

Interactive comment on “Case study of ozone anomalies over northern Russia in the 2015/2016 winter: Measurements and numerical modeling” by Y. M. Timofeyev et al.

Y. M. Timofeyev et al.

smyshl@rshu.ru

Received and published: 4 May 2018

Response to the comments on the paper by Referee #2

Case study of ozone anomalies over northern Russia in the 2015/2016 winter: Measurements and numerical modeling By Yury M. Timofeyev, Sergei P. Smyshlyaev, Yana A. Virolainen, Alexander S. Garkusha, Alexander V. Polyakov, Maxim A. Motsakov, Ole Kirner

Dear Referee,

Thank you for your comments on the paper and constructive recommendations. We

C1

have tried to follow your suggestions and have utilized most of them. Following we mention how the manuscript has been changed according to your comments.

Major issue:

Two additional numerical experiments were carried out with RSHU CTM to confirm the conclusions about the dominant role of the dynamical processes in the observed short-term ozone loss: one did not take into account the formation of polar stratospheric clouds in the Arctic zone, and the second did not take into account the chemical destruction of ozone to the north of the northern polar circle. A comparison of the three model experiments for the three stations considered in this paper is shown in Fig. 6. The results of model experiments have shown that the main features of the short-term ozone loss are reproduced even without taking into account chemical destruction within the polar zone. At the same time, the influence of chemical processes becomes noticeable at the end of March, especially for Pechora.

Minor issues.

1. Page 1, line 15: The sentence corrected with replacement “unlikely” to more strong statement.
2. Page 1, lines 23-24. The sentence modified with attention shifted from the statement to a question whether chemical destruction on the surface of polar stratospheric clouds, for which a long existence of PSCs is necessary, to be responsible for the observed anomalies, or other factors, especially dynamic ones, would have a greater effect on the observed features. . 3. Page 1, line 28. Corrected form 2016 to 2015/2016.
4. Introduction. The motivation extended with a justification of the need for additional measurements and numerical model experiments.
5. The term "ozone depletion" almost everywhere in the paper is replaced by "ozone loss".
6. A short description of the PSC formation and evolution code with appropriate refer-

C2

ences is added to the section 3. The code accounts for STS, NAT and ICE particles formation on the base of sulfur aerosol. 7. The motivation for using two different models is added. An additional numerical experiment using the ERA-INTERIM reanalysis data was performed with the RSHU model in order to compare the effect of different meteorological data on the comparison of the results of numerical modeling and local observations. The results of a comparison of numerical modeling and observations, as well as comparisons between models with different meteorological data, are expanded. 8. Page 5, lines 11-13. The sentence has been modified with a shift to a chance of heterogeneous ozone destruction which is checked at the following discussion. "This is a result of dynamical isolation, which leads to stratospheric cooling and potentially may cause ozone depletion as a result of heterogeneous chemical reactions on PSCs particles leading to chlorine activation." 9. Page 5, last paragraph. Results of additional numerical experiments without PSC processing included are added into discussion to demonstrate the prevalent role of dynamical processes in the observed short-term ozone loss. 10. Figures 4 and 5 are corrected to make numbers more visible. 11. Figure 5. Corrected to 10(-8). Actually this means that ozone loss coefficient was multiplied by 10(8) before plotting. Thank you again for taking the time to review our manuscript.

With respect, Yu.M.Timofeyev, S.P.Smyshlyaev, Ya.A.Virolainen, A.S.Garkusha, A.V.Polyakov, M.A. Motsakov, O.Kirner.

Interactive comment on Ann. Geophys. Discuss., <https://doi.org/10.5194/angeo-2018-15>, 2018.

C3

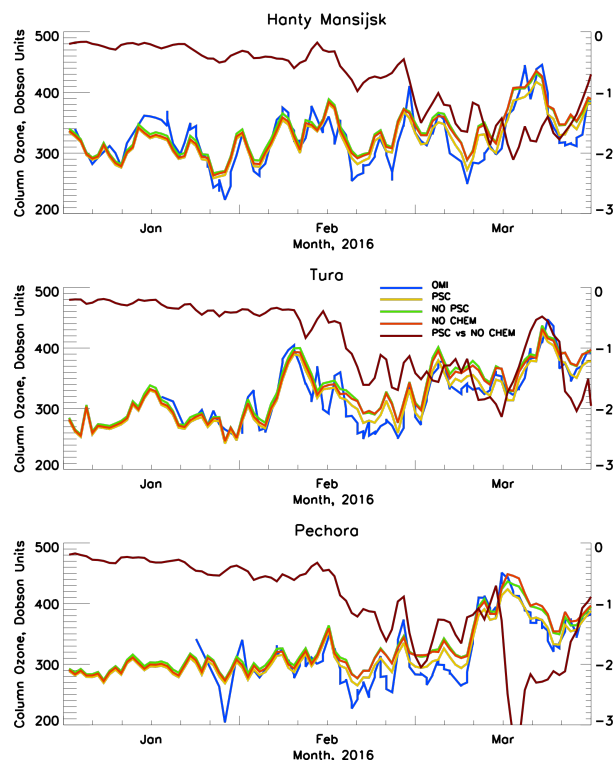


Fig. 1. Figure 6. Comparison of the model experiments with a RSHU model with and without PSC processing and polar chemistry at all

C4