Convective Processes Working Group

Co-Chairs

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Joint ARM User Facility and ASR PI Meeting

Thursday, October 27, 2022

Photo courtesy of Ramón Alberto Acuña (SMN).

Mission

The mission of the Convective Processes Working Group is to document from observations and modeling, and thereby develop understanding of, the dynamical, thermodynamical, microphysical, and radiative processes that together determine the evolution of convective cloud systems from formation to dissipation, and to translate this understanding into methods for representing convective cloud processes in numerical weather and climate models.

Sign up for our WG mailing list: https://adc.arm.gov/armuserreg/
You need to sign up for an ARM account if you don't have one yet and then go to "subscriptions"

Photo courtesy of Ramón Alberto Acuña (SMN).

Research Themes

Convective System Transitions

- Shallow to Deep (Liquid to Ice, Entrainment, Cold Pools)
- Mesoscale-Synoptic Organization (MCS Life Cycle, Cold Pools, MJO)

Convective Dynamics

- Observational Retrievals
- Entrainment, Detrainment, and Dilution
- Two-way Interactions with Microphysics and Surrounding Environment

Aerosol-Cloud Interactions

- Liquid and Ice Microphysical Effects
- Cloud Dynamical Effects

Parameterization Evaluation and Improvement

- Convection and Organization
- Microphysics
- Turbulence

Photo courtesy of Ramón Alberto Acuña (SMN).

2020-21 ARM/ASR PI Meeting Discussions

- A lot of focus on ***updraft size, strength, and entrainment***, which are critical to shallow-to-deep transition, vertical transport, and cumulus parameterizations. There is a lot of progress currently happening in this area.
  - ***Sensitivities to evolving environmental (thermodynamic, kinematic, aerosol) conditions*** are not quantified.
  - A critical need to formulate new, better targeted ***observational strategies***.
  - ***Tropical, oceanic shallow through deep convection*** is an ideal target.
- Other topics of discussion:
  - Interest in better utilizing ***Doppler spectra***.
  - More ***distributed profiling networks*** for near-cloud meteorological information would be very beneficial.
  - ARM data is uniquely positioned to further tackle ***stratiform-anvil-radiation research***.
- Not much consensus for prioritization of community data needs and directions apart from the need for ***scanning radar retrievals and better-informed observations/modeling strategies*.**

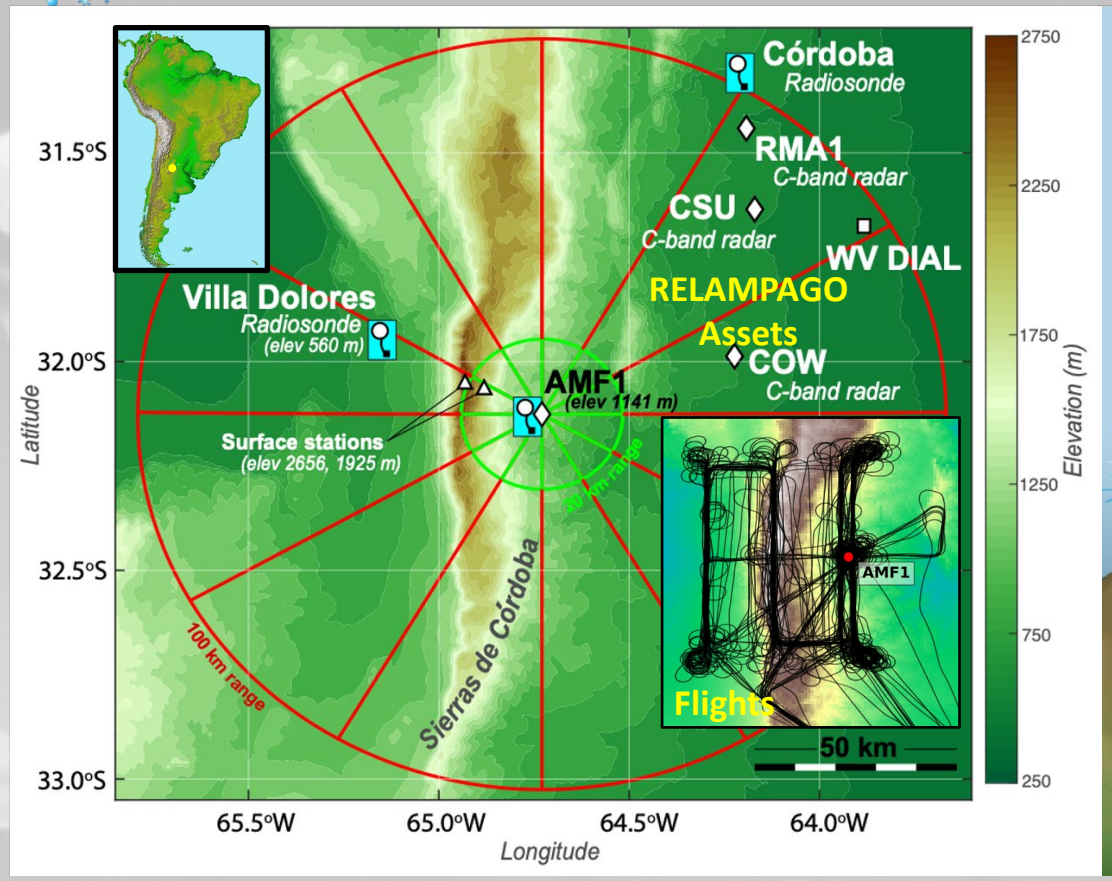
Photo courtesy of Ramón Alberto Acuña (SMN).

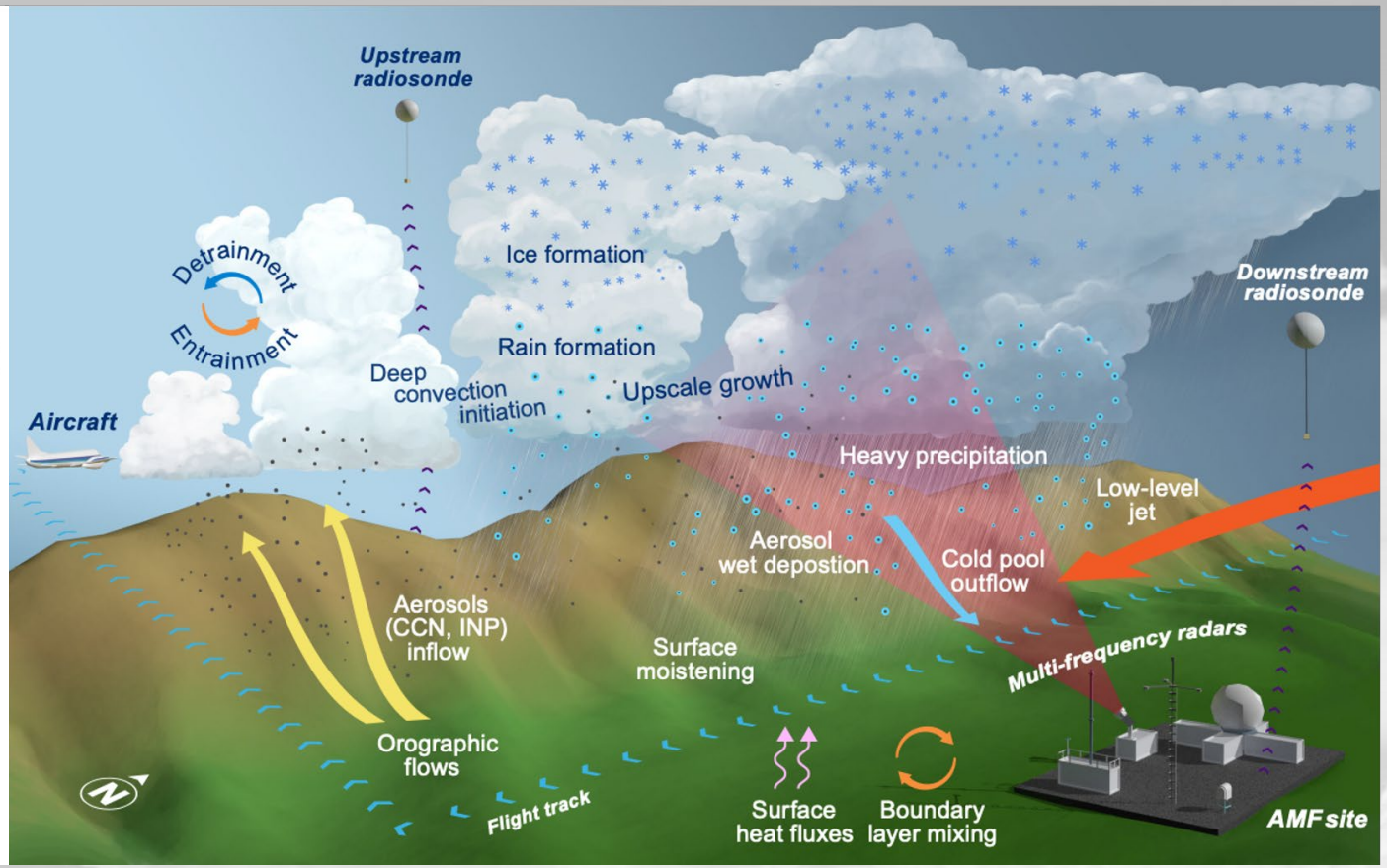
Recent/Future Field Campaigns

- **Recent Field Campaigns**
  - CACTI (orographic convection in Argentina) Oct 2018 – Apr 2019; adam.varble@pnnl.gov
    - LASSO-CACTI (LES runs of shallow to deep cases); william.gustafson@pnnl.gov, vogelmann@bnl.gov
  - COMBLE (cold air outbreak convection on Norway coast) Dec 2019 – May 2020; geerts@uwyo.edu
  - TRACER (coastal convection near Houston, TX) Oct 2021 – Sep 2022; mjensen@bnl.gov
- **Ongoing Field Campaigns**
  - SAIL (orographic convection in Colorado Rockies) Sep 2021 – June 2023; drfeldman@lbl.gov
- **Upcoming Field Campaigns**
  - SEUS (inland convection over the SE US) tentatively begins Sep 2023; seusteam@arm.gov

Photo courtesy of Ramón Alberto Acuña (SMN).

CACTI





AMF1 and CSAPR2 deployed between Oct 2018 and Apr 2019 in the Sierras de Córdoba range of central Argentina.

IOP with 22 flights performed by the G-1 (8 Deep CI, 8 Cu, 3 μ-physics, 3 aerosols) coincident with RELAMPAGO.

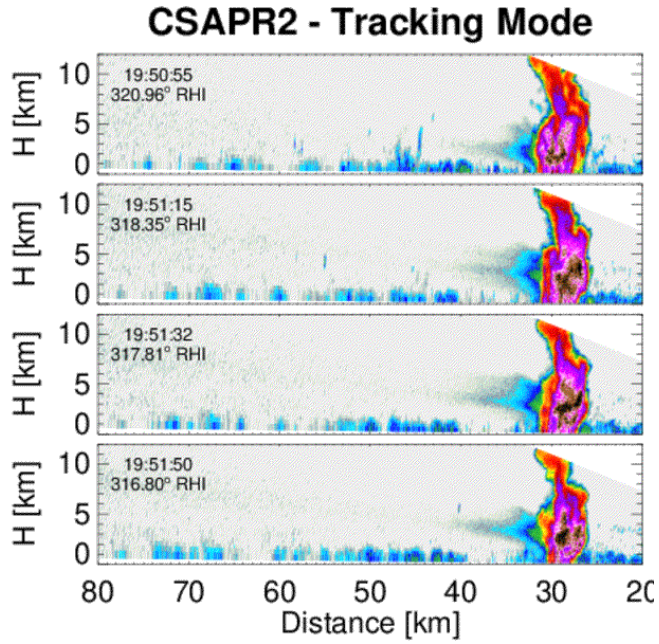
Amongst the most datasets of any AMF campaign including comprehensive, calibrated Ka-, X-, and C-band radar datasets.

https://www.arm.gov/research/campaigns/amf2018cacti

Photo courtesy of Ramón Alberto Acuña (SMN).

TRacking Aerosol Convection interactions ExpeRiment (TRACER)

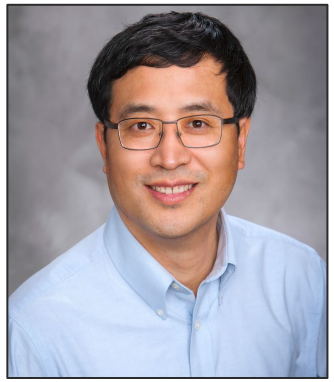
- Year-long campaign and four-month IOP wrapped on September 30th
- Overall instruments operated very well despite challenging conditions
- Very positive first demonstration of automated convective cell-tracking by C-SAPR2
- Collaborative analysis and modeling efforts are forming/ongoing
  - TRACER modeling group meeting on Tuesday (01 Nov) [ACPC-style MIP planned]
  - TRACER data and science workshop planned for Spring 2022
  - AMS special collection approved
  - Aim to develop more collaborative analysis or modeling efforts



Science Product Development Led by a Team of Scientists

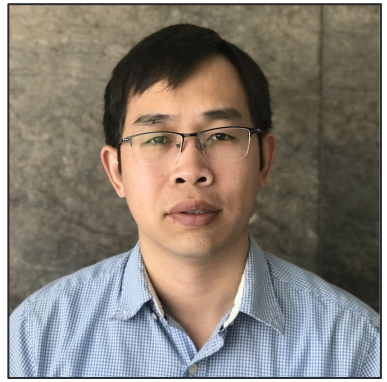
ARM Translator Group

Translators are liaisons between the scientific community and ARM software developers that develop Value-Added Products (VAPs) and open-source tools for the user community.



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

Expanding ARM Open-Source Resources

Open-Source Python Based Analysis Tools

- Data oriented metrics and diagnostics
  - Facilitates use of ARM ground-based measurements for climate model evaluation and model inter-comparison
  - Open-source software includes data and code
- Resources for exploring, visualizing, consolidating ARM data
  - Python-ARM Radar Toolkit (Py-ART)
  - Atmospheric data Community Toolkit (ACT)
  - PyDSD – drop size distribution
  - ARM Data Integrator (ADI)
- https://github.com/ARM-DOE/

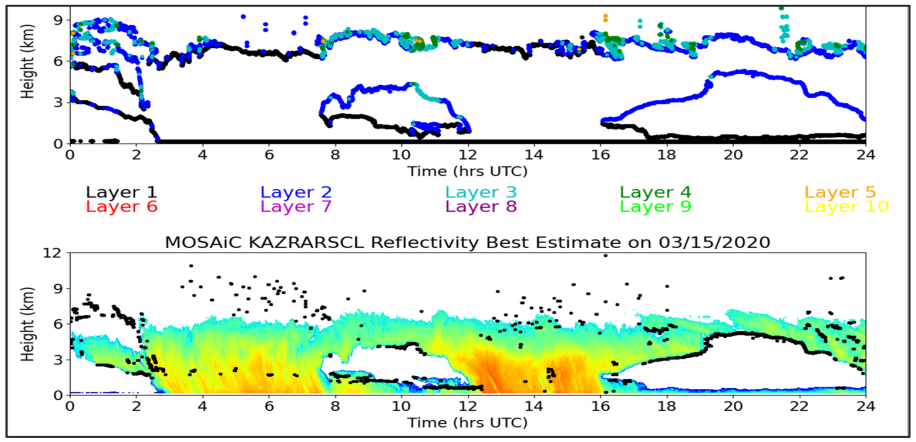
Future Plans

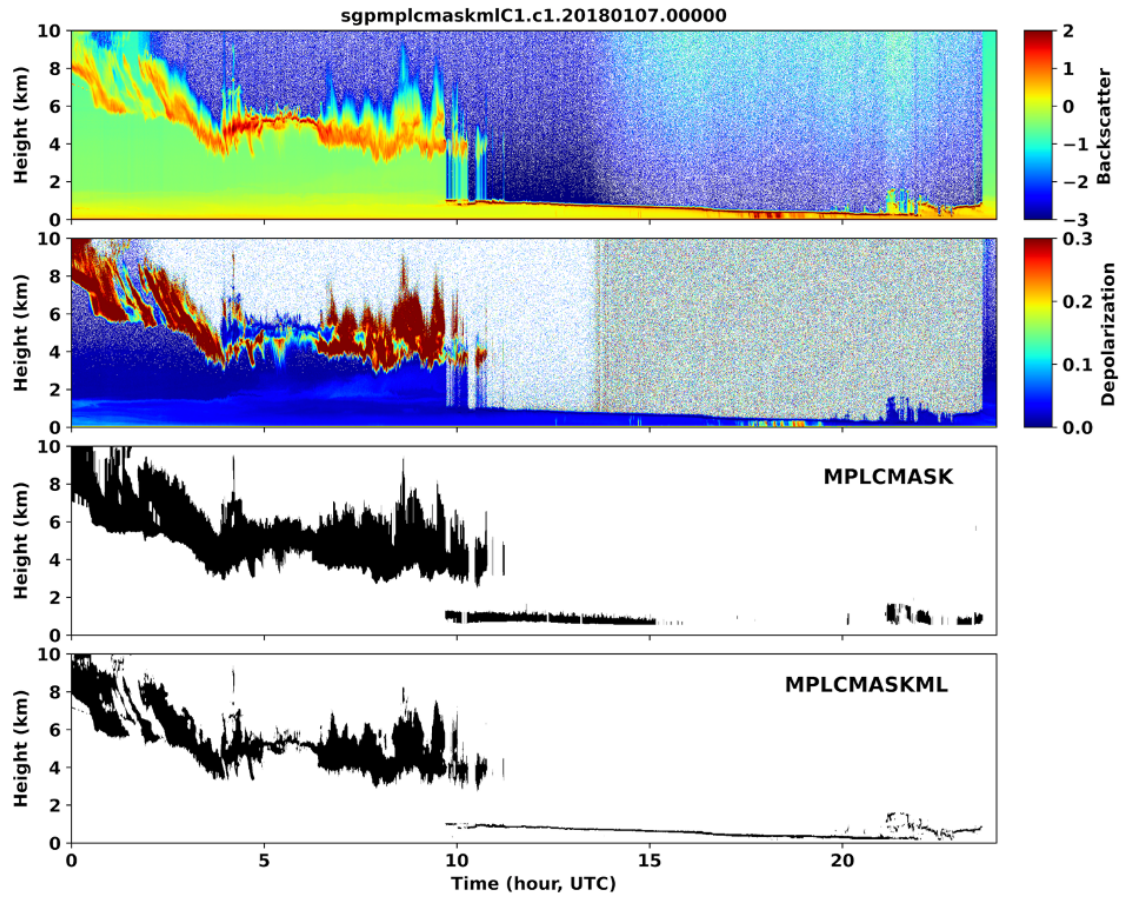
- Modernization of ARM's code base
- Expand model diagnostic packages
- Data consolidation resources for users
- Open workforce development tutorials
- Develop cookbooks for running and visualizing VAPs

TRACER Cookbooks will be here!
github.com/ARM-Development/tracer-radar

Value Added Products for the Deep Convective Group

- Almost every group has products suited to this group. ***This is a sample***.
- VARANAL and ARMBE (Xie).
- CMAC (corrected radar data, Collis).
- Clouds Optically Gridded by Stereo (COGS, Romps/Giangrande).
- Micropulse Lidar Cloud Mask Machine Learning (MPLCMASKML, Zhang).
- Active Remote Sensing of Clouds (ARSCL, Giangrande)





www.arm.gov/connect-with-arm/organization/translators

Data Product Highlight: VARANAL and ARMBE for AMFs

CAMPAIGNS NAME (Featured)	Start	Duration	VARANAL	ARMBE
Tracking Aerosol Convection Interactions Experiment (TRACER)	10/01/21	12 months	**Ongoing**	**Planned**
Surface Atmosphere Integrated Field Laboratory (SAIL)	09/01/21	1.8 years	**Planned**	**Planned**
Cold-Air Outbreaks in the Marine Boundary Layer Experiment (COMBLE)	12/01/19	6 months	Completed	Completed
Multidisciplinary Drifting Observatory for the Study of Arctic Climate (MOSAiC)	10/11/19	12 months	**Planned**	**Ongoing**
Cloud, Aerosol, and Complex Terrain Interactions (CACTI)	10/01/18	7 months	Completed	Completed
Profiling at Oliktok Point to Enhance YOPP Experiments (POPEYE)	07/01/18	3 months		Completed
Aerosol and Cloud Experiments in the Eastern North Atlantic (ACE-ENA)	06/01/17	8.9 months	Completed	Completed
Macquarie Island Cloud and Radiation Experiment (MICRE)	03/01/16	2.1 years	Completed	
ARM West Antarctic Radiation Experiment (AWARE)	11/23/15	1.1 years	Completed	Completed
ARM Support for the Plains Elevated Convection at Night Experiment (PECAN)	06/01/15	1.5 months	Completed	
Observations and Modeling of the Green Ocean Amazon (GOAMAZON)	01/01/14	1.9 years	Completed	Completed
Midlatitude Continental Convective Clouds Experiment (MC3E)	04/22/11	1.5 months	Completed	
RAdiative Divergence using AMF, GERB, and AMMA STations (RADAGAST) (NIM)	01/01/06	1 years		Completed

Contact: Shaocheng Xie, LLNL, xie2@llnl.gov

Feedback to ARM

- There is information on ARM's plans online with a form where you can provide feedback on what capabilities you think are most important and why:
  - https://www.arm.gov/about/future-directions

- Additional information can be found in recorded ARM webinars on a variety of topics:
  - https://www.arm.gov/data/work-with-arm-data/webinars/

Photo courtesy of Ramón Alberto Acuña (SMN).

Agenda

- 210-225 *Jiwen Fan* (remote): “Notable impact of wildfires in the western US on weather hazards in the central US”
- 225-240 *Henrique Barbosa*: “GoAmazon 2014/15 observations of the shallow-to-deep convection transition in Amazonia”
- 240-255 *Zhe Feng*: “Bridging observations and LES towards reducing uncertainties in convection-permitting models”
- 255-310 *Dan Kirshbaum*: “Cumulus dilution: Correlation versus causation”
- 310-325 *Jake Mulholland*: “Does vertical velocity influence entrainment in moist thermals”
- 325-340 *John Peters* (remote): “Using geostationary satellite imagery to understand environmental controls on entrainment in deep convection”
- 340-355 *Hugh Morrison*: “Control of the shallow-to-deep convective transition by environmental relative humidity and the horizontal scale of sub-cloud forcing”
- 355 – Open discussion

Photo courtesy of Ramón Alberto Acuña (SMN).