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# The Quantification of Uncertainty in Cloud Retrievals (QUICR) Focus Group

*Overview and update*

*Shaocheng Xie and Alain Protat (Co-Chairs)*

## Participants

*J. Comstock, J. Delanoë, M. Deng, M. Dunn, R. Hogan, D. Huang, M. Jensen, S. Klein, G. Mace, R. Marchand, S. McFarlane, Q. Min, E. O'Connor, S. Shen, M. Shupe, D. Turner, Z. Wang, and C. Zhao*

# Mission Statement

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**“to develop a methodology for characterizing and quantifying uncertainties in current and future ARM cloud retrievals, separately for different cloud regimes, in support of both retrieval algorithm improvement and cloud modeling study”**

# Approaches

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1. Assemble multiple retrieval products on a common grid with uncertainty for each of the products quantified
2. Extensively evaluate these retrievals using BBHRP and in-situ data, as well as OSSE datasets
3. Implement advanced statistical methods to quantify uncertainties in these cloud retrievals for different cloud regimes
4. Use new instruments and develop synergetic retrievals to improve the accuracy of retrievals

**\*\*BBHRP – Broadband Heating Rate Profile**

**\*\*OSSE – Observation System Simulation Experiment**

***This is a 5-yr plan, but we will do it step by step.***

# Expected Outcomes from QUICR

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- **We will build-up a cloud retrieval case library along with the BBHRP testbed for testing and improving cloud retrievals.**
- **We should be able to retrieve cloud properties with their uncertainties better quantified.**
- **We should be in a better position to provide recommendation on including or excluding certain retrieval algorithms, simple (applied for many cases) vs. comprehensive schemes (only for certain case), to the science community**

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What have we done so far and  
what are we doing now?

# We have created and released the ARM Cloud Retrieval Ensemble Dataset (ACRED)

## 9 ARM Ground-Based Cloud Retrievals

SITE	RETRIEVALS	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
SGP	MICROBASE													
	MACE													
	CLOUDNET													
	DENG													
NSA	MICROBASE													
	SHUPE_TURNER													
	WANG													
	DENG													
TWPC1	MICROBASE													
	COMBRET													
	DENG													
TWPC2	MICROBASE													
	COMBRET													
	DENG													
TWPC3	MICROBASE													
	COMBRET													
	CLOUDNET													
	DENG													
	VARCLOUD													
	RADON													

- Provide a rough estimate of uncertainty in current retrievals
- Contain LWC/LWP/Re\_liq, IWC/IWP/Re\_ice, Optical depth
- Well documented
- Have been used by the community

We are adding more quantities to ACRED

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## **MFRSR cloud/aerosol retrievals and applications** *from Prof. Qilong Min (SUNY at Albany)*

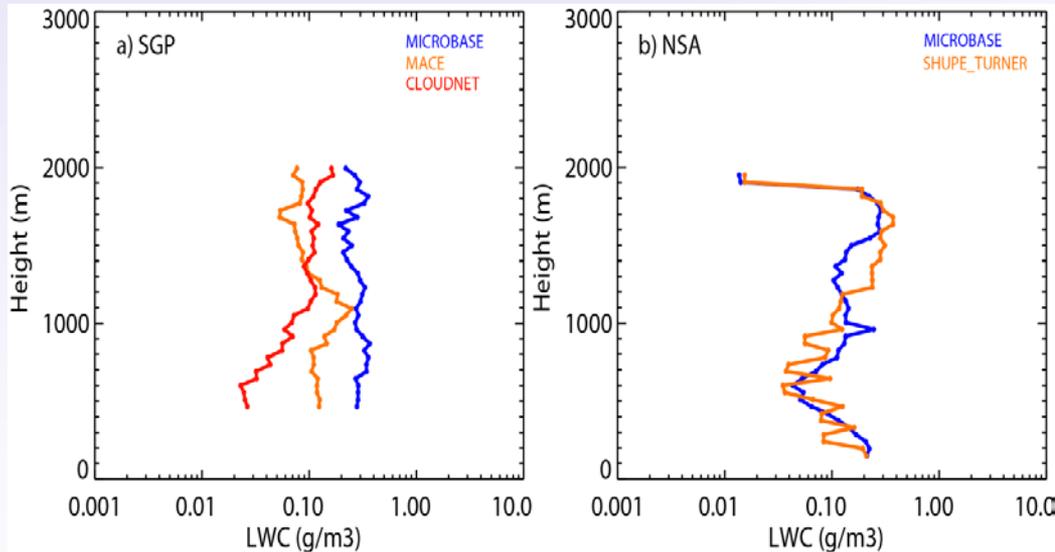
- **Cloud optical depth and effective radius from MFRSR :**  
**MFRSRCLDOD1MIN.VAP**
- **Available on six fixed ARM sites (SGP, Darwin, Manus, Nauru, Barrow, and Atqasuk) and some AMF field campaigns (PT-Reyer and Azores)for multi-years.**
- **The retrieval dataset has been used by the research community**

# We have characterized differences among current retrievals

- Zhao, Xie, and 16 coauthors. 2012, JGR, (Minor revisions)

LWC - SGP

LWC - NSA

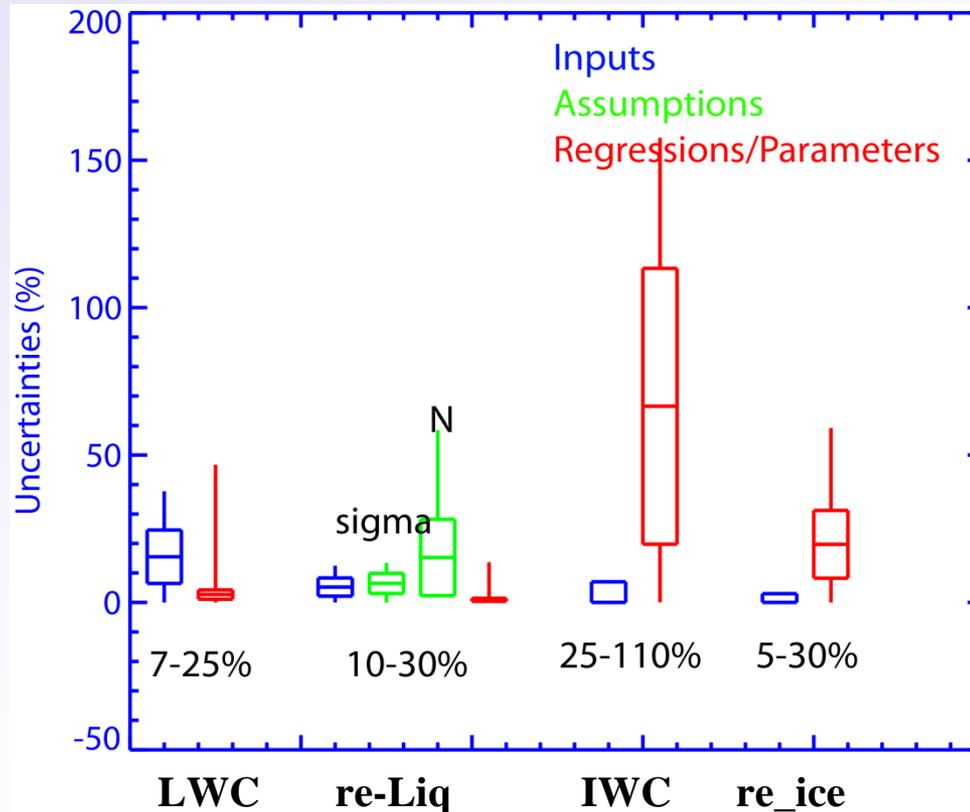


**Most differences can be explained by**

- **retrieval theoretical bases**
  - **assumptions**
  - **input and constraint parameters**
- Issues raised in the paper could be served as a baseline for future studies.

# We are analyzing uncertainties associated with selected retrievals

## Uncertainties with MICROBASE



**MACE, VARCLOUD  
will be the next**

**C. Zhao, S. Xie, M. Dunn, M. Jensen (2012)**

# We are building-up a cloud retrieval case library

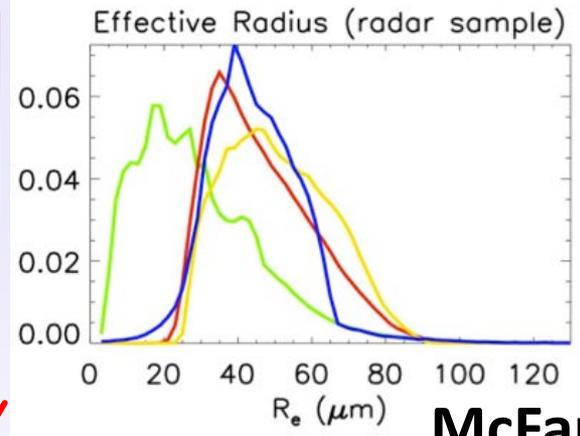
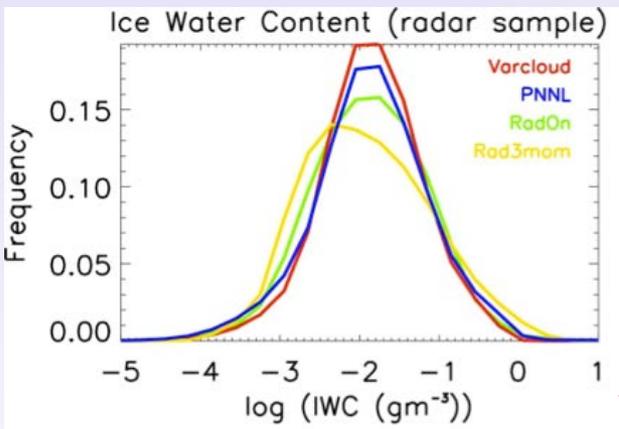
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- **Uniform input data files for running different retrieval algorithms**
- **In-situ data from both ARM and non-ARM field campaigns and radiative fluxes for evaluation and validation**
- **A questionnaire has been constructed and distributed to a few people already – Current expressions of interest from in-situ : A. Heymsfield, A. Korolev, G. McFarquhar, A. Schwarzenboeck, and J. W. Strapp.**

**More people welcome !**

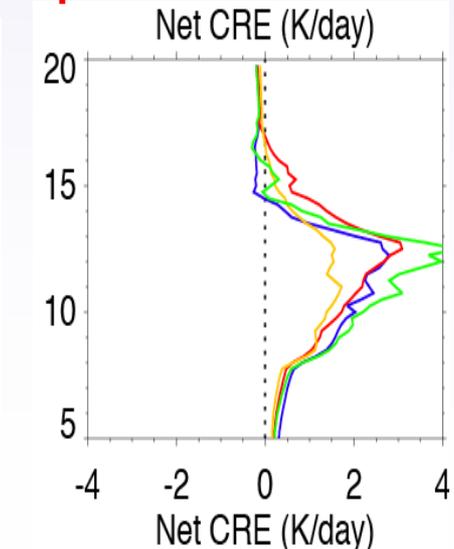
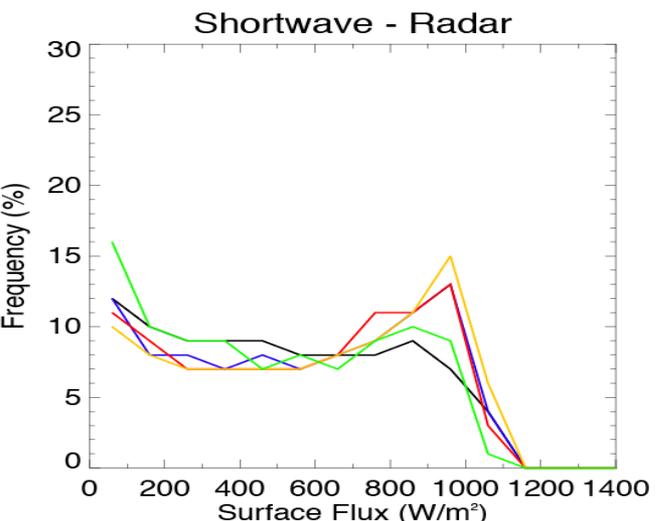
# We are characterizing the radiative impact of differences in retrievals using BBHRP

## Ice cloud retrievals



**McFarlane, Comstock, Protat, Delanoë, Deng (2012)**

## BBHRP outputs



# We are integrating ACRED in RIPBE for BBHRP

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- **Create a high-resolution ACRED consistent with RIPBE to facilitate the use of BBHRP in evaluating various cloud retrievals**
- **Define cases for intercomparison studies**
- **Important pilot study for QUICR – other retrieval PIs could follow the same path to use BBHRP.**

# We have a very successful breakout session and a lot of things to do .....

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- **Successful, lots of people, good discussions, agreement on the proposed scientific and infrastructure activities**
- **Identified specific tasks to work on in the near term**
  - Need to add up a specific task in QUICR to look at sensitivity of retrievals to the input datasets
  - Need to refine the methodology to select in-situ cases for the test case library
  - ARM and non-ARM in-situ data are needed : some funding support may be needed to interact with in-situ people
  - Need to make the use of BBHRP easier to run with different retrieval techniques (ongoing pilot study : integrate ACRED in RIPBE)
- **Identified very important 2-ways synergies with the **IcePro** group (*Greg McFarquar and David Mitchell*) (in-situ work from IcePro → QUICR & QUICR-validated retrievals will serve IcePro objectives)**
- **Collaborate with our colleagues in European. They are making similar integrated efforts on addressing the uncertainty in cloud retrievals of ground based measurements collected in Europe (*Susanne Crewell, University of Cologne*)**