



Ionosphere and arctic research with Suomi100 nanosatellite

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The Suomi100 nanosatellite was launched on Dec. 3, 2018 (<http://www.suomi100satelliitti.fi/eng>). The 1 Unit (10 cm x 10 cm x 10 cm) polar orbit cubesat will perform geospace, ionosphere and arctic region research with a white light camera and a radio wave spectrometer instrument which operates in the 1-10 MHz frequency range.

The Suomi 100 satellite is a manifestation of a modern technology that provides new possibilities to study Earth's ionosphere by using small spacecraft and 3D computer simulations. Suomi 100 satellite type of nanosatellite, so called CubeSat, provides a cost effective possibility to provide in-situ measurements in the ionosphere. Moreover, combined CubeSat observations with ground-based observations give a new view on auroras and associated electromagnetic phenomena. Especially joint CubeSat – ground based observation campaigns enable the possibility of studying the 3D structure of the ionosphere.

At the same time, increasing computation capacity has made it possible to perform simulations where properties of the ionosphere, such as propagation of the electromagnetic waves in the medium frequency, MF (0.3-3 MHz) and high frequency, HF (3-30 MHz), ranges is based on a 3D ionosphere model and on first-principles modelling. Electromagnetic waves at those frequencies are strongly affected by ionospheric electrons and, consequently, those frequencies can be used for studying the plasma. On the other hand, even if the ionosphere originally enables long-range telecommunication at MF and HF frequencies, the frequent occurrence of spatio-temporal variations in the ionosphere disturbs communication channels, especially at high latitudes. Therefore, study of the MF and HF waves in the ionosphere has both a strong science and technology interests.

We present computational simulation and measuring principles and techniques to investigate the arctic ionosphere by a polar orbiting CubeSat which radio instrument measures HF and MF waves. We introduce 3D simulations, which have been developed to study the propagation of the radio waves, both ground generated man-made radio waves and space formed space weather related waves, through the 3D arctic ionosphere with a 3D ray tracing simulation and a local scale full kinetic electromagnetic simulation. We also introduce the Suomi100 CubeSat mission and its initial observations.