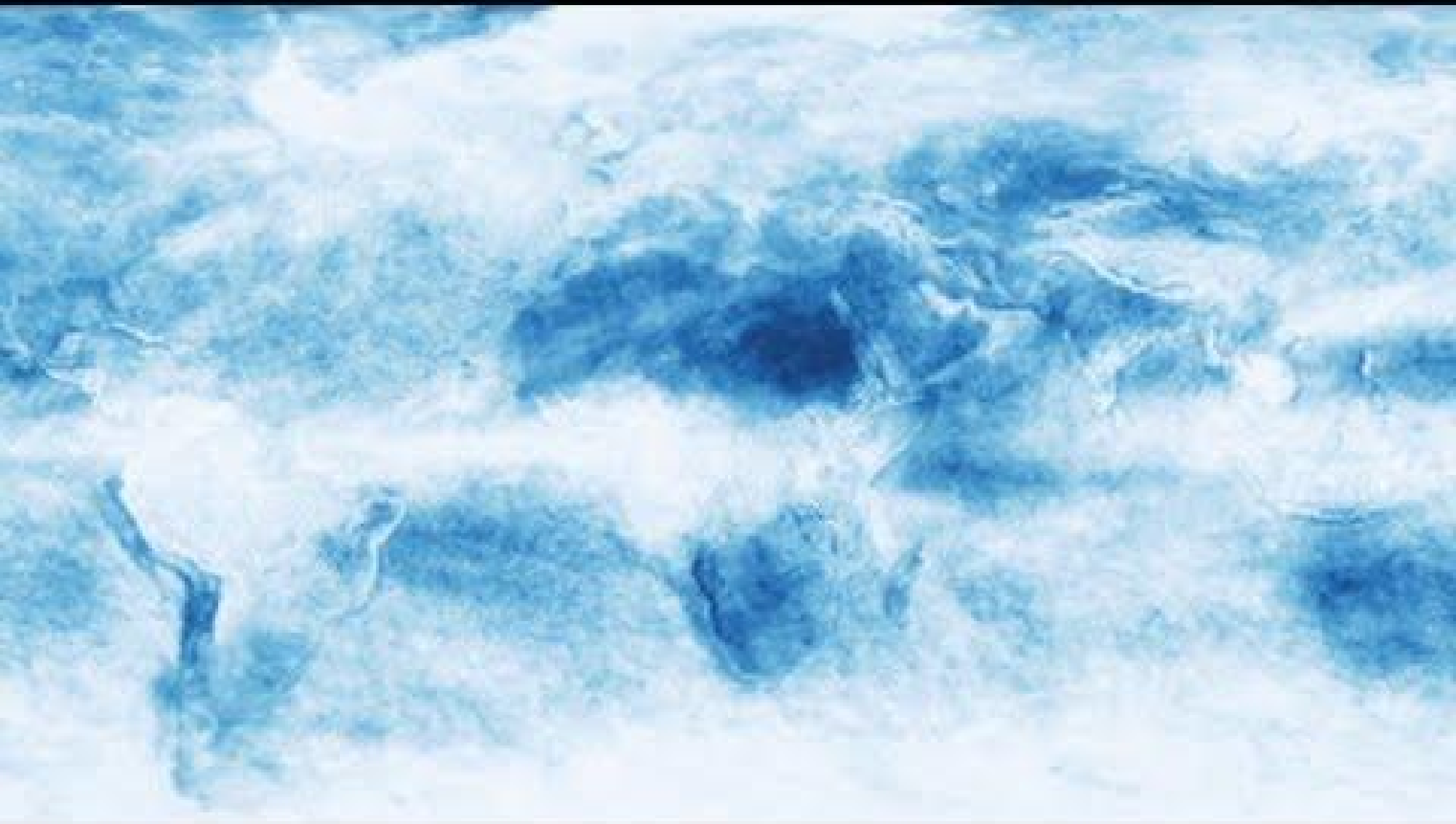

1
00:00:08,170 --> 00:00:04,080
[music]

2
00:00:08,190 --> 00:00:12,340
Narrator: In order to understand the Earth's climate,

3
00:00:12,360 --> 00:00:16,520
it's critical we understand how warm the planet is, how its temperature changes over time

4
00:00:16,540 --> 00:00:20,670
and what factors can force those changes.

5
00:00:20,690 --> 00:00:24,800
The sun is the Earth's primary source of heat, constantly bathing us with solar radiation.

6
00:00:24,820 --> 00:00:28,920
The land surface, cloud cover and our atmosphere

7
00:00:28,940 --> 00:00:33,050
help determine how much of that heat is reflected and how much is retained.

8
00:00:33,070 --> 00:00:37,140
Loeb: How that changes over time is really critical

9
00:00:37,160 --> 00:00:41,220
because in a climate system that's in equilibrium

10
00:00:41,240 --> 00:00:45,270
those two should really balance and if they do

11
00:00:45,290 --> 00:00:49,300
then the temperatures will remain relatively constant with time.

12
00:00:49,320 --> 00:00:53,470
Now when you add greenhouse gases such as carbon dioxide,

13
00:00:53,490 --> 00:00:57,660

methane, you change that radiation balance

14
00:00:57,680 --> 00:01:01,840
at the top of the atmosphere, you reduce the amount of outgoing radiation

15
00:01:01,860 --> 00:01:06,020
and so that imbalance means more energy is in the system.

16
00:01:06,040 --> 00:01:10,200
Part of it goes into the ocean, is stored in the ocean,

17
00:01:10,220 --> 00:01:14,350
and part of it goes into actually warming the Earth.

18
00:01:14,370 --> 00:01:18,500
Narrator: One of NASA's most important tools for measuring that heat

19
00:01:18,520 --> 00:01:22,640
is an instrument on board the Aqua, Terra, TRMM, and NPP satellites,

20
00:01:22,660 --> 00:01:26,780
called CERES, Clouds and the Earth's Radiant Energy System.

21
00:01:26,800 --> 00:01:30,910
Parkinson: The CERES instrument has

22
00:01:30,930 --> 00:01:35,030
exactly three channels, but those three channels

23
00:01:35,050 --> 00:01:39,130
have been tuned to get really really important information

24
00:01:39,150 --> 00:01:43,170
about long wave radiation from the Earth's system,

25
00:01:43,190 --> 00:01:47,200
the reflected short wave radiation from the sun, and then

26
00:01:47,220 --> 00:01:51,230
a window channel of radiation. So it’s got three channels that give us huge

27
00:01:51,250 --> 00:01:55,410
amounts of information about the radiation budget of the Earth.

28
00:01:55,430 --> 00:01:59,580
Narration: CERES observations complement data from another instrument on Aqua and Terra

29
00:01:59,600 --> 00:02:03,780
called MODIS. MODIS has a smaller footprint,

30
00:02:03,800 --> 00:02:07,920
but much higher resolution to its data, illuminating how the energy budget is affected

31
00:02:07,940 --> 00:02:12,110
by clouds, dust particles, oceans, and land cover.

32
00:02:12,130 --> 00:02:16,280
That energy budget can also be influenced by natural events

33
00:02:16,300 --> 00:02:20,460
such as the La Nina and El Nino weather patterns, the amount of ice and snow

34
00:02:20,480 --> 00:02:24,630
covering the Earth, and events that impact the Earth’s atmosphere like volcanoes.

35
00:02:24,650 --> 00:02:28,770
Researchers use CERES data and similar data sets

36
00:02:28,790 --> 00:02:32,860
from the past, to establish a long term trend that encompasses

37
00:02:32,880 --> 00:02:36,980
all those factors and the natural variation of the Earth’s radiation budget.

38
00:02:37,000 --> 00:02:41,080

Loeb: If you want to look at changes in the system

39
00:02:41,100 --> 00:02:45,160
that are significant that might be associated with

40
00:02:45,180 --> 00:02:49,200
actual global warming, you have to measure

41
00:02:49,220 --> 00:02:53,310
above that natural variablility, so you need a long record.

42
00:02:53,330 --> 00:02:57,340
Narration: The CERES instruments and their predecessors have been taking the Earth's temperature for almos

43
00:02:57,360 --> 00:03:01,530
and this data can be used in conjunction with other measurements of the Earth's vital signs.

44
00:03:01,550 --> 00:03:05,710
Loeb: And so having the CERES measurements, the ocean

45
00:03:05,730 --> 00:03:09,890
heat storage measurements, measurements of sea level rise,

46
00:03:09,910 --> 00:03:14,070
measurements of land ice volume, all of those should give you

47
00:03:14,090 --> 00:03:18,250
a coherent picture of how things are changing