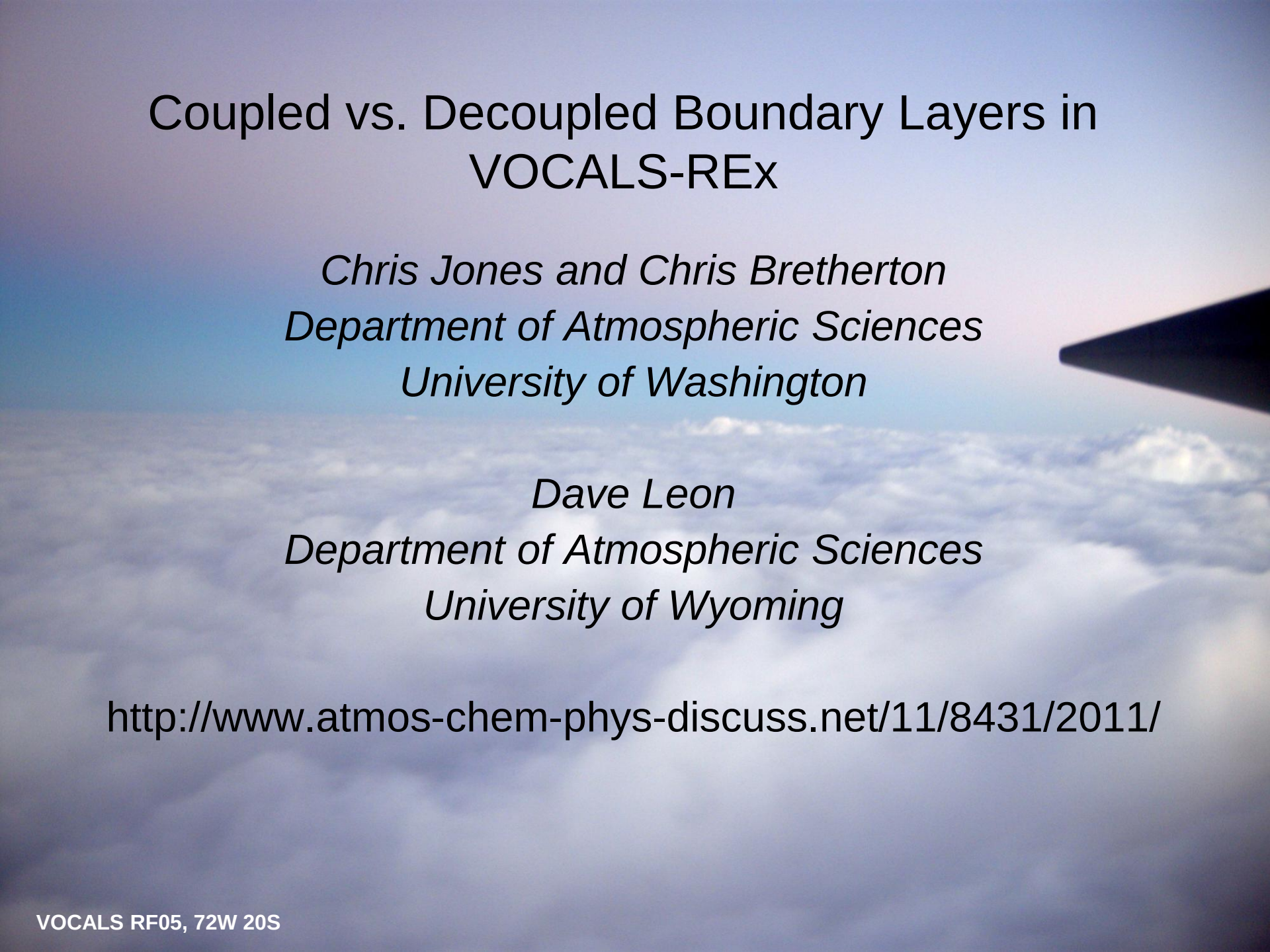
Coupled vs. Decoupled Boundary Layers in VOCALS-REx

Chris Jones and Chris Bretherton
Department of Atmospheric Sciences
University of Washington

Dave Leon
Department of Atmospheric Sciences
University of Wyoming

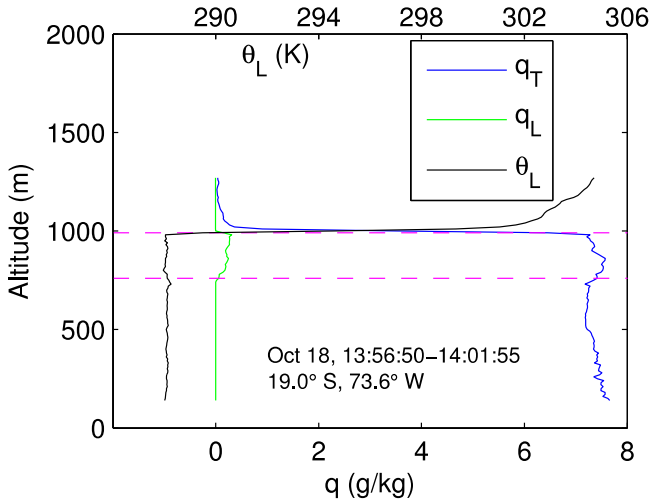
http://www.atmos-chem-phys-discuss.net/11/8431/2011/



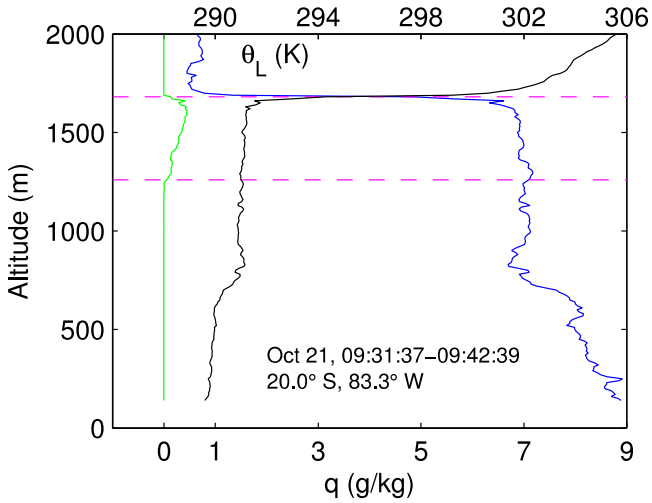
Two decoupling criteria

Profiles: $\Delta q = q_t\ (<0.25z_i) - q_t(0.75\text{-}1z_i) > 0.5\ g\ kg^{-1}$

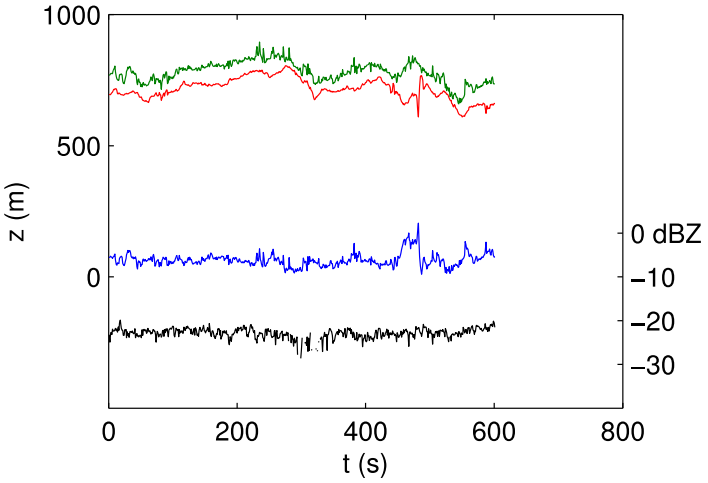
Coupled

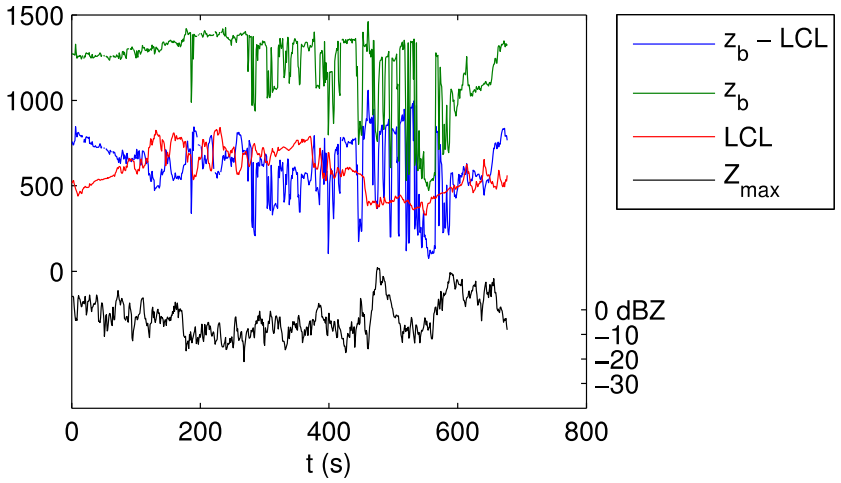


Decoupled

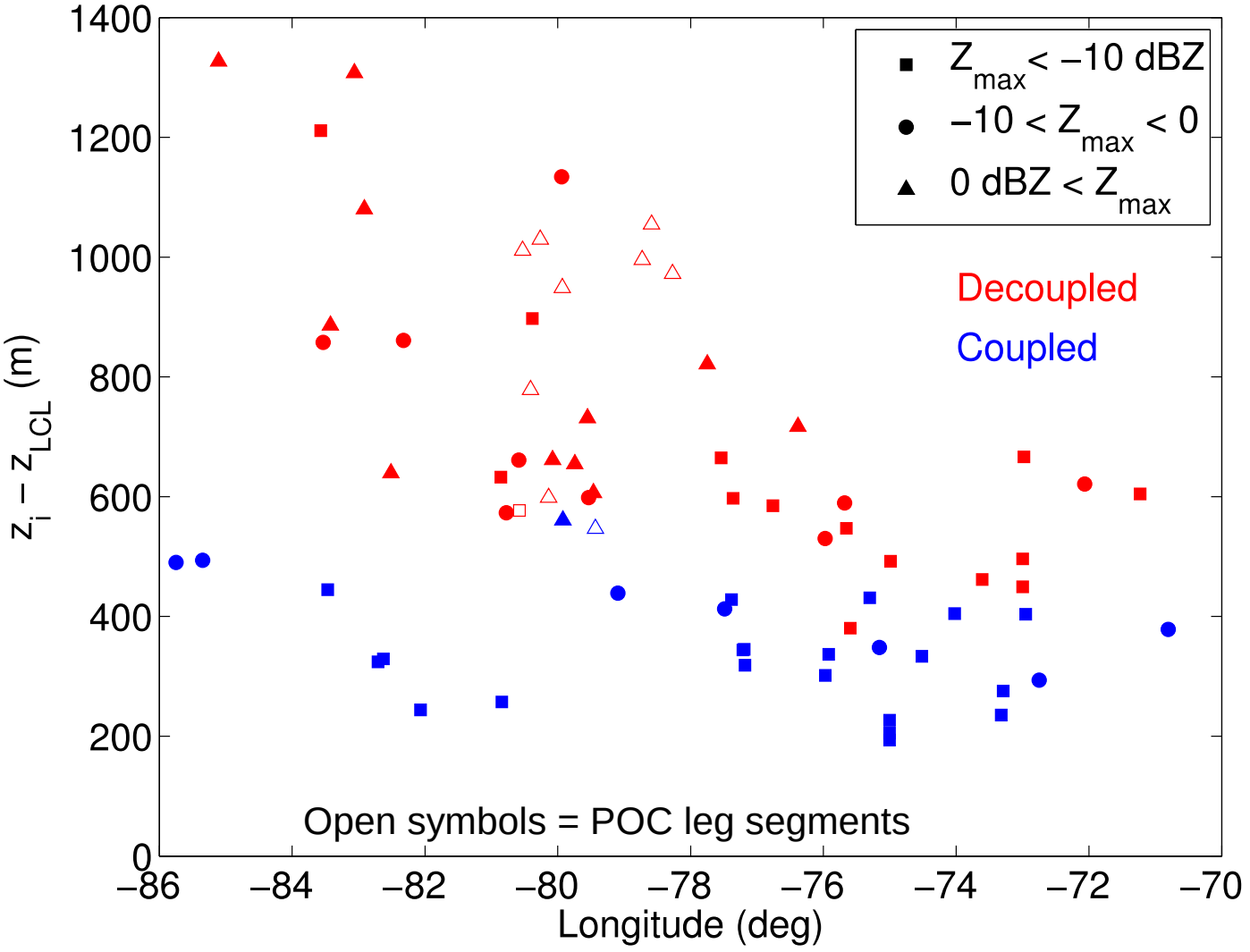


Subcld legs: Δz_b = Leg-mean lidar z_b – LCL > 100 m





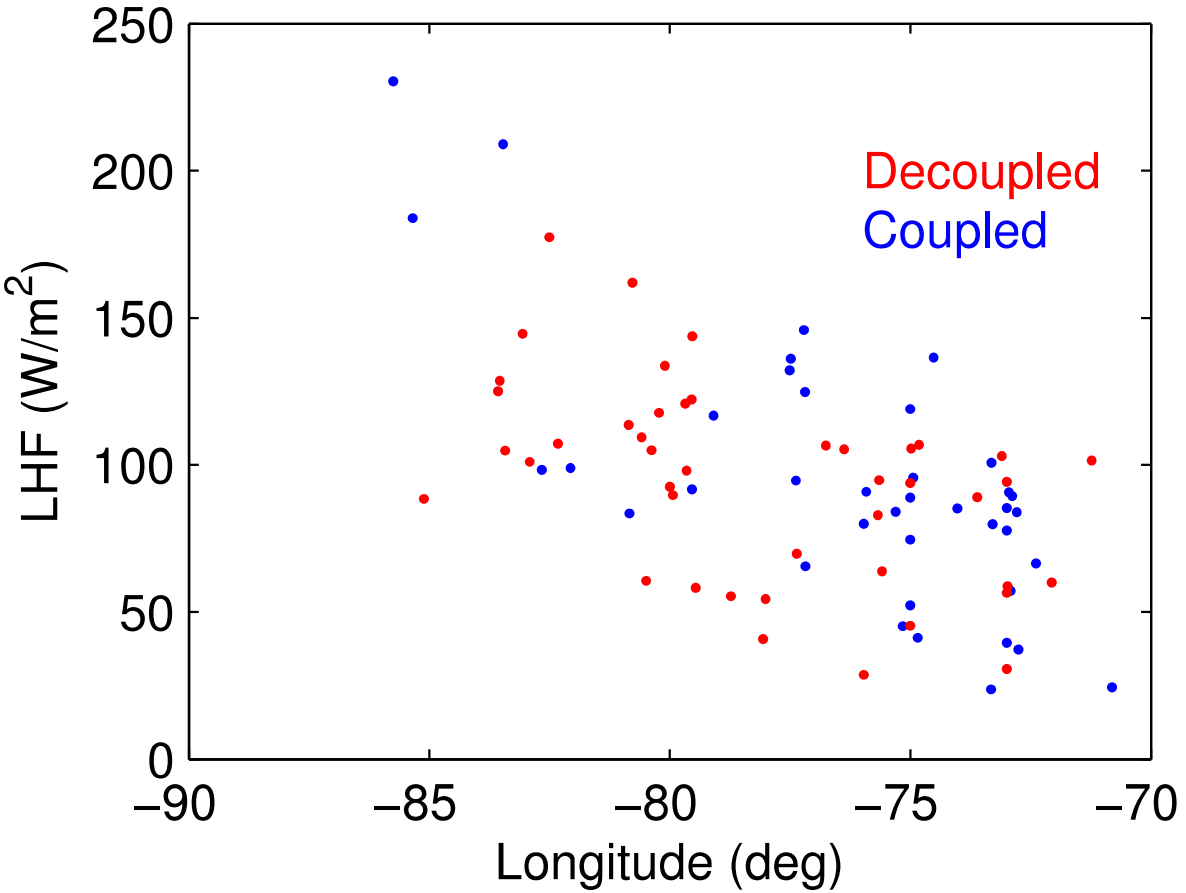
Decoupling correlates with well-mixed cloud thickness



…as does drizzle, but causality unclear.

Decoupling uncorrelated to wind speed

Bretherton and Wyant (1997) suggested stronger latent heat fluxes should promote decoupling – not seen in our results.



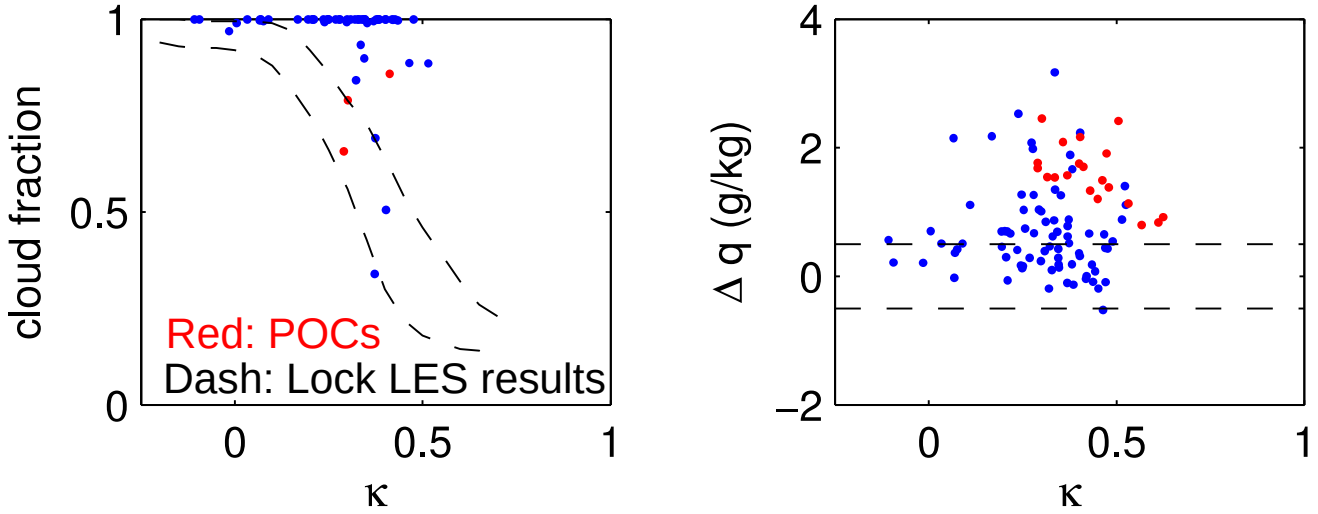
Decoupling not correlated with inversion jumps

- Lock (2009) and others have suggested high values of

  $\kappa = 1 + c_p \Delta\theta_l / L\Delta q_t$

  induce strong entrainment and Sc cloud breakup.

  Strong entrainment might also favor decoupling.
- Use REx C-130 profiles to calculate jumps/decoupling, adjacent subcloud legs to calculate cloud fraction.



- κ > 0.4 often (but not always) goes with broken cloud.
- For κ < 0.5 there is no obvious correlation of κ and decoupling.
- POC and non-POC distributions overlap