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Chemistry of New Particle Growth in Mixed Biogenic and Urban Emissions - Insights from CARES

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Regional New Particle Events

- NPG is stronger and faster at T0 than at T1

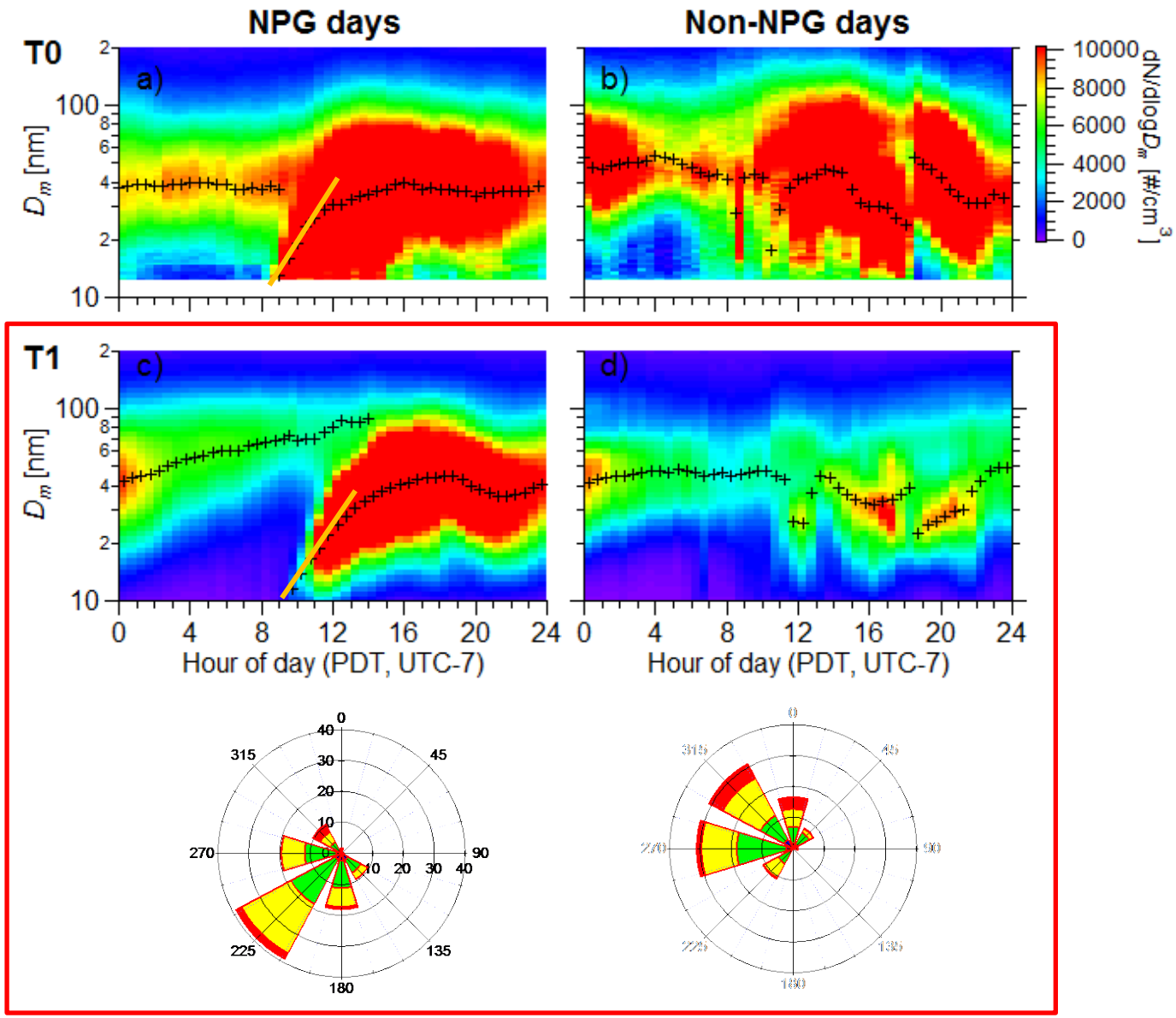
  T0: $\Delta D_m/\Delta t$
  ~ 7 nm hr^{-1}

  T1: $\Delta D_m/\Delta t$
  ~ 6 nm hr^{-1}

- Less frequent NPG at BFRS (~ 30% of time): $\Delta D_m/\Delta t$ 3.8 nm hr^{-1}

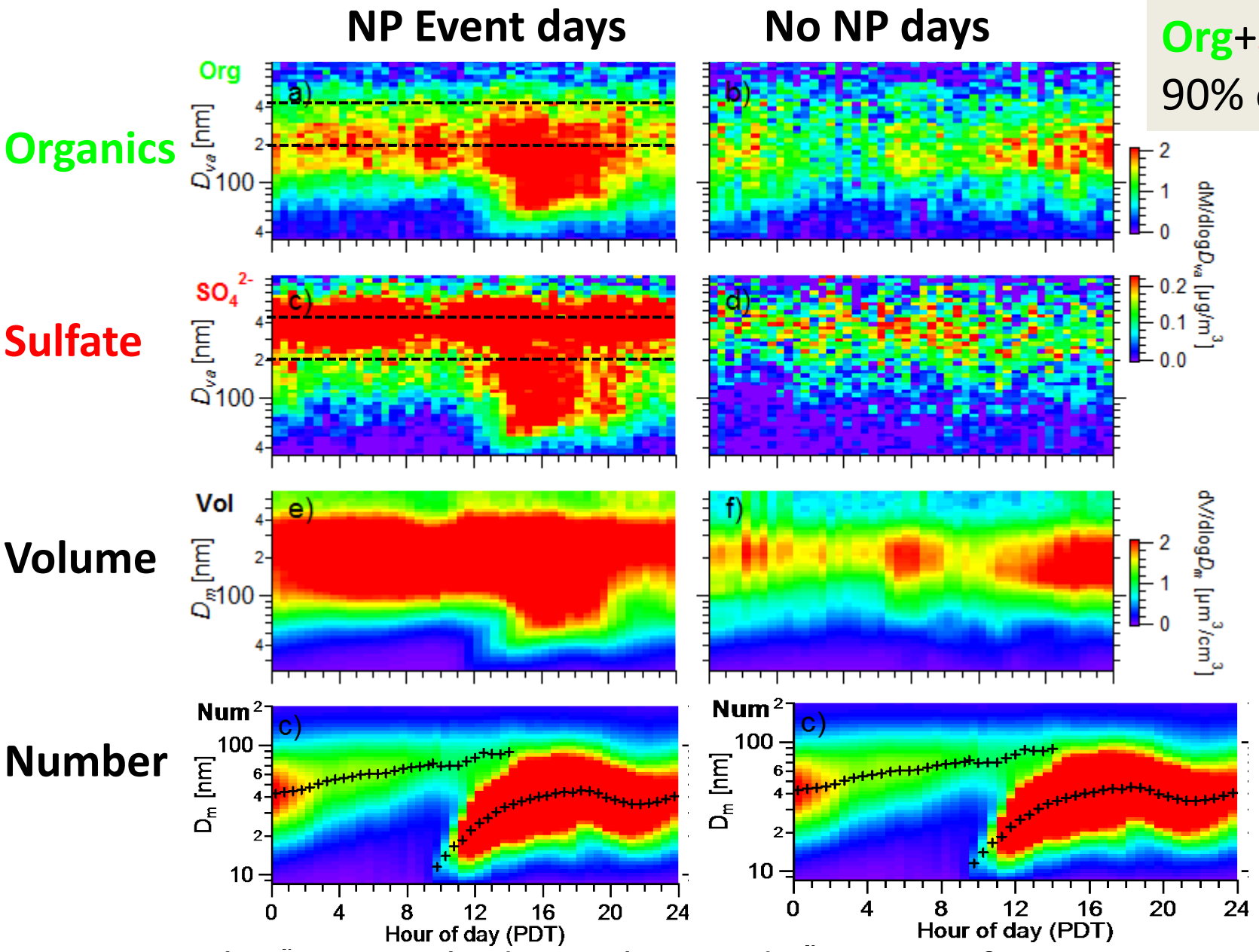
  Lunden et al., 2006

- NPG at T1 is associated w/ SW flow



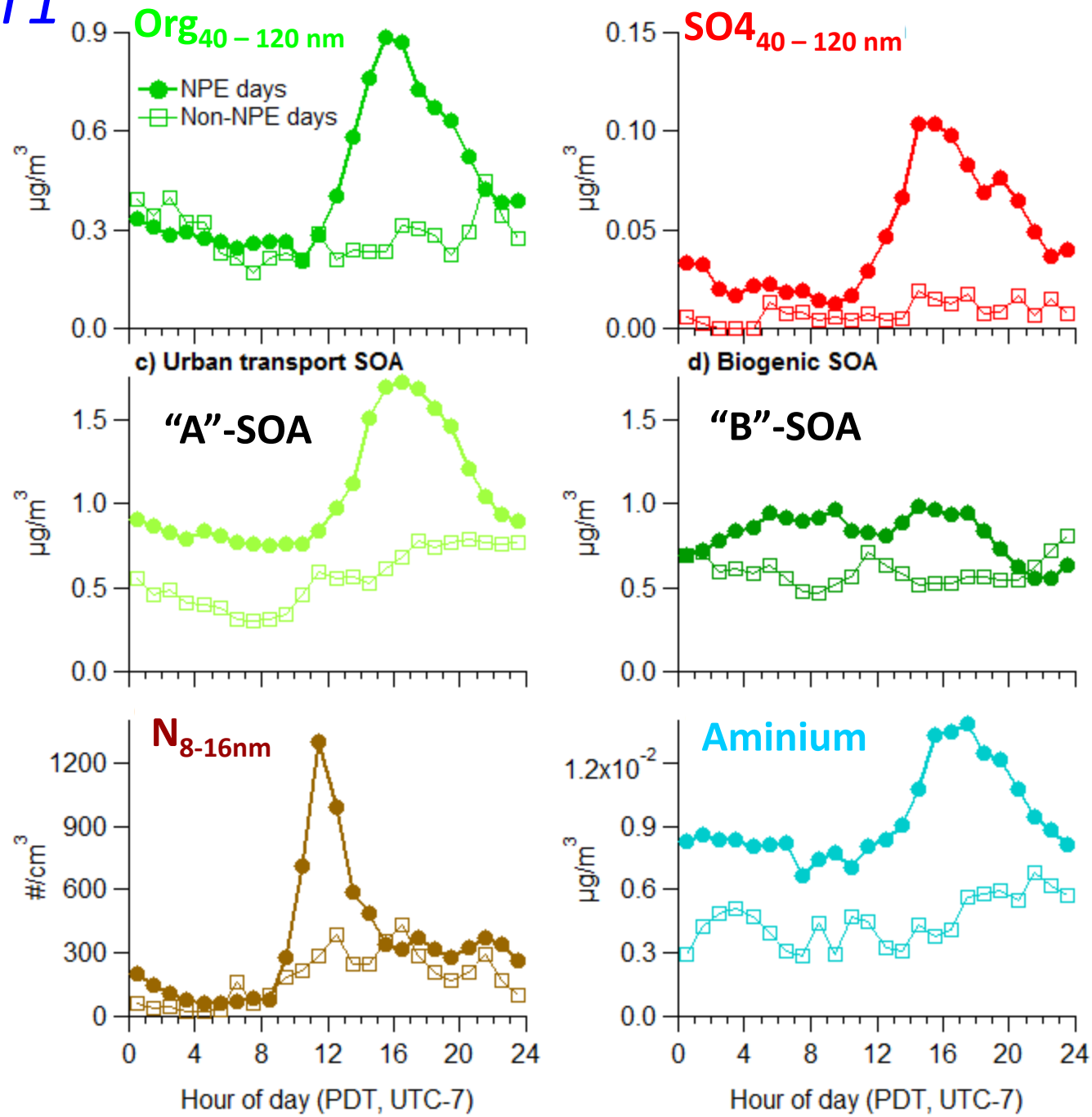
Evolution of Particle Chemistry at T1

Org+SO4 > 90% of PM_1



- *NP growth was mainly driven by condensation of **organics** & **sulfate***

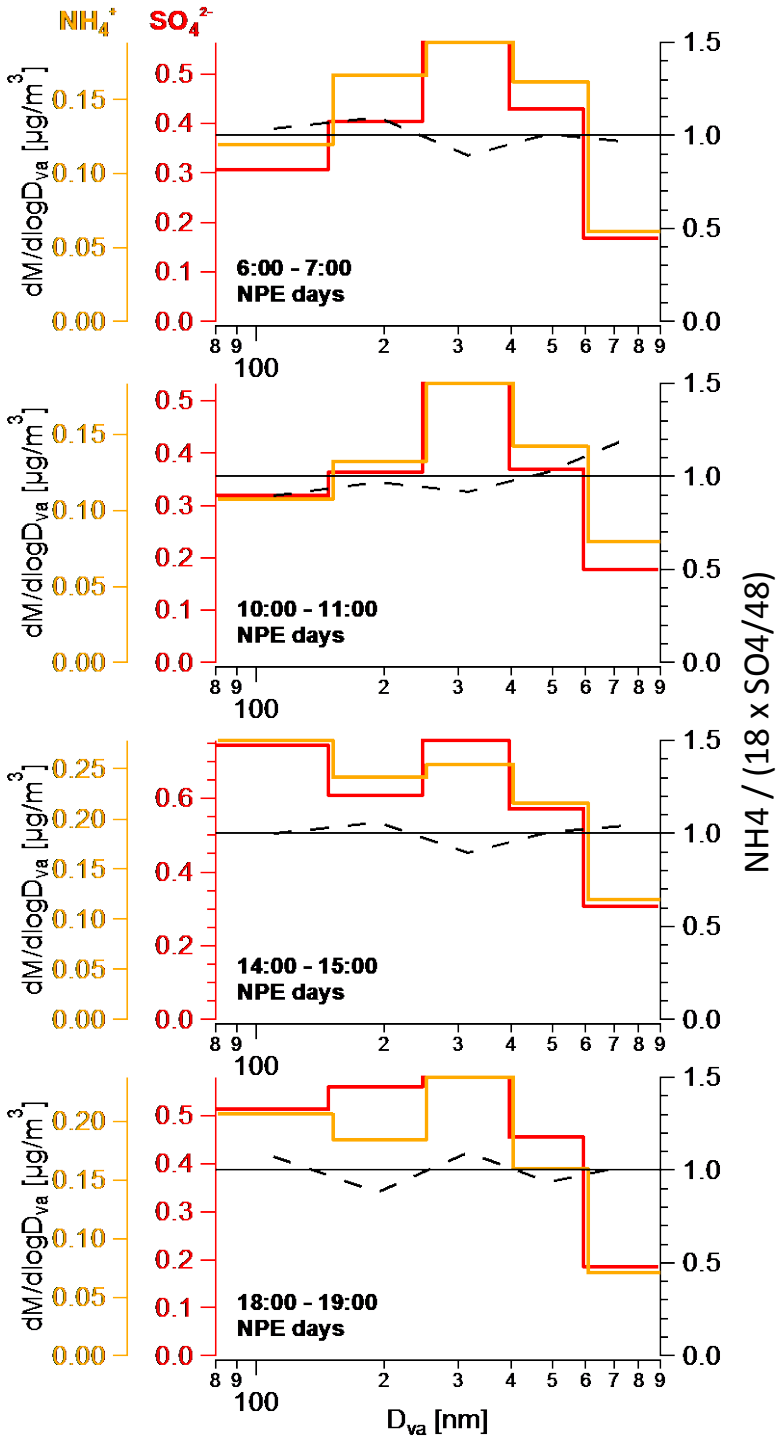
T1



Chemistry of NP growth:

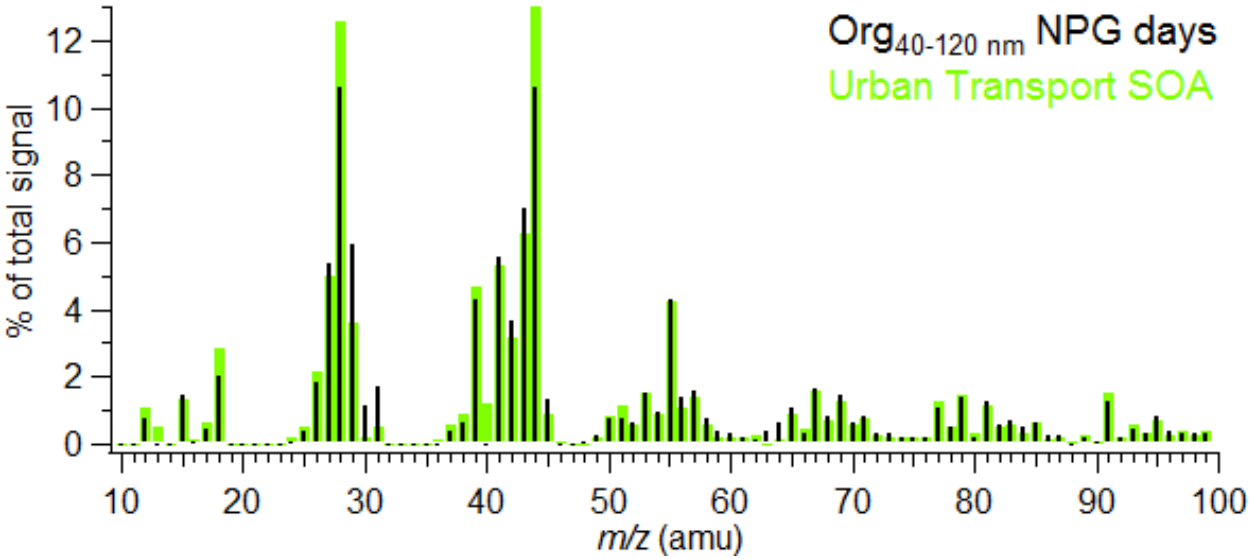
- *SOA* >> *Sulfate*
- "A"-SOA >> "B"-SOA
- ↑ of aminium species

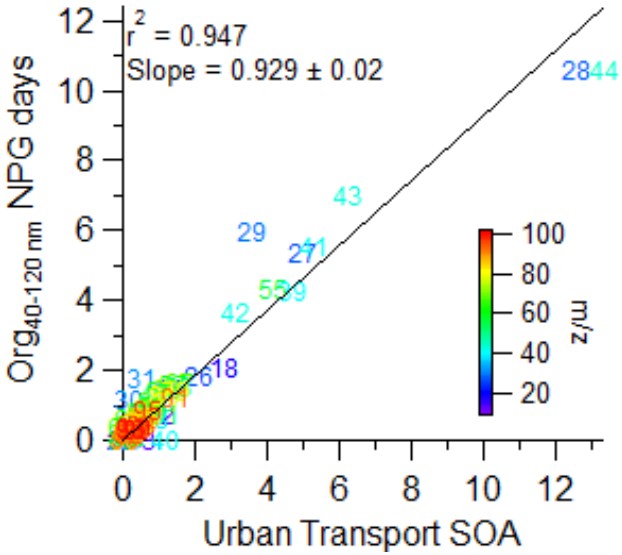
amines likely played a role in NPE.

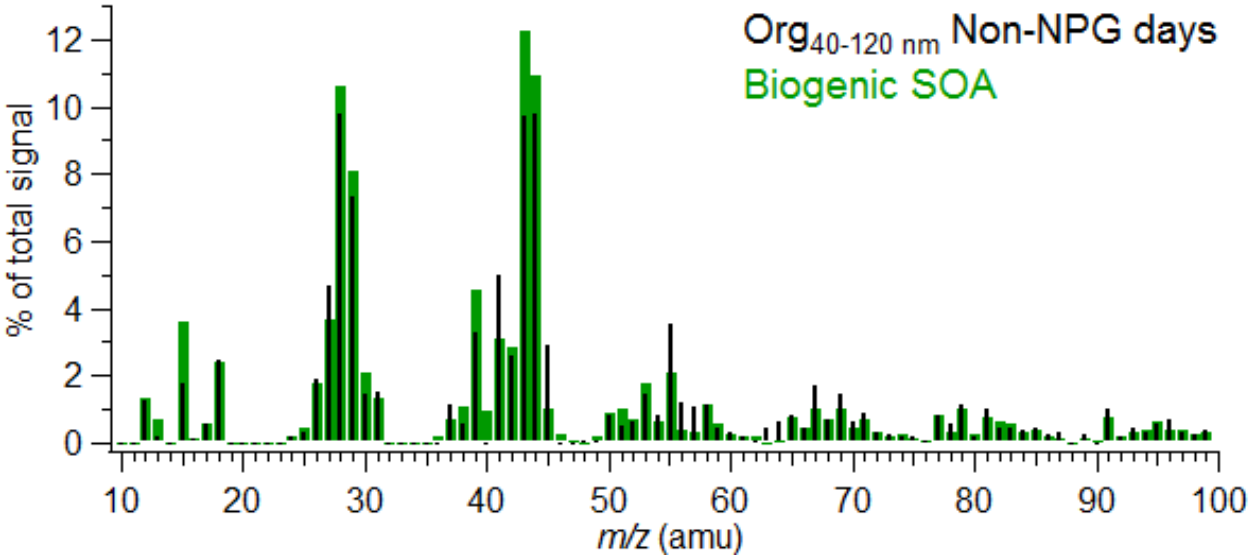


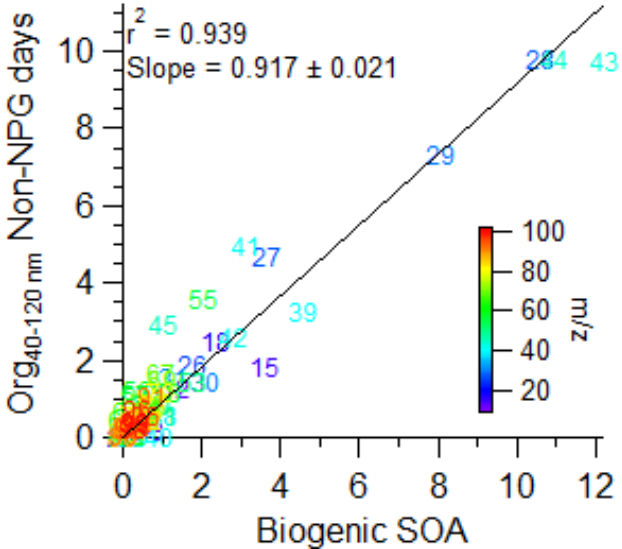
Ultrafine particles were fully neutralized during NPE

New Particle Growth Mainly Contributed by "A"-SOA

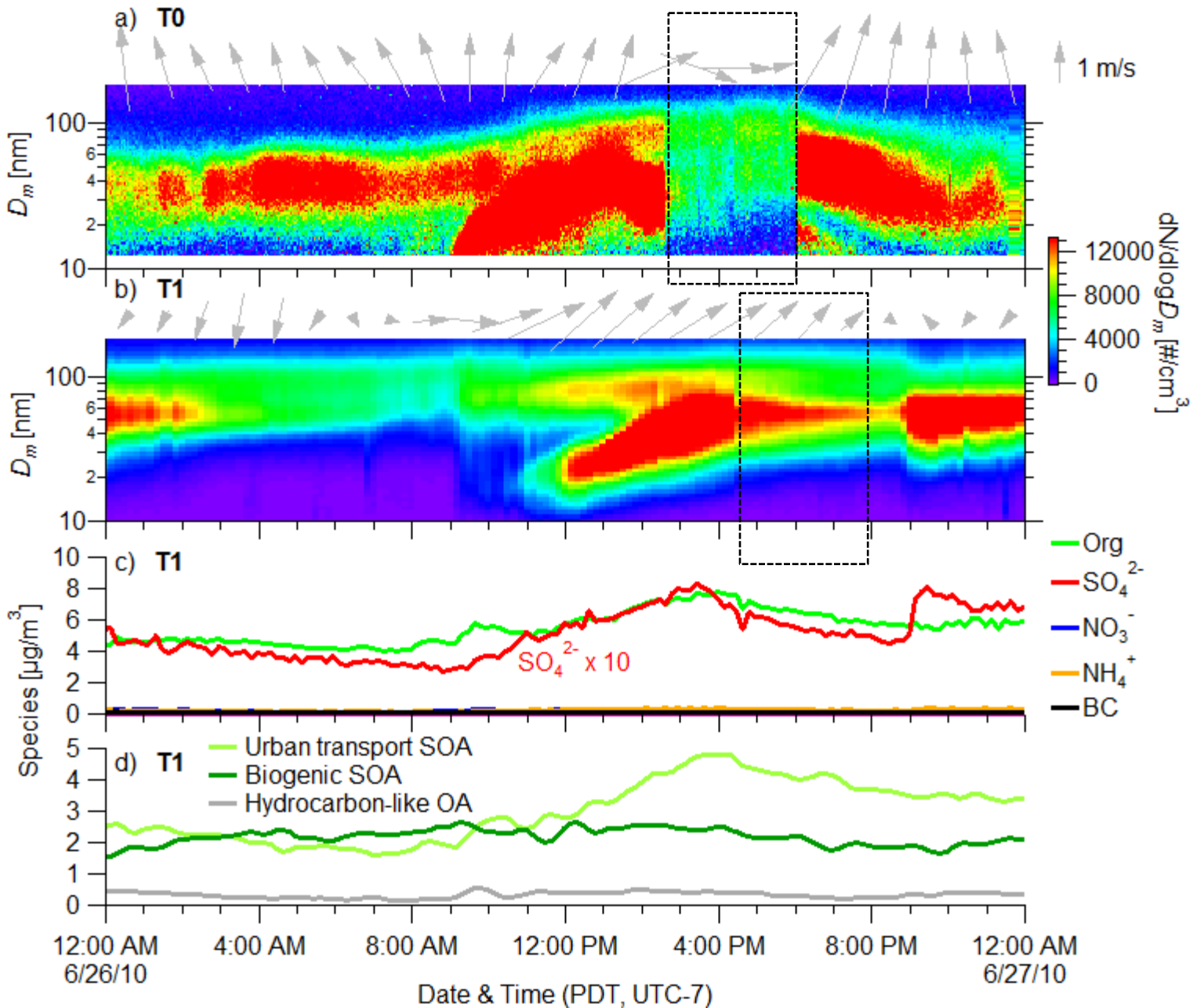








NPE in mixed biogenic and urban emissions – Lessons from CARES

- Regional NP events occurred almost daily at T0 & T1 in June, 2010.
- NPE were associated w/ SE winds bringing urban plumes from Sac. to T1.
- Higher NP growth rate closer to urban emissions: *T0 (7.1±2.7 nm/hr) > T1 (6.2±2.5) > Blodgett Forest (3.8±1.9; Lunden et al. 2006)*
- Insights into chemistry of NP growth at T1 (based on HR-ToF-AMS):
  - Growth of new particles was driven primarily by oxygenated organic species and, to a lesser extent, ammonium sulfate.
  - Organics contributed to NP growth have similar composition as "A"-SOA.
  - New particles were fully neutralized during growth, consistent with high NH_3 concentration in the region.
  - Aminium species ↑ significantly during NPE →amines played a role.
- NP formation and growth are important processes in N. Cal., promoted by the interactions between biogenic emissions and urban plumes.
- Need to better understand the chemistry of NP formation and growth:
  - Field observations with instrumentation capable to measure particles < 10 nm and stable clusters (e.g., Nano-SMPS, APi-ToF, nano-CIMS…) and key gas phase species (e.g., amines).
  - Laboratory studies to assess how the interactions between biogenic and anthropogenic pollutants affect new particle growth

Dominant Roles of Organics in New Particle Growth