NOAA GOES-R AWG Cloud Height Algorithm (ACHA)

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Algorithm Description

- ACHA was developed originally for GOES-R and will be the operational algorithm and provide height information to the GOES-R AMV algorithm.
- Since the GOES-R effort, ACHA was modified to support AVHRR, MODIS, VIIRS, GOES-IM, GOES-NOP, MTSAT, SEVIRI, COMS and GOES-Sounder.
- Runs in NOAA Operations now in CLAVR-x.
- Part of the PATMOS-x Climate Data Set and comparisons to other algorithms can be seen in the CREW/ICWG and GEWEX Cloud Assessment Reports.
- ACHA is an Optimal Estimation Algorithm that uses a fast IR model for clear-sky calculations and analytical radiative transfer approximations. As a result, ACHA is relatively fast.
- Multi-layer clouds are accounted for by treating the lower cloud layer as an elevated "surface".
- ACHA also derives cloud optical depth, particle size and the "true" top and base heights.

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ACHA Methods to Improve Edge Performance

- We recognize that AMV applications use cloud edges for tracking and therefore cloud edge performance is key.
- Cloud edges usually are thin and often include sub-pixel variability that prohibits retrievals using spectral information from the pixel alone.
- ACHA does the following steps to improve edge performance:

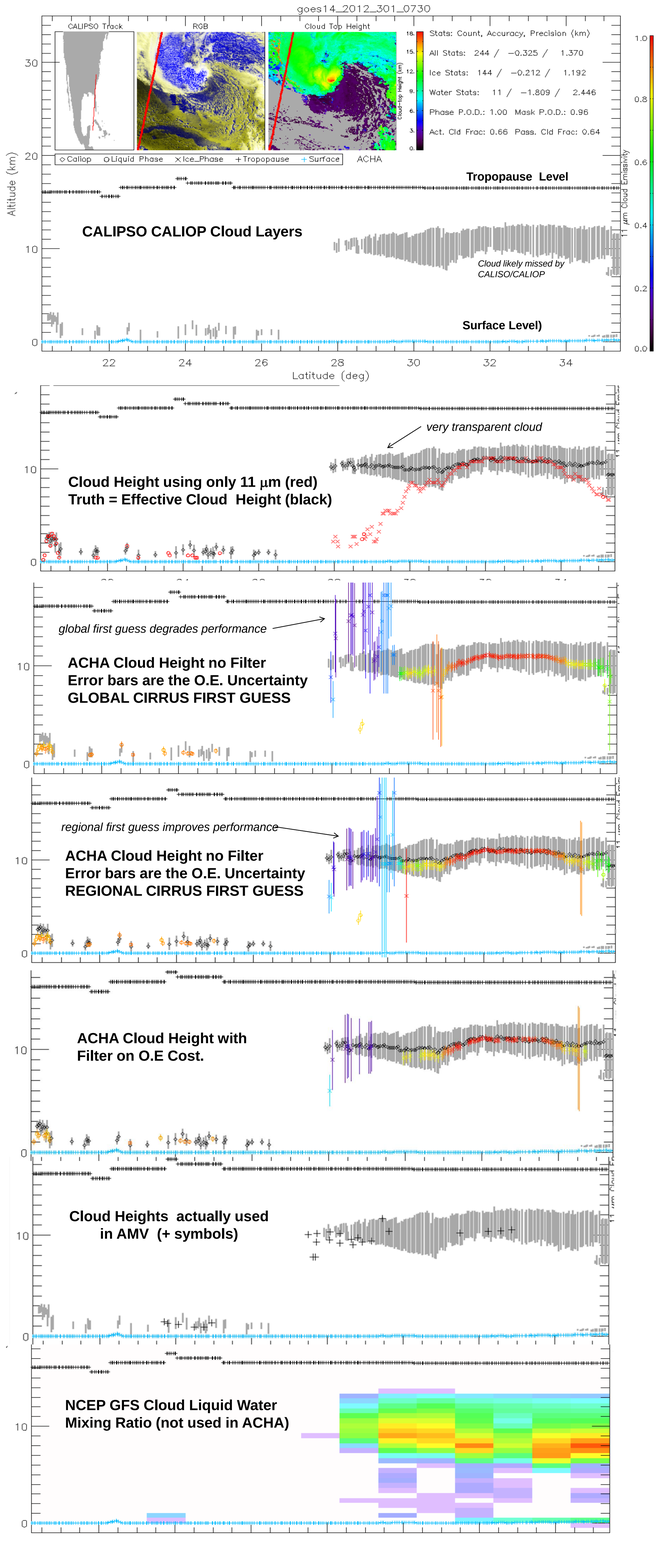
1. *For pixels near a opaque part of a cloud, use the opaque pixel results as first guess for the edge.*
2. *Construct a cirrus height field using all opaque cirrus results within a larger region (250 km). Use this as first guess when #1 fails. (REGIONAL FIRST GUESS)*
3. *If #1 and #2 fail, use GLOBAL FIRST GUESS based on a climatology of CALIPSO cirrus heights.*

- These edge methods played a big role in the Hurricane Sandy example shown here.

Conclusions

- ACHA meets the GOES-R specifications but further work is needed to optimize its performance for AMV. These improvements include:
  - Edge performance
  - Temporal stability
  - Multi-layer performance
  - More useful uncertainty estimates and diagnostic flags
- The IWWG is welcomed and encouraged to collaborate with the Cloud Height Working Group of the ICWG and help the cloud retrieval community make progress in supporting AMVs.

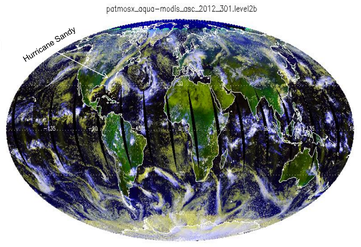
Example of GOES ACHA Performance Relative to CALIPSO for Hurricane Sandy October 2, 2012



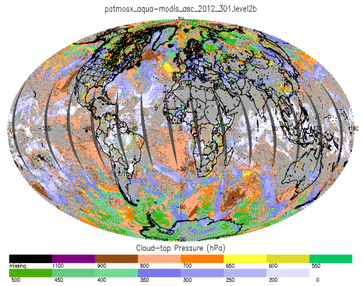
Spectral Content Sensitivity. Using MODIS/AQUA to Simulate ACHA Performance on GOES-R, VIIRS and GOES-13

MODIS provides many IR bands that allow ACHA to simulate multiple sensors. Data from four days in 2012 (one day in January, April, July and October) and MODIS/AQUA used here. Here we simulate ACHA running on the following sensors with IR channels as listed:

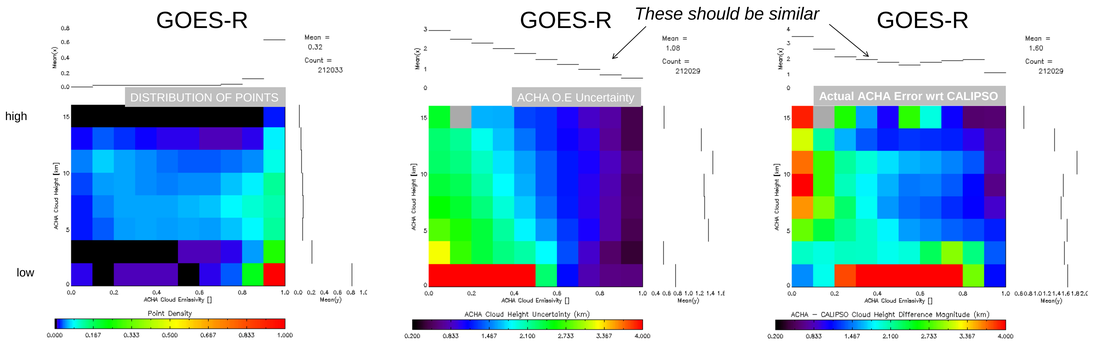
GOES-R = 11, 12, 13.3 μm
VIIRS = 8.5, 11, 12 μm
GOES-13 = 6.7, 11, 13.3 μm



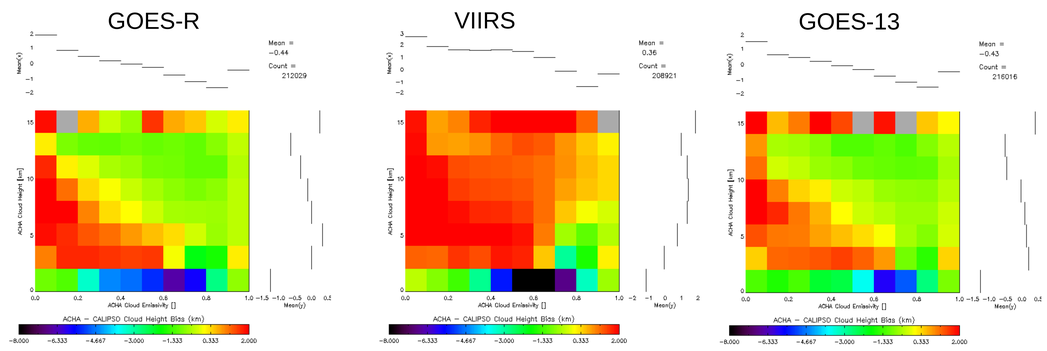
Example MODIS/AQUA ACHA Output



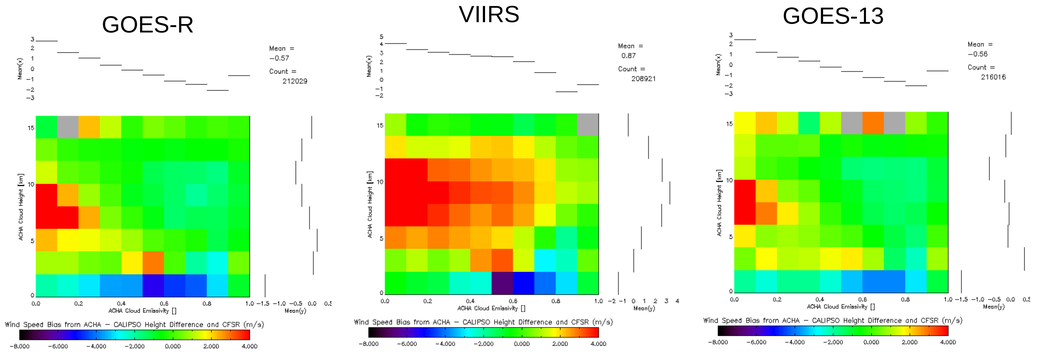
Comparison of ACHA Height Uncertainties to Observed ACHA-CALIPSO Differences



Distribution of ACHA – CALIPSO Height Biases as a Function of Spectral Channels



Distribution of ACHA – CALIPSO Height Biases Expressed as NCEP/CFSR Wind Speed Biases



NASA CALIPSO/CALIOP data provided by http://www-calipso.larc.nasa.gov/

Real-time ACHA Products are available at http://cimss.ssec.wisc.edu/clavr