Capability Review – Shortwave Spectral Instruments

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Background

- ARM Triennial review outcomes
  - Develop plan to review ARM capabilities on a routine basis
  - Over the last year we have reviewed SACRs and spectral SW instruments
- Recent workshop reports and BAMS article identify hyperspectral measurements have significant potential to provide constraints on:
  - Cloud microphysical processes
  - Aerosol-cloud interactions
  - Broken clouds
  - Cloud thermodynamic phase and mixed-phase clouds
  - 3D cloud properties when combined with scanning radar

ARM Hyperspectral Instruments

Instrument	Data Availability	Measurement	Wavelength (nm)	Primary Derived Parameters
RSS, RSS105	5/2003 – 5/2007 **Retired**	Direct, diffuse, total hemisph.	Si (360–1,070)	Radiative feedback using spectral signature of atmospheric constituents, 3D-radiative effects
SWS	5/2006 – 5/2015 4/2017-4/2021	Narrow FOV radiance	Si (350–1,000), InGaAs (970–2,200)	Aerosol and cloud optical depth, particle size, water path
SASHe	3/2011 – present	Direct, diffuse, total hemisph.	Si (350–1,000), InGaAs (970–1700)	Radiative feedback using spectral signature of atmospheric constituents, 3D-radiative effects
SASZe	3/2011 – present	Narrow FOV radiance	Si (350–1,000), InGaAs (970–1700)	COD, particle size, water path, cloud phase

Review Criteria – Scientific Impact and User Statistics

Scientific Impact

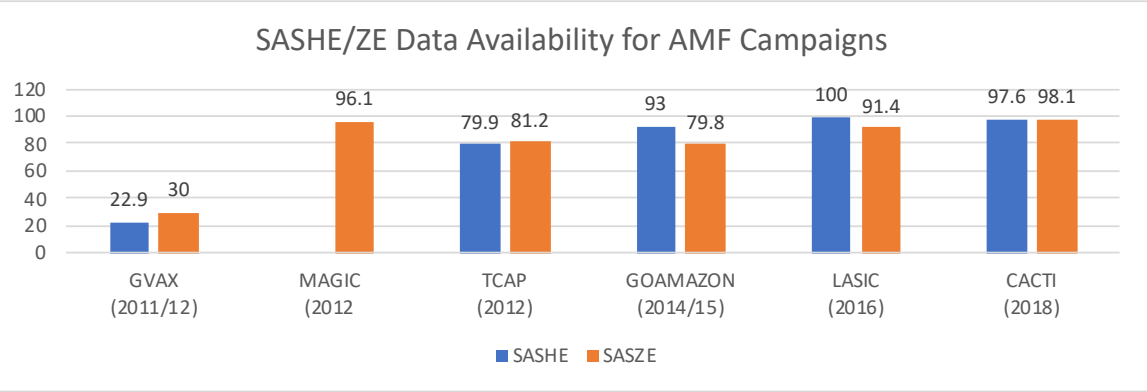
- Publications/Citations
  - SWS: 4/71
  - SASHe: 0/0
  - SASZe: 2/7
- Topics:
  - Radiative signatures and cloud properties in the cloud-to-clear transition zone
  - Cloud optical depth retrieval evaluation

User Statistics 2011 - 2021

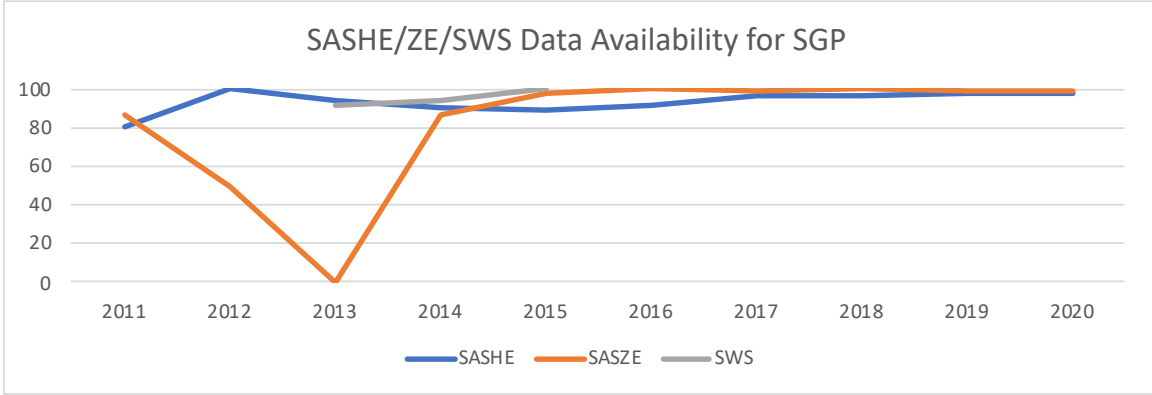
- Unique Users
  - SASHe – 32
  - SASZe – 43
  - SWS – 15

Review Criteria – Data Availability and Data Quality

Data Availability - AMFs



Data Availability - SGP



Data Quality

Site	Instrument/level	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
SGP	SWS b1	1			2					3							
SGP	SASZE VIS a1											4					
TCAP	SASZE VIS a1																
GVAX	SASZE VIS a0																
GOAMAZON	SASZE VIS a1									5							
MAGIC	SASZE VIS a1																
CACTI	SASZE VIS a1																
LASIC	SASZE VIS a1											6					
SGP	SASHE VIS b1																
TCAP	SASHE VIS b1																
GOAMAZON	SASHE VIS b1																
CACTI	SASHE VIS b1																
LASIC	SASHE VIS b1																

Review Criteria – Maintenance and Costs

- Maintenance
  - SASHe – Significant more maintenance issues than SASZe and SWS or MFRSR
  - Mainly due to issues with the shadowband
- Costs - reasonable

Challenges and Recommendations

Challenges

- Maintaining SWS and SASZe calibrations
- Expert users only – no retrieved quantities available for non-experts
- Software becoming difficult to support
- SWS spectrometers no longer supported
- SASHe has persistent banding issues and requires a redesign

Recommendations

- Increase usability of archived measurements
  - Thorough quality assessment
  - Flag periods of saturation and misalignment of shadowband
  - Apply PI algorithms to archive retrieved cloud properties
- Discontinue support of SWS
- Given the value of SW hyperspectral measurements – explore commercial options