Study of stability and consistency of AMSU/MHS across missions using an AI/ML model

Intern: Anna Hall
Mentors: Xi Shao, Feng Zhang, Changyong Cao

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Cooperative Institute for Satellite Earth System Studies

Motivation:

- NOAA-15's AMSU-A greatly enhanced NWP forecast skill. After its deorbit this summer, we need to ensure consistency to the new sounder launching next year.

Research Goals:

- Build a training dataset pairing NOAA-15 AMSU-A brightness temperatures with ERA5 reanalysis data, train a multilayer perceptron (MLP) neural network (NN), and evaluate the model's performance.

Outline:

- Creating the training dataset
- Training the MLP NN
- Evaluating the Model

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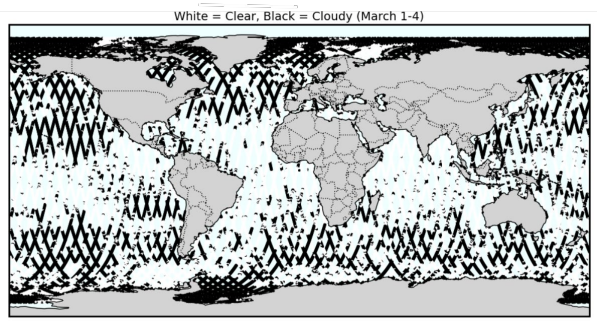
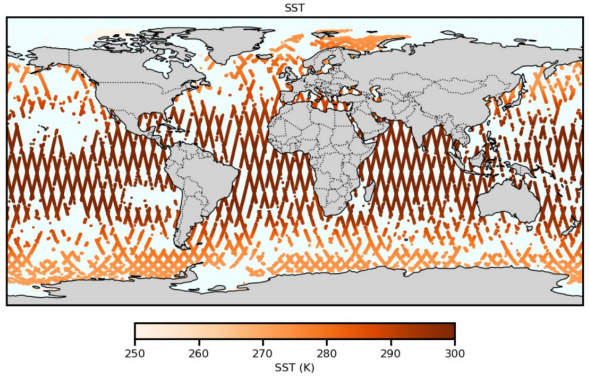


Clear sky determined with cloud mask (white:clear, black:cloudy)



ERA5 SST matched with AMSU-A and filtered with cloud mask

1. Clear sky over ocean from ex. March 1-4, 2023 (at 2 nadir pixels only).
2. ERA5 matched with AMSU-A in space and time
3. Model Inputs (total: 16 variables):
    1. 12 AMSU BT channels
    2. Satellite/scan geometry
    3. Surface pressure
4. Model Targets (total: 77 variables):
    1. Surface wind direction
    2. Surface wind speed
    3. Surface temperature
    4. ERA5 temperature and water vapor (37 layers for each)

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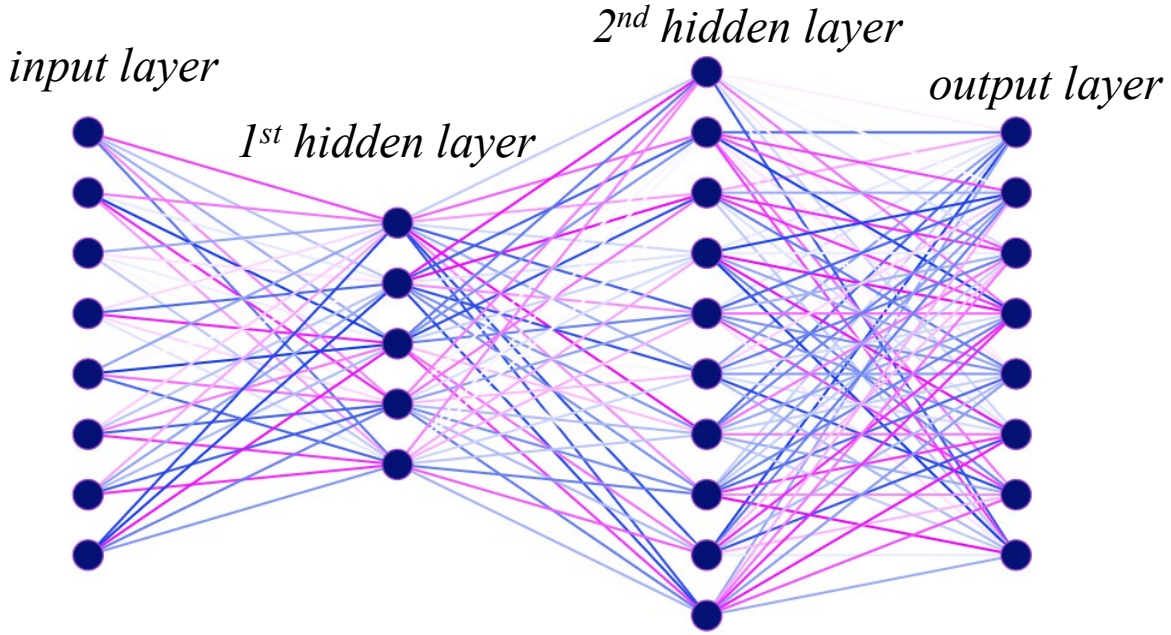

25,000 total points:

18,000 used for training
3,000 used in validating
4,000 used in testing

(for March 1-4, 2023)

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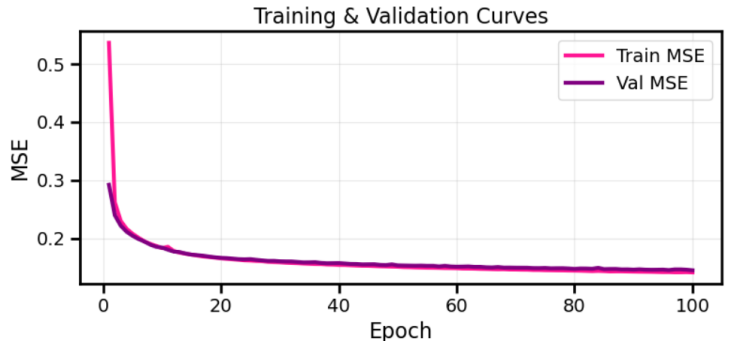
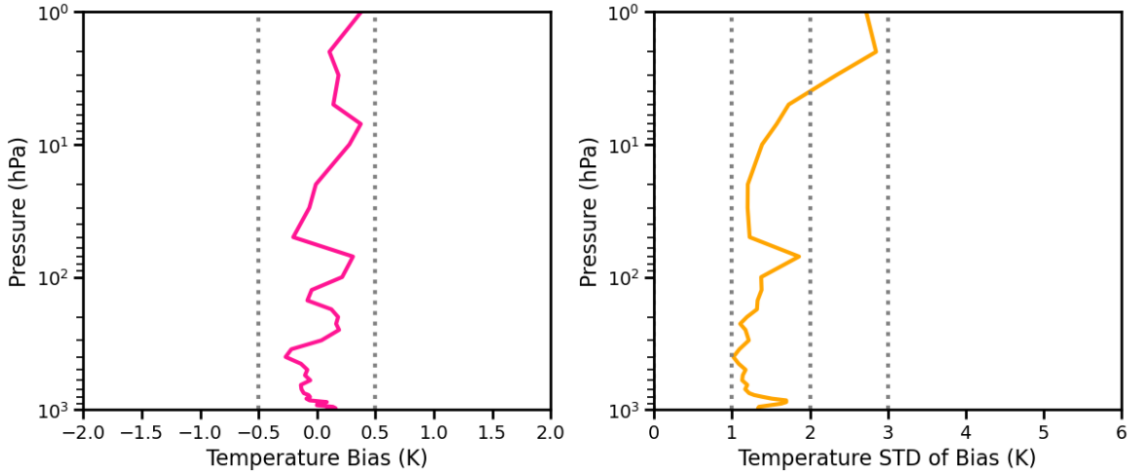


ML model assessment, trained over 100 epochs



Temperature bias stays within -0.5K and 0.5K
Differences occur around the **upper troposphere** and **lower stratosphere**

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Conclusions and Future Work:

- Built a **4-day matched AMSU-A/ERA5** training dataset (nadir-only, clear-sky)
- Preliminary results of the MLP pipeline show **low temperature bias** in the vertical compared to ERA5 profiles
- To more effectively train the AI/Model we need to **scale up** our training dataset beyond our current 4-day span