MODIS/VIIRS Continuity IR-Cloud Top Properties (IR-CLDPROP)

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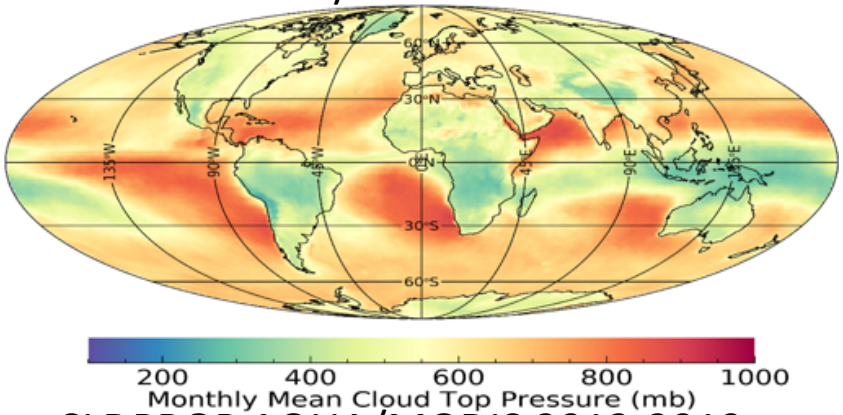
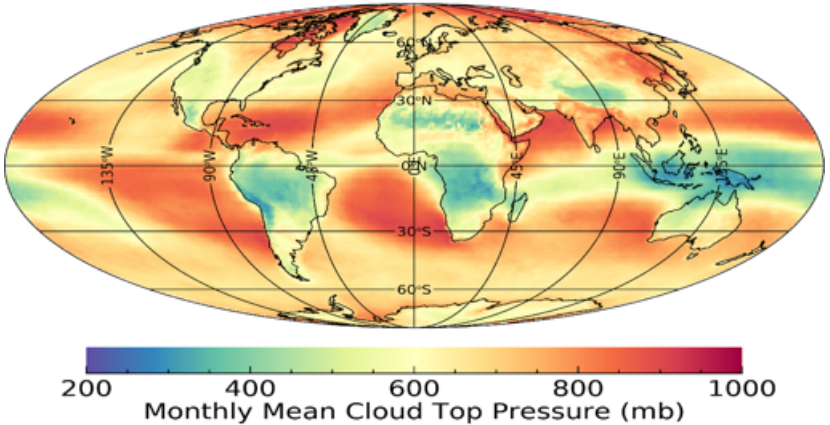
- The goal of the IR-CLDPROP is to generate a record of cloud macrophysical properties (**cloud top temperature-height-pressure**) and microphysical properties (**phase**, **emissivity**, **optical depth, particle size**) using the shared Longwave InfraRed (IR) observations from MODIS and VIIRS (8.5, 11 and 12 µm).

- Due to spectral differences in VIIRS and MODIS, CLDPROP can not run the traditional CO_2 Slicing Approach and adopted the NOAA Enterprise AWG Cloud Height Algorithm (ACHA).

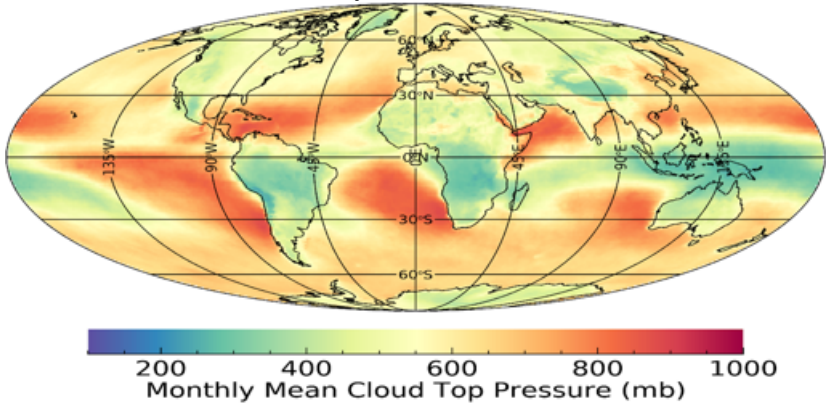
CLDPROP SNPP/VIIRS 2012-2019



C61AQUA/MODIS 2012-2019



CLDPROP AQUA/MODIS 2012-2019



The Challenge of Consistency

- The MODIS Science Approach to IR Cloud Properties was the CO_2 slicing method. This approach is ideal in that it *minimizes sensitivity to cloud microphysics and uncertainties with the surface.*

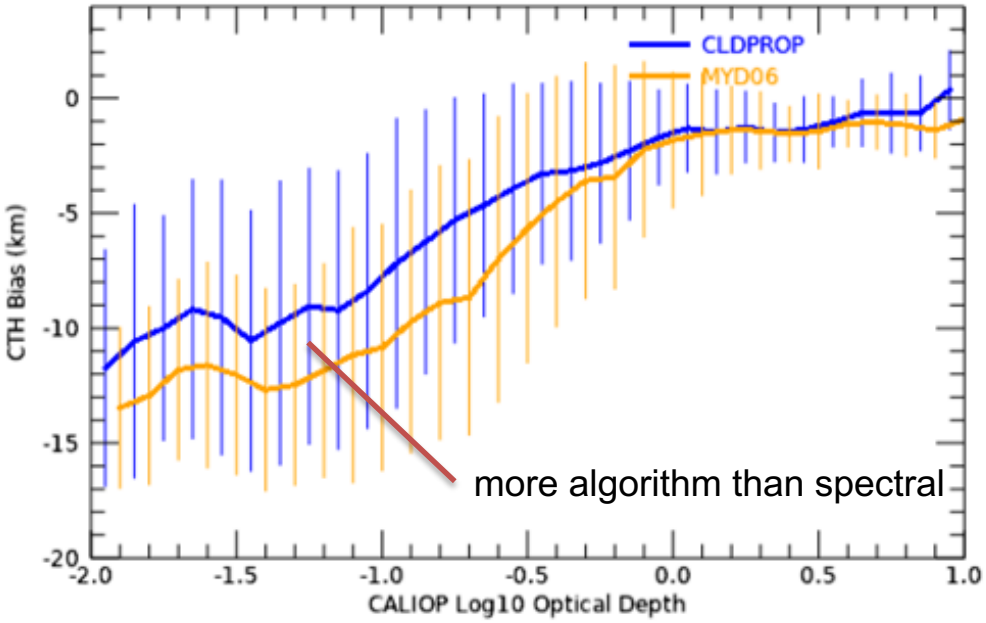
- VIIRS provides only IR window channels (8.5, 11 and 12 micron). This necessitates an IR algorithm that *must account for cloud microphysics and surface impacts.*

- Therefore, the approach used here (ACHA) retrieves not only the cloud emissivity but also the cloud particle size.

- Given these physical differences, we expect differences in the results (see Fig. to right).

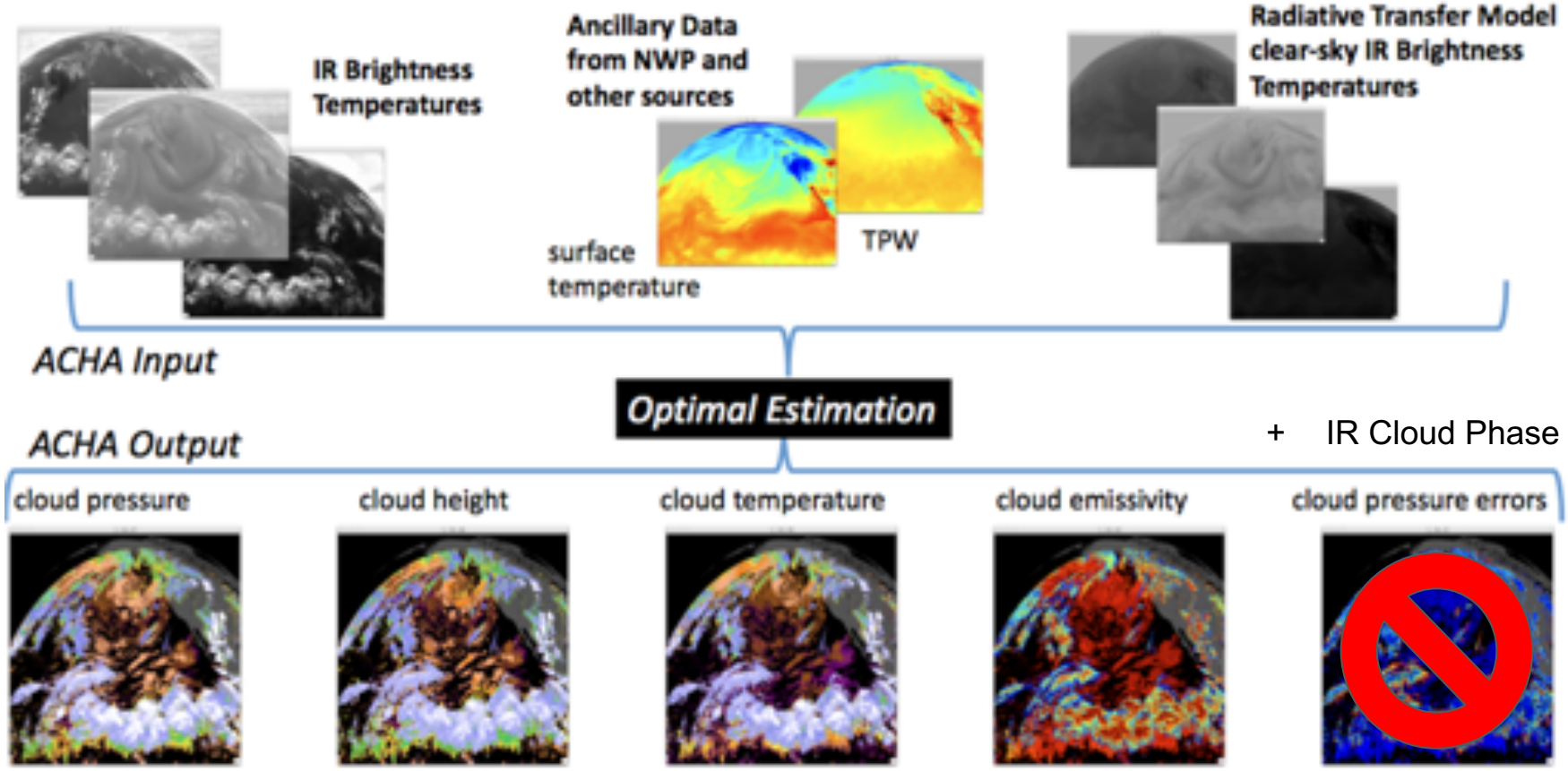
- See User Guide for detailed comparisons of CLDPROP and C61.

Cloud-Top Height Bias wrt CALIPSO/CALIOP for Ice Clouds



ACHA = NOAA Enterprise Cloud Height Algorithm

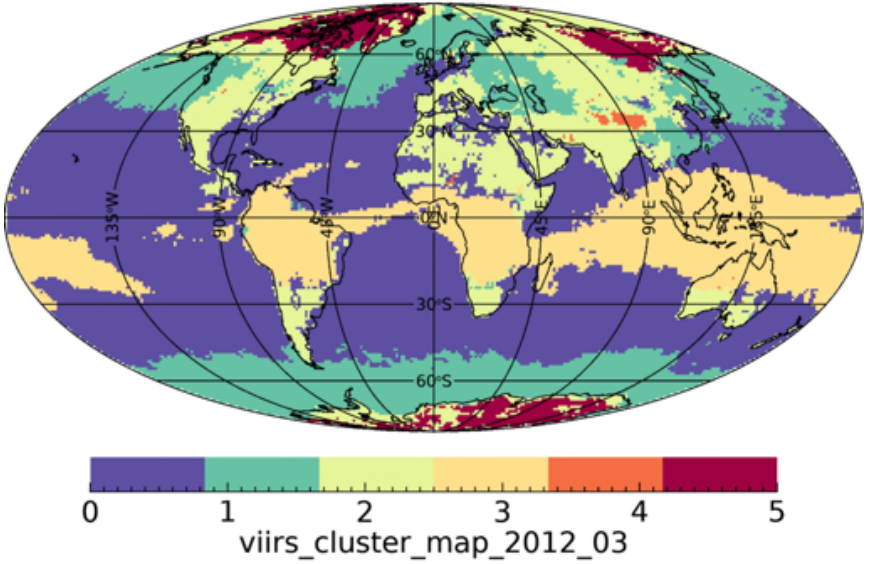
How AWG CLOUD HEIGHT (ACHA) Works



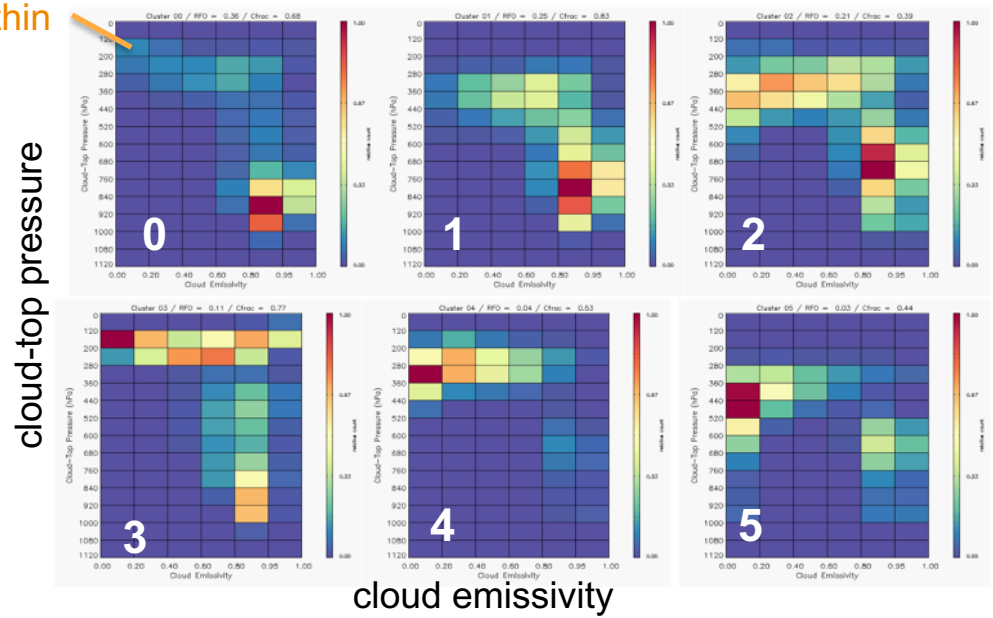
Using IR Weather States to Test MODIS/VIIRS CLDPROP Consistency

- The **CLDPROP_M3 data provides 2d histograms of cloud-top pressure and cloud emissivity** at 1°x1°
- We apply the concept of Weather States to these histograms (K-Means Clustering) and ask the question: ***Are the Weather States (WS) consistent in IR-CLDPROP data from MODIS and VIIRS?***
- Motivated by ISCCP cloud-top pressure / cloud optical depth WS from George Tselioudis (GISS).
- We chose to use 6 clusters and included cloud fraction as a discriminator (preliminary).

6 IR Weather States from CLDPROP_M3_VIIRS 2012-2019

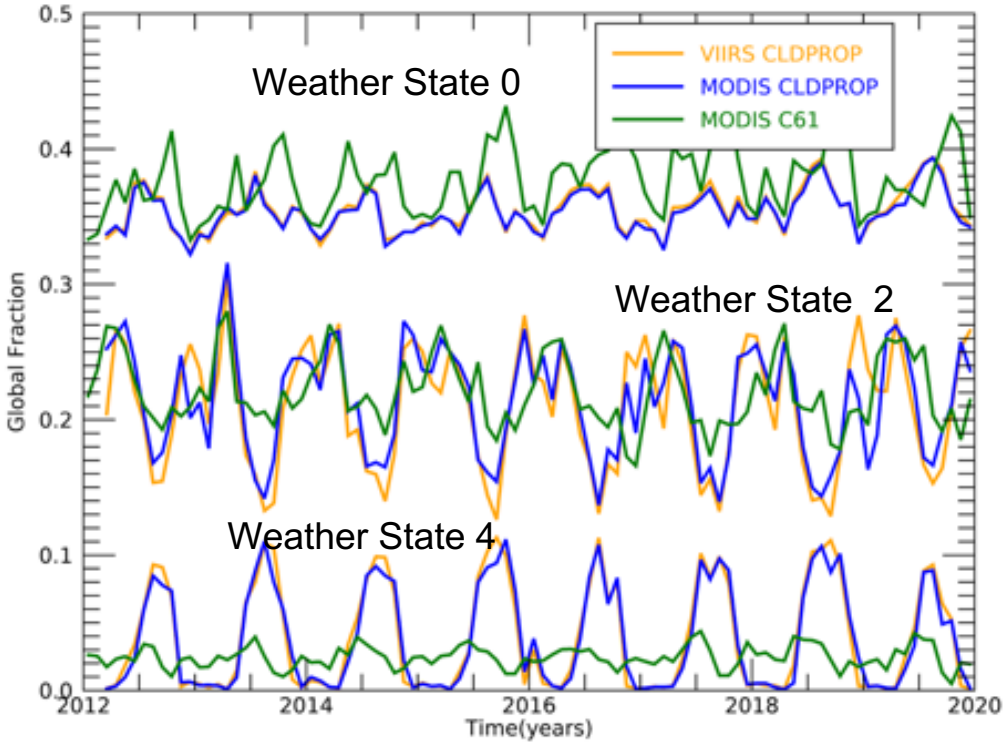


6 IR Weather States CTP/Emiss/CFRAC
Clusters shown in increasing order of occurrence.

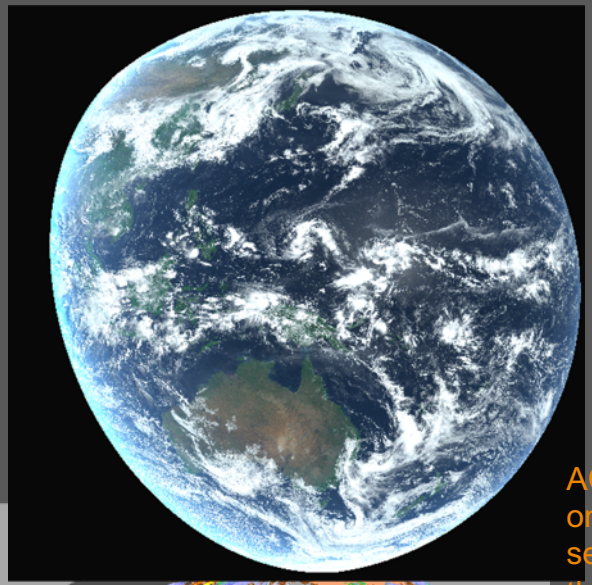


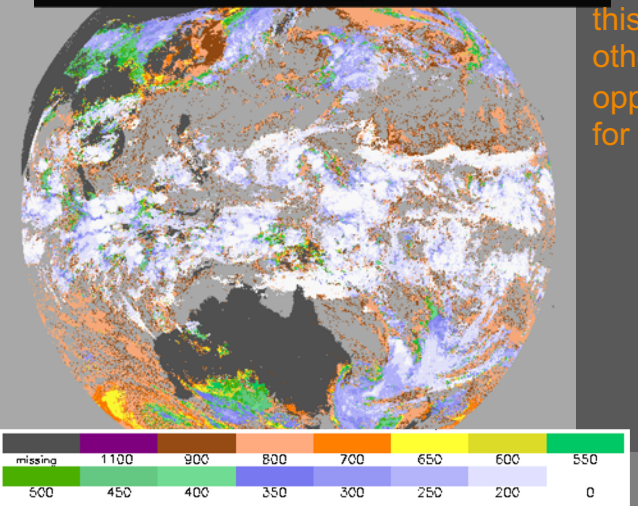
Observed Consistency in IR Weather States

- For all Weather States, **the two CLDPROP data are similar**.
- MODIS C6.1 (MYD08_M3) results come from MODIS C6.1 data begin passed through the Weather States defined by CLDPROP Data.
- **MODIS C6.1 Weather States differ** in coverage from those in CLDPROP.
- We'll continue to develop the IR Weather States to gain more insight to the cloud macrophysical climate signals from MODIS+VIIRS.



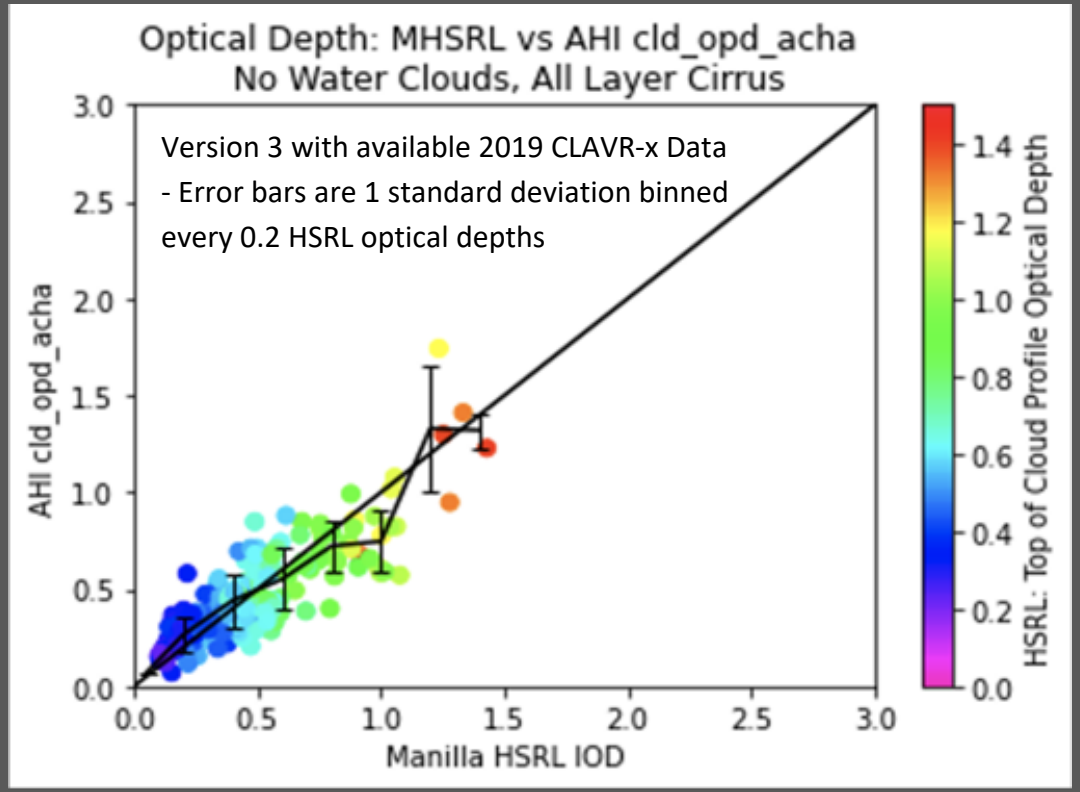
Comparing ACHA Cirrus Optical Depths to an HSRL during CAMP2EX.





AHI Cloud-top Pressure (hPa)

ACHA runs on many sensors and this provides other opportunities for validation



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Conclusions

- CLDPROP runs the NOAA ACHA algorithm that use MODIS/VIIRS IR Window Channels to make Cloud Height/Pressure/Temperature, Cloud Phase and Emissivity.

- Performance is comparable with MODIS C61 CO_2 Slicing even though the physical and spectral basis of the approaches differ.

- NOAA-20 versions of ACHA delivered to the A-SIPS.

- We continue to try and improve ACHA and this includes using CrIS data to make the IR mitigate the spectral differences of MODIS and VIIRS and allow for more consistency of CLDPROP and C61.

- We are using the IR-CLDPROP archives to conduct climate research with the weather states derived from the Cloud Pressure / Emissivity histograms.