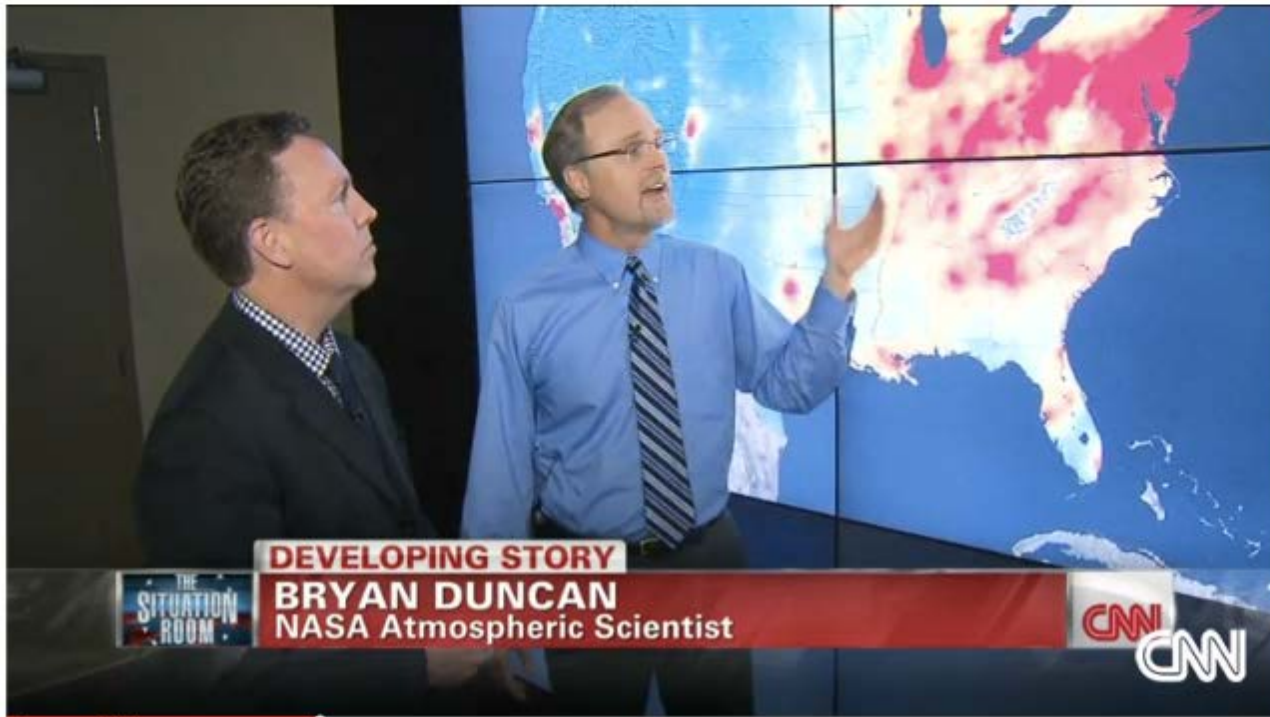
- Identify *your* goals and *your* message → pursue and accept consistent opportunities
- Try a range of media and methods that you advance (public talks, Twitter, tour groups, video, museum activities, op-eds)
- Work with your institutional press office
 - Press releases related to your own work
 - Responding to news items and events



NASA data shows nationwide air improvement -- but still more needed

By Dugald McConnell, CNN

Updated 9:39 PM ET, Fri June 27, 2014



Top stories



Gold-medal winner mugged in Rio



Bank employees publicly spanked

Source: CNN

Goals of Twitter

www.twitter.com/NASA_AQAST

- “Mini Press Releases”
- Connect with air quality management agencies
- Connect with Reporters
- Connect with other NASA orgs
- Link to URLs on Media Center
- 2500+ followers





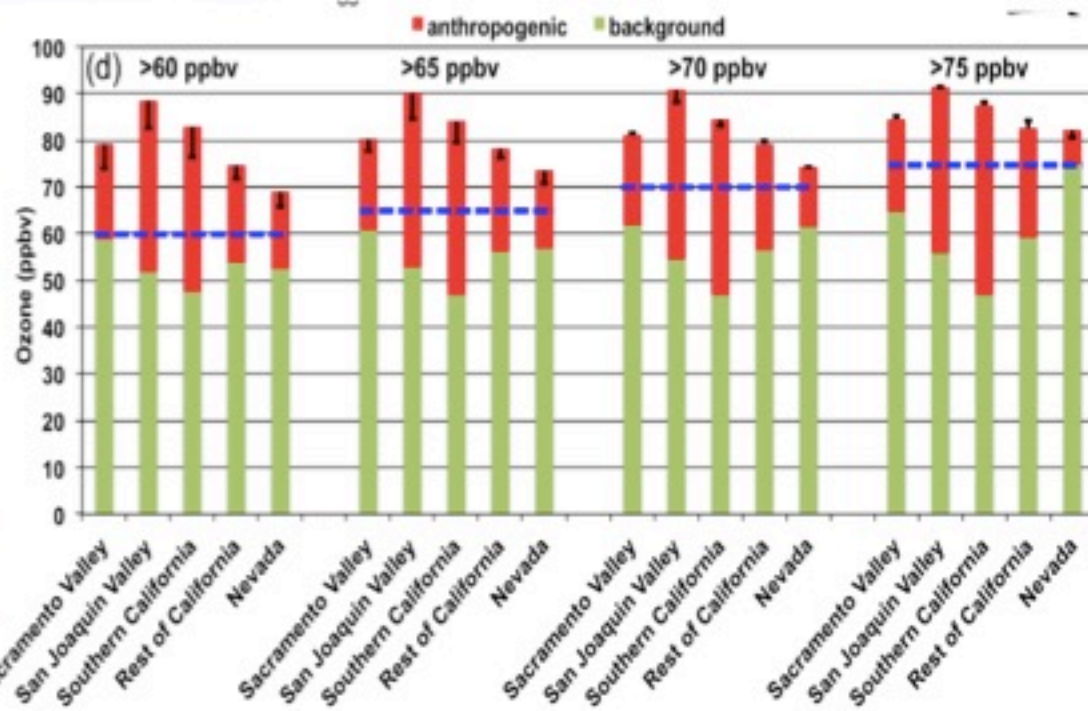
AQAST helps EPA and U.S. West prepare for new ozone standard

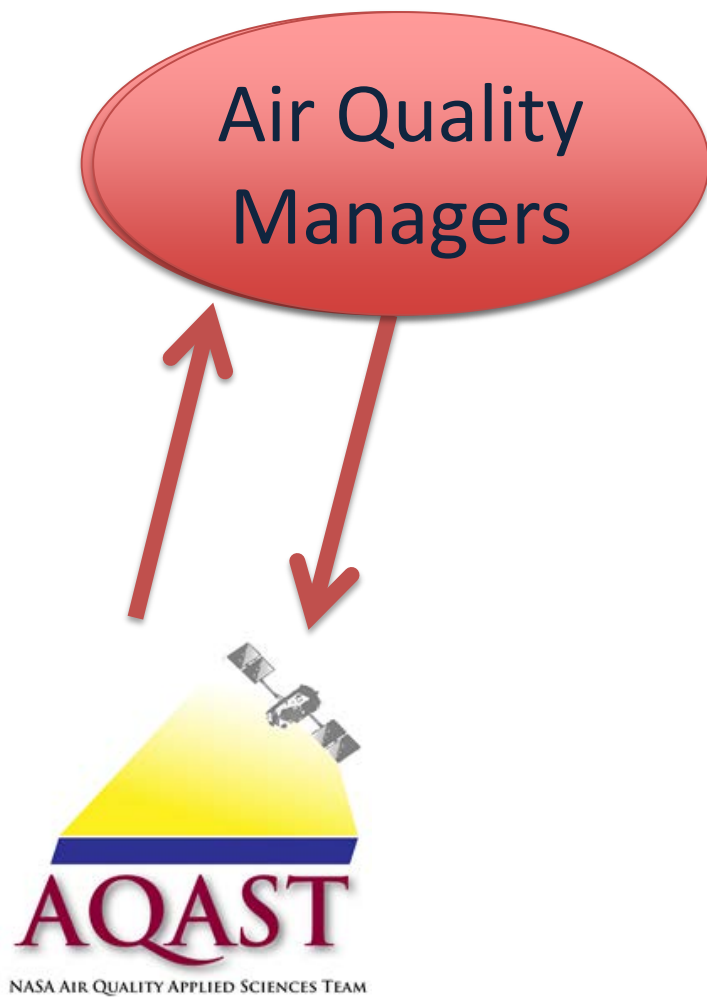


- On October 1, 2015 EPA will release a new ozone standard, requiring reductions in emissions, raising the question how much ozone is beyond U.S. control?
- The NASA Air Quality Applied Sciences Team (AQAST) quantified ozone for EPA Scientific Assessment and the EPA Policy Assessment
- AQAST researchers continue work in this area, including constraints from satellite data

"It has been extremely valuable for us to align research initiatives with air quality management needs"
– Gail Tonneson,
EPA Region 8 (West)

"We have leveraged a lot of Arlene [Fiore]'s work in characterizing background ozone,...Her work has been incorporated in ..documents for the proposed ozone standard revisions."
– Pat Dolwick, EPA OAQPS

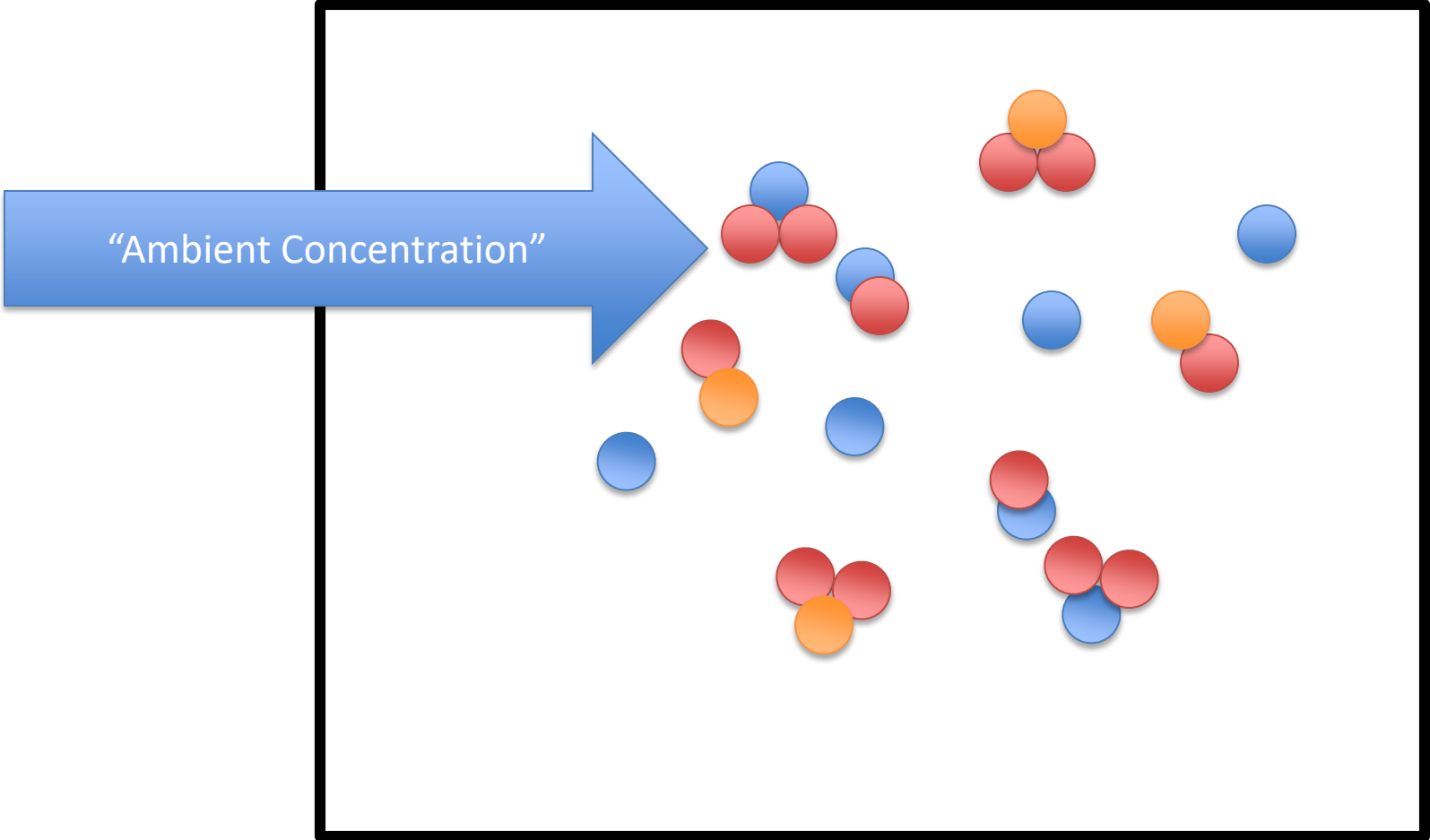




US Air Quality Management

- Operational efforts to reduce levels of health- and welfare-damaging air pollution
- Setting air quality and emission limits
- Designing and enforcing rules to meet federal, state, or local limits
- Federal EPA + 10 Regional Offices
- 50 U.S. States offices
- Multi-state “RPO”s
- Intra-state air districts (30+ in CA)





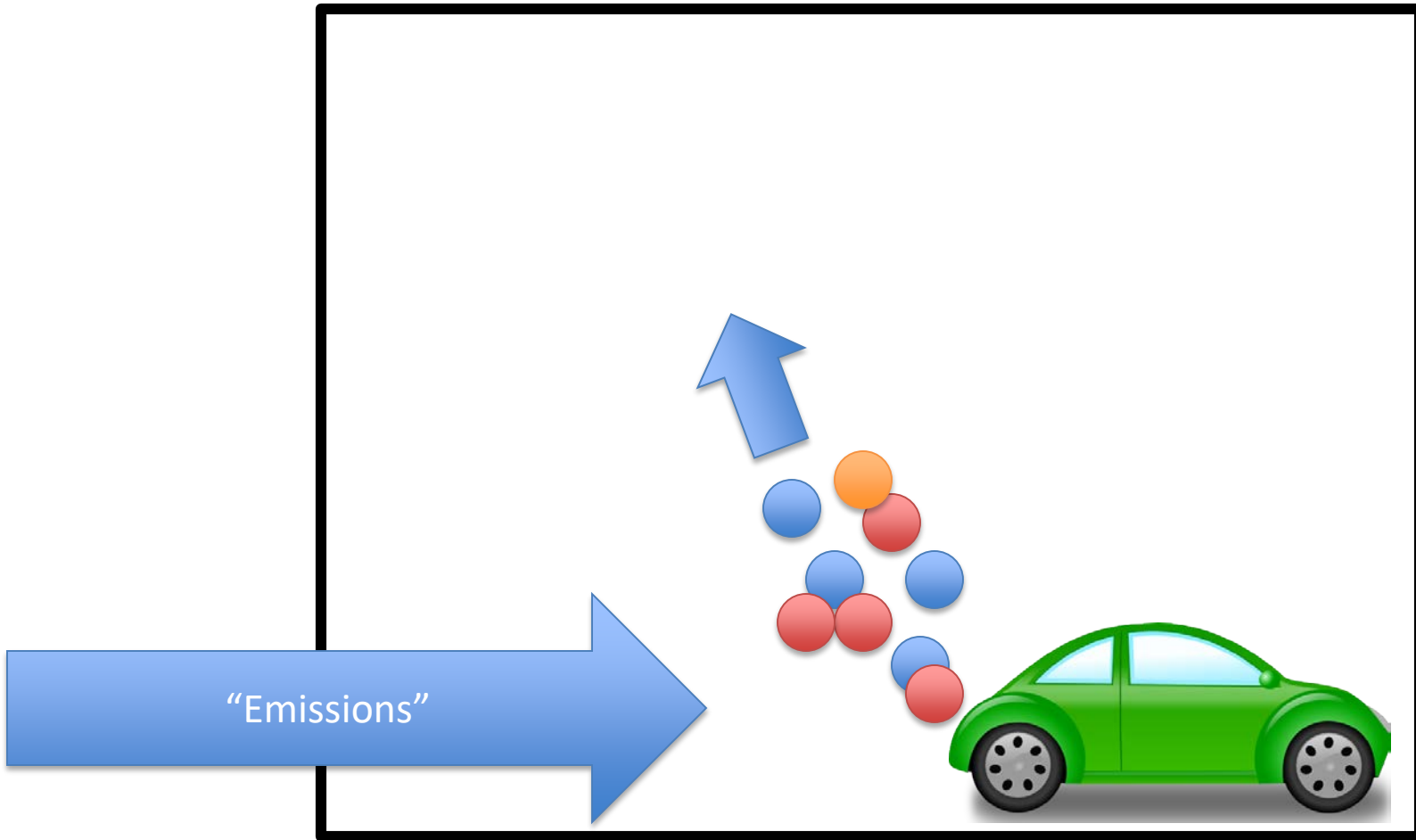
National Ambient Air Quality Standards (NAAQS)

The [Clean Air Act](#), which was last amended in 1990, requires EPA to set [National Ambient Air Quality Standards](#) (40 CFR part 50) for pollutants considered harmful to public health and the environment. The Clean Air Act identifies two types of national ambient air quality standards. **Primary standards** provide public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly. **Secondary standards** provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

EPA has set National Ambient Air Quality Standards for six principal pollutants, which are called "criteria" pollutants. They are listed below. Units of measure for the standards are parts per million (ppm) by volume, parts per billion (ppb) by volume, and micrograms per cubic meter of air ($\mu\text{g}/\text{m}^3$).

Pollutant [final rule cite]		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide [76 FR 54294, Aug 31, 2011]		primary	8-hour	9 ppm	Not to be exceeded more than once per year
			1-hour	35 ppm	
Lead [73 FR 66964, Nov 12, 2008]		primary and secondary	Rolling 3 month average	0.15 $\mu\text{g}/\text{m}^3$ (1)	Not to be exceeded
Nitrogen Dioxide [75 FR 6474, Feb 9, 2010] [61 FR 52852, Oct 8, 1996]		primary	1-hour	100 ppb	98th percentile, averaged over 3 years
		primary and secondary	Annual	53 ppb (2)	Annual Mean
Ozone [73 FR 16436, Mar 27, 2008]		primary and secondary	8-hour	0.075 ppm (3)	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particle Pollution Dec 14, 2012	PM _{2.5}	primary	Annual	12 $\mu\text{g}/\text{m}^3$	annual mean, averaged over 3 years
		secondary	Annual	15 $\mu\text{g}/\text{m}^3$	annual mean, averaged over 3 years
		primary and secondary	24-hour	35 $\mu\text{g}/\text{m}^3$	98th percentile, averaged over 3 years
	PM ₁₀	primary and secondary	24-hour	150 $\mu\text{g}/\text{m}^3$	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide [75 FR 35520, Jun 22, 2010] [38 FR 25678, Sept 14, 1973]		primary	1-hour	75 ppb (4)	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

0.70 ppm
2015



1 U.S. EPA Clean Air Act National Ambient Air Quality Standards

50 State Environmental Agencies

...

1000s of Regulated Industries

**Ambient
Concentrations**

1 U.S. EPA
Clean Air Act
National Ambient Air Quality Standards

50 State Environmental Agencies

...

1000s of Regulated Industries

Emissions

1 U.S. EPA Clean Air Act National Ambient Air Quality Standards

~7 Regional Planning Organizations

LADCO

NESCAUM

WRAP

CenSARA

MARAMA

+

50 State Environmental Agencies

1000s of Regulated Industries

1 U.S. EPA
Clean Air Act
National Ambient Air Quality Standards

10 EPA Regional Offices

R1

R2

R3

R8

R9

R10

~7 Regional Planning Organizations

LADCO

NESCAUM

WRAP

CenSARA

MARAMA

+

50 State Environmental Agencies

WI

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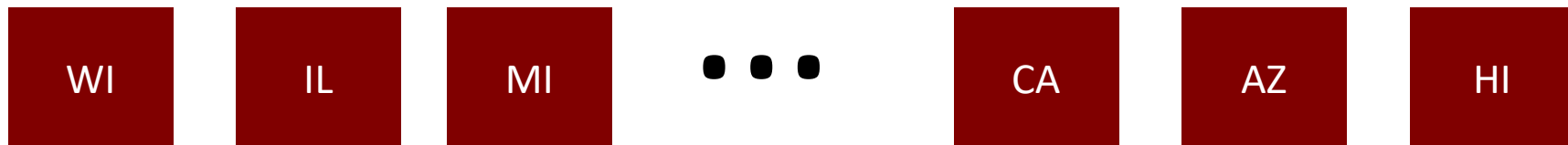
1000s of Regulated Industries

1 U.S. EPA
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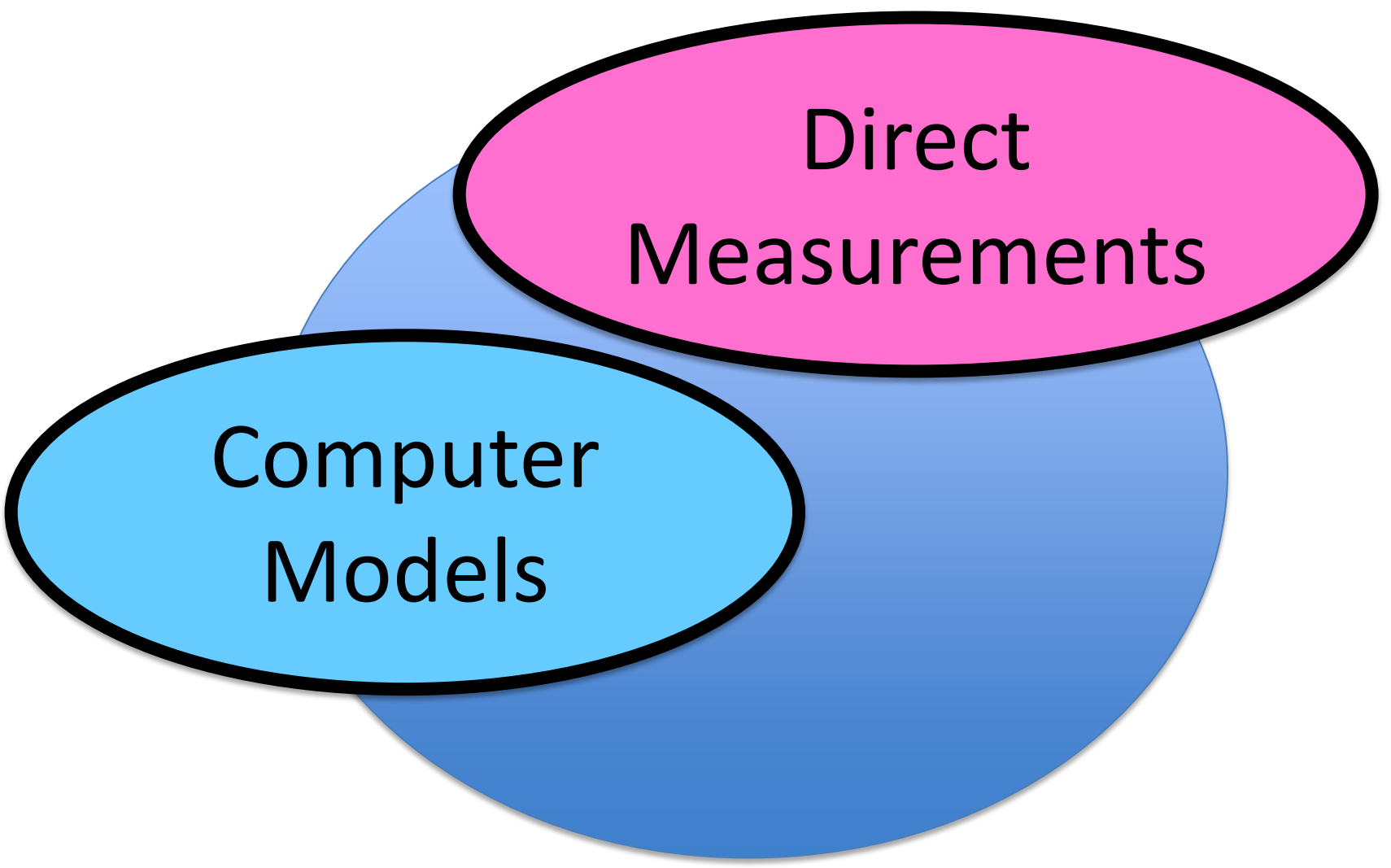
county or sub-regional AQM



1000s of Regulated Industries



Sources of Data

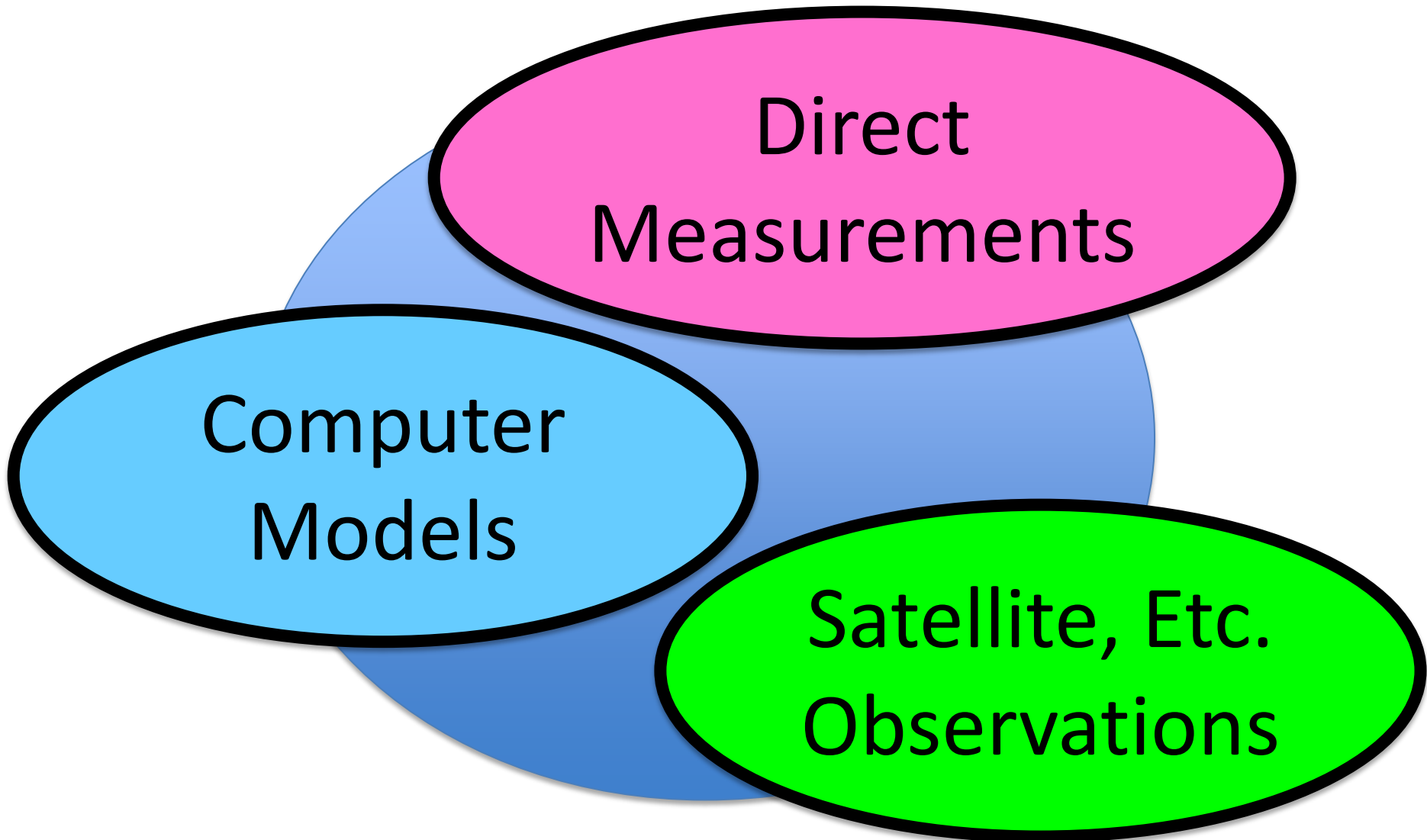


Direct
Measurements

The diagram consists of a large blue circle in the background. Overlapping the top-right portion of this circle is a pink oval with a black border, containing the text 'Direct Measurements'. Overlapping the bottom-left portion of the blue circle is a light blue oval with a black border, containing the text 'Computer Models'.

Computer
Models

AQAST Mission: Link New Data & Tools



Potential Monitoring Site Purposes

A Role for Remote Sensing?

- | | |
|--|-----|
| 1. To Determine Compliance with National Ambient Air Quality Standards (NAAQS) | No |
| 2. To Develop Regional Pollution Trends in Urban and Rural Areas | Yes |
| 3. To Evaluate the Effects of Population, Land Use and Transportation on Air Quality | Yes |
| 4. To Evaluate Air Dispersion Models | Yes |
| 5. To Provide Air Quality Information to the Public | Yes |

Adapted from a slide of
Bart Sponseller, WI DNR

Big Picture

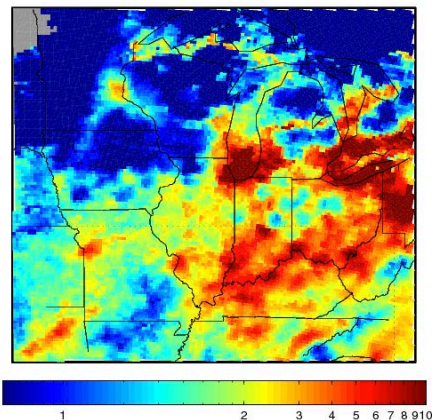
- Culture of team engagement
- Responsive, flexible, listening
- Regular meetings & partnerships
- All projects required partner(s)
- User of surveys for feedback and prioritizing issues
- Reaching out to new audiences
- Presenting work in a “not AGU” style



Engaging AQM Community



AQAST AQtivities



Active

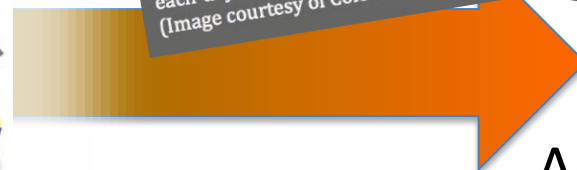
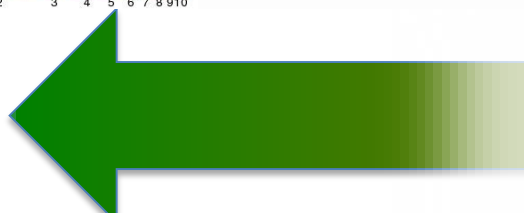


Patrick Reddy was an integral member of the forecasting team that ensured FRAPPÉ's aircraft made successful flights each day during the month long campaign (Image courtesy of Colorado DPHE).

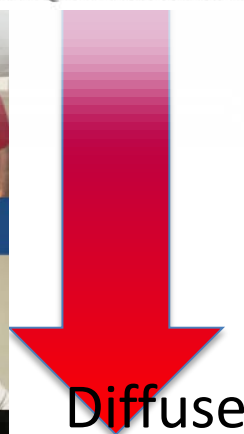


Gabriele Pfister was the co-lead of the FRAPPÉ campaign, an extended effort to understand air quality in Colorado's Front Range (Image courtesy of NCAR/UCAR).

Basic



Advanced



Diffuse



Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

Atmospheric Environment

journal homepage: www.elsevier.com/locate/atmosenv

Review

Satellite data of atmospheric pollution for U.S. air quality applications: Examples of applications, summary of data end-user resources, answers to FAQs, and common mistakes to avoid

Bryan N. Duncan ^{a,*}, Ana I. Prados ^{a,b}, Lok N. Lamsal ^{a,c}, Yang Liu ^d, David G. Streets ^e, Pawan Gupta ^{a,c}, Ernest Hilsenrath ^{b,f}, Ralph A. Kahn ^a, J. Eric Nielsen ^g, Andreas J. Beyersdorf ^h, Sharon P. Burton ^h, Arlene M. Fiore ⁱ, Jack Fishman ^j, Daven K. Henze ^k, Chris A. Hostetler ^h, Nickolay A. Krotkov ^a, Pius Lee ^l, Meiyun Lin ^m, Steven Pawson ^a, Gabriele Pfister ⁿ, Kenneth E. Pickering ^a, R. Bradley Pierce ^o, Yasuko Yoshida ^{a,g}, Luke D. Ziemba ^h

Success Stories

Colorado has used satellite data to support regulatory decision-making

total volatile organic compounds (VOCs), but the OMI instrument does detect formaldehyde (HCHO). Past studies have shown how satellite HCHO can be used to estimate VOC abundance.⁴

Tales from the Front Range

Colorado is part of the U.S. Environmental Protection Agency (EPA) Region 8, where the Rocky Mountains and other topographic features affect the NO₂ distribution in a way that would be nearly impossible to assess from ground-based data alone. Using space-based data, air quality managers can see detailed NO₂ distributions by month, or in some cases by day, across all of Colorado and neighboring states. Figure 1a provides an overview of this region's topography, and Figure 1b shows an example of satellite-detected NO₂ distributed throughout canyon areas.

In 2009, there was debate as to whether the Front Range region operated as a nitrogen oxides (NO_x)-sensitive regime, suggesting that NO_x controls would be effective in controlling ozone (O₃) levels.

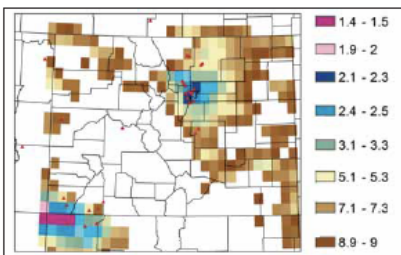


Figure 2. Ratio of tropospheric HCHO to tropospheric NO₂ over the Colorado Front Range area, derived from mean GOME₂ satellite measurements for July 2007 and 2008. A ratio of above 1.0 may indicate a NO_x-sensitive ozone production regime. All ratios in this region show ratios are above 1.0. Gridded data from KNMI TEMIS (<http://www.temis.nl/airpollution/no2.html>).
Figure courtesy of Patrick Reddy, from presentation "2008 Ozone Season Review Briefing to the Colorado Air Quality Control Commission," September 17, 2009 (figure legend adjusted for clarity). Full presentation available at http://www.colorado.gov/airquality/repository/temis_Rc.aspx?file=O3+2008+AQCC+Presentation+Sept+Elv+without+stru.ppt.



Above and Left:
Witman, Holloway and Reddy, EM 2014;

Houston, we have a solution



We would like to see AQAST focus all of their efforts on Texas,” Estes said. “But that wouldn’t be fair to the other states.”

Working with AQAST has been “kind of like a genie offering us three wishes, and we are trying to find the best wishes to choose.”

“The ongoing involvement of air quality managers in AQAST ...lets us continually adapt our efforts and address emerging needs as policies and conditions evolve”





ARSET

Applied Remote Sensing Training

Earth Sciences Division

Applied Sciences

ASP Water Resources

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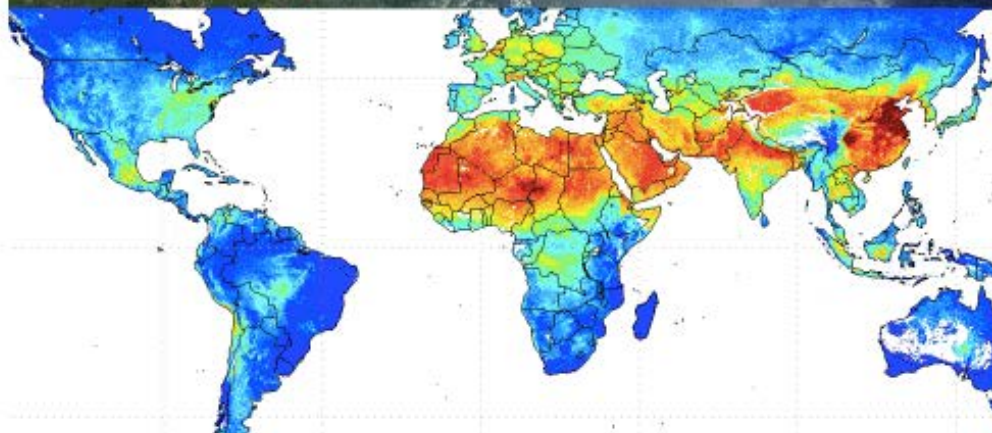
Applied Remote Sensing Training



Introduction to
Satellite Remote
Sensing for Air
Quality
Applications

July 6-Aug 3, 2016
Wednesdays
8:00-9:00 a.m. EDT

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Upcoming Training

Disasters

[Using NASA Remote
Sensing for Disaster
Management](#)

06/09/2016 to 06/30/2016

Goals of Press Releases, Videos & AQAST Stories

- Tell compelling stories
- Link AQAST activities to news events
- Highlight AQAST in press releases
- Engage public, reporters, stakeholders, etc. with AQAST activities – widen the AQAST tent



How did AQAST connect researchers with AQM agencies?

Prior to AQAST

- respondents had 0-6 AQM partners
- Average pre-AQAST partners = 1.7

After AQAST

- Every respondent reported an increase in AQM partnerships
- Post-AQAST, respondents had 1-16 AQM partners
- Average post-AQAST partners = 5.7

How did AQAST connect researchers

Pri

AQAST enabled crossing paths with regional and state air managers across the country in a way that hadn't happened with earlier work relevant to air quality policy

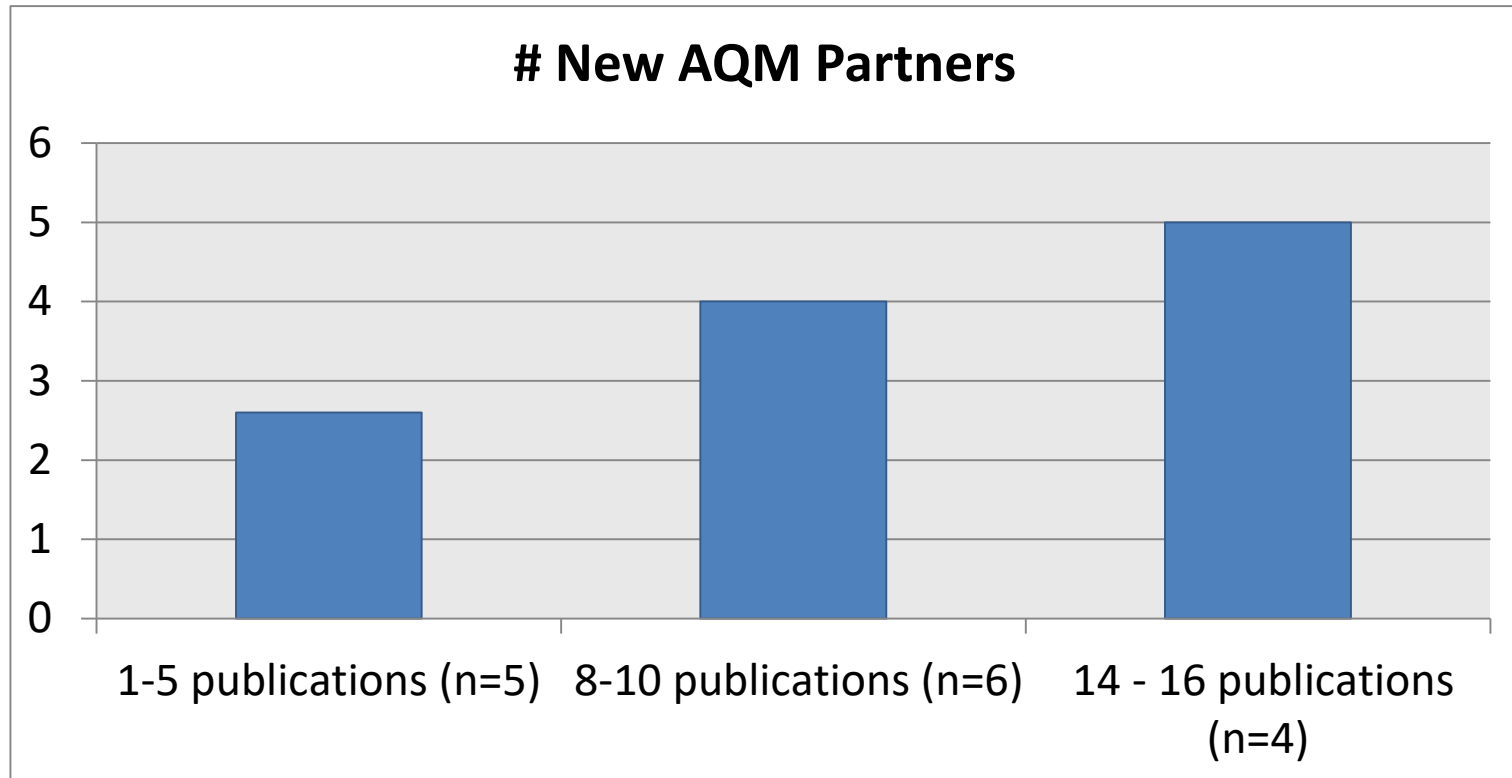
- Adv

great to have as an official goal of a grant to work with AQ managers

Being part of a high-profile team increased my ability to connect with stakeholders

g post AQAST pa

Trade-off Between Outreach and Publications?



Respondents with highest publication rates averaged 5 new AQM agency contacts

Trend 6: Between Outreach and

Found out about other new satellite products and techniques

New

6
5
4

For a relatively small budget, AQAST was able to add great value to existing satellite data.

feedback from AQAST members and AQ managers allowed my research objectives to focus better and evolve over the last five years.

16 publications
(n=4)

pondents with highest publication rates averaged 5 new AQM agency contacts

“Please rank how the following aspects of AQUEST affected your overall work - publications, talks, etc. Relative to a regular NASA grant at the same funding level and duration”

Flexible Funding

Tiger Team Structure

Visibility of AQUEST

Emphasis on serving air quality managers

Emphasis on collaboration

Regular AQUEST meetings

Access to AQUEST colleagues and stakeholder partners

Access to NASA program managers through AQUEST



1: Not at all

2: Somewhat

3: Very much

4: Transformative

“Please rank how the following aspects of AQAST affected your overall work - publications, talks, etc. Relative to a regular NASA grant at the same funding level and duration”

Flexible Funding (3.13)

Tiger Team Structure (3.07)

Visibility of AQAST (3.0)

Emphasis on serving air quality managers (3.57)

Emphasis on collaboration (2.87)

Regular AQAST meetings (3.13)

Access to AQAST colleagues and stakeholder partners (3.07)

Access to NASA program managers through AQAST (1.7)



1: Not at all

2: Somewhat

3: Very much

4: Transformative

“Please rank how the following aspects of AQUEST affected your overall work - publications, talks, etc. Relative to a regular NASA grant at the same funding level and duration”

Flexible Funding (3.13)

Tiger Team Structure (3.07)

Visibility of AQUEST (3.0)

Emphasis on serving air quality managers

Emphasis on collaboration (2.87)

Regular AQUEST meetings (3.13)

Access to AQUEST colleagues and resources

Access to AQUEST program managers

*over time there is a
real team that crosses
individual interests*

*Regular semi-annual
meetings were valuable
...We have developed
really strong working
relationships*

2: Somewhat

3: Very much

4: Transformative

“How successful was AQUEST in helping you and your funded collaborators accomplish the following goals?”

Advance individual projects that link NASA data and tools with the AQM community? 3.33

Work with Tiger Teams to connect NASA data and tools with the AQM community? 3.07

Build connections with air quality managers and other stakeholders? 3.26

Build collaborations with other AQUEST members? 3.40

Work on cutting edge air quality research? 3.33

Increase the use of NASA data and tools into your research? 3.13

Encourage your engagement in science with impacts and use to stakeholders? 3.5

Share updates at regular meetings? 3.45

Stay up-to-date on issues and science at regular meetings? 3.5

Promote your work via the web? 2.93

Promote your work via newsletters? 2.86



“The AQAST meetings provided a great collaborative opportunity...[but] Podium time [should have been] given out in larger chunks to groups with major accomplishments”

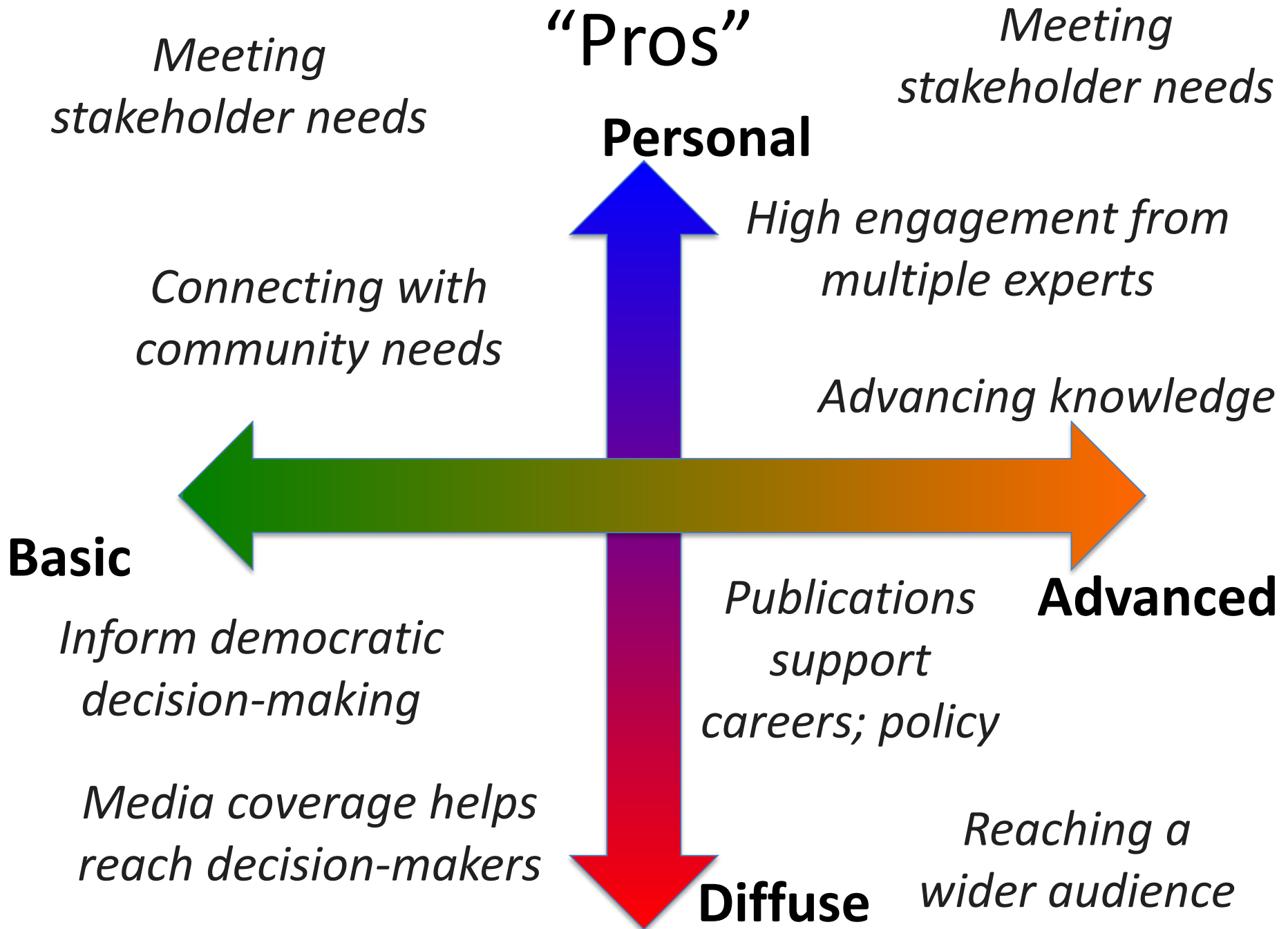
with the air quality management

Actually, publicity initiated by AQAST was valuable in getting our work out into the open.

work on cutting edge air quality research?
Increase the use of research into
Encourage

The web sites and newsletters are well-done, but nobody has ever approached me and said "Hey I read about your work in the AQAST newsletter"

s? 3.5



“Cons”

Expensive

Personal

*May not be
publishable*

Time-consuming

*May not be
fundable*

*Subject to politics and
personality*



Basic

Advanced

*For news coverage,
must link to news cycle*

*Science publishing may
not be accessible*

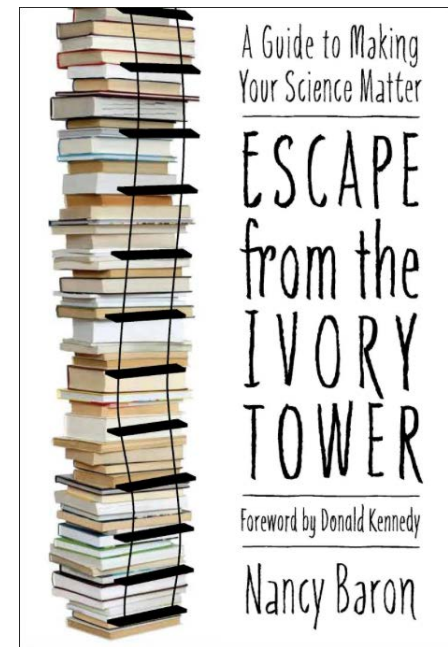
*Advanced research may
be difficult to “message”*

*May not reach
intended audience*

Diffuse

6 Easy Ways to Engage

1. Learn more about communication and engagement
2. Email your press office prior to next research publication
3. Set up a “profersonal” Twitter account
4. Update your website with a plain-language description of what you do and why
5. Invite a local air quality manager to coffee
6. Say “yes” next time you are invited to talk to a non-science group



twitter



Twitter @tracey_holloway

Email taholloway@wisc.edu

Thank you!



NASA Air Quality Applied Sciences Team

Earth Science Serving Air Quality Management Needs

