

# Towards an ARM ArcticShark Baseline Capability

FAN MEI

Pacific Northwest National Laboratory

ARM/ASR PI meeting, Oct. 2022

# TigerShark and ArcticShark mission

- ▶ Starkville, MS, March 2021
  - 11.7 hours, 5 flights
- ▶ Greenwood, MS, June 2021
  - 10 hours, 5 flights
  - Staggered Visual Observers
- ▶ Blackwell, OK, November 2021
  - 15.4 hours, 7 flights
  - Staggered Visual Observers
- ▶ Blackwell, OK, July 2022
  - 12.5 hours, 7 flights
  - Staggered Visual Observers
- ▶ Fully instrumented flights
  - Atmospheric parameters: P, T, RH, Winds
  - Aerosols: total concentration, size distribution, absorption coefficient and chemical composition
  - Gases phase: CO<sub>2</sub> and H<sub>2</sub>O
  - Surface Properties from a multispectral camera images.



# ARM UAS data (DOI: 10.5439/1846798)



Sort By: A-Z ⌵ i

SEARCH BY DATE RANGE

Start Date  to End Date

Categories 7

- Aerosols 5
- Atmospheric State 8
- Atmospheric Carbon 2
- Cloud Properties 7
- Non-geophysical 5
- Radiometric 5
- Surface Properties 4

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Measurements 11

Sites 1

Data Type 2

Datastreams 41

Facilities 4

Data Levels 2

- a1 13
- b1 14

Enter a category, measurement, datastream, site, source or keyword to begin your search. 🔍 i

**Search Results** - Showing 1-18 of 18 data products

✕ Data Level: a1
✕ Data Level: b1
✕ Search: sgp\*tbs OR sgp\*U3

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Data Products (18)
● Primary Measurements (36)
● Recommended Data (1)
● All Data (18)

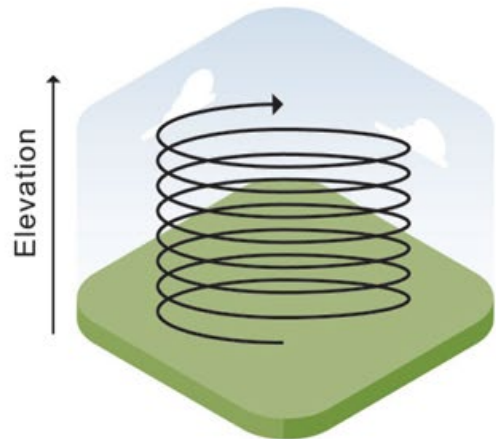
Sort by: Relevance ⌵ i Timeline Options Page Size: 20 ⌵ < < 1 > >

Data Product	Description	View Details & Get Data
tbspops	Tethered Balloon System (TBS) Portable Optical Particle Spectrometer (POPS)	⌵
aafh2o	Airborne measurements of H2O concentrations	⌵
aafirt	Infrared Thermometer (IRT) on airborne platform	⌵
aafmcpc	ARM Aerial Facility (AAF) - Unmanned Aircraft Systems, Mixing Condensation Particle Counter	⌵
aafmetaims	ARM Aerial Facility (AAF) Aircraft Integrated Meteorological Measurement System (AIMMS) - Meteorological data	⌵
aafnav	ARM Aerial Facility (AAF) Navigation (NAV) Datastream	⌵
aafpopsi	ARM Aerial Facility (AAF) Portable Optical Particle Counter (inside payload bay)	⌵
aaftrh	ARM Aerial Facility (AAF) Temperature and Relative Humidity	⌵

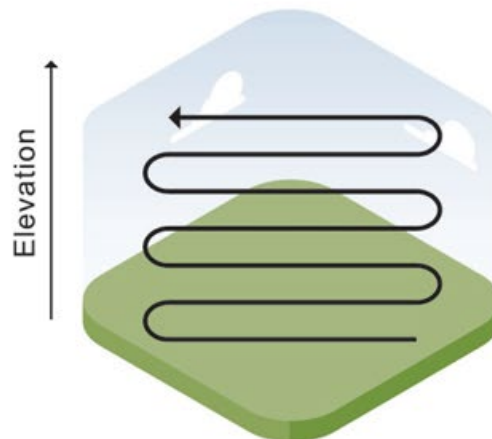
Feedback

# Four typical flight patterns

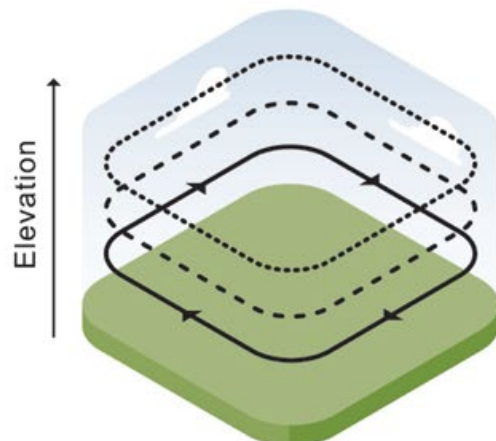
**A** Spiral flight pattern



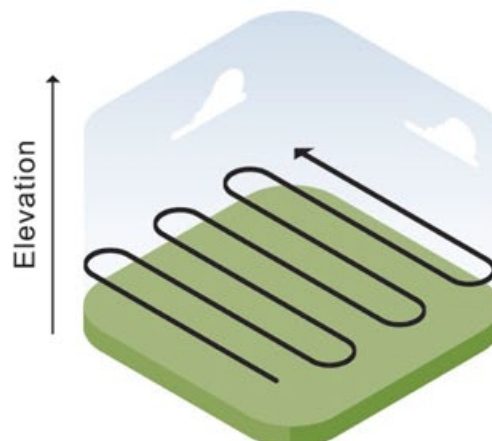
**B** Vertical profiling flight pattern



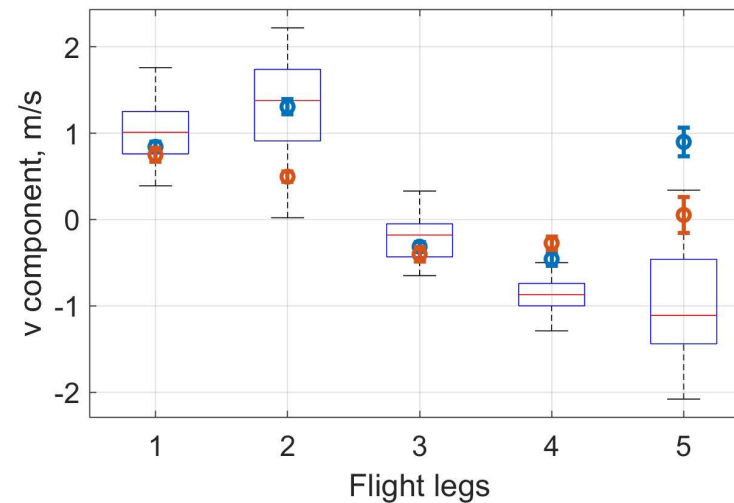
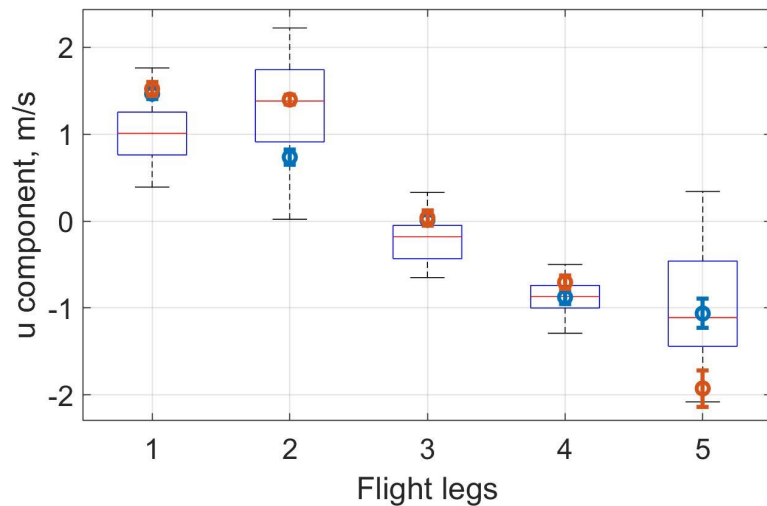
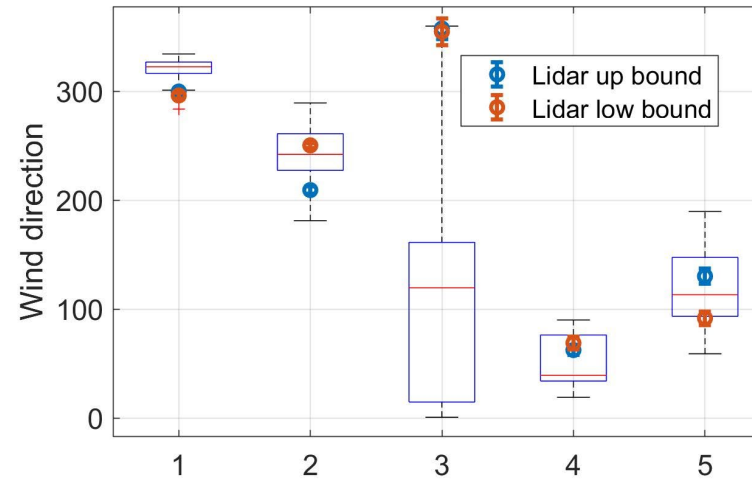
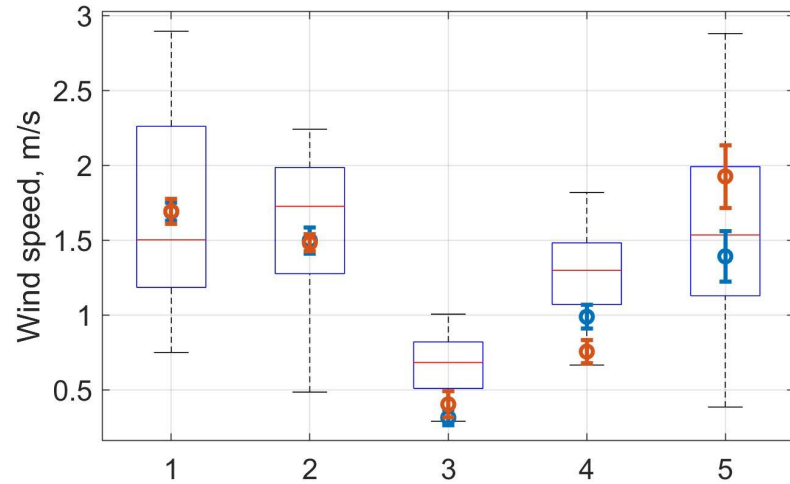
**C** Grid-based flight pattern



**D** Spectral mapping flight pattern

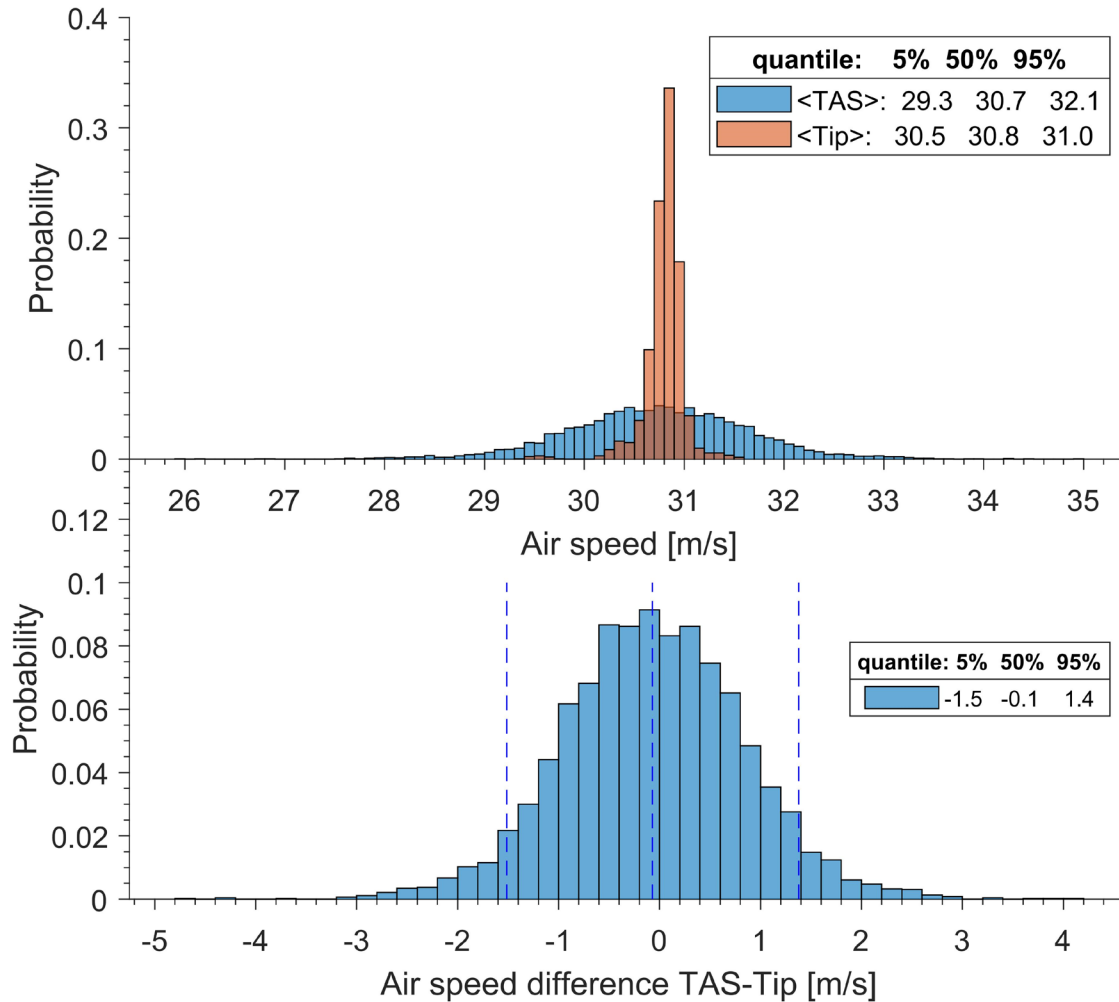


# Wind parameters comparison between the AIMMS-30 and Doppler Lidar retrieval



Mei, F., Pekour, M., Dexheimer, D., de Boer, G., Cook, R., Tomlinson, J., Schmid, B., Goldberger, L., Newsom, R., and Fast, J.: Observational data from uncrewed systems over Southern Great Plains, Earth Syst. Sci. Data, 14, 3423–3438, 2022, <https://doi.org/10.5194/essd-14-3423-2022>

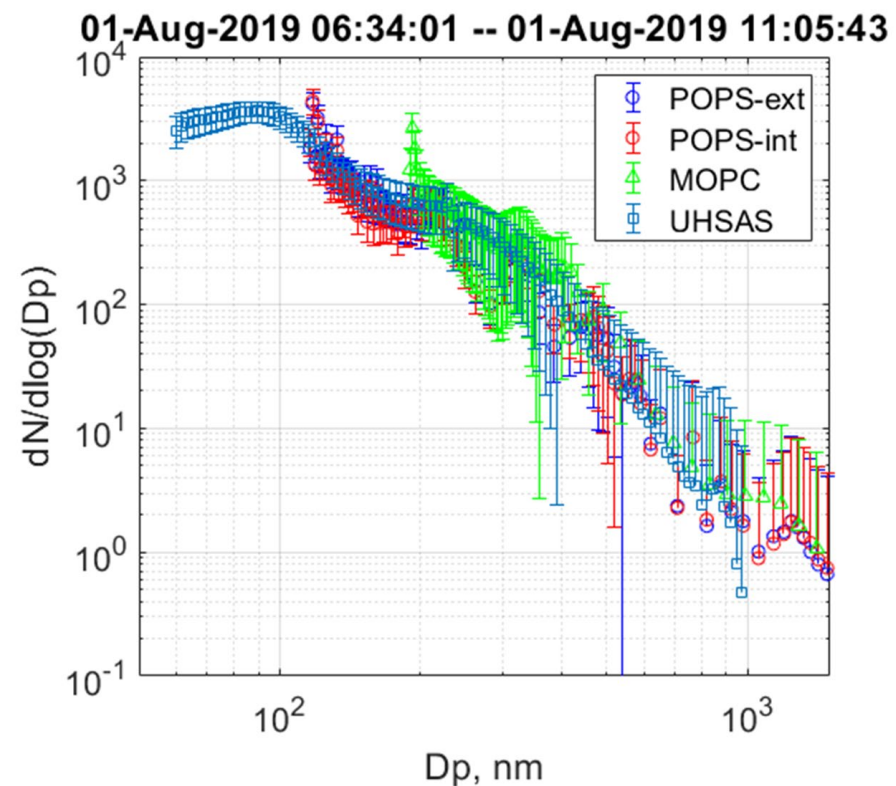
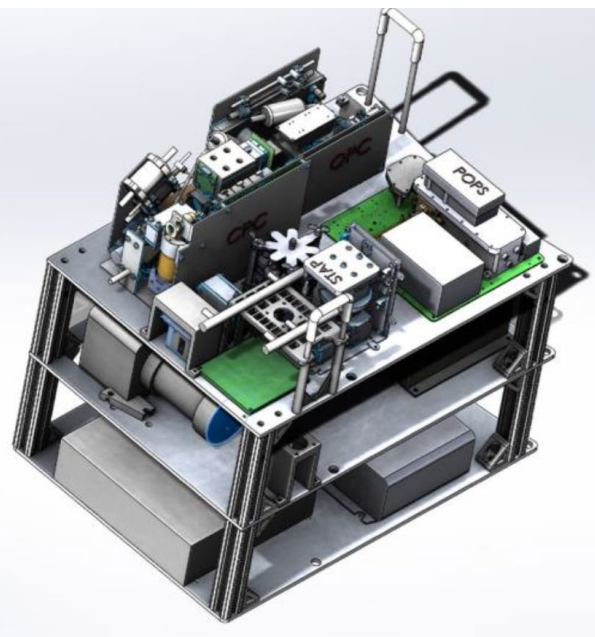
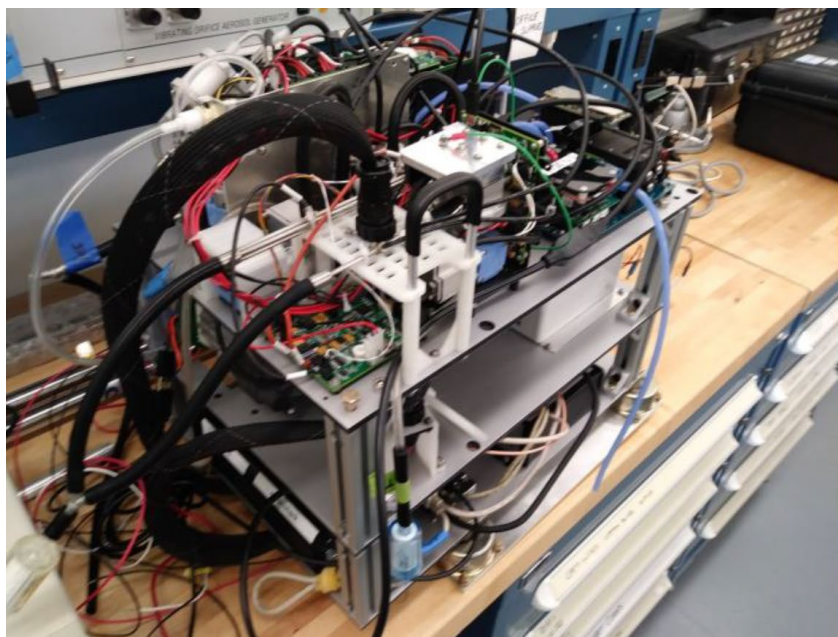
# Aerosol payload community inlet



The isokinetic inlet performance evaluated using one level flight leg on 11/08/2021.

Pekour MS and M Newburn. 2022. [Aerosol Inlets for a Mid-Sized Uncrewed Aerial System \(UAS\)](#). Ed. by Robert Stafford, ARM user facility. DOE/ SC- ARM- TR- 277. 10.2172/1863934.

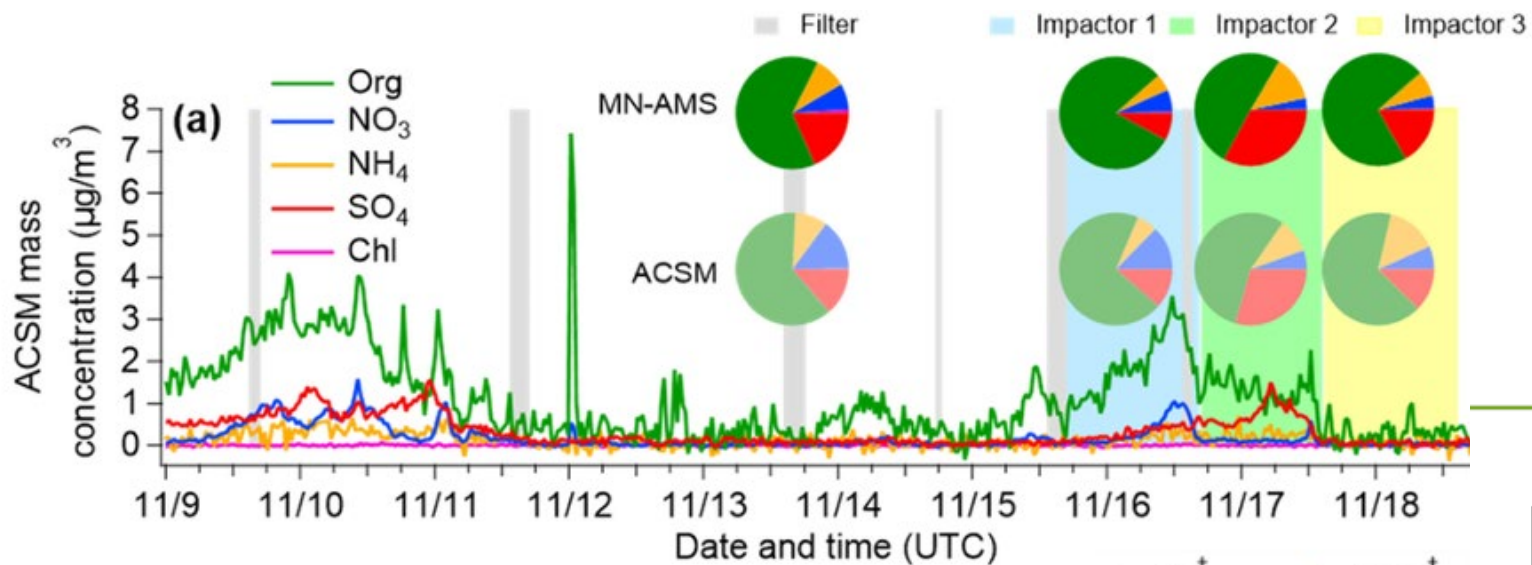
# ACCESS Instruments and POPS



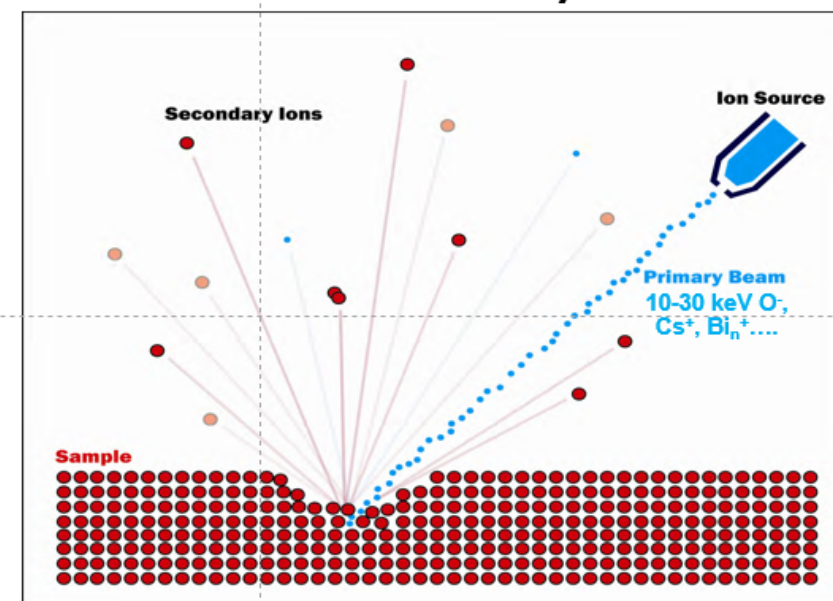
## Characterization efforts

- POPS, MCPC, MOPC, and STAP have been calibrated following the guidelines recommended by GAW-WCCAP.
- Periodic inter-comparison performed before or after flights.

# Chemical composition offline analysis with advanced techniques



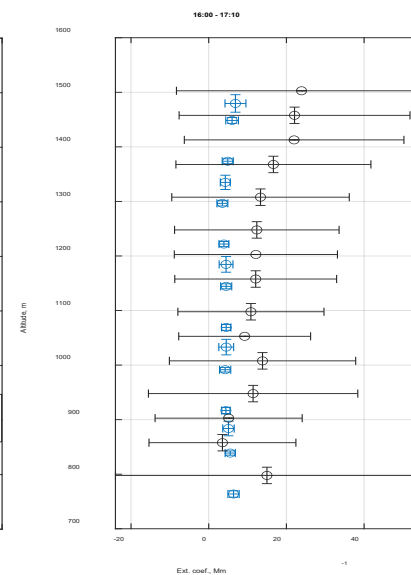
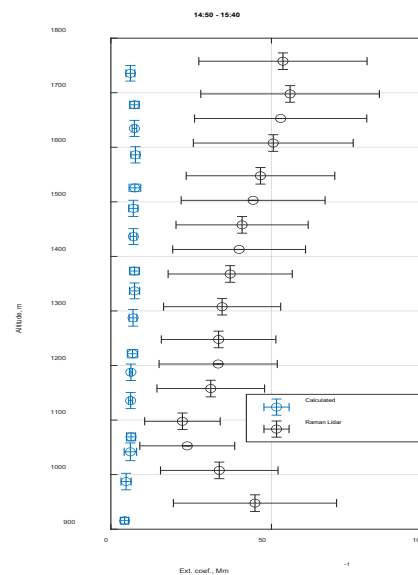
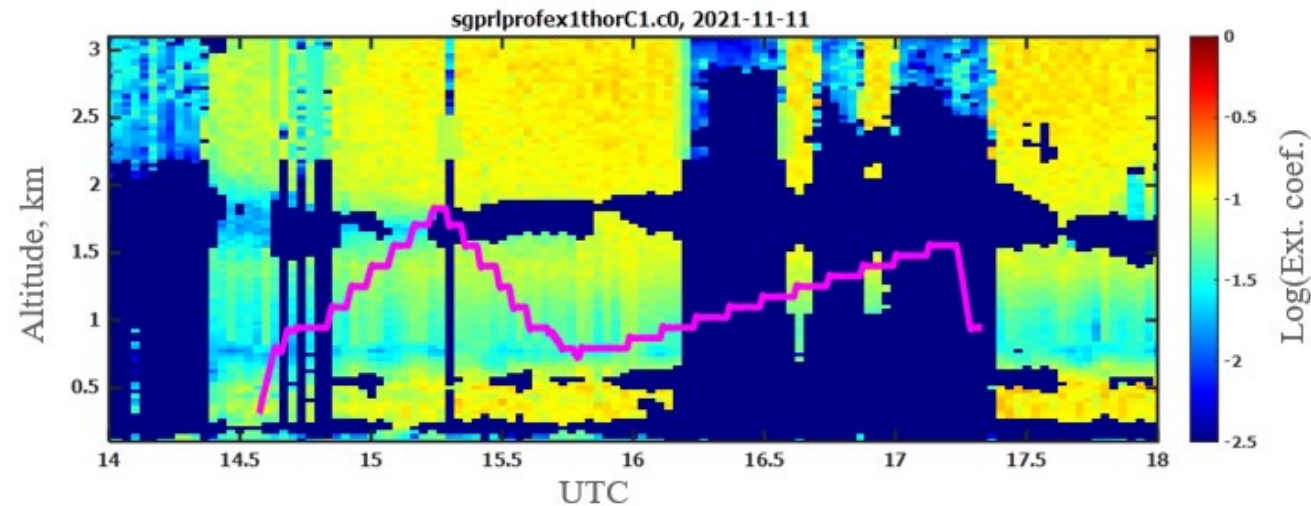
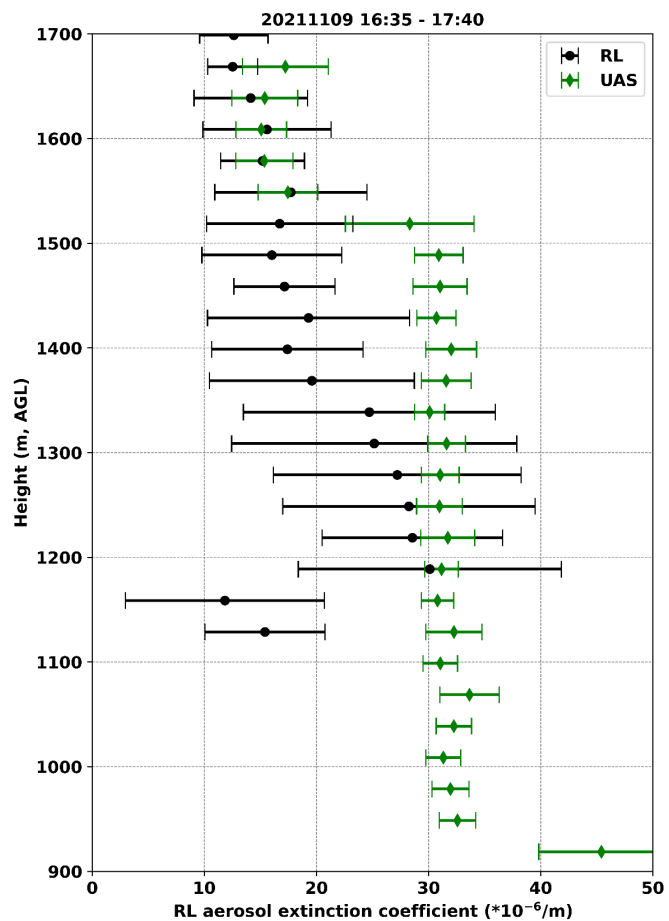
## SIMS: a surface analysis tool.



Niedek, C. R., Mei, F., Zawadowicz, M. A., Zhu, Z., Schmid, B., and Zhang, Q.: Quantitative Chemical Assay of Nanogram-Level PM Using Aerosol Mass Spectrometry: Characterization of Particles Collected from Uncrewed Atmospheric Measurement Platforms, *Atmos. Meas. Tech. Discuss.* [preprint], <https://doi.org/10.5194/amt-2022-246>, in review, 2022.



# Improving aerosol optical properties profiling



## Future directions

- ▶ Science-oriented datasets with the payload development
  - Aerosol and Atmospheric Properties Profiling (A<sup>2</sup>P<sup>2</sup>)
  - Aerosol-Cloud Interaction (ACI)
  - Land Surface – Atmosphere Interaction (LSAI)
  - New Particle Formation (NPF)
  - Turbulence structure and flux measurements
  
- ▶ Standardized/merged datasets
  - Interagency standard.
  - LASSO evaluation package