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Interannual variability of stratospheric ozone and temperature in response to 11-year solar cycle: FFT and Wavelet Coherence Analysis

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The interannual variability of stratospheric ozone mass mixing ratio (O_3) and temperature (T) from 1979 to 2012 is investigated using the latest ERA-Interim reanalysis product delivered by the European Centre for Medium Range Weather Forecasts (ECMWF). In particular, the response of the stratosphere to the quasi-eleven solar activity cycle is investigated using the Mg II Index time series for the common time section.
Results reveal the following features: (i) Upward (downward) trends characterize zonally averaged O_3 anomalies in the upper (middle-lower) stratosphere, while prevailing downward trends affect the T field. Mg II Index shows a downward trend mainly driven by the 24th cycle that is weaker compared with the previous two; (ii) Correlations between O_3 and Mg II, T and Mg II, and O_3 and T are consistent with photochemical reactions occurring in the stratosphere and large-scale transports; (iii) The FFT analysis of zonally averaged O_3 anomalies reveal a periodicity of 11.3 year in the upper and middle stratosphere, which disappears near the tropopause level (100 hPa); (iv) The Wavelet cross-spectra and coherence between O_3 and Mg II Index show common power at near-11 year periodicity and different relative phase shift in the upper and middle stratosphere.