Opportunity Title: Use of Airborne BRDF Products to Improve Passive Satellite Retrievals
Opportunity Reference Code: 0087-NPP-NOV23-ARC-EarthSci

Organization National Aeronautics and Space Administration (NASA)

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Application Deadline 11/1/2023 6:00:59 PM Eastern Time Zone

Description A key problem in aerosol retrieval from remote-sensing observations is to distinguish between surface and atmospheric contributions due to the close coupling of aerosol optical depth (AOD) and surface bidirectional reflectance-distribution function (BRDF) in the satellite signal. The aerosol contribution is small compared with the surface contribution, particularly over bright desert surfaces, snow and urban areas. This study will analyze Cloud Absorption Radiometer (CAR) data from a number of airborne campaigns in Atmospheric Composition to investigate the impact of BRDF on AOD retrieval especially over heterogeneous scenes observed by satellites.

By systematically characterizing mixed pixels at multiple spatial scales, this effort will not only allow the algorithm development and calibration/validation (cal/val) communities to improve retrieval of reflectance-based surface properties (e.g., spectral albedo), but will also improve the accuracies of several upstream products (e.g. AOD and cloud mask/detection over land). The effort will also lead to improvements in surface anisotropy models, and to the a priori database information used in global land science algorithms to characterize surface types and to model energy balance at the Earth's surface.

Specific objectives include:

(i) Understand how to scale up BRDF from the airborne scale (from 6-100 m) from the NASA CAR to spaceborne scales e.g. from MODIS.

(ii) Understand the importance of uncertainty and traceability in going from CAR level-1b sensor radiance to TOA reflectance and then to level-2 gridded BOA (Bottom of the Atmosphere)/TOC (Top of the Canopy) BRDF.

(iii) Understand how best to exploit optimal estimation to deliver better estimates of uncertainties in AOD retrieval over heterogenous landscapes.

The CAR BRDF data are very unique and has potential to improve aerosol retrieval from new generation of sensors in geostationary orbit, such Advanced Baseline Imagers (ABI) on GOES-16 and GOES-17. But there is no currently available GIS software that has the ability to re-project footprints of the CAR measurements to allow scaling to satellites resolutions. So, a new method will be developed for this purpose and use it to analyze the CAR BRDF data sets from past airborne campaigns. Using a digital terrain model (DTM) or a digital surface model (DSM), we will first create from the raw CAR data (level-1C) a vector file in such a way that each CAR measurement pixel will be represented by geocoded polygons of its re-projected footprint with attributes. These attributes include values of

measured radiances, plus auxiliary information (time, diameters, geometry angles, flight angles, and some basic statistics (e.g. mean) and information of overlapped surface (elevation, slope, aspect, land cover). The vector file will then be spatially indexed with all the attributes. This will help creation of other products on-demand, notably geocoded raster (with GeoTIFF or NetCDF format) verifying end-user specific requirements. The gridded product will then be used to explore issues related to the use of albedo ratios, as compared to ratios of BRDF or actual surface reflectance in AOD retrieval from MODIS and potentially the geostationally ABIs, and compare retrievals to collocated ground-based measurements made by AERONET sun photometers. This effort will lead to better understanding and mitigation of uncertainty in satellite estimates of AOD.

Location:
Ames Research Center
Moffet Field, California

Field of Science: Earth Science

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Applications with citizens from Designated Countries will not be accepted at this time, unless they are Legal Permanent Residents of the United States. A complete list of Designated Countries can be found at: https://www.nasa.gov/oiir/export-control.

Eligibility is currently open to:

- U.S. Citizens;
- U.S. Lawful Permanent Residents (LPR);
- Foreign Nationals eligible for an Exchange Visitor J-1 visa status; and,
- Applicants for LPR, asylees, or refugees in the U.S. at the time of application with 1) a valid EAD card and 2) I-485 or I-589 forms in pending status

Eligibility Requirements

- **Degree:** Doctoral Degree.