The UW PEATE Evaluation Capabilities: Resolving Biases Between CALIOP and MODIS Using IR Retrievals for MODIS Collection 6

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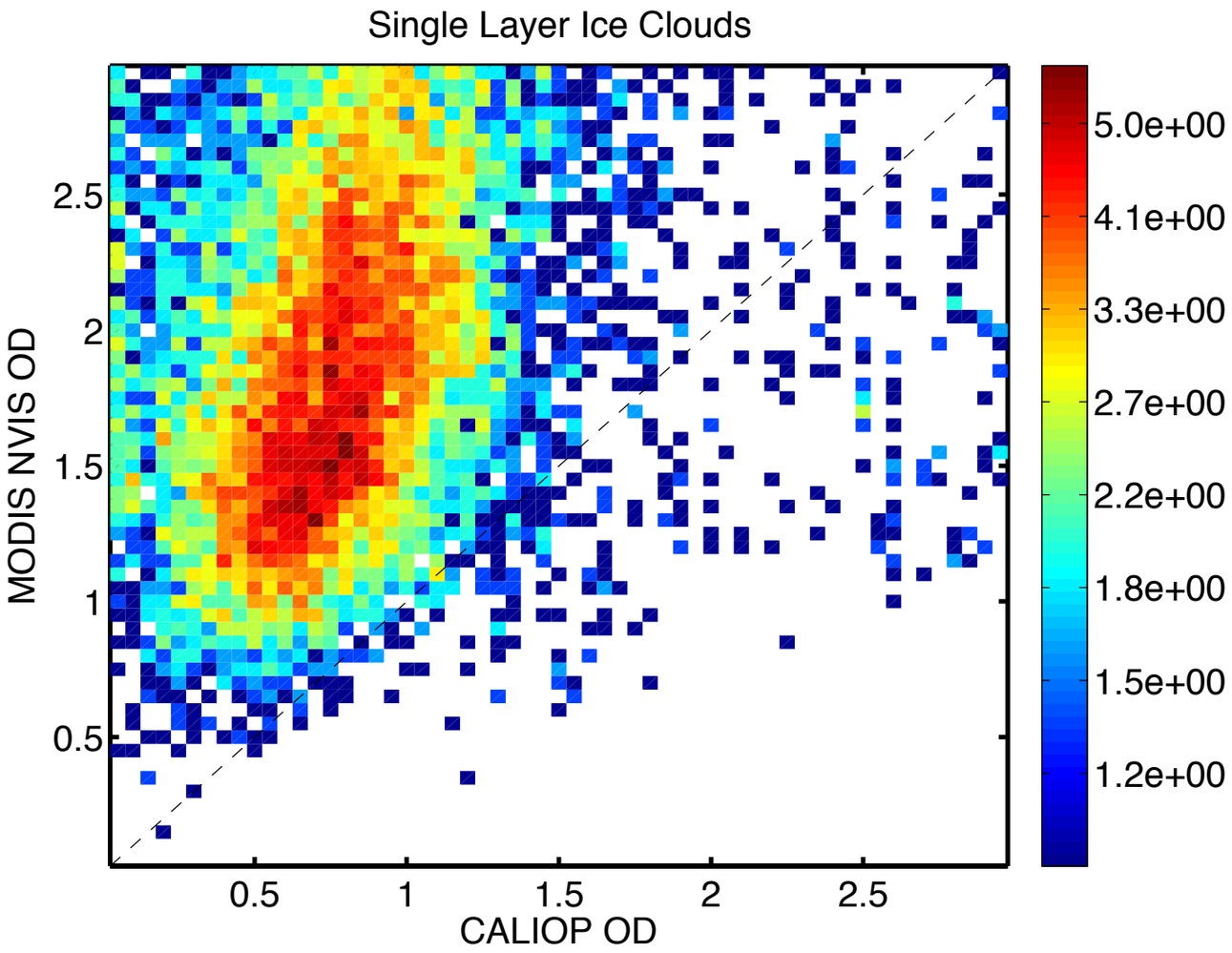
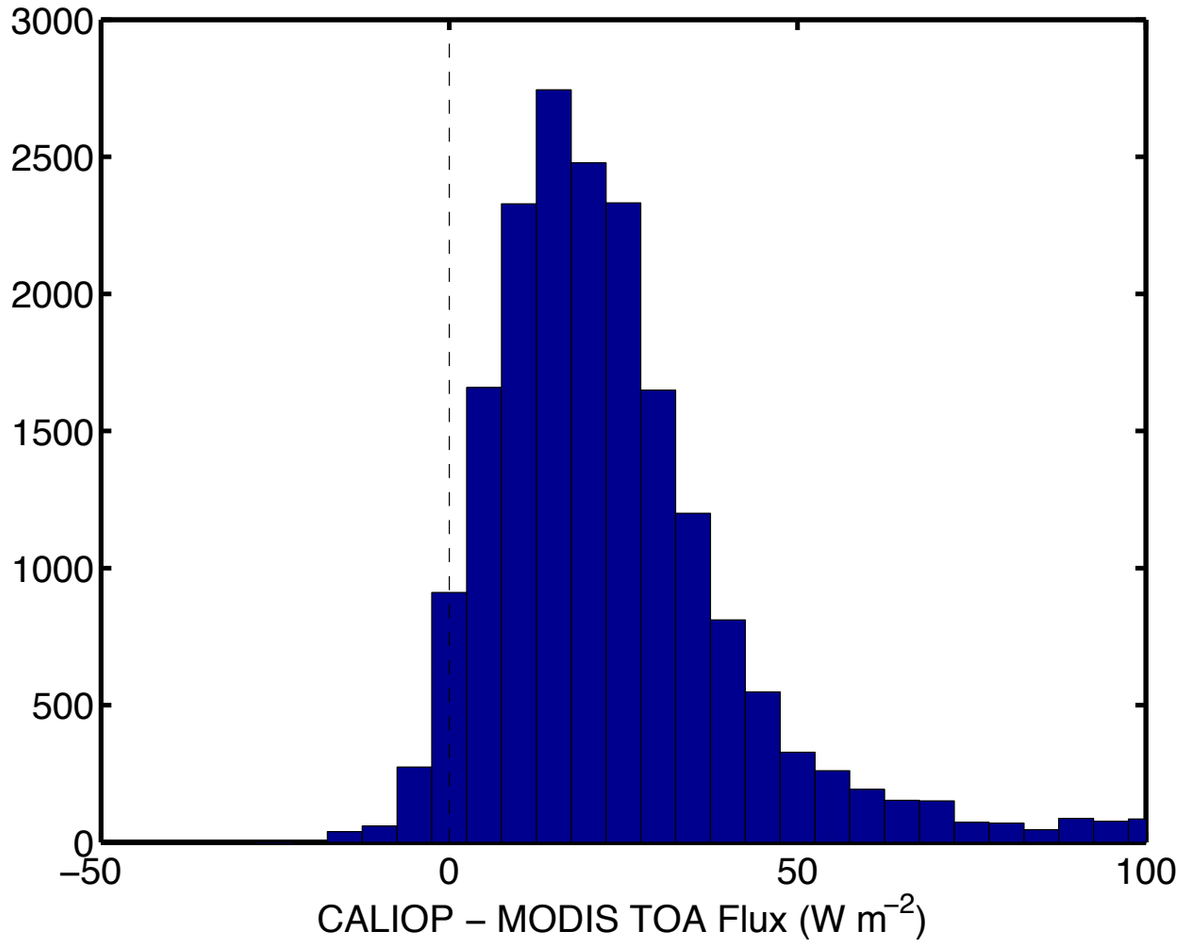
Motivation

- The NASA EOS C5 cirrus optical depth retrievals differ by up to a factor of two between observation systems (MODIS (C5), CALIOP (V3), 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 resolve these biases?

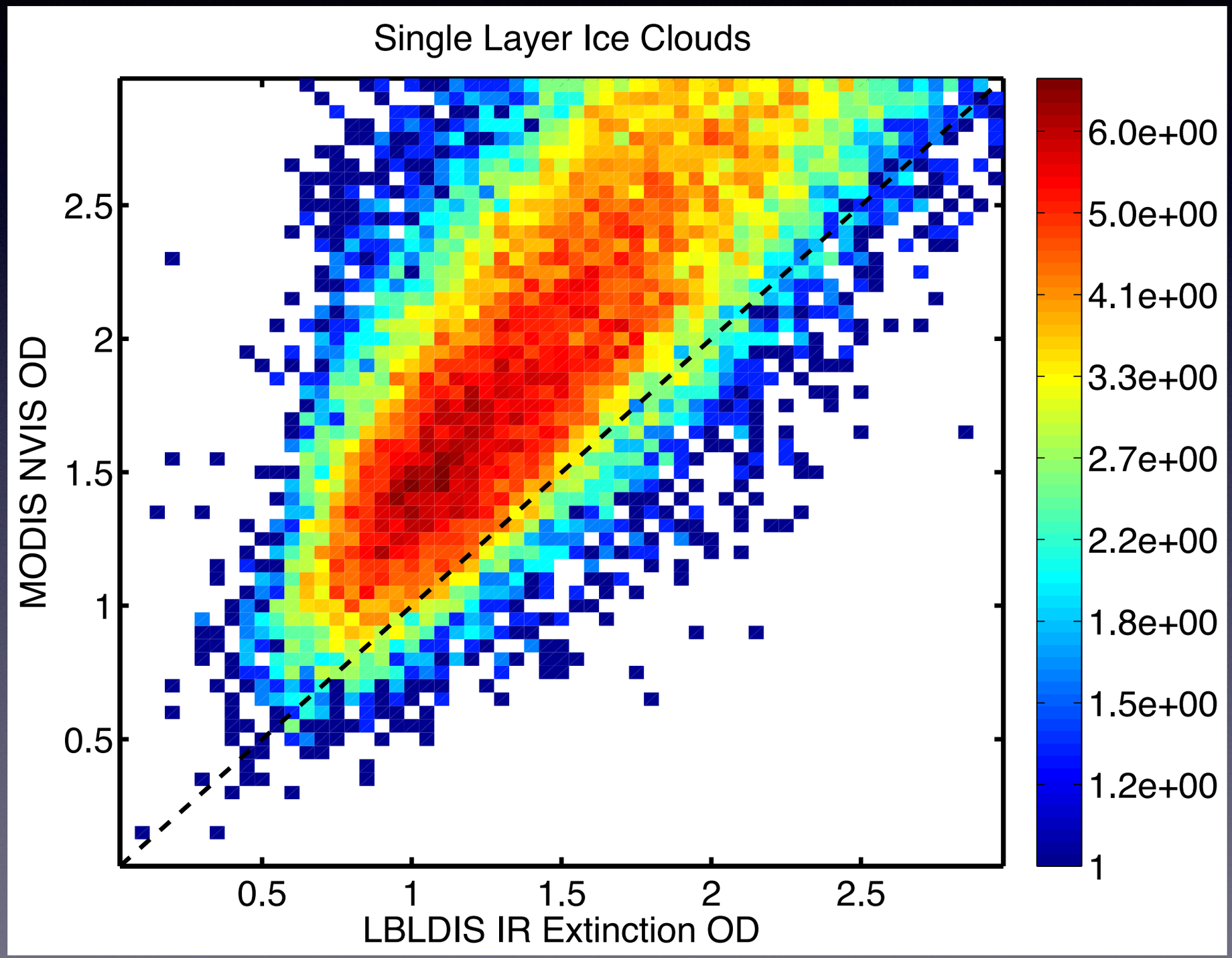
MODIS vs CALIOP OD



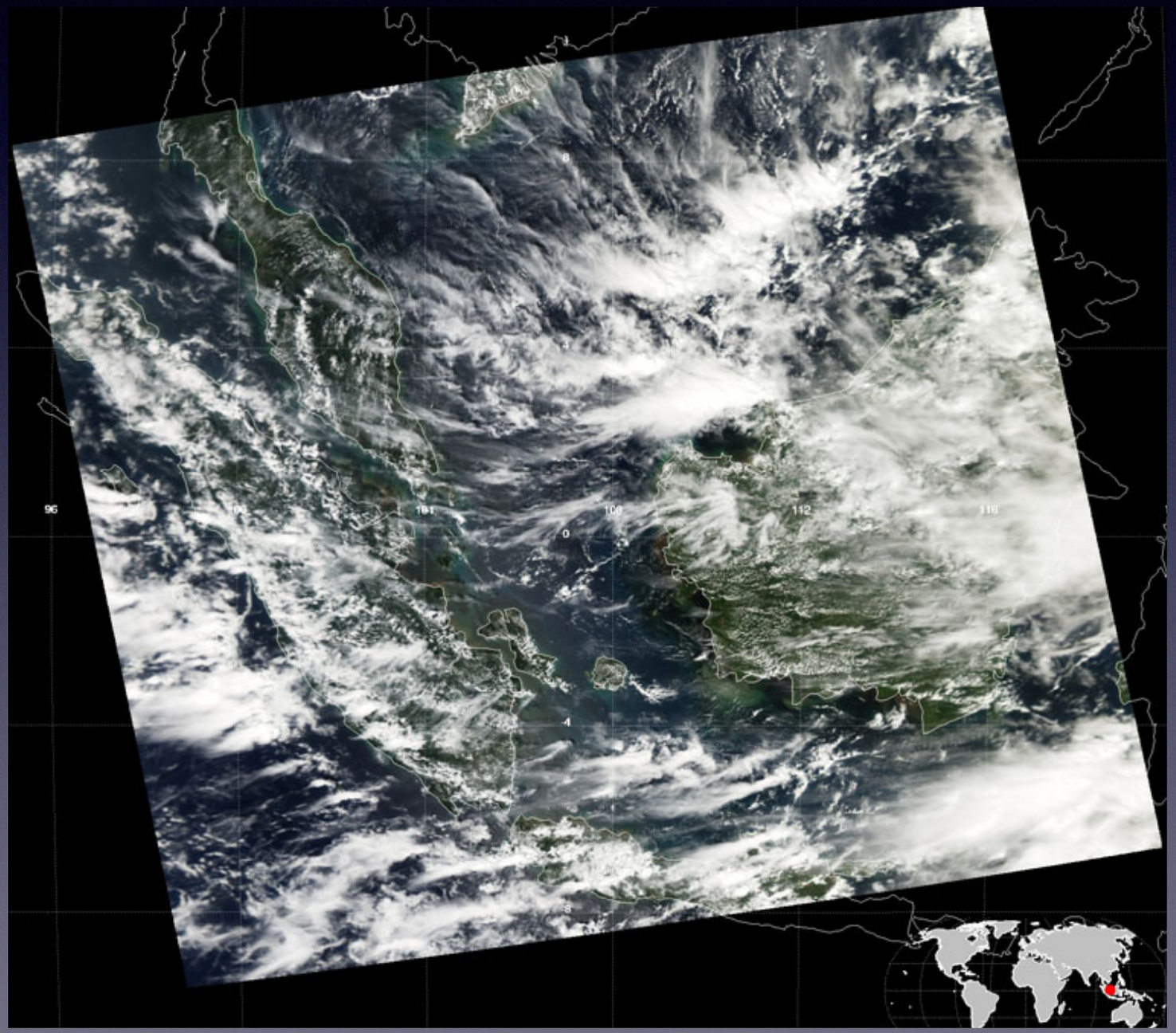


- 1 Month (January 2010) Non Polar (60 deg)
- Collocated IIR, CALIOP, and MODIS
- Single layer ice clouds less then 4 km thick
- Non attenuating (for CALIOP)
- Ocean only

IR vs MODIS C5 OD

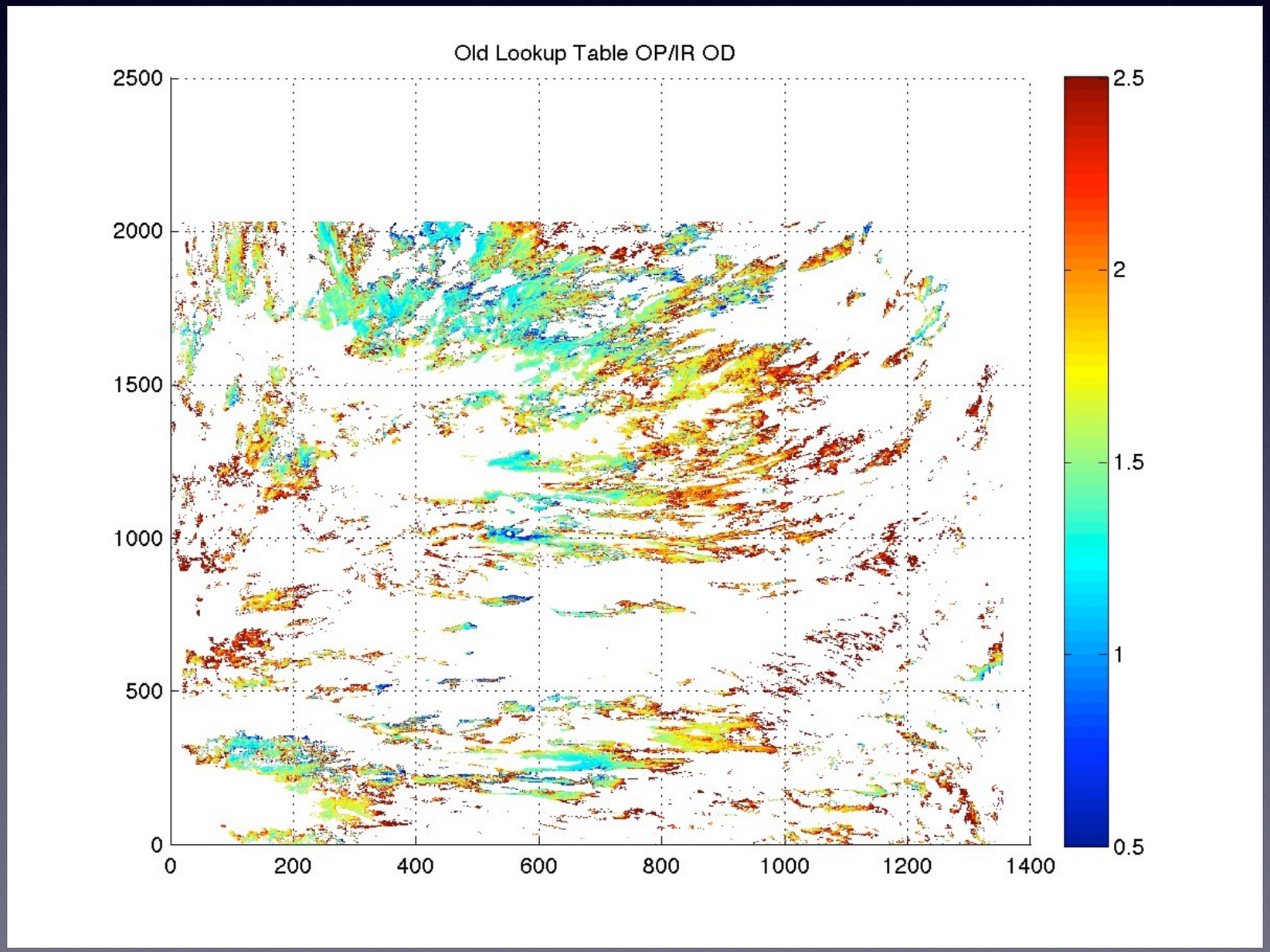


MODIS RGB Jan 11 2010



MODIS C5 Scattering Angle Bias

{C5 OD} / {IR OD}



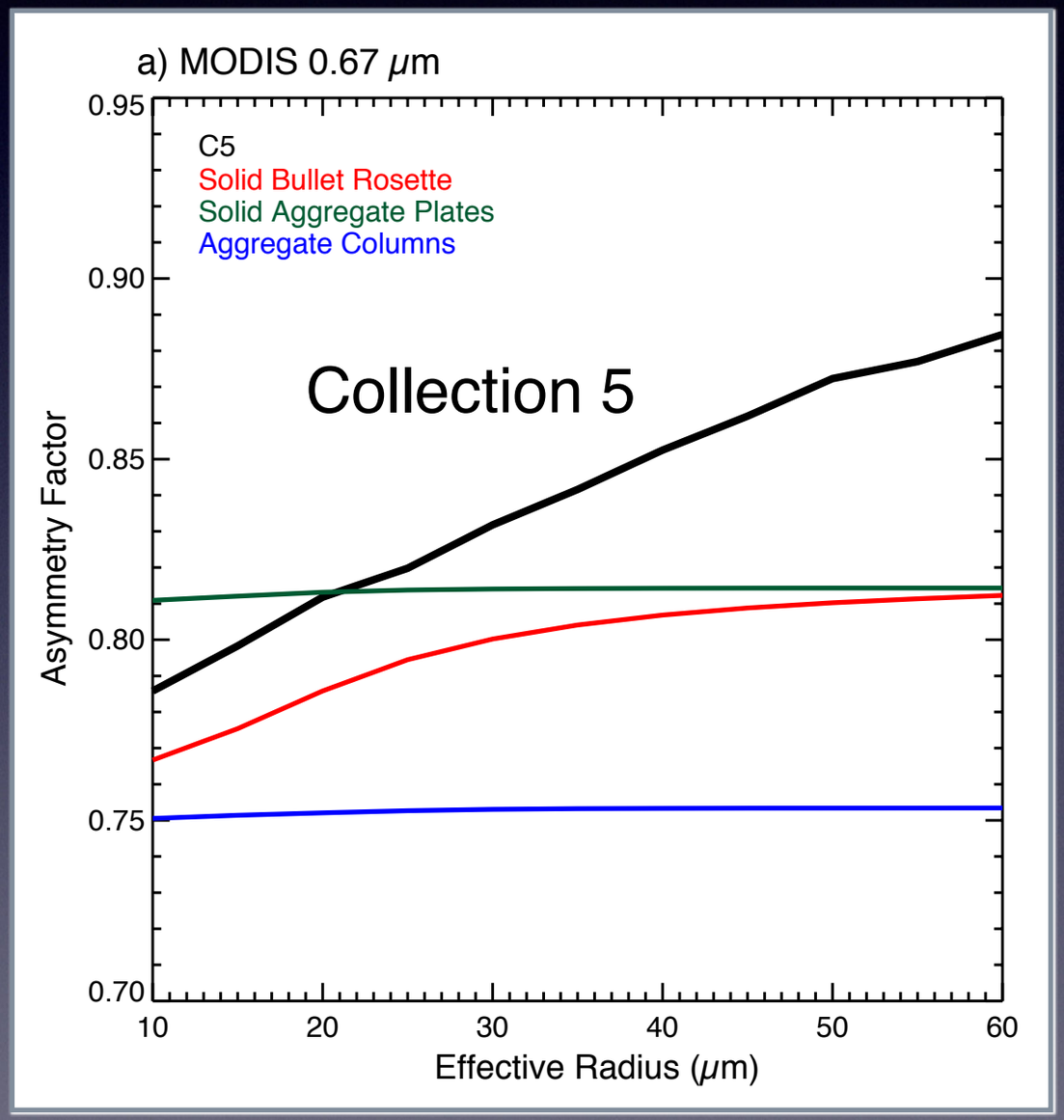
MODIS Scattering Properties

- To first order the MODIS retrieval of optical depth is:

$$R_\nu = (1 - g) \times \tau$$

- For ice, g is determined by relating MODIS spectral observations to theoretical single scatter calculations
- Question: Are these calculations representative of real ice crystals?

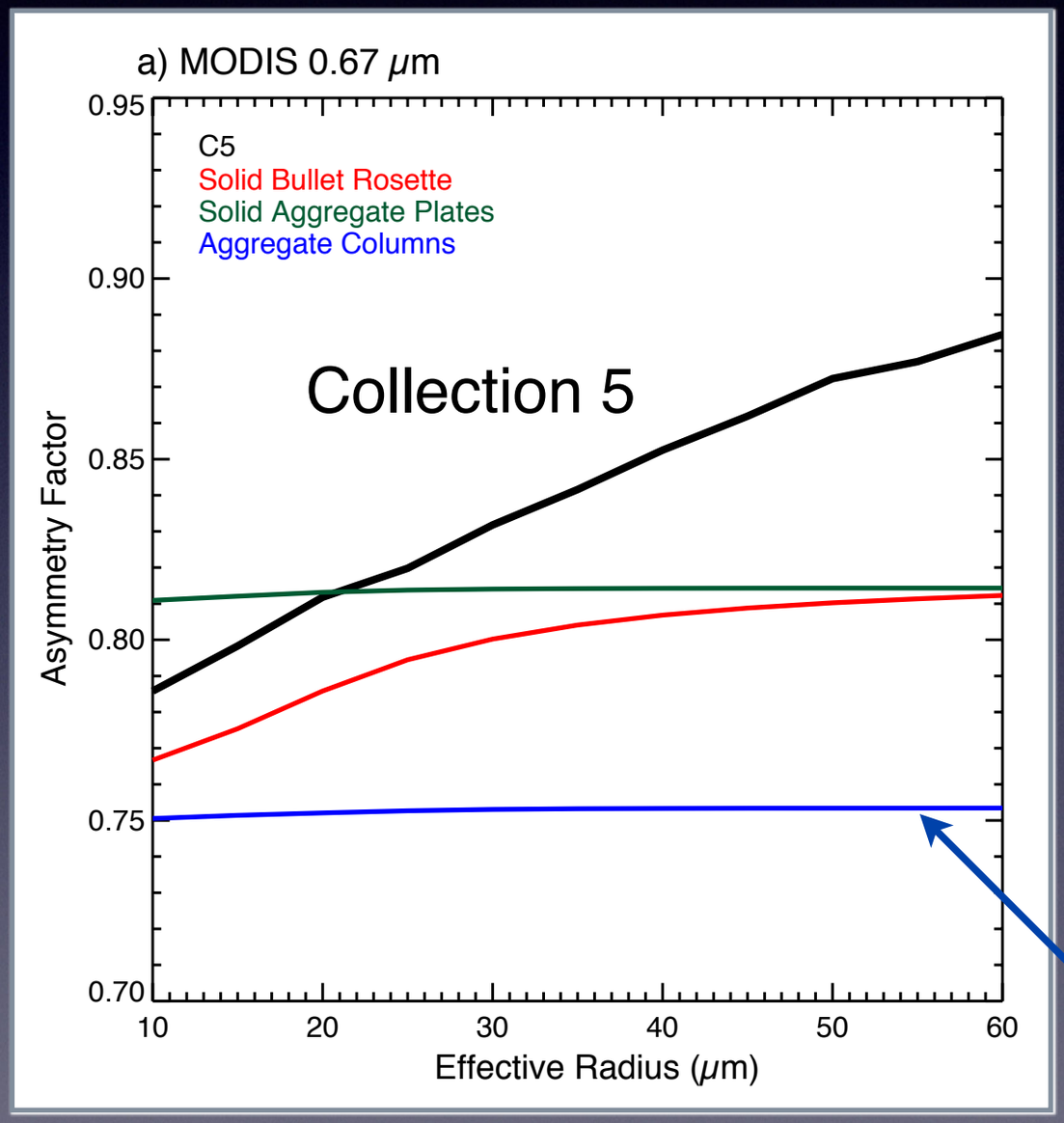
Effect of Ice Cloud Model Uncertainties On MODIS OD



larger COT

smaller COT

Effect of Ice Cloud Model Uncertainties On MODIS OD



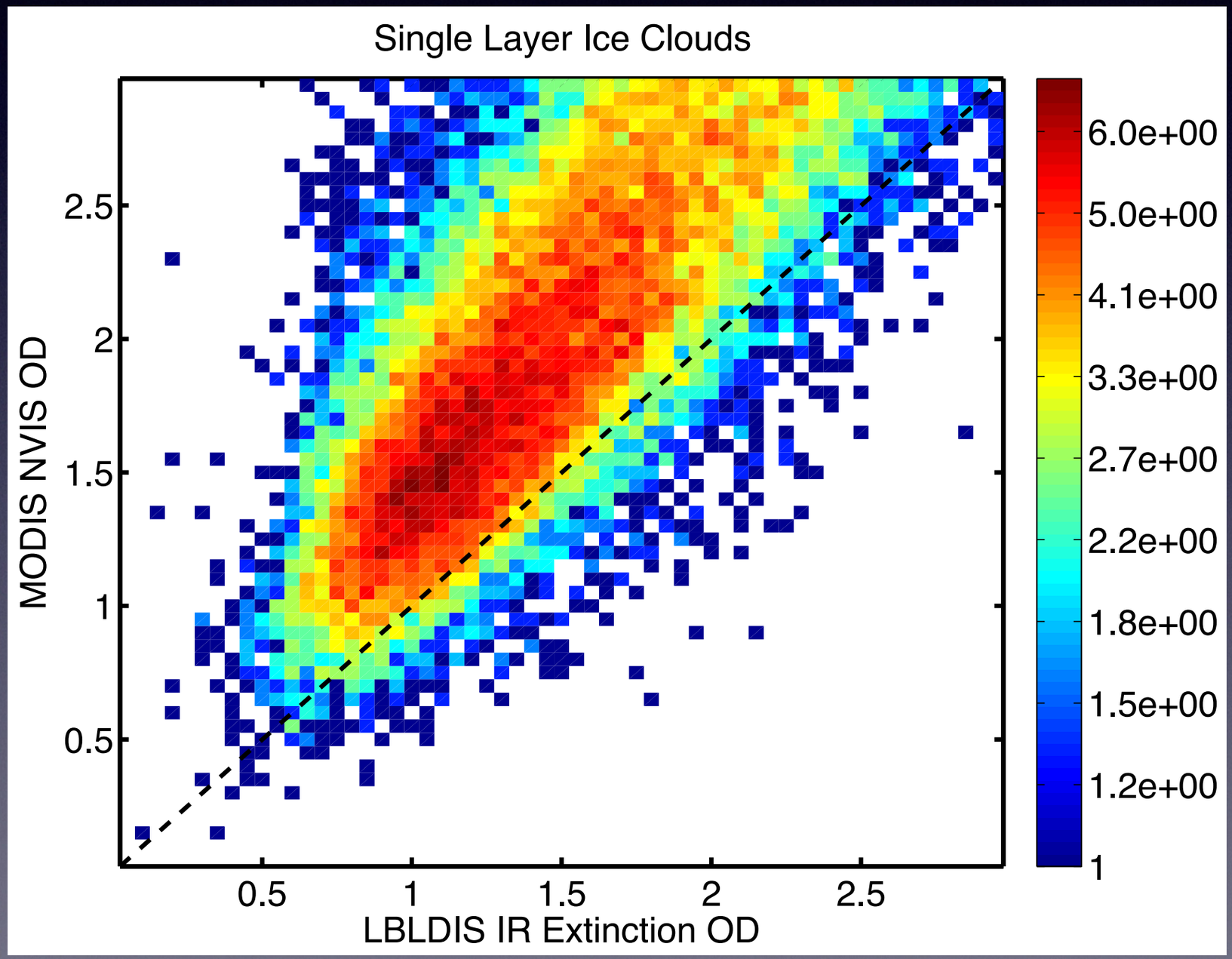
larger COT

smaller COT

MODIS Collection 6: severely roughened aggregated column

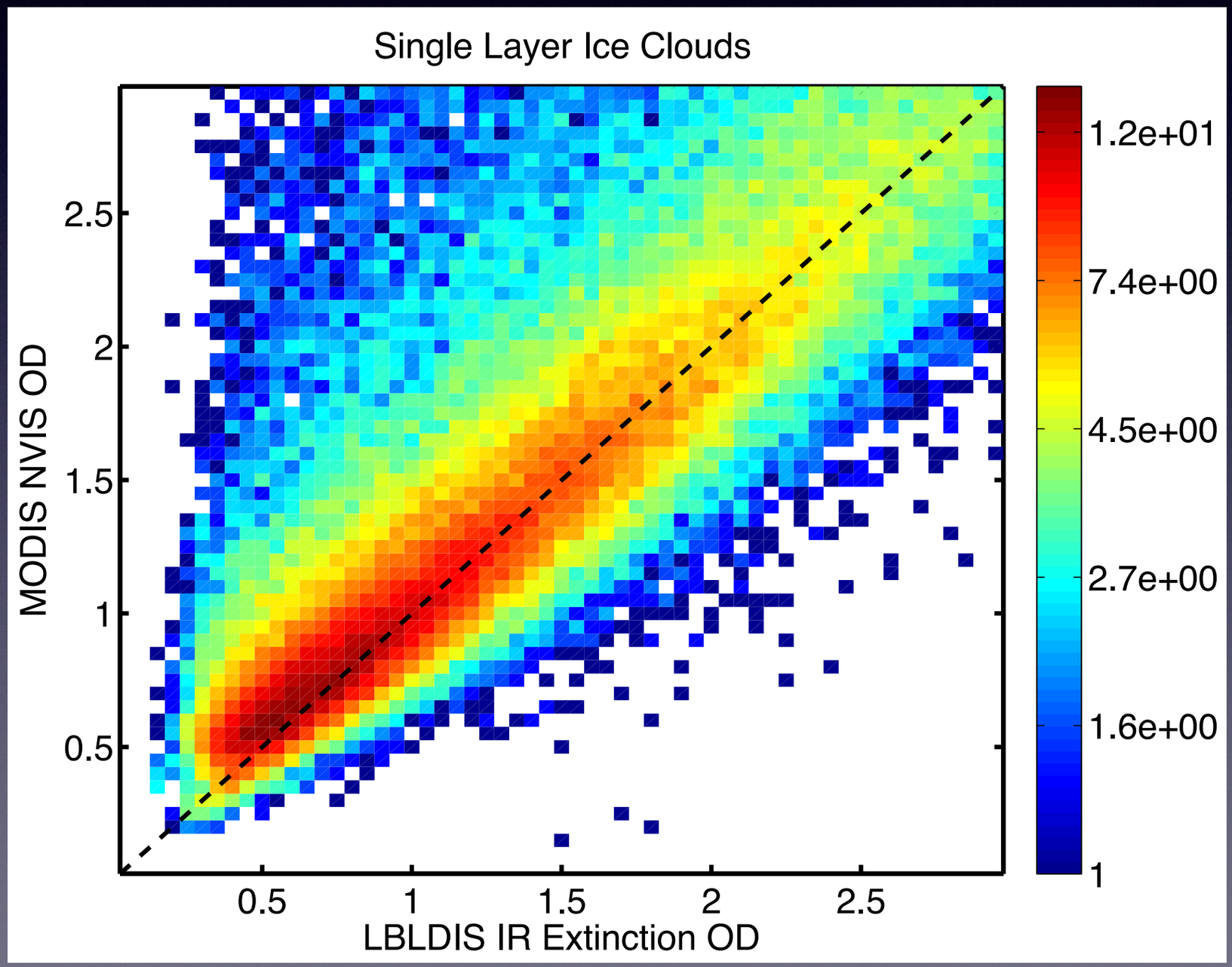
Aggregated Columns (C6)

Collection 5



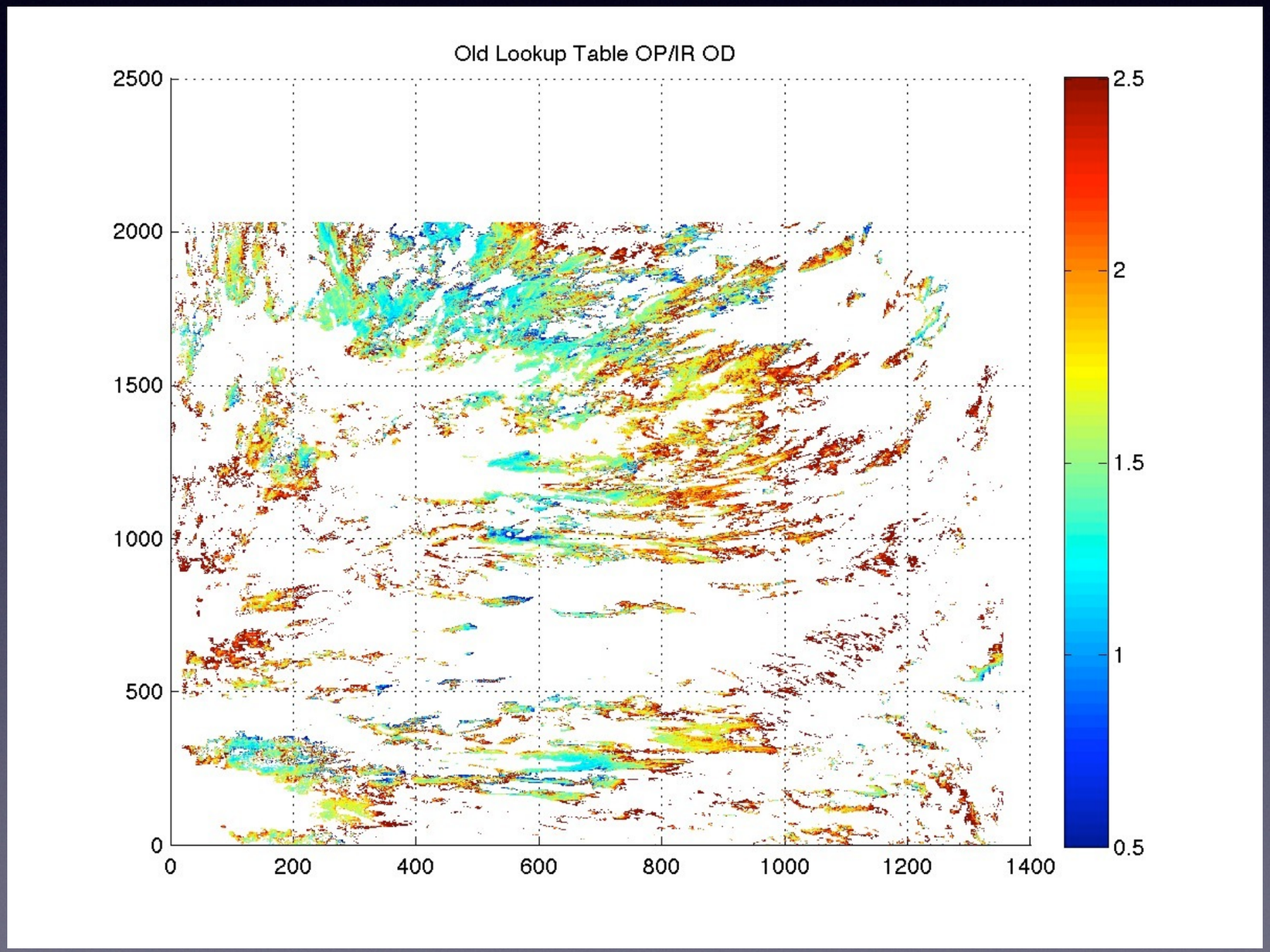
Aggregated Columns (C6)

Collection 6



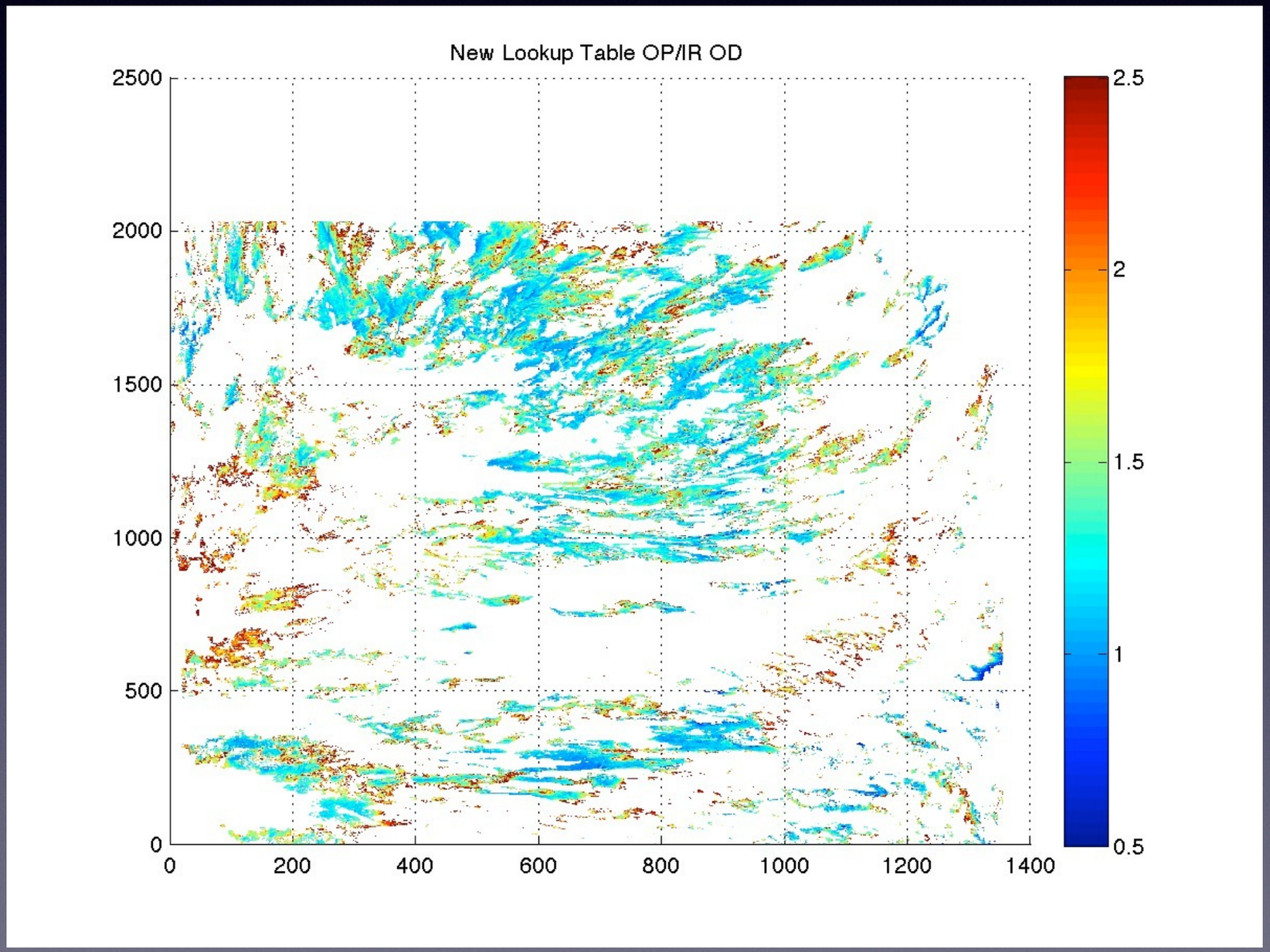
Aggregated Columns (C6)

C5 LUT

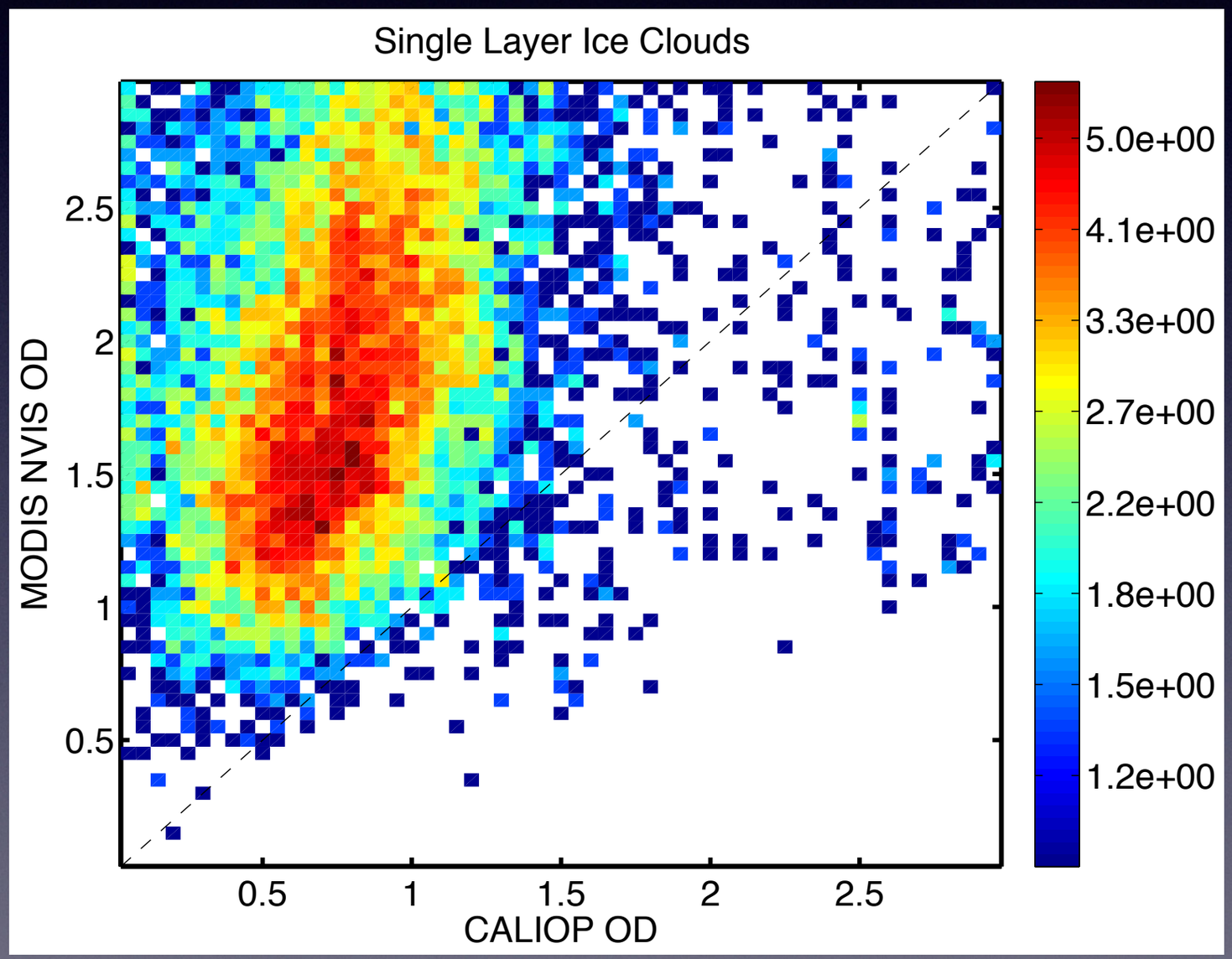


Aggregated Columns (C6)

ACOL LUT



MODIS vs CALIOP OD



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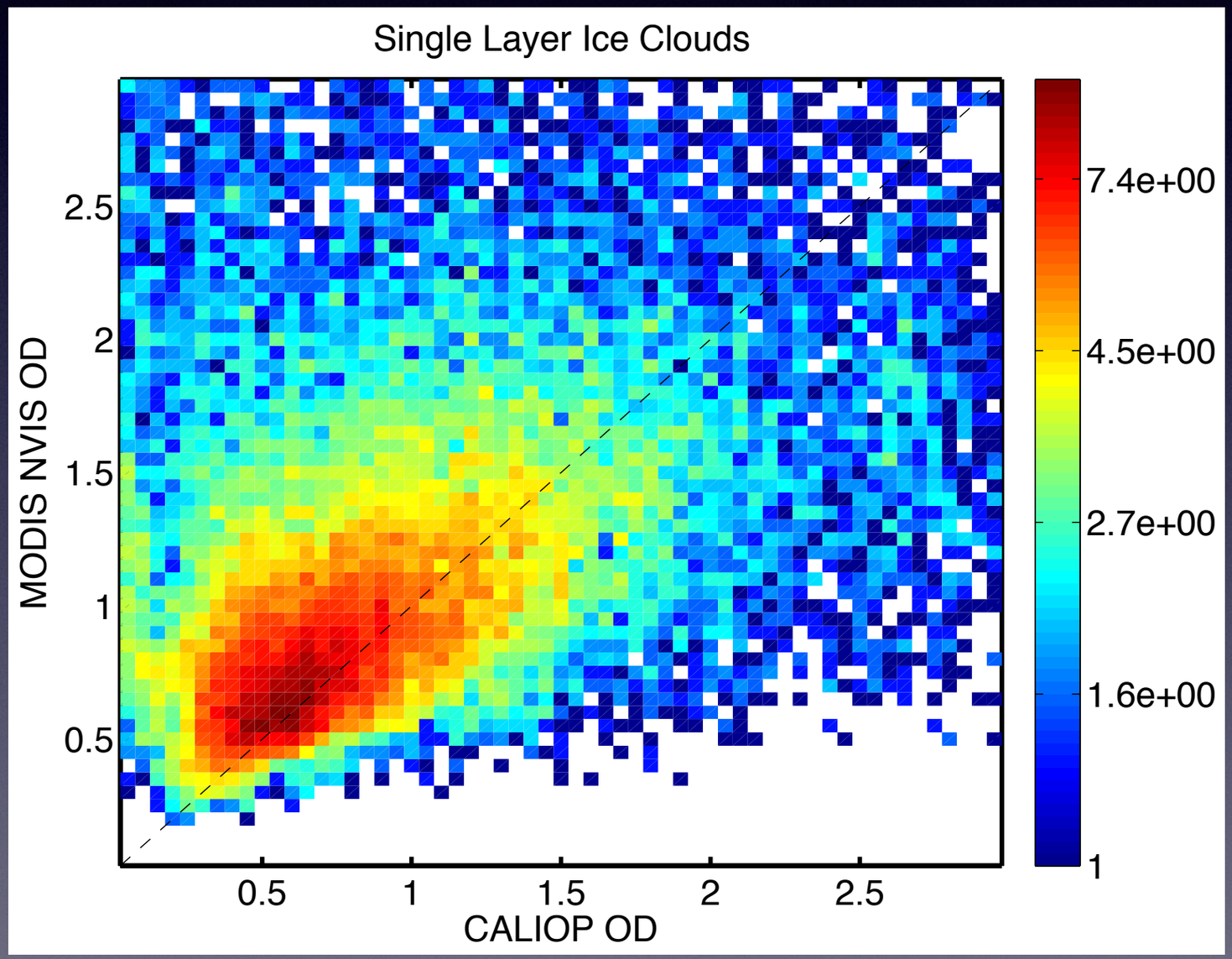
MODIS vs CALIOP OD

MODIS C6 and CALIOP Modified Lidar ration (25 ->32)



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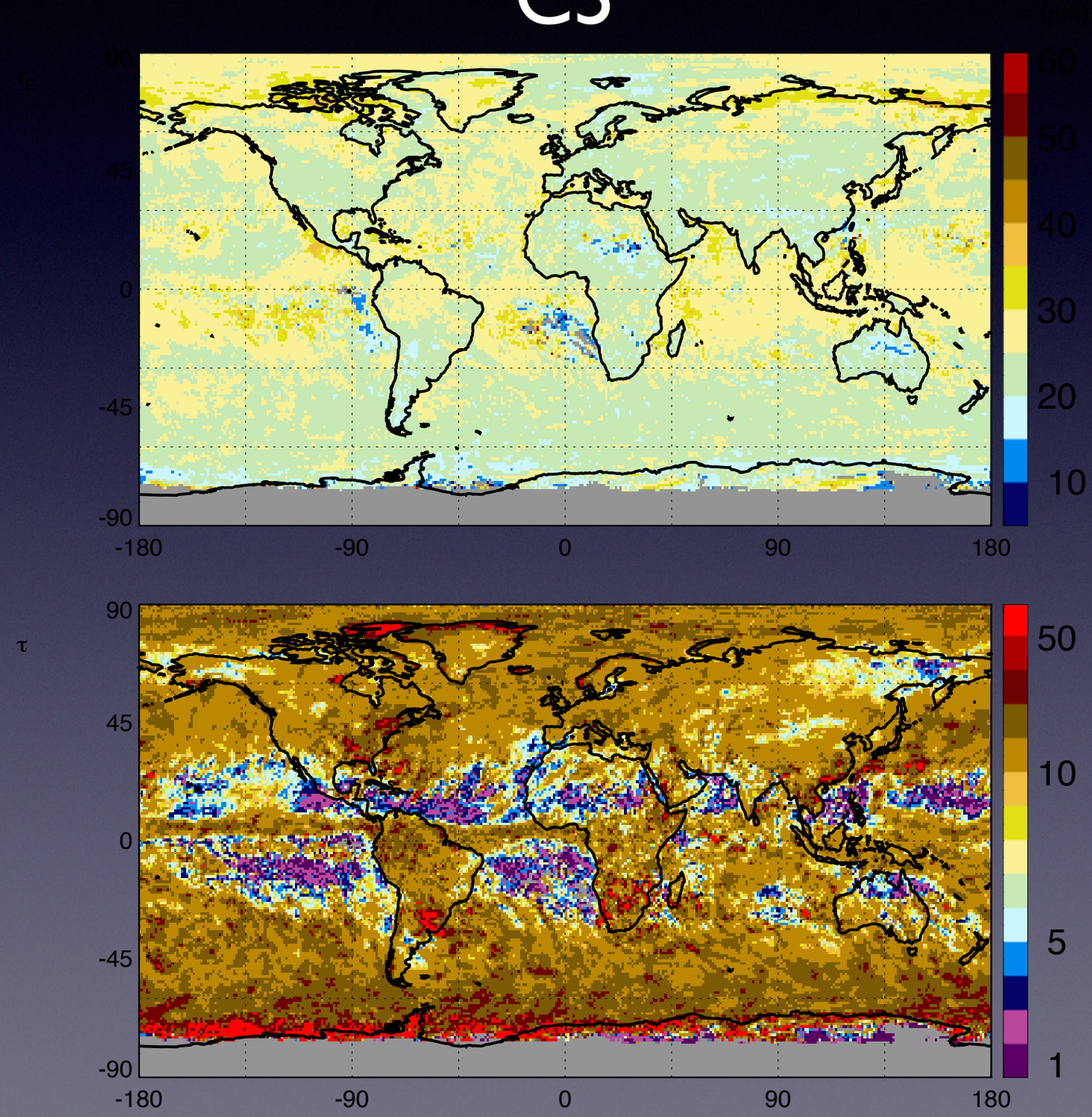
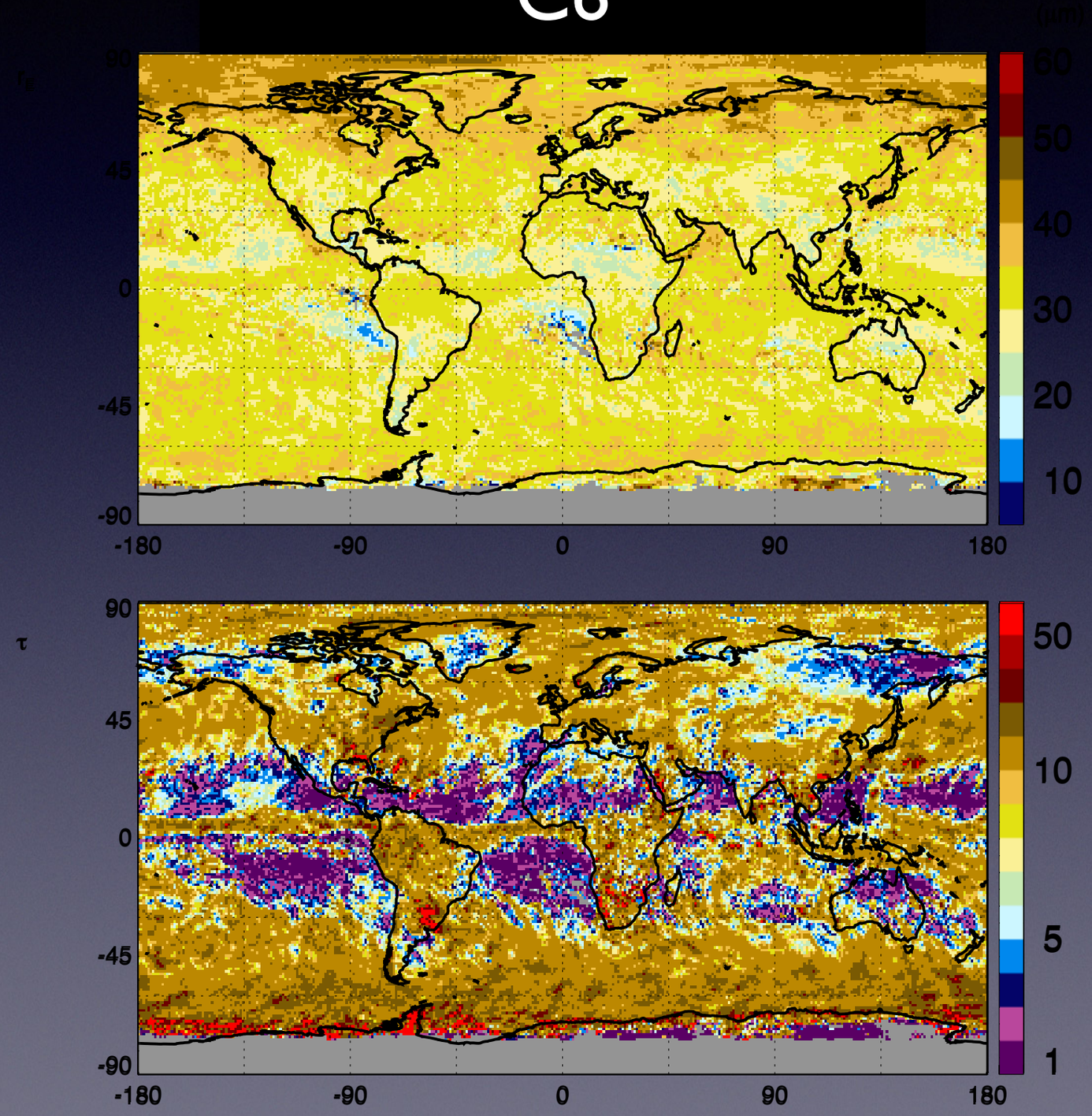
MODIS L3 Impacts

C5



MODIS L3 Impacts

C6



Take away messages

- Both CALIOP and MODIS OP (C5) cirrus retrievals have biases with respect to the IR that are being addressed
- IR optical depth retrievals of cirrus provide a consistent reference (MODIS, CALIPSO IIR)
- Solar reflectance retrievals are very sensitive to model assumptions
- The MODIS C6 OP products will use a modified gamma distribution applied to single habit (severely roughened aggregated columns). The integrated properties and lookup tables will be made available through the MODIS Atmosphere team site (Steve Platnick).
- The CALIOP unconstrained retrieval is using a lidar ratio (too small) that is not consistent with nighttime constrained retrievals. We find that a lidar ratio of 31 results in significantly better agreement with the IR compared to the current value of 25.