Inhomogeneous Mixing Effects on Stratus cloud and drizzle microphysics

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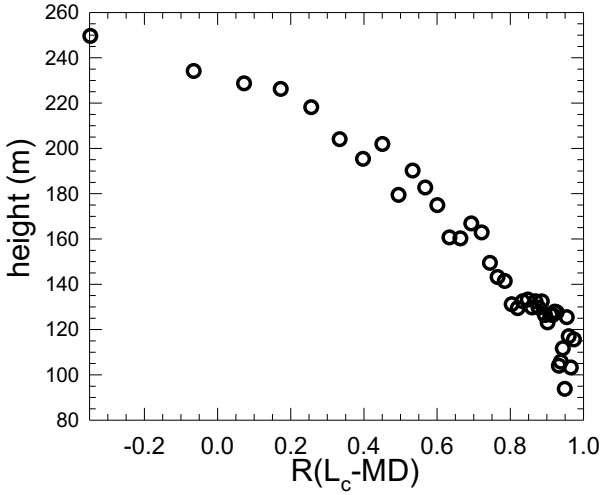
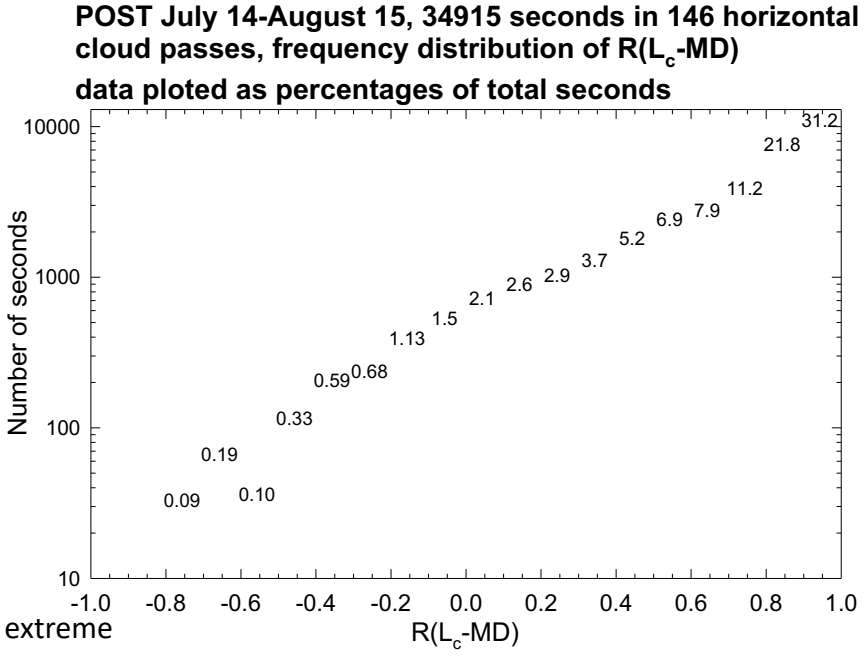
Inhomogeneous mixing was introduced to explain warm cloud precipitation (Baker et al. 1980) by reducing cloud droplet concentration, N_c.

Expanded POST analysis by running R over 50s intervals for all but edges of the 146 horizontal cloud passes. 4.6% negative.





$R(L_c\text{-}MD)$ is lower further from cloud base.

All horizontal data from 15 flights

Since R(L_c-MD), L_c, MD & drizzle change with height it is difficult to separate inhomogeneous mixing from height (depth) effects. Divided data into 41 height or depth (distance from cloud top) bins. Then compare R between R(L_c-MD) and microphysics variables and R(L_c-MD) with height or depth (red). Red of Fig. 3 denotes depth bias. Red is closer to zero R. Negative R for variable with R(L_c-MD) means greater values for lower R(L_c-MD), more inhomogeneous.

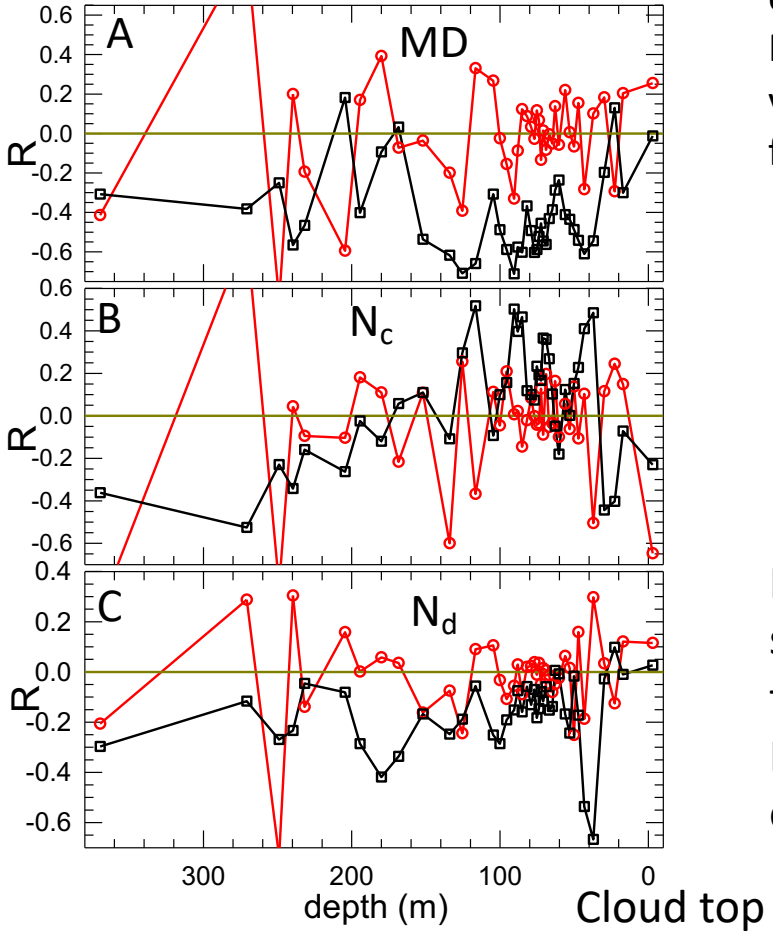


Fig. 3. Correlation coefficients, R, of microphysics with 50-s running R(L_c-MD) (black squares) and with depth (red circles) of 852 seconds within each 41 depth bin. **A** Mean cloud droplet diameter, MD. **B** Cloud droplet concentration, N_c. **C** Concentration of smallest drizzle drops, N_{d6440}. Gold lines mark R 0.

But, CCN variations also cause negative negative R(L_c-MD). There were CCN variations among POST flights.

	MD	N_c	N_d
Day	12.20	147	0.19
Night	11.52	221	0.09

Inhomogeneous mixing should have negative R for MD and drizzle with R(L_c-MD) but positive R of N_c with R(L_c-MD).

	flights	RMDR	N+	N-		RN_cR	N+	N-		$RN_{d4064}R$	N+	N-
all mnR	15	-0.41	3	38		0.06	25	16		-0.16	3	38
daylight	7	-0.46	4	37		-0.01	23	18		-0.13	10	31
nighttime	8	-0.30	7	34		0.03	26	15		-0.14	9	32
polluted	8	-0.21	10	31		-0.16	10	31		-0.12	12	29
clean	7	-0.25	10	31		-0.12	16	25		-0.02	24	17

Contra indications red

For all 15 flights negative R for MD and N_d and positive R for N_c.

But when flights are restricted to type or especially for individual flights when CCN are mostly constant R for N_c often goes positive and R for MD and N_d is less and not always negative. Lower N_c is the original basis of inhomogeneous mixing.

		MD				N_c				N_d		
flight	time	N+	N-	R		N+	N-	R		N+	N-	R
L18	night	14	26	-0.09		10	31	-0.18		15	26	-0.07
L21	day	12	29	-0.26		25	16	0.08		25	16	0.01
L27	night	8	33	-0.15		15	26	-0.05		15	26	-0.08
L28	night	23	18	0.08		9	32	-0.24		17	24	-0.06
L30	day	17	24	-0.16		17	24	-0.13		24	17	0.03
G01	day	10	31	-0.45		25	16	0.15		9	32	-0.42
G02	day	0	41	-0.40		39	2	0.25		30	10	0.06
G04	day	22	19	0.04		19	22	-0.13		24	17	-0.07
G05	night	25	15	0.04		28	13	0.04		25	16	0.02
G07	night	16	25	-0.15		20	21	-0.10		22	19	-0.03
G08	night	21	20	0.03		23	18	0.04		21	20	-0.02
G11	night	8	33	-0.25		19	22	-0.02		19	22	-0.03
G12	night	19	22	0.03		11	30	-0.21		10	31	-0.21
G14	day	17	24	-0.03		29	12	0.07		19	22	-0.03
G15	day	12	29	-0.12		11	30	-0.10		26	15	0.01

Contra indications red

Only August 1 and 14 completely satisfy inhomogeneous.

But inhomogeneous mixing is at least sometimes indicated in most flights.

Possible inhomogeneous mixing effect is difficult to separate from CCN effects.