Seasonal and Inter-annual Variations of Polar TOA Irradiance and Cloud Cover

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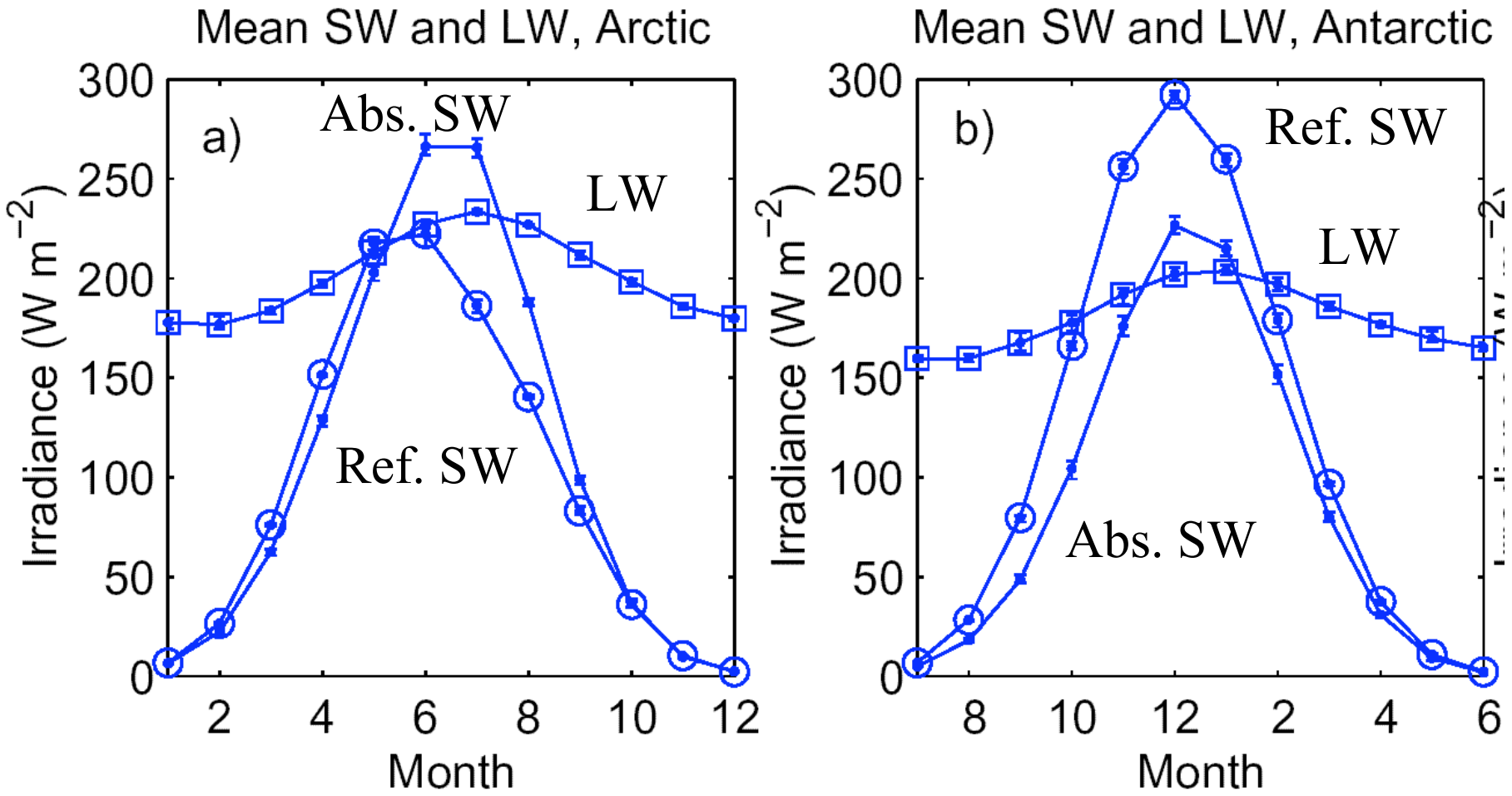
Objectives

- Understand Seasonal variations of TOA SW and LW irradiances over the Arctic and Antarctic.
- Understand Seasonal variations of cloud cover.
- Evaluate trends in the SW irradiance and cloud cover associated with sea ice cover change.

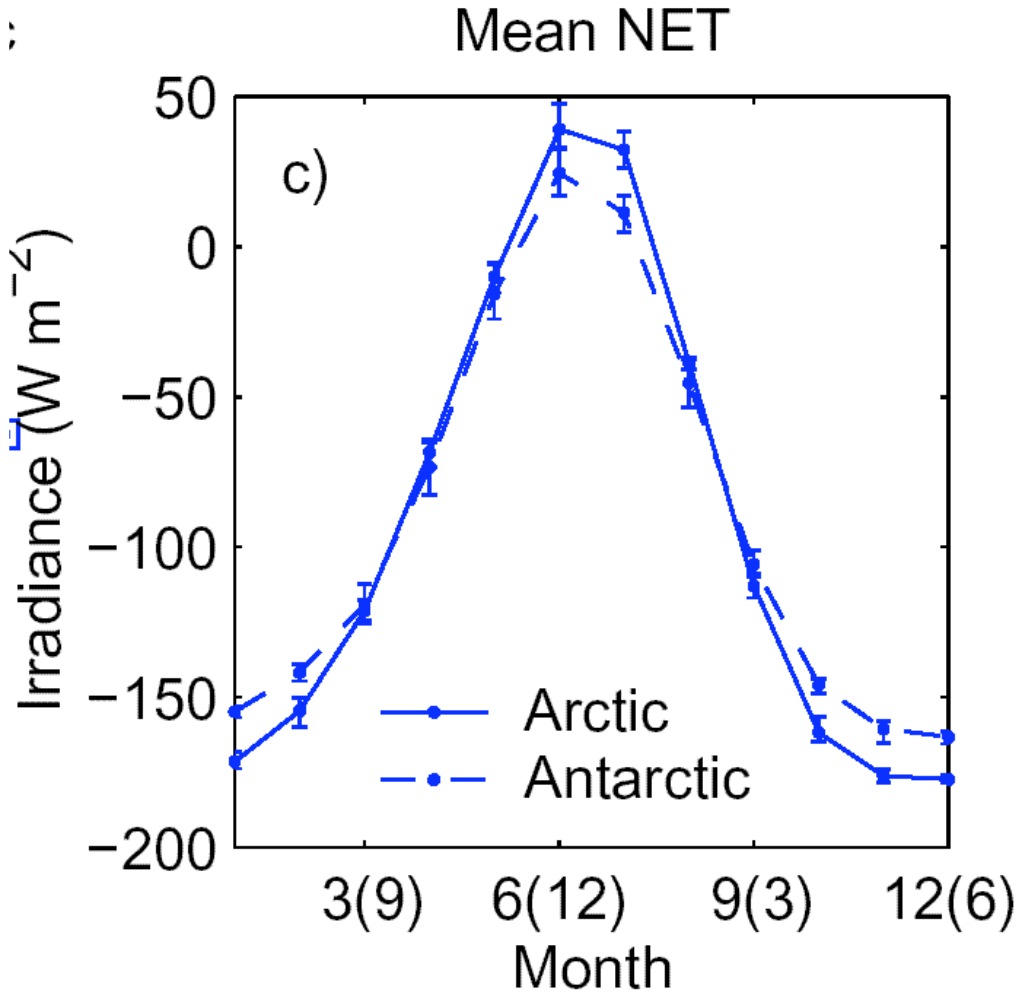
Methods

- Use Terra SSF Ed2B_Rev1 from March 2000 through Fe. 2004 and Aqua Ed1B from Aug.2002 through Feb. 2004.
- Derive the daily mean SW and LW irradiances and cloud cover over 1 degree by 1 degree areas.
- Derive area-weighted mean values over the Arctic (60-90N) and over the Antarctic (60-90S).
- Compute anomalies and estimate trends.

Seasonal Variations, Radiation



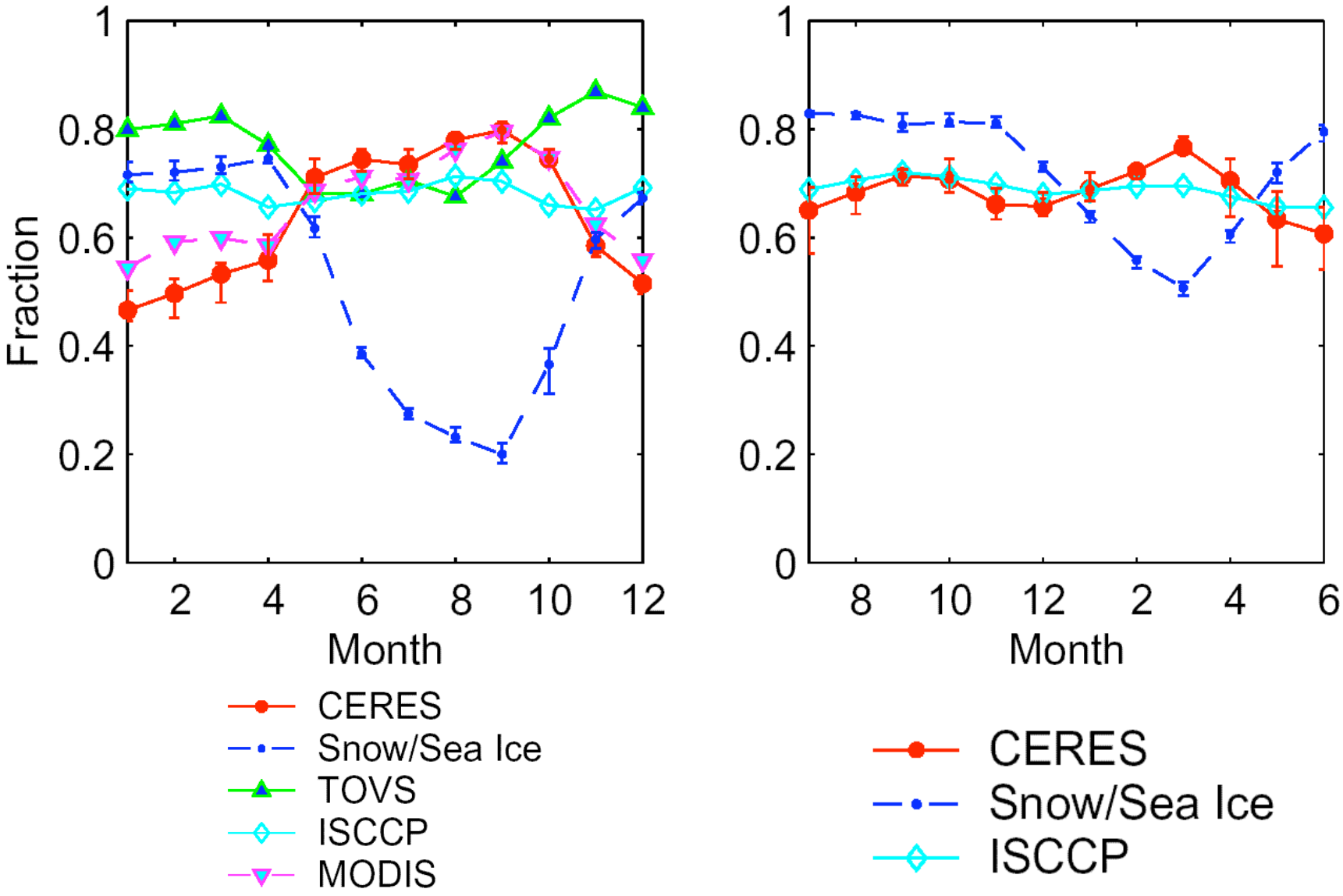
Seasonal Variation, NET



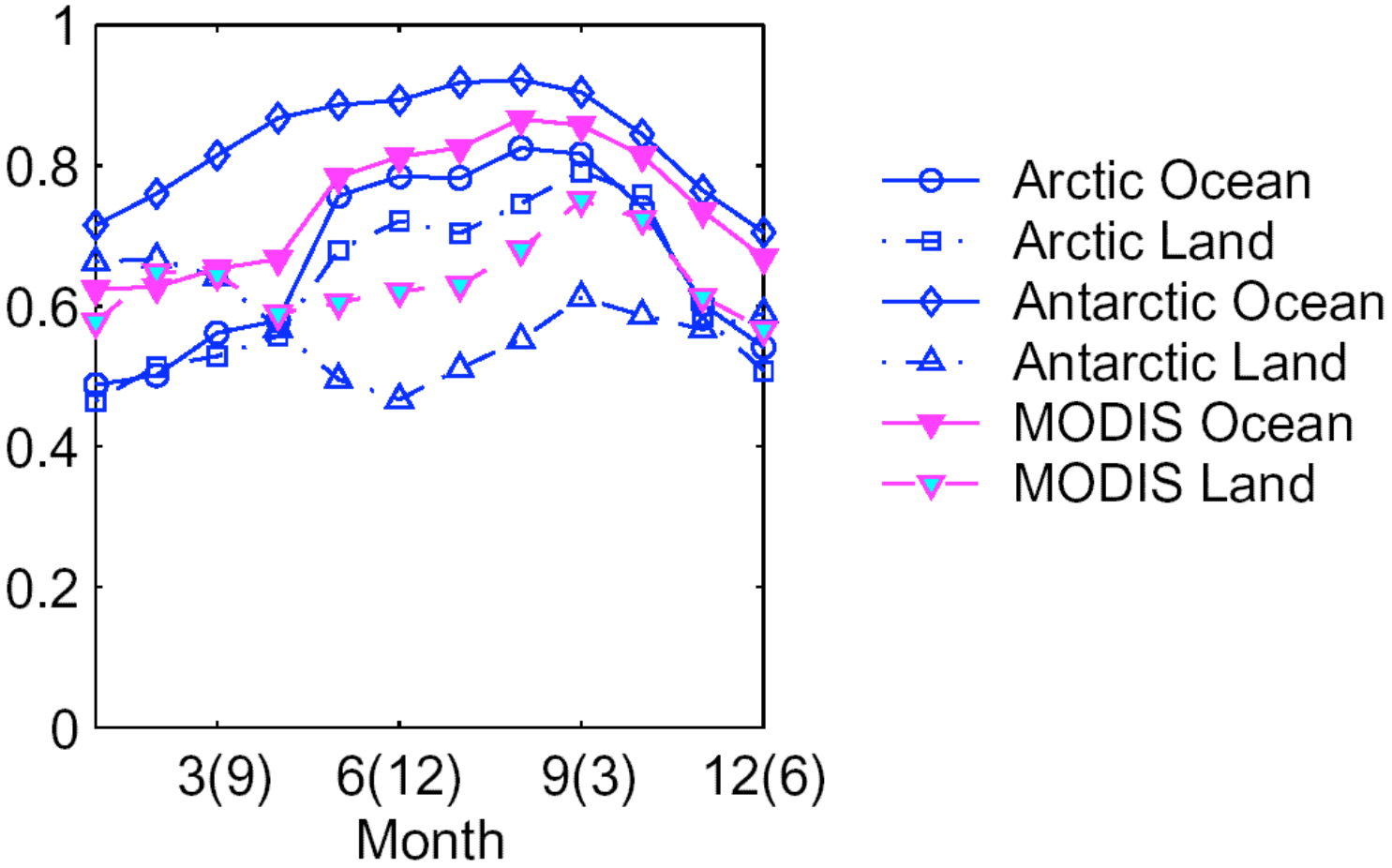
Annual Mean TOA Irradiance and Albedo

CERES (ERBE)	Arctic (60N – 90N)	Antarctic (60S – 90S)
Downward Shortwave ($W\ m^{-2}$)	204.2 (201.3)	206.8 (202.5)
Albedo	0.469 (0.487)	0.566 (0.591)
Longwave ($W\ m^{-2}$)	201.1 (201.2)	179.8 (179.8)
Net ($W\ m^{-2}$)	-92.6 (-97.9)	-90.1 (-97.0)

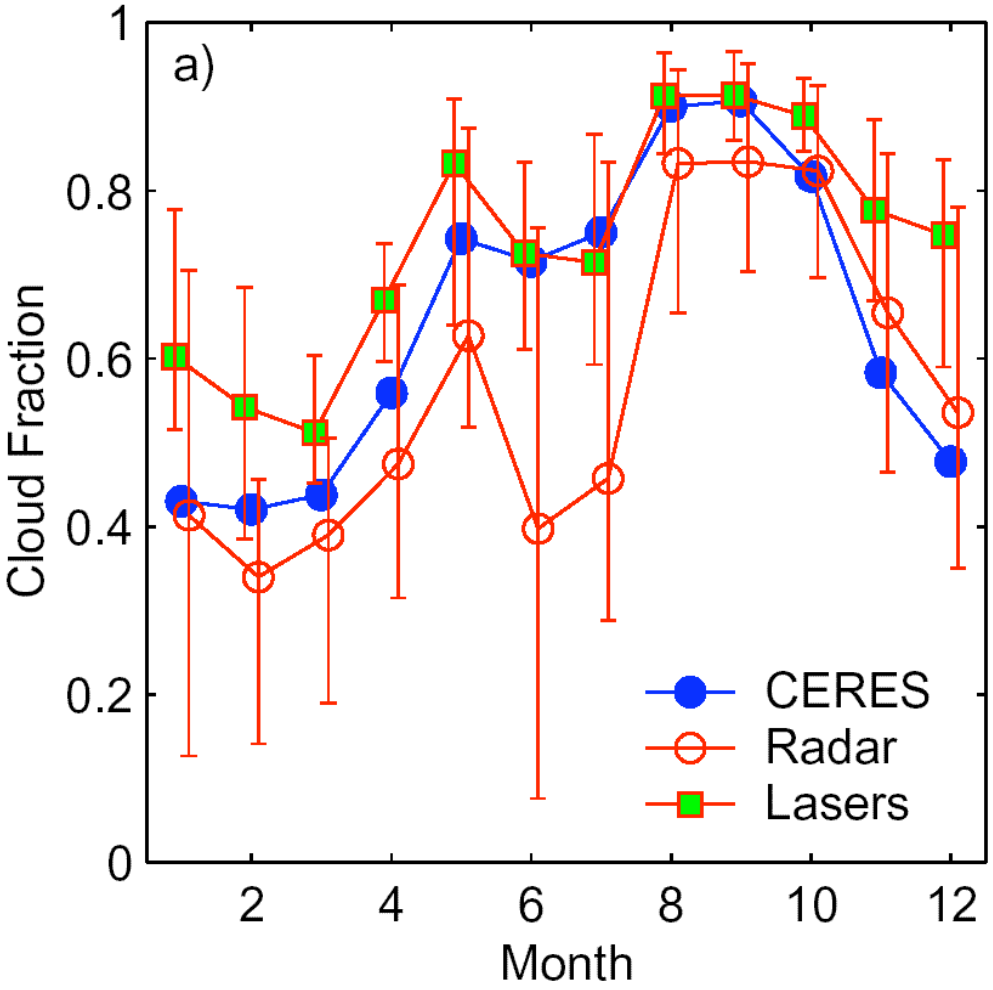
Seasonal Variations, Cloud Cover



Seasonal variation
Clouds over Ocean and Land



Comparison with Cloud Occurrence Derived from Ground-based Active Sensors



Day + night clouds over Barrow, AK

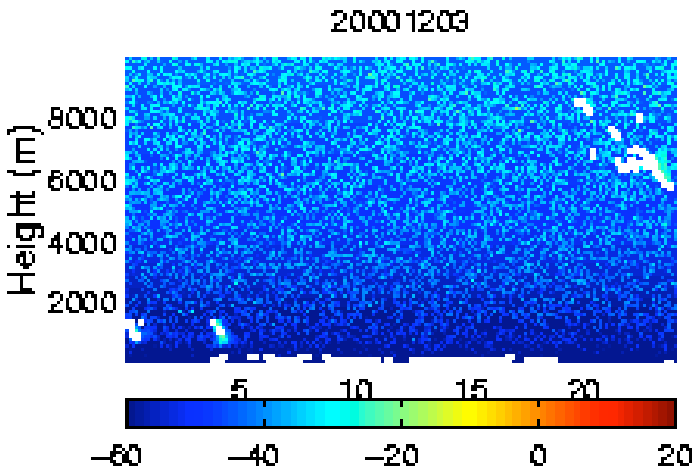
March 2000 – Feb. 2004

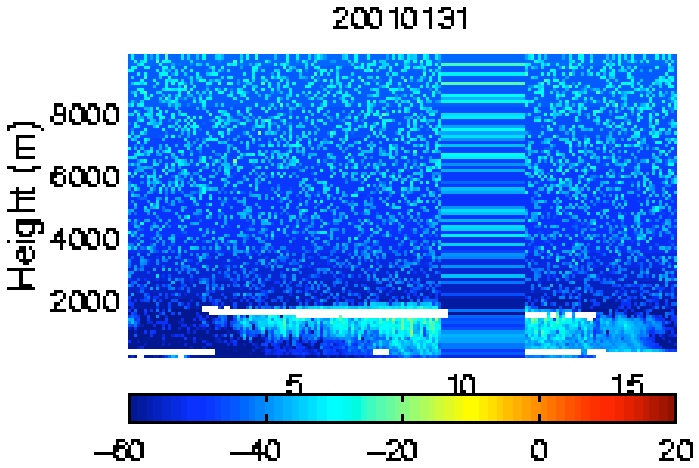
CERES: CERES cloud algorithm

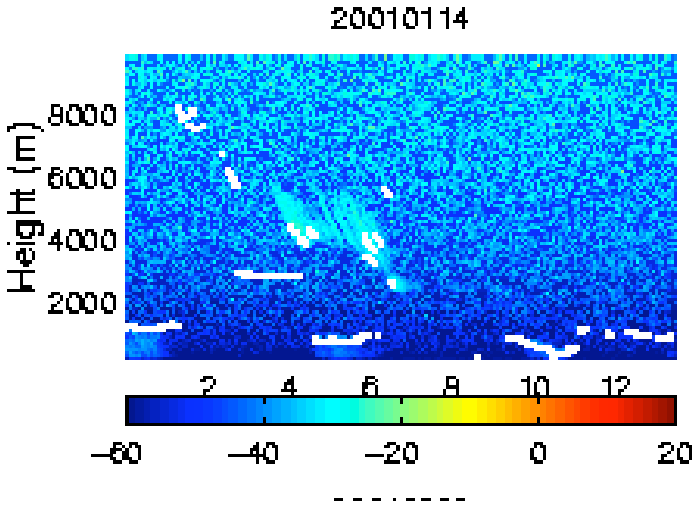
Radar: Millimeter Cloud Radar

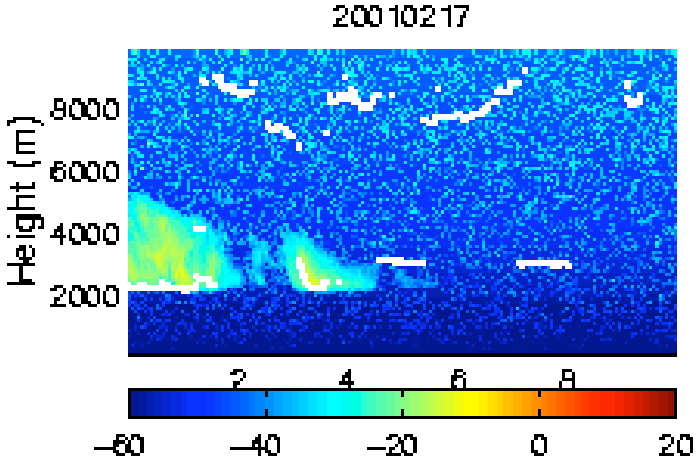
Lasers: micro-pulse lidar Vaisala celometer

Large differences in Radar and Laser-based Cloud Occurrence

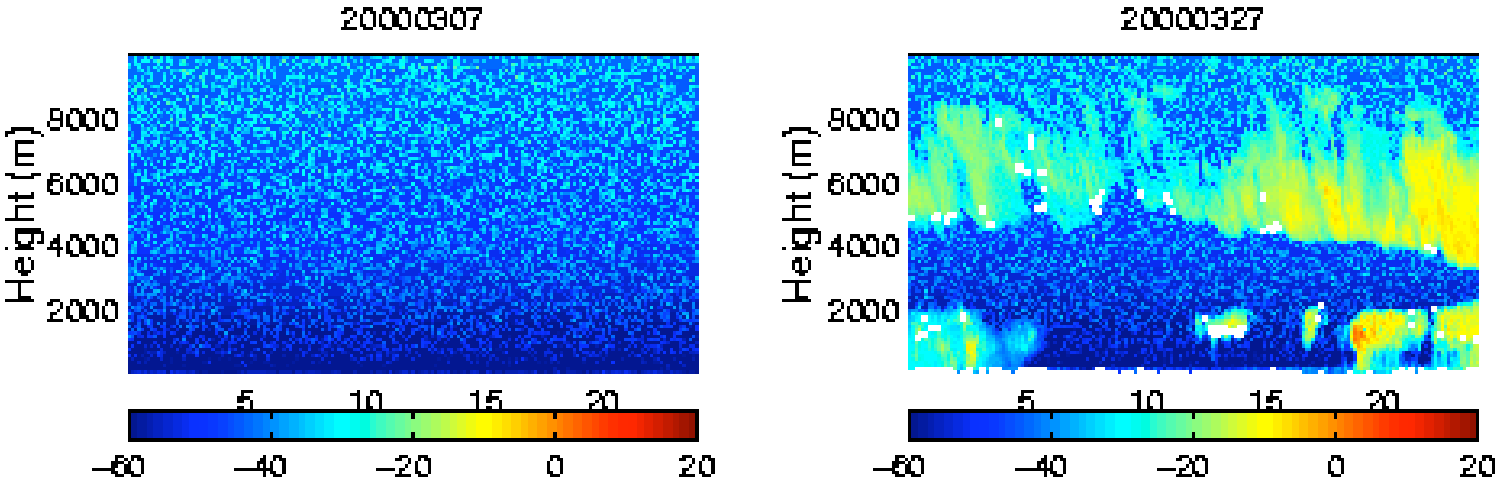






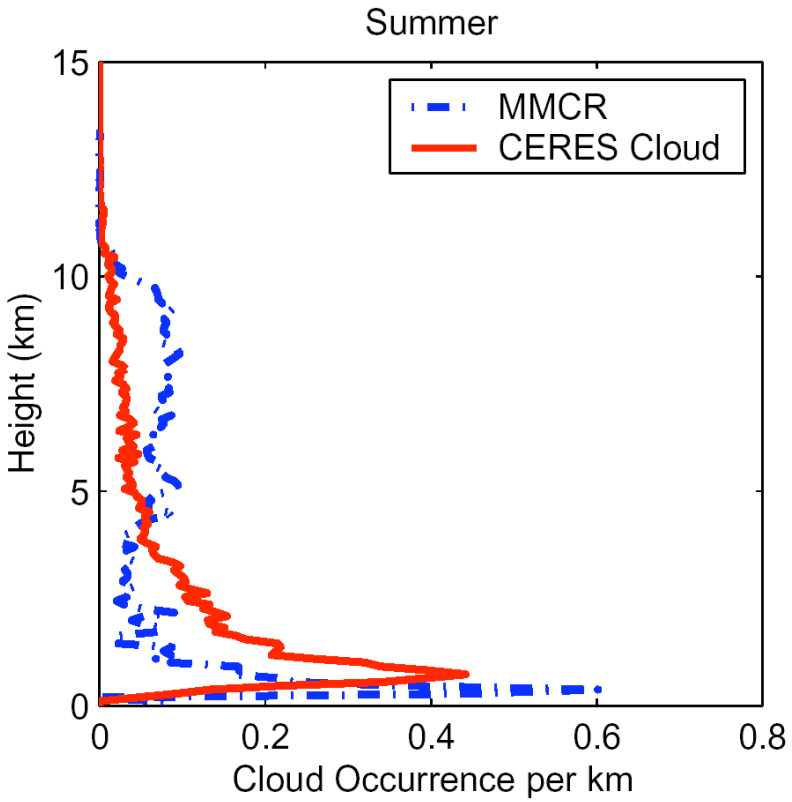


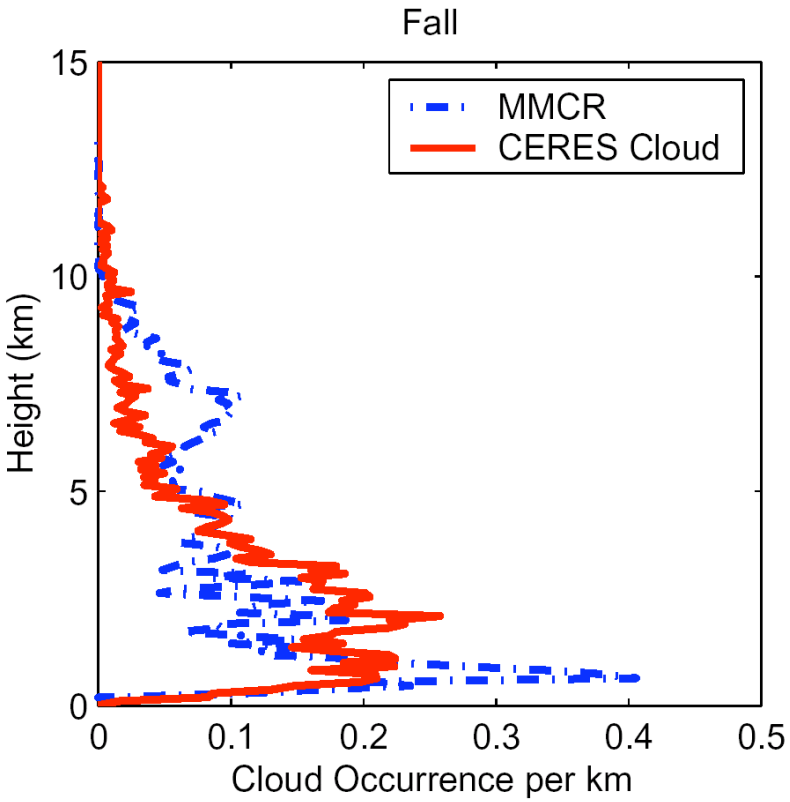
Smaller Difference in Cloud Occurrence



Clear day

Cloud Vertical Profile

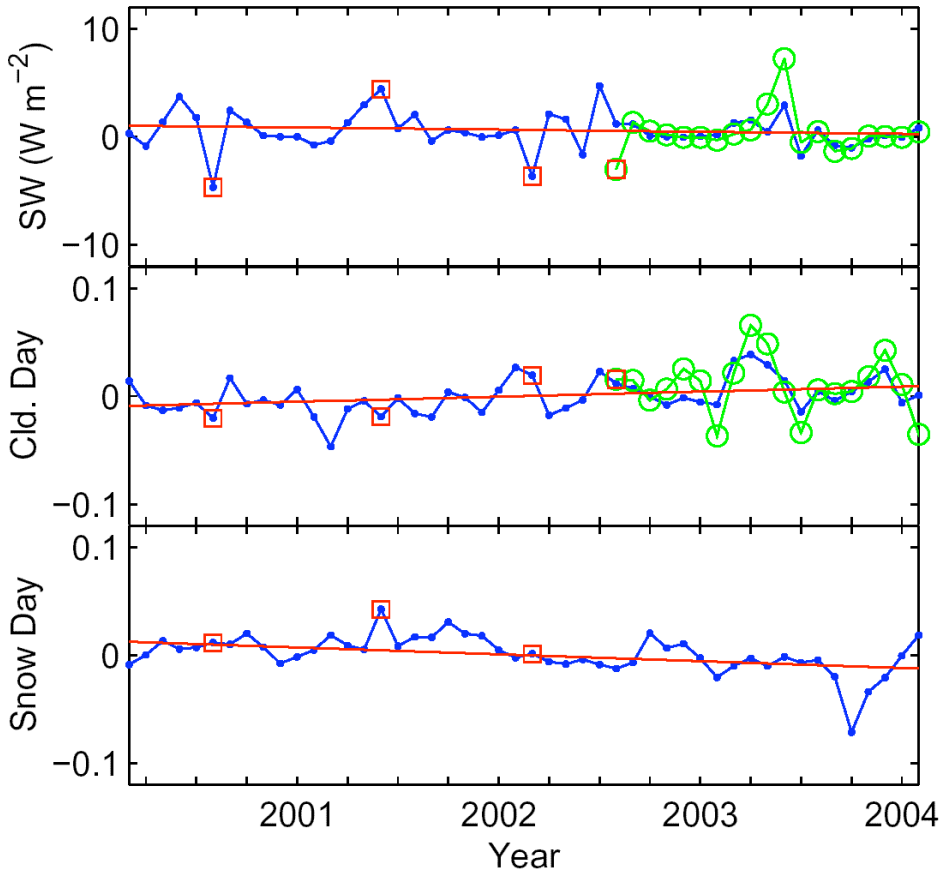




Day + night clouds

over Barrow, AK

Daytime Trends Over the Arctic

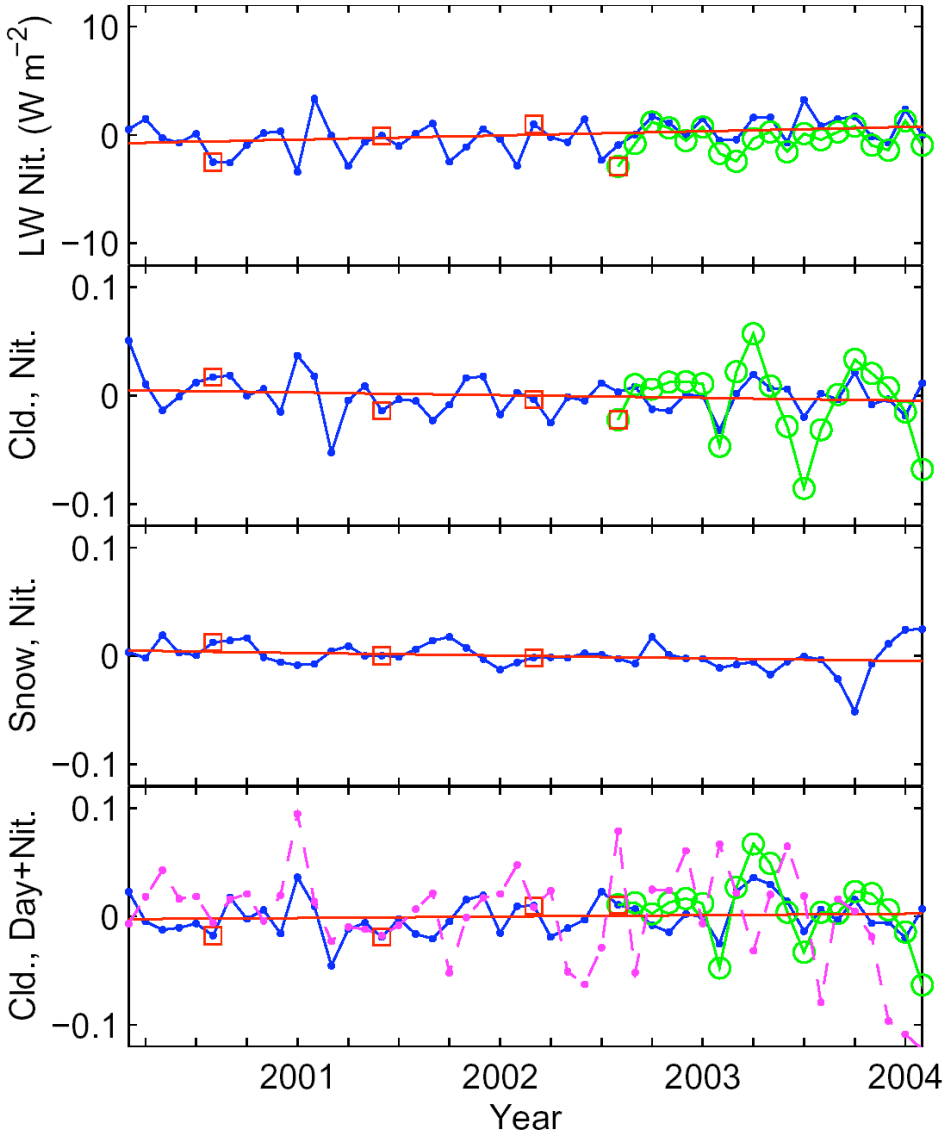


2.0±2.0 W m^{-2}

0.047±0.041

-0.064±0.055

Nighttime Trend Over the Arctic



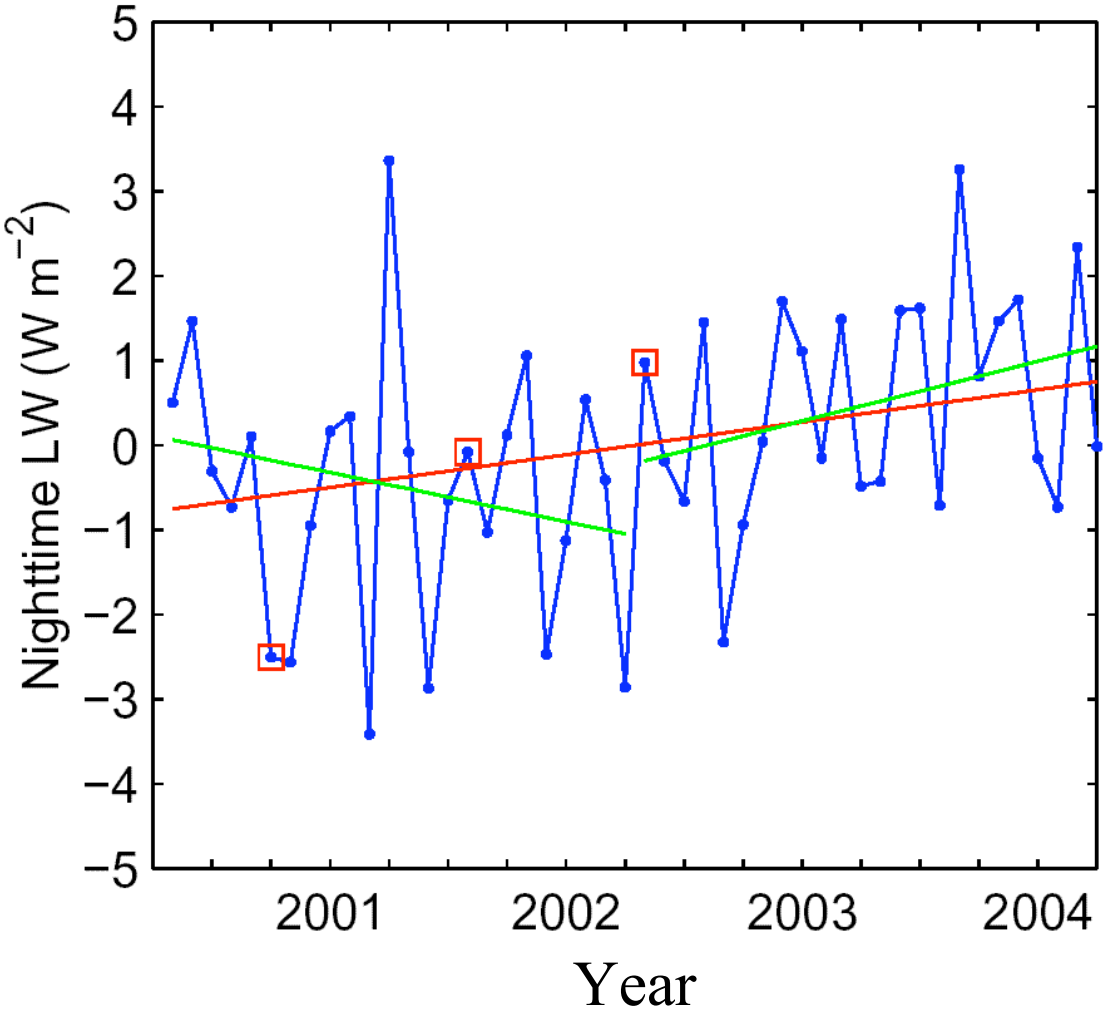
3.8±2.2 W m^{-2}

-0.024±0.028

-0.024±0.036

0.012±0.032

LW Night Irradiance



Conclusions

- The daytime cloud fraction over the Arctic from March 2000 through February 2004 increased at a rate of 0.047 ± 0.041 per decade.
- The corresponding top-of-atmosphere (TOA) shortwave irradiances show no significant trend during this period.
- The influence of reduced Arctic sea ice cover on TOA shortwave radiation is reduced by the presence of clouds and compensated by the increase in cloud cover.
- The cloud fraction and TOA shortwave irradiance over the Antarctic show no significant trend during the same period.