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Impact of Stratospheric Major Warmings and the Quasi Biennial Oscillation on Variability of Statospheric Water Vapor

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Water vapour entering the stratosphere through the tropical tropopause varies on a broad range of timescales, from daily to decadal. While the seasonal cycle defines the well-known tape recorder, the inter-annual variability is affected by various processes/mechanisms, like the Quasi Biennial Oscillation (QBO) and the El Nino Southern Oscillation (ENSO). Furthermore, transient dehydration events are associated with Major Stratospheric Warmings (MWs) which are triggered by the extratropical planetary waves, regularly disturbing the northern polar vortex during the boreal winter. Based on simulations with the Chemical Lagrangian Model of the Stratosphere (CLaMS) for 1988-2013 period, driven by the ECMWF ERA-Interim reanalysis we analyse the impact of the QBO phase and of the MWs on the amount of water vapor entering the stratosphere during the boreal winter. The water vapor entry values are by $\sim$0.5 ppmv smaller during the easterly than during the westerly QBO phase. In addition, the dehydration effect related to MWs reaches its maximum about 2-4 weeks after the central date of the MW. Whereas during the easterly QBO phase there is a clear drying of $\sim$0.3 ppmv about 3 weeks after the MW, the direct impact of the MW during the westerly QBO phase is smaller ($\sim$0.2 ppmv) and more diffusely spread over time. We discuss how this MW-associated enhanced dehydration combined with a higher frequency of MWs in 2000s may have contributed to the lower stratospheric water vapor during this period.