

MODIS Cloud Mask and Partly Cloudy Pixel Retrievals and Shipboard Observations of the Surface Radiation Budget

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GOALS:

- 1) Identify which of the cloudy pixels in the MODIS cloud mask are partly cloudy and associated with a layered cloud system.
- 2) Assess quality of shipboard observations of surface radiative fluxes.

Retrieval Method

Retrieval scheme follows Arking and Childs (1985) and is described in Coakley et al. (2005).

- For single-layered cloud systems, identify overcast pixels and determine altitude of cloud layer.
- For each pixel, radiances are given by

$$I = (1 - A_C)I_S + A_C I_C(z_C)$$

A_C = Fractional cloud cover within a pixel

I_S = Average cloud-free radiance within a pixel

$I_C(z_C)$ = Average overcast radiance within a pixel

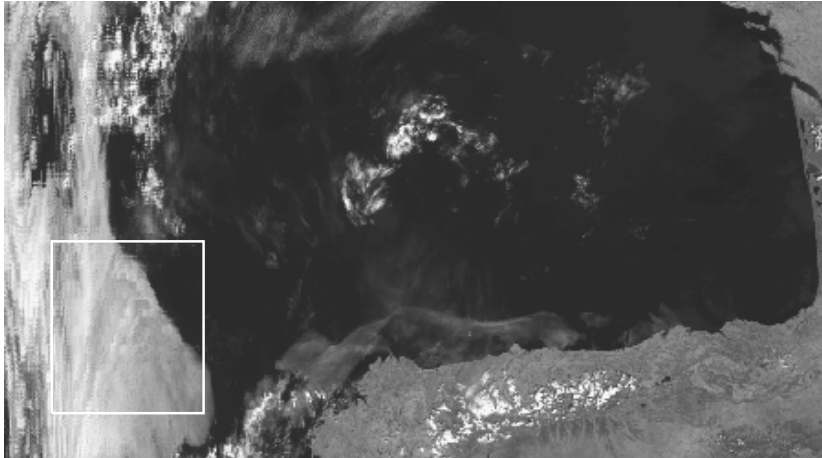
z_C = Average cloud altitude obtained from nearby overcast pixels.

- For each pixel, adjust A_C, τ, R_e so that calculated radiances at 0.64, 1.6, 2.1, 3.7, and 11 μm match those observed.

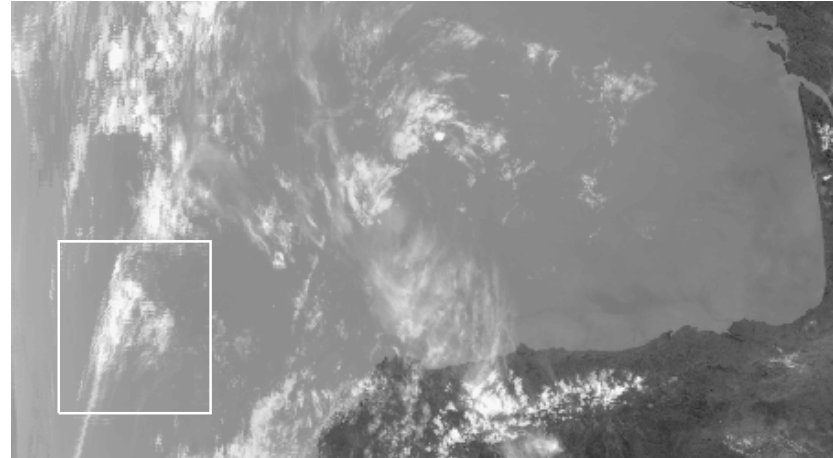
MODIS and Partly Cloud Pixel Retrieval Cloud Masks

Terra MODIS, 20 May 2004, 1130 Z

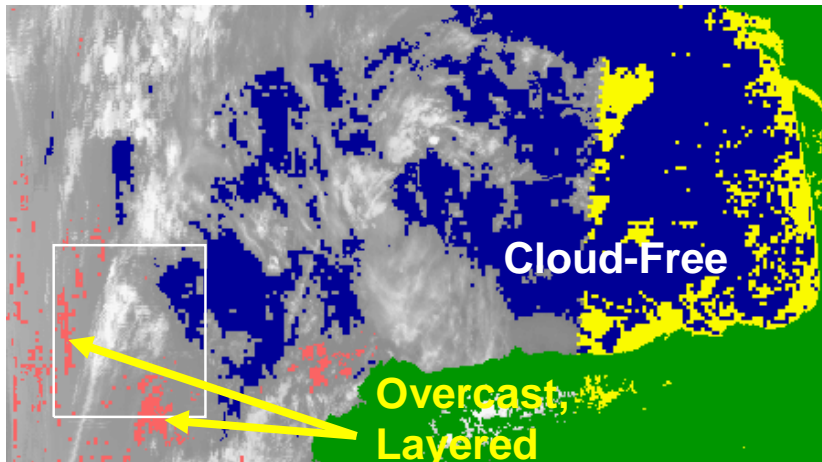
0.84- μm Reflectance



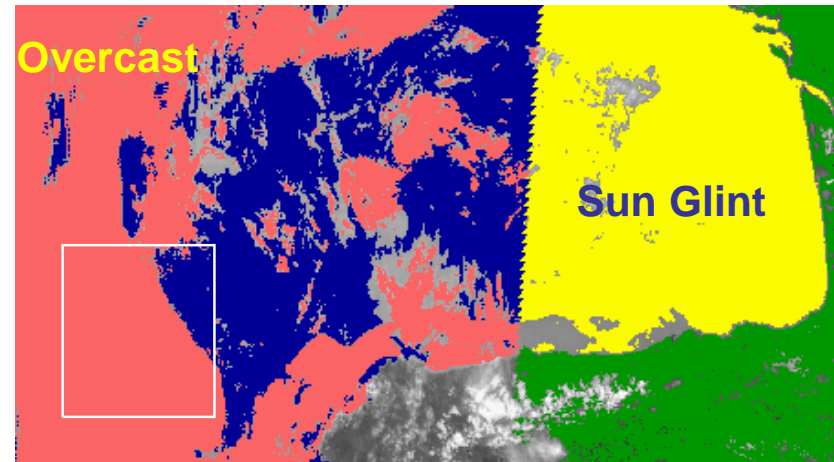
11- μm Radiance



Partly Cloudy

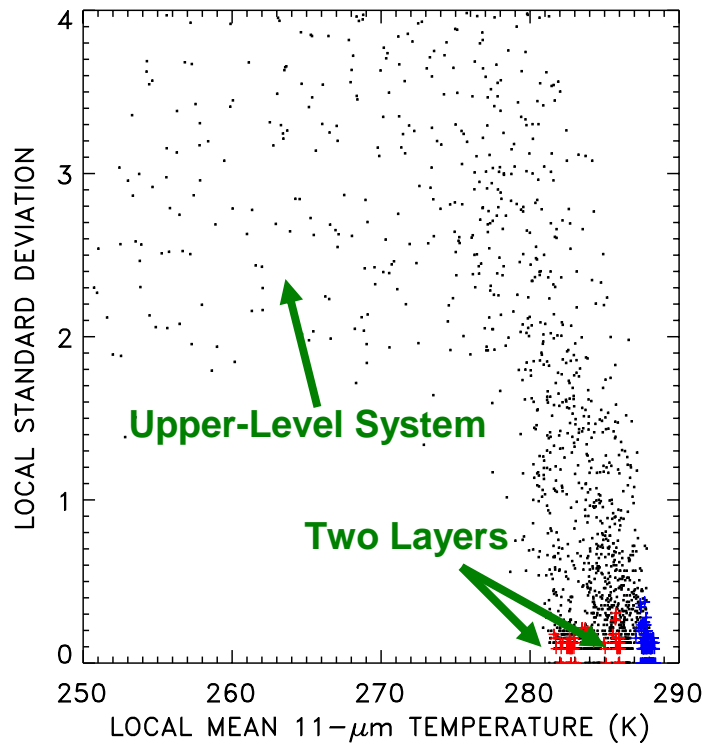


MODIS

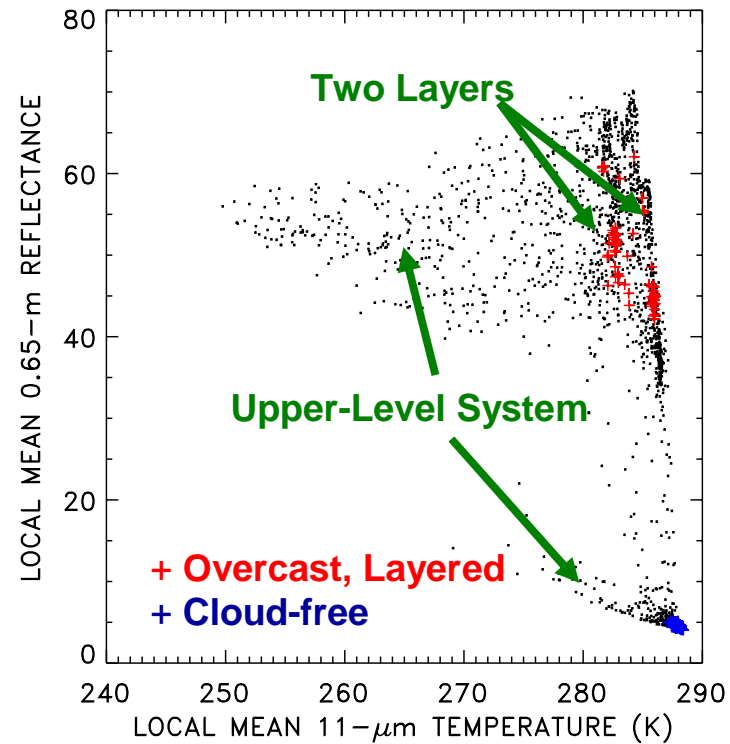


Local Spatial and Spectral Relationships

Local Means and Standard Deviations, 11- μm Radiance



Local Means 0.64- μm Reflectance and 11- μm Radiance



Statistics constructed from 4×4 arrays of 1-km pixels within 180-km scale region

Strategies for Isolating Layered Clouds in Multilayered Systems

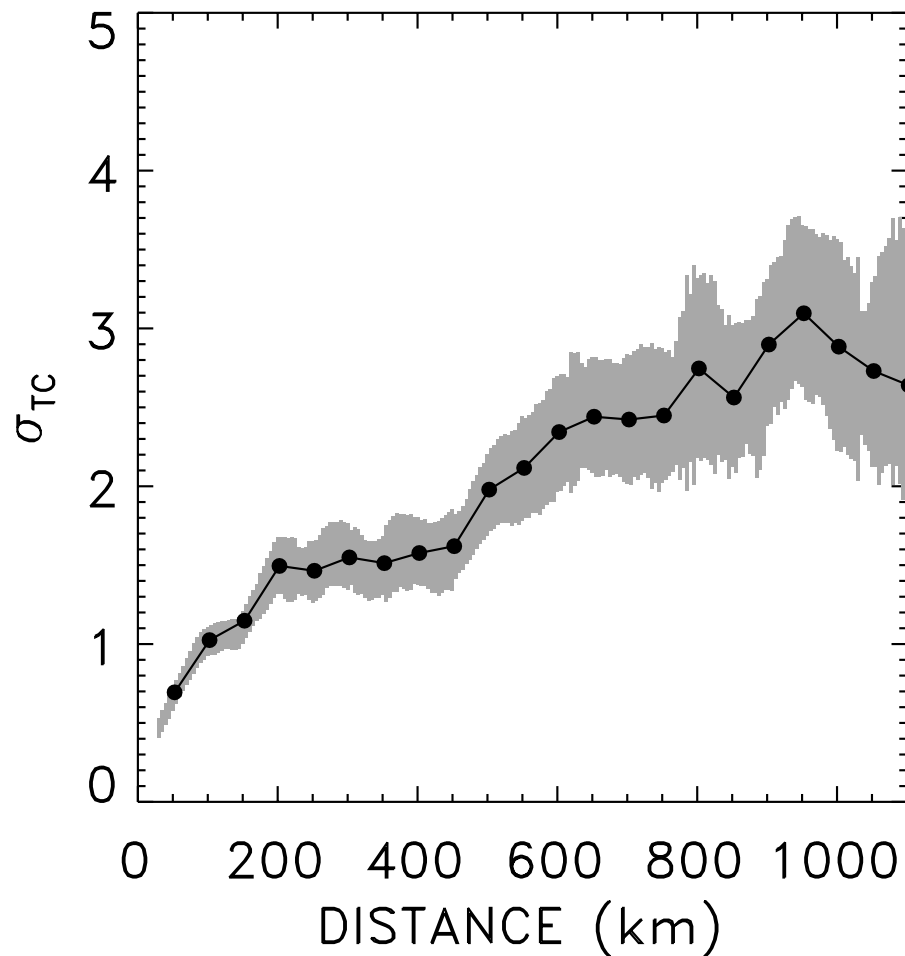
- **Challenge:** *Analyze pixels with single-layered system as close as possible to multilayered systems.*

Characterize layer properties within small regions ($\sim 10 \times 10$ pixel arrays) and identify as mixed pixels those that are unlikely to fall within the statistics of the layer within the region.

- **Challenge:** *How far from overcast pixels can reliable layer altitudes be determined?*

Currently staying within 50 km.

RMS Errors in Layer Temperature and Distance for Low-Level, Single-Layered Systems

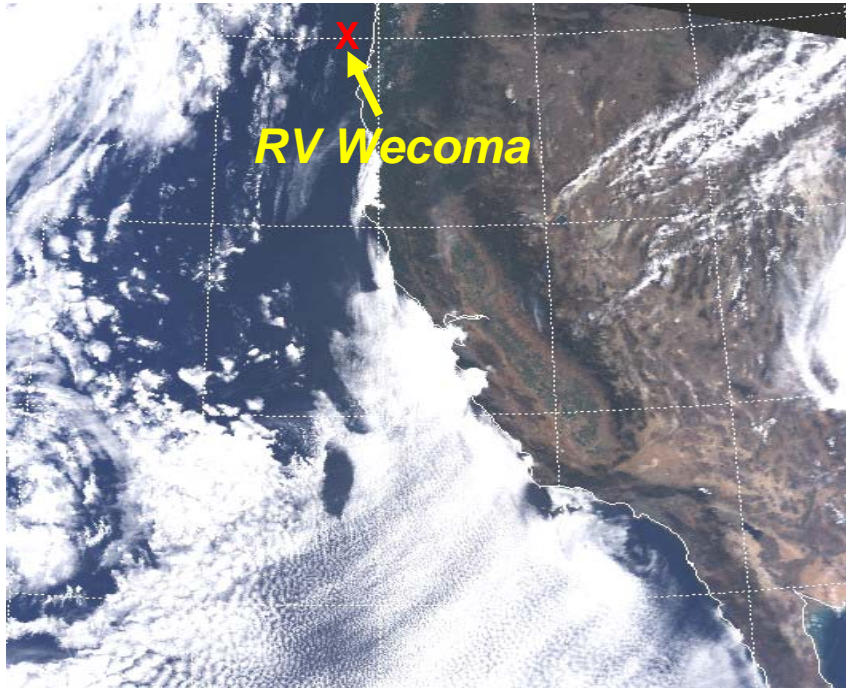


Based on Temperatures for 1-km pixels overcast by single-layered clouds.

Observations from 3 years of observations for summertime marine stratus in the north Atlantic.

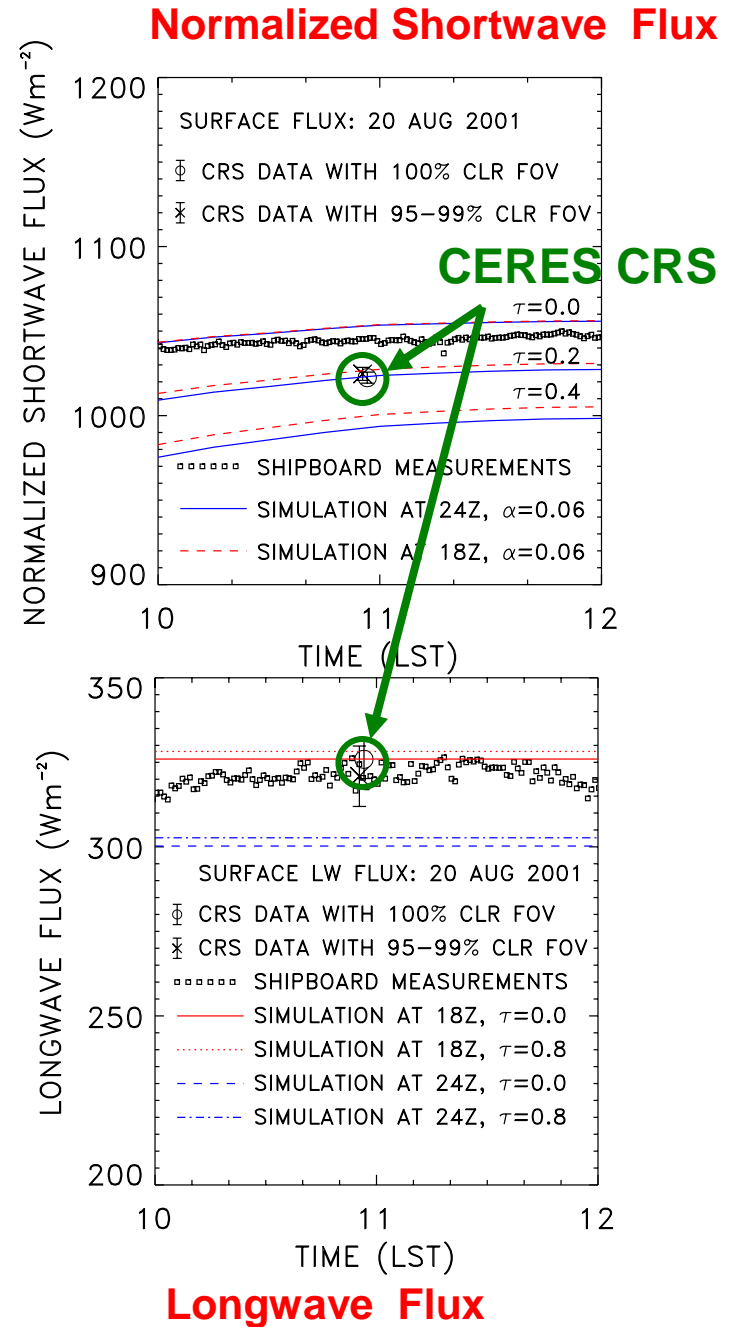
***Strategy:* Accept errors in cloud properties that are smaller than mesoscale (~50-km) variability.**

Shipboard Observations of Surface Radiative Fluxes

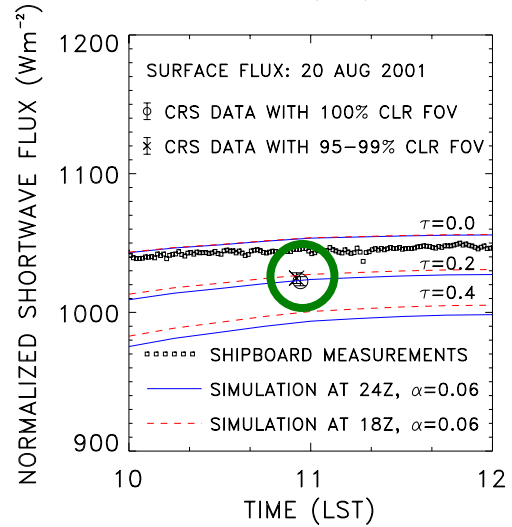
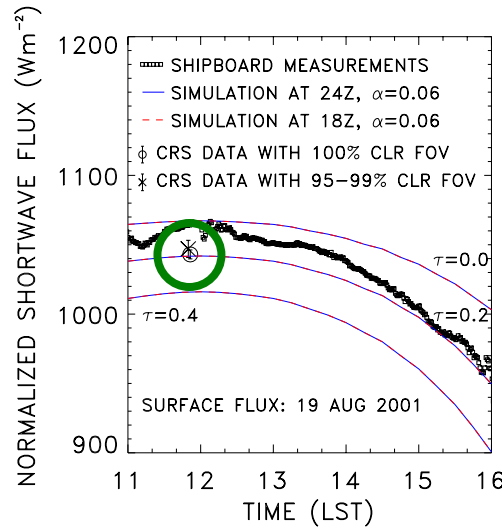
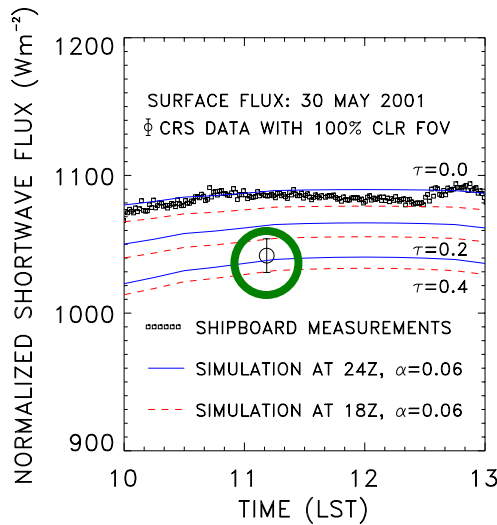
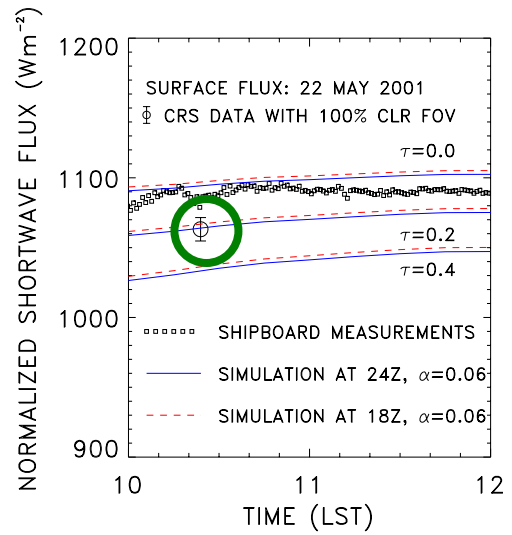
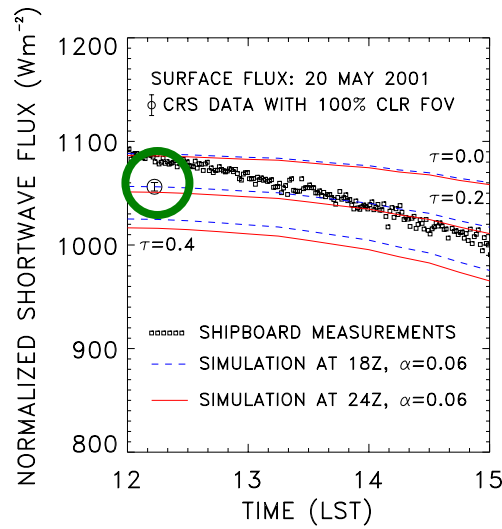
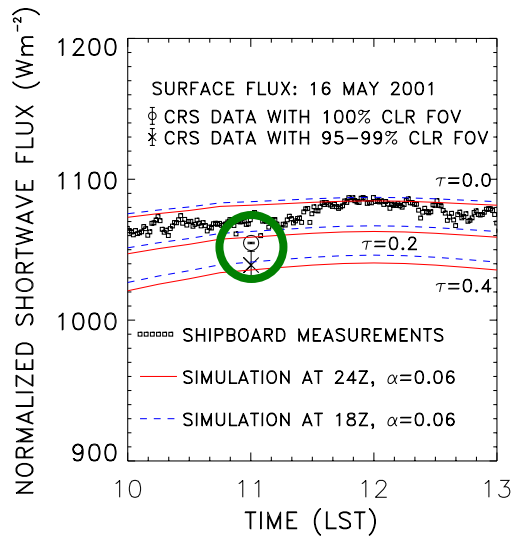


Calculated fluxes based on NCEP analyzed temperature and humidity profiles interpolated to the position of the ship.

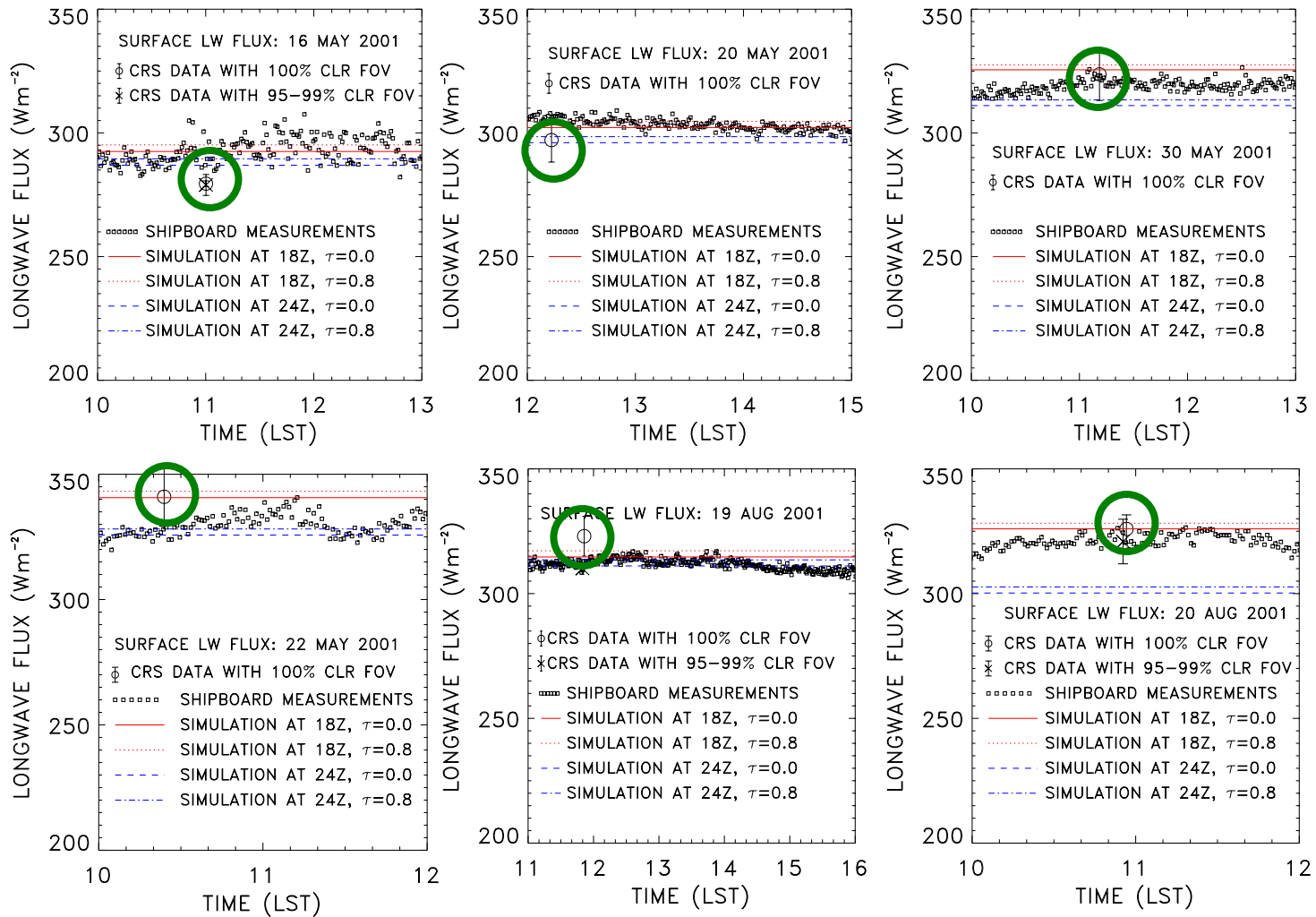
CERES CRS observations within 50 km of ship.



Normalized Shortwave Fluxes



Longwave Fluxes



*...on to all-sky
observations...*