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The effect of Forbush decreases on the polar-night HOx concentration

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It is well-known that energetic particle precipitations during solar proton events increase ionization rates in the middle atmosphere enhancing the production of hydrogen oxide radicals (HOx) involved in the catalytic ozone destruction cycle. There are many studies where the contribution of energetic particles to the formation of hydrogen oxide radicals and ozone loss has been widely investigated. However, until now, there was no solid evidence that the reduction in galactic cosmic ray fluxes during a magnetic storm, known as Forbush-effect, directly and noticeably affects the polar-night stratospheric chemistry.
Here, the impact of the Forbush decrease on the behaviour of hydrogen oxide radicals was explored using the chemistry-climate model SOCOL.
We found that hydrogen oxide radical lost about half of its concentration over the polar boreal night stratosphere owing to a reduction in ionization rates caused by Forbush decreases after solar proton events occurred on 17 and 20 of January 2005. A robust response in ozone was not found. There is not any statistically significant response in (NOx) on Forbush decrease events as well as over summertime in the southern polar region.
The results of this study can be used to increase the veracity of ozone loss estimation if stronger Forbush events can have a place.

Reference: Mironova I, Karagodin-Doyennel A and Rozanov E (2021) , The effect of Forbush decreases on the polar-night HOx concentration affecting stratospheric ozone. Front. Earth Sci. 8:618583. doi: 10.3389/feart.2020.618583

https://www.frontiersin.org/articles/10.3389/feart.2020.618583/full

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