Overlapping Cloud Retrieval Using VIIRS

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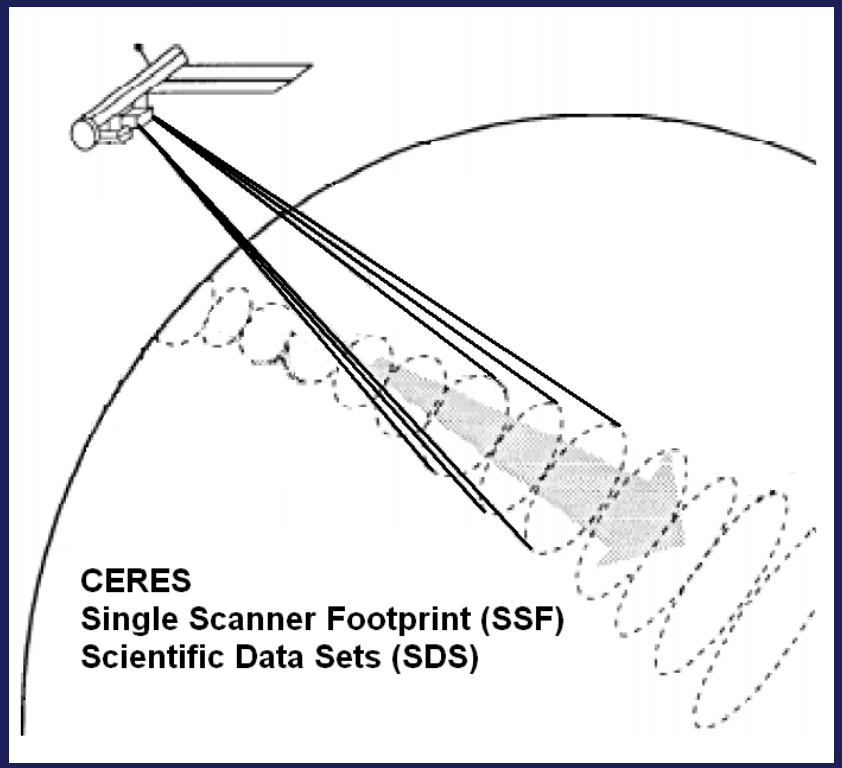
Outline

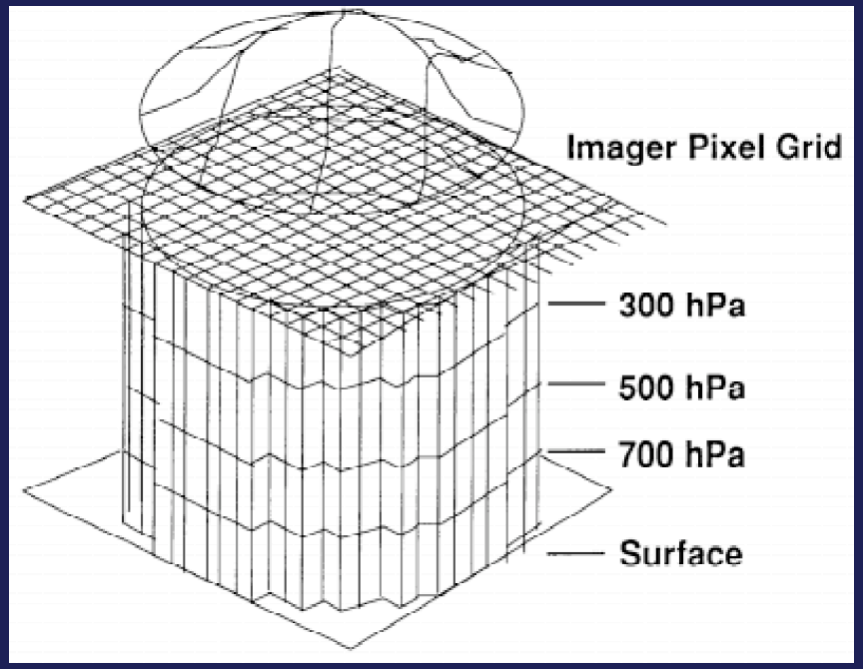
- Introduction and Motivation
  - CERES-MODIS to CERES-VIIRS
- Objective
- Preliminary Results
- Summary
  - Current Status

Clouds and the Earth's Radiant Energy System (CERES)

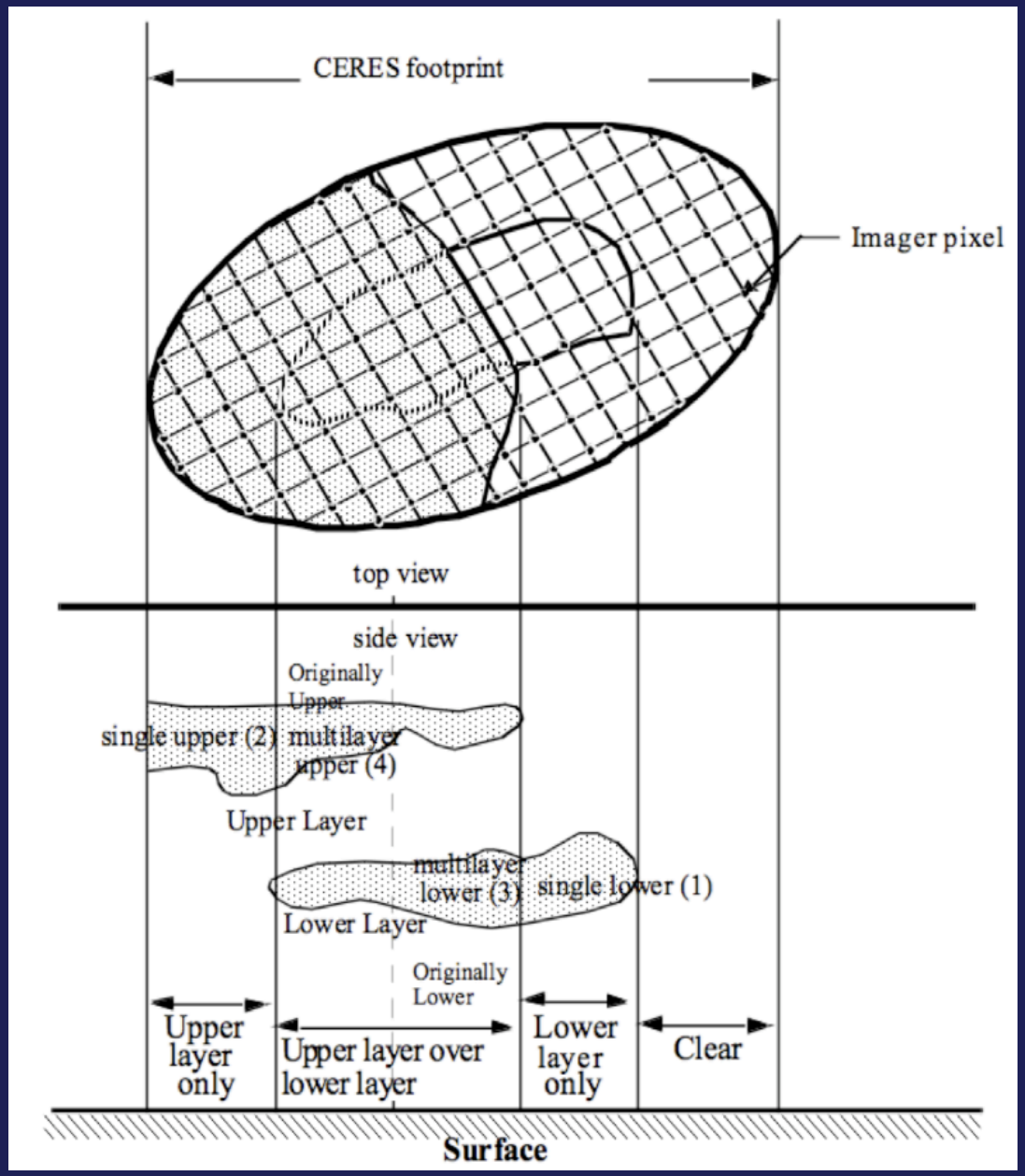
CERES is a key part of NASA's Earth Observing System. It provides:

- Long-term global radiative fluxes from the top of the atmosphere (TOA) to the earth's surface; and
- Consistent cloud property retrievals from the imager pixel gridded data.





CERES Multilayer Cloud Properties



Within a CERES footprint:

- Single- and multi-layered cloud fractions and their associated layer mean cloud properties:
- Fractions of single-layer upper clouds with Pc < 500 mb;
- Fractions of single-layer lower clouds with Pc > 500 mb;
- Fractions of multi-layered clouds with the upper-layer Pc < 500 mb and the lower-layer Pc > 500 mb.

Motivation – The Data Spatial Resolution

Objective

- Develop a new multispectral multilayer algorithm for use with the VIIRS data to:

  - Identify pixels containing overlapped cirrus and water clouds; and

  - Retrieve separately the cirrus and water cloud properties for the overlapping pixel.

- Study the new VIIRS algorithm with use of the CERES/MODIS data to:

  - Test the “VIIRS” multilayer retrieval algorithm; and

  - Compare the “VIIRS” multilayer results with those obtained based on the CERES CO_2 multilayer algorithm.

Algorithm Framework

Suomi-NPP CERES

Retrieve upper cirrus cloud properties using VIIRS

↓

Estimate overlapping lower water cloud properties based on total cloud optical depth

↓

Iterate and determine the multilayered upper-cirrus and lower-water cloud properties

Aqua/Terra CERES

Retrieve upper cirrus cloud properties using MODIS

↓

Estimate overlapping lower water cloud properties based on total cloud optical depth

↓

Iterate and determine the multilayered upper-cirrus and lower-water cloud properties

VIIRS Bands

VIIRS Band	Central Wavelength (μm)	Wavelength Range (μm)	Spatial Resolution
I1	0.64	0.6-0.68	0.375 km (& 0.75 km)
I3	1.61	1.58-1.64	
I4	3.74	3.55-3.93	
I5	11.45	10.5-12.4	
M3	0.488	0.478-0.488	0.75 km
M4	0.555	0.545-0.565	
M5	0.672	0.662-0.682	
M7	0.865	0.846-0.885	
M8	1.24	1.23-1.25	
M9	1.378	1.371-1.386	
M10	1.61	1.58-1.64	
M11	2.25	2.23-2.28	
M12	3.70	3.61-3.79	
M14	8.55	8.4-8.7	
M15	10.763	10.26-11.26	
M16	12.013	11.54-12.49	
DNB	0.7	0.5-0.9	0.75 km

Ice over Water Cloud Properties

- The determined overlapping cloud properties: (same parameters as the CERES Edition 4)

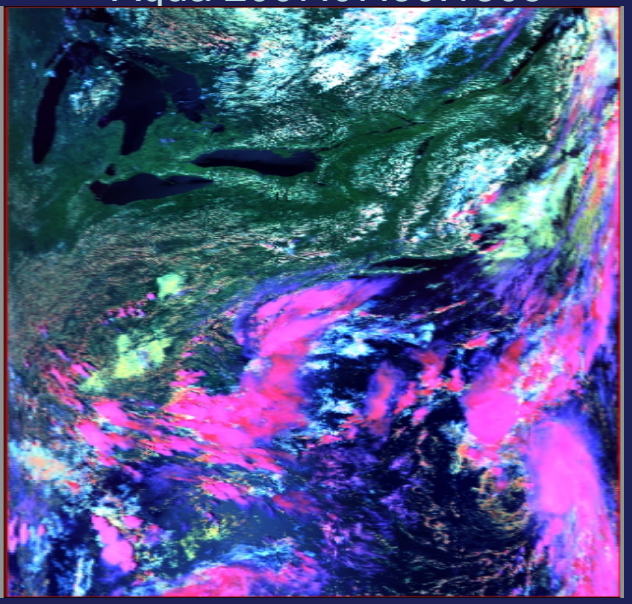
Upper Layer (Ice Cloud)	Lower Layer (Water Cloud)
Cloud Top Pressure	Cloud Top Pressure
Cloud Top Temperature	Cloud Top Temperature
Cloud Top Height	Cloud Top Height
Cloud Visible Optical Depth	Cloud Visible Optical Depth
Cloud IR Emissivity	Cloud IR Emissivity
Ice Particle Effective Radius	Water Droplet Effective Radius

Preliminary Study Using MODIS Data

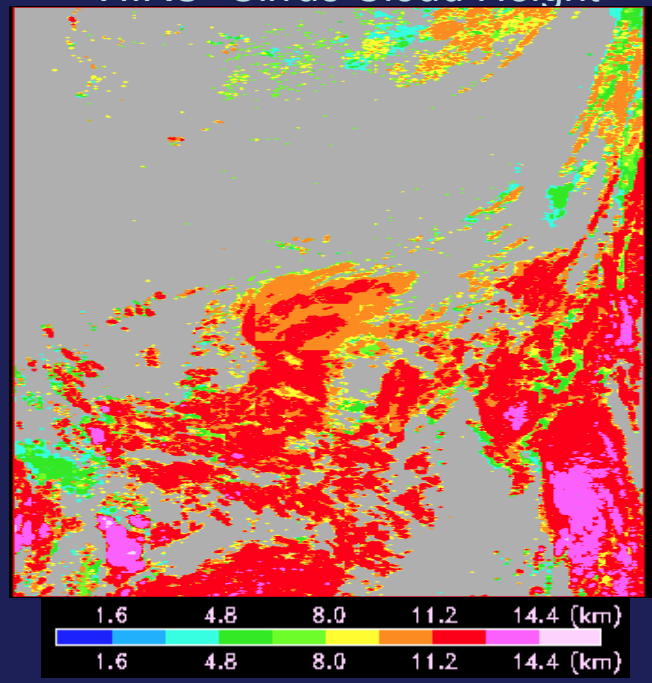
- The VIIRS study can be compared to our more experienced MODIS CO_2-slicing retrieval that is used as the benchmark results.
- The MODIS has easier manageable pixel-level data size for repeatedly algorithm testing and refinements.
- We are assessing the generally good cases (~90%) and also examining some tough cases (~10%).

Preliminary Results

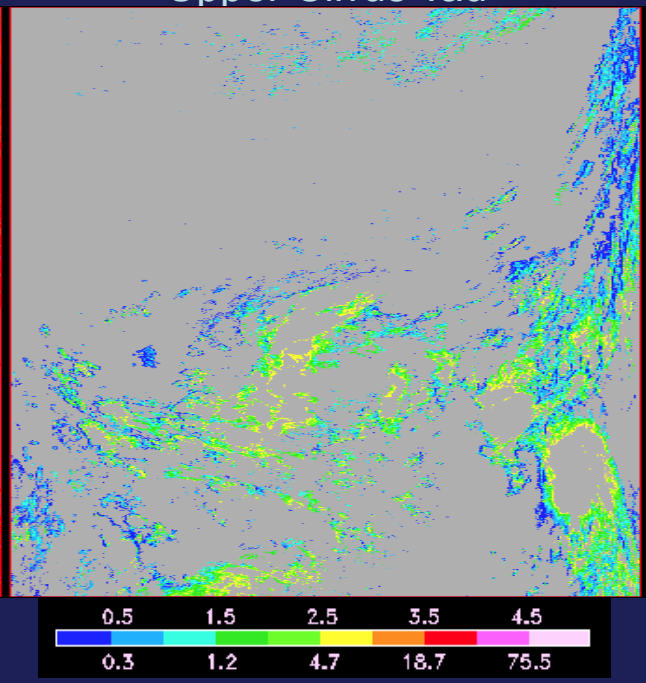
Aqua 2007.07.30.1805



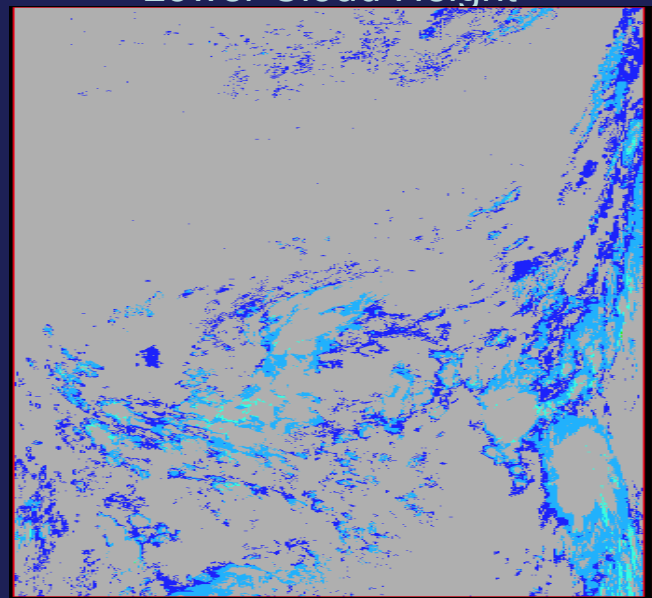
"VIIRS" Cirrus Cloud Height



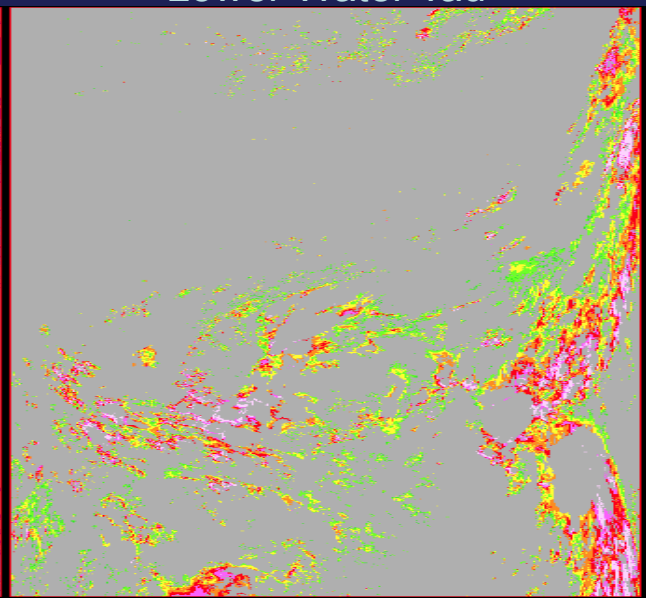
Upper Cirrus Tau



Lower Cloud Height

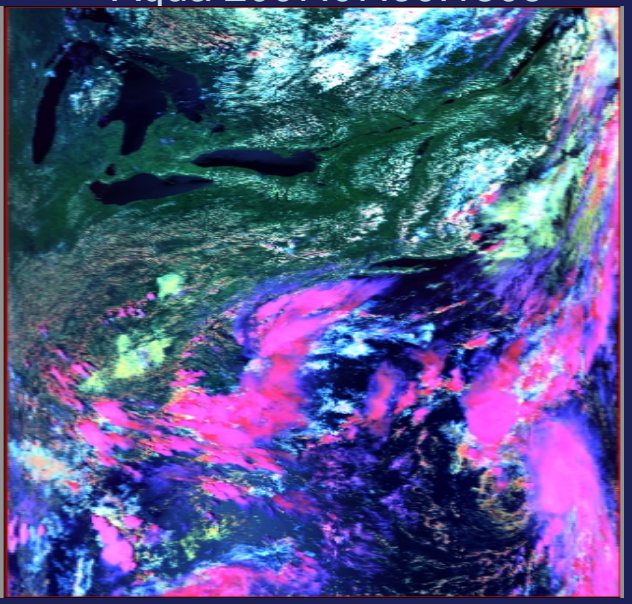


Lower Water Tau

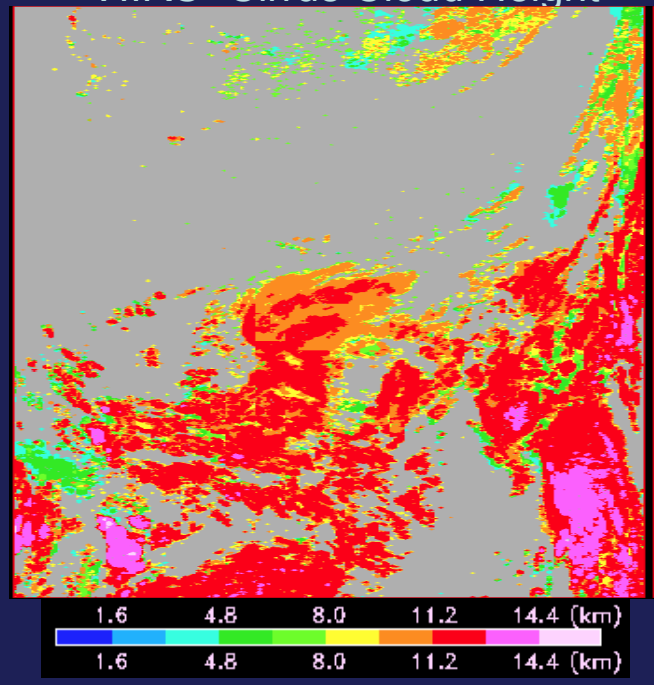


Comparisons

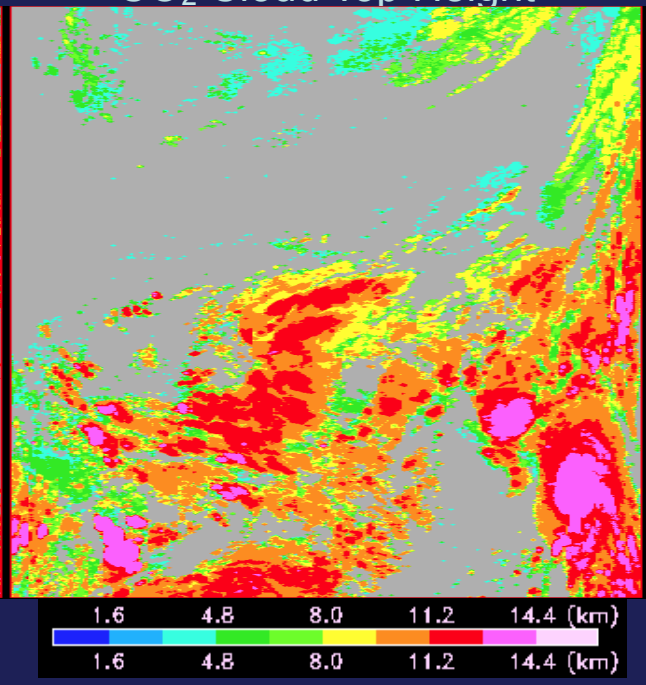
Aqua 2007.07.30.1805



"VIIRS" Cirrus Cloud Height



CO_2 Cloud Top Height



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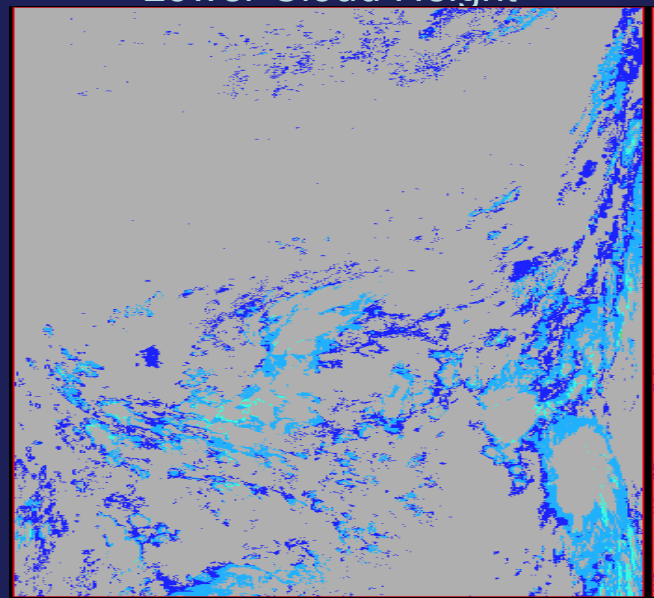

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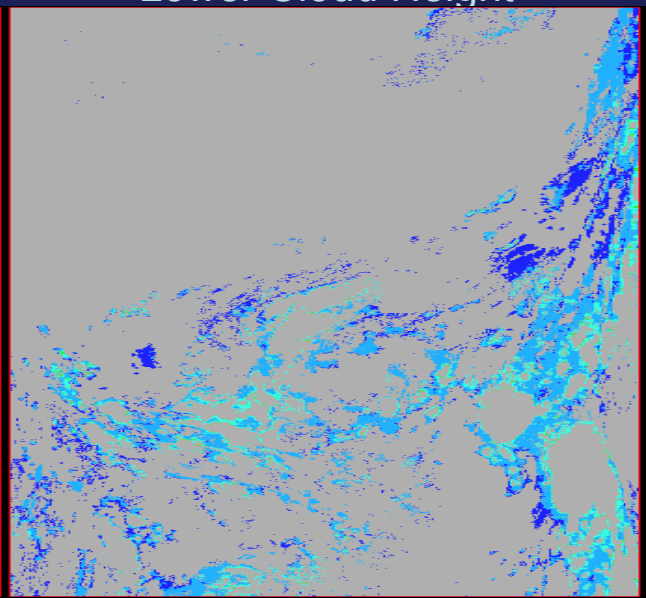

Comparisons

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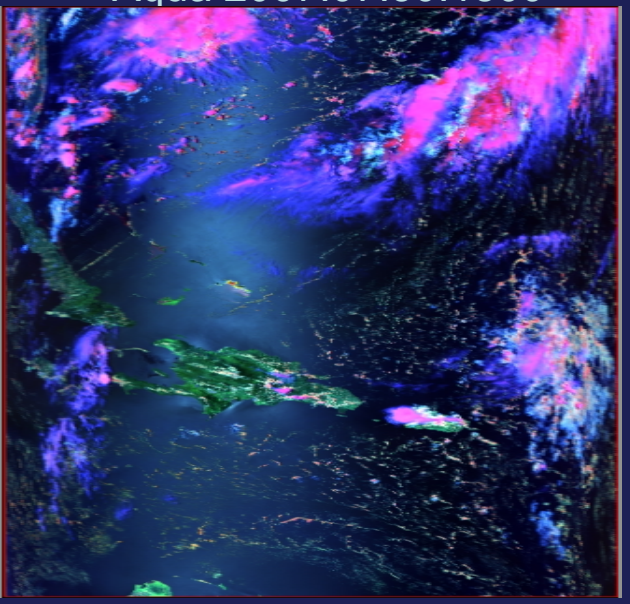
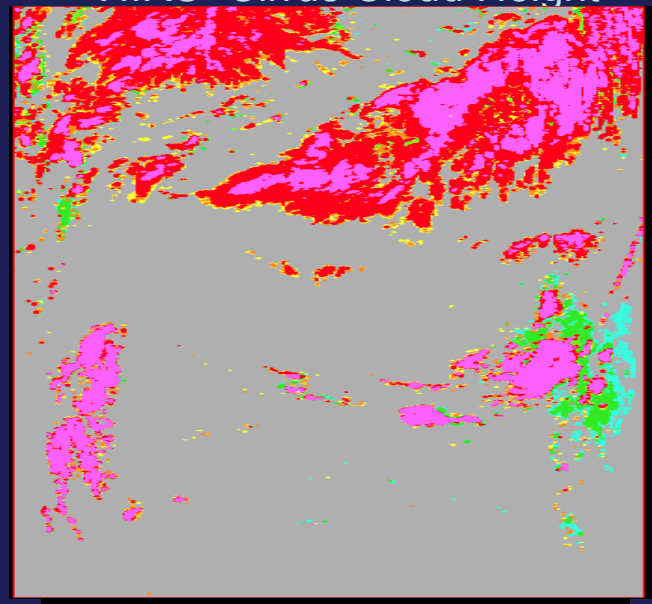
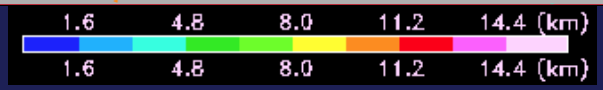
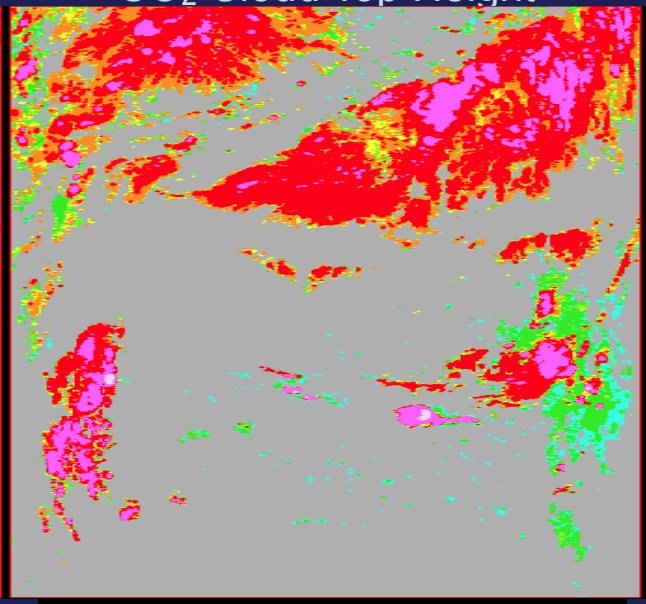


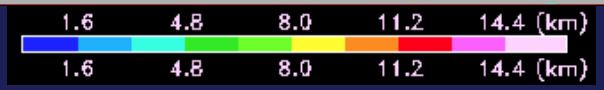
"VIIRS" Cirrus Cloud Height



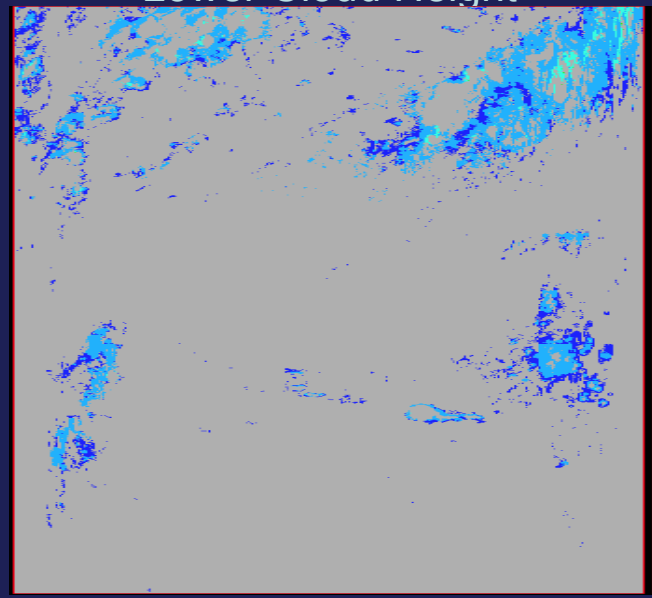


CO_2 Cloud Top Height

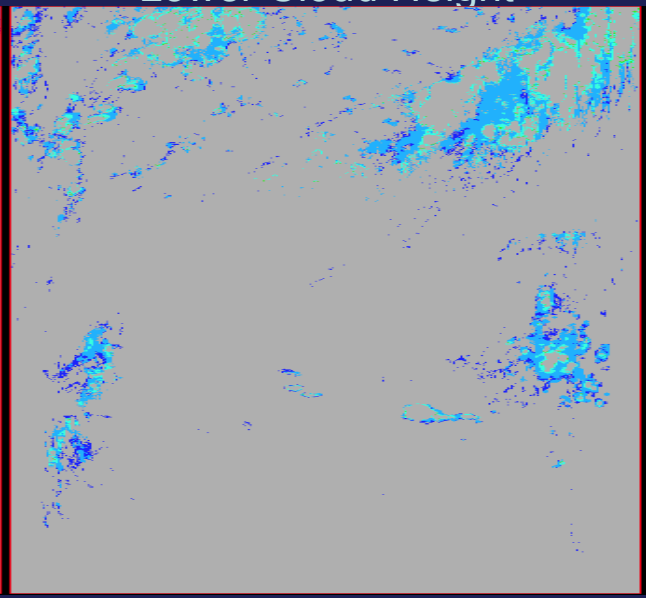




Lower Cloud Height



Lower Cloud Height



Comparisons

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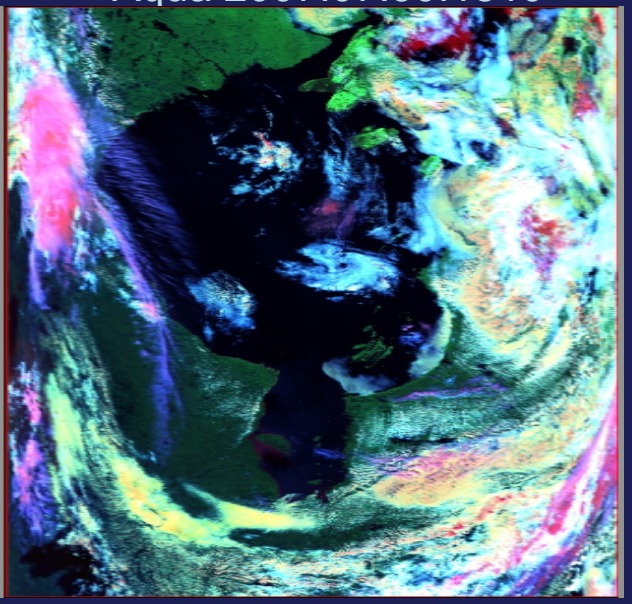
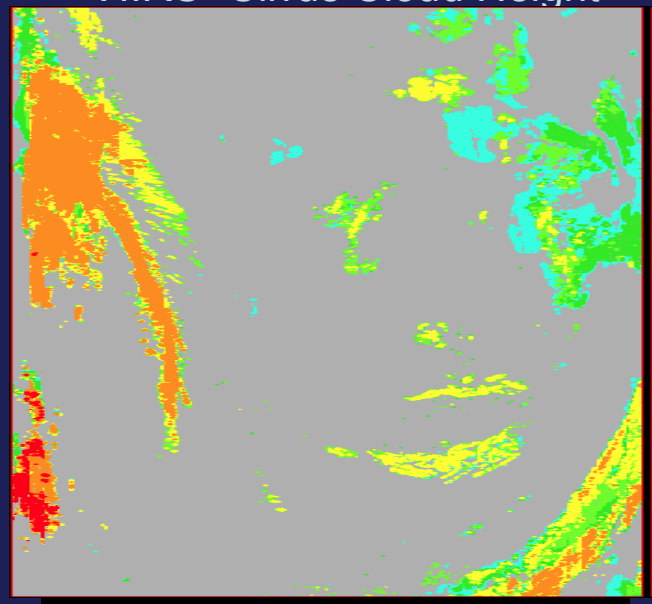
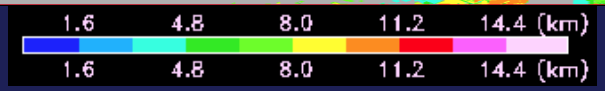
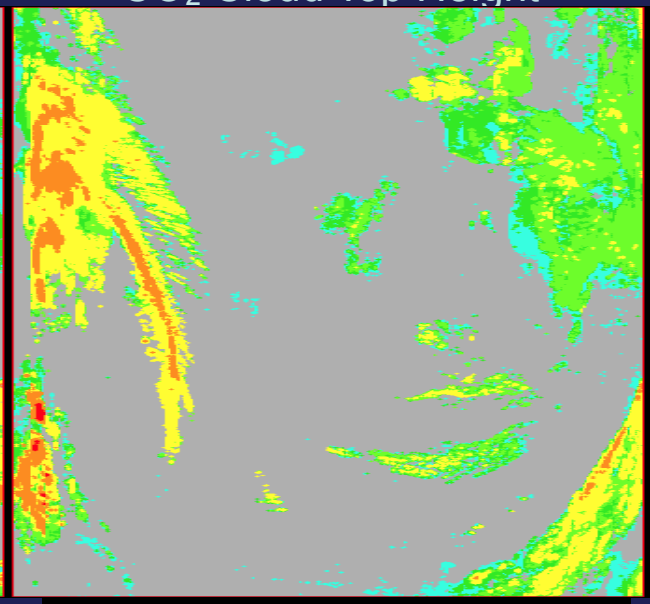


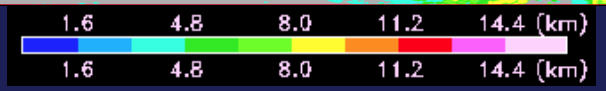
"VIIRS" Cirrus Cloud Height





CO_2 Cloud Top Height





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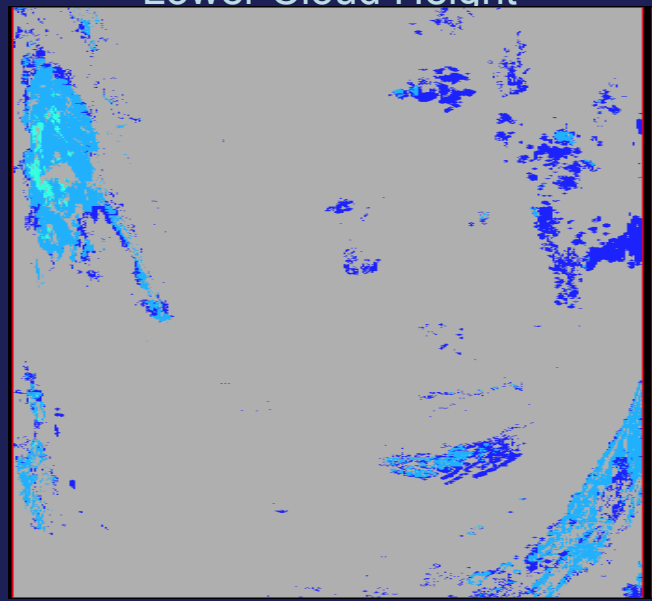

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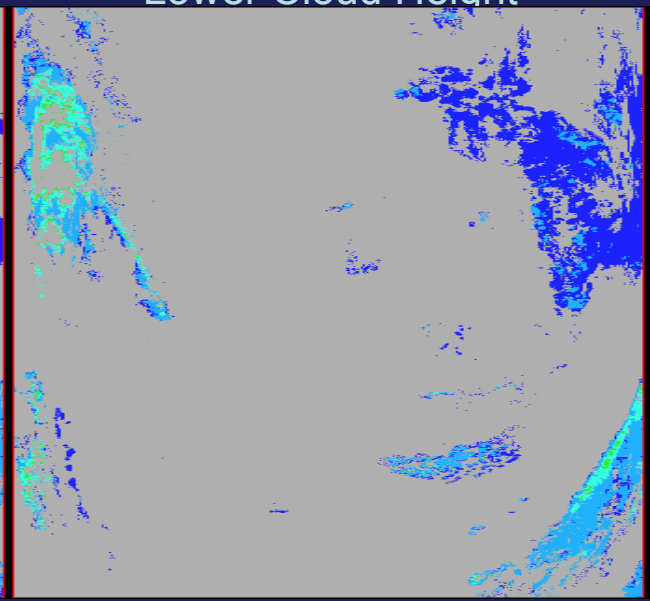

Comparisons

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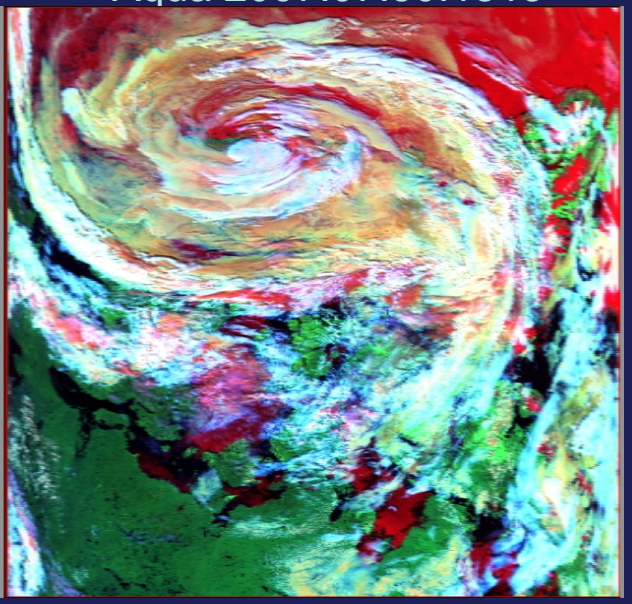
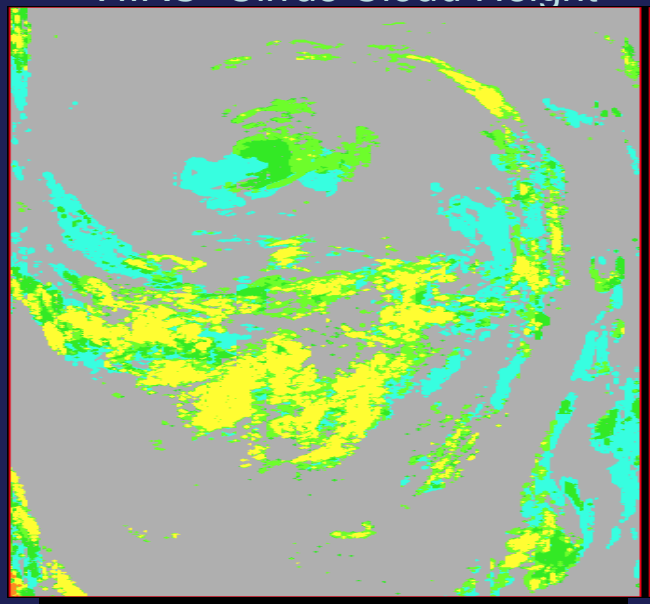
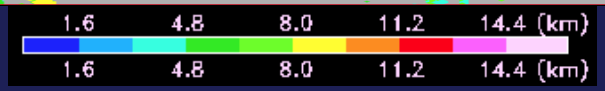
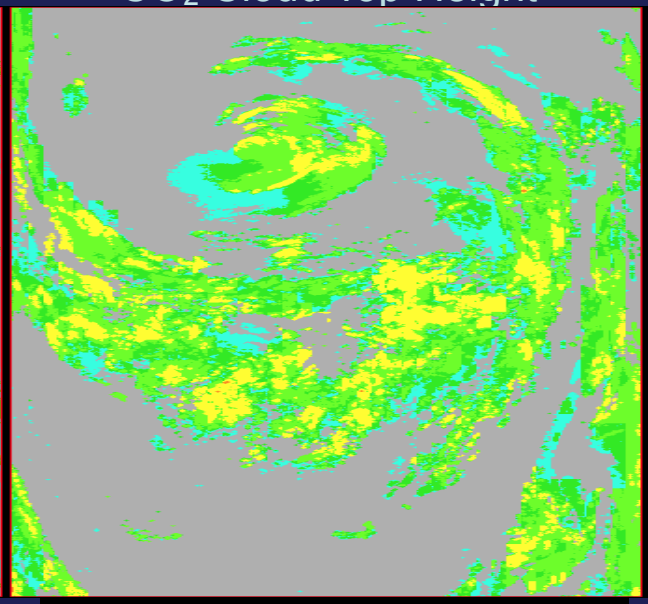


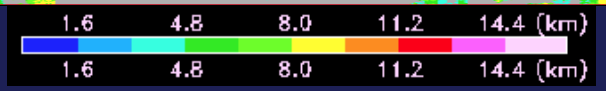
"VIIRS" Cirrus Cloud Height



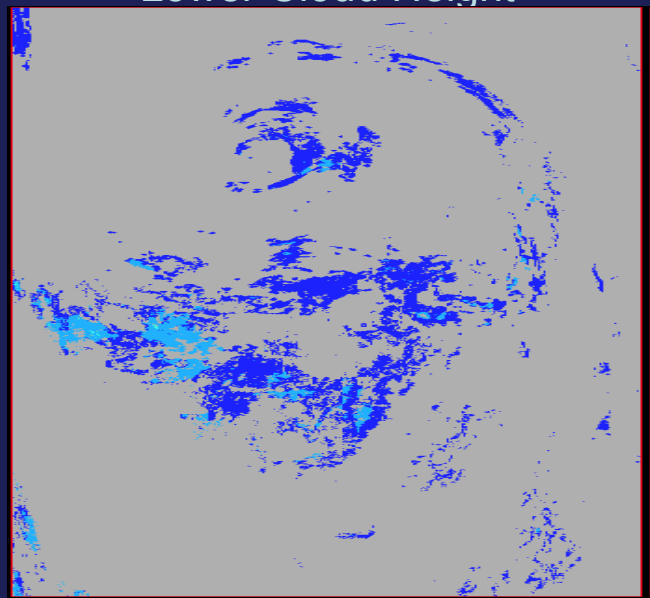


CO_2 Cloud Top Height





Lower Cloud Height



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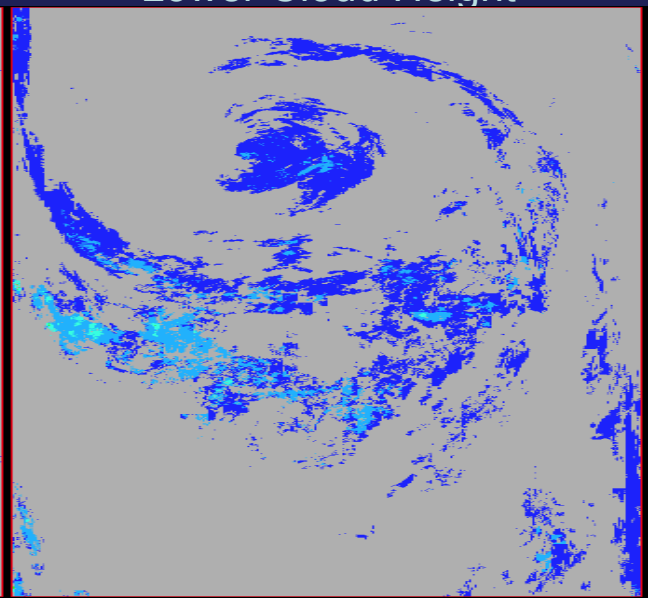

Comparisons

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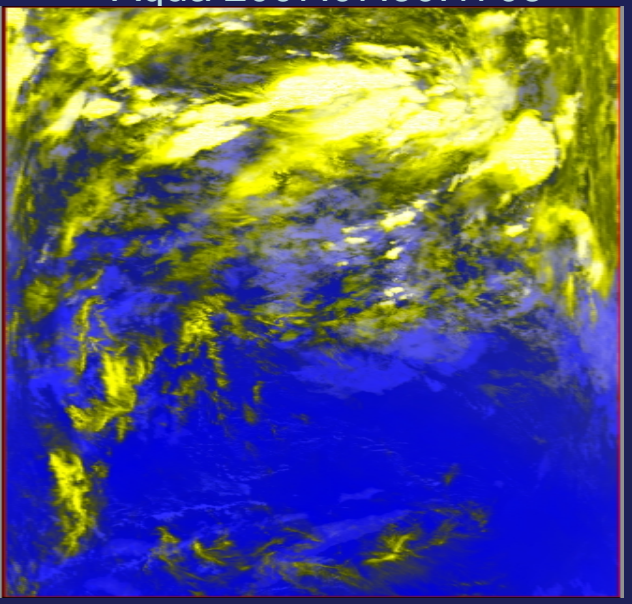
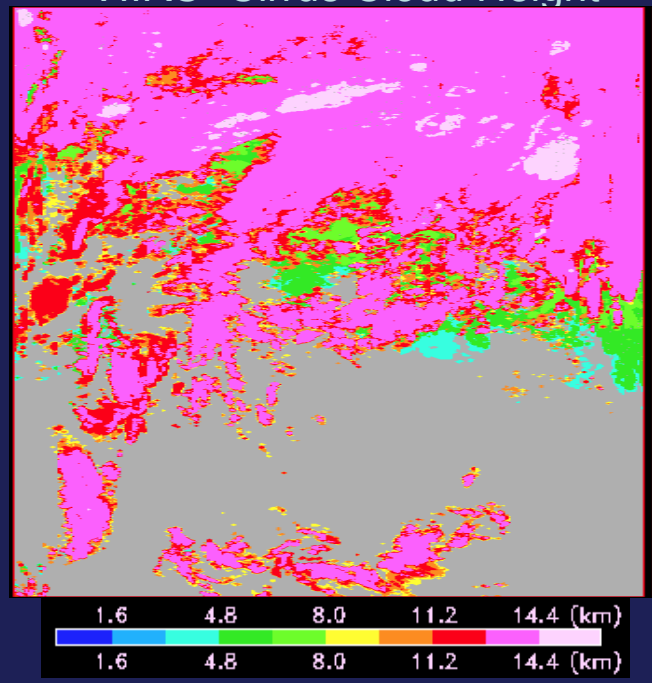
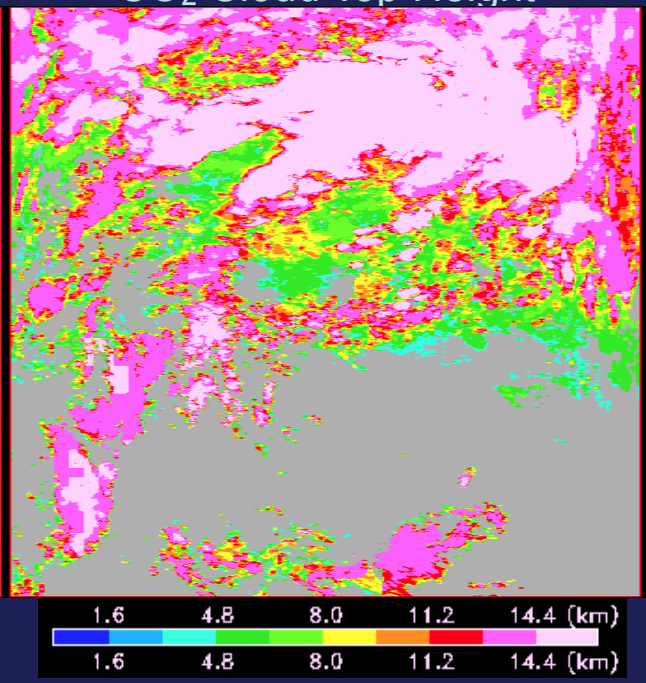


"VIIRS" Cirrus Cloud Height



CO_2 Cloud Top Height



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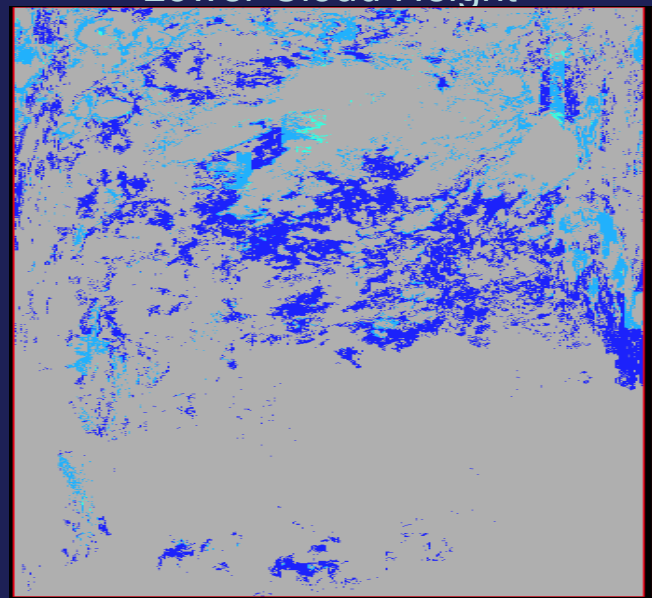

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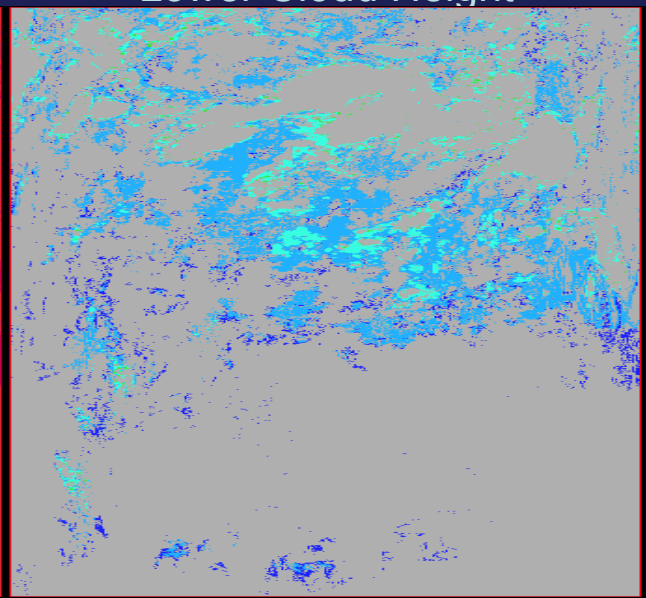

Summary – Current Status

- The new VIIRS multilayer cloud retrieval algorithm is currently under evaluation for its global applications.
- The preliminary comparisons showed that the "VIIRS-like" multilayer retrieval is compatible with the CERES CO_2 multilayer retrieval.
- The current plan is to deliver the algorithm code in a few weeks (according to code delivery deadline) for its testing within the CERES VIIRS framework.