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ISSN: 2332-2519
Journal of Astrobiology & Outreach

Commentary

Applications of Modern Digital Technology: Very High Frequency (VHF) Radars to Study Meteors

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DESCRIPTION

The field of meteorology has a long history, and it was very active before the middle of the 1970s. These investigations were done to understand more about the meteors themselves as well as the atmosphere in which they burn up. It has been described several of the previous astronomical findings. The frequency of new meteor research, particularly for atmospheric applications, decreased throughout the 1980s and early 1990s. This was partially attributed to the retirement of certain active researchers, as well as the fact that insufficient technology to an extent constrained fresh potential advancements. Many earlier investigations employed photographic film or rather rudimentary computer detection techniques, and some of the study required a lot of labour.

Because to the limitations of computer algorithms, it was frequently impossible to distinguish between real meteor echoes and "non-meteor" echoes. The meteorological community also believed that other methods, such as spaced antenna studies, could be used to quantify middle atmosphere wind more effectively. One notable exception was the employment of narrow beam Very High Frequency (VHF) radars to study meteors, albeit meteor detection rates were sometimes low because the radars were frequently designed for VHF investigations. This scenario changed with the advent of quick digitising technologies and swift personal computers with big memory buffers. It was now possible to feed data to memory and evaluate it "on the fly" using multi-tasking operating systems like UNIX on personal computers.

Furthermore, extremely high rejection probability for lightning, E-region echoes, impulsive RF interference, auroral echoes, and other interference sources were now attainable because to the development of highly specific meteor selection and analysis algorithms. Today, processes that traditionally required manual intervention and took hours or days to complete on massive data sets may be carried out instantly. It was also possible to use more recent, sensitive detecting methods. Narrow beams or, more frequently, interferometric approaches have been the two main technologies utilized by meteor radars. Wider beams are typically used in interferometric techniques. It is possible to employ beams that are essentially isotropic in the limit, and these beams can detect meteors over the entire sky.

While narrow-beam methods assume that most meteors observed happened somewhere in the radar's main beam, interferometric approaches use phase information collected at the receiving antennas to pinpoint the locations of meteors. The fact that prior meteor studies frequently used receiving antennas spaced only a half-wavelength apart, and the coupling between these antennae might be strong, was another drawback of the interferometric method. As a result, this led to biases in the phases that the antennas measured, which led to mistakes in the meteors' location.

Only in the 1990s did this design begin to see improvements. Following this, a 5-antenna system with minimum antenna spacing of 2 wavelengths was utilized, with four antennas spaced by generally 1.5-3 wavelengths. Effects of coupling have been examined in the latter system. The availability of these novel antenna configurations increased meteor systems' dependability. Two further phenomena lastly revived interest in meteor studies. The first was the approaching Leonid meteor storm, and the second was the potential for satellite damage from meteors. The military and astronomical communities have rekindled their interest as a result of these incidents.

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Received: 02-Jan-2023, Manuscript no: JAO-23-19890; **Editorial assigned:** 05-Jan-2023, Pre QC no. JAO-23-19890(PQ); **Reviewed:** 19-Jan-2023, QC no. JAO-23-19890; **Revised:** 25-Jan-2023, Manuscript no. JAO-23-19890(R); **Published:** 03-Feb-2023, DOI: 10.35248/2332-2519.23.11.276.

Citation: Walker W (2023) Applications of Modern Digital Technology: Very High Frequency (VHF) Radars to Study Meteors. J Astrobiol Outreach.11:276.