

# EDMOND Meteor Database

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In the paper, a next version of the video meteor orbit database EDMOND (European viDeo MeteOr Network Database) is presented. The database is a result of cooperation and data share among several European video networks. There are also included the IMO VMN (Video Meteor Network) data. The latest version (v. 4) of the database contains 83 369 of orbits selected by conservative criteria.

## 1 Introduction

Thanks to a broad international cooperation of video meteor observers from several European countries, we managed to create a multi-national network EDMOND (European viDeo Meteor Observation Network) (Kornoš et al., 2013). Nowadays, following national networks, in alphabetical order, are connected to the European viDeo Meteor Observation Network: - BOAM (French amateur observers France BOAM network / Base des Observateurs Amateurs de Mtores), CEMeNt (Central European Meteor Network, cross-border network of Czech and Slovak amateur observers), HMN (Hungarian amateur observers, Hungarian Meteor Network / Magyar Hullcsillagok Egyeslet), IMTN (Italian amateur observers in Italian Meteor and TLE network), PFN (Polish Fireball Network / Pracownia Komet i Meteorow, PkiM), SVMN (Comenius University network, Slovak Video Meteor Network), UKMON (British amateur observers, UK Meteor Observation Network) and several individual observers from Bosnia and Herzegovina, Serbia and Ukraine where an extensive network is being created.

In the last year, observers affiliated in the IMO VMN have started to share their data and the data of EDMOND and IMO VMN have been merged. The IMO VMN has been created in 1999 and at present it consists of observers from Germany, Slovenia, Italy, Hungary, Finland, Portugal, Netherlands, U.K., Spain, Poland and Belgium. More than 1.2 million of single-station meteors of IMO VMDB (Video Meteor Database) means a predominant contribution to the database.

One can say that nowadays EDMOND and VMDB is collecting data from observers from a substantial part of Europe and due to this international cooperation, a meteor activity is monitored almost over the entire Europe. By count, the database has accumulated 1 639 358 records of single-station meteors from 2000 to 2013. The statistics is presented in Table 1 and the counts of single-station meteors in particular years are plotted in Figure 1. Data reduction from some years is not completed yet.

Two different tools are used by observers in EDMOND

and IMO VMN: MetRec software written by S. Molau (1999) and UFO Tool written by SonotaCo (2009). In the last column of Table 1, there is highlighted the software used in particular networks (stations).

Table 1 – Networks, stations, single-station meteors

Network	Num. of stations	Meteors single	Tool
BOAM	10	26 779	UFO
CEMeNt	15	40 742	UFO
HMN	13	167 834	MetRec
IMNT	15	135 534	UFO
PFN	23	30 576	UFO
			MetRec
SVMN	3	39 257	UFO
UKMON	4	3 372	UFO
Bosnia	4	1 390	UFO
Serbia	1	58	UFO
MeteorsUA	6	1 742	UFO
IMO VMN	61	1 192 092	MetRec
<b>Total</b>	<b>155</b>	<b>1 639 358</b>	

## 2 Compilation and reduction of the database

The catalogue of meteor orbits is created by using the software UFOOrbit. The application imports all data in the UFO format. That means, all data obtained and analyzed by UFO Tools can be used without any change, on the other hand, data obtained by the MetRec software have to be converted into the UFO format (they are converted by the programme INF2MCSV written by SonotaCo). In the program UFOOrbit, all combinations of meteors in time interval  $dt = 5$  sec are created. For these combinations, the level  $Q_0$  is set and another additional conditions have to be also set (parameters are defined in the UFO Manual <sup>1</sup>):

- $Gm\% > -100\%$  (overlapping of a meteor seeing from two stations)

<sup>1</sup>[http://sonotaco.com/soft/U02/U021Manual\\_EN.pdf](http://sonotaco.com/soft/U02/U021Manual_EN.pdf)

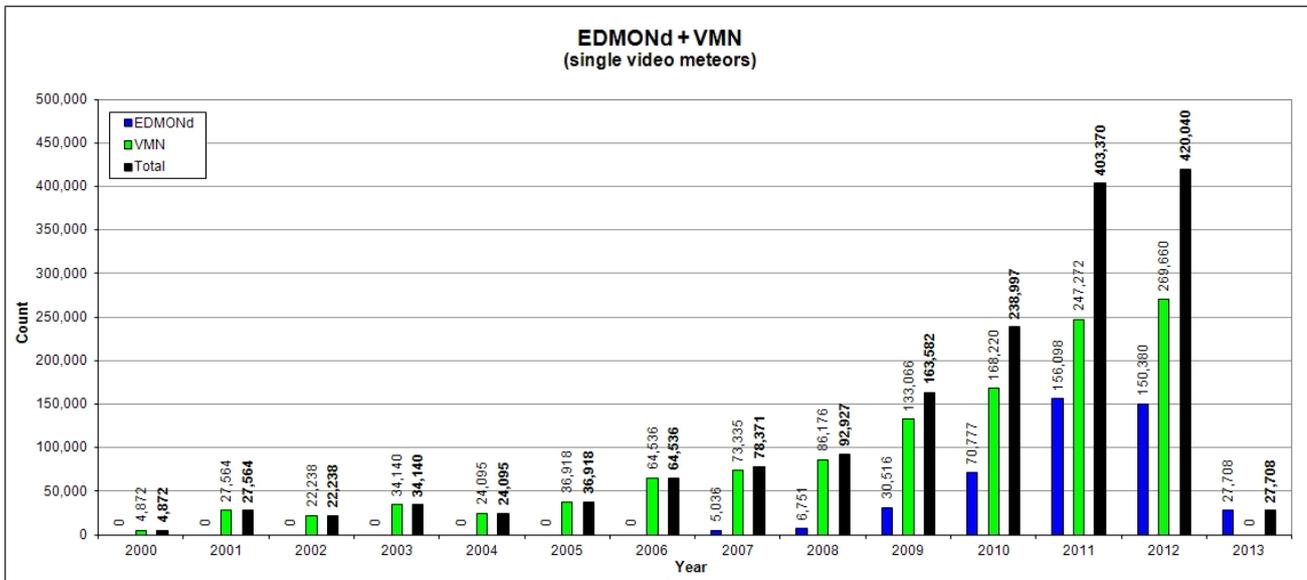


Figure 1 – Number of single-station meteors in EDMOND and IMO VMN

- $H1 \in (15; 200)$  km (beginning height)
- $H2 < 200$  km (terminal height)
- $QA > 0.15$  (empirical quality parameter from interval 0;1)
- $dV < 7$  km s<sup>-1</sup> (the largest difference in velocity among stations considered in computing the orbit)

The last one is the most important modification in comparison to the previous versions of the database. The value 7 km s<sup>-1</sup> is 10% of the largest geocentric velocity of a bound object (unfortunately, it is not possible to set the value 10%). In this way, most of false meteors are eliminated.

The output from UFOOrbit is a set of orbits which contains preliminary orbits computed for every station of the considered meteor and also a mean "UNIFIED" orbit as a final solution. To reject less precise orbits and also the rest of false orbits, another filter is applied to the set of orbits in two ways (see also Kornoš et al., 2013): a) criteria applied only to the line UNIFIED as a final solution; b) criteria applied to every line of a meteor; if any line does not fulfill the criteria, the meteor is rejected:

- $Q_0$  1.0 deg (observed trajectory angle)
- $dur > 0.1$  sec (duration of the meteor)
- $Qc > 10$  deg (convergence angle)
- $dGP < 0.5$  deg (distance of two poles of the orbit)
- $dv12\% < 7.07\%$  (difference in geocentric velocity between unified and one of the considered stations)

A combination of EDMOND and IMO VMDB data provided 109 445 preliminary meteor orbits. After applying stricter limiting conditions, altogether 97 665 (v. 4a) and 83 369 (v.4b) meteor orbits have remained in the database.

Table 2 – Number of orbits in the version 4a and 4b in particular years.

Year	v.4a	v.4b
2001	287	251
2002	84	71
2003	137	113
2004	42	33
2005	89	82
2006	601	531
2007	1 358	1 143
2008	2 197	1 941
2009	4 731	4 193
2010	13 301	11 505
2011	32 443	27 562
2012	39 456	33 425
2013	2 939	2 519
<b>Total</b>	<b>97 665</b>	<b>83 369</b>

### 3 Summary

EDMOND v. 4 is a result of a processing of more than 1.6 million meteor records obtained in 2000 - 2013 at stations in dozens countries in Europe. Several hundreds of observers have participated in collecting of this enormous data set. It is one of the most complex databases of meteor orbits obtained by sensitive video technique.

The database contains about 71 000 double-station, almost 10 000 three-station and more than 2 000 four-station orbits. In the database, there is about 49 000 sporadic and 35 000 shower meteors and we could identify 249 showers by IAU MDC list ( $D' = 0.1$ , Drummond, 1991) when at least 5 meteors in every shower is required. After a small inspection we can say that the EDMOND database is in size and also in quality similar to well known Japanese database of video orbits (SonotaCo, 2009), which has started in 2007.

The data about these orbits will be freely accessible at the website <http://cement.fireball.sk> and at the web site of the Astronomical and Geophysical Observatory of the Comenius University in Modra, <http://www.daa.fmph.uniba.sk>. Data are sorted by years of observation.

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