A Bright Fireball Over The State of Rio Grande do Sul

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ABSTRACT

In June 7th, around 01:33 (UT), inhabitant from, Argentina, Paraguay and Uruguay observed a very bright fireball. The event was widely recorded including by two monitoring stations from BRAMON. Using some of those videos, it was possible to determine that the fireball entered in the atmosphere with a velocity of 14.3 km/s and began its bright trajectory at an altitude of 104 km over the south of Paraguay. It travelled 393 km to the southeast until reach the dark flight at an altitude of 27.4 km over the midwest of the state of Rio Grande do Sul. The preliminary results of the calculated energy correspond to a pre-atmospheric mass between 3.25 10^3 and 5.75 10^3 kg (about 1.2 m to 1.4 m in diameter) and it is estimated that about 10% of the original mass reached the ground. The shallow trajectory created a large meteorite strewn field, that could extend from the cities of Jari to Santa Maria (Rio Grande do Sul, Brazil). Teams went to the are and conducted searches for meteorite in the region, but no fragments were found so far.

INTRODUCTION

The growth of video cameras use has increased the number of brilliant meteor recorded in the world. The recordings may or may not be made by equipment associated with projects dedicated to meteor monitoring[1]. These projects are present in many countries like USA, Japan, European countries and, more recently, in Brazil. The BRAMON (Brazilian Meteor Observation Network) is a meteor-monitoring network created in 2014 to record and study meteors over Brazil, which is in a privileged position in the southern hemisphere[2,3]. At the night of June 7th, around 01:33 (UT), inhabitant from Brazil (mainly in the states of Rio Grande do Sul, Santa Catarina and Paraná), Argentina, Paraguay and Uruguay observed a very bright fireball. The event was widely recorded by many security cameras, witness using cellphones and by two monitoring stations from BRAMON (Figure 1).

Figure 1. Meteor as seen from Monte Castelo (Santa Catarina state) and Caxias do Sul (Rio Grande do Sul state).

Objective: Evaluate the atmospheric trajectory and pre-atmospheric mass of the progenitor object of the meteor, and estimate the strewnfield and the mass of meteorite fragments that reached ground.

METHODS

❖ **Location:** Security cameras were in Caxias do Sul, Porto Alegre and Venâncio Aires, Rio Grande do Sul state, and a BRAMON station (JJS2) in Monte Castelo, Santa Catarina state.

❖ **Equipment:** Cameras with CCD of similar sensibility curves, quantum efficiency peak near 90% (around 650 nm)[4], a cutoff for wavelengths exceeding 750 nm, 30 frames/s rate, luminous fluxes about 0,1 lx, FOV of about 120 deg^2 (plate scale of hundreds of arcsec/pixel).

❖ **Analysis:** To obtain the atmospheric trajectory and the heliocentric orbit, it is necessary the ascension and declination of the beginning and end of the meteor trajectory and the transit time between these points. Coordinates were estimated using the plate scale and the equatorial coordinates of the FOV centers in each frame, which, in turn, were obtained from the approximate azimuth and height of the FOV centers inferred by information provided by the camera users. The videos were synchronized by comparison of the light curves of the meteor in each recording. To obtain the most likely meteorite strewnfield, wind distribution data at different altitudes are taken into account to determine the lateral deviation of the fragments after dark flight[5].

RESULTS AND DISCUSSION

The meteor was very long and lasting and its bright trajectory began at an altitude of 104 km over southern Paraguay at a speed of 14.3 km/s. For 27.5 seconds, it crossed 393 km of atmosphere passing over parts of Argentina and the Northwest of the Rio Grande do Sul state, disappearing at 27.4 km altitude above the town of Jari (Figure 2). The long duration of the phenomenon initially suggested that it could be a reentry of space debris, but the geocentric velocity proved it to be a meteor. The triangulation data and the analysis of the luminous intensity of the bolide allowed more accurate calculations of the energy released during its atmospheric passage and, consequently, the determination of the object mass[6]. These calculations indicate an initial mass between 3.25 10^3 and 5.75 10^3 kg, being that the uncertainty obtained for this mass is caused by the inaccuracy in the measurement of the luminous flux in different recordings. Using the average density of an ordinary chondrite meteorite (3.84g/cm^3), the most common meteorite type recovered on the Earth surface, the diameter of the meteoroid size was estimated in 1.2 m to 1.4 m and is believed that about 10% of the original mass reached the ground[7]. The shallow trajectory of the meteor and the low intensity of side winds over the area at that moment allowed the fragments to travel more than 50 km during the dark flight before reaching the ground. These facts helped the creation of a large meteorite strewnfield (Figure 3), which could extend from the cities of Jari to Santa Maria (Rio Grande do Sul state). Teams went to the are and conducted searches for meteorite in the region, but no fragments were found so far. The area has farms with plantations and cattle, making the search hard.

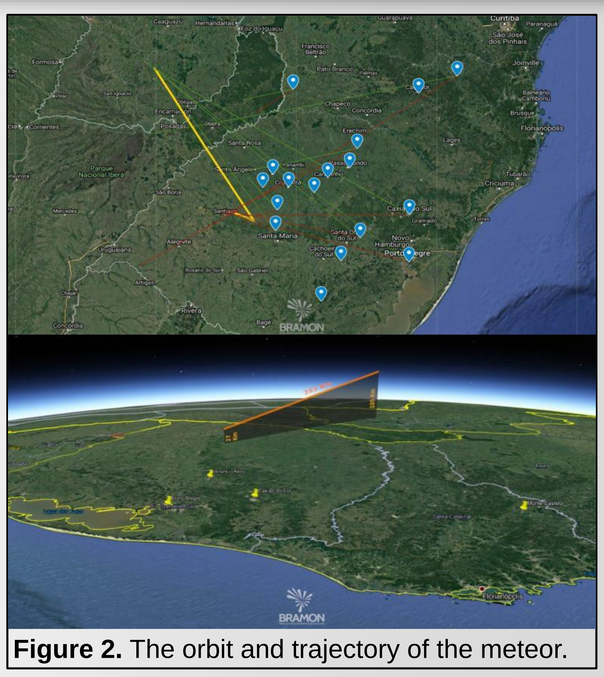

Figure 2. The orbit and trajectory of the meteor.

Figure 3. Meteorite strewnfield estimation for the meteor over the Rio Grande do Sul state.

CONCLUSIONS

The meteor travelled 393 km from south Paraguay until reaching midwest Rio Grande do Sul with a velocity of 14.3 km/s. Its bright trajectory began at 104 km until reach the dark flight at 27.4 km. It had a pre-atmosphec mass over 3 metric tons and it is estimated that about 10% of the original mass fell between Jari and Santa Maria (Rio Grande do Sul state).

Figure 4. Video analysis.
Link: tinyurl.com/BolideRS

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