Improving the capability of MODIS for cloud optical thickness retrievals of thin cirrus using the 1.38 μm channel

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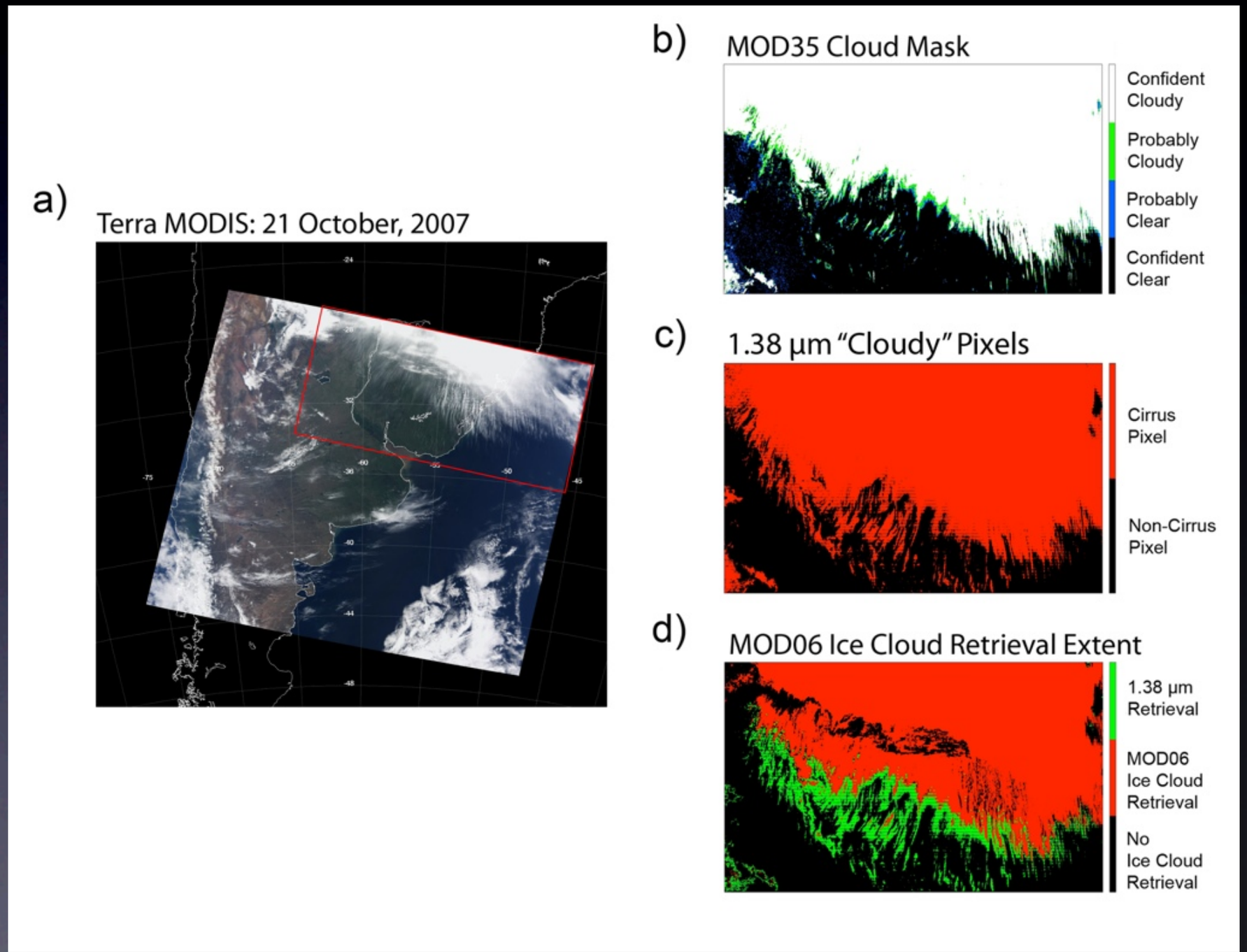
Outline

- Motivation.
- Proposed work.
- Retrieval methodology, examples, and baseline uncertainties.
- Retrieval comparison
  - MOD06, CALIOP.
- To-do list.

Motivation



(Meyer & Platnick, 2010)

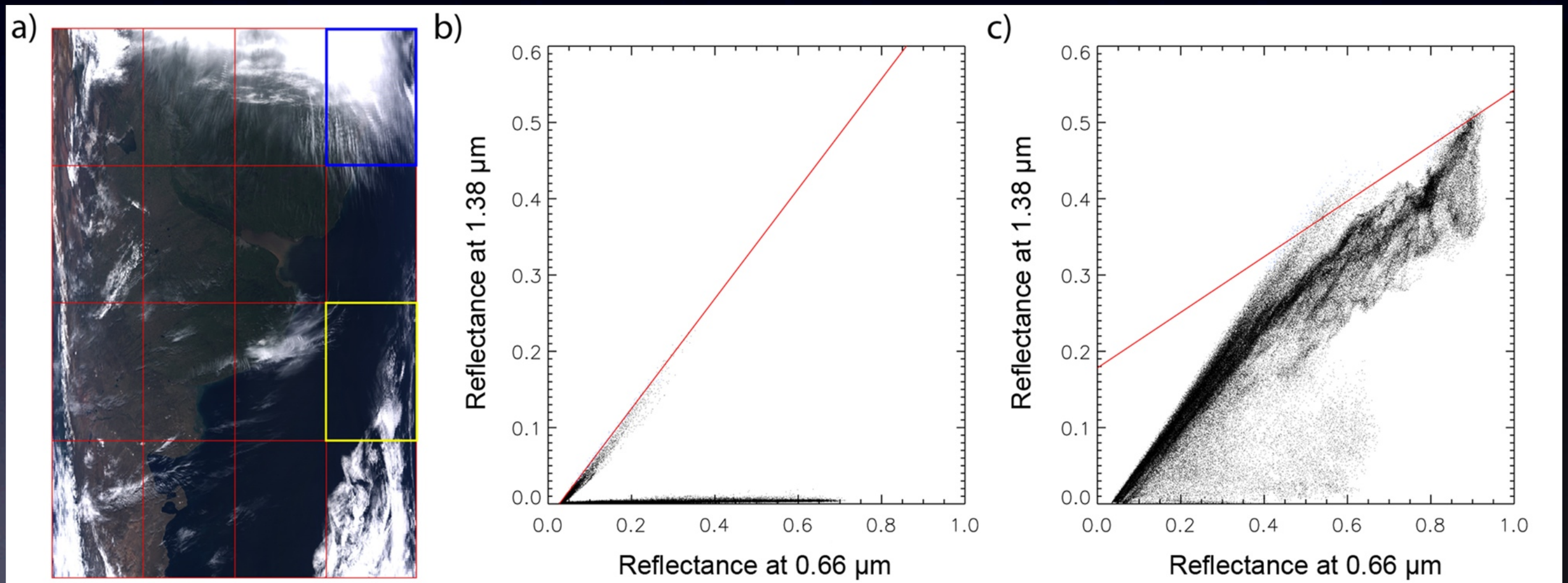
Proposed Work

- Integrate and further develop our 1.38 μm cirrus optical thickness retrieval within a research-level version of MOD06.
  - Produce baseline retrieval uncertainty estimates.
- Perform comparisons with similar datasets.
  - MOD06 (moderately thick cirrus), CALIOP, etc.
- Evaluate the retrieval components to further constrain uncertainty estimates and identify potential biases.
  - Example: Evaluate above-cloud water vapor estimates using CALIOP (cloud top height), MERRA, MLS (upper atmosphere water vapor), etc.
- Investigate the impact of additional thin cirrus retrievals in MOD06 on global optical thickness aggregation.
- Implement new ice cloud models.

Cirrus Retrieval

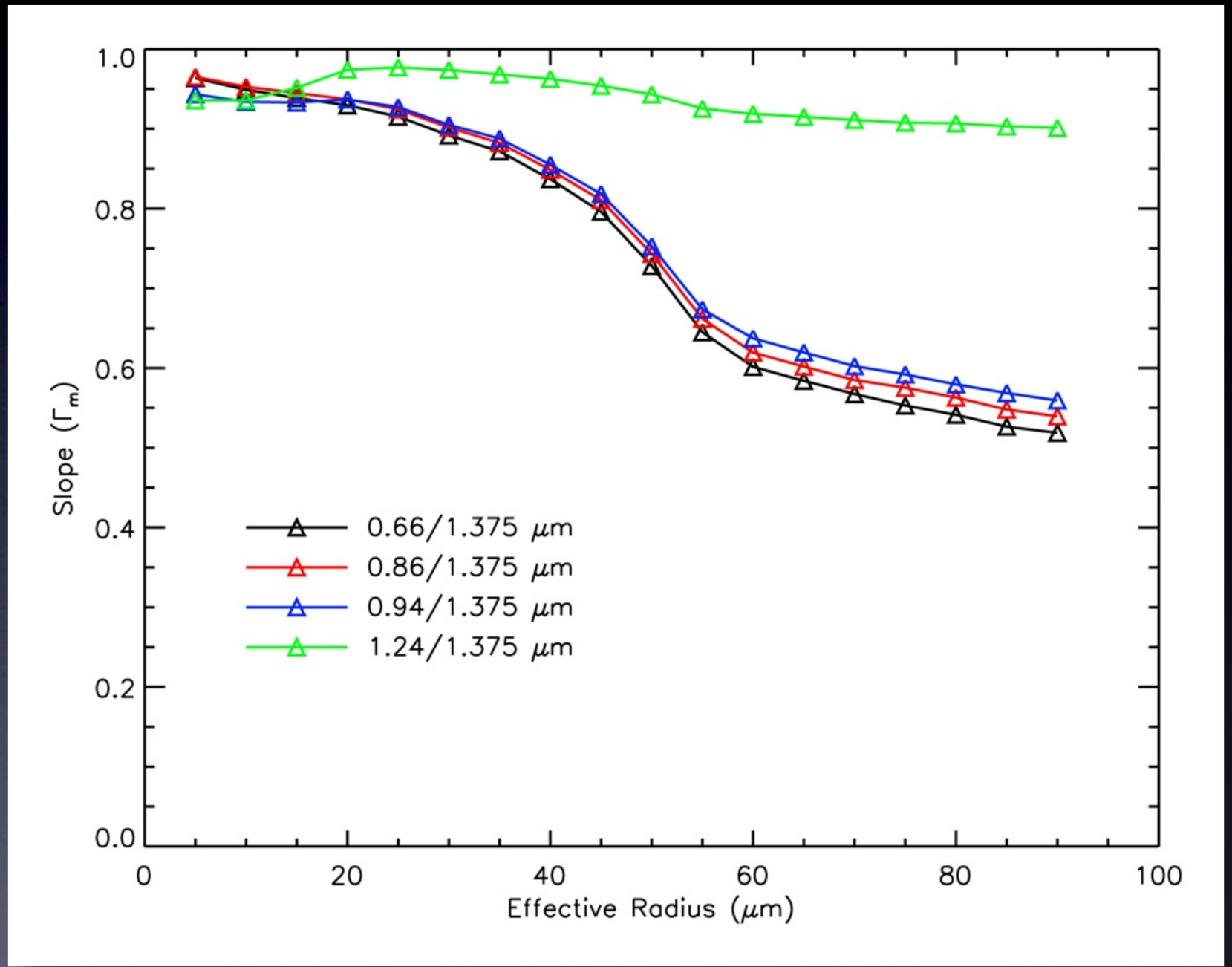
- Previously developed a 1.38 μm-based cirrus optical thickness retrieval algorithm.
  - Combines the 1.24 μm channel with 1.38 μm to characterize the above/in-cloud water vapor attenuation at 1.38 μm, applying the underlying assumptions of the cirrus reflectance product (Gao et al., 2003) at pixel-level.
  - Derives cloud optical thickness from corrected 1.38 μm reflectances using pre-computed look-up tables.
  - Provides estimates of the baseline retrieval uncertainty (effective particle size, 1.24 μm surface albedo, instrument).
  - Currently ocean-only.
    - Cox-Munk approach to characterize the angular dependence of ocean surface reflection (Cox and Munk, 1954a,b).
  - Uses MOD021KM Uncertainty Index to screen poor quality 1.38 μm pixels.
- Further info: K. Meyer and S. Platnick, 2010: Utilizing the MODIS 1.38 μm channel for cirrus cloud optical thickness retrievals: Algorithm and retrieval uncertainties. *J. Geophys. Res.*, vol. 115.

Retrieval Methodology



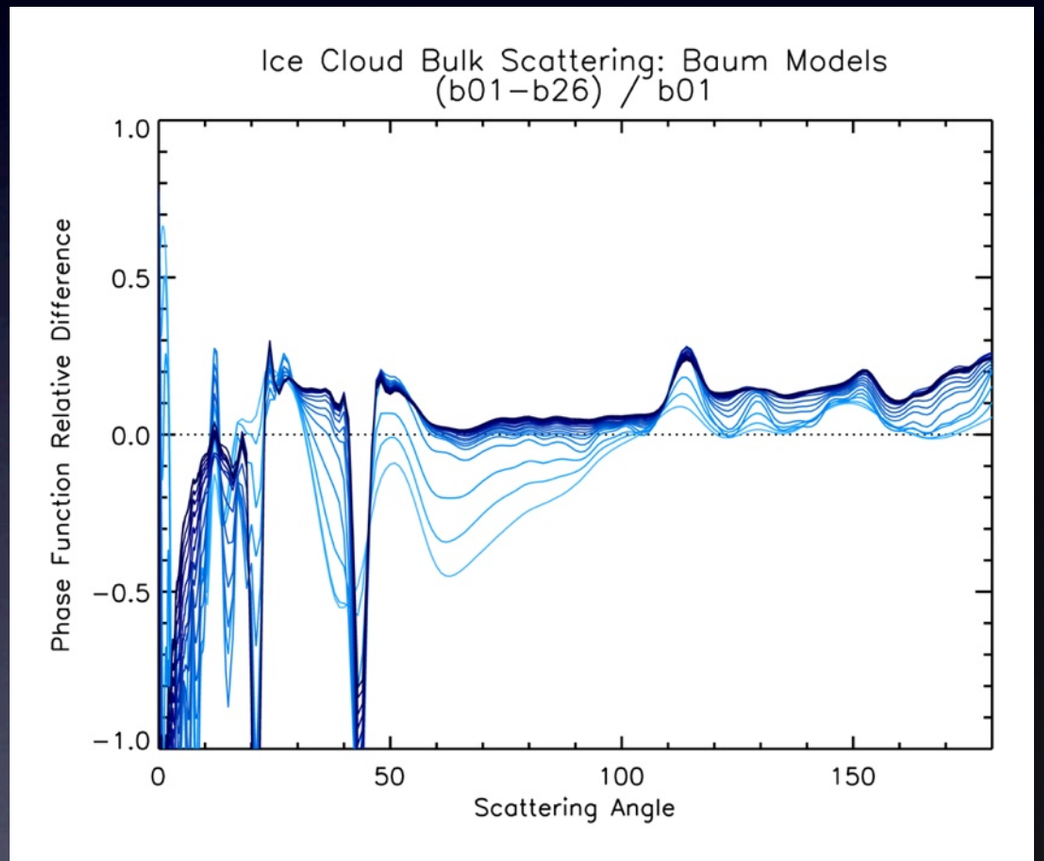
(Meyer & Platnick, 2010)

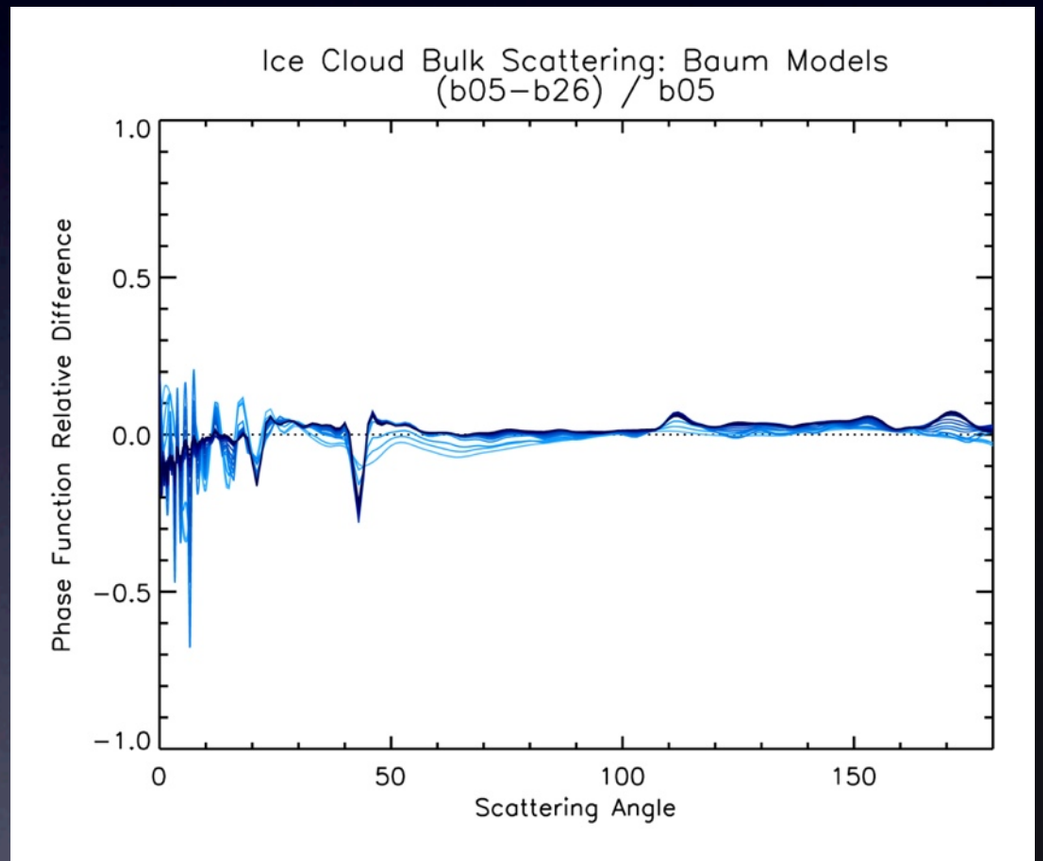
Retrieval Methodology



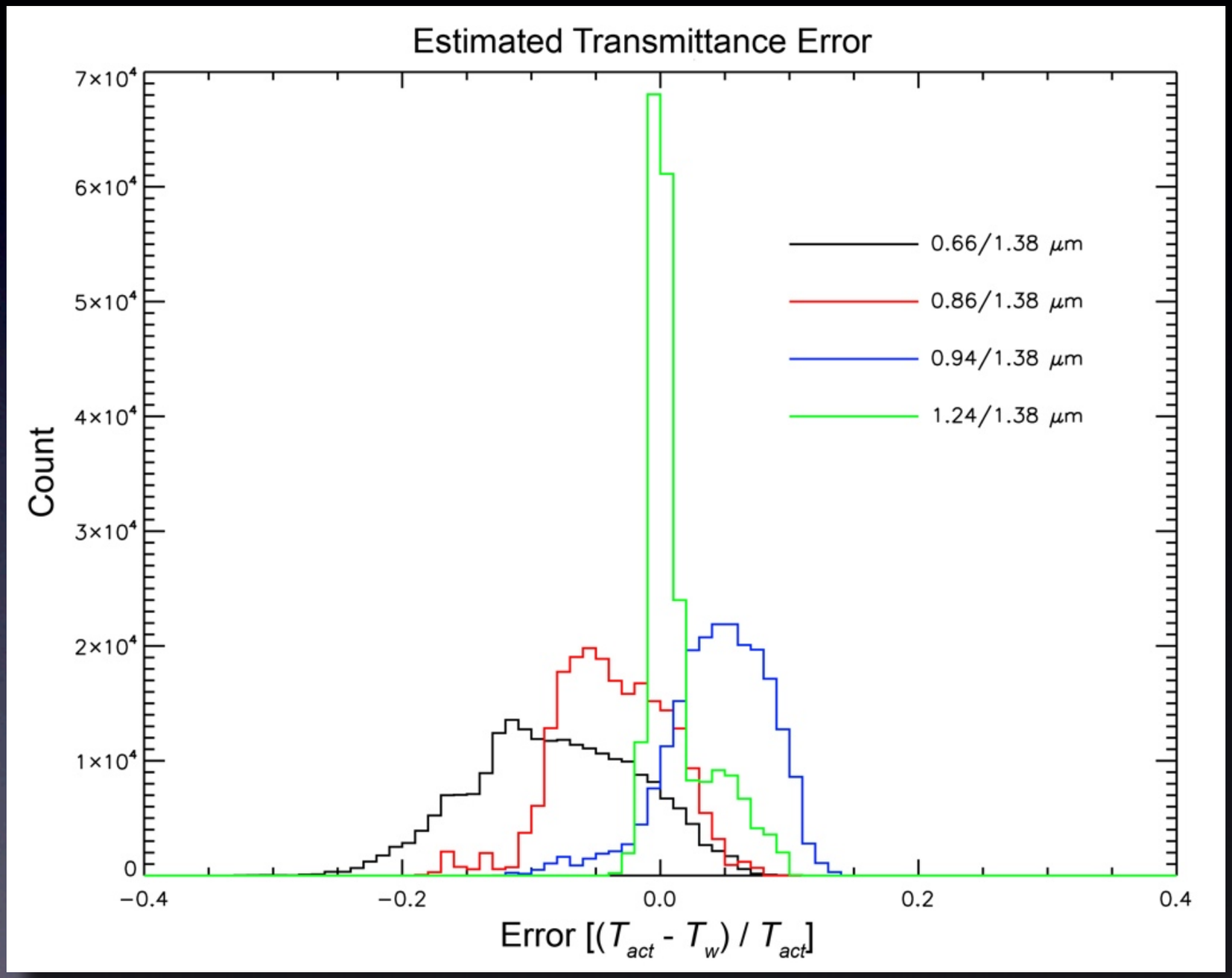
(Meyer & Platnick, 2010)

Retrieval Methodology



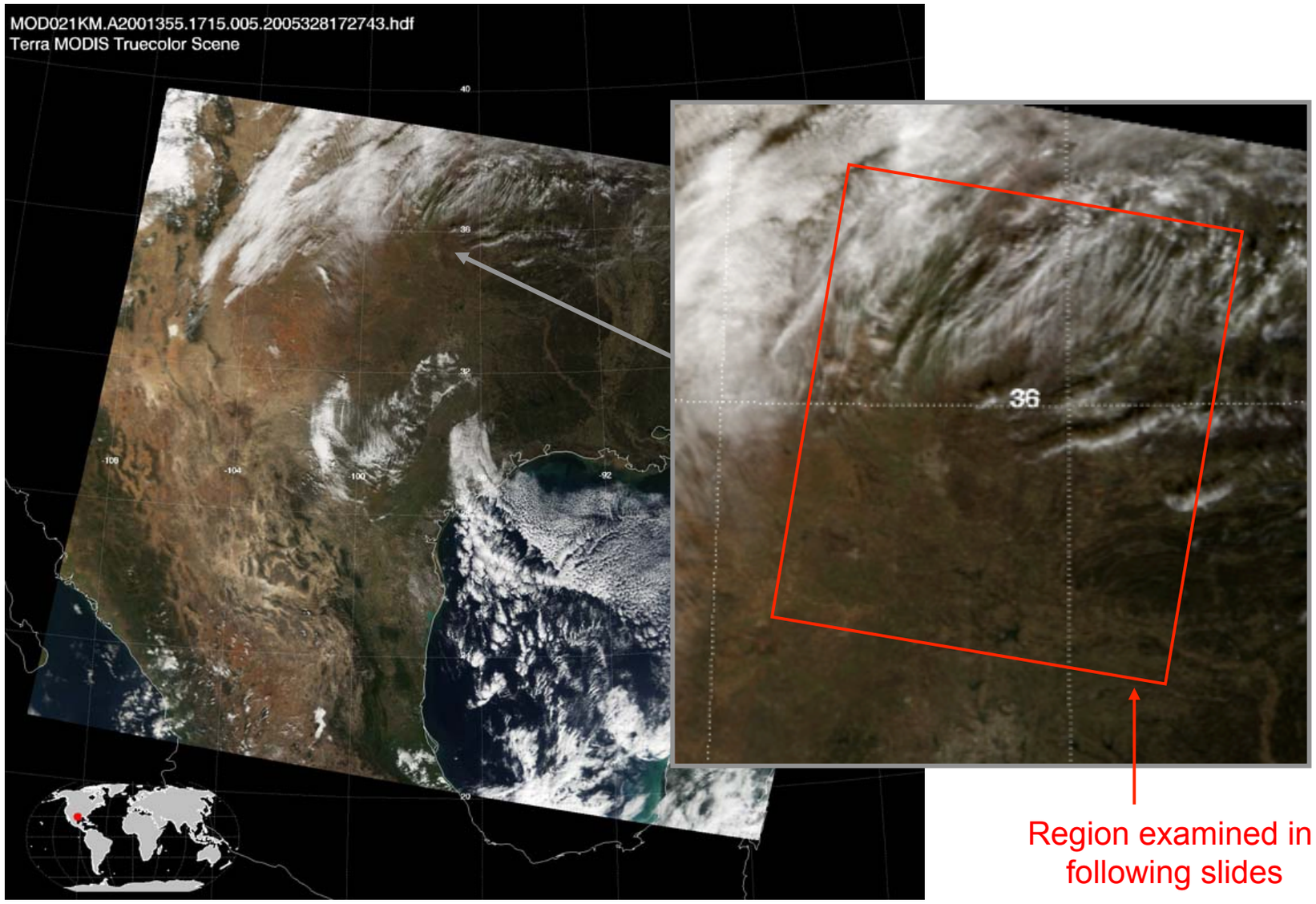


Retrieval Methodology



(Meyer & Platnick, 2010)

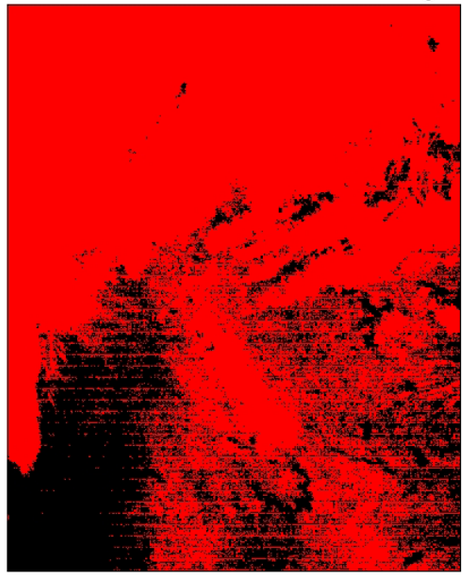
Uncertainty Index



Courtesy of Gala Wind

Uncertainty Index

Cirrus Reflectance Flag



Cirrus Pixel

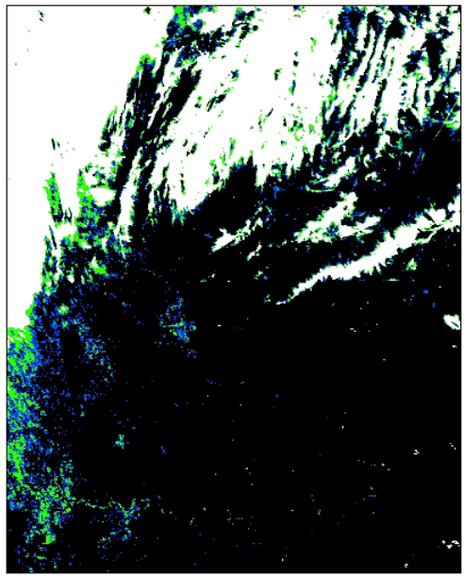
Non-Cirrus Pixel

Cirrus Reflectance Flag (without UI=15)

Cirrus Pixel

Non-Cirrus Pixel

MOD06 Cloud Mask



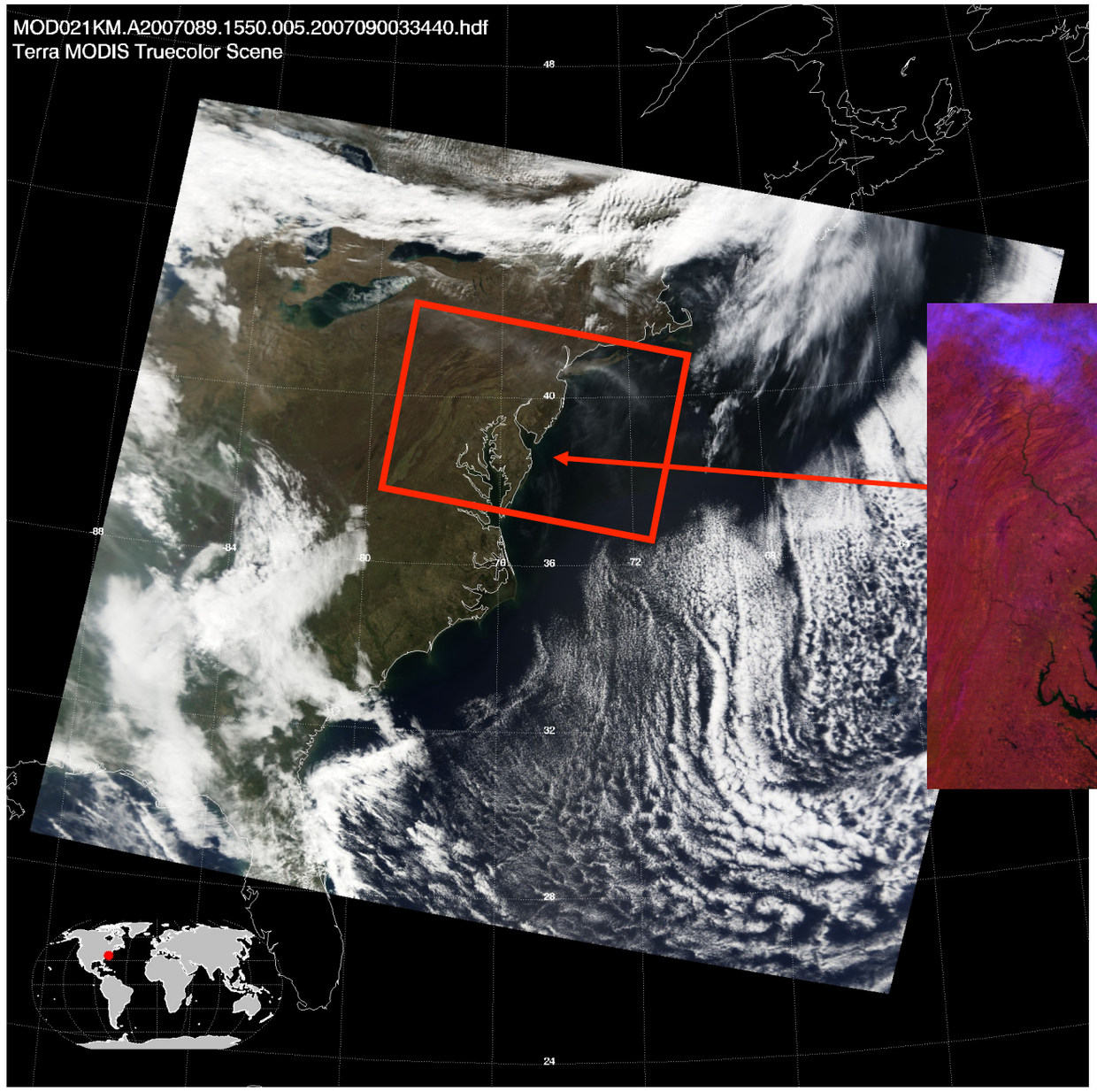
Confident Cloudy

Probably Cloudy

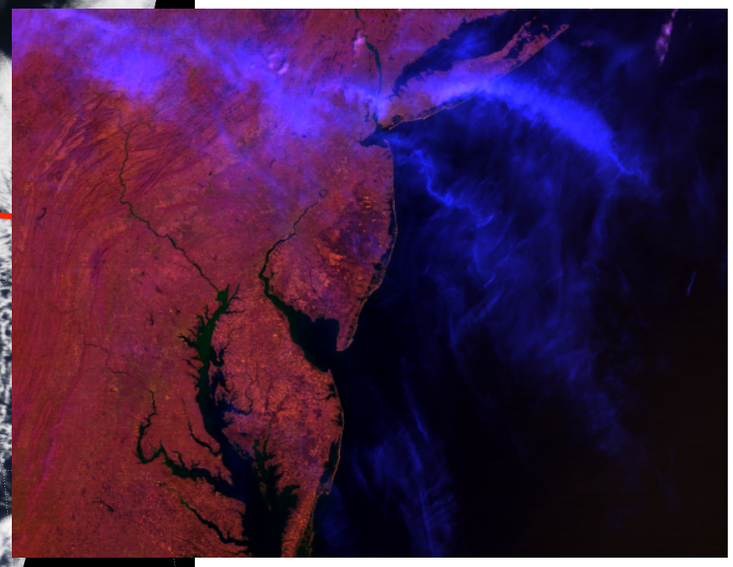
Probably Clear

Confident Clear

Uncertainty Index



False-color image
(R:2.1um, G:0.65um,B: 1.38um)

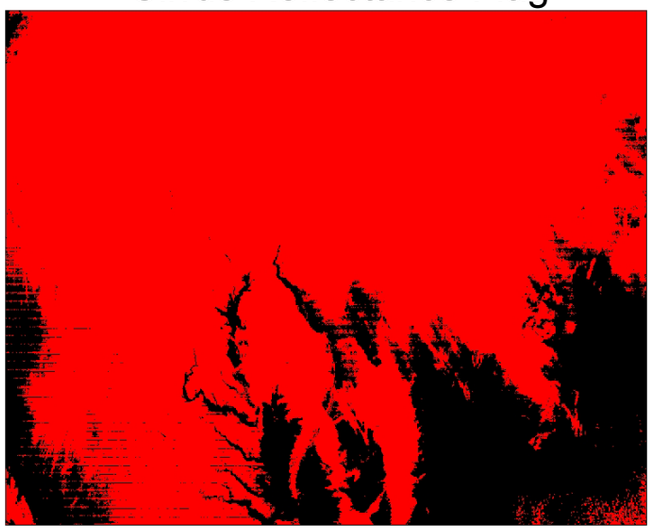


Region examined in following slides

Courtesy of Gala Wind

Uncertainty Index

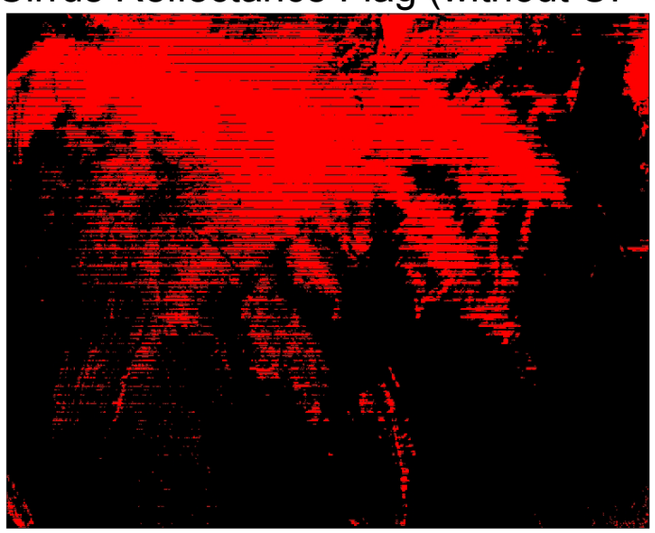
Cirrus Reflectance Flag



Cirrus Pixel

Non-Cirrus Pixel

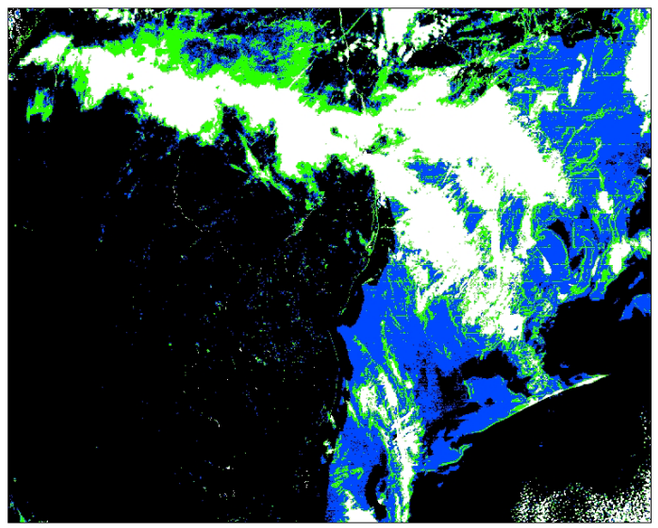
Cirrus Reflectance Flag (without UI=15)



Cirrus Pixel

Non-Cirrus Pixel

MOD06 Cloud Mask



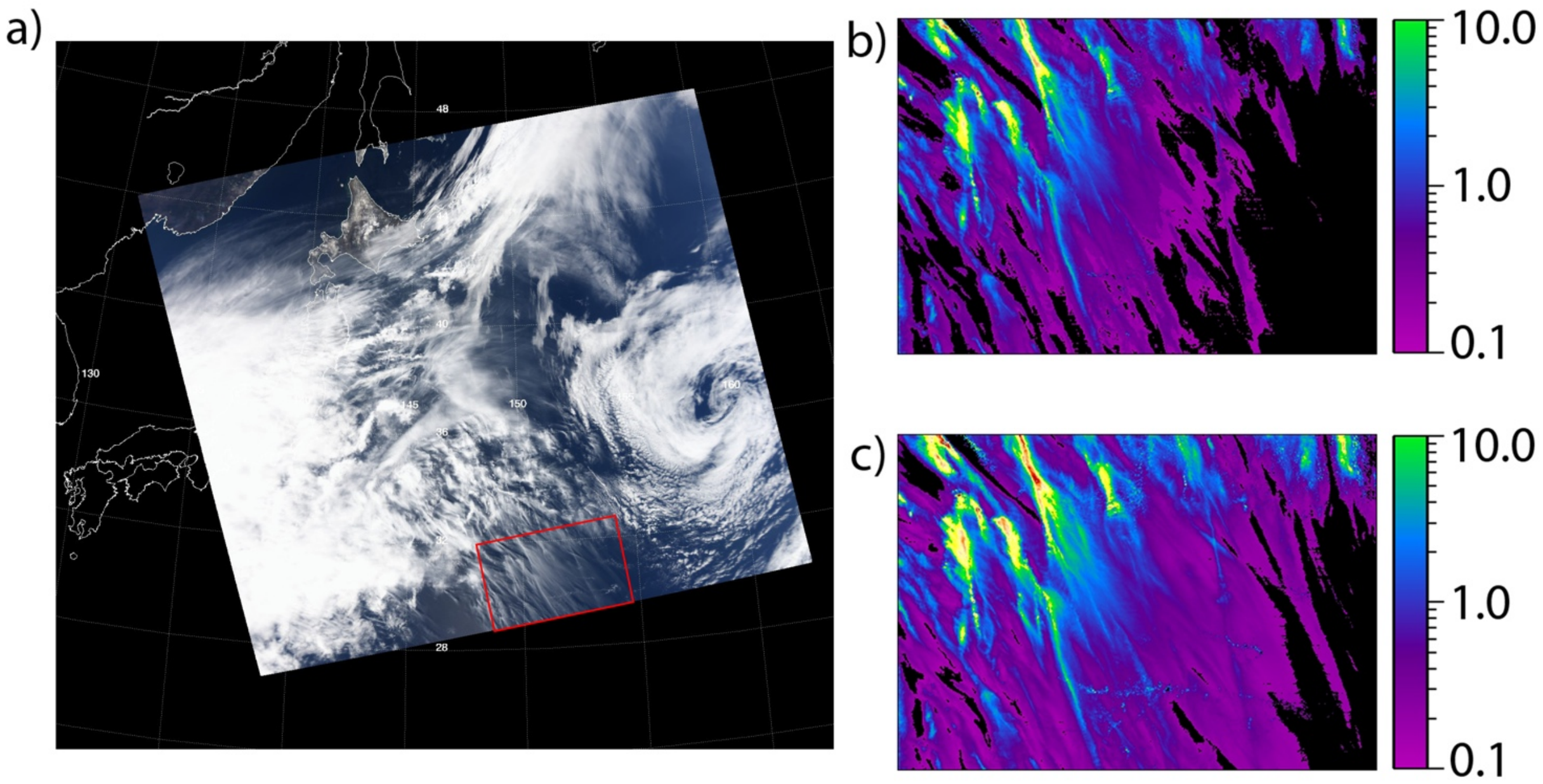
Confident Cloudy

Probably Cloudy

Probably Clear

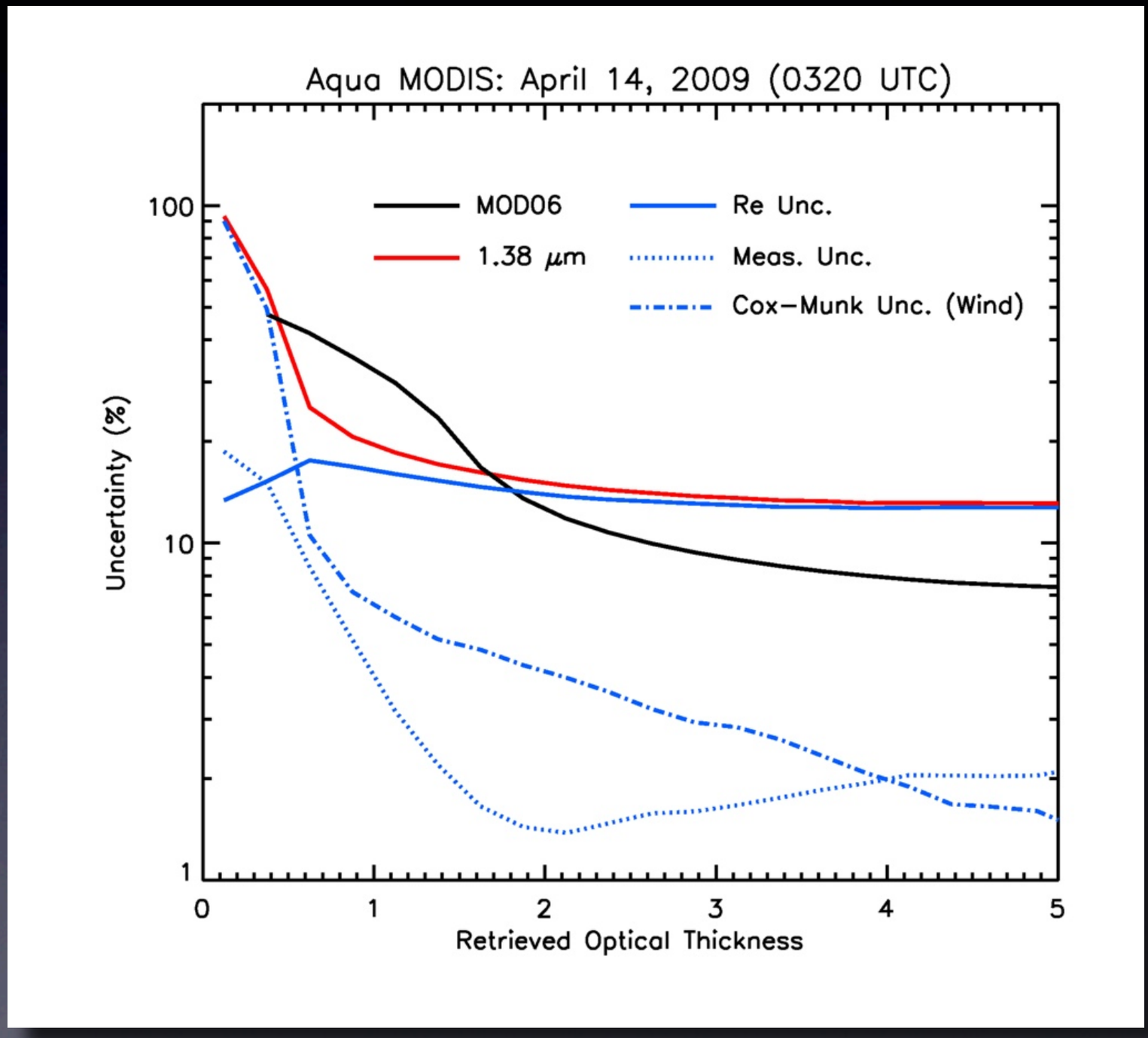
Confident Clear

Retrieval Example



(Meyer & Platnick, 2010)

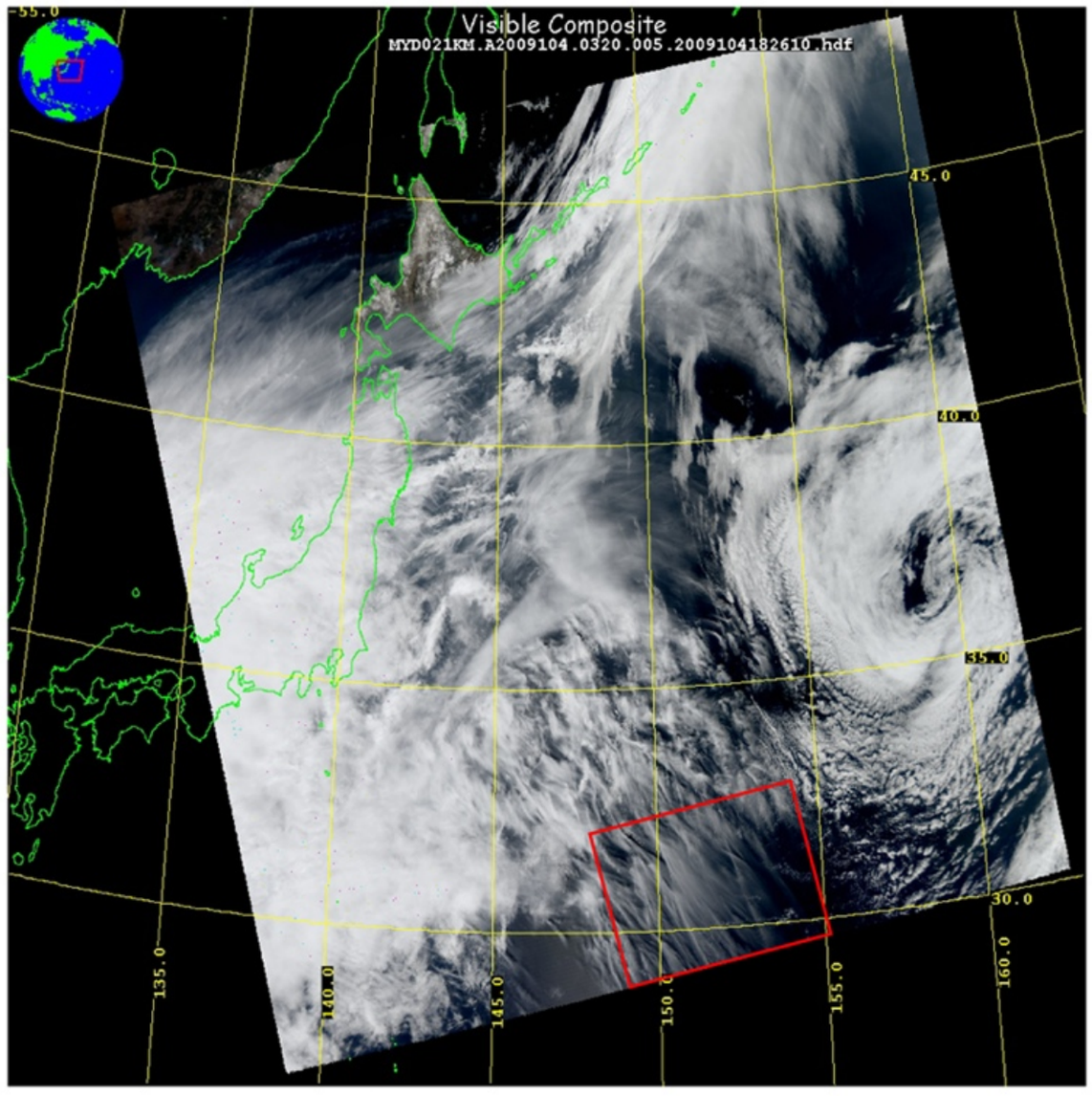
Baseline Uncertainty



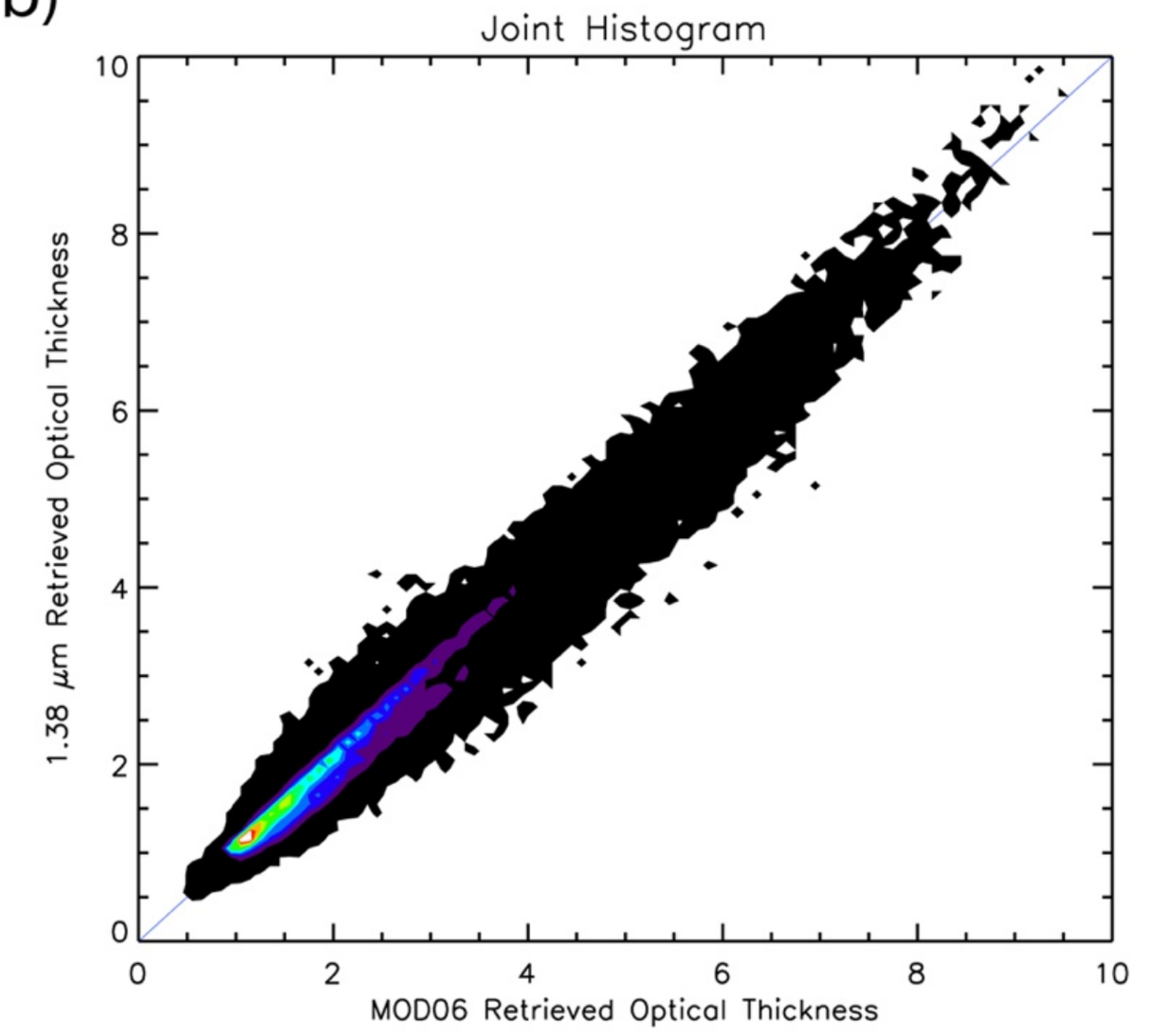
(Meyer & Platnick, 2010)

Comparison with MOD06

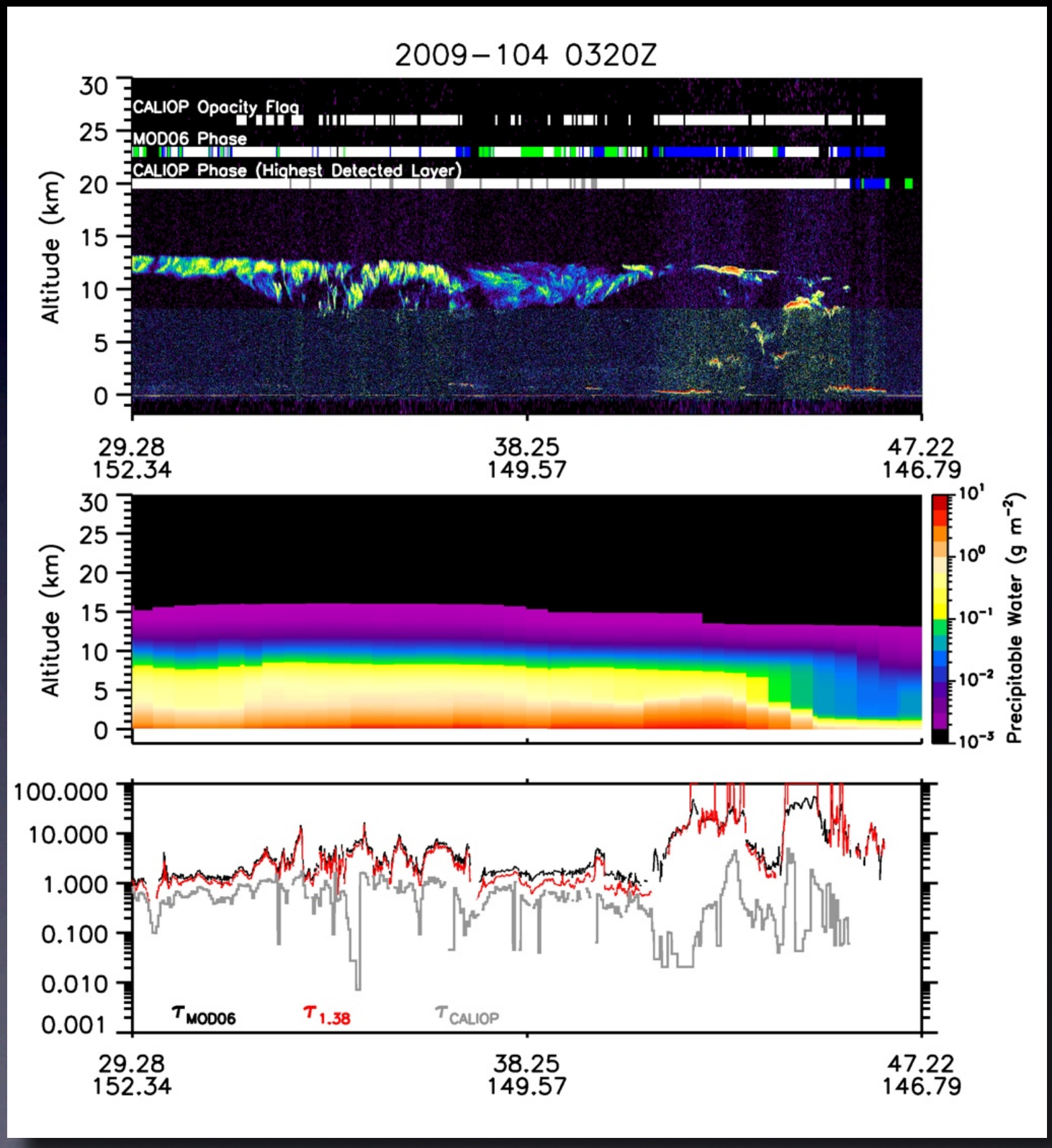
a)



b)



Co-location with CALIOP



To-Do List

- Integrate retrieval algorithm within research-level C6.
- Retrieval component evaluation.
  - Above/in-cloud water vapor attenuation (transmittance) estimates.
    - Use atmospheric profile (NCEP GDAS, MERRA, MLS) to convert transmittance to cloud top height.
    - Compare with MOD06, CALIOP, etc.
- Retrieval comparison (MOD06, CALIOP, etc.).
- New C6 ice cloud models (affects both component evaluation and retrieval comparison).
- Impact studies.
  - Global aggregation (i.e., MOD08_D3, *E3, *M3).