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Comment on amt-2021-123

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Referee comment on "The University of Washington Ice–Liquid Discriminator (UWILD) improves single-particle phase classifications of hydrometeors within Southern Ocean clouds using machine learning" by Rachel Atlas et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-123-RC1, 2021

As someone who is inexperienced in all but the simplest of machine learning, I thoroughly enjoyed reading this manuscript. It is very well organized, takes the reader step by step through the various stages of algorithm development, testing and application, and addresses most of the questions that I might have had about the parameters chosen, implementation and application. The use of the algorithm to measure the heterogenity of mixed phase clouds I found especially intriguing. I commend the authors on a very nicely done study, well presented.

There is, of course, a "however". I have the following questions bear considering:

1) A number of previous studies were mentioned that used various methodologies for pattern recognition of OAP images. I am assuming that the authors were made aware of many of these as a result of our workshop summary in BAMS back in 1985. Can the authors explain why they chose Holroyd as opposed to Hunter, Rahman or Duroure? These latter three approach seemed to hold a lot of promise but were limited by computing power at that time. I certainly don't expect the authors to try and test their algorithm against these others, but a word of explanation would be helpful.

2) I could not find an explanation of why the particular 15 parameters were selected for the training, in particular not only is the use of interarrival time (IAT) puzzling, it is also somewhat troubling since there seems to be only two possible physical links between this parameter and the phase of a particle: 1) ice crystal shattering or water droplet splatter or 2) inhomogeneity in clouds. It was briefly mentioned that images with IATs shorter than a constant threshold were rejected as artifacts but Korolev et al have shown that a constant threshold should not be used but that a dynamic threshold should be set according to the number concentration. His studies show that the distribution of IATs from shattered particles often overlap those of real particles, leading to some uncertainty in artifact rejection. Is it possible that the IAT is a significant factor because it is identifying/reject

liquid or ice solely because they are artifacts? Alternatively, the IAT has been used to identify inhomogenieties in cloud by looking if they are Poisson distributed. In another publication Korolev has postulated that due to the WBF effect, there might be clusters of droplets between single ice particles. Perhaps this is why the IAT is a factor. Could the authors comment on why they chose the IAT in the first place and why it should have an impact?

3. Pervious efforts to develop algorithms used simulated images where their shapes, orientation, roughness, size could be precisely defined. Did the authors give any consideration to this as a complementary approach?

A final recommendation is I think it would be very helpful to show a real image with all the parameters defined. Some are obvious, others not so much.

Thanks again for a delightful read.