

# components

*from MACv2 optics  
(or AERONET)*

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*MPI-Meteorology*



# main points

- in MACv2 **components are 'radiatively 'defined**
  - **even at other than mid-visible wavelengths**
- **the mix of components is consistent with MAC**
  - **their sum reproduces mid-visible, AODc, AODf, AAODf, AAODc plus RE<sub>,fine</sub> of MACv2**
- **in terms of global annual AOD (at 550nm)**
  - **SU: 0.037, OC: 0.022, BC: 0.04**
  - **DU: 0.031, SS: 0.028**

...and by scaling with bottom-up modeling:

  - **anthrop: 0.030-0.041 (fine) / 0.04-0.06 (coarse)**

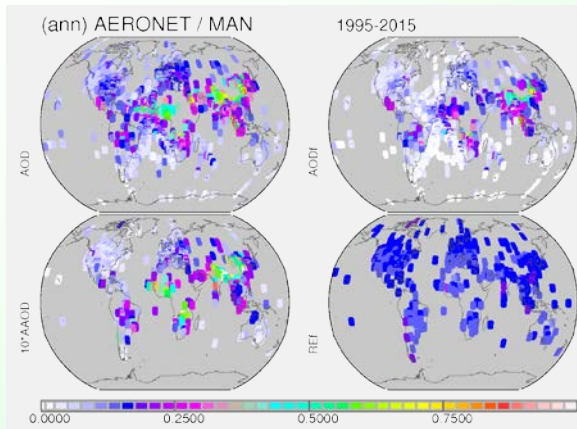
<b>total</b> <b>0.122</b>
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# AERONET - the 'trusted' reference

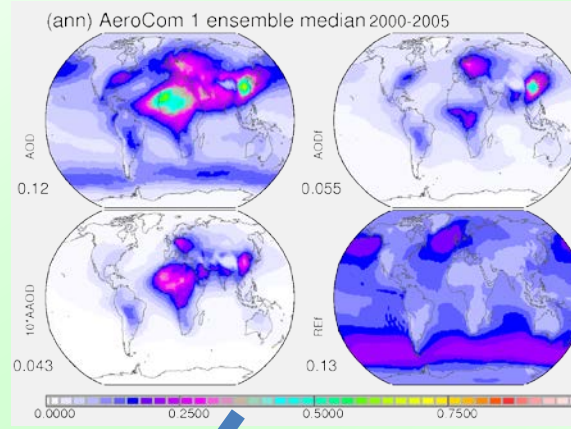
- **amount by size: AOD<sub>f</sub> and AOD<sub>c</sub> (f<0.5um<c)**
  - multi-spectral AOD (SDA)
  - detailed 22bin size-distribution (inversion)
- **absorption by size: AAOD<sub>f</sub> and AAOD<sub>c</sub>**
  - extend SSA of higher (highest) AOD to low AOD cases
  - use fine-mode fraction **plus** absorption Angstr. parameters (abs<sub>440</sub>/abs<sub>670</sub>, abs<sub>670</sub>/abs<sub>1020</sub>) to separate AAOD by size-mode
- **fine-mode size: RE<sub>f</sub>**
  - effective radius from AOD contributions in the 10 lower size-bins.

# MACv2 ingredients

## AERONET quality



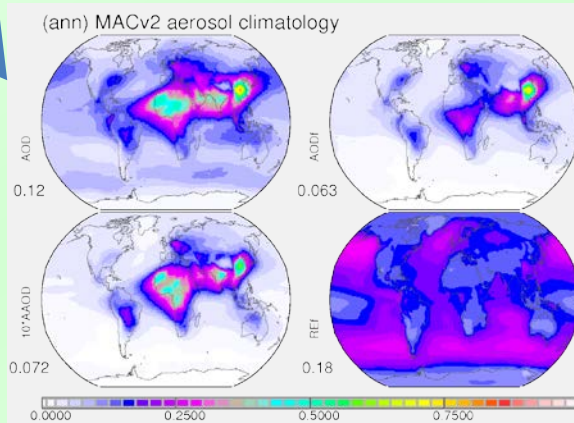
## AEROCOM model spatial context



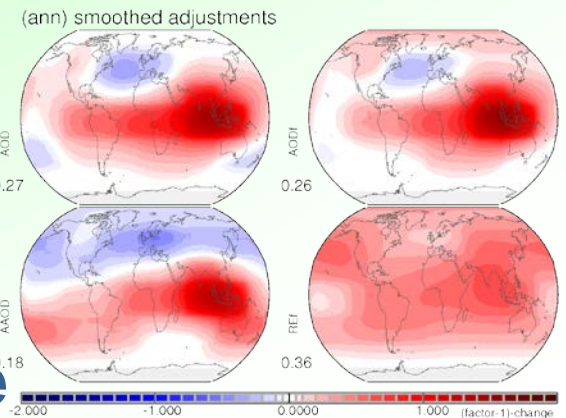
AOD | AODf

AAOD | REF

MACv2



changes  
to model  
**increase**  
decrease

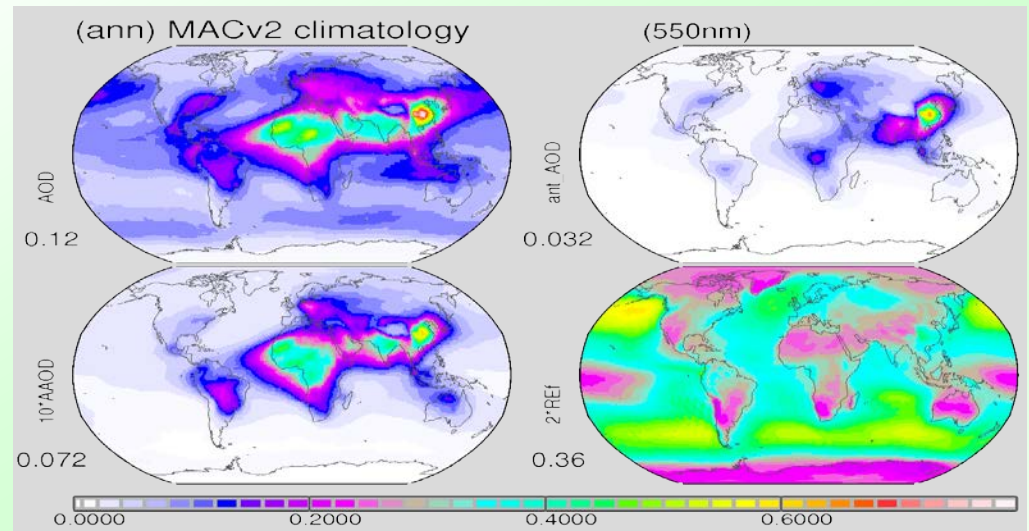


# the MACv2 climatology

monthly 1x1 maps (←AERONET +modeling)

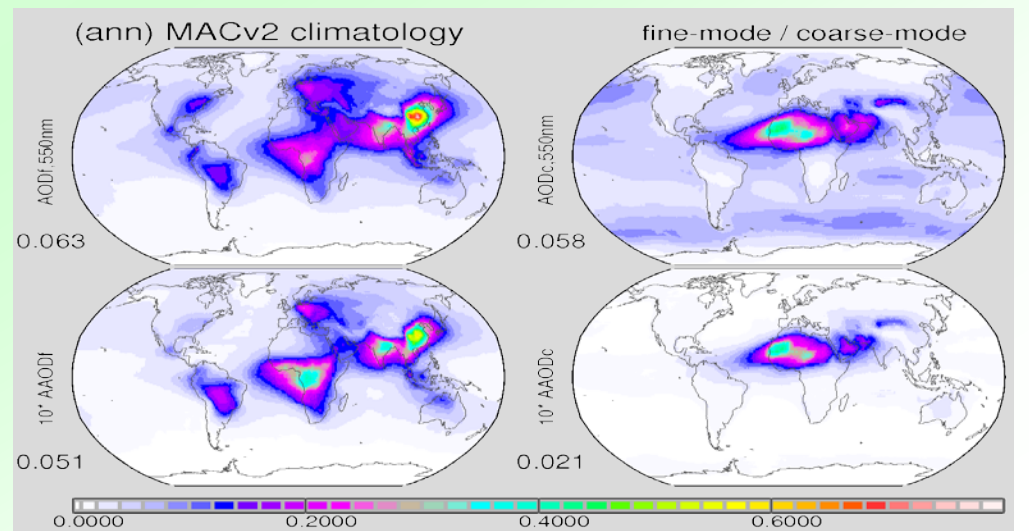
- annual maps →

- AOD 550 0.12
- AAOD 550 0.0072
- antAOD 550 0.032
- REf [um] 0.18



- annual maps →

- AODf 550 0.063
- AODc 550 0.058
- AAODf 550 0.0051
- AAODc 550 0.0021



# the procedure

- **pre-define aerosol components (as in bottom up aerosol component schemes)**
  - **DU (mineral dust)                    coarse-mode (5 sizes)**
  - **SS (seasalt)                            coarse-mode (1 size)**
  - **BC (soot) (OC shell)                fine-mode (1 size)**
  - **OC (abs organics)                    fine-mode (1 size)**
  - **SU (non abs, small)                fine-mode (6 sizes)**

# pre-definitions

## log-normal size-distr. & refrac indices

aerosol type	label	$r_e$	$r_m$	$s_d$	$RF_R$	$RF_I$	SSA	opt.D	MEE	N
		[um]	[um]		at 550nm wavelength				m2/g	[/m2]
soot	BC	<b>.06</b>	.03	1.7	<b>1.70</b>	<b>.700</b>	.155	0.004	8.9	3.4 e+12
organic	OC	<b>.12</b>	.06	1.7	<b>1.53</b>	<b>.005</b>	.970	0.022	3.0	9.0 e+12
soot +o.shell	CA	<b>.12</b>	.06	1.7			.615	0.012		3.2 e+12
sulfate *	SU	<b>.16</b>	.08	1.7	<b>1.43</b>	<b>.000</b>	.999	0.037	3.2	1.9 e+12
seasalt	SS	<b>2.5</b>	.75	2.0	<b>1.50</b>	<b>.000</b>	.999	0.028	0.31	2.6 e+10
dust *	DU	<b>1.5</b>	.93	1.55	<b>1.53</b>	<b>.001</b>	.962	0.031	0.27	3.4 e+10
cloud water	water	<b>10</b>	6.7	1.5	<b>1.33</b>	<b>.000</b>	.999	10.0		2.5 e+10
cloud ice	ice	<b>40</b>	20	1.7	<b>1.31</b>	<b>.000</b>	.999	0.5		1.1 e+08

5 extra aerosol sizes for SU:

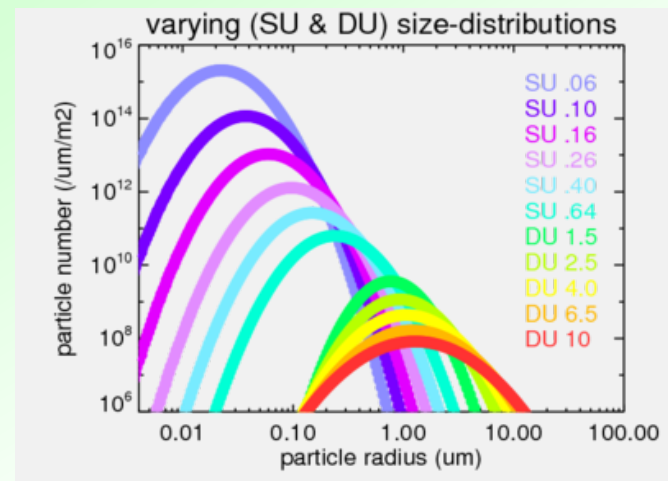
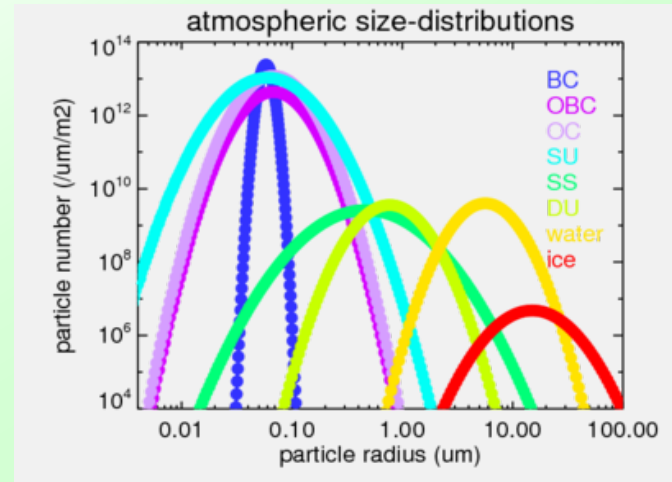
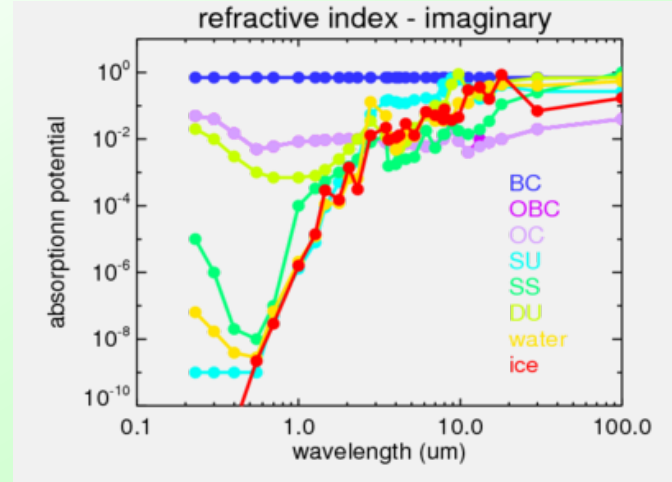
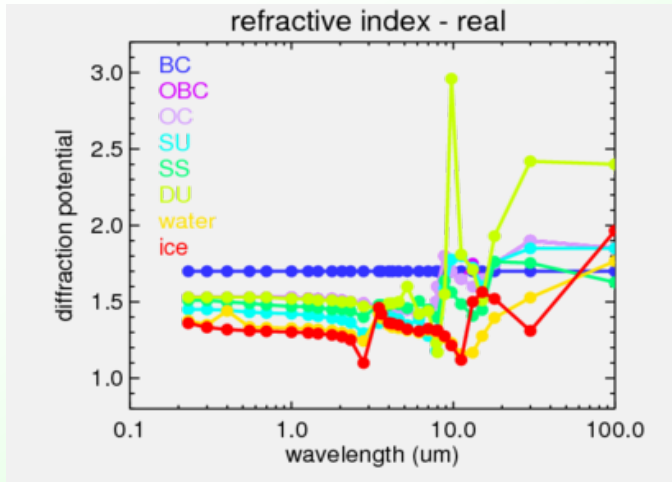
- $r_e = .06\mu\text{m}$  (0.03um/1.7), **.10** (.05/1.7), **.26** (.13/1.7), **.40** (.20/1.7), **.64** (.32/1.7)

4 larger aerosol sizes for DU:

- $r_e = 2.5\mu\text{m}$  (1.2um/1.70), **4.0** (1.6, 1.85), **6.5** (2.0, 2.00), **10.0** (2.5, 2.50)

# refractive indices / size-distr.

BC  
 OBC  
 OC  
 SU  
 SS  
 DU  
 water  
 ice



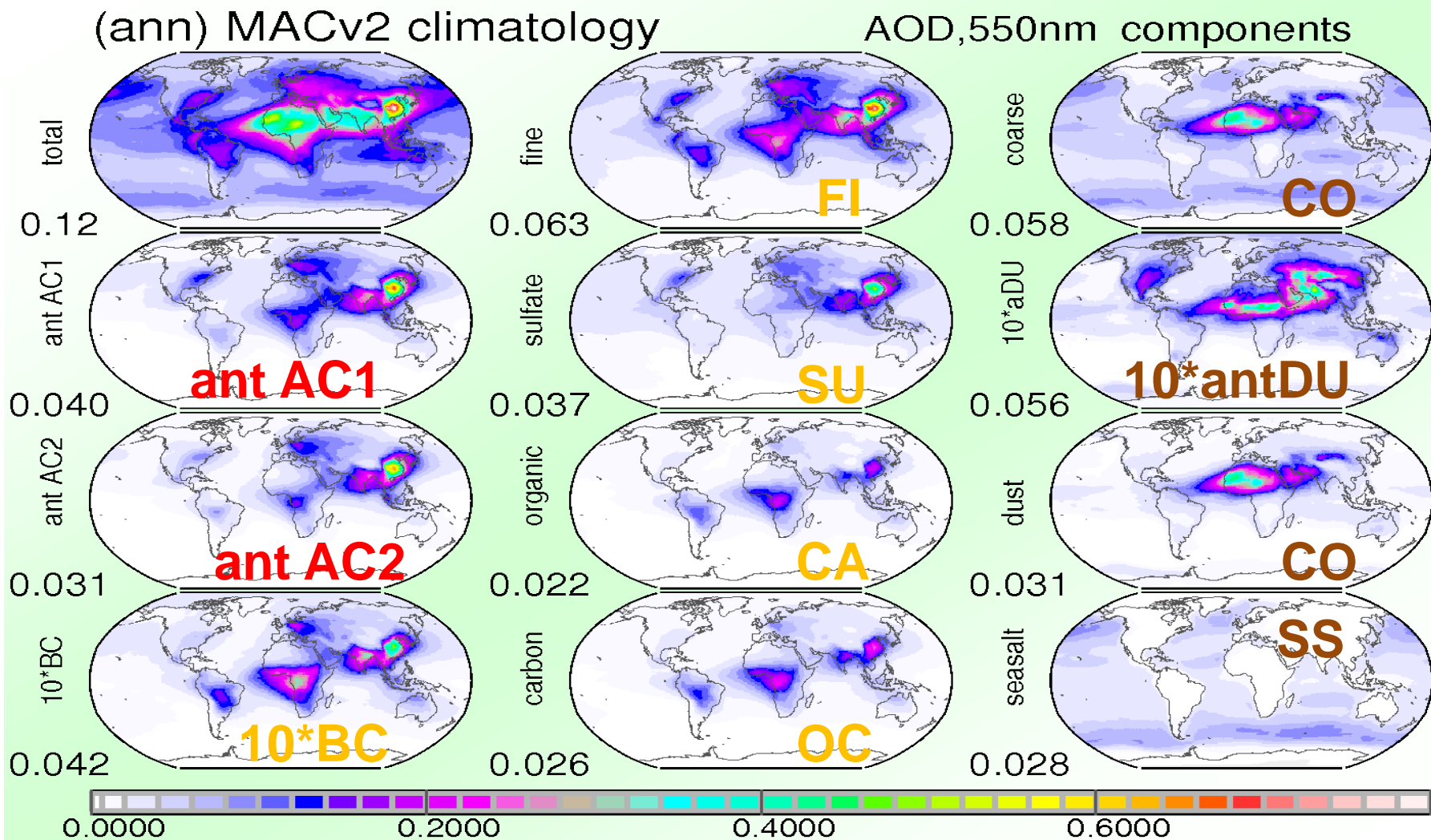
SU .06  
 SU .10  
 SU .16  
 SU .26  
 SU .40  
 SU .64  
 DU 1.5  
 DU 2.5  
 DU 4.0  
 DU 6.5  
 DU 10



# the selection process

- **fine mode AOD 550nm**
  - **SU, OC or BC**
  - **fine mode AAOD 550nm**
    - **strong abs  $\rightarrow$  BC (+OC shell)  $re = 0.12 \mu m$**
    - **weak abs  $\rightarrow$  OC [ $OC_{aod} > 5 * BC_{aod}$ ]  $re = 0.12 \mu m$**
    - **non abs  $\rightarrow$  SU  $re = 0.06$  to  $0.6 \mu m$  ( $\leftarrow$  REf)**
- **coarse mode AOD 550nm**
  - **DU or SS**
  - **coarse mode AAOD 550nm**
    - **weak absorption  $\rightarrow$  smaller & less dust**
    - **larger absorption  $\rightarrow$  larger & more dust**
    - **no absorption  $\rightarrow$  SS (SS, AODmin over ocean req)**

# AOD assignments



# what does it mean ?

- at each location and month the aerosol mixture is defined – consistent with MACv2
- with quantified optical properties (amount , size and absorption) to all considered components
- all relevant aerosol optical properties (AOD, SSA, ASY) via mixture are automatically defined at ANY wavelength
  - not just at mid-visible wavelengths, where component attributions were assigned

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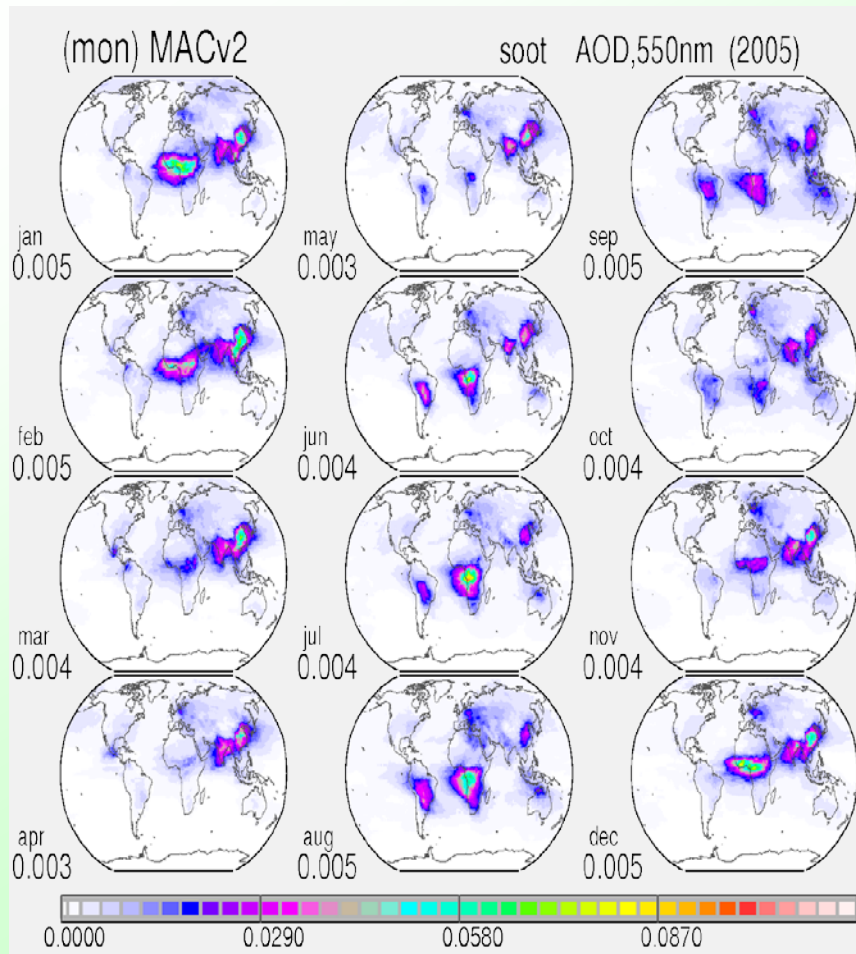


# extras

- **component monthly properties**
- **BC AOD and OC AOD** *(1 to 5 scale)*
- **SU AOD and SU-size** *(non abs fine-mode)*
- **DU AOD and DU-size**
- **SS AOD and TOT AOD** *(1 to 7 scale)*

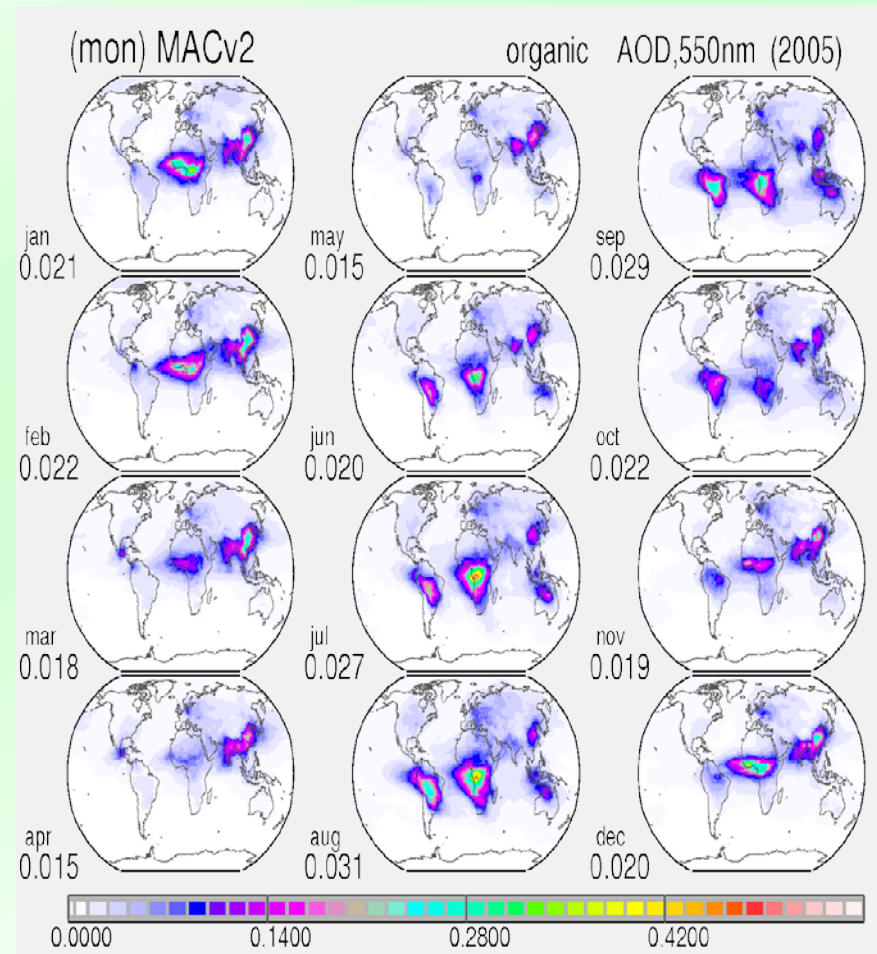
# BC / OC - AOD

- BC



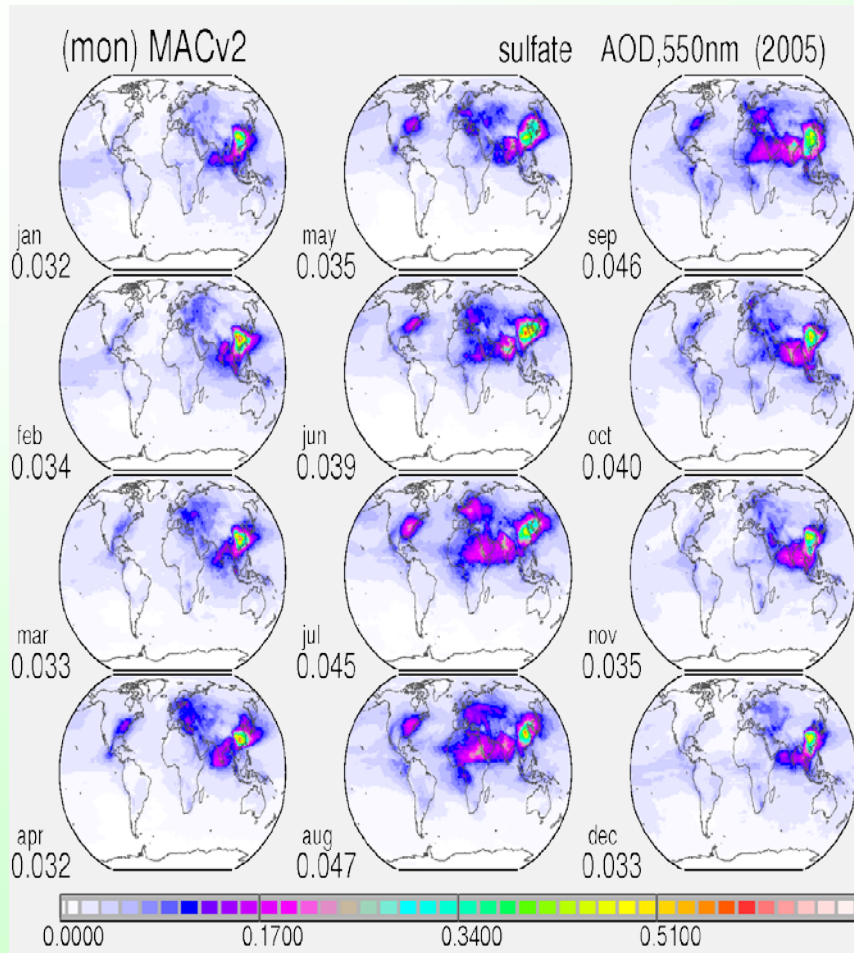
- OC

scale 5x larger

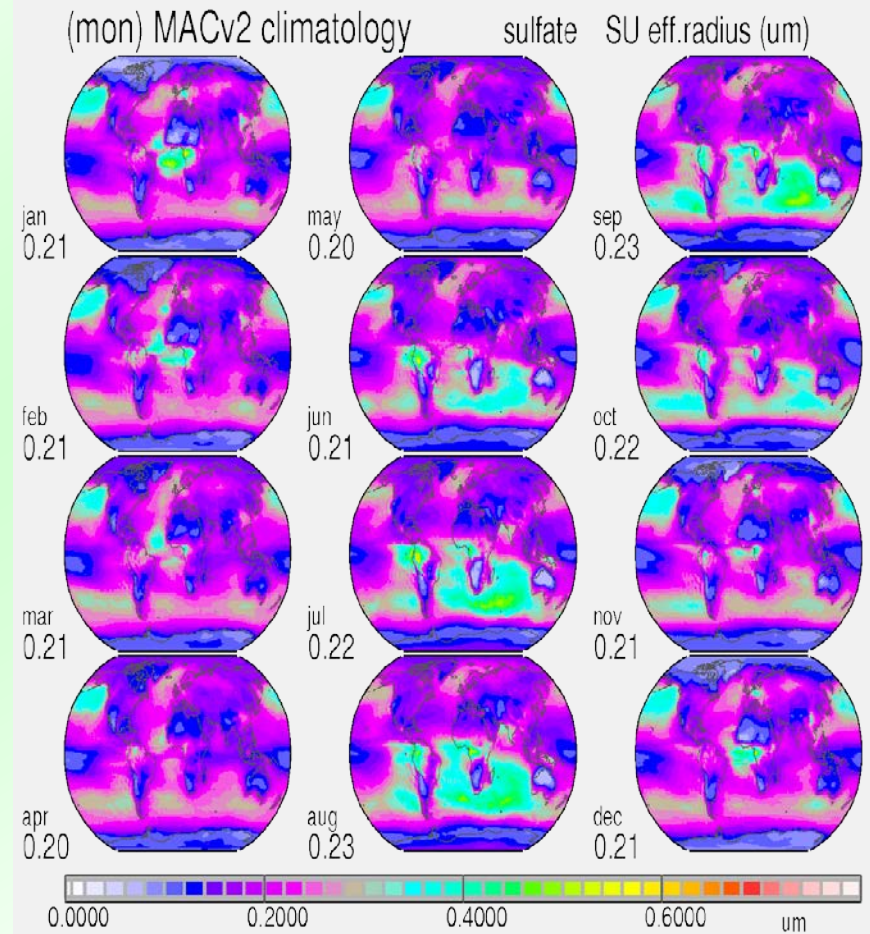


# SU - AOD / size

- AOD 550nm**



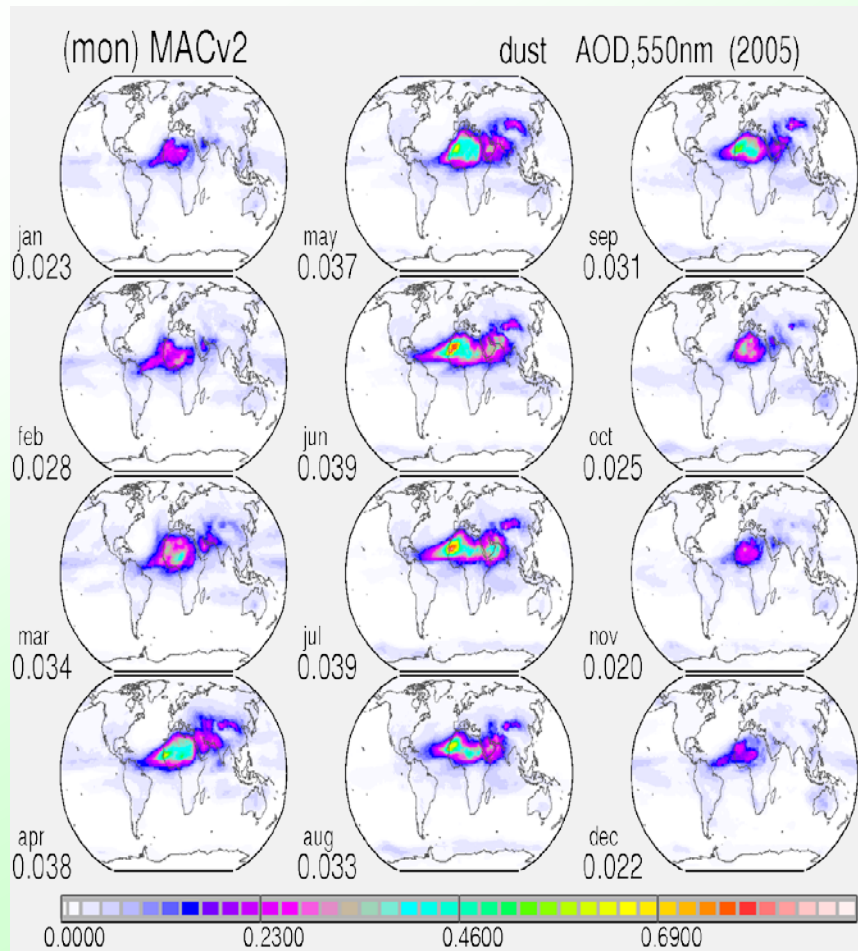
## re (um)



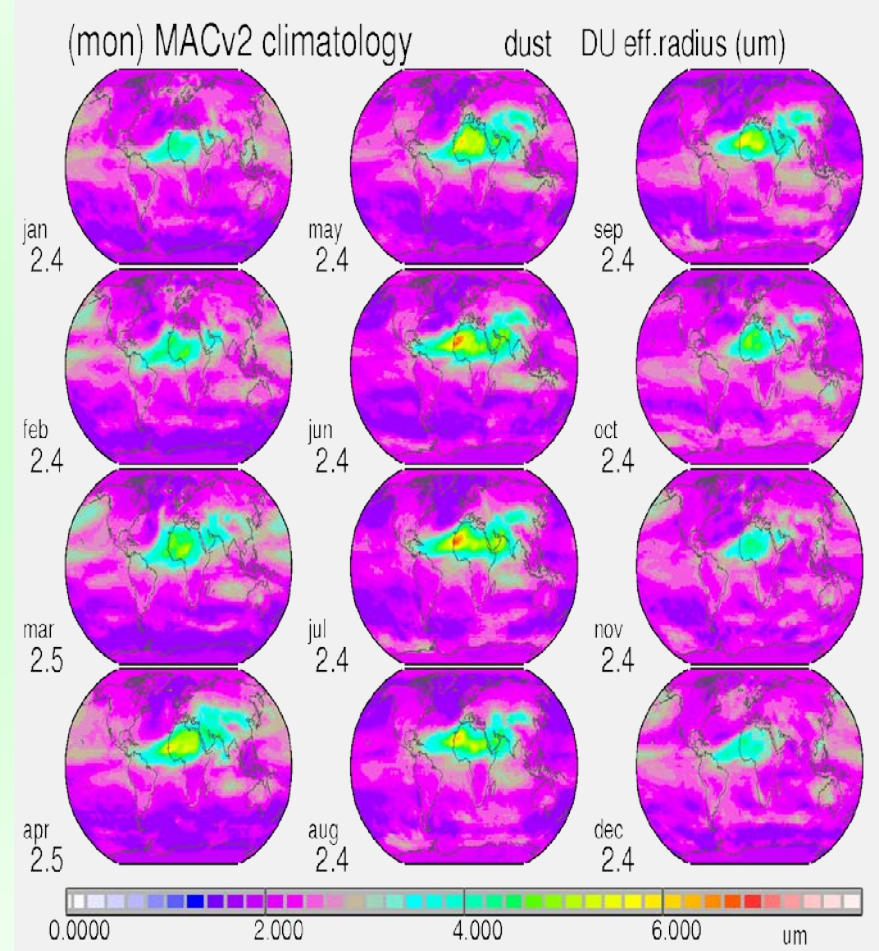


# DU - AOD / size

- AOD 550nm**

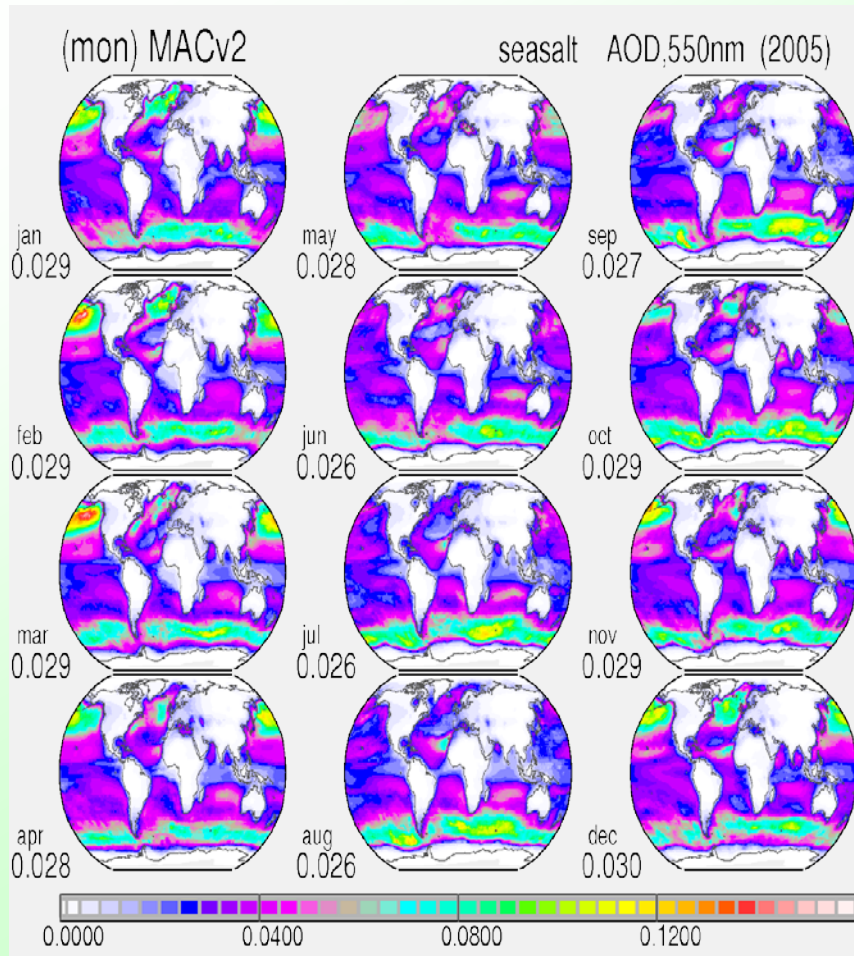


## re (um)

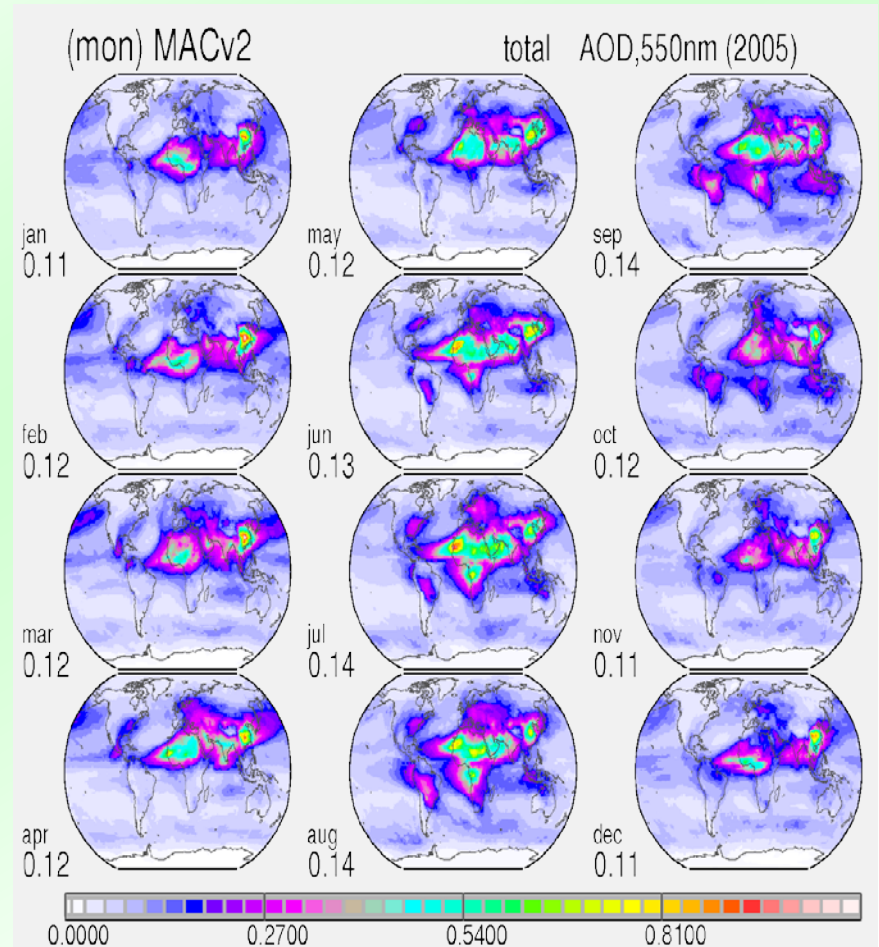


# SS / TOT - AOD

- SS - AOD 550nm



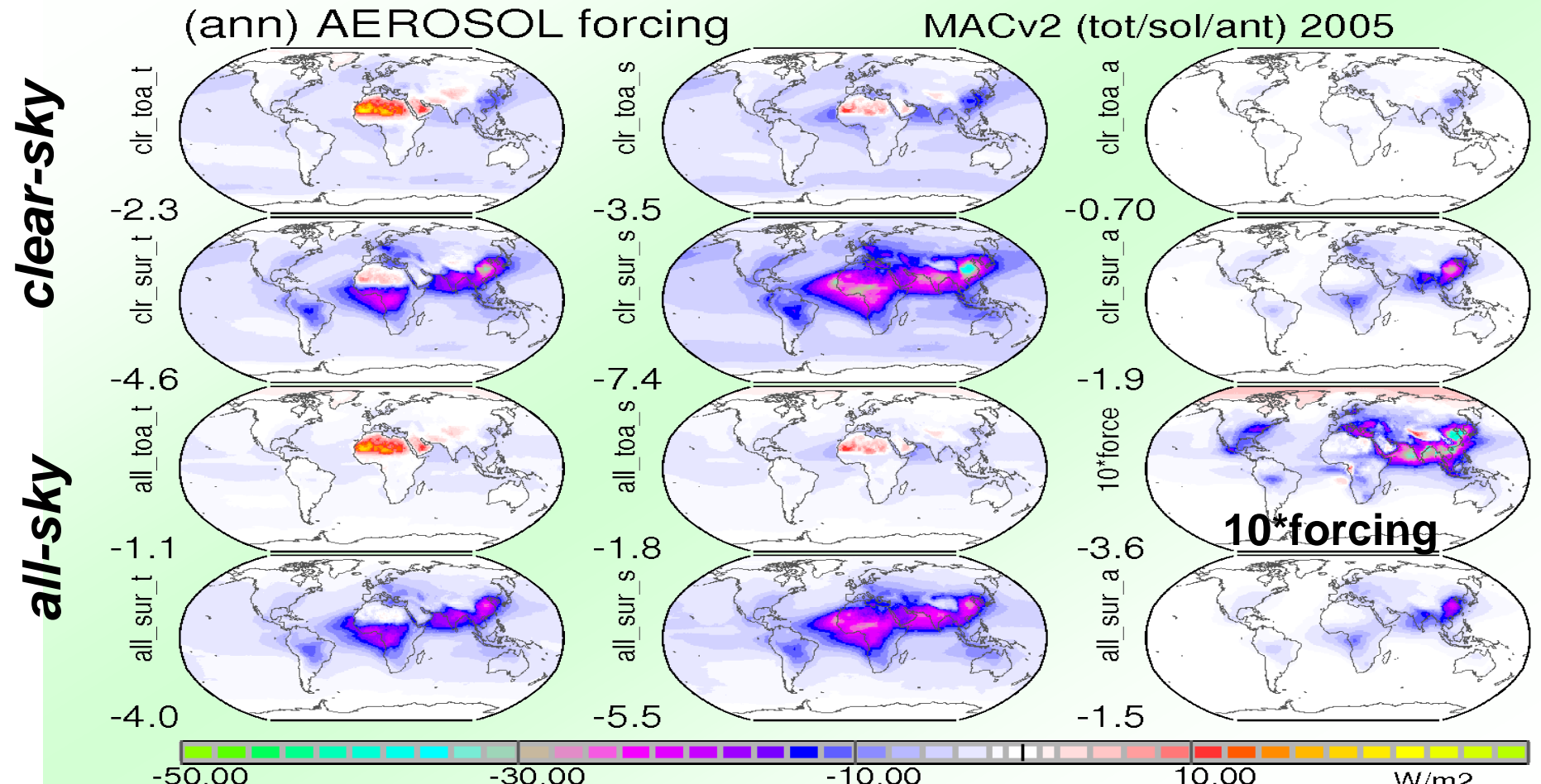
- total AOD 550nm



# today's direct effects

cooling and warming

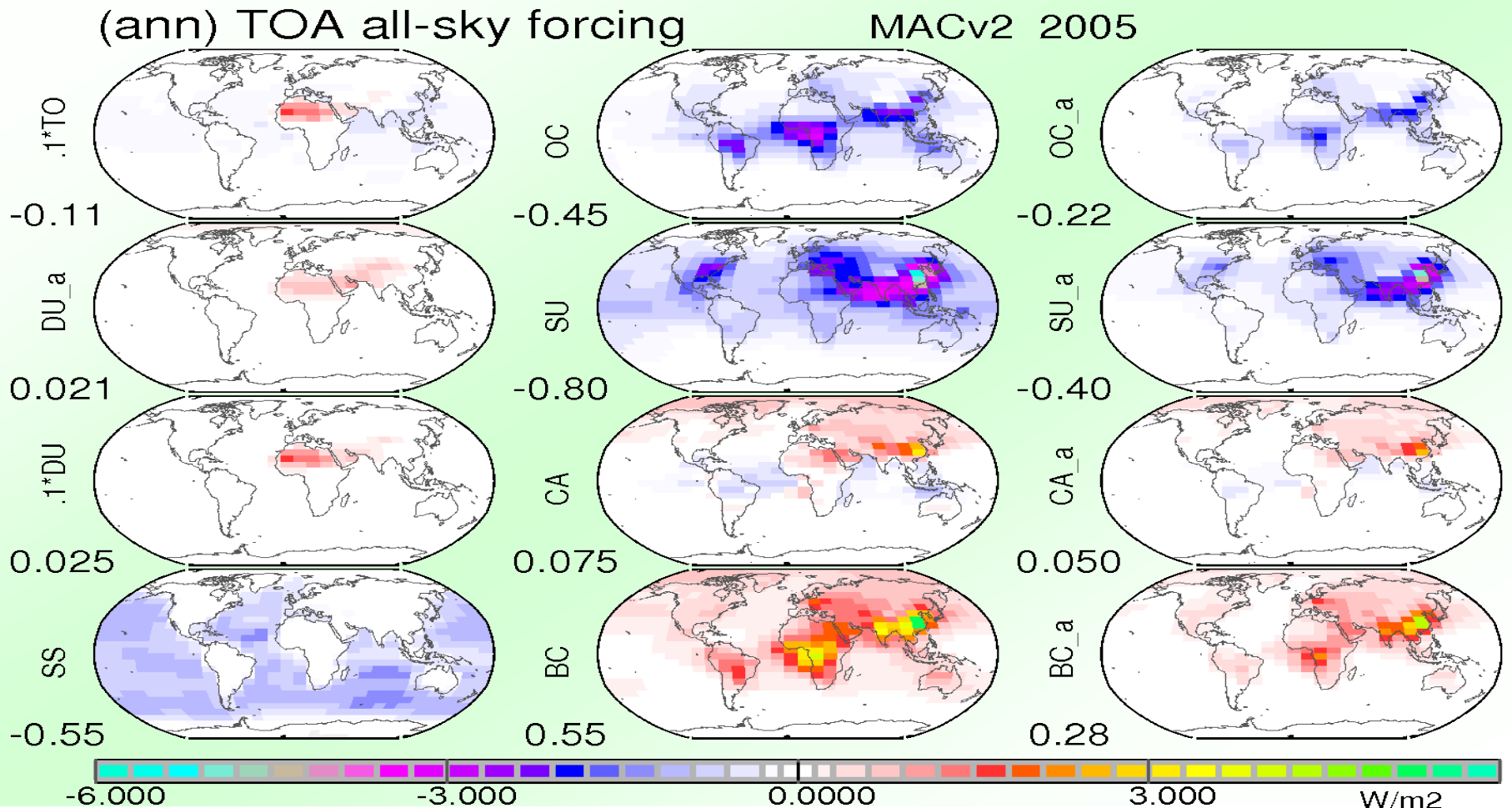
- total (solar+IR) / total (solar) / anthropogenic



# component rad.effects

BC ant: 0.28 to 0.44 W/m<sup>2</sup> ( ← what is BC ant fraction?)

- all-sky (today) OC/SU/BC/CA/DU/SS +anthr



# component rad.effects

- **clear-sky (today) OC/SU/BC/CA/DU/SS +anthr**

