

Comparing Cloud Optical Depth Retrievals at the Pt. Reyes (CA) Deployment of the ARM Mobile Facility

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Retrieval method

- This method retrieves "local" cloud optical properties in a fully 3D cloud situation, using zenith radiances from a 2-channel narrow-field-of-view (2NFOV) radiometer.
- These two channels, 673 nm (RED) & 870 nm (NIR), have similar cloud properties but strong spectral contrast in vegetated surface reflectance. Pt. Reyes is "green" (see at right) and ideal for this method !!



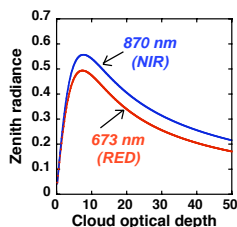
Summary

- We retrieve cloud optical properties in a fully 3D cloud situation, using zenith radiance measured from the two-channel narrow-field-of-view (2NFOV) radiometer.
- For overcast clouds, cloud optical depths retrieved from the 2NFOV agree well with those from the flux method, but they are ~30% larger than MODIS retrievals.
- For cumulus clouds, the 2NFOV retrieval algorithm is the only ground-based passive remote sensing method able to unambiguously retrieve cloud optical depth.

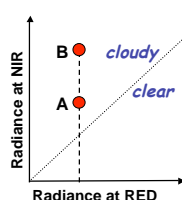
Retrieval method

1. Get info on the cloud optical depth τ ...

Zenith radiances in these two channels (I_{RED} & I_{NIR}) are very different for a given cloud optical depth τ , due to a strong contrast in surface albedo, (see figure at right).



2. Get info on the cloud fraction A_c ...



Vegetated surface at RED is dark while at NIR is bright. Points A & B have the same RED but different NIR radiances. Due to surface-cloud interactions, more photons get through clouds to the surface at B than at A. Thus point B corresponds to a lower "effective" cloud fraction, A_c .

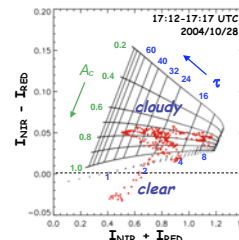
3. Retrieve τ and A_c in a fully 3D cloud situation

We calculate I_{RED} & I_{NIR} as a function of τ and A_c , and build a lookup table (LUT):

$$I_{RED} = I_{RED}(\tau, A_c)$$

$$I_{NIR} = I_{NIR}(\tau, A_c)$$

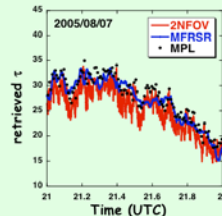
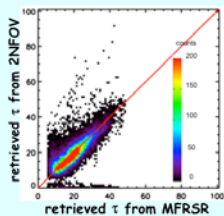
Observations from the ARM 2NFOV radiometer (red dots) in a fully 3D cloud situation are distributed in our LUT. From here, we are able to retrieve τ & A_c .



Comparison with other retrievals

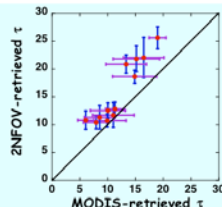
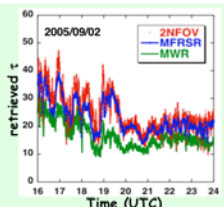
Overcast cases -- comparison with retrievals from MFRSR, MWR, MPL & MODIS

- Comparison of cloud optical depths τ retrieved from 2NFOV and from Multi-Filter Rotating Shadowband Radiometer (MFRSR) using 8 μ m effective radius.



- Compare 2NFOV-retrieved τ with those from solar background signal of Micro-Pulse Lidar (MPL).

- Comparison of cloud optical depths τ retrieved from 2NFOV and from MicroWave Radiometer (MWR), using retrieved liquid water paths and 8 μ m droplet effective radius.



- Compare 2NFOV-retrieved τ with those from 11 coincident MODIS Aqua overpasses for overcast cases.

Broken cloud case -- comparison with retrievals from MWR & MPL

