Organic Aerosol Volatility Parameterizations and their Impact on Atmospheric Composition and Climate

Kostas Tsigaridis, Susanne Bauer

Center for Climate Systems Research, Columbia University
NASA Goddard Institute for Space Studies
kostas.tsigaridis@columbia.edu
### OA volatility in global models

<table>
<thead>
<tr>
<th>Volatility</th>
<th>Emissions</th>
<th>Chemistry</th>
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<td>Primary</td>
<td>Secondary</td>
<td>Primary</td>
</tr>
<tr>
<td>noSOA Non-volatile</td>
<td>Non-volatile</td>
<td>BB+Anthro 0.15*Terp</td>
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To take into account the intermediate volatility organic compounds (IVOCs); Shrivastava et al., 2008.

Dentener et al., 2006
Global model skill against OA measurements

- Simple SOA, non volatile
- Explicit SOA, semi-volatile

Emitted, Chem, Chem + other

Organic aerosol complexity

Tsigaridis et al., 2014
Median model – surface

Tsigaridis et al., 2014
Median model – vertical

Model median

Model diversity

1 μgC m\(^{-3}\)

Tsigaridis et al., 2014
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**Aerosol parameterization**
- OMA: One-moment aerosols (bulk)
- MATRIX: Aerosol microphysics

**Dentener et al., 2006**

To take into account the intermediate volatility organic compounds (IVOCs); Shrivastava et al., 2008.
OA at surface

SOA

noSOA - SOA

VBS - SOA
POA/SOA vertical distribution

- **Secondary**
  - Green: All organics non-volatile
  - Blue: All biogenic SOA semi-volatile
  - Red: All organics semi-volatile

- **Primary**
OA vertical distribution

Green: All organics non-volatile
Blue: All biogenic SOA semi-volatile
Red: All organics semi-volatile
OA column burden

SOA

noSOA - SOA

VBS - SOA
Aerosol Optical Depth @ 550 nm

SOA

noSOA - SOA

VBS - SOA
Shortwave aerosol forcing

noSOA - SOA

~0 W m$^{-2}$

VBS - SOA

-0.14 W m$^{-2}$
Conclusions

• Aerosol microphysics do not significantly alter the mean OA vertical profile or comparison with surface measurements. This might not be the case for semi-volatile OA with microphysics.

• The inclusion of some (or all) of OA as semi-volatile strongly impacts their vertical profile, with climate implications.

Application against high altitude measurements:
Bauer (A51N-0269)

VBS with microphysics:
Gao, Tsiganidis and Bauer (A43G-0371)
Extra
Comparison with surface measurements

Green: All organics non-volatile
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