GOES-R AWG Product Validation Tool Development

Clear Sky Mask

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OUTLINE

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- **Summary**

The AWG Cloud Team Members and Products

AWG Cloud Team Chair : Andrew Heidinger

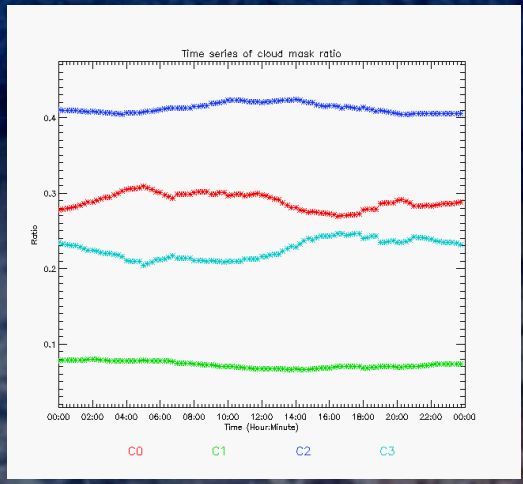
- Cloud Mask
  - Andrew Heidinger (Lead)
  - William Straka III
- Cloud Type/Phase
  - Michael Pavolonis (Lead)
- Cloud Height/Temperature/Pressure & Cloud Cover Layers
  - Andrew Heidinger (Lead)
- Daytime Optical/Microphysical Properties
  - Andi Walther
  - Andy Heidinger
  - Steve Platnick
  - Ping Yang
- Nighttime Optical/Microphysical Properties
  - Pat Minnis (Lead)
  - Pat Heck

Validation Strategies

- Truth datasets
  - CALIPSO/CALIOP
    - The CALIPSO lidar provides very direct measurements of the presence of cloud.
    - It is unaffected by surface characteristics (snow, desert, glint …)
    - Only shortcoming is in the separation of cloud from aerosol
  - Visual Analysis
    - Manual inspection of the cloud mask coupled with L1 data (i.e. suitable false color images) remains an important tool for routine validation.
  - Comparable products from other institutes (NASA EUMETSAT, etc.)
    - Not all successful cloud masks use the same tests or philosophy
    - AWG mask uses methods developed in other masks. Routine monitoring of other masks helps identify our relative strengths and potential new tests.
- Validation tools needed
  - CALIPSO validation tool developed. Applies to MODIS, SEVIRI and AVHRR
  - Tools developed to compare ACM to other masks (IDL).
  - Tools being developed for ACM validation against SURFRAD.

Routine Validation Tools ACM

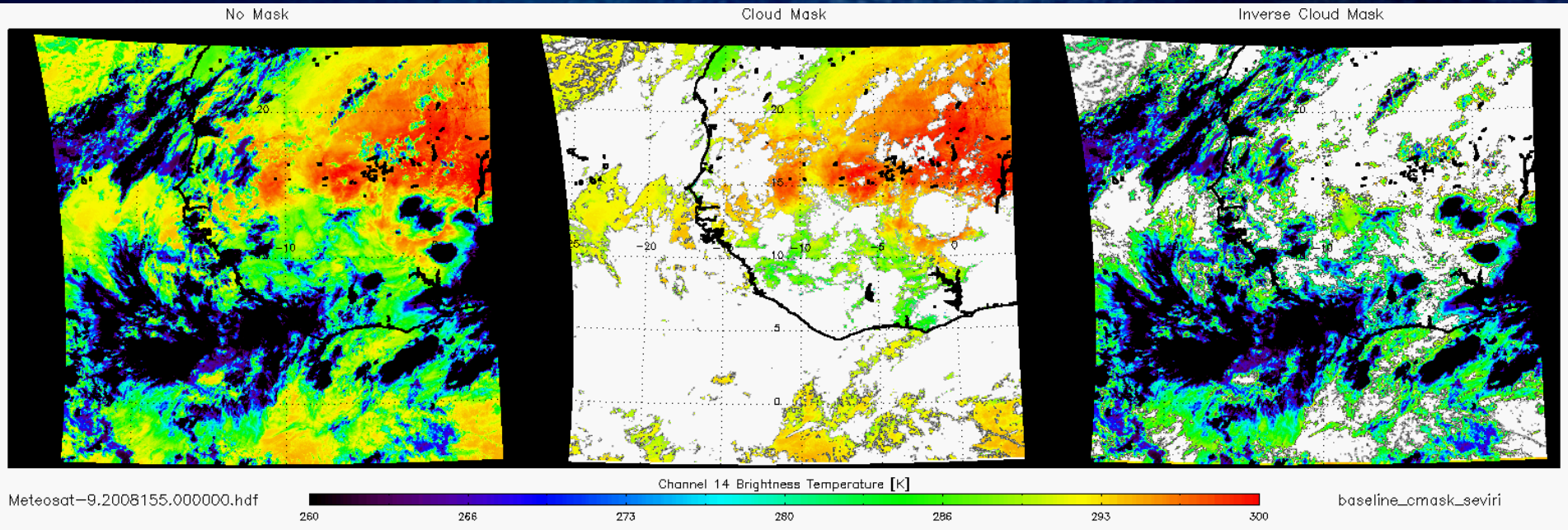
- Visual analysis
  - Easiest to perform in an operational manner
  - Can be done on a variety of software tools (IDL, McIDAS-V, etc.)
  - Utilizes 11μm BT and 0.64μm reflectance with clouds from ACM overlaid
- Trend analysis
  - Percentage of scene of each of the 4-level cloud mask values.
    - Shows the trend over the course of a day on the percentage of pixels of each cloud mask value.
    - Implemented as part of the routine product monitoring tool developed by the AIT
    - Works only with FD and NHEM images.
    - If one category abruptly changes, deep dive tools can investigate the cause.



Example "Routine" ACM Output

The images below show a daily animation of the ACM applied to SEVIRI.

- *image on left is the 11 μm brightness temperature (BT)*
- *center image is the cloud mask (white = cloudy) overlaid on the 11 μm BT*
- *right image is the inverse of the center image (white = clear).*

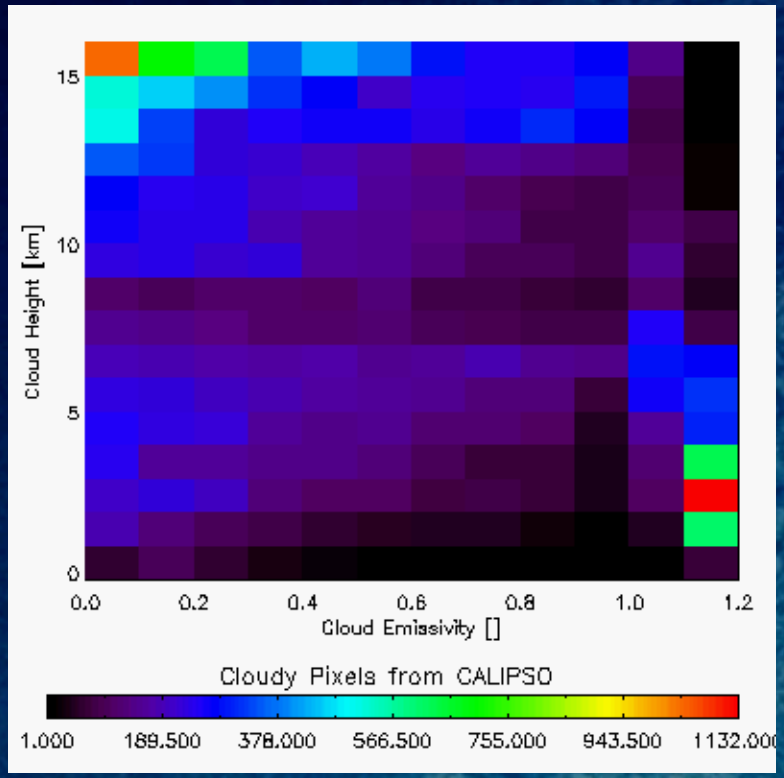


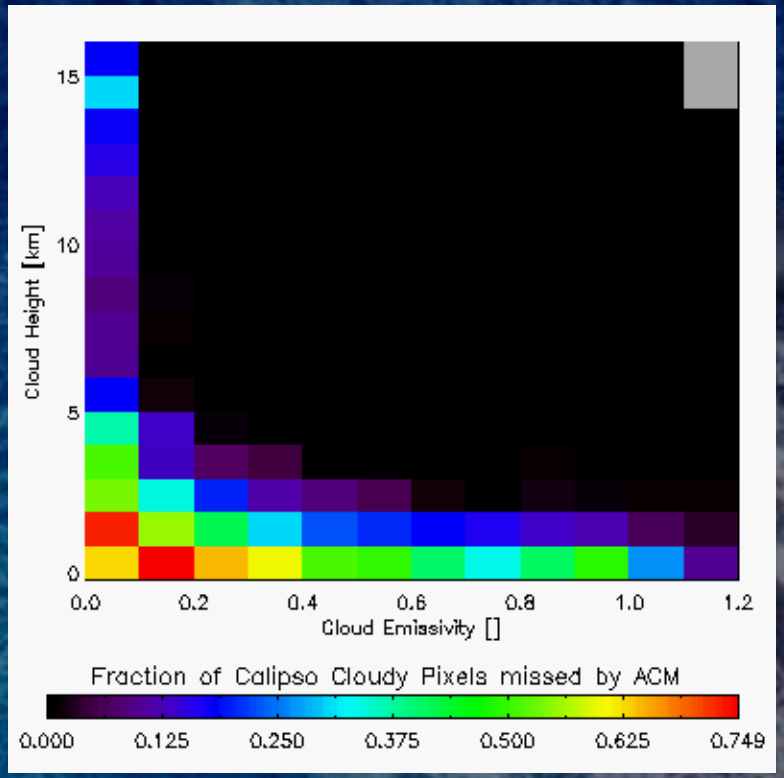
"Deep dive" Validation Tools: ACM

- Co-located CALIPSO Routine
  - Currently run in IDL
  - In addition to L2 products and static ancillary data, tool requires RTM radiance information to run as well as information from the lidar, such as cloud fraction, profile information (height and temperature, used to determine cloud emissivity in the sounder).
  - Requires co-located lidar was available in a timely manner
  - In GOES-R era, EarthCare satellite or other satellite with a space based lidar can be used.
  - Provides information on where the ACM misses cloud relative to the spacebased lidar.
- Comparisons to other cloud mask products
  - Currently done in IDL, but can be done in McIDAS-V easily
  - Requires L2 information from other sensor (VIIRS, MODIS) to be available in a timely manner and to be validated
  - Also requires L1 information to validate other products performance

ACM CALIPSO-based Validation

The following images illustrate the height/emissivity distribution of the cloud distribution as determined by CALIPSO for the 10-week run on SEVIRI. The image on the left shows the distribution of all co-locations. The image on the right shows the distribution of missed cloud.



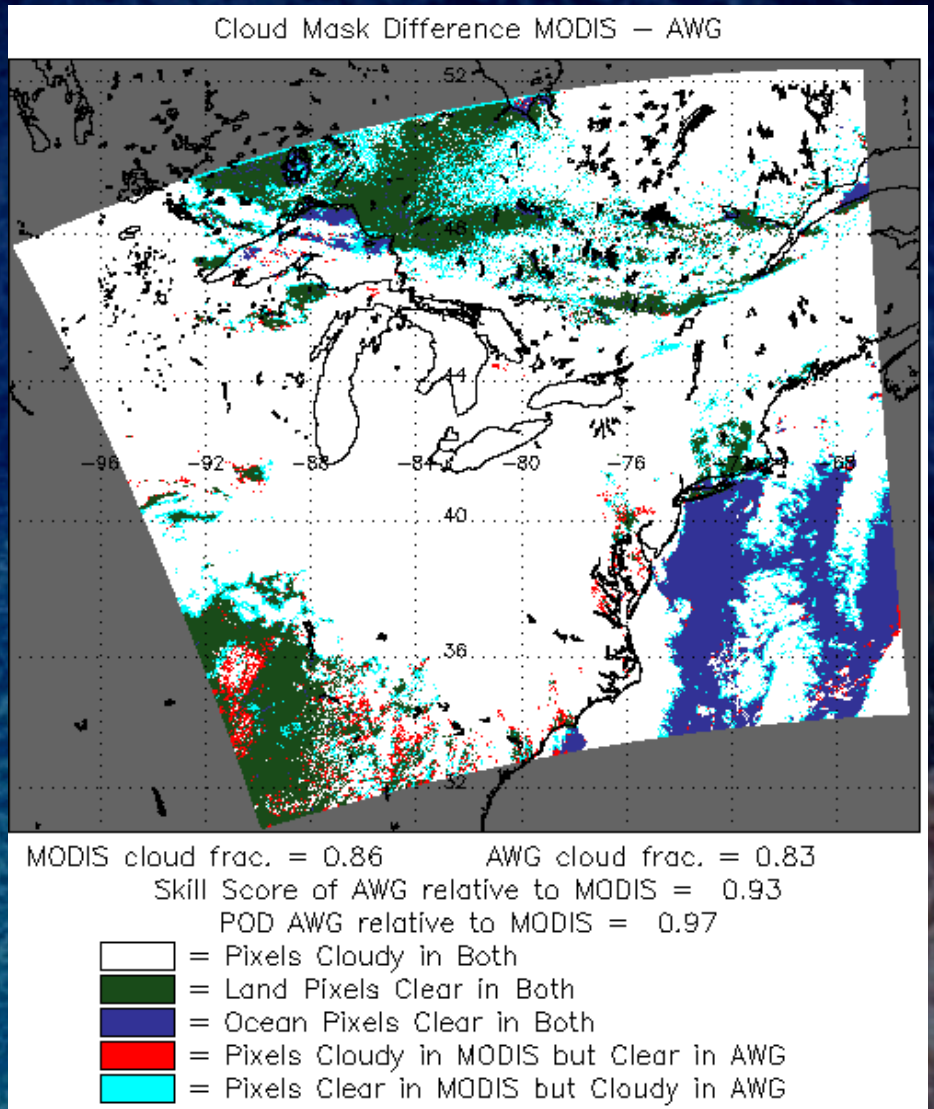


Inter-satellite (LEO) ACM Comparison

- *The MODIS cloud mask from NASA (developed at CIMSS) provides a well-characterized mask designed for an advanced imager.*

- *The image on the right shows a comparison of the ACM run on data from AQUA as compared to the MODIS cloud mask from that scene.*

- *This can be done with any polar orbiting satellite (NASA EOS, JPSS, Metop) that has a cloud mask product.*

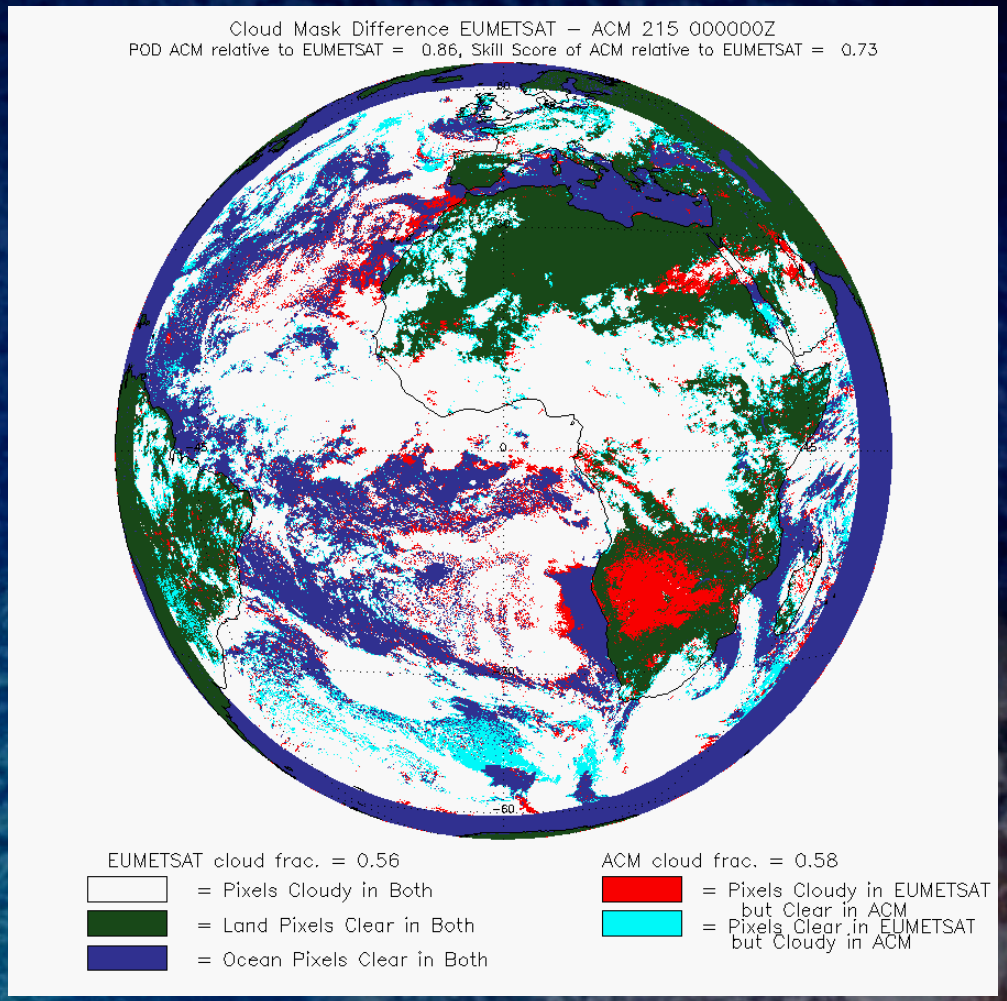


Inter-satellite ACM Comparison

- *The EUMETSAT Meteorological Product Extraction Facility (MPEF) Cloud Mask cloud mask provides a well-characterized mask designed for the imagery used as proxy*

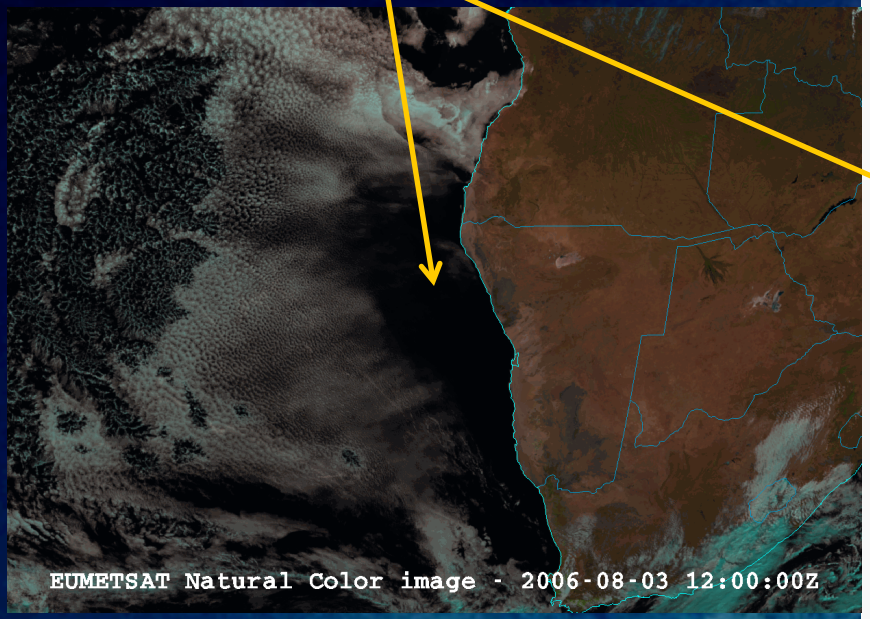
- *The animation on the right shows a comparison of the ACM run on data from SEVIRI as compared to the EUMETSAT cloud mask from that scene.*

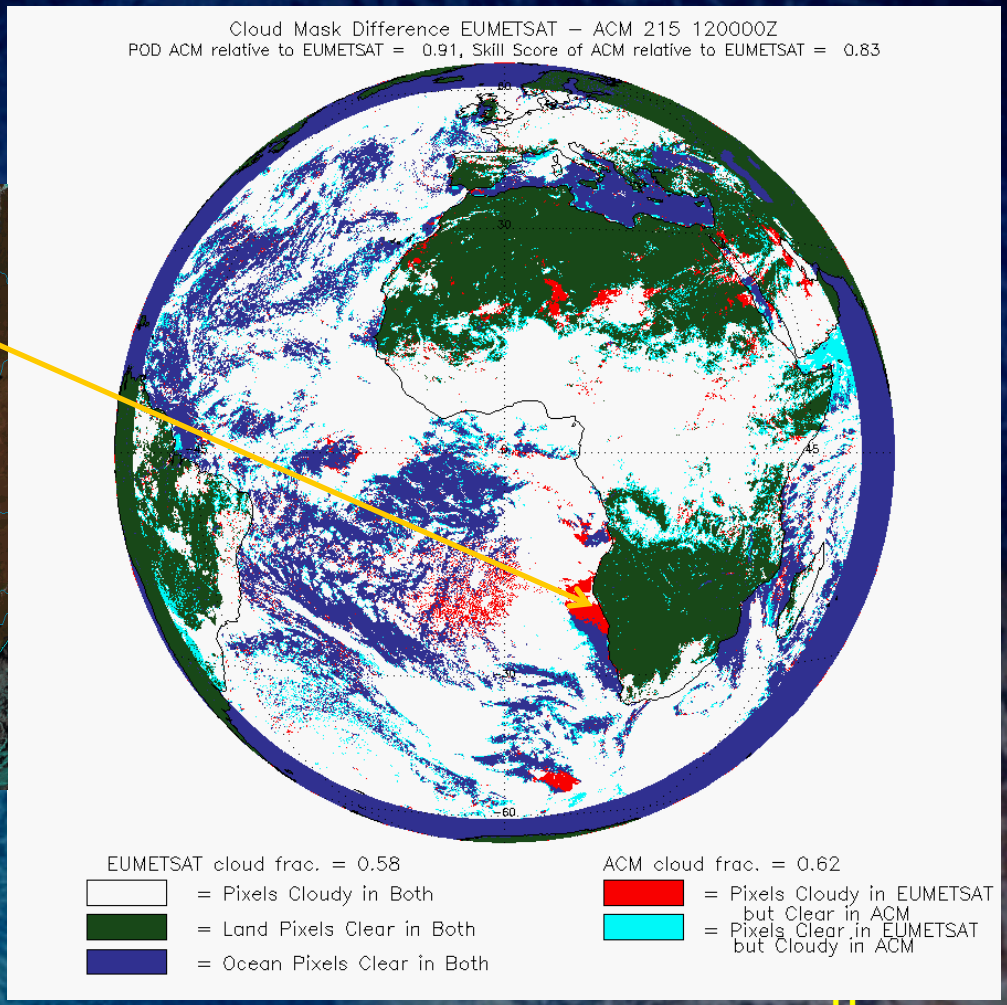
- *Inter-satellite comparisons of cloud mask (and other products) can provide insight as to deficiencies and improvement in both products (next slide)*



Inter-satellite ACM Comparison

False cloud in EUMETSAT product off coast of Nambia





Ideas for the Further Enhancement and Utility of Validation Tools

- Combining Efforts to Validate Against CALIPSO
  - Many algorithm leads have their own CALIPSO capabilities.
  - We have modified our ACM validation tool to use the AWG-funded UW/SSEC CALIPSO matchup files. Results were the same but there is more information in the UW/SSEC files.
- Cloud Validation Web-Site.
  - While the CIMSS sites offered good imagery for visual inspection, we don't have a near real-time or automated CALIPSO validation. We need this.
  - ICARE is a good example.
- McIdas-V
  - We are discussing with the McIDAS-V team on how to validate with CALIPSO data
  - Would like to see ability to read in ARM and other space and ground-based lidars

Summary

- ACM validation against other cloud mask is mature.
- Final validation of the ACM needs to be done in the context of its use by the downstream algorithms.
- Beyond the SST team (which took an active role in ACM), this has not been done.
- Guidance from the other Application Teams are needed if we are to develop Application-specific ACM validation tools.