Utilizing infrared sounder hyperspectral resolution spectra to improve MODIS/VIIRS Cloud Continuity Masks

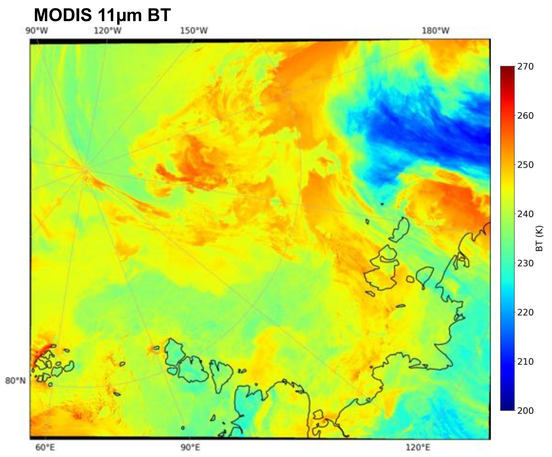
D. Fu (dfu43@wisc.edu), R. E. Holz, R. Kuehn, P. Veglio, G. Quinn, Z. Hodge, E. Borbas

Space Science and Engineering Center, University of Wisconsin–Madison

The MODIS-VIIRS Continuity Cloud Mask (MVCM) has been developed to provide continuity between MODIS and VIIRS products by using only channels common to both sensors. The absence of certain infrared bands from VIIRS makes it difficult to accurately retrieve cloud properties that rely on those spectral channels (e.g., 6.7 μm water vapor band and the 15 μm CO2 bands) (Baum et al. 2012). The goal is to utilize the hyperspectral information from sounders and test the performance of the MVCM algorithm to becoming better agreement with MYD35 for the continuity record (MODIS to VIIRS).

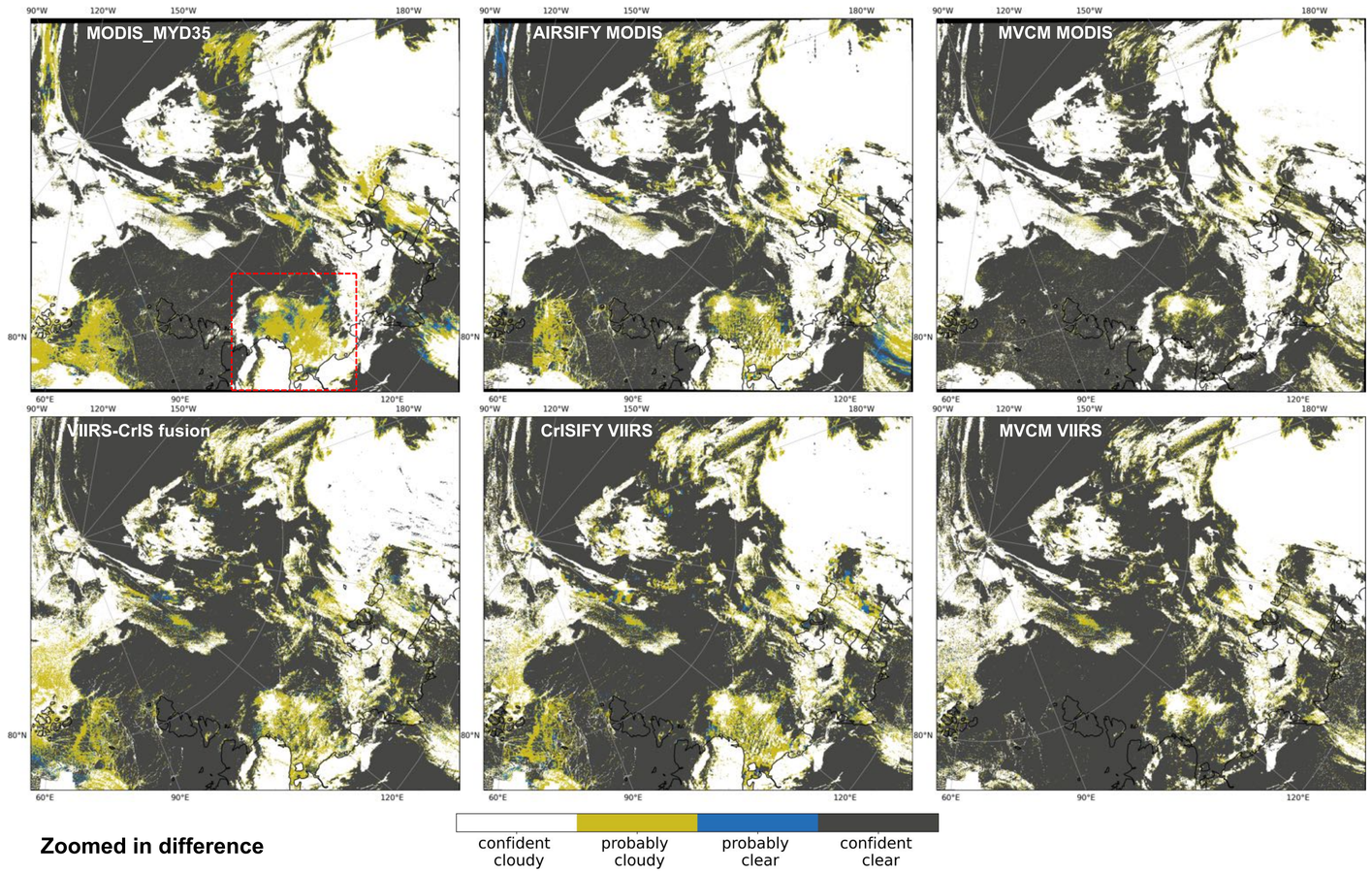
The Sounder/Imager convolution algorithm

- Collocation between the imager (MODIS or VIIRS) and the sounder (AIRS or CrIS) is determined based on instrument viewing geometry and temporal information.
- Spectral shifts are applied to the MODIS spectral response function (SRFs) (Tobin et al. 2006), infrared hyperspectral radiance from the sounder is then convolved with MODIS SRFs to match with MODIS spectral resolution.
- The convolved radiance value is assigned to all collocated imager pixels within the corresponding sounder footprint. Imager pixels that are outside the sounder footprints are populated by fill values.
- The convolved channels are added (for VIIRS + CrIS) / replaced (for MODIS + AIRS) in the original imager L1B product.

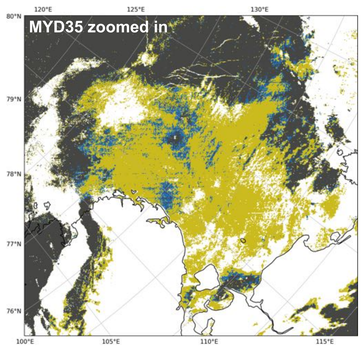


- MODIS L1B radiance was coarsened (e.g., averaged) over each corresponding collocated AIRS footprint to directly compare with AIRSIFY radiance. After applying the suggested SRF shifts, the scene temperature dependence is mostly removed (especially for MODIS Band 35), and the median difference between the AIRSIFY (with shifted MODIS SRF) and MODIS are mostly within ~0.3 K.
- When the AIRSIFY L1B radiance is used for deriving cloud mask, the fill values are further interpolated to ensure continuity in determined feature masks. This feature is currently still under investigation.

Case study



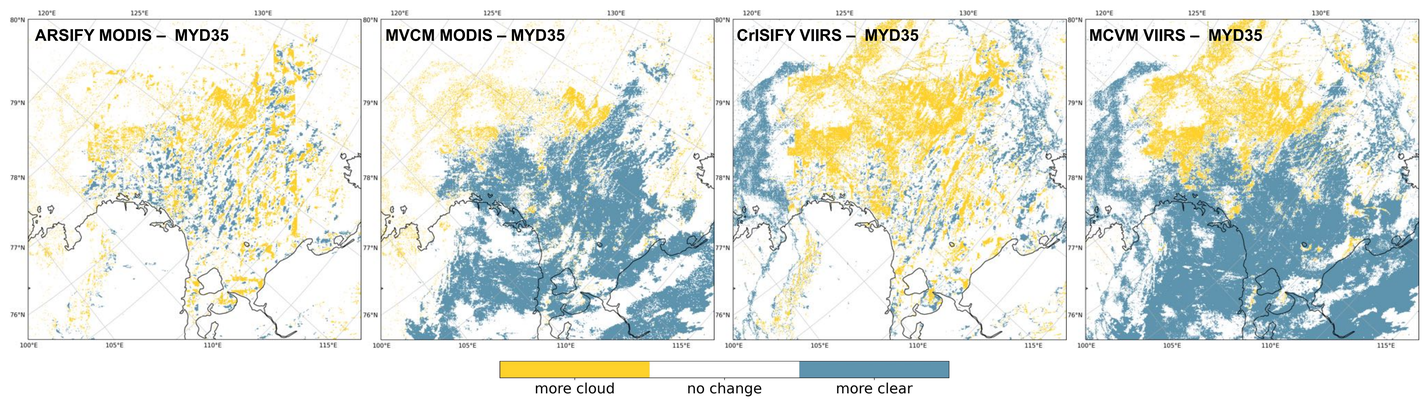
Zoomed in difference



- The added spectral information from the sounder impact MVCM performance for night scenes over cold surface (e.g., polar region, as shown in case study).
- The added sounder infrared spectral information tend to restore “confident clear sky” to “probably cloudy” over polar regions, which is more in line with the MYD35 cloud mask. In polar night scenes, AIRSIFY MODIS is significantly improved over MVCM when compared to MYD35.

Future Development Plans

- Evaluate daytime polar scenes with nighttime channels only for better validation of cloud detection at a granule level.
- Currently two months of AIRSIFY MODIS produced, perform MVCM retrievals across all granules and cross-compare with MYD35, regular MVCM masks, and collocated CALIPSO products.
- Once validated, produce standalone product for both AIRSIFY L1B and CrISIFY L1B.



References

- Baum, B. A., Menzel, W. P., Frey, R. A., Tobin, D., Holz, R. E., Ackerman, S. A., Heidinger, A. K., and Yang, P.: MODIS cloud top property refinements for Collection 6, *J. Appl. Meteorol. Clim., 2006.*
- Tobin, D. C., Revercomb, H. E., Moeller, C. C., and Pagano, T. S.: Use of Atmospheric Infrared Sounder high–spectral resolution spectra to assess the calibration of Moderate resolution Imaging Spectroradiometer on EOS Aqua, *J. Geophys. Res., 2012.*