Forcing of the middle and upper atmosphere by high-energy particle precipitation and new observational opportunities by the EISCAT_3D radar

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One aspect of sever space weather is the precipitation of high-energy particles into the atmosphere at high latitudes. Recent observational and model results on the particle precipitation as source of atmospheric variability challenge us to implement better and continuously monitoring observational infrastructure for middle and upper atmospheric research. As ability to forecast of the effects by extreme individual space weather events and knowledge of space climate related coupling features in the geospace environment and atmosphere are a must in the future modern society, we need to pay attention to integrated studies utilizing space-based measurements, modeling and ground-based measurements. Here we review recent results related to atmospheric forcing by particle precipitation via effects on chemical composition. We also show the future research potential of new ground-based radio measurement techniques, such as spectral riometry and incoherent scatter by new phased-array radars. EISCAT_3D will be a new, volumetric, i.e. 3-dimensionally imaging radar, distributed in Norway, Sweden, and Finland. It is expected to be operational from 2020 onwards, surpassing all the current IS radars of the world in technology. It will be able to produce continuous information of ionospheric plasma parameters in a volume, including 3D-vector plasma velocities. For the first time we will be able to map the 3D electric currents in ionosphere, as well as we will have continuous vector wind measurements in mesosphere. The geographical area covered by the EISCAT_3D measurements can be expanded by suitably selected other continuous ground-based observations, such as optical and satellite tomography networks providing 3D imaging capability. New space missions will gain from this emerging capacity enhancement of ground-based observations.

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