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# Variability of mesospheric water vapor above Bern in relation to the 27-day solar rotation cycle

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We investigate the solar-terrestrial response of mesospheric water vapor from a mid-latitudinal observation site at the 27-day solar rotation cycle time scale. Eight years of water vapor profile measurements above Bern ($46.88°$ N/$7.46°$ E) by the microwave radiometer MIAWARA are used to study prominent oscillation features. The spectral data analyses shows enhanced oscillations in the 27-day period band above $0.1$ hPa during the rising sunspot activity of solar cycle 24. Aura MLS observations of $H_2O$ support these results by showing a similar behavior. The relationship between mesospheric $H_2O$ and the solar Lyman-$\alpha$ flux ($F_{Ly\alpha}$) is studied by comparing the similarity of their temporal oscillations. The $H_2O$ oscillation is negatively correlated to $F_{Ly\alpha}$ oscillation with a correlation coefficient of up to $-0.3$ to $-0.4$, and the phase lag is 6–10 days on $0.04$ hPa. The confidence level of the correlation is $\geq 99\,\%$.

Additionally we compute wavelet power spectra, cross-wavelet transform and wavelet coherence (WTC). The latter shows significant (two $\sigma$ level) correlations occurring intermittently in the 27 and 13-day band with variable phase lock behavior. Large $F_{Ly\alpha}$ oscillations appeared after the solar superstorm in July 2012 and the $H_2O$ oscillations show a well pronounced anti-correlation. The competition between advective transport and photo-dissociation loss of mesospheric $H_2O$ may explain the sometimes variable phase relationship of mesospheric $H_2O$ and $F_{Ly\alpha}$ oscillations. Generally, the WTC analysis indicates that solar variability causes observable photochemical and dynamical processes in the mid-latitude mesosphere.