While traditional machine learning methodologies (e.g., Random Forest) have been widely used to estimate PBLH, most studies heavily rely on specific remote sensing instruments or focuses on limited time-period or specific region of interest. More importantly, lack of enough physical explanation is another concern. To address this issue, this manuscript introduces a multi-structure deep neural network (DNN) model that is used to generate yield a robust 27-year PBLH dataset over the Southern Great Plains from 1994 to 2020. Through leveraging a variety of meteorological data, independent of remote sensing instruments, this model yielded an PBLH dataset over the SGP with robust accuracy, consistently yielding lower bias values across various conditions and datasets. Besides, the generalizability of this model to different geographic regions and climate zones are explored, exhibiting high potential and less uncertainties in terms of seasonal, diurnal variability. Overall, this manuscript is well organized with clear enough logic, I would like to offer the following suggestions for further improvement:

Major commments:

1. Introduction: Except for the lidar systems, the authors seem to ignore the radar wind profiler, which provides the direct measurements of turbulence in the atmosphere and thus affords the retrievals of PBLH. A variety of algrithms or methods in the lieterature have been proposed to accomplished this task. Therefore, the authors can augument the current literature review in this regard.
2. Line 89-102: The reason for the selection of multi-structure deep neural network (DNN) in the retrieval of PBLH lacks necessary literature support. Are there similar model constructed based on DNN? If any, how is the performance compared with other models or methods? This should be clarified and some necessary references are required to be cited here.

Specific comments:

1. Line 50: “it” is redundant and can be removed.
2. Line 54: “climate models” -> “climate projections”
3. Line 83: “PBL heights using thermodynamic profiles or backscatter profiles from Lidar or Atmospheric Emitted Radiance Interferometer (AERI)” -> “PBLH using thermodynamic profiles Atmospheric Emitted Radiance Interferometer (AERI) or using backscatter profiles from Lidar”
4. Line 87: “Moreover,” -> “For example, ”
5. Line 89: “marked progress” -> “made great progress”
6. Line 136: Some words are missing between “latent heat fluxes” and “the surface instruments”
7. Line 365-367: is there any supporting material for the threshold used to define low cloud (maximum cloud fraction between 0-4 km exceeding 1%)??