

# The statistical analysis of the height distribution and velocity distribution of Perseid meteor showers

Pei-Ying Wu<sup>1</sup>, I-Ching Yang<sup>1</sup>, and Chun-Nan Lin<sup>2</sup>

<sup>1</sup>Department of Applied Science, National Taitung University, Taitung, Taiwan

<sup>2</sup>Department of Distribution Management, Shu-Te University, Kaohsiung, Taiwan

## Abstract

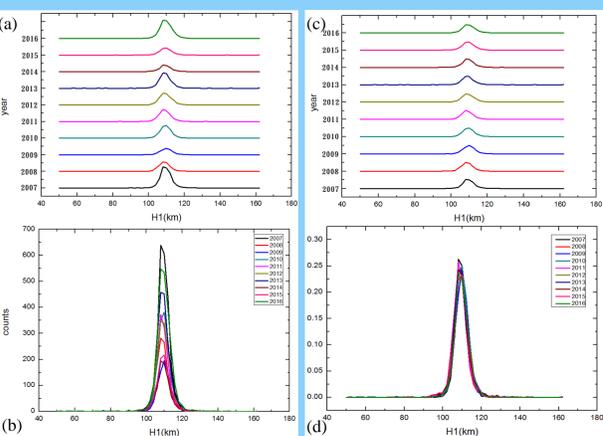
Our study contains 14 805 Perseid meteor showers of the SonotaCo database from 2007 to 2016 in Japan. We obtain their height distributions and velocity distributions. The kurtosis and skewness of the height distributions and velocity distributions are considered.

## Introduction

According to SonotaCo database in 2007 to 2016, we would to discuss the shape of the height distributions and velocity distributions of Perseid meteor showers. Here, the height has the beginning height and the end height, and the velocity has the geocentric velocity and the heliocentric velocity.

## The statistical analysis of the height distribution

The beginning height distributions of Perseid meteor shower in 2007 to 2016 is plot in Figure 1. To describe the symmetry of the distribution curve, Figure 2 is shown. The kurtosis and skewness are calculated in Table 1 for the measure of the tailedness and the asymmetry of distribution. The Figure 3, Figure 4, and Table 2 are completed for the end height distribution of Perseid meteor shower.



Year	Kurtosis	Skewness
2007	40.22178	-2.93681
2008	1.694996	0.353089
2009	1.996663	-0.00873
2010	16.94567	-0.98926
2011	10.2318	-0.79348
2012	3.650017	0.00134
2013	31.99889	-0.65664
2014	5.638423	0.225124
2015	21.48264	1.618778
2016	9.441355	-0.25029

Table 1. the Kurtosis and Skewness of the beginning height distributions yearly.

Figure 1. (a) the beginning height distributions yearly; (b) overlay the beginning height distributions; (c) the normalized beginning height distributions; (d) overlay the normalized beginning height distributions.

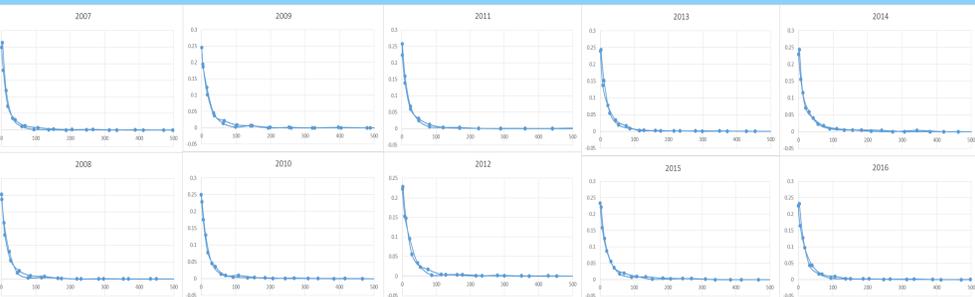
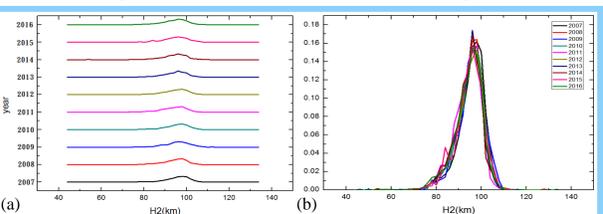


Figure 2. the count vs  $(H1 - \bar{H1})^2$  plot of the right hand side and the left hand side of curve in Figure 1(d). Where  $\bar{H1}$  is the height which has maximum value of count.



Year	Kurtosis	Skewness
2007	6.258561	-1.50042
2008	0.925984	-0.80628
2009	0.471848	-0.5255
2010	2.539355	-0.98926
2011	1.434566	-0.79348
2012	1.135825	-0.73765
2013	5.416417	-1.10313
2014	2.586341	-0.9186
2015	1.3859	-0.45123
2016	2.204816	-1.00251

Table 2. the Kurtosis and Skewness of the end height distributions yearly.

Figure 3. (a) the normalized end height distributions; (b) overlay the normalized end height distributions.

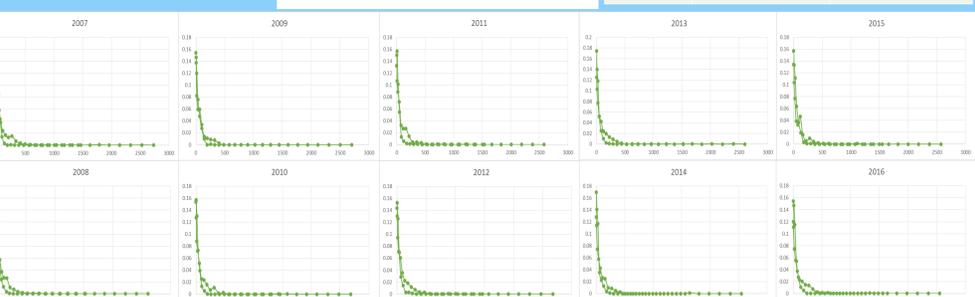
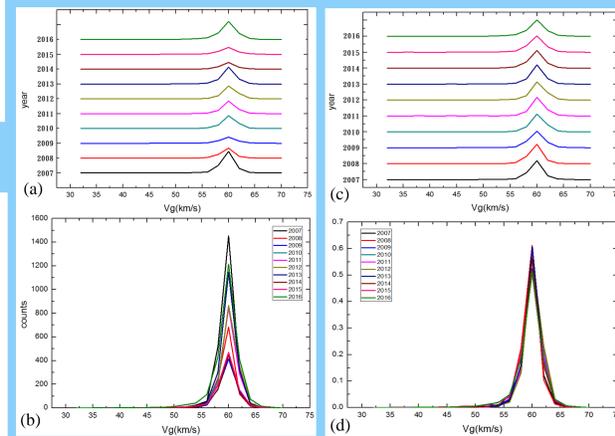


Figure 4. the count vs  $(H2 - \bar{H2})^2$  plot of the right hand side and the left hand side of curve in Figure 3(b). Where  $\bar{H2}$  is the height which has maximum value of count.

## The statistical analysis of the velocity distribution

For the same means, Figure 5-8 and Table 3-4 are done for the velocity distribution of Perseid meteor shower.



Year	Kurtosis	Skewness
2007	37.45115	-4.5443
2008	18.08323	-2.09244
2009	8.064054	-1.56145
2010	34.65781	-3.63871
2011	30.76895	-3.48506
2012	21.27527	-2.71751
2013	35.01786	-3.65819
2014	12.76156	-1.95245
2015	14.64384	-2.54844
2016	13.15525	-2.37531

Table 3. the Kurtosis and Skewness of the geocentric velocity distributions yearly.

Figure 5. (a) the geocentric velocity distributions yearly; (b) overlay the geocentric velocity distributions; (c) the normalized geocentric velocity distributions; (d) overlay the normalized geocentric velocity distributions.

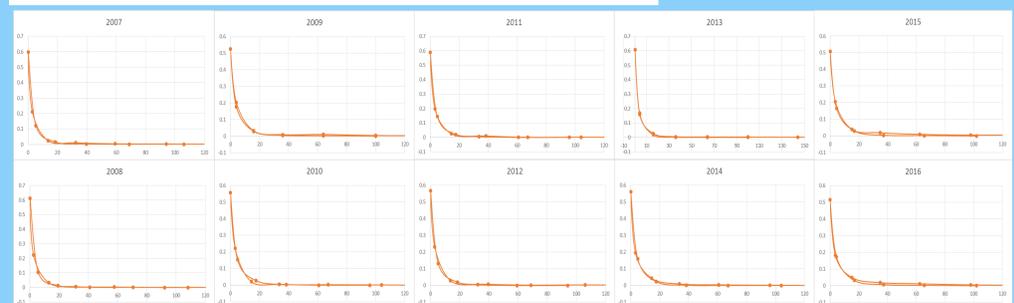
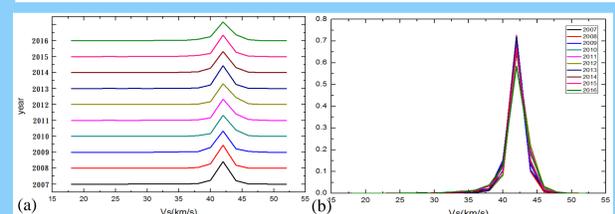


Figure 6. the count vs  $(Vg - \bar{Vg})^2$  plot of the right hand side and the left hand side of curve in Figure 5(d). Where  $\bar{Vg}$  is the velocity which has maximum value of count.



Year	Kurtosis	Skewness
2007	30.53541	-4.00529
2008	18.98717	-2.18475
2009	8.643117	-1.46666
2010	28.45243	-3.38084
2011	28.81138	-3.41411
2012	26.91166	-3.25684
2013	32.54614	-3.54314
2014	11.05086	-1.85638
2015	15.16172	-2.71522
2016	10.51124	-2.14398

Table 4. the Kurtosis and Skewness of the heliocentric velocity distributions yearly.

Figure 7. (a) the normalized heliocentric velocity distributions; (b) overlay the normalized heliocentric velocity distributions.

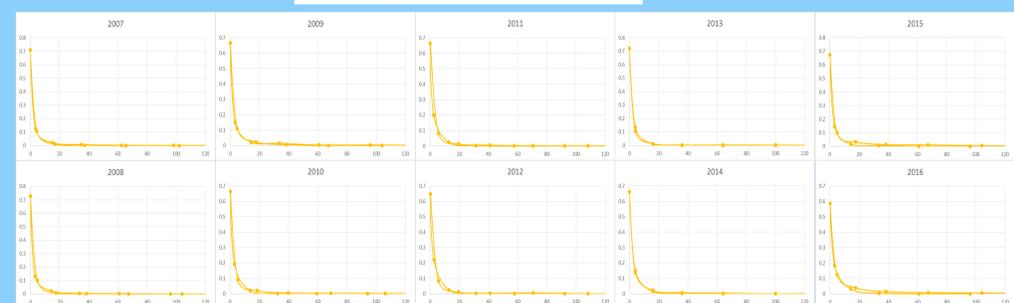


Figure 8. the count vs  $(Vs - \bar{Vs})^2$  plot of the right hand side and the left hand side of curve in Figure 7(b). Where  $\bar{Vs}$  is the velocity which has maximum value of count.

## Result

Our results show: 1. the height distributions are symmetry, leptokurtic, and zero skewness; 2. the velocity distributions are symmetry, leptokurtic, and positive skew.

## Acknowledgements

I.-C. Yang and P.-Y. Wu would like to thank the Ministry of Science and Technology (Taiwan) for financial support.