Operational Cloud Detection Systems in the NPOESS GOES-R Era

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INTRODUCTION

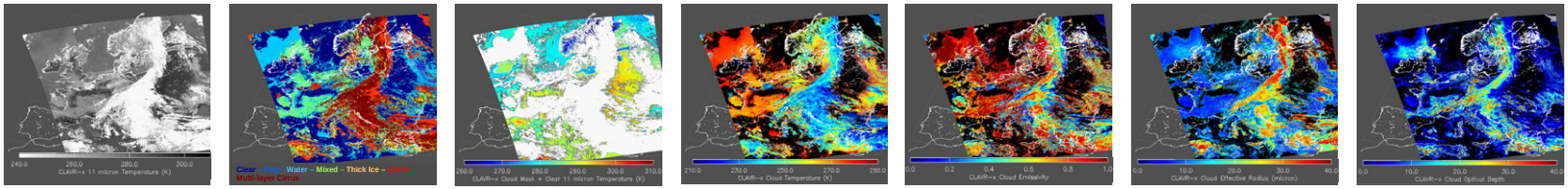
The NOAA National Environmental Satellite, Data, and Information Services (NESDIS) Extended Clouds from AVHRR (CLAVR-x) is a processing system used to detect clouds at the pixel level in the AVHRR data and to derive needed cloud properties. CLAVR-x meets the constraints of real-time processing with a minimal of ancillary data needed for real-time applications and generates global cloud products requested by NOAA's customers. It serves multiple AVHRR applications and provides clear and cloudy pixels and cloud properties with enough quality control to allow for accurate estimation of both clear and cloudy environmental data records.

CLAVR-x will be extended and adapted to use data from the NPOESS Visible Infrared Imager / Radiometer Suite (VIIRS) of instruments and data from the GOES-R Advanced Baseline Imager (ABI).

CLAVR-x FEATURES

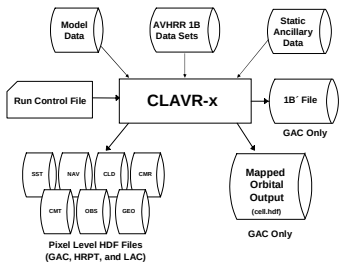
- Reports cloud mask in 4 levels: clear, probably clear, probably cloudy and cloudy.
- Uses spatial uniformity tests to reduce cloud contamination in clear and cloudy pixels and produces six cloud types: fog, water, super-cooled water, opaque ice, cirrus and multi-layer cirrus.
- Uses NWP, SST weekly analyses and a Fast RTM model (PFAST) in cloud detection, property estimation and product generation such as optical depth and particle size regionally at 1 km and globally at 4 km pixel and 55 km grid.
- Derives day time Cloud Optical Depth and Effective Radius from a 1D Var approach using 0.63 and 1.6 or 3.75 μm observations.
- Uses a split-window approach to estimate cloud temperature and emissivity.
- Details: http://cimss.ssec.wisc.edu/clavr

Example: CLAVR-x Cloud Properties – NOAA-18, ASC, April 28, 2006

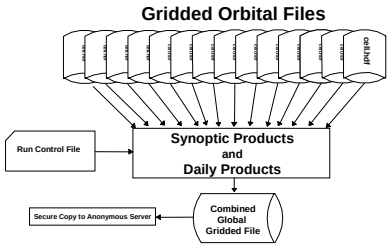


Wavelength Center (μm)		
AVHRR	**NPOESS/VIIRS**	**GOES-R/ABI**
	0.412	
	0.445	0.47
	0.488	
	0.555	
0.58 – 0.68	0.640	0.64
	0.672	
	0.746	
0.725 – 1.10	0.865	0.865
	0.7	
	1.24	
	1.38	1.378
1.58 – 1.64	1.61	1.61
	2.25	2.25
	3.70	
3.55 – 3.93	3.74	3.90
	4.05	
		6.19
		6.95
		7.34
	8.55	8.50
		9.61
		10.35
10.30 – 11.30	10.76	11.20
	11.45	
11.50 – 12.50		12.30
		13.30

Orbital Processing Configuration



Multi-Orbit Processing



Pixel Level Output

- **AVHRR 1B** pixel level cloud mask (input to radiation budget)
- **HDF Files**

SST – high resolution SST data
NAV – latitude and longitude (needed for SST mapping)
CLD – pixel level cloud properties
CMR – cloud mask results (more information than in the 1B´)
CMT – complete cloud mask test results (24 values)
OBS – calibrated channel observations
GEO – sensor and solar zenith angles

- Cloud 11 micron emissivity
- Cloud 0.63 micron optical depth (day)
- Cloud effective particle size (day)
- Surface Temperatures (Land, Ice)
- Normalized Difference Vegetation Index
- Split window total precipitable water

Gridded Level Products

- Cloud Amounts (Total, water, ice, high, mid, low)
- Mean and statistical distribution of pixel level properties
- Radiance statistics for each cloud mask value (clear, cloudy)
- Global Precipitation Index

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