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Comparative atmosphere-ionosphere coupling and climatology of early Earth & Mars

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To understand the role of stellar forcing in upper atmospheric
chemistry and its influence upon planetary climate evolution at the surface we use
Aeroplanets code(1) to study the chemistry of a N2-CO_2 rich
early Earth/Mars atmosphere exposed to large XUV & UV fluxes (10x the present day flux)
and fluxes from energetic protons accelerated in CME & CIR-driven shocks from
our early sun. Our model suggests that protons with hard energy slopes
accelerated from dense and magnetized shocks produce large abundances of N2O
(up to 1000 ppmv) dependent upon CO_2 abundances and other factors. We then
take the vertical profile of the greenhouse gas abundance from these models as
inputs to a 3-D General Circulation Model called ROCKE-3D (2). We will show some
of the photochemical pathways and results from recent 3-D GCM simulations
that demonstrate that these N2O abundances may solve the Faint Young Sun Paradox.

(1) Gronoff et al. 2012, JGR, VOL. 117, A04306, doi:10.1029/2011JA016930
(2) Way et al. 2017 ApJS, 231, 12, doi: 10.3847/1538-4365/aa7a06