



# **ARM Translator Products for EPCAPE**

**Shaocheng Xie**

**Lawrence Livermore National Laboratory**

# Science Product Development Led by a Team of Scientists



## ARM Translator Group

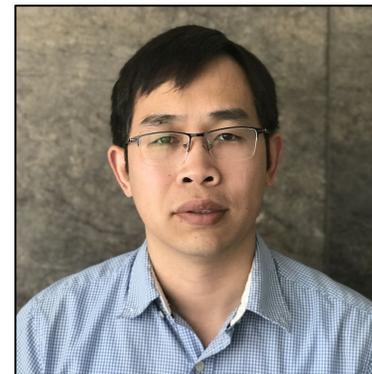
Translators are liaisons between the scientific community and ARM infrastructure staff members, and develop Value-Added Products, or VAPs, from the direct output of ARM instruments or other VAPs.



**Shaocheng Xie**  
Warm Clouds POC  
EPCAPE POC



**John Shilling**  
Aerosol POC  
TRACER POC



**Damao Zhang**  
High-Latitude POC  
SAIL POC



**Scott Collis**  
Convective POC  
AWAKEN POC



**Scott Giangrande**  
Lead Translator  
COMBLE POC



**Krista Gaustad**  
Software  
Development



**Ken Kehoe**  
Data Quality

- **Translators actively engage with the climate community to promote:**
  - i. Improved accessibility
  - ii. Improved documentation and uncertainty estimates for ARM datasets
  - iii. New support for data visualization and analyses
  - iv. New modeling diagnostics or forward-instrument operator tools
  - v. New model-observational hybrid activities
- **Translators prioritize efforts based on input from the communities including the ARM UEC, AMSG, CPMSG, Triennial Review, ASR WGs, ARM field campaign ST.**
  - Provide more timely AMF VAP production and formalizing of AMF VAP request processes in conjunction with ARM infrastructure leads and active AMF campaign Pis
  - Support for new instrumentation and capabilities (e.g., AOS, scanning radar and lidar)
  - Data quality and uncertainty
  - Improvements to product communication and accessibility

# Core ARM Translator VAPs for EPCAPE – An Initial List



EPCAPE Translator Point of Contact: Shaocheng Xie [xie2@lnl.gov](mailto:xie2@lnl.gov)



Image from Russell et al. 2021 – EPCAPE Science Plan

The list includes aerosol and cloud properties as well as the large-scale conditions.

The list could be revised according to feedbacks from the EPCAPE science team.



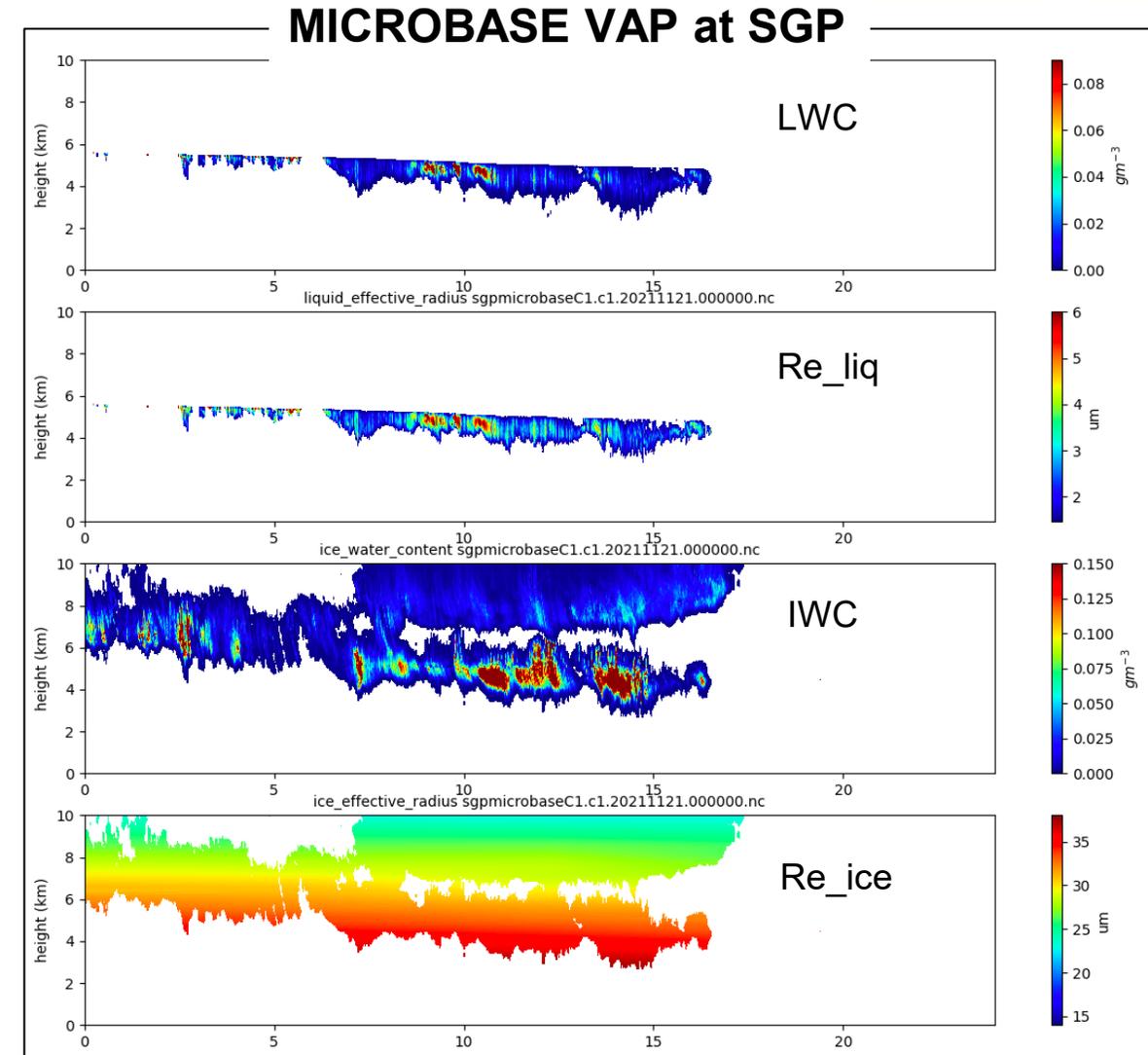
ARM VAP	Translator / Contact	Expected Timetable
AOP/AOD	Shilling	1 week of data collection for AOP, ~1 year for AOD
AERloe	Zhang	6 months of end of campaign
ARMBE	Xie	<1 month when required VAPs available
AERINF	Zhang	1 week of data collection
ARSCL	Giangrande	< 1 month of data collection
INTERPSONDE	Giangrande	< 1 month of data collection
MWRRET	Zhang	1 week of data collection
MICROBASE_PLUS	Giangrande	Upon availability of MWRRET
PBL Height	Zhang	1 week of data collection
MPLCLDMASK	Zhang	1 week of data collection
DLPROF	Zhang	1 week of data collection
QCRAD / RADFLUX	Zhang	1 week of data collection
QCECOR	Xie	1 month of end of campaign
SPHOT COD	Giangrande	6 months of end of campaign
LDQUANTS/VDISQUANTS	Giangrande	<1 week of data collection
SACRGRID	Giangrande	<2 months of data collection
VARANAL	Xie	3-6 months of end of campaign

# Continuous Baseline Microphysical Retrieval (MICROBASE) VAP

ARM

For more VAP information, please contact Meng Wang: [mwang@bnl.gov](mailto:mwang@bnl.gov)

- MICROBASE is available again at SGP, ENA, PVC, ASI, GAN, and other ARM sites in the ARM Archive.
- This VAP provides “baseline” retrievals for:
  - Liquid Water Content (LWC),
  - Ice Water Content (IWC),
  - Effective Size ( $D_e$ ).
- The updated VAP includes additional uncertainty quantification, with additional validation/closure efforts planned for FY23.

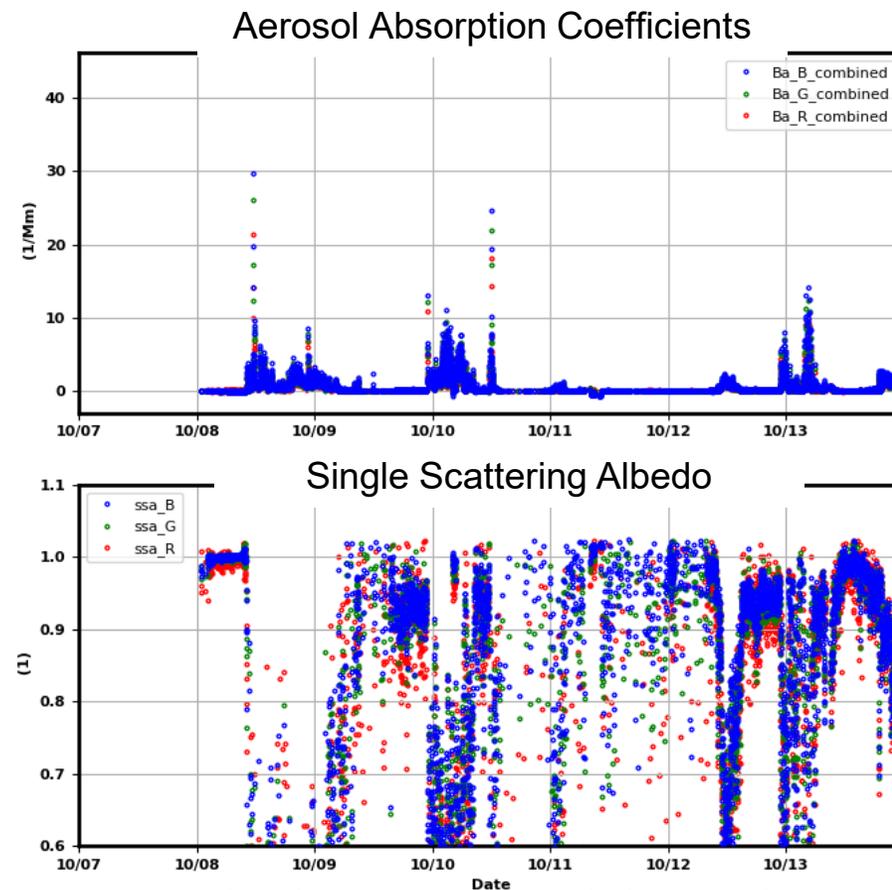


# Aerosol Optical Properties (AOP) VAP: an example for MOSAIC



- ▶ AOP VAP combines PSAP extinction and Nephelometer scattering data at 3 wavelengths to calculate:
  - aerosol absorption coefficients
  - corrected scattering
  - SSA
  - angstrom exponent (absorption and scattering)
- ▶ Data are available for the entire MOSAIC period at 1 or 10 minute frequency.
  - NOTE: 1 minute frequency has mix of 1 and 10  $\mu\text{m}$  impactor states.

## Examples of AOP MOSAIC Data



2 of 7799 Refresh Timeline Data Show Groups Sorted by: Start Date

mosaoppsap1fyynn1hM1.c1  
mosaoppsap1fyynn1mM1.c1

2019 10 08 2019 11 2019 12 2020 01 2020 02 2020 03 2020 04 2020 05 2020 06 2020 07 2020 08 2020 09 2020 10 02

# The Constrained Variational Analysis

(Zhang and Lin 1997)

For more VAP information, please contact Shaocheng Xie xie2@llnl.gov

Constraints

$$\left\{ \begin{aligned} \langle \nabla \cdot \bar{V} \rangle &= -\frac{1}{g} \frac{dp_s}{dt} \\ \frac{\partial \langle q \rangle}{\partial t} + \langle \nabla \cdot \bar{V} q \rangle &= E_s - P_{rec} - \frac{\partial \langle q_l \rangle}{\partial t} \\ \frac{\partial \langle s \rangle}{\partial t} + \langle \nabla \cdot \bar{V} s \rangle &= R_{TOA} - R_{SRF} + LP_{rec} + SH + L \frac{\partial \langle q_l \rangle}{\partial t} \\ \frac{\partial \langle \bar{V} \rangle}{\partial t} + \langle \nabla \cdot \bar{V} \bar{V} \rangle + f \bar{K} \times \langle \bar{V} \rangle + \nabla \langle \varphi \rangle &= \bar{\tau}_s \end{aligned} \right.$$

- Forcing is dynamically and thermodynamically consistent
- More suitable to drive SCM/CRM/LES than the forcing derived with conventional method (Mass-conserved only) and NWP analyses (Ghan et al. 2001, Xie et al. 2004)

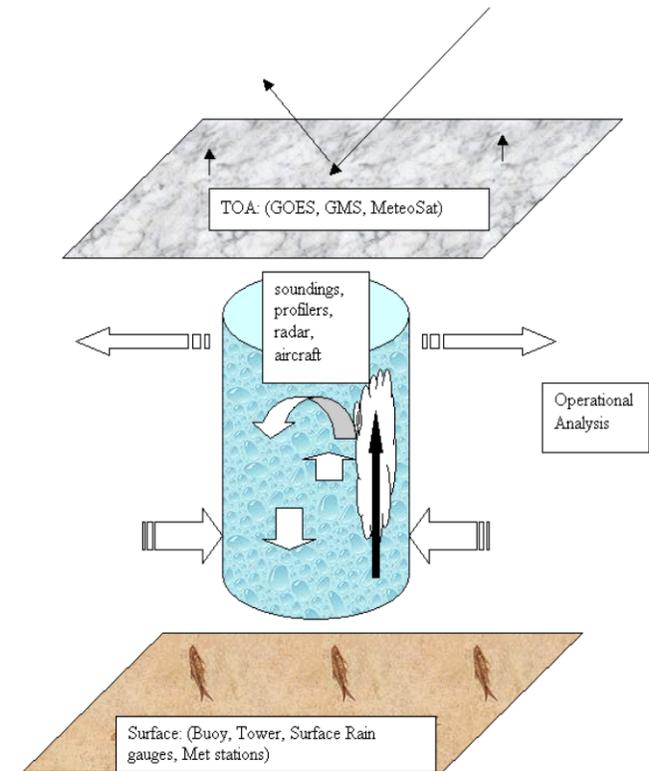


Figure 1. Schematic figure of an atmospheric column in VARANAL.

Courtesy of Dr. M.H. Zhang)

# Data Needed for The Variational Analysis

- **Large-scale state variables (u, v, T, q, ps)**

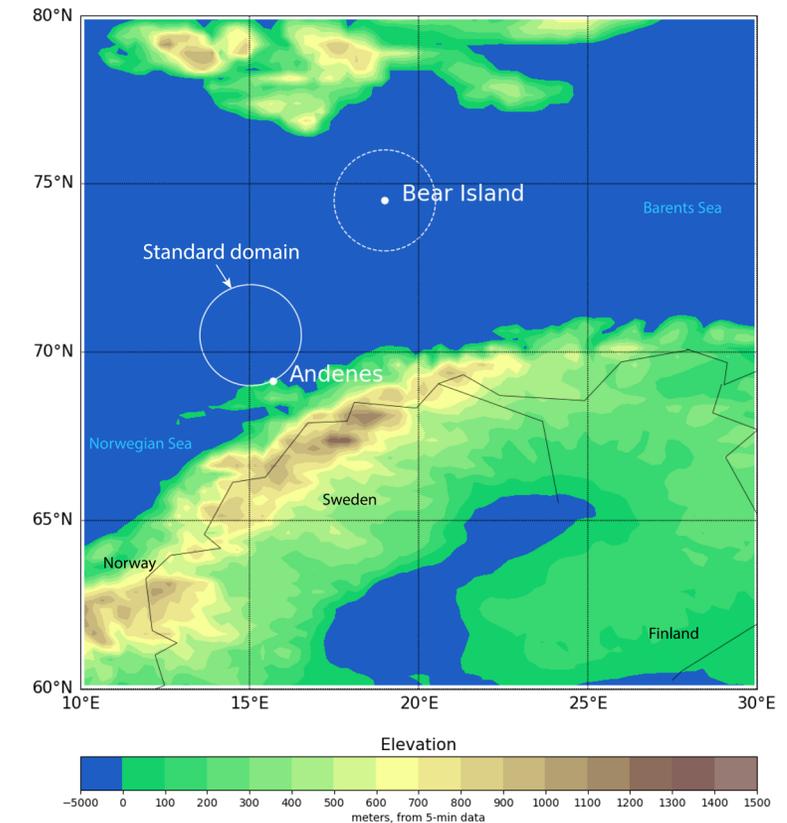
- Well-defined sounding array available in IOPs
- NWP analysis/reanalysis – e.g., ECMWF, NCEP, ERA-5, ...

- **Constraints**

- TOA: radiative fluxes from satellite observations (VISST)
- Surface: obs from ARM and local meteorological stations
  - Surface radiative fluxes
  - Surface sensible and latent heat fluxes
  - Surface precipitation
  - Cloud liquid water path

Forcing data will be generated to support cloud modeling activities organized by the science team

## Variational Analysis Forcing for COMBLE



# Questions?

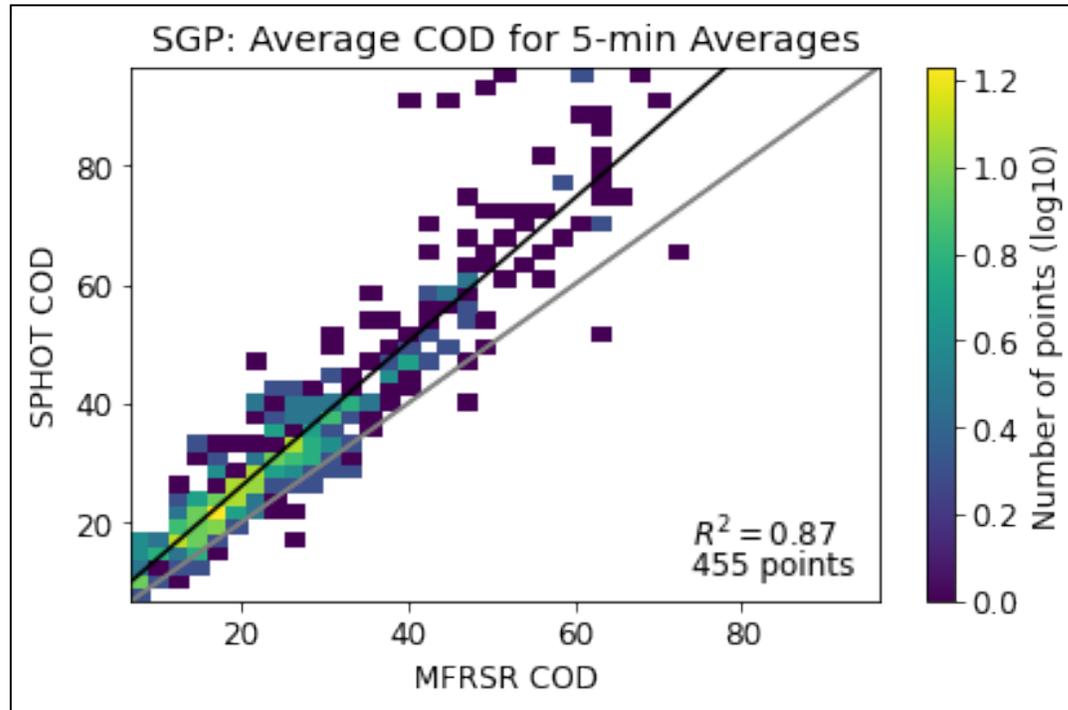
Let's know your data needs and we are here to support!

**Translator POC for EPCAPE: Shaocheng Xie (LLNL), [xie2@llnl.gov](mailto:xie2@llnl.gov)**

# ARM Cimel Sunphotometer Cloud Mode VAP Product



For more VAP information, please contact Lynn Ma: [malynn@bnl.gov](mailto:malynn@bnl.gov)



- Microphysical Cloud Properties from ARM Cimel Sunphotometer
- New Cloud Optical Depth (COD), Cloud droplet effective radius (EFF), and Liquid Water Path (LWP) retrievals.
- Uncertainty quantification, and long-term ARM evaluation.
- Initial dataset release covering ARM SGP site can be downloaded now. Adding ENA, COMBLE, LASIC, and other sites soon.