Implementation and testing of a deep neural network emulator for aerosol activation in E3SM

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Efficient use of novel machine learning tools that are python-based in climate models requires careful software design. In the EAGLES project, we demonstrate that the "Fortran Keras Bridge" library can be used to call a previously trained deep neural network (DNN) emulator. The model simulation time is reduced on CPU machines even for a sophisticated DNN emulator. The library also has the flexibility to allow quick updates of the emulator with minimum efforts. In addition, we found that some numerical and physical considerations need to be accounted for to ensure stable model simulations. We will present the workflow that connects the machine learning tools with current E3SM and show results from the E3SM global simulations. We will also discuss the workflow for integrating machine learning tools with future generation E3SMs running on GPU machines.