EXAMINING THE IMPACT OF MICROPHYSICS PARAMETERS IN WRF SIMULATIONS OF A JANUARY 2019 VERMONT WINTER STORM

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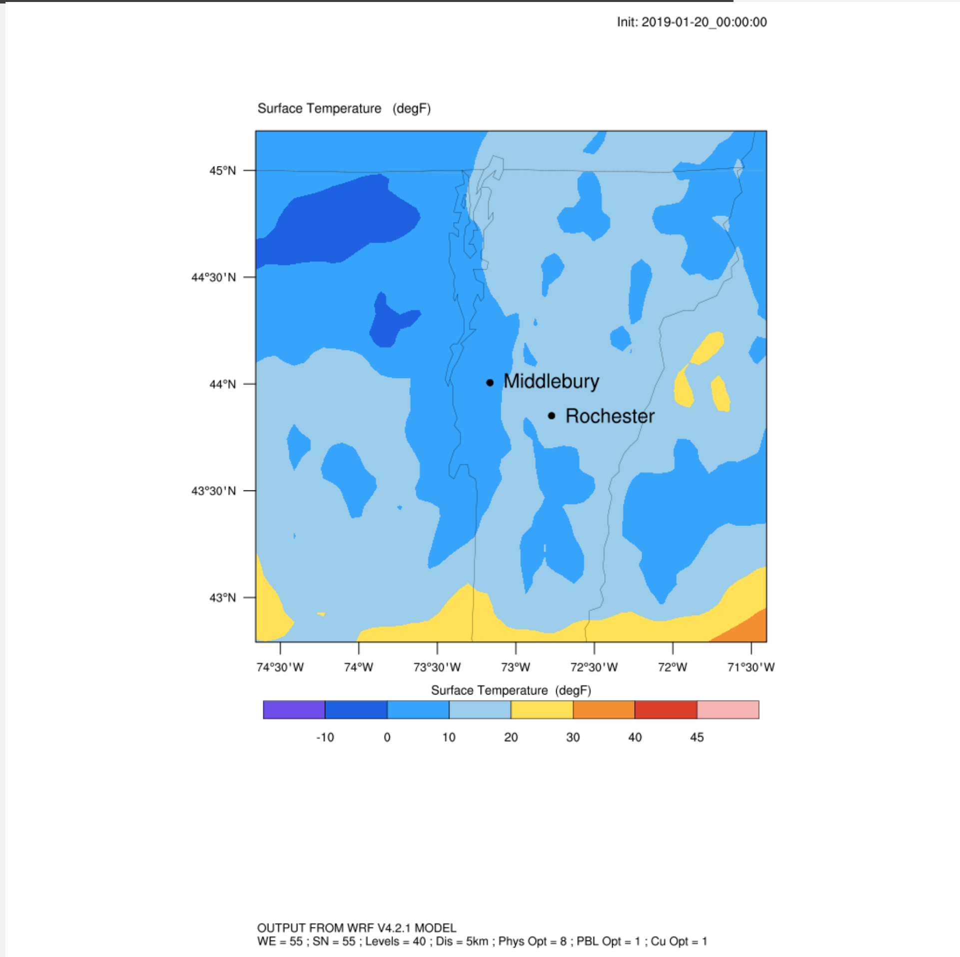
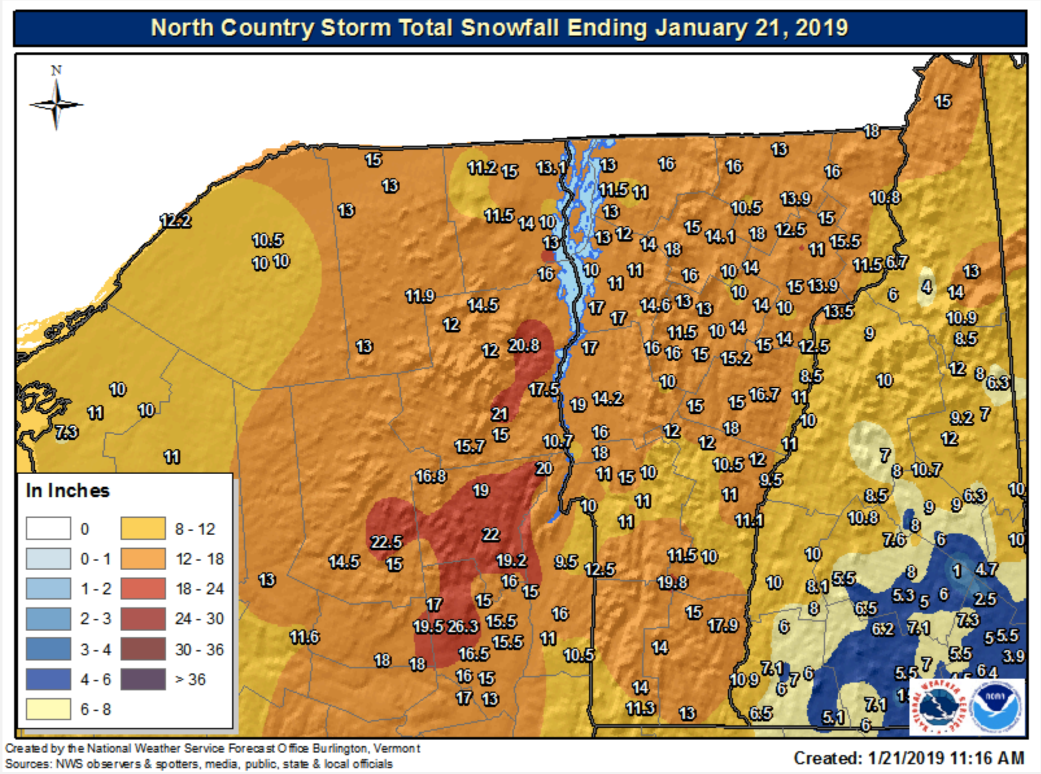
OBJECTIVES

- Examine the physics of the clouds in a Jan 2019 winter storm in VT
- Track precipitation data at various sites for computer simulations of the storm
- Compare results to real observations at sea level site (Middlebury) and mountain site (Rochester)



THE JANUARY 20-21, 2019 WINTER STORM

- Timing
- Temperatures < 0 °F
- 10:1 Snow : liquid ratio



NWS Burlington

METHODS

- Thompson
- WDM6
- ETA (Ferrier)
- Morrison 2 moment

NCAR

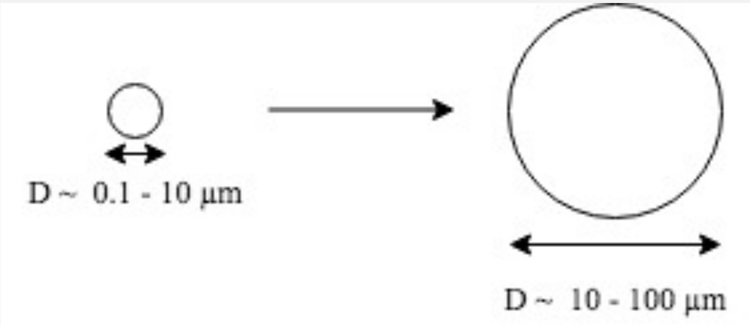
NCAR

NCAR Command Language

Wolfram

CLOUD MICROPHYSICS

- Study of tiny particles in clouds



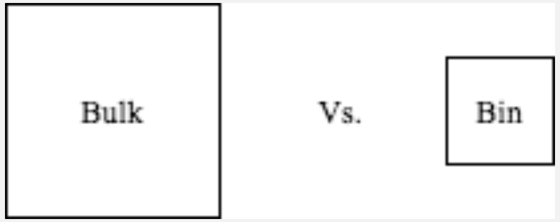
Collision rate of cloud particles:

$$\tau^{-1}_{coal} \approx (\, \pi\, \varrho_p\, g \,/\, 9\eta)\, N\, r_M^{\,4}$$

Particles grow, atmosphere becomes saturated, fall as precipitation

Such a complex process, how can we model it …?

CLOUD MICROPHYSICS MODELING



	Thompson	WDM6	Eta (Ferrier)	Morrison 2 Moment
Moment	1	2	1	2
Mass Variables	Qc, Qr, Qi, Qs, Qg	Qc, Qr, Qi, Qs, Qg	Qc, Qr, Qs, Qt	Qc, Qr, Qi, Qs, Qg
Number Variables	Ni, Nr	Nn, Nc, Nr		Nr, Ni, Ns, Ng
Snow Density	Varies with size	Fixed	Fixed	Fixed

Bulk scheme uses Gamma distribution as particle size distribution (many assumptions at play)

$$N_x(D) = \int N_{0x} D^{\mu} e^{\lambda_x D} dD$$

(Galligani et al. 2017)

RESULTS

- On this slide, I hope to display a data table that shows snowfall totals for each microphysics scheme at the two locations that I will be analyzing data, and I will show actual observations from the storm.

ANALYSIS

- Here I will give a brief discussion of which microphysics scheme best predicts snowfall for the storm, and what that means for selecting MP parameterizations when weather modeling and how this can inform operational forecasting.
- I will also compare my results to similar studies of MP (McMillen and Steenburgh, 2015; Jankov, et al. 2011)

FUTURE DIRECTIONS

- Analyze other microphysics parameterizations not chosen in this project
- Modify other aspects of the WRF physics (Cumulus physics, radiation, land surface physics, etc.)