February 2025 CARMELO report

by CARMELO network
(Cheap Amatorial Radio Meteor Echoes LOgger)

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Introduction

February is one of the least active months speaking of meteoric showers. Unlike January, characterized by the peak of Quadrantids, and other months with more pronounced events, the central winter period has no particularly interesting showers. However, radar observation allows detection of otherwise undetectable phenomena, such as Daytime Showers, meteor showers whose radiant is so close to the Sun that it cannot be observed by traditional optical methods. Data collected by the CARMELO network in February show signals consistent with the presence of the χ-Capricornids (114 DXC) shower.

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.

February 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 February.

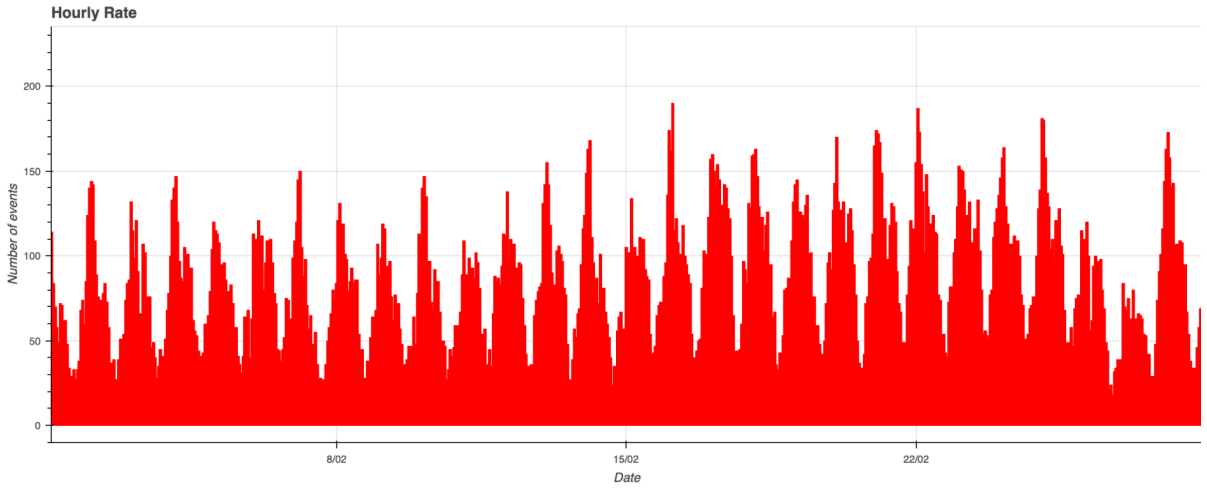

Fig. 1: February 2025 data trend.

Daytime Showers

Daytime showers are meteor showers whose radiants are located very close to the Sun's position in the sky, making them impossible to observe with optical instruments. Unlike nocturnal showers, which have radiants that are clearly visible above the horizon in the evening or nighttime hours, Daytime Showers can be detected almost exclusively through radar observations (1, 2). Their radiants are typically located between 20° and 30° west of the Sun and are identified by radio-forward scatter and radar techniques.

The absence of optical observations means that information about these showers is often limited. While the best-known nocturnal showers, such as the Perseids or Geminids, have well-documented activity rates and well-defined parameters, many Daytime Showers still remain poorly studied. Some of them show higher activity and have even been detected by video observation networks, while others have such weak activity that their precise characterization is difficult.

However, radar observations in recent decades have made it possible to map the main diurnal showers and recognize their activity at specific times of the year. Among the best known (2) are the Arietids (171 ARI), active between May and June (3), and the Sextantids (221 DSX), active between September and October. In the winter period, however, the activity of Daytime Showers is generally lower, with smaller showers showing activity that is difficult to distinguish from background noise.

However, analysis of these showers is important to better understand the distribution and characteristics of the meteoroid population in the Solar System. Although their activity is often lower than that of the main swarms, their study allows us to refine meteor flow models and improve our understanding of interplanetary particle dynamics.

χ-Capricornids (114 DXC)

The χ-Capricornids (114 DXCs) are a diurnal meteoric shower active between Jan. 29 and Feb. 28, with a maximum expected around Feb. 13 at solar longitude 324.5° (2). This shower was detected by radar observations, as the proximity of its radiant to the Sun prevents traditional optical detection. The activity of the shower is classified as low, with a meteoroid distribution characterized by low masses and relatively low velocities.

The radiant of the χ-Capricornids rises around 6:30 a.m. and sets around 2:30 p.m. (local time in Italy), thus limiting the useful time window for their radar observation. Because of their low activity,

there are no significant increases in the intensity of their radio signals or significant changes in the duration of the detected echoes. However, observations over the years have shown that this shower is consistent with the collected data, suggesting that a fraction of the detected meteors may indeed belong to the χ-Capricornids.

Previous studies, including those reported by Jürgen Rendtel in 2014 (2), indicate that the meteoroid population belonging to the χ-Capricornids may derive from a progenitor source that has not yet been identified with certainty. The fact that the observed meteors have low intensity and short radio echoes suggests that the fragments are the result of a prolonged erosion process, rather than a recent fragmentation event.

Data collected by the CARMELO network in February show signals consistent with the presence of χ-Capricornids. However, the absence of significant peaks in signal intensity and variations in the duration of the echoes suggests that the shower, if indeed the signal is present, is mainly composed of small-mass, low-velocity meteoroids.

In *fig. 2*, the gray rectangle highlights the visibility window of the radiant above the horizon in Italy.

Analyzing the hourly rate of events and the maximum signal power (*Max Power*), there is an absence of marked fluctuations around the expected maximum. This behavior confirms the low activity of the swarm, but the compatibility of the data with the predictions nevertheless suggests that a portion of the detected meteors may indeed belong to the χ-Capricornids.

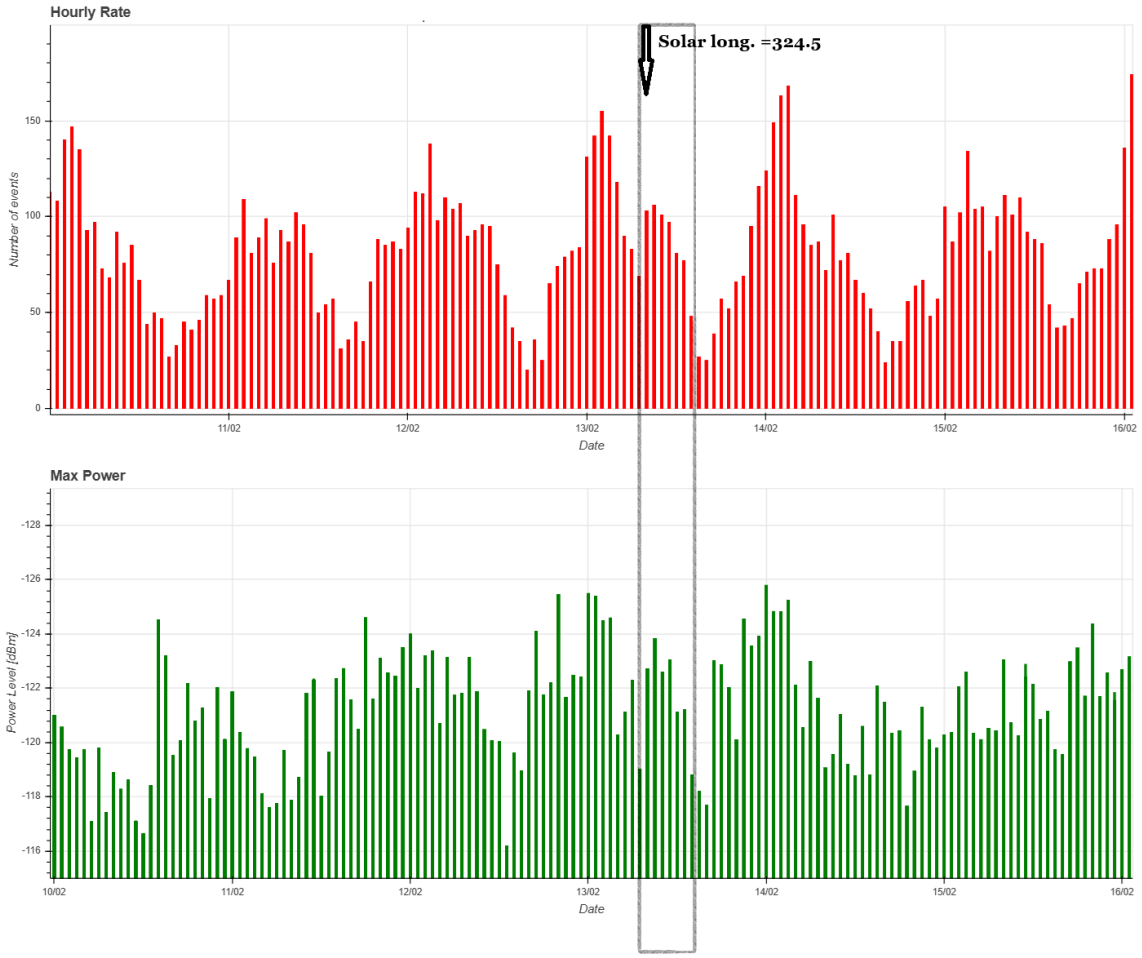

Fig. 2: Compatibility of CARMELO observations with the presence of the χ-Capricornids shower.

CARMELO updates

An interesting new development for the CARMELO network is the publication of the new web page dedicated to viewing observational data divided by observer. Thanks to this tool, each observer now has the ability to view his or her own data independently, without seeing them superimposed on those of other network members.

This feature has already proved particularly useful for studying radio noise trends. In fact, by analyzing the data individually, it is possible to observe how the quality of recordings can vary depending on geographical location, the type of antenna used and local environmental conditions.

In some cases, significant differences emerge between stations, offering interesting insights for calibration and improvement of observations.

The new web page is available here.

The CARMELO Network

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 Theyta, 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) Rendtel, J. (2014): Meteor Shower Workbook. *IMO*
(2) Rendtel, J. (2014): Daytime Meteor Showers, *Proceedings of the IMC, Giron, pp. 93-97*
(3) Campbell-Brown, M.D. (2004): Radar observations of the Arietids, *Monthly Notices of the Royal Astronomical Society, Vol. 352, Issue 4, pp. 1421–1425*