

# AOD comparisons

## GEWEX-GDAP

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# satellite aerosol data

- are NO direct measurement ... but rather
- a solar backscatter interpretation requiring
  - data on aerosol properties
    - What aerosol size ?
    - What aerosol absorption ?
    - What aerosol shape ?
  - data on environmental properties
    - Are NO clouds in the image? or even near-by?
    - Are directional surface contributions known ?
    - Is trace-gas absorption considered?

# satellite aerosol data differ

- even for the same aerosol product (AOD<sub>550nm</sub>) !
  - end-users are more confused
    - ‘uncertainty’ is no real answer
    - scatter plots are no comfort
  - retrieval background is needed
    - sensor capabilities
    - underlying retrieval assumptions
    - expert assessment (maturity)
- several aerosol ‘assessments’ were made
  - mainly just for aerosol optical depth at 550nm
    - more comparisons - hardly recommendations
    - only few reports were finished to be relevant
      - new sensors, updated methods ....

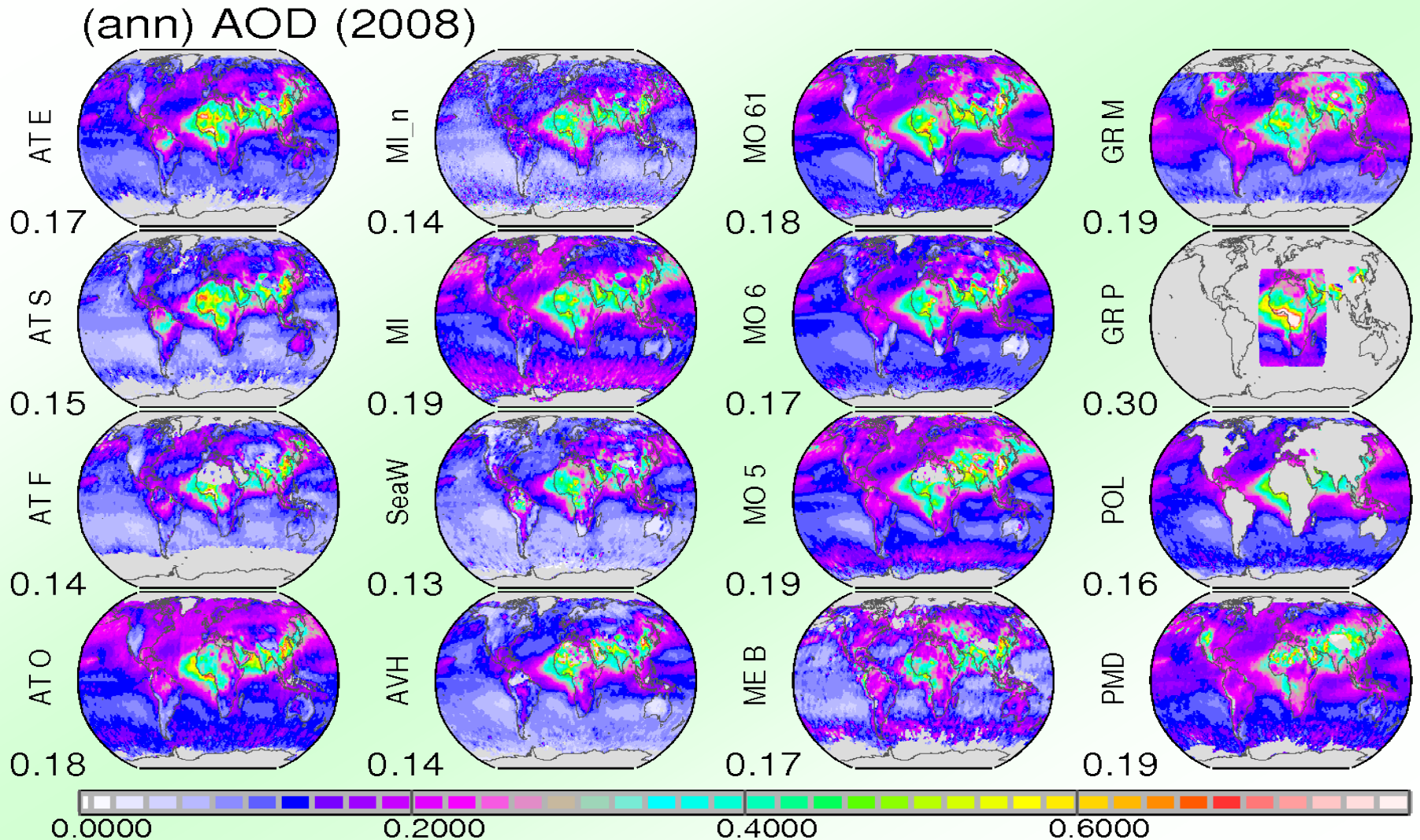
AEROSOL  
ASSESSMENT

# OK, there are differences

- **sensors have different capabilities**
  - **though often not used at their full potential**
- **sensors have different coverage**
  - **swath width, viewing directions differ**
- **... but would we expect those large differences for annual AOD (at 550nm) 2008 averages ?**
  - **ATSR** (Swansea, Finland, Oxford, ensemble)
  - **MISR** (v23,v22), **DBLue SeaWifs**, **DBLue AVHRR**
  - **MODIS** (c6.1, c6, c5) **MERIS** (Bremen, GRASP)
  - **POLDER** (GRASP, std) **PDMAMix** (EUMETSAT)

# AOD choices !

general similarity but also diferent

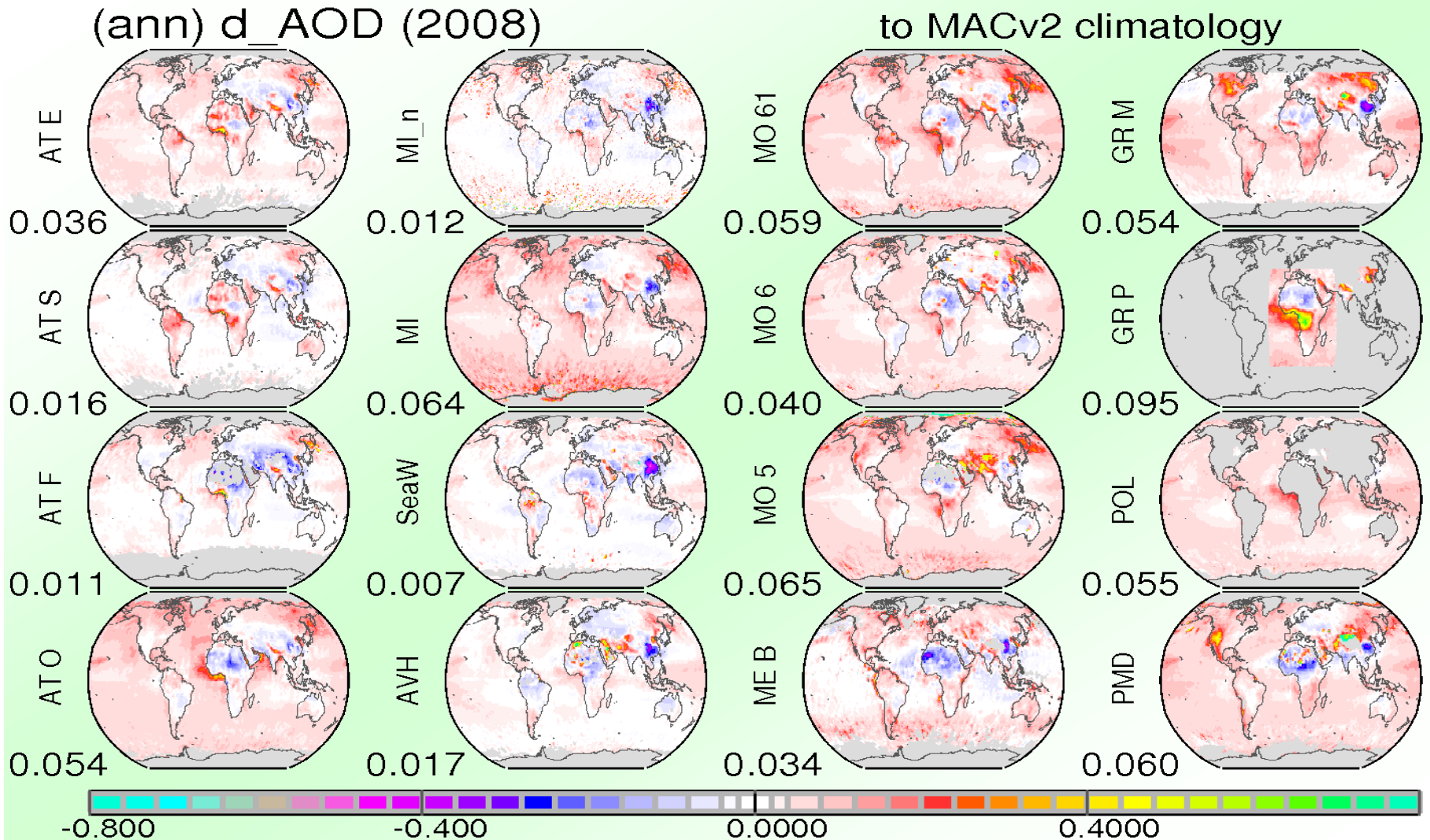


# a closer look

- **let us compare to a common reference**
  - MACv2 aerosol climatology (no 2008 match)
  - the new MISR (v23) retrieval
    - MISR with its multi-viewing and multi-spectral capabilities was on average the best former over land on the new retrieval is near to the over oceans as well.
- **The difference range : -0.8 to +0.8**
  - the is huge (global average AOD is near 0.14 !)
    - Blue colors: significant underestimates
    - Red colors: significant overestimates

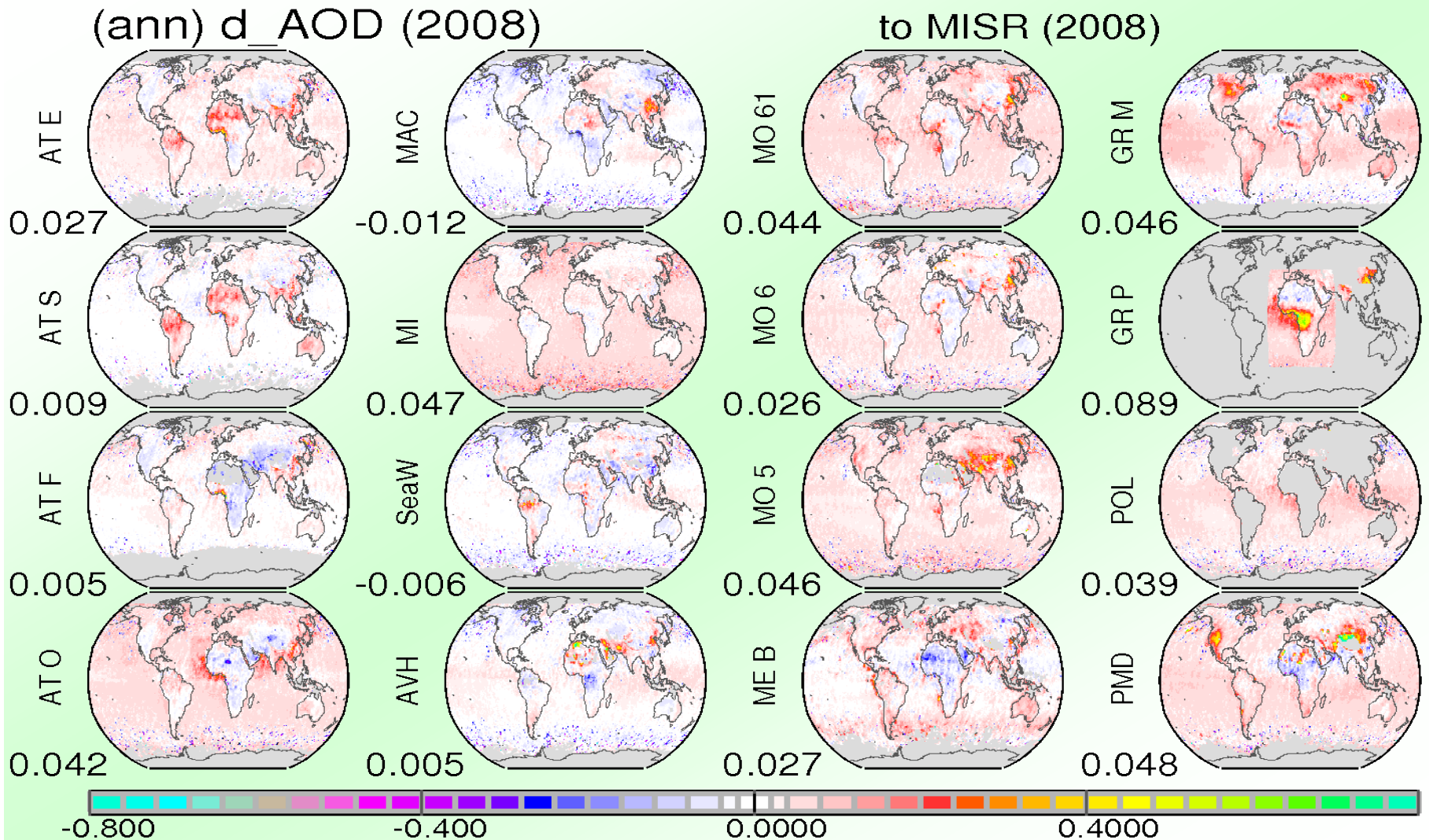
# difference to MACv2

the less colors the better



# AOD differences to MISR

the less colors the better





# first impression

- **best over oceans**
  - MISR (new), SeasWiFS, ATSR-SU, AVHRR (db)
- **best over land**
  - more difficult (aerosol type, surface treatment)
  - MISR is on average near the top
- **questions**
  - What about larger MODIS data over Siberia and western Africa?
  - What about larger Congo data in GRASP-Pol?

# what now ?

- we need to know **why** there are **big** differences !
  - and the retrieval groups want to know too !
- plus: a good AOD performance can be artifact !
  - AVHRR (Stowe): larger size, smaller absorption
- advancement via supplementary data-maps (even if not retrieved) ... **help with diagnostics**
  - AODf (assumed) fine-mode AOD ?
  - AODc (assumed) coarse-mode AOD ?
  - AAODf assumed fine-mode AAOD ?
  - AAODc assumed coarse-mode AAOD ?
  - albedo applied surface reflectance ?

# regional focus

- pick a trusted reference (based on AERONET) with global cover → then explore differences
- with spatial / seas. distributions of differences
  - AOD, AOD<sub>f</sub>, AOD<sub>c</sub>, AAOD, AAOD<sub>f</sub>, AAOD<sub>c</sub>, Alb
- ... focus on larger deviations
  - even aerosol type treatment can be addressed
- with at times very large differences...
  - getting the big picture seems more important first, than getting lost in level 2 case studies

# an plea to retrieval groups

- to all retrieval (*and AeroCom modeling*) groups
  - provide not just maps of ‘aerosol products’ but also add diagnostic maps revealing retrieval assumptions for aerosol size, aerosol absorption and surface reflectance, i.e.

|                       |                   |                   |             |
|-----------------------|-------------------|-------------------|-------------|
| • AOD                 | AOD <sub>f</sub>  | AOD <sub>c</sub>  | mid-visible |
| • AAOD                | AAOD <sub>f</sub> | AAOD <sub>c</sub> | properties  |
| • surface reflectance |                   |                   | (550nm)     |
- having these supplementary maps, allows for a more meaningful diagnostics
  - with more insights on retrieval/model biases
  - to better convey strengths and weaknesses

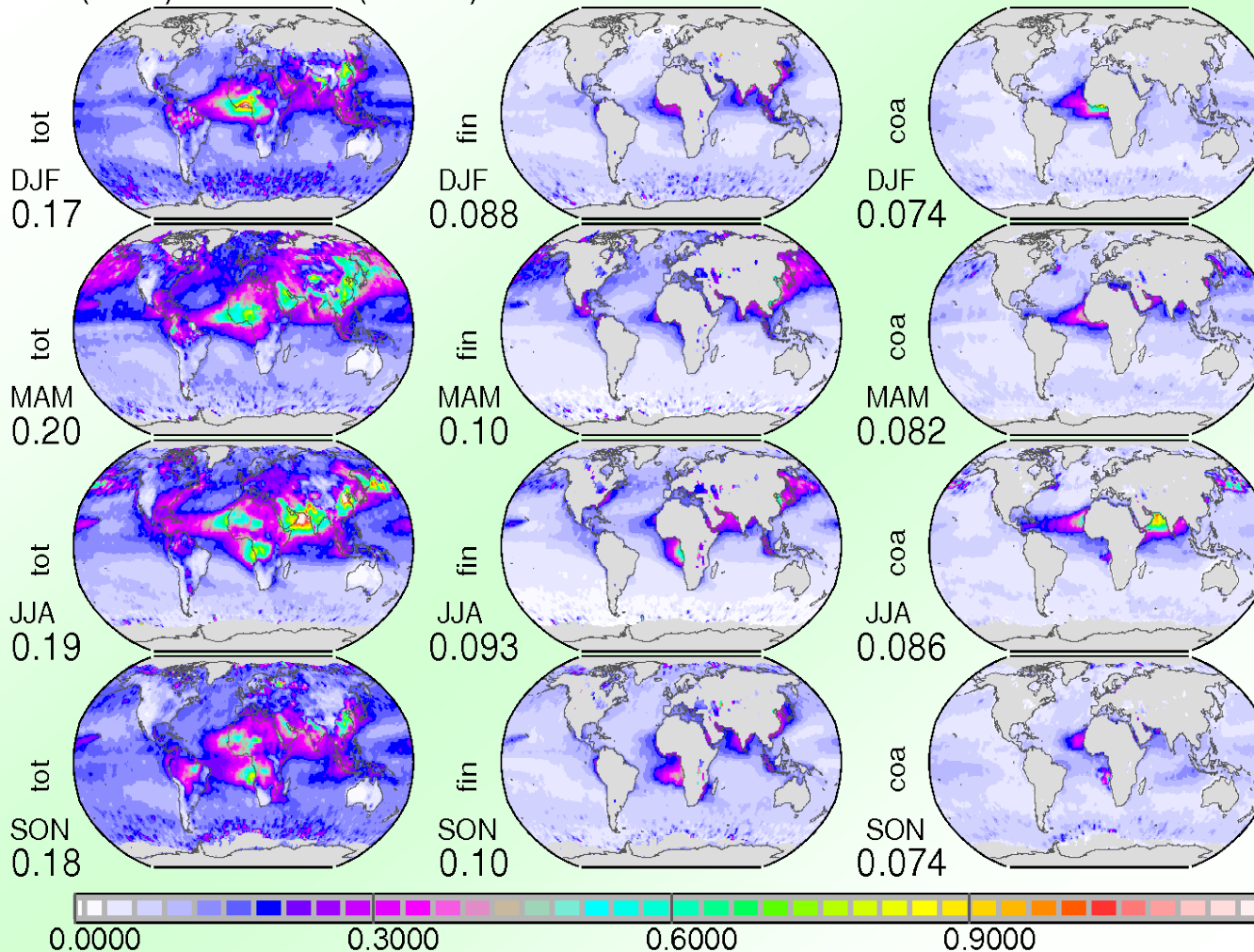


# extras

- **MODIS 6.1 vs MISR**
  - a year 2008 comparison  
(with available ‘diagnostics’)

# MODIS 6.1 (AOD, AOD<sub>f</sub> ocean, AOD<sub>c</sub> ocean)

(sea) MODIS (2008)

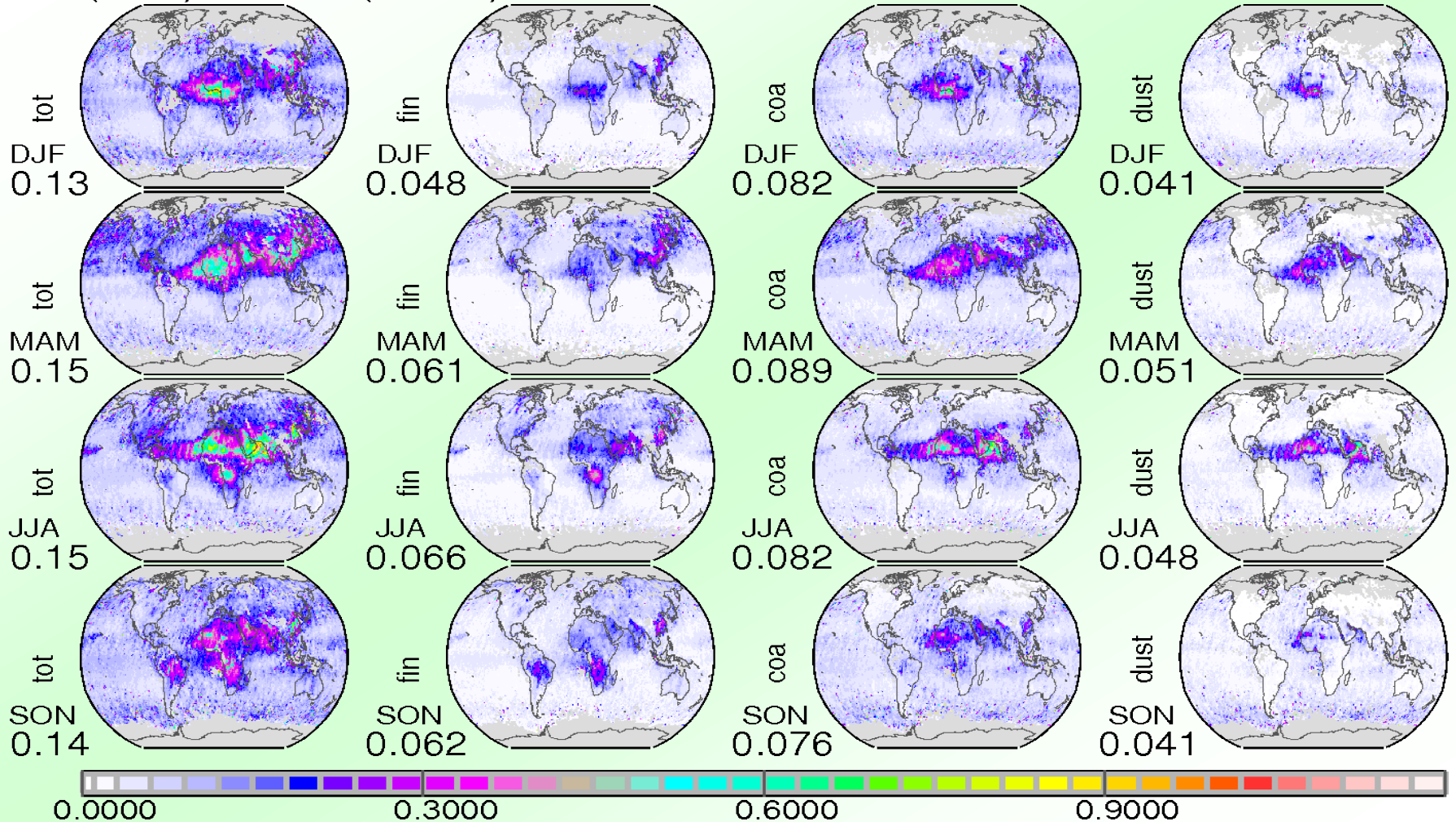


**AOD<sub>f</sub>** (and thus **AOD<sub>c</sub>**) over land is **not** provided

Diagnostics could also provide **AAOD<sub>f</sub>** and **AAOD<sub>c</sub>**

# MISR (AOD, AODf, AODc, AODdust)

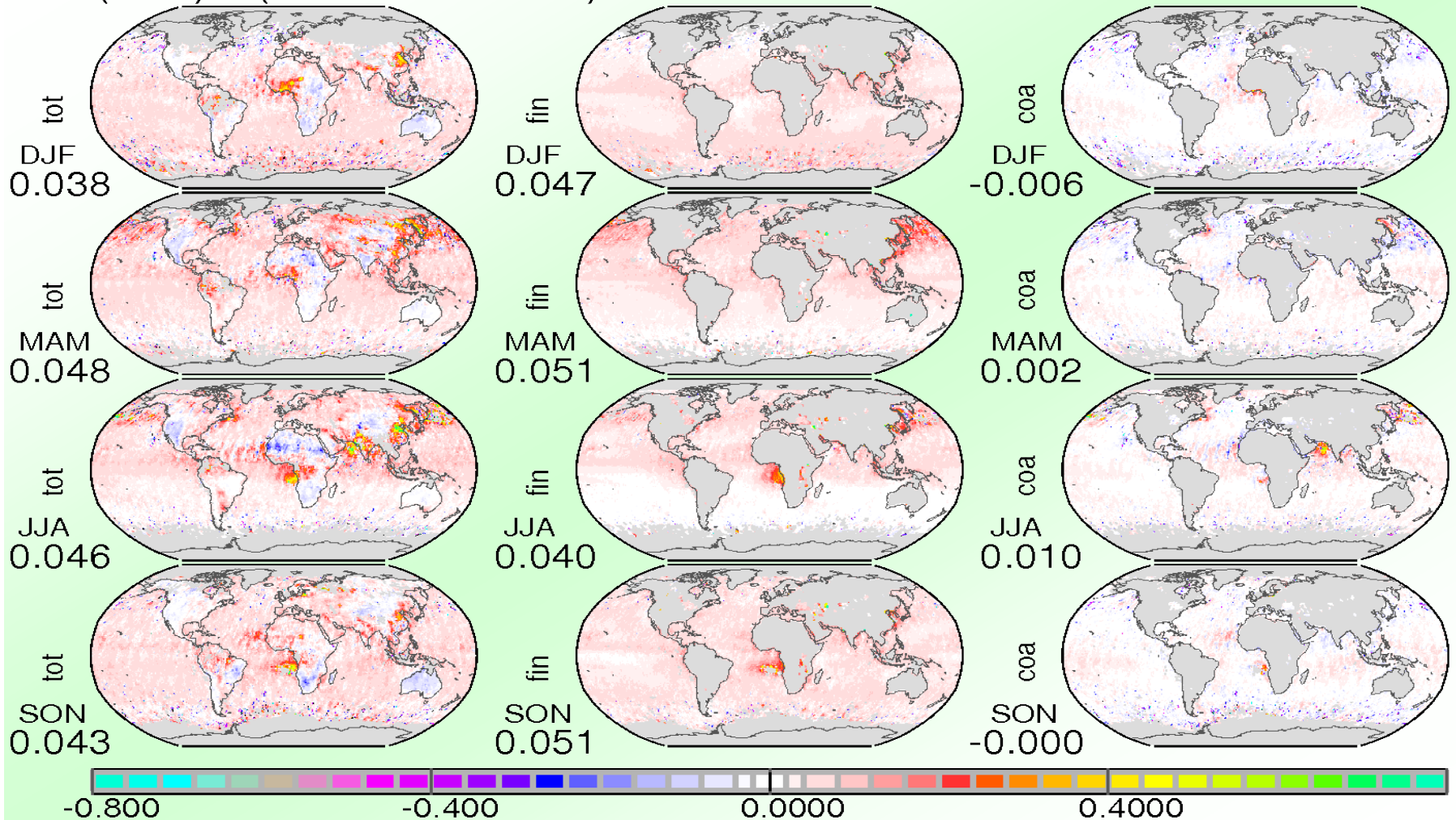
(sea) MISR (2008)





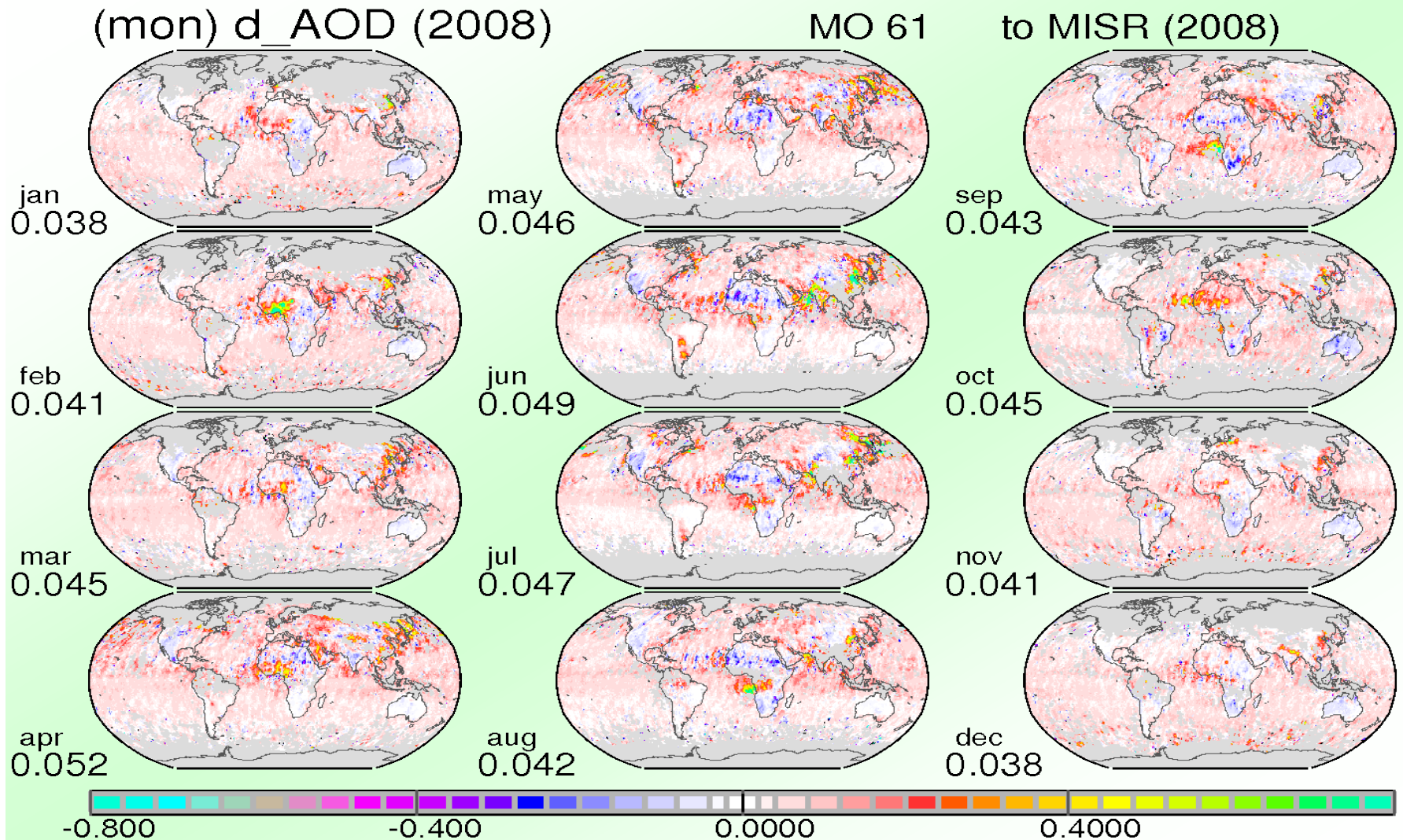
# diff ( MODIS *minus* MISR ) ~ 0.04!

(sea) d(MODIS-MISR)



# diff ( MODIS *minus* MISR )

many regions/months with  $>0.2$  differences !



# selected questions

- why is the oceanic fine-mode AOD in MODIS so much larger than for MISR?
- why are winter AOD and summer central Africa AOD (both associated with biomass burning) so much larger in MODIS?
  - fine mode diagnostics from the retrieval model over land would help
- Why sees MODIS less (dust) AOD over the Sahara during summer