Analysis of Cloud Property Uncertainties in MICROBASE

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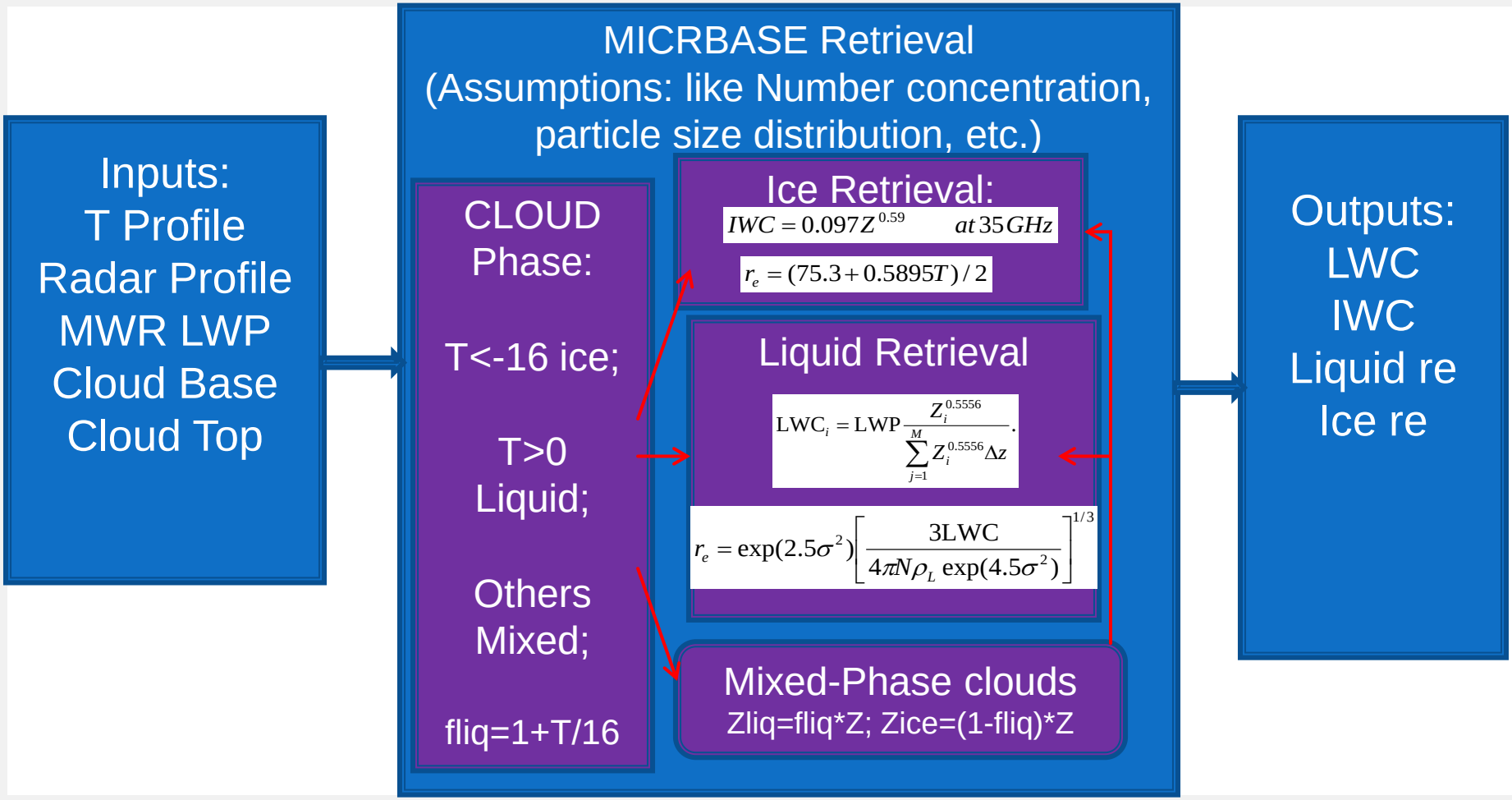
Motivation

- Accurate cloud properties are needed for cloud process study and for better constraining cloud representations in climate models
- One major goal of QUICR is to develop methodologies to characterize and quantify cloud retrieval uncertainties, separately for different cloud regimes
- Different methods have been proposed for this purpose. Here we show the uncertainty quantification results for MICROBASE retrievals with a perturbation method.

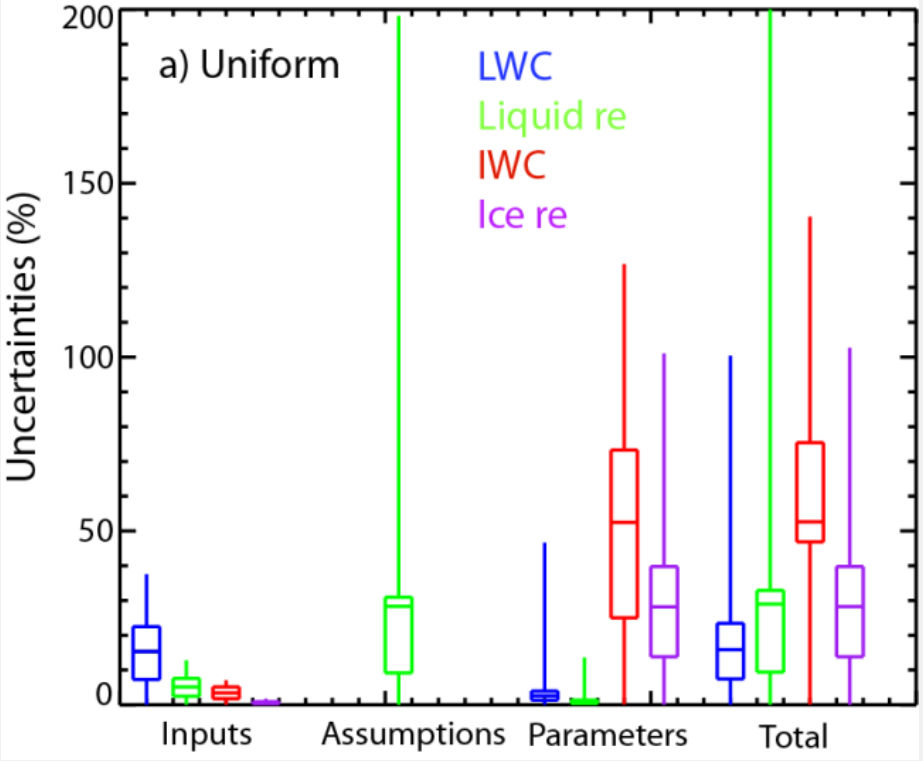
Structure of MICROBASE Retrieval



Zhao et al. (2012) have shown cloud retrieval uncertainties are directly related to the retrieval inputs, assumptions, and parameters in the empirical regression equations. This study quantifies cloud retrieval uncertainties by perturbing these factors within reasonable ranges.

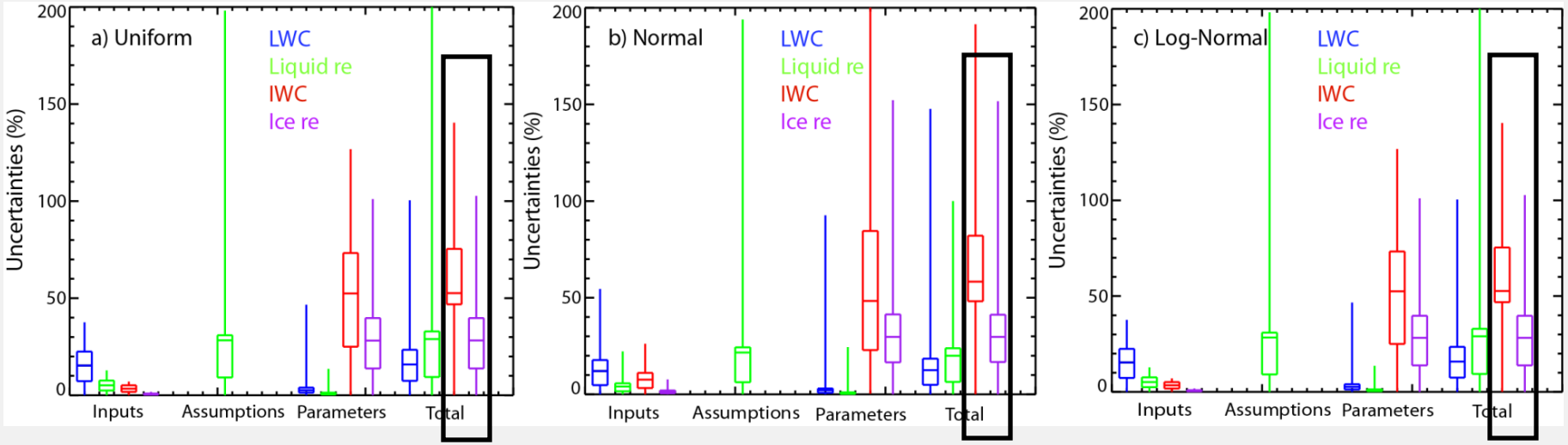
Uncertainties From Different Factors

The dominant factor of cloud retrieval uncertainties varies with cloud property variables



Other influential factors (e.g. ice crystal habit) have not been explored

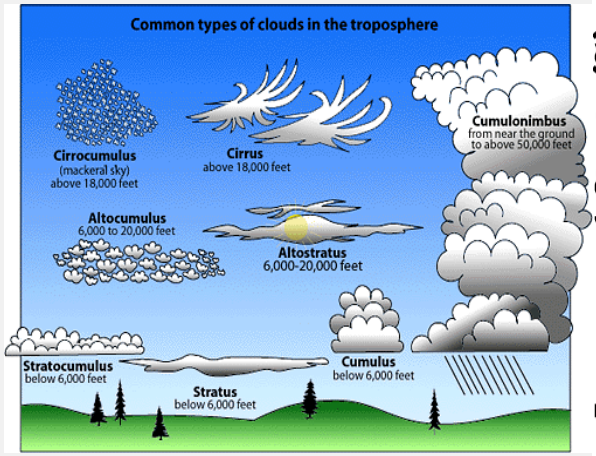
Dependency of Cloud Retrieval Uncertainties to Sample Distribution of Perturbations

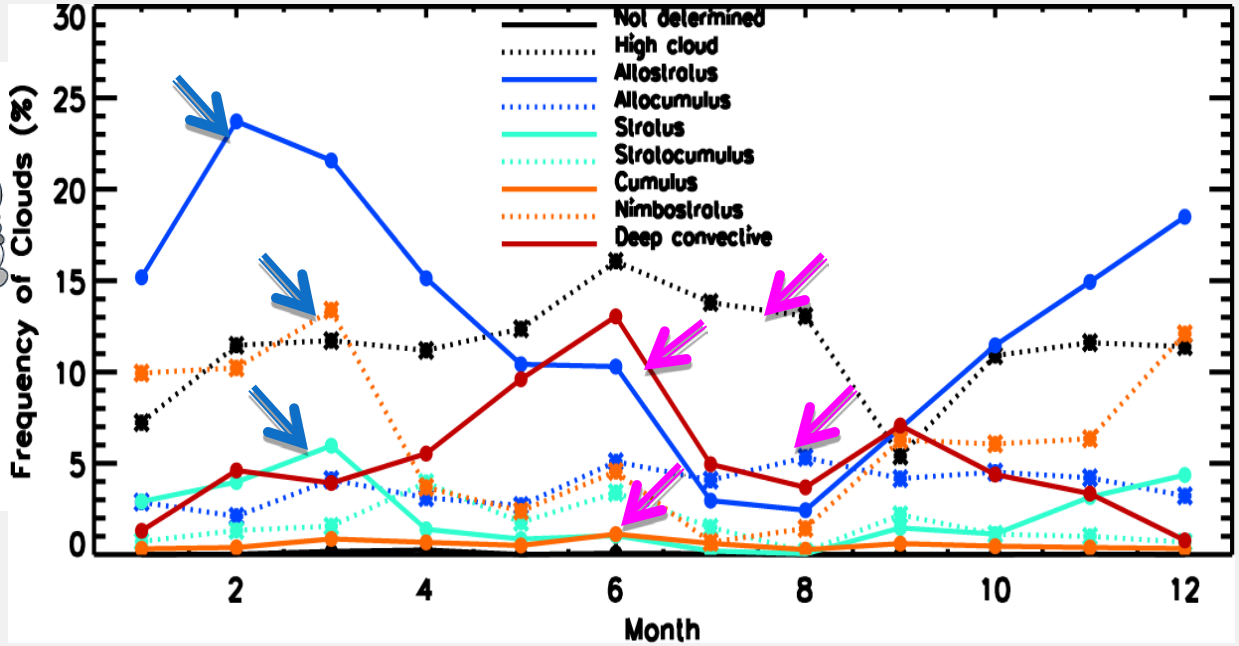


The cloud retrieval uncertainties determined from the perturbation method are weakly dependent on the sampling distribution used in the perturbations

Ensemble Cloud Properties of MICROBASE and Cloud Retrieval Uncertainties for Different Types of Clouds

Clouds in 1999-2001 at SGP



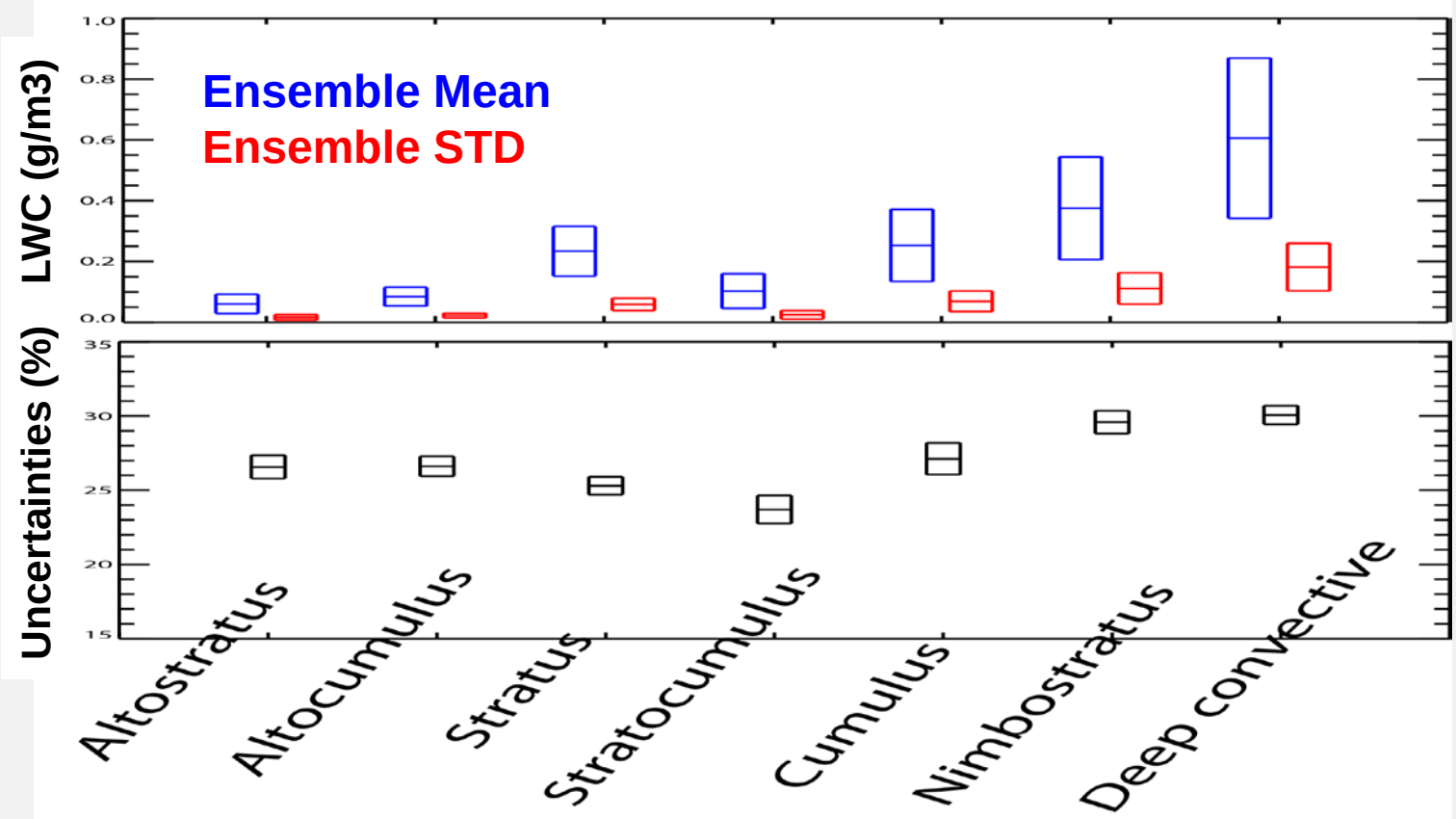


Cloud Classification (9 types): ARM Value Added Product

Cloud classification method is based on Wang and Sassen (2001)

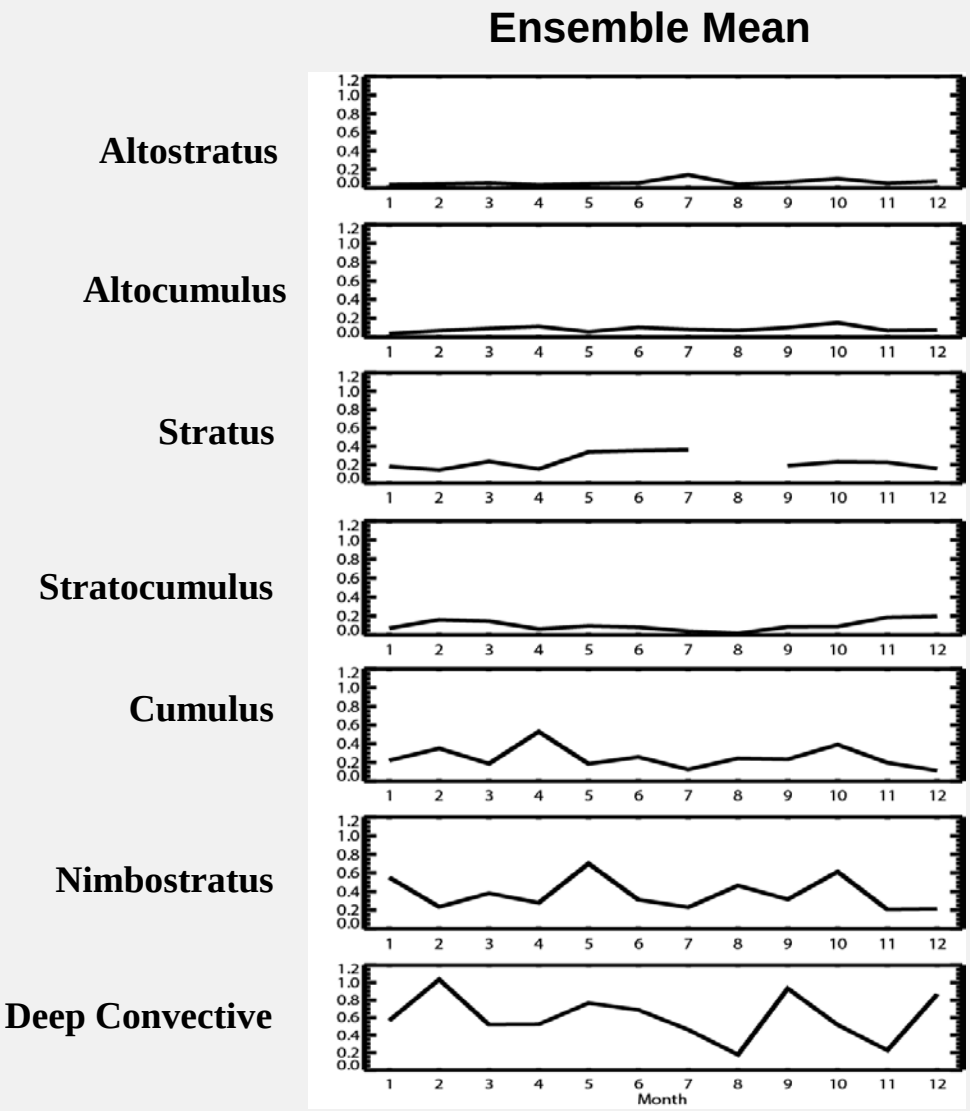
'High cloud' and 'Not determined' clouds are not considered in following analysis

Variation of Ensemble Retrievals and Uncertainties of LWC with Cloud Types (Low & Med clouds)



- **Ensemble mean and standard deviation (STD) of LWC vary with cloud types, with deep convective clouds maximum.**
- **Uncertainties varies with cloud types, with deep convective clouds maximum.**

Seasonal Variation of Ensemble Retrievals of LWC



Various types of clouds show different seasonal variations and magnitudes in LWC, with largest values for cumulus, nimbostratus and deep convective clouds.

Summary

- Cloud retrieval uncertainties can be quantified with a perturbation method – perturbing the influential factors within the reasonable ranges
- The major uncertainty contributing factor varies with cloud variables that are retrieved; the uncertainties determined with perturbation method are dependent on the sample distributions, while this dependency is weak in this study
- The perturbation ensemble means and standard deviations of LWC vary a lot with cloud types, with maximum values for deep convective clouds
- The cloud retrieval uncertainties vary with cloud types, with maximum values for deep convective clouds. The uncertainties of LWC for most types of clouds lie between 20% and 30%
- Various types of clouds also show different seasonal variations and magnitudes in LWC

Thanks!