PHYS 0704 - Annotated Bibliography

Michael Wasserstein

September 22, 2020

References

[1] S. Y. Bae, S.-Y. Hong, and W.-K. Tao, "Development of a Single-Moment Cloud Microphysics Scheme with Prognostic Hail for the Weather Research and Forecasting (WRF) Model," *Asia-Pacific Journal of Atmospheric Sciences*, vol. 55, no. 2, pp. 233–245, May 2019. [Online]. Available: https://doi.org/10.1007/s13143-018-0066-3

> This paper gives an overview of the very new WSM7 microphysics scheme, which I don't intend to use in my simulations, but it is something that I can consider looking at.

[2] I. Jankov, L. D. Grasso, M. Sengupta, P. J. Neiman, D. Zupanski, M. Zupanski, D. Lindsey, D. W. Hillger, D. L. Birkenheuer, R. Brummer, and H. Yuan, "An Evaluation of Five ARW-WRF Microphysics Schemes Using Synthetic GOES Imagery for an Atmospheric River Event Affecting the California Coast," *Journal of Hydrometeorology*, vol. 12, no. 4, pp. 618–633, Aug. 2011. [Online]. Available: https://journals.ametsoc.org/jhm/article/12/4/618/5482/An-Evaluation-of-Five-ARW-WRF-Microphysics-Schemes

> Similar to the McMillen and Steenburgh reference, this one provides a sample of a similar analysis to what I hope to conduct. This one uses the WSM6, Thompson, Schultz, Morrison 2 moment, and Lin schemes, and it is particularly interesting because it compares results to satellite data for atmospheric rivers. I plan to only compare my data to observed snowfall totals, but this is an interesting approach.

[3] K.-S. S. Lim and S.-Y. Hong, "Development of an Effective Double-Moment Cloud Microphysics Scheme with Prognostic Cloud Condensation Nuclei (CCN) for Weather and Climate Models," *Monthly Weather Review*, vol. 138, no. 5, pp. 1587–1612, May 2010. [Online]. Available: https://journals.ametsoc.org/mwr/article/138/5/1587/71265/Development-of-an-Effective-Double-Moment-Cloud

This reference gives a good overview of the WDM6 microphysics scheme. I have not yet read it, but it will give me a good sense of the changes in the physics that I will be making when I use this scheme.

[4] J. D. McMillen and W. J. Steenburgh, "Impact of Microphysics Parameterizations on Simulations of the 27 October 2010 Great Salt Lake–Effect Snowstorm," *Weather and Forecasting*, vol. 30, no. 1, pp. 136–152, Feb. 2015. [Online]. Available: https://journals.ametsoc.org/waf/article/30/1/136/39921/Impact-of-Microphysics-Parameterizations-on

This reference serves as a good example for the type of analysis that I hope to conduct in my research. Essentially, McMillen and Steenburgh conduct a similar microphysics analysis of a lake effect storm in Utah using 4 different microphysics schemes. This set a god example for my report, and it gives me a good idea of the microphysics schemes that I should choose and the controls that I can use.

[5] H. Morrison, G. Thompson, and V. Tatarskii, "Impact of Cloud Microphysics on the Development of Trailing Stratiform Precipitation in a Simulated Squall Line: Comparison of One- and Two-Moment Schemes," *Monthly Weather Review*, vol. 137, no. 3, pp. 991–1007, Mar. 2009. [Online]. Available: https://journals.ametsoc.org/mwr/article/137/3/991/70576/Impact-of-Cloud-Microphysics-on-the-Development-of

This reference was the introduction of the Morrison microphysics scheme for WRF. It gives me a good idea of the differences between double moment and single moment MP schemes. In this reference, I learned that 2 moment schemes predict mixing ratios of the hydrometeor species in addition to number concentration.

[6] C. Skamarock, B. Klemp, J. Dudhia, O. Gill, Z. Liu, J. Berner, W. Wang, G. Powers, G. Duda, D. Barker, and X.-y. Huang, "A Description of the Advanced Research WRF Model Version 4," 2019.

This reference, highly cited in any of the papers that I have read that use WRF, provides an overview of the model. It tells me the equations that serve as the basis for WRF, gives some insight into the physics of the model, and talks about setting domains, among other topics.

[7] W.-K. Tao, D. Wu, S. Lang, J.-D. Chern, C. Peters-Lidard, A. Fridlind, and T. Matsui, "High-resolution NU-WRF simulations of a deep convective-precipitation system during MC3E: Further improvements and comparisons between Goddard microphysics

schemes and observations," *Journal of Geophysical Research: Atmospheres*, vol. 121, no. 3, pp. 1278–1305, 2016. [Online]. Available: https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1002/2015JD023986

This paper gives an overview of the Goddard microphysics scheme, which I may decide to use for some simulations, though I'm not certain.

[8] G. Thompson, P. R. Field, R. M. Rasmussen, and W. D. Hall, "Explicit Forecasts of Winter Precipitation Using an Improved Bulk Microphysics Scheme. Part II: Implementation of a New Snow Parameterization," *Monthly Weather Review*, vol. 136, no. 12, pp. 5095–5115, Dec. 2008. [Online]. Available: https://journals.ametsoc.org/mwr/article/136/12/5095/68204/Explicit-Forecasts-of-Winter-Precipitation-Using

This reference is the introduction of the Thompson microphysics scheme in WRF. In reading this paper, I learned that in the Thompson scheme better predicts the shape of snow because it does not assume that snow is spherical. While spherical snow can be assumed for certain densities, at higher snow densities, the shape must be changed.

[9] N. US Department of Commerce, *The January 20-21, 2019 Winter Storm*. [Online]. Available: https://www.weather.gov/btv/The-January-20-21-2019-Winter-Storm

This National Weather Service (NWS) report on the January 2019 snowstorm that I'll be analyzing provides a fantastic overview of the storm. It gives a good idea of the synoptic and mesoscale environments, the impacts of the storm, and some basic data. It gives me a good idea of what actually happened in January 2019.