Determining exospheric hydrogen density using Lyman-α solar irradiance measurements from SOLSTICE

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The final layer of the earth's atmosphere, the exosphere, extends from ~500km-10,000km above the earth's surface and is characterized by atomic densities of hydrogen so low that atomic collisions seldom occur. The small amount of hydrogen, however, still has a significant impact on satellite drag and satellite sensor observations that must look through the exosphere. The Solar Radiation Comparison Experiment (SORCE), which orbits well within the exosphere, at ~645km, exemplifies this effect**.** The Solar-Stellar Irradiance Comparison Experiment (SOLSTICE) on SORCE samples a wide range of solar spectral irradiances, including Lyman-α, and is impacted by the effects of exospheric hydrogen. As solar photons enter the exosphere, hydrogen scatters Lyman-α out of the line of sight to SOLSTICE. SOLSTICE measures over a range of path lengths through the exosphere as it orbits, dependent on the angle between the satellite and the sun. The longer the path length, the more scattering of light occurs before reaching the satellite. By correcting the data from SOLSTICE for Lyman-α scattering, we not only produce a better solar irradiance data set for climate and other studies, but we can also learn more about the density of hydrogen in the exosphere. SORCE has been in orbit since 2003, so we can track the changes in the density of exospheric hydrogen through the solar cycle. This research is aimed at determining the impact of Lyman-α scattering on the SOLSTICE data set, finding a function to model the density of hydrogen in the exosphere, and tracking the changes in exospheric hydrogen density through time. This information will improve our understanding of the interactions between the sun and the upper atmosphere, as well as helping improve satellite drag models.