Analysis of seismo-electromagnetic phenomena by a microwave radiometer loaded on a satellite

Takashi Maeda[1]; Tadashi Takano[2]

[1] Electronics Engineering, The University of Tokyo; [2] ISAS, JAXA

http://www.radionet.isas.jaxa.jp/

It was experimentally shown that rock crash by static pressure caused radiowave emissions at 300MHz, 2GHz and 22GHz. This result suggests the microwave is emitted on the occasion of earthquakes.

Encouraged by this circumstance, we aim to build the computer system to detect microwave emissions associated with crustal alterations, which trigger earthquakes, by a microwave radiometer loaded on a satellite. At present, the microwave radiometer 'AMSR-E' loaded on the remote sensing satellite 'Aqua' is the most suitable for our purpose.

AMSR-E is a multi-frequency (6.9 / 10.65 / 18.7 / 23.8 / 36.5 / 89 GHz), dual-polarized microwave radiometer that detects faint microwave emissions from the Earth's surface and atmosphere. According to Planck's law, radiowaves at various frequencies are emitted from the surface of every object. The brightness temperature T' [K] of an object is given by T' = e T, where the emissivity of the object is e and the physical temperature is T [K]. The emissivity depends on objects or frequencies. The received power of the antenna P [W] is given by P = k T' B, where k is Boltzmann constant and the bandwidth of the radio meter is B [Hz]. The power emitted from the Earth's surface can be calculated from P.

Considering the generation of the microwaves by a rock crash associated with earthquakes, it is difficult for the microwaves to propagate to the Earth's surface directly because of strong attenuation in case a hypocenter is under the sea bottom or under the ground containing water. However, if there are some cracks from the underground to the ground surface and if the ground contains water, the cracks are considered to act as waveguides to guide the microwaves with small attenuation. If a crack is as wide as a few centimeters, it is enough for the microwave to propagate. Based on this model of microwave emission from underground, we are now investigating the AMSR-E data on earthquakes with bigger magnitude and with shallower hypocenter under the ground. Moreover, on an earthquake caused by an active fault, we focus on the brightness temperature data on not only the epicenter but also fault planes appearing on the ground.

As a result, before some earthquakes caused by active faults, it has been detected that the microwave was emitted more strongly at fault planes appearing on the ground than at their vicinity. We show the current analysis result on each event.