

May 2026 CARMELo report

by CARMELo network
(Cheap Amatorial Radio Meteor Echoes Logger)

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Introduction

In June, during the first half of the month, the CARMELO network detected activity consistent with the daytime shower of the Arietids (171 ARI), which we analyzed using our RZHR algorithm.

Methods

The CARMELO network consists of SDR radio receivers. In them, a microprocessor (Raspberry) performs three functions simultaneously:

- 1) By driving a dongle, it tunes the frequency on which the transmitter transmits and tunes like a radio, samples the radio signal and through the FFT (Fast Fourier Transform) measures frequency and received power.
- 2) By analyzing the received data for each packet, it detects meteoric echoes and discards false positives and interference.
- 3) It compiles a file containing the event log and sends it to a server.

The data are all generated by the same standard, and are therefore homogeneous and comparable. A single receiver can be assembled with a few devices whose total current cost is about 210 euros.

To participate in the network read the instructions [on this page](#).

June data

In the plots that follow, all available [at this page](#), the abscissae represent time, which is expressed in UT (Universal Time) or in solar longitude (Solar Long), and the ordinates represent the hourly rate, calculated as the total number of events recorded by the network in an hour divided by the number of operating receivers. The time resolution is 15 minutes.

In *fig. 1*, the trend of signals detected by the receivers for the month of June.

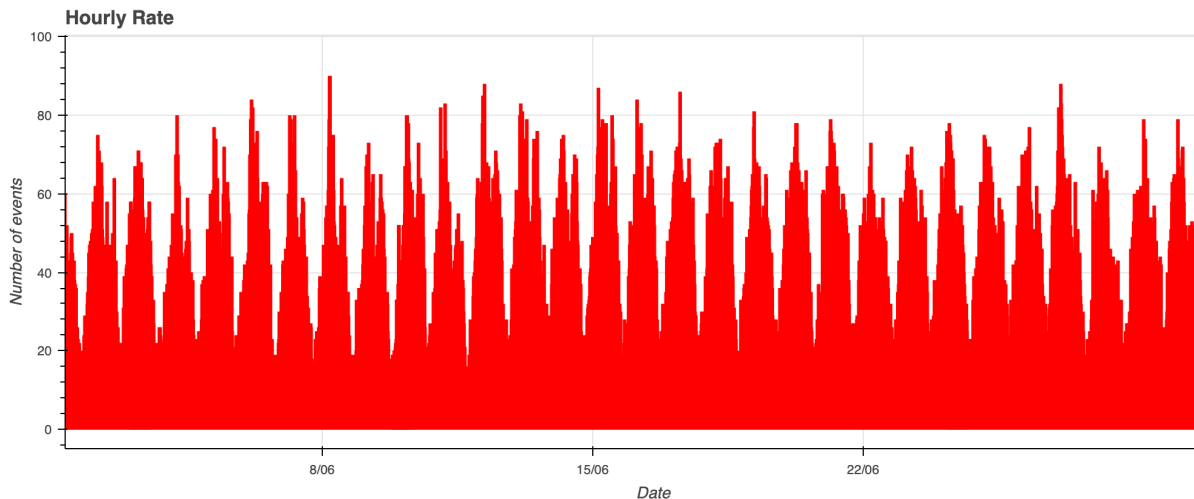


Fig. 1: June 2026 data trend.

Arietids

The Arietids (171 ARI) are a meteor shower active from mid-May to mid-June. It is the most intense daytime meteor shower of the year: its peak occurs when the Sun is already high in the sky, making visual observation extremely difficult, with fewer than one visible meteor per hour. However, Arietid meteors are easily detectable with radio equipment.

The shower's radiant is located in the constellation Aries, about 4 degrees southeast of the star 41 Arietis, and just 30 degrees from the Sun.

The origin of the Arietids has not yet been identified with certainty. The shower's orbit is consistent with both that of asteroid 1566 Icarus and that of comet 96P/Machholz, which are the leading candidates for the parent body (1). It has also been hypothesized that the Tunguska event may have been caused by a fragment of the same parent body as the meteor shower (2), although this theory remains unconfirmed.

The meteor shower was first detected in the summer of 1947 at the Jodrell Bank Observatory through radio observations. Since the peak activity occurs during daylight hours, visual observations are very difficult, and the characteristics of the meteor shower remain partly uncertain even today. Estimates of the active period vary from author to author: some sources indicate it is active from May 22 to July 2, others from May 14 to June 24, while the peak is generally placed around June 7. The International Astronomical Union adopts a range between solar longitudes 73° and 90° , with a peak at 77° . The entry velocity of the meteors also varies somewhat across different estimates, with values ranging from approximately 35 to 42 km/s.

All of these characteristics make radio observations particularly valuable for studying the meteor shower. The low elevation of the radiant above the horizon, and its overlap with the minor Zeta Perseids (ζ -Perseids) meteor shower, call for some caution in interpreting the data obtained using the RZHR algorithm (3).

The construction of RZHR

By RZHR (Radio Zenithal Hourly Rate), we mean the hourly rate of radiometeors in a shower, calculated by processing data from meteor scatter receivers.

This tool allows us to make a significant leap in quality, moving away from the qualitative analysis we have conducted so far (which relied exclusively on graphs) and transitioning to the direct processing of data from our database. To do this, we developed a Python script with the help of the “Cursor” tool, an AI-powered code editor created by Anysphere. This support proved crucial in developing a satisfactory script.

First, it should be clarified that, in calculating the RZHR, we make certain approximations, including:

- 1) We do not take into account that the varying geographical distribution of receivers causes them to “see” meteors from slightly different angles.
- 2) We disregard the fact that observations are not isotropic but are influenced by antenna pointing, which favors a specific sector of the sky over the entire sky.
- 3) We define a contribution as “sporadic” even though it may also include meteors from small showers.

The algorithm for this calculation uses data from the database of all meteors recorded by the CARMELo network. First, it asks the user to identify certain days on which no significant meteor shower activity is expected. These days are selected as close as possible to the date being analyzed. This data is then averaged to form a second database called the “sporadic average.”

This database is then subtracted from the one for the days under examination, during which a meteor shower is presumed to be present. Any negative values are eliminated, and the profile is smoothed using a smoothing function.

The figure is then divided by the sine of the radiant’s altitude above the horizon, calculated for an average Italian location in the same way as the algorithm used to calculate the ZHR (Zenithal Hourly Rate), which, as we recall, is:

$$ZHR = \frac{N * r^{6.5-L_m}}{\sin h_R * T_{eff} * F}$$

Where:

- N : number of meteors counted.
- L_m : the limiting magnitude of a star that is visible to the observer.
- r : shower’s density (the ratio indicating how many more meteors are visible for each magnitude; typically ranging from 2.0 to 3.5).
- h_R : angular height of the radiant above the horizon in degrees.
- T_{eff} : actual observation time (in hours).
- F : field-of-view correction factor.

The temporal resolution, which is 15 minutes in the original data, is retained at that value; therefore,

the term H in RZHR should be considered as $\frac{H}{4}$.

To estimate the activity of the Arietids, the sample of sporadic meteors (in *fig. 2*) was collected during the second half of May, when the shower had not yet reached a significant level of activity and no other major meteor showers were active. The analysis was then extended to data collected between June 4 and 21, a period during which the database shows a clear increase in the number of meteors detected.

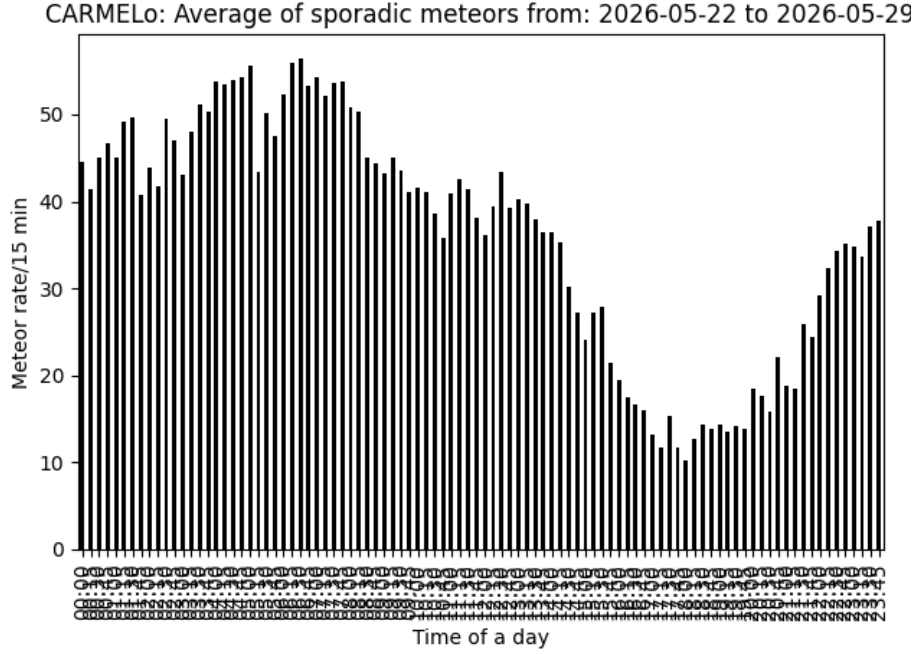


Fig. 2: A sample of sporadic meteors collected in the second half of May 2026.

Fig. 3 shows the trend in meteor activity recorded by the network, limited to the hours when the radiant was above the horizon for most of the observing stations, between solar longitudes 73° and 89° (i.e. between June 4 and June 21).

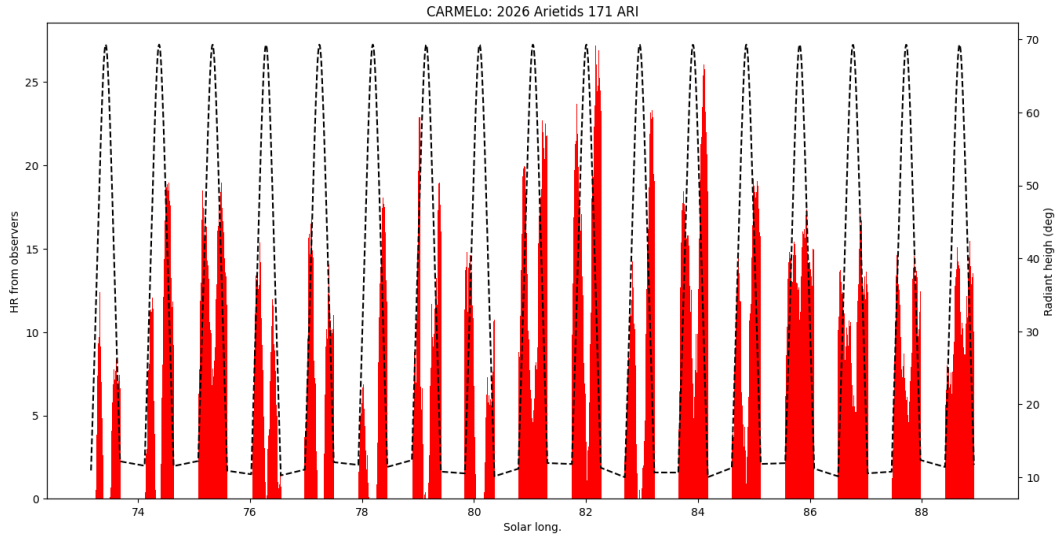


Fig. 3: Meteor activity between June 4 and 21, 2026, limited to the hours when the radiant was at least 10° above the horizon, as a function of solar longitude, and the altitude of the Arietid radiant (dashed line). The contribution of the Zeta Perseids (ζ -Perseids) is neglected.

Calculating the RZHR using the algorithm we developed (3) yields the results shown in *fig. 4*.

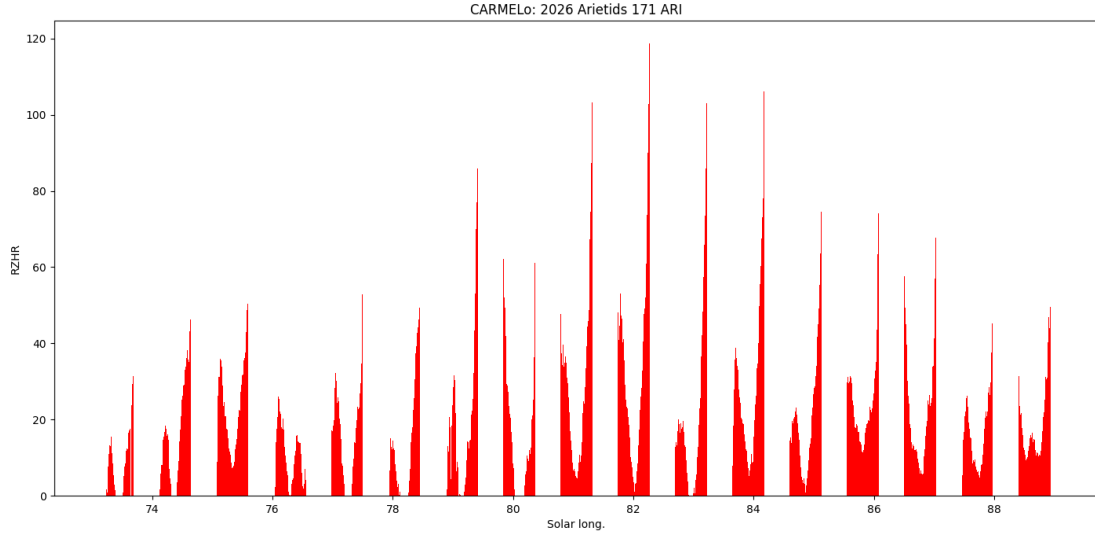


Fig. 4: Residual distribution of events. The contribution of the Zeta Perseids (ζ -Perseids) is negligible.

A first peak is observed at a solar longitude of approximately 77° , which is in good agreement with the predictions reported in the literature. In addition to this, however, a second, more pronounced peak also emerges around a solar longitude of 82° , corresponding to approximately June 13—thus occurring a few days later than the generally predicted peak.

To make the data easier to interpret, we interpolated the maximum values to construct a smoothed curve, which is shown in *fig. 5*.

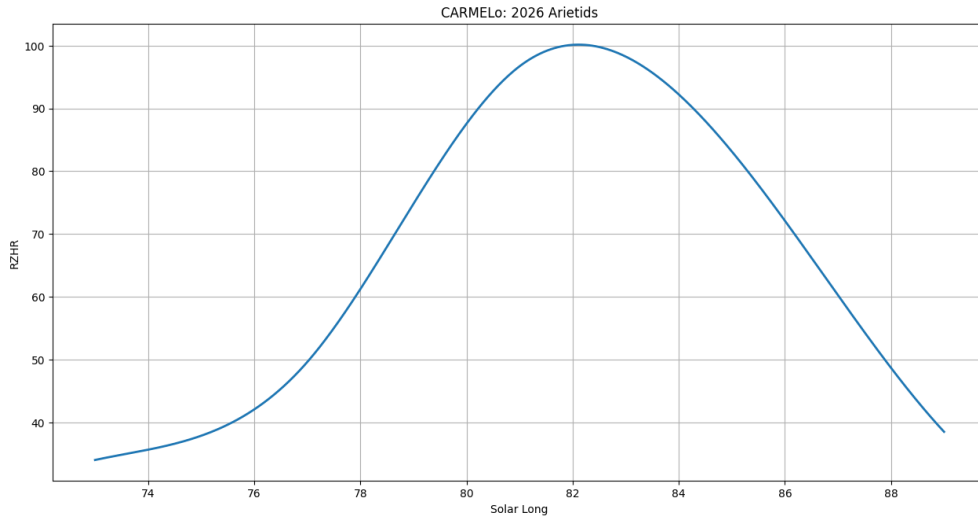


Fig. 5: Distribution of events after interpolation, as a function of solar longitude.

Zeta Perseids

The Arietids are not the only daytime meteor shower active in June. As we mentioned at the beginning, the Zeta Perseids (ζ -Perseids) are also expected during the same period; this shower has very similar observing conditions: the radiant is close to the Sun, making visual observations extremely difficult—so much so that, in this case as well, the information available in the literature is rather limited.

Unlike the Arietids, considered the main daytime meteor shower of the year, the Zeta Perseids are generally classified as a shower with low activity. For this reason, no in-depth dedicated analysis has been conducted, particularly in light of two factors. First, data from the Canadian CMOR radar show extremely low activity during the period of interest. Furthermore, when applying the RZHR algorithm to the data collected in June—taking into account the radiant of the Zeta Perseids, even after interpolation—no significant deviations emerge compared to the results for the Arietids, confirming the limited impact of this shower on our observations.

The CARMELo Network

The network currently consists of 17 receivers located in Italy, Spain, the UK, Switzerland and the USA. The European receivers are tuned to the Graves radar station frequency in France, which is 143.050 MHz. Participating in the network are:

- ❖ Lorenzo Barbieri, Budrio (BO) ITA
- ❖ Associazione Astrofili Bolognesi, Bologna ITA
- ❖ Associazione Astrofili Bolognesi, Medelana (BO) ITA
- ❖ Paolo Fontana, Castenaso (BO) ITA
- ❖ Associazione Astrofili Pisani, Orciatice (PI) ITA
- ❖ Gruppo Astrofili Persicetani, San Giovanni in Persiceto (BO) ITA
- ❖ Roberto Nesci, Foligno (PG) ITA
- ❖ MarSEC, Marana di Crespadoro (VI) ITA
- ❖ Gruppo Astrofili Vicentini, Arcugnano (VI) ITA
- ❖ Associazione Ravennate Astrofili Rheyta, Ravenna (RA) ITA
- ❖ Mike German, Hayfield, Derbyshire UK
- ❖ Mike Otte, Pearl City, Illinois USA
- ❖ Yuri Malagutti, Comano (TI) CH
- ❖ Leslie Fry, Trawscoed Ceredigion, Wales UK
- ❖ Brian Coleman, Redenham Observatory, Andover, England UK
- ❖ Radio club La Salle University, Barcellona ESP
- ❖ Alberto Latini, Carona (TI) CH

The authors' hope is that the network can expand both quantitatively and geographically, thus allowing the production of better quality data.

Bibliography:

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