

# Desert Aerosols

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# Fast Facts on Aerosols

- Aerosols are solid or liquid particles suspended in the atmosphere. They are less than five microns in size.
- If there were no aerosols in the atmosphere, there would be no clouds. Variations in aerosols content in the atmosphere can change the frequency of cloud occurrence, cloud thickness, and rainfall amounts.
- Once these particles grow, we are able to notice them as they scatter and adsorb sunlight.
- They interact directly and indirectly with the Earth's radiation budget and climate. As a direct effect, the aerosols scatter sunlight directly back to space. As an indirect effect, aerosols in the lower atmosphere can modify the size of cloud particles, changing how the clouds reflect and absorb sunlight, thereby affecting the Earth's energy budget.

## Sources of the key climate-affecting aerosol types

Source	Region	Dominant Species
Industrial pollution	Eastern North America, Europe, Eastern Asia	water-soluble inorganic (e.g., sulfate, nitrate, ammonium), organic carbon, elemental carbon
Biomass combustion	tropical/subtropical South America and Africa	organic carbon, elemental carbon
Wind-blown dust	disturbed arid soils	mineral dust
Natural	remote continental, remote marine, free troposphere	

# Why do we care about aerosols?

- Aerosols tend to cause cooling of the Earth's surface almost immediately. Because most aerosols reflect sunlight back into space, they have a "direct" cooling effect by reducing the amount of solar radiation that reaches the surface. The magnitude of this cooling effect depends on the size and composition of the aerosol particles.
- It is thought that aerosol cooling may partially offset expected global warming that is attributed to increases in the amount of carbon dioxide from human activity. Aerosols are also believed to have an "indirect" effect on climate by changing properties of clouds.

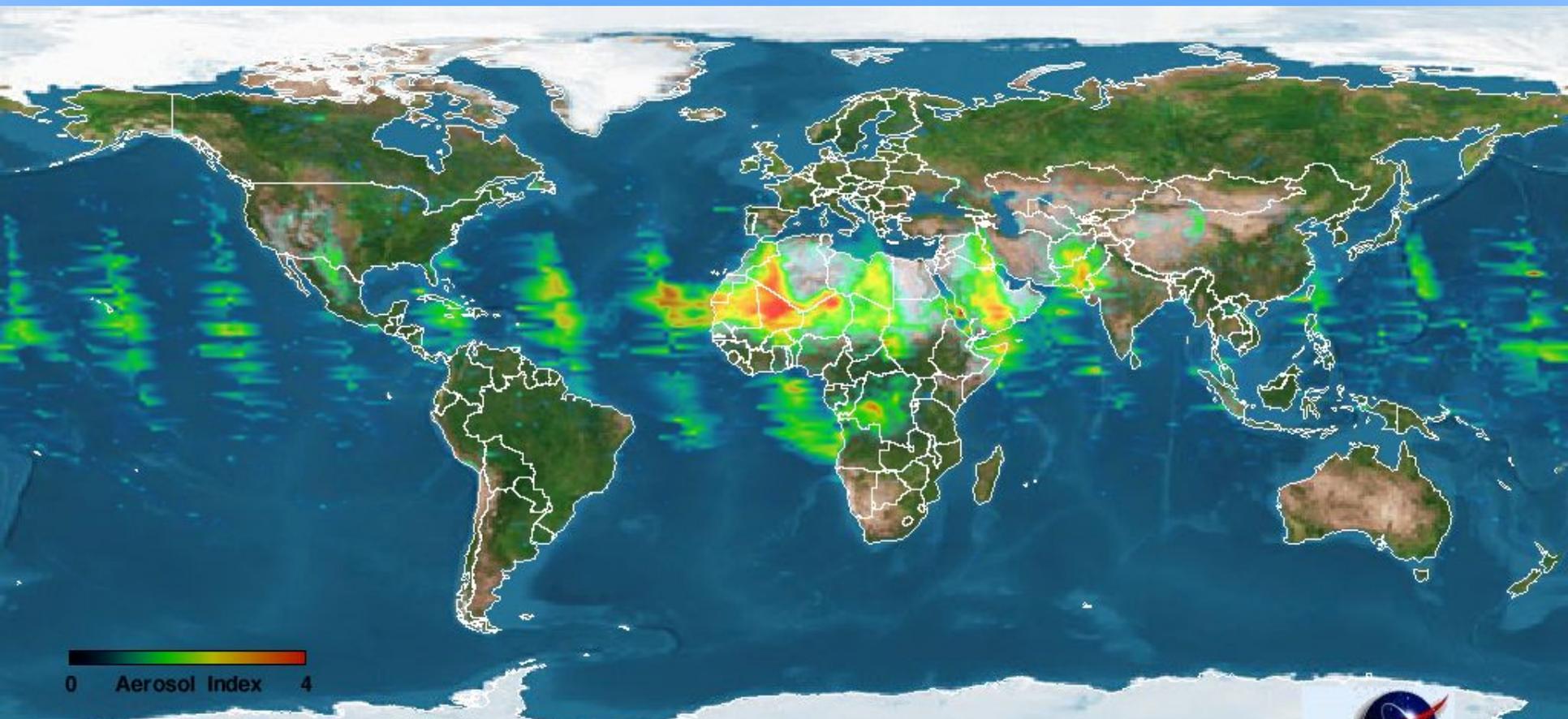
# Aerosols and Their Effects



Aerosol particles larger than about 1 micrometer in size are produced by windblown dust and sea salt from sea spray and bursting bubbles. Aerosols smaller than 1 micrometer are mostly formed by condensation processes such as conversion of sulfur dioxide (SO<sub>2</sub>) gas (released from volcanic eruptions) to sulfate particles and by formation of soot and smoke during burning processes. After formation, the aerosols are mixed and transported by atmospheric motions and are primarily removed by cloud and precipitation processes.

# Our NASA mission

- NASA monitors aerosols with the Total Ozone Mapping Spectrometer (TOMS)
- Current Aerosol Hotspot is the Sahara Desert in Northern Africa.
- Dust from the Sahara travels across the Atlantic Ocean and affects the Caribbean, the Americas and even New York.



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Earth Probe TOMS Aerosol Index



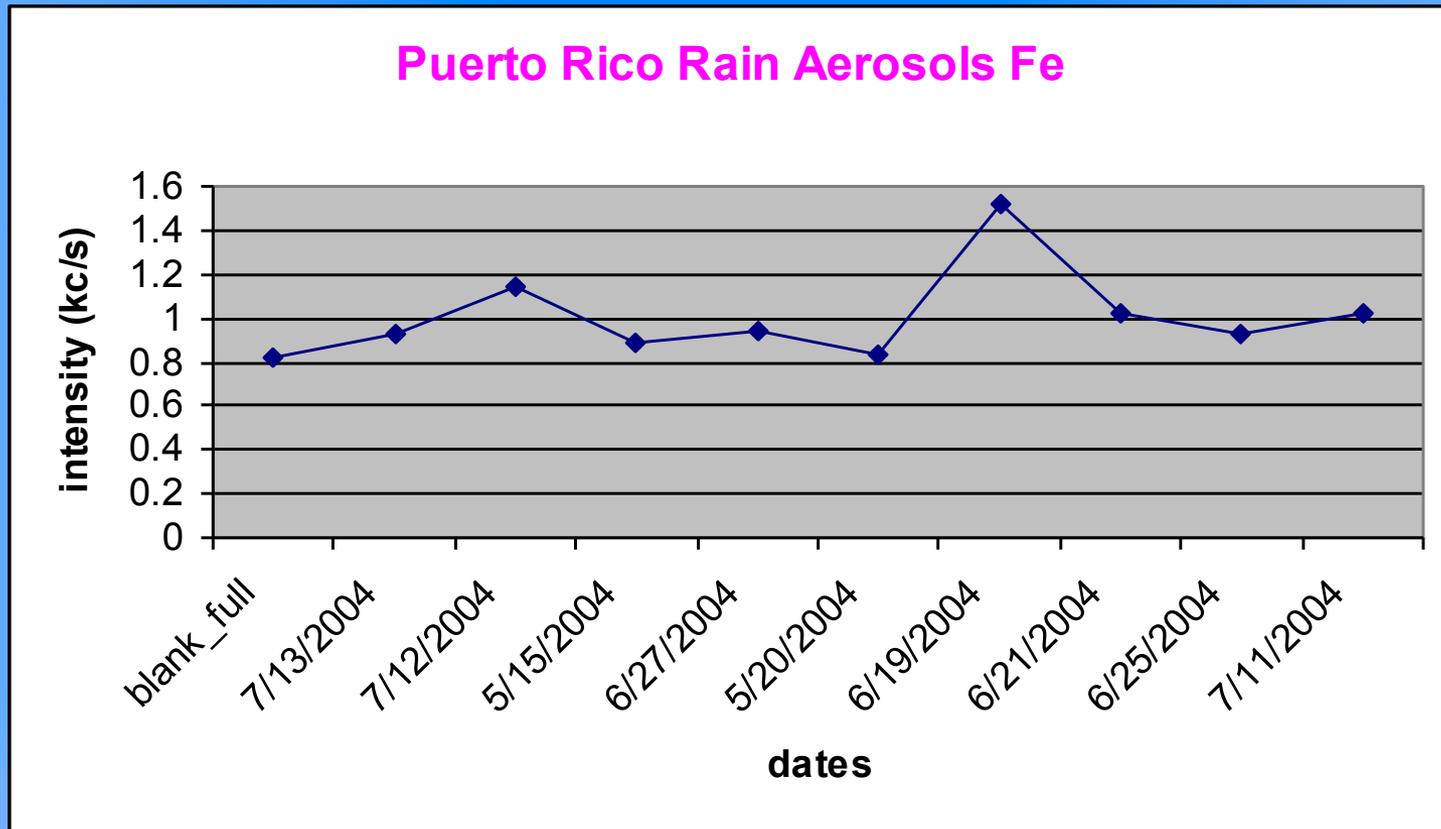
# How do Earth Scientists Study Aerosols?

- Properties of aerosols such as size, composition, index of refraction and optical single scattering are important to remote sensing applications.
- We create our own “desert dust” to study its optical properties
- We find out maximum concentration of particles in order to get good scattering measurements (Scattering Spectrometer)
- Collect aerosols in filters and rainwater and prepare them for geochemical analysis (X-Ray Fluorescence)

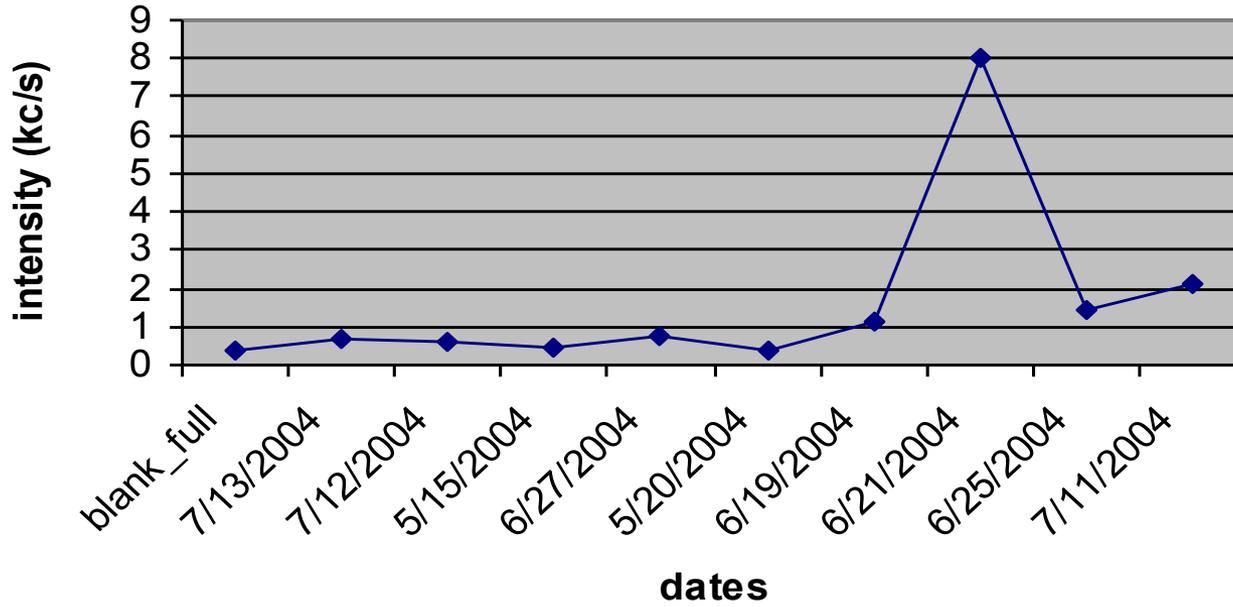
- Desert dust is made up of quartz, metal oxides and various clay minerals.
- Clay minerals and silica were brought into suspension using sonic waves (Biosonik 3000)
- Concentration of suspended particles was determined by weighing a drop of sample on a slide, evaporating the water and reweighing the slide.
- Rainwater samples were collected at various locations at CCNY. Samples were then filtered using a vacuum pump.
- Samples were then pressed into pellets for x-ray fluorescence analysis.

# XRF preps/ Opt. Scattering preps

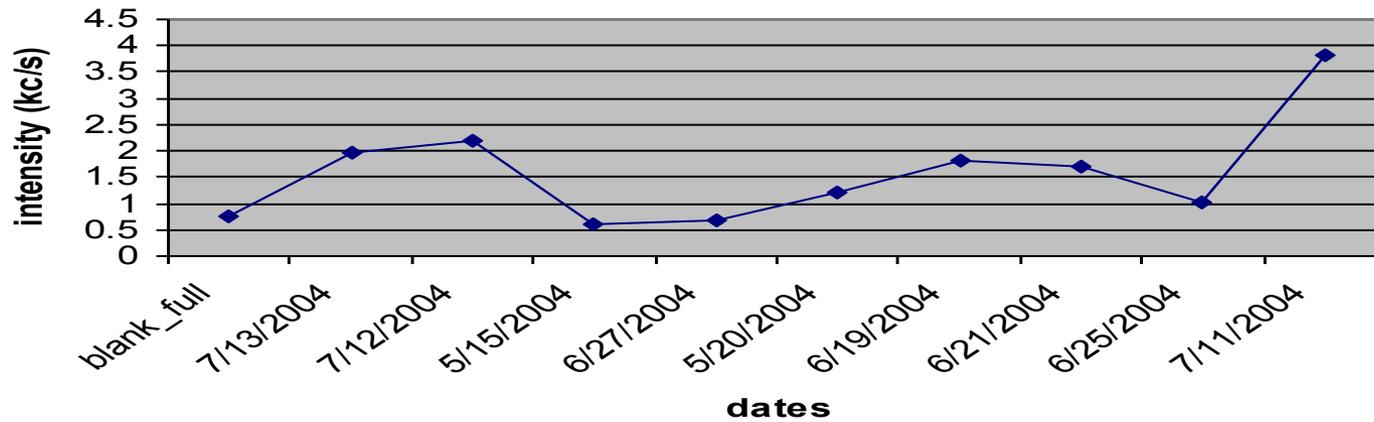
# Graphs conclusions of rain water



## Puerto Rico Rain Aerosols Ti



## Puerto Rico Rain Aerosols Ca



# Importance

- According to NASA-Goddard Space Flight Center TOMS Principal Investigator, Dr. Jay Herman,  
“Of primary interest is obtaining the **particle size distribution, optical depth, and single scattering** albedo (absorption) in both the visible and UV. These properties are being used to estimate the radiative forcing in the atmosphere, and subsequently its effect on weather and climate. These last two are of intense interest to planetary exploration, especially for the Martian atmosphere. **On Mars the dust in the atmosphere plays a much larger role than on Earth, both in scouring the land and in altering atmospheric properties. Atmospheric heating on Mars during dust storms is of considerable interest.** “ (Personal communication with Karin Block, 6/2004)

# Results

Further work

# References

Picture of crew