



Understanding the electrodynamics of the 3-dimensional high-latitude ionosphere: present and future

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Traditionally, due to observational constraints ionospheric modelling and data analysis techniques have been devised either in one dimension (e.g., along a single radar beam), or in two dimensions (e.g., over a network of magnetometers). With new upcoming missions like the Swarm ionospheric multi-satellite project, or the EISCAT 3D project, the time has come to take into account variations in all three dimensions simultaneously, as they occur in the real ionosphere. The link between ionospheric electrodynamics and the neutral atmosphere circulation which has gained increasing interest in the recent years also intrinsically requires a truly 3-dimensional (3D) description. In this paper, we identify five major questions that need to be addressed by 3D ionospheric modelling and data analysis. We briefly review what proceedings in the young field of 3D ionospheric electrodynamics have been made in the past to address these selected question, and we outline how these question can be addressed in the future with additional observations and/or improved data analysis and simula-

tion techniques. Throughout the paper, we limit the discussion to high-latitude and mesoscale ionospheric electrodynamics, and to directly data-driven (not statistical) data analysis.