Thermosphere monitoring based on routine ionospheric observations: method and validation plan

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Despite obvious progress in generating both theoretical and empirical ionospheric models for researchers and applications the main part of the Earth's atmosphere presented by neutral species is still 'terra incognita". Direct observations of thermospheric neutral composition, temperature and winds technically are very complicated and expensive. Therefore one hardly may hope to have any thermosphere monitoring system in the nearest future. On the other hand a necessity in such a system is obvious keeping in mind thousands of satellites (communication, military, navigation) orbiting around the Earth, their orbiting characteristics being dependent on neutral density. The use of world-wide routine ionospheric observations at F2-region heights to retrieve thermospheric parameters may be considered as a solution. In this workshop we will discuss how it will be possible to implement this approach. The following steps should be considered:

1. To develop such a method which is based on ISR observations as the most complete and reliable. The list of ISR routine observations include Ne(h), Te(h), Ti(h), Vl(h) profiles. This is enough to solve an inverse problem of aeronomy and find a consistent set of main aeronomic parameters: neutral composition (O, O_2, N_2), temperature Tn(h), total EUV solar ionizing flux, equivalent meridional thermosperic wind Vnx.
2. To compare retrieved thermospheric parameters with available empirical models (MSIS series) and direct optical TIMED observations of column O/N_2 ratio.
3. To develop a method to retrieve thermospheric parameters using only bottom side Ne(h) profiles as we will have in reality dealing with digisonde Ne(h).
4. To compare ISR bottom side Ne(h) profiles with routine digisonde profiles and estimate errors in the retrieved parameters resulted from the difference in the observed Ne(h) profiles.
5. In the case of routine digisonde observations such parameters as Te(h), Ti(h), vertical plasma drift Vl(h) are absent, but they are used in the continuity equations for ionospheric ions which are used in the method. Therefore methods to parameterize these parameters should be developed. This is a special and not a simple problem.
6. A basic validation of the developed method can be achieved through comparison with the full initial method based on ISR observations.

In the case of a successful solution of the problem listed it will be possible to organize a thermosphere monitoring over Europe where 8 Digisondes participating in the DIAS e-infrastructure, provide ionospheric observations in real time.

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