A Value Added Product for Cloud Type and Cloud Phase Classification

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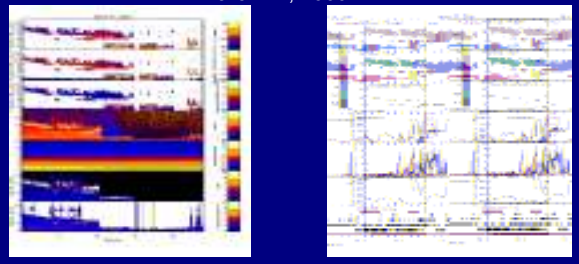
Introduction

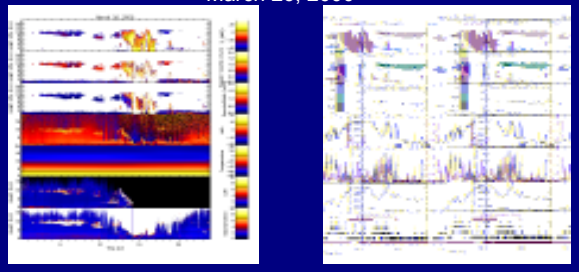
Different active and passive remote sensors can provide complementary capabilities for developing the remote sensing algorithm for the cloud type and phase classification in different climate regions. Pure ice and water clouds are relatively straightforward to identify using ground based remote sensing instruments. However, middle level clouds can often contain mixtures of ice and water, which are difficult to discriminate. Although mixed-phase clouds can be studied with in situ measurements that are able to provide detailed microphysical properties, it is very expensive to accumulate large datasets. We use the DOE ARM program's long-term dataset of ground based measurements to develop a Cloud Classification Value Added Product (VAP) to classify clouds at all ARM sites on a continuous basis.

Examples

March 21, 2000



March 26, 2000



March 21 and 26 in 2000 are used to demonstrate the VAP output. The VAP will produce cloud type, phase, and precipitation information, which are in the right plots on the first, second and the lowest panels. The left panels are used to diagnose the quality of the VAP classifications.

Methods: for algorithm description see Wang and Sassen (2001)

➔ *Cloud Phase Determination*

❖ **Temperature thresholds are first used to discriminate between ice, water and mixed phase**

	Cloud base	Cloud Top
Ice	T < -35° C	None
Mixed Phase	T > 0° C	T < -35° C
Water	none	T > 0° C

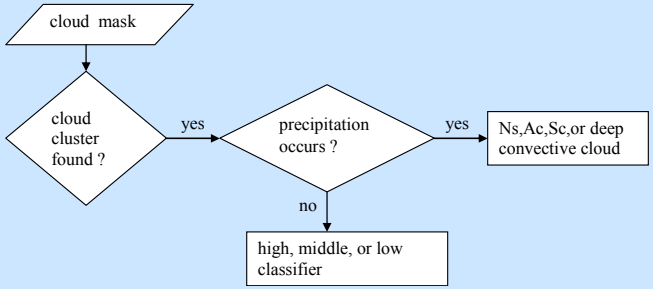
❖ **Other instruments help further discriminate phase**

- Raman Lidar → depolarization, aerosol scattering ratio
- Microwave Radiometer →liquid water path
- Millimeter Wavelength Cloud Radar → reflectivity factor
- Merged Sounding VAP → temperature profile

➔ *Cloud Type Determination*

❖ Rule-based classification + fuzzy logic (based on SGP observations)

❖ Cloud clusters identified using active remote sensors (MMCR and Lidar cloud mask)



❖ Ns, Ac, Sc and deep convection are distinguished based on precipitation intensity and duration, cloud thickness, and temporal duration.

❖ Non-precipitating clouds are classified as high, middle and low clouds depending on altitude, thickness and detection of liquid water by the MWR.

Summary

❖ This cloud classification VAP will be first applied at the Southern Great Plains site.

❖ Will be extended to the North Slope and Tropical Western Pacific Sites where limited depolarization data is available.

→ Usage

- Evaluation of model simulations and process studies at all ARM sites
- Evaluation of satellite based retrieval algorithms
- Input to MICROBASE for conditional retrieval applications

Outputs from the VAP
(Cloud Macrophysical Properties)

Cloud Boundaries
Cloud Thickness
Cloud Phase
Cloud Type
Precipitation Information

Reference

Zhien Wang, and Kenneth Sassen, 2001: Cloud Type and Macrophysical Property Retrieval Using Multiple Remote Sensors. Journal of Applied Meteorology: Vol. 40, No. 10, pp. 1665–1682.

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