Radiation, Aerosol Joint Observation-Modeling Exploration over Glaciers in Himalayan Asia (RAJO-MEGHA)

PI: Si-Chee Tsay, NASA Goddard Space Flight Center, Greenbelt, MD 20771

Abstract

The snowpack and glaciers in High Mountain Asia (HMA), the so-called *Third Pole* or *Water Tower of Asia*, feed major Asian rivers thus serve as lifelines to nearly 2-billion people. Hence, the rapid retreat of the HMA snowpack/glaciers poses an imminent danger to the water supply and environmental hazards not only to the regional inhabitants, but also to the global ecosystem through feedback mechanisms. Comprehensive regional-to-global assimilation models (e.g., GEOS-5), advancing in lockstep with the advent of satellite observations (e.g., MODIS-/CERES-like sensors) and complementary surface/suborbital measurements (e.g., AERONET/EVS), are playing an ever-increasing role in developing mitigation strategies. However, the complex characteristics of HMA, such as its rugged terrain, atmospheric inhomogeneity, snow susceptibility, and ground-truth accessibility, introduce difficulties for the aforementioned research tools to retrieve/assess radiative effects on snow/ice melting with a high degree of fidelity. To quantify radiative forcing, better understanding of the transport/evolution of light-absorbing aerosols (e.g., dust, soot) aloft, the surface solar/terrestrial irradiance budget, and snow reflectivity/absorptivity with/without impurities is essential.

The objectives of this RAJO-MEGHA (*Sanskrit for Dust-Cloud*) project are to exploit the latest new developments of satellite, ground-based network and modeling capabilities to help understand and further predict these changes over the HMA. Specifically, the tasks are:

1) To provide near real-time MODIS satellite products during the pre-monsoon season at 1 km resolution over the HMA by employing the state-of-the-art *enhanced-Deep Blue* algorithm to retrieve aerosol optical depth (AOD), snow grain size and impurity, and the radiative forcing estimates due to the presence of light-absorbing aerosols. The AOD retrieved over snow/ice surfaces will be validated against AERONET measurements taken near the glaciers, while the satellite derived surface radiative effects will be compared with the ground-based irradiance measurements. We will also work closely with regional research groups in Nepal to validate the retrievals of snow grain size and snow impurity using snow samples taken in the field;
2) To populate a solar-powered network of AERONET sun/sky spectroradiometers, in-house developed *e-Pandora* spectrometers, and the SMARTLabs thermal-dome-effect-corrected SEBRA at targeted glaciers (e.g., Langtang) and aerosol inflow sites (e.g., current regional research sites of ICIMOD, such as Lumbini). Measurements from the first two ground-based sensors will provide ground-truth information of aerosol, cirrus and surface bidirectional reflectance properties while the third radiometer sets will provide for accurate irradiance fields available at surface; and
3) To assess GEOS-5 data assimilation products including surface irradiance estimates (12 km resolution) with a land-surface-model enabled, as well as CERES retrieved single-scanner-footprint (20 km) product, based on ground-truth measurements.