Development of a Smart Ground-based Radiometer for Weather Study - ML TPW retrieval algorithm for the 22 GHz radiometer

Intern: Niko Zhang

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Cooperative Institute for Satellite Earth System Studies

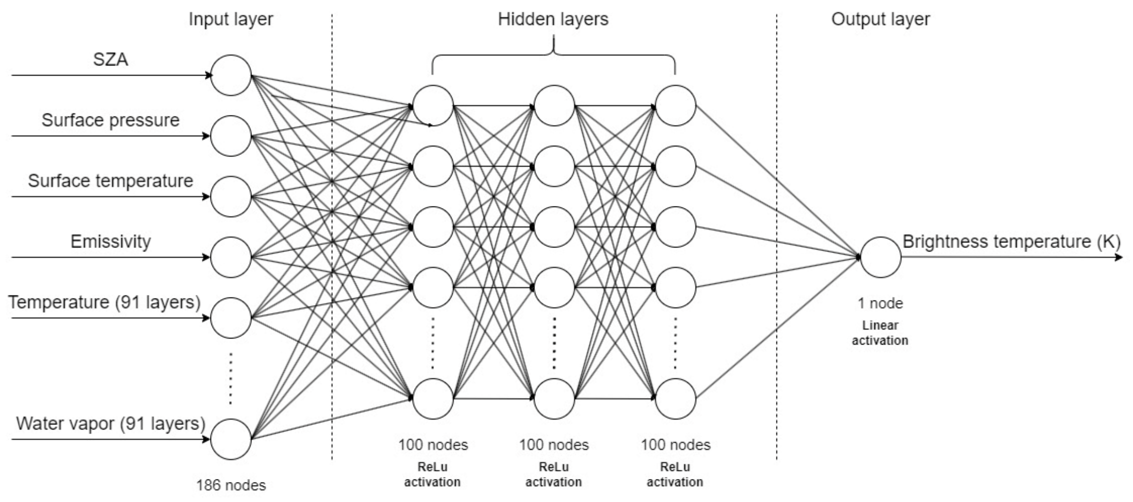
Objectives

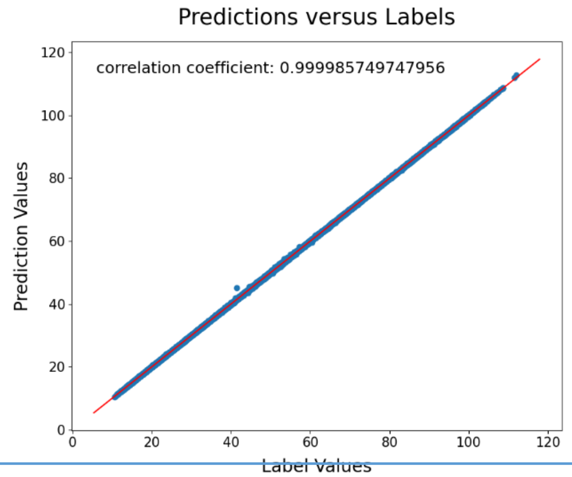
- Develop a deep-learning-based forward emulator (DLFE) to see if neural networks are good alternatives for calculating BTs for the 22 GHz radiometer.
- Develop a retrieval algorithm using a deep neural network with BT for predicting the total precipitable water vapor density (TPW) from the atmosphere for 91 layers in altitude.

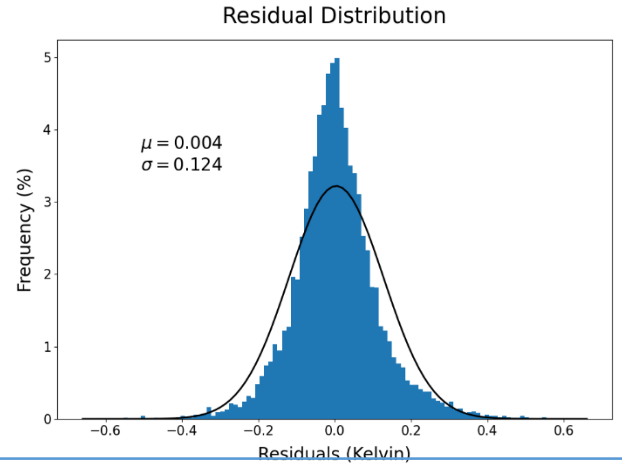
Data

- MonoRTM simulated BTs for 22 GHz radiometer
- Surface P and T, and air T and water vapor profiles (91-layer) extracted from ECMWF
- Emissivity: [0.3, 0.7]
- Sensor zenith angle: [0, 70]

DLFE Figures







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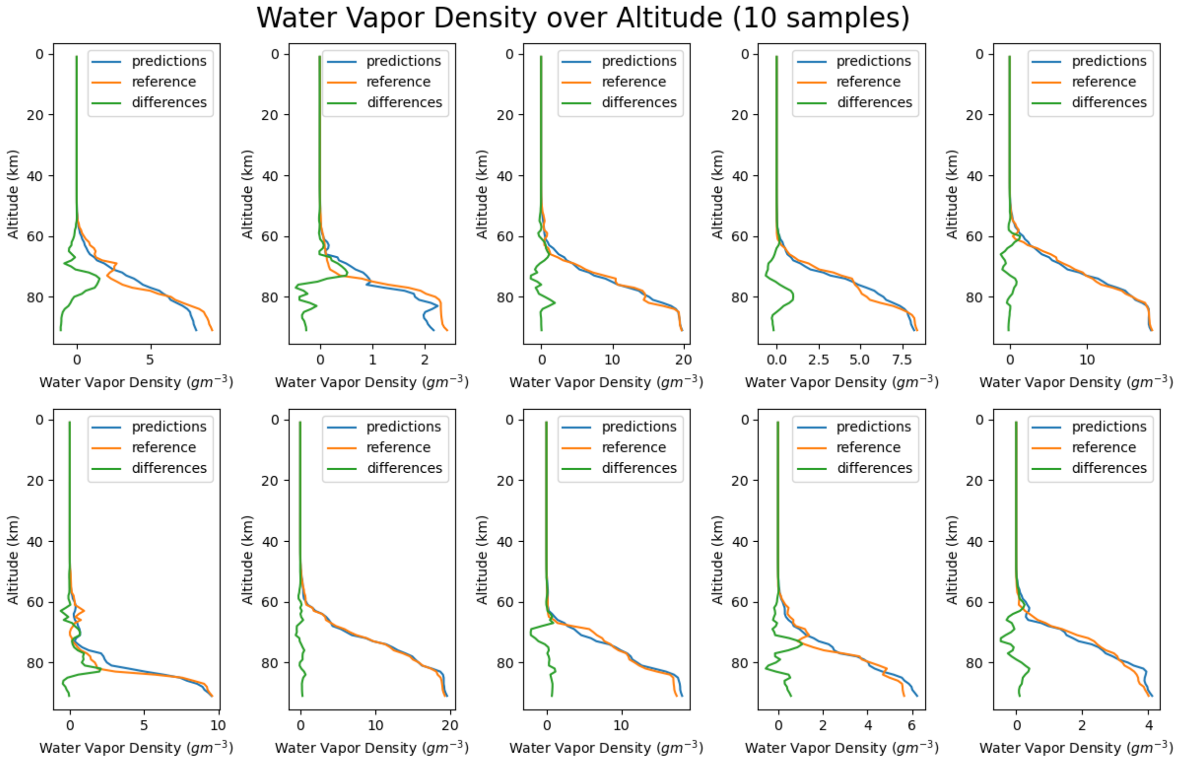
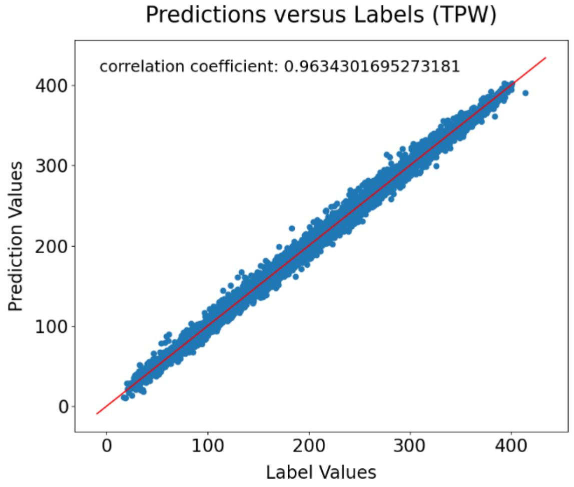
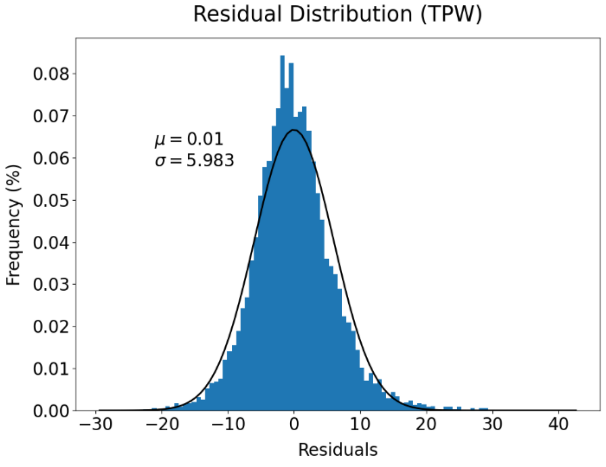
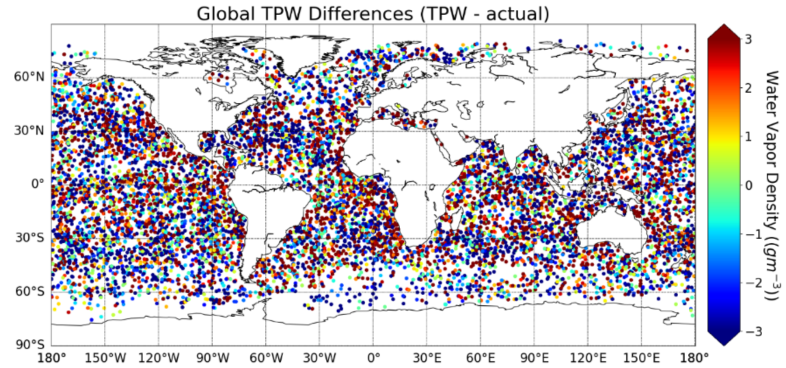
TPW Retrieval Figures









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Conclusion and Future Work

DLFE

- Neural networks can be used in place of current meteorological methods for quickly calculating scientific measurements.
- DLFE gave highly accurate BT predictions and was significantly faster than the radiative transfer model.
- More testing is required to determine if DLFE generalizes well to new data, as the testing dataset came from the same data collection that was used for model training.

TPW Retrieval

- More work needs to be done to increase the accuracy in the upper layers
  - Highly accurate in layers 1 to 60, but slightly less accurate in layers 61 to 91
- To improve accuracy in upper layers, we can add more features for the model's input.
  - We have already tried adding the 91-layer pressure to the model's input with no noticeable improvement, so we will have to look for additional features contained in the ECMWF data.
  - Directly use TPW as label