Bayesian Estimation of Volcanic Ash Plume Height by Weather Radar Network

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In order to make an initial condition of volcanic ash fall forecasts, Japan Meteorological Agency (JMA) basically uses volcanic ash plume height observed by highly sensitive cameras. This method has a disadvantage that, in the case of poor visibility, volcanic ash plume height would not be determined by the visual observation. In such a circumstance, volcanic ash plume detection methods using remote sensing technology such as weather radars are desired. Since weather radar uses a radio wave, volcanic ash plume can be detected in the case of cloudy weather. However, it should be noticed that single polarization radars, such as JMA weather radars, are not useful at rainy conditions.
The authors analyzed a case of the eruption at Mt. Ontake, and concluded that JMA radar echo height showed an over-estimated value compared to the ash plume height deduced from a photo taken at Mt. Aino. Since the data observed by Tokyo radar had a bias because of an anomalous propagation, the composite radar echo height was over-estimated.
To estimate volcanic ash plume height more accurately, the authors introduce a Bayesian estimation method. The procedure to estimate a volcanic ash plume height is as follows: 1. assume that a probability density function (PDF) of each radar echo height follows a normal distribution; 2. multiply the prior probability by the PDFs; 3. normalize the composite PDF. Moreover, Bayesian updating can make the prior probability better. Using the Bayesian method, we can eliminate effects of anomalous propagations. The disadvantage of this method is that, in the case of fewer radar coverage, we can't get accurate estimation. In such a case, the prior probability become more important.
In this presentation, preliminary results of the method will be shown.

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