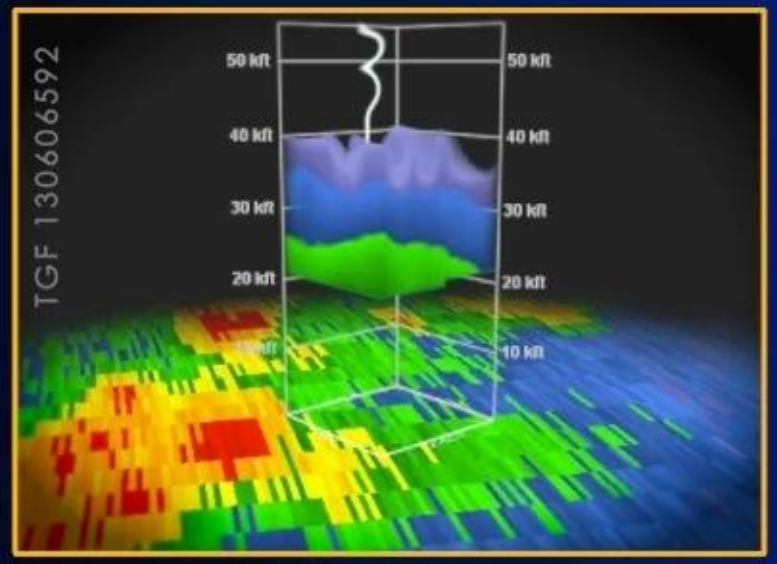
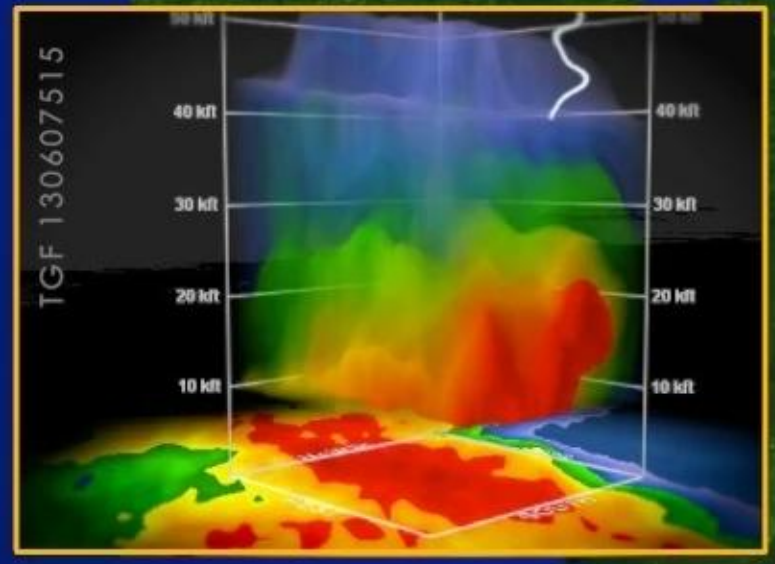
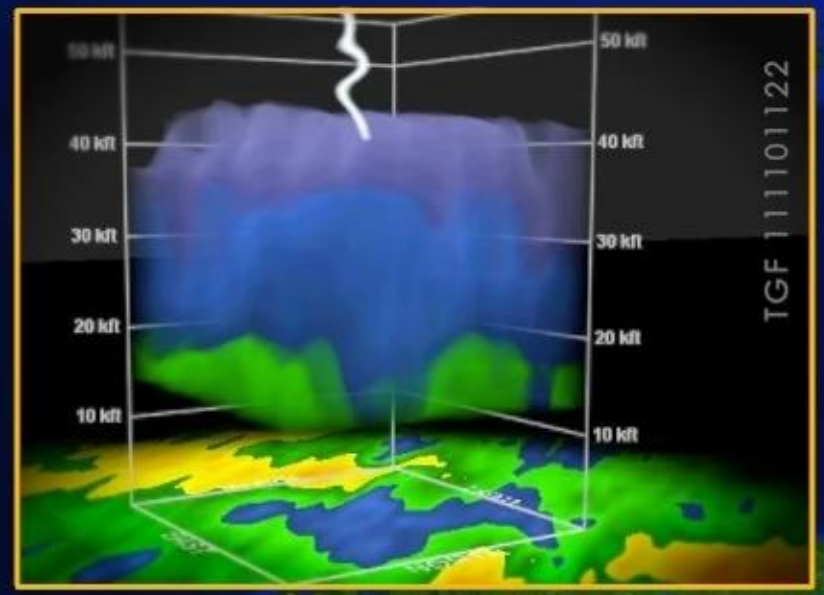


Tropical Storm Andrea
June 6, 2013 12:12:17 UT



Deep convection
June 7, 2013 12:22:04 UT



Nov. 1, 2011 2:56:11 UT
Winter storm
wind-shear-based instability

1
00:00:12,070 --> 00:00:04,020
[Thunder]

2
00:00:12,090 --> 00:00:16,110
Deep within their roiling clouds, thunderstorms hold an elusive

3
00:00:16,130 --> 00:00:20,170
surprise. Under just the right conditions, they produce some of the highest

4
00:00:20,190 --> 00:00:24,250
energy radiation naturally found on Earth: terrestrial gamma-ray

5
00:00:24,270 --> 00:00:28,270
or TGFs for short.

6
00:00:28,290 --> 00:00:32,290
Studies by NASA's Fermi Gamma-ray Space Telescope

7
00:00:32,310 --> 00:00:36,320
have shown that TGFs fire up about 1,100 times a day.

8
00:00:36,340 --> 00:00:40,330
Now, new research combines Fermi detections

9
00:00:40,350 --> 00:00:44,360
with ground-based radar and lightning location data.

10
00:00:44,380 --> 00:00:48,380
These studies show that TGFs come from more diverse types of storms than previously thought

11
00:00:48,400 --> 00:00:52,410
In a thunderstorm, collisions among rain and snow cause different

12
00:00:52,430 --> 00:00:56,440
parts of the clouds to develop positive and negative electrical charges.

13
00:00:56,460 --> 00:01:00,470

When the strength of the electric field overcomes the insulating properties in

14
00:01:00,490 --> 00:01:04,480
the thundercloud, a lighting flash occurs.

15
00:01:04,500 --> 00:01:08,500
Most lightning occurs entirely within the cloud and is called an intracloud flash.

16
00:01:08,520 --> 00:01:12,530
All lightning produces a strong and sudden change in the storm's electric field,

17
00:01:12,550 --> 00:01:16,540
but the upward portion of an intracloud flash sometimes sends a surge

18
00:01:16,560 --> 00:01:20,570
of electrons rushing toward the upper part of the storm. Reaching

19
00:01:20,590 --> 00:01:24,600
speeds nearly as fast as light, these accelerated electrongs give off

20
00:01:24,620 --> 00:01:28,610
gamma rays when their paths are deflected by air molecules. Using

21
00:01:28,630 --> 00:01:32,640
global lightning location networks, scientists can determine a TGF

22
00:01:32,660 --> 00:01:36,680
position more accurately than with Fermi data alone. Two dozen

23
00:01:36,700 --> 00:01:40,690
localized TGFs occurred within areas covered by next-generation weather

24
00:01:40,710 --> 00:01:44,710
radar systems. This gives scientists the opportunity to begin studying

25
00:01:44,730 --> 00:01:48,750
the kinds of storms that produce TGFs. These slices of

26
00:01:48,770 --> 00:01:52,770
radar data capture different types of storms encompassing a wide range of

27
00:01:52,790 --> 00:01:56,780
updraft strengths. Even the weakest of them produced a TGF.

28
00:01:56,800 --> 00:02:00,830
Another finding: TGFs seem to occur

29
00:02:00,850 --> 00:02:04,840
in the same altitude range, between 7 and 9 miles high.

30
00:02:04,860 --> 00:02:08,860
Lightning can form at much lower altitudes, so there's every reason

31
00:02:08,880 --> 00:02:12,940
to think TGFs can too, but gamma-rays from TGFs occuring

32
00:02:12,960 --> 00:02:16,960
deeper in the atmosphere are greatly weekend, they're too dim for Fermi to detect,

33
00:02:16,980 --> 00:02:21,020
which probably means the satellite is undercounting them.

34
00:02:21,040 --> 00:02:25,050
TGFs may be far more common than we think. With this

35
00:02:25,070 --> 00:02:29,080
knowledge, scientists can design experiments to track storms and

36
00:02:29,100 --> 00:02:33,140
study how TGFs relate to their strength and evolution. This will give us

37
00:02:33,160 --> 00:02:37,240
an even better understanding of planet Earth's most powerful natural particle

38
00:02:37,260 --> 00:02:41,270

accelerator. [Beeping]