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Amateur contributions to meteor astronomy

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Abstract

Traditionally, amateur astronomers have always been contributing significantly to the field of meteor astronomy. They contribute in many different areas: Visual observations are still the de-facto standard to produce hourly rate curves; video camera networks like the SonotaCo network or the IMO camera network have been collecting meteor lightcurves and orbit data for many years now. Forward scattering observations are also done by many amateur astronomers. In this paper we will focus on the contribution of amateur astronomers using video cameras for observing meteors and present some results, showing that the data sets now are getting large enough to allow data interpretation previously only achievable with radar data.

1. Introduction

Since more than 20 years, amateurs have observed meteors not only with photographic cameras but also with image-intensified video cameras. Since the advent of fairly low-cost non-intensified cameras produced for the security camera market, the use of video cameras for the regular monitoring of meteor activity has increased dramatically. The results of two camera networks are described here: The video network of the International Meteor Organisation (IMO), coordinated by S. Molau operates cameras mainly in Europe but also a few in the US and previously also in Australia. The other network described here is in Japan, operated by amateur astronomer SonotaCo.

2. The IMO network

The IMO network evolved from the initially German 'AKM network', where AKM stands for Arbeitskreis Meteore, a German amateur meteor observer group. Due to the strong involvement of the AKM in the IMO, the network expanded quickly outside Germany and now has contributors from many countries. It has been operational within the IMO since 2004 and has collected more than 550000 meteor observations available via http://www.imonet.org. The network collects data from individual stations, which use both intensified and non-intensified video cameras. Meteors are automatically detected using the software MetRec written by one of us (S. Molau). The archived data contains summary files for observations per station and night listing all meteors and its peak magnitude and position. In addition, for individual meteors images of the complete meteor event, an animation of the meteor, right ascension and declination of the meteor in each of the detected frame, and its magnitude can be stored.

3. The SonotaCo network

This network consists of a set of similar non-intensified cameras of type Watec. It is operational since 2004. The network covers over 50 % of the sky above the landmass of Japan and is arranged such that the cameras have overlapping fields allowing the direct determination of meteor orbits. The data starting from 2007 is available via http://www.sonotaco.jp/doc/SNM/index.html and contains a total of 65000 meteor orbits reduce from 490000 single-station observations. The main data product is files containing meteor orbits and their light curves. Data capture is done using the software tool UFOcapture; data evaluation is done using the UFOanalyzer and UFOorbit.

4. Selected results

Many different kinds of studies can and have been done with these datasets, e.g. search for meteor stream radiants or statistics of lightcurves. Recently, both datasets were used to produce a plot of the radiants of all sporadic meteors observed over several years. A typical plot, generated with the SonotaCo data, is shown in Figure 1 and compared to data acquired with radar systems. It can be seen that enough data is in the dataset to see the main sporadic sources: The so-called north- and south apex sources, the helion and ant-helion sources, and the northern toroidal source. 'Apex' is the apparent direction of movement of the Earth, the 'helion' source seems to come from the direction of the sun. Since both the radar and the video network are on the northern hemisphere, the coverage towards the south is less complete.

Professional meteor astronomers currently develop models to link these sources to real objects by dynamical modeling of the dust evolution (e.g. [1]). These models predict both density and velocity of the radiants together with the mass of the particles. As optical and radar systems cover different mass regimes, a detailed analysis of the optical observations will allow to further constrain these models. This shows that the data from amateurs can be a very valuable addition to the radar datasets.

In addition to the sporadic background, optical observations can be used to analyze shower meteors. For details, see e.g. [3] and [4].

References

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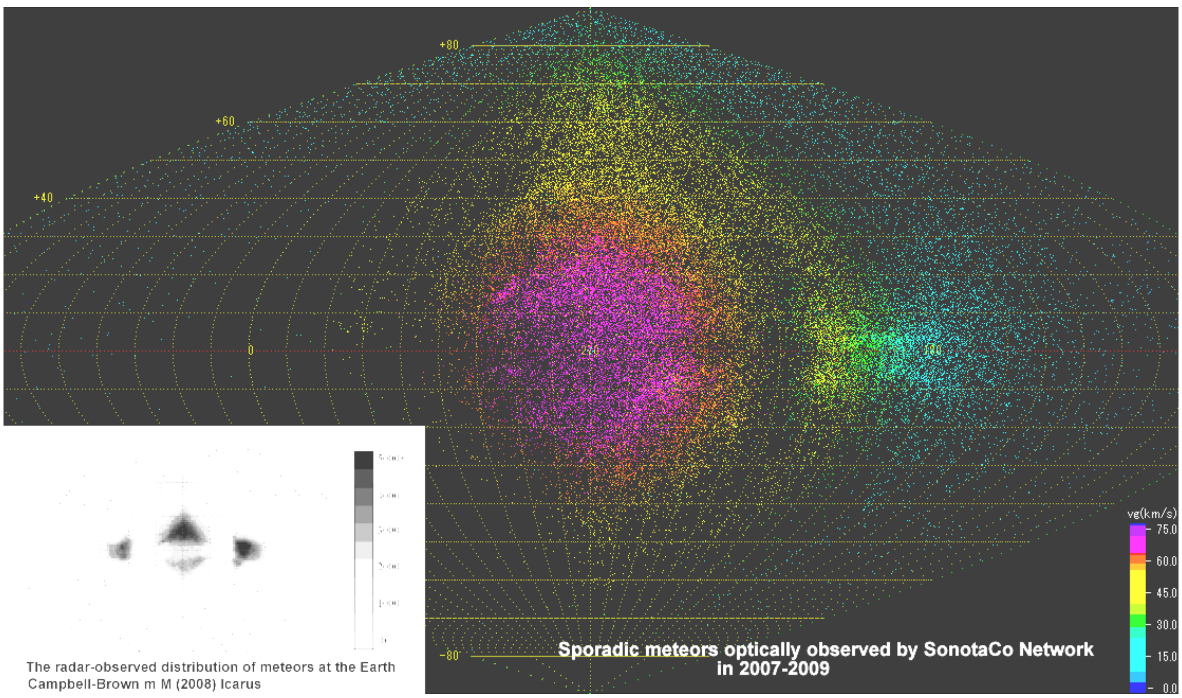

Figure 1: Sporadic meteors, optically observed, by the SonotaCo network from 2007 to 2009. The colours show the velocity. The black-and-white insert shows the sporadic radiants obtained by the Canadian Meteor Orbit Radar [2].