

Polar Cloud Behavior: Leveraging active satellite observations to evaluate CESM-LE representation

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Clouds and Polar melt

Clouds enhance Greenland ice sheet meltwater runoff

K. Van Tricht, S. Lhermitte, J. T. M. Lenaerts, I. V. Gorodetskaya, T. S. L'Ecuyer, B. Noël, M. R. van den Broeke, D. D. Turner & N. P. M. van Lipzig

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Big Shelves Of Antarctic Ice Melting Faster Than Scientists Thought

MARCH 26, 2015 5:32 PM ET



CHRISTOPHER JOYCE



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UP IN THE CLOUDS

Low cloud enhanced 2012 Greenland heatwave **PAGE 83**

PLATE TECTONICS
HOW THE WEST WAS MADE
The rise and rise of western North America
PAGES 35 & 50

WEAPONS CONTROL
DOUBLE JEOPARDY
Add biological threats to chemical weapons law
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QUANTUM PHYSICS
POINT OF NO RETURN
How you'd really die in a black hole
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Determining cloud cover

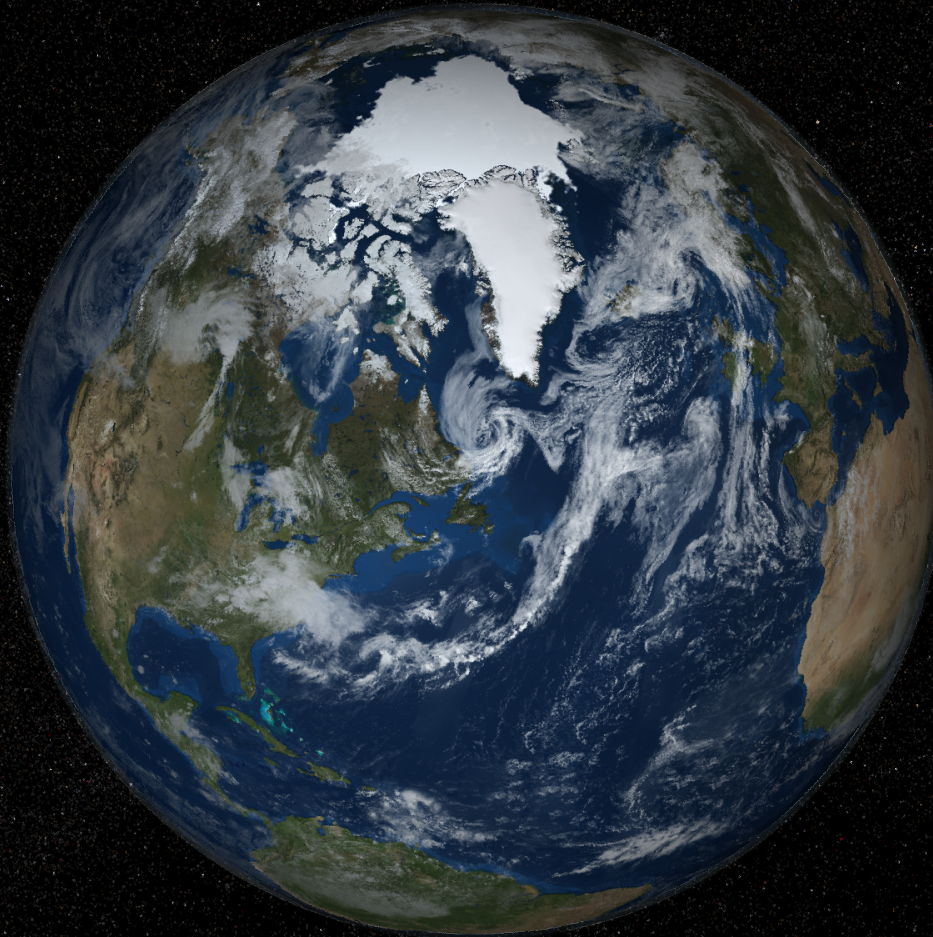
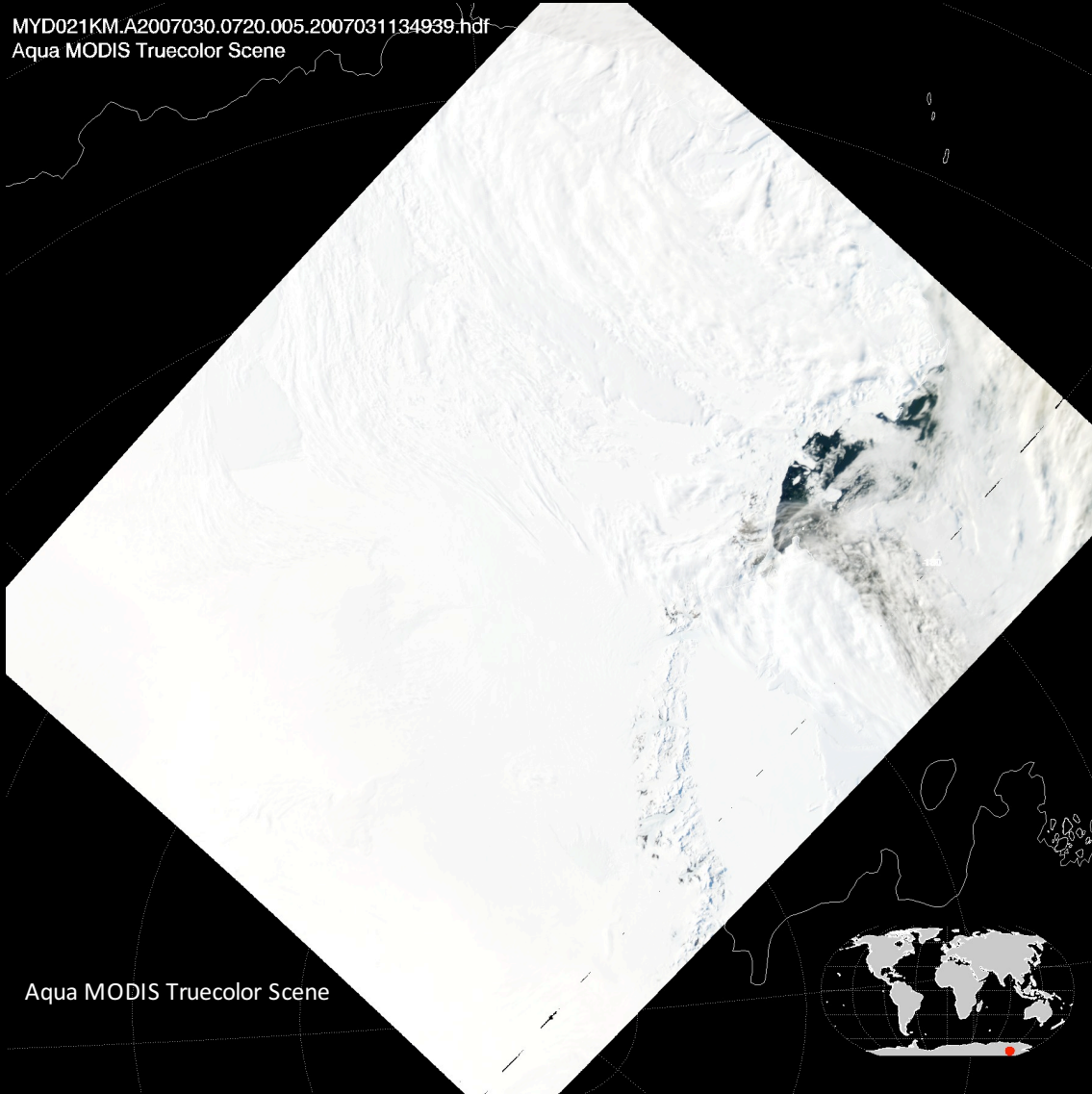


Image: NASA/Goddard Space Flight Center Scientific Visualization Studio The Blue Marble data is courtesy of Reto Stockli (NASA/GSFC).

Polar cloud challenges

MYD021KM.A2007030.0720.005.2007031134939.hdf
Aqua MODIS Truecolor Scene



Aqua MODIS Truecolor Scene

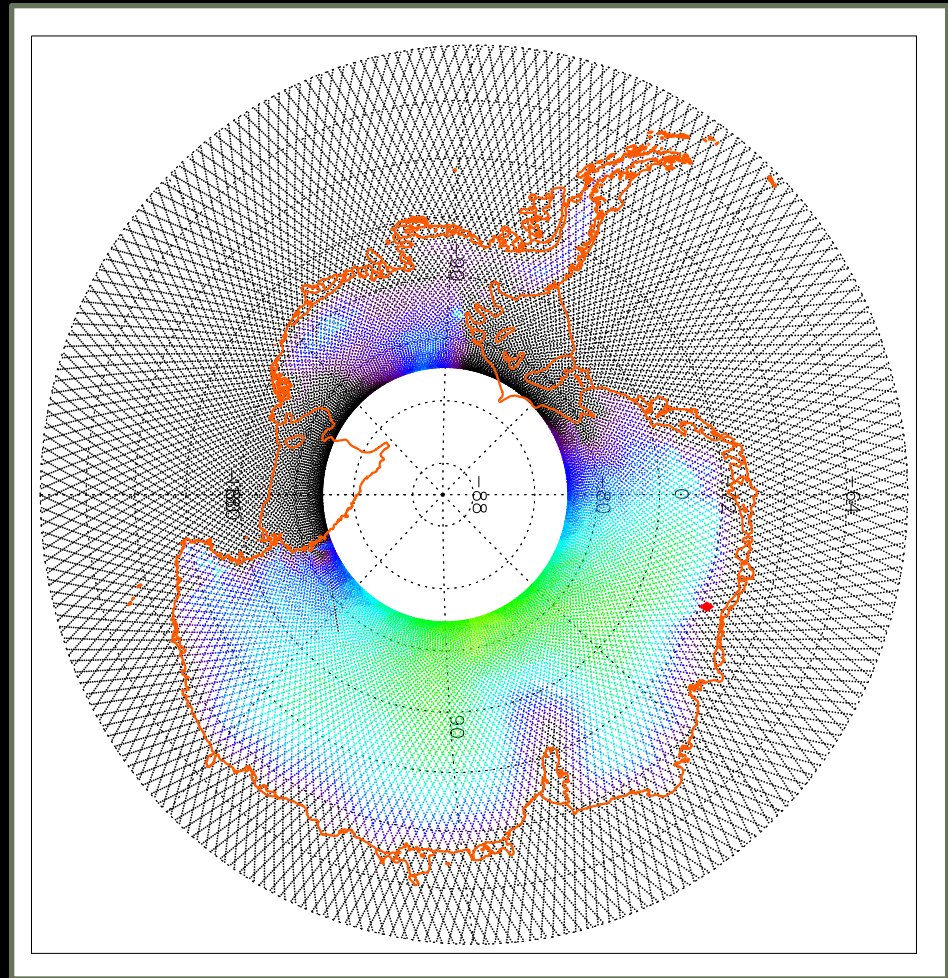
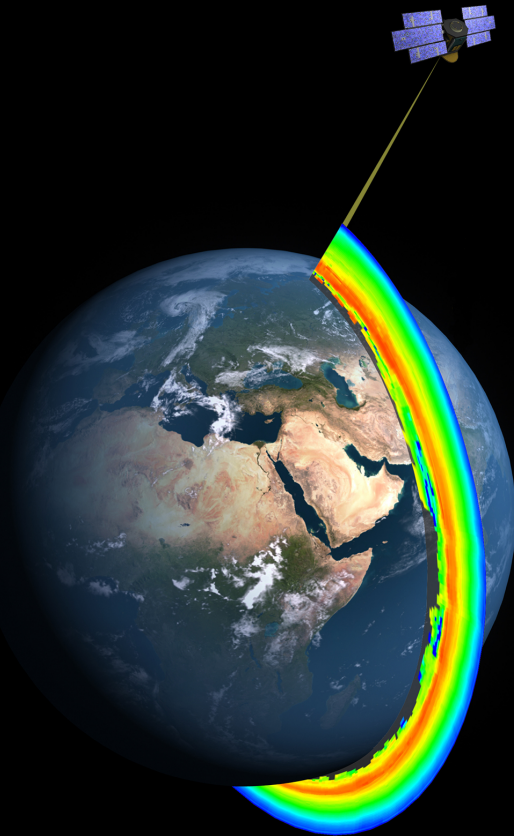
Visible Wavelengths:

- Difficult to write programs to identify cloud edges
- Only available in summer months

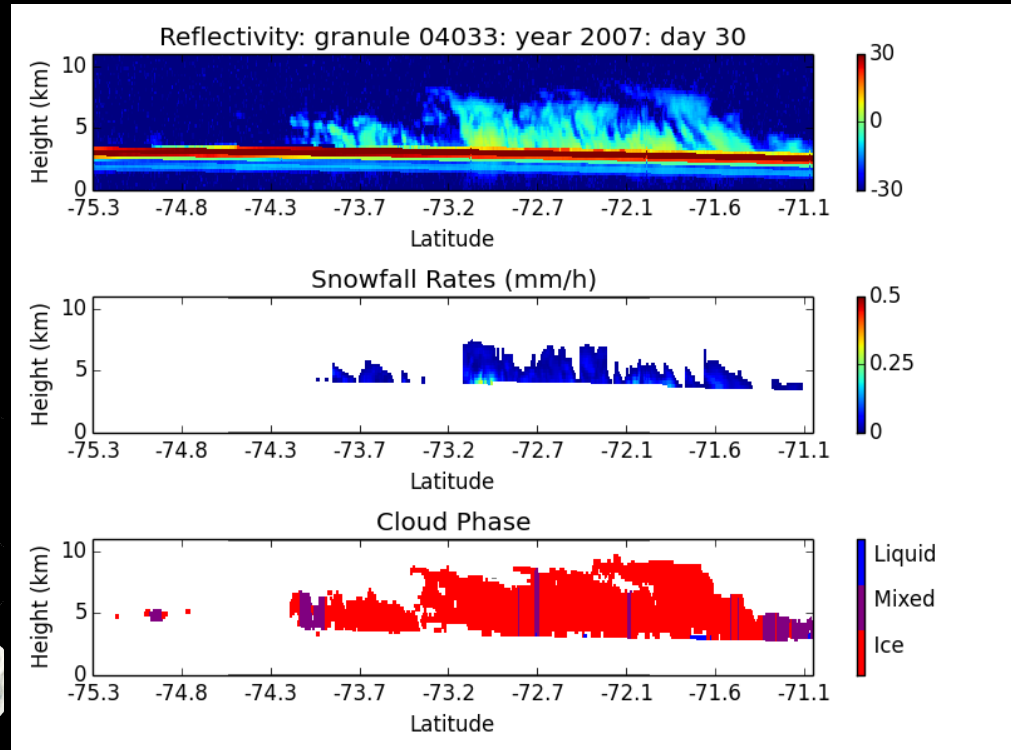
Longer Wavelengths:

- Clouds can be detected day and night, but require temperature contrast

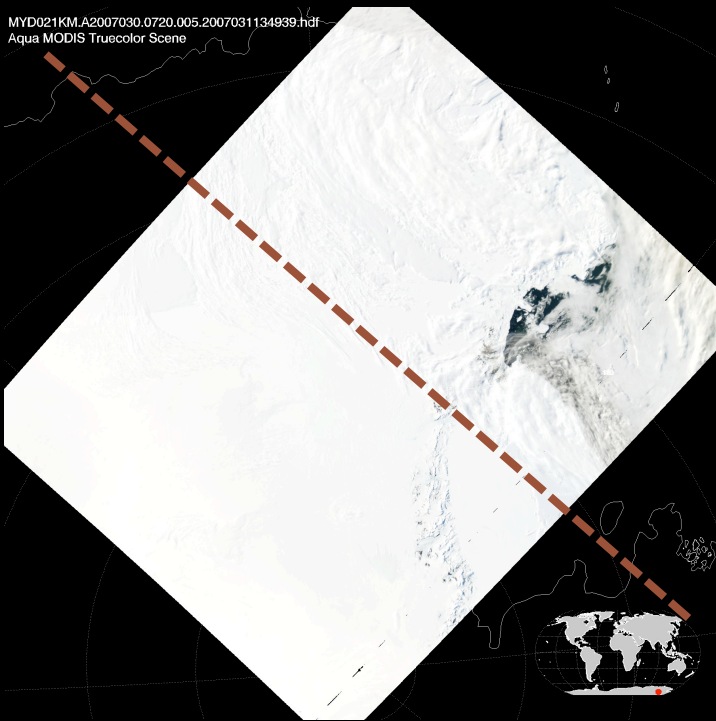
CloudSat



CloudSat's unique perspective



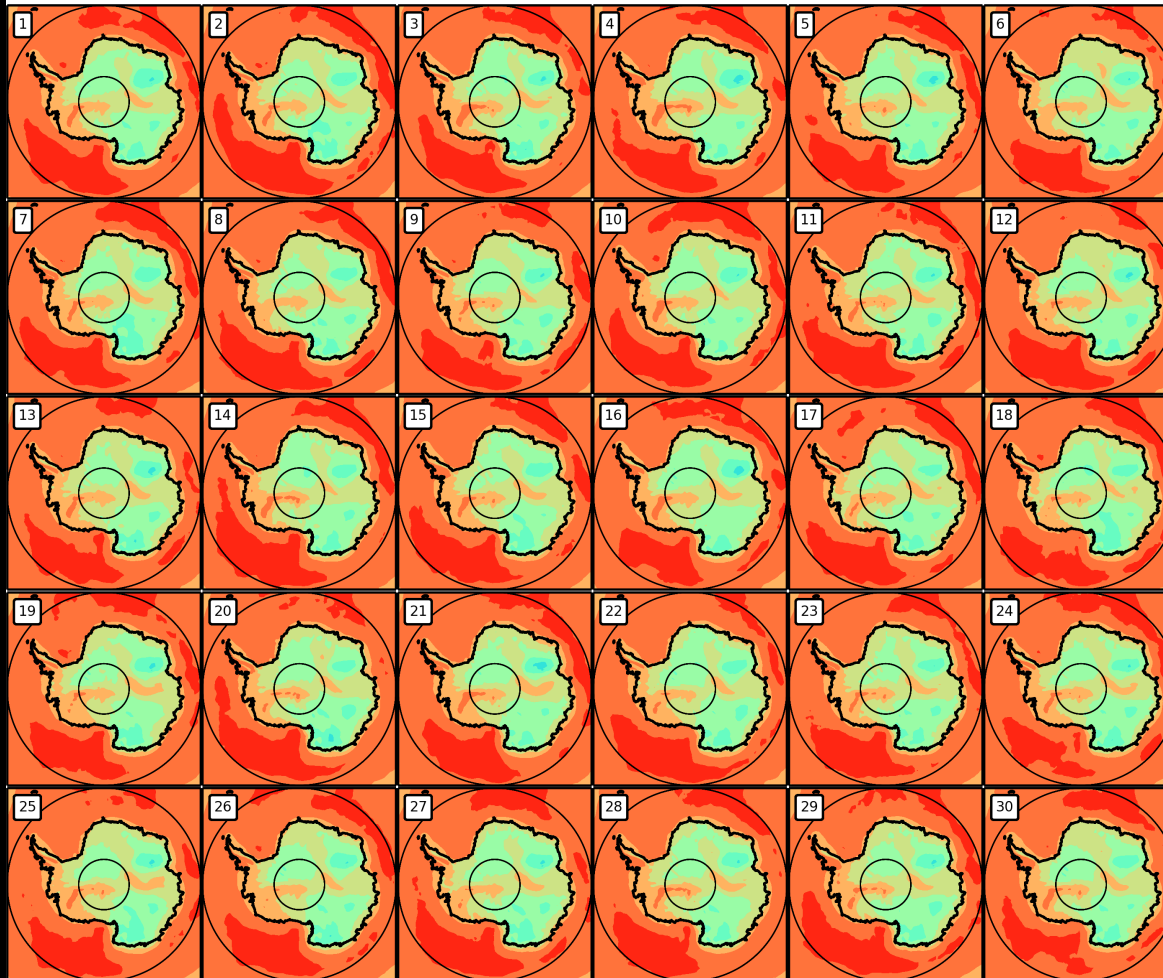
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Aqua MODIS Truecolor Scene



Aqua MODIS Truecolor Scene

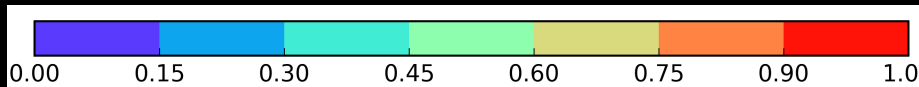
CESM – Large Ensemble

Jan2007 - Dec2010 Average Cloud Fraction

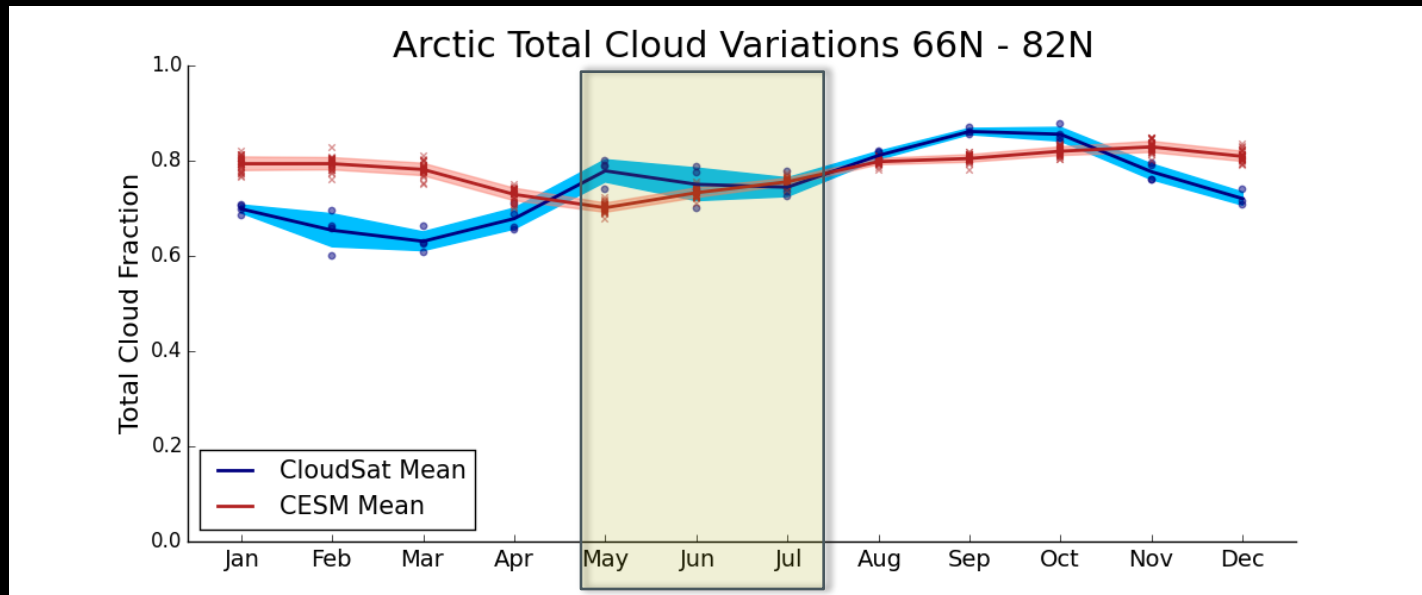
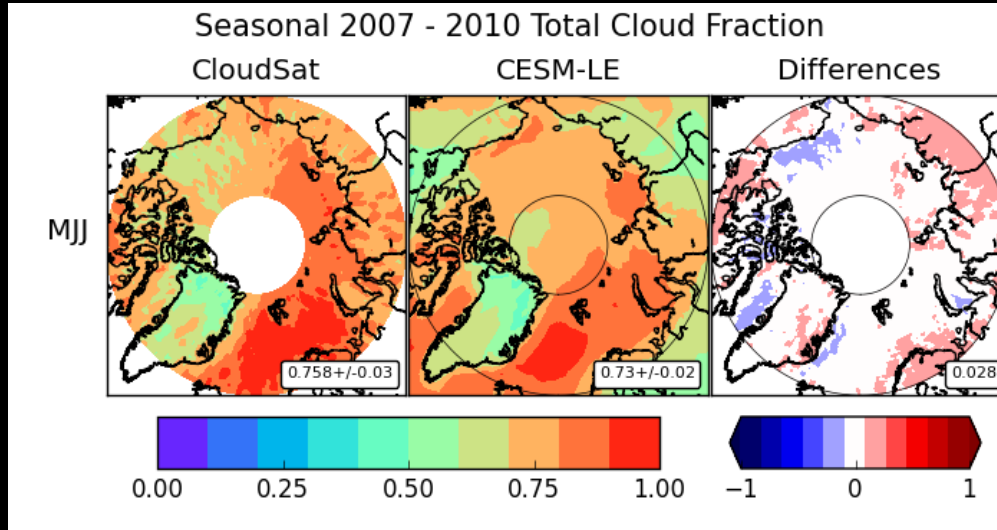


Benefits:

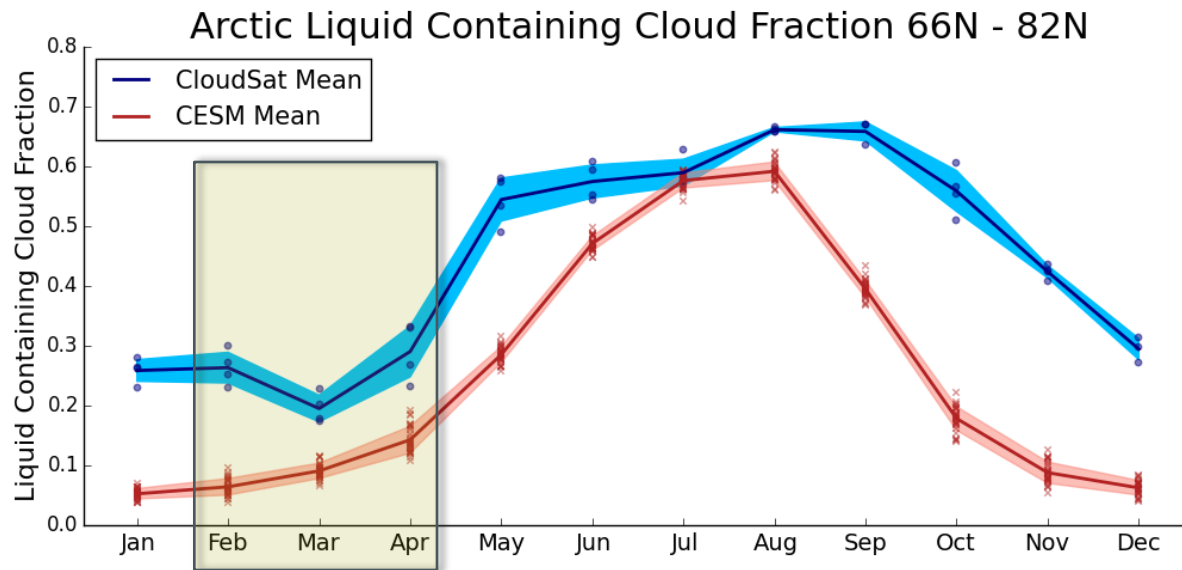
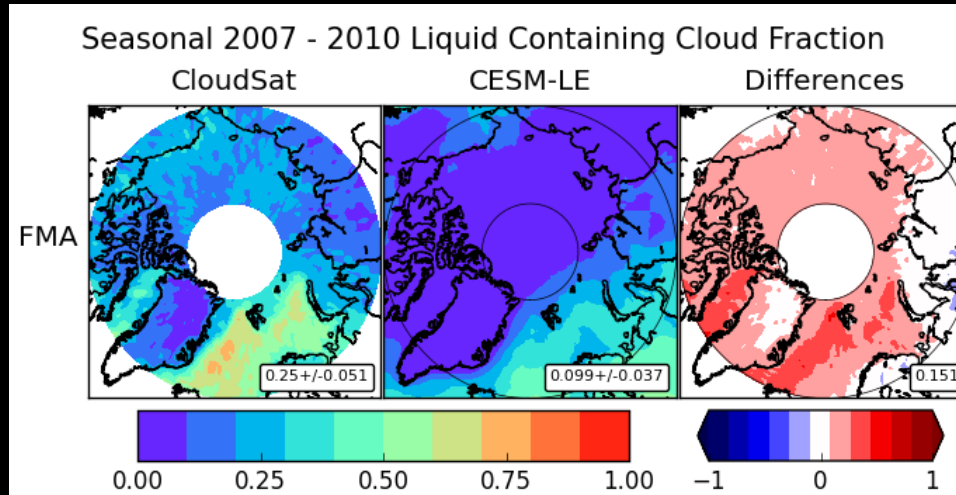
- 30 individual members provide the range of internal model variability



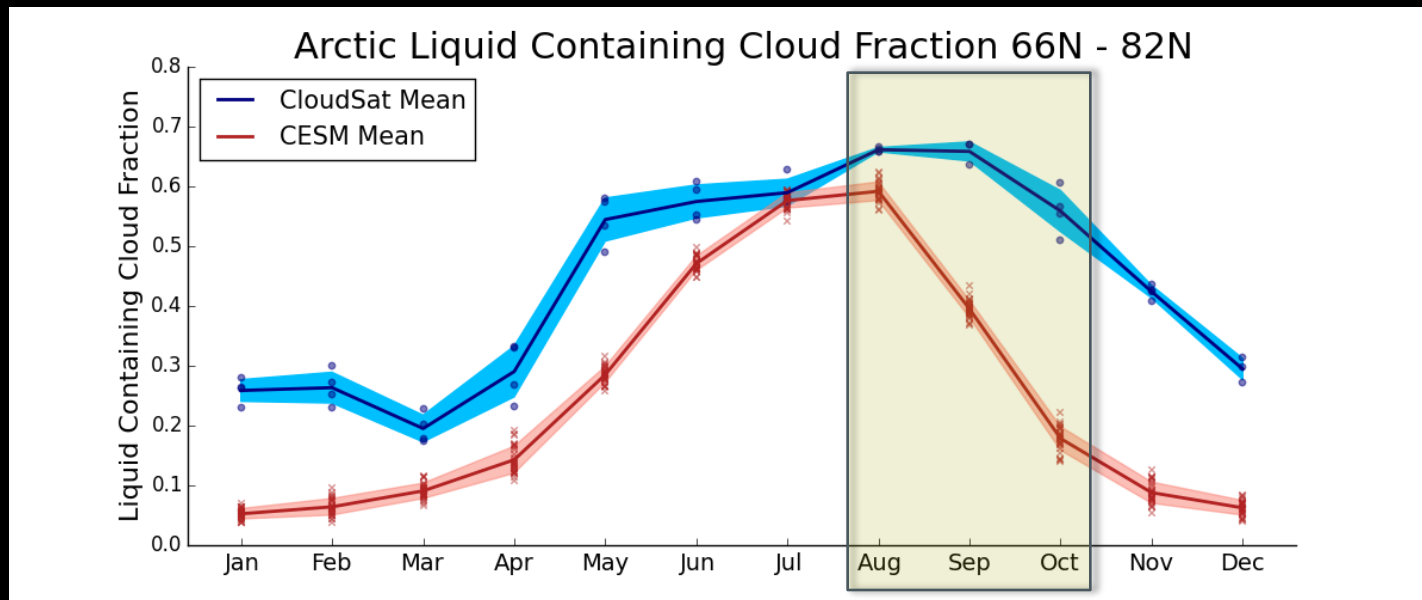
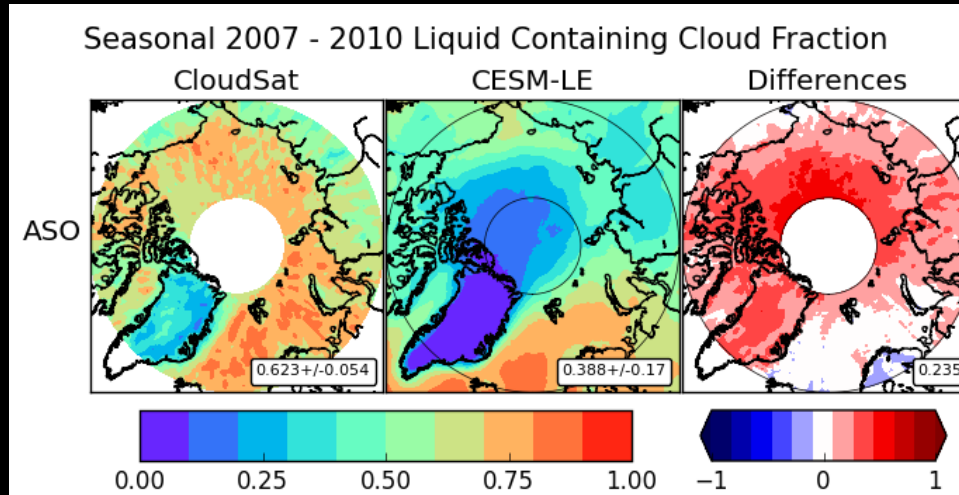
Cloud fraction



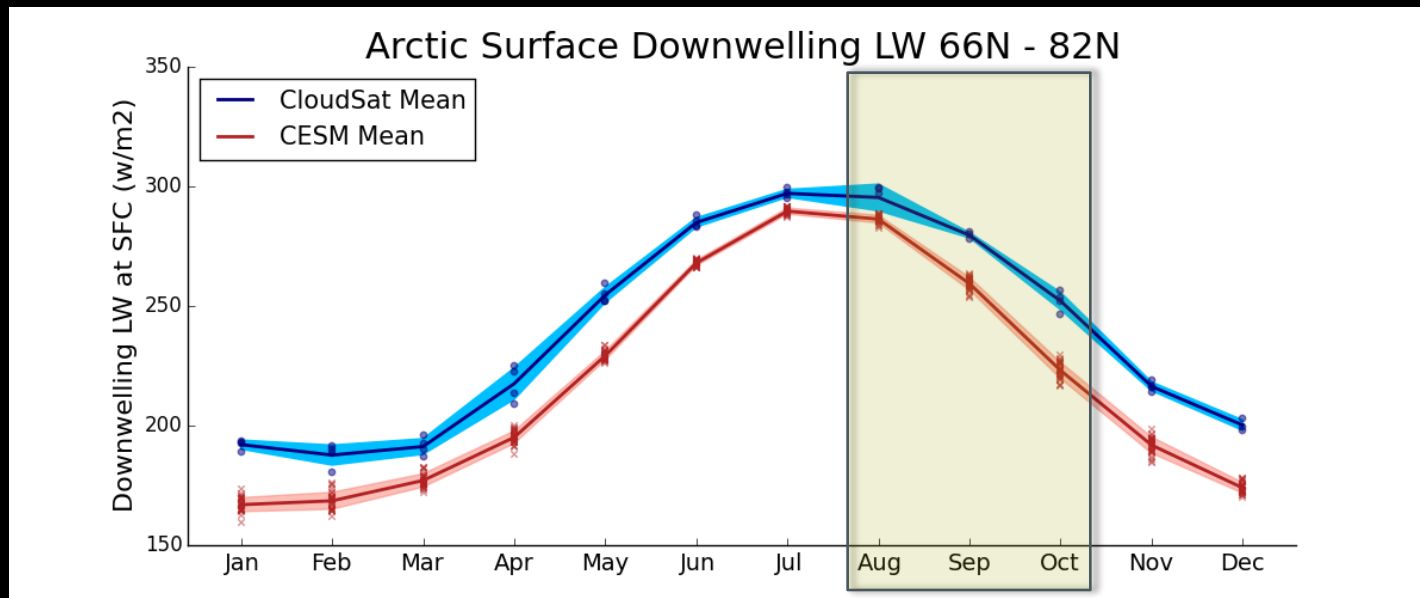
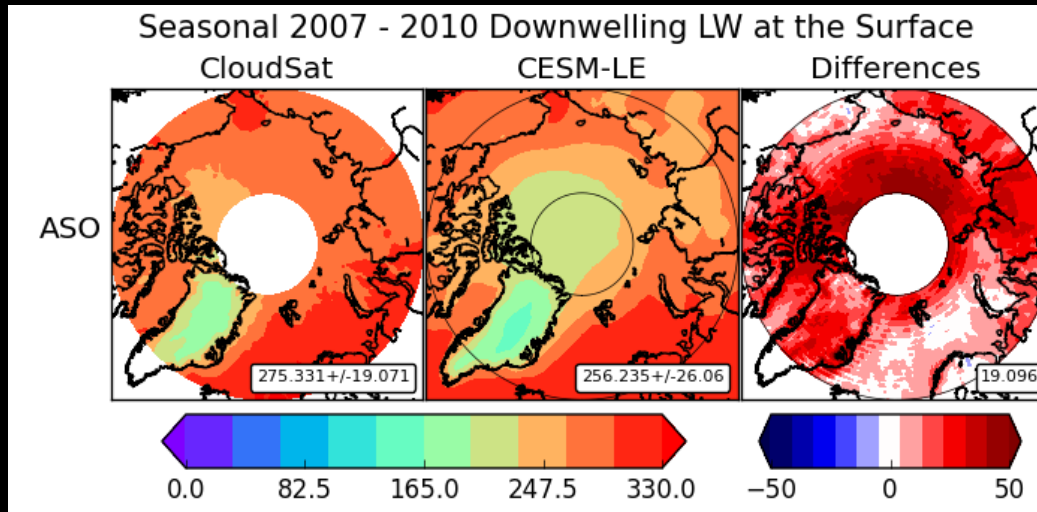
Liquid containing cloud fraction



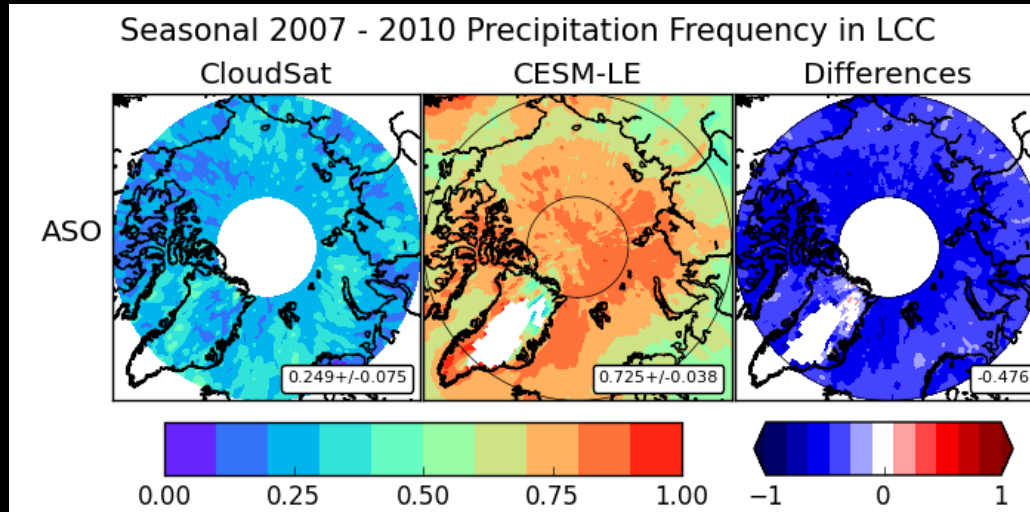
Liquid containing cloud fraction



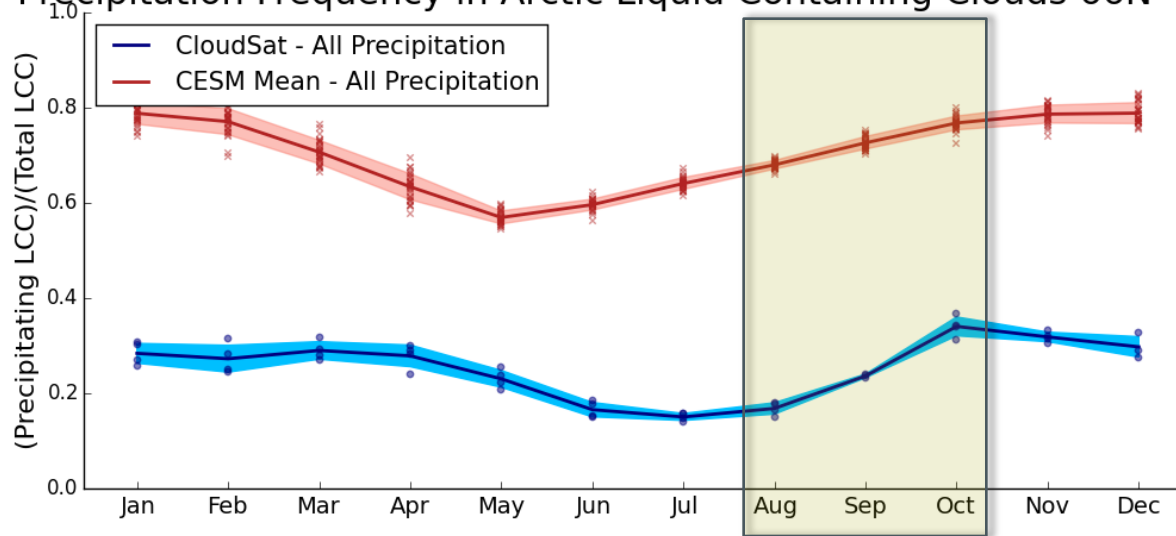
Downwelling LW radiation



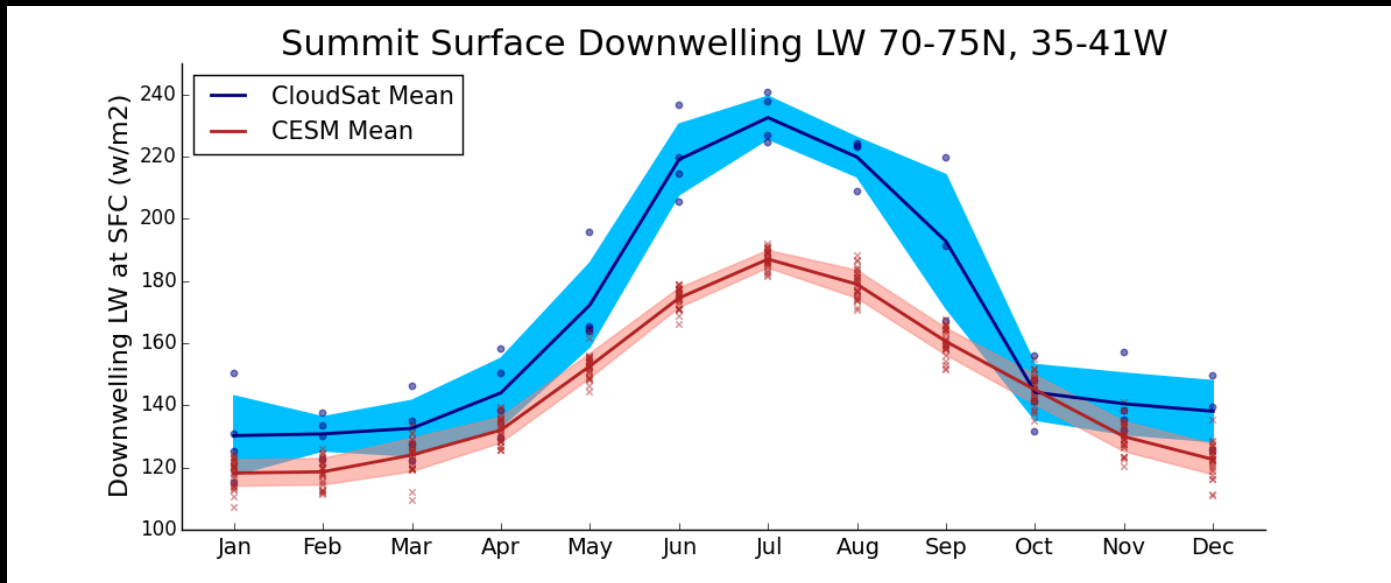
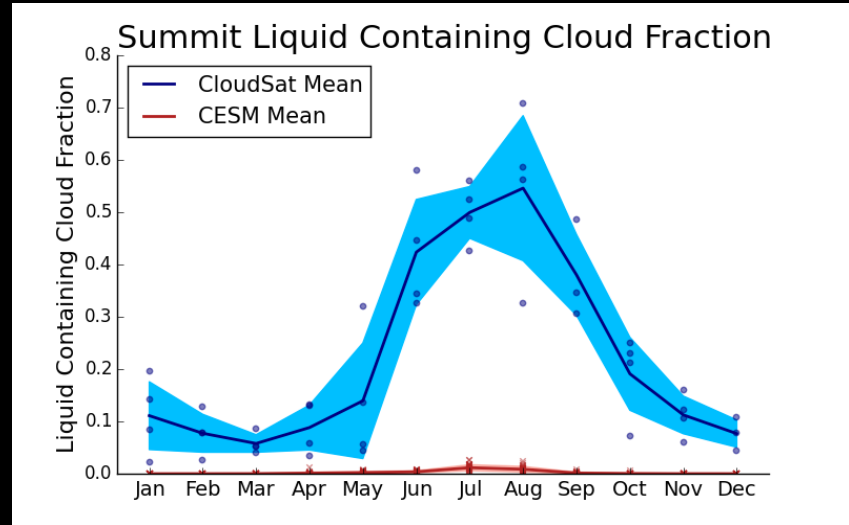
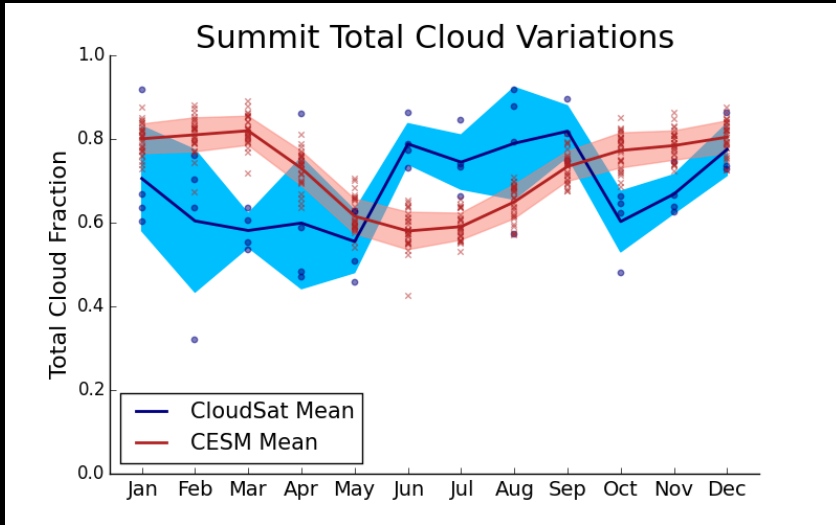
Fraction of LCCs precipitating



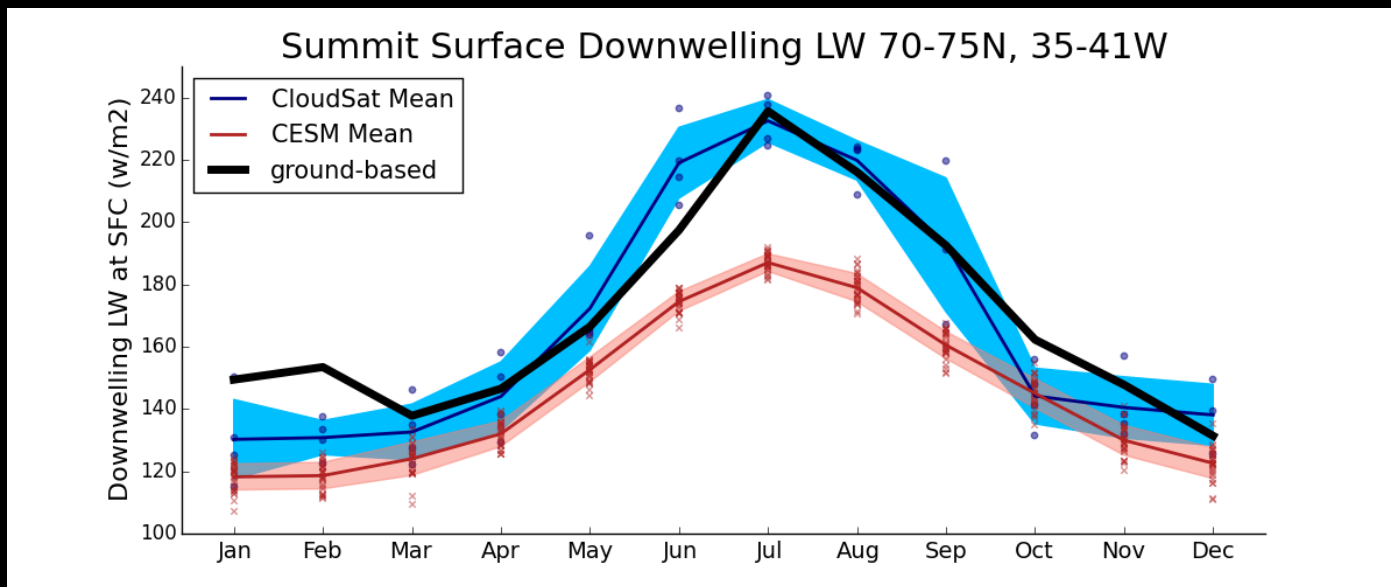
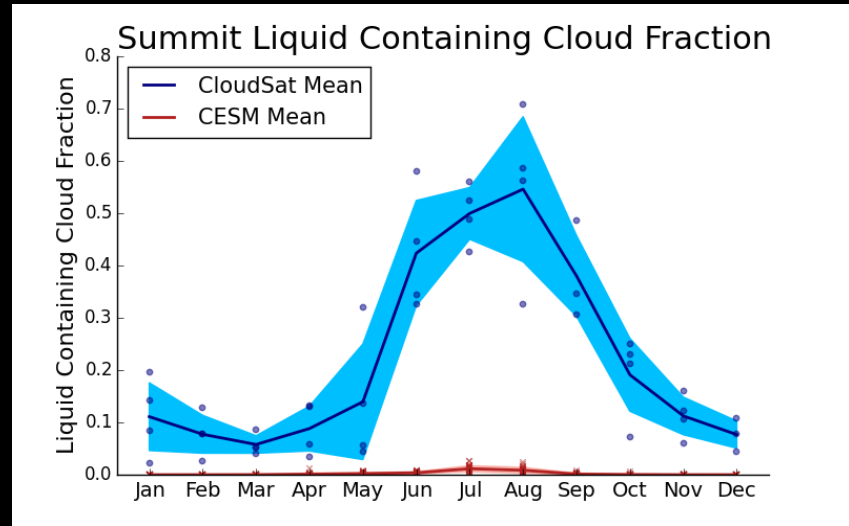
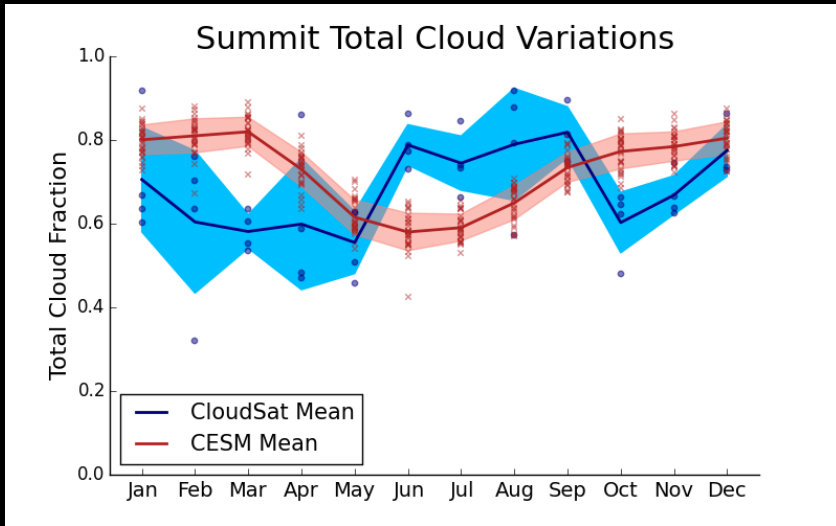
Precipitation Frequency in Arctic Liquid Containing Clouds 66N - 82N



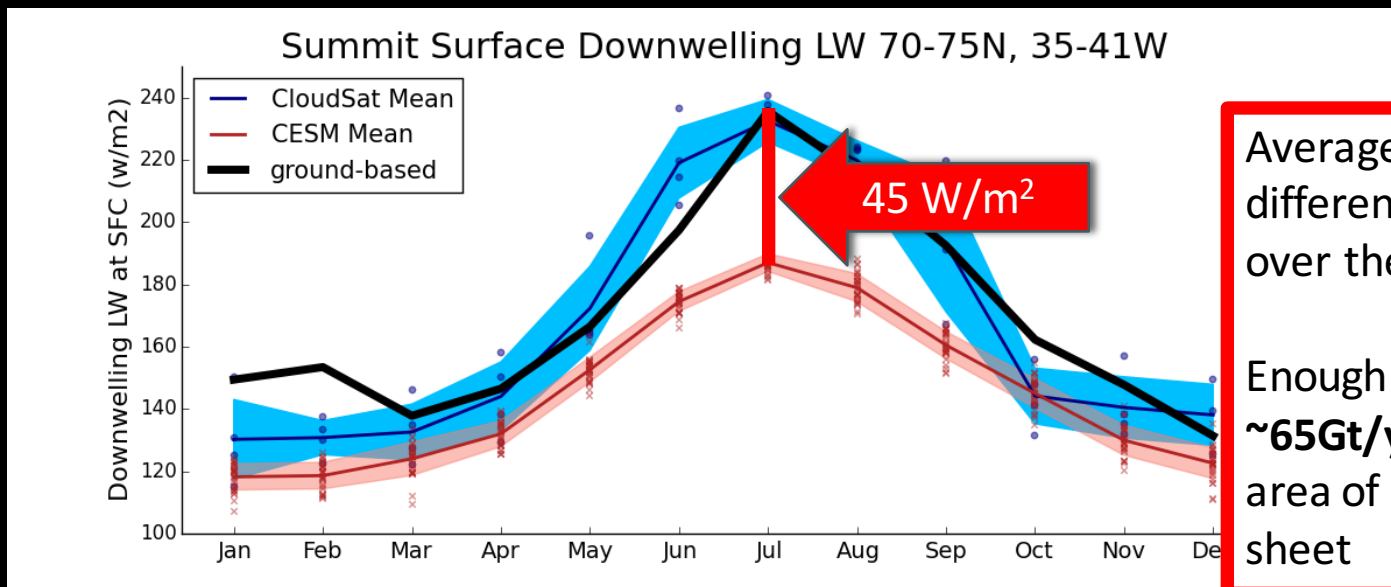
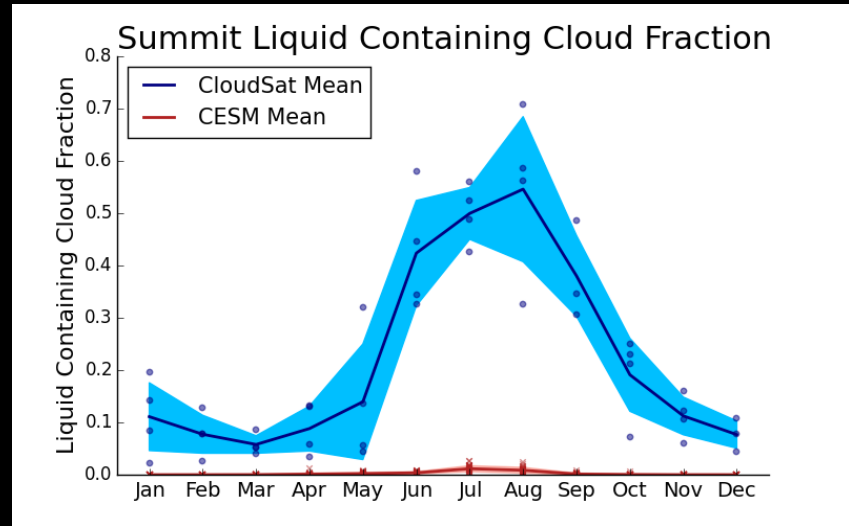
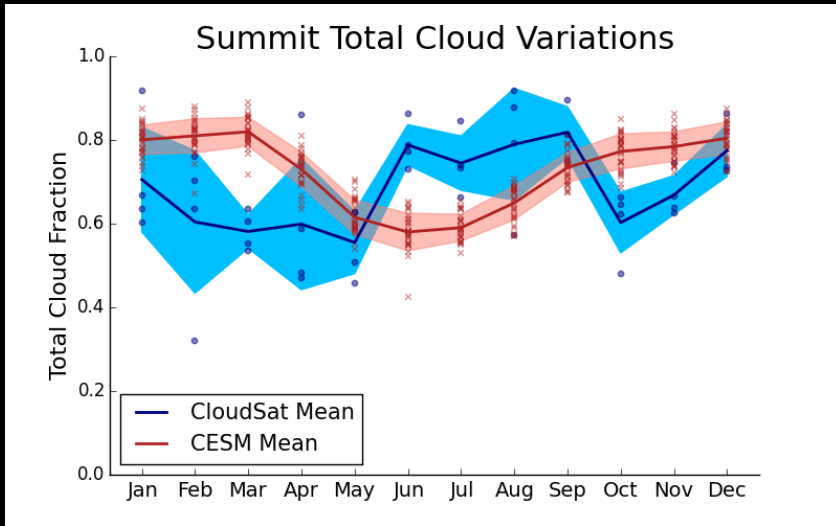
Summit Station Results



Summit Station Results



Summit Station Results



Average CloudSat/CESM difference of **21 W/m^2** over the annual cycle

Enough energy to melt **~65Gt/y** of ice over the area of the Greenland ice sheet

Conclusions

- CloudSat observations show persistent LCC throughout the year in the polar regions
- CESM-LE systematically underestimates LCCs, overestimates the precipitation frequency in LCCs, and underestimates downwelling LW radiation
- Initial comparisons of ground-based observations at Summit, Greenland support CloudSat's spaceborne observations of downwelling LW

Future work

- Additional ground based validation from Summit, Antarctic AWS stations, and field campaigns
- Further examination of the microphysical parameters of CESM, utilize COSP, design branch experiments

Questions

- How large a role does downwelling LW play in land and sea ice behavior in CESM? (SW and temperature bias as well)
- How best can these space based observations be utilized in evaluating CESM processes?
- In designing branch simulations off of the CESM-LE to improve LCC representation, what best practices/pitfalls/etc. should I (an observationalist) be aware of?

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Questions??

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