A Unique Airborne Multi-angular Dataset for Calibration and Validation of Earth Satellite Products

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https://car.gsfc.nasa.gov/
Overview of the CAR Instrument

Sensor Characteristics:
- 14 spectral bands (0.34 to 2.29 μm).
- IFOV: 1° (17.5 mrad).
- Scan 190° from zenith to nadir.
- Scan rate: 100 scans per minute (1.67 Hz).
- Platform: NASA P-3B.

https://car.gsfc.nasa.gov/
BRDF of Different Natural Surfaces

- Seven types:
  - water
  - vegetation
  - clouds
  - snow/sea ice,
  - non-vegetation
  - wetlands
  - smoke (biomass burning and fuel)

See Gatebe et al., 2016: Remote Sens. Env., 179, 131–148
Multi-spectral Surface Bidirectional Reflectance Factor (BRF) for:
snow & sea ice, ocean, clouds, smoke plumes, salt pan (i.e.,
calibration sites), vegetation (grass, savanna, forests, etc), urban.

Ocean BRF: 472 nm

Chesapeake LH; August 02, 2001

See Gatebe et al., 2005: JAS, 62, 1072–1092
Ship wakes produce ocean bubbles; enhance ocean reflectance >100%.

Global radiative forcing of ship wakes \(-0.14 \pm 50\%\) mWm\(^{-2}\).


Highlight: Ship Wake Impact on Ocean Brightness & Climate
Best ever in-situ measurements for accuracy analysis of analytical snow BRDF models.

- Developed, tested, and evaluated new models of macroscopic surface roughness that adjust the plane-parallel radiative transfer solution to experimental snow BRF.

Summary

◊ Unique airborne measurements:
  - Full Angular coverage.
  - Different scales and scene types.
  - High SNR even over dark scenes.

- Where is the data?
  - CAR data is widely distributed through NASA Goddard Earth Science Data Information and Services Center.
  - [https://disc.gsfc.nasa.gov/datasets?keywords=CAR](https://disc.gsfc.nasa.gov/datasets?keywords=CAR)
  - The end product -- calibrated radiances in NetCDF (network Common Data Format) -- is a self-contained, self-describing, and information-rich data set.

- Applications: atmosphere, land, ocean, cryosphere, etc.