A Collocated A-Train Data Set for Ice Radiative Model Evaluation: Description and Summary of Results

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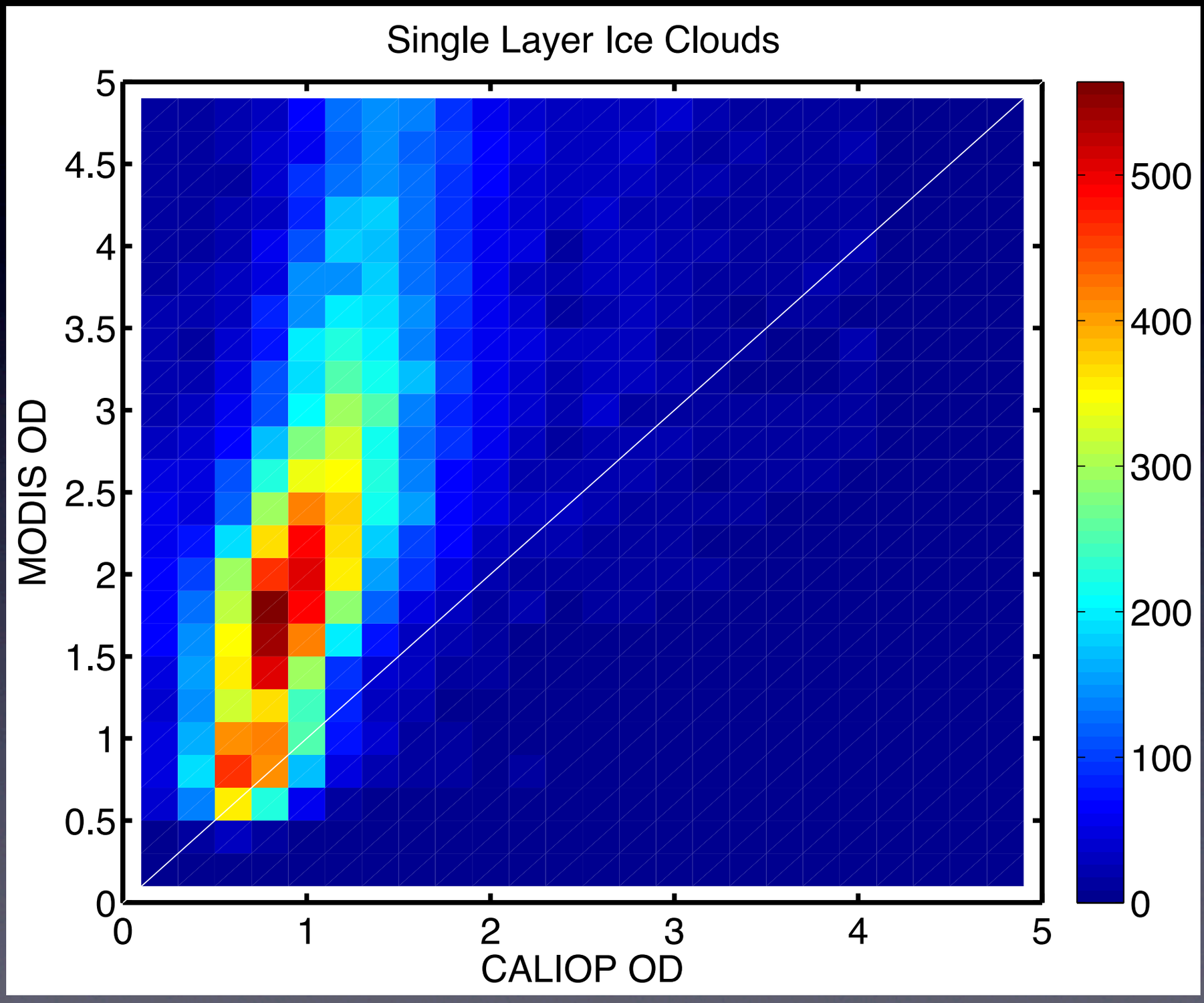
Motivation

- The NASA EOS cirrus optical depth retrievals differ by up to a factor of two between observation systems (MODIS, CALIOP, and the CALIPSO IIR)
- When the cirrus OD retrievals are applied to forward radiative transfer calculations MODIS and CALIOP do not agree with measured TOA radiances
- How do we identify a reference OD and better understand (and improve) the EOS retrievals ?

The Data Set

- 1 Month (August 2006) Non Polar (60 deg)
- Collocated IIR, CALIOP, and MODIS
- Single layer ice clouds less then 4 km thick
- Non attenuating (for CALIOP)
- Ocean only

MODIS vs CALIOP OD

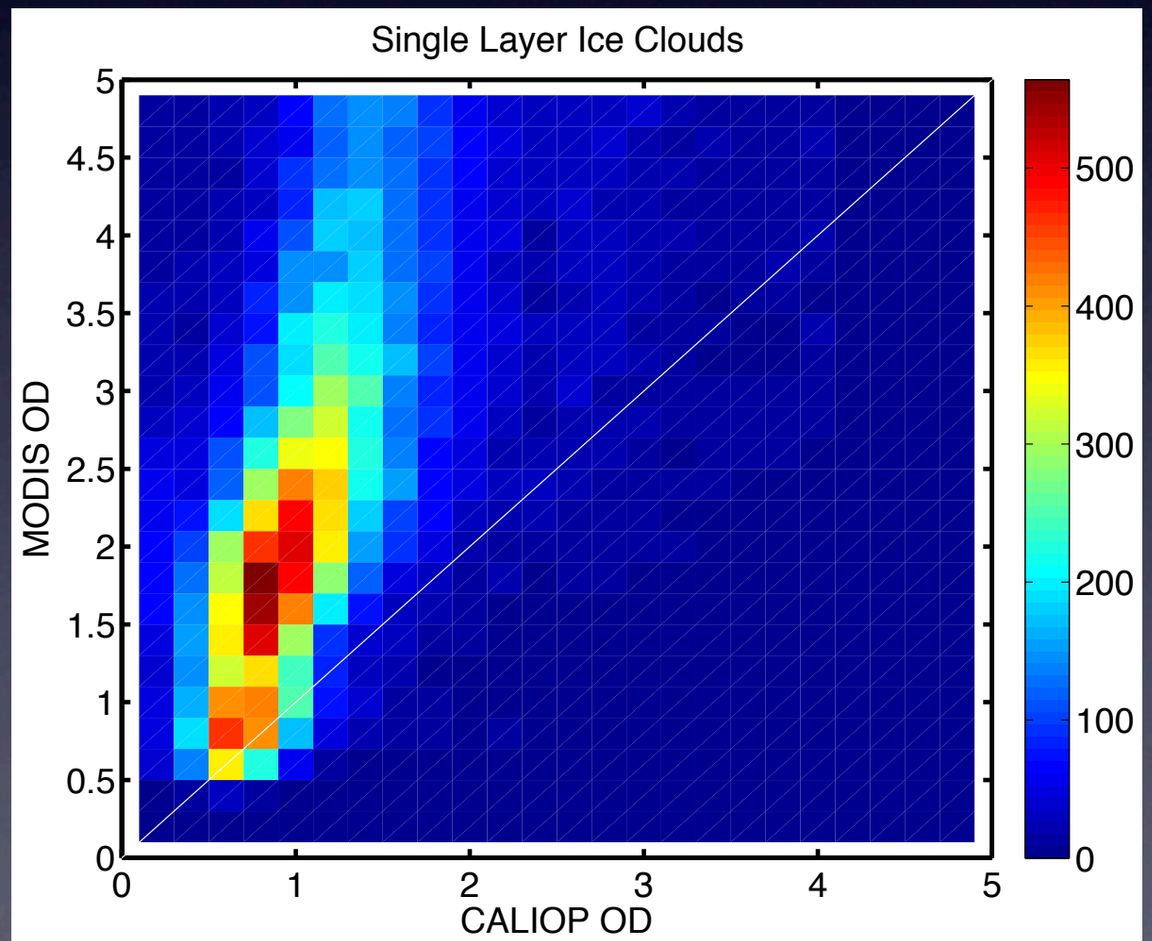


Methodology

- Identify a reference OD that provides radiative consistency (IR)
- Test retrieval bias hypotheses
- Re-process retrievals and compare against the reference OD (The UW Atmospheric PEATE)

IR vs MODIS OP

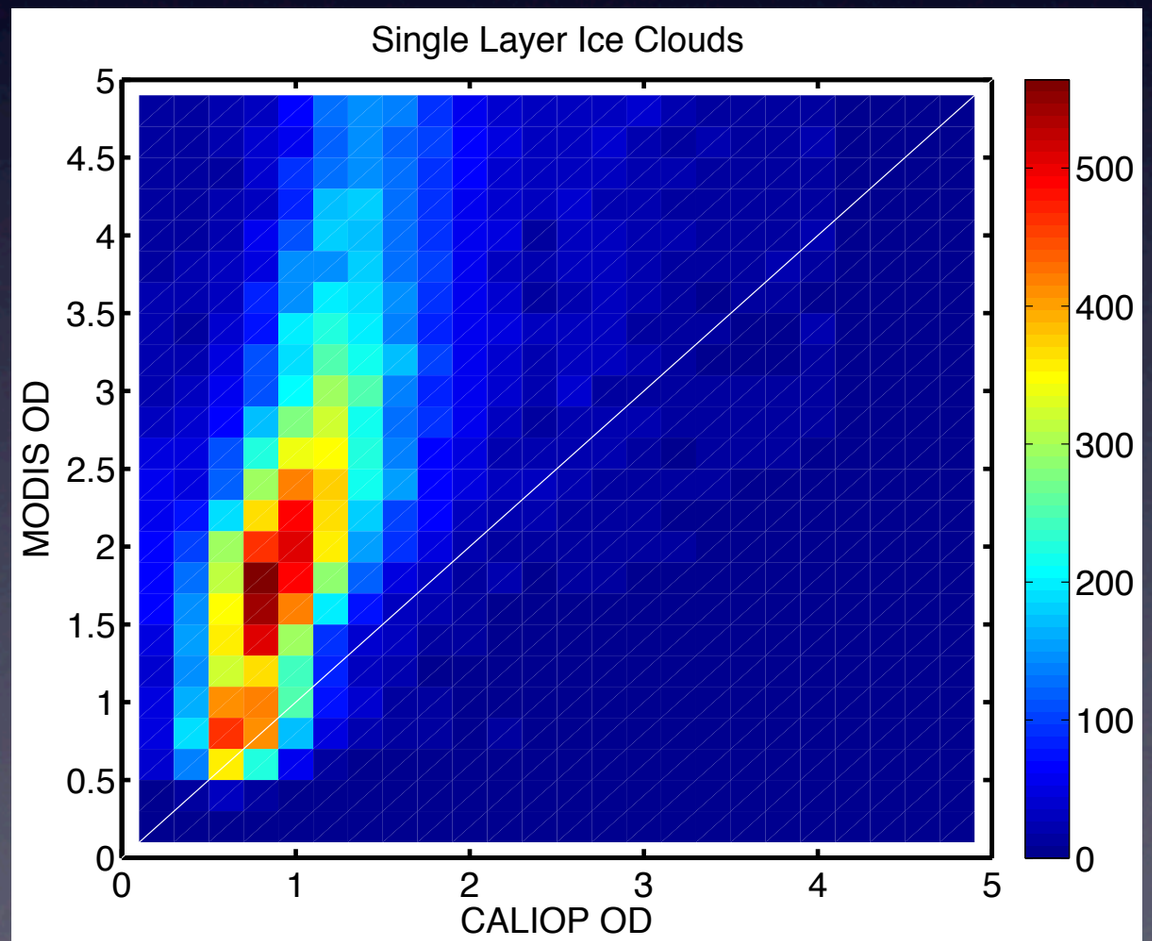
MODIS OP CALIOP Day



IR vs MODIS OP

Is MODIS is using incorrect
single scatter properties (g)?

MODIS OP CALIOP Day



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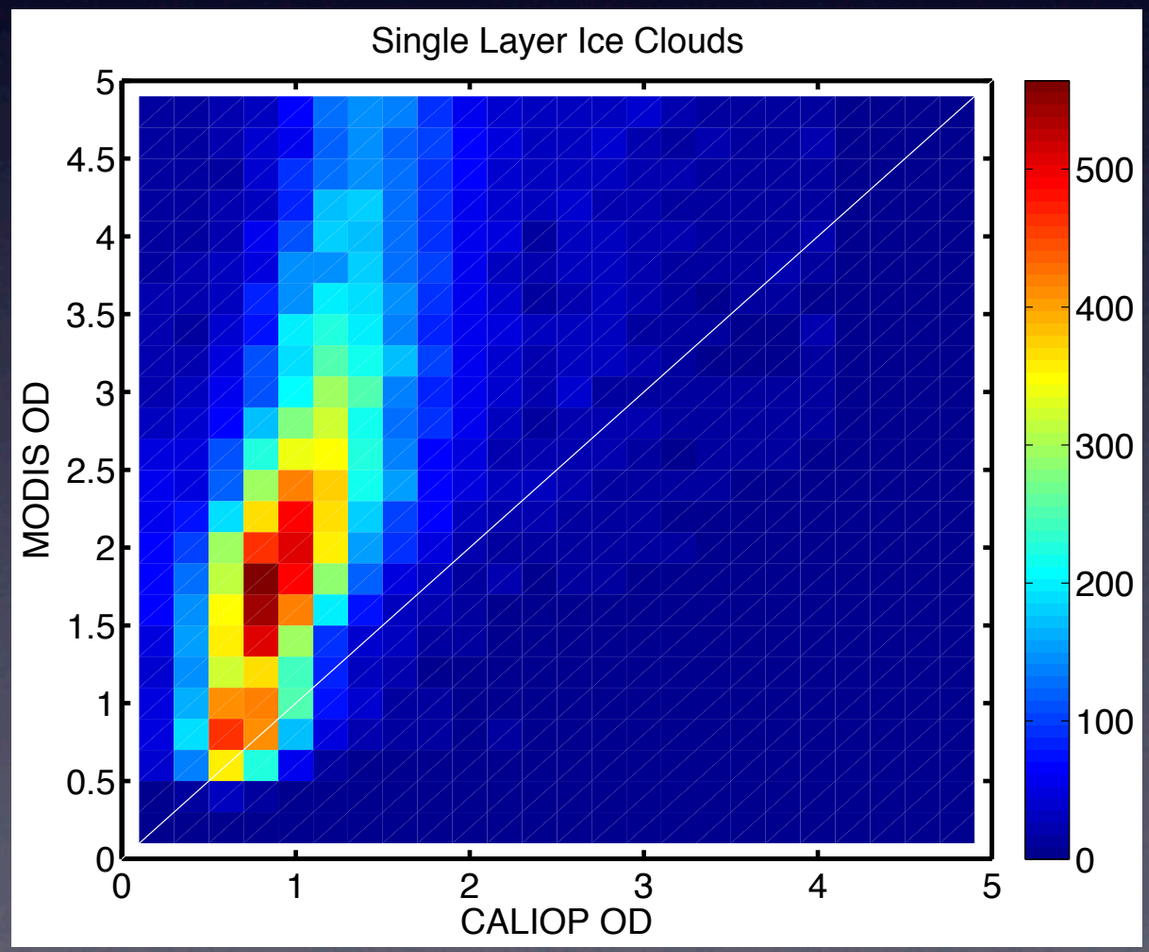
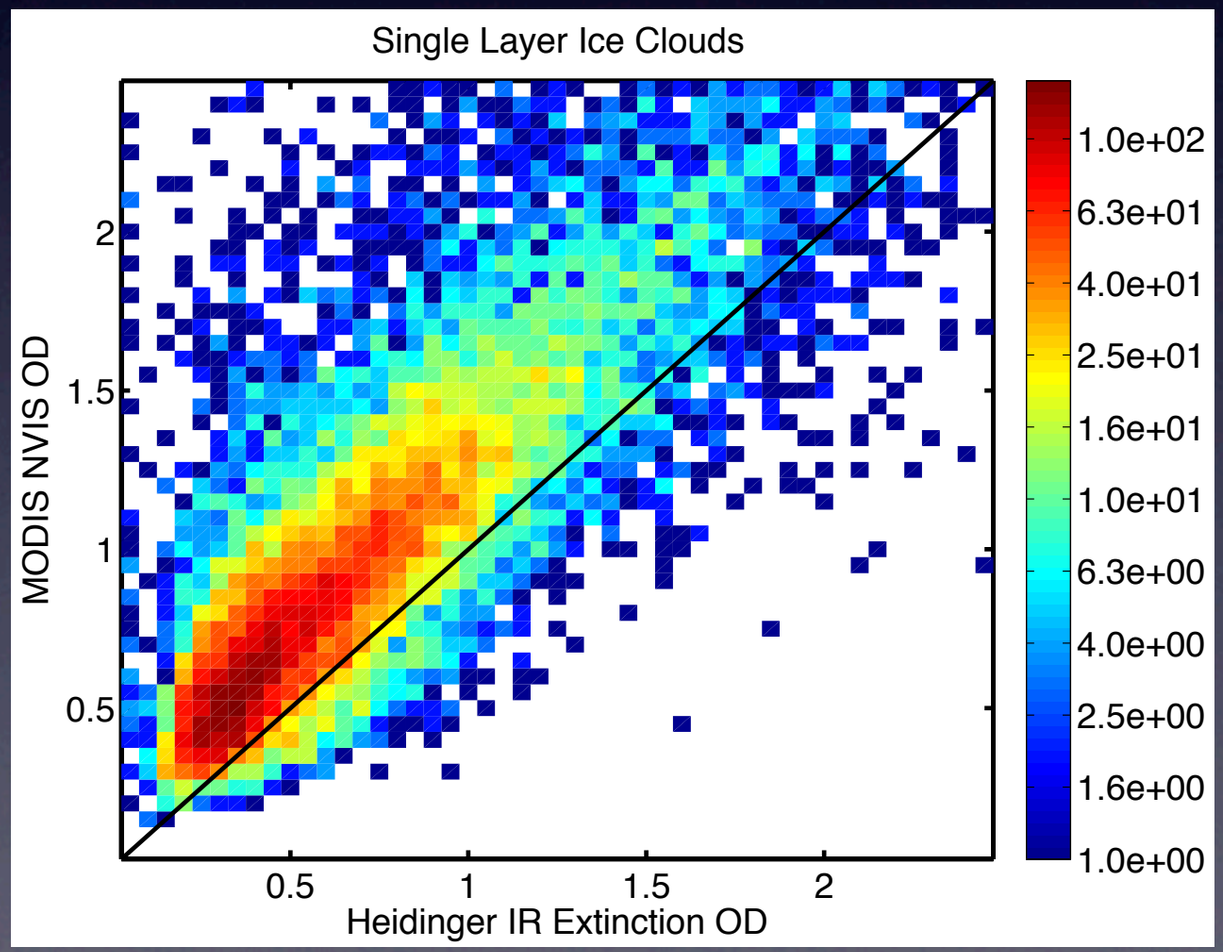


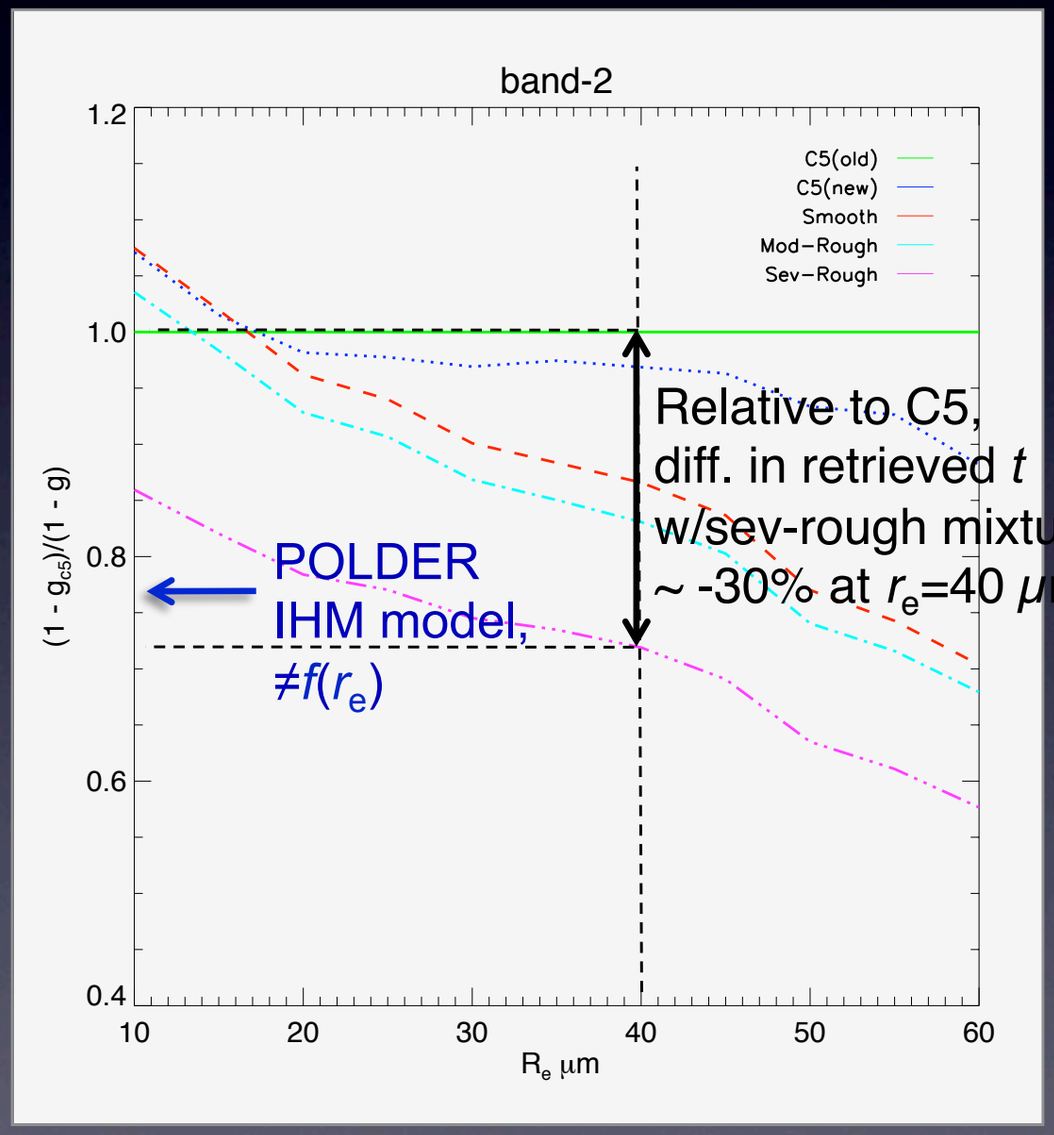
MODIS OP vs IR



Effect of Ice Cloud Model Uncertainties On MODIS OD

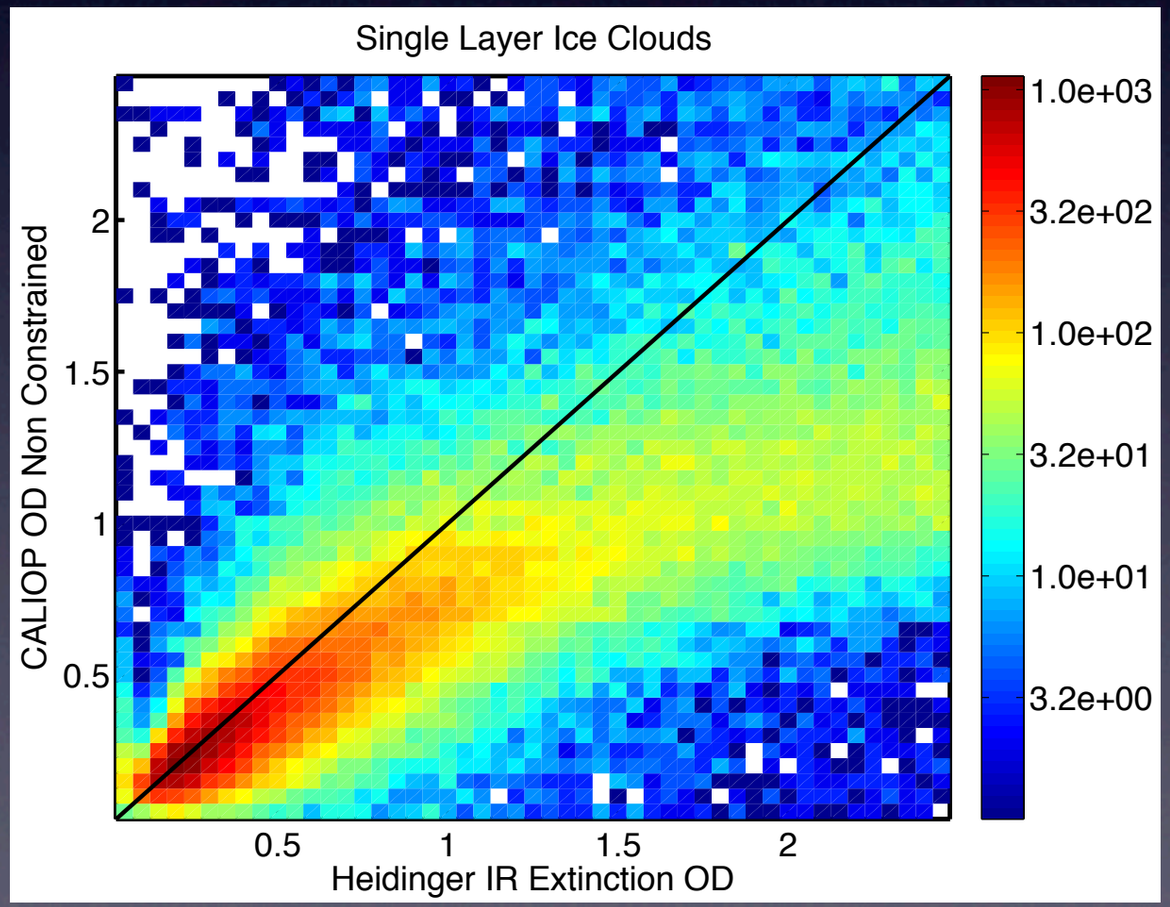
$R \sim t^* = t\ [1\text{-}g(r_e)]$

$t/t_{C5} \sim [1\text{-}g_{C5}(r_e)] / [1\text{-}g(r_e)]$



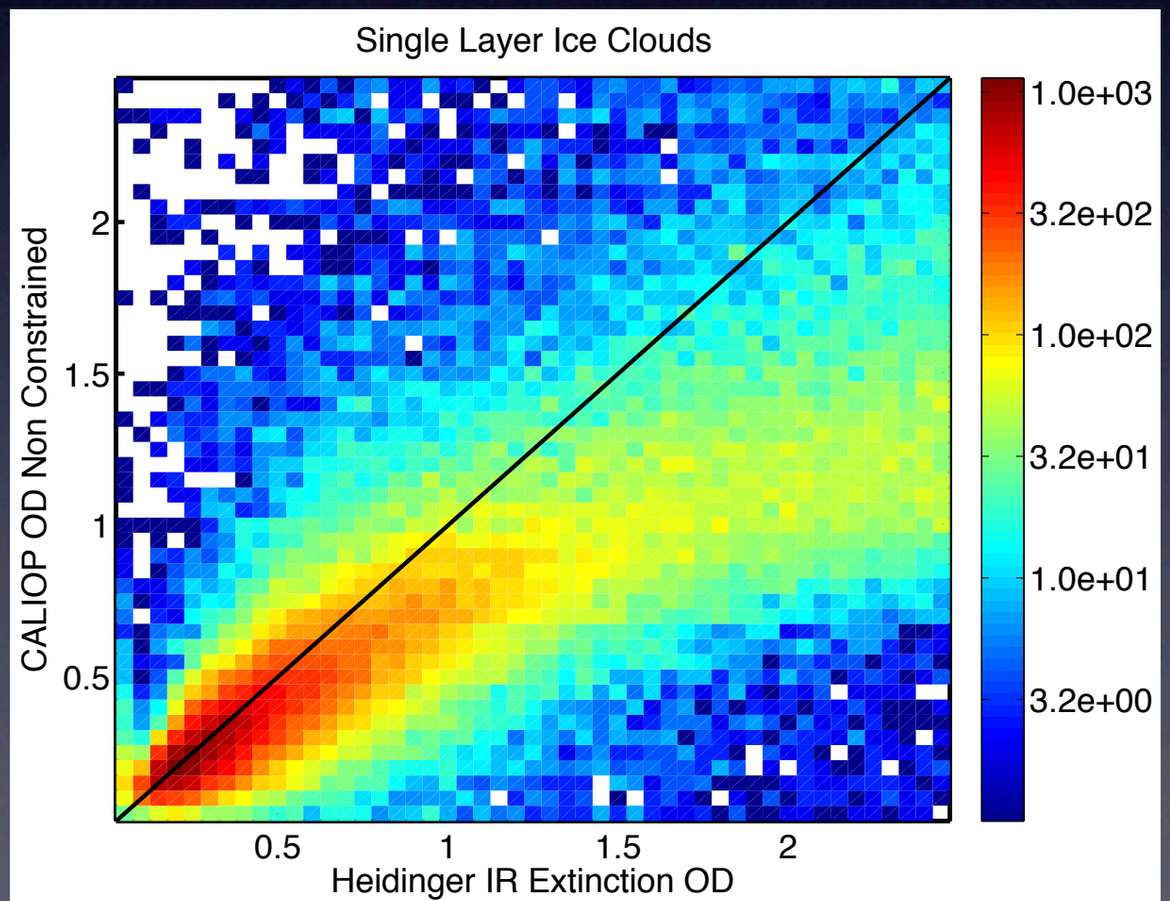
IR vs CALIOP

Day (Non Constrained)

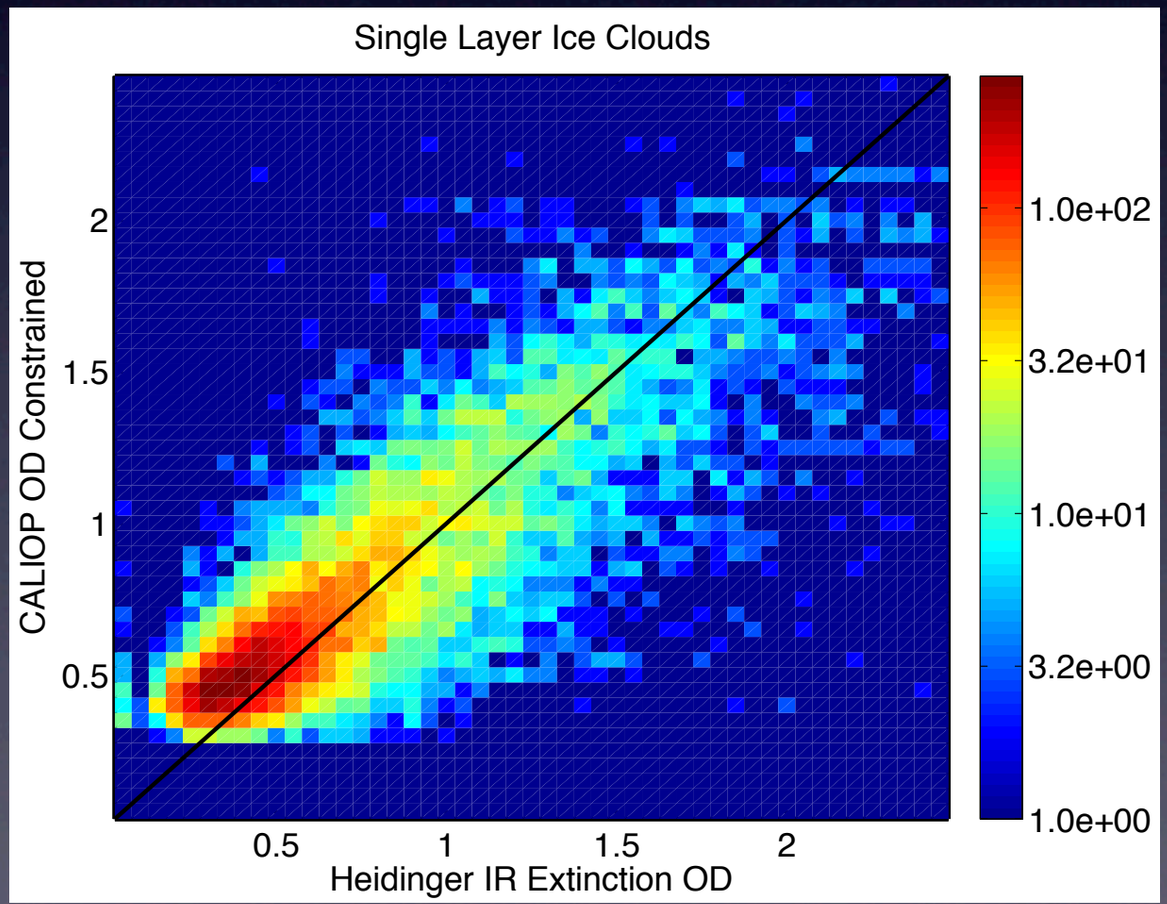


IR vs CALIOP

Day (Non Constrained)



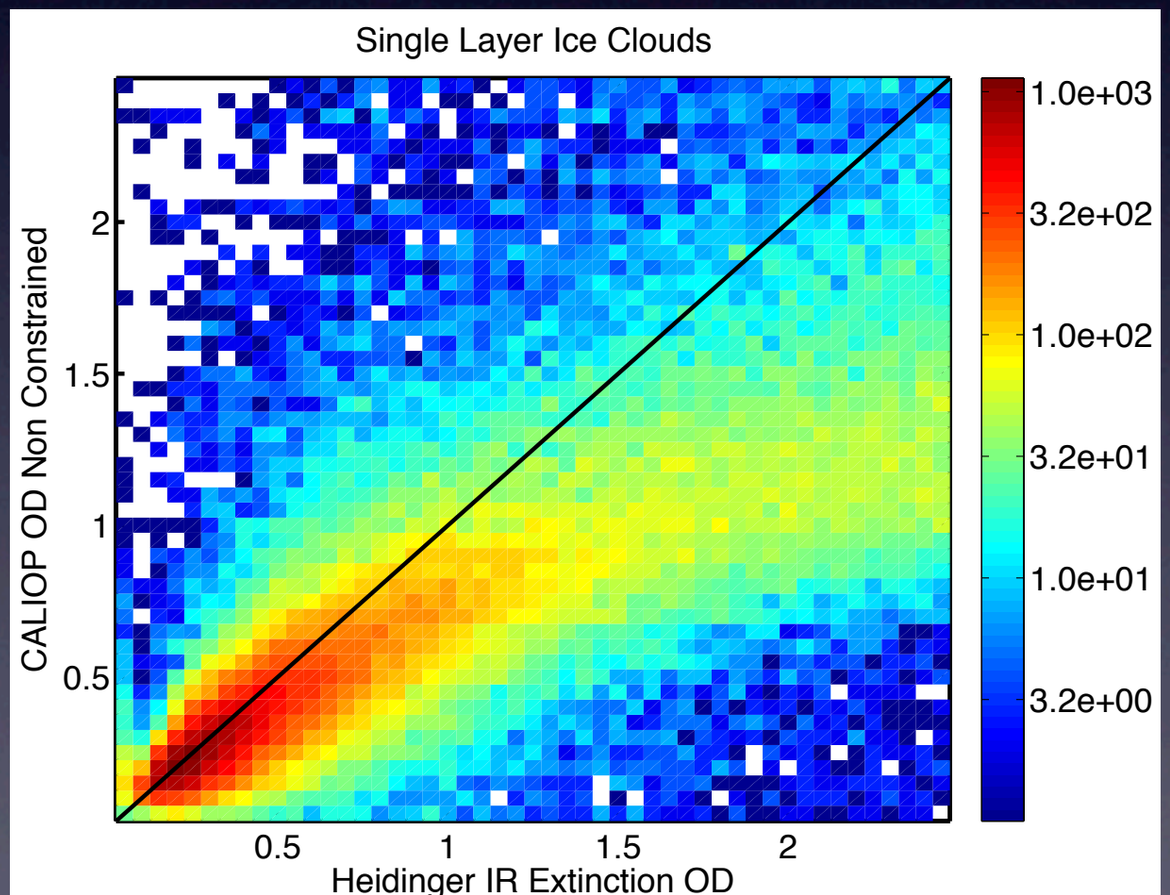
Night (Constrained)



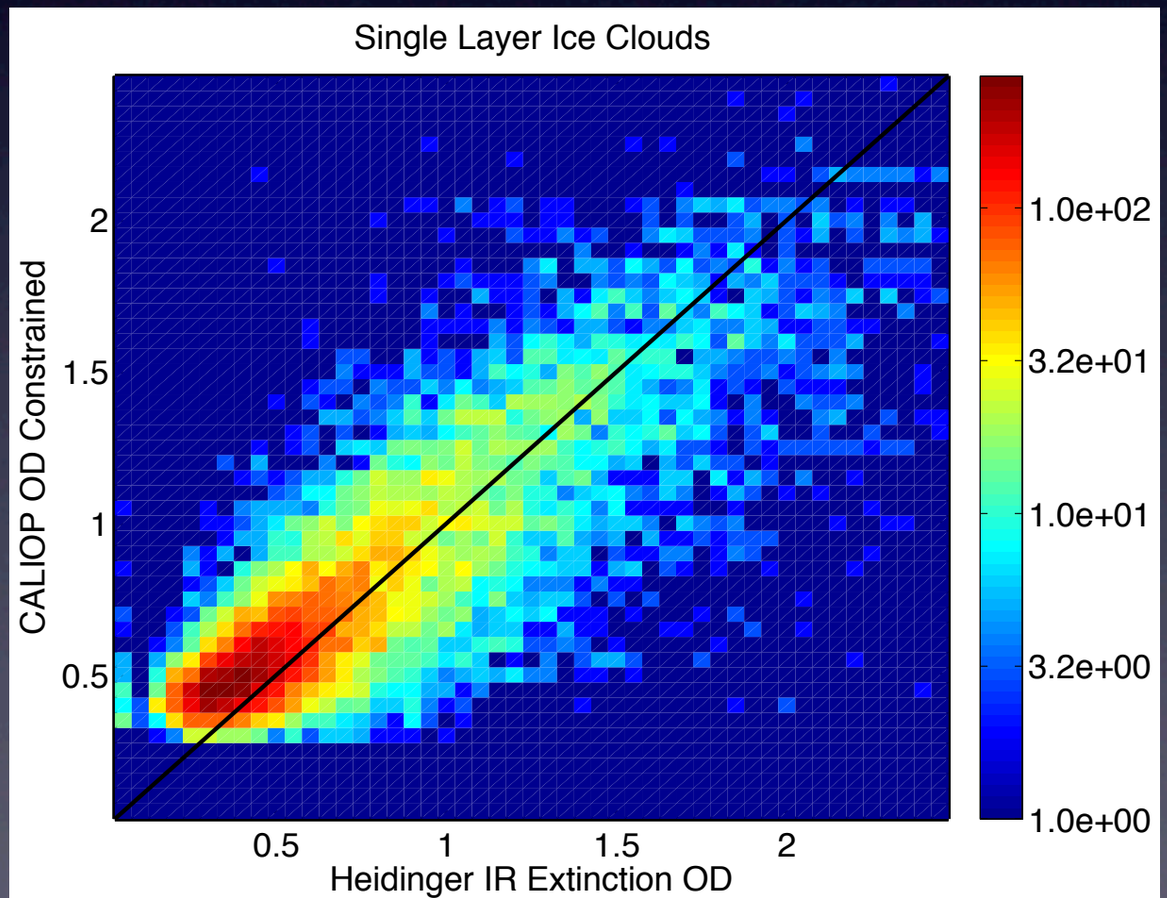
IR vs CALIOP

CALIOP is assuming an incorrect lidar ratio for non-constrained retrievals

Day (Non Constrained)

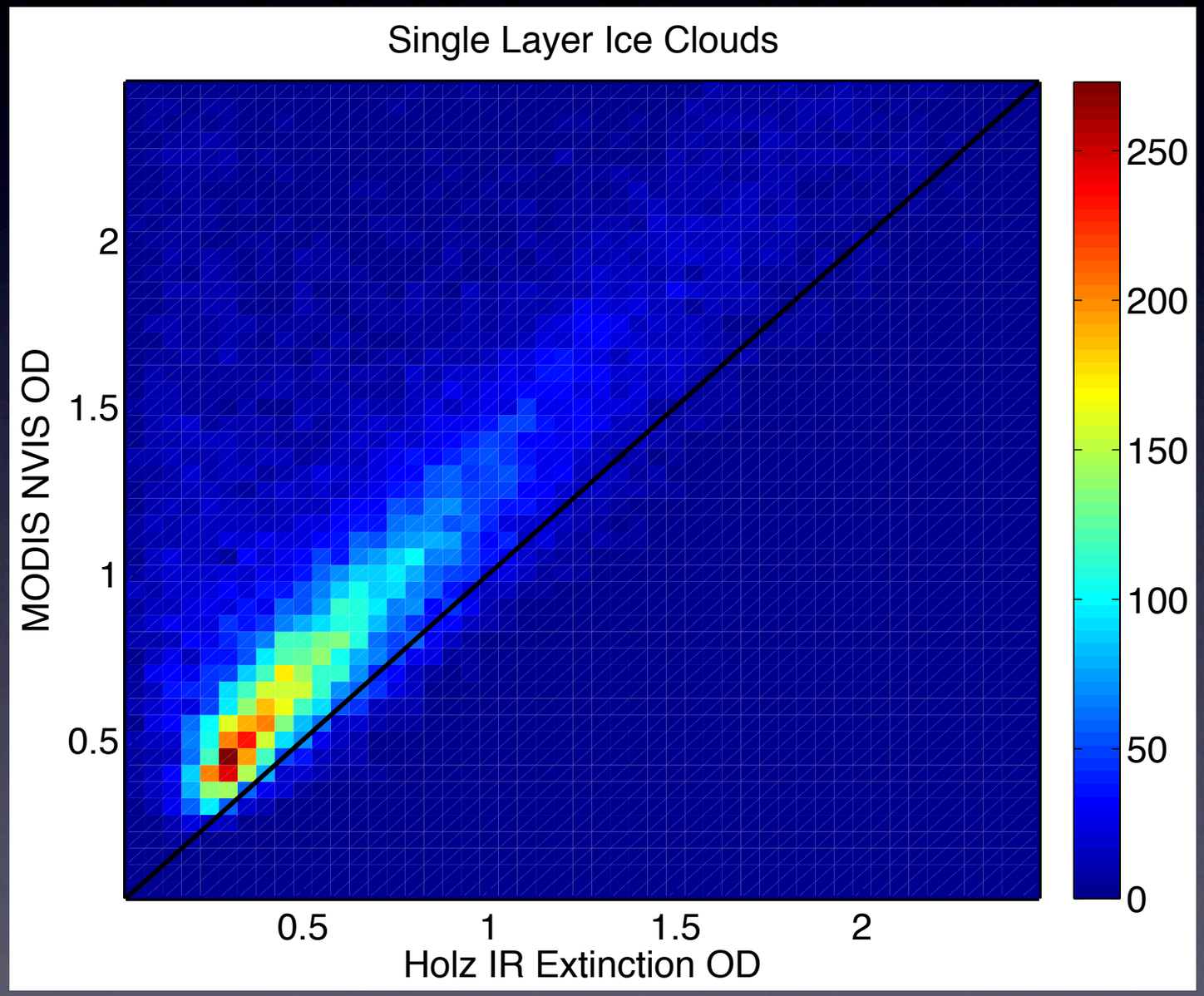


Night (Constrained)



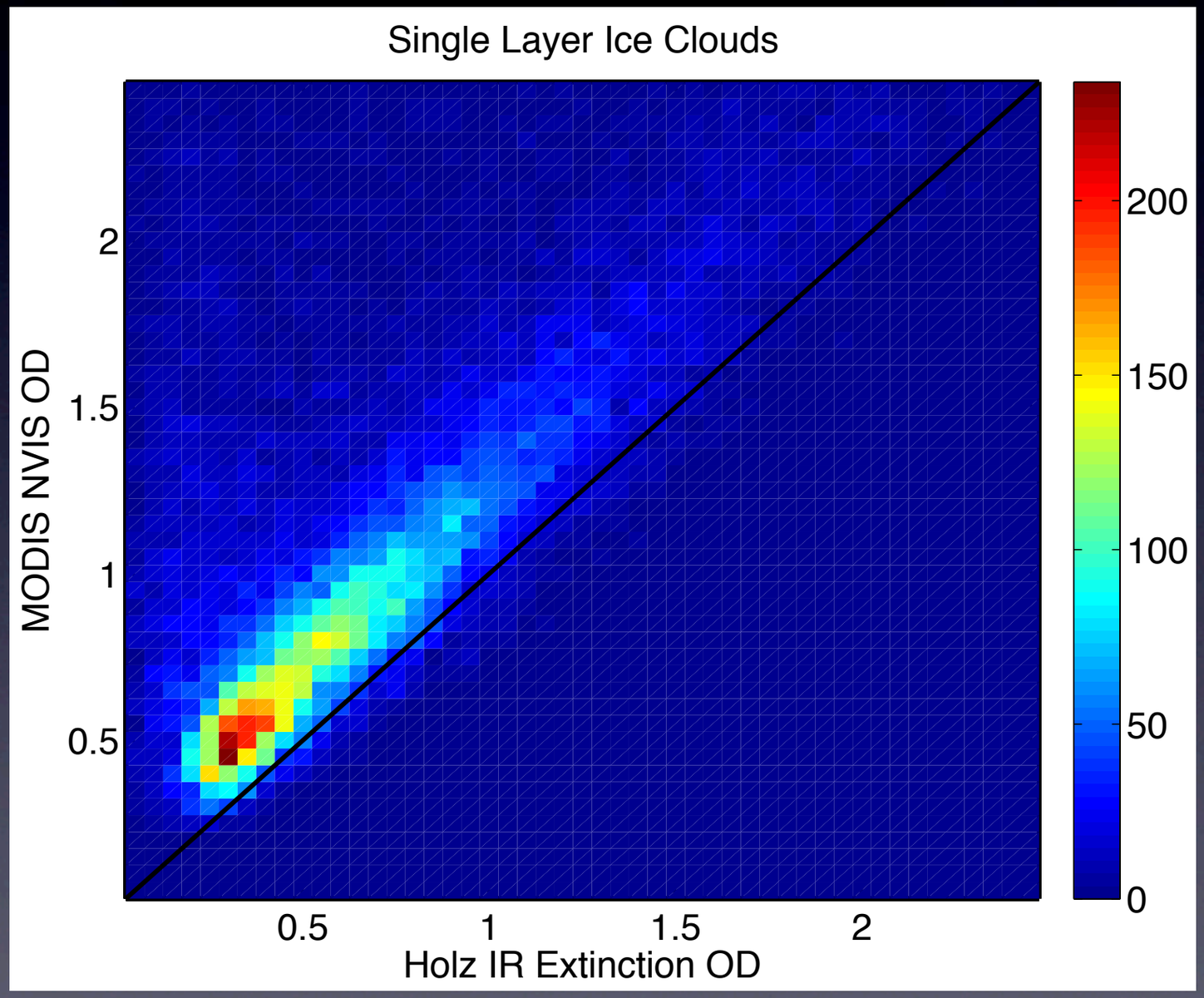
Ice Look Up Table Impact

C5 w/out f_delta LUT



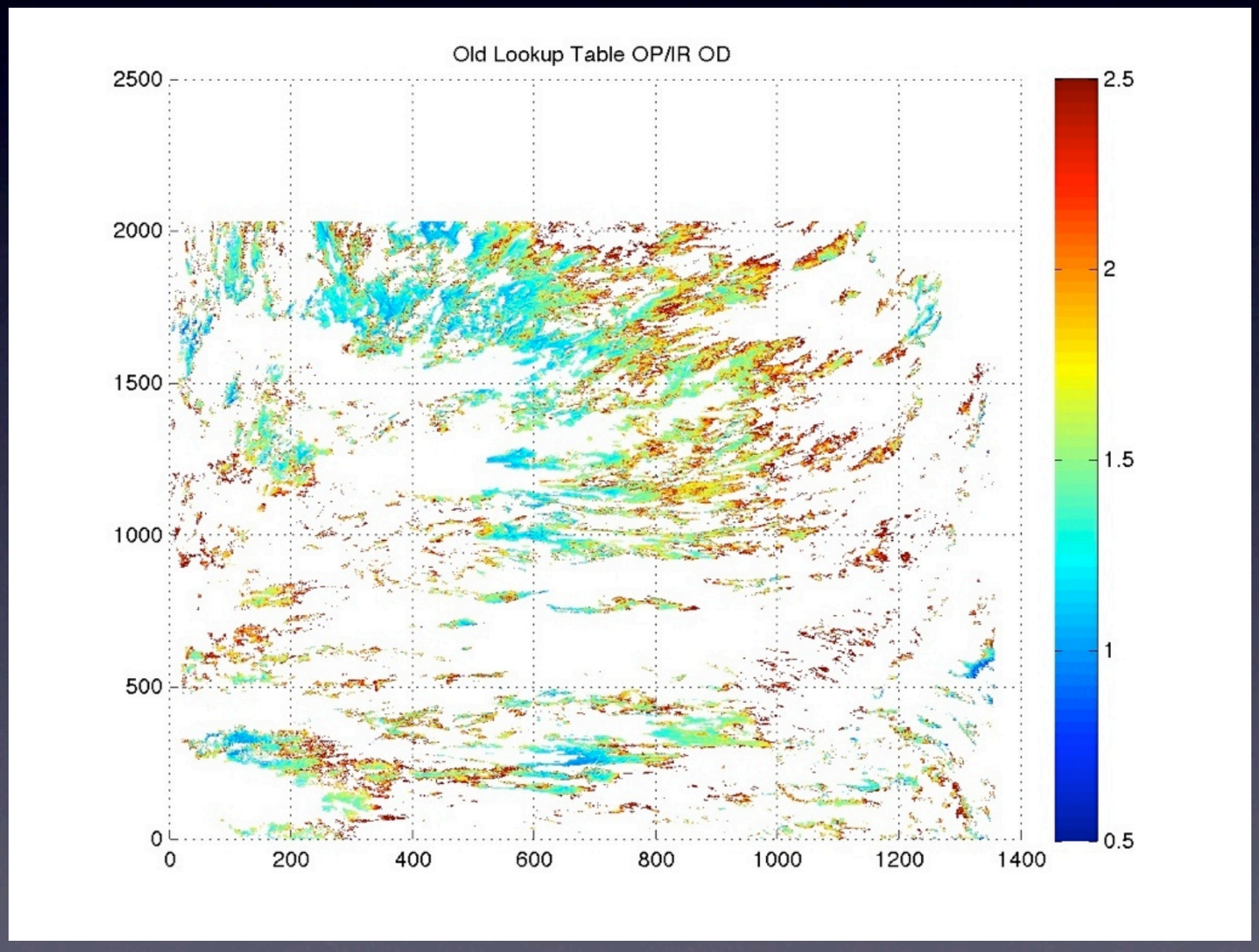
Ice Look Up Table Impact

Severely Rough SBRT



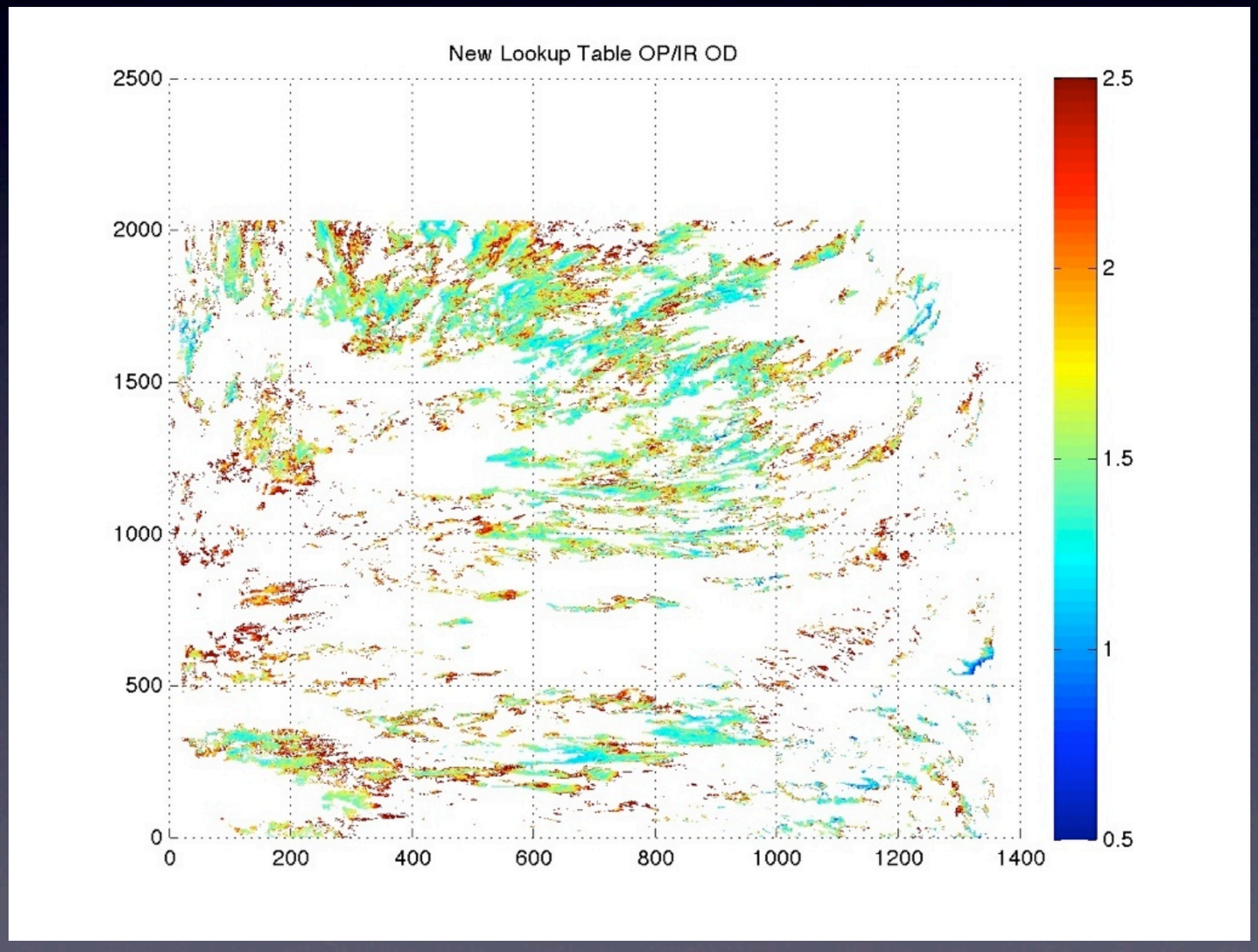
MODIS OD Scan Angle Dependance

MODIS C5 LUT / IR

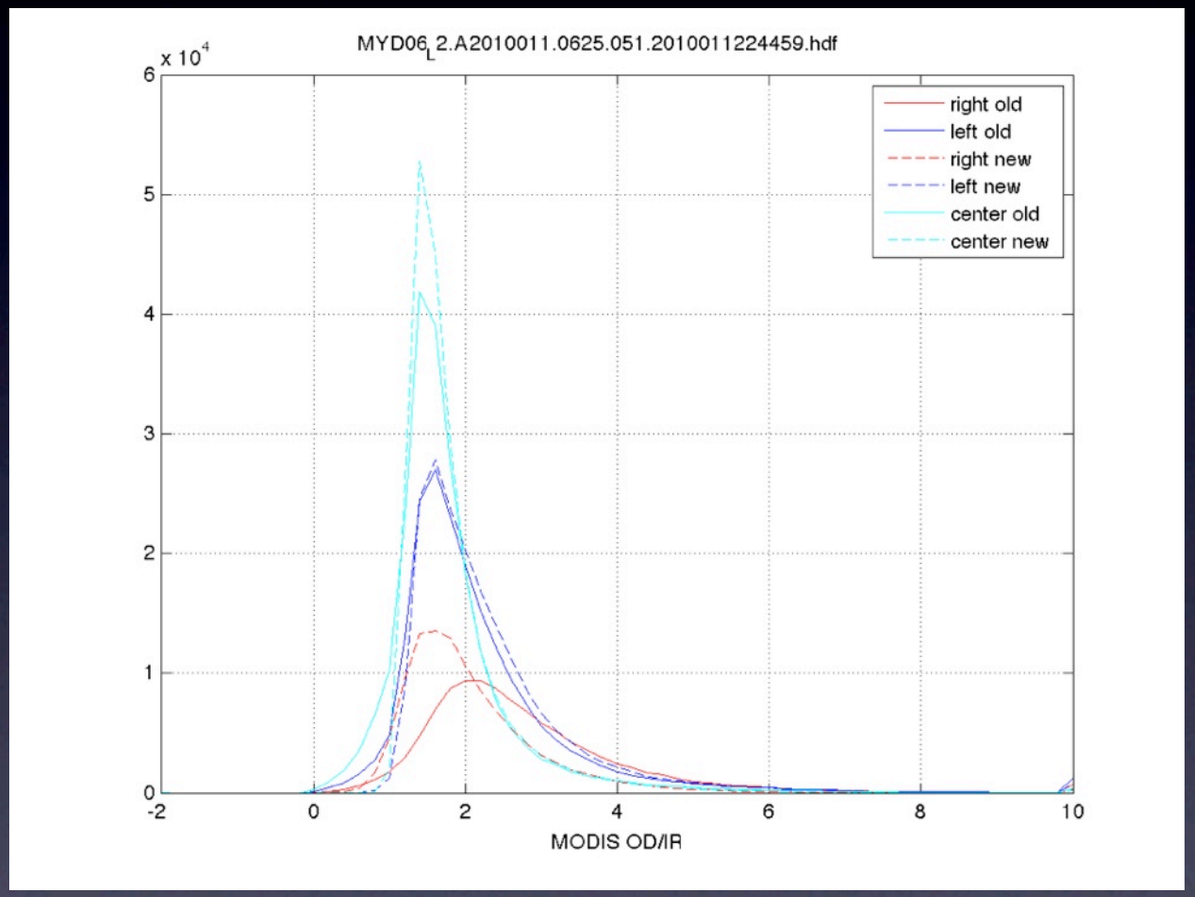


MODIS OD Scan Angle Dependance

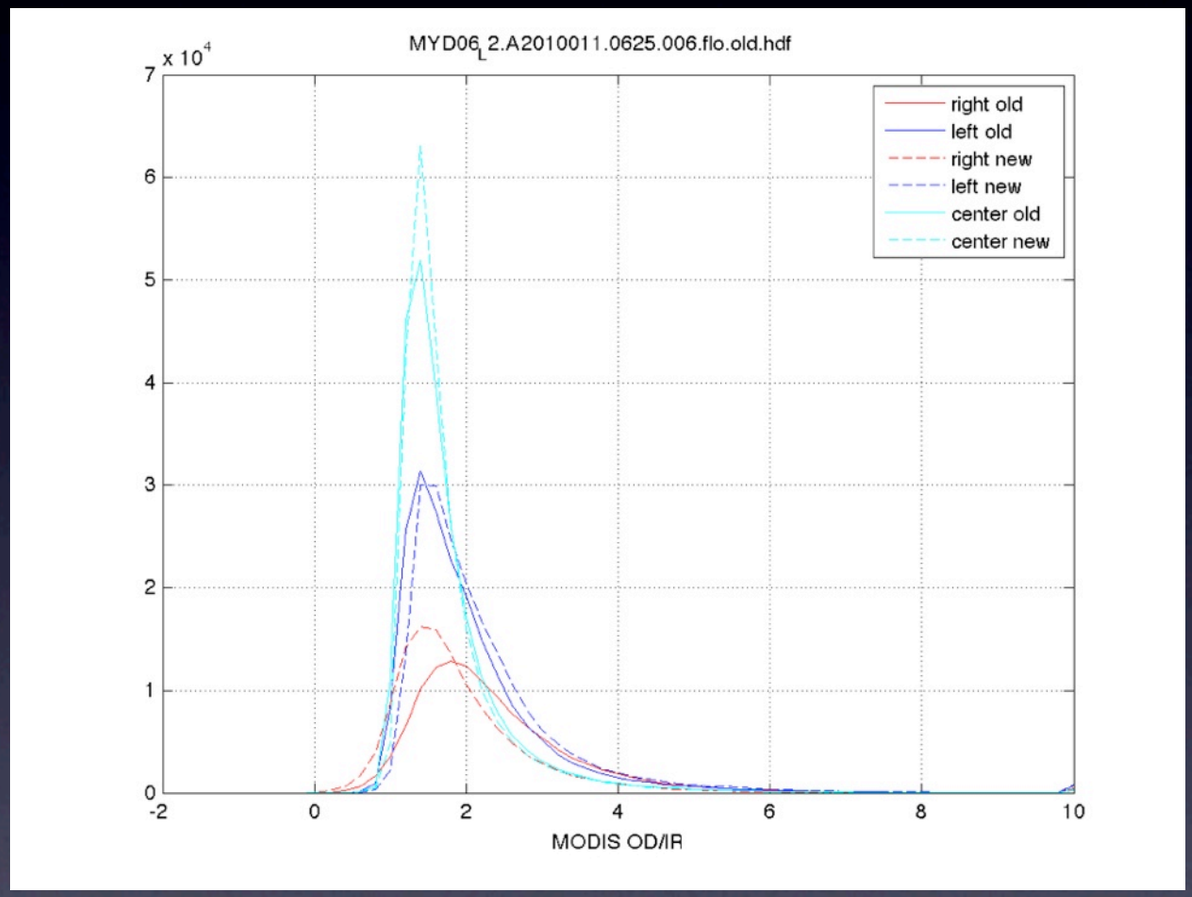
MODIS RSBR LUT / IR



Scan Dependents Relative to the IR

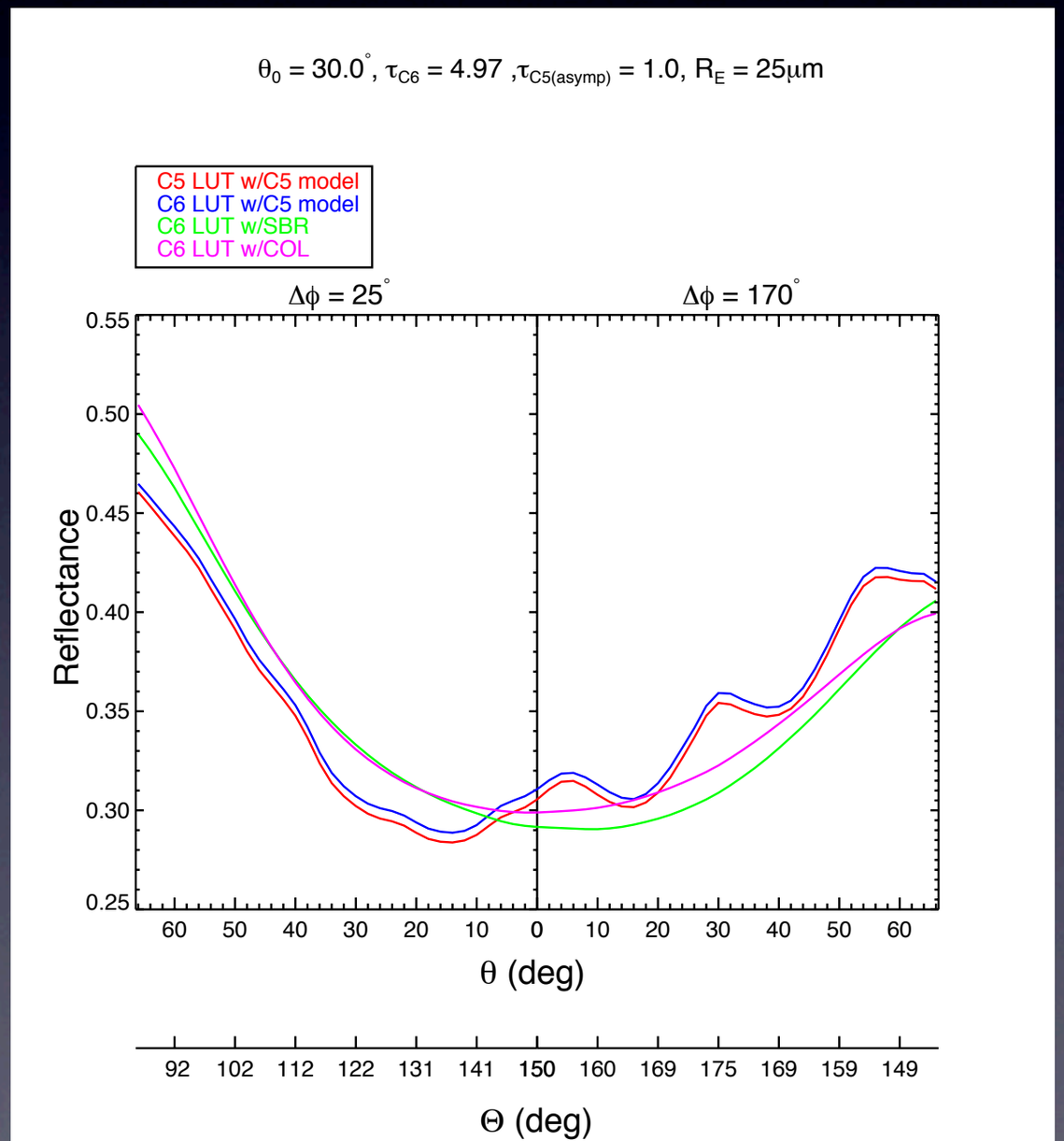


Old = LAADS 5.1
New = PEATE SRB



Old = PEATE C5
New = PEATE SRB G2

LUT Sensitivity to Scattering Angle



Take away messages

- Ice models chosen for Collection 6 processing should initially strive to provide spectral consistency between MODIS solar reflectance and infrared measurements.
- MODIS solar reflectance observations do not contain direct information on ice cloud optical thickness (only scaled optical thickness) and require model assumptions
- There can be significant scan angle dependent biases in the OP retrievals. Comparisons with CALIOP only sample a limited range of scattering angles.
- There are still many questions to resolve regarding ice LUT selection for C6