Suomi 100 Satellite Space Radio

HF/MF skywave propagation analysis

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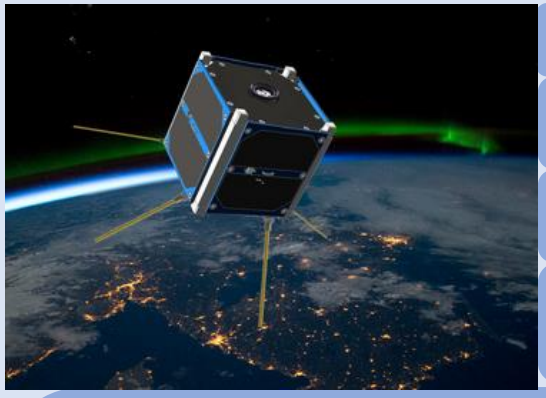


Suomi 100 cubesat mission

Size: 10 x 10 x 10 cm ***Mass: 1.1 kg***

Orbit: Polar 575 km circular LEO

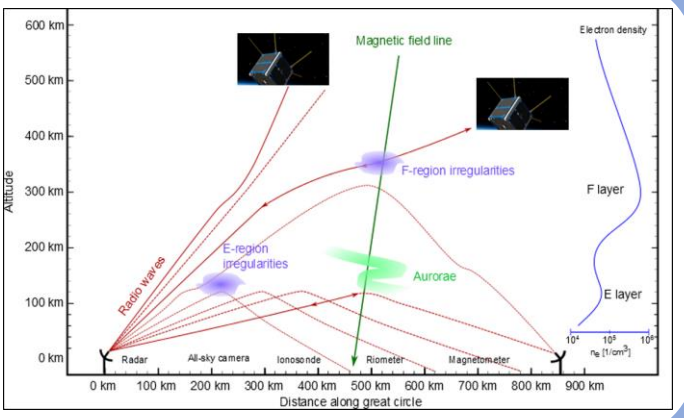
Payload: 1-10 MHz radio receiver
Visible-spectrum camera

SUOMI100 SATELLIITTI

Ionosphere plasma electrons oscillate at ~1-10 MHz. Consequently, HF/MF radio waves undergo strong refraction and absorption that can be studied with the Suomi 100 satellite.

The HF/MF spectrum is used for

- Over-the-horizon radar for e.g. military aviation
- Skywave radio communication and broadcasting
- Ionosondes in ionosphere and space research



Computer simulation of skywave radio propagation by ray tracing

Radio paths are solved by numerically integrating the Hamiltonian ray equations.

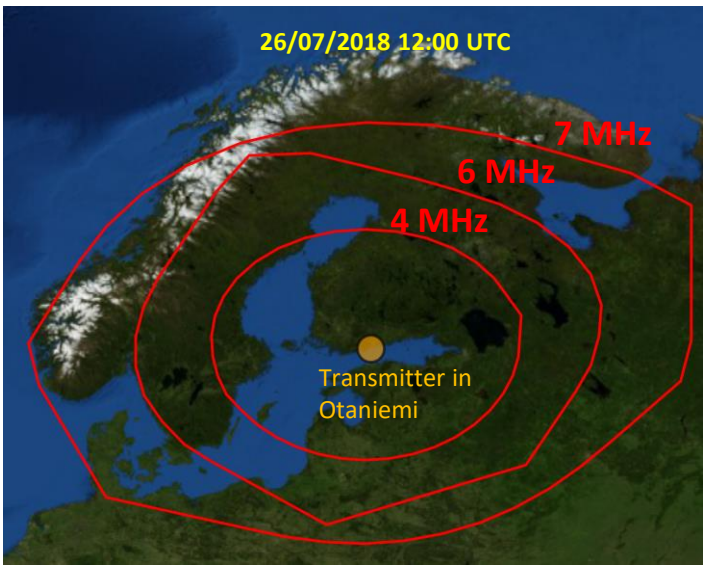
Ionosphere simulation parameters are provided by either the user or an atmospheric model (e.g. IRI)

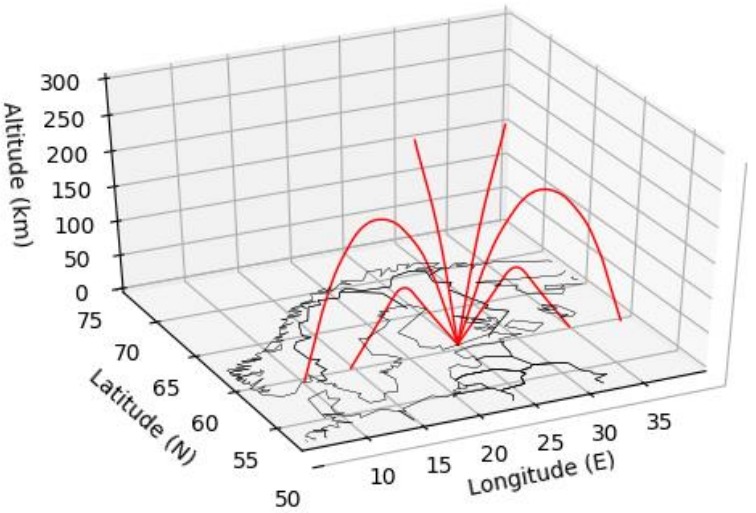
$$\frac{d\boldsymbol{k}}{dt} = \frac{\partial H/\partial \boldsymbol{r}}{\partial H/\partial \omega}$$

$$\frac{d\boldsymbol{r}}{dt} = -\frac{\partial H/\partial \boldsymbol{k}}{\partial H/\partial \omega}$$

Ray tracing is used to estimate

- Maximum usable frequency
- Transmission coverage maps
- Signal intensity and absorption in D-layer
- Wave polarization





Left: Single hop skywave coverage map for various frequencies predicted by ray tracing
Right: Three-dimensional ray tracing results for various elevation angles. Frequency = 7 MHz