August 2025 CARMELO report

by CARMELO network
(Cheap Amatorial Radio Meteor Echoes LOgger)

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Introduction

August is the month of the Perseids. This year, although the shower is as scattered as ever, a peak in meteor activity was recorded on the night of August 13.

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.

August 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.

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

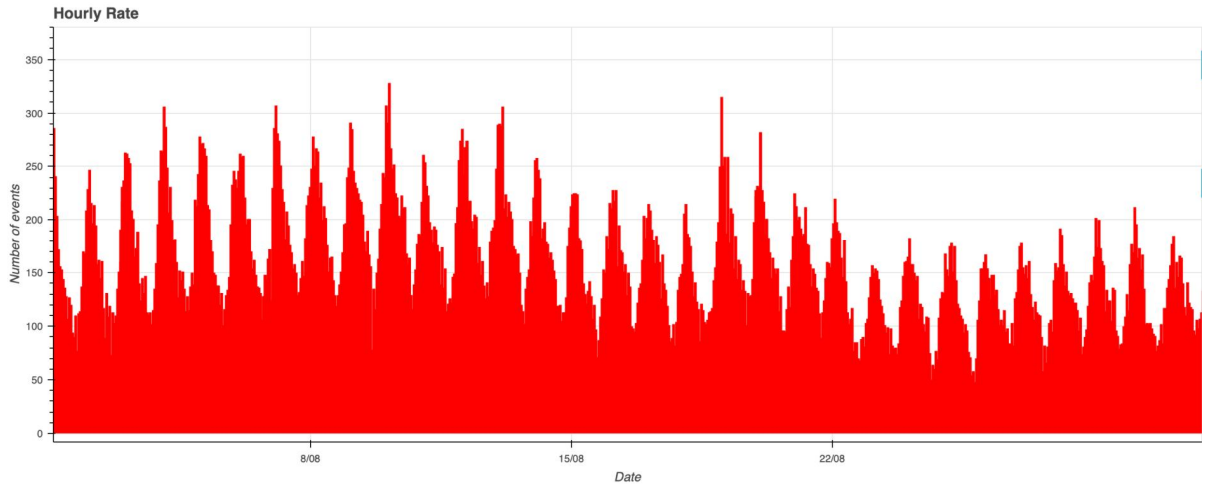

Fig. 1: August 2025 data trend.

Perseids

The Perseids (PER) are one of the most famous and spectacular meteor showers of the year, active from late July until almost the end of August. Peak activity occurs around mid-August, but the shower is notable for its rather long duration: the meteors can be observed for several weeks, making it a widespread phenomenon that is not limited to a single night.

The Perseids originate from debris left behind by the comet Swift-Tuttle, which the Earth encounters every year at this time. The radiant is located in the Perseus constellation, from which the shower takes its name. The meteors are particularly fast, with an entry speed into the atmosphere of about 61 km/s, and produce bright and persistent trails, often accompanied by traces of ionization that are easily detectable even through radio observations.

This year, the CARMELO network recorded the highest activity of the swarm on the night of August 13, lasting about 5-6 hours, between solar longitudes 140.1° and 140.4°, as shown in *fig. 2*.

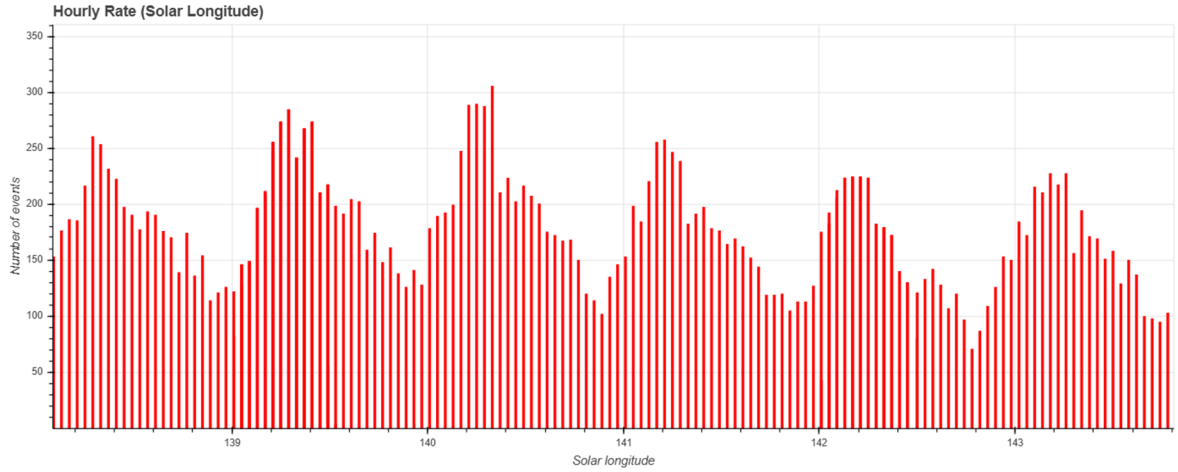

Fig. 2: Maximum meteor activity recorded between solar longitudes 140.1° and 140.4°.

Visual observations from the International Meteor Organization (IMO), shown in *fig. 3*, and camera data from the Global Meteor Network (GMN), shown in *fig. 4*, also indicate a peak in the shower's activity around August 13 (1), (2).

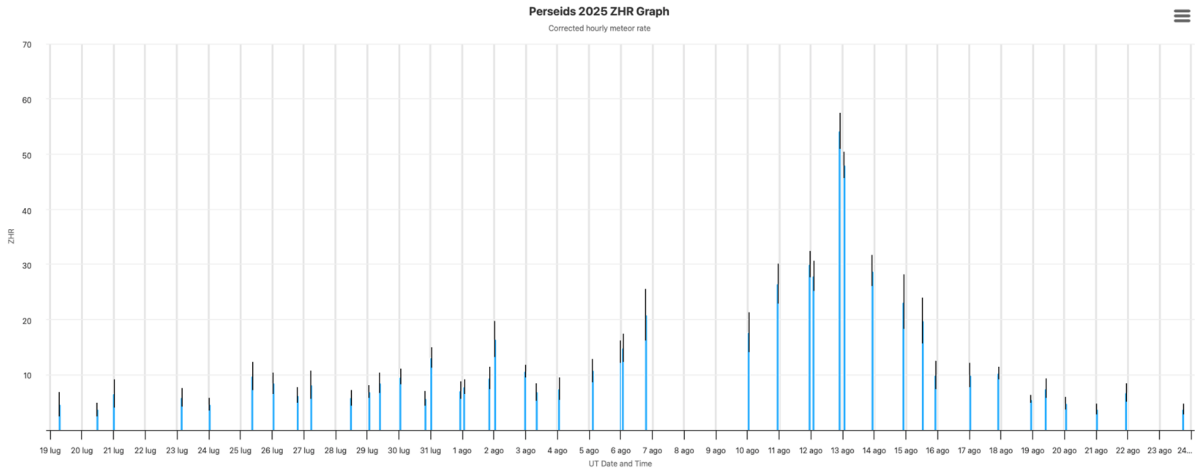

Fig. 3: Plot of the ZHR (Zenithal Hourly Rate) recorded by IMO.

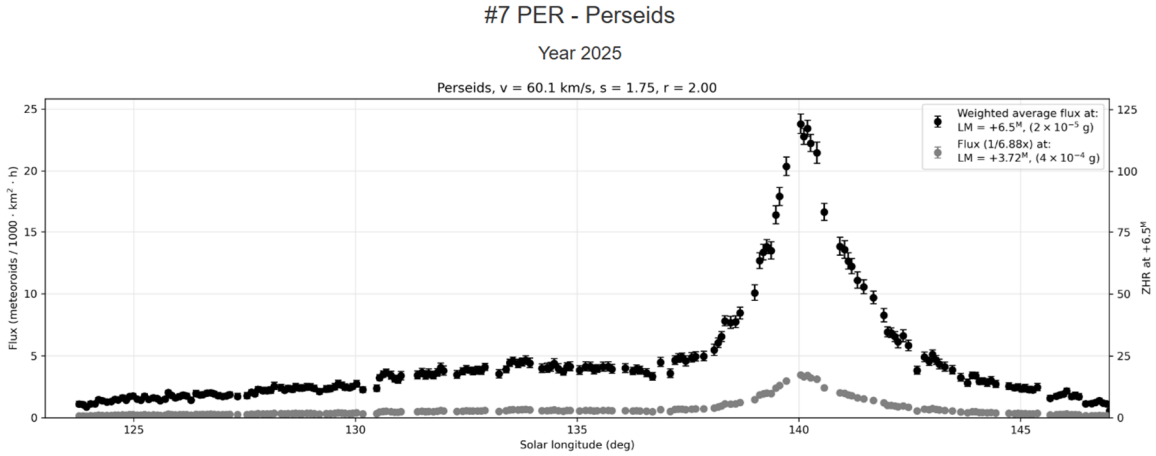

Fig. 4: Plot of the meteoroid flux in the atmosphere recorded by GMN cameras.

Returning to our radio data, we observe an increase around 08:00–09:00 UT on August 12, both in the received power plot (*fig. 5*) and in the meteor echo duration plot (*fig. 6*).

We know that the duration of a radio echo depends on the time required for the meteor trail to dissipate (saturation of the cylinder): the greater the number of ionized atoms, the longer the deionization process lasts. The number of ionized atoms is also proportional to the kinetic energy of the bodies colliding with the upper layers of the ionosphere: the more energetic the impact, the more atoms are disintegrated, and consequently the denser the radio meteor appears.

Since kinetic energy is given by:

$$E_c = \frac{1}{2} m v^2$$

and since all meteors belonging to the same shower travel at the same velocity v, it follows that the only varying parameter is m, namely the mass.

Therefore, we can hypothesize that around 08:00–09:00 UT on August 12, at solar longitude 139.57°, an increase in kinetic energy was measured. This suggests that meteoroids of greater mass than the average Perseids entered the atmosphere, about thirty hours in advance of the peak hourly rate.

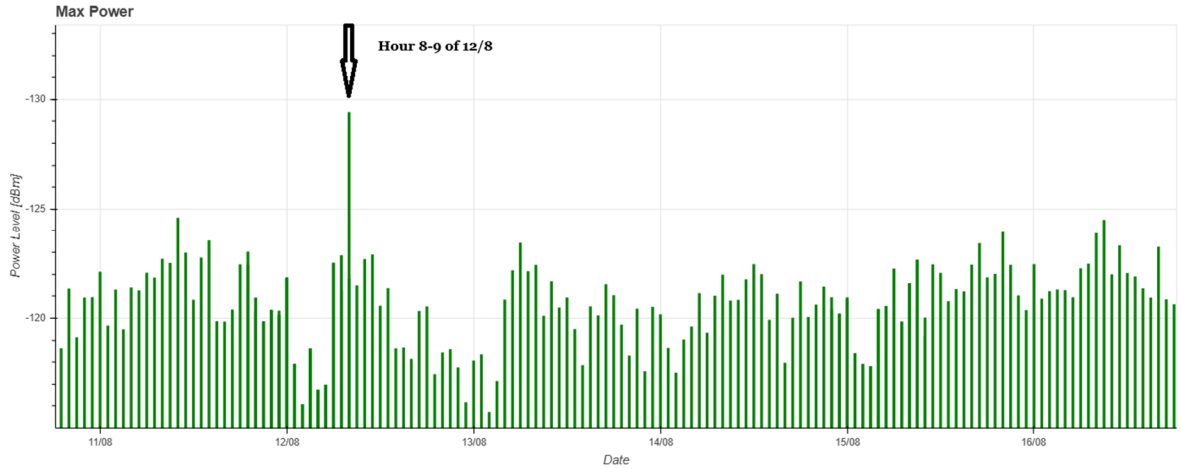

Fig. 5: Plot of the meteor echo power showing a peak at solar longitude 139.57°.

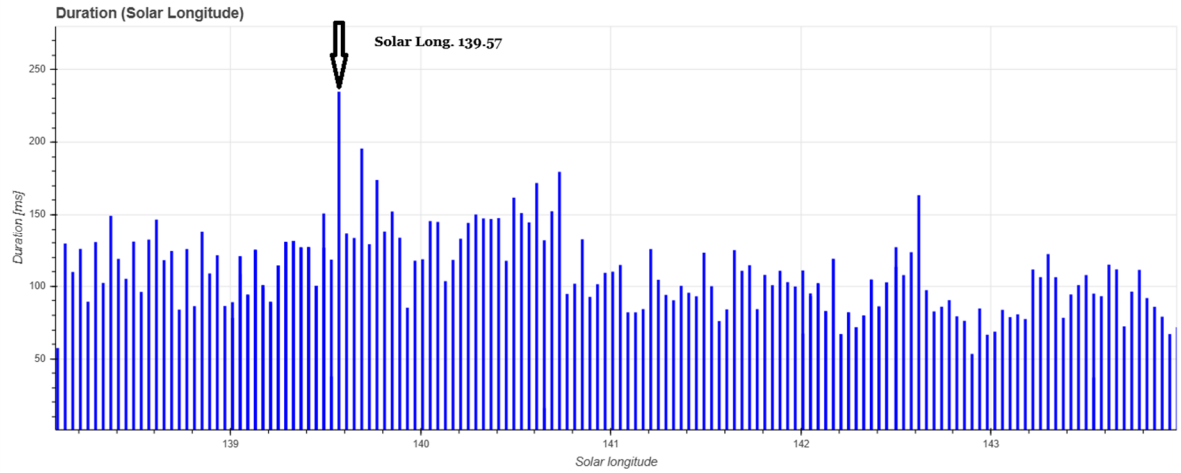

Fig. 6: Plot of the meteor echo duration showing a peak at solar longitude 139.57°.

The network currently consists of 14 receivers, 13 of which are operational, located in Italy, the UK, Croatia 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
- Paolo Fontana, Belluno (BL) 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
- Akademsko Astronomsko Društvo, Rijeka CRO
- Mike German a Hayfield, Derbyshire UK
- Mike Otte, Pearl City, Illinois USA

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

Bibliography:

(1) International Meteor Organization
(2) Global Meteor Network