EM-ACROSS System: Installation at the Kusatsu-Shirane Volcano, Japan

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We have been working on establishing an electromagnetic routine monitoring system called EM-ACROSS. ACROSS stands for Actively Controlled Routinely Operated Signal System. The source signal is composed of a set of sine waves with multiple line frequencies and is precisely controlled by the synchronization with a 10MHz GPS signal. This allows stacking receiver signals for a long time, even with a relatively small power transmitter.
EM-ACROSS system was installed at Kusatsu-Shirane volcano, located 200km NW of Tokyo. The Kusatsu-Shirane volcano is an andesitic-to-dacitic volcano known for its phreatic activity in historical times. The internal structure of the most active crater, Yugama, was modeled to the depth of 2km by magnetotelluric soundings with 91 sites, and a three-dimensional resistivity structure was obtained (Tseng et al., 2020). We now aim to image the temporal variation of the resistivity structure in four dimensions.
The transmitter system is composed of a GPS-controlled function generator that can output arbitrary signals at two channels. For each channel, the signal time series consists of a set of 8 frequencies. The two sets have slightly different frequencies, so two sets of independent signal time series can be recorded in the receiver without interference. The amplitudes of the transmitter signals have a larger amplitude toward lower frequencies to counteract the natural signals. The phases of the sine components are randomized to avoid generating a peaking. We installed two current dipoles in NS and EW directions. The signals from the two channels of the function generator were 80 times amplified by the two power amplifiers.
The receiver sites measure electric and magnetic signals using MT receivers. As we have two current dipoles, we can obtain tensor responses simultaneously. In addition, as the transmitter signal consists of a set of specific line frequencies, we can also measure magnetotelluric signals without disturbances.

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