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The solar and geomagnetic origin of the long-term trends in the ionospheric/thermospheric variability over Rome since 1976

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In this study the nature of the long-term trends of the ionospheric and thermospheric parameters retrieved by leveraging on the Rome ionosonde data digitally recorded since 1976 is investigated. The following quantities have been investigated under sunlit conditions (12:00 LT): critical frequency of the F1 layer (f_oF1); critical frequency of the F2 layer (f_oF2), O_2 concentration at 300 km ([O_2]); ratio between O and N_2 concentrations at 300 km ([O]/[N_2]); exospheric temperature (T_{ex}); thermospheric density at 300 km (ρ_T). The ionospheric parameters are manually scaled by the corresponding ionograms, while thermospheric ones are retrieved by THERION method [1] making use of ionosonde observations and a physical model of the ionospheric F region. The use of monthly median values allows to filter transient excursions of the investigated parameters, focusing on the long-term trends. To check whether solar/geomagnetic activity is the only driver of the ionospheric/thermospheric variability, the solar cycle and geomagnetic activity variations through the solar radio flux at 10.7 cm (F10.7) and the geomagnetic index A_p were considered. To identify the various frequency/period components of the considered time series and identify the trends, the spectral properties have been obtained with high scale/time resolution through the Fast Iterative Filtering (FIF) algorithm [2]. A regression analysis of the thermosphere/ionosphere parameters against geomagnetic/solar activity parameters have then been performed to investigate the nature of such trends. A clear ~11-year periodicity has been found in all the time series, with a tendency to shift to slightly larger scales during time, in accordance with the widening of the last solar cycles. The regression analysis against solar/geomagnetic activity indices indicates that the identified trends seem to be due exclusively to the external forcing.

References

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