Relation of Sprite Sightings to UFO Sightings

by

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(13110)

Abstract

An investigation of Transient Luminous Events was initiated after reading an article in which one of the leading researcher in that field made the remark that it was possible that UFO reports could be explained by these events. This paper is reporting the results of that investigation. In brief it has been concluded that although some pictures of Sprites in particular look like disc shaped saucers, it would be impossible for any witness to mistake one for a UFO. However, it was also concluded that it would be possible for a faux witness to fake a report with a picture of a Sprite. This paper was written to provide MUFON members with information needed to recognize a Sprite picture and to respond intelligently to any statement linking the two events

Contents

Transient Luminous Event (TLE) is the generic name associated with a family of short-lived electrical-breakdown phenomena that occur well above the altitudes for normal lightning. “Sprites”, a form of TLE, are large but weak luminous flashes that appear directly above active thunderstorm systems and are triggered by cloud-to-ground lightning strokes. Their spatial structures range from small single or multiple vertically elongated spots, to bright groupings which extend from high above the cloud tops to altitudes up to almost 60 miles. Sprites are normally reddish-orange in their upper regions, with bluish hanging tendrils below. Throughout this document, photographs of Sprites will be presented to provide Field Investigators a concept of various results obtained. Figure 1 is a reproduction of the first color image obtained of a Sprite.

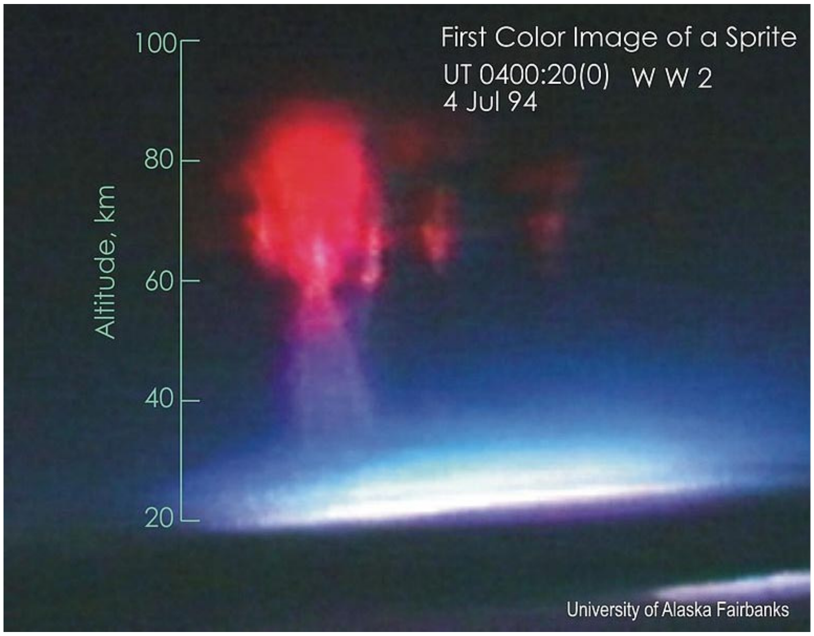


Figure 1; Photograph by University of Alaska at Fairbanks

The first thesis investigated in this paper (Section 4) is the fallaciousness of a relationship between UFO sightings and Sprites. Although at present this connection only seems to be starting in the UFO skeptic community it is expected by the author to grow in both size and intensity. The difficulty caused by any growth in this concept is that it threatens the one piece of evidence normally available for UFO sightings; the picture. Initial UFO reports in the mid 20th century were basically just visual sightings. It was therefore not difficult to pass off those reports as simple misinterpretations, hoaxes or hallucinations. Since radar scans are not as available as is generally thought, the best piece of evidence available at present to confirm witness reports is a picture.

The genesis of the Sprite-UFO connection seems to stem from an off the cuff statement by a leading researcher in the field of TLEs. While discussing Sprites, he mentioned that they may explain some UFO sightings. Although he did not actually attribute any specific UFO sighting to a Sprite, the statement was then (unfortunately) picked up by many electronic publications. Since none of these sites have dated (other than a year) their story or referenced its origin, it is difficult to determine the location of the initial statement.

It will be shown in this paper that this type of misinterpretation will never occur. Its inverse, of a fake report entered with a picture of a Sprite is however likely to occur. That takes us to the second thesis of this paper; to present MUFON investigators with a concept of what a picture of a Sprite looks like in order to recognize these faux sightings. This will be discussed further in Section 5.

This paper is focused on Sprites. They, however are only one category in a menagerie (also including Elves, Trolls, and Blue Jets among others) of TLEs. Figure 2 is a movie picture frame supplied by Thomas Ashcraft of New Mexico of a Sprite with a giant Elve surrounding it like an inner tube.

Figure 2: Sprite Cluster with Giant Elve: Thomas Ashcraft

1.0 Brief History of TLEs

There have been anecdotal reports from Seafarers and mountain-dwellers of high altitude lights occurring above thunderstorms for centuries if not millennia. They were however only statements and could easily be ignored by the metrological community. In 1925, Physicist Charles Wilson (inventor of the cloud chamber and Nobel Prize winner) predicted the creation of very energetic “runaway” electrons by thunderstorms. Additionally with the advent of the aviation age many reports of these lights began coming in from by pilots.

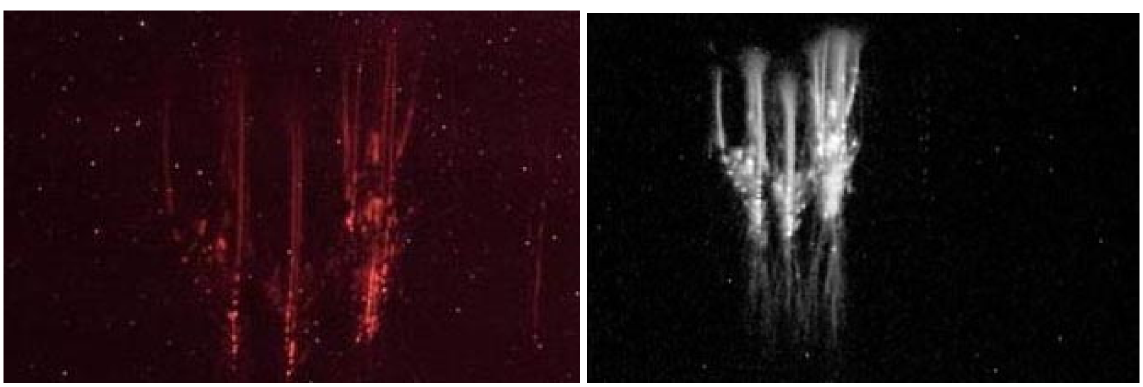
Due to a lack of absolute proof, meteorologists continued to scorn even the possibility of the existence of TLEs. The number of sightings or the quality of the witness did not matter. This type of thinking is of course, self reinforcing. Since most pilots do not wish to flunk their annual flight physicals, reports are then held back; and holding reports back further strengthens the concept there is nothing to see.

In 1989 this concept was shattered when, while testing a low-light video camera two scientists from the University of Minnesota accidentally captured two frames showing giant twin pillars of light extending upward more than 30 kilometers above a distant thunderstorm. With this evidence meteorologists could no longer claim TLEs were hallucinations (or worse) and mainstream scientists started a search to determine what was going on. Since that time, thousands of TLEs have been discovered, photographed, and categorized by type. It is now accepted science that TLEs have probably been around for millennia and play a major role in the terrestrial electrical environment. It is hard at this point to resist pointing out the obvious. What else is being ignored about things occurring high in our atmosphere?

2.0 Characteristics of Sprites

Recent research carried out at the University of Houston seems to indicate that all lightning strikes attempt to create a Sprite or its precursor a Sprite Halo. However, Sprites are almost always triggered by powerful cloud-to-ground lightning strikes. It seems to this author that this implies Sprites are the result of [1]Positive lightning as opposed to the more normal [2]Negative lightning. These strikes send massive amounts of electric charge to the ground. This loss of charge in the cloud rapidly (a few milliseconds after the lightning strike) increases the electric field in the middle atmosphere above the cloud beyond the point of "dielectric breakdown". Electrical streamers which we recognize as a "Sprite" then first race wards towards the cloud followed a few milliseconds later by upwards ones from the point of origin. These streamers are actually not continuous but are clusters of small (10–100m, 30–300 ft) balls of ionization. The downward streamers travel at speeds of up to ten percent the speed of light. Sprites may be horizontally displaced by up to 50 km from the location of the underlying lightning strike. At this time it does not appear that the downward streamers reach the thunderclouds. That however may be a result of the brilliance of the initiating lightening flash drowning out any view of the occurrence.

Sprites have variously been described as having shapes that resemble jellyfish, carrots, or columns. They are sometimes preceded by the reddish halo mentioned above. Sprites often are



Near Infra-red photograph Standard Movie Frame

Figure 3: Carrot Sprite: Amarillo Texas; 13 June 2012; Thomas Ashcraft

seen in clusters of two or more and typically span an altitude range 31 miles (50 km) to 56 miles (90 km). They have a low surface brightness being described as dimmer (~200 kilo-Rayleighs[3])[4] than an aurora (max ~1000 kilo-Rayleighs). For that reason they have only been imaged at night and then primarily with highly sensitive (low light) cameras. The can however be seen on dark nights with the naked eye if ones eyes are sufficiently dark-adapted and the light from the initiating lightning strike has been shielded out. It is unfortunate that the "brightness" of Sprites is quoted in Rayleighs and no standard distance between source and observer quoted. A Rayleigh is a unit used by astronomers in discussing the observed relative brightness of stars and is therefore a perceived brightness rather than an inherent one. It is a measure of the number of photons seen from extended events and as such includes the average distance to the source in it. For an event emitting photons uniformly in all directions, the photon density will decrease by a factor of the square of the distance from the source to the receiver, Therefore, if the brightness quoted is for a distance of 100 km, and the observer is actually 200 km away, he would see a “brightness” that is reduced by a factor of 4 from the quoted value. This is discussed in more detail in Appendix A.

Sprites have a very short lifetime. Overall they may last approximately tens of mille-seconds. However the complete lifetime would only be visible to a low light camera. Their maximum viewable lifetime is closer to a hundredth of a second (10 m-sec). Therefore, even to low light cameras, these events are just a flash of light. It may also be noted that the light seen from Sprites is not the standard brightness of a lightning flash. In fact the light seen is more akin to light from a fluorescent bulb as it arises from an excitation of the surrounding gas (Nitrogen for the red coloring). Direct viewing of a Sprit is not an easy task. The following are the general steps listed in most sites to follow for seeing a Sprite.

- Check radar and satellite maps to locate storms within range of your location.
- Choose a moonless night with low haze, smoke or pollution in a setting away from urban light pollution. (Light from Tel Aviv is seen to drown out the sprite’s light in Figure 4.)

Figure 4: Sprite seen over Tel Aviv; ILAN

- Let your eyes become dark adapted for 5 or 10 minutes.
- If lightning from the storm system is visible, block it out. (Figure 5 provides an example of this. When the initiating lightning can be seen, it tends to dominate what the eye see. The lightning in this picture is positive lightning coming from the top of the storm cloud.)

Figure 5: Sprite with Initiating Lightning: Japan TV

- Look off to the side of the storm since dimly illuminated objects are more easily seen in the corner of the eye.
- Bring an AM radio and tune it away from any station to hear any static burst originating from the lightning creating the Sprite.
- Bring a comfortable chair and be patient.

The best distance to see a Sprite from would be approximately 100 km. This is close enough that blocking out the initiating lightning would not be difficult, and the Sprite has a large vertical extent. As shown in Appendix. B, at this distance the Sprite will extend from ~11º above the horizon to ~41º. Additionally the storm should be below ~5.5º. Secondarily, at this distance, the Sprite will be fairly bright as it gets brighter as one approaches it. Much closer than this would make it difficult to see the Sprite due to the storm-clouds and make it much more difficult to block out the initiating lightning..

The basic sound associated from Sprites is at approximately 1 Hertz. That is in the infrasound range and is well below the range of human hearing. As with most infrasound waves, it can travel extreme distances and be “heard” on special radio receivers. While not thunder in the usual sense of the word, it is the acoustic signature of the processes.

3.0 Origin of the UFO–Sprite Connection

The picture that seems to have been the origin of UFO comments was taken by the ILAN[5] Science Team of Tel-Aviv University. The image[6] is black and white and shows what looks like a circular craft with bright light in the center of the bottom. The team states that the Sprite was about 30 miles high, 39 miles wide, and about 175 – 259 miles from the camera. Although the author does have a copy of the photograph it is copyrighted cannot be shown here.

A similar picture (Figure 6) taken by Thomas Ashcraft of Heliotown New Mexico of an event occurring at 36.3278 N, -101.4644 W (top of the Texas Panhandle centered East-West).

Figure 6: Sprite – 12 April 2012

It is easily seen what was being referring to with the UFO statement. The Sprite does have a vague similarity to a saucer shaped UFO seen through clouds. That, however is all it is. A vague similarity in a frame from a movie. Interestingly, although the ILAN tem has many pictures and movies on its web page[7] (and it is suggested all FIs go there and look at them) the picture from 12 September 2006 is nowhere to be found. The only copy available seems to be the news article mentioned above.

As with most Sprite pictures, what is seen is not a slice of the lifetime of the Sprite. It is a picture of the total lifespan. This picture in figure 6 is a frame of a movie taken by Mr. Ashcraft at a frame rate of 29.97 fps. Assuming a fast shutter speed of approximately 1/30, this shutter was open for over 30 mille-seconds and thus can encompass the entire life of the Sprites.

4.0 Fallacy of the UFO–Sprite Connection

The obvious problems with seeing and taking pictures of Sprites is their unpredictability, their lifetime, and the amount of light available. In terms of photographs, this is extremely vexing. In fact, even if the photographer could anticipate the location and time a Sprite would appear, taking its picture with a standard camera is impossible due to the low light. In one source, found, it was explained that one would need to have a camera and film system with an ISO of approximately 2 million (more than 1000 times more sensitive than any standard camera) to get the picture.

It is, of course possible to get pictures using low light video systems. A video system eliminates the requirement to know in advance when and where a Sprite will appear. It should be remembered these are special systems and not just tricks to allow more light into a standard system. Due to the low light and short pulse times, Sprite video cameras incorporate low light night vision image intensifiers (photomultipliers). Although the cost of these items is coming down but they are still not inexpensive for individuals.

Seeing a Sprite is not as difficult as taking a picture of one, but to the naked eye they do not have the appearance of a UFO. Basically in real time, they are just a flash (a blob) of light. The author admits to have read in a few blogs that “persistence” of vision would allow one to see the “UFO” even with the short flash. That is absolutely false. Watch the first 10 seconds of the video at http://vimeo.com/40304124. Even with dark adjusted eyes, the flash is not intense enough to leave much of a lasting impression. It basically looks like a subdued lightning flash such as one occurring behind a cloud to spread the light all around and remove any view of the actual source. Added to the fact the observer would probably not be staring at the location in real time eliminates any possibility of it being misidentified as a UFO.

The final reason to not misinterpret Sprites is their static nature. They last about 10 milli-seconds and they do not move. This eliminates any possibility of the item hovering over a location; flying off from the location; or making any flight maneuvers impossible for a terrestrial flying object. The following is a list of reasons to misinterpret Spite as a UFO (left) and a similar list (right) that says that such misinterpretation would not occur. This is obtained from the above paragraphs and from the steps to follow to see a Sprite.

Sprite is misinterpret as UFO	**Sprite cannot be misinterpret as UFO**
Picture looks like a UFO	Sprites look like a blob of light to the eye
	If not looking for a Sprite it will look like lightning
	A normal still picture is not possible
	Sprites require expensive video to obtain picture
	Sprites do not hover for a period of time
	Sprites do not move around at all
	Have to block out ground lightning to see Sprite
	Sprites cannot be seen from urban area
	Sprites can only be seen on moonless nights

Have to dark adapt eyes to see a Sprite

Basically, the above listing says that although it would be possible for an observer to pass off a single picture of a Sprite as a disc UFO, it wouldn't fool the observer himself. That however, is not a misinterpretation, it is a fake. It is therefore up to the FI to remember what these pictures of Sprites look like to assure this does not happen.

5.0 Faked Sightings

It was stated in the last section that it is up to the FI to assume that pictures of Sprites are not passed off as a UFO in a fake report. Using Figure 6 as an example the following are relatively obvious.

1 There will never be a sharp outline. The disc shape is a construct of the flash and does not have an edge.

2. There will always be downward streamers in the center. In essence they look more like the base of rockets than UFO lights. In some pictures the streamers will be more diffuse like the halo without the sharp outlines seen in Figure 6.

3. The picture will almost always be black and white. If a color picture was offered, the disk shape becomes almost indistinguishable from the background. Therefore in addition to being a color not normally associated with UFOs, it is almost impossible to see.

As always when dealing with photographs The FI should check the EXIF data for the source of the picture (many EXIF readers are available on the internet[8]). Most people do not have the ability to get to the actual Sprite source pictures and will copy them from the internet using Photoshop. They will also have to crop off the data from the pictures. If you check the pictures use in this document, it is obvious that that was exactly what was done here. Regardless of the outcome of the picture source check, one should also check the date, time, and location the picture was taken to compare with the witness' narrative.

The following is another possible UFO-Sprite photograph.

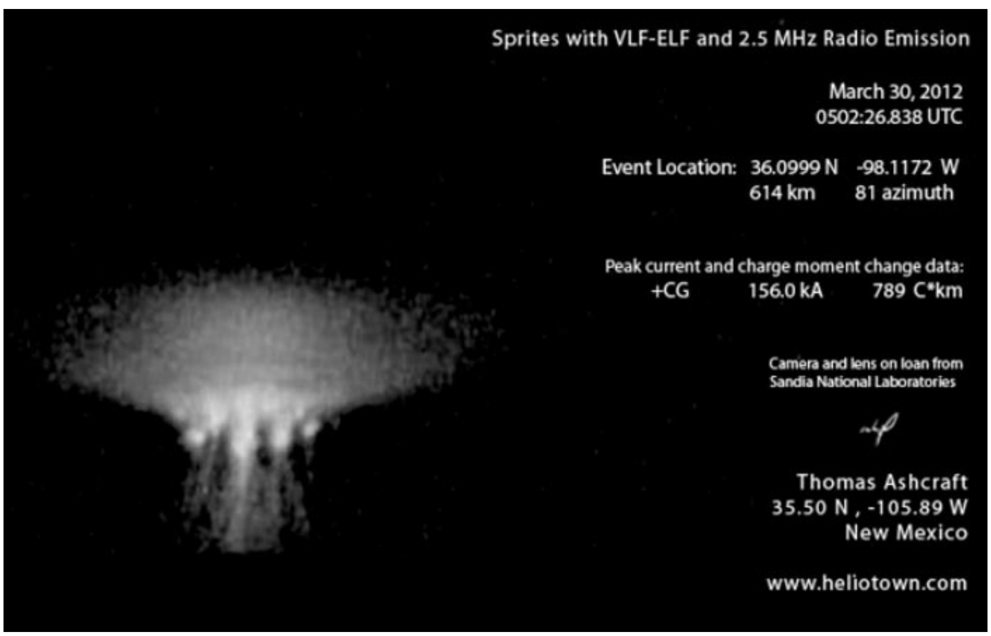


Figure 7: Sprite over Mexico: Thomas Ashcraft

6.0 References and Comments

1 Positive lightning: Positive lightning makes up less than 5 % of all lightning. It occurs when the initial leader stroke forms at the positively charged cloud tops, with the consequence that a negatively charged streamer issues from the ground. It has been determined that positive lightning bolts are typically six to ten times more powerful than negative bolts, last around ten times longer, and can strike several kilometers or miles distant from the clouds. An average bolt of positive lightning carries a current of 300 kilo-Amperes (about ten times as much current as a bolt of negative lightning), transfers a charge of up to 300 Coulombs, have a potential difference up to 1 gigga-Volts (a thousand million Volts), and dissipate approximately 250 gigga-Joules..

2 Negative Lightning: Negative lightning makes up more than 95 % of all lightning. They start when an invisible negatively charged leader stroke is sent out from the cloud. As it does so, a positively charged streamer is usually sent out from the positively charged ground. When the two leaders meet, the electric current greatly increases. The region of high current propagates back up the positive stepped leader into the cloud. This "return stroke" is the most luminous part of the strike, and is the part that is really visible. Most negative lightning strikes last about a quarter of a second. They carry a current of 30 kilo-amperes, transfer a charge of about 5 Coulombs, have a potential difference of about 100 mega-Volts and dissipate about 500 mega-Joules

3 Rayleigh: "en.wikipedia.org/wiki/Rayleigh_(unit)" - The Rayleigh is a CGS unit of light intensity used in astronomy to measure the brightness of the night sky, auroras, etc. One Rayleigh represents the light intensity of one million photons of light emitted in all directions per square centimeter of receiver per second. A dark night sky has a light intensity of about 250 Rayleighs.

4 Barrington, CP; Fast Photometric Imaging of High Altitude Optical Flashes Above Thunderstorms; Stanford University (Doctoral Thesis); 2000; 108 pgs; Figure 3-7, Page 44

5 ILAN (Imaging of Lightning And Nocturnal flashes); http://tau-geo.tau.ac.il/ilan/Default.aspx This name could also be a reference to Ilan Ramon, the first Israeli astronaut. In 2003, he flew on the STS-107 mission with optical equipment designed to obtain calibrated images of Sprites.

6 A Sprightly Explanation for UFO Sightings?; American Friends – Tel Aviv University; Monday, February 23, 2009; http://www.aftau.org/site/News2?page=NewsArticle&id=8803

7 The ILAN web page containing links to their pictures and movies is found at: http://tau-geo.tau.ac.il/ilan/Albums.aspx?albumyear=2009&pageIndex=1 - Do not search for these pages, Google shows old links that no longer exit.

8 "Jeffrey's Exif Viewer"; http://regex.info/exif.cgi ; This is a an EXIF viewer that is relatively easy to use

Appendix A: Sprite Intensity

As stated earlier, the intensity of a Sprite is given in Rayleighs. Effectively this unit states the number of photons that hit the eye per unit time. If one considers a constant (invariant in time) source, the number of photons emitted can not change. Finally, if one considers the source to be isotropic (same in all directions) the total number (N_p) of photons on any sphere surrounding the source must be independent of the size of the sphere (a constant).

Sphere area: $A = 4 \pi R^2$

The Intensity of any light beam is the irradiated power deposited per unit area.

Intensity: $I = P / A$

The Power is the photon energy per unit time and the energy is the photon energy.

$$\text{Energy} = [\text{Planck's constant} \sim 6.63 \times 10^{-34}] \text{ frequency}$$

Because light is usually comprised of many frequencies, the light intensity measured is normally the average for multiple frequencies ($< f >$). The intensity as a function of sphere radius is therefore given by:

$$I(R) = N h < f > / (t \; A) = K / A = K' / R^2$$

If the intensity is defined for a witness 100 km away, one 200 km away would see an intensity four (4) times less intense and one at 300 km would see it nine (9) times less intense.

In reality since the distance is never stated in talking about Sprites, there probably isn’t one standard distance. The numbers quoted are probably averages over multiple distances. Therefore one should not try to determine any absolute value, just remember if one moves to a different distance from the Sprite the Intensity seen will change by the square of the distance ratio.

A second point of note is that the above discussion assumed an isotropic source. Effectively this is equivalent to assuming a point source. Extended sources are rarely if ever isotropic when close to the source. The above discussion is therefore a far-field approximation.

Appendix B: Sprite Viewing Angles

Figure B1 is used to calculate the viewing angle (α) for each portion of the Sprite and Storm as a function of distance (d_g) from the event. In this figure R_E represents the average radius of the Earth and h_o represents the lowest elevation viewable by the witness.

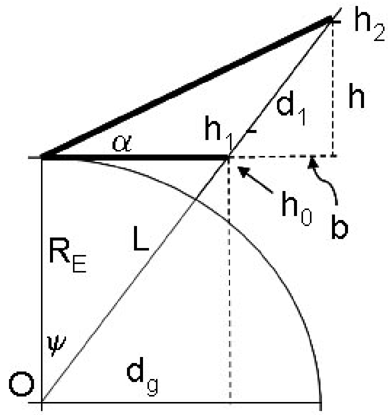


Figure B1: Sprite Viewing Angles
(Note: h_1 in the above figure is not used and d_1 is the length from h_0 to h_2.)

Data used to determine the viewing angles:

$R_E \approx 6371$ km $\quad d_g = 100$ km, 200 km, 300 km

$h_2 = 20$ mi (32.19 km), 90 mi (144.84km)

Also: Assume the storm-clouds can reach at ~35,000 feet (10.67 km):.

Equations to determine the lowest altitude at the Sprite location that is seeable by the viewer:

$\psi = \tan^{-1}(d_g / R_E)$; $\quad L = d_g / \sin\psi$; $\quad h_0 = L - R_E$.

d_g (km)	ψ (deg)	L (km)	h_0 (km)
100	0.89925	6371.7689	0.7689
200	1.79805	6374.1481	3.1481
300	2.69597	6378.06735	7.06735

Equations to determine the Viewing angle α corresponding to altitude h_0 are:

$d_1 = h_2 - h_0 \quad b = d_1 \sin\psi \quad h = \mathrm{sqrt}(d_1^2 - b^2)$

$\alpha = \tan^{-1}(h / (d_g + b))$

	d_g (km)	d_1 (km)	b (km)	h (km)	α_b (deg)
Sprite Base	100	19.10075	0.2997715	19.0983975	10.7808
	200	18.20195	0.5711179	18.1929879	5.1832
	300	17.30403	0.8139157	17.2848777	3.2886
Sprite Top	100	89.2411	1.3990008	89.2301335	41.3475
	200	86.8519	2.7251297	86.8091366	23.1811
	300	82.93265	3.9008360	82.8408590	15.2479
Storm Top	100	9.9011	0.1553901	9.8998806	5.6451
	200	7.5219	0.2360127	7.5181964	2.1503
	300	3.60265	0.1694549	3.5986625	0.6869

Appendix C: TLE Menagerie & the Atmosphere

As stated in the introduction on page 4, Sprites are only one category in a menagerie of TLEs. The following figure (C1) is a collage of a few of these TLEs indicating their normal shapes, colors, and altitudes.

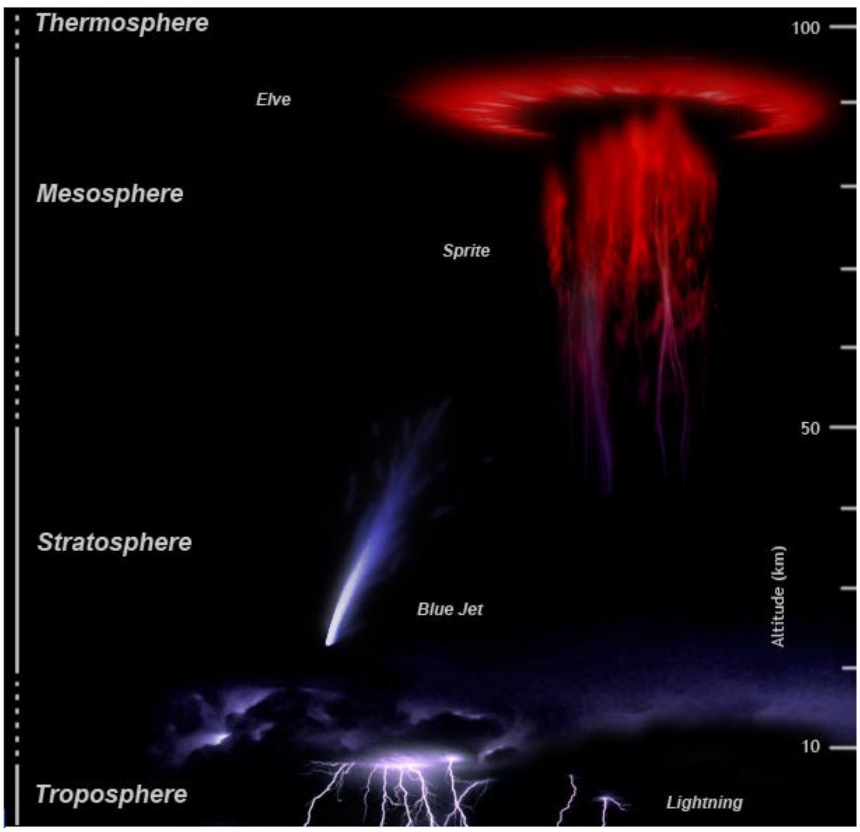


Figure C1: Transient Luminous Events

In Section 2 (page 5) it was indicated that Sprites start high above the initiating storm clouds sending streamers down toward the cloud and upward to the Ionosphere. The following figure (C2) provides a rough description of this process in the atmosphere. Sprites often start around 45 miles high and extend upwards to the edge of the ionosphere and sometimes downwards to as low as 15-20 miles. This extent is shown in the figure. In addition to their huge vertical extent, they also have a large (tens of miles) horizontal extent.

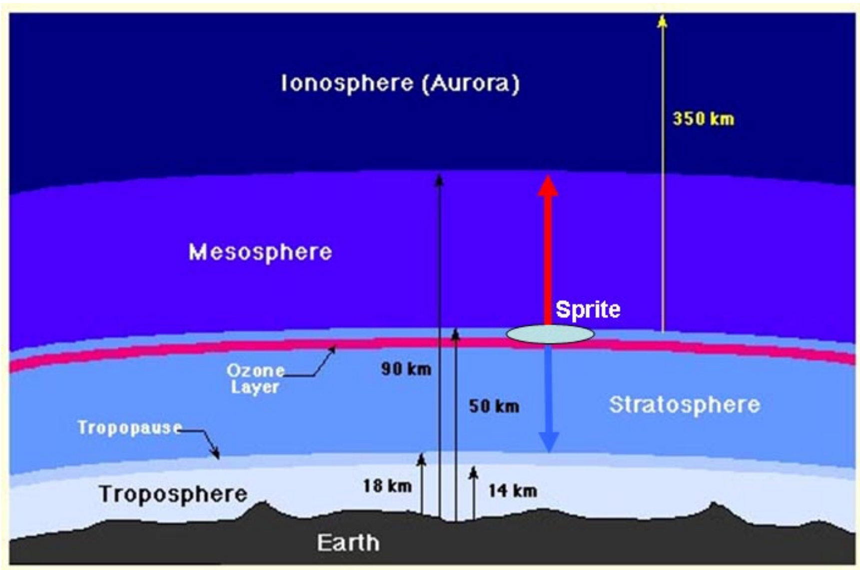


Figure C2: Atmospheric Layers

The lowest layer of the atmosphere is the Troposphere. It is about 10 miles thick and contains almost all of the Earth's weather systems. The next layer is the stratosphere. This layer is defined by a slowly increasing temperature with altitude. It is also the home of the Ozone layer which is vital to protecting Earth from most of the UV radiation streaming from the sun. The next layer up is the Mesosphere. Above the Mesosphere is the Ionosphere. The bottom of the Ionosphere is the Thermosphere (not shown) where most auroras are found. Finally, the top of the Ionosphere gradually merges into "space".