USING MODIS and AIRS for Cloud Property characterization

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1. AIRS sub-pixel cloud characterization using MODIS data

AIRS sub-pixel cloud characterization (Li et al. 2004a) with MODIS:

(a) collocated MODIS 1 km cloud mask is used to derive an AIRS single footprint cloud mask;

(b) collocated MODIS 1 km cloud phase mask is used to derive an AIRS single footprint cloud phase mask;

(c) collocated MODIS 1 km surface and cloud type classification mask (Li et al. 2003) is used to derive an AIRS single footprint surface and cloud type classification mask.

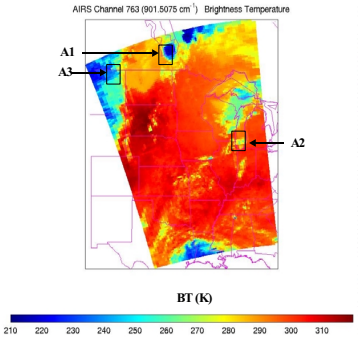


Figure 1. BT of an AIRS window channel (901.69 cm^{-1}) on 06 September 2002

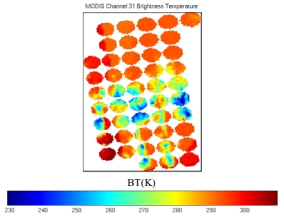


Figure 2a. 1km MODIS 11μm BT superimposed to the small area A2 indicated by Figure 1.

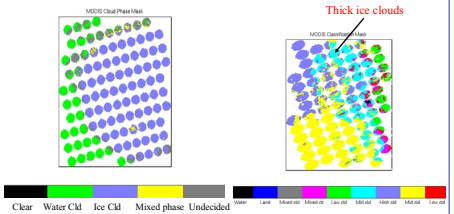
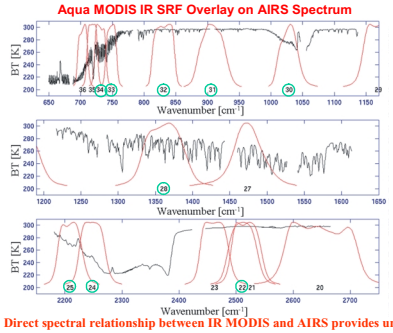


Figure 2b. 1km MODIS phase mask superimposed to the small area A1 indicated by Figure 1.

Figure 2c. 1km MODIS classification mask superimposed to the small area A3 indicated by Figure 1.

2. AIRS cloud-clearing with MODIS



Direct spectral relationship between IR MODIS and AIRS provides unique application of MODIS in AIRS cloud_clearing !

Figure 3. MODIS Spectral Response Functions (SRFs) overlap with an AIRS brightness temperature spectrum.

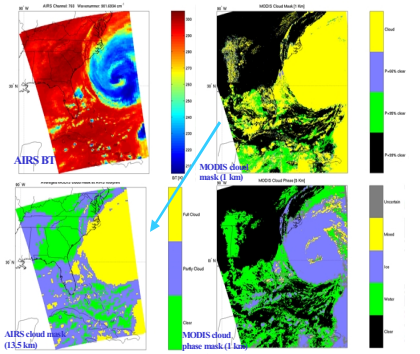
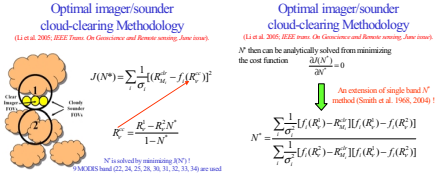


Figure 4. An AIRS window (12 μm) brightness temperature (upper left), MODIS 1 km cloud mask (upper right), AIRS cloud mask derived from the MODIS cloud mask (lower left), and MODIS 1 km cloud phase mask used for AIRS cloud phase mask (lower right).



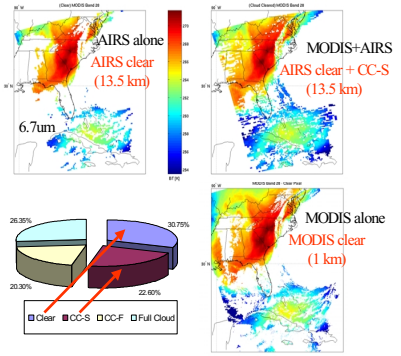


Figure 5. The BT images of MODIS band 28 (7.3 μm) convoluted from the AIRS clear footprints (upper left), the AIRS clear plus successful cloud-cleared footprints (upper right), and the MODIS clear BT observations with 1 km spatial resolution (lower right).

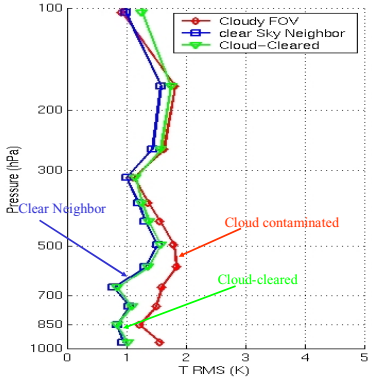
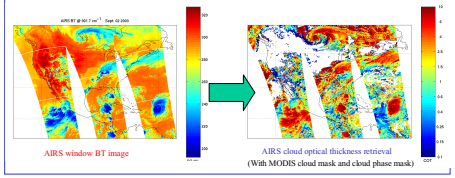


Figure 6. Temperature RMS difference between AIRS retrievals and the ECMWF analysis, ~ 250 thin cloudy footprints are included in the statistics.

3. MODIS/AIRS synergism for cloud property retrieval

With help of MODIS cloud mask and cloud phase mask, products such as cloud-top pressure (CTP), cloud particle size (CPS) in radius, cloud optical thickness (COT) can be retrieved from AIRS data with 1DVAR or minimum residual (MR) algorithms (Li et al. 2004b; 2005b). Note: there is no AIRS single footprint operational cloud property products.



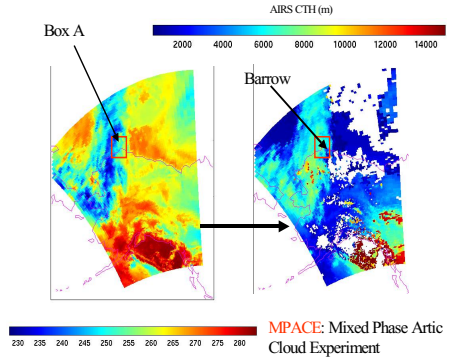


Figure 7. AIRS window (11 μm) BT (left) and retrieved cloud-top height (m) (right) during MPACE.

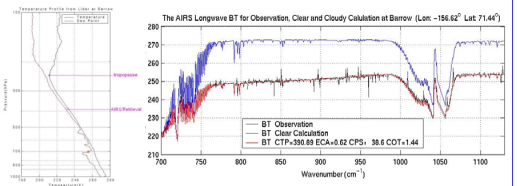


Figure 8. AIRS BT spectra from clear calculation, observation, and calculation with retrieved CTP, ECA, CPS and COT at ARM Barrow site.

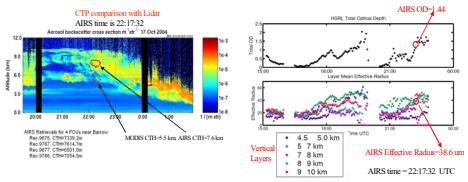


Figure 9. Comparisons between AIRS cloud-top height (CTH), optical depth (OD), and effective radius with lidar observations at ARM Barrow site.

4. Conclusions

(1) MODIS can help AIRS in sub-pixel cloud detection, classification and characterization.

(2) MODIS can help AIRS cloud-clearing on the single FOV basis.

(3) MODIS can be used together with AIRS for cloud property retrievals during both daytime and nighttime.

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