Determination of the trajectory of the Kanto Bolide using shockwave signals recorded by geophones

Yoshiaki Ishihara[1]; Shin'ichi Sakai[2]; Shin'ya Tsukada[3]; Muneyoshi Furumoto[1]

[1] Natural Sci. and Tec., Kanazawa Univ.; [2] Earthquake Research Institute, Univ. of Tokyo; [3] JMA

Fireballs, bolides or meteoroids passing through the atmosphere with high velocities generate strong shockwaves. The shockwaves are often detected by ground instruments such as a seismometer. The seismological records provide two kinds of information, the shockwave arrival time and the amplitude of the ground motion generated by the shockwave at each seismic station. The shockwave arrival time data enable us to determine trajectories of the fireballs. For example, Ishihara et al. [2003] determined the trajectory of the 1998 Miyako fireball using the arrival times.

Many people, who lived in the Kanto region Japan, heard unaccountable detonating sound at 22:10 (the local time JST = UT + 9h) on June 16, 2003. When the loud sound was heard, it was cloudy, but several people witnessed a bright object flew over the sky. A camera operated by Japan Meteorological Agency at Ito (34.967 N, 138.100 E, 40 m), recorded a luminous moving object.

We inspect the seismic array data around the time when the loud sound was heard. The fireball crossed the sky just above a dense seismic array, which is installed by the Japan Meteorological Agency, Earthquake Research Institute Univ. of Tokyo, Tohoku Univ. and National Research Institute for Earth Science and Disaster Prevention. The array comprises 126 stations an area of 3.8 x 10^4 [km^2]. We identify shockwave signals from the fireball at 40 seismic stations including sensors installed at a deep borehole (deeper than 1000 m). We determine the bolide's trajectory using shockwave arrival times at 20 seismic stations. The obtained trajectory parameters are as follows; the meteoroid velocity of 14 [km/s], the azimuth of the trajectory of 229.5 [degree], the incident angle of trajectory of 15.5 [degree].