

# Evaluating New Particle Formation in GEOS-Chem-TOMAS

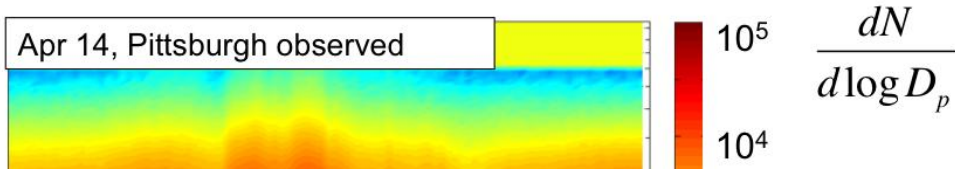
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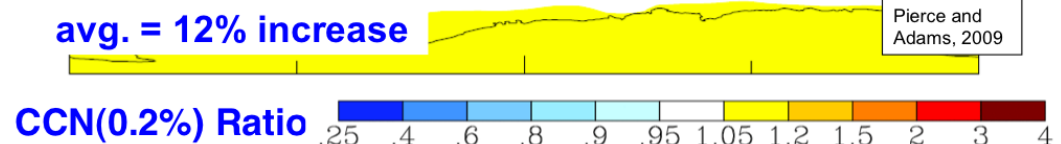
# New Particle Formation and CCN



## Observations

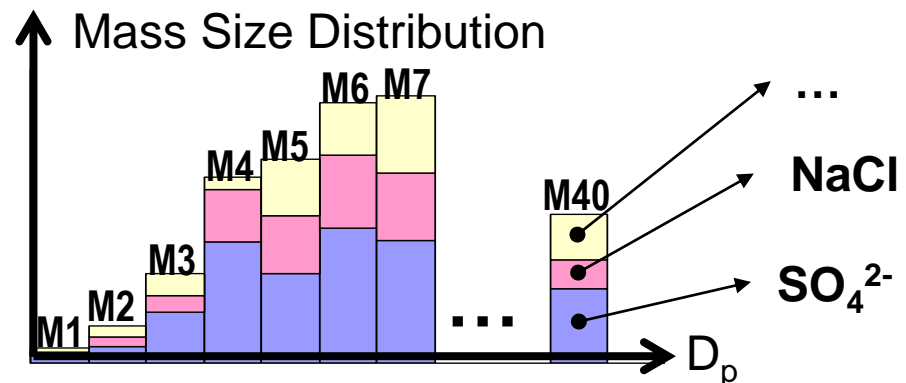
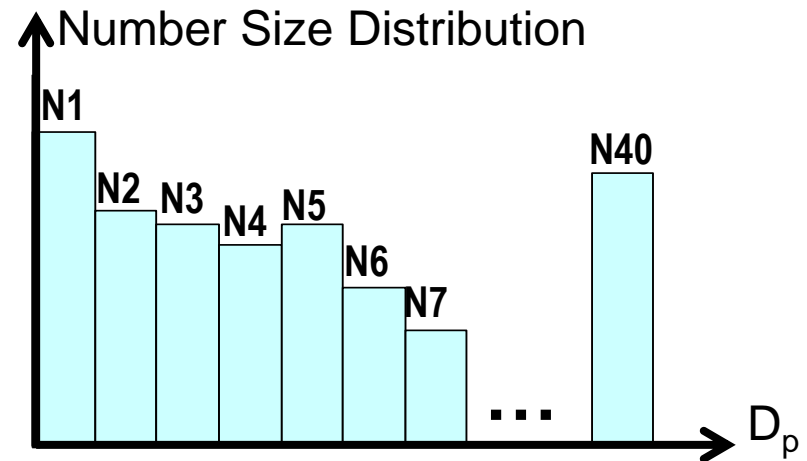
- Ambient measurements show growth to CCN sizes (~80 to 100 nm)
- Models predict modest sensitivity of CCN to nucleation
- Are they predicting aerosol dynamics correctly?
  - no robust nucleation theory
  - not enough SOA? Not enough growth to CCN?

## Models



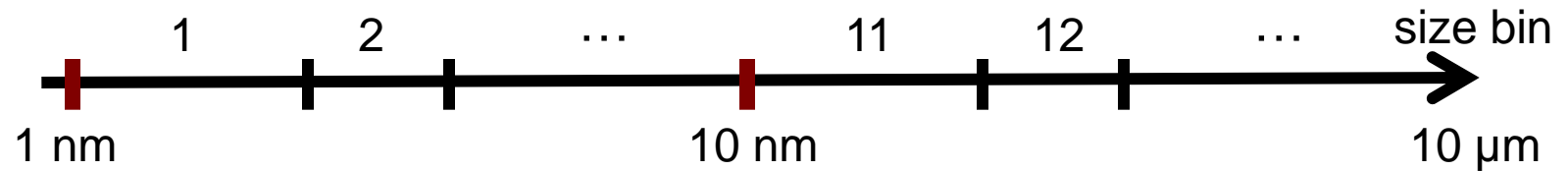
## Two Moment Aerosol Sectional microphysics algorithm

- Part of standard GC code
- Condensation, coagulation, nucleation, cloud processing
- Size-resolved species:
  - $\text{SO}_4$ , NaCl, OC, EC, dust
- 40 size sections
- CCN calculated from Köhler theory



# TOMAS features

- Size resolution:



TOMAS-40: Explicit nucleation mode dynamics to 1 nm

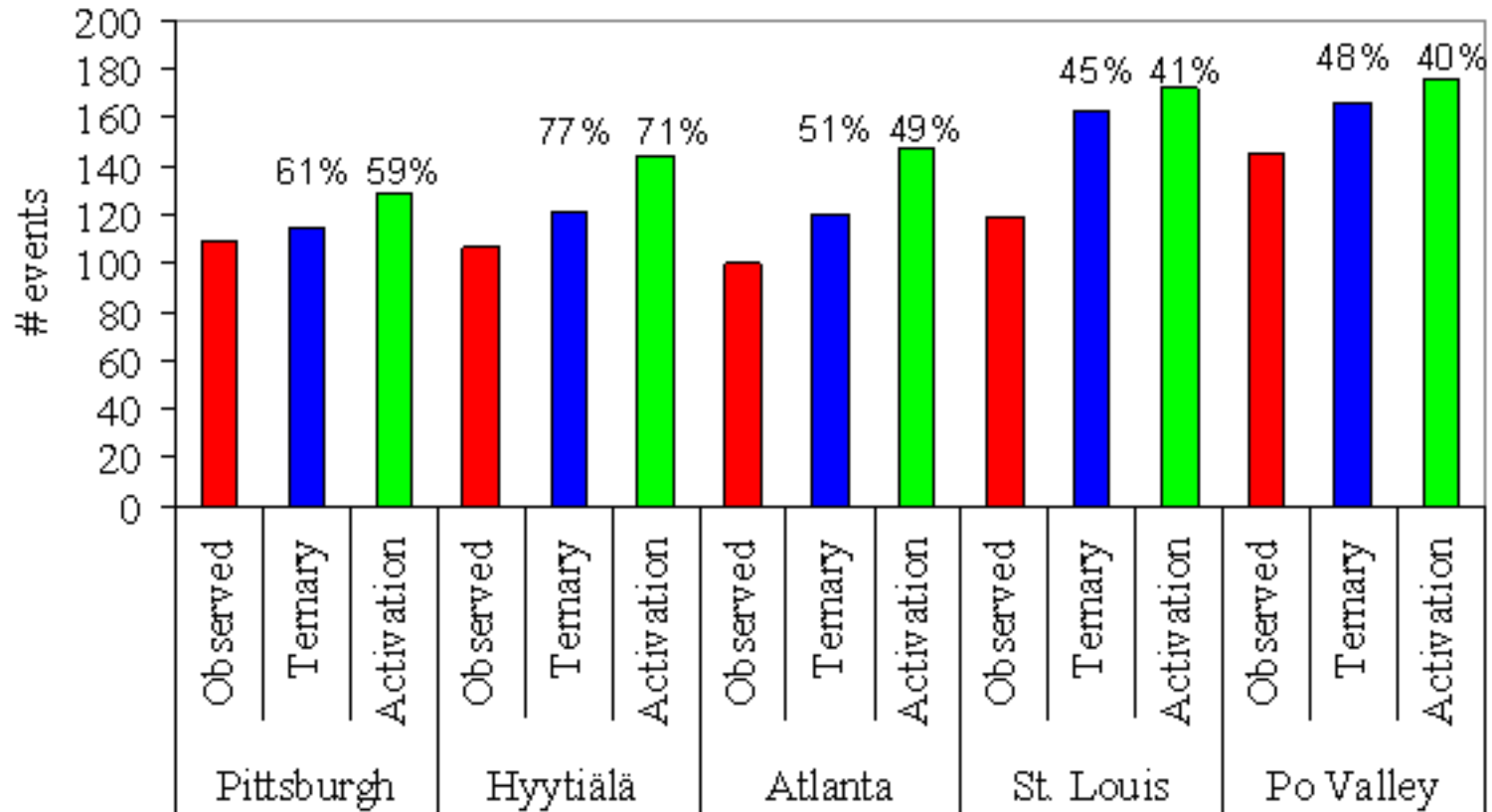
TOMAS-36 or TOMAS-15: Dynamics to 3 nm

TOMAS-30 or TOMAS-12

- Time resolution: up to 30 min intervals
- Nucleation: **Binary** (Vehkamäki et al. 2002), **Ternary** (Napari et al. 2002), **Activation** (Kulmala et al. 2006), **Ion-mediated** (Yu et al. 2008)

# Evaluating TOMAS nucleation

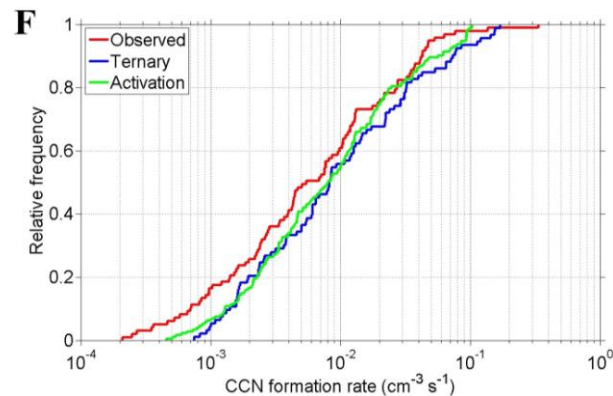
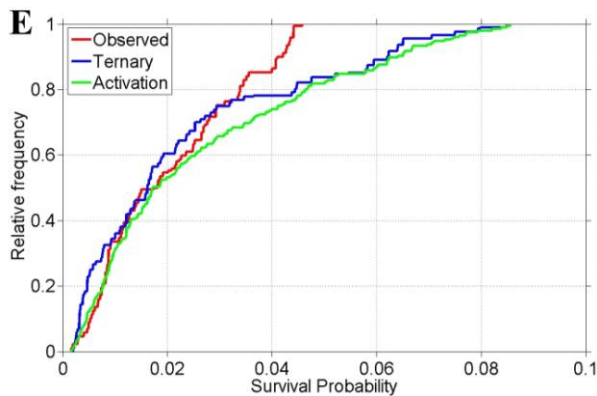
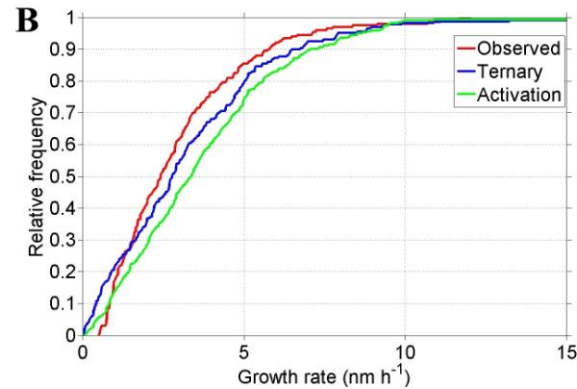
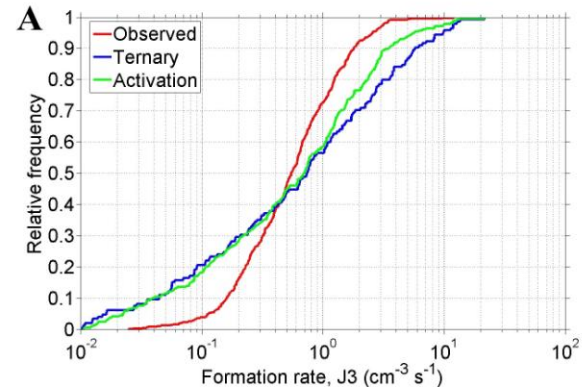
One year of nucleation events



- 5 sites, 7+ metrics of comparison
- Events more frequent in ternary model by 18% averaged across all sites

# Evaluating TOMAS nucleation dynamics

## Hyttiälä Empirical CDFs



## Hyttiälä median values

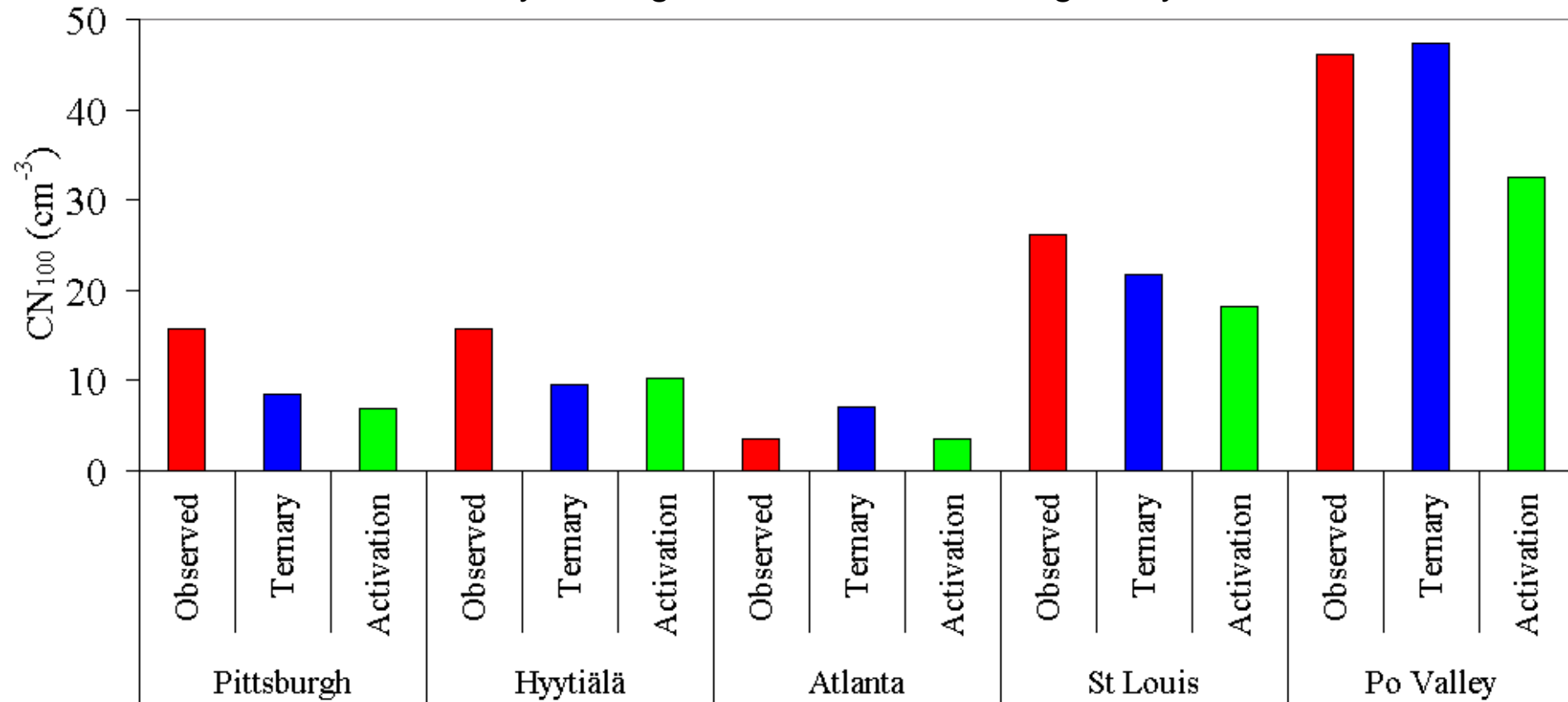
	Obs	Ter.	Act.
$J_3$	0.5	0.7	0.7
GR	2.3	2.9	3.4
SP	1.8	1.8	1.7
%			
$J_{100}$	.005	.008	.008

## Hyttiälä LMNB

	Ter.	Act.
$J_3$	0.23	0.20
GR	0.04	0.06
SP%	-0.05	-0.08
$J_{100}$	0.023	0.020

# CCN concentrations from nucleation events

Annually averaged CN100 from all single day events



- Ternary underpredicts CN100 at Pittsburgh (-34%) and Hyttiälä (-45%) but not for Po Valley (5%)

# Conclusions

- TOMAS, hosted by GEOS-Chem, simulates aerosol microphysics and calculates resultant number and mass size distributions
- TOMAS can be obtained by downloading GEOS-Chem
- TOMAS show modest but non-negligible CCN sensitivity to new particle formation
- Nucleation and growth dynamics are predicted reasonably well by TOMAS
- TOMAS related inquiries can be directed to Dan Westervelt ([dwesterv@andrew.cmu.edu](mailto:dwesterv@andrew.cmu.edu))
- [http://wiki.seas.harvard.edu/geos-chem/index.php/TOMAS\\_aerosol\\_microphysics](http://wiki.seas.harvard.edu/geos-chem/index.php/TOMAS_aerosol_microphysics)