July 2026 CARMELo report

by CARMELo network
(Cheap Amatorial Radio Meteor Echoes Logger)

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Introduction

In July, the CARMELO network detected moderate meteor activity. Two meteor showers were identified by radio observations in the Northern Hemisphere during the month: the Alpha Lacertids (328 ALA) and the Psi Cassiopeids (187 PCA). Toward the end of the month, activity increased slightly for the Southern Delta Aquariids (5 SDA).

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.

July 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 July.

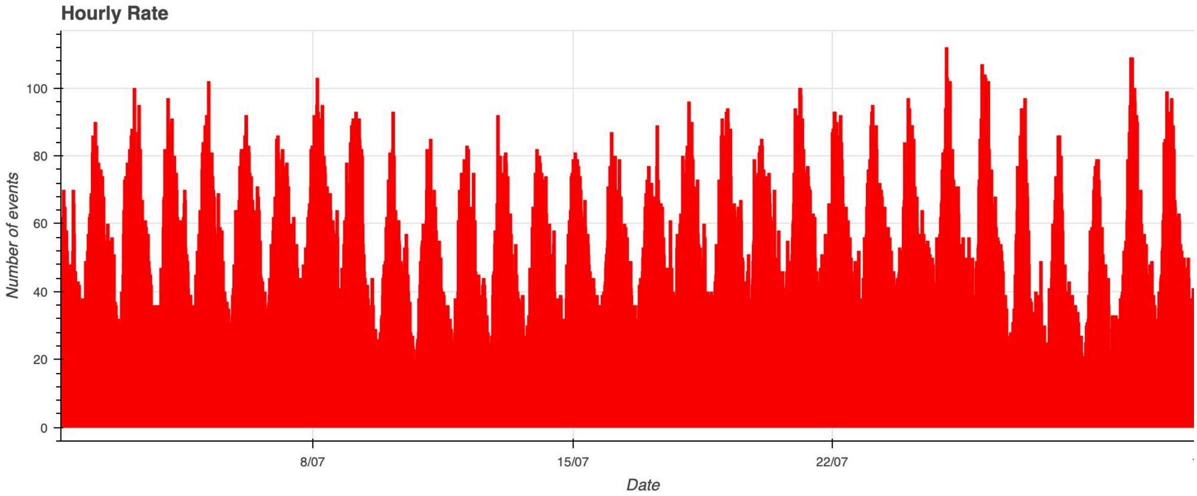

Fig. 1: July 2026 data trend.

Alpha-Lacertids and Psi-Cassiopeids

The Alpha-Lacertids (328 ALA) and the Psi-Cassiopeids (187 PCA) are two minor meteor showers associated with the summer sky in the Northern Hemisphere. These showers have been known for some time, but they are much less intense and have been studied far less than the major annual showers: the relatively small number of meteors associated with them makes it difficult to clearly distinguish their activity from the background of sporadic meteors and other showers active during the same period.

The Alpha Lacertids have their radiant in the region of the constellation Lacerta, approximately at RA 343° and Dec +53°, and reach an approximate peak in the first half of July, while the Psi Cassiopaeids have their radiant in the constellation Cassiopeia, at approximately RA 356° and Dec +71°, and reach an approximate peak around the middle of the month.

In July 2026, radio observations conducted in the Northern Hemisphere revealed activity primarily from these two meteor showers. According to data from the CMOR (Canadian Meteor Orbit Radar), the Alpha-Lacertids are active roughly from July 9 to 14, while activity from the Psi-Cassiopaeids is detectable approximately from July 15 to 25 (1).

In data collected by the CARMELo network, however, both meteor showers are difficult to identify. Their weak activity produces relatively small variations compared to the overall meteor background, which can easily be confused with normal fluctuations in the number of sporadic events detected by the network. For this reason, unlike what happens with more intense showers, the graphs (e.g., *fig. 1*) do not show a particularly distinct peak attributable to the ALA or PCA.

Southern Delta Aquariids

The Southern Delta Aquariids (5 SDA) are one of the major meteor showers of the summer. They are active for several weeks, roughly from mid-July to the second half of August, with the peak activity concentrated in the last days of July. The radiant is located in the constellation Aquarius, near the star Delta Aquaridi, and because of its relatively southern position, the shower is particularly favorable for observers in the southern hemisphere, although it can also be observed from the mid-latitudes of the northern hemisphere.

The meteors of the Southern Delta Aquariids enter Earth's atmosphere at a speed of about 41 km/s, and the shower can reach a ZHR of around 20–25 meteors per hour. Unlike showers characterized by a very brief and well-defined peak, however, the SDA generally exhibit activity that is quite extended over time, with variations that can unfold over the course of several days.

Observations from the Global Meteor Network (GMN) have shown an increase in activity over several years in the region around solar longitudes 126–127°, although the pattern can vary significantly from year to year (3).

However, analyzing the Southern Delta Aquariids in the data collected by the CARMELo network in July 2026 presents a problem. On July 27, just days before the shower's peak activity, the network's highest-performing receiver malfunctioned due to a lightning strike. The system was restored on July 30, resulting in a gap of about three days in the observations.

This interruption has particularly noticeable consequences for the analysis using the RZHR algorithm (2), as it affects precisely the most important part of the SDA activity profile.

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 Southern Delta Aquariids, the sample of sporadic meteors (in *fig. 2*) was collected during the second half of June, when no other major meteor showers were active.

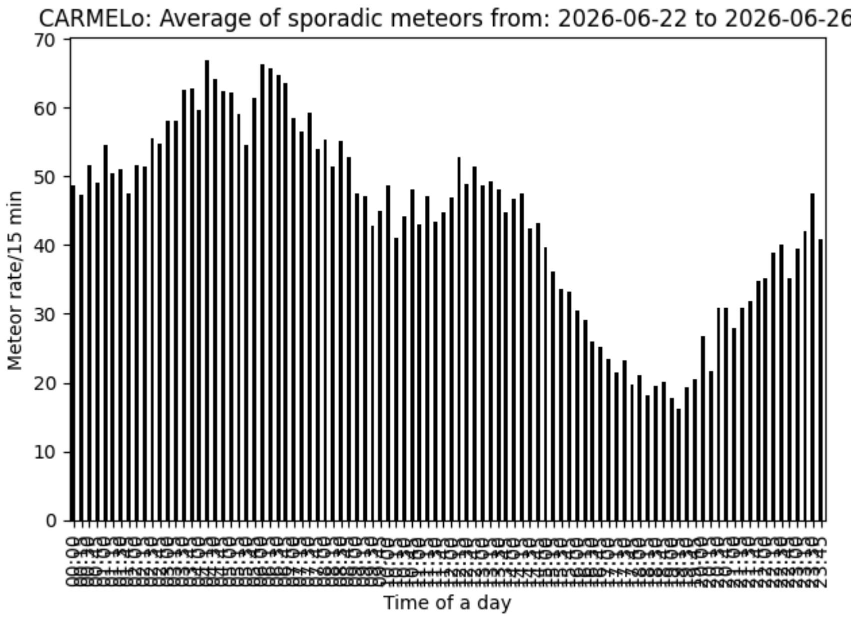

Fig. 2: A sample of sporadic meteors collected in the second half of June 2026 for analysis of the Southern Delta Aquarids.

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 July 23 and August 7 (between solar longitudes 120° and 134°).

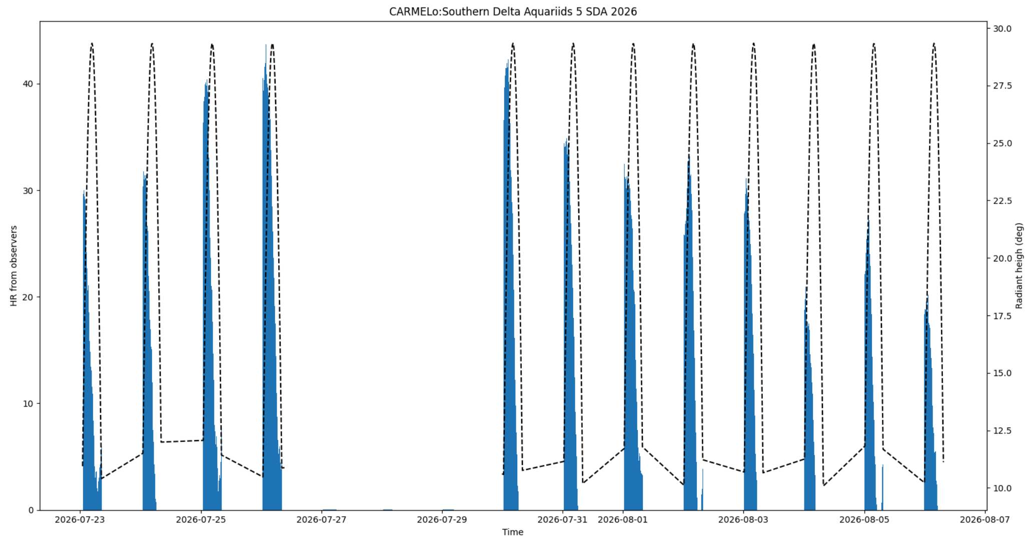

Fig. 3: Meteor activity trend between July 23 and August 7, 2026, limited to the hours when the radiant was at least 10° above the horizon, as a function of solar longitude, and the altitude of the Southern Delta Aquariids' radiant (dashed line). The three-day gap in data is due to the malfunction mentioned above.

It can be seen that most of the events attributable to the meteor shower are observed in the early morning hours, when the radiant reaches its highest point in the sky.

Calculating the RZHR using the algorithm we developed (2) yields the results shown in *fig. 4*.

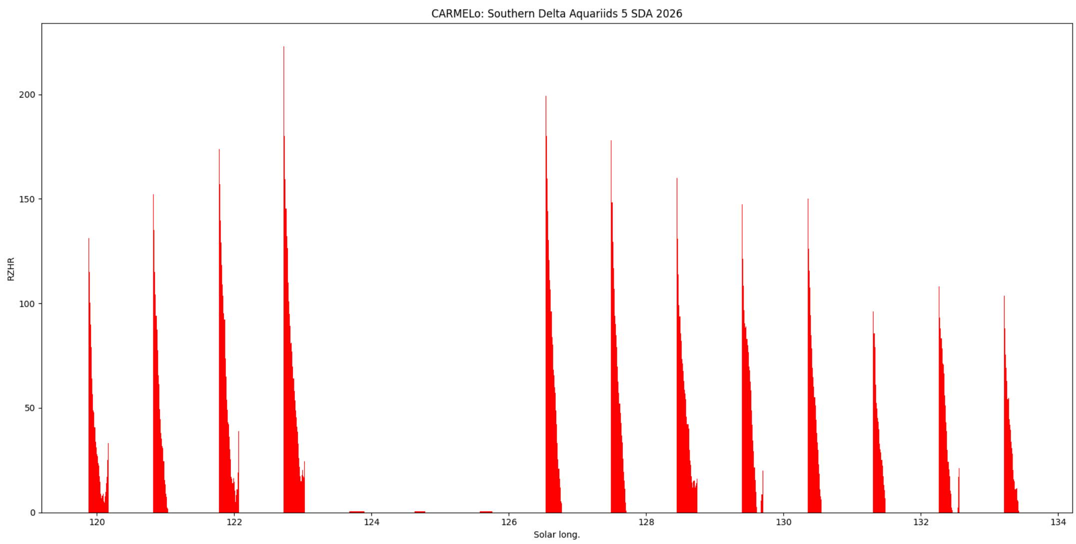

Fig. 4: Residual distribution of events.

In *fig. 5*, on the other hand, we present a reconstruction of the trend in daily highs, shown as a curve obtained by interpolating the maximum values.

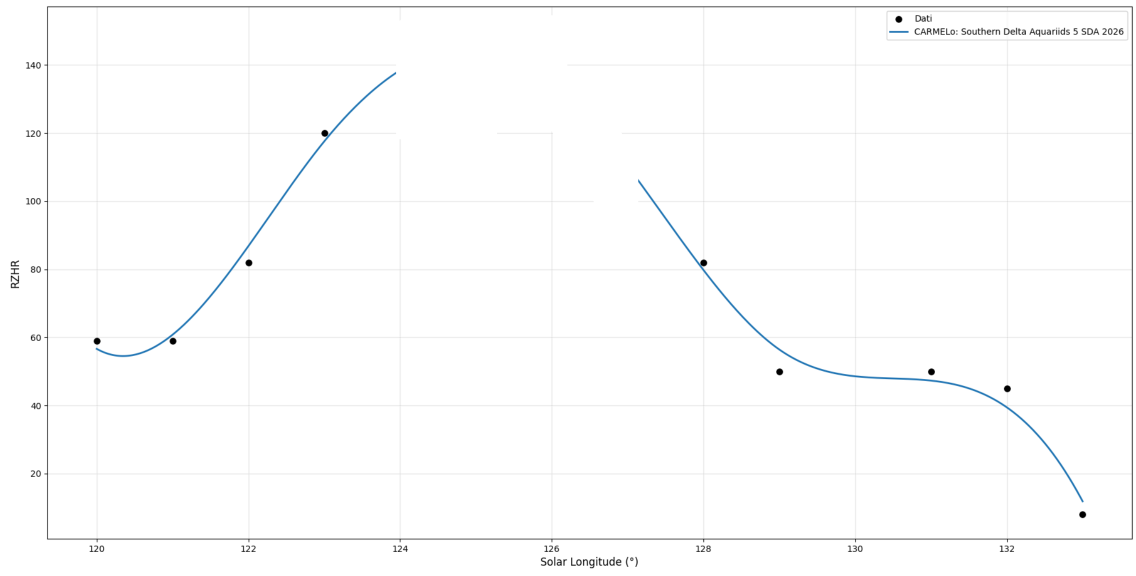

Fig. 5: Distribution of events after interpolation, as a function of solar longitude.

These latest graphs clearly reveal the main limitation of the data collected this year: due to the malfunction mentioned before, observations are missing around solar longitudes 125–127°, that is, corresponding to a particularly interesting phase of the Southern Delta Aquariids' activity. In fact, video observations from the GMN network place the swarm's peak around solar longitudes 126–127°.

The "gap" of about three days in the CARMELo data therefore prevents us from fully reconstructing the peak of the 2026 Southern Delta Aquariids and, above all, from directly comparing its position and intensity with what was observed using other techniques.

The CARMELo Network

The network currently consists of 18 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, Orciatico (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
- ❖ AstroCampania, Agerola (NA) ITA

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

Bibliography:

(1) CMOR
(2) L. Barbieri, M. Maglione (2026): May 2026 CARMELo report, *eMetN Meteor Journal*
(3) Paul Roggemans et al. (2025): Global Meteor Network Report 2025, *eMetN Meteor Journal*