

Long-term trends in thermospheric and ionospheric parameters as the reflection of solar activity long-term variations

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The Earth's upper atmosphere is under the total control of solar activity as the Earth is in the atmosphere of the Sun. Using retrieved thermospheric parameters from observed foF1 long-term variations in Tex and neutral composition have been revealed for the period of 5 solar cycles. The residual trends in Tex and ρ are small (< 1% per decade) and statistically insignificant. Large and physically unreal Tn=Ti trends obtained from ISR observations may be related to the routine ISR method. Solar and geomagnetic activities are two channels controlling of foF1, foF2 and hmF2 long-term variations. Atomic oxygen, [O] and [O]/[N2] ratio control foF1 and foF2, while Tex controls the hmF2 long-term variations. A linear trend in (hmF2)_{11y} estimated over the (1962-2010) period is small and insignificant. The foF2 and foF1 long-term variations demonstrate a negative trend over the (1962-2010) period. However it is not related to the CO₂ concentration increase but is due to [O] decrease after ~ 1990. A close similarity between (foE)_{11y} and (R₁₂)_{11y} (c.c. = 0.996) tells us that the origin of these (foE)_{11y} variations is the Sun. The residual (foE)_{11y} trend is small (~ 0.029% per decade) and insignificant. Thus (foE)_{11y} variations are totally dependent on variations of solar activity. The main conclusion – all revealed long-term variations of thermospheric and ionospheric parameters have a natural (not anthropogenic) origin related to long-term variations in solar activity.