Towards a Statistical Climatology of the Relationship of between Updraft Velocity, Liquid Water Path and Cloud Droplet Number Density, Preliminary Analysis from MASRAD and COPS

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Focus of Research

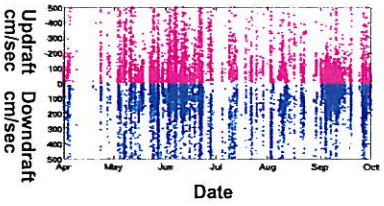
Dynamics of of Coupled, Thin Clouds from two AMF Sites
One marine and one continental

Point Reyes, CA
MASRAD IOP

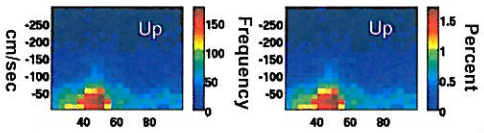
Murg Valley, Black Forest Germany
COPS IOP

1. Observations and/or Retrieved Data used in the analysis

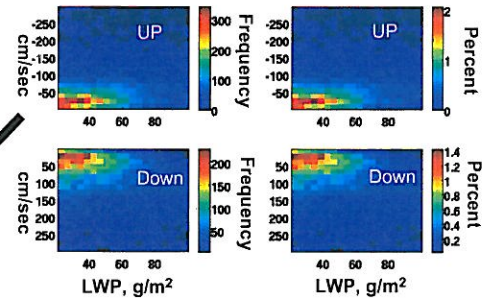
a) Cloud Drop Motion from 95GHZ Radar
COPS example below



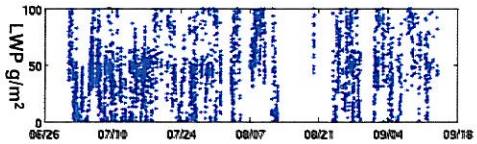
Point Reyes Updraft Velocities



Black Forest Updraft and Downdraft Velocities

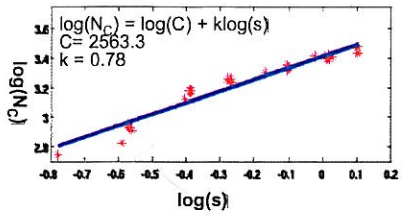


b) Liquid Water Path from MWRRET
Point Reyes example below



c) CCN spectra from AOS
example from COPS

Assuming $N_c = Cs^k$
where N_c = number of activated nuclei
s = supersaturation
C and k = parameters from power law



d) Identification of well mixed boundary layer
1) for PYE, analysis of all sonde results
2) for FKB Lifting Condensation Level (LCL) compared to ceilometer observations of cloud base hight
- LCL retrieved from surface temperature, pressure and relative humidity

2. After identifying the observations of thin, coupled clouds, the downdraft velocities were used to calculate supersaturation and number of activated nuclei after Twomey, 1959.

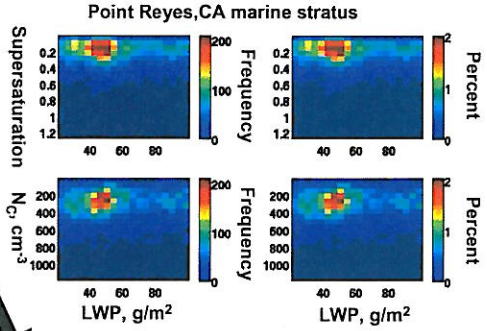
$$N_C = 0.88C^{2/(k+2)}[7e\text{-}2U^{3/2}]^{k/(k+2)}$$

$$s_{max} = 3.6[1.6e\text{-}3U^{3/2}/C]^{1/(k+2)}$$

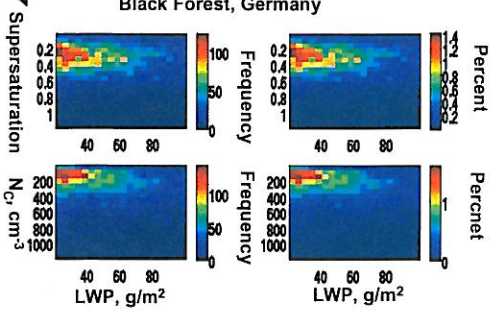
	PYE Mean	PYE Std	COPS Mean	COPS Std
Umax, cm/sec				
all points	-57.6	46.6	-62.2	56.1
cluster*	-30.8	18.8	-30.3	17.3
LWP, g/m²				
all points	55	21	51	22
cluster	44	13	40	12
Supersaturation				
all points	0.22	0.13	0.36	0.18
cluster	0.18	0.07	0.32	0.10
# Nuclei, cm⁻³				
all points	312	114	304	222
cluster	281	77	198	84

*cluster = based upon the data from 2 dimensional histograms for the 40 bins (10% of the bins) with highest counts

Point Reyes,CA marine stratus



Black Forest, Germany



3. What We've Learned about thin clouds at these locations

- The marine stratus at Point Reyes shows a tighter clustering of LWP but similar values and range in variability of downdraft velocities. (See details in table below)
- Even though the downdraft velocities are similar, the two locations show different distributions for supersaturations and number of activated nuclei due to their different aerosol populations.
- The Black Forest exhibited both a larger range of supersaturation and a greater number of activated nuclei than Point Reyes.
- Aerosol parameters for thin, coupled clouds in this study
  - COPS C mean 2250 std 970
  - PYE C mean 765 std 426
  - COPS k mean 1.58 std 0.52
  - PYE k mean 0.50 std 0.18 (C and k after Twomey, 1959)

Twomey, S., 1959. The nuclei of natural cloud formation: the supersaturation in natural clouds and the variation of cloud droplet concentration. Geofis. Pura et Appl., 43, 243-249