**Comparisons of mesospheric temperatures between 70 and 110 km: USU lidar, NASA’s TIMED satellite, and the MSIS2 empirical model**

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**Introduction:** Earth’s atmosphere can be characterized by its temperature structure, dividing the atmosphere into natural discrete regions. The mesosphere, which is the atmospheric region extending from 50 km to ~100 km, has been the least studied. Rayleigh-scatter lidars (RSL) and rockets can obtain local high-resolution measurements above one spot, while satellites looking almost horizontally obtain global measurements.  These measurements can be analyzed to produce a vertical profile over a given spot.  The Rayleigh-scatter lidar (RSL) at USU has been collecting data on a portion of the mesosphere since 1993. In 2014 and 2015, these measurements were extended upward from 80 km to 110 km. Measurements in this region were also recorded by the Sounding of the Atmosphere using Broadband Emission Radiometry (SABER) instrument on NASA’s TIMED satellite.

**Methods:** A comparison was done on the accuracy between the RLS temperatures and uncertainties to the temperatures and uncertainties from the SABER instrument on NASA's TIMED satellite. The RLS temperatures were reduced using two methods, the Hauchecorne-Chanin method and the newer Optical Estimation Method. These different reduction methods were both compared to the SABER data. The RSL data and SABER data were both compared to temperatures from NRL’s empirical MSIS2 model for the compared nights. Graphs of these comparisons were created (using Python) for both individual nights and monthly averages, which show four sets of temperatures that identify measured differences in the atmospheric region 70 km to 110 km above USU. The data from the RSL was obtained from USU, and the SABER data was accessed from [saber.gats-inc.com](http://saber.gats-inc.com/).

**Results:** All the curves showed similarity in June and July with a distinct mesopause near 85 km. The SABER temperatures were significantly higher above 105 km. The temperatures below 85 km agreed very well with between SABER, RSL, and the MSIS2 model for June, July, August, September, February, and March. In October, November, December, and January, the temperatures at 95 km and above showed up to 25 K difference. The SABER temperatures reached a minimum near 100 km, which was up to a 50 K difference below the RSL temperatures. The MSIS2 model temperatures at 85 km and below in December and January were also considerably lower than the observed RSL and SABER temperatures.

**Conclusions:** The LIDAR measurements showed considerable agreement with the SABER data, but there are important differences that need continuing analysis. These differences could come from many sources, such as instrument error or incorrect assumptions in the analysis. One item of interest is the pattern of the SABER data to sharply increase above 105 km, which the RSL temperatures lack.