Ground-based Network and Supersite Observations to Complement and Enrich EOS/Terra Research: The past 10 years and beyond

Si-Chee Tsay, Brent N. Holben, and E. Judd Welton

Sciences and Exploration Directorate, NASA Goddard Space Flight Center,
Greenbelt, MD USA (si-chee.tsay@nasa.gov)

Since 1997 NASA has been successfully launching a series of satellites – the Earth Observing System (and Terra as its flagship) – to intensively study, and gain a better understanding of, the Earth as an integrated system. Space-borne remote sensing observations, however, are often plagued by contamination of surface signatures. Thus, ground-based in-situ and remote-sensing measurements, where signals come directly from atmospheric constituents, the sun, and/or the Earth-atmosphere interactions, provide additional information content for comparisons that confirm quantitatively the usefulness of the integrated surface, aircraft, and satellite datasets. Through numerous participations, particularly but not limited to the EOS remote-sensing/retrieval and validation projects over the years, NASA/GSFC has developed and continuously refined two ground-based networks and one mobile observatory that proved to be vital in providing high temporal measurements, which complement and enrich the satellite observations. These are: the **AERONET** (**AE**rosol **RO**botic **NET**work, http://aeronet.gsfc.nasa.gov/), a federation of ground-based globally distributed network of spectral sun-sky photometers; the **MPLNET** (**M**icro-**P**ulse **L**idar **NET**work, http://mplnet.gsfc.nasa.gov/), a similarly organized network of micro-pulse lidar systems measuring aerosol and cloud vertical structure continuously; and the **SMART–COMMIT** (**S**urface-sensing **M**easurements for **A**tmospheric **R**adiative **T**ransfer – **C**hemical, **O**ptical & **M**icrophysical **M**easurements of **I**n-situ **T**roposphere, http://smart-commit.gsfc.nasa.gov/) mobile observatory, a suite of spectral radiometers and in-situ probes acquiring supersite measurements.

Most MPLNET sites are collocated with those of AERONET, and both networks always support the deployments of SMART-COMMIT worldwide. These data products follow the data structure of EOS conventions: Level-0, instrument archived raw data; Level-1 (or 1.5), real-time data with no (or limited) quality assurance; Level-2, not real time but quality assured; and Level-3, reprocessed/derived data. All data files from Level-1 and above are (or can be) in NetCDF format and are publicly accessible through respective websites, except for those of SMART-COMMIT due to data volume and variety (plots openly available but data by request). AERONET provides a long-term, continuous and globally distributed observations of aerosol optical, mircrophysical and radiative properties for aerosol research and characterization, validation of satellite retrievals, and synergism with other databases. The MPLNET measurements further extend parameters to include the vertically resolved aerosol and cloud properties, such as, aerosol and cloud heights, planetary boundary-layer structure and evolution, and profiles of extinction and backscatter. When running all at supersite mode, advances for better quantifying the radiative energetics in the surface-atmosphere system and better understanding of the atmospheric processes can be made.

New and improved algorithms are continuously being developed for current and future satellite missions that will place a greater demand on the accuracy and fidelity of the ground-based measurements for validation, multi-dataset synergism and long-term climate research. Up until this time, satellite validation studies using sun-sky scanning spectral photometry measurements (e.g., AERONET) have relied on point observations extrapolated to a two-dimensional domain to compare to the satellite retrievals. Collaborating with the Chinese National Space Administration, NASA/GSFC is leading an experimental plan, the *Distributed Regional Aerosol Gridded Observation Networks* (*DRAGON*), to implement a meso-scale gridded (40 x 90 km^2, with 10 km spacing) network of sun/sky photometers, encompassing urban, agricultural and mountain landscape over the Washington DC and Beijing metropolitan area for validation of satellite aerosol products and comparison/validation of ground-based aerosol retrievals. In addition, an inclusion of handful Leosphere EZ-Lidars at UV-wavelength is underway to enhance the MPLNET profiling of aerosol and cloud properties. A 94-GHz scanning cloud radar is also currently under construction for the **ACHIEVE** (**A**erosol-**C**loud-**H**umidity **I**nteractions **E**xploring & **V**alidating **E**nterprise) mobile observatory, scheduled for the first deployment in Spring 2011. SMART-COMMIT-ACHIEVE is planning to provide ground-based test-bed data of the aerosol-cloud-water cycle interactions with high temporal and spectral resolutions. In this talk, we will present NASA/GSFC ground-based facilities (Figure 1 for an overview), serving as network or supersite observations, which have been playing key roles in major international research projects over diverse aerosol regimes to complement and enrich the scientific research of Terra, in particular, and EOS, in general.

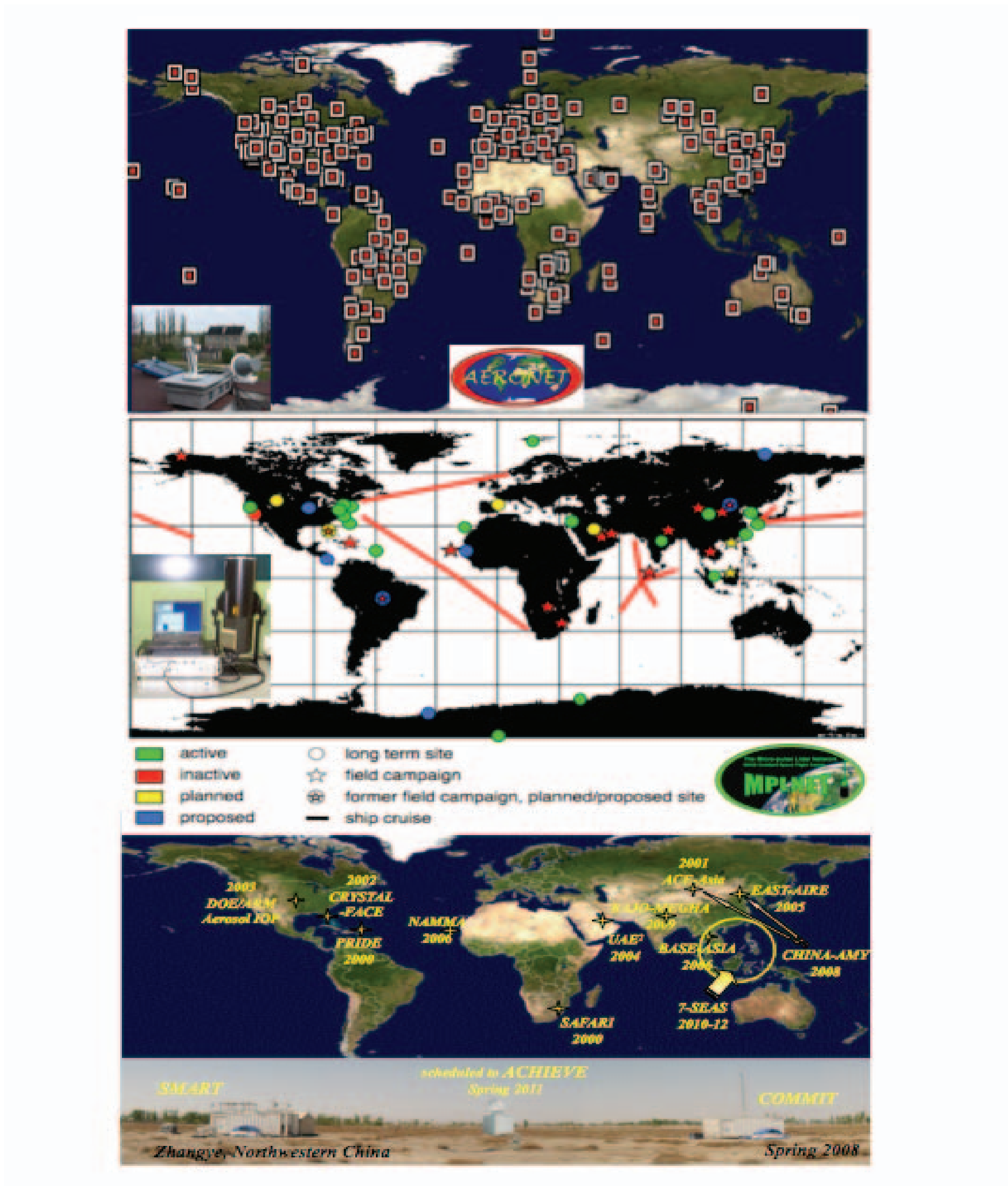

Figure 1. AERONET and MPLNET global distributions and SMART-COMMIT field deployments during past decade

References:

AERONET: **AE**rosol **RO**botic **NET**work, http://aeronet.gsfc.nasa.gov/

MPLNET: **M**icro-**P**ulse **L**idar **NET**work, http://mplnet.gsfc.nasa.gov/)

SMART–COMMIT: **S**urface-sensing **M**easurements for **A**tmospheric **R**adiative **T**ransfer **–** **C**hemical, **O**ptical & **M**icrophysical **M**easurements of **I**n-situ **T**roposphere, http://smart-commit.gsfc.nasa.gov/