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Upper transition height at European mid-latitudes for the years of 2010 and 2016: surprising changes

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Our previous studies with the Kharkiv incoherent scatter radar (49.6 N, 36.3 E) data in 2006–2010 revealed that the upper (O+ to H++He+) transition height at mid-latitudes is much more sensitive to the changes in solar and geomagnetic activity than was previously thought [1]. In 2016, solar activity was decreasing and both daily and average F10.7 indices were approaching those in 2010. Solar activity was ∼12% higher in June and ∼ 6% higher in September 2016. Geomagnetic activity was low for the measurements in both 2010 and 2016. Given the difference in solar activity, the 2016 nighttime upper transition heights would be expected to be ∼55 km higher in June and ∼ 30 km higher in September. On the contrary, the observed nighttime minimum of the upper transition heights were ∼18 km higher in June 2016 and ∼28 km lower in September 2016. This is a surprising result given that the measured ion temperatures indicate that the exospheric temperature in 2010 and 2016 were similar. The unexpectedly low values of the upper transition height in 2016 may be caused by reduced thermospheric hydrogen escape during the 2012–2014 solar maximum, which was notably weaker than previous maxima. We also show results of the upper transition height obtained from processing of the COSMIC electron density vertical profiles. A comparison with the latest version of the IRI ion composition model (TBT) is also presented.

[1] Kotov, D. V., V. Truhlík, P. G. Richards, S. Stankov, O. V. Bogomaz, L. F. Chernogor, and I. F. Domnin (2015), Night-time light ion transition height behaviour over the Kharkiv (50°N, 36°E) IS radar during the equinoxes of 2006–2010, J. Atmos. Sol. Terr. Phys., 132, 1–12, doi:10.1016/j.jastp.2015.06.004.