4STAR: Spectrometer for Sky-Scanning, Sun-Tracking Atmospheric Research

Results from TCAP Summer 2012 Flights

A multi-agency collaboration involving PNNL, NASA Ames, NASA GSFC, and more!

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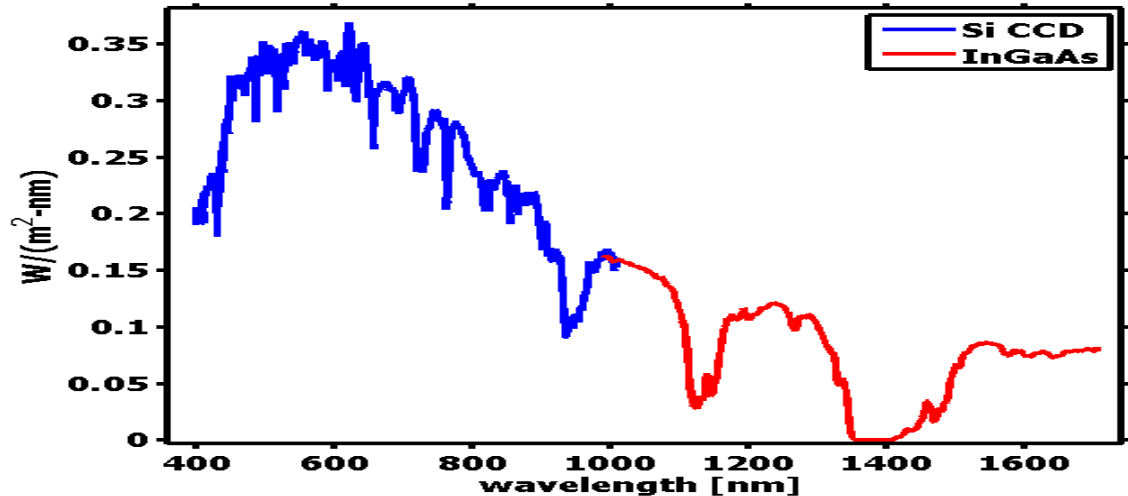

AERONET-like capability

Ground-based direct beam + sky scanning yields column-integrated properties:
- AOD
- Size distributions
- Single-scattering albedo
- Asymmetry parameter
- Aerosol shape / sphericity
- Cloud OD, cloud properties

AATS-like capability:

AOD at 13 wavelengths & H_2O

horizontally and vertically resolved through airborne design and deployment

Airborne hyperspectral measurements of direct sunlight and angularly resolved sky radiance.

Field campaign overview

▶ 4STAR operated successfully on ALL flights, TCAP I & II

▶ Acquired direct sun measurements and AODs in all TCAP I flights, most TCAP II flights and from the ground.

▶ Favorable sky scans on 4 days in TCAP I, even more during TCAP II,

▶ Numerous flight legs operated in zenith cloud mode.

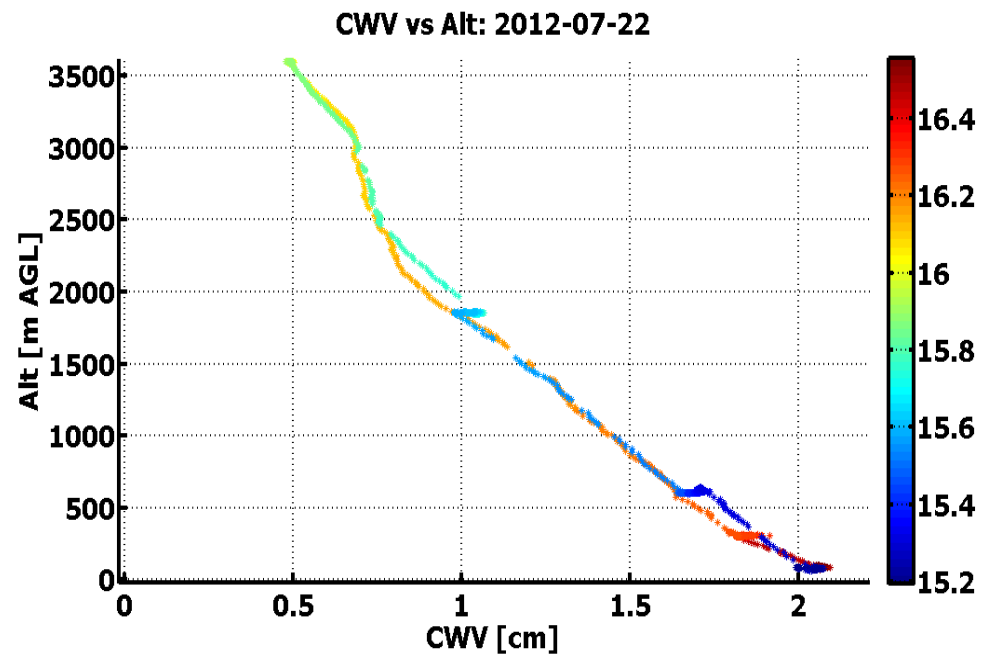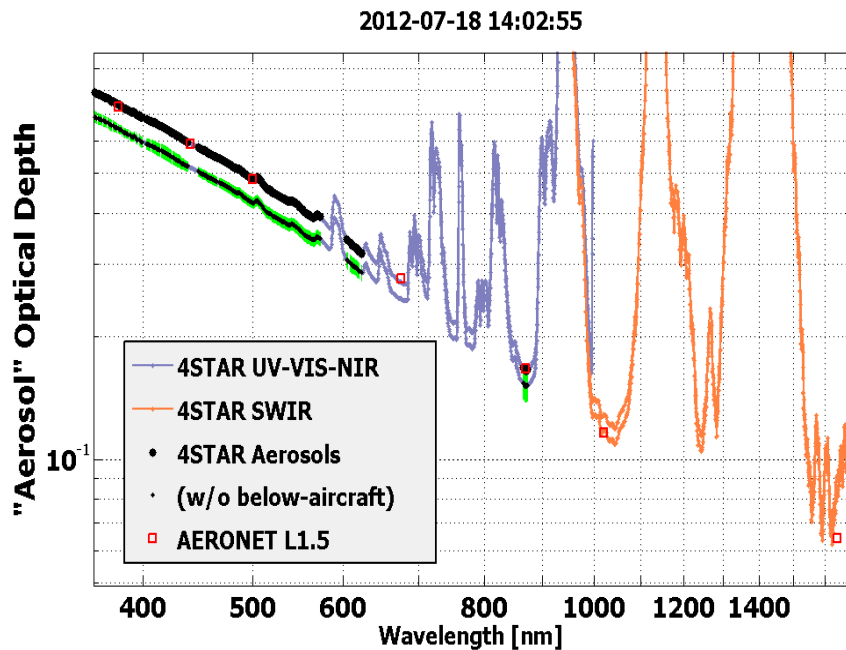▶ Yohei Shinozuka leading a paper comparing 4STAR, HSRL, and G1 scattering+absorption measurements from TCAP I.

4STAR on ground, n = 23

AERONET at the Airport

λ (nm)	380	440	500	675	870	1020	1640
RMSΔ	0.010	0.012	0.012	0.010	0.012	0.014	0.015

2012-07-18 14:02:55

CWV vs Alt: 2012-07-22

Conclusions:

▶ **4STAR had an outstanding first field campaign!**

▶ Comparisons of AOD with surface and in-situ aerosol optical properties look strong.

▶ Water and trace gas retrievals show good potential.

▶ First-ever hyperspectral airborne sky scans collected. Initial AIP retrievals are mostly encouraging but much validation work remains.

▶ Zenith-mode cloud radiances collected with concurrent upwelling at 6 MFR wavelengths from 415-1640 nm.

▶ What is the down-side?