CAMS BeNeLux

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This paper gives an overview of the current status of the BeNeLux CAMS video meteor network as operated in the Netherlands and Belgium, and part of the NASA funded automated meteor video surveillance project CAMS.

1 Introduction

For meteor detection, one can chose nowadays from an increasing number of video systems. Examples are Metrec (Molau, 2014), UFOCapture[1] or CAMS (Jenniskens, 2011). Rather than being individual instrumental camera projects all of these also succeed in forming substantial networks, administering data, and delivering results in a consistent way. A tracer for their success is that the number of video stations is rapidly growing.

While each system has naturally its own pros and cons, in this paper we do focus only on the CAMS system. CAMS stands for *Cameras for All sky Meteor Surveillance* and was developed as NASA sponsored project by Gural and Jenniskens (Jenniskens, 2011) for forming a double station network in California/US for the detection of (cometary) meteor streams in order to validate the IAU Working List of Meteor Showers[2] (Kanuchova, 2013). CAMS for this reason aimed at delivering heliocentric orbits, and in addition light curves.

In 2011, CAMS was introduced in the Netherlands as part of the NASA Draconid outburst observing campaign in nearby Kühlungsborn (Vaubaillon, 2014), after which trials were carried out from 2 Dutch stations on the Orionids 2011 with 2x4 cameras. The obtained result of ~100 double station meteors (Johannink, 2013) was considered as an outstanding success. In March 2012, camera operators Jobse and Neels started with regular observations from two stations. One month later the network was already expanded to four stations (operated by Johannink and Breukers), which can be seen as the start of CAMS BeNeLux (BeNeLux being the union of the three neighboring states Belgium, the Netherlands and Luxembourg). With networks in the US and the most recent in New Zealand, CAMS BeNeLux acts as the Northern European counterpart within CAMS.

In this paper we aim at reporting on the status of CAMS BeNeLux and as well invite enthusiastic new camera operators to join.

2 CAMS hardware

Although a number of excellent detailed papers have been published about CAMS and its hardware (Jenniskens, 2011; Gural, 2011), we here briefly summarize the technics behind CAMS, all standardized:

- CAMS uses a standard sensitive Watec 902H2 video surveillance camera. No image intensifier is applied.
- It uses a 12mm F1.2 C-mount lens, giving approx. 20x30˚ FoV.
- Image acquisition of the analogue video output is done through a EZCAP USB framegrabber dongle.
- An old (but at least dual core) PC is sufficient for data collection.
- CAMS developed its own software, with also a version for single station cameras, called *single-CAMS*, which is available for free. It recognizes meteors in real time, archives them, and enables astrometry. After each observing night all relevant data is to be made available manually by emailing three txt files for further processing.
- CAMS can be easily operated remotely.

The most expensive part in the system is the camera, due to its sensitivity. Recent market investigation identified newer and cheaper versions (Samuels, 2014), bringing the price down considerably.

Recently the CAMS data format triggered also others to write additional software, in this particular case a user-friendly image viewer, also freely available (Vida, 2014).

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[1] http://sonotaco.com/e_index.html
[2] IAU Working List of Meteor Showers, http://www.astro.amu.edu.pl/~jopek/MDC2007/Roje/roje_lista.php?corobic_roje=0&sort_roje=0

Two examples of recently realized stations of the BeNeLux CAMS network are shown in *Figure 1* and *Figure 2*.

Figure 1 – Station Wildert. The cameras typically are mounted in weatherproof video surveillance casings, being cheap and making realization of a new station an easy exercise.

Figure 2 – Station Heesch.

3 CAMS BeNeLux status

As of October 2014, the CAMS BeNeLux network consists of 32 cameras, 3 other being installed, and another ~10 being planned. The current set of 32 cameras is operated from 14 stations, as is illustrated in *Figure 3*. Together they capture a large fraction of the Netherlands (*Figure 4*). The center and south of the Netherlands is well-covered and further expansion of the network is expected in the North of the Netherlands, Belgium, Luxembourg and Germany. Not visible in *Figure 4* are 2 camera fields that extend already into Germany and another field west of the Belgian coast over the North Sea.

Figure 3 – Current distribution of stations over Belgium and the Netherlands.

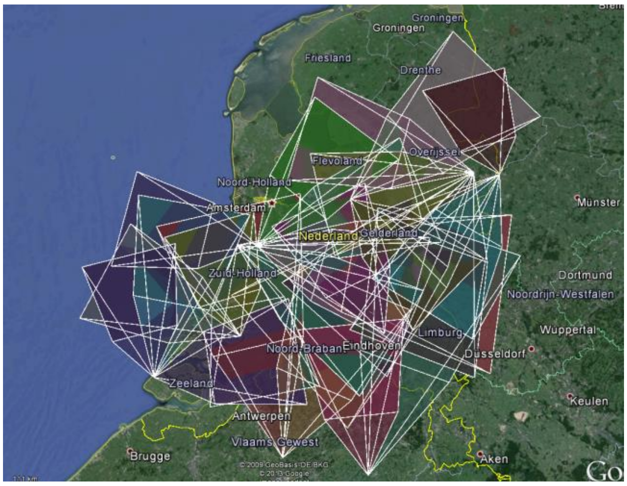

Figure 4 – Covered atmospheric volume with CAMS BeNeLux.

4 Project organization

No network works well for a longer period without proper coordination. The CAMS BeNeLux coordination is primarily done by Carl Johannink. All observers send their results to the coordinator in principle the same day, which are then administered and processed soon after (usually also the same day), after which the data products (i.e. orbits) are known. There is also a standby-coordinator (Martin Breukers) who takes over in case Johannink is absent. This way a fast processing time can be guaranteed as well as a quick response to the observers. Giving fast and proper feedback to the observers is seen as a key element in keeping the network and their operators motivated. In addition, once a year a workshop is organized in which CAMS progress, technical details and questions as raised by the operators are discussed.

Being part of NASA's CAMS project, all data is regularly sent to Jenniskens for further analysis and publication. The tendency is that after ~ 1 year all data becomes public.

5 CAMS BeNeLux data

Based on the local weather conditions each operator decides him/herself to operate the camera yes or no. Typically, each station is approx. half of all nights in operation and captures 5-20 meteors per (quiet) night. During an entire clear night the network is able to register over a 100 double station orbits. On a monthly basis the total number of double station meteors sums up to ~1000 or more. *Figure 5* illustrates the monthly yield since the startup of the network until August 2014. *Figure 6* gives as an idea what can be done with the data: e.g. the radiant distribution around Geminid maximum in 2013. Regularly, (preliminary) results are published, what was done on both the η-Aquariids and Camelopardalids (Johannink (2013), resp. Jenniskens (2014)).

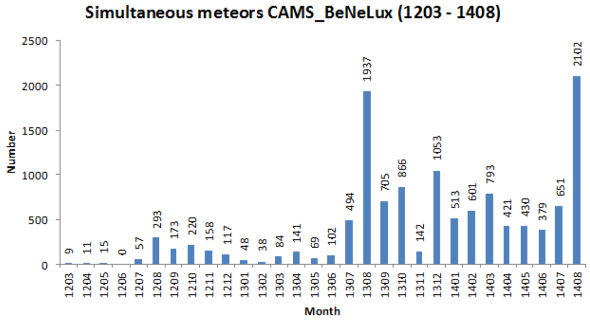

Figure 5 – Monthly distribution of double station meteors, as obtained by CAMS BeNeLux. Due to the constantly increasing number of stations, the number of captured orbits increases too.

6 Fireball information

Despite the fact that CAMS is not designed as a fireball patrol network, the large number of stations and its coverage enable that any bright fireball event is generally captured by one or more CAMS cameras too. *Figure 7* shows a recent fireball as example. CAMS turns out to be able to deliver orbits from fireballs as well, in particular when based on the fainter beginning or end of the trail, and for this reason are of additional value to the more conventional and less sensitive All sky fireball patrol cameras based on fisheye lenses (Bettonvil, 2014), CAMS provides results of similar accuracy.

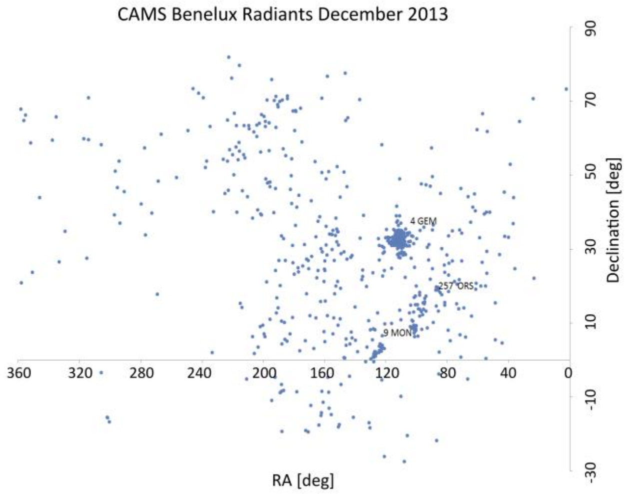

Figure 6 – Radiant distribution in December 2013.

7 Conclusions

With 32 cameras CAMS BeNeLux has grown towards a major video network in 2.5 years of time. Administration and processing run rather well and provide a wealth of information. We learned a number of things from the rapid network expansion:

- Setting up a CAMS station is easy to do.
- Operating a CAMS station is easily done too, remote access included.
- It delivers very useful information in the form of orbital data and light curves.
- CAMS BeNeLux has an excellent coordination, it is one of the keys to its success.
- Data are processed rapidly, with fast feedback to the observers and distribution of intermediate results.
- Being part of NASA's CAMS it offers a paved way to scientific results.

We welcome new users to join.

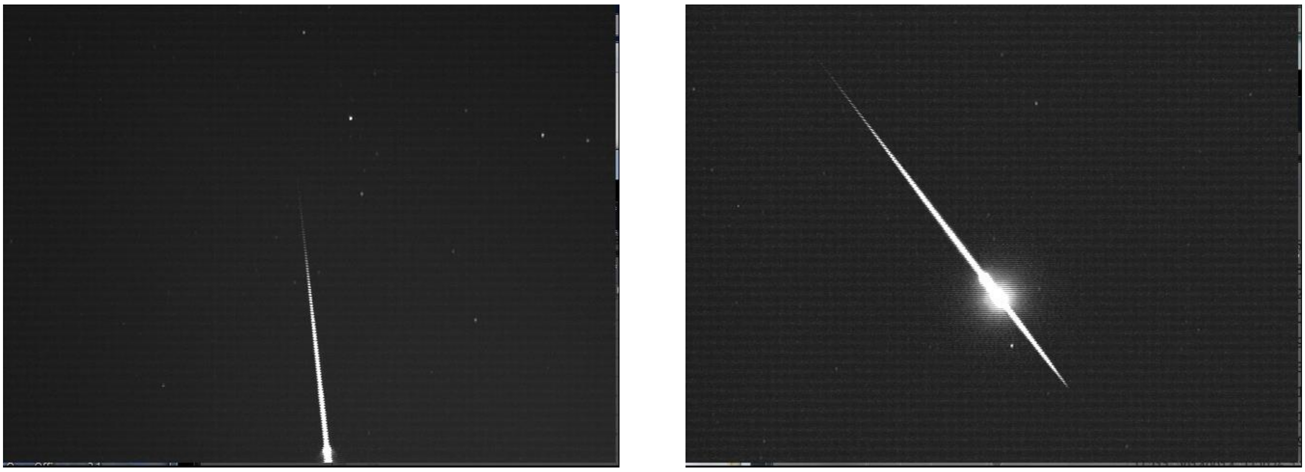

Figure 7 – 2014 September 14 at 23h17m04s UT fireball as captured by the CAMS BeNeLux stations Ermelo and Gronau. CAMS gave as result for the radiant $\alpha = 307.3° \pm 0.4°$, $\delta = +32.7° \pm 0.4°$, $V_g = 18.0 \pm 0.1$ km/s.

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