What Have We Learned from MERRA about Reanalyses of the Stratosphere?

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The Modern-Era Retrospective analysis for Research and Applications (MERRA) reanalysis includes a well-resolved middle atmosphere. The upper boundary of the underlying model is in the mesosphere, near 80km, and the input data streams include the Stratospheric Sounding Unit (SSU) and Advanced Microwave Sounding Unit (AMSU) radiance observations. These two datasets provide observational constraints on the deep-layer thermal structure in approximately the 10-2hPa region, the middle to upper stratosphere, which is above the highest range of most radiosonde ascents. This analysis will focus on the difficulties of producing realistic analyses in the middle to upper stratosphere: these arise largely because of vertical averaging inherent in the AMSU and SSU observations, the sensitivity to model biases in this region, the relative biases among the same channels on different instruments, and the orbital sampling of the satellites (morning or afternoon orbits). These issues will be illustrated with examples from MERRA and enhanced by discussions of potential ways of improving the middle atmosphere in future reanalyses.

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