

Parameterizations of Microphysics for Mesoscale Models: Applications to QPF

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RESEARCH GOALS

- 1. Improve parameterizations of microphysics for tropical cyclones.
- 2. Incorporate improved parameterizations into MM5.
- 3. Determine sensitivity of hurricane simulations and QPF to microphysics.
- 4. Evaluate simulations against observations.

MASS-WEIGHTED VELOCITY

$$V_m = \frac{\int_0^{\infty} N(D)V(D)m(D)dD}{\int_0^{\infty} N(D)m(D)dD} \quad (1)$$

$$N(D) = N_0 \exp(-\lambda D) \quad (2)$$

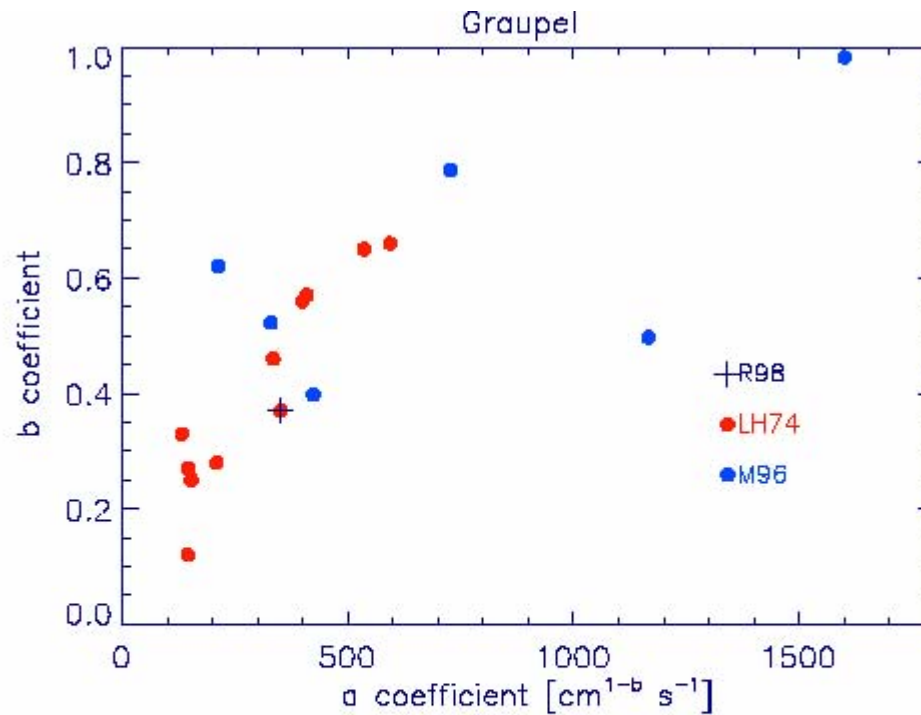
$$V(D) = aD^b \quad (3)$$

or

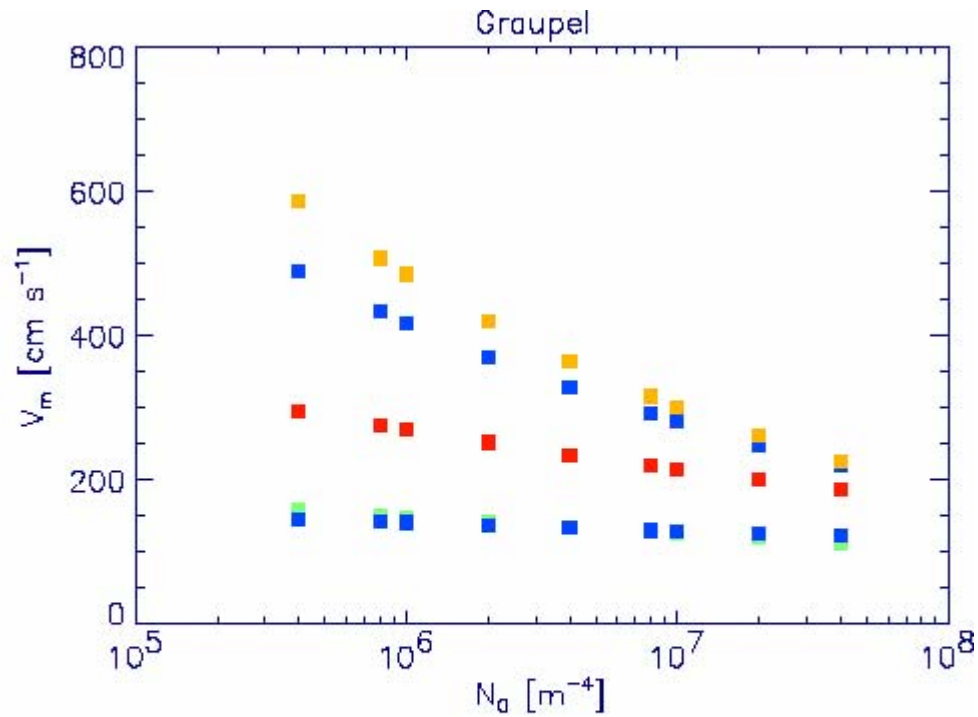
$$m(D) = \rho \pi D_m^3 / 6 \quad (4)$$

ISSUES:

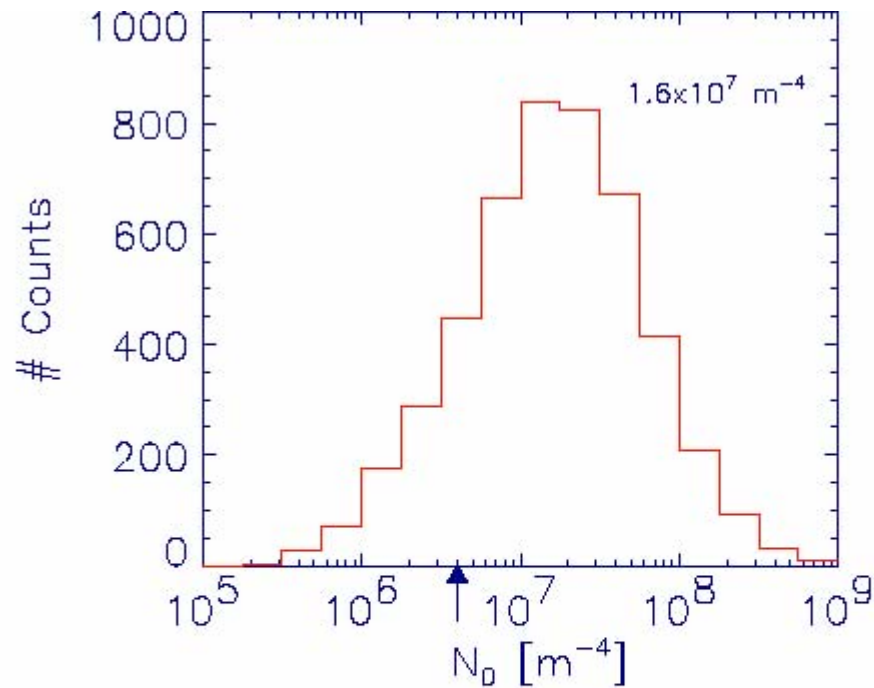
1. $N(D)$ defined in terms of either D or D_m .
2. D_m typically used to calculate $m(D)$.
3. Variation of parameters (N_0 , a , b , α , β).



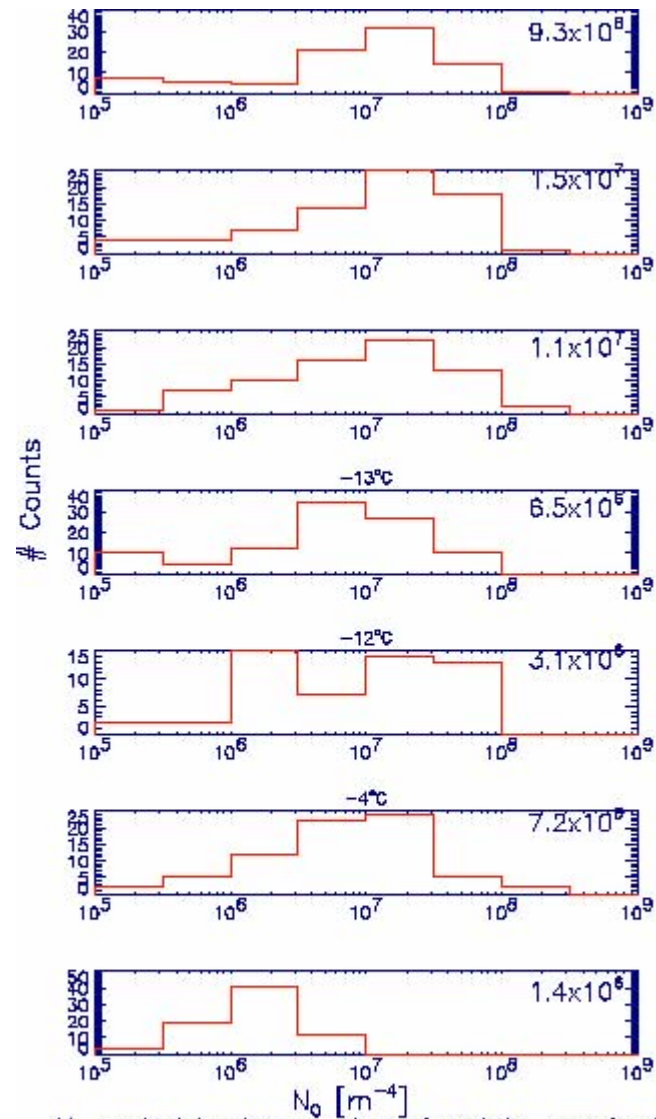
- $V(D) = aD^b$
- a and b coefficients vary widely for graupel category
- similar variations in a, b noted for snow category
- this variation has large impact on V_m



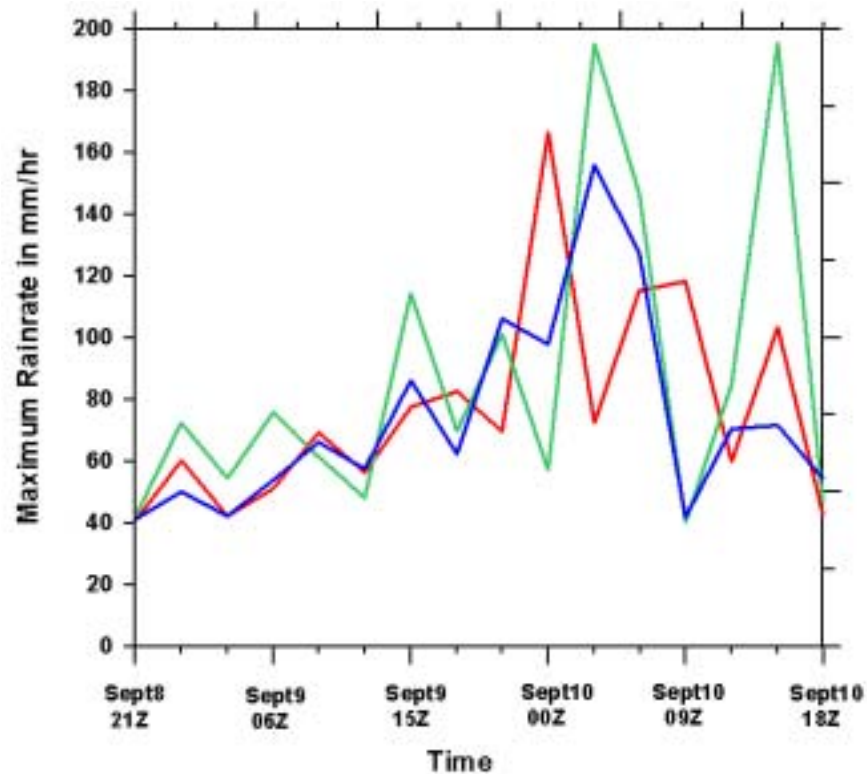
- $N(D) = N_0 \exp(-\lambda D)$
- N_0 affects V_m by approx. factor of 2
- different colors represent different a, b coefficients



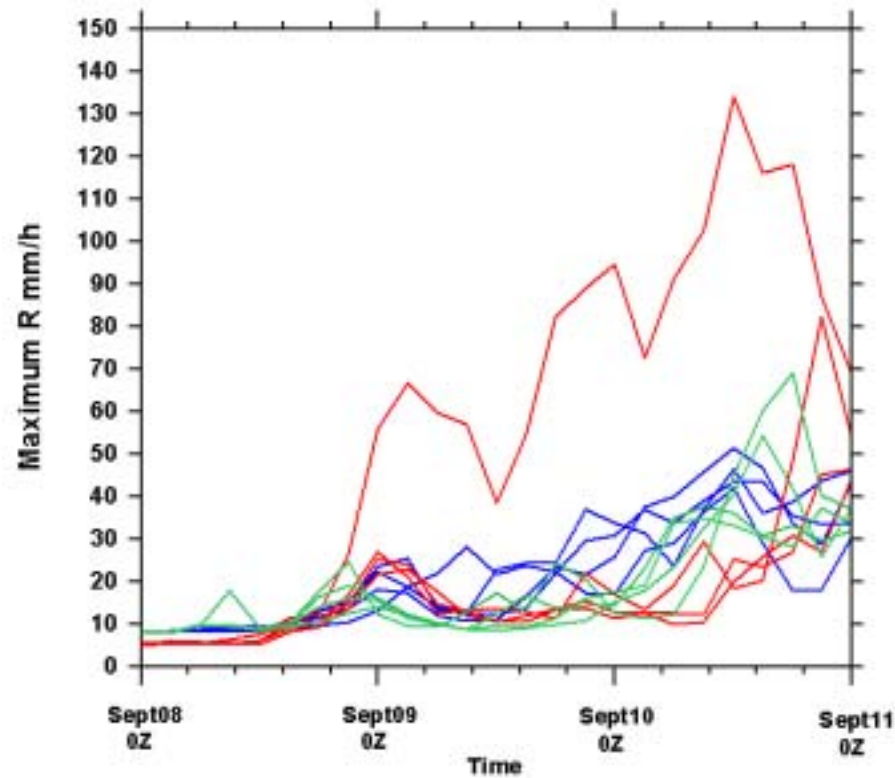
- histograms for N_{0g} measured in tropical cyclones
- N_{0g} can vary by 2 orders of magnitude, implications for modeling unknown
- arrow designates value of N_{0g} commonly used in models



- N_0 sorted by temperature for data acquired in Hurricane Tina (1992)
- larger N_0 for colder temperatures



- Maximum R at the surface from 9km simulations
- Different lines correspond to variations in fallspeed relations for graupel
- Precipitation patterns varies, but not total amount of precipitation from storm



- Maximum R at surface from 27km simulations
- Different colors for different convection and PBL schemes
- Lines of same color for different microphysics schemes

Eta and Kain-Fritsch Blackadar and Betts-Miller Eta and Betts-Miller