Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2019-206-RC2, 2019

Atmospheric Measurement Techniques Discussions

Interactive comment on "A Convolutional Neural Network for Classifying Cloud Particles Recorded by Imaging Probes" *by* Georgios Touloupas et al.

Anonymous Referee #2

Received and published: 11 August 2019

"A Convolutional Neural Network for Classifying Cloud Particles Recorded by Imaging Probes" describes the application of a convolutional neural network for classification of images of atmospheric hydrometeors from holographic imagers and other imaging probes. This technique could be of great help in particular for the classification of holographic data sets. This topic is of interest for the atmospheric sciences community and fits the scope of AMT. The application of the CNN is explained in great detail and the text is well-written but there are various things that should be added to the manuscript prior to publication.

General comments:

(1) The introduction needs more depth in terms of methods suitable for ice versus liquid water particle classification. Here, particle classification by shape is discussed in great

detail but there are also other possibilities, e.g. using the forward scattering pattern as it is done by the SID-3 instrument. Please discuss also the other options to distinguish ice from liquid water in the introduction. There are examples given in Korolev et al. (2017) and other references.

(2) There is way more literature about ice particle classification available. For example, O'Shea et al. (2016) were also using a machine learning approach to classify ice particles with the distinction between spheres and other shapes being part of it. I would like to see a comparison of the different schemes in the introduction, and a clearer presentation of what is the innovative part of your method in this context.

(3) Images of droplets obtained by a holographic imager tend to appear somewhat distorted at far away distance from the camera and the lateral center of the detector. Could that be one reason for a rather low accuracy in the classification of small ice crystals?

(4) Would the skill of the CNN improve if out-of-focus particles (a common type of objects that can be seen as artifact) were removed completely from the sample and processed separately with different methods?

Specific comments:

Page 2, line 10: The minimum diameter issue is also mentioned in Korolev et al. (2017) - it is Figure 5-10 that demonstrates this issue very well.

Page 3, line 23: At this point it is useful to discuss the accuracy of the focus finder subroutine. How much can a particle be out of focus to still be recognizable as a particle and not being treated as an artifact?

Figure 2: It would be helpful to get an idea of the phase and amplitude values and the particle size (how much stronger is the amplitude signal of the particle in comparison to background noise?)

Page 4, line 3: Do you have an estimate of how strong the classification bias typically is? One way to estimate the classification bias is to classify the same dataset by two or more independent users.

Page 6, line 7: Please provide some evidence that this is really an optimum choice (either in supplement or another appendix).

Page 6, line 9: How is the zero padding interpreted by the CNN? This is something that could introduce a bias.

Page S1, line 31: What does KDE stand for?

References:

Korolev, A., G. McFarquhar, P. R. Field, C. Franklin, P. Lawson, Z. Wang, E. Williams, S. Abel, D. Axisa, S. Borrmann, J. Crosier, J. Fugal, M. Krämer, U. Lohmann, O. Schlenczek and M. Wendisch (2017): Chapter 5: Mixed-phase clouds: progress and challenges. AMS Meteorological Monographs 58, 5.1-5.50.

O'Shea, S. J., T. W. Choularton, G. Lloyd, J. Crosier, K. N. Bower, M. Gallagher, S. J. Abel, R. J. Cotton, P. R. A. Brown, J. P. Fugal, O. Schlenczek, S. Borrmann and J. C. Pickering (2016): Airborne observations of the microphysical structure of two contrasting cirrus clouds. J. Geophys. Res.: Atmospheres 121 (22), 13510-13536.2016JD025278.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2019-206, 2019.