Atmospheric Chemistry Effects by Pulsating Aurora

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Today we want to understand the behavior of our planet Earth, in an Earth system science sense, where we address the whole chain of relevant processes, originating from primary energy output from Sun and ending in the climatic variability of Earth. An example of such efforts is the currently started international VarSITI programme, as continuation of the earlier CAWSES program by SCOSTEP, Scientific Committee on Solar-Terrestrial Physics, enhancing our understanding of the space environment and its impacts on life and society. Recent research has shown (Andersson et al. 2014) that energetic electron precipitation EPP, as mapped by the MEPED detector onboard NOAA/POES satellites during 2002-2012, caused several long-lasting up to 90% destructions of mesospheric ozone at 60-80 km altitudes, as seen by 3 satellite instruments GOMOS, MLS and SABER. Most studies so far on atmospheric effects of energetic particle precipitation concentrated on the indirect particle precipitation effect caused by the production of odd nitrogen (NOx) in the polar upper atmosphere, its subsequent transport to lower altitudes inside the wintertime polar vortex, depletion of ozone in the stratosphere, and effects on the radiative balance of the middle atmosphere, which may further couple to atmospheric dynamics and propagate downwards by changing polar winds and atmospheric wave propagation through wave–mean flow interaction.

Here we make theoretical quantitative study quantitatively how pulsating aurora may change in-situ the chemistry at mesospheric and lower thermospheric altitudes at high latitudes. We use the detailed coupled neutral and ion chemistry model of the upper atmosphere, the Sodankyla Ion Chemistry model SIC. We show options for future experimental observations by combined incoherent scatter radar and significance of various optical supporting measurements for such studies. Our aim in the future is to narrow the uncertainty, which still exists in estimating the climatic effects due to the variability in the geospace environment, specially using these results together with future available data from satellite missions, such as the ERG satellite.

References

Andersson M. et al., ”Missing driver in the Sun-Earth connection from energetic electron precipitation impact on mesospheric ozone”, accepted in Nature Communications Sep 2014.