# Using HIRS Observations to Construct Long-term Global Temperature and Water Vapor Time Series

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Outline of the Study

- To develop temperature and water vapor retrieval schemes using a neural network technique.

- To construct long-term time series of temperature and water vapor in the troposphere.

- To better understand the variability of temperature and water vapor.
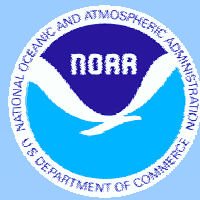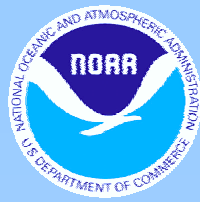
Training Data

- A diverse sample of atmospheric profiles selected from ECMWF ERA-40 analyses.

- RTTOV-8 is used to simulate HIRS channel brightness temperatures

- The sample profiles and corresponding HIRS brightness temperatures are randomly divided into three data sets:

  - 60% training set
  - 20% testing set
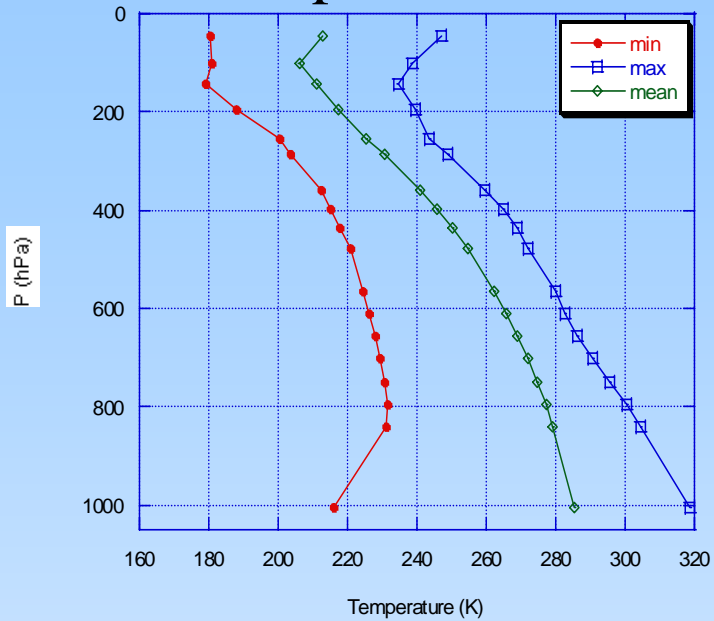 - 20% independent validation set
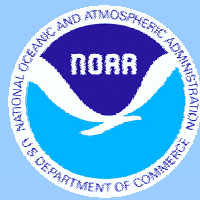
Neural Network

- Five layers (three hidden layers), back propagation.

- Separate neural networks for temperature and water vapor.

- Input: HIRS channels 1-12 and CO_2 concentration.

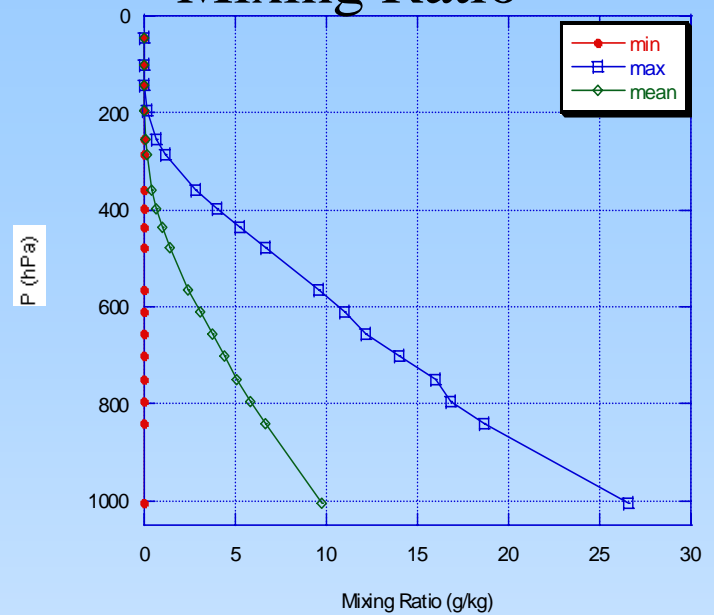- Output: Temperature profiles from 1005 to 50 hPa and water vapor profiles from 1005 to 300 hPa.
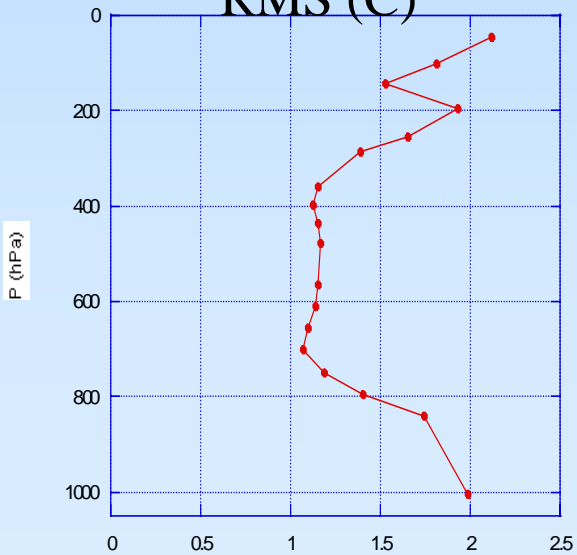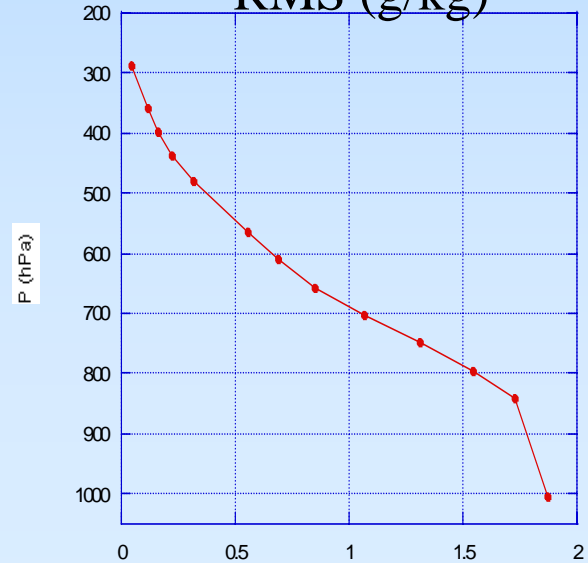
Training Data
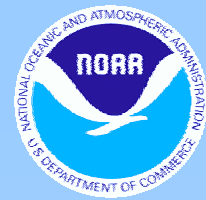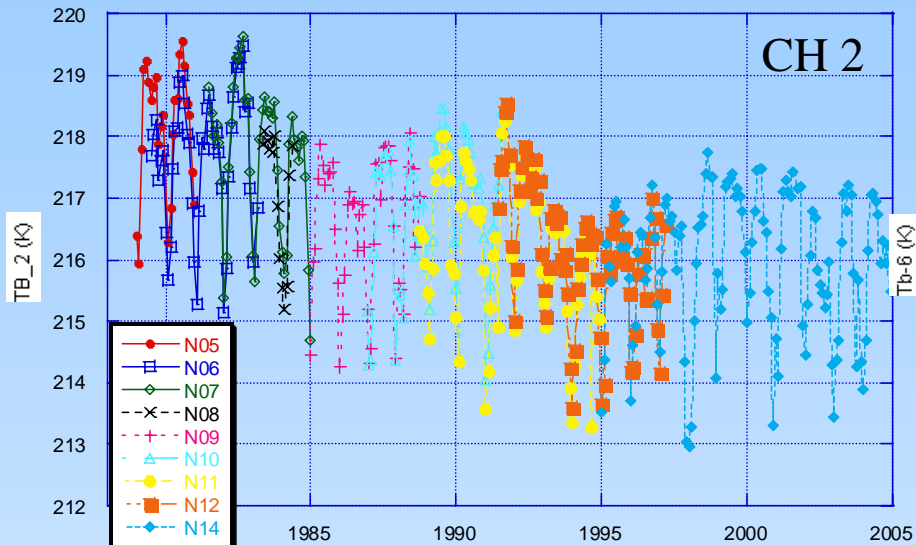
Clear-sky HIRS Channel Brightness Temperatures
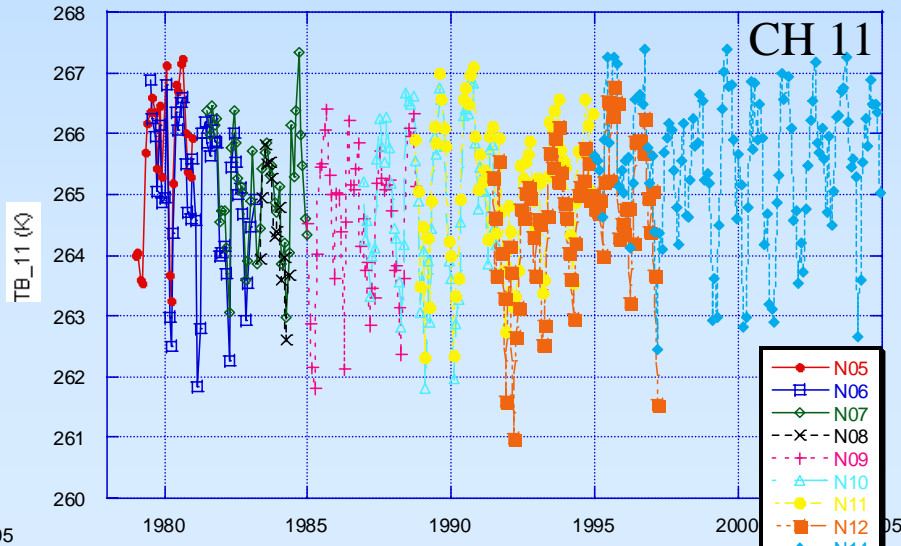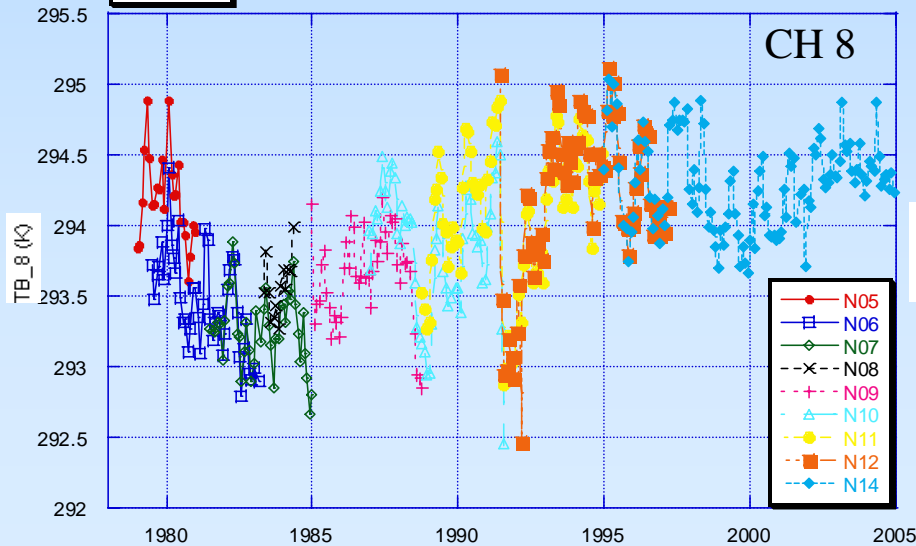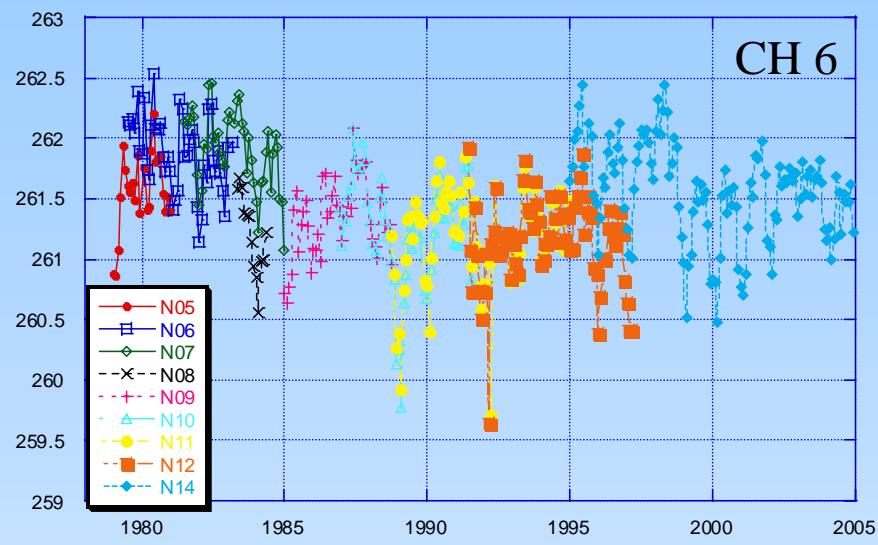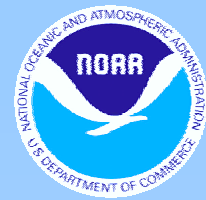
Clear-sky HIRS Channel-5 Brightness Temperatures

CO$_2$ Increase

MAUNA LOA OBSERVATORY, HAWAII
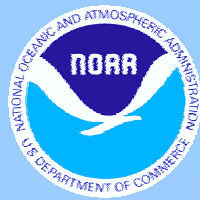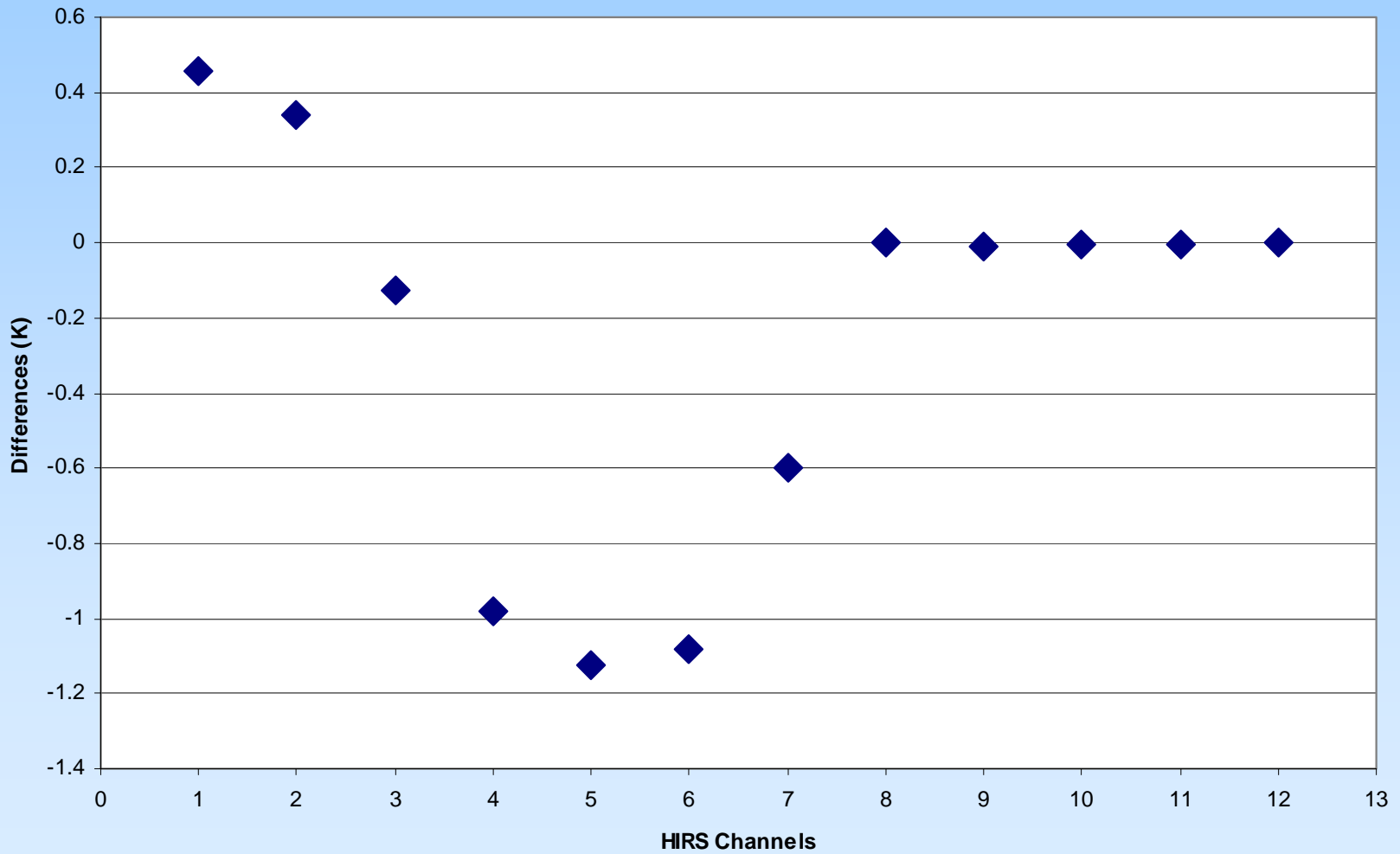MONTHLY AVERAGE CARBON DIOXIDE CONCENTRATION

MLO-144

21-Jul-04
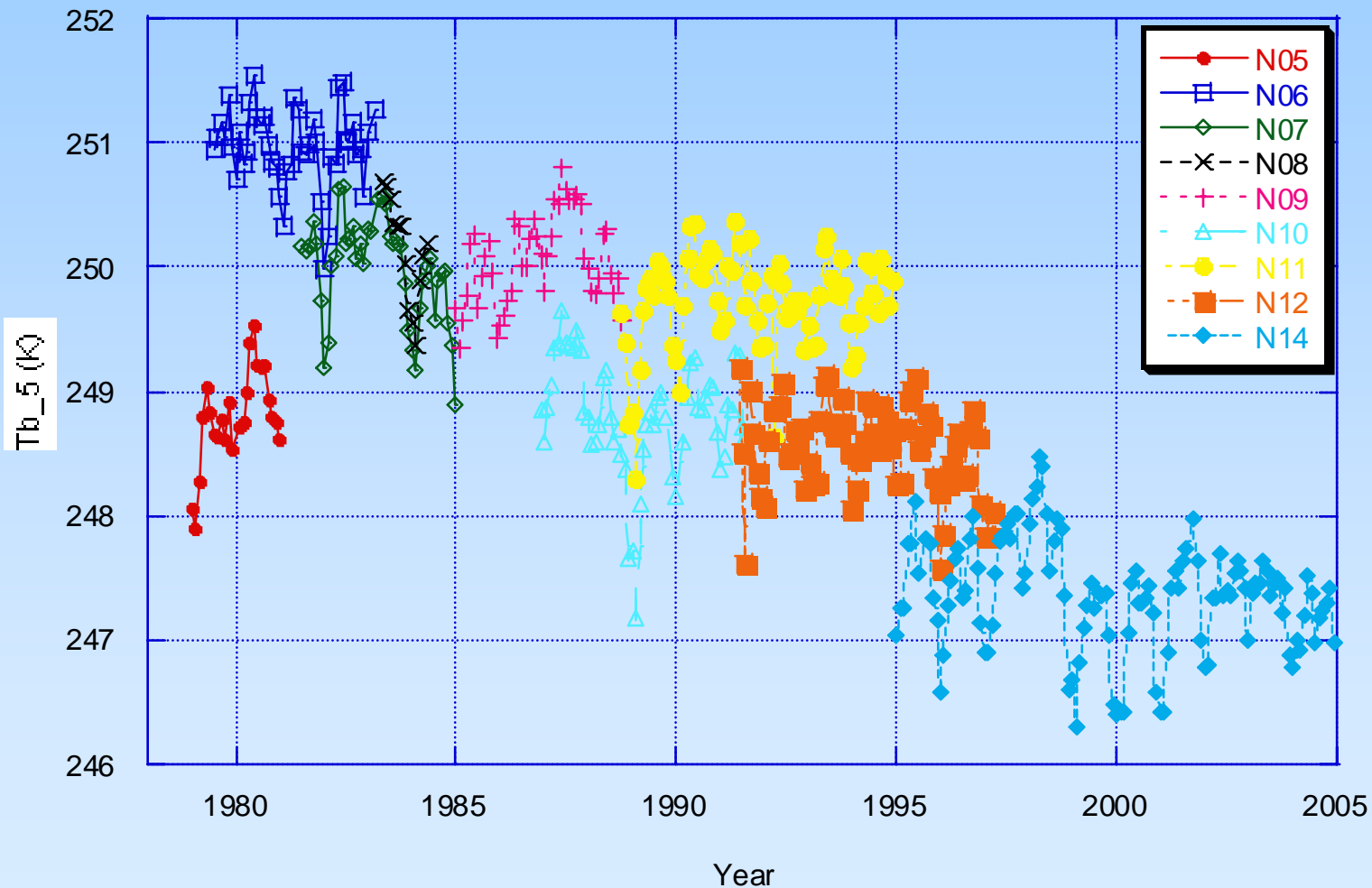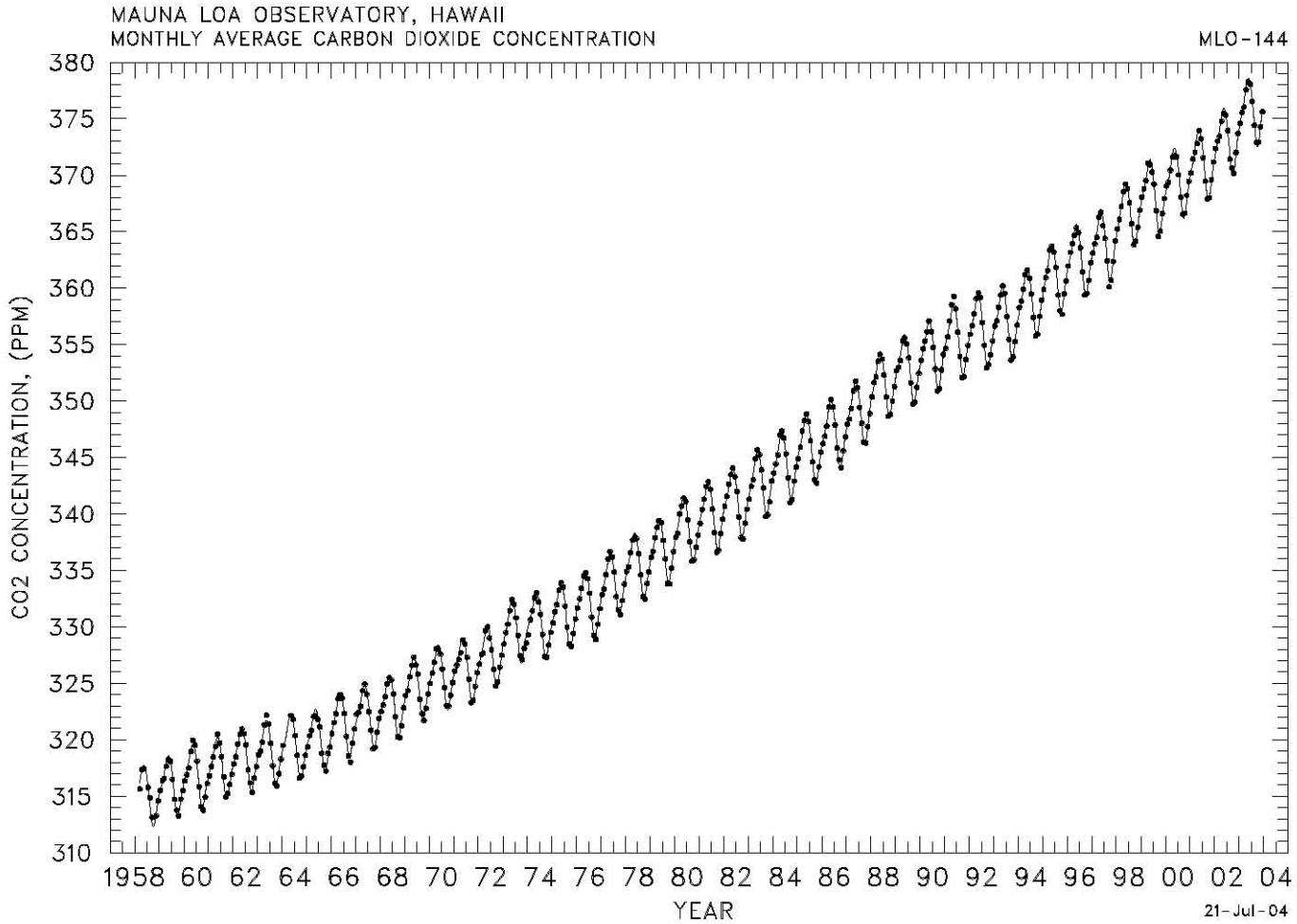
CO$_2$ Impact

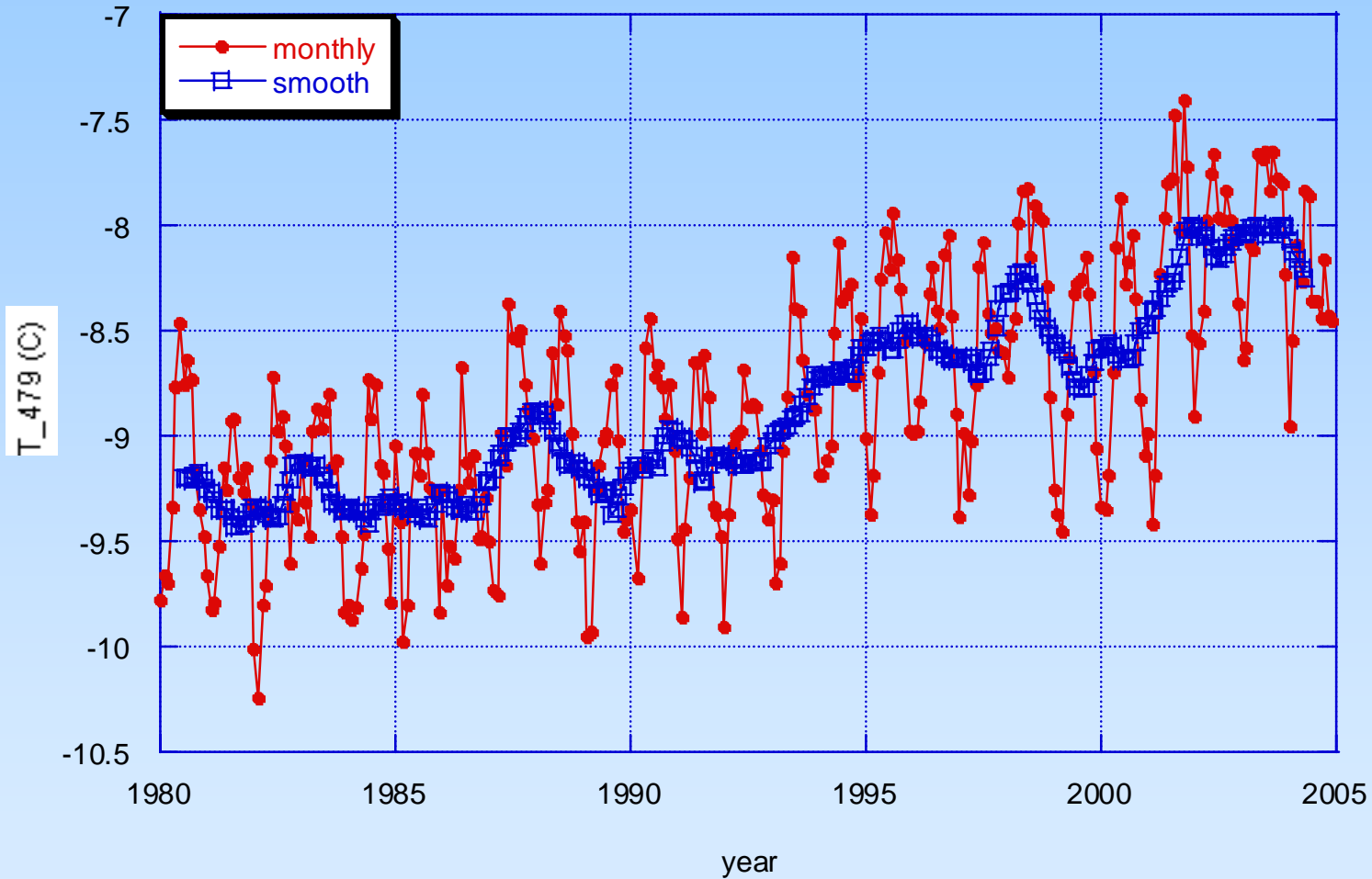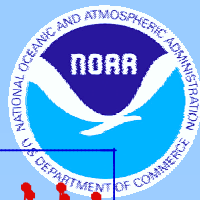**HIRS Differences between 370 and 330 ppmv of CO2, Derived by RTTOV-8**

Monthly Mean Temperature

30S-30N, 0-3UTC

- Monthly mean 479hPa temperature for 30-60N (upper panel) and 30-60S (lower panel), 0-3UTC.

- Both northern and southern mid-latitudes show warming trends.
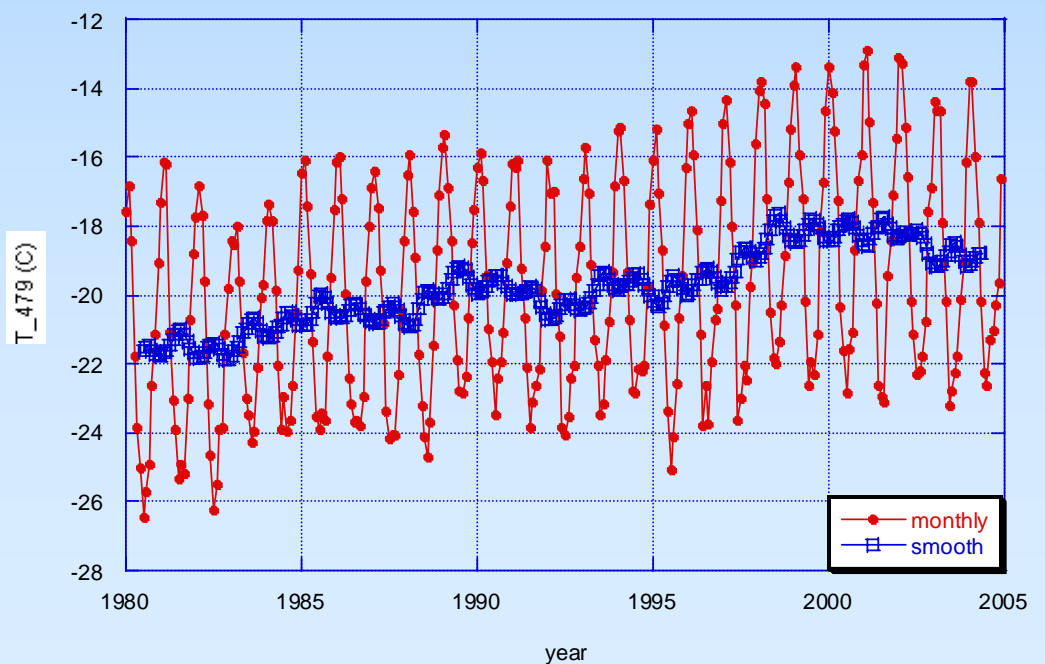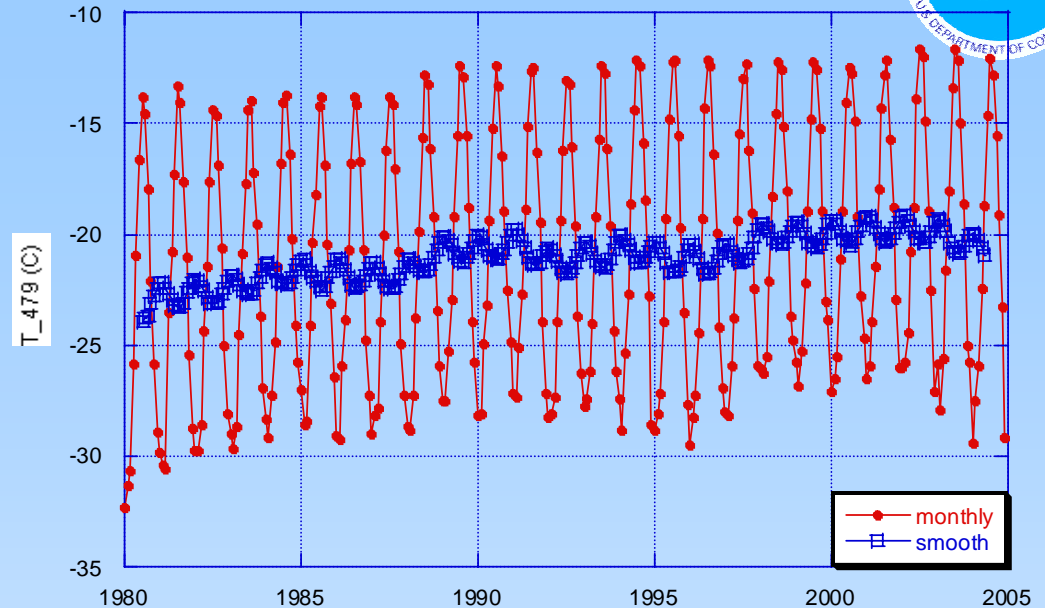
- Monthly mean 479hPa temperature for 60-90N (upper panel) and 60-90S (lower panel), 0-3UTC.

- Through the last twenty-five years, summer mean temperature rose significantly over both north and south poles.

Monthly Mean Mixing Ratio

30S-30N, 0-3UTC

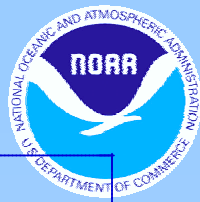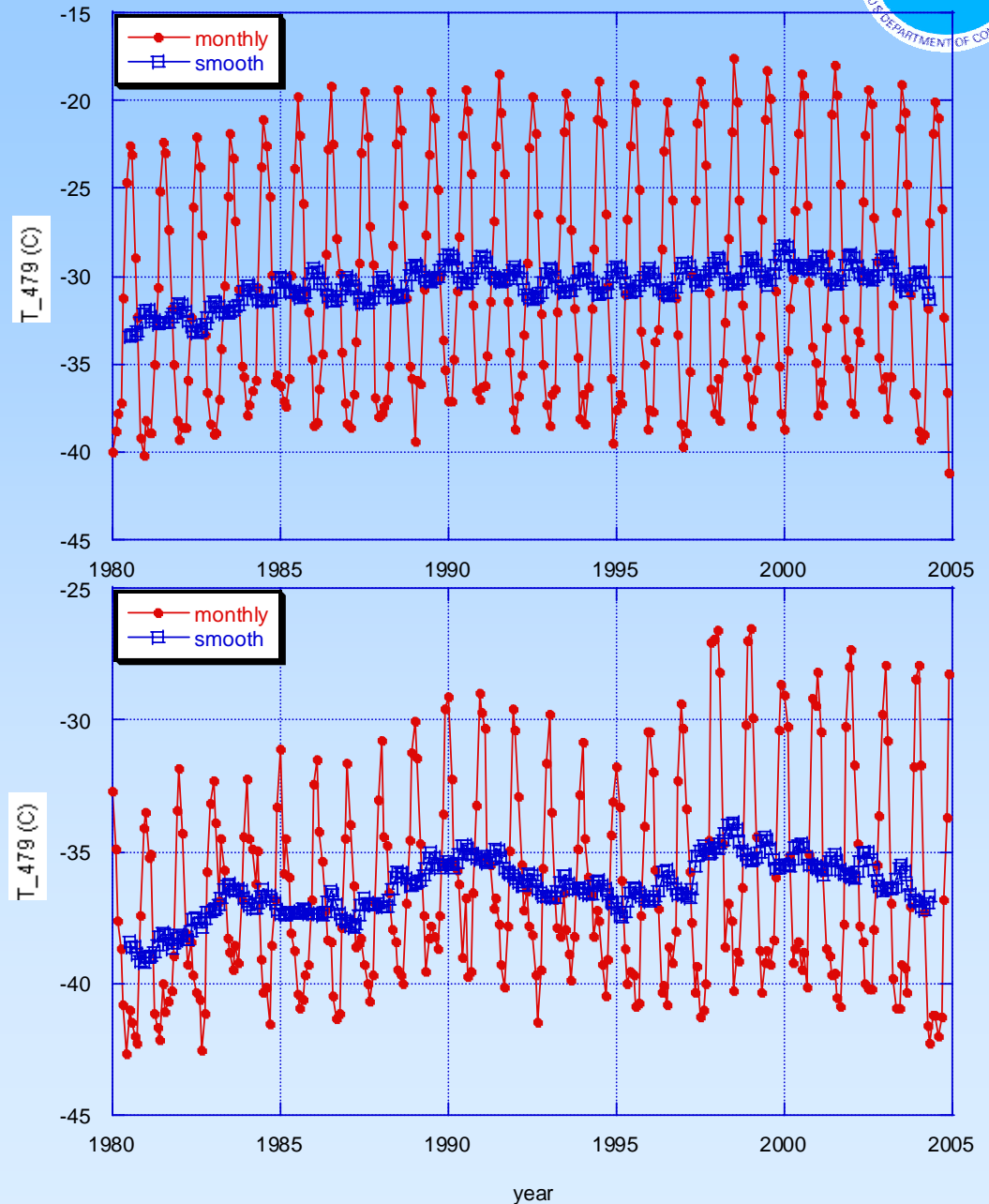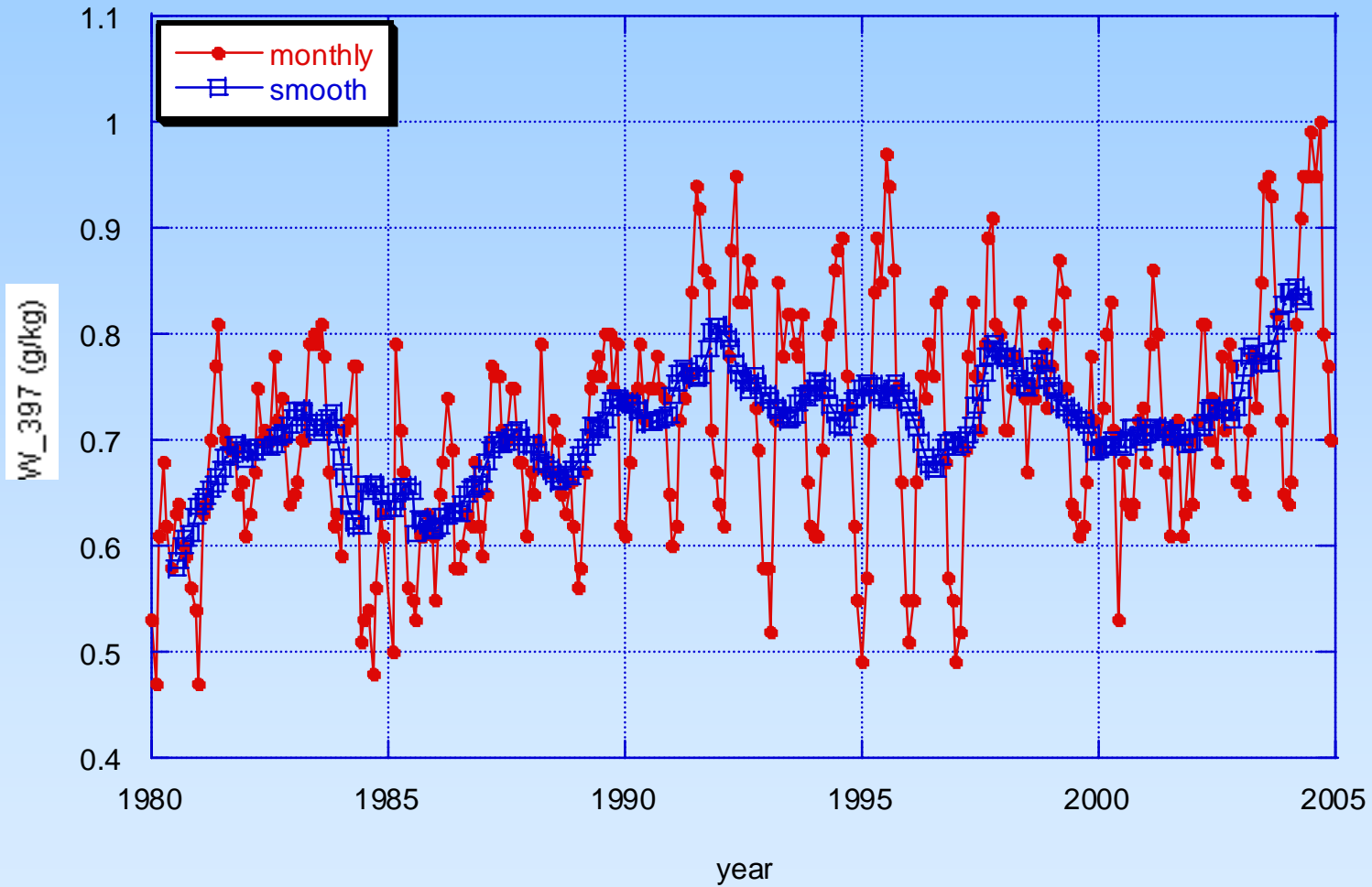# Summary and Conclusion

- A neural network technique is applied to the retrievals. The training dataset is constructed with sampled profiles from ECMWF ERA-40 representing the global atmospheric conditions and RTTOV-8 simulated HIRS brightness temperatures.

- Carbon dioxide is included in the retrievals.

- The time series shows increases of temperatures in all the latitudes. However, the patterns of the temperature increase are different in different latitude zones.

- This work is in the early stage of the study. Better inter-satellite calibration and validation are planned.

Next Steps

- Apply a better inter-satellite calibration algorithm.

- Continue the work to include recent satellites.

- Extend the time series back in time by using VTPR data (1972-1979) to construct temperature and water vapor profiles.

- Validate the retrievals using other independent data sources.