

AOD at 550nm **estimates from BSRN**

BSRN-meeting 2016

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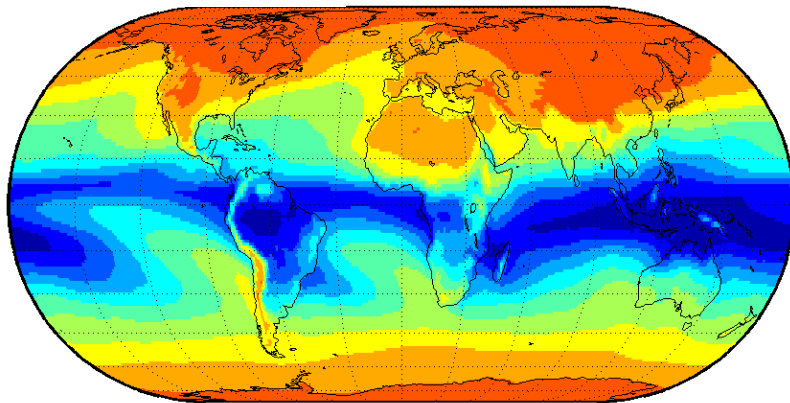
the concept

- BSRN provides downward solar broadband fluxes for SW diffuse, direct and total radiation
- determine cloud-free cases using Long & Ackerman algorithm (2000)
- convert direct broadband solar attenuation via (bbAOD) into a mid-visible AOD (visAOD) with look-up tables using needed ancillary data
 - column water vapor (of ECMWF [0-50kg/m²])
 - AOD fine mode fraction (of the MAC climatology)
 - solar zenith angle (time/location info [0-78deg])

column water vapor

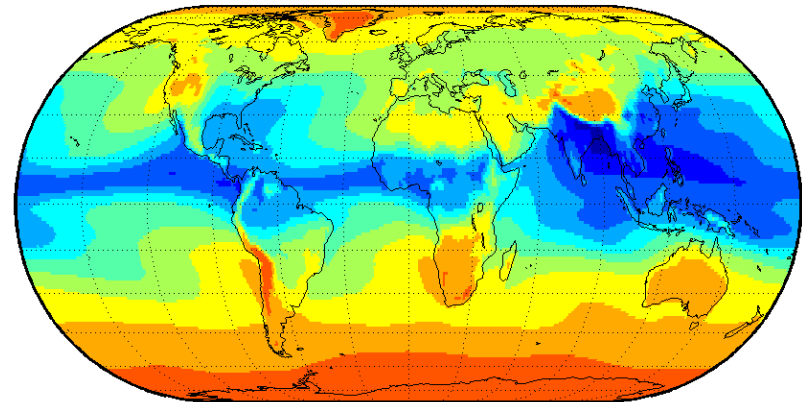
ERA-interim monthly averages

January



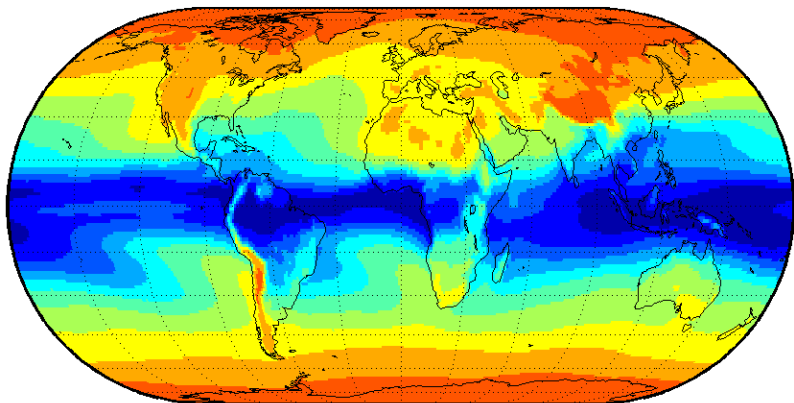
IWV in [kg/m²]

July



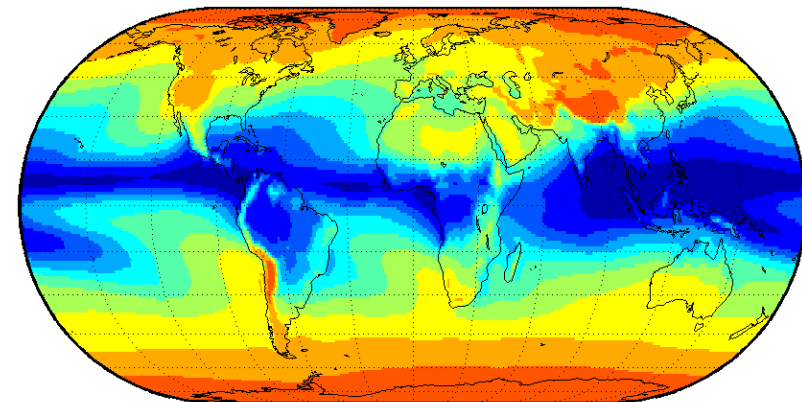
IWV in [kg/m²]

April



IWV in [kg/m²]

October

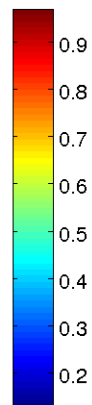
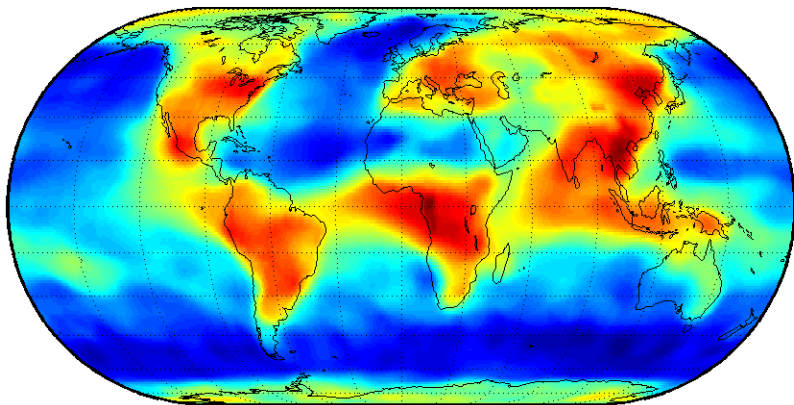


IWV in [kg/m²]

AOD fine-mode fraction

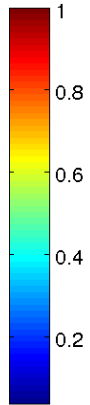
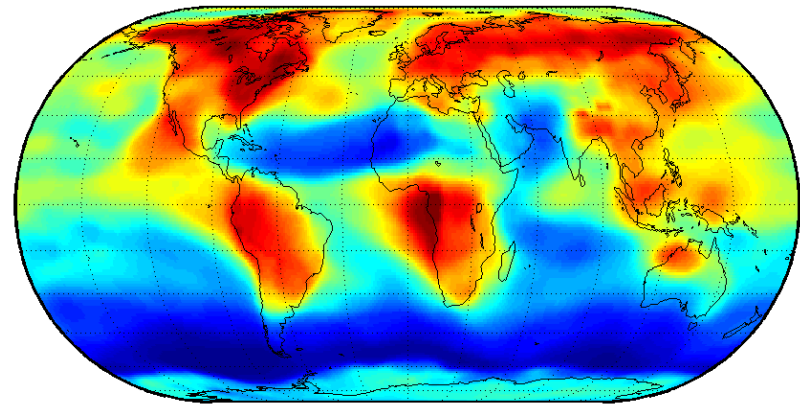
fine-mode ($\text{reff} = 0.14\mu\text{m}$), coarse mode ($\text{reff} = 2.0\mu\text{m}$)

January



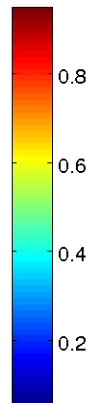
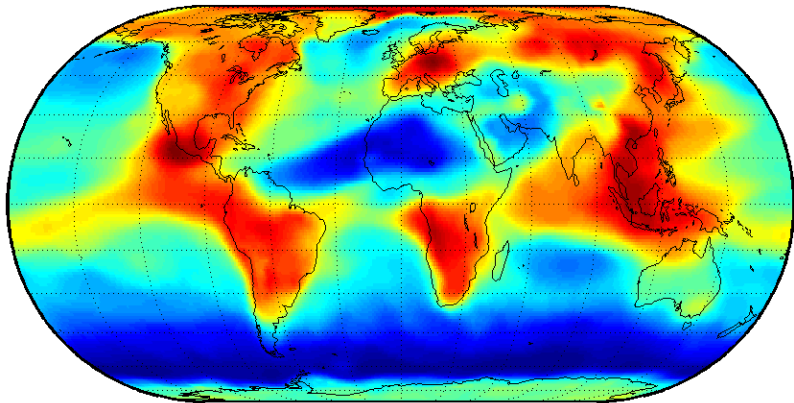
FMF

July



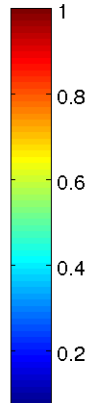
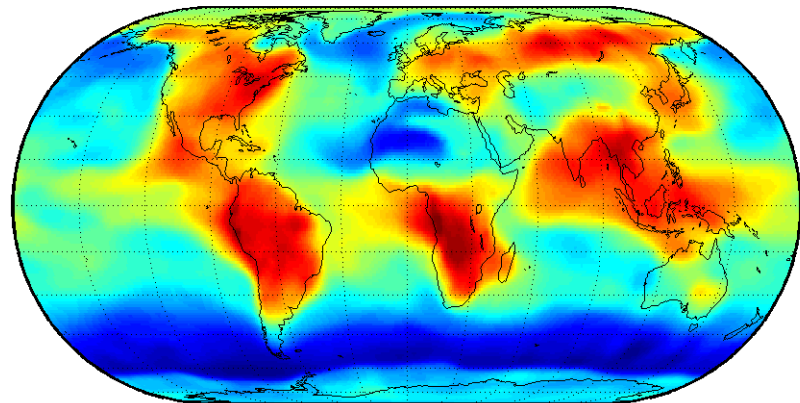
FMF

April



FMF

October



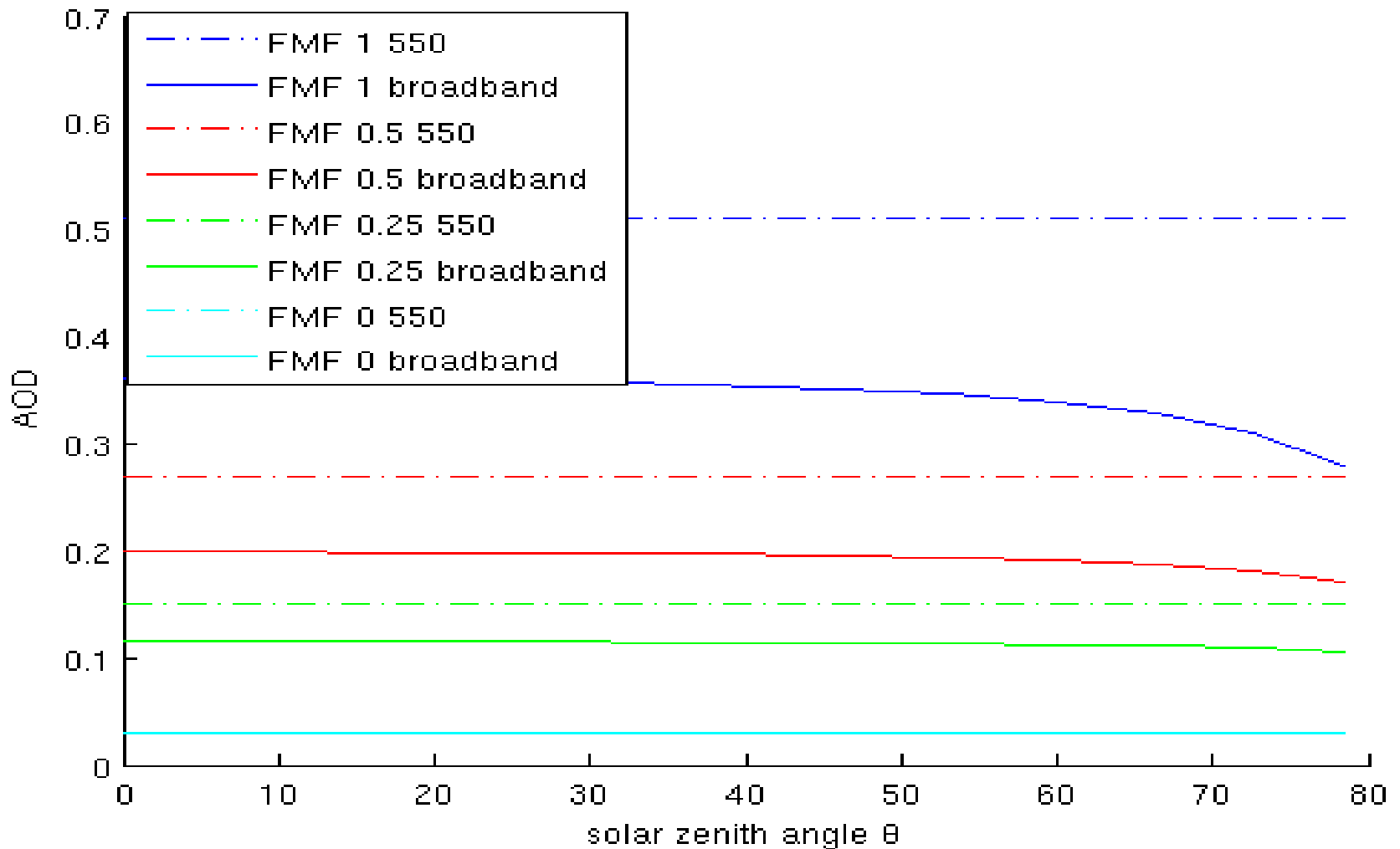
FMF

look-up tables !

- **extracts:**
- **broadband AOD** (*based on clear-sky solar attenuation containing trace gas absorption*) **vs** **mid-visible AOD**
... as function of the solar zenith angle
 - for a fixed water content / selected FMF
 - for a fixed fine-mode fraction / selected water

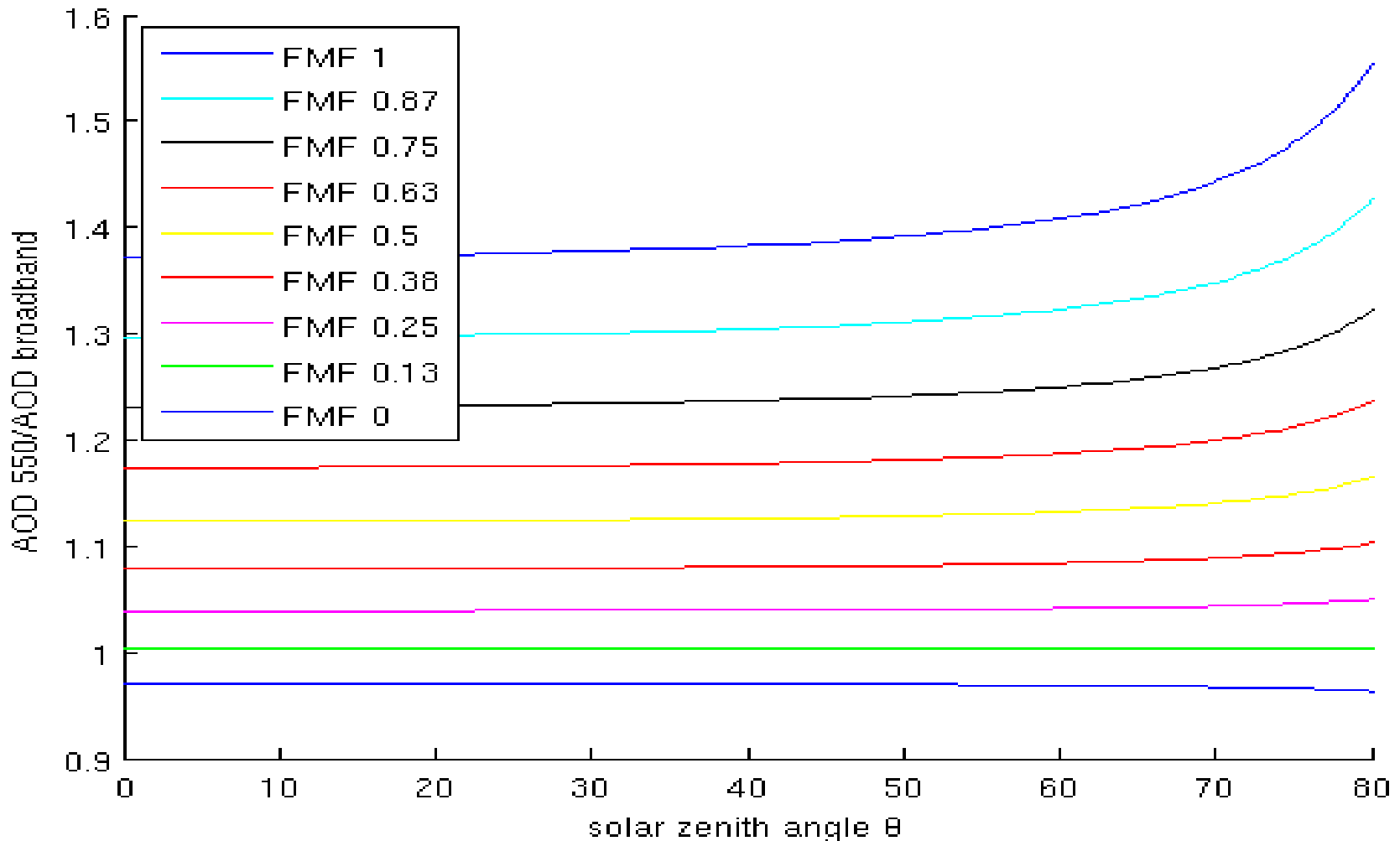
bbAOD vs visAOD (sun elev, FMF)

assuming constant water content of 14 kg/m²



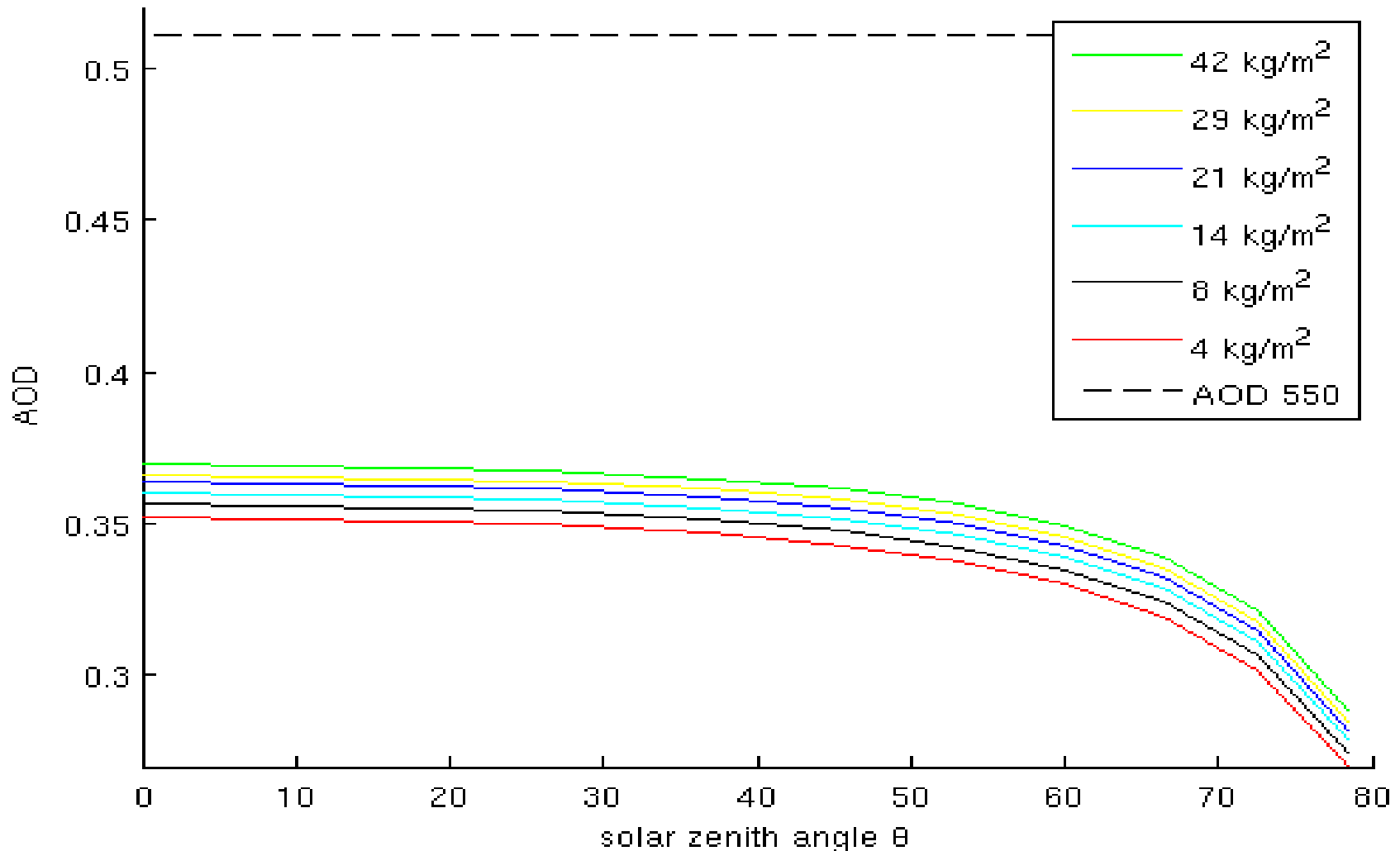
visAOD/bbAOD factor (sun elev, FMF)

assuming a water content of 14 kg/m²



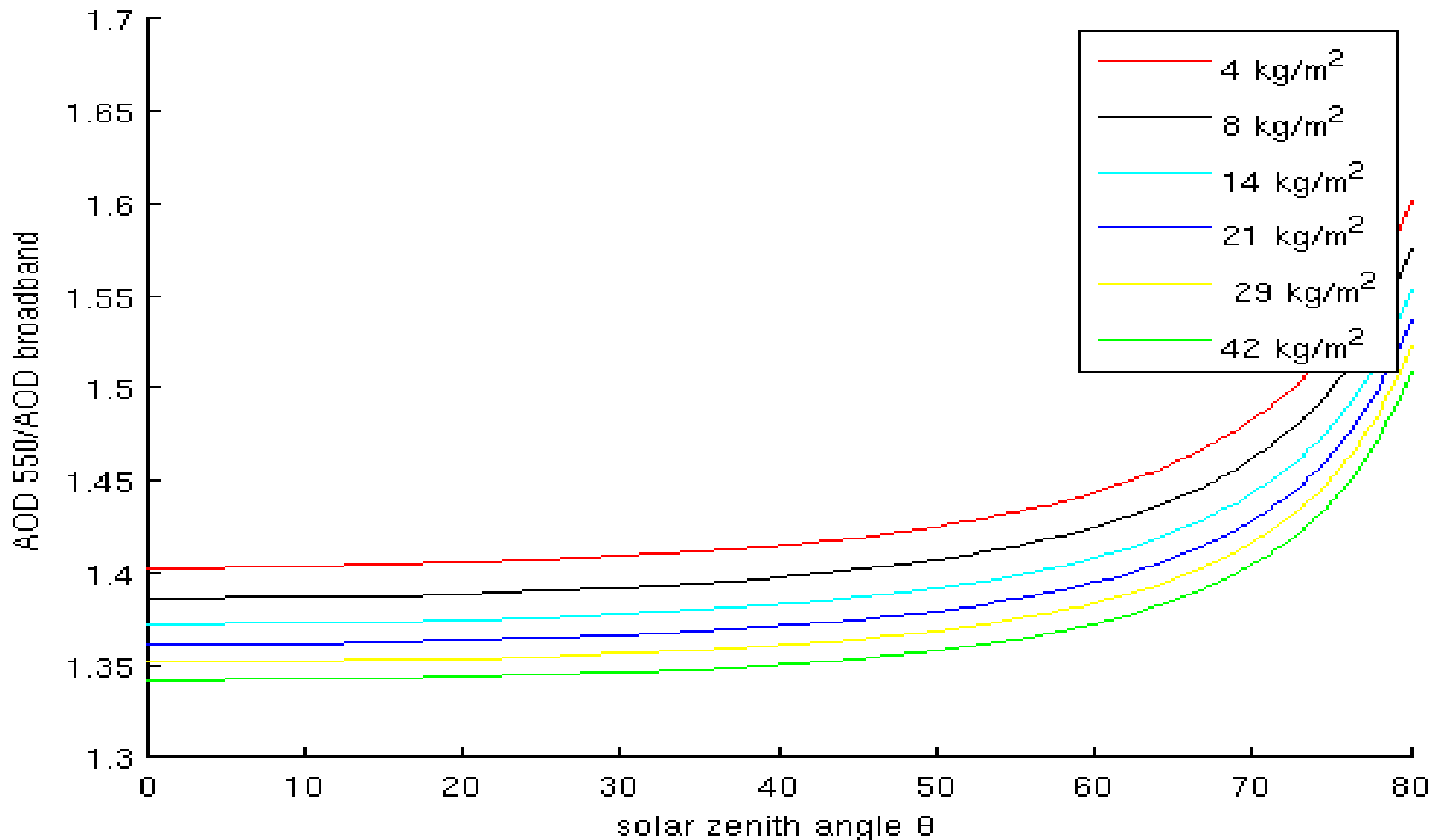
bbAOD vs visAOD (sun elev, water)

assuming a fine-mode fraction of 1 (only small size aerosol)



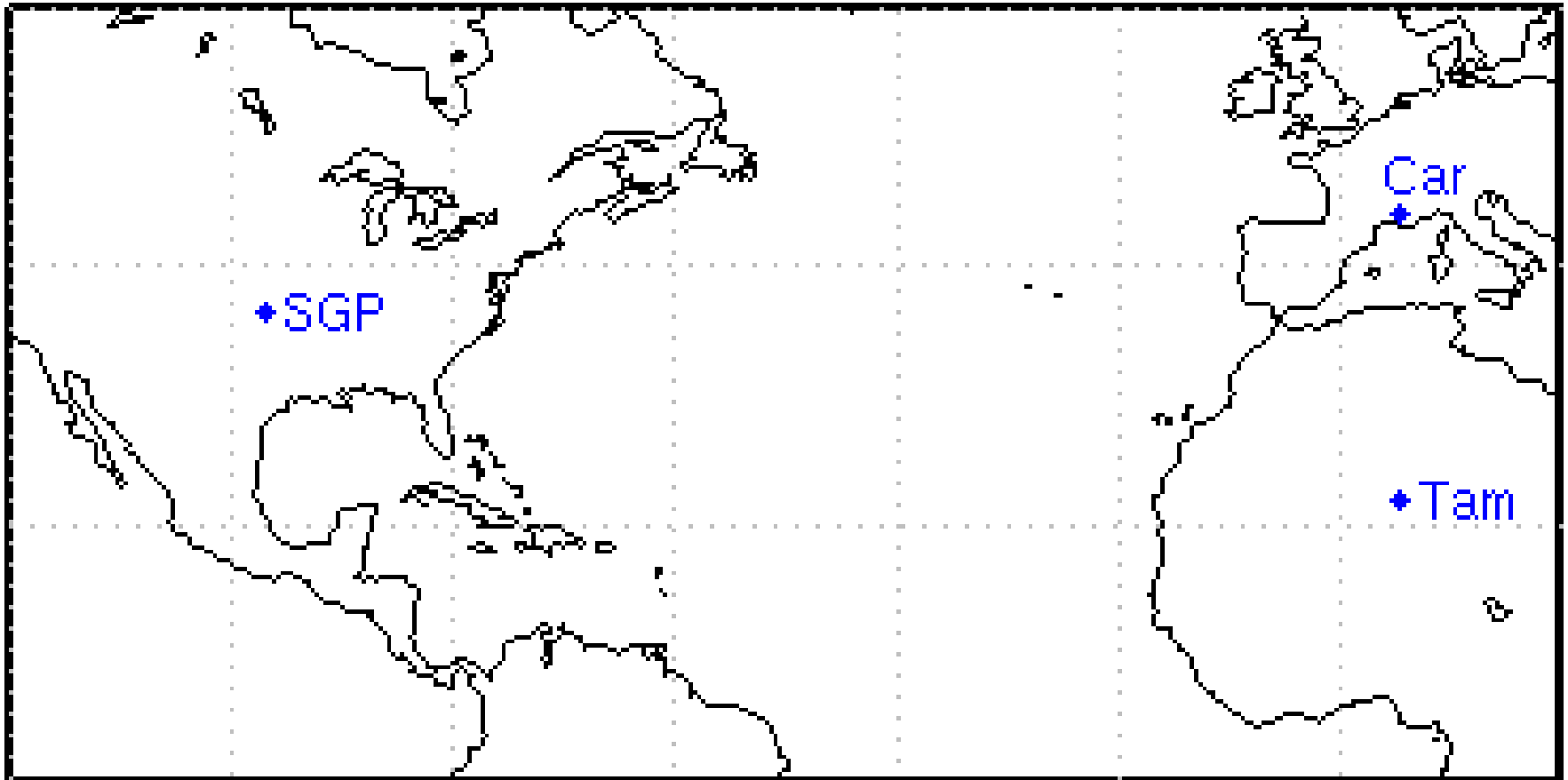
visAOD/bbAOD factor (sun elev, water)

assuming a fine-mode fraction of 1 (only small size aerosol)



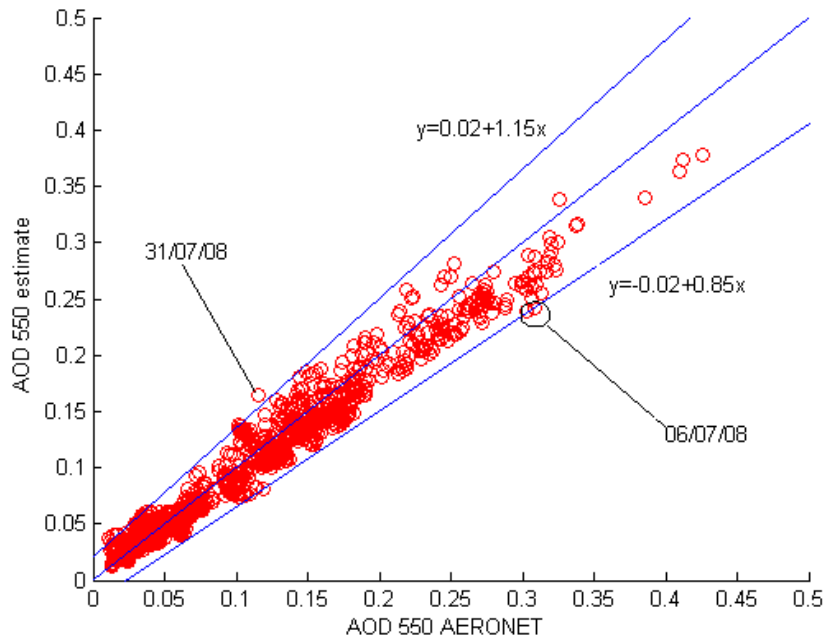
evaluation

at 3 AERONET sites (offering AOD, FMF and water data) :
Carpentras (Car), Tamanrasset (Tam), DOE-SGP site (SGP)

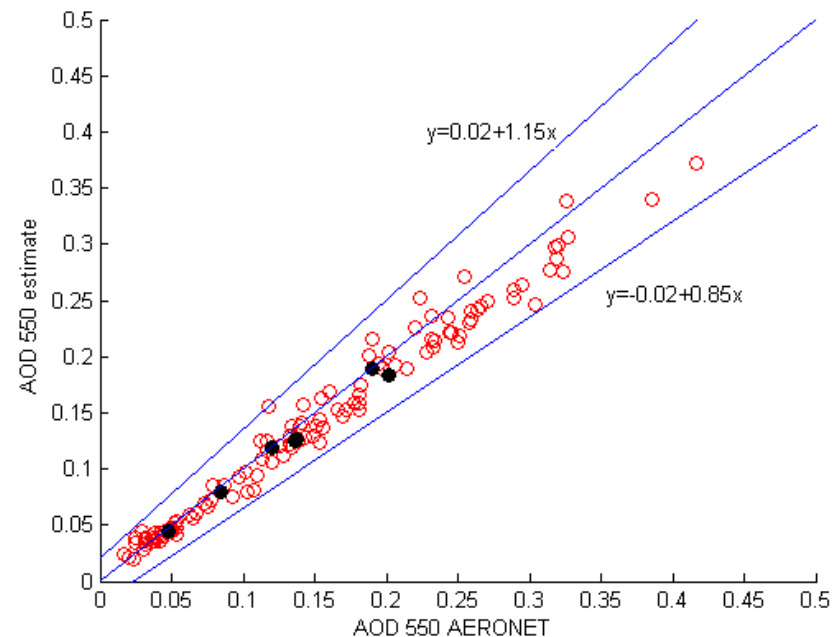


Tamanrasset

- **Y-coordinate:** AOD retrieval
- **X-coordinate:** actual AERONET AOD value



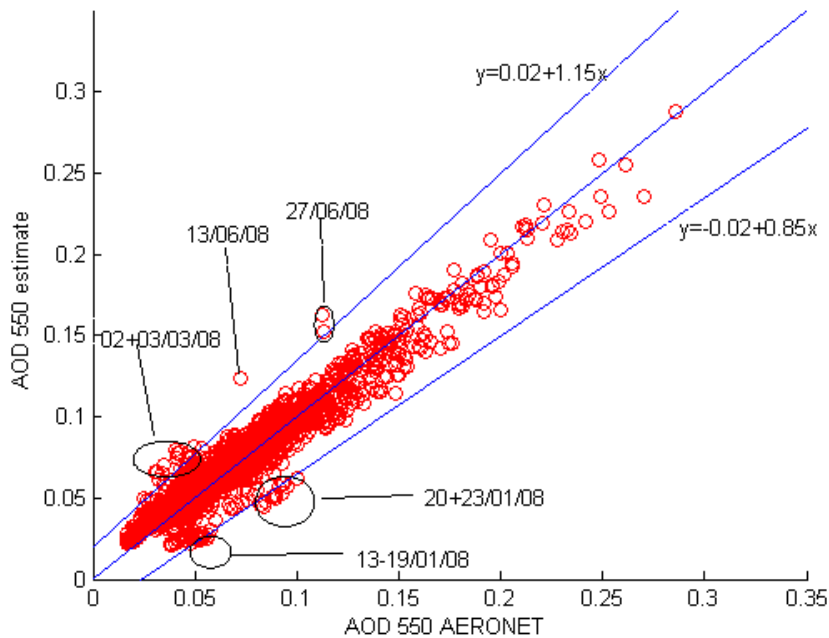
1-minute data



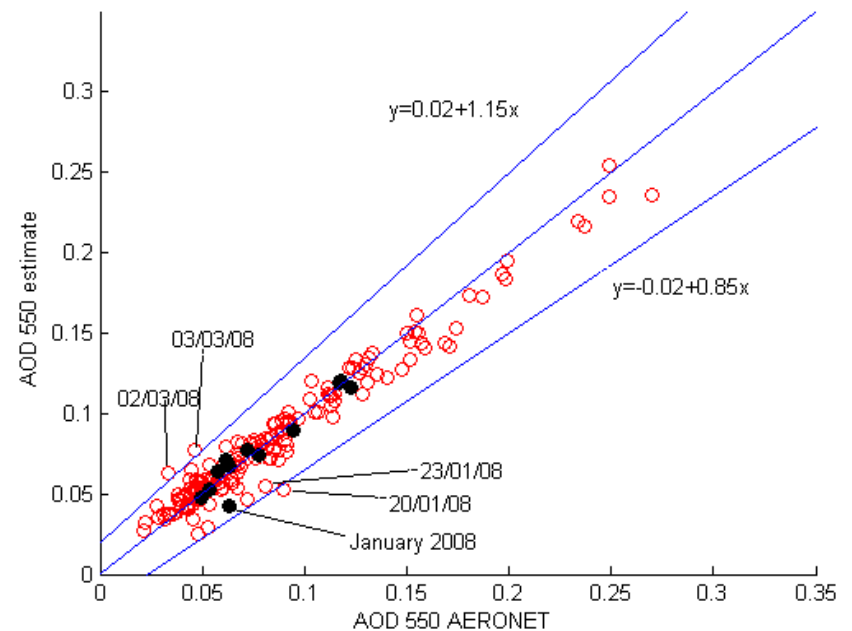
daily data, monthly data

Carpentras

- **Y-coordinate:** AOD retrieval
- **X-coordinate:** actual AERONET AOD value



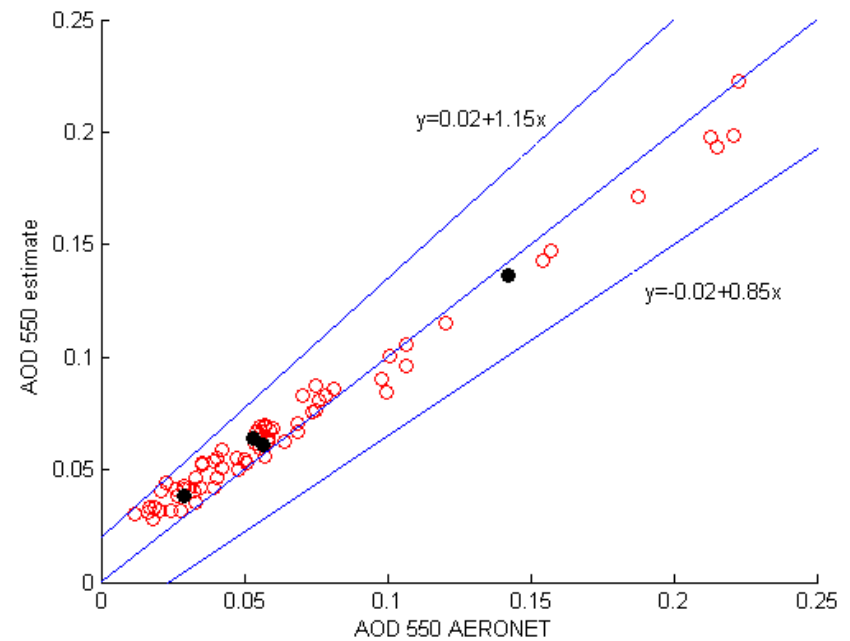
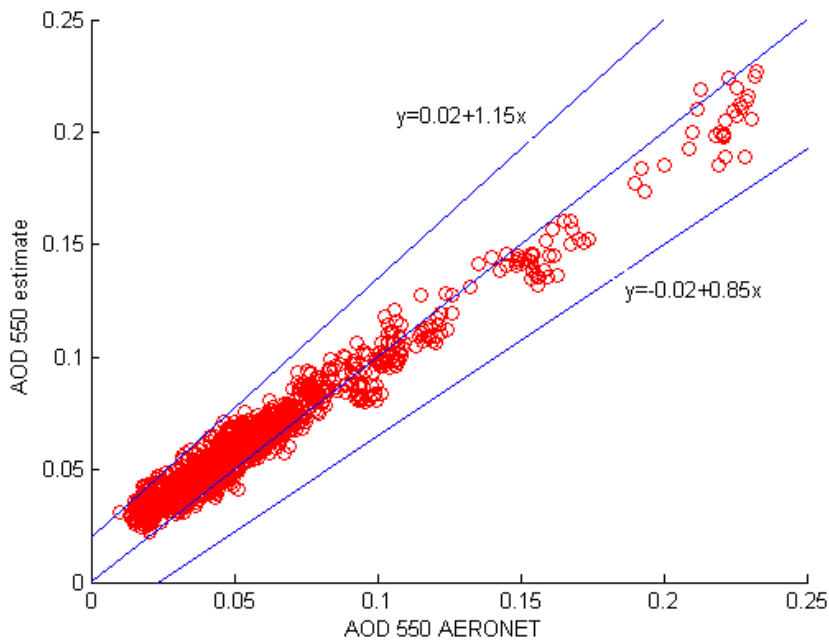
1-minute data



daily data, monthly data

SGP site

- **Y-coordinate:** AOD retrieval
- **X-coordinate:** actual AERONET AOD value



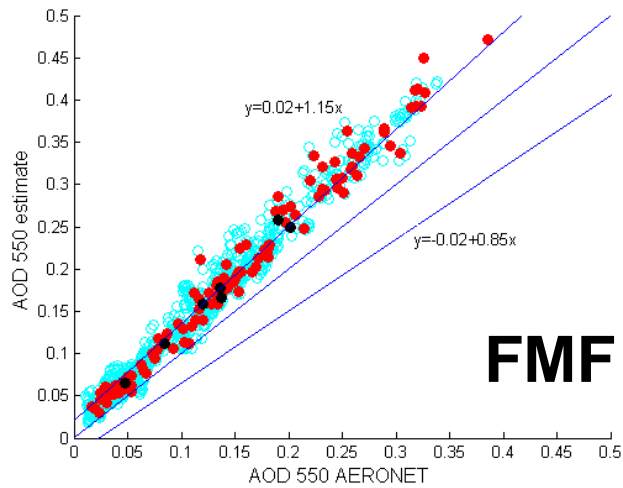
1-minute data

daily data, monthly data

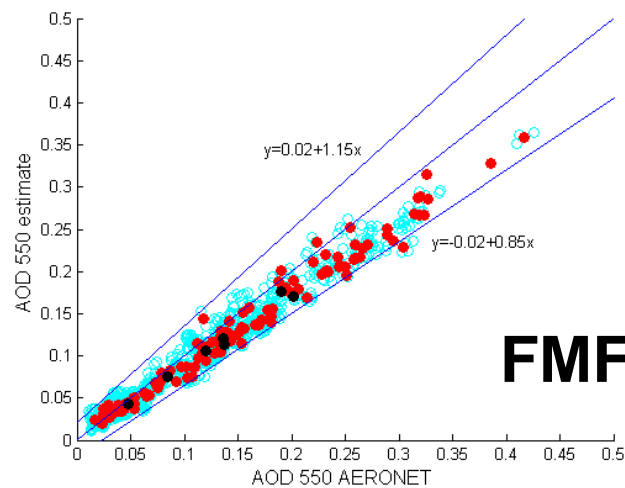
sensitivity tests

- **visAOD overestimate**
 - if aerosol size is underestimated (FMF=1 case)
 - if atmos. water is underestimated (5 kg/m² case)
- **visAOD underestimate**
 - if aerosol size is overestimated (FMF=0 case)
 - if atmos. water is overestimated (20 kg/m² case)
- **relative large errors at lower AOD events**

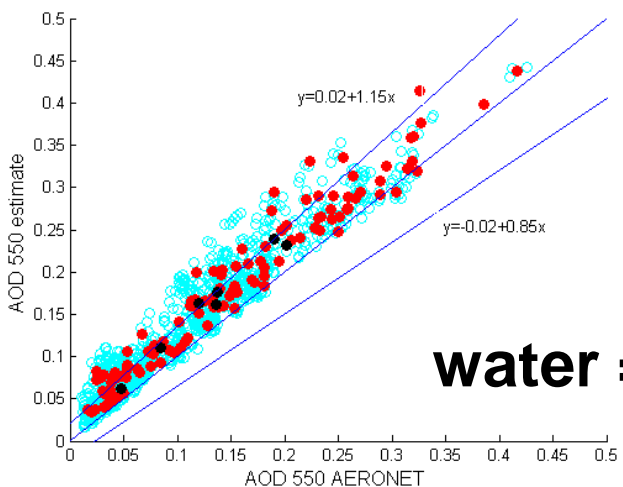
Tamanrasset - sensitivities



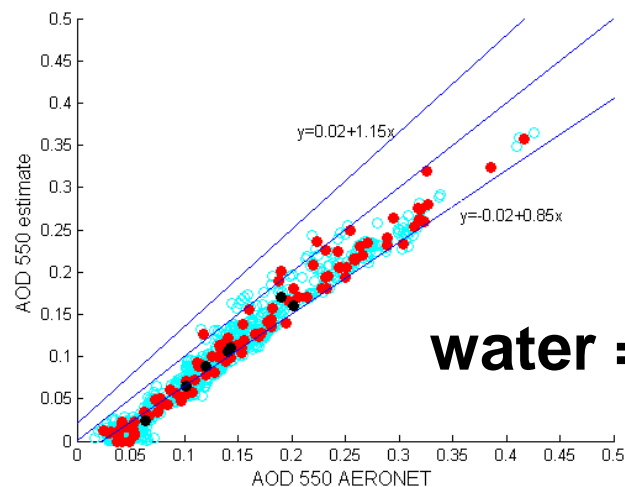
FMF = 1.0



FMF = 0.0



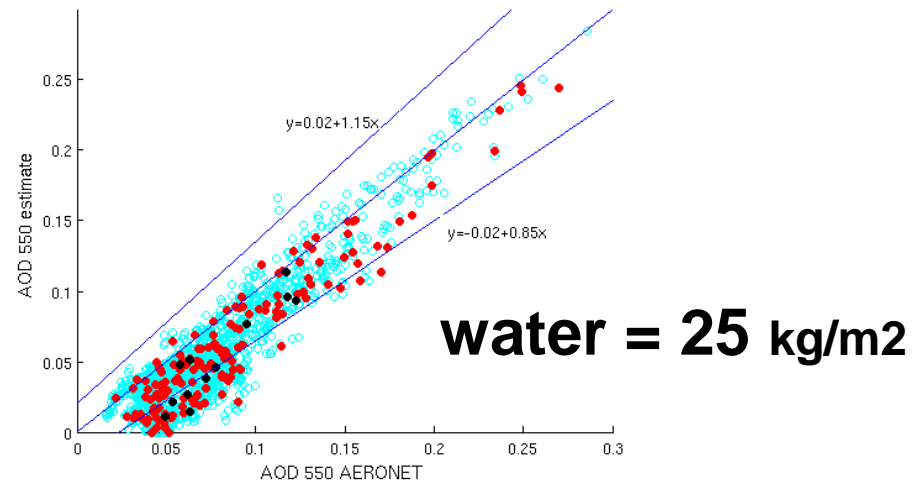
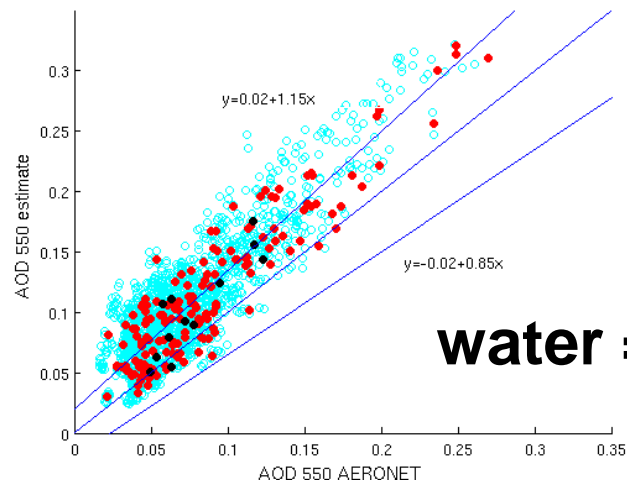
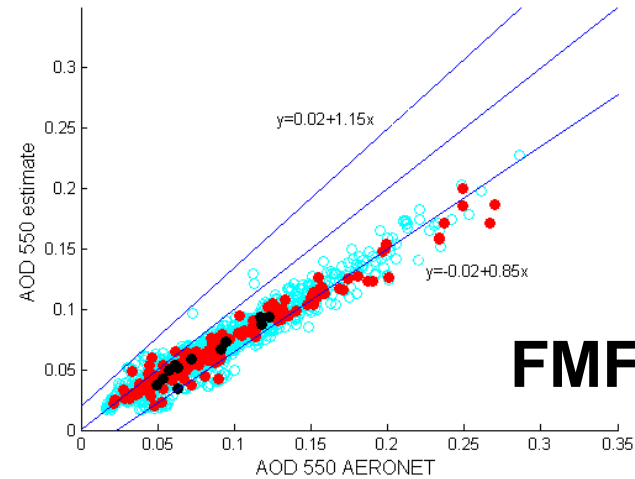
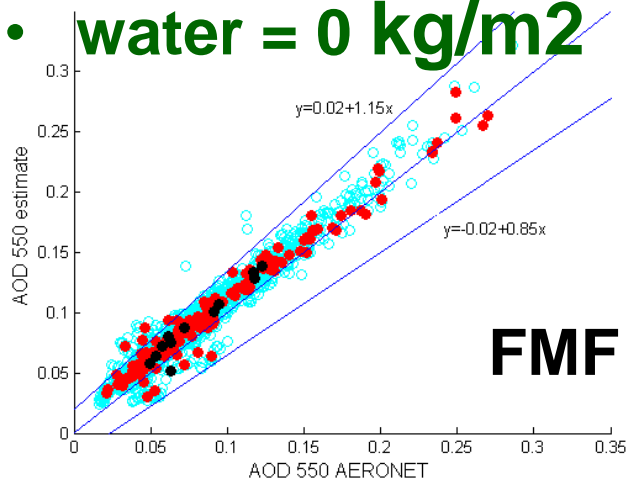
water = 0 kg/m²



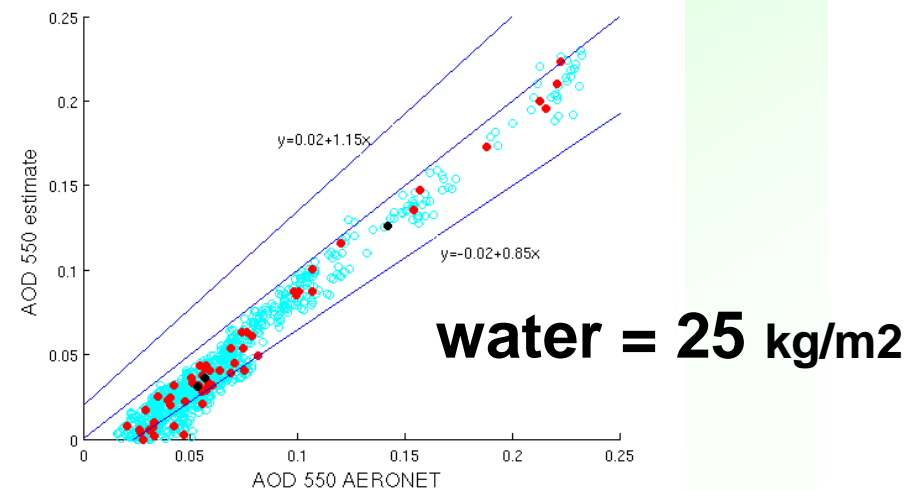
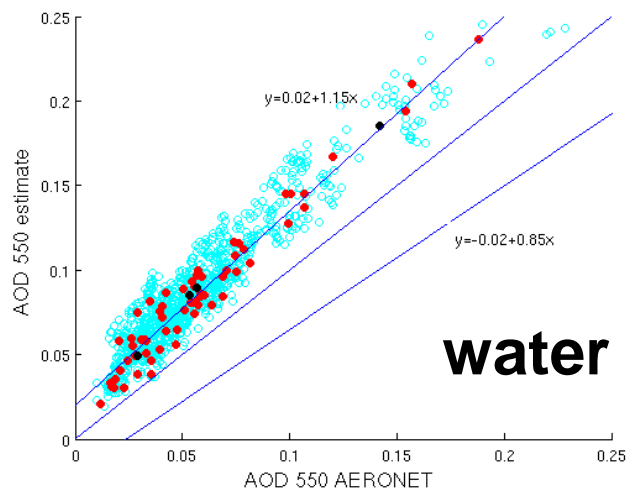
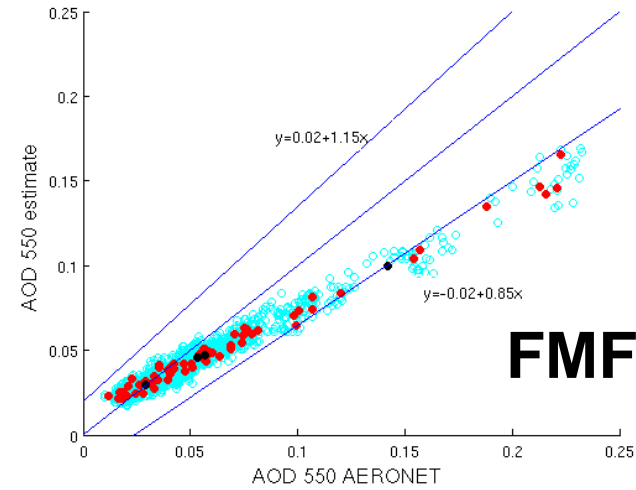
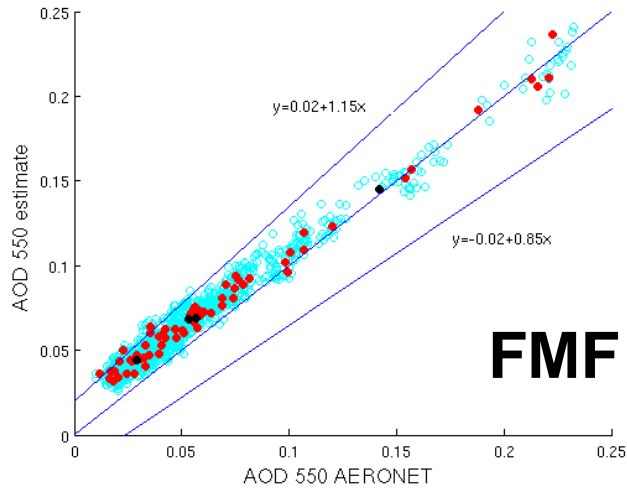
water = 20 kg/m²

Carpentras - sensitivities

- **water = 0 kg/m²**



SGP site - sensitivities



summary

- **simple method offers 'reasonable' AOD values**
 - non-negligible impacts of assumptions (to column water vapor and aerosol size) limit the accuracy, in particular at low AOD values
- **applied to a relatively large volume of BSRN data will draw interest from user community**
 - qualitative info (e.g. seasonality, daily cycles)
- **better understand temporal solar flux trends**
 - how much is dimming / brightening related to aerosol compared to cloud changes?

outlook

- **better water estimates**
 - ... can be provided (high priority)
 - using LW clear-sky fluxes in combination with (skin-) surface temperature
 - look-up table needs to be established
- **better aerosol size information**
 - ... can be improved (lower priority)
 - update the climatology to make the FMF a function of AOD based on monthly AERONET statistics