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Interactive comment on "Inferring thermospheric composition from ionogram profiles: A calibration with the TIMED spacecraft" *by* Christopher J. Scott et al.

Anonymous Referee #1

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Referee report on the paper "Inferring thermospheric composition from ionogram profiles: A calibration with the TIMED spacecraft" by Christopher J. Scott, Shannon Jones, Luke A. Barnard

An attempt is made to use very old ideas on F1-layer formation to extract any thermospheric data from ground-based ionosonde observations. I did not find in the paper any results on "thermospheric composition" retrieved from ionogram profiles which could be analyzed and compared to other observations or models.

Introduction is devoted to general description of the ionosphere and problems such as CO2 impact on the upper atmosphere, long-term trends etc. which are not discussed

in the paper. The authors should formulate the problem being solved in the paper in a comparison with earlier publications in this field. Which new idea or results are they going to present in the paper. The problem is called – an inverse problem of aeronomy when aeronomic parameters (neutral composition, temperature, winds, solar EUV flux) are extracted from ionospheric observations. There are publications in this field which are not mentioned in the paper. For instance, Oliver, W. L. (1979). Incoherent scatter radar studies of the daytime middle thermosphere, Ann. Geophys., 35, 121–139. gives a method how ISR observations can be used to infer atomic oxygen and neutral temperature at F2-region height. The method by Perrone, L., & Mikhailov, A. V. (2018a). A New Method to Retrieve Thermospheric Parameters From Daytime Bottom-Side Ne(h) Observations. J. Geophys. Res. Space Physics, 123,10,200–10,212. https://doi.org/10.1029/2018JA025762 exactly solves the problem considered in the paper and this solution is more general than given in the reviewed paper.

The method used by the authors was proposed by H. Rishbeth around 50 years ago. So the authors should take this in account. The same ideas used by the authors may be found in "An introduction to the ionosphere and magnetoshere" by J.A. Ratcliffe (1972).

The majority of references are coming back to 1960-1970 as if ionospheric science has stopped since then.

The method is based on many assumptions which are not confirmed by anything.

In general the approach used in the paper does not correspond to the present day level and the paper cannot be recommended for a publication in Ann. Geophys.

Specific comments

P2 L1 While the ionosphere makes up only a small fraction (∼0.01%) of the upper atmosphere In which units this 0.01% is measured?

P3 L1-5 These are well-known aspects of the thermospheric physics therefore this

paragraph may be deleted.

P4 L19 seconds) for a given ion. Not just “ion” but molecular ions NO+ and O2+ and this is important.

P4 L21 This dissociative recombination of ionisation associated with molecular gases Not molecular gases but molecular ions

P5 3 Ground-based ionospheric monitoring- the ionosonde The whole part is devoted to the history of ionospheric sounding and should be deleted from the paper.

P5 L8 Since the dominant ionisable gas is atomic oxygen This is not so, the production rates of q(N2+) and q(O2+) are comparable to q(O+) at F1-region heights.

P7 L25 All these assumptions should be confirmed.

P7 L25 that the loss rate, α, is assumed to vary inversely with temperature and therefore H. It is known that dissociative recombination coefficients depend on Te rather than on Tn, but Te is not specified in the method.

P9 L4 It is know that F1-layer is mainly composed of molecular ions rather than O+.

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