MOSAIC: A flexible new aerosol thermodynamics model
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Goals

• Implement MOSAIC aerosol model into GEOS-Chem

• Provide new modeling opportunities

• This is a work in progress – interested in feedback and needs of modeling community
Aerosols in GEOS-Chem

Initial conditions

\[ t = t_0 \]

Gases
(eg \( HNO_3 \))

Aerosols
(eg \( NO_3^- \))

\[ \text{ISORROPIA II} \]
(eg \( HNO_3 \leftrightarrow NO_3^- \))

Equilibrium partitioning

\[ t \rightarrow \infty \]

Gases

Aerosols*

*Indicates aerosol species.
Possibilities

• MOSAIC models internally-mixed aerosol in N bins:
  • **Size-dependent non-equilibrium** partitioning w/ hysteresis
  • Aerosol microphysics (sectional)
  • Organic species (BC, OC, SORGAM)
  • Sea salt and crustal components (Na, Cl, Ca)
  • Inorganic mass (e.g. dust)
  • Coming soon: modal aerosols, externally mixed aerosol...
• MOSAIC actively updated and widely implemented
Nitrate partitioning - equilibrium

Nitrate partitioning – kinetic

(c) PM$_1$ (Hybrid)

(d) PM$_{1-10}$ (Hybrid)

Nitrate partitioning

- Figure from Trump et al 2015

- Total PM$_{10}$ not sensitive to aerosol distribution

- Partitioning between PM$_1$ (harmful) and PM$_{1-10}$ controlled by non-equilibrium processes

Goals and preliminary tests

1. Bulk MOSAIC – 90% (minimal code disruption)

2. Sectional MOSAIC – 40%
   - 2-bin
   - 4-bin
   - 8-bin

3. Mineral dust? SOA?
Bulk nitrate

Bulk MOSAIC - ISORROPIA II

ISORROPIA II

-2 0 +2 +4

0 10 20
Bulk ammonium
Bulk sulfate

Bulk MOSAIC – ISORROPIA II

ISORROPIA II

-0.08 -0.04 0

0 1 2 3 4
Sectional implementation in GEOS-Chem

Nitrate on non-dust PM_{2.5}/PM_{10}
Future work

• Determine most useful features for GEOS-Chem community

• MOSAIC includes sectional and modal size distributions

• Need to simulate and validate against observations
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References and credits
