

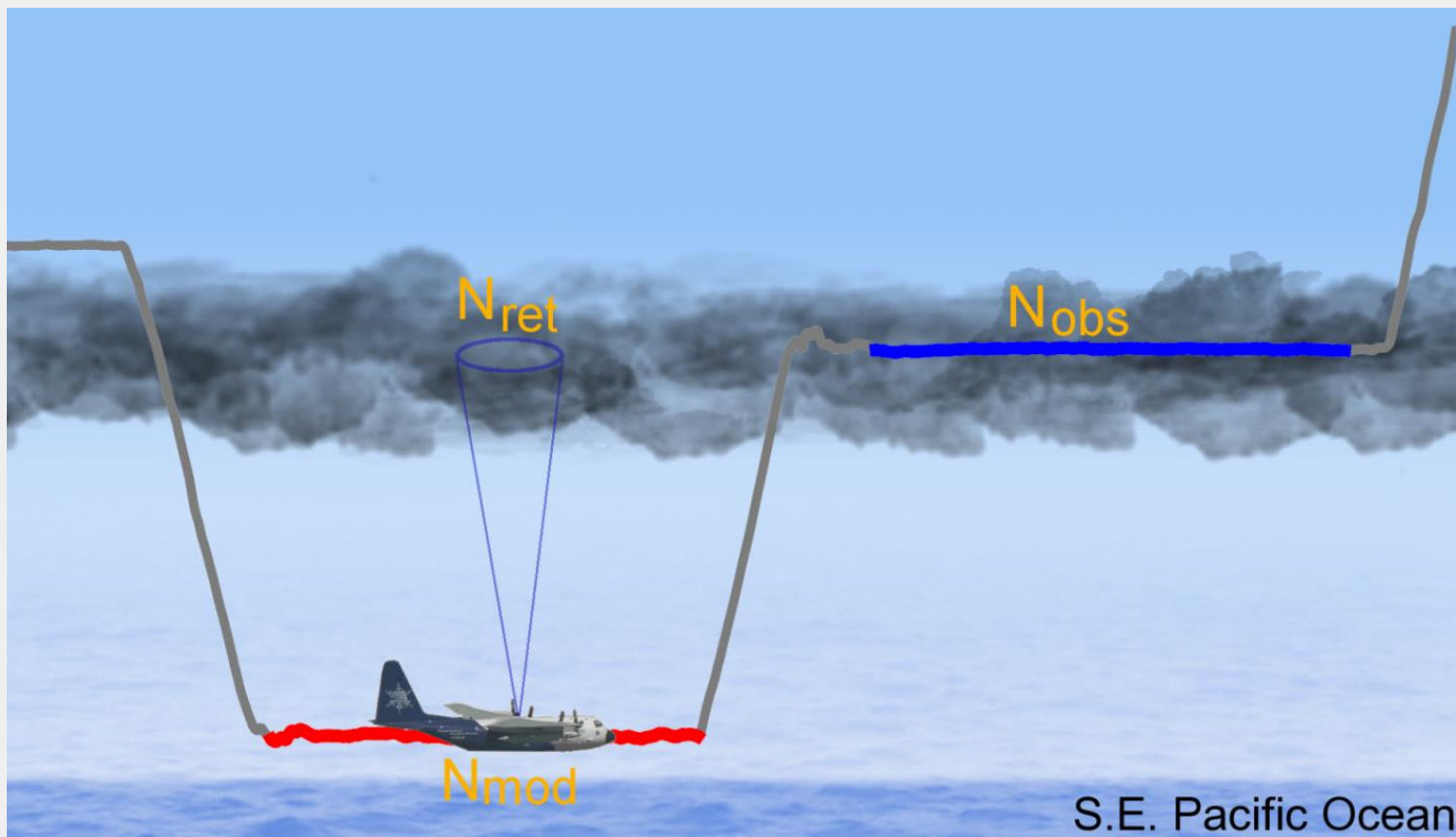


**Droplet Concentrations and Spectral Broadening  
in Southeast Pacific Stratocumulus Clouds**

**Jeff Snider, David Leon and Zhien Wang**

**University of Wyoming**

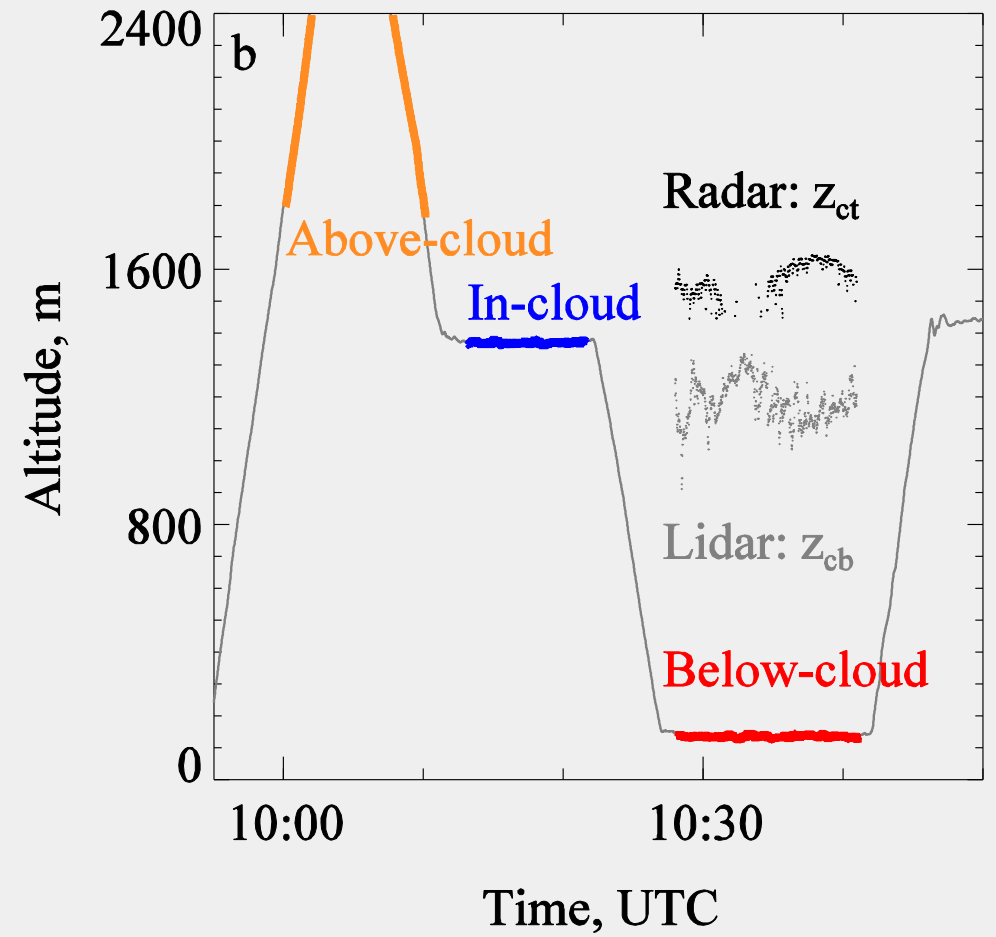
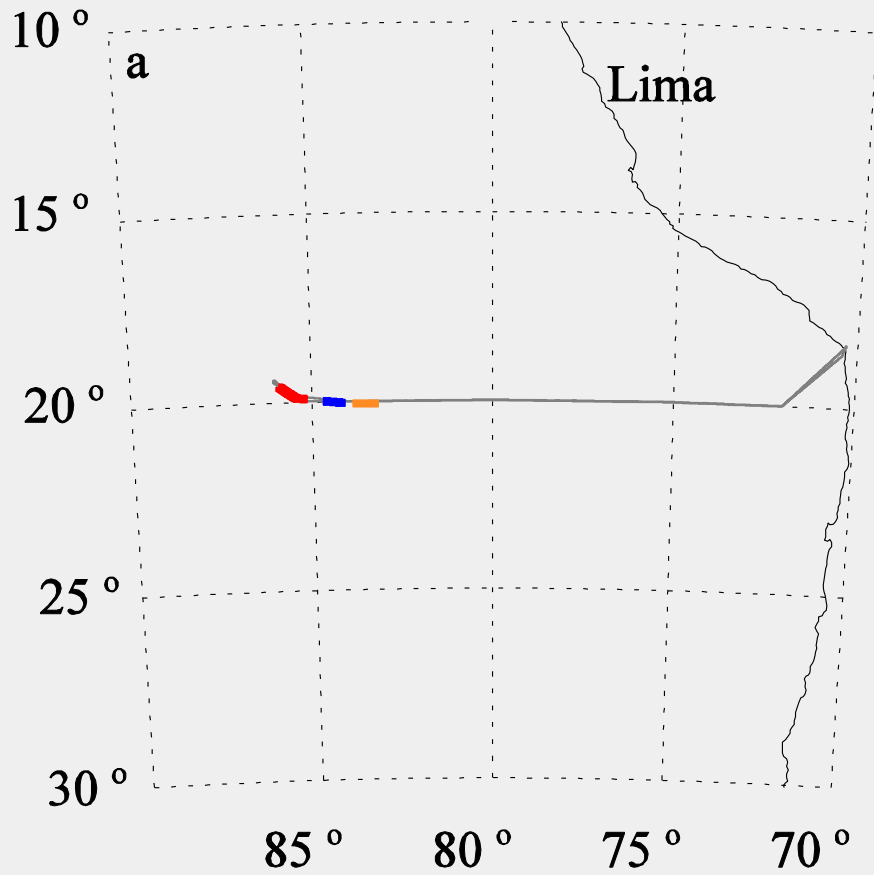
**[jsnider@uwyo.edu](mailto:jsnider@uwyo.edu)**



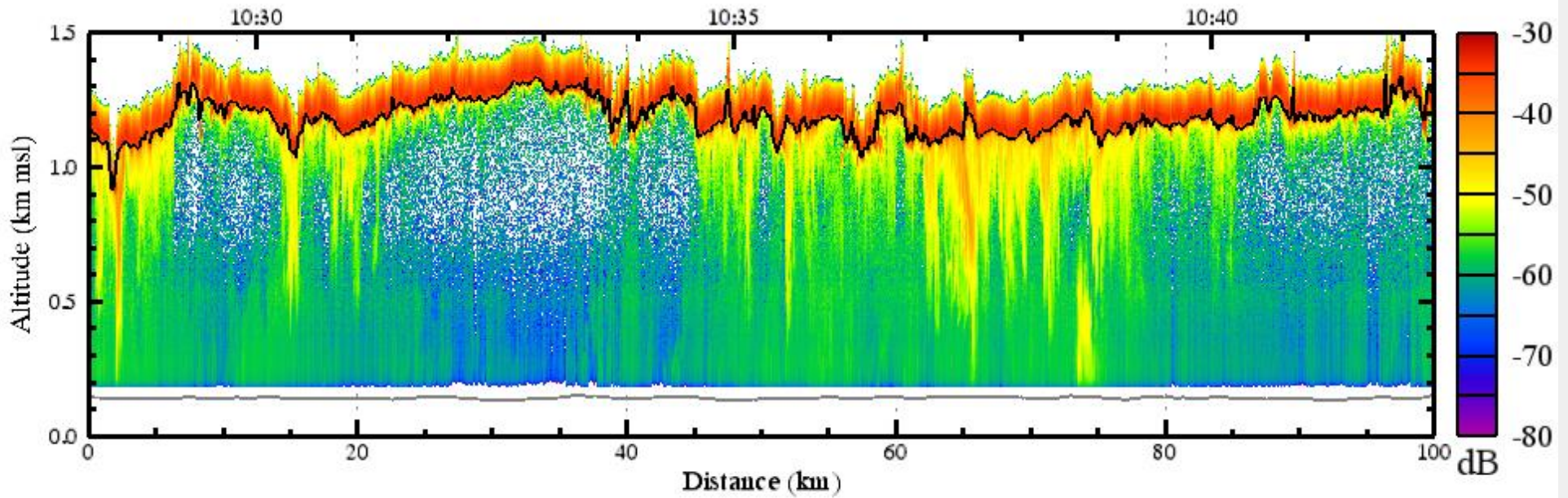
**Observed Droplet Conc. and Stand. Dev.:  $N_{obs}$  and  $\sigma_{obs}$**

**Lidar-retrieved Droplet Conc. and Stand. Dev.:  $N_{ret}$  and  $\sigma_{ret}$**

**Parcel-modeled Droplet Conc. and Stand. Dev.:  $N_{mod}$  and  $\sigma_{mod}$**

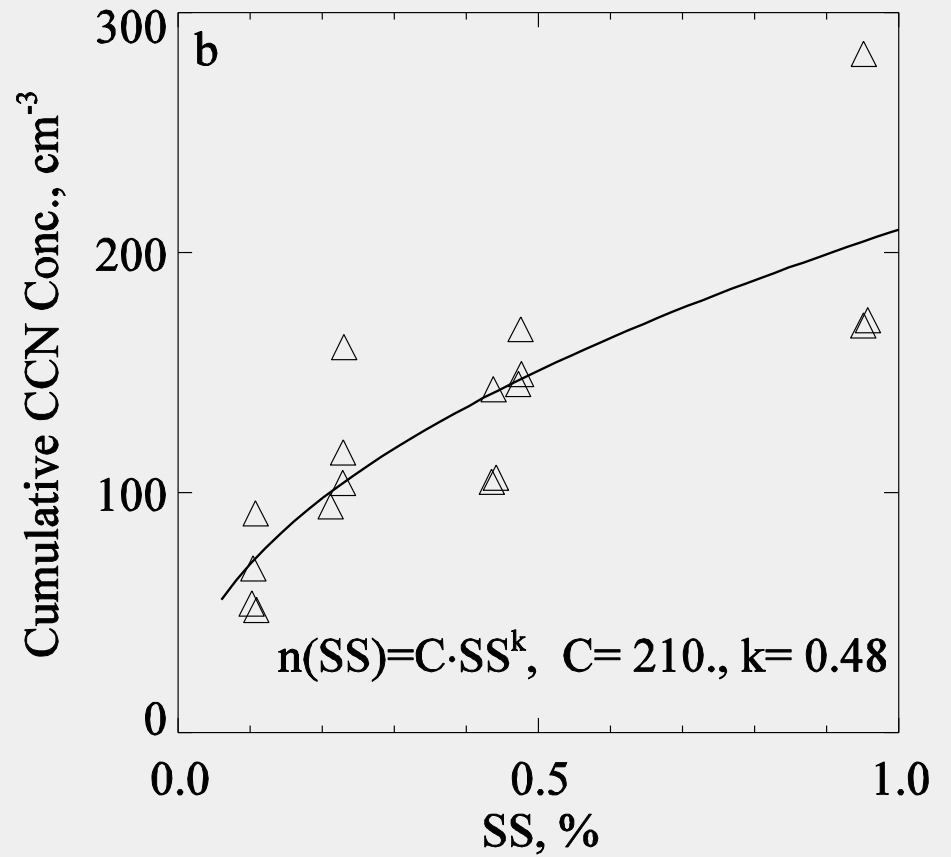
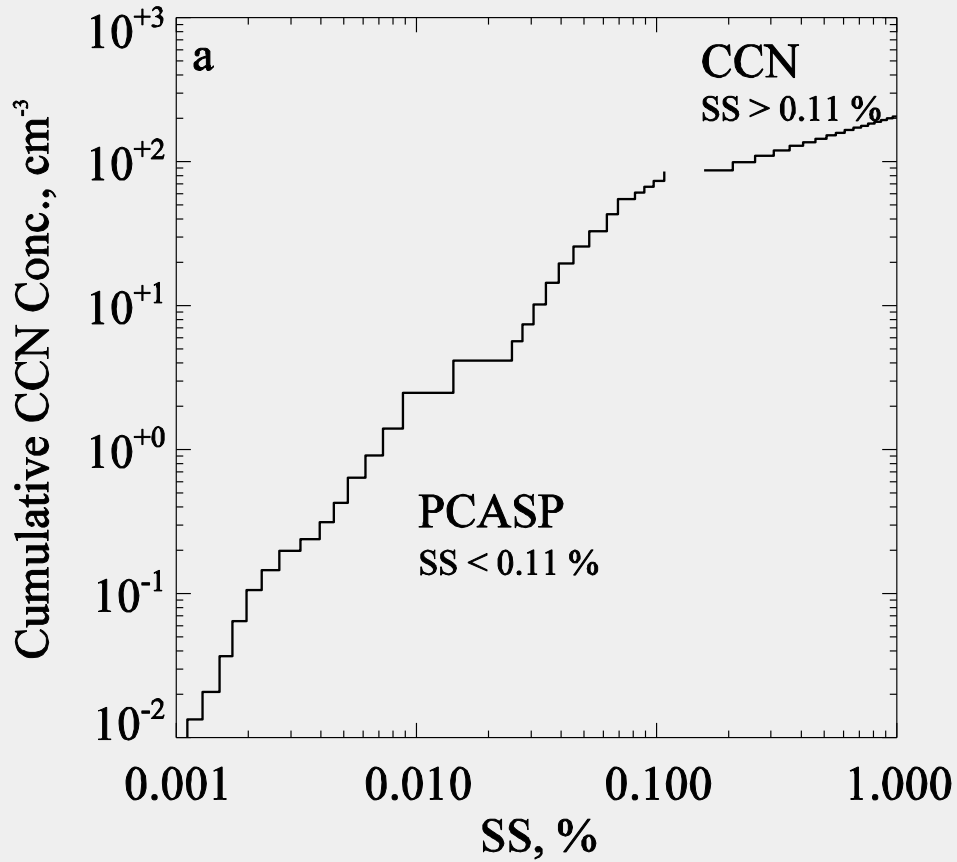


## 2008 VOCALS Campaign using Data from the NCAR C-130



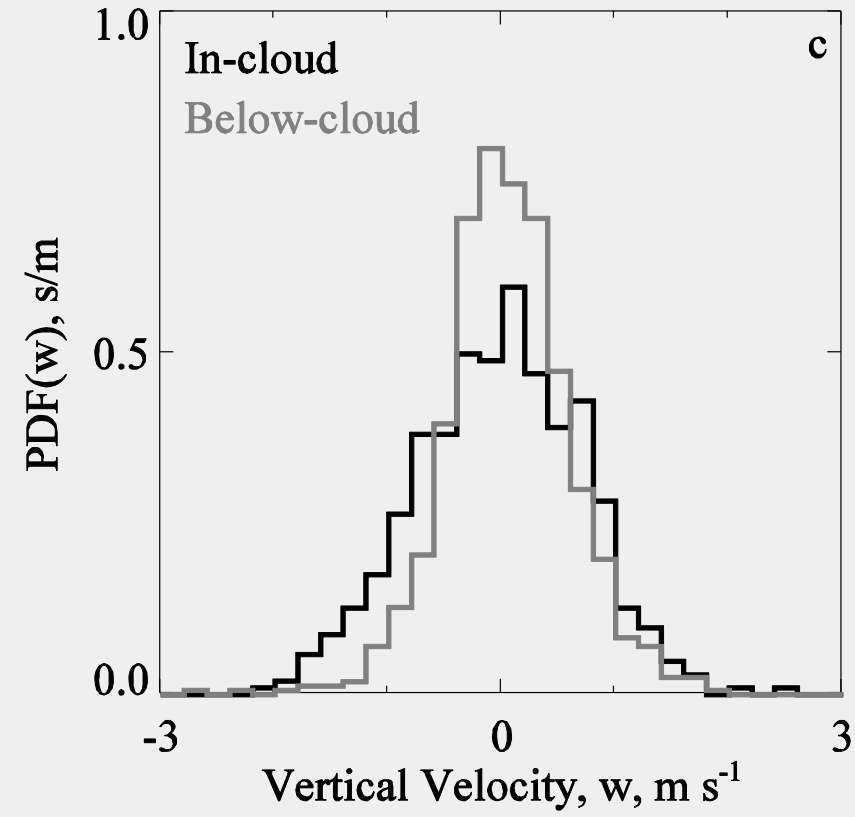
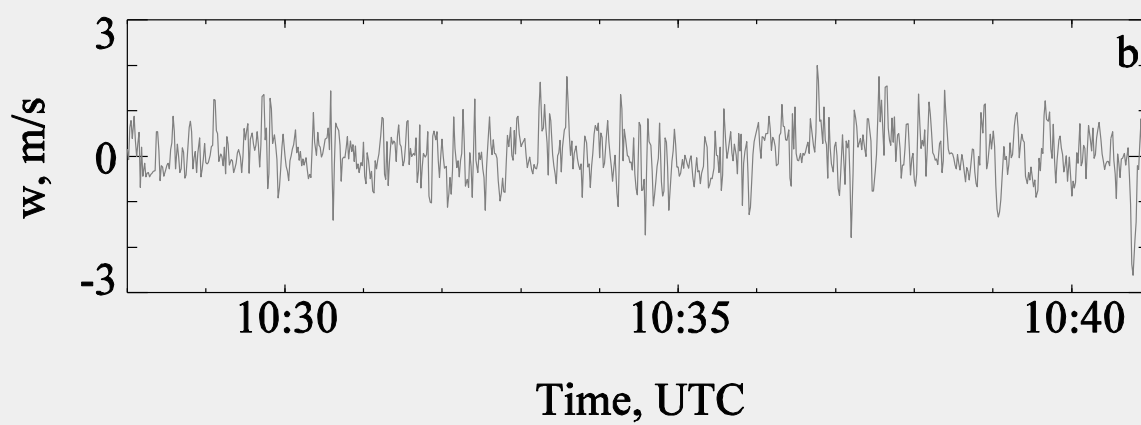
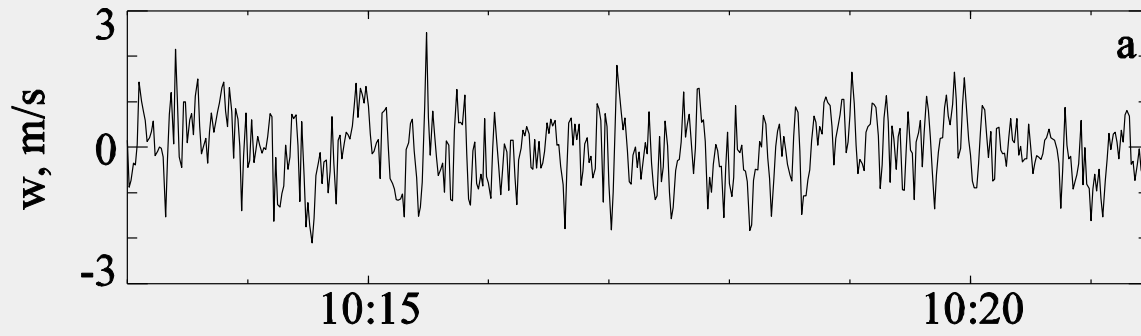
**Drizzle Cells within Sc in most analysis intervals**

**POCs within some of the analysis intervals**

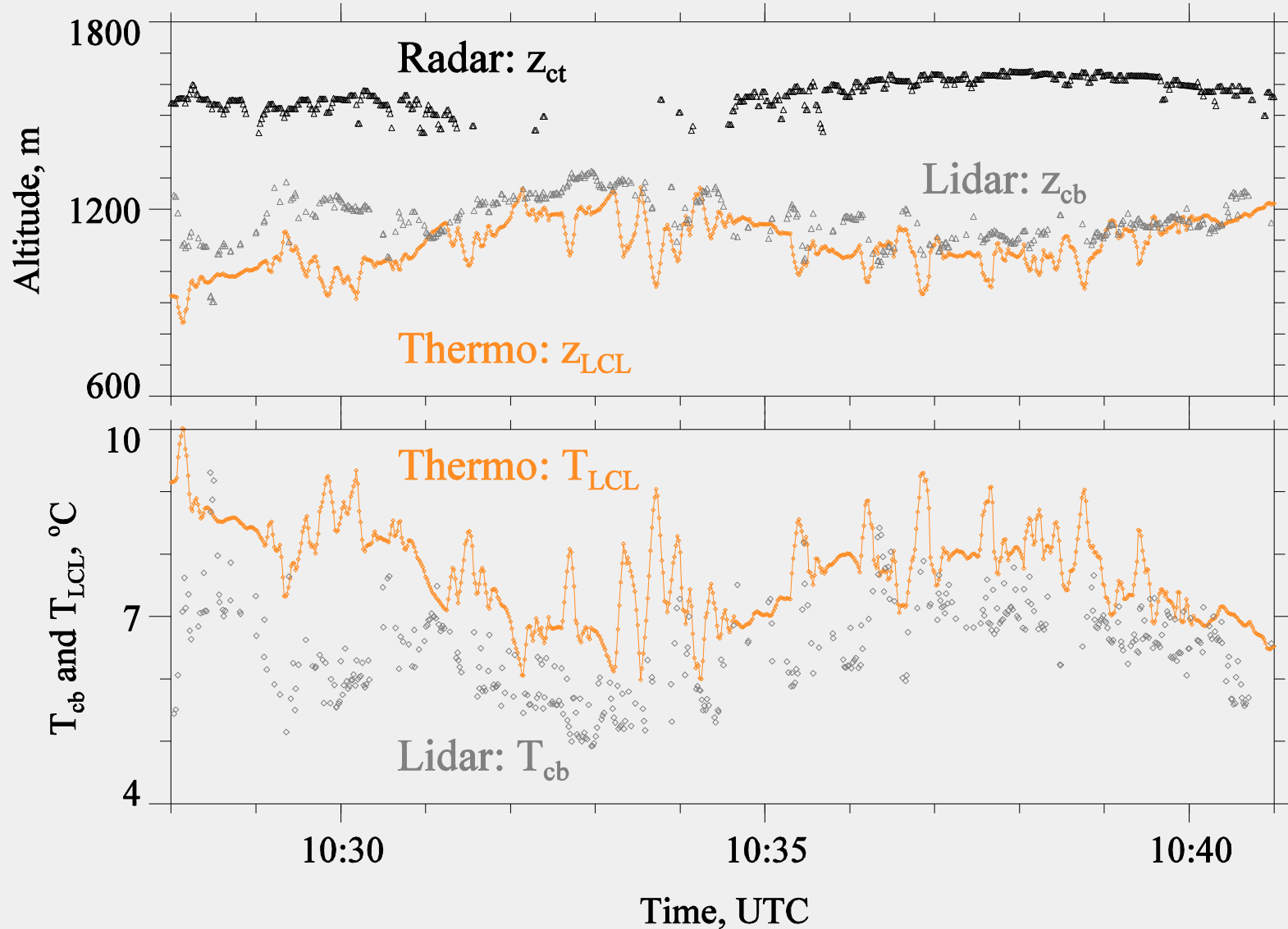


## Merged PCASP/CCN measurements

### Example analysis-interval, below cloud measurements



# Vertical velocity measurements

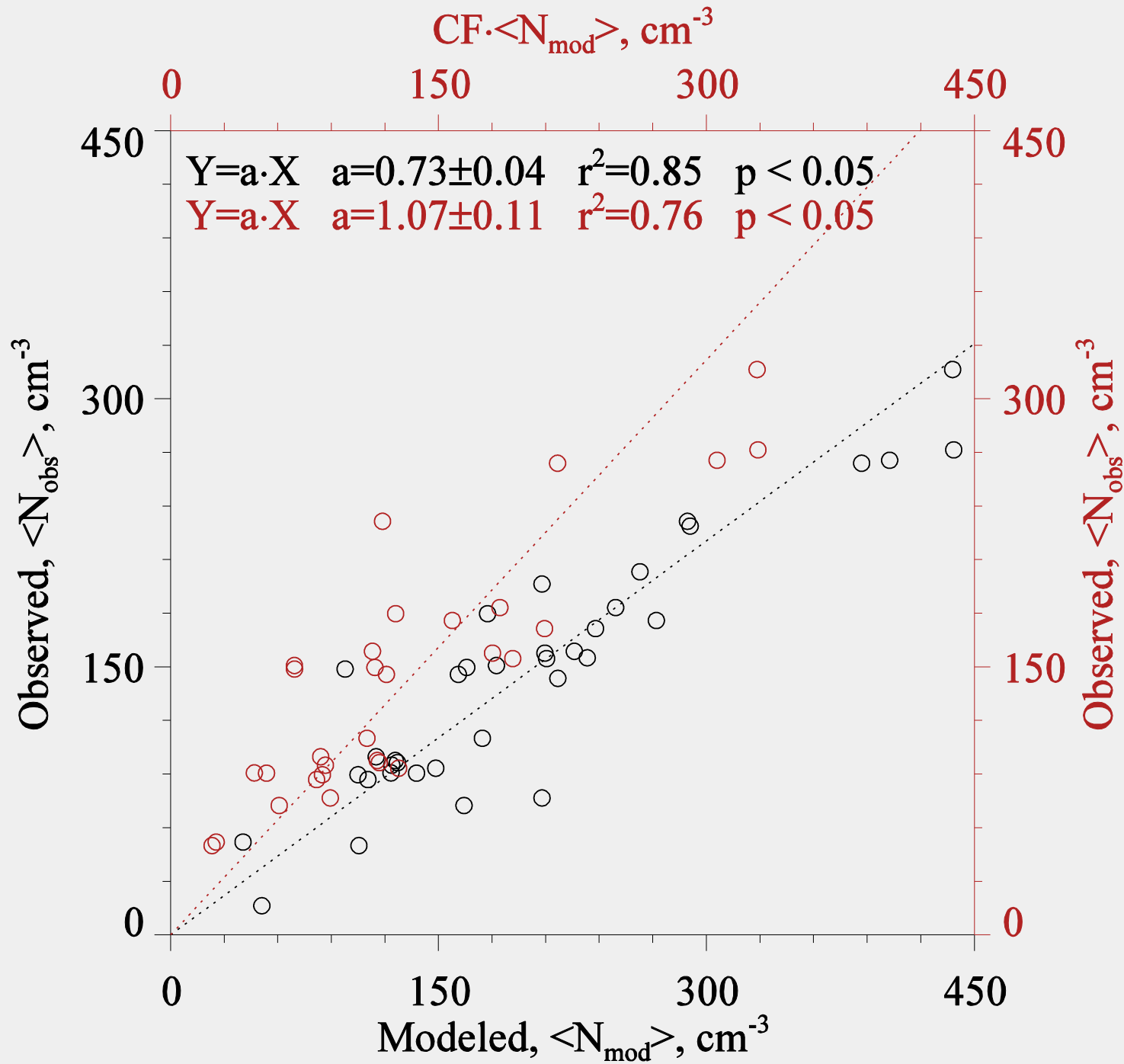


## Jones, Bretherton, and Leon, Coupled vs. decoupled boundary layers in VOCALS-REx, ACP, 2011

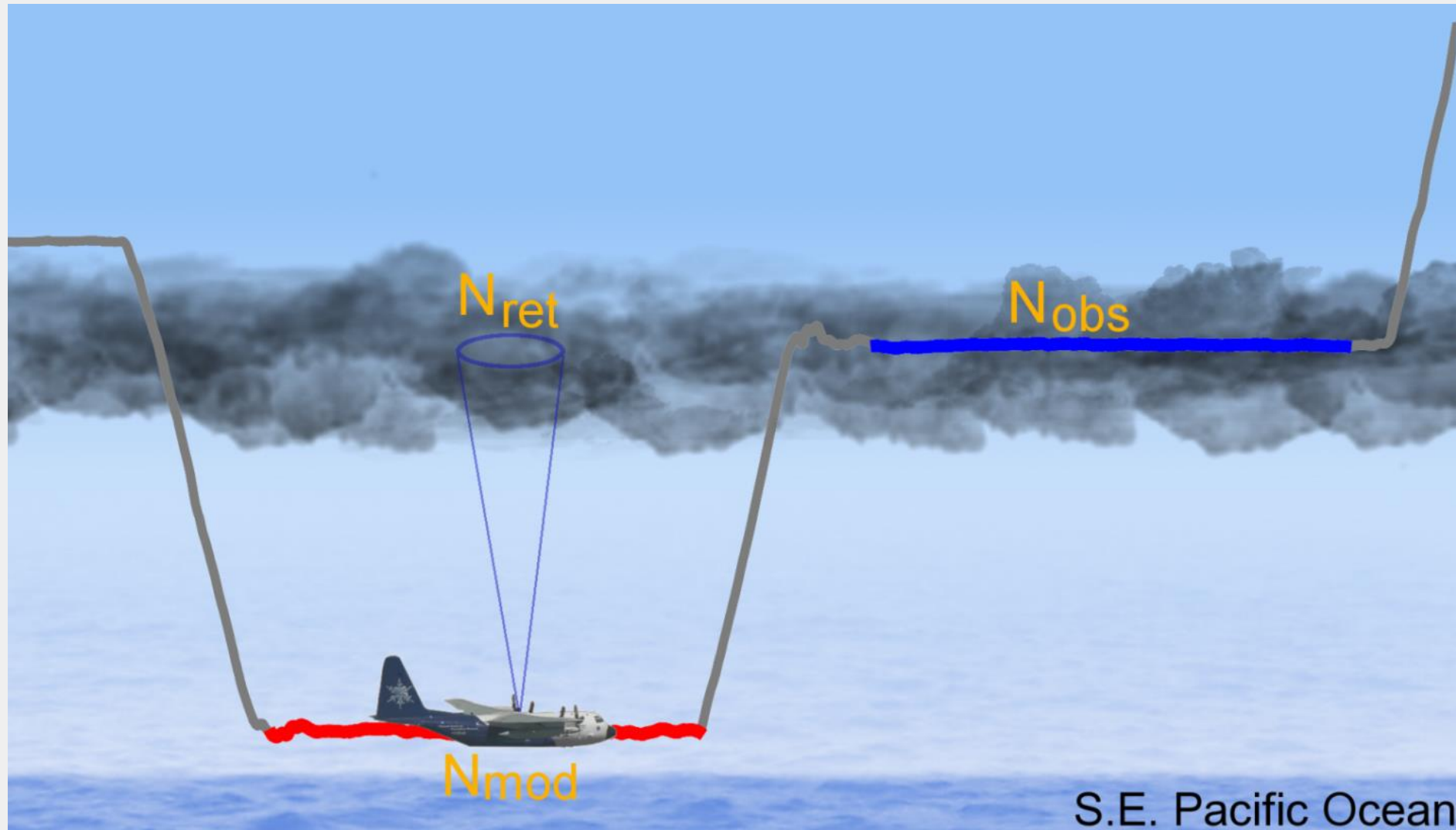
$$CF = \frac{\Gamma_1 \cdot H_1}{\Gamma_2 \cdot H_2} = \frac{N}{N_A}$$

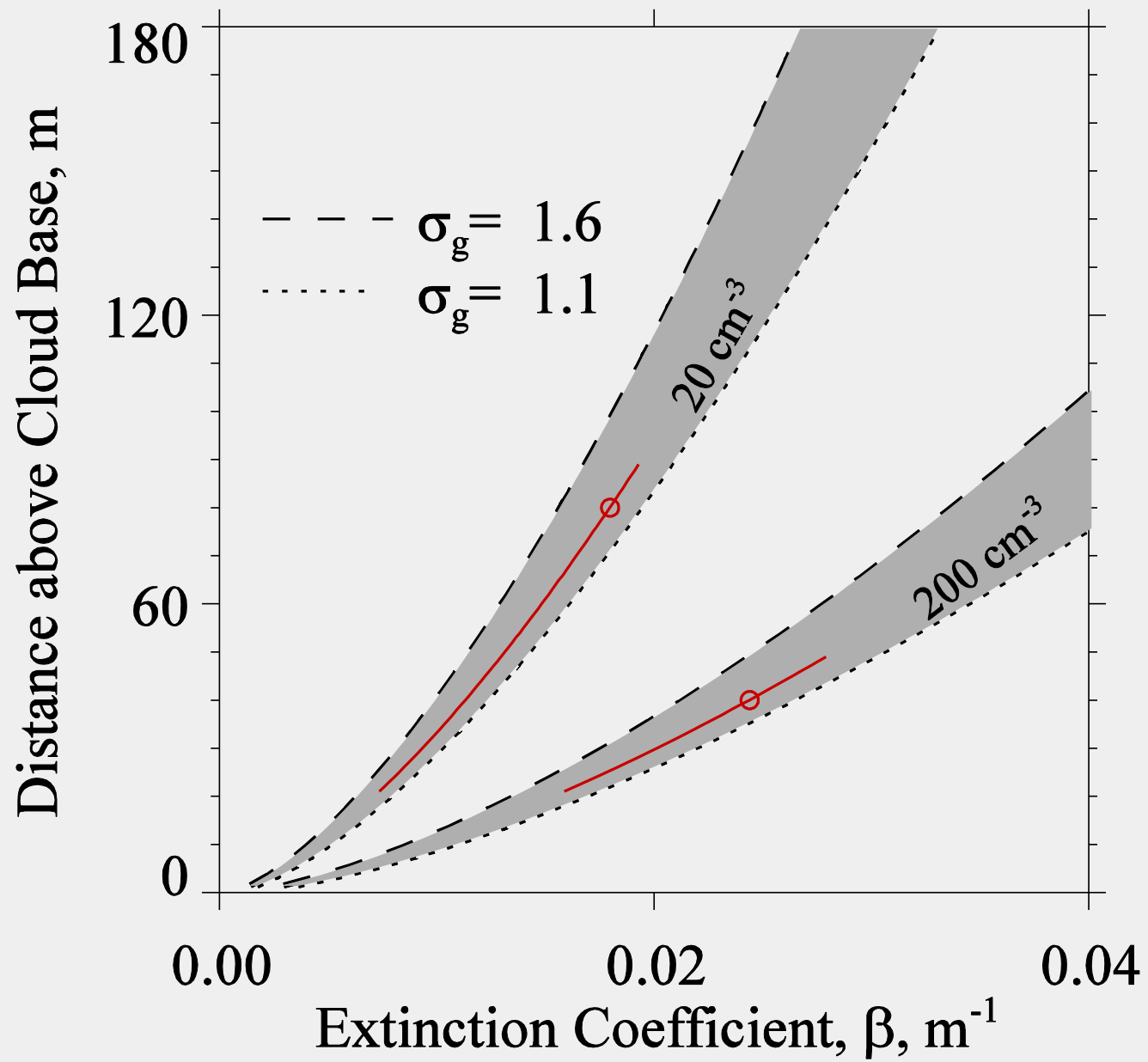
**Snider, Leon, and Wang, Droplet concentration and spectral broadening in SE Pacific stratocumulus, JAS, 2017**





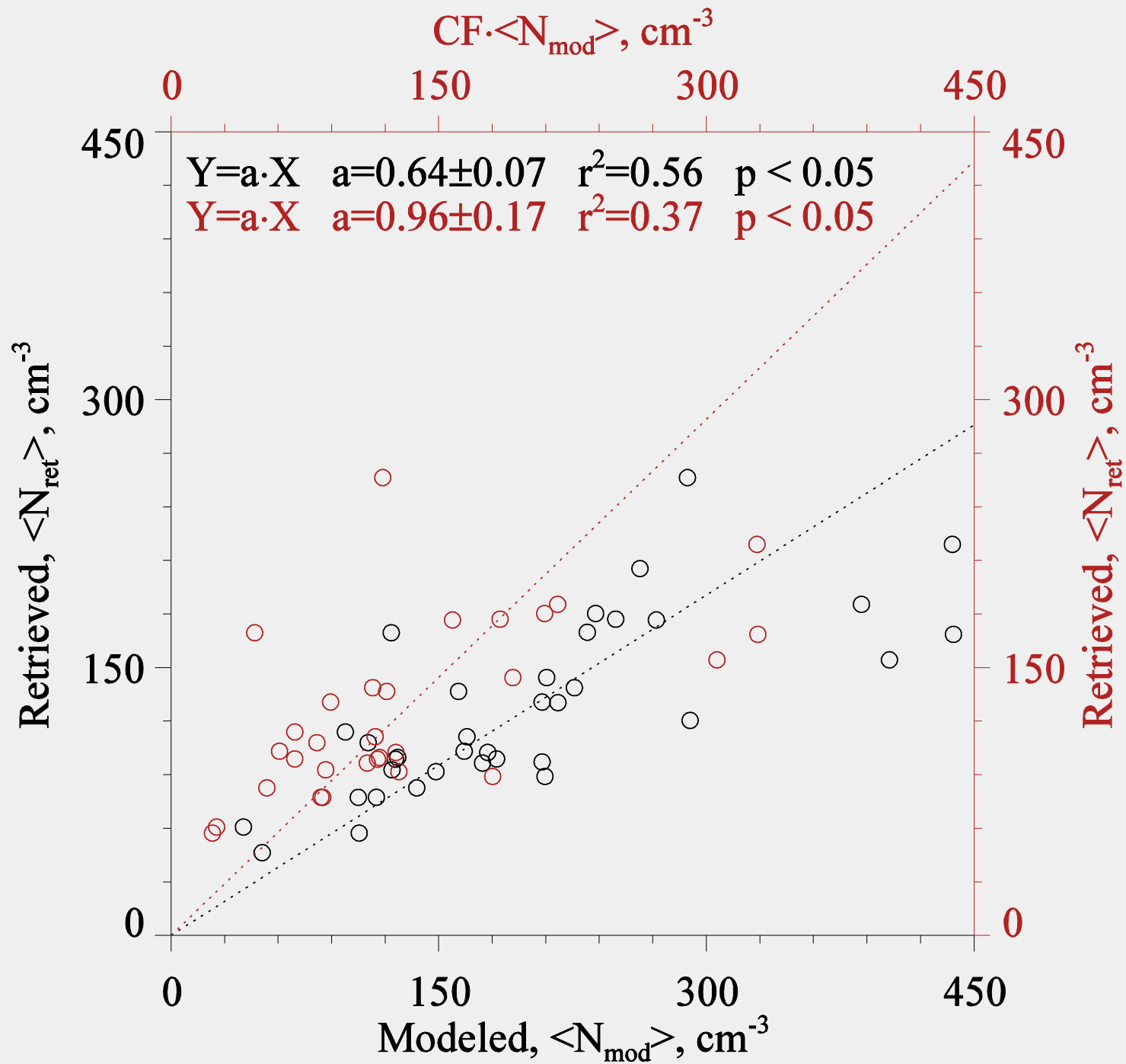
# Droplet Concentration Retrieval - Methodology





Geometric Standard Deviation, $\sigma_g$	Relative Concentration Error
1.05	-0.50
1.10	-0.43
1.20	-0.29
1.30	-0.14
1.40	0.00
1.50	+0.14
1.60	+0.29

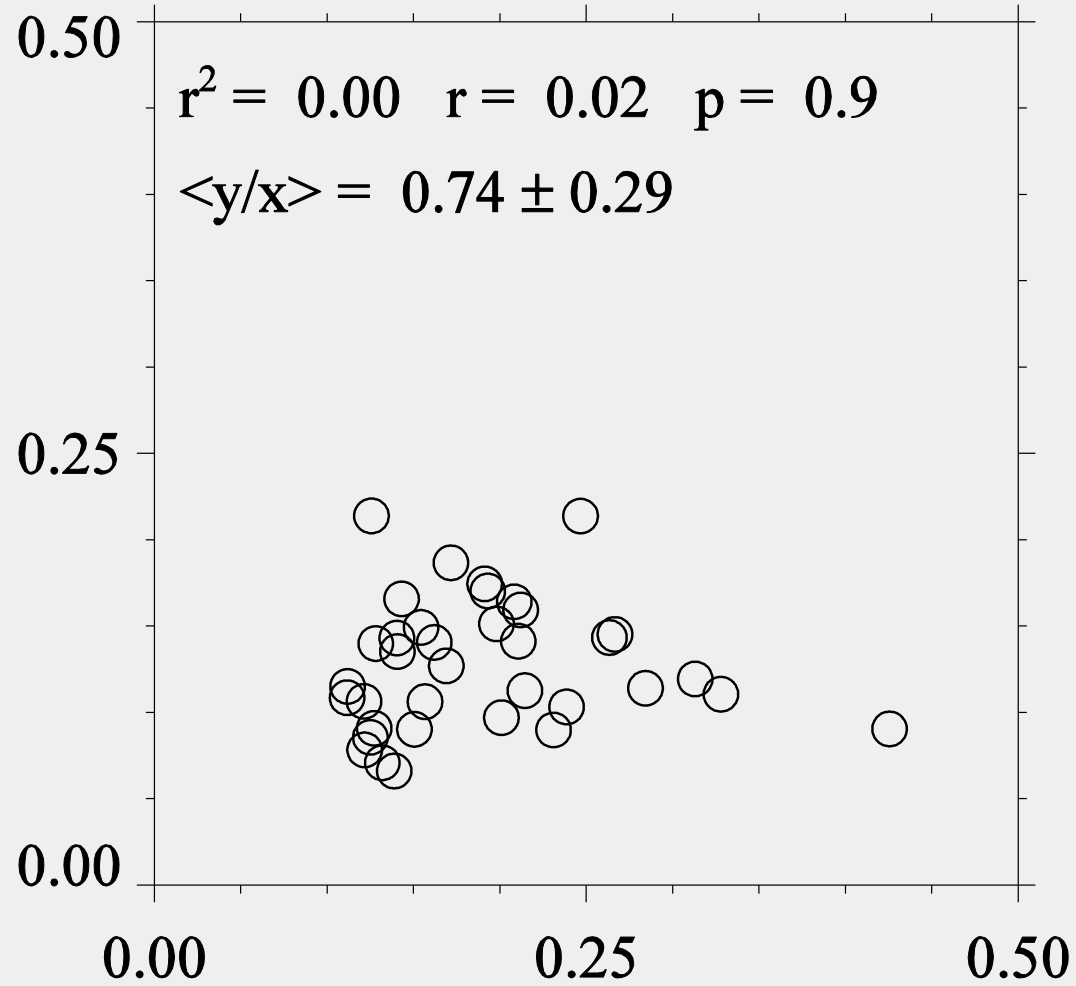
**All Retrievals assume the geometric standard deviation of droplet size is  $\sigma_g = 1.4$  (based on averaged in-cloud data)**



$$\frac{\sigma_D}{\langle D \rangle} = \frac{1}{3} \cdot \frac{\sigma_{mod}}{\langle N_{mod} \rangle}$$

**Cooper, Effects of variable droplet growth histories on droplet size distributions. Part I: Theory, JAS, 1989**

(1/3) · Concentration Dispersion (modeled)



Diameter Dispersion (measured and corrected)

**Our differential activation + internal mixing parcel model predicts droplet concentrations 30% larger than observed within VOCALS stratocumulus**

**Correction factor (CF) was derived. When the CF is used to scale the modeled concentrations N-closure is achieved**

**N-closure is also obtained when comparing retrieved (CF modified) and modeled concentrations**

**On average, the model accounts for 74 % of the measured dispersions corrected for instrument broadening; however, the model vs measured correlation is not significant**

**See Snider et al., Droplet Concentration and Spectral Broadening in Southeast Pacific Stratocumulus Clouds, in Early Online Release at Journal of the Atmospheric Sciences, 2017**