

# UAF's Unique Applied Research Capabilities:

## Unmanned Aircraft and Airborne Contaminants

Dr. Catherine F. Cahill

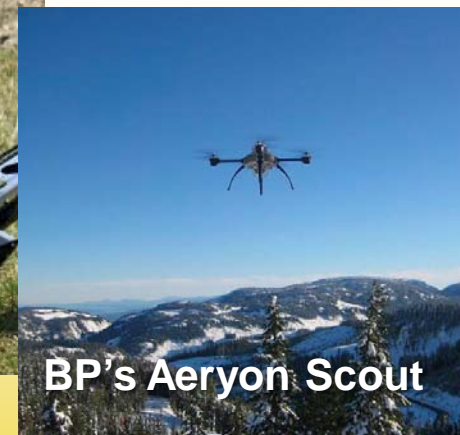
Associate Professor

Department of Chemistry & Biochemistry  
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# UA Unmanned Aircraft Capabilities

The UA Unmanned Aircraft Program specializes in:

- ◆ Operating small aircraft for emergency response and scientific research purposes
- ◆ Developing aircraft payloads and data handling techniques needed for these missions



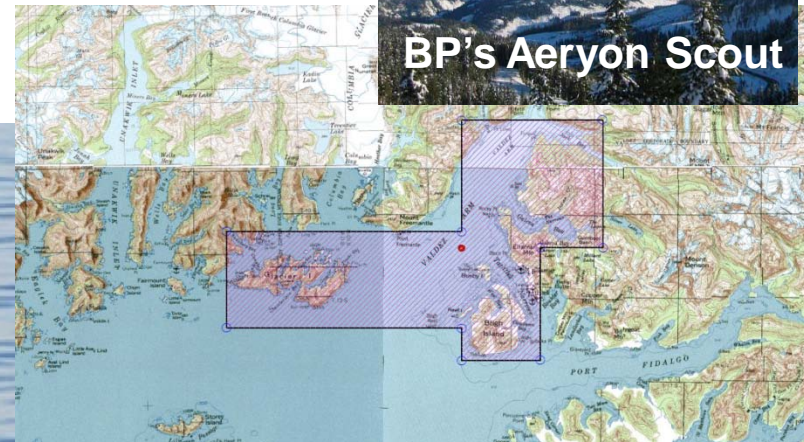
# Oil Spill Monitoring

Prince William Sound Technology Evaluation (Conoco Phillips and BP)

**Objective:** Understand how small-unmanned aircraft can contribute to environmental cleanup operations associated with an oil spill

## Partners:

- u Alaska Department of Environmental Conservation
- u US Fish and Wildlife
- u Environmental Protection Agency



Prince William Sound  
Airspace

# Meeting the Arctic Challenge

Unmanned Bering Sea Operation, May 2009

Harsh conditions:

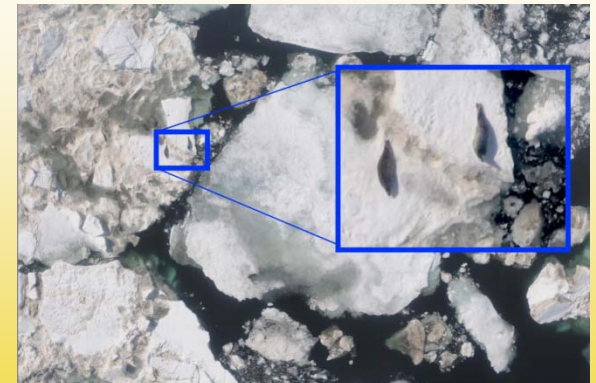
- u Icing potential
- u Low visibility

Lack of infrastructure:

- u No runways
- u No cell phones



UAF scientists successfully overcame these challenges to obtain high-resolution imagery for an ice seal survey



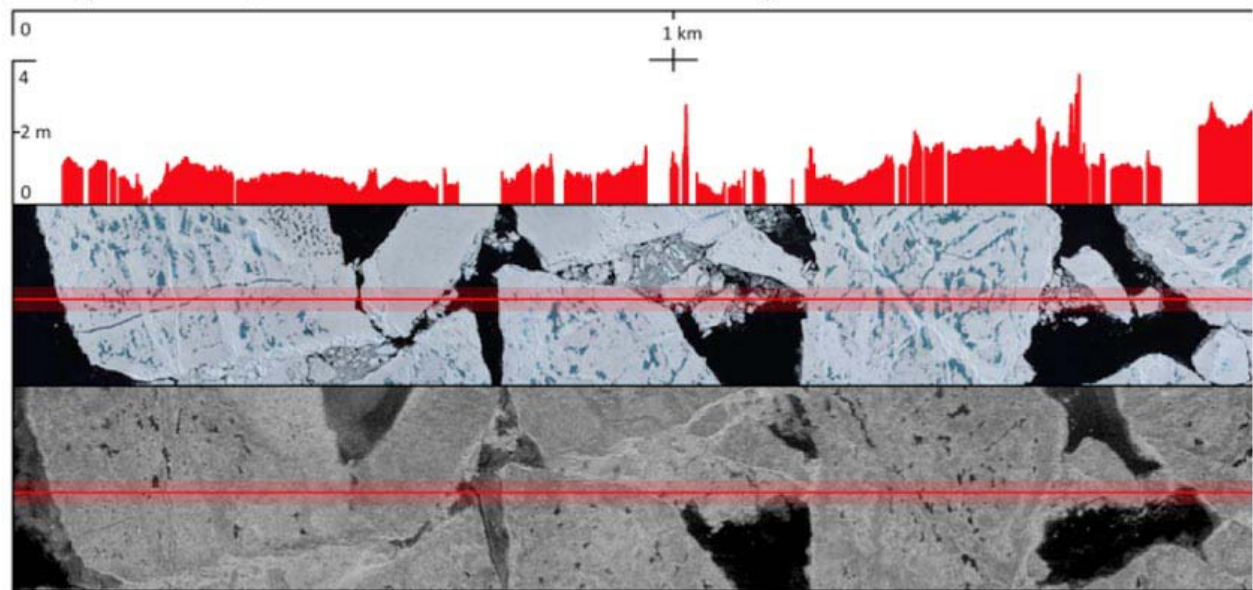


# Payloads for Alaska-centered Research: Ice Profiling LIDAR

Technology deployed by NASA in Greenland and Svalbard Norway

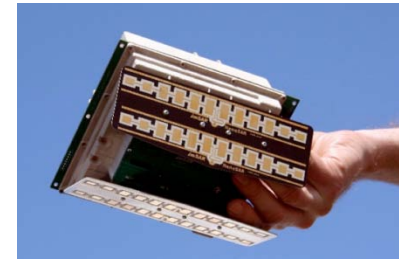


**LIDAR**  
**Color Visible**  
**SAR**



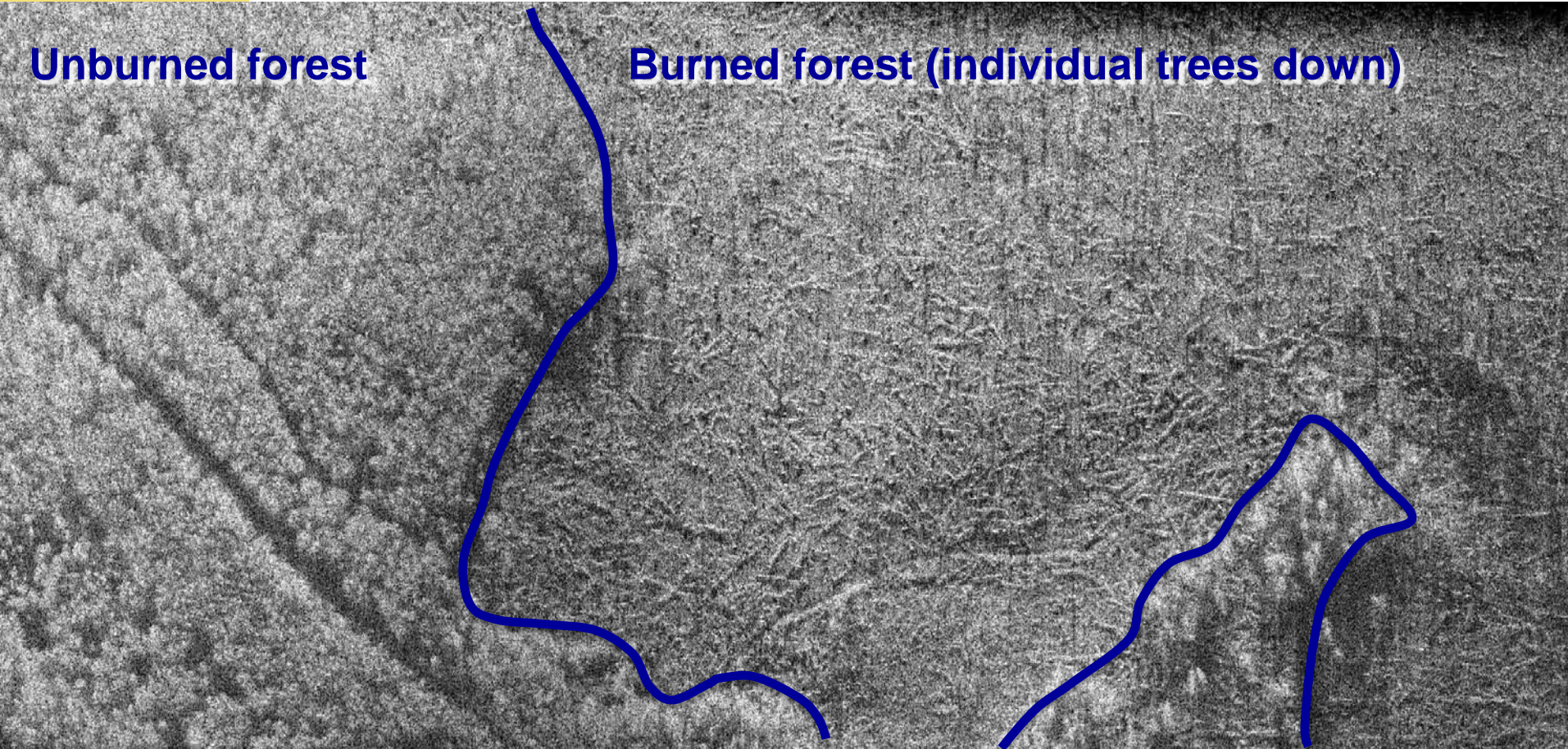


# Payloads for Alaska-centered Research: Miniature Airborne Synthetic Aperture Radar (SAR)



Unburned forest

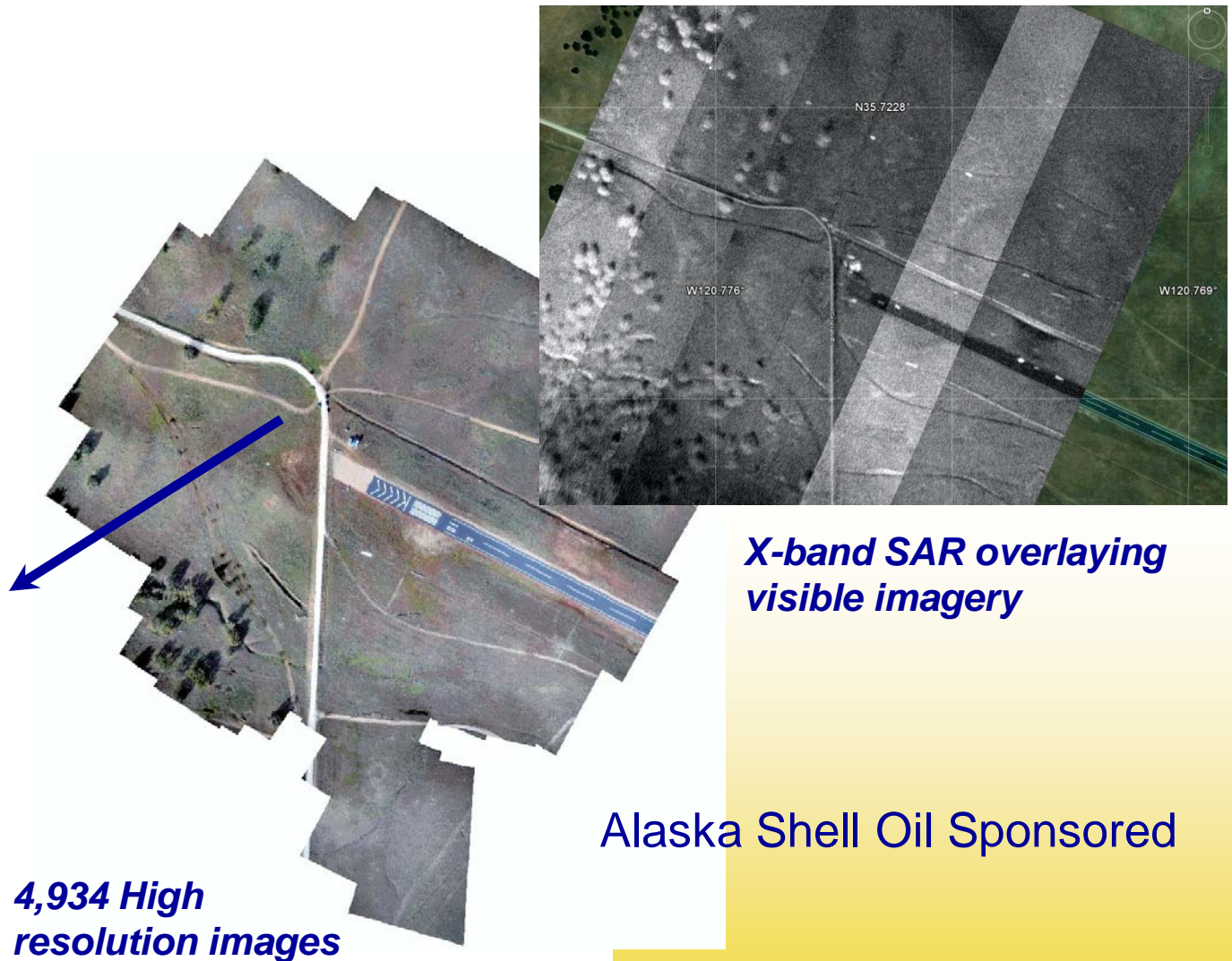
Burned forest (individual trees down)





# Data Products

Combining airborne, visible & SAR products



***X-band SAR overlaying visible imagery***

**Alaska Shell Oil Sponsored**

***4,934 High resolution images***

# Integrated into Emergency Response



Wildfire Incident Command Team Support  
August 2009



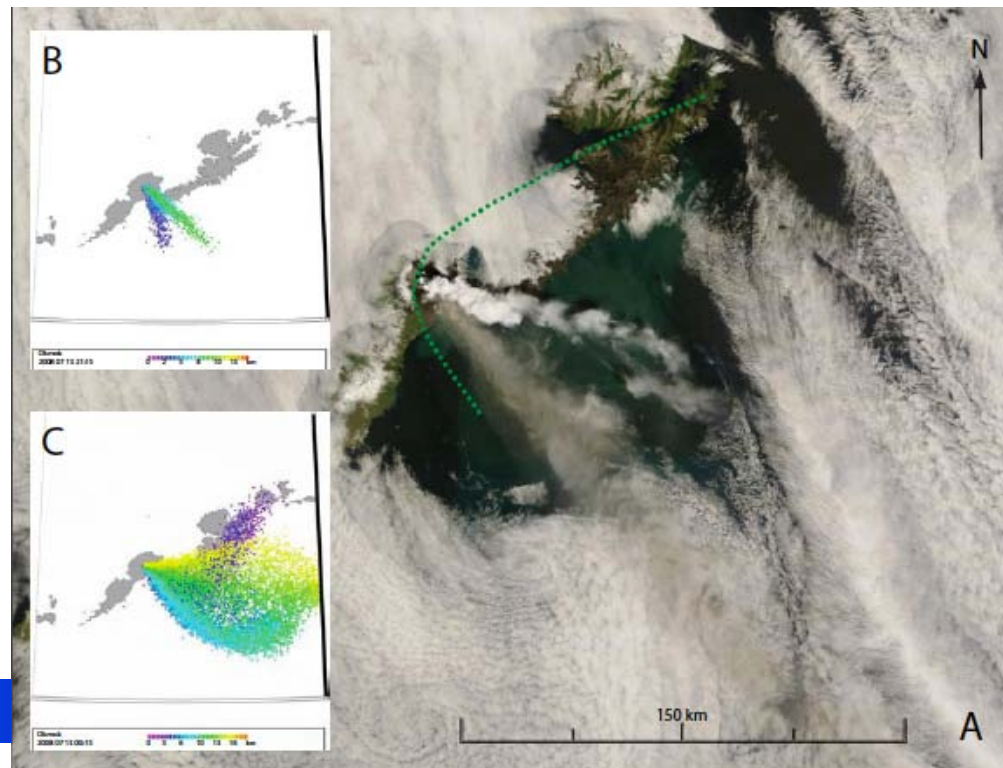
Natural Disaster Exercise Response  
May 2010





# Aircraft and Volcanic Ash

- ◆ Volcanic ash is hazardous to aircraft
- ◆ Unmanned aircraft can collect ash in a volcanic plume
- ◆ This provides the data needed to improve model predictions and validate satellite observations



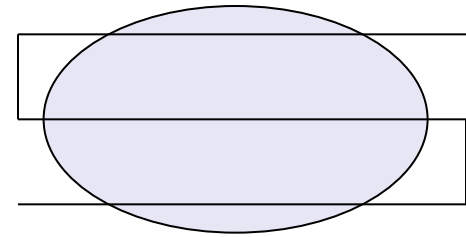
MODIS true color satellite image and Puff model analysis of Okmok Volcano

# Aerosol Collection

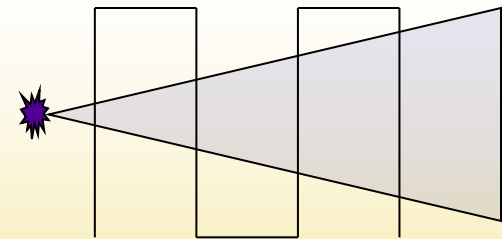
Airborne DRUM Sampler  
Developed at UAF



Airborne Plume Mapping



Vertical



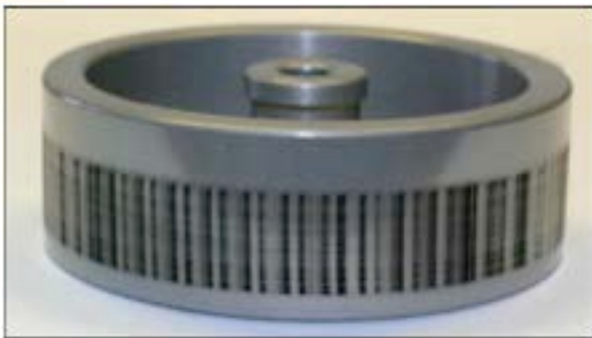
Horizontal



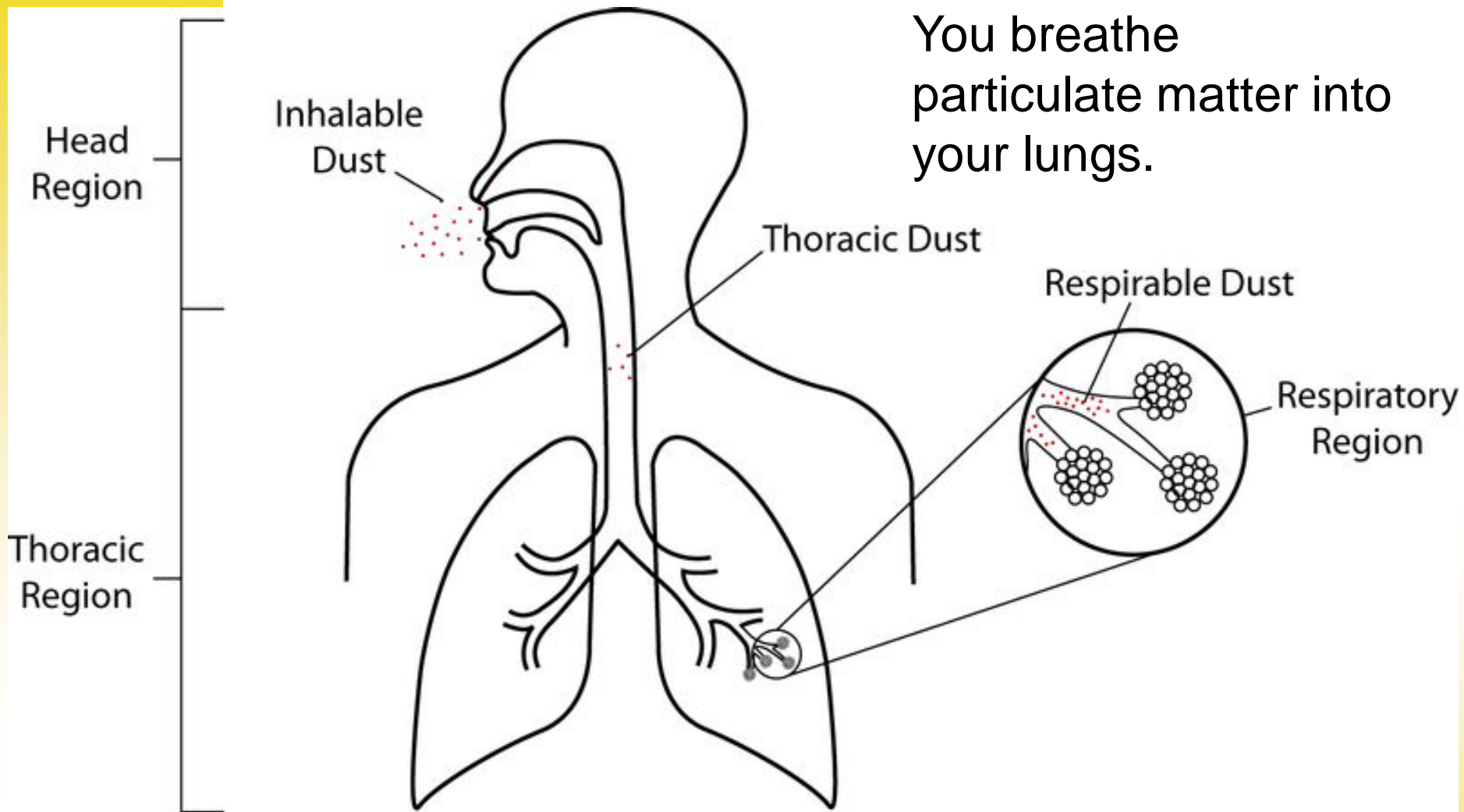
# DRUM Aerosol Impactor

**Measures aerosols in 8  
breathable size fractions:**

- 10 to 5.0  $\mu\text{m}$
- 5.0 to 2.5  $\mu\text{m}$
- 2.5 to 1.15  $\mu\text{m}$
- 1.15 to 0.75  $\mu\text{m}$
- 0.75 to 0.56  $\mu\text{m}$
- 0.56 to 0.34  $\mu\text{m}$
- 0.34 to 0.26  $\mu\text{m}$
- 0.26 to 0.09  $\mu\text{m}$

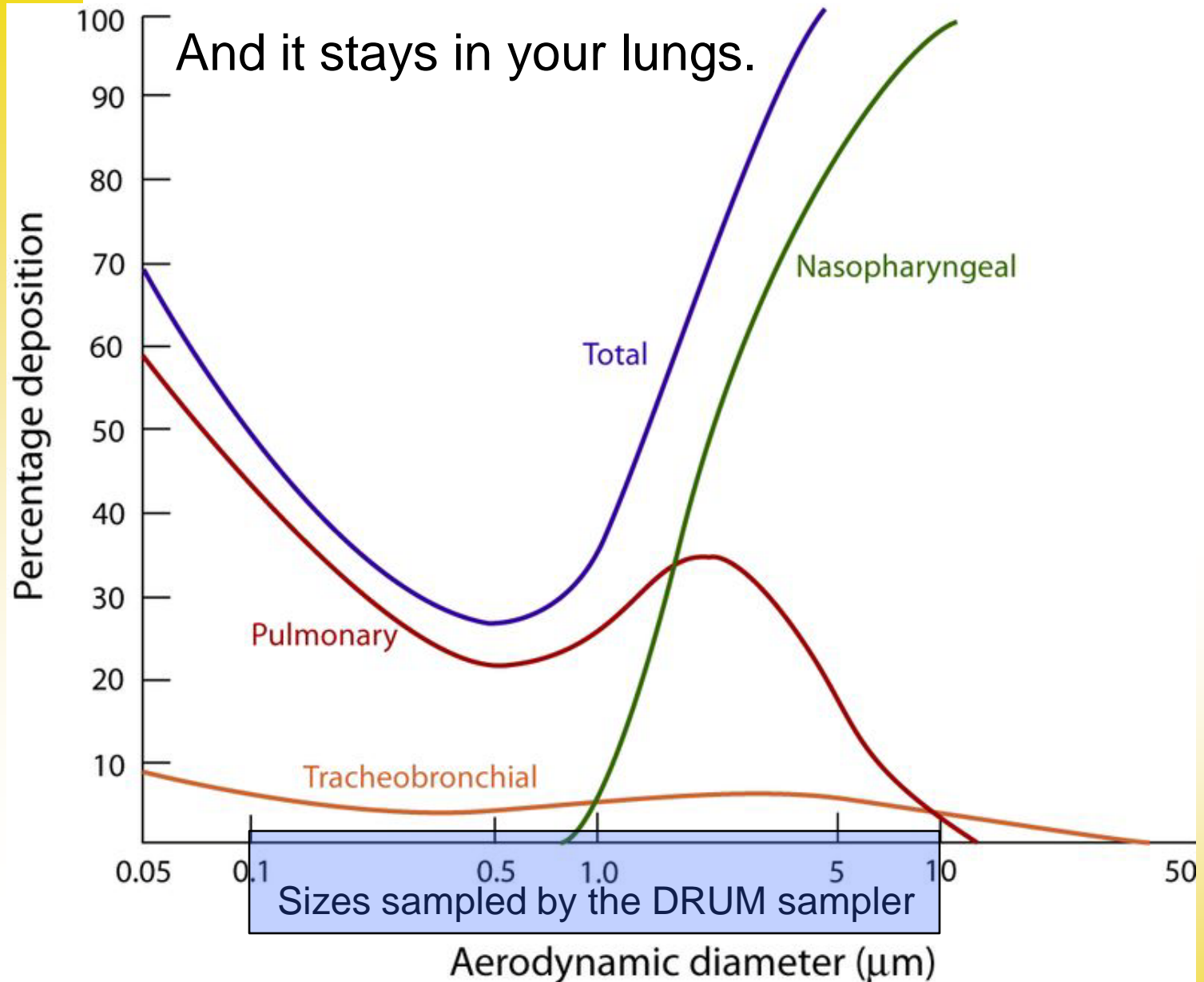


You breathe particulate matter into your lungs.



"Regional particulate deposition" from Principles of Industrial Hygiene. Available at: <http://ocw.jhsph.edu>. Copyright © Johns Hopkins Bloomberg School of Public Health. Creative Commons BY-NC-SA. Adapted from Annals of American Conference of Governmental Hygienists, Vol 11





"Site of particle deposition" from Principles of Industrial Hygiene. Available at: <http://ocw.jhsph.edu>. Copyright © Johns Hopkins Bloomberg School of Public Health. Creative Commons BY-NC-SA. Adapted from Annals of American Conference of Governmental Hygienists, Vol 11

# Health Effects of Short-Term PM<sub>2.5</sub> Exposure

- u Premature death in people with heart and lung disease
- u Non-fatal heart attacks
- u Increased hospital admissions, emergency room visits and doctor's visits for respiratory and cardiovascular diseases
- u Increased respiratory symptoms such as coughing, wheezing and shortness of breath

[http://www.epa.gov/air/particles/pdfs/20060921\\_factsheet.pdf](http://www.epa.gov/air/particles/pdfs/20060921_factsheet.pdf)



# Health Effects of Long-Term PM<sub>2.5</sub> Exposure

- u Premature death in people with heart and lung diseases, including death from lung cancer
- u Reduced lung function
- u Development of chronic respiratory disease in children

# Aerosols in Iraq and Afghanistan

Purpose of this study:

- ◆ Determine the concentrations, compositions, sizes, and sources of fine particulate matter
- ◆ Support health professionals:
  - ◆ Making decisions on how to protect soldier health
  - ◆ Identifying the potential sources of any observed future health issues

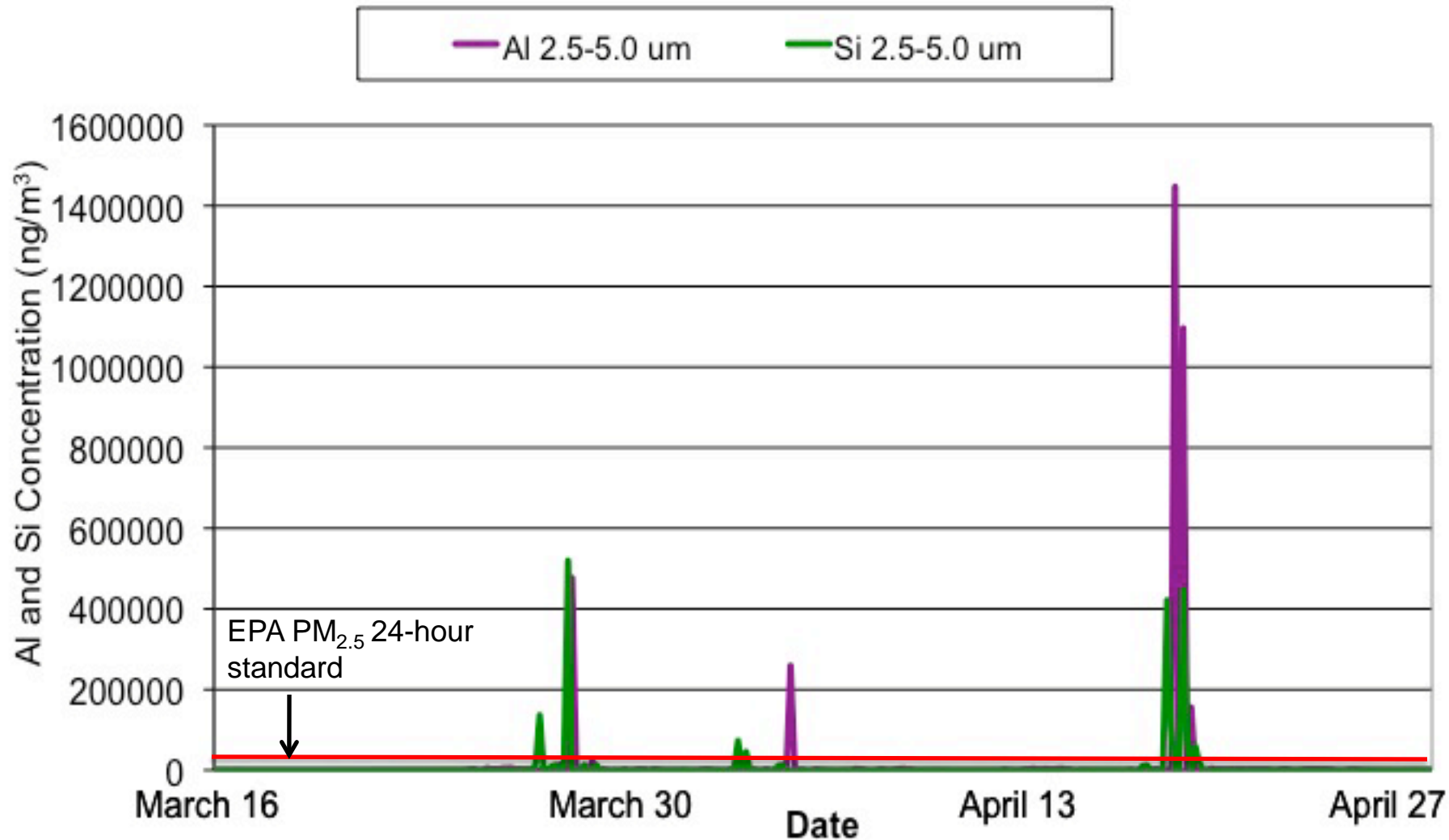






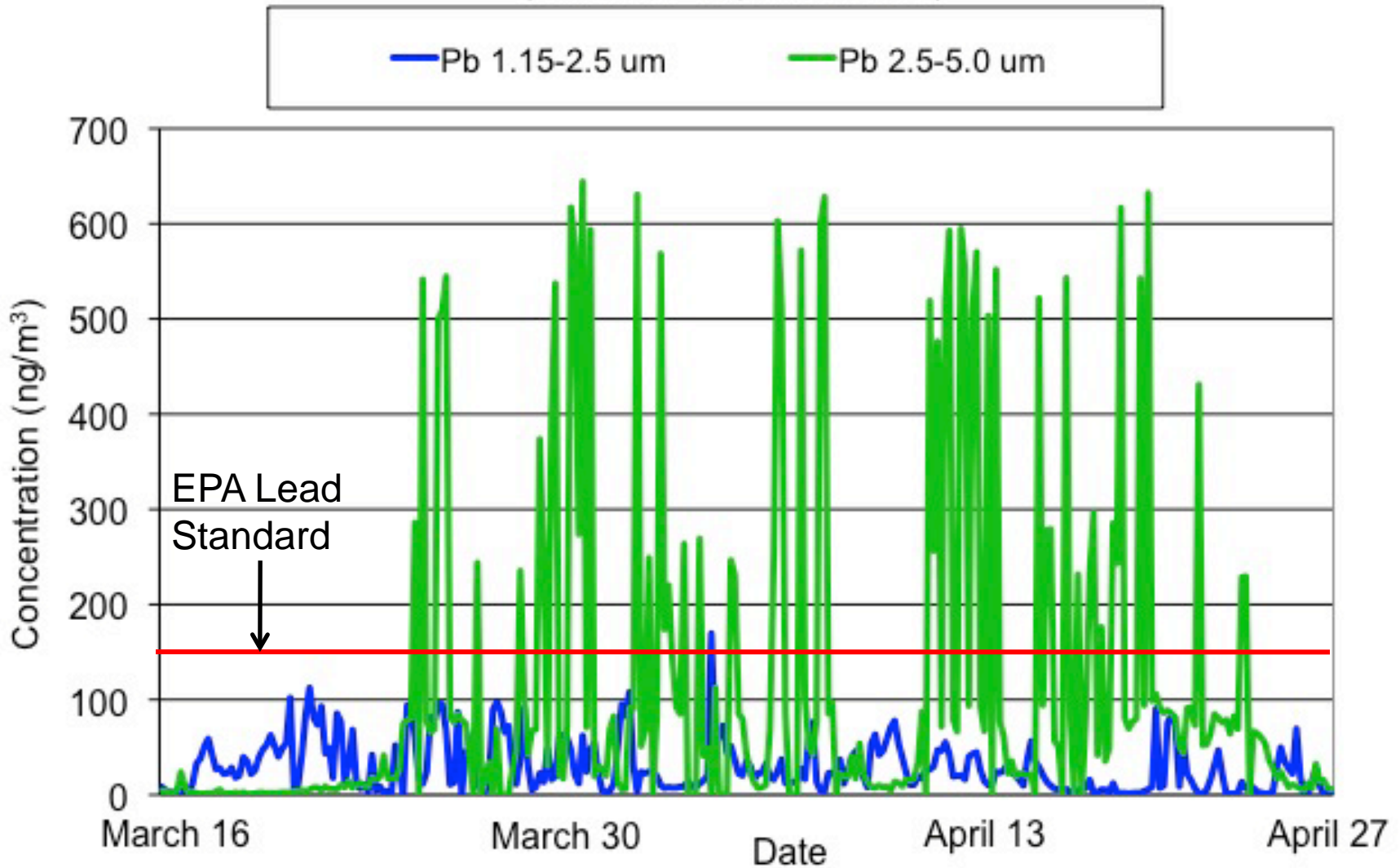
# Camp Victory, Baghdad, Iraq

## High Concentrations of Soil



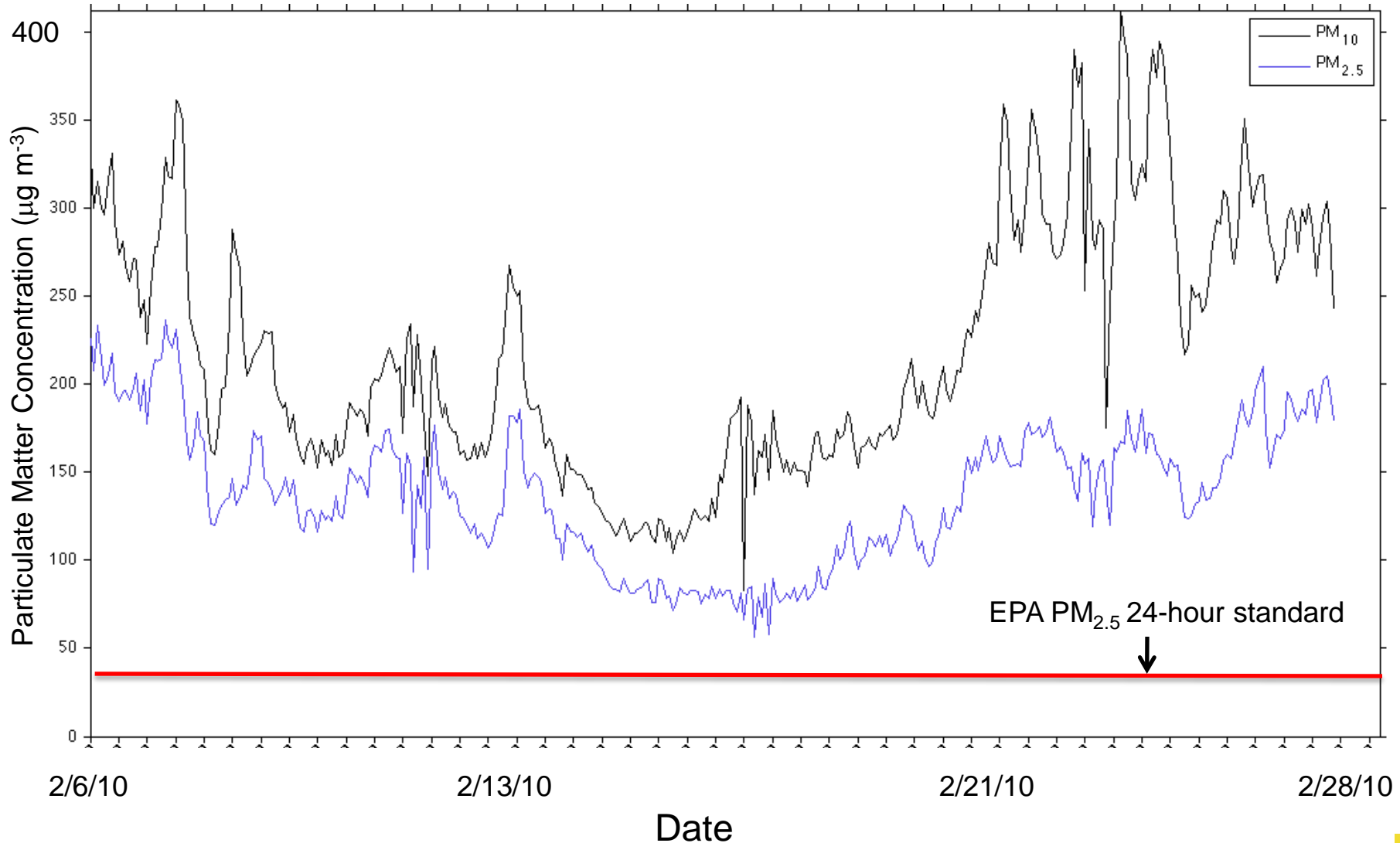
# The Aerosols Contain Lead

(March 16 - April 27, 2008)



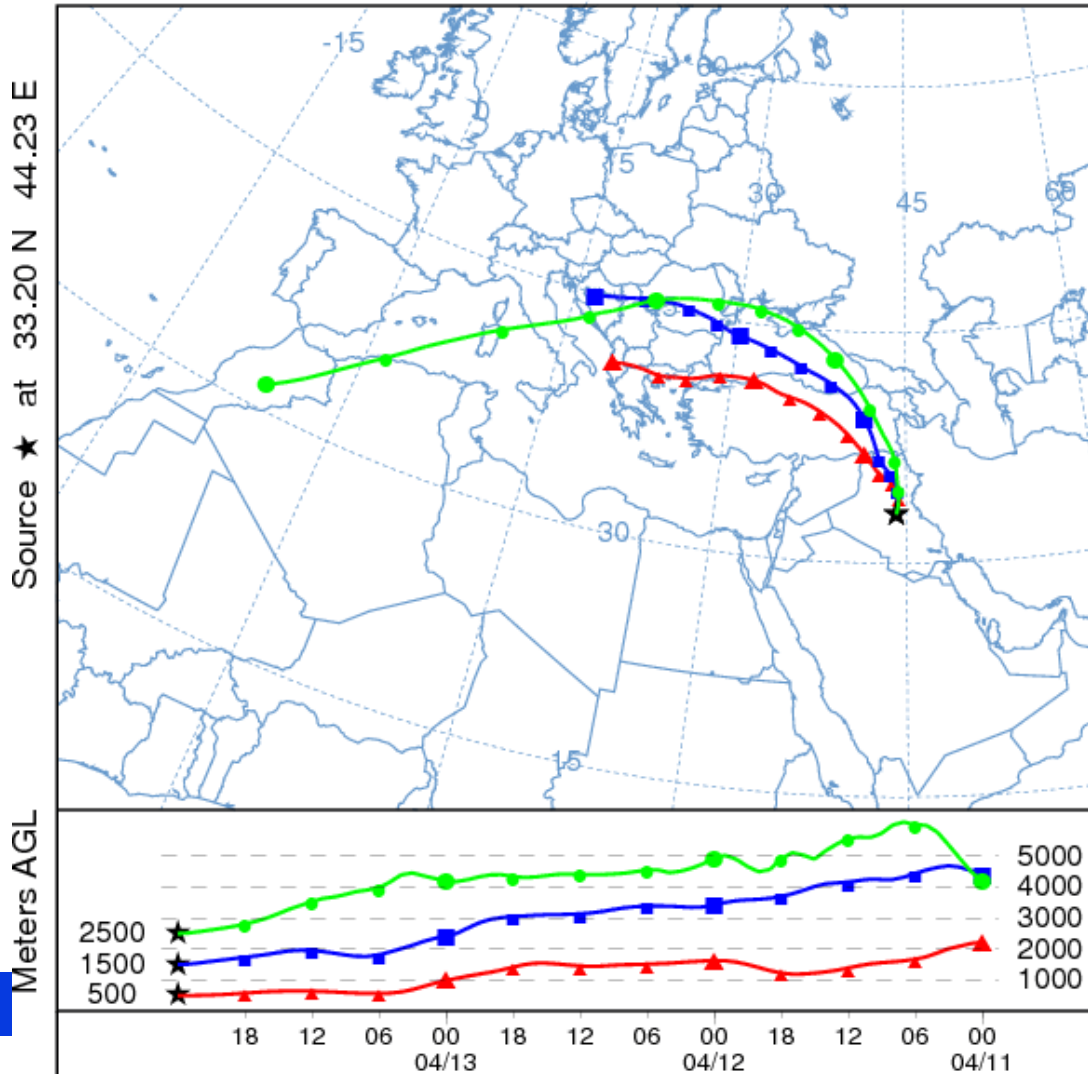


# Bagram Air Force Base, Afghanistan Particulate Matter Concentrations



# Where Did the Air Come From?

NOAA HYSPLIT MODEL  
Backward trajectories ending at 0000 UTC 14 Apr 08  
GDAS Meteorological Data



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CAPTION By David Furst, AFP/Getty Images

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**Big Fishing Yields Small Fish:** Researchers map predator loss

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**New brain cell growth restores function**  
3.29.11 - Regeneration helps repair learning and memory after injury in mice  
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3.29.11 - Dead stars may actually be a good place to hunt for life, plus organic-free asteroids and watery comets in this week's news

**DNA flaws can stack up as cancer grows**  
3.29.11 - Acute myeloid

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Pre-chewed baby food common in HIV-positive households, study suggests  
By [Janet Raloff](#)  
Mar 22nd 2011

**On the Scene**  
Intel Science Talent Search finalists reflect on their week in D.C.  
By [Science News Staff](#)  
Mar 15th 2011

**Deleted Scenes**  
An update on scientific integrity  
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**Comment**  
Japan crisis may have little effect on U.S. energy policy  
By [Michael Levi](#)  
Mar 25th 2011


**Math Trek**  
Outsides

Dust storms like this one in Baghdad can expose troops to unsafe levels of dust and other particles, air-quality monitoring indicates. **Full Story** Kevin Gelibert

**SN TODAY:**

**Great-grandpa's genes gone, effects stay**  
Removing an obesity-preventing scrap of DNA from a mouse lineage doesn't prevent descendants from reaping its slimming benefits for generations.  
[Read the full story.](#) | Mar 31st 2011  
Found in: [Body & Brain](#) and [Genes & Cells](#)



A sunset sky with a silhouette of an airplane and a crane. The sky is a mix of blue, orange, and yellow. The airplane is in the middle left, and the crane is on the right side. The text "Thank you for your attention!" is overlaid in white.

Thank you for your attention!

Questions?