Comparison of Simultaneously Measured Thermospheric Temperatures from the TIMED/SABER and the ISS/ NIRS Experiments

Presented by

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Outline

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- Motivations
- Observations/Technique
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Abstract/Conclusions

• In Oct 2010, the first space science payload on the International Space Station, RAIDS began remote sensing observations of the Earth's lower thermosphere (100-300 km altitudes) with a suite of eight instruments covering the wave length range from 40 to 800 nm.

•The Near Infrared Spectrometer (NIRS) provided limb scan profiles of the (0-0) and (1-1) vibrational transitions of the O_2 atmospheric band spectrum.

•Temperature used for this analysis has been determined from the rotational structure of the (0-0) band.

•To determine the measured temperature's validity, we compare the NIRS results with temperature measurements obtained with the SABER instrument on the NASA TIMED satellite which have been validated from about 100 km and below.

•The NIRS data overlaps the SABER data in this region of validated SABER temperatures. If NIRS can be validated with SABER in this region, then it can be used at higher altitudes where SABER cannot be trusted.

• NIRS can measure the region because the NIRS instrument is thought to only be dependent on receiving a signal from a region that is thermalized.

• In the altitude range 80 to 105 km we find:

1.The difference between SABER and NIRS : 18.2+/-26K

2.The difference between SABER and MSIS: 4.97+/- 22K

3.The difference between NIRS and MSIS: -14.5+/- 11K

Science Motivation

- Temperature is a key state variable in any system.
- A description of the temperature in the Earth's lower thermosphere (100-150 km) is hampered by the paucity (lack of) of measurements.
- The region is influenced from disturbances on the sun, energy input from the magnetosphere, and waves propagating upward from the lower atmosphere.
- In space sciences, understanding the complex interrelationships is an important and timely topic as discussed in the Heliophysics Decadel Survey carried out by the National Research Council.

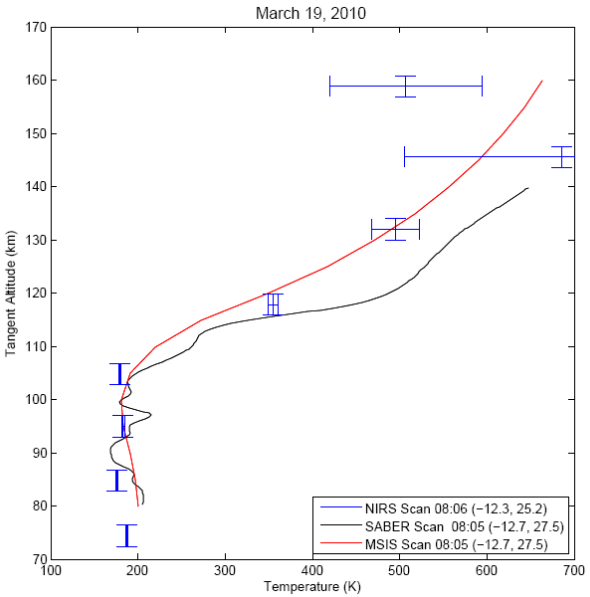
Using STK to find Coincidences

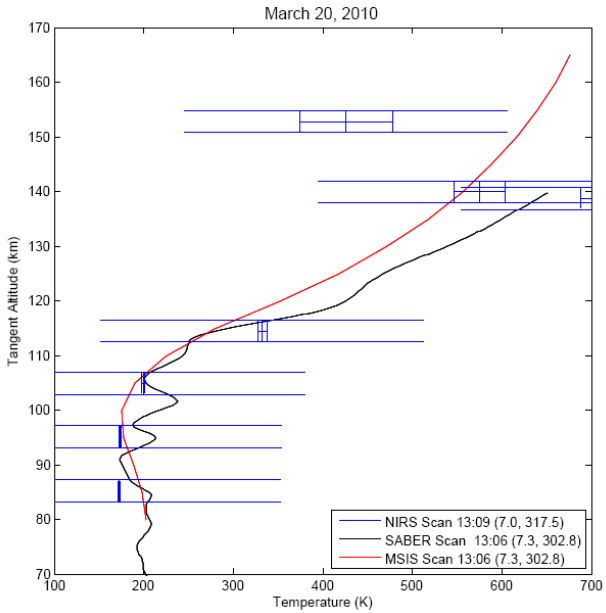
- STK was used to identify times and locations when SABER and NIRS were observing a common volume
- Values used were no more than 20 minutes in time difference…Most were less than 10 minutes.
- Values of Longitude varied no more than 10 degrees.
- Values of Latitude varied no more than 5 degrees.

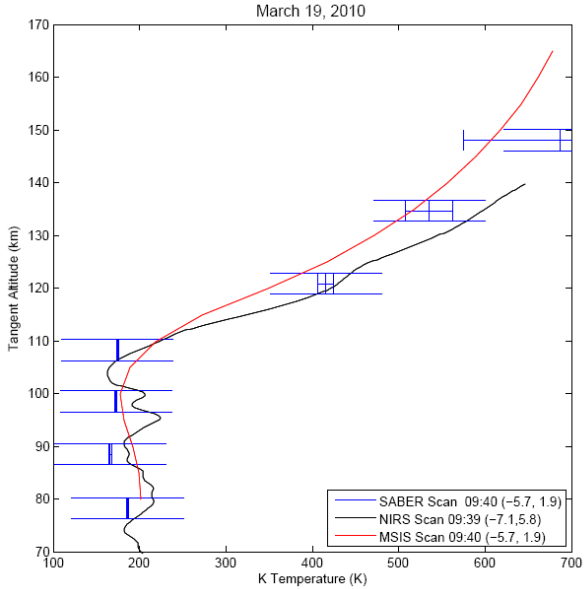
Data Collection

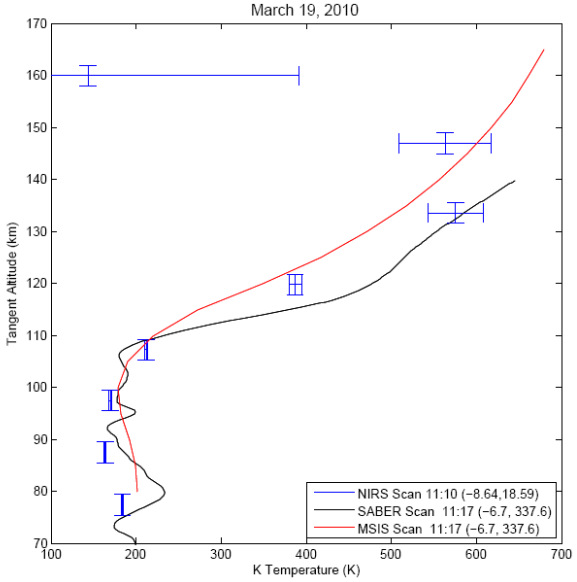
- SABER temperature Data provided from the GATS website
- ISS/NIRS temperature data provided from the Aerospace Corporation.
- SABER scans continuously and ISS does not, so conjunctions were chosen when ISS had data

Measurements : SABER, NIRS and MSIS-model Temperatures

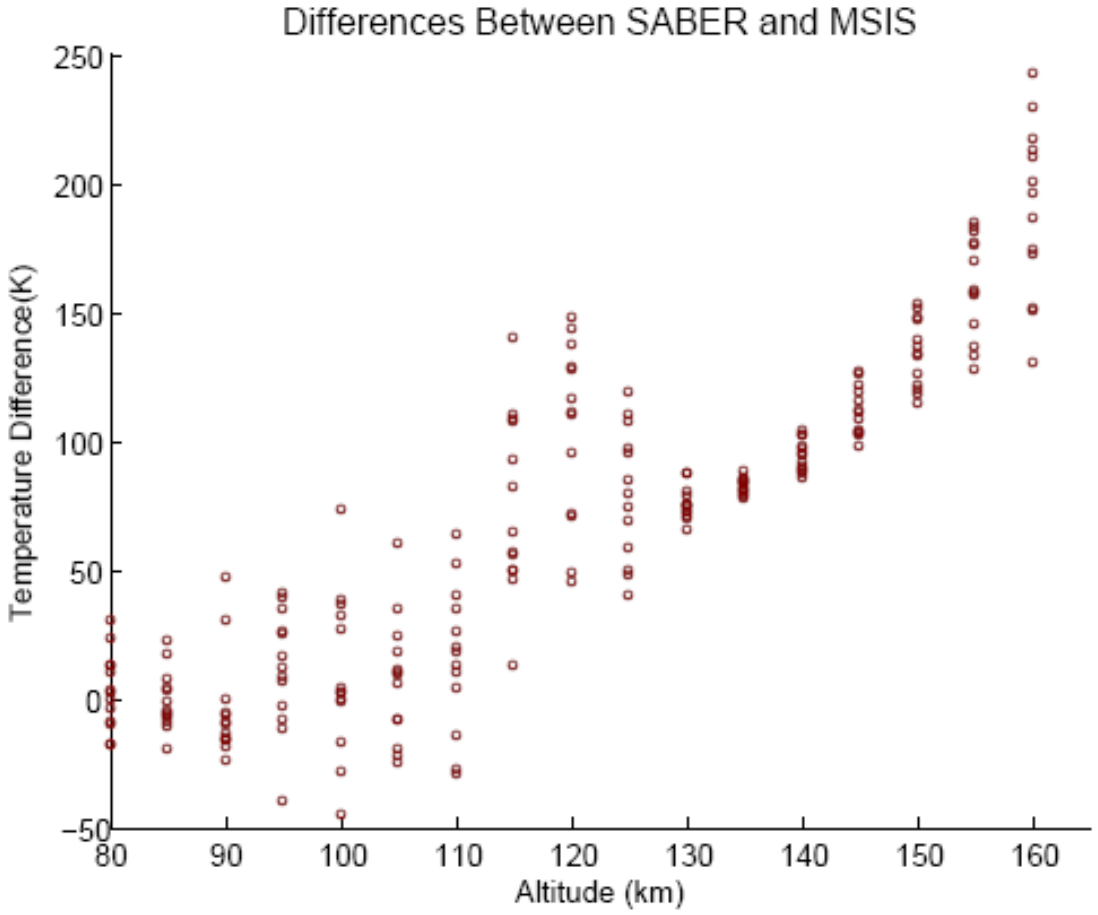




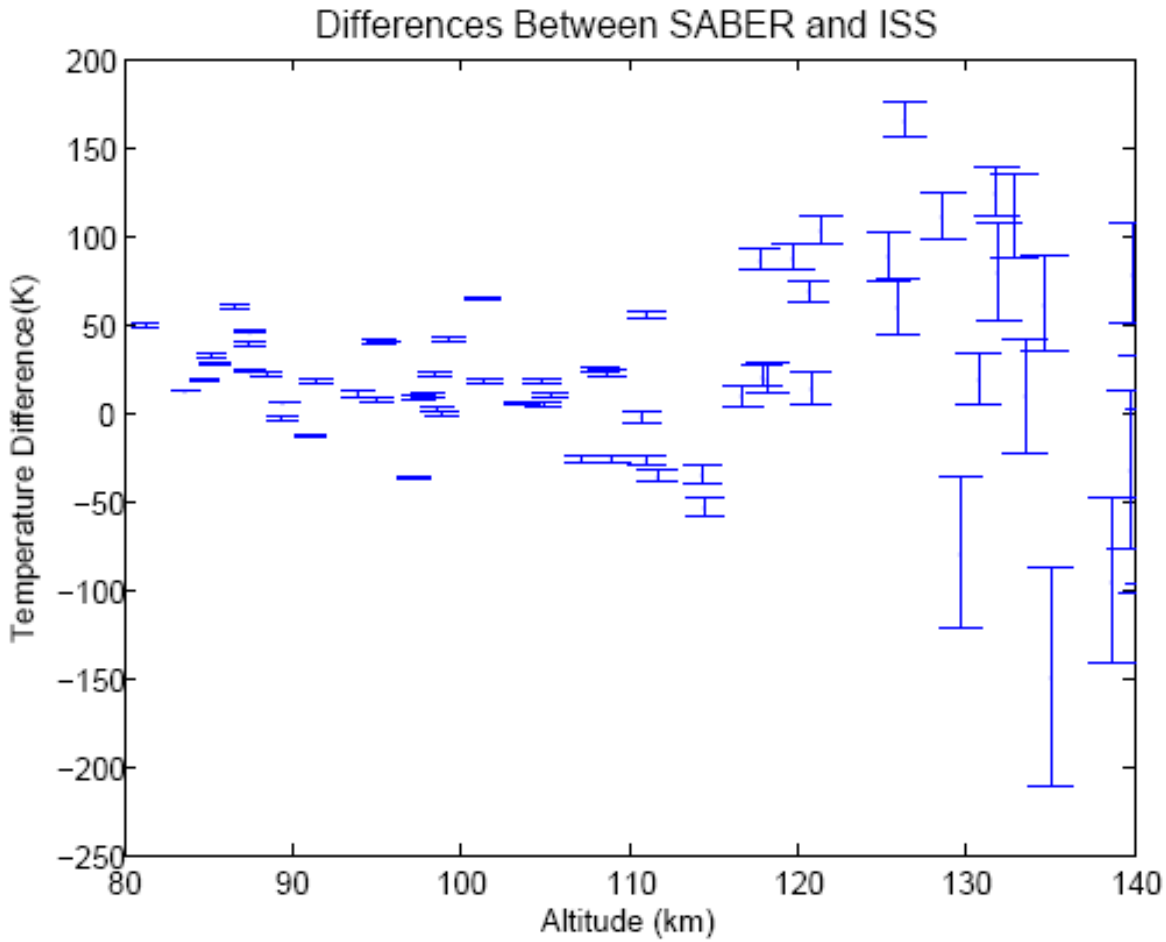




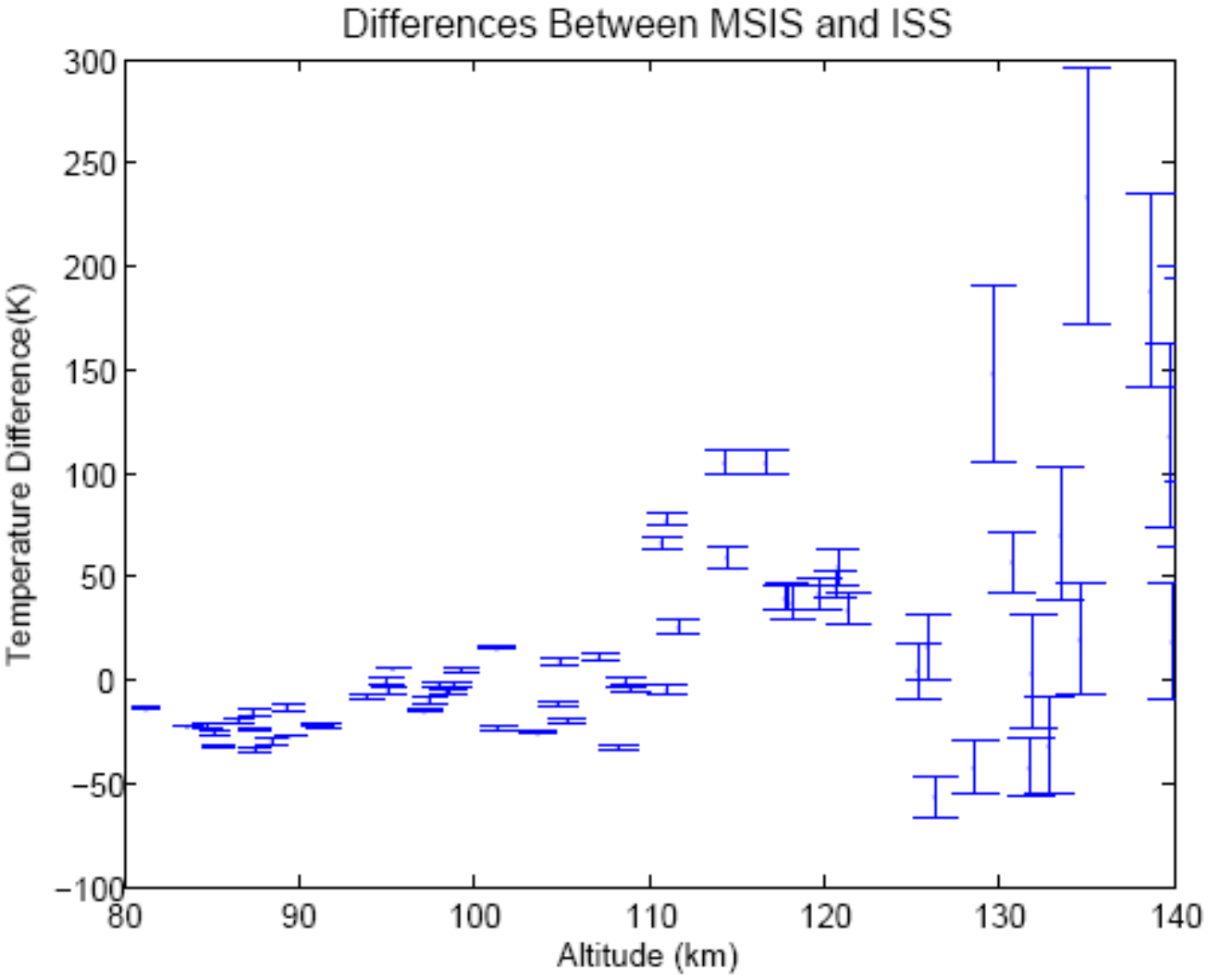
Measurements: SABER – MSIS Temperatures vs. Altitude



Measurements: SABER – NIRS Temperatures



Measurements: MSIS – ISS Temperatures



Temperature Average Differences (K)

	Altitude 80 - 105	**Altitude ~ 113-127 km**
SABER - MSIS	4.97+/-21.95	87.02+/-33.99
NIRS - MSIS	-14.53+/-10.93	40.60+/-41.17
SABER - NIRS	18.24+/-25.63	87.02+/-33.99

CONCLUSIONS

- We have found that NIRS gives temperatures ~18 +/-26 K cooler than SABER near the mesopause where the neutral temperature is ~ 200 K. The SABER data, because of its fine altitude grid is able to show detailed variability that is not possible with the sparse altitude sampling for NIRS. Hence the large uncertainty in the difference is not surprising. A larger sample of data could give greater confidence in the bias. We used 12 conjunctions of NIRS and SABER, but many other examples are available for study.