Calculation of the ray paths and propagation times of HF radio waves using the simulator of HF-START project.

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HF simulator Targeting for All user's Regional Telecommunications (HF-STRAT) is a collaborative project with NICT, ENRI and Chiba University to provide the information of nowcast of radio propagation. In this project, propagation of HF radio waves is calculated by ray-tracing. Using the results of ray-tracing, we have determined whether HF radio wave travels between any two points. To confirm the results of ray-tracing, we have observed the differences of the propagation time of the HF radio waves transmitted from Nagara transmitter, RadioNIKKEI (35.46N, 140.20E). HF receivers are located at Chiba University (Chiba, 35.62N, 140.10E), Sarobetu (Hokkaido, 45.16N, 141.74E), Numata (Gunma, 36.62N, 139.02E), Yamagawa (Kagoshima, 31.20N, 130.61E), Ogimi (Okinawa, 26.68N, 128.15E). In the ray-tracing calculation, therefore, we have calculated propagation paths and times between transmitter and the receivers. In comparing the propagation time between Chiba and the other receivers, it is found that there was a difference of the propagation time between the ray-tracing results and the observations. This is because it is assumed that ground waves are propagated from Nagara to Chiba. By calculating the loss of electric field strength between Nagara and Chiba, we found out that the loss of sky wave that is reflected by ionosphere was almost same as that of ground wave. Thus, it is possible that the radio wave propagation between Nagara and Chiba is not ground wave but sky wave that is reflected by ionosphere or both ground wave and sky wave signals are received simultaneously by receiver at Chiba. As for further calculation, we plan to use the electron density distributions determined by GAIA and GNSS tomography in the ray-tracing calculation.