

## Significance of the D-region ion chemistry in the atmospheric forcing from above by precipitating high-energy particles

\*Esa Turunen<sup>1</sup>

1.Sodankyla Geophysical Observatory, University of Oulu

Although the ionisation degree of middle atmosphere -lower thermosphere region is low, it surprisingly turns out that ion chemistry plays a significant role in causing variations in concentrations of neutral chemically active minor constituents during events of excess ionisation, such as auroral particle precipitation. Here we first give an overview of the D-region ion chemistry, pointing out the relevant processes, which can be both direct and indirect via first generating chemically active minor constituents of the atmosphere, such as odd nitrogen and odd hydrogen, which in turn can affect for example atmospheric ozone via catalytic reactions either directly in-situ, or after transport in atmosphere to lower altitudes and lower latitudes. We show recent results using the detailed coupled neutral and ion chemistry model, the Sodankyla Ion Chemistry model. We also show how the upcoming new incoherent scatter radar facility EISCAT\_3D, together with coordinated other currently planned measurements, will enhance the research opportunity in studying the coupling between geospace environment and atmosphere of Earth during high energy particle precipitation into the atmosphere.

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