Abstract - In 2002, the Sounding of the Atmosphere using Broadband Emission Radiometry (SABER) instrument aboard the Thermosphere Ionosphere Mesosphere Energetics and Dynamics (TIMED) satellite went online and has since been providing radiometric data concerning the mesosphere and lower thermosphere/ionosphere (MLTI) region of the atmosphere. Researchers at the Utah State University NASA Space Grant Consortium have been tasked with validating measurements of the hydroxyl airglow volume emission rates (VER) taken by SABER. To this end, we compare SABER measurements of the altitude distribution of hydroxyl airglow to measurements taken by photometers aboard rockets launched between 1961 and 1986 that were catalogued in 1988 by Baker and Stair [1]. We select for comparison SABER scans taken near these launch sites at the same time of year, and at similar solar zenith angles. We then plot the selected SABER altitude profiles alongside renormalized rocket photometer profiles. Important considerations for comparison are the mean thickness of emission layers, the mean altitude of their centers, and relative numbers of bifurcated airglow emission layers, which manifest as altitude profiles with two or more peaks.

Matching Measurements

To match each rocket measurement to SABER profiles, we select SABER scans with tangent points within a few degrees latitude and longitude of each rocket’s launch site. Greater tolerance is allowed for longitudinal deviations, as global plots suggest longitudinal homogeneity, while, in contrast, indicating appreciable latitudinal sensitivity. We disregard any that are not taken at the same time of year (within a couple of weeks) or time of day (within a few degrees solar zenith angle).

After selection, rocket-borne photometer measurements are renormalized to SABER-measured peak VER, for comparison of relative airglow emission strength altitude distributions. This is done for every band available for each rocket flight, and each match provides two comparison measurements from SABER: one from the the 1.6 micrometer channel (bands OH(5,3;4,2)) and one from the 2.0 micrometer channel (bands OH(9,7;8,6)). This process has generated 2244 profile pairs for comparison, made up of 1130 unique SABER profiles and 29 rocket photometer profiles.

OH Layer Thickness and Altitude

We have compared the average widths and altitudes of matched SABER profiles to working numbers provided by Baker and Stair [1]. A summary table is provided below:

<table>
<thead>
<tr>
<th>Rocket Photometer Channel</th>
<th>Mean (km)</th>
<th>Standard Deviation (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.6 um</td>
<td>8.6</td>
<td>3.1</td>
</tr>
<tr>
<td>2.0 um</td>
<td>9.0</td>
<td>2.1</td>
</tr>
</tbody>
</table>

We do not find any significant correlation between bifurcation measured by rocket photometers and bifurcation measured by SABER. We note, however, that the distribution of such events is not uniform, hinting at the presence of lurking variables. Understanding the factors that influence this phenomenon is the topic of current research.

Conclusions

Both peak altitude and width show good agreement for the SABER OH channels, and rocket photometers. Both parameters for rocket photometers are bounded by the parameters for the two SABER channels, and are within a standard deviation of each. Variations are therefore easily explainable by sampling variation. The bifurcation data, on the other hand, suggests the presence of unconsidered factors that influence hydroxyl layer bifurcation. The observed distribution has prompted our current investigations into these factors.

References