# The MODIS Collection 5 dark-target aerosol products: Level 3 Aggregation

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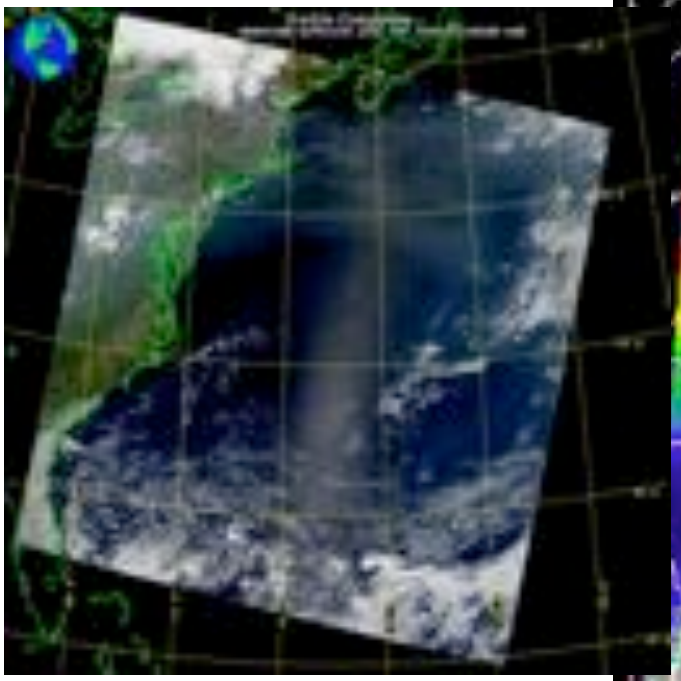
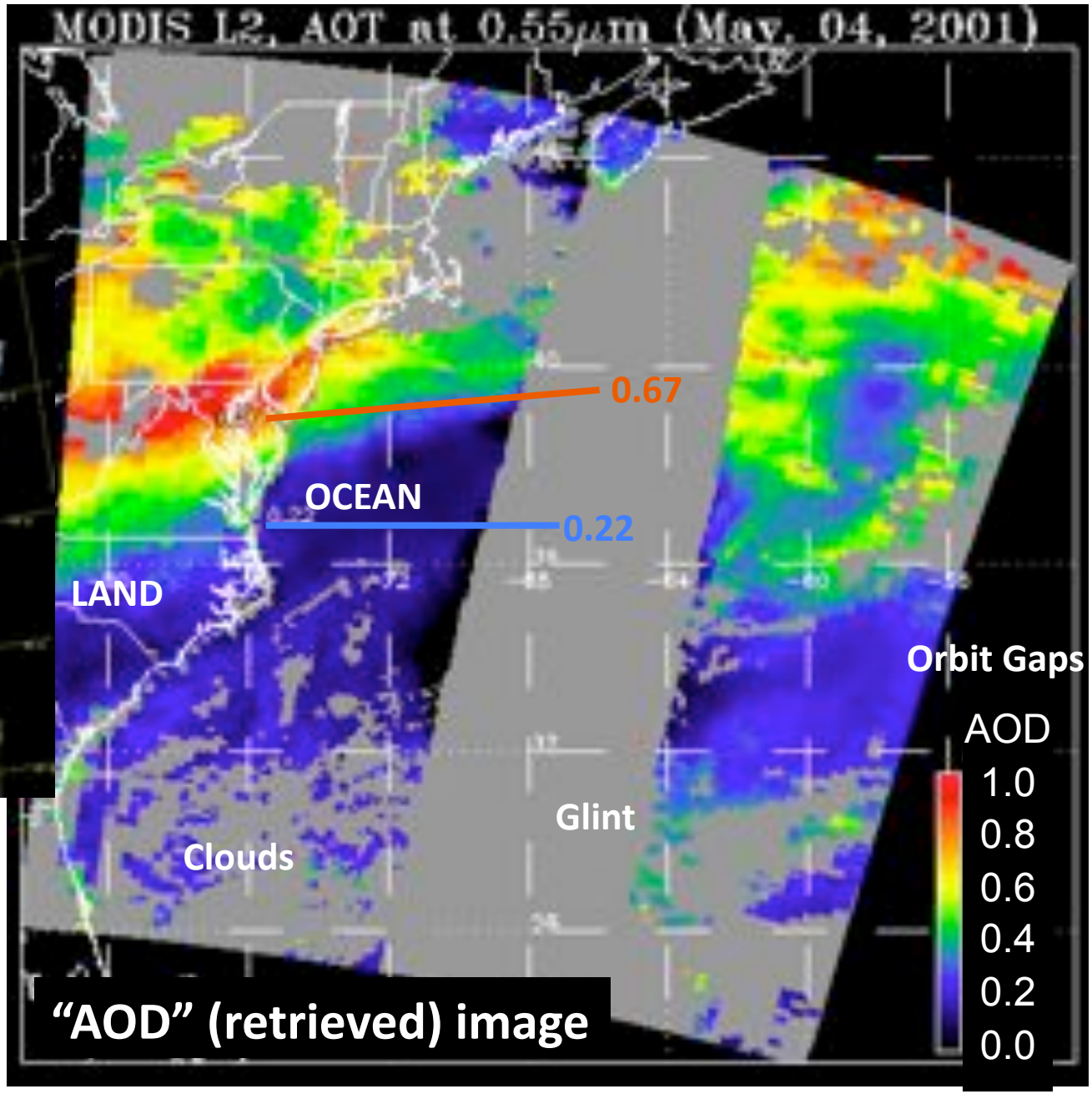
# AOD "Validated" over both ocean and land

**May 4, 2001**



**"RGB" (visible) image**

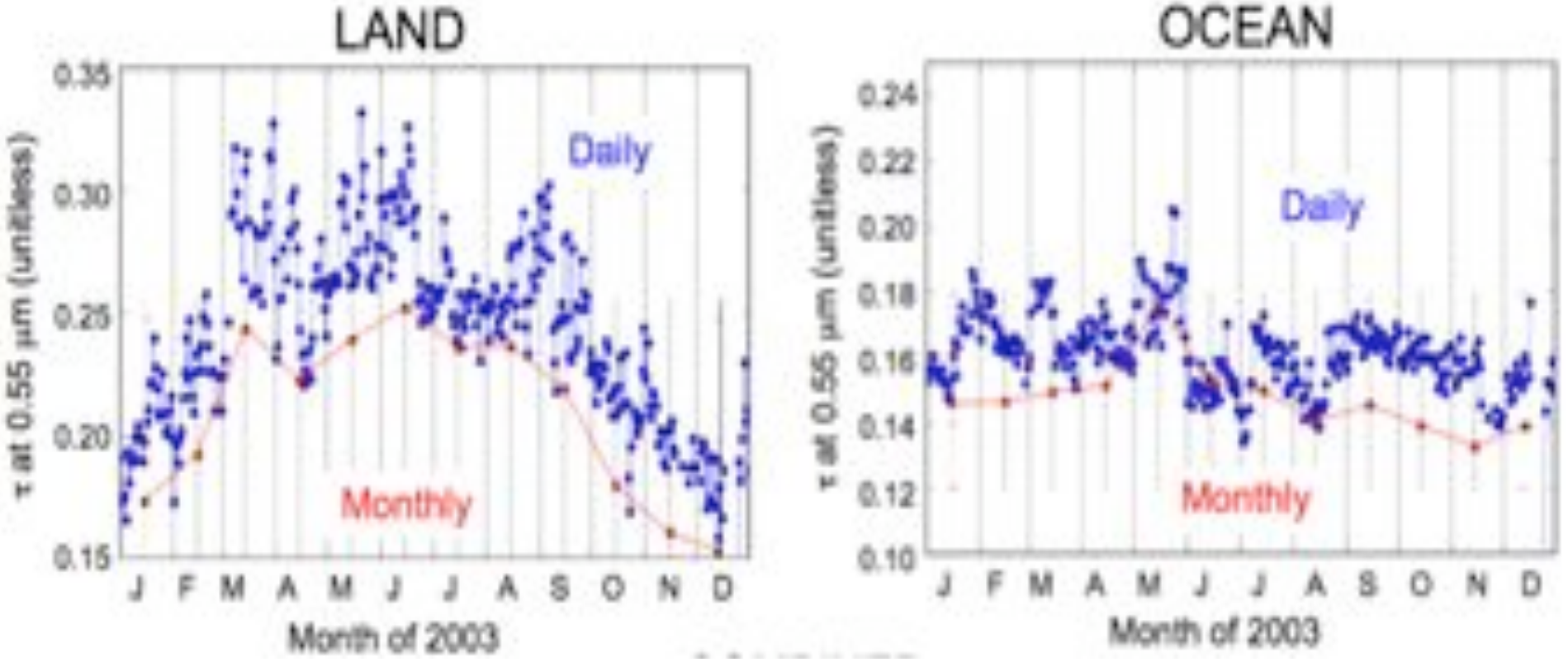
**Sampling is problem!**



# What is global mean AOD?

- Modelers want to know…
- Useful for determining “trends” in global processes
- “Level 3” is gridded (1° x 1°) statistics of Level 2 (~ 10 km)
- Operationally, we produce
  - Daily (D3),
  - Eight-Day (E3)
  - Monthly (M3)

# Global mean AOD from "Giovanni" monthly (M3) vs daily (D3) for 2003

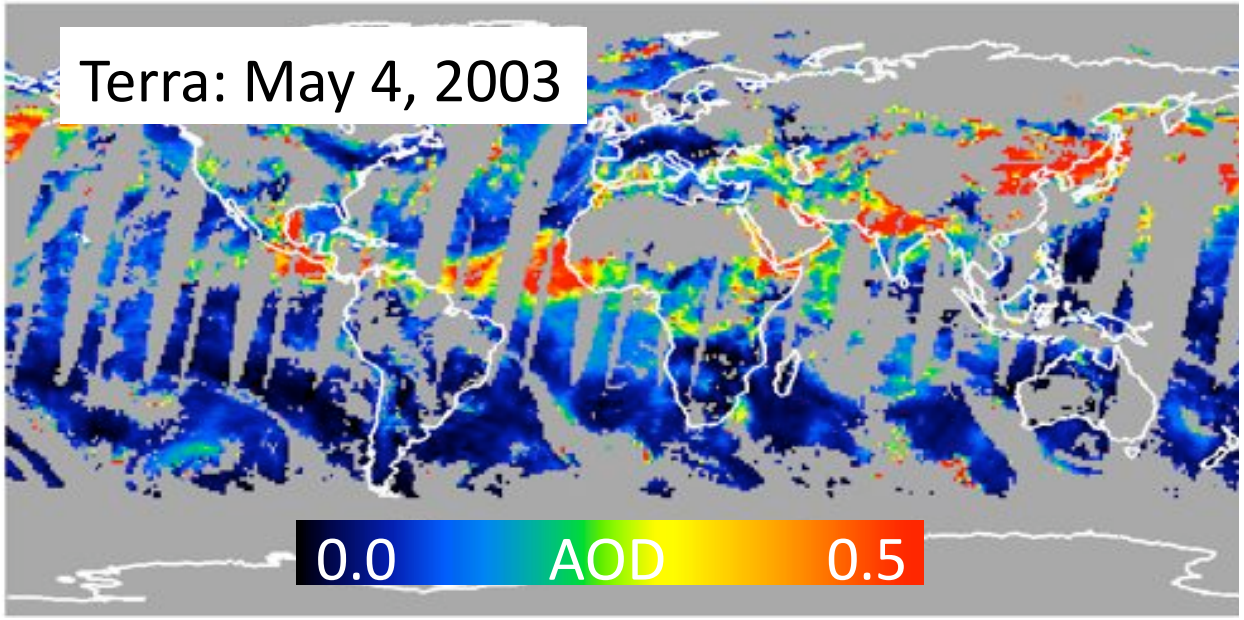



- Spatial averages of Level 3 maps, using Equal Area weighting
- D3 : 'Mean' products; M3 : 'Mean_Mean' products
- D3 ≠ M3!! >10% difference!
- Due to pixel weighting for computing M3; clear sky bias

# What happened? From L2 to D3

For each day and each 1° x 1° grid location, we collect the *i* L2 pixels and compute daily mean, with weights, *W*

$$\bar{\tau} = \sum_i W\tau \Big/ \sum_i W$$ + Choices for W and which i's




Two D3 products
- W = 1: "Mean"
- W = QC: "QA_Mean"
  QC=0 gets 0× weight
  QC=3 gets 3× weight
  "QC" is Quality Confidence"

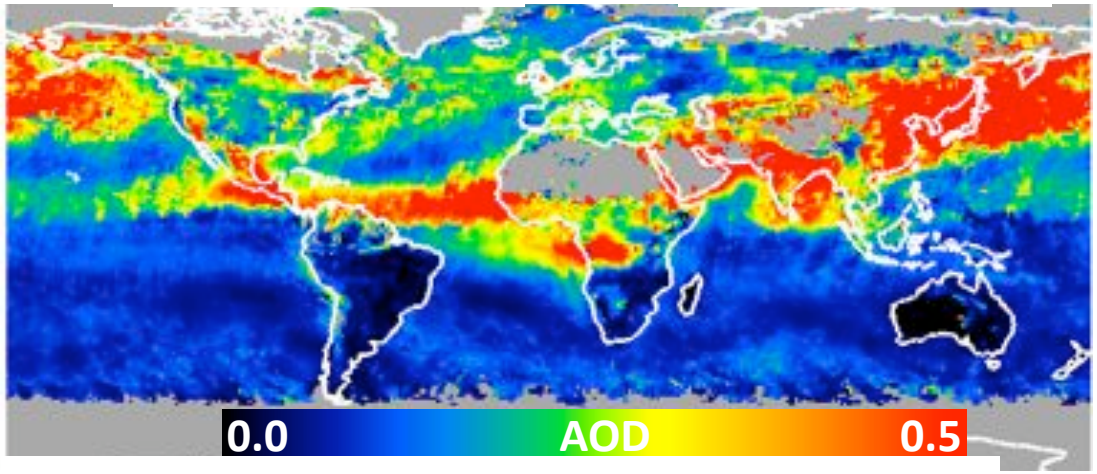
Thus, increasing daily sampling from <10% (L2) to ~30% (D3)

# From D3 to M3

For each month and each 1° x 1° grid location, collect the *j* D3 values and assign weights, *X*.

$$\bar{\bar{\tau}} = \sum_j X\bar{\tau} \Big/ \sum_j X$$ + More Choices { Pixel thresholds, QA thresholds, Etc

MOD08_M3 (M3) May 2003 (Terra)



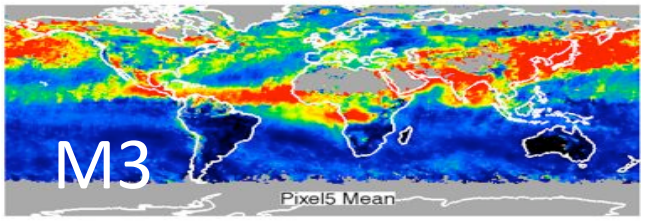

**Ocean**: Effective_Optical_Depth_Average_Ocean_Mean_Mean
**Land**: Corrected_Optical_Depth_Land_Mean_Mean

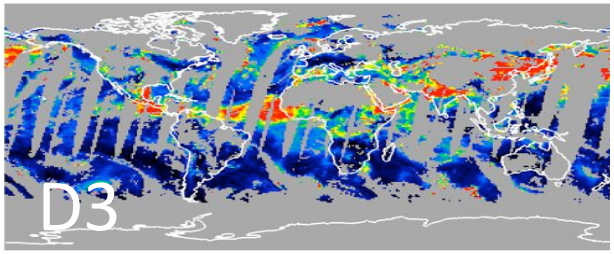
Two M3 products
- W=1, X=PC: "Mean_Mean"
- W=QC, X=PC: "QA_Mean_Mean"

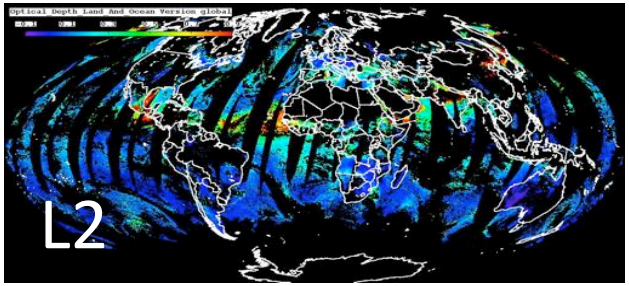
PC = "Pixel Counts" or W/day
PC>5 per day to count for M3

>75% of globe sampled per month

# How to compute global mean $\overline{\overline{\tau}}$?




$\overline{\overline{\tau}}$ M3-> and all decisions for aggregation and weighting within

$\overline{\overline{\tau}}$ D3-> and decisions for aggregation and weighting (simple, pixel counts, confidence?)

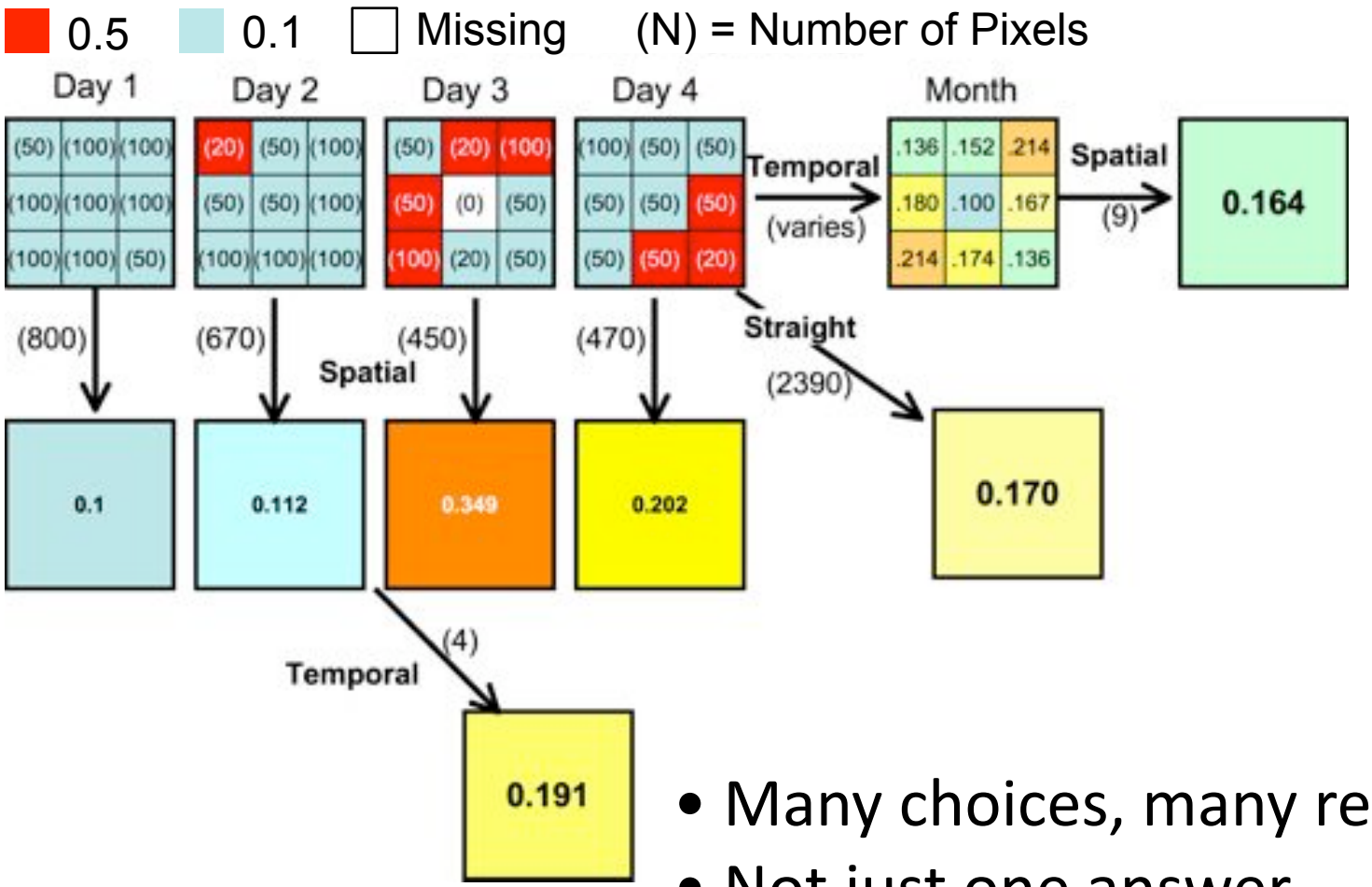
$\overline{\overline{\tau}}$ L2-> Sampling VS global aerosol representation

- Many choices for aggregation and weighting
- Accentuate different aerosol/cloud features
- Accentuate different limitations of MODIS sampling

Levy et al., TGARS 2009

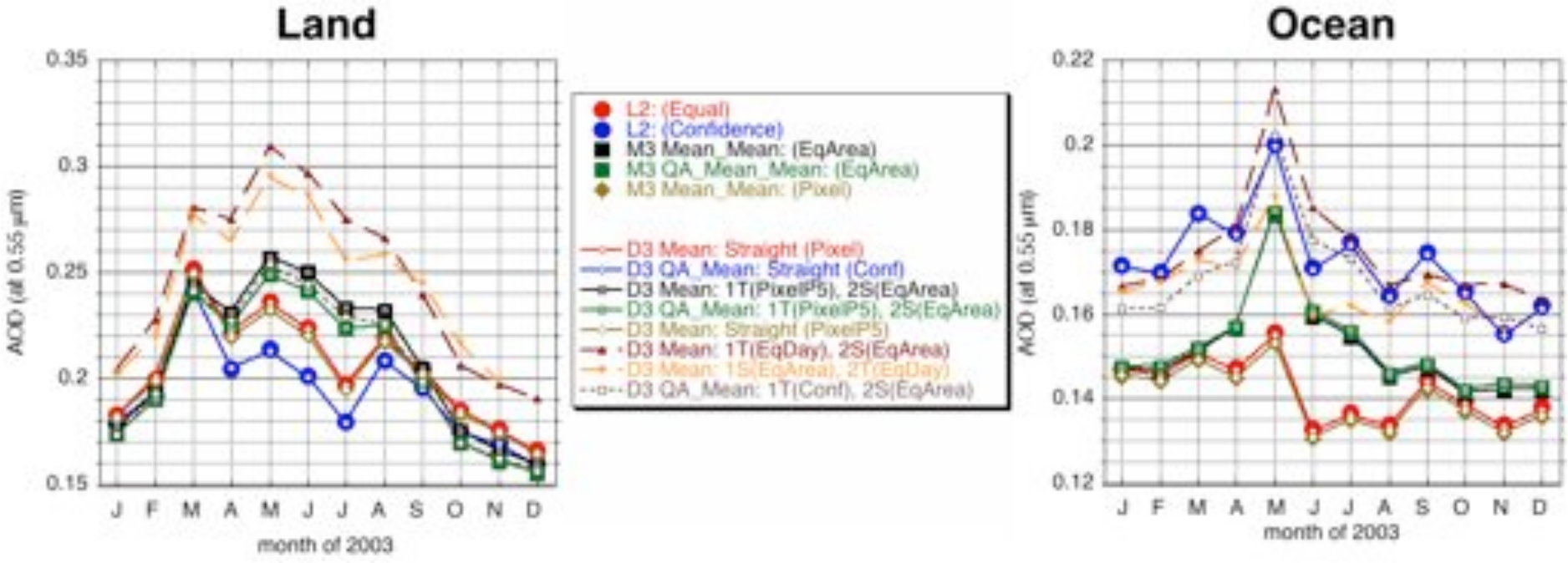
# Choices are important

How should we compute “global” mean?




- Many choices, many results
- Not just one answer

# Even more choices: more results




**“Reasonable” Choices:**

**Global means can vary by 40%**

**The “best” one is not known, yet**

# Conclusions

- It is ***ridiculous*** to consolidate the complexity of the global spatial patterns of aerosol into a ***single global mean***.

- Data is never the absolute truth. A 'well-calibrated' measurement (radiance) has uncertainties. A 'validated' retrieved parameter (Level 2) compounds those uncertainties. Aggregations (Level 3) again compound uncertainties.

- Different aggregations stress different aspects of sampling, cloud and aerosol variability.

- There is much more work to do
  - Analyses of pixel counts, data confidence and regional dependencies, correlations with clouds
  - High level spatial statistics
  - Collaborative evidence (surface, aircraft, etc)
  - Model simulations
  - Integration with other satellite datasets (MISR, A-train, etc)