SOA WORKSHOP REPORT

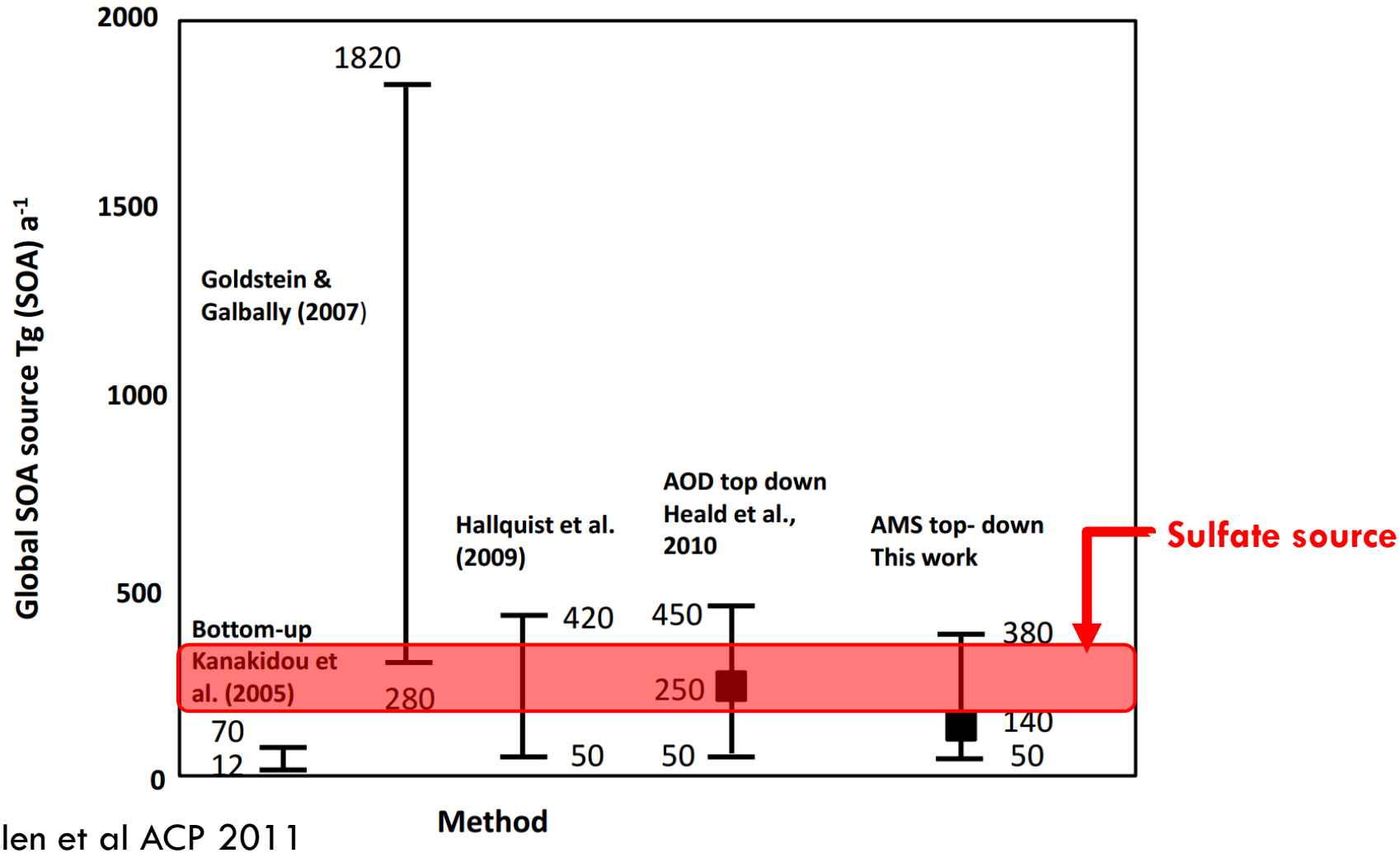
Manish Shrivastava (PNNL) and Joel Thornton (UW)

Supported by the U.S. Department of Energy's ASR Program

ASR
Atmospheric System Research

Joel Thornton, Department of Atmospheric Sciences
University of Washington

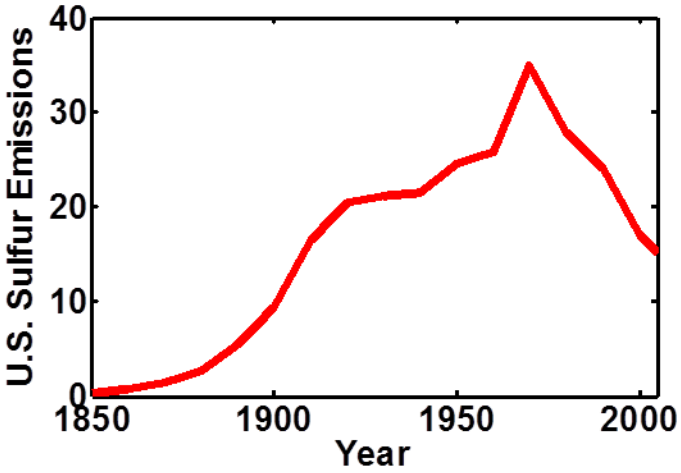
Secondary Organic Aerosol (SOA) - importance

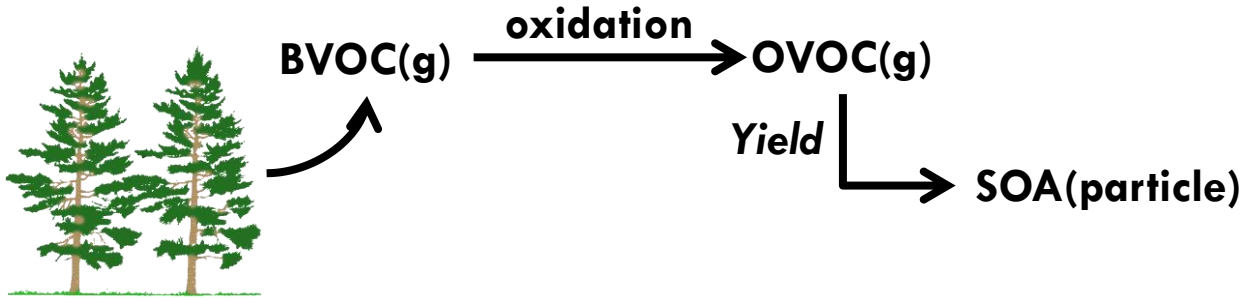


Spracklen et al ACP 2011

Key SOA-related science questions

- Extent to which human activities directly or indirectly enhance formation of SOA





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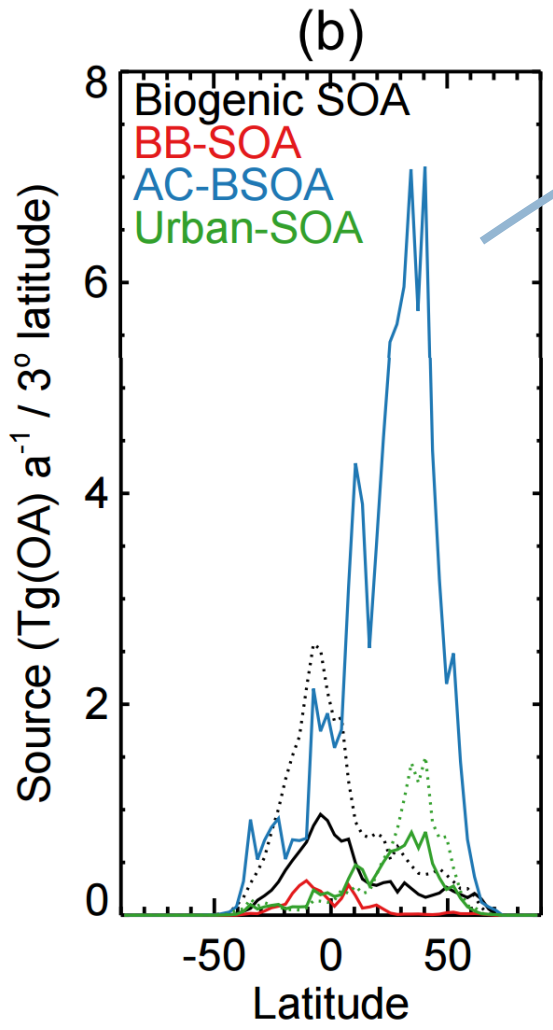

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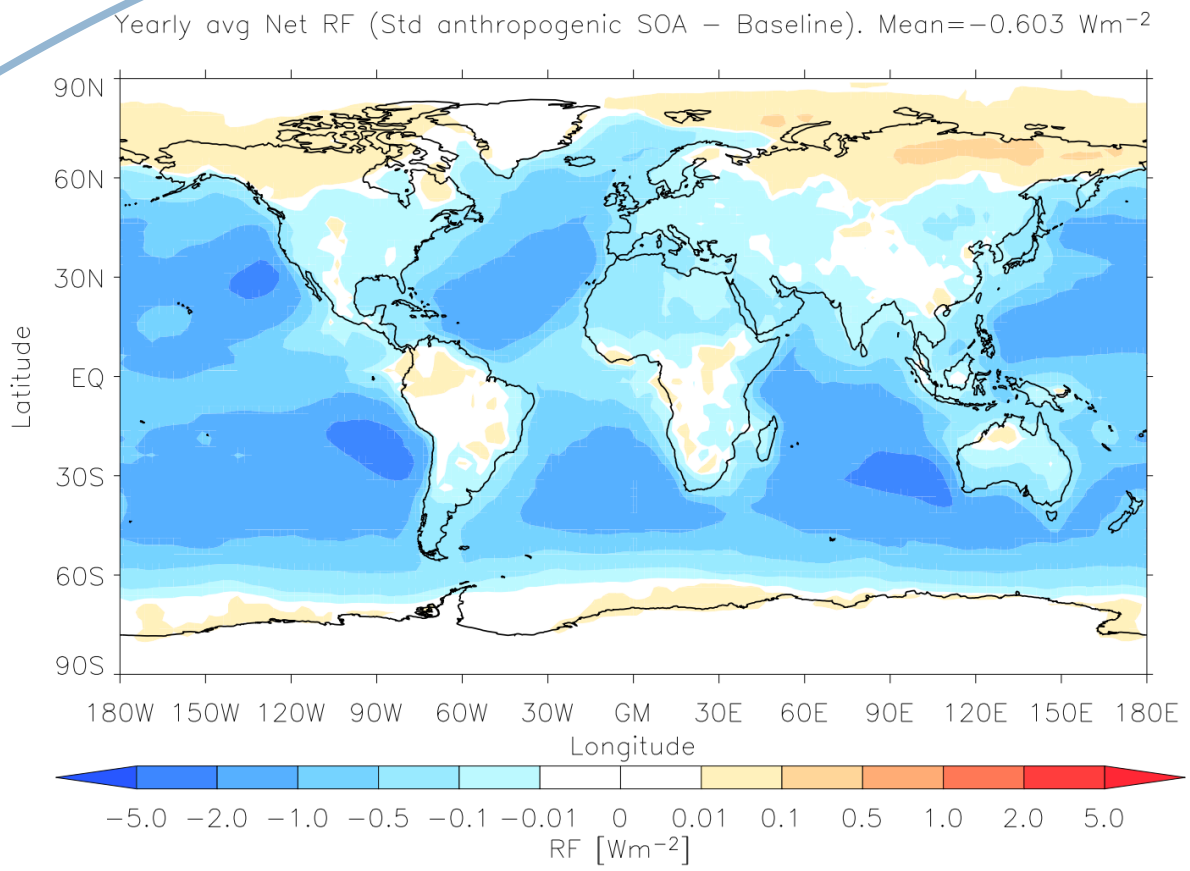
ACRF ~ - 0.6 W/m²



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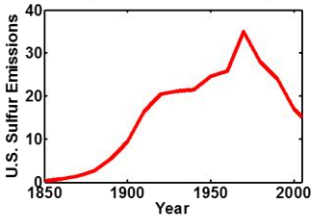
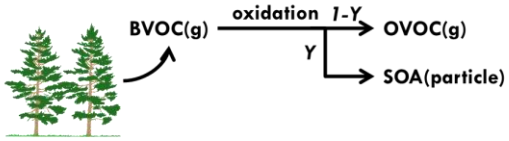
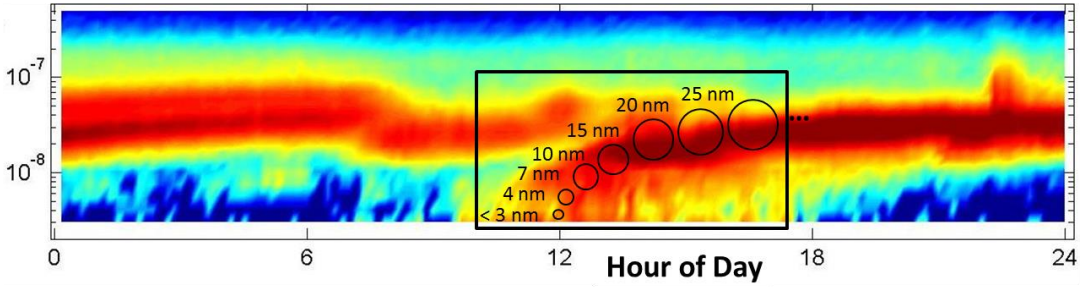
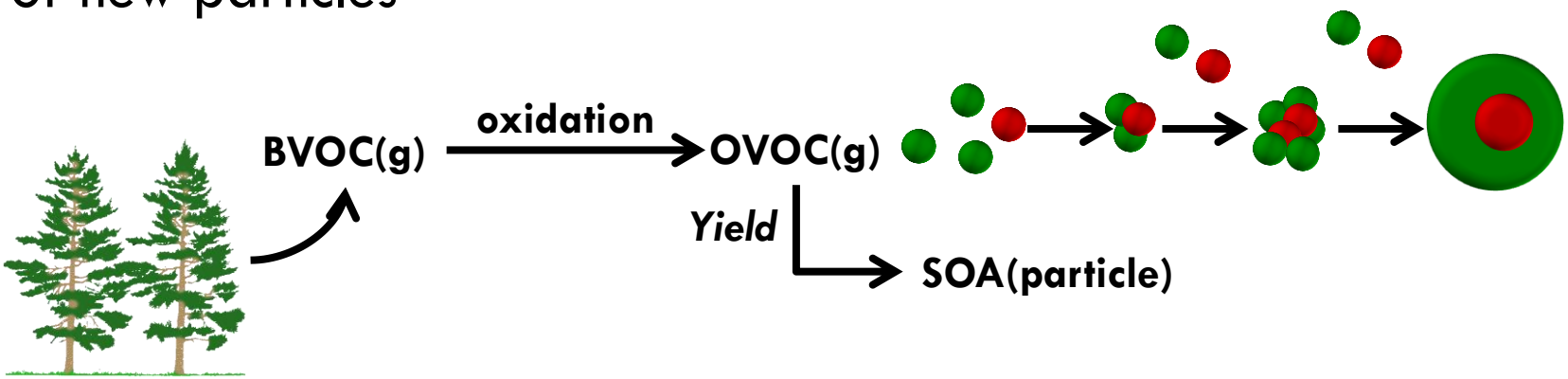


- Conversion efficiency of biogenic VOC to SOA – not even from a top-down perspective





- Contribution of BVOC oxidation to the formation and growth of new particles



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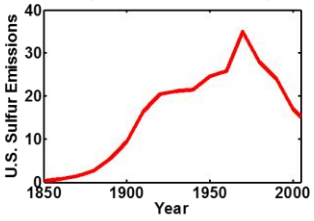

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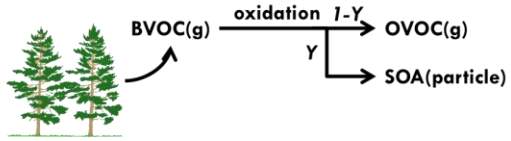

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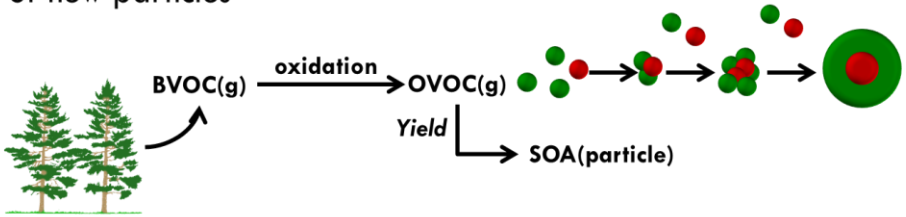
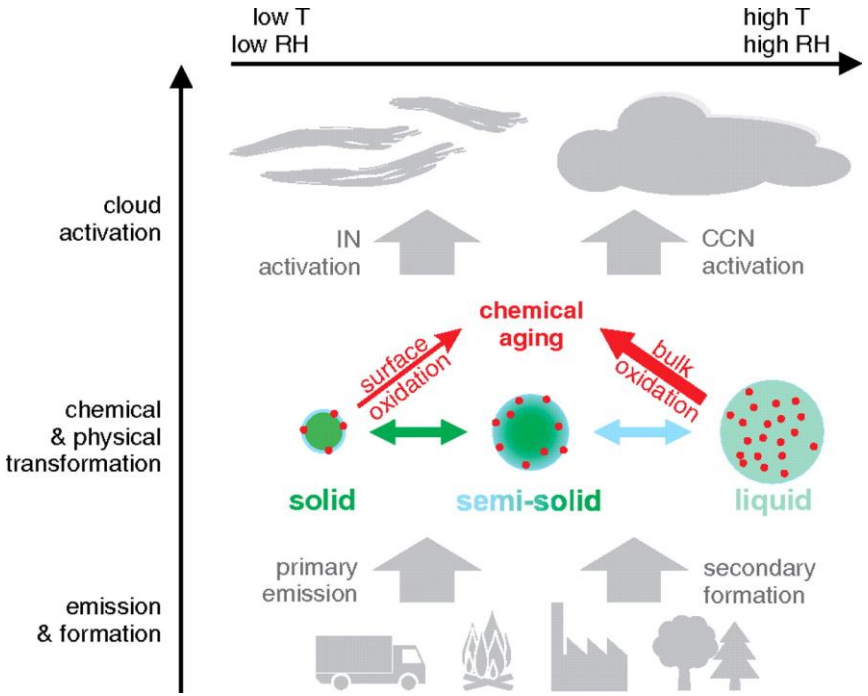


- What is the phase state of SOA?



Enhanced SOA formation from mixed anthropogenic and biogenic

Phase of atmospheric secondary organic material affects its reactivity

Mikinori Kuwata and Scot T. Martin[1]

School of Engineering and Applied Sciences and Department of Earth and Planetary Sciences, Harvard University, Cambridge, MA 02138

Edited by Mark H. Thiemens, University of California San Diego, La Jolla, CA, and approved September 11, 2012 (received for review May 29, 2012)

The interconversion of atmospheric organic particles among solid, semisolid, and liquid phases is of keen current scientific interest, especially for particles of secondary organic material (SOM). Herein, the influence of phase on ammonia uptake and subsequent particle-phase reactions was investigated for aerosol particles of

Xuan Zhang[a,1], Christopher D. Cappa[a,1,2], Shantanu H. Jathar[a], Renee C. McVay[a], Joseph J. Ensberg[a], Michael J. Kleeman[b], and John H. Seinfeld[a,c,2]

The atmospheric occurrence of organic semisolid particles ca
have important implications for aging processes. Aging can sig
nificantly alter a particle's physicochemical properties, includin
hygroscopic and optical properties (1). Diffusion of molecule
in a semisolid, however, is much slower than in a liquid. Th

LETTER

doi:10.1038/nature13032

A large source of low-volatility secondary organic aerosol

Mikael Ehn[1,2], Joel A. Thornton[2,3], Einhard Kleist[4], Mikko Sipilä[2], Heikki Junninen[2], Iida Pullinen[1], Monika Springer[1], Florian Rubach[1], Ralf Tillmann[1], Ben Lee[3], Felipe Lopez-Hilfiker[3], Stefanie Andres[1], Ismail-Hakki Acir[1], Matti Rissanen[2], Tuija Jokinen[2,5], Siegfried Schobesberger[2], Juha Kangasluoma[2], Jenni Kontkanen[2], Tuomo Nieminen[2,6], Theo Kurtén[7], Lasse B. Nielsen[8], Solvejg Jørgensen[8], Henrik G. Kjaergaard[8], Manjula Canagaratna[9], Miikka Dal Maso[10], Torsten Berndt[5], Tuukka Petäjä[2], Andreas Wahner[1], Veli-Matti Kerminen[2], Markku Kulmala[2], Douglas R. Worsnop[2,9], Jürgen Wildt[4]

SOA Workshop to Advance Model Capability

New Strategies for Addressing Anthropogenic-Biogenic Interactions of SOA in Climate Models

M Shrivastava
JA Thornton

June 8 – 9, 2015
PNNL

December 2015

Chris Cappa	Philip Rasch
Jiwen Fan	Pontus Roldin
Jerome Fast	Siegfried Schobesberger
Charlotte Geffen	John Seinfeld
Steven Ghan	John Shilling
Allen Goldstein	James Smith
Alex Guenther	Jian Wang
Ian Kraucunas	Douglas Worsnop
Tuukka Petaja	Rahul Zaveri
Jeff Pierce	Alla Zelenyuk

U.S. DEPARTMENT OF ENERGY
Office of Science

ASR
Atmospheric System Research

Workshop Goals

- What are some of the most significant recent advances in our understanding of SOA sources and properties?
- What aspects of these advances are known well enough to be incorporated into regional or global models?
- What aspects require more understanding before being incorporated?
- What are the technical challenges to incorporating such advances into models?

Workshop Outcomes - Report

- A set of SOA processes or properties now understood at a mechanistic or quantitative level allowing for sensitivity studies in earth system models
  - Acid catalyzed SOA formation from isoprene epoxydiol
  - Reactions producing low and extremely low organic vapors from autoxidation chemistry
  - SOA hygroscopic behavior (sub and supersaturated regimes)
  - Diffusion limitations due to RH-dependent viscosity
  - Aging of biomass burning
  - Others…

Workshop Outcomes - Report

- A set of recommendations for future basic research needs and technical requirements for improving representation of SOA in earth system models
  - Reduce uncertainty in epoxydiol kinetic parameters
  - Improve quantitative estimates of LVOC and ELVOC yields for different precursors
  - Role of walls in laboratory determined SOA yields
  - Quantify importance and identify key mechanisms of particle-phase accretion chemistry
  - Improved understanding of SOA viscosity dependence upon precursor and formation conditions
  - Others…

Workshop Outcomes – Beyond the Report

- A discussion of the report within the broader ASR community during breakout sessions

- A manuscript based on the report and subsequent discussions submitted to *Reviews of Geophysics*

Manish Shrivastava, Christopher Cappa, Jiwen Fan, Allen Goldstein, Alex Guenther, Jose Jimenez, Chongai Kuang, Alexander Laskin, Scot Martin, Nga Lee Ng, Tuukka Petaja, Jeffrey Pierce, Philip Rasch, Pontus Roldin, John Seinfeld, John shilling, James Smith, Joel Thornton, Rainer Volkamer, Jian Wang, Douglas Worsnop, Rahul Zaveri, Alla Zelenyuk, Qi Zhang, **Recent advances in secondary organic aerosols (SOA): Implications for global climate forcing**, *Reviews of Geophysics, in revision*

Workshop outcomes

- A continuing discussion about leveraging unique opportunities in ASR to combine process level understanding w/modeling capabilities