

Validation of CRYSTAL-FACE satellite-derived cloud properties with aircraft measurements

David P. Duda
Hampton University
Hampton, VA USA

Patrick Minnis
Atmospheric Sciences
NASA Langley Research Center
Hampton, VA USA

David Doelling
Michele Nordeen
Mandy Khaiyer
Analytical Services and Materials, Inc.
Hampton, VA USA

Peter Pilewskie
NASA Ames Research Center
Francisco P. J. Valero
Scripps Institution of Oceanography, UCSD

R. Paul Lawson
SPEC, Inc.
K. Frank Evans
University of Colorado

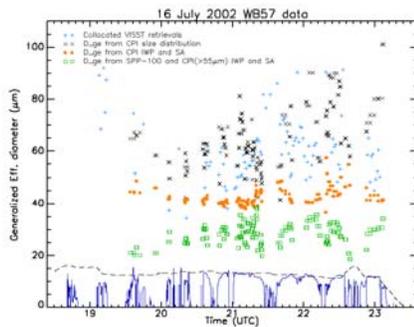
INTRODUCTION

- We compare satellite-derived cirrus cloud properties with aircraft-based measurements from the CRYSTAL-FACE campaign. Data from the Geostationary Operational Environmental Satellite (GOES-8) imager are used in the remote sensing retrievals.

METHOD

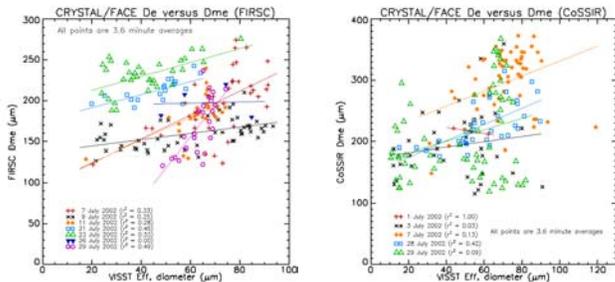
- The VISST (Visible Infrared Solar-Infrared Split-Window Technique) was used to derive cloud height, optical depth, phase, effective particle size and water path for each pixel from several GOES daytime scenes (the solar zenith angle must be $\leq 78^\circ$). This algorithm is described in detail by Minnis et al. (1995).

CPI/SPP-100 PARTICLE SIZE



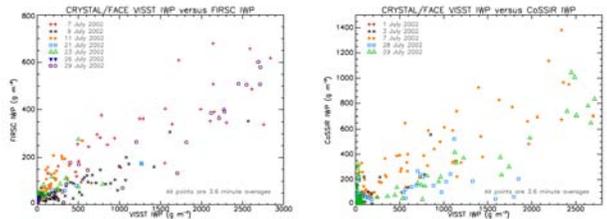
Cloud particle sizes were computed from collocated CPI and SPP-100 data using the definitions of generalized effective diameter (D_{ge}) defined in Fu (1996). The VISST retrievals match the D_{ge} based on the CPI size distribution better than the D_{ge} based on the ice water content/area ratios measured by the probes.

FIRSC and CoSSIR ICE PARTICLE SIZE



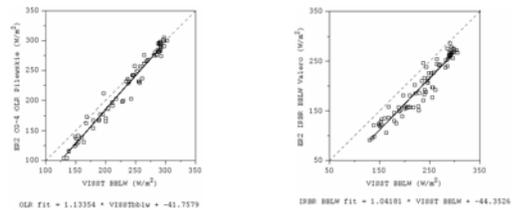
The relationships between the median mass equivalent sphere diameters derived from FIRSC and CoSSIR measurements and the VISST particle size retrievals vary from flight to flight, and within each flight. The differences are likely the result of differences in the sensitivities of the retrievals to cloud particles throughout the depth of the clouds, and in the effects of particle shape on the retrievals (especially on the VISST retrievals).

FIRSC and CoSSIR ICE WATER PATH

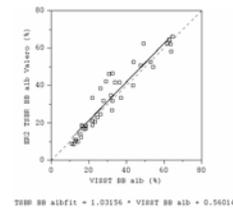


Collocated VISST retrievals of ice water path are correlated with measurements of ice water path from the FIRSC and CoSSIR instruments. However, the FIRSC IWPs are half as large as the CoSSIR IWPs for equivalent satellite-derived values.

SOLAR AND LONGWAVE BROADBAND FLUXES



GOES upward longwave flux estimates are compared to collocated aircraft measurements (10-min averages centered on half-hourly GOES data).



Solar broadband TOA fluxes estimated from GOES narrowband observations are well-correlated with collocated ER-2 measurements.

FUTURE WORK

- Continue cloud property comparisons with instruments from other aircraft (e.g. particle size probes on Citation aircraft).
- Improve aircraft collocations.
- Determine the effects of cloud microphysical properties on particle size and ice water path comparisons.
- New GOES narrow-to-broadband conversions using CERES data.
- Include atmospheric corrections and aircraft pitch/roll adjustments in longwave and shortwave flux comparisons.

REFERENCES

Fu, Q., 1996: An accurate parameterization of the solar radiative properties of cirrus clouds for climate models. *J. Climate*, 9, 2058-2082.

Minnis, P., and Coauthors, 1995a: Cloud optical property retrieval (subsystem 4.3). Cloud analyses and radiances inversions (subsystem 4), Vol. III, Clouds and the Earth's Radiant Energy System (CERES) algorithm theoretical basis document, NASA Ref. Publ. 1376, Vol. 3, 135-176. Available at <http://techreports.larc.nasa.gov/ltrs/95/NASA-95rp-1376vol3.refer.html>.