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Implementation of SDR-based scintillation detector system and preliminary observation with magnetometer and radar

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The upper part of Earth's atmosphere is ionized by solar ultraviolet and X-ray radiation. This region is called the ionosphere. It is located from about 60km to 1000km altitude and separated to some regions according to their characteristics. The ionosphere plays an important role for radio wave propagations. These propagations are dependent on the condition of the ionosphere, because the ionosphere changes these conditions temporally and spatially by background fluctuations. Some disturbances are regular and repeated, such as daily, seasonal, and solar activity. In addition, some disturbances are irregular, such as sporadic E layer, and plasma bubbles. These disturbances cause the ionospheric scintillation, rapid intensity and phase changes of radio waves which pass through the ionosphere. Therefore, the observation of ionospheric scintillation is equivalent to observing the state of the ionosphere, which is very important for space weather research.

We operate a worldwide magnetometer and FM-CW network, MAGDAS. We have produced many scientific results related to space weather research by using these data. At this time, we developed the SDR (Software-Defined Radio) -based scintillation detector system for our additional observation. We use the USRP N210 with WBX daughter board from Ettus research as the front end, and signal processing software based on some open source products. Active GPS antenna with 30db gain and additional low noise amplifier are connected to the system for signal receiving. The operating system for signal processing part is Linux(64bit) on Core i5 system. We installed this system at Sasaguri, Fukuoka, Japan (33.64N, 130.51E, in Geographic Coordinate). We operate magnetometers and a FM-CW radar at Sasaguri station. Thus, our new device can observe GPS scintillation simultaneously with magnetic field variation recorded by magnetometer and ionosphere plasma density profile detected by FM-CW ionogram. In this paper, we will introduce the progress of this development and preliminary data.