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Two hundred fifty years of aerosols and climate: the end of the age of aerosols

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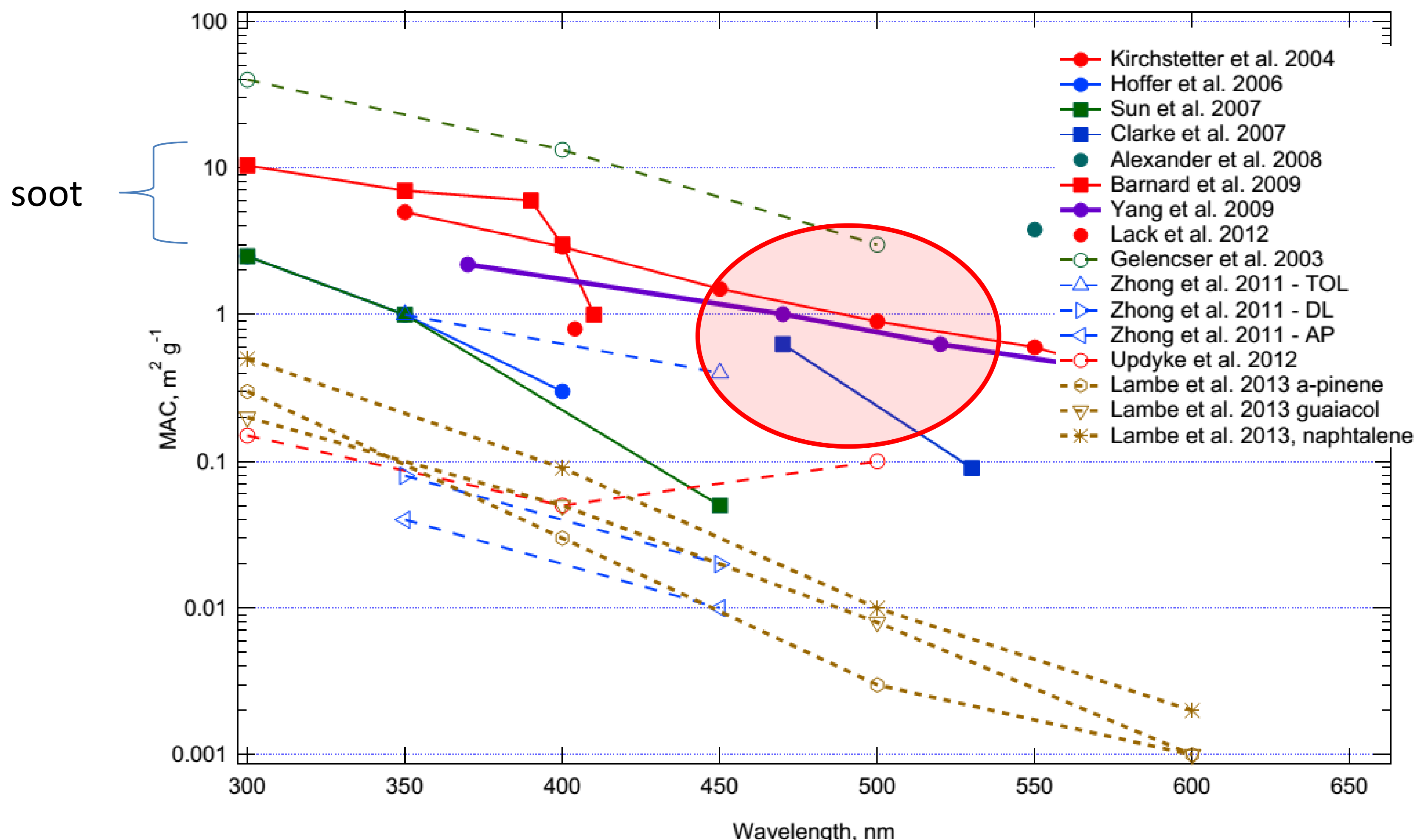
Table 1. Assumed range for radiative forcing. Year 2000 anthropogenic emissions (total emissions – assumed preindustrial baseline) are BC: 5.7 TgC; OC: 17.4 TgC; SO_2: 111 $TgSO_2$.

Year 2000 Forcing			
	Low	Medium	High
Global 2000 Forcing ($W\,m^{-2}$)			
BC	0.23	0.40	0.57
OC	−0.11	−0.056	−0.025
SO_2 Dir	−0.60	−0.40	−0.20
Cloud Indir	−1.2	−0.70	−0.30
Average Unit Forcing ($mW\,m^{-2}\,Tg^{-1}$)			
BC	40	70	100
OC	−6.3	−3.2	−1.4
SO_2 Dir	−5.4	−3.6	−1.8

Spracklen et al. (2011)
anthropogenic OC ~ 100 TgC

Mounting evidence that SOA absorbs visible wavelengths

UV-Visible Absorption by Organic Aerosols



Significant absorption
at visible wavelengths

Relationship between Oxidation Level and Optical Properties of Secondary Organic Aerosol

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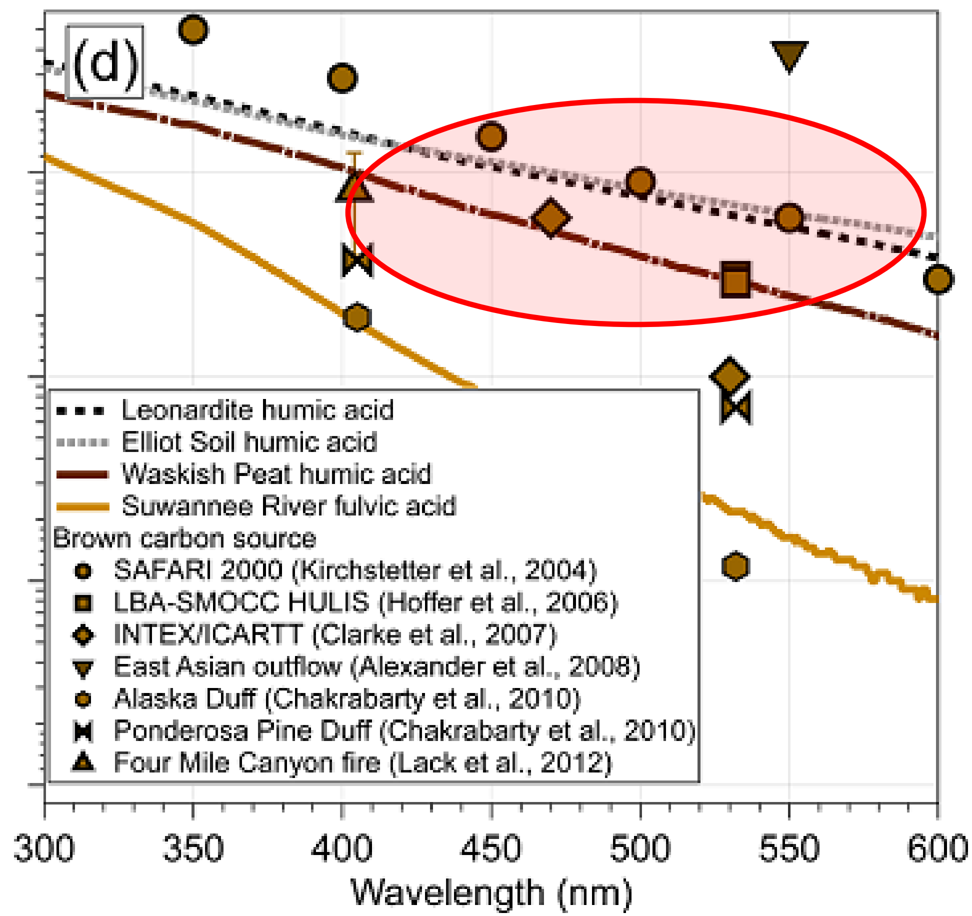
ES&T, 2013



Significant absorption
In visible range

Revised RF of Organic Aerosols
100 Tg/yr (Spracklen et al. 2011)
+ 7 mW m^{-2} / Tg (~ 1/10 of soot)

+ 0.7 W m^{-2}

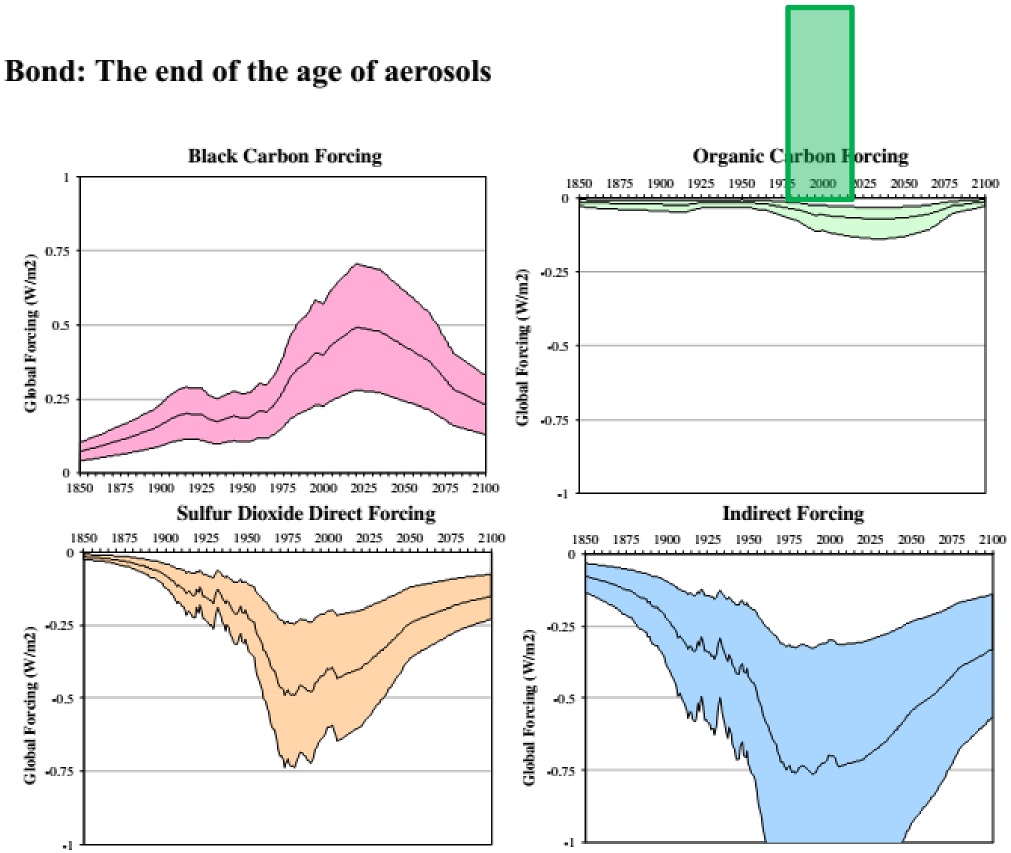
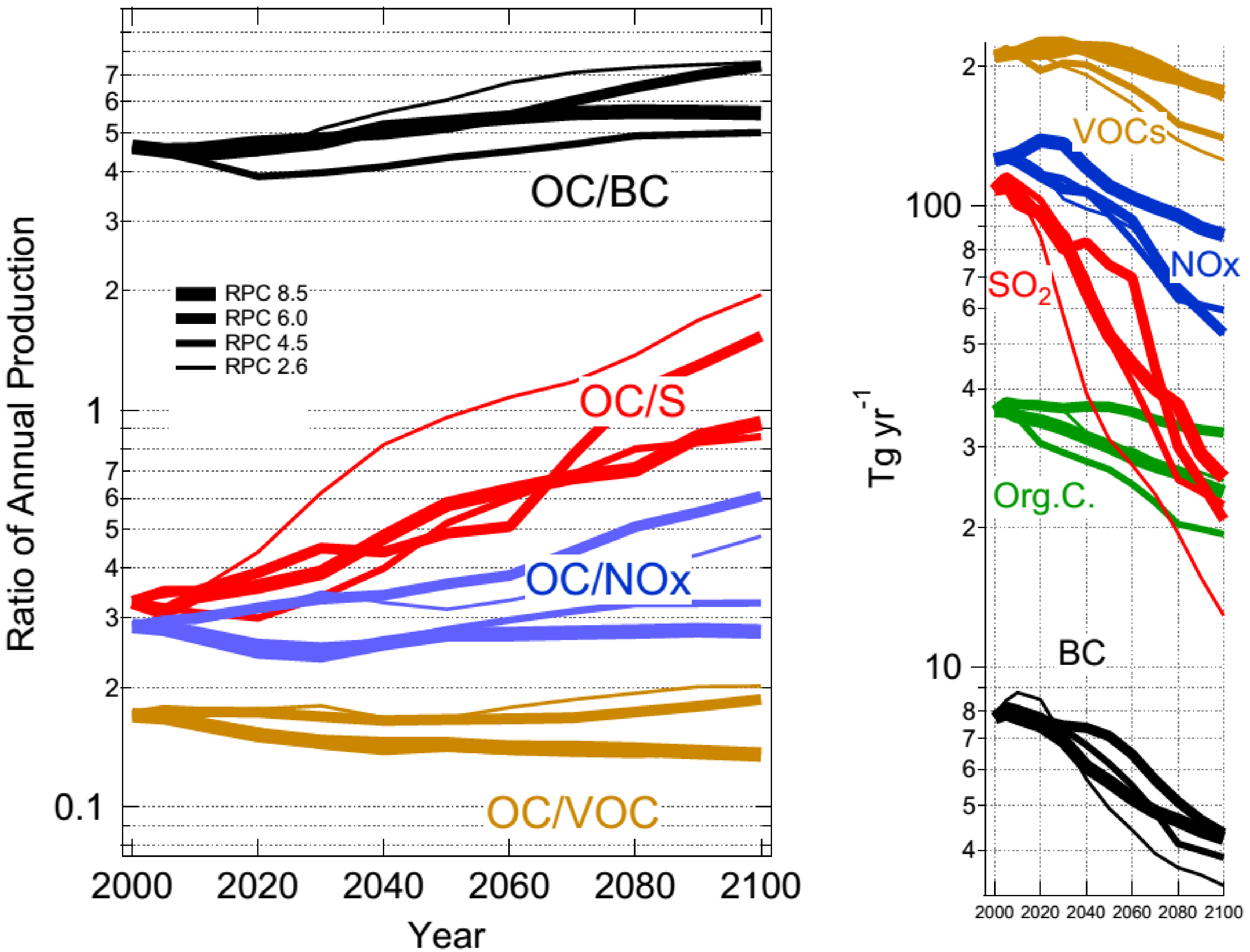


Fig. 3. Radiative forcing ranges for black carbon, organic carbon, sulfate aerosol, and indirect cloud forcing estimated by combining historical emissions estimates plus future emissions under the reference case scenario.

“The Return of the Age of Organic Aerosols”



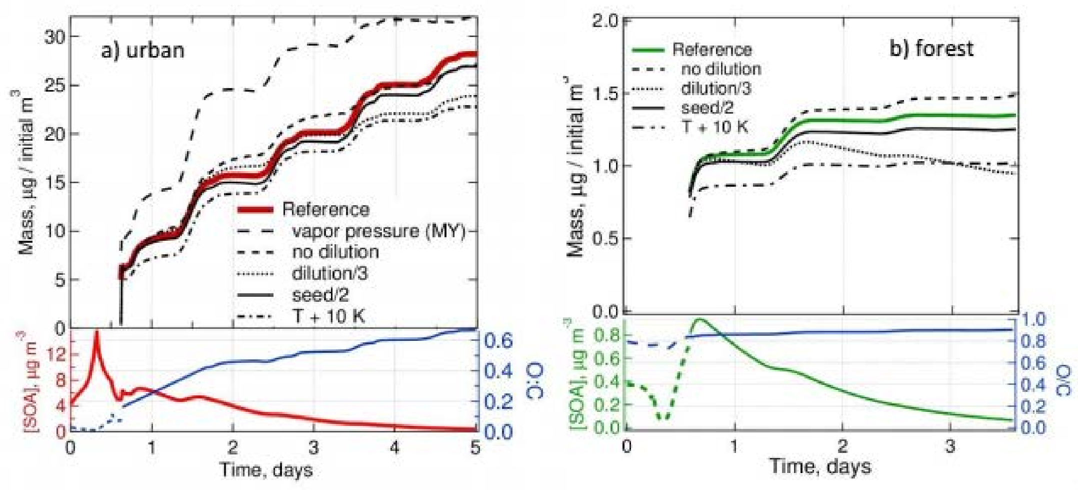
The Return of the Age of Organic Aerosols

However, may be different organic composition than pre-industrial:

- Will sulfate (?) decline also cause a decline in BSOA?
  - Recent field campaign data critical to understand this.

- Are we currently underestimating anthropogenic SOA?

Mexico City 2006
MILAGRO
DOE/NSF/NASA



Colorado 2011
BEACHON
NSF

Lee-Taylor et al., in internal review, 2014

Chemical Composition of Organics is Key Determinant of Climate-Relevant Aerosol Properties:

Optical Properties, esp. absorption vs. scattering

Particle Mass Growth Rates

Non-precipitation removal:

- dry deposition
- heterogeneous oxidation
- photolysis

Hygroscopicity

Growth Mechanisms with Emphasis on Particle Chemistry

(John Shilling and Sasha Madronich)

Initial survey:
(respondents: Alma, Rahul, Manish, Barbara, Jerome, Alla, Joel – thank you)

1) *What particle-phase chemical reactions are included in models at all scales (box, regional, and global)?*
   MOSAIC, ADCHAM

2) *What kinds of research activities are currently in progress regarding this area, particularly within ASR/DOE funding?*
   Evolution of size distribution (PNNL chamber)
   Volatility markers, SVOC uptake (UCI expts, theory)
   FIGAERO, MOVI gas and particle composition, volatility (UW)

3) *Any specific activities, such as field campaigns, coordinated lab studies, or model intercomparisons, that we could work toward as a group to improve the representations of SOA growth mechanisms in models?*
   Gas phase inputs from GECKO-A
   Simplified oligomerization , new particle formation in WRF-Chem, CAM5.
   Aerosol testbed
   Comparisons for CARES, GoAmazon, Thornton's and Goldstein's labs,

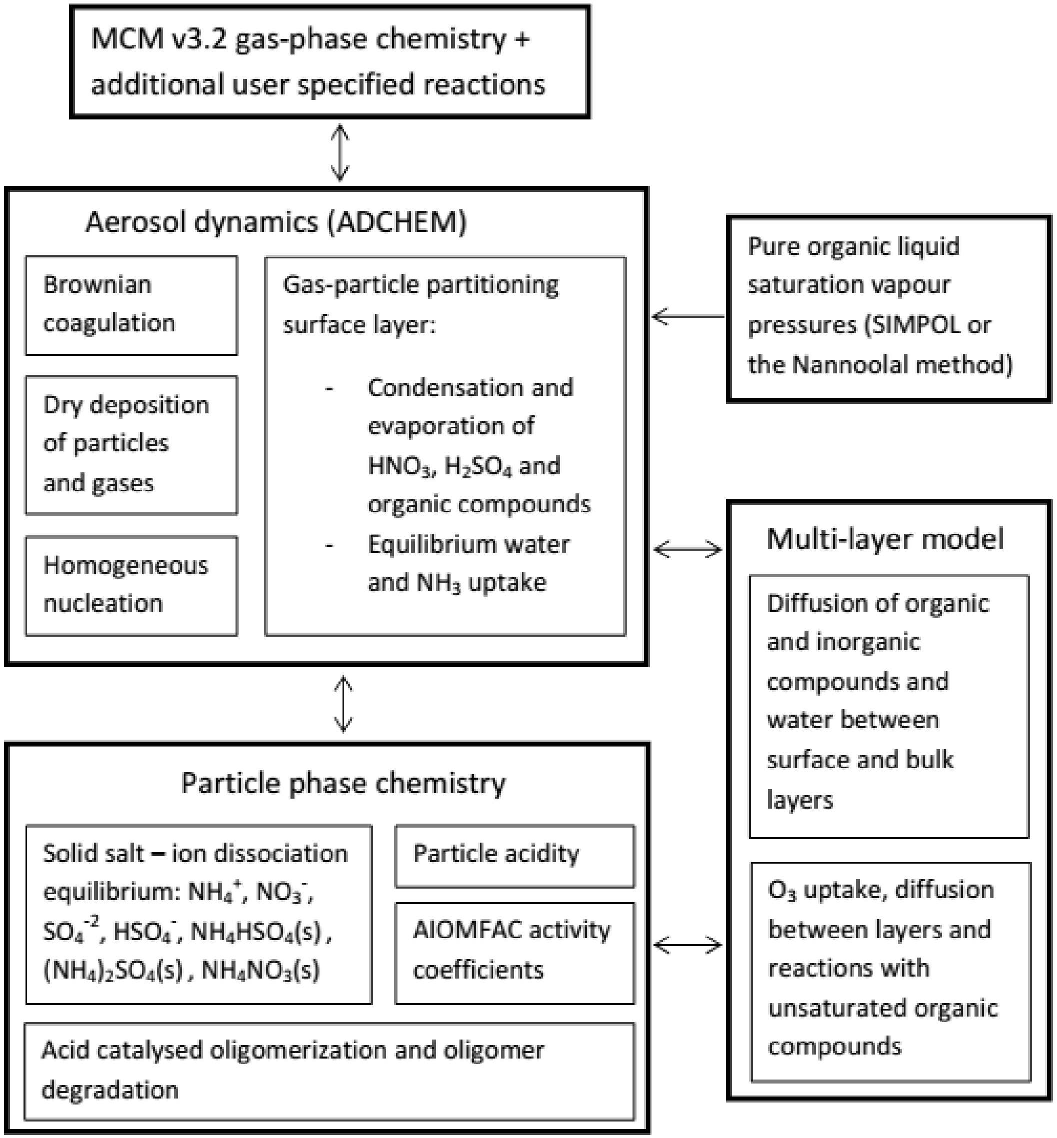


Fig. 1. Schematic picture of the ADCHAM model structure.

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