Hygroscopicity and CCN Activity of Secondary and Processed Primary Organic Aerosols

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Objectives:

(1) Evaluate the effect of **oxidative aging** on the **CCN activity** of primary organic aerosol (**POA**) of varying carbon number and functionality

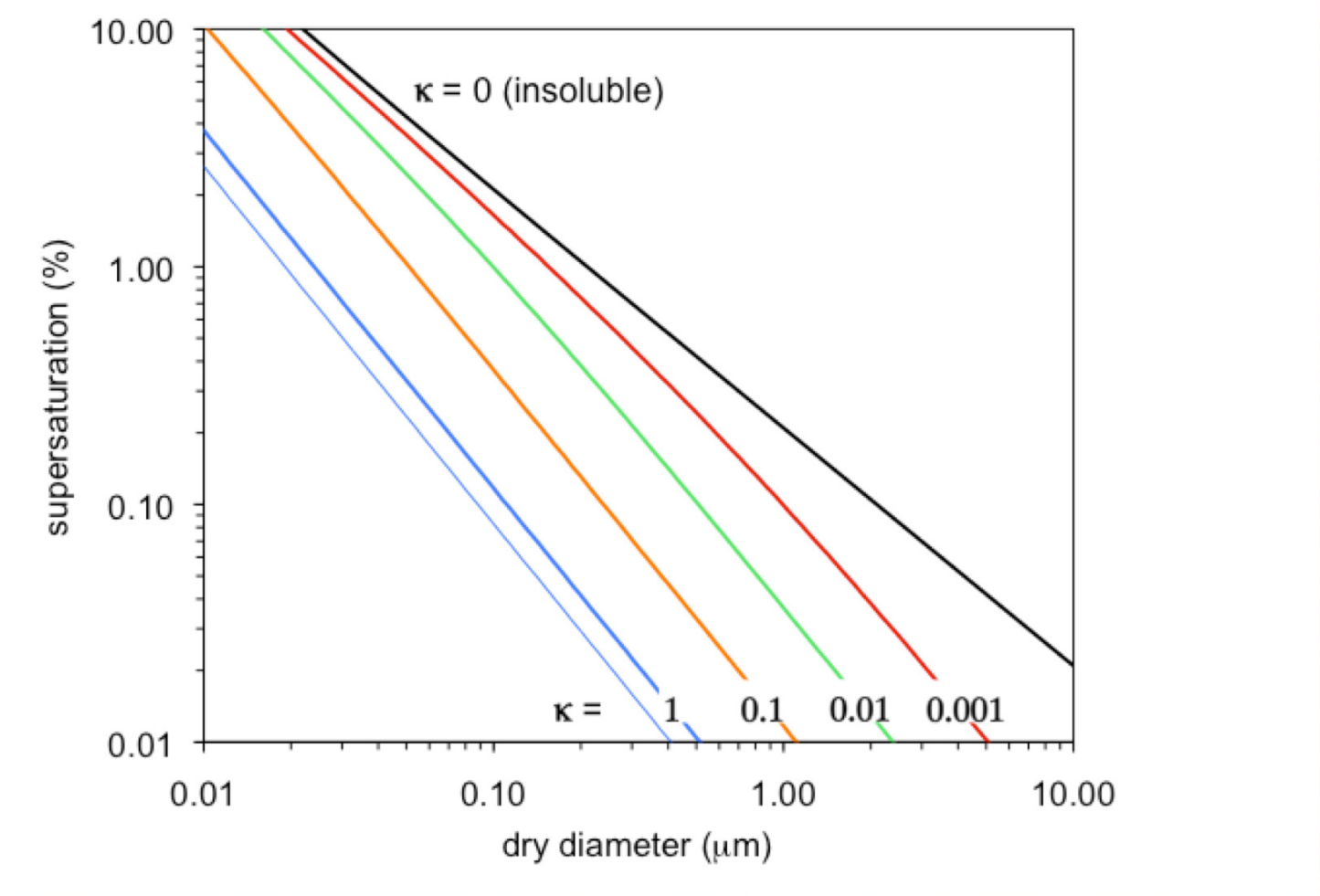
(2) Evaluate the **CCN activity** of secondary organic aerosol (**SOA**) generated from precursor molecules of varying carbon number and number of double bonds, with varying functionality in SOA from different oxidants

(3) Develop a fundamental model to **relate CCN activity to chemical structure and functionality**

Methods:

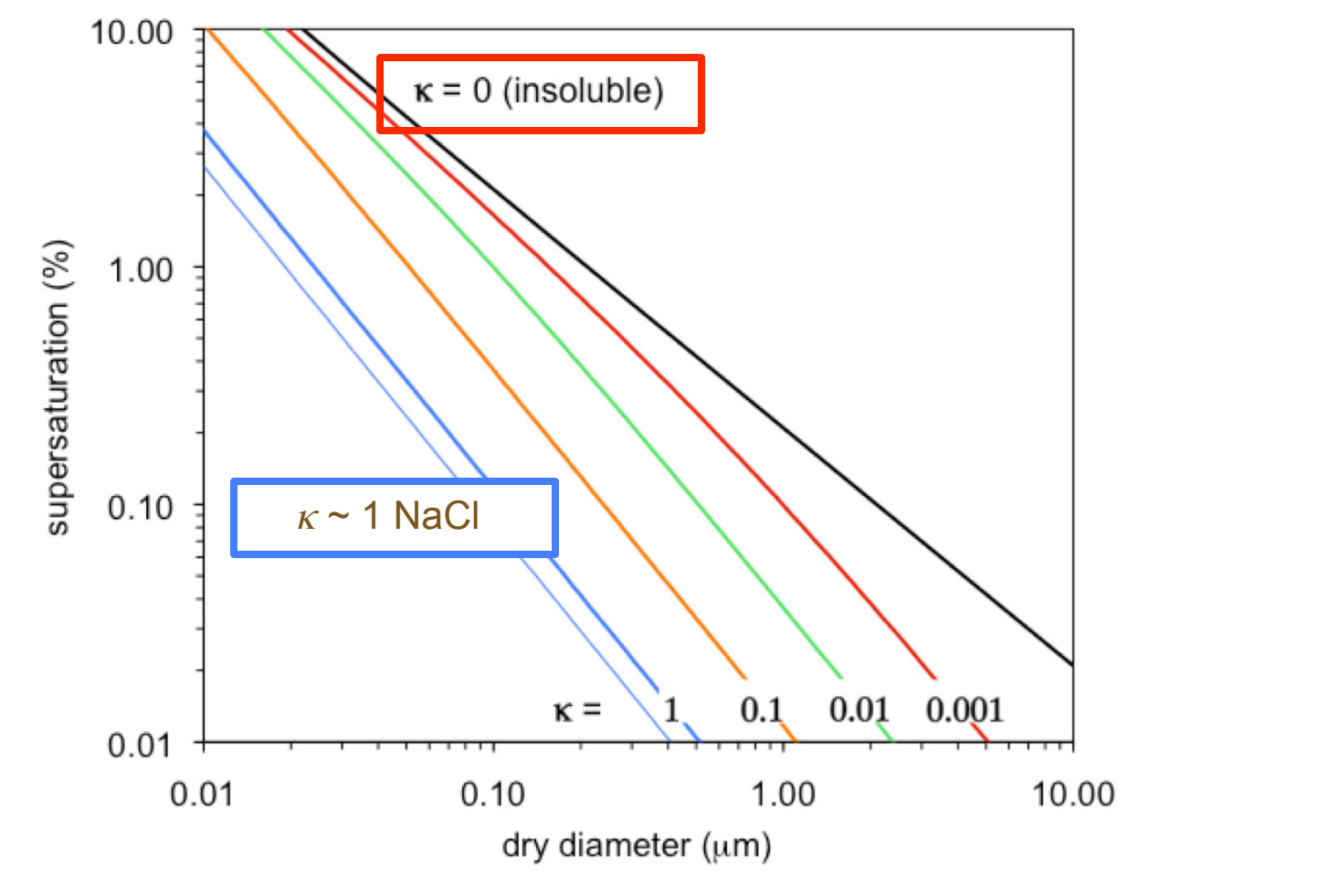
- Generate SOA / oxidize POA particles in Riverside's 6 m^3 smog chamber
- Use chemical analytical methods to analyze functional groups, other properties in resulting aerosol
- Use CCN counter to quantify relationship between critical supersaturation (S_c) and dry diameter (D_{dry})
- Organize findings using "hygroscopicity parameter"

The hygroscopicity parameter

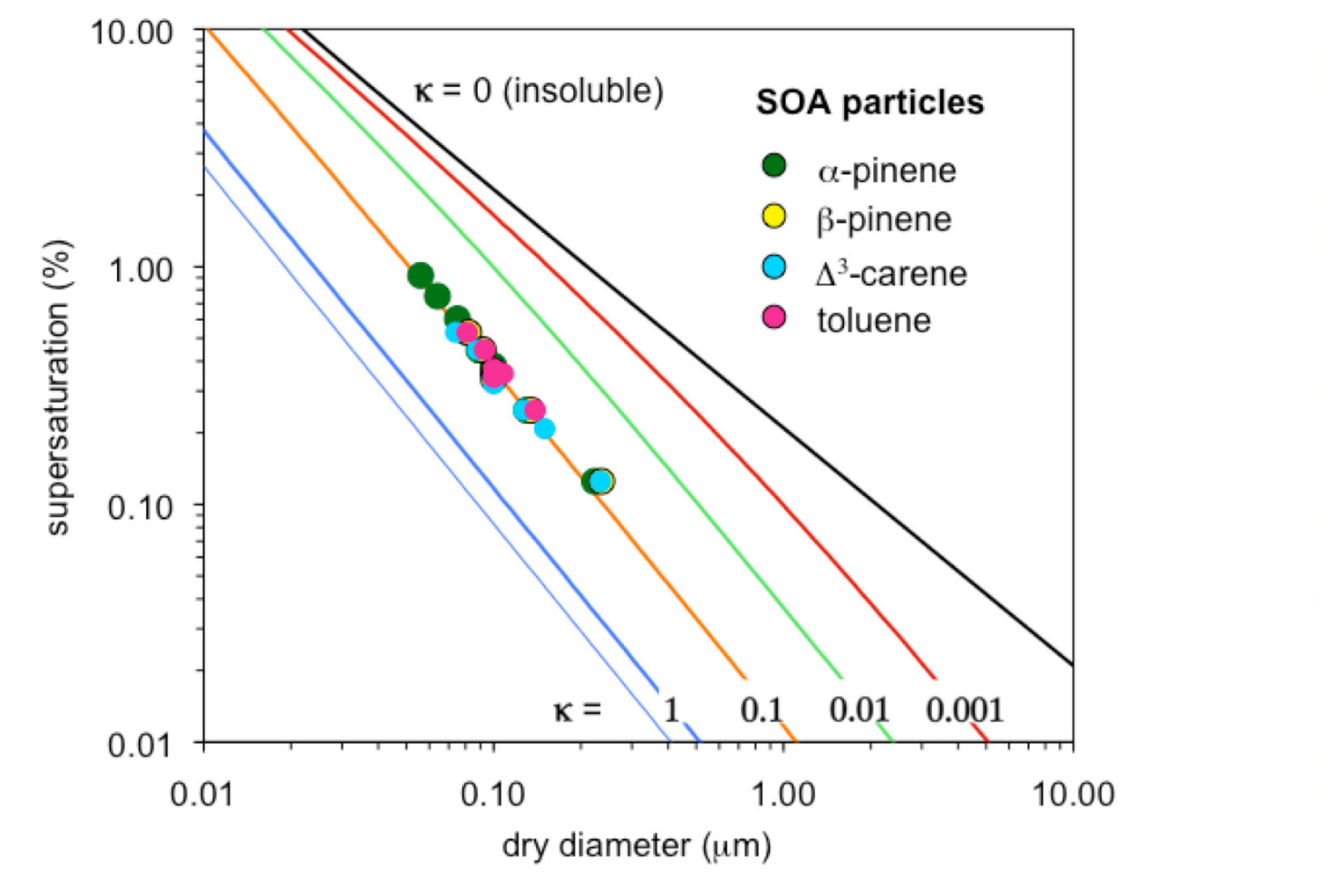


(Petters & Kreidenweis, 2007; 2008)

The hygroscopicity parameter

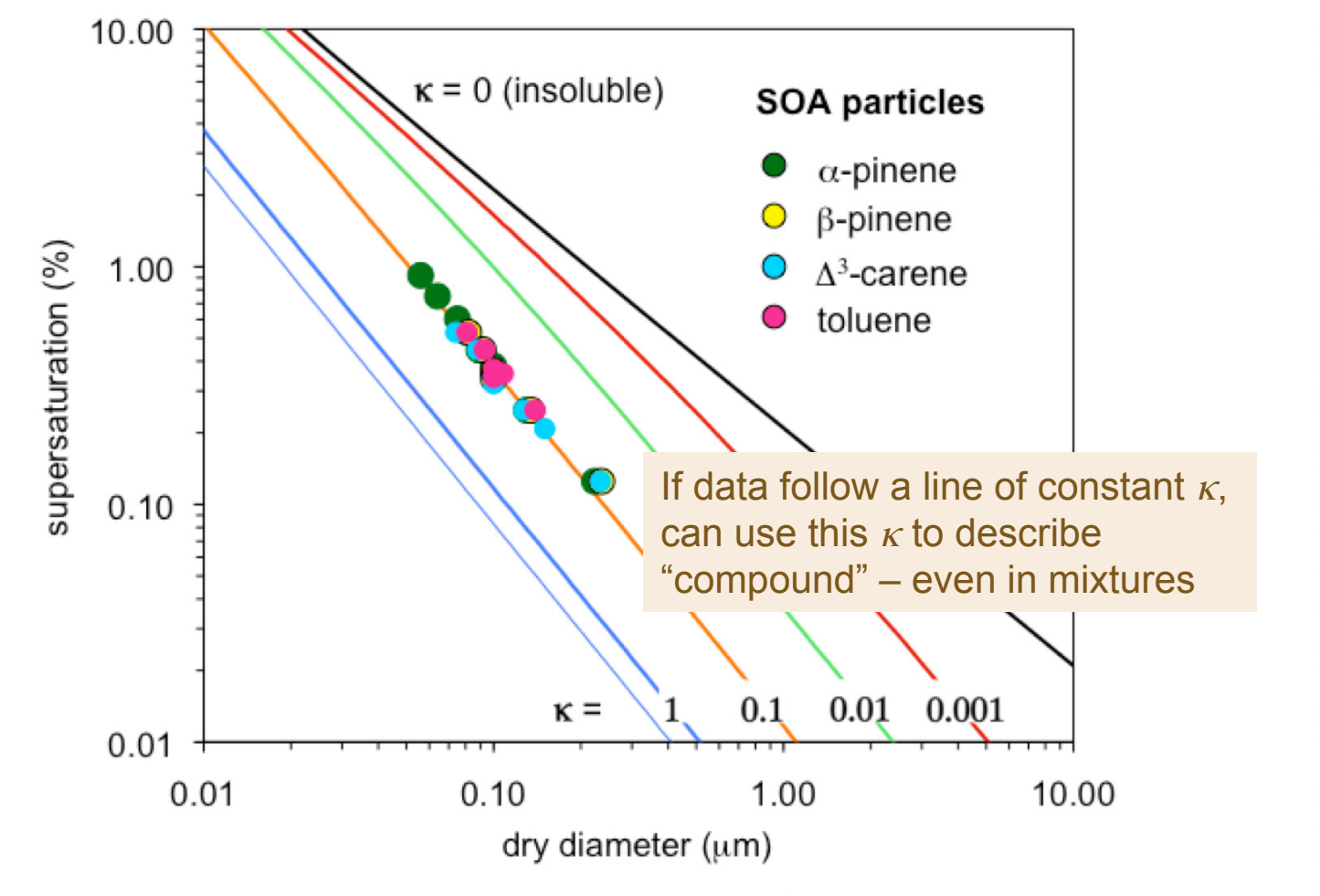


The hygroscopicity parameter



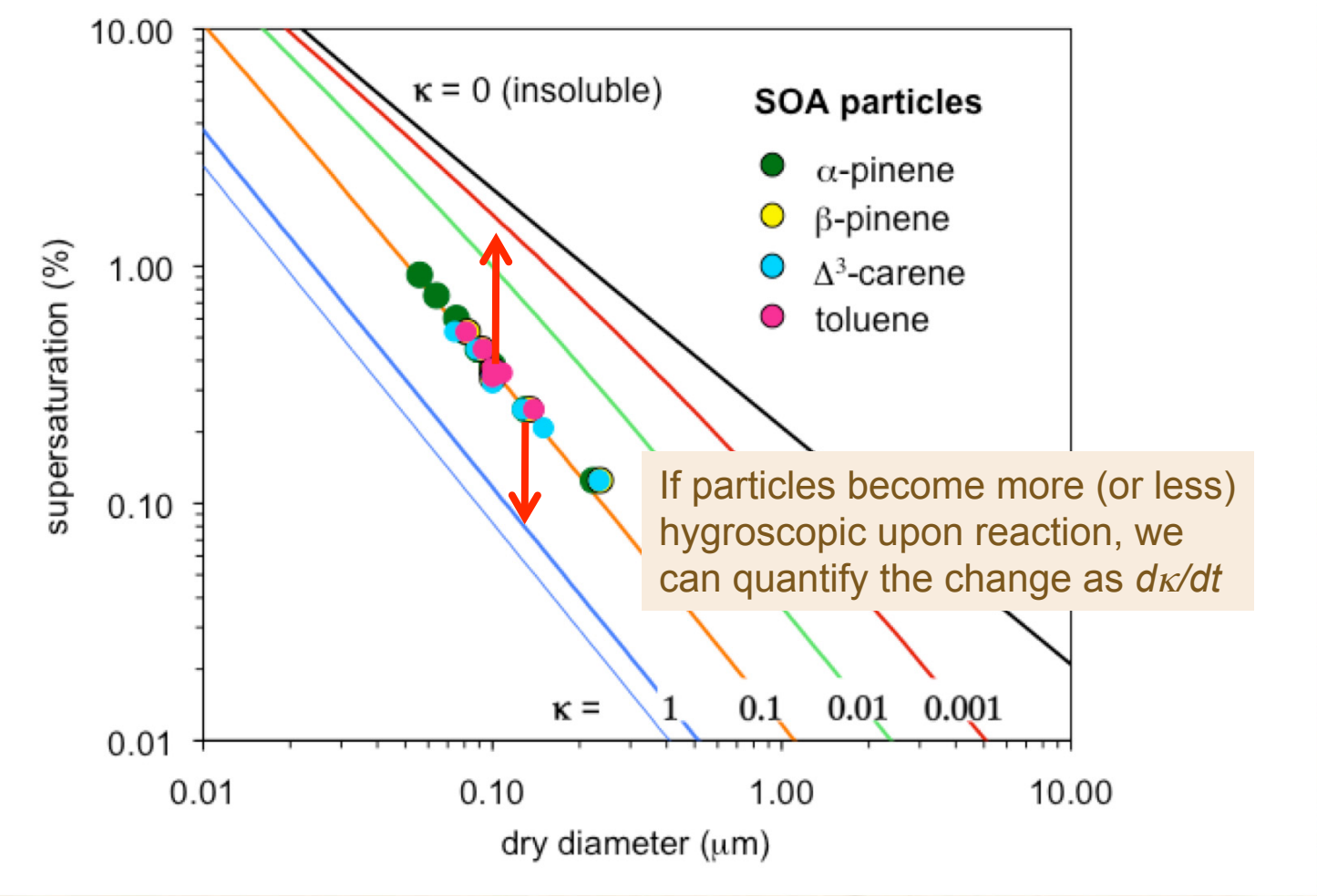
(Prenni et al., 2007)

The hygroscopicity parameter



If data follow a line of constant κ, can use this κ to describe "compound" – even in mixtures

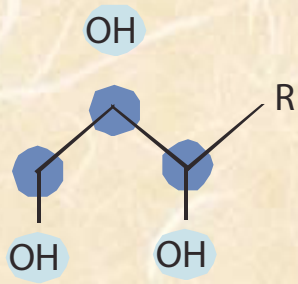
The hygroscopicity parameter



If particles become more (or less) hygroscopic upon reaction, we can quantify the change as $d\kappa/dt$

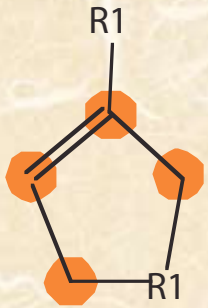
Partial derivatives of κ

$$\left(\frac{\partial \kappa}{\partial \text{chain}}\right)_{\text{functional group}}$$



polyols and saccharides (C3-C18)

$$\left(\frac{\partial \kappa}{\partial \text{FG}}\right)_{\text{chain}}$$

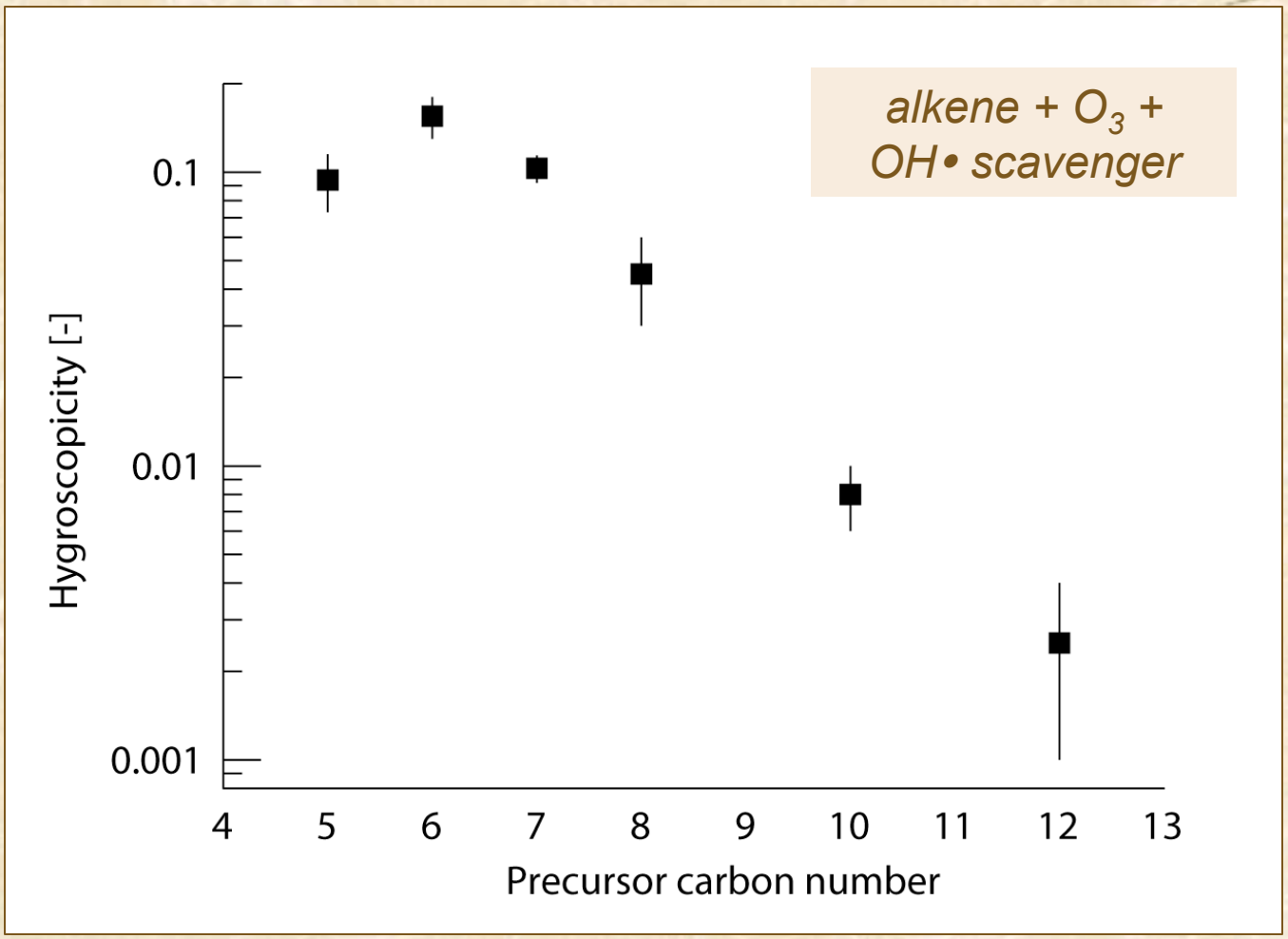


SOA from cyclic and substituted cyclic alkenes (C5-C12) + oxidant

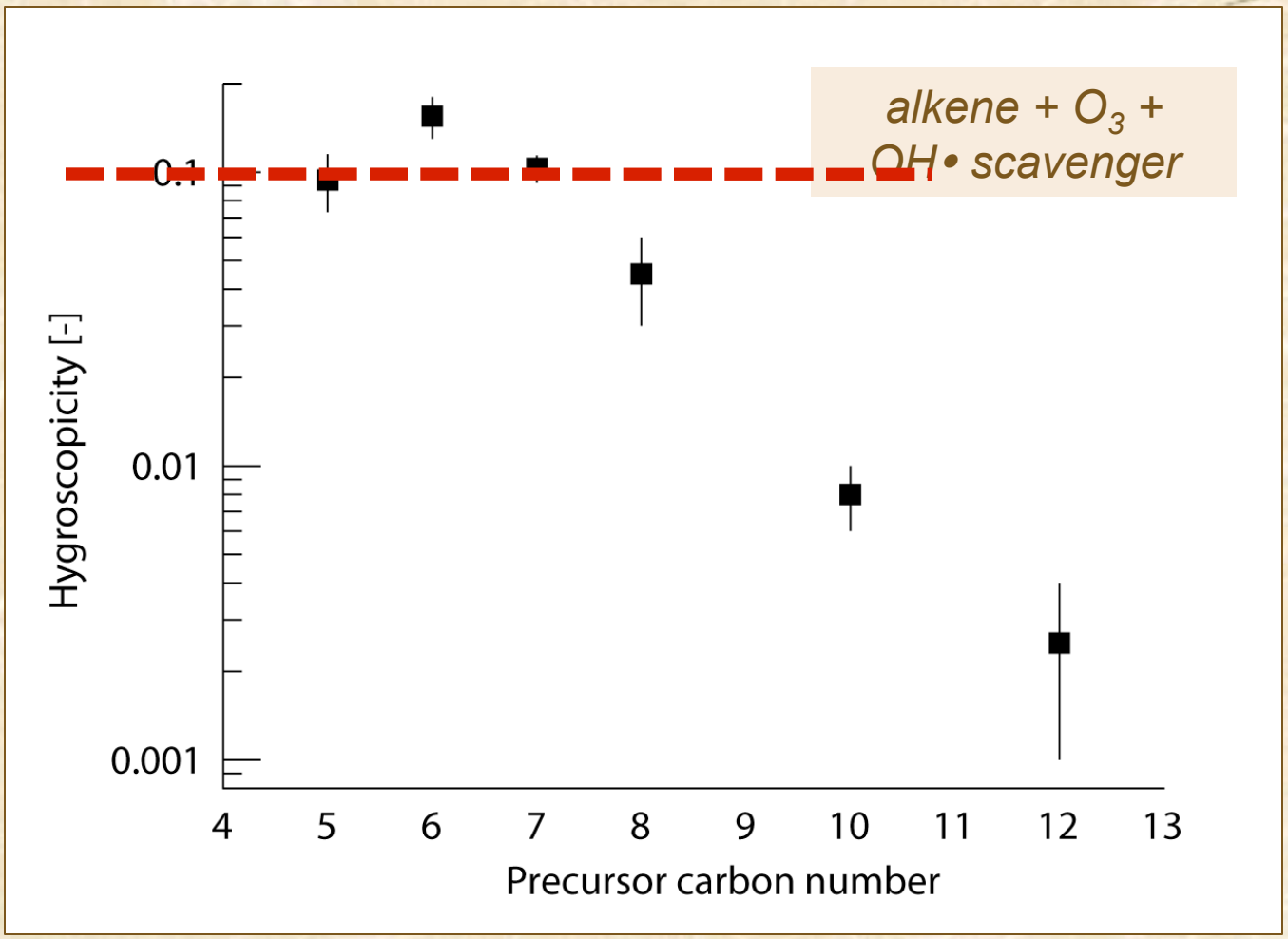
We have completed series of experiments (*see poster*):

- SOA from 1-alkenes (C7-C17) + oxidant
- SOA from cyclic and substituted cyclic alkenes (C5-C12) + oxidant
- oligoethylene glycols (100 < MW < 2000 g $mole^{-1}$)
- polyols and saccharides (C3-C18)

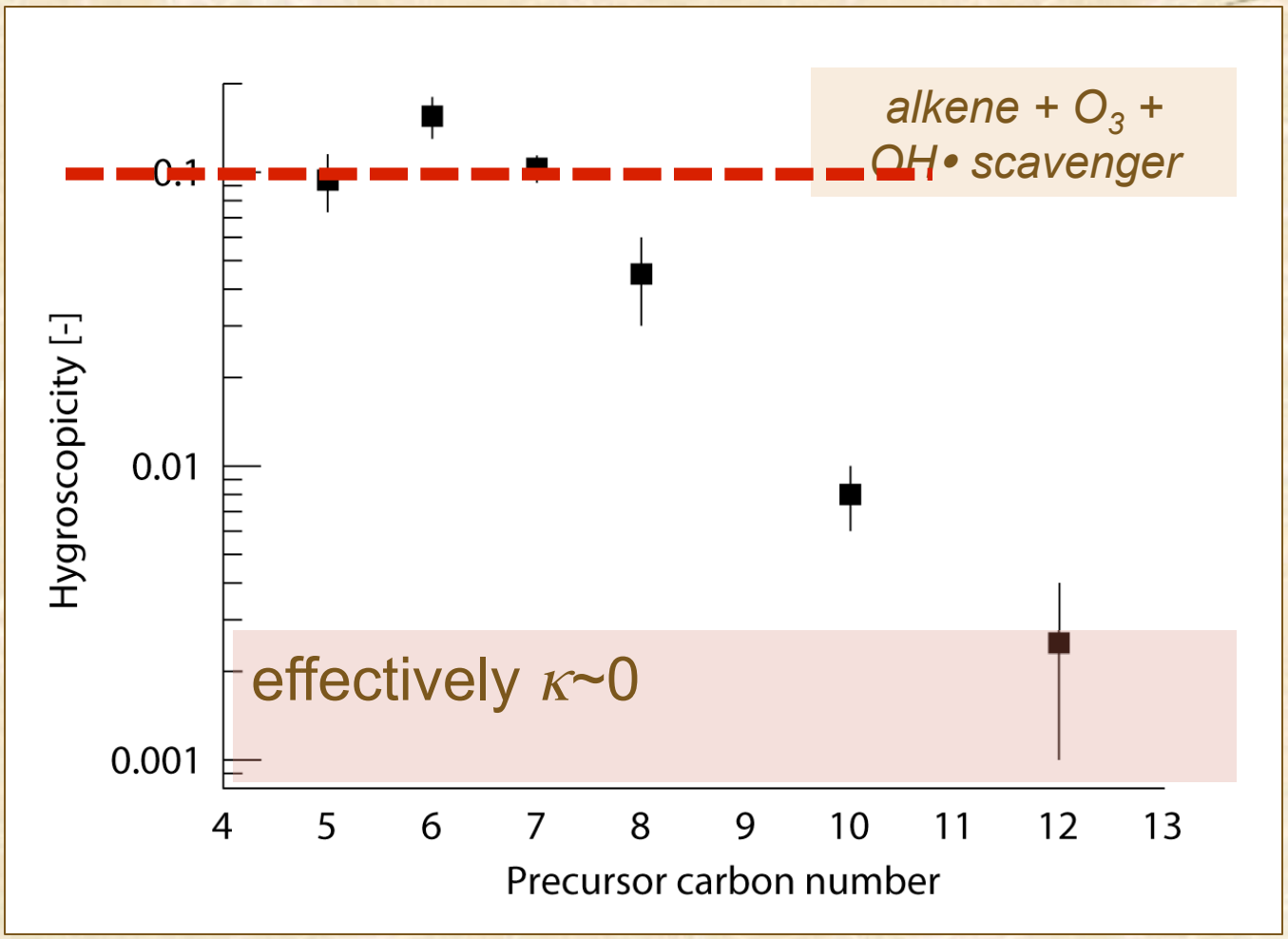
SOA from cyclic alkenes



SOA from cyclic alkenes



SOA from cyclic alkenes



Deliverables

- Database that will be used to define the number of "classes" of organic carbon needed to describe its impact on CCN
  - Source-based
    (e.g., can be coupled to photochemical model, to predict κ_{SOA} from specific VOC+oxidant)
  - Composition-based
    (e.g., κ_{OC} from measured or modeled species)