Acronym soup

MPL-NET, REALM, GLAS, CALIPSO

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University of Maryland,
Baltimore County
The Micro-pulse Lidar Network (MPLNET)

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Co-I’s: James Spinhirne, Si-Chee Tsay, Brent Holben

Staff: James Campbell, Timothy Berkoff

MPLNET website: http://mplnet.gsfc.nasa.gov
The Micro-pulse Lidar Network: (MPLNET)

Mission: Long-term, world-wide observations of aerosol and cloud vertical structure using common instrument/data processing

Funding: NASA Earth Observing System & Radiation Sciences Program

Activities:
- co-locate sites with AERONET sunphotometers, and if possible BSRN radiometers
- partner with other independent research groups interested in MPL measurements (federated network)
- participate in field experiments and research cruises
- work with aerosol modelers to study aerosol transport processes


MPLNET website: http://mplnet.gsfc.nasa.gov
Real-time MPLNET Data Products:

Level 1.0 - lidar signal

Level 1.5a - extinction profiles correlated with AERONET data

- uncertainties are calculated for all data products
- MPLNET uses co-located AERONET data for processing
- MPLNET and AERONET results are correlated in 1 data file
The Regional East Atmospheric Lidar Mesonet: REALM

http://alg.umbc.edu/REALM

<table>
<thead>
<tr>
<th>Location</th>
<th>PI</th>
<th>Type(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egbert, ON</td>
<td>K.I. Strawbridge</td>
<td>Scanning elastic</td>
</tr>
<tr>
<td>Durham, NH</td>
<td>I. Dors</td>
<td>Winds</td>
</tr>
<tr>
<td>Halifax, NS</td>
<td>T. Duck</td>
<td>Elastic, Raman</td>
</tr>
<tr>
<td>New York, NY</td>
<td>S. Ahmed</td>
<td>Elastic, DIAL</td>
</tr>
<tr>
<td>State College, PA</td>
<td>C.R. Philbrick</td>
<td>Raman, DIAL</td>
</tr>
<tr>
<td>Baltimore, MD</td>
<td>R.M. Hoff</td>
<td>Elastic, Raman</td>
</tr>
<tr>
<td>Greenbelt, MD</td>
<td>D.N. Whiteman</td>
<td>Raman</td>
</tr>
<tr>
<td>Greenbelt, MD</td>
<td>D. Venables</td>
<td>Raman</td>
</tr>
<tr>
<td>Hampton, VA</td>
<td>M.P. McCormick</td>
<td>Elastic</td>
</tr>
<tr>
<td>Huntsville, AL</td>
<td>M. Newchurch</td>
<td>DIAL</td>
</tr>
<tr>
<td>Atlanta, GA</td>
<td>G. Gimmestad</td>
<td>DIAL</td>
</tr>
</tbody>
</table>
Monitoring the Megacity
June 2, 2003  ELF Lidar

Terra MODIS 1530 UT

0654-0843 UTC

0.5º x 0.5º grid

ABOVE
ELF, Chesapeake Lighthouse, VA

1334-1929 UTC
Optical Depth from MODIS/AERONET

MOD04 Aerosol OD
15:30 UT June 2

AOT, Cove Site = 0.394
@ 500 nm
Colorco trajectories, GSFC.

Initial time: May 19, 2003 1800 UTC
Forward trajectories +/- 2° of GSFC Site between June 1 - 3, 2003 between 700 - 400 hPa

Modis
Firecounts
Target Site
Days (approx)
to reach target
300 hPa n=(93)
500 hPa n=(52)
700 hPa n=(61)
Judd Welton  
NASA Goddard Space Flight Center  
Laboratory for Atmospheres

GLAS Atmospheric Science Team:  
James D. Spinhirne, Stephen P. Palm,  
Dennis Hlavka, William Hart, Matthew McGill
Example of Initial GLAS Data (1064 nm) March 3, 2003 Dust from West Africa

GLAS signals from ICESat:
04:40 UTC
MODIS images from Terra and Aqua:
12:40 and 14:00 UTC
(MODIS rapid response website - rapidfire.sci.gsfc.nasa.gov)

Preliminary outcome from initial dataset:
GLAS 1064 nm channel is detecting water & ice clouds, and moderate to high concentration aerosol plumes
GLAS was not within MODIS swath during Feb/Mar 03, but despite time difference of several hours, comparisons with dust plume images are not bad
Geoscience Laser Altimeter System
Global Lidar Measurements of Clouds and Aerosol in the Atmosphere

Atmospheric (Asian) Brown Cloud Over Indian Ocean
Middle East Dust Over Iran
Multi-level Clouds Over Russia

J. Spinhirne /GSFC January 2004
GLOBAL ORBITAL LIDAR OBSERVATIONS OF CLOUD AND AEROSOL VERTICAL DISTRIBUTION

Geoscience Laser Altimeter System

J. Spinhirne /GSFC January 2004
SPACE LIDAR OBSERVATION OF THE DISTRIBUTION OF AEROSOL
New Input for Models

GLAS View of Saharan Dust Layer

532 nm

Asian Dust and Pollution

J. Spinhirne /GSFC  January 2004
Data Access

E.J. Welton, NASA Goddard Space Flight Center, Judd.Welton@nasa.gov, 11/18/03

GLAS Atmospheric Science Team Website: glo.gsfc.nasa.gov

* Realtime images available within ~8 hours of observation
Update on Names

As of 11/01, PICASSO-CENA, ESSP3, ESSP3-CENA, P-C, ... is:

The **CALIPSO** Mission
( **C**loud- **A**erosol **L**idar and **I**nfrared **P**athfinder **S**atellite **O**bservations)

D. M. Winker, LaRC/NASA, PI

And,

the CALIPSO lidar now has a name:

**CALIOP**

( **C**loud- **A**erosol **L**idar with **O**rthogonal **P**olarization)

(rhymes with “I - O - P”)
Mission Concept

Coincident Observations from CALIPSO, CloudSat, and EOS-PM address the role of clouds and aerosols in the Earth Radiation Budget
Implementation

- One spacecraft with 3 science instruments:
  - 3 channel lidar
  - IR imager
  - wide-field camera
- Launch in March 29, 2005
- 3-year mission
- Fly in formation with EOS-PM in polar orbit
## Measurement Capabilities

<table>
<thead>
<tr>
<th>Data Product</th>
<th>Measurement Capabilities and Uncertainties</th>
<th>Representative Spatial Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Night Horizontal x Vertical</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20 km x 120 m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 km x 60 m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 km x 60 m</td>
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<tr>
<td></td>
<td></td>
<td>333 m x 30 m</td>
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<tr>
<td></td>
<td></td>
<td>8 km horizontal</td>
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<tr>
<td></td>
<td></td>
<td>3.5 km x 120 m</td>
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<tr>
<td></td>
<td></td>
<td>16 km x 60 m or 4 km x 240 m</td>
</tr>
<tr>
<td>Aerosol layer top and base height</td>
<td>$\beta_{\text{min}} = 2.5 \times 10^{-4}$ km$^{-1}$ sr$^{-1}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\left( \tau = 0.005 \text{ for a 500 m thick layer} \right)$</td>
<td></td>
</tr>
<tr>
<td>Thin cloud top and base height</td>
<td>$\beta_{\text{min}} = 1 \times 10^{-3}$ km$^{-1}$ sr$^{-1}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\left( \tau = 0.005 \text{ for a 250 m thick layer} \right)$</td>
<td></td>
</tr>
<tr>
<td>Thick cloud base height</td>
<td>Layer $\tau &lt; 5$</td>
<td></td>
</tr>
<tr>
<td>PBL cloud structure</td>
<td>$\beta_{\text{min}} = 1.6 \times 10^{-2}$ km$^{-1}$ sr$^{-1}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\left( \text{total error} \right)$</td>
<td></td>
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<tr>
<td></td>
<td>$\frac{\partial \tau}{\tau} \leq 40%$ (includes 30% error in $S$)</td>
<td></td>
</tr>
<tr>
<td>Aerosol $\tau$</td>
<td>$\frac{\partial \sigma}{\sigma} \leq 30%$ (random error only)</td>
<td></td>
</tr>
<tr>
<td>(Resolutions for case of $\tau = 0.1$)</td>
<td></td>
<td></td>
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<tr>
<td>Circrus $\tau$, $\sigma$ (z)</td>
<td>Within a factor of 2 for $\tau &lt; 5$</td>
<td></td>
</tr>
<tr>
<td>Ice/water phase</td>
<td>Layer by layer</td>
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</tbody>
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Backups
MPLNET: Instruments

- **Micro-pulse Lidar Systems (MPL)**
  - compact & semi-autonomous
  - 523 nm wavelength
  - PRF 2500 Hz
  - eye-safe, output energy in µJ
  - small FOV, no multiple scattering

- **Sunphotometer**
  - Sites & Experiments: NASA Aerosol Robotic Network (AERONET) sunphotometers by Cimel
  - Handheld Microtops sunphotometer used on ocean cruises

- **Original MPL Design (Type 1-3)**
  - **Transceiver:**
    - 20cm Cassegrain Telescope on top Laser Head, Detector, Optics below
  - **Scalar Unit:**
    - Data at 30, 75, 150, 300 m vert. res.
  - **Laser Power Supply:**
    - 1 W Nd:YLF Laser Diode (Doubled to 523nm on Head)
  - **Laptop Computer:**
    - Data Acquisition, Storage (1 min res)

- **New MPL Design (Type 4)**
  - **Basic System Specifications:**
    - Same optical design, and wavelength with similar output energy. Temporal/Spatial resolutions the same. Still eye-safe & autonomous
  - **Improvements:**
    - More rugged design
    - Improved laser supply creates longer lifetime and control of laser via computer
    - Multi-channel data system
    - Fiber coupled detectors

* First three commercially produced Type 4 MPL systems are now under contract with Sigma Space Corporation.
Aerosol Properties from TOMS observations

California Fires

October 27-2003
TOMS – Aeronet comparison during SAFARI2000

Sept.5 2000

Optical depth (380 nm)  
Single scattering albedo  
Absorption optical depth

82% of points are within expected accuracy limits (0.1 or 30%)

63% within +/- 0.03
87% within +/- 0.05
Aerosol over clouds
OD 0.6-0.8

October 31, 2003
Bay of Fundy region
TERRA MODIS RGB

TERRA MODIS Optical Depth
Correlations between AOD and PM2.5 (hourly)

Engel-Cox et al., 2004
BIRMINGHAM
Site 010732003

Correlation = 0.63*
Correlation = 0.62*

PM 2.5 (µg/m³)

Aerosol Optical Depth

Mass Concentration Land (1.0E-6g/cm²)

Date

*Correlation estimates based on data for this site only.