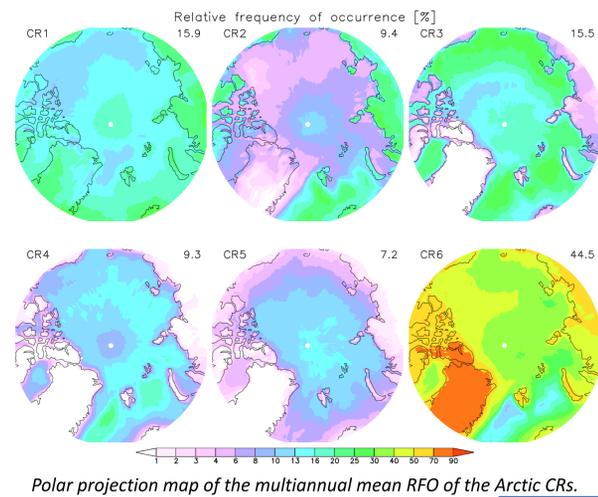
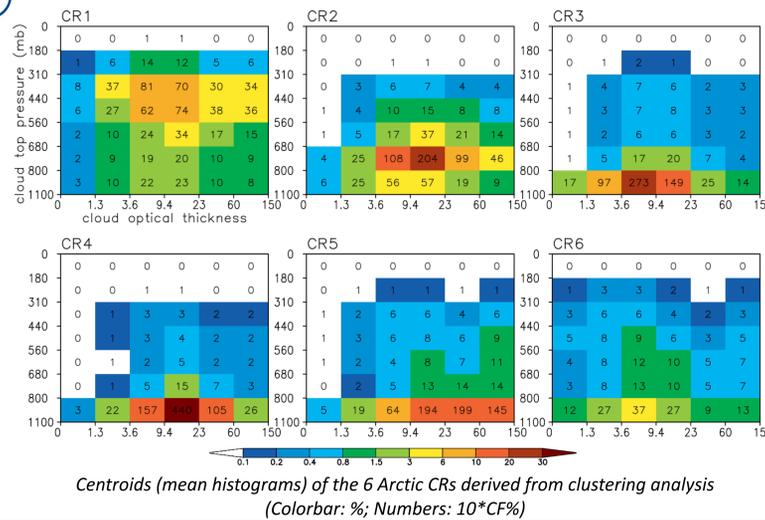


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## Arctic MODIS Cloud Regimes (CRs)

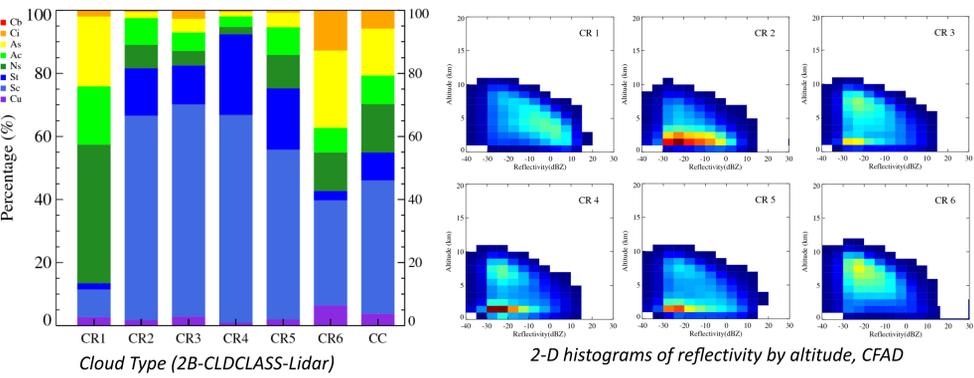
- Arctic Region (70°N-90°N)
- MODIS C6.1 Daily 1° Terra/Aqua CTP-COT histograms
- 15 years (Dec 2002 to Nov 2017)
- k-means clustering with K=6 giving best results (repeatability in 14 out of 20 trials)
- CloudSat/CALIPSO for 2007-2010 period
- Analysis for only Sunlit period and location!



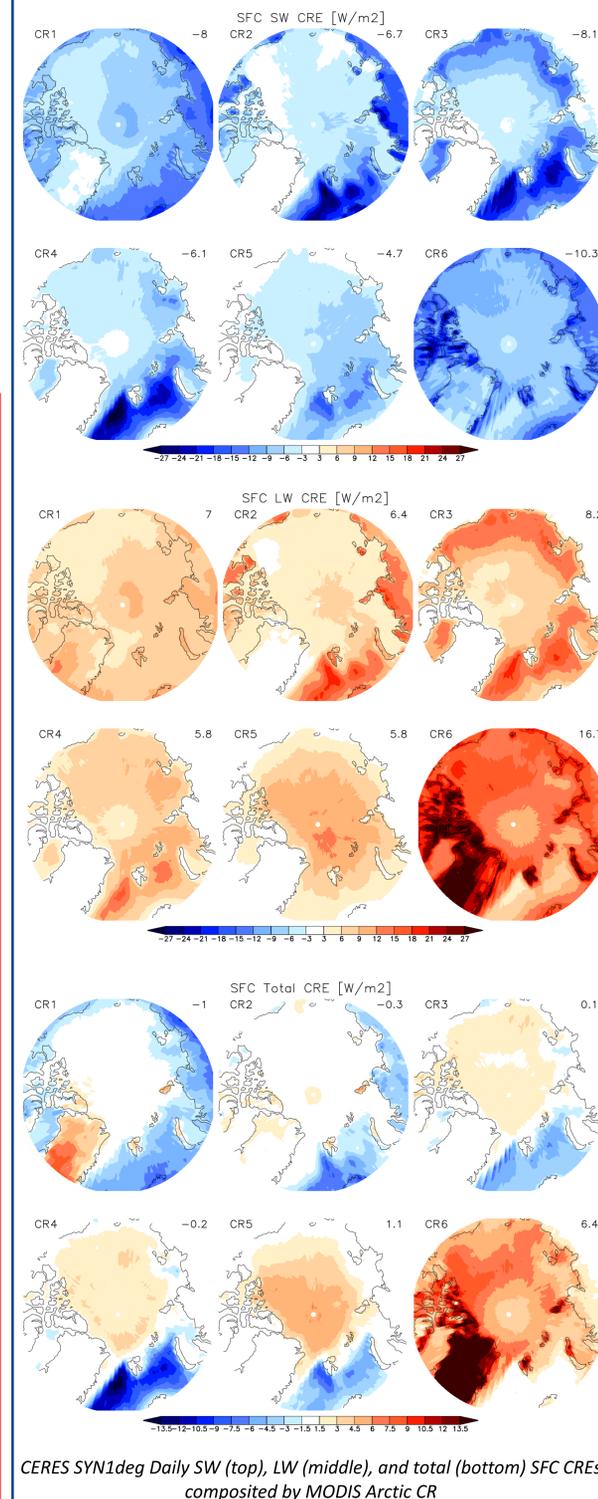
Arctic CR	CR1	CR2	CR3	CR4	CR5	CR6
RFO (%)	15.9	9.4	15.5	9.3	7.2	44.5
CF (%)	77.0	80.0	68.2	81.5	77.0	31.2
CTP (hPa)	595	750	861	879	825	798
SW TOA	-54.1	-64.9	-47.1	-55.9	-55.6	-18.0
Cont. (%)	21.9	15.6	18.6	13.3	10.2	20.4
SW SFC	-50.3	-71.3	-52.3	-65.6	-65.3	-23.1
Cont. (%)	18.2	15.3	18.5	13.9	10.7	23.5
LW TOA	5.7	-17.0	-5.8	-6.5	-5.6	-1.8
LW SFC	44.0	68.1	52.9	62.4	80.6	37.5
Cont. (%)	14.0	12.8	16.4	11.6	11.6	33.5

CR1: Land, Storm CR2: Land, Atlantic CR3: Ocean, Boundary layer, CR4: Ocean, Atlantic CR5: Polar, CR6: Small CF, Greenland, Marginal Sea

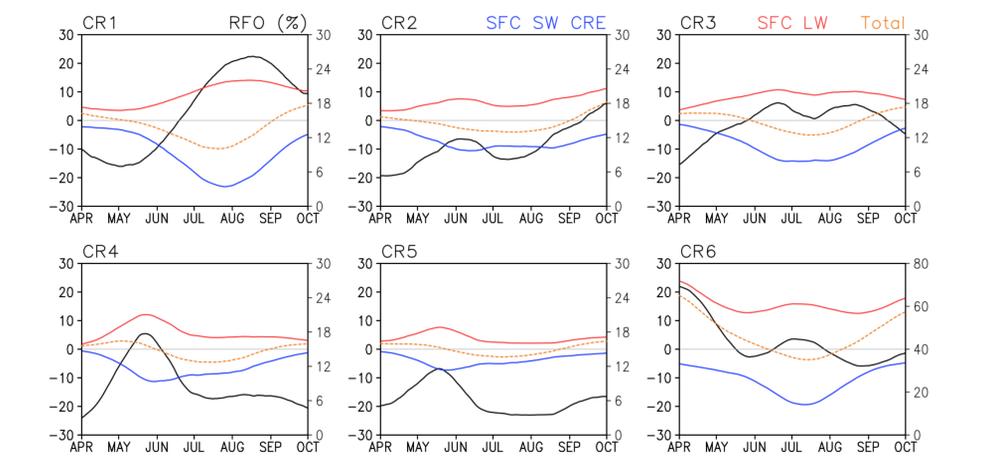
## View from CloudSat/CALIPSO



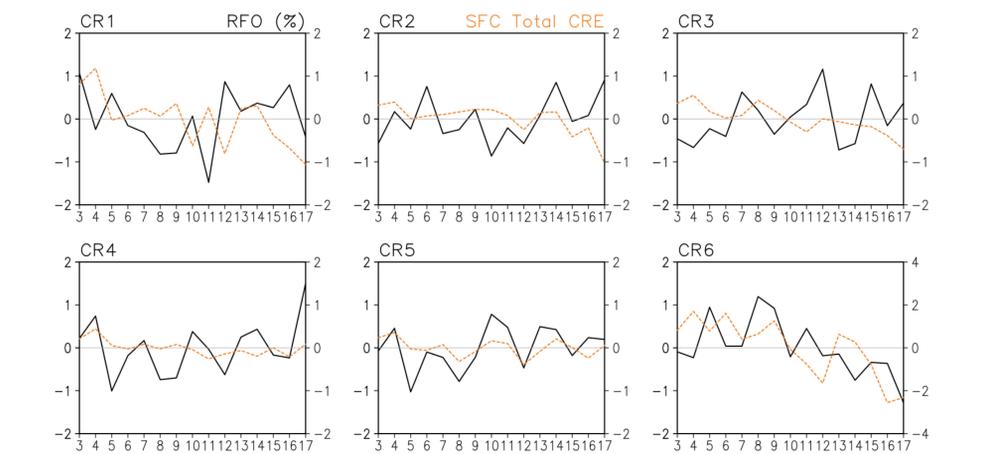
## Surface Cloud Radiative Effects (CREs) from CERES



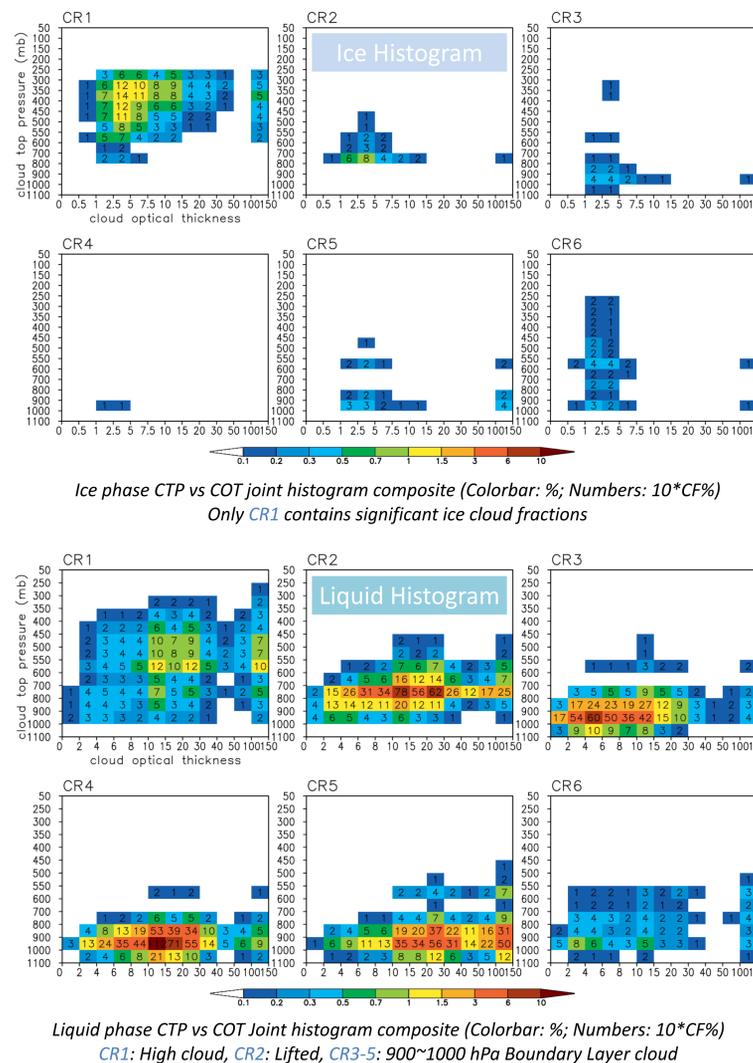
## Seasonal and interannual changes



Seasonal changes of RFO (%), surface SW CRE (W/m<sup>2</sup>), LW CRE (red), and total CRE (dotted, orange)  
 CR1: Summer, Cooling CR2: Autumn, Cooling CR3: Summer CR4: May-June CR5: May-June CR6: Spring, Warming



## More detailed CTP-COT Histogram



Ice phase CTP vs COT joint histogram composite (Colorbar: %; Numbers: 10\*CF%)  
 Only CR1 contains significant ice cloud fractions

Liquid phase CTP vs COT joint histogram composite (Colorbar: %; Numbers: 10\*CF%)  
 CR1: High cloud, CR2: Lifted, CR3-5: 900~1000 hPa Boundary Layer cloud