

Activity of Red Sprite and its Occurrence Time

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Abstract:

We have tabulated the occurrence time of red sprites based on the papers published between 1990 and 1997. The result suggests that red sprite is most active around midnight. Hence the window from 23:00 to 01:00, in the local time, would be more preferred for the observation of red sprite.

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 - Red sprite distribution based on the number of papers

I. Introduction:

To maximize the observation efficiency of the ISUAL mission, the pointing direction of the imager and the observation time zone needed to be chosen critically. Unfortunately, there is no published data regarding the daily occurrence time distribution of red sprite. Thus, as requested by the ISUAL mission, we search the published literatures of red sprites and analyze the records of observation. Totally 22 papers¹⁻²², published from 1990 to 1997 and as shown in the list of the referred papers,

have been surveyed. The result indicates that red sprite is most active around midnight. Hence, to have a better observation rate of sprite, the observation window from 23:00 to 01:00 local time, could be more preferred.

II. Results of the Statistics:

The activity distribution of lightning in Fig. 1 indicates that lightning is most active around midnight. As shown in Fig. 2, the activity distribution of red sprites represented by the number of the red sprite events seems also peaks around 1:00 to 2:00 AM. Since the number of events is not reported in all the referred papers, the distributions shown in Fig.1 and Fig.2 could be biased by the few papers which did. To alleviate this possibility, we further sort the observed red sprites occurrence times in the referred papers into time bin of hourly interval. In this sorting scheme, red sprites which were observed in very closed time span was only counted once in each paper. Figure 3 is the paper-number distribution of the observation of red sprites and it indicates that red sprite is most active from PM 23:00 to AM 1:00. This result also agrees with the activity distribution of lightning very well. Thus, based on these data, we conclude that red sprite is most active around midnight and we would like to suggest to coordinate the ISUAL observation accordingly for achieving a better efficiency..

III. The list of referred papers:

1. K.N. Baral, and D. Mackerras, "Positive Cloud-to-Ground Lightning Discharges in Kathmandu Thunderstorms," *Journal of Geophysical Research* 98 10331–10340 (1993) .
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3. W.L. Boeck, O.H. Vaughan Jr., R.J. Blakeslee, B. Vonnegut, M. Brook, and J.M. Kune, "Observations of lightning in the stratosphere," *Journal of Geophysical*

Research 100, 1465–1475 (1995) .

4. S.A. Cummer, and U.S. Inan, “Measurement of Charge Transfer in Sprite-Producing Lightning Using ELF Radio Atmospherics,” *Geophysical Research Letters* 24 1731–1734 (1997).
5. R.L. Dowden, J.B. Brundell, and W.A. Lyons, “Are VLF rapid onset, rapid decay perturbations produced by scattering off sprite plasma?,” *Journal of Geophysical Research* 101, 19175–19183 (1995) .
6. R.C. Franz, R.J. Nemzek, and J.R. Winckler, “Television Image of a Large Upward Electrical Discharge Above a Thunderstorm System,” *Science* 249 48–50 (1990).
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9. H. Fukunighi, Y. Takahashi, M. Sato, A. Shono, M. Fujito, and Y. Watanabe, “Ground-based observations of ULF Transients Excited by Strong Lightning Discharges Producing Elves and Sprites,” *Geophysical Research Letters* 24 2973–2976 (1997).
10. D.L. Hampton, M.J. Heavner, E.M. Wescott, and D.D. Sentman, “Optical Spectral Characteristics of Sprites,” *Geophysical Research Letters* 23 89–92 (1996).
11. U.S. Inan, T.F. Bell, V.P. Pasko, D.D. Sentman, E. M. Wescott, and W.A. Lyons, “VLF Signatures of Ionospheric Disturbances Associated with Sprites,” *Geophysical Research Letters* 22 3461–3464 (1995).
12. U.S. Inan, C.B. Leigh, S. Hansen, V.S. Glukhov, T.F.. Bell, and R. Rainrden, “Rapid Lateral Expansion of Optical Luminosity in Lightning-Induced Ionospheric Flashes Referred to as ‘elves’, ” *Geophysical Research Letters* 24 583–586 (1997).
13. W.A. Lyons, “Characteristics of Luminous Structures in the Stratosphere Above Thunderstorms as Imaged by Low-Light Video,” *Geophysical Research Letters* 21, 875–878 (1994) .
14. W.A. Lyons, “Sprite observations above the U.S. High Plains in relation to their parent thunderstorm systems,” *Journal of Geophysical Research* 101, 29641–29652 (1996) .
15. S.B. Mende, R.L. Rairden, G.R. Swenson, and W.A. Lyons, “Sprite Spectra; N₂ 1 PG band identification,” *Geophysical Research Letters* 22 2633–2636 (1995).
16. R.L. Rairden, and S.B. Mende , “Time resolved Sprite Imagery,” *Geophysical*

Research Letters 22 3465–3468 (1995).

17. S.C. Reising, U.S. Inan, T.F. Bell, and W.A. Lyons, “Evidence for Continuing Current in Sprite-Producing Cloud-to-Ground Lightning,” *Geophysical Research Letters* 23 3639–3642 (1996).
18. D.D. Sentman and E.M. Wescott, “Observations of Upper Atmospheric Optical Flashes Recorded from an Aircraft,” *Geophysical Research Letters* 20, 2857–2860 (1993) .
19. D.D. Sentman, E.M. Wescott, D.L. Osborne, D.L. Hampton, and M.J. Heavner, “Preliminary results from the Sprites94 aircraft campaign : 1. Red sprites,” *Geophysical Research Letters* 22 1205–1208 (1995).
20. J.R. Winckler, “Further observations of cloud-ionosphere electrical discharges above thunderstorms,” *Journal of Geophysical Research* 100, 14335–14345 (1995) .
21. J.R. Winckler, R.C. Franz, and R.J. Nemzek, “Fast Low-Lever Light Pulses From the Night Sky Observed With the SKYFLASH Program,” *Journal of Geophysical Research* 98 8775–8783 (1993) .
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Lightning

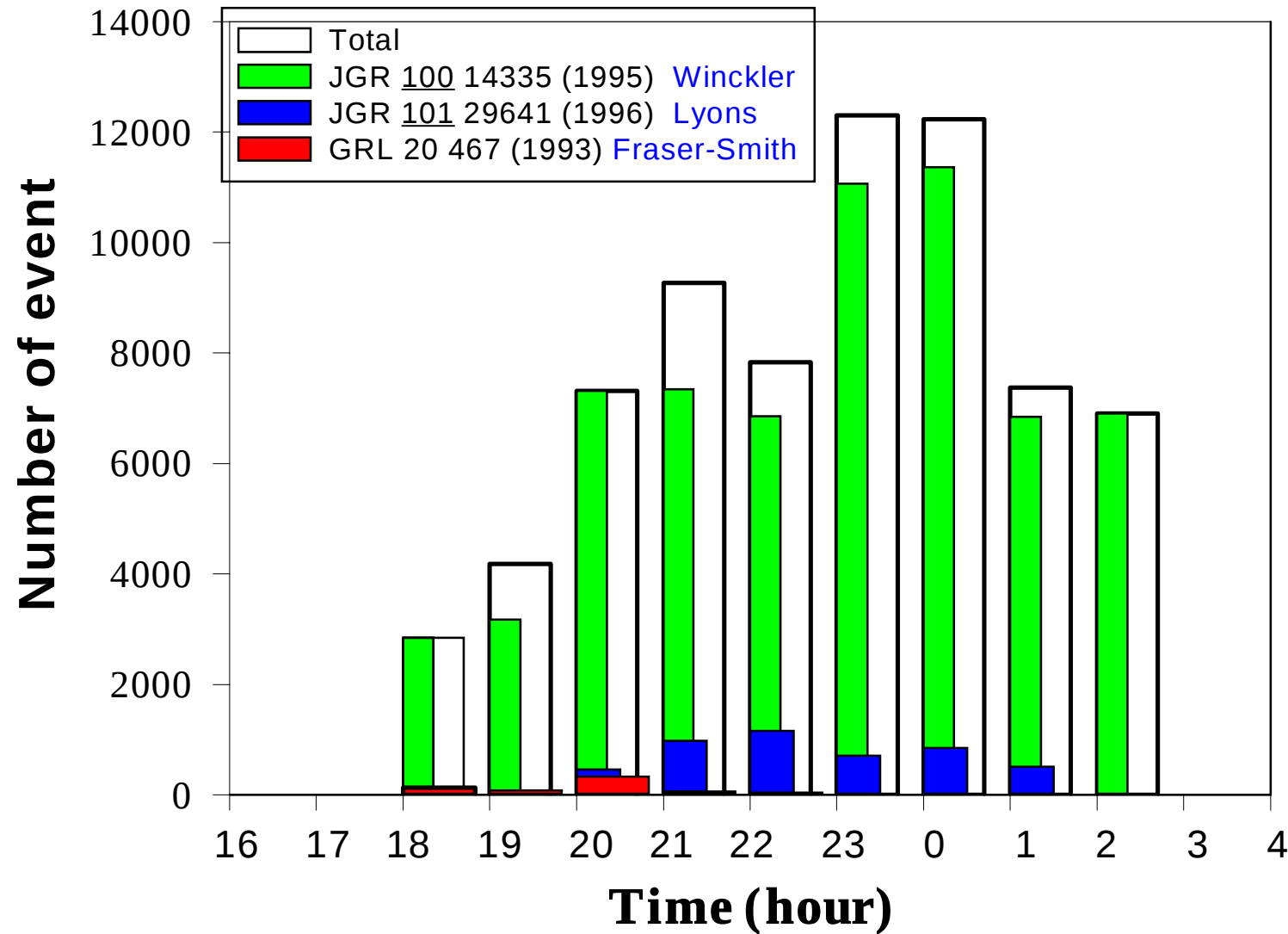


Fig. 1 The occurrence time distribution of lightnings

Red Sprite

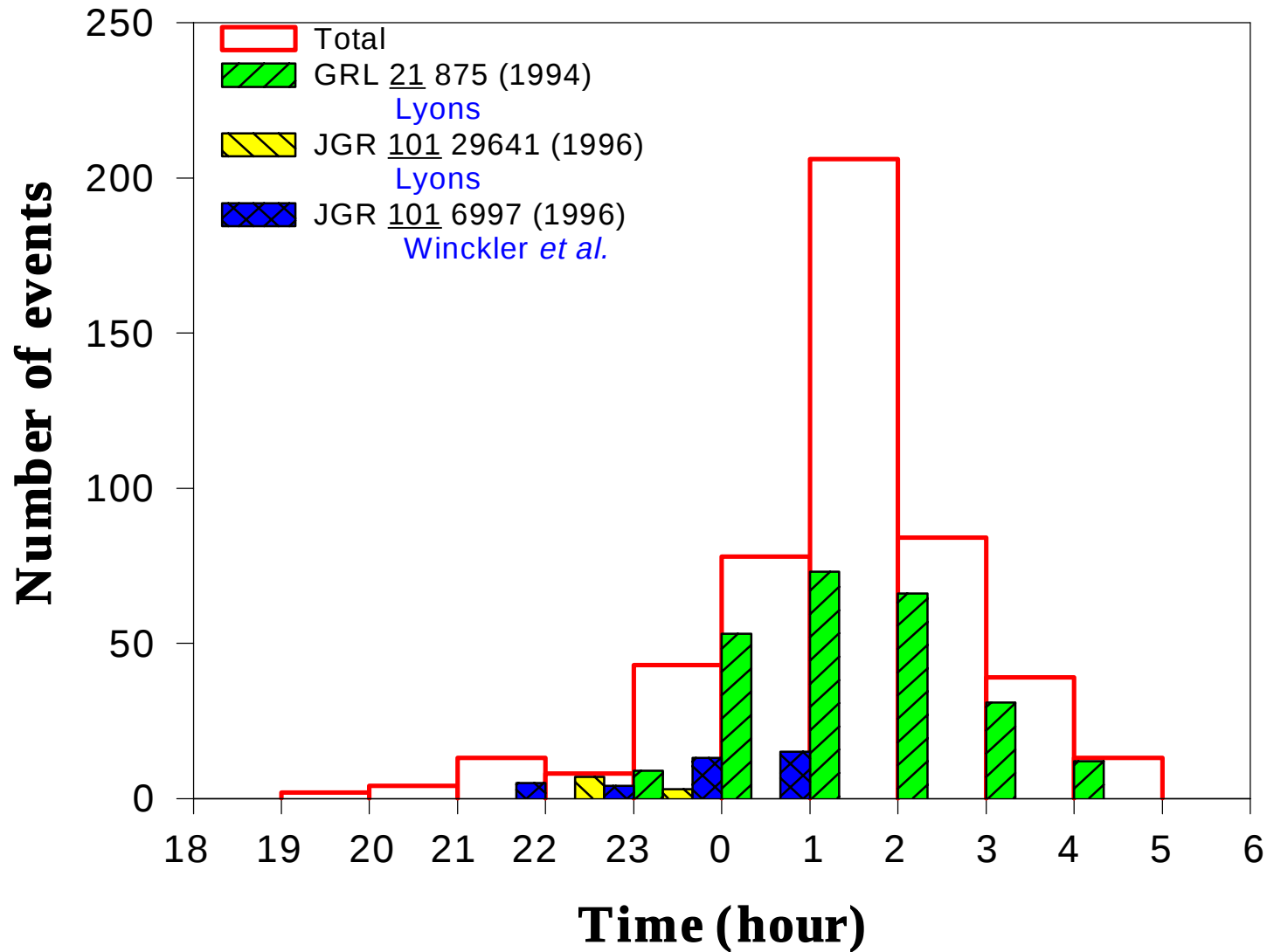


Fig. 2 The occurrence time distribution of the reported red sprites

Red Sprite

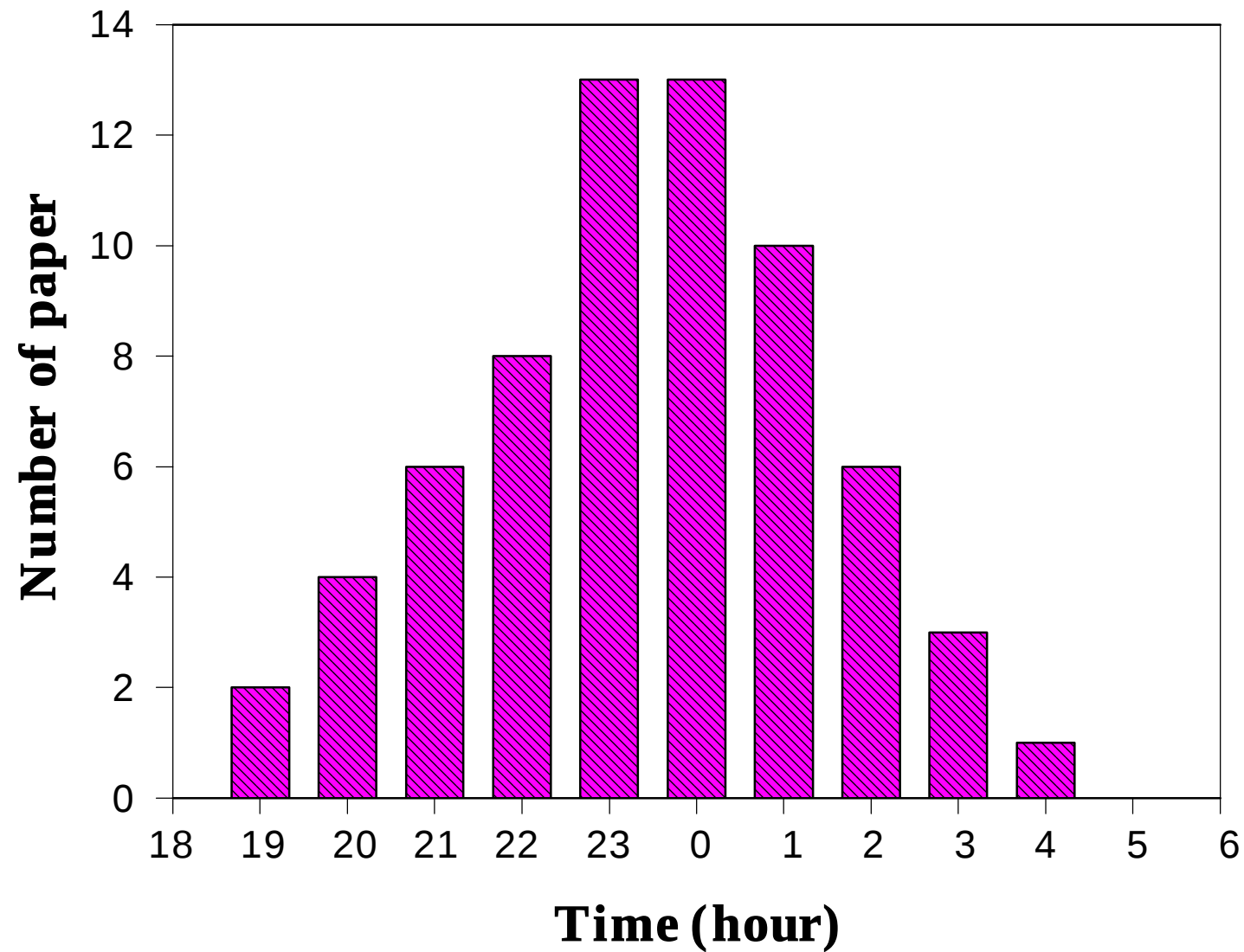


Fig. 3 The occurrence time distribution of red sprites sorted into hourly bin