The use of *D*-criteria to assess meteor shower significance

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In theory, a meteor shower can be distinguished from the sporadic meteor background by its short duration and orbital similarity. In practice, the duration and strength of a shower and the orbital similarity between its constituent meteors varies widely between showers. Further complicating matters is the anisotropy of the sporadic background. These combined factors make it difficult to distinguish between shower and sporadic meteors with a single, static set of criteria.

The orbital similarity, or *D*-, parameters are often used to assess the relationship between meteors [1,2,3]. The more dissimilar two orbits are, the higher their computed *D* value will be; generally, meteors are considered related if their *D*-parameter falls below some cutoff value [4]. However, this approach will include some sporadic meteors, and when a weak shower lies near a sporadic source, the false positive rate for shower association can be quite high. Additionally, this cutoff approach does not assess whether the shower itself is significant.

We present a method for using *D*-parameters to extract showers from a dataset that automatically takes shower strength into account and tests for significance [5]. We accomplish this by calculating the false positive rate for shower association using "shower analogs," which are identical to the original shower except in solar longitude.

This method is applied to a set of more than 30,000 meteors detected by the NASA All-Sky Fireball Network [6] and the Southern Ontario Meteor Network (SOMN) [7]. We previously detected 29 showers in our data using this method [5]; now, with another year of data, we have several additional detections. Figure 1 presents one example: the 2016 July gamma Draconid outburst.

There are several benefits to using our method. First, it provides a test of shower significance (see Fig. 2 for an example of a non-detection). Second, it quantifies the probability that a meteor belongs to a given shower as a function of *D*-parameter. Finally, it quantifies the strength of a shower, even when individual members cannot be identified with 100% accuracy.

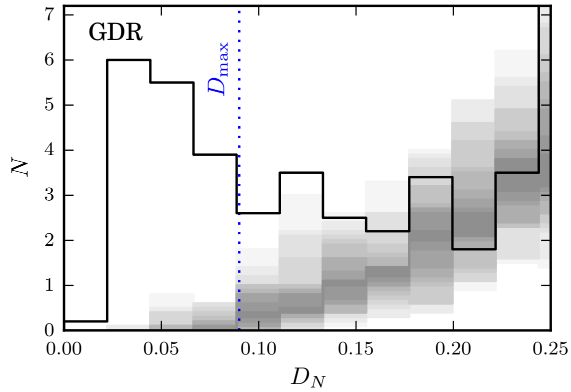

Figure 1. Distribution of D_N [3] between meteors and the July gamma Draconid (GDR) shower orbit (solid black line). D_N values are also calculated relative to a set of GDR analogs (gray region). In this case, the shower is significant and Galligan's recommended cutoff value of 0.09 [4] is a reasonable choice.

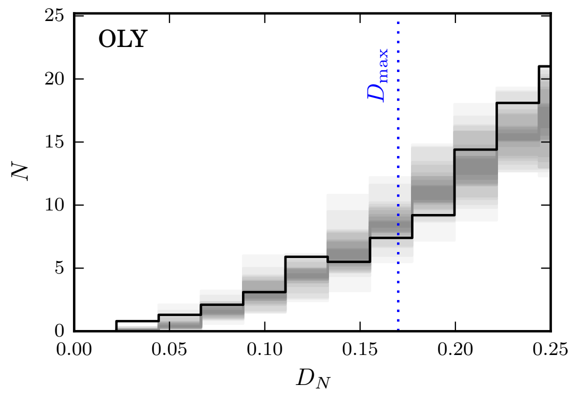

Figure 2. Distribution of D_N between meteors and the October Lyncid (OLY) orbit (solid black line). In this case, the searched-for shower is completely insignificant in our dataset and member identification using Galligan's cutoff of 0.17 would yield many false positives.

References:

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