



1  
00:00:02,180 --> 00:00:04,120  
Convective storms hold an extraordinary

2  
00:00:04,140 --> 00:00:07,980  
surprise. Under just the right conditions,

3  
00:00:07,980 --> 00:00:12,260  
they fire off some of the highest-energy light naturally found on Earth--

4  
00:00:12,280 --> 00:00:16,430  
terrestrial gamma-ray flashes, or TGFs.

5  
00:00:16,450 --> 00:00:20,570  
Rising and falling snow and ice particles

6  
00:00:20,590 --> 00:00:24,780  
repeatedly collide, filling the cloud with electrical charge. Once the

7  
00:00:24,800 --> 00:00:28,920  
electric field is strong enough, a current flows and a lightning flash

8  
00:00:28,940 --> 00:00:32,970  
occurs. The flash produces an abrupt reconfiguration of

9  
00:00:32,990 --> 00:00:37,100  
the electric field. In some cases, a surge of electrons

10  
00:00:37,120 --> 00:00:41,280  
rushes toward the upper part of the storm at speeds nearly as

11  
00:00:41,300 --> 00:00:45,480  
fast as light. When deflected by air molecules, these

12  
00:00:45,500 --> 00:00:49,590  
accelerated electrons give off gamma rays, producing a TGF.

13  
00:00:49,610 --> 00:00:53,740

## Data from NASA's Fermi Gamma-ray Space Telescope

14

00:00:53,760 --> 00:00:57,840

suggest more than a thousand TGFs occur each day all over the globe.

15

00:00:57,860 --> 00:01:02,020

For the first time, improved data link dozens of

16

00:01:02,040 --> 00:01:06,080

TGFs to specific tropical weather systems.

17

00:01:06,080 --> 00:01:10,300

Tropical storms far from land tend to generate less frequent lightning.

18

00:01:10,320 --> 00:01:14,350

Nevertheless, observations show they are surprisingly prolific producers

19

00:01:14,370 --> 00:01:18,430

of TGFs. Tropical Storm Manuel

20

00:01:18,450 --> 00:01:22,440

made landfall just shy of hurricane strength. As it rapidly

21

00:01:22,460 --> 00:01:26,590

weakened, it produced two TGFs within 24 hours.

22

00:01:26,610 --> 00:01:30,730

More typically, TGFs are associated with the strengthening

23

00:01:30,750 --> 00:01:34,920

phase of a storm. As Typhoon Bolaven rapidly

24

00:01:34,940 --> 00:01:39,050

developed in 2012, thunderstorms nearly 500 miles from

25

00:01:39,070 --> 00:01:43,150

its center launched a TGF with four distinct pulses.

26

00:01:43,170 --> 00:01:47,230

So far, the record-holder for TGFs

27

00:01:47,250 --> 00:01:51,320

is the rapidly strengthening tropical wave that later gave birth

28

00:01:51,340 --> 00:01:55,510

to Hurricane Julio. It produced four TGFs within

29

00:01:55,530 --> 00:01:59,720

100 minutes. A fifth followed the next day, with nothing further.

30

00:01:59,740 --> 00:02:03,850

What scientists learned so far

31

00:02:03,870 --> 00:02:08,040

is that weather tropical storms are capable of producing more TGFs,

32

00:02:08,060 --> 00:02:12,230

and those events can arise anywhere in the storm.

33

00:02:12,250 --> 00:02:16,300

For stronger storms, like hurricanes and typhoons, TGFs are more common

34

00:02:16,320 --> 00:02:20,500

in the outer rain bands, which host the highest lightning flash rates

35

00:02:20,520 --> 00:02:24,730

in these storms. The findings provide new insights

36

00:02:24,750 --> 00:02:28,780

into the relationship between storm intensity, lightning frequency,

37

00:02:28,800 --> 00:02:32,940

and TGFs. This adds another important piece to the puzzle

38

00:02:32,960 --> 00:02:37,130

of our understanding of TGFs and how they are created in thunderstorms--

39

00:02:37,150 --> 00:02:41,210

the most powerful natural particle accelerators on planet Earth.

40

00:02:45,330 --> 00:02:49,390

On-screen text: NASA astrophysics