Long-term trends in the total electron content (TEC)

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The long-term trends in the total electron content (TEC) have very little been studied. Lean et al. (2011; J. Geophys. Res., 116, A00H04, doi:10.1029/2010JA016378) studied trends in TEC globally based on JPL maps for 1995-2010. However, their trends appear to be too positive, which is not plausible taking into account the trends in other ionospheric parameters. Therefore they prefer the less positive trends calculated under the assumption of the same level of solar activity in solar cycle minima 22/23 and 23/24. However, as it is now clear, this is not a correct assumption. Lastovicka (2013; J. Geophys. Res. Space Phys., 118, 3831–3835, doi:10.1002/jgra.50261) selected a region around Florence, Italy, as a region with available historical TEC data based on Faraday rotation measurements and remarkably larger than average trends in TEC by Lean et al. (2011). Historical data from Florence provide no trend in TEC. However, foF2 from Juliusruh provide slight negative trends for 1976-1996 but no trends for 1995-2010. Thus the question of reality of trends by Lean et al. (2011) remained open.

Here we use TEC from GIM and JPL data for two European regions with high Lean's trends, regions around Florence and around Prague, using 10-14 LT medians, 1998-2015, yearly average values. A classical approach is applied. First a model of solar activity dependence of TEC is constructed separately for each region from all data. Then model data are subtracted from experimental data and analysis is made with residuals. This analysis shows that early data (1998-2001) are by several TECU lower than they should be according to solar activity, the year 2002 is intermediate and in 2003-2015 the data fit well a weak or rather no trend of TEC. The change in TEC data does not seem to be jump-like, it lasted at least a year, if not longer. Thus the positive TEC trends reported by Lean et al. (2011) appear to be affected by data problem; real trends are evidently less positive if any.