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Effect of meteoritic dust on the variation of global rainfall

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ABSTRACT

The tendency for the recurrence of rainfall singularities, on or near the same calendar date has been the subject of controversy for many years. Some researchers propounded the phenomenon that dust from meteors acting as rain forming condensation nuclei is the cause. This concept is well known as meteor-rain hypothesis. Most of the investigations on meteor-rain hypothesis had been carried out by scientists in 1950's and 1960's. All those investigations have been dealt with limited available local precipitation data from different parts of the world and meteor shower information. This research is an attempt made to understand the level of influence caused by meteoritic dust on the variability of global rainfall. To the best of our knowledge this is the first time that such an attempt has been made in the global context using northern and southern hemispheric precipitation data covering the entire world. The data files of global precipitation for 30 year period 1981-2010, obtained from NOAA database, were used as precipitation data. Data obtained from Visual Meteor Database **(**VMDB) of International Meteor Organization-IMO, on meteor rate data and meteor magnitude data for 30 year period 1982-2011 were used as meteor data for the analysis. By shifting one series relative to the other, the relationship between the meteor series and the rainfall series was studied for the greatest positive correlation, using variety of statistical analysis methods. The best correlation (r = 0.97) was found with a lag of 6 to 7 months after a meteoritic activity.

1. INTRODUCTION

The tendency for the recurrence of weather events on or near the same calendar date has been the subject of controversy for many years. Occurrence of the heaviest rainfalls on specified calendar dates and their repetition are characterized as rainfall singularities. Some researchers argued that the phenomenon cannot be accounted for climatological factors and that dust from meteors acting as rain forming condensation nuclei is the cause. This concept is well known as meteor-rain hypothesis.

1.1 Early experiments

When the meteor hypothesis was first propounded, it had excited sufficient interest and controversy that a great deal of experimental and statistical work had been undertaken in various parts of the world, designed to test the predictions of the theory and to extend the knowledge of the various links in the chain. Figure 1 shows a comparison of meteor shower dates and rainfall peaks declared by founder of meteor-rain hypothesis [3], Most of the investigations on meteor-rain hypothesis had been carried out by scientists in 1950's and 1960's.

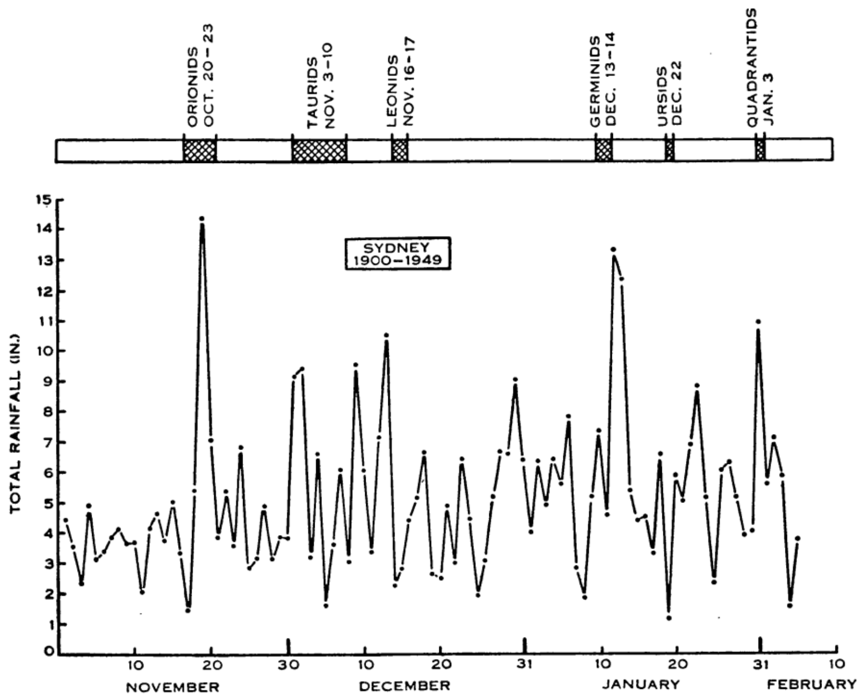

Fig. 4.—Daily rainfall of Sydney for November, December, and January for the period 1900–1949, together with dates of the main meteor streams displaced 29 days in time.

Figure 1: A comparison of meteor shower dates and rainfall peaks declared by founder of meteor-rain hypothesis for the period of 1900-1949, together with dates of the main meteor streams displaced 30 days in time.[3]

1.2 Novelty of present study

All above previous analyses were dealt with limited available data and lack of resources at that time. All those investigations had been done based on local precipitation data from different parts of the world and meteor shower information. But today reliable and well organized global data resources are available for both precipitation as well as meteor activity.

This paper describes an attempt made to understand the level of influence caused by meteoritic dust on the variability of global rainfall. To the best of our knowledge this is the first time that such an attempt has been made in the global context using northern and southern hemispheric precipitation data covering the entire world and practically observed worldwide meteor activity data.

1.3 Objectives of the study

The awareness of an impending fall of extraterrestrial dust might be a significant factor in estimating weather extremes of rain. The objectives of this study are (a) to understand the role played by meteoritic dust as an extraterrestrial source of rain forming condensation nuclei and (b) to study the level of influence of meteoritic dust on the variation of diurnal rainfall of the world.

1.4 Global data of precipitation and meteor

The data files of global precipitation were obtained from National Oceanic and Atmospheric Administration (NOAA), USA database for 30 year period from 1981-2010. Using diurnal precipitation data of 18048 - five dimensional grid points taken from around the globe, the composite precipitation were computed for each day for the 30 year period of 1981 – 2010. The daily variation of precipitation rates will be calculated separately for 365 days of the year and composite mean will be determined for each day.

Data obtained from Visual Meteor Database (VMDB) of the International Meteor Organization (IMO) on meteor rate data and meteor magnitude data for 30 year period 1982-2011 were used as meteor data for the analysis. The daily variation of meteor rates will be calculated separately for 365 days of the year and composite mean will be determined for each day.

2. EXPERIMENTAL

The relationship between the meteor series and the rainfall series were studied by matching the events in one series with those of the other. By shifting one series relative to the other, it is possible to find out what time interval or lag must elapse between the series to produce the greatest positive correlation. Since both series contain 365 days and considered as periodic, it is possible to determine the correlation. An interface of special software designed by author to visualise the relationship is shown in Figure 2.

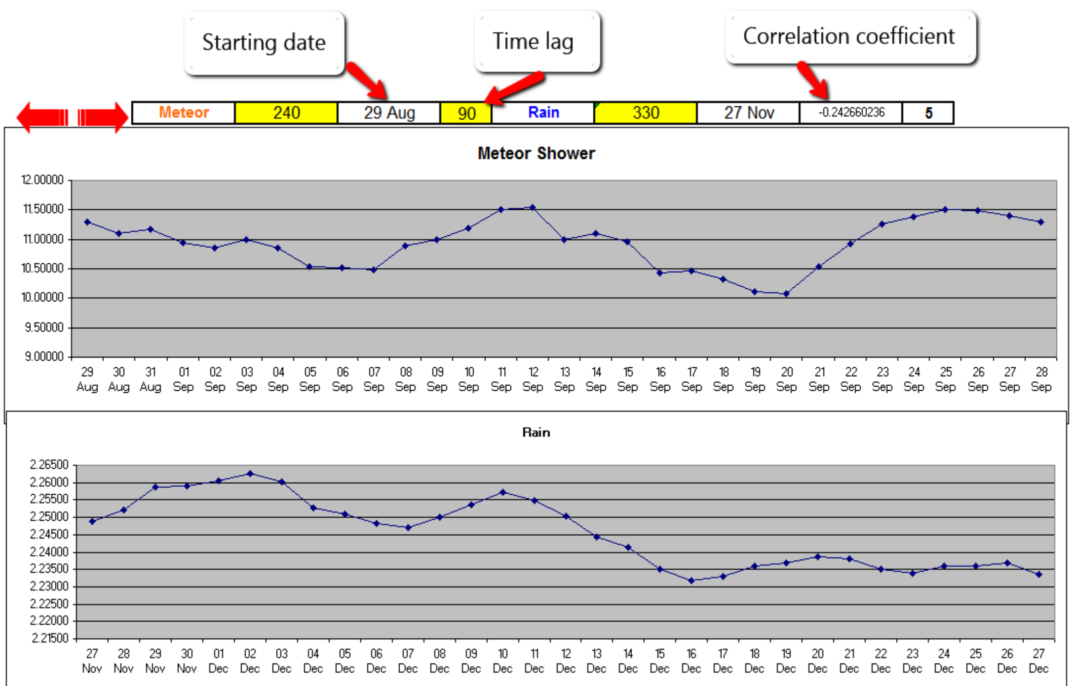

Figure 2: An interface of comparing meteor series and precipitation series. Using this graphical software, relationship and graphical form of two series for any time lag can be illustrated.

3. RESULTS AND DISCUSSION

3.1 Singularity days

Results of a few significant singularity days were found to tally with those reports of previous researches obtained from various parts of the world and that pattern is found to be continued year by year. The Table 1 shows a few of selected peaks obtained by the present research and those comparing with the peaks recorded by previous researchers.

Table 1: A few of selected peaks obtained by present research and those are comparing with the peaks recorded by previous researchers.

Precipitation	Precipitation	Precipitation	Noctilucent clouds	Freezing nuclei	Cirrus clouds	Snow cover
Present research	Bowen(1953, 1956a, 1956b) [3][4][5]	Maybank Qureshi (1966) [9]	Vestine (1934) [10]	Kline and Brier (1958) [7]	Bigg (1957a, 1957b) [2]	Bowen (1956c) [6]
4-Jan	3-Jan					
16-Jan	12-Jan	13-Jan		13-Jan	12-Jan	12-Jan
22-Jan	22-Jan	22-Jan		22-Jan	22-Jan	23-Jan
30-Jan	31-Jan	29-Jan		30-Jan	1-Feb	30-Jan
2-Apr		5-Apr				
12-Apr		14-Apr				
26-Apr		23-Apr				
4-May		2-May				
17-Jun		17-Jun				
23-Jun		27-Jun	23-Jun			
1-Jul		5-Jul	30-Jun			
1-Sep		31-Aug				
12-Sep		9-Sep				
3-Nov	5-Nov					
8-Nov	8-Nov					
19-Nov	18-Nov					
28-Nov	27-Nov					
1-Dec	2-Dec				6-Dec	7-Dec
12-Dec	13-Dec			16-Dec		
21-Dec	21-Dec				18-Dec	18-Dec
26-Dec	27-Dec					
31-Dec	31-Dec			31-Dec	30-Dec	31-Dec

3.2 Time lags

A few different statistical methods were used to determine the time lag for the sublimation of meteor dust for precipitation. The relationship was investigated using cross-correlation test, lagged correlation test, correlogram, zero-epoch method, and peak & trough analysis. Figure 3 shows the results of zero-epoch method that is lag frequency variations with time. Figure 4 shows the results cross-correlogram of cross-correlation test for 365 days. Figure 5 shows the correlogram of 30 days correlation test for meteor series Jul 09 to Aug 08, indicates highest correlation 0.97 after 216 days of meteor activity.

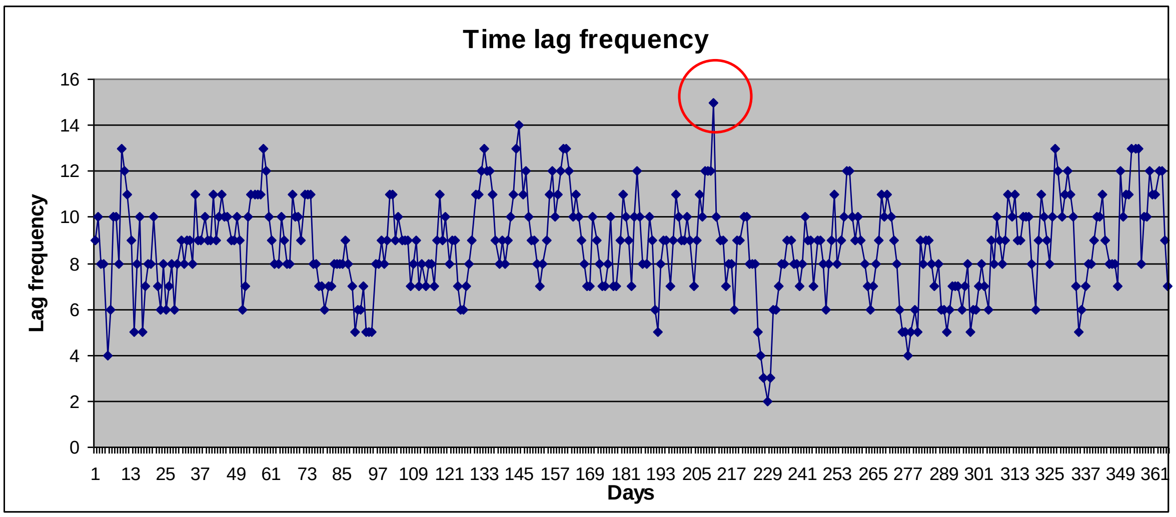

Figure 3: The results of zero-epoch method that is lag frequency variations with 365 days time, indicates the absolute maximum being on 209th day after zero-epoch of the meteoric peaks.

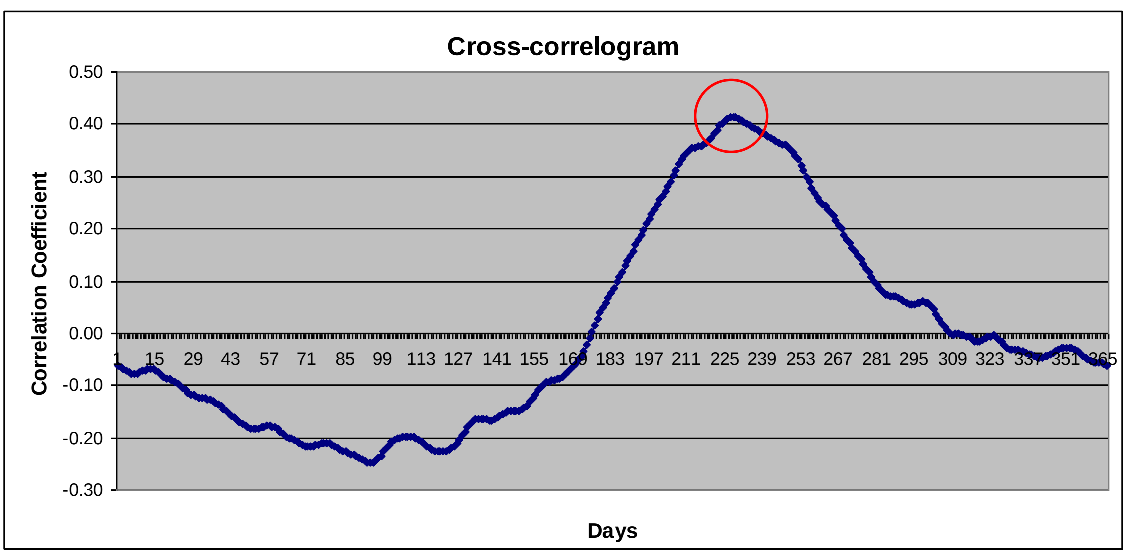

Figure 4: The cross-correlogram - correlation coefficients against the time lag to interpret the set of autocorrelation coefficients as a result of cross-correlation test for 365 days. The absolute maximum being on 226 days time lag

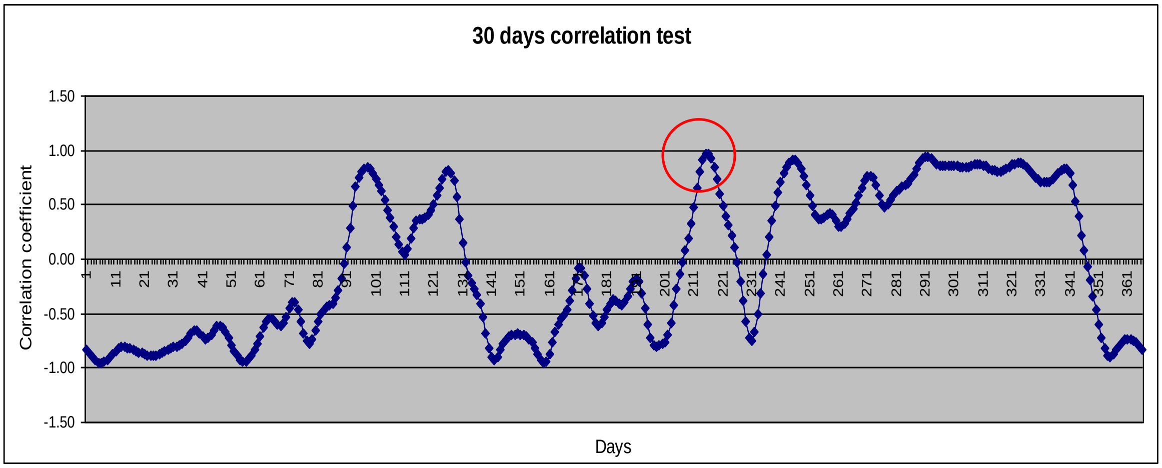

Figure 5: The correlogram of 30 days correlation test for meteor series Jul 09 to Aug 08, indicates highest correlation 0.97 after 216 days of meteor activity.

According to above overall statistical tests the best correlations were found with a lag of 6 to 7 months or 180 to 210 days after a meteoritic peak activity. When searching the famous time lag 28-30 days of previous researchers, a poor correlation (r = -0.08) was found.

4. CONCLUSION

This research is based on the global data of both precipitation as well as meteor activities. But previous researches had been carried out with limited available local precipitation data of various parts of the world at the time. Previous researchers had considered meteor shower days as high meteor activity dates without referring actual data; the reason was lack of actual data. In this investigation we have used practically observed worldwide meteor data for calculations; it is fairer than meteor shower information, it is included shower meteor data as well as sporadic meteor data, because 75% of overall meteor activities occur due to sporadic meteors.

According to present investigation of authors, calculated time lag is different from previous researcher's time lags. According to (Link, 1969) and some other researchers, the falling time of meteoric particles depend on different factors.[8] Those are the size of the particles, density of the particles and the composition of the particles. Metallic particles are falling faster than stony particles. Due to these circumstances it is very difficult to say an exact time lag for the sublimation process. That might be the reason that different researchers declared different time lags as their sublimation period. However we do not hesitate to conclude the time lag according to our investigation as 6 to 7 months.

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