Assessment of upper tropospheric and stratospheric water vapor and ozone in reanalyses as part of S-RIP

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Reanalyses are widely used to understand atmospheric processes and past variability and are often used to stand in as "observations" for comparisons with climate model output. Because of the central role of water vapor (WV) and ozone (O_3) in climate change, it is important to understand how accurately and consistently these species are represented in existing global reanalyses. Here, we present the results of WV and O_3 intercomparisons that have been performed as part of the SPARC Reanalysis Intercomparison Project (S-RIP). The comparisons cover a range of timescales and evaluate both inter-reanalysis and observation-reanalysis differences.

The assimilation of total column ozone (TCO) observations in newer reanalyses results in realistic representations of TCO in reanalyses except when data coverage is lacking, such as during polar night. The vertical distribution of ozone is also relatively well represented in the stratosphere in reanalyses, particularly given the relatively weak constraints on ozone vertical structure provided by most assimilated observations and the simplistic representations of ozone photochemical processes in most of the reanalysis forecast models. For times when vertically resolved observations are not assimilated, biases in the vertical distribution of ozone are found in the upper troposphere and lower stratosphere in all reanalyses.

In contrast to O_3, reanalysis stratospheric WV fields are not directly constrained by assimilated data. Observations of atmospheric humidity are typically used only in the troposphere, below a specified vertical level at or near the tropopause. The fidelity of reanalysis stratospheric WV products is therefore dependent on the reanalyses' representation of processes that influence stratospheric WV, such as tropical tropopause layer temperatures and methane oxidation. The lack of assimilated observations and known deficiencies in the representation of stratospheric transport in reanalyses result in much poorer agreement amongst observational and reanalysis estimates of stratospheric WV. Hence, stratospheric WV products from the current generation of reanalyses should generally not be used in scientific studies.

Key words: stratosphere, water vapor, ozone, reanalyses, S-RIP

References

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