The Angular Signature Cloud Mask (ASCM) focuses on the forward-scattering with low clouds and featureless clouds. D and C cameras in the forward-scattered direction, and then taking the C-camera a cloud. The SDCM works well for high clouds, even over bright surfaces, but struggles.

2) MISR data is collected over a very brief period of time compared to aircraft data. Thus, a graph of MISR data versus time, for correlation to the aircraft, is not truly accurate. The larger the displacement is between the aircraft measurement time and the MISR overpass, the more likely a cloud is to have formed, modified, or dissipated. Therefore, a large difference in time introduces a high error.

Description of the MISR Instrument:

MISR has 4 spectral channels, centered at 446 nm, 558 nm, 672 nm, and 866 nm. In addition, MISR has 9 cameras, one that is directed at nadir; four that are directed ahead of the nadir camera (forward cameras) and four that are directed behind the nadir camera (aft cameras). The nadir camera is directed at 0°, while the off-nadir cameras are directed at 26.1°, 35.4°, 45.6°, 55.8°, 66.0°, 70.5°. MISR has a 275 m resolution for all bands for the nadir camera, 275 m resolution for the red bands in the off-nadir cameras, and 1190 m resolution for the other bands in the off-nadir cameras.

MISR Cloud Masks:

MISR has three cloud masks available, which complement each other’s strengths and weaknesses.

The Radiometric Camera-by-camera Cloud Mask (RCCM) uses a specific set of spectral and spatial thresholds, categorized by surface type, solar zenith angle, and azimuth angle for each camera. Through the use of three separate thresholds, each MISR pixel is categorized as cloudy or clear, with either high or low confidence. This technique works well over open ocean and some land surfaces, but has some difficulty over bright terrain, such as snow, ice, and desert.

The Stereoscopically Derived Cloud Mask (SDCM) utilizes the parallax effect to determine which regions are clear. The parallax effect allows stereo heights to be calculated. If the stereo height is greater than 562 meters, then the SDCM defines it as a cloud. The SDCM works well for high clouds, even over bright surfaces, but struggles with low clouds and featureless clouds.

The Angular Signature Cloud Mask (ASCM) focuses on the forward-scattering properties of clouds compared to the surface. By taking blue minus near-IR for both the D and C cameras in the forward-scattered direction, and then taking the C-camera result minus the D-camera result, the Band-Differenced Angular Signature (BDAS) is calculated. For cloud cover, the Band-Differenced Angular Signature is more strongly positive than for clear regions. A threshold is applied to the BDAS to create the ASCM. The ASCM does especially well over polar regions, but the forward-scattered signal weakens as one approaches lower solar zenith angles.

The desired result is to coordinate MISR cloud masks, reflectances, stereo heights and BDAS data to corresponding flight paths. Two possible methods allow for this kind of analysis:

1) Flight path data can be plotted onto a MISR grid. This technique will allow a visual analysis of each scene, to determine which time periods may be the most promising to investigate.

2) Take the latitudes and longitudes for each time step from the flight paths, and provide the corresponding MISR data value for that longitude and latitude. The effect is a graph of MISR data vs. flight time. This method is more useful for numerical analysis.

Cases During CRYSTAL-FACE:

July 9th saw a mixture of dense cloud cover, patchy cumulus, and isolated cirrus clouds just east of the Yucatan Peninsula. Of the three realized opportunities for MISR, this overpass provided the most variety for analysis.

July 11th also saw a mix of cloud types. However, in terms of cirrus cloud measurements, most of the prominent cirrus clouds were above low-level clouds. These conditions do not allow for a validation of either the RCCM or the SDCM, which may be receiving some information from the lower level clouds. However, the ASCM may be validated, due to the oblique angle. The upper-level cirrus clouds will be displaced more than the lower level clouds, leading to a separation of the cloud layers.

Plotting MISR data as a function of flight time:

Showing the flight path on a MISR grid provides some visual information on what each aircraft encountered during the overpasses. However, in order to overlay the MISR data with instrument data, the MISR data must be plotted as a function of flight time.

Future Work:

The task of determining the minimum optical depths from MISR has yet to be achieved. As data from various CRYSTAL-FACE instruments becomes available, the first validations from MISR will begin. As shown above, MISR data has been prepared for the task of comparison to CRYSTAL-FACE instrument data.