



## **Thunderstorm monitoring with VLF network and super dense meteorological observation system**

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It's not easy to understand the inside structure and developing process of thunderstorm only with existing meteorological instruments since its horizontal extent of the storm cell is sometimes smaller than an order of 10 km while one of the densest ground network in Japan, AMEDAS, consists of sites located every 17 km in average and the resolution of meteorological radar is 1-2 km in general. Even the X-band radar realizes the resolution of 250 m or larger. Here we suggest a thunderstorm monitoring system consisting of the network of VLF radio wave receivers and the super dense meteorological observation system with simple and low cost plate-type sensors that can be used for measurement both of raindrop and vertical electric field change caused by cloud-to-ground lightning discharge, adding to basic equipments for meteorological measurements. The plate-type sensor consists of two aluminum plates with a diameter of 10-20 cm. We carried out an observation campaign in summer of 2013 in the foothills of Mt. Yastugatake, Yamanashi and Nagano prefectures in Japan, installing 6 plate-type sensors at a distance of about 4 km. Horizontal location, height and charge amount of each lightning discharge are estimated successfully based on the information of electric field changes at several observing sites. Moreover, it was found that the thunderstorm has a very narrow structure smaller than 300 m that cannot be measured by any other ways, counting the positive and negative pulses caused by attachment of raindrop to the sensor plate, respectively. We plan to construct a new super dense observation network in the north Kanto region, Japan, where the lightning activity is most prominent in summer Japan and surrounded by our VLF systems developed for detecting sferics from lightning discharge, distributing more than several tens of sensors at every 4 km or shorter, such as an order of 100 m at minimum. This kind of new type network will reveal the unknown fine structures of thunderstorms and open the door for constructing real time alert system of torrential rainfall and lightning stroke especially in the city area.