

NRL Solar and IR Radiometric Measurements During POST



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NRL Scientific Objectives:

- Quantify the impact of **solar radiative heating** and **infrared radiative cooling** on the evolution and persistence of **marine stratocumulus** clouds
- Quantify the radiative properties and effects of the **Entrainment Interface Layer** (EIL)

NRL Measurements:

- **Solar and Infrared Irradiance – surface to above cloud tops:**
 - Platform: CIRPAS Twin Otter
 - Solar and IR heating and cooling rates
 - Solar reflectivity (albedo) of cloud tops



Marine stratocumulus

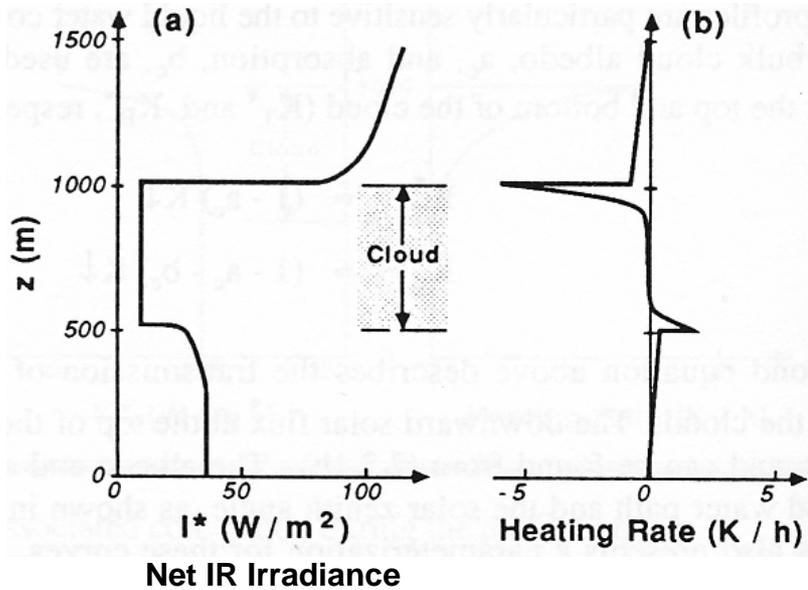
Navy Applications:

- Improvement of Navy Large Eddy Simulation models of marine boundary layer

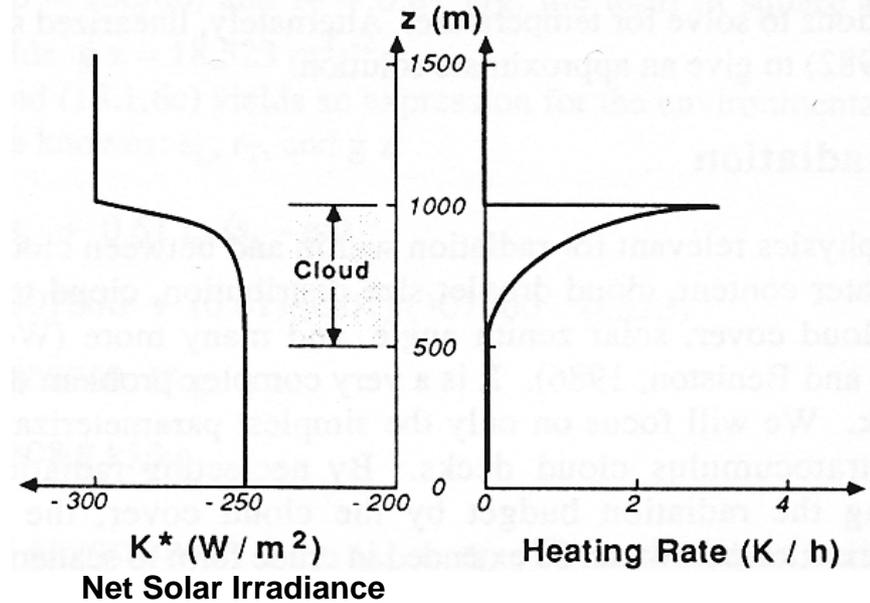
Classic Radiative View of an Idealized Stratocumulus Cloud (Stull, 1988)



IR



Solar



- IR cooling at cloud top (and warming at cloud base) => Primary driver of

convection => **What is radiative effect of Entrainment Interface Layer**

- Location of cooling/heating spikes uncertain

- Solar heating offsets IR cooling

• Dependent on:

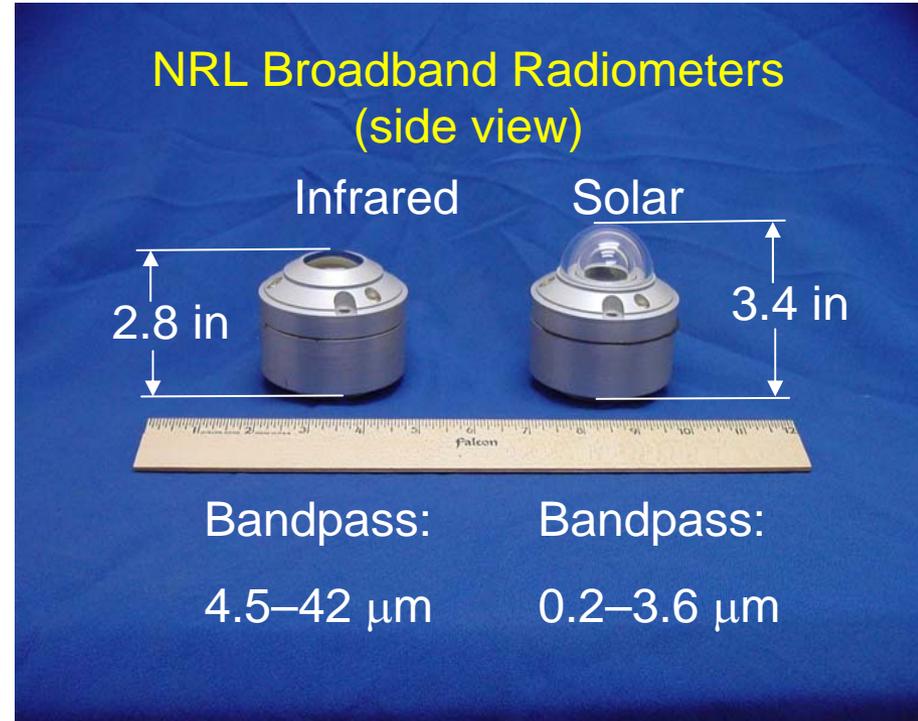
- cloud properties
- time of day (solar zenith angle)

NRL Solar and IR Radiometers: Instrument Description



Description:

- **Modified** Kipp & Zonen CM-22 pyranometers (solar) and CG-4 pyrgeometers (IR)
 - **Amplification of signal at sensor:**
 - New housing
 - Current loop mode operation
- **Fully calibrated** pre- and post-mission at CIRPAS Radiometer Calibration Lab
- Hemispheric field-of-view
- Solar and IR radiometer pair on top and bottom of Twin Otter



Basic Quantities Measured:

- **Up- and down-welling broadband solar and IR irradiance**
- Estimated accuracy: 3% (precision < 1%)

Derived Quantities:

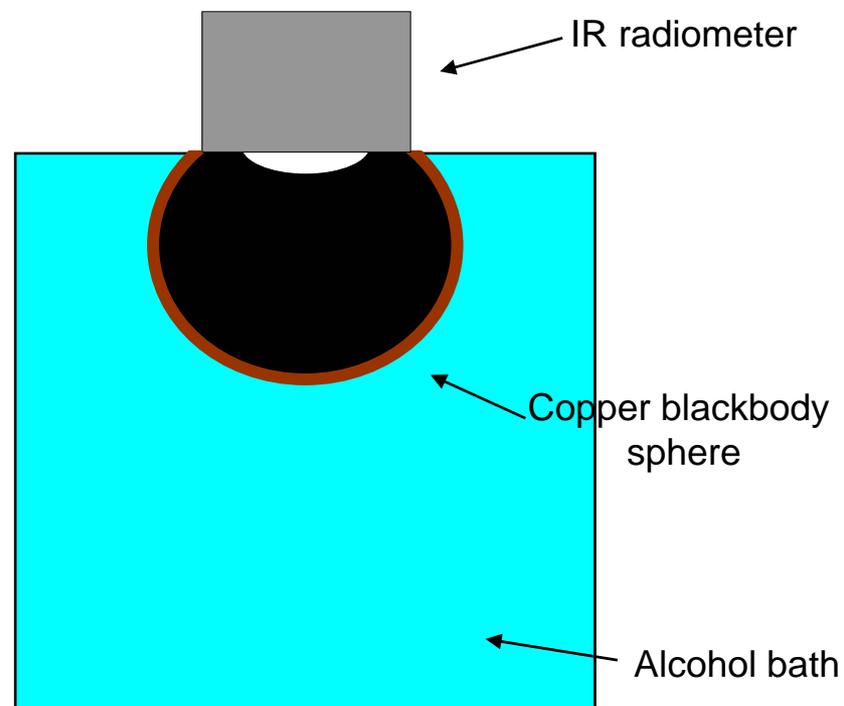
- Net solar and IR flux
- Solar and IR absorption and heating rates
- Cloud albedo

NRL IR Radiometers: Calibration Procedure



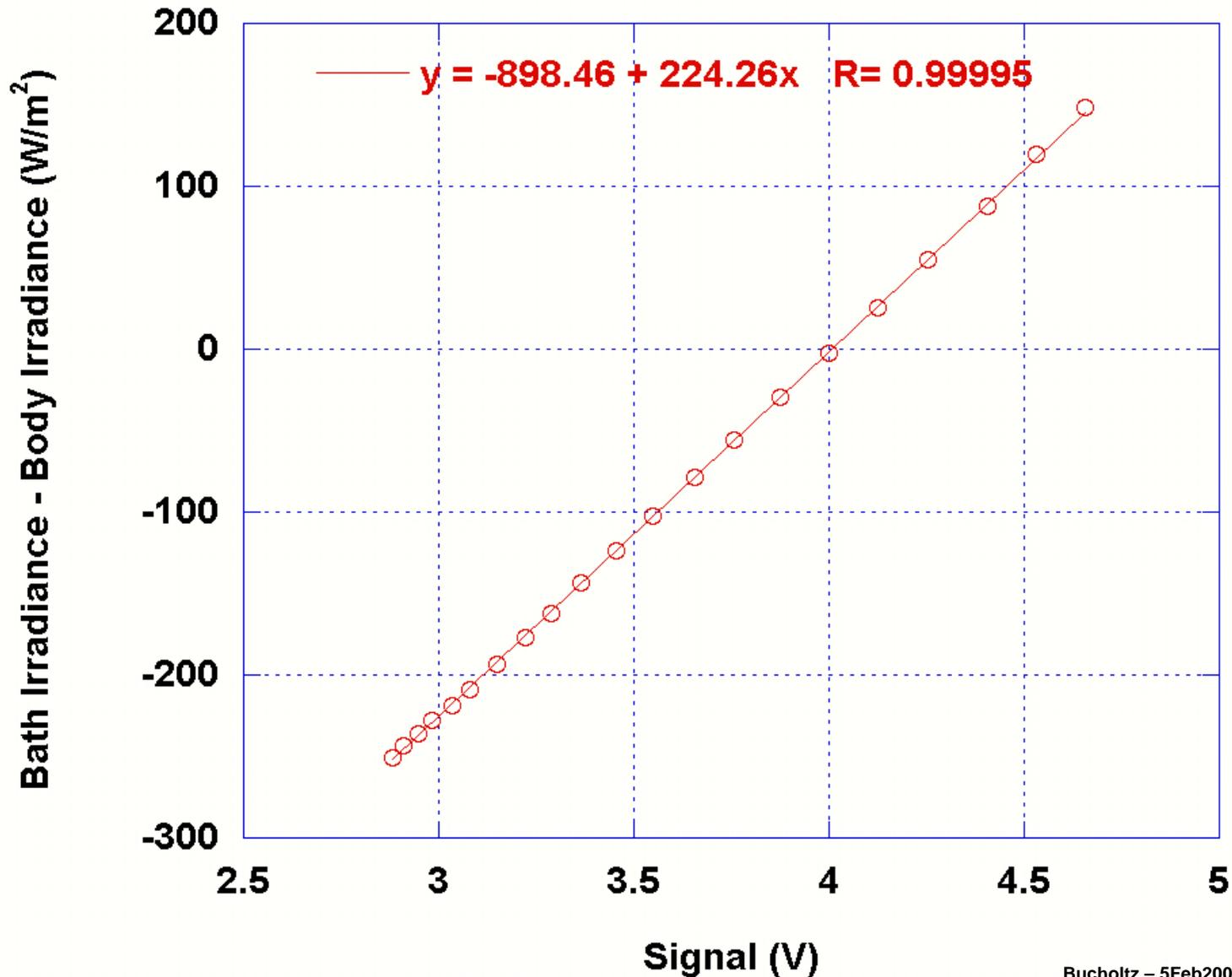
Description:

- A hollow copper sphere painted inside with a high emissivity flat black paint serves as the blackbody
- The “blackbody” sphere is immersed in an alcohol bath
- The IR radiometer views the blackbody
- The temperature of the alcohol bath is varied from -60 C to 40 C
- The signal of the IR radiometer versus the temperature of the blackbody gives the calibration equation

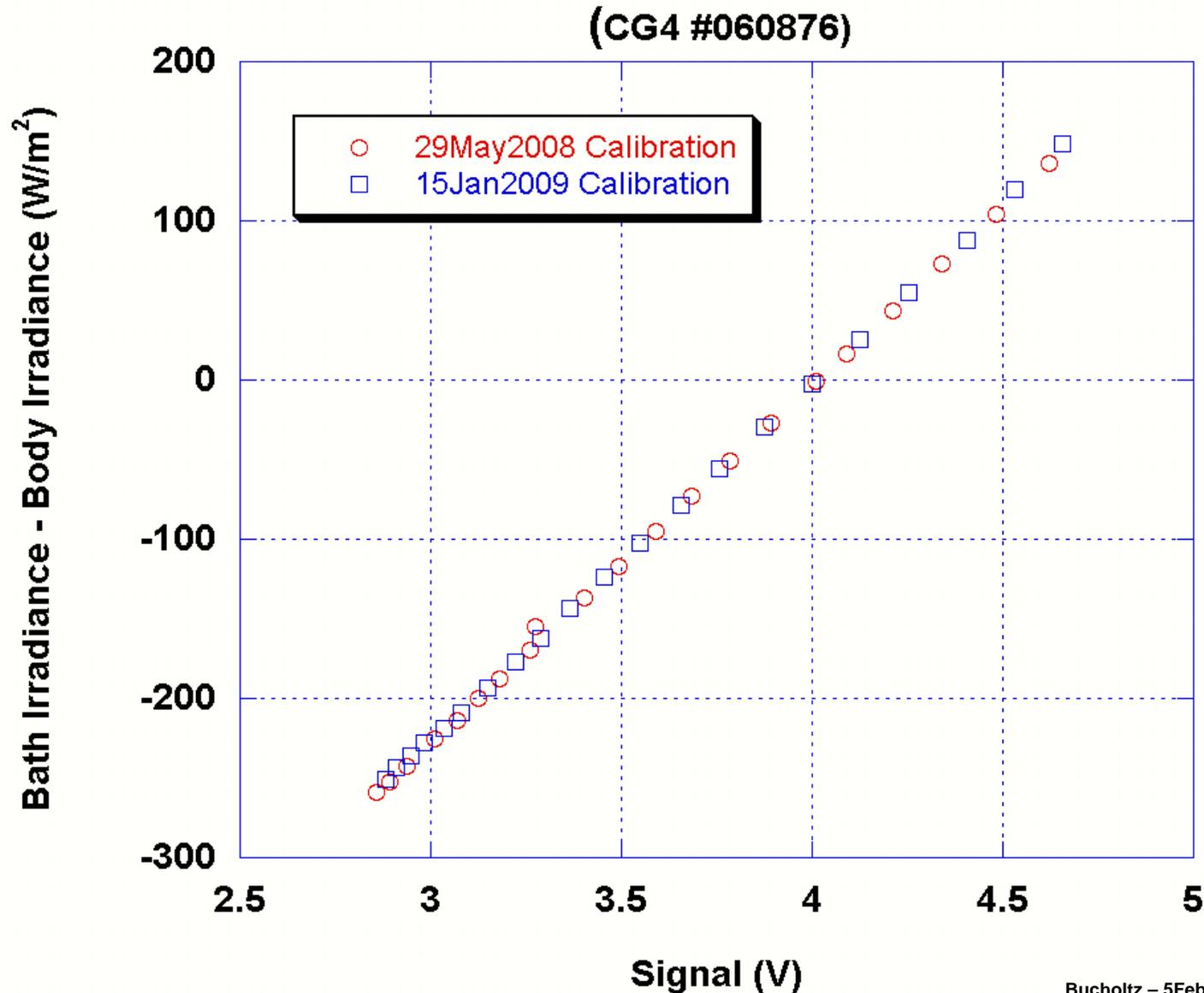


IR Calibration of CG4 #060728

Zenith IR for POST



Comparison of IR Calibrations Before and After POST

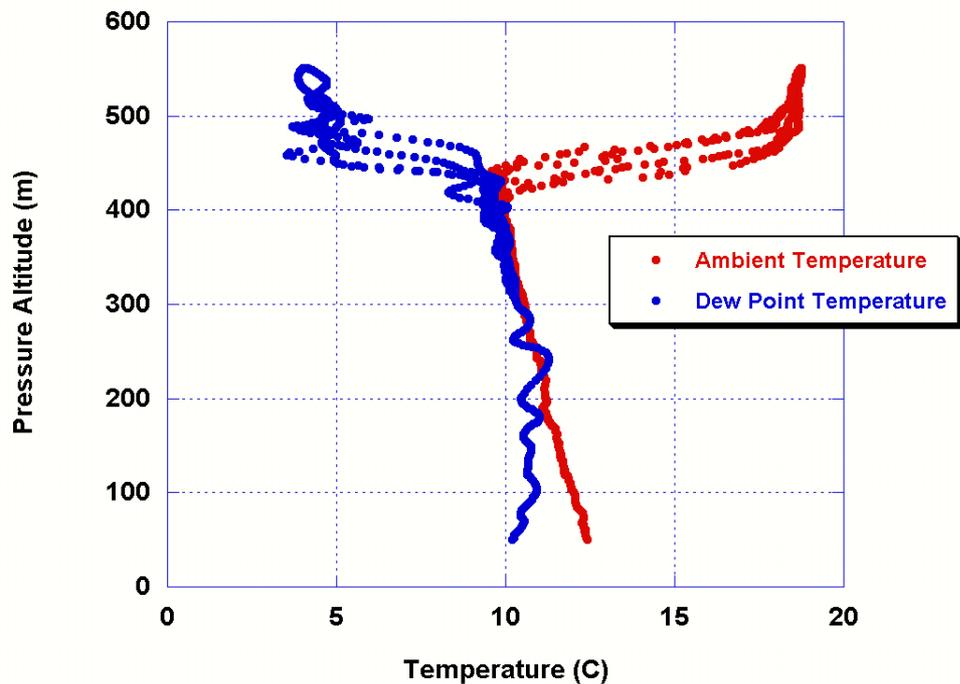


Data Example

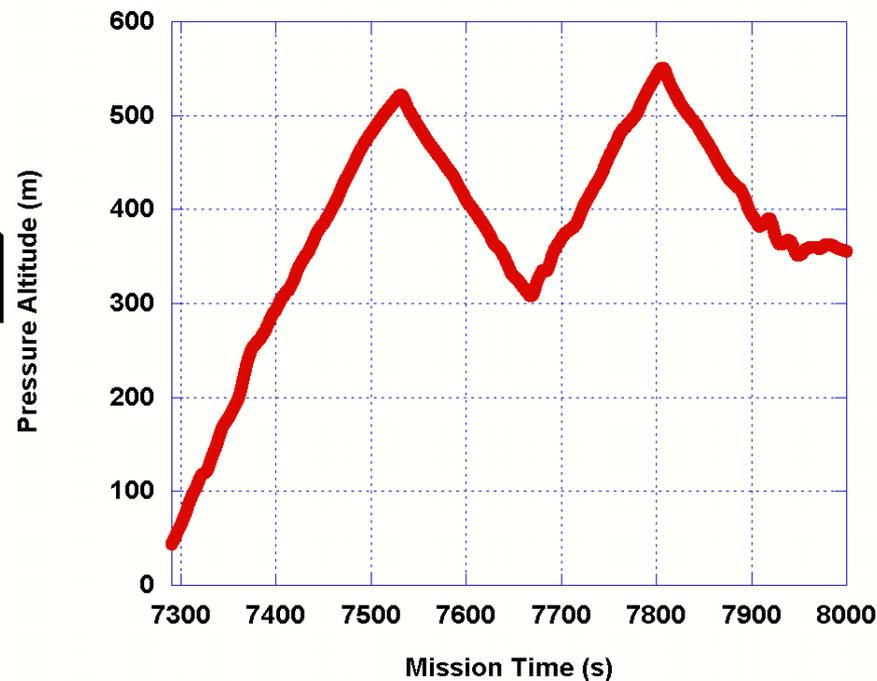
Flt #2 17 July 2008 (Daytime) 18.69-18.89 hrs GMT



Temperature-Dew Point Profile

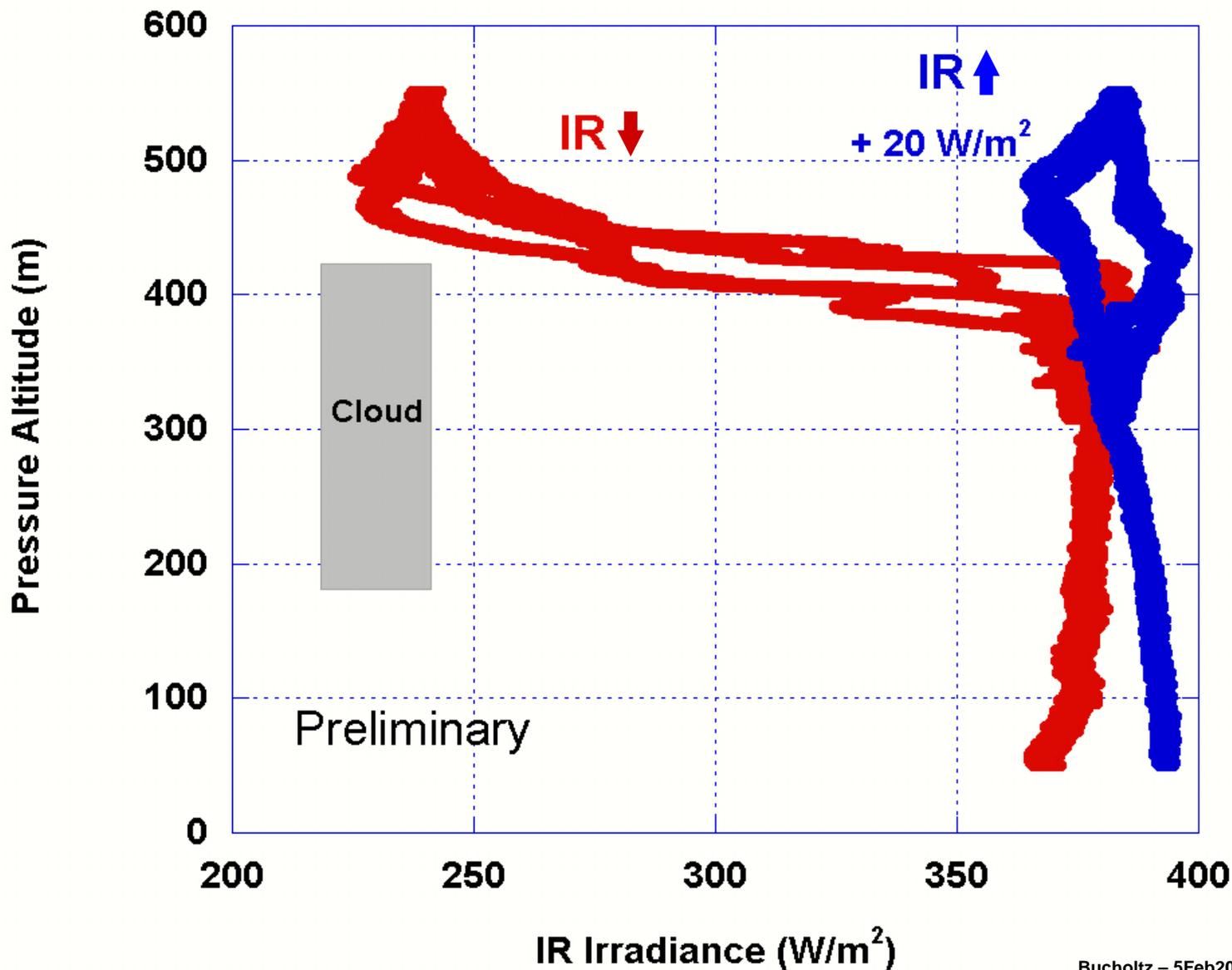


Flight Altitude Profile



Down- and Up-welling IR Irradiance

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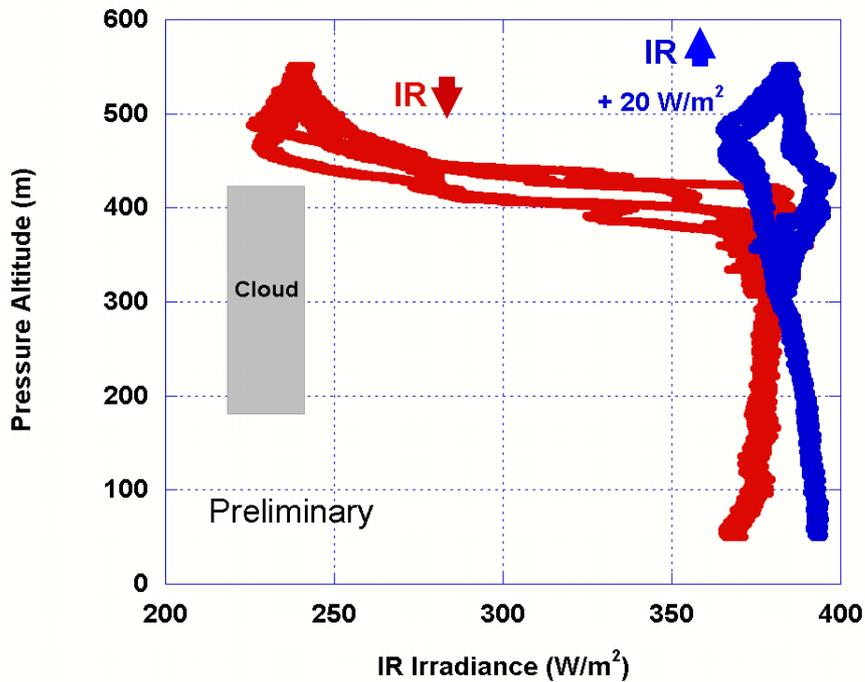


Comparison of Actual and Idealized IR Flux

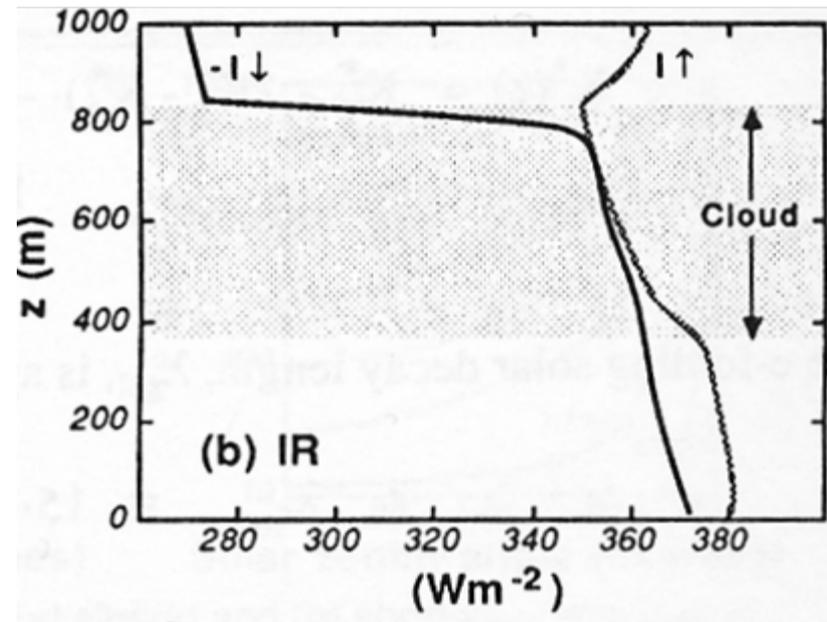
Flt #2 17 July 2008 (Daytime) 18.69-18.89 hrs GMT



Actual IR Measurements



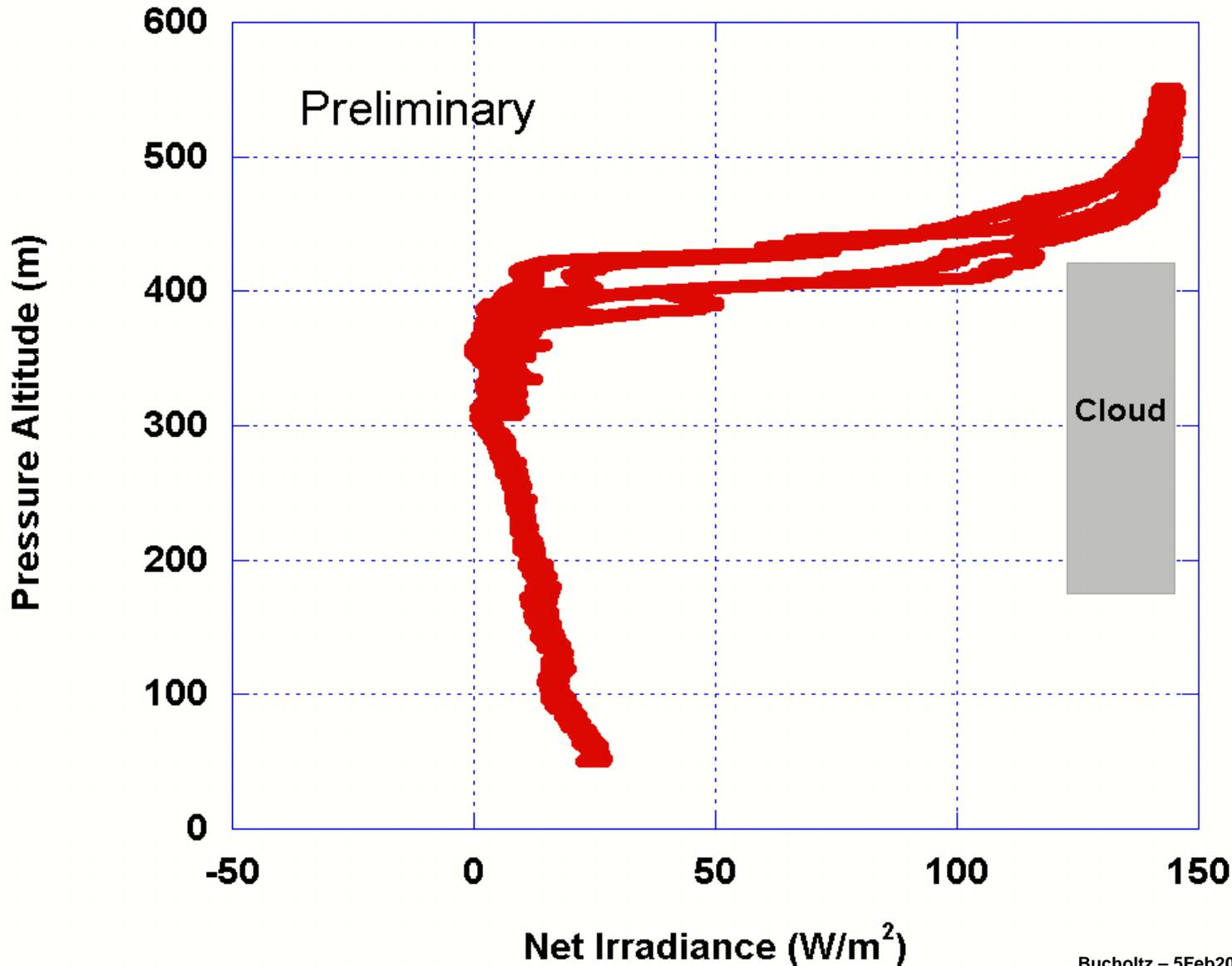
Idealized IR Fluxes



from Nicholls, 1984

Net IR Irradiance

Flt #2 17 July 2008 (Daytime) 18.69-18.89 hrs GMT

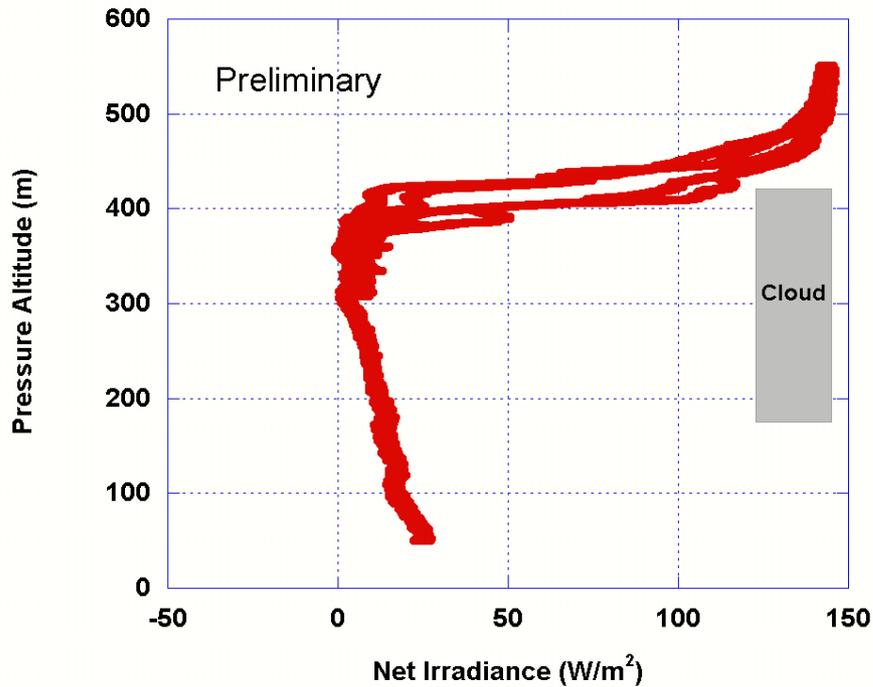


Comparison of Actual and Idealized Net IR Flux

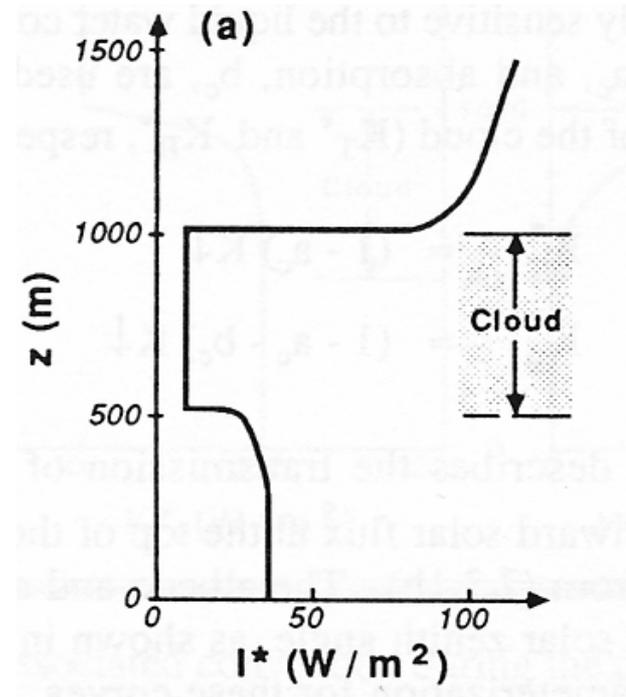
Flt #2 17 July 2008 (Daytime) 18.69-18.89 hrs GMT



Actual Net IR Measurements



Idealized Net IR



NRL Solar and IR Radiometers: Data Status and Analysis Plans



- **IR Radiometers:**

- Initial check made of data quality
- Finalizing analysis of calibrations
 - Issue: incorrect temperature of calibration bath
- Begun more in-depth flight by flight analysis

- **Solar Radiometers:**

- Initial check made of data quality
- In process of analyzing calibrations
- Will begin in-depth flight by flight analysis shortly

- **Timeline for data archive submission:**

- Mid-March – Solar and IR irradiance data submitted to archive

- **Future Work:**

- Leveling of solar irradiance data
- Net Fluxes, Heating Rates, etc.