Pre-GLORY Assessment of Aerosol Characteristics

**Abstract**

NASA has tentative plans to launch the GLORY satellite in 2008 that will measure atmospheric aerosols and pollutants. The study of aerosols is very important because aerosols have both cooling and heating effects on earth’s climate. The cooling effect that aerosols have on the surface of the Earth is known as direct climate forcing. This is due to the direct reflection of radiation from the sun. Aerosols also have an effect on the radiative properties of Earth’s cloud cover, known as indirect climate forcing. Although scientists are looking at aerosol characteristics in the New York region that can be used for validation purposes. Comparisons between urban and rural areas have also been made. Another aspect of this project is developing an initial protocol for the GLORY ground-truth validation. By comparing GLOBE sunphotometer data to AOT data from other instruments, the accuracy of the sunphotometers can be analyzed. After tests have been completed to make sure the instruments have been calibrated correctly, a protocol for accurate readings by high school and middle school students can be created. These instruments will be distributed to students around the world to take readings of Aerosol Optical Thickness as part of the satellite validation plan.

**How are Aerosols?**

- Both natural and anthropogenic aerosols have many different effects on global climate, ecosystem development, and human health.
- Have both cooling effect (direct forcing) and heating effect (indirect forcing).
- Aerosols are solid and liquid particles suspended in gas.

**GLORY Mission**

The GLORY satellite will feature an instrument to measure atmospheric aerosols and man-made pollutants in the atmosphere. The on-board instruments are:

- Aerosol Polarity Sensor (APS) which will collect global aerosol data based on measurements of light reflected within the solar reflective spectral region of Earth’s atmosphere.
- Total Irradiance Monitor (TIM); collects measurements of total solar irradiance (TSI), (the amount of solar radiation in the Earth’s atmosphere over a period of time).

**Looking at Aerosol Concentration and Distribution**

The MICROTOPS II is a hand-held multi-band sunphotometer that measures aerosol optical thickness at 1020nm. The MICROTOPS II is a hand-held multi-band sunphotometer that measures aerosol optical thickness at 1020nm. The GLOBE sunphotometer uses a light emitting diode (LED) to detect the strength of the sun’s light.

**What are Aerosols?**

- Both natural and anthropogenic aerosols have many different effects on global climate, ecosystem development, and human health.
- Have both cooling effect (direct forcing) and heating effect (indirect forcing).
- Aerosols are solid and liquid particles suspended in gas.

**Handheld Sunphotometers**

- Both instruments measure AOT on different wavelengths.

**Wind Direction and Regional Trends**

Aerosol composition can be different based on the source of the particulates. A region close to the ocean could be expected to have a larger amount of sodium while an area with farmlands would have a greater amount of nitrates. When comparing the regions throughout a 5 year long time period, there were very subtle differences in the composition. The differences in total volumes varied more than the breakdown compositions.

**Future Work**

- Designing educational modules/protocols for validation of the GLORY Mission
- Assessment of PM 2.5 Levels and Composition dependence on:
  - Season
  - Temperature
  - Wind Speed
  - Wind Direction
  - Barometric Pressure

**Sulfates and Nitrates Observations**

Nitrates begin as nitrous oxide and can be formed in two ways:

1) Cloud droplets containing Nitric Acid vapor evaporating leaving behind nitrates.
2) Nitric acid vapor sometimes changes phase together with ammonia, creating ammonium nitrate aerosol (NH4NO3).

Nitrate formation is also temperature dependent. During summer months when atmospheric temperature is high, Nitrous Oxide is consumed to create ozone, it can no longer form nitrates. Since this process occurs mainly when the temperature is high, there will be less nitrates forming in earth’s atmosphere.