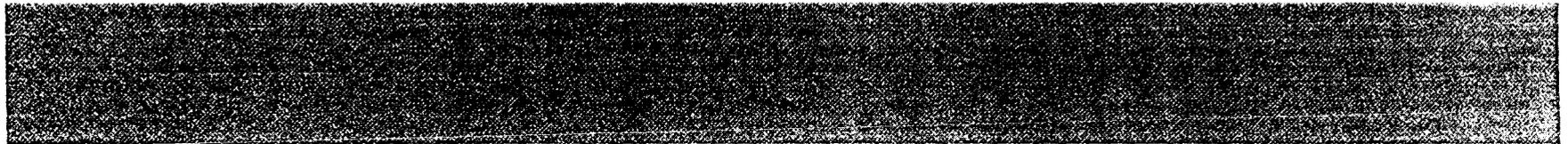


Atmospheric Visibility Monitoring (AVM) Program



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Muthu Jeganathan and
Loretta Tong

JPL

Jet Propulsion Laboratory





Outline



- ➡ Program objective
- ➡ Project **overview** and description
- ➡ Atmospheric transmission data
- ➡ Future upgrades & enhancements
- ➡ Summary



A VM: Objectives



- ➔ Obtain Atmospheric Transmission Statistics Data to Support Optical Communications
 - ◆ Atmospheric loss in optical comm. channel
 - ◆ Joint PDFs for multiple site reception
 - ◆ Statistical modeling
 - ◆ Extrapolate PDFs for other sites

AVM: Description



- An autonomous system that measures ground intensity of stars through different filters
 - ◆ 10-inch (4-cm) diameter f/10 telescope
 - ◆ Six spectral filters (5 operational)
 - ◆ Cooled slow-scan CCD camera
 - ◆ Weather station to guard system
 - ◆ 386 powered PC controls all subsystems and collects data



A VM: Description



- One star observed every 15 minutes
 - ◆ Standard stars between 0 & 4 magnitude
 - ◆ About 50 stars in list covering entire sky
- **Each** star observed through 6 filters
 - ◆ Narrow band: 532 nm, 830 nm & ~~1.06 μ m~~
 - ◆ Broad band: Astronomical V, R & I
- 24 observations (images) per hour



AVM: Description



- ➔ Collected data is automatically sent via modem to a dedicated computer at **JPL** **on a daily basis**
- ➔ Image/data processing reveals star intensity values on ground
- ➔ Attenuation determined by normalizing ground intensity values to **above-the-atmosphere** intensity values
- ➔ Subsequent data analysis provides statistical information of interest



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AVM: Sites

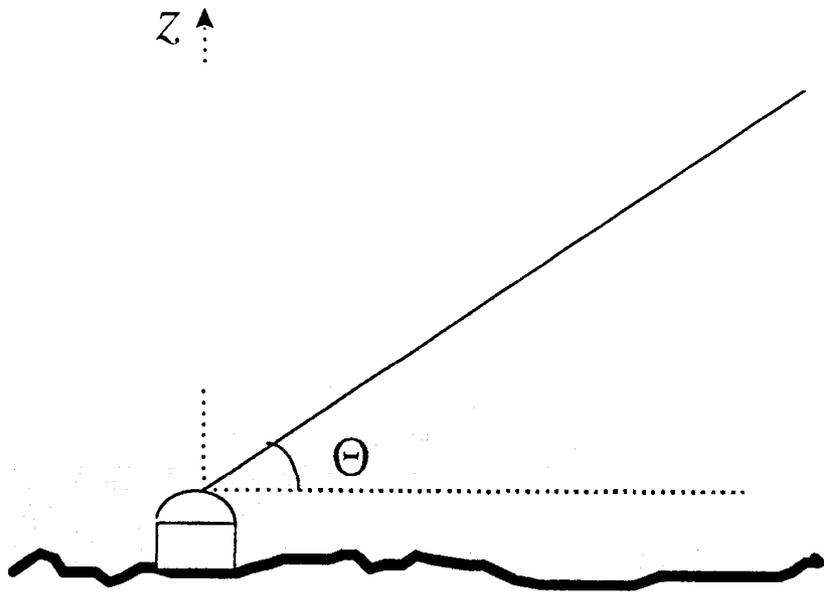
- Table Mountain Facility (TMF)
 - ◆ Altitude: 2.3 km (7500 ft)
- Mt. Lemmon near Tucson Arizona
 - ◆ Altitude: 2.8 km (9150 ft)
- ~~Mesa near JPL~~
- Goldstone (as of August 1996)
 - ◆ Altitude: 1 km (3400 ft)

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System Calibration



- ➔ Calibration achieved from observation of stars through different air-mass



$$I = I_0 \exp(-\sec \theta \int \alpha(z) dz)$$

$$I = I_0 \eta^{-\sec \theta}$$

$$y = \ln I$$

$$y_0 = \ln I_0$$

$$x = \sec \theta \text{ (air mass)}$$

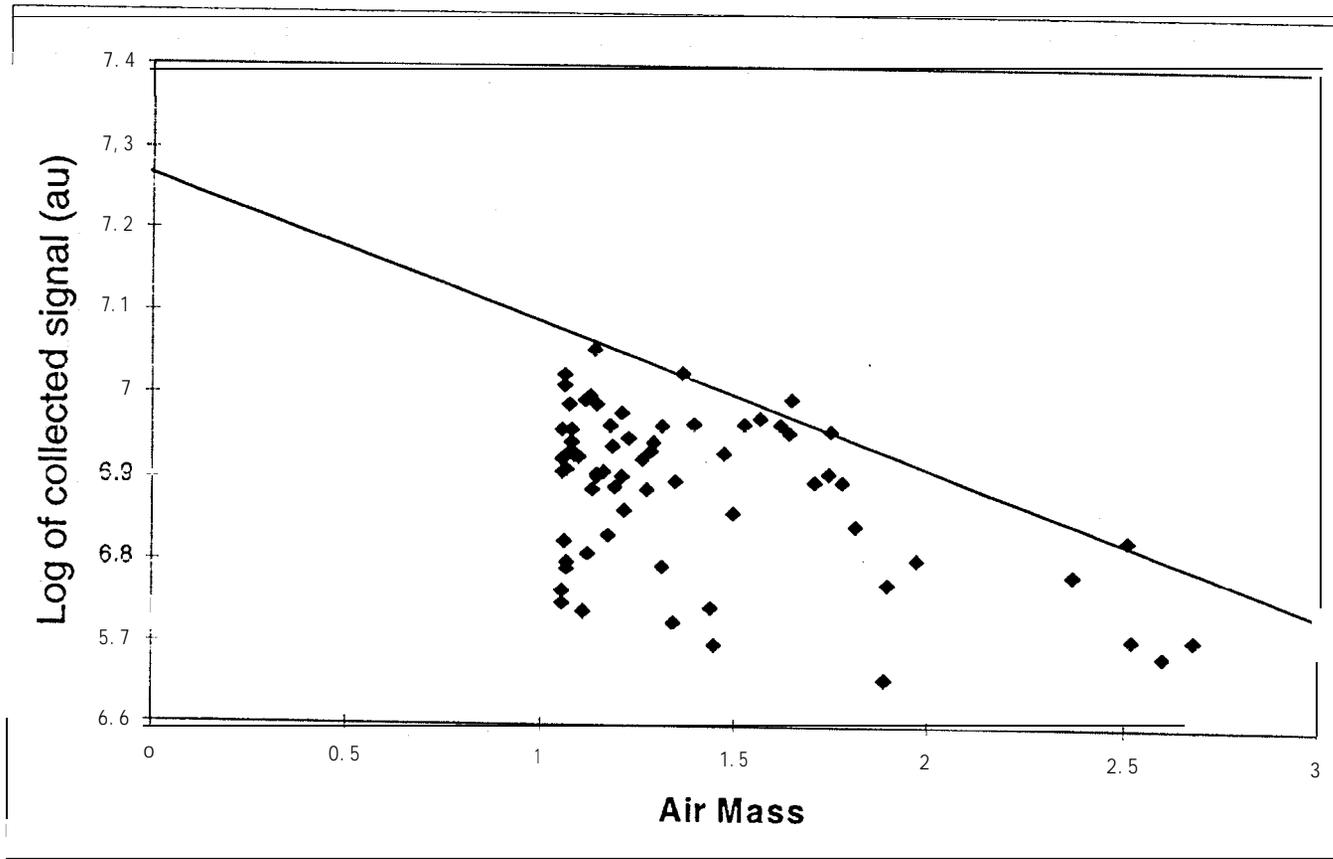
$$y = y_0 - \eta x$$



Calibration



Observation of star #5933 through 860 nm filter from TMF

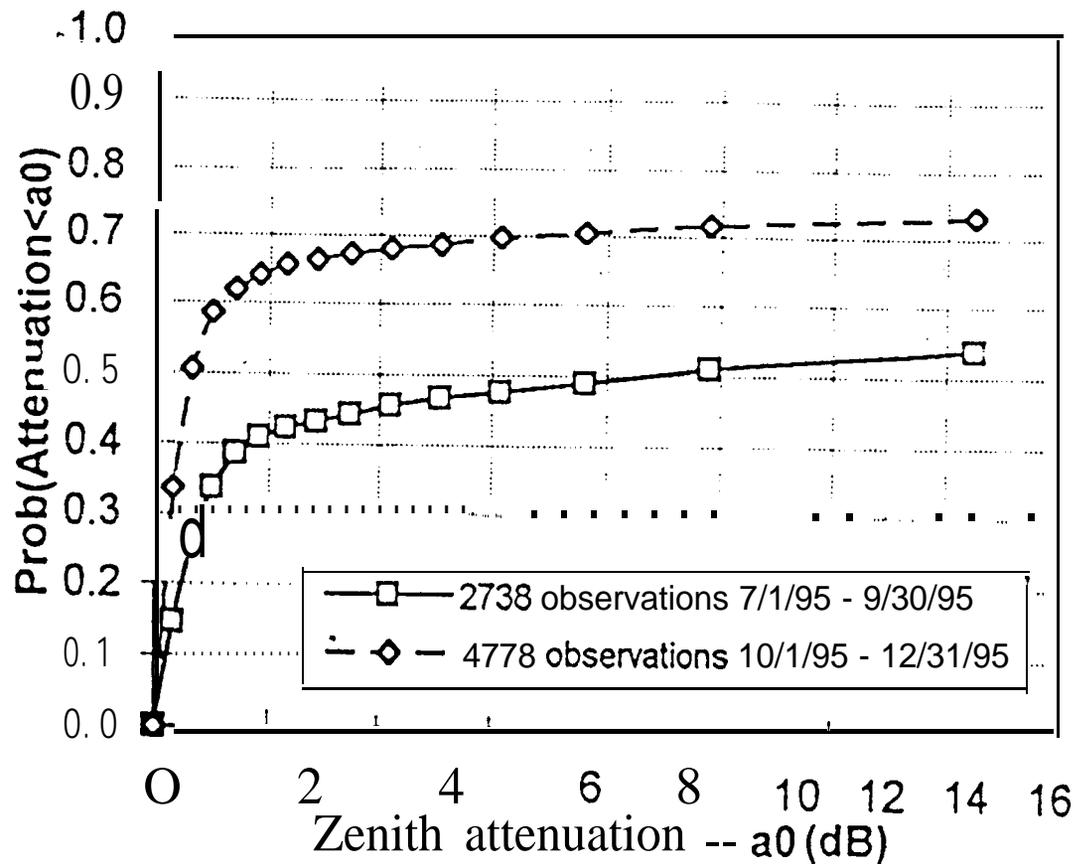




Visibility Statistics



Site: Mt. Lemmon; Filter 860 nm
Period: 3rd and 4th quarter of 1995

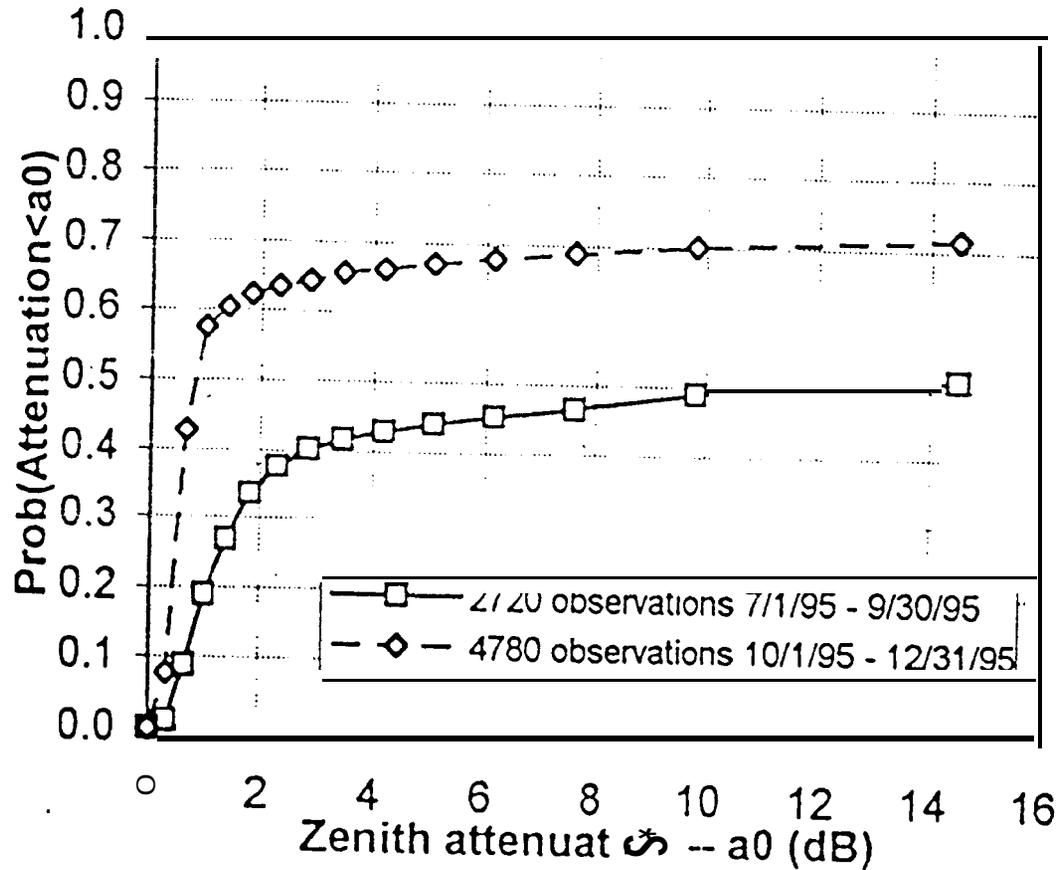




Visibility Statistics



Site: Mt. Lemmon; Frequency: 532 GHz
 Period: 3rd and 4th quarter of 1995



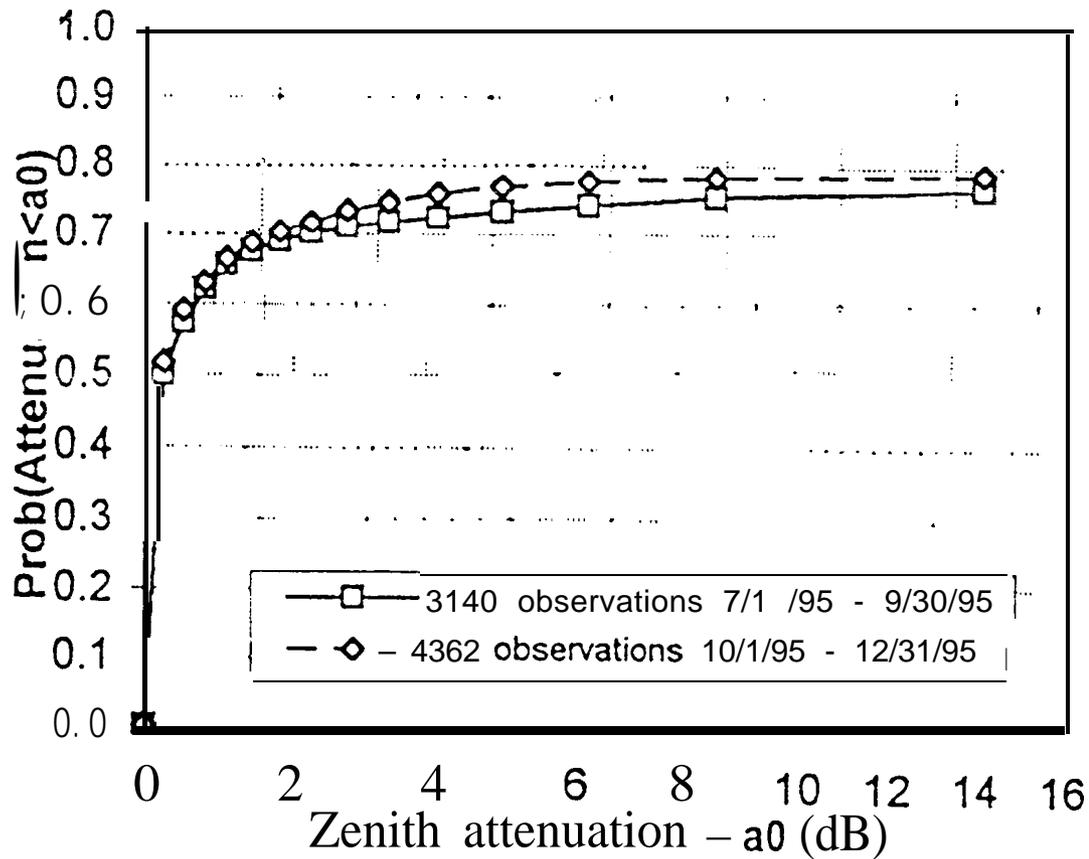


Visibility Statistics



Site: TMF; Filter 860 nm

Period: 3rd and 4th quarter of 1995



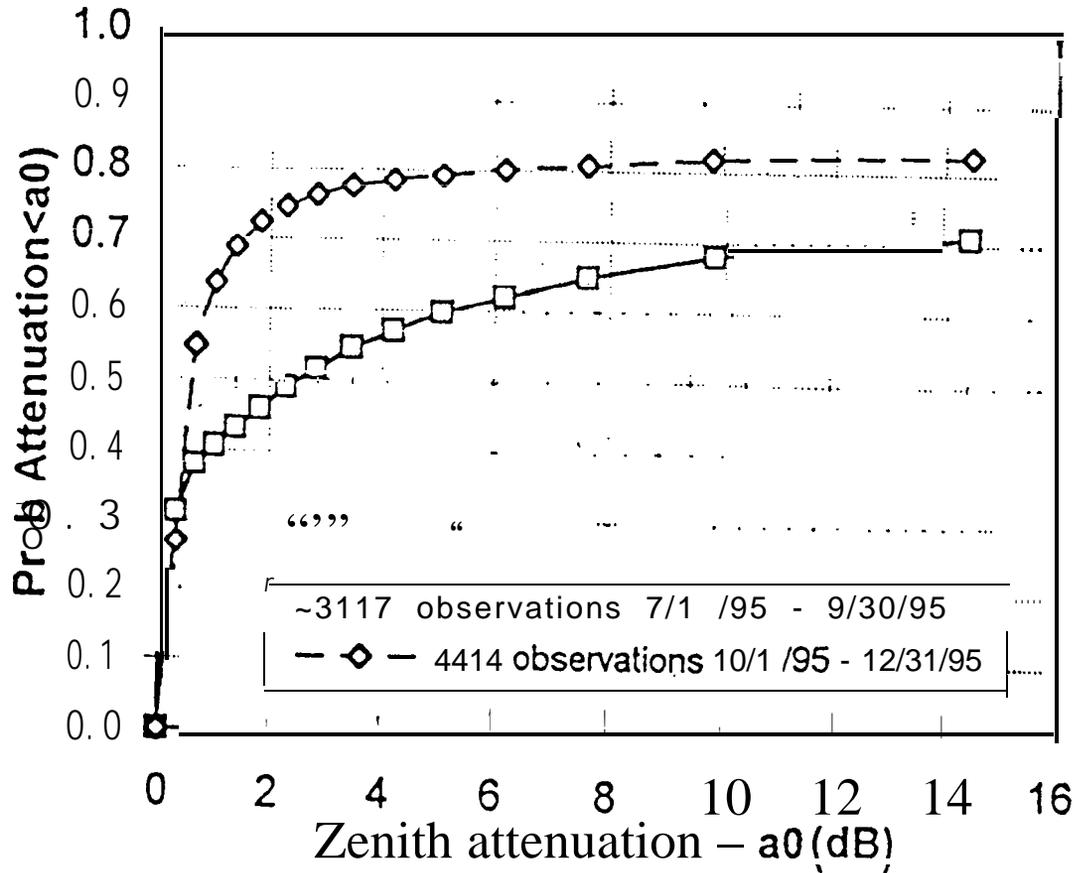


Visibility Statistics



Site: TMF; Filter 532 nm

Period: 3rd and 4th quarter of 1995





Work in Progress



- Maintain AVM data **using** MS Access
- **Use** queries to extract necessary data
- Analyze extracted data using Interactive Data Language (**IDL**)
- **Obtain joint** statistics from the three sites (diversified-site availability)



Planned Activities



- **Capability to collect data in the IR**
 - ◆ especially at the important laser wavelengths of 1.06 μm and 1.55 μm

- **Compare and correlate AVM data to other atmospheric databases**

- **Statistical modeling and prediction**

Conclusions



- **Fully autonomous** AVM systems collect atmospheric visibility data **from three sites**
- Database of visibility data is being created to easily extract atmospheric transmission statistics information