An Estimate of Infrared Radiation Effect by Sub-Visual Ice Clouds

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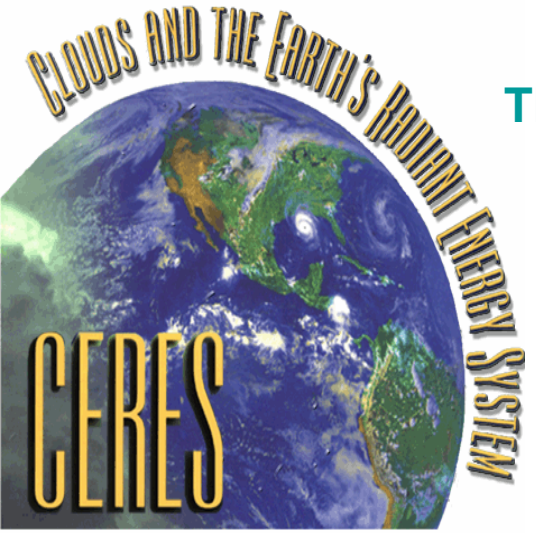


Thanks to Seiji Kato for providing C3M data

Newport News, Virginia,
April 28-30, 2009

Introduction

Sub-visual clouds in this study mean super-thin clouds which cannot be detected by MODIS but are classified as “clouds” by CALIPSO.

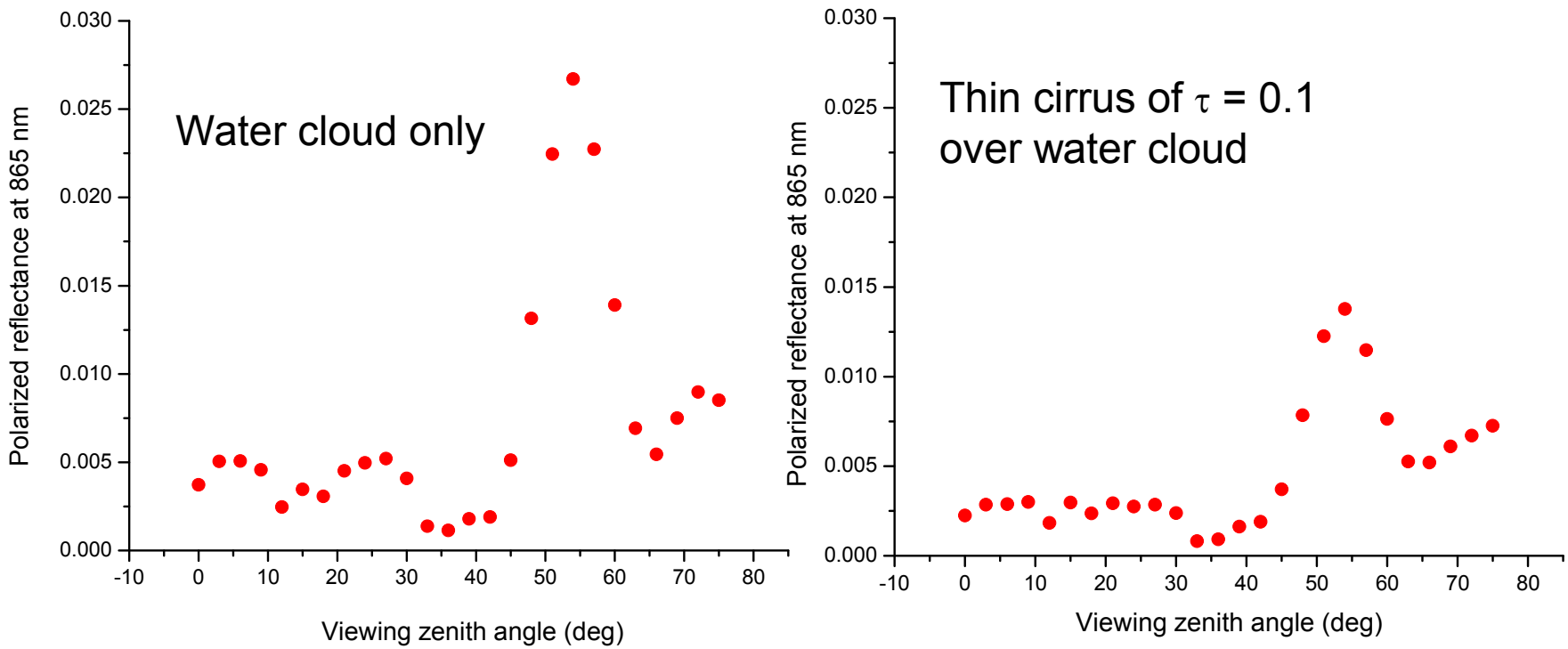
These clouds may exist globally and may have effects on Earth-atmosphere radiation budget, remote sensing of aerosols, and retrieval of surface skin temperature.

What is the global coverage of these thin clouds? Any geo-location dependence?

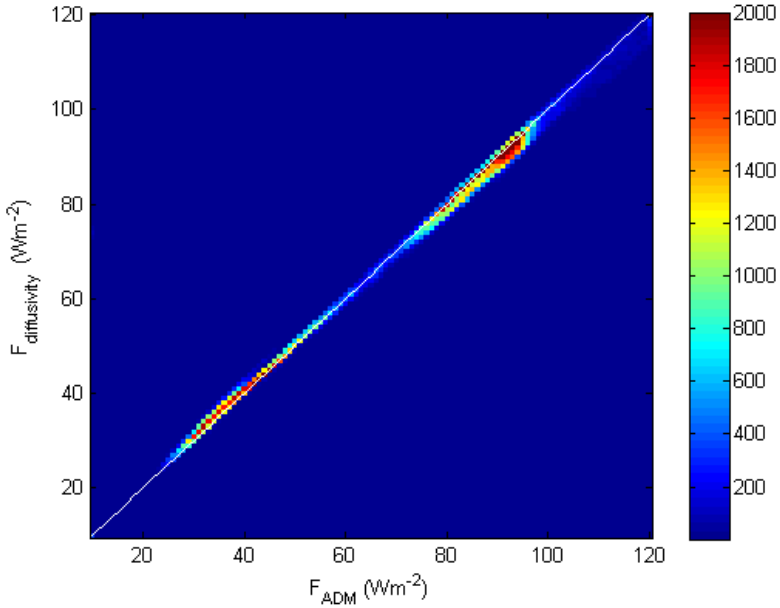
What are the infrared and shortwave radiation effects of these clouds?

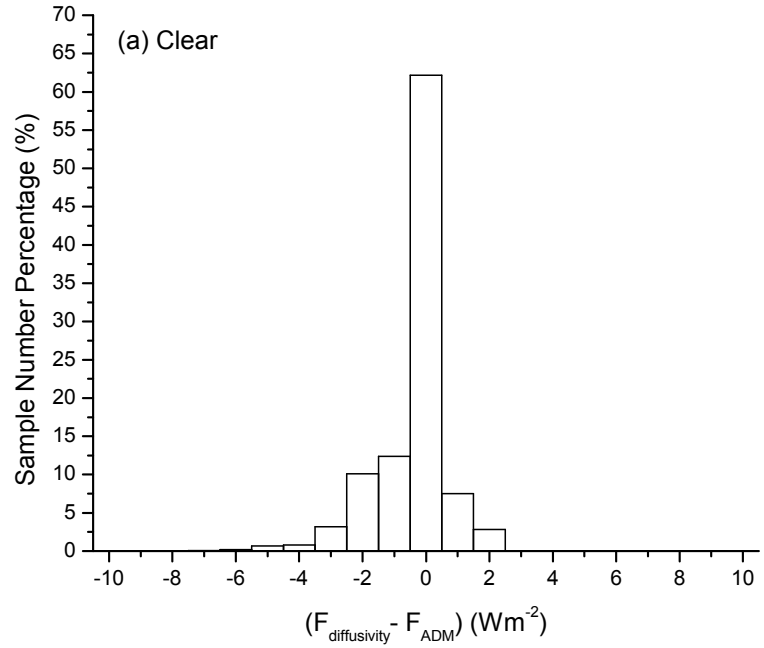
To study these subtle clouds, however, large amount of high-quality measurement data are required.

In this study, one month of CCCM data of July 2006, which merges MODIS, CERES and CALIPSO measurements, are analyzed.



Model-simulated effect of sub-visually thin ice clouds on polarized reflectance at a wavelength of 865 nm.

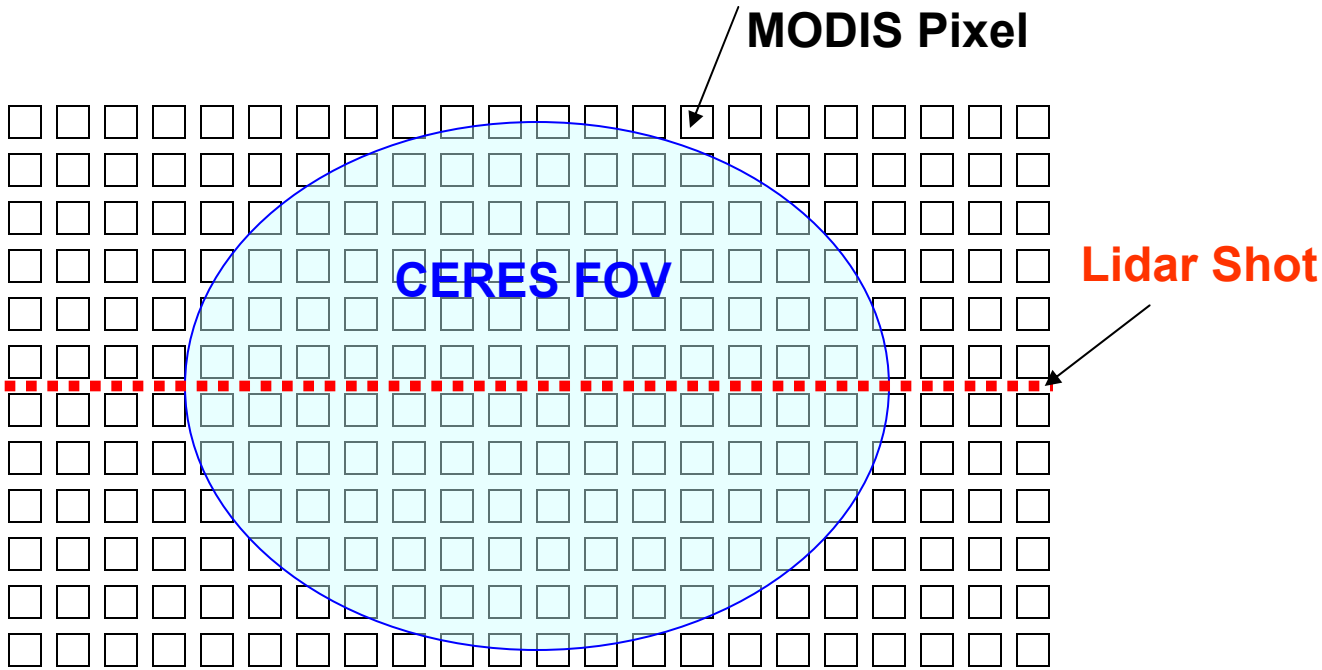




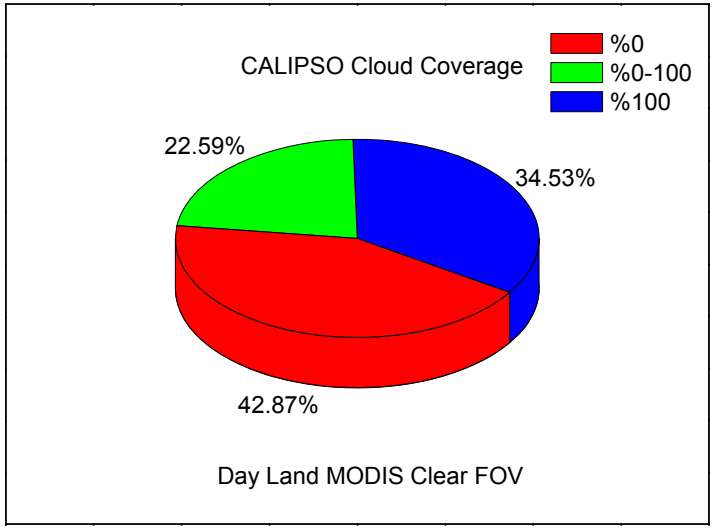
Comparisons of the window fluxes from the diffusivity approximation and CERES WN ADMs for 31 days of January 2005 for latitudes between 75 deg S and 75 deg N. The color bar shows the occurrence frequency of the samples.

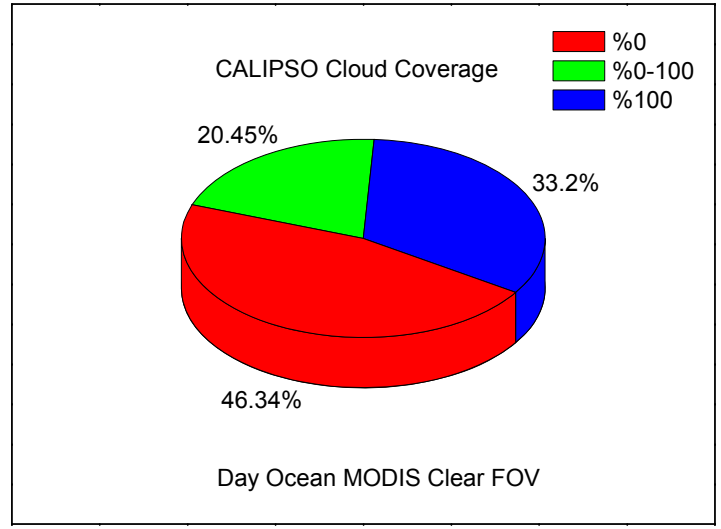
Histograms of the differences between the window-channel fluxes from the diffusivity approximation and CERES ADMs for 31 days of January 2005.

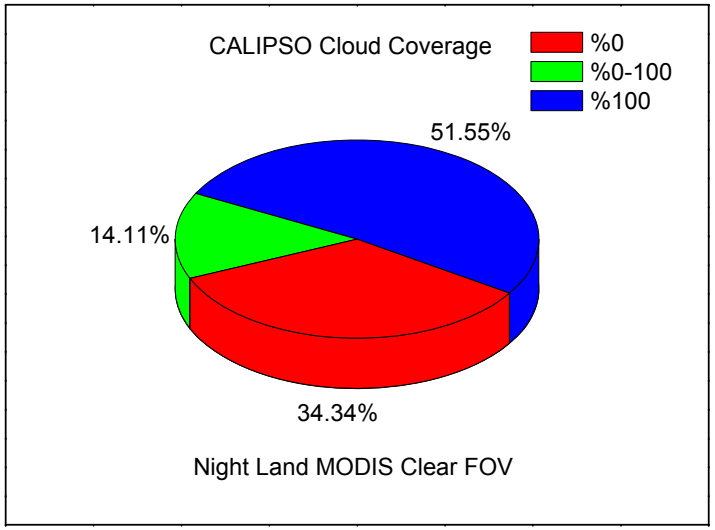
Method and Data

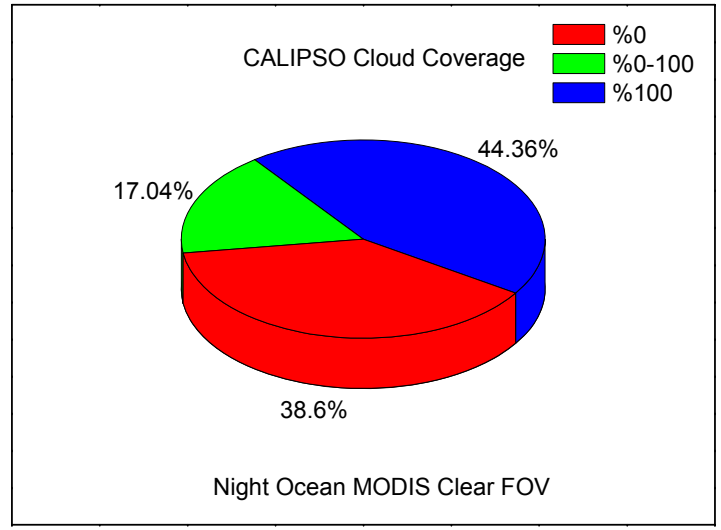


Sub-visually cloudy CERES FOV:
MODIS Clear, CALIPSO Cloudy

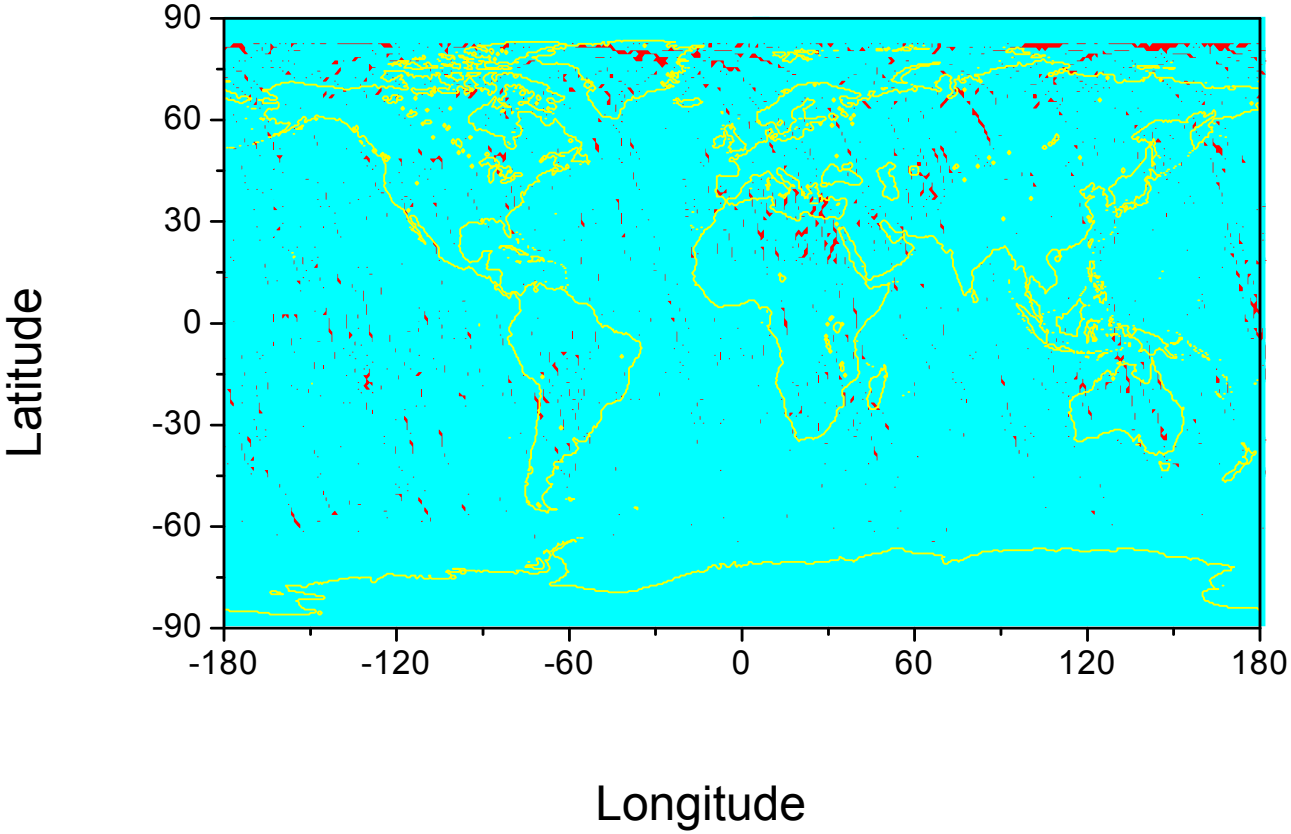




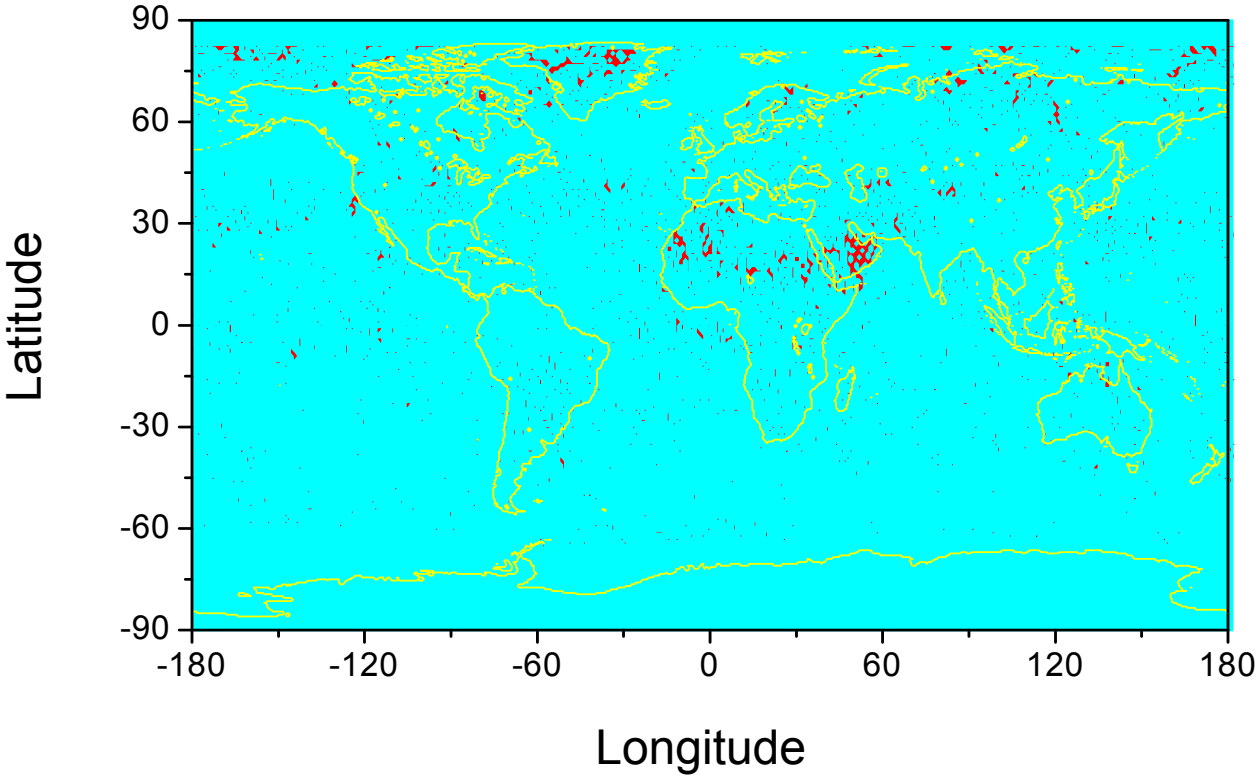




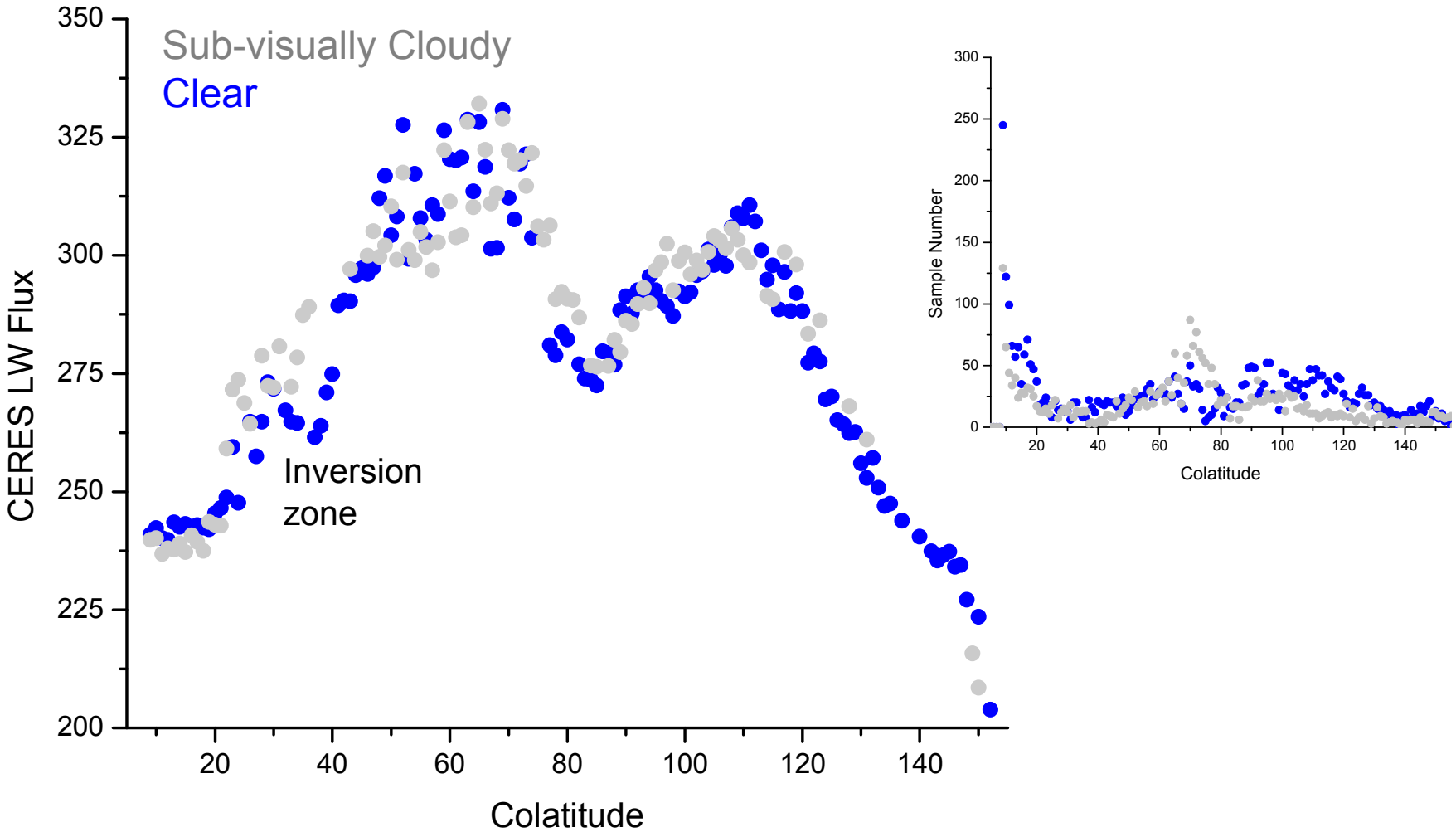
Percentage of CALIPSO-measured cloudy cases over MODIS clear scenes



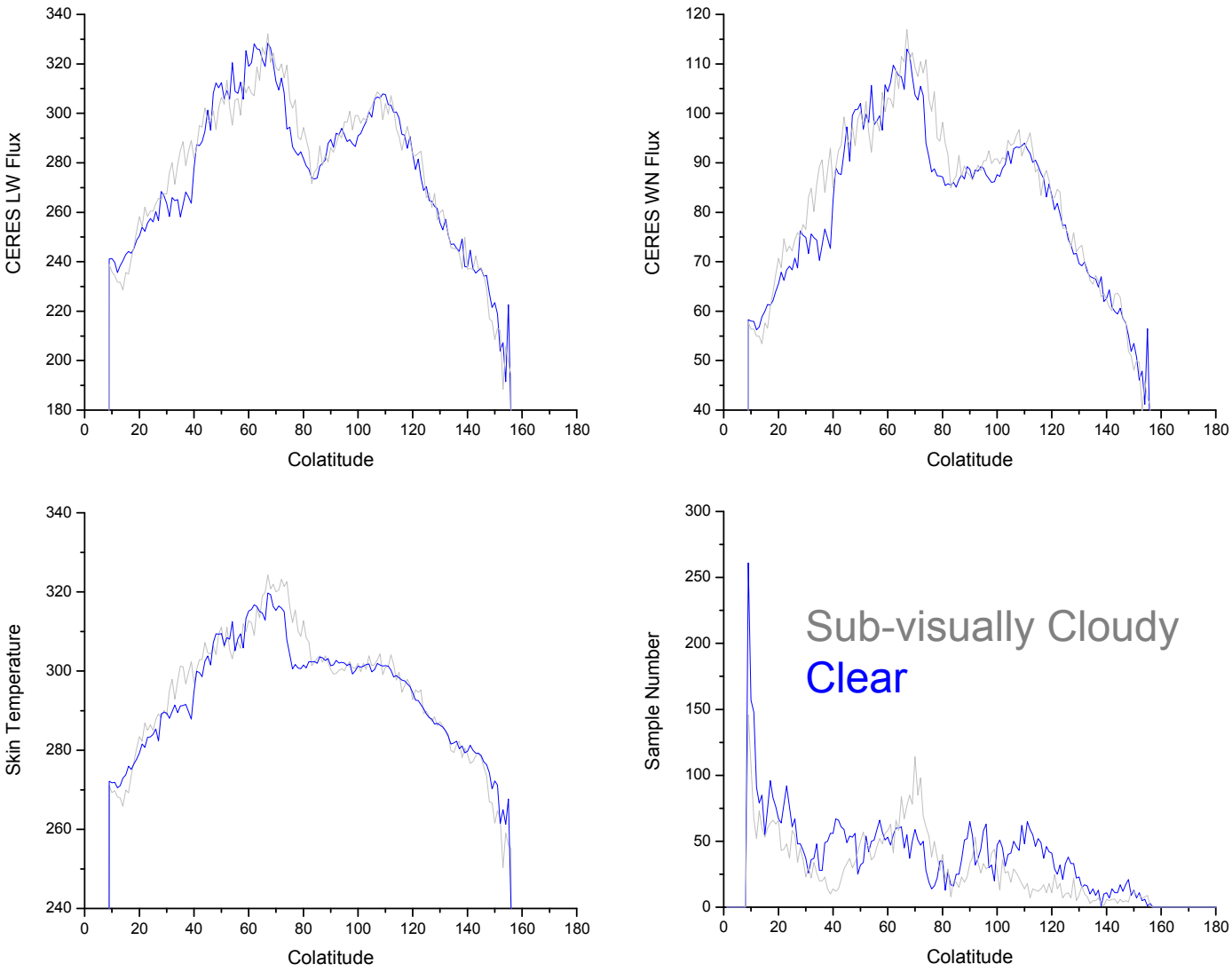
Day Clear Sampling Locations



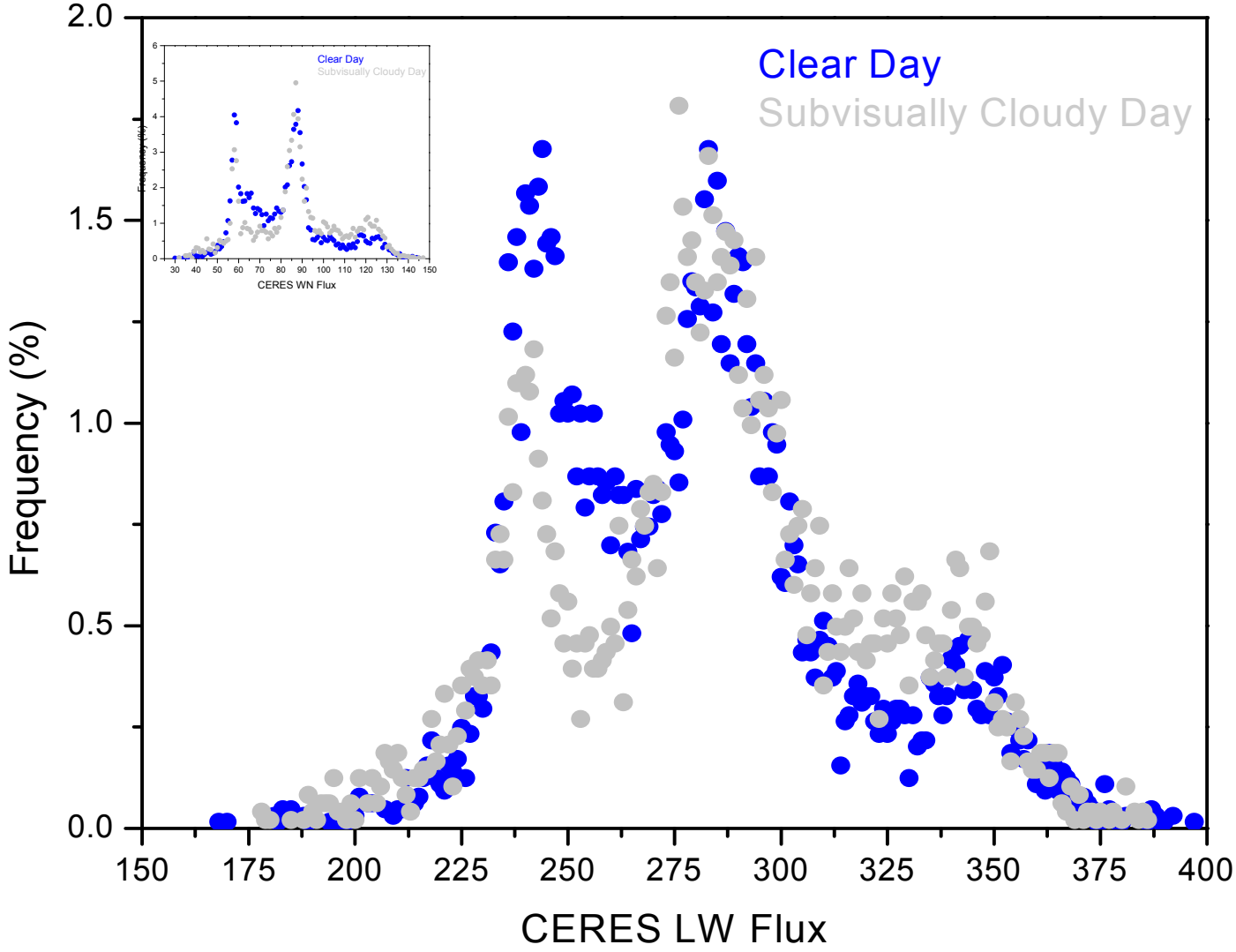
Day Sub-visually Cloudy Sampling Locations



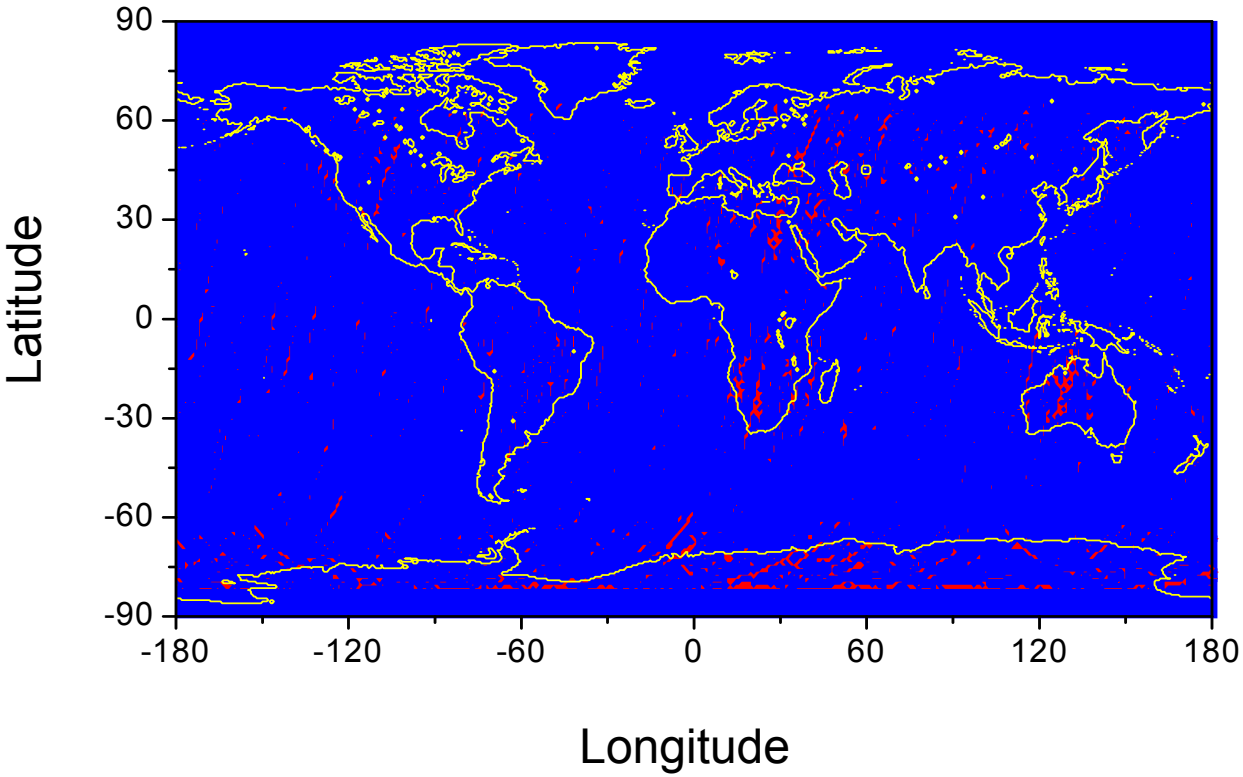
Ocean daytime zonally mean longwave flux



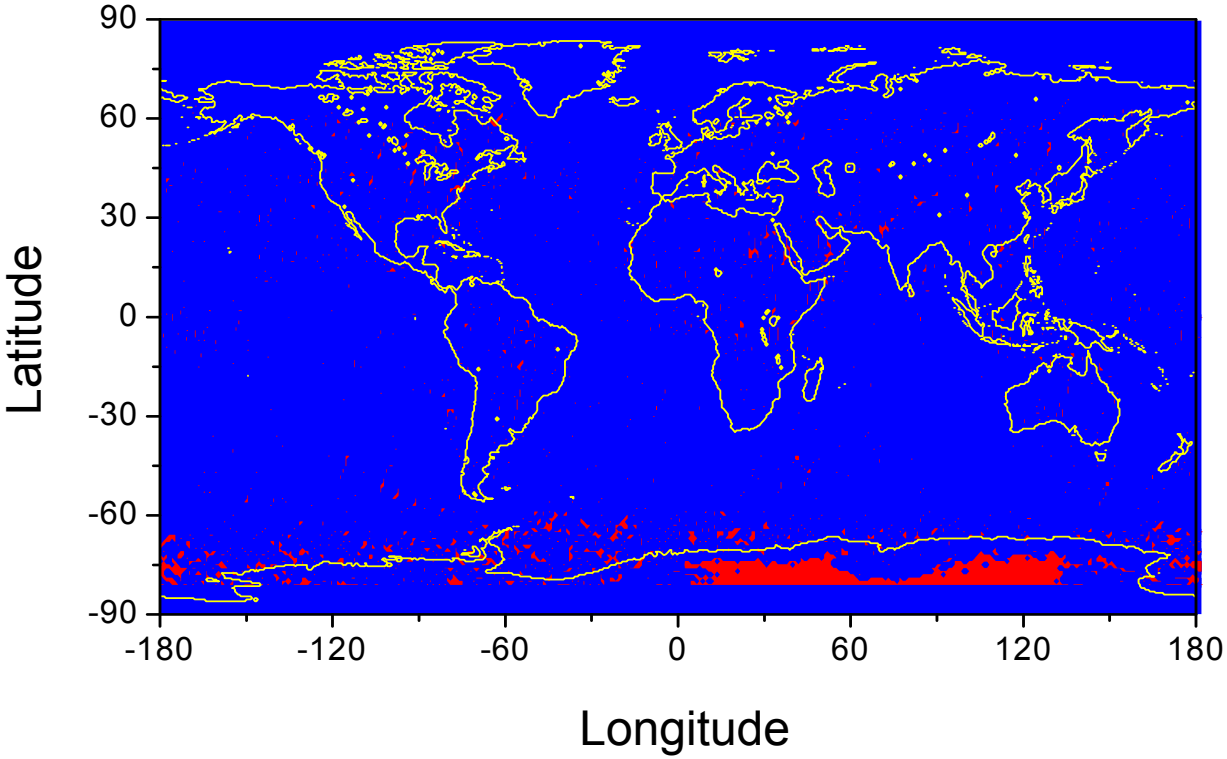
All Scene day zonally mean LW, WN fluxes and skin temperature



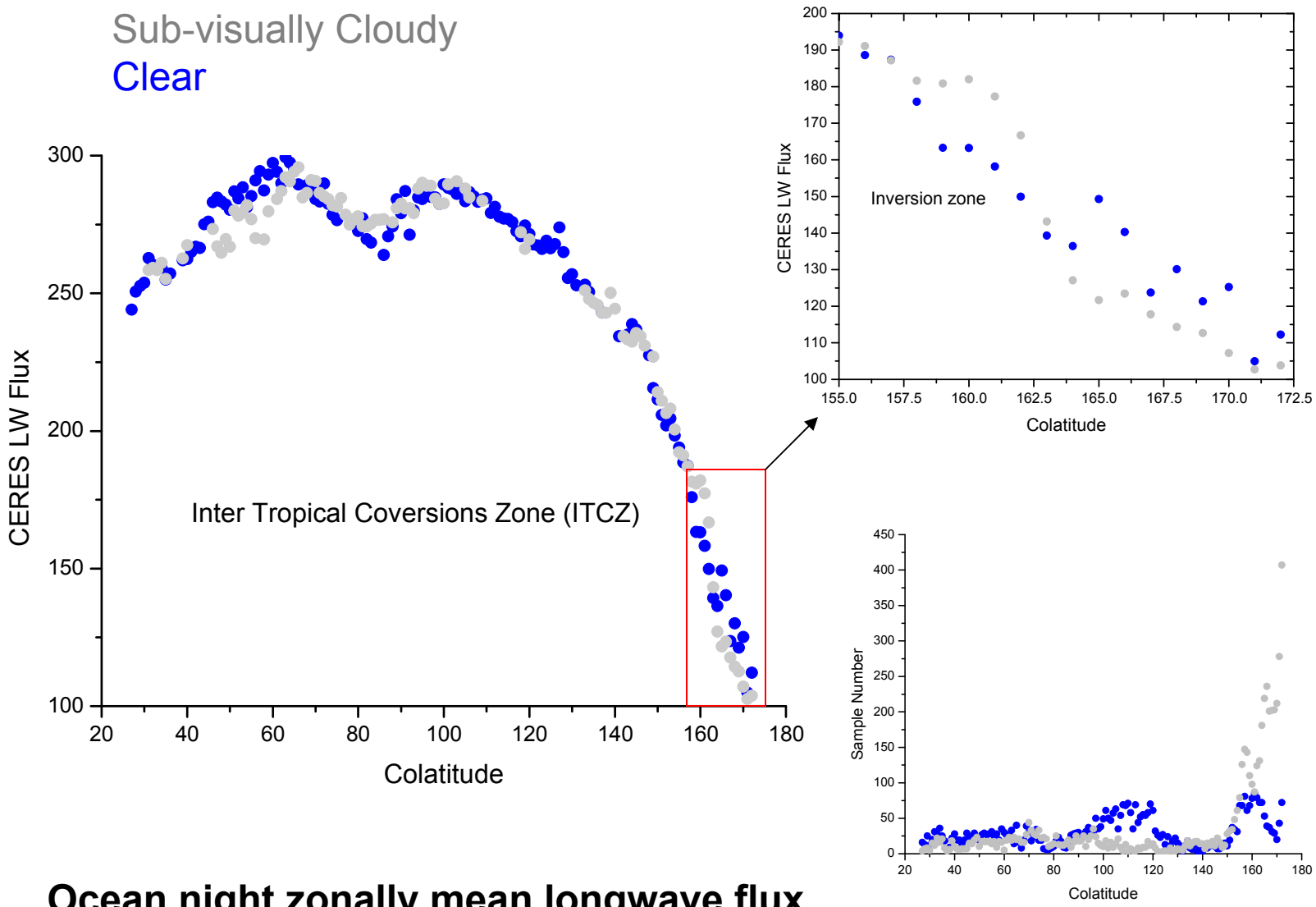
Occurrence frequency of longwave flux



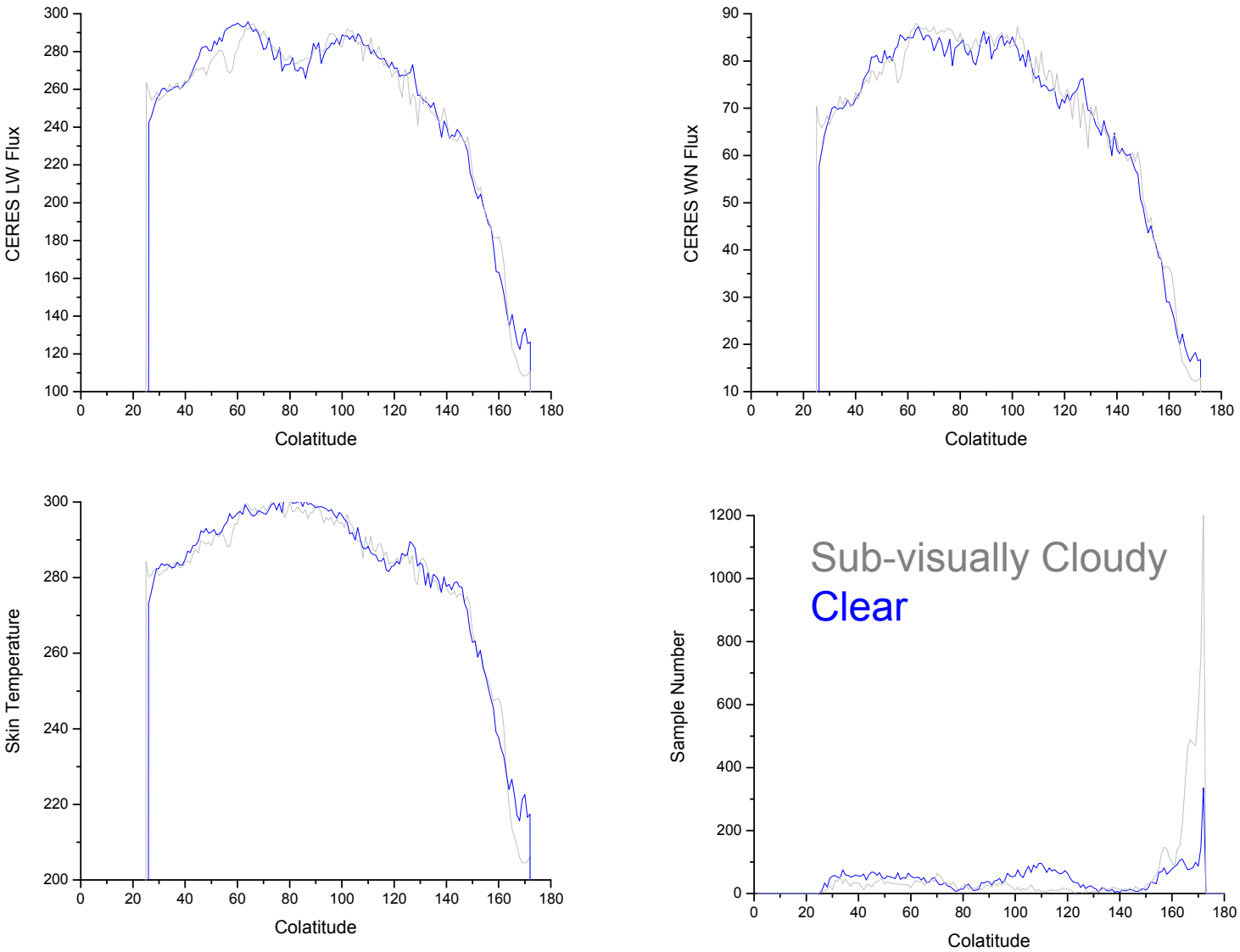
Night Clear Sampling Locations



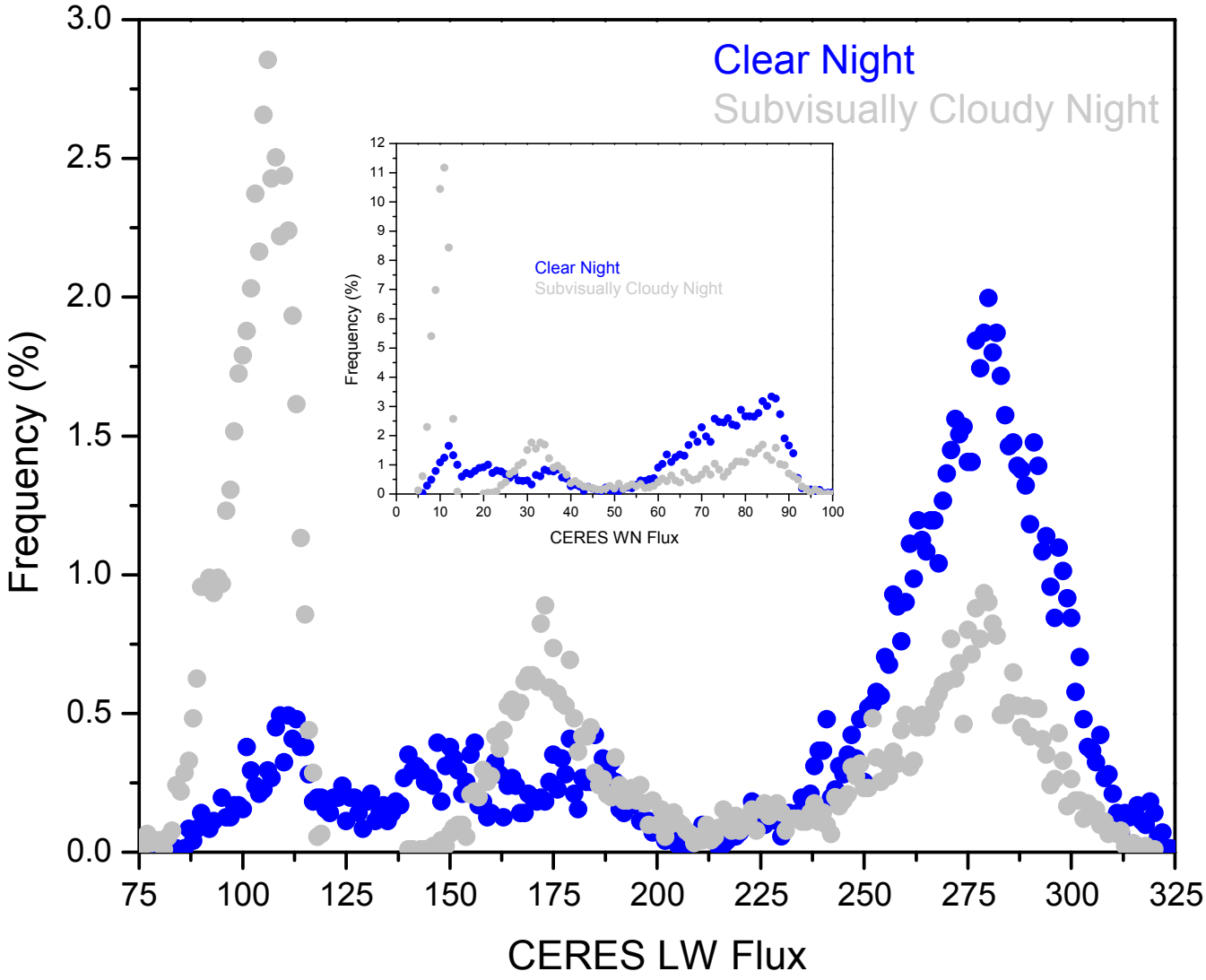
Night Sub-visually Cloudy Sampling Locations



Ocean night zonally mean longwave flux



All Scene night zonally mean LW, WN fluxes and skin temperature



Occurrence frequency of longwave flux

Conclusion

The sample numbers are low in this study, limited by available data.
A “Beta” version of conclusion can be summarized as follows:

1. Up to 50% of MODIS-derived clear sky scenes may be covered by sub-visually thin clouds. Nighttime land has the biggest chance to be covered by sub-visually thin clouds.

2. The longwave and window radiation forcing of the sub-visually thin clouds seem not very significant.

3. Global distribution of sub-visually thin clouds seems to have some scene-type dependence. Measurement error or sampling bias?

4. Except for temperature inversion zone, sub-visually thin clouds generally reduces the outgoing infrared radiation. This is more significant during nighttime.