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# Nonlinear response of tropical lower stratospheric temperature and watervapor to ENSO

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A series of simulations using the NASA Goddard Earth Observing System Chemistry-Climate Model are analyzed in order to assess interannual and sub-decadal variability in tropical lower stratospheric temperature and water vapor over the past 35 years. The impact of El Niño-Southern Oscillation in this region is nonlinear. While moderate El Niño events lead to cooling in this region,strong El Niño events lead to warming,even as the response of the large scale Brewer Dobson Circulation appears to scale nearly linearly with El Niño. This nonlinearity is shown to arise from the response in the Indian Ocean to El Niño:strong El Niño events that lead to warming in the Indian Ocean lead to tropospheric warming extending intothe tropical tropopause layer and up to the cold point, where it allows for more water vapor to enter the stratosphere. The net effect is that both strong La Niña and strong El Niño events lead to enhanced entry water vapor and stratospheric moistening. These results lead to the following interpretation of the contribution of sea surface temperatures to the millennial drop in water vapor in late 2000: the very strong El Niño event in 1997/1998 which featured remarkably warm Indian Ocean SSTs,followed by more than two consecutive years of La Niña, led to enhanced lower stratospheric water vapor. As this period ended in early 2001, entry water vapor concentrations declined. This effect led to a decrease in water vapor of 0.14ppmv after 2001, which accounts for approximately 23% of the observed drop.