EGUsphere, referee comment RC2
https://doi.org/10.5194/egusphere-2022-559-RC2, 2022

Comment on egusphere-2022-559

Anonymous Referee #2

Referee comment on "Emulating Aerosol Optics with Randomly Generated Neural Networks" by Andrew Geiss et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-559-RC2, 2022

Review of the manuscript egusphere-2022-559 by Geiss et al.

The manuscript (MS) presents a new method (based on Artificial Neural Networks (ANNs)) for online calculation of the optical properties of the internally mixed aerosols. Current parametrizations and look-up tables are either computationally unaffordable or fail to capture the large variabilities in aerosol properties. The training dataset is based on the Mie code that directly computes the optical properties of aerosols by considering the variability of the particle sizes, wavelengths, and refractive indices. This approach is similar to previous parameterizations but uses a higher resolution for different parameters. By evaluating ANNs with randomly generated wirings, the optimal network architectures are identified for SW and LW. The results show that randomly generated deep ANNs lead to lower error compared to the conventional multi-layer perceptron. Besides, the ANN-based parameterization outperforms the current parameterization.

The paper is very well structured and written. I really enjoyed the detailed explanations of the assumptions and methods that makes it easy to follow the results. The methods and results are robust with major benefits for the aerosol modeling community. Thus, I recommend publication after addressing the minor points/questions listed below.

- With respect to the I/O, it is not clear why nine variables are chosen. Any pre-processing or input selection procedure? Especially two parameters "surface mode radius over wavelength" and "surface mode radius" are obviously correlated. This should not happen.
- Why do you need one-hot encoding? What additional information does it contain for the modes?
- It can be expected that 2-3 hidden layers can capture the nonlinearities of the system very well and more hidden layers often lead to over-fitting (shown in Fig 2). But it is not clear if the rather minor MAE reduction by random wired networks (outperform is too strong here) is justified by its computational costs/complexity.

- I would like to see ANN vs. Mie similar to figure 5 but for all parameters: extinction coefficient, single scattering albedo and asymmetry parameter in SW and WL.