August 28, 2009
03:31:52.21 UTC

1
00:00:13,060 --> 00:00:09,020
Thunder claps

2
00:00:13,080 --> 00:00:17,100
of times every second. Most of these electrical flashes remain in the clouds,

3
00:00:17,120 --> 00:00:21,190
with only about a fifth of them reaching low enough to strike trees, buildings

4
00:00:21,210 --> 00:00:25,220
or the ground. Yet lightning bolts in the clouds deliver a unique and

5
00:00:25,240 --> 00:00:29,260
powerful punch of their own. They're directly linked to events that produce some of the

6
00:00:29,280 --> 00:00:33,290
highest-energy radiation naturally found on Earth: terrestrial gamma-ray

7
00:00:33,310 --> 00:00:37,350
flashes, or TGFs for short.

8
00:00:37,370 --> 00:00:41,460
Thanks to recent work by NASA's Fermi Gamma-ray Space Telescope,

9
00:00:41,480 --> 00:00:45,560
scientists have come a few steps closer to understanding these extraordinary outbursts.

10
00:00:45,580 --> 00:00:49,620
When lightning flashes high in the clouds, its energy may alter the strong

11
00:00:49,640 --> 00:00:53,670
electric fields near the top of the storm. About a thousand times each

12
00:00:53,690 --> 00:00:57,760
day, this sudden change triggers an upward surge of high-speed electrons.

13
00:00:57,780 --> 00:01:01,790

Reaching speeds nearly as fast as light, these accelerated electrons give

14
00:01:01,810 --> 00:01:05,820
off gamma rays when they're deflected by air molecules.

15
00:01:05,840 --> 00:01:09,850
TGFs happen quickly and randomly, so even catching them by satellite has

16
00:01:09,870 --> 00:01:13,900
been difficult. But new results from the Gamma-ray Burst Monitor on Fermi

17
00:01:13,920 --> 00:01:17,940
are giving scientists fresh insights. Last year

18
00:01:17,960 --> 00:01:21,980
the GBM team showed that TGFs well away from Fermi produced beams of

19
00:01:22,000 --> 00:01:26,020
charged particles that could travel along Earth's magnetic field and hit the satellite.

20
00:01:26,040 --> 00:01:30,080
Now, thanks to advancements in data processing, Fermi's GBM

21
00:01:30,100 --> 00:01:34,140
is better at detecting TGFs than ever before. As a result,

22
00:01:34,160 --> 00:01:38,260
scientists have discovered that radio signals once thought to be produced by the lightning that

23
00:01:38,280 --> 00:01:42,370
triggers a TGF are in fact broadcast by TGFs themselves.

24
00:01:42,390 --> 00:01:46,400
Each lightning stroke creates a burst of Very Low

25
00:01:46,420 --> 00:01:50,430
Frequency radio waves. Through the World Wide Lightning Location Network,

26
00:01:50,450 --> 00:01:54,470
scientists use this unique radio signal to track electrical activity around the globe.

27
00:01:54,490 --> 00:01:58,500
For some time, scientists have know that TGFs were associated with

28
00:01:58,520 --> 00:02:02,530
strong radio signals, so it was natural to think that these radio signals were

29
00:02:02,550 --> 00:02:06,560
produced by the lightning stroke that triggered the TGFs. Here's one

30
00:02:06,580 --> 00:02:10,590
instance that highlights why the GBM team now questions this interpretation.

31
00:02:10,610 --> 00:02:14,610
It's August 2009 and Fermi is flying over thunderstorms

32
00:02:14,630 --> 00:02:18,620
off Mexico's West Coast. Each symbol marks the location of a lightning

33
00:02:18,640 --> 00:02:22,630
The highlighted circle shows how much of

34
00:02:22,650 --> 00:02:26,650
Earth's surface Fermi can see at any given moment. Just as the satellite passes

35
00:02:26,670 --> 00:02:30,680
over the storms, a TGF occurs. There's no other lightning

36
00:02:30,700 --> 00:02:34,710
near that position when Fermi detected the TGF.

37
00:02:34,730 --> 00:02:38,750
hundreds of TGFs and comparing them to radio-based lightning locations,

38
00:02:38,770 --> 00:02:42,780

the GBM team concludes that both the gamma-ray and the the strong radio emission comes

39
00:02:42,800 --> 00:02:46,780
from the TGF. The team also finds that weaker radio bursts

40
00:02:46,800 --> 00:02:50,810
ocurring up to several thousandths of a second before or after a TGF

41
00:02:50,830 --> 00:02:54,830
actually represent the individual lightning stroke associated with it.

42
00:02:54,850 --> 00:02:58,870
The GBM findings confirm a theory published in 2011

43
00:02:58,890 --> 00:03:02,900
that the same avalanche of speedy electrons that creates a TGFs gamma

44
00:03:02,920 --> 00:03:06,920
rays also produce strong Very Low Frequency radio signals.

45
00:03:06,940 --> 00:03:10,940
With this knowledge, scientists can pair the Fermi

46
00:03:10,960 --> 00:03:14,960
TGF sample with the more precise radio positions from the World Wide Lightning

47
00:03:14,980 --> 00:03:19,020
Location Network. This will clarify weather patterns associated with TGFs

48
00:03:19,040 --> 00:03:23,080
and usher in new studies, perhaps helping scientists determine which

49
00:03:23,100 --> 00:03:27,110
types of thunderstorms produce some Earth's highest-energy natural light.