#### Sources and fate of global organic aerosol

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#### Aerosols

- Liquid or solid particles suspended in gas
- Also known as fine particulate matter
- Size range: 1 nm to 10 μm
- Sources: fossil & biofuel combustion, forest fires, vegetation
- Composition: organics, black carbon, sulfates, nitrates, ammonium, metals, sea salt & dust



## Aerosols and Climate



- Aerosols result in global cooling
- Aerosols offset 20-60% of global warming



# Organic Aerosols (OA)

- Organic aerosols (OA) account for 20 to 90% of fine particulate matter (Zhang et al., 2007).
- But they are much less understood, because in the atmosphere,
  - ✓ they exist as a complex mixture of thousands of different compounds with different properties
  - ✓ we know very little about the physical and chemical processes that they partake in



- Shortcomings
  - $\checkmark$  Model evaluation is done using OA mass concentrations only
  - ✓ Models under-predict OA mass concentrations



- Possible solutions
  - ✓ New metrics: isotopic composition, oxygenation, volatility
  - ✓ Correcting the treatment of POA





## General Circulation Model (GCM)





# Results

- Configurations
  - ✓ Old model

#### ✓ This model or New model

- Model predictions vs observations
  - ✓ Mass concentrations
  - ✓ Isotopic Composition
  - ✓ Degree of oxygenation
  - ✓ Volatility



## Model vs Observations - OA mass concentration





## Model vs Observations - Source contribution

- Contemporary = wood, charcoal, agricultural residue, biogenic VOC's
- Fossil = gasoline, diesel, coal



# Model vs Observations - Isotopic contribution

- Ontemporary = wood, charcoal, agricultural residue, biogenic VOC's
- Fossil = gasoline, diesel, coal



Winter

\*Schichtel et al., 2008



# Model vs Observations - Degree of oxygenation

OOA / OA - Surrogate for degree of oxygenation





\*Data: David Lee & Ilona Riipinen, Cappa & Jimenez, 2010



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- In this work,
  - ✓ Correct for treatment of POA
  - ✓ Conduct a more comprehensive model evaluation
  - ✓ Improve prediction capabilities over old model



## **Policy Implications**

- This work helps in taking a small step in addressing the uncertainty that surrounds the impact of aerosols in our environment
- Policy relevance
  - ✓ Impact of pollutants on public health (mass concentrations)
  - ✓ Fossil fraction of pollution (isotopic composition)
  - ✓ Reduce the uncertainty on the indirect effect (oxygenation)
  - ✓ Semi-volatile pollutants have a higher damage potential (volatility)



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