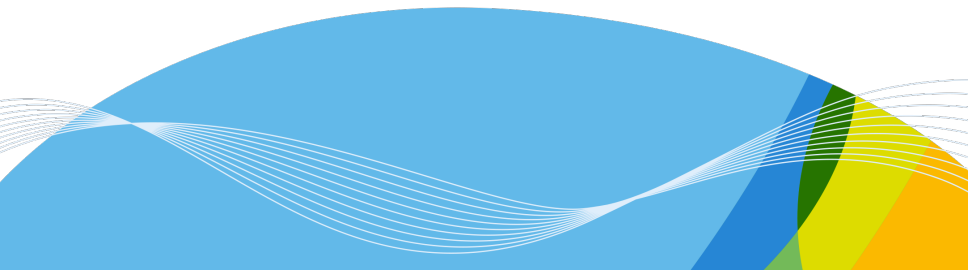




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Solar wind and atmosphere – about the planned review paper

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Goals

1. Combine research papers and provide usefull reference for future studies.
2. Cover things that have not been covered in reviews.
3. Improve the review by Gray et al. considering particles.



Recent review papers since 2010

1. Sinnhuber, M., Nieder, H., and Wieters, N.: **Energetic particle precipitation and the chemistry of the mesosphere/lower thermosphere**, *Surv. Geophys.*, doi:10.1007/s10712-012-9201-3, 2012.
2. A. A. Krivolutsky and A. I. Repnev: **Impact of Space Energetic Particles on the Earths Atmosphere**, *Geomagnetism and Aeronomy*, 2012, Vol. 52, No. 6, pp. 685-716.
3. E. Rozanov, M. Calisto, T. Egorova, T. Peter, W. Schmutz: **Influence of the Precipitating Energetic Particles on Atmospheric Chemistry and Climate**, *Surv Geophys* (2012) 33:483-501 DOI 10.1007/s10712-012-9192-0.
4. Gray, L. J., et al. (2010), **Solar influences on climate**, *Rev. Geophys.*, 48, RG4001, doi:10.1029/2009RG000282.
5. Annika Seppälä, Katja Matthes, Cora E Randall and Irina A Mironova (2014) **What is the solar influence on climate? Overview of activities during CAWSES-II**, *Progress in Earth and Planetary Science* 2014, 1:24.
6. Clilverd, M. A., C. J. Rodger, M. E. Andersson, A. Seppälä and P. T. Verronen, **Linkages between the radiation belts, polar atmosphere and climate: electron precipitation through wave particle interactions** in book *Waves, Particles and Storms in Geospace*, Oxford University Press, in press 2015.



Topics covered in the recent studies

1. EPP, solar wind, CME, HSSW, geomagnetic activity and storms, Ap/Kp, GCR. Atmospheric effects, auroral NO in the lower thermosphere, SPE NOx/HOx/ozone, NOy, chlorine, MEE and NOx descent.
2. Energetic Particles: Impact on the Composition of the MLT Region. Particle ionization/dissociation, formation of NOx and Ox, formation of NOx by ion chemistry, excited N, ion chemistry and HOx, ozone loss, chlorine, HNO3, N2O.
3. Interaction with Atmospheric Dynamics and Long-Term Impacts of Energetic Particle Precipitation (EPP). NOx coupling to atmosphere below, observations, effect on ozone. SSW and NH/SH differences. SPE/indirect NOx comparison. Atmospheric dynamics, joule heating, particle heating, chemical heating, radiative heating and cooling, thermospheric response, SPEs, geomagnetic activity and stratospheric/tropospheric dynamics.



Topics covered in the recent studies

1. Atmospheric ionization, production mechanisms for HOx and NOx, GCR, SPEs (flares?), comparison of NOx sources, REP + indirect NOx effect, EUV + Aurora + NOx transport, HNO3 and chlorine, GCR and NOx. Review of results: short-term SPE effects from the 1970s on, NOx descent, dynamical effects.
2. GCR, SPE, EEP, and AE introduced. HOx and NOx, short-term effects modeling, long-term effects modeling, this paper has SOCOL + SPE + GCR + AE (NOx UBC only). Results: NOx, HOx, ozone and T, geopotential height and SAT.
3. Solar variability in general, bottom-up, top-down. 4.4 charged particle effects, HOx and NOx production, indirect NOx effect, ozone affected in the SH above 10 hPa, but not enough to influence stratospheric ozone and circulation, a lot on GCR.



Topics covered in recent studies

1. Geomagnetic storms, particle wave interaction, radiation belt flux changes.
2. Energetic particle precipitation, ionization of the upper atmosphere.
3. Effect on atmospheric chemistry, HOx, NOx, Ozone.
4. New ion chemistry parameterizations, direct HOx and indirect NOx effects.
5. Polar vortex and descent, SSWs, long-term ozone change in the stratosphere.
6. Coupling to dynamics, links to annular modes, NAO/NAM, modulation of atmospheric wave propagation
7. Connection to surface climate.



Possible approaches

1. Modelling view, different view.
2. Restriction of the paper scope.
3. Concentrate on very recent results.
4. Abandon review, make new science.