ELS-XV-2015 Abstracts
ELS-XV-2015-47
Electromagnetic & Light Scattering XV 2015, Leipzig

Modeling Light Scattering by Volcanic Ash Using Ellipsoids

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Every now and then volcanoes spew significant amounts of ash into the atmosphere, where it might be transported over great distances and cause, for example, significant complications to air traffic. This makes global monitoring and modeling of the ash clouds important.

Irregularly shaped volcanic dust particles can be substantially porous and thus their scattering behavior is challenging to model. Even so, simpler model geometries may work adequately in reproducing optical properties. In an effort to model the measured scattering properties of volcanic dust particles, we use ellipsoidal model particles. This approach has been previously shown to work well for the mineral dust [1, 2]. In addition to previously available data from Pinatubo (Philippines), St. Helens (USA) , Lokon (Indonesia) and Redoubt (USA), new laboratory measurements from Eyjafjalla (Iceland)and Puyehue (Chile), were used to validate the approach. These measurements consist of the full scattering matrix, the size distribution, , an estimate for the refractive index and some electron microscope images of the particles [3].

It was found that volcanic dust particles can be reasonably well modeled with various ellipsoidal shape distributions of model particles. As expected, the fits were far better than those achievable by using spherical model particles. However, there is room for improvement left especially with polarization elements. An equiprobable ellipsoidal shape distribution is suggested to be used as a simple, yet well performing first approximation.

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