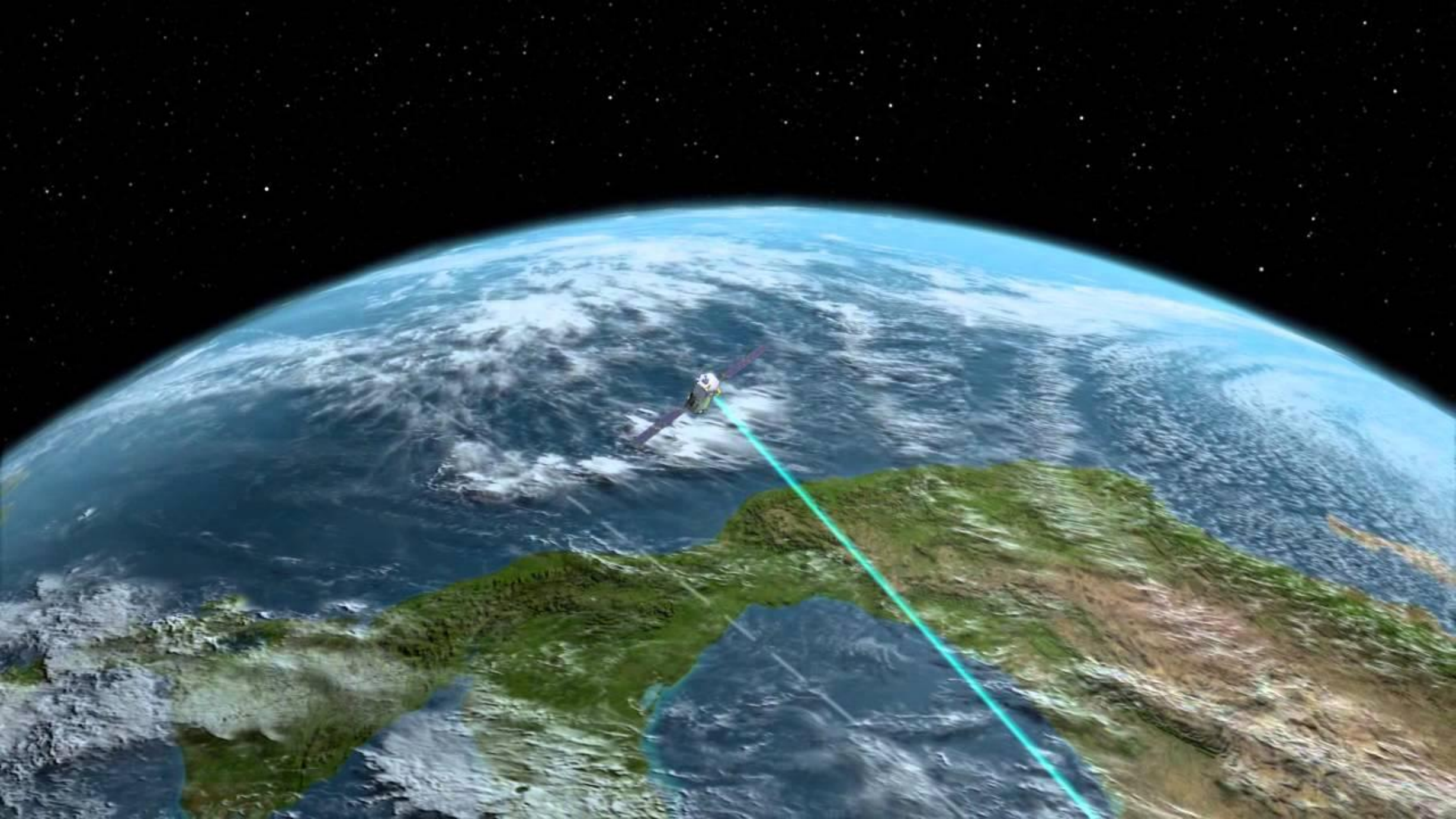

1
00:00:03,800 --> 00:00:10,450
Carbon dioxide is a very, very important gas
and it's building up rapidly in our atmosphere.

2
00:00:10,450 --> 00:00:17,140
We're tipping towards warmer conditions. So
buildup of carbon dioxide in the atmosphere,

3
00:00:17,140 --> 00:00:22,220
buildup of greenhouse gases in the atmosphere,
is going to lead to a warmer world.

4
00:00:24,160 --> 00:00:30,960
There is quite a lot of urgency to see what
we can get from a satellite like OCO-2.

5
00:00:32,750 --> 00:00:33,750
Take a breath.

6
00:00:35,390 --> 00:00:41,059
As you exhale, you're releasing carbon dioxide
into the air around you. On a small scale,

7
00:00:41,060 --> 00:00:45,940
you've just demonstrated a process that's
repeated, every moment, around the world.

8
00:00:46,000 --> 00:00:51,359
Natural and manmade sources pour carbon dioxide
into the atmosphere, while plants and the

9
00:00:51,359 --> 00:00:56,579
ocean absorb it . . . and sometimes release
a portion of it back into the air.

10
00:00:56,579 --> 00:01:01,219
This is the "global carbon cycle." The Earth
itself is breathing.

11

00:01:01,219 --> 00:01:07,320
NASA's Orbiting Carbon Observatory-2, or OCO-2,
is designed to study this process from a whole

12
00:01:07,320 --> 00:01:08,460
new perspective.

13
00:01:11,360 --> 00:01:17,620
OCO-2 is based on the original Orbiting Carbon
Observatory mission launched in February 2009.

14
00:01:17,730 --> 00:01:22,900
However, that mission ended before it even
began, as a launch vehicle failure resulted

15
00:01:22,900 --> 00:01:25,940
in the loss of the satellite shortly after
liftoff.

16
00:01:27,900 --> 00:01:35,260
But by the time the sun rose the next morning,
we had already started to formulate plans

17
00:01:35,280 --> 00:01:40,380
to restart the mission; that turned out to
be a very long process.

18
00:01:40,380 --> 00:01:45,540
The restart became OCO-2, which is nearly
identical to the lost OCO satellite.

19
00:01:46,440 --> 00:01:51,640
The body of the spacecraft -- called the "bus" -- is a hexagon-shaped cylinder measuring about

20
00:01:51,640 --> 00:01:57,040
three by six-and-a-half feet. A pair of 10-foot-long
solar array wings generate

21
00:01:57,080 --> 00:01:59,340
power for OCO-2's systems.

22
00:02:00,290 --> 00:02:05,480
The satellite carries one very important instrument
designed to peer down through the atmosphere

23
00:02:05,480 --> 00:02:10,140
and precisely measure the quantity of carbon
dioxide it finds there.

24
00:02:10,140 --> 00:02:17,140
CO2 is a colorless, odorless gas that's formed
when one carbon molecule binds to two oxygen

25
00:02:17,180 --> 00:02:22,250
molecules. It's a greenhouse gas, meaning
it absorbs and then traps radiation that's

26
00:02:22,250 --> 00:02:24,540
reflected from the Earth's surface.

27
00:02:24,540 --> 00:02:29,950
The mission's scientific instrument features
a trio of high-resolution spectrometers that

28
00:02:29,950 --> 00:02:33,480
will break this reflected light into its component
colors.

29
00:02:33,480 --> 00:02:38,440
So you can literally measure the brightness
of the light in these colors carbon dioxide

30
00:02:38,440 --> 00:02:43,370
absorbs, and count the number of molecules
throughout the atmospheric column from the

31
00:02:43,370 --> 00:02:44,950
top to the bottom.

32

00:02:44,950 --> 00:02:51,350
Earth's plants and oceans absorb carbon dioxide,
and also emit it back into the atmosphere.

33
00:02:51,350 --> 00:02:55,880
This give-and-take is a natural process -- and
has taken place as long as there's been life

34
00:02:55,880 --> 00:02:57,260
on the planet.

35
00:02:57,260 --> 00:03:02,850
But that balance began to shift with the dawn
of the Industrial Age. That's when human activities

36
00:03:02,850 --> 00:03:09,750
began to pump more and more carbon dioxide
into the atmosphere.

37
00:03:09,750 --> 00:03:16,750
But the amazing thing is that half of that
buildup has occurred since 1980. And one quarter

38
00:03:17,480 --> 00:03:24,480
of that buildup has happened since 2001. So
the rates of buildup of carbon dioxide in

39
00:03:24,480 --> 00:03:30,740
our atmosphere, mainly from burning fossil
fuels and other human activities, is growing

40
00:03:30,740 --> 00:03:33,930
faster and faster as time goes on.

41
00:03:33,930 --> 00:03:38,620
From its vantage point in orbit, OCO-2 will
be able to track Earth's atmospheric carbon

42
00:03:38,620 --> 00:03:43,020
dioxide around the globe -- about twice a

month, through every season, for at least

43
00:03:43,020 --> 00:03:44,920
two years.

44
00:03:44,920 --> 00:03:49,540
Although humans have been adding significant
amounts of carbon dioxide to the atmosphere

45
00:03:49,540 --> 00:03:54,680
over the past two centuries, it also appears
that Earth's plants and oceans have been absorbing

46
00:03:54,680 --> 00:03:56,560
more than usual.

47
00:03:56,560 --> 00:04:01,060
Where this additional carbon dioxide is going
is one of the big mysteries scientists hope

48
00:04:01,060 --> 00:04:02,310
to solve with OCO-2.

49
00:04:04,580 --> 00:04:08,640
As the chlorophyll in plants absorbs sunlight and carbon dioxide

50
00:04:08,720 --> 00:04:11,060
to create carbohydrates through photosynthesis,

51
00:04:11,620 --> 00:04:15,320
they re-emit small fractions of this energy as fluorescence.

52
00:04:15,860 --> 00:04:21,239
The instrument on board OCO-2
will be able to detect this "chlorophyll florescence,"

53
00:04:21,239 --> 00:04:25,439
allowing scientists to see where plants are
actively growing -- and whether there's a

54
00:04:25,439 --> 00:04:28,749
response in atmospheric CO2.

55
00:04:28,749 --> 00:04:33,150
And the two in combination, carbon dioxide
in the atmosphere AND an indicator of how

56
00:04:33,150 --> 00:04:39,499
effective plants are at taking CO2 out of
the atmosphere -- it' s just an impossibly

57
00:04:39,499 --> 00:04:43,460
brilliant combination from a science point
of view.

58
00:04:43,460 --> 00:04:50,300
OCO-2 will circle Earth every 99 minutes.
As it sweeps from south to north, across the sunlit hemisphere.

59
00:04:50,440 --> 00:04:54,980
It will pass overhead
around 1:30 in the afternoon, local time.

60
00:04:54,990 --> 00:05:01,619
After about a 16-day period, we're back on
exactly the same ground track. That gives

61
00:05:01,629 --> 00:05:06,819
us the opportunity to map out the whole Earth
a couple of times a month.

62
00:05:06,819 --> 00:05:12,089
But first, OCO-2 has to get into the right
place in Earth orbit. The spacecraft will

63
00:05:12,089 --> 00:05:18,889
get its boost into orbit from a Delta II rocket,
a reliable vehicle with a "workhorse" reputation.

64
00:05:18,889 --> 00:05:24,490
NASA's Launch Services Program ensures the
spacecraft and rocket are ready to fly, and

65
00:05:24,490 --> 00:05:28,750
manages the countdown and liftoff, working
in tandem with rocket provider

66
00:05:28,750 --> 00:05:30,219
United Launch Alliance.

67
00:05:30,760 --> 00:05:35,979
The NASA Launch Services Program team has
been preparing for the OCO-2 mission for almost

68
00:05:35,979 --> 00:05:42,979
two years now. This will be our first Delta
II launch in just over two and a half years,

69
00:05:42,980 --> 00:05:48,960
and we've been very focused on integrating
the OCO-2 spacecraft onto the Delta II.

70
00:05:48,960 --> 00:05:53,969
The launch team is based at the Kennedy
Space Center in Florida, but they travel

71
00:05:53,969 --> 00:05:58,770
frequently to Vandenberg Air Force Base to
make sure everything's on track.

72
00:05:58,770 --> 00:06:04,349
OCO-2 has to launch from the California site
in order to accomplish its mission.

73
00:06:04,349 --> 00:06:10,360
The OCO-2 mission requires a polar orbit.
That's an orbit that would cross the north

74

00:06:10,360 --> 00:06:16,960
and south poles, and covers a tremendous amount
of area of the surface of the Earth. And the

75
00:06:16,960 --> 00:06:21,969
only way to achieve a polar orbit from U.S.
soil is from Vandenberg Air Force Base in

76
00:06:21,969 --> 00:06:23,460
California.

77
00:06:23,460 --> 00:06:28,680
Months before launch, the Delta II was transported
from the manufacturing facility in Decatur,

78
00:06:28,680 --> 00:06:33,660
Alabama to Vandenberg, where the stages were stacked
together at Space Launch Complex 2.

79
00:06:34,600 --> 00:06:36,880
When everything's checked out, they'll start building

80
00:06:36,889 --> 00:06:41,759
the rocket on the pad, kind of like a LEGO
system. So you'll start with the first stage,

81
00:06:41,759 --> 00:06:46,129
and then the second stage, which will be the
top part of the rocket. You attach the solid

82
00:06:46,129 --> 00:06:49,789
motors on the outside, which are the three,
white little motors that are attached to the

83
00:06:49,789 --> 00:06:55,990
base of the rocket. And then just check it
out and make sure, as a whole, that it works.

84
00:06:55,990 --> 00:07:01,229
The spacecraft was assembled by Orbital Sciences

Corporation and tested at its facility in

85
00:07:01,229 --> 00:07:07,749
Gilbert, Arizona, then trucked to the launch
site for final checkouts and functional tests.

86
00:07:07,749 --> 00:07:11,710
After the satellite is installed atop the
rocket, it's enclosed in the fairing that

87
00:07:11,710 --> 00:07:15,699
will protect it during the first minutes of
its climb to orbit.

88
00:07:15,699 --> 00:07:20,399
Once the countdown begins, the launch team
will spend the night at their consoles, monitoring

89
00:07:20,399 --> 00:07:23,909
the health of the Delta II rocket and the
OCO-2 spacecraft.

90
00:07:23,909 --> 00:07:29,069
OCO-2 is going to be launching just before
3 o'clock in the morning so we will be arriving

91
00:07:29,069 --> 00:07:34,340
on console approximately 10 o'clock at night.
And on launch day it's really a joy to sit

92
00:07:34,349 --> 00:07:41,880
back and watch our NASA team work hand in
hand with our contractor team from United Launch Alliance.

93
00:07:41,880 --> 00:07:46,920
and also with our fellow government team from
the U.S. Air Force at Vandenberg Air Force

94
00:07:46,930 --> 00:07:52,729
Base, and see this whole team pulling all

their components together that are required

95
00:07:52,729 --> 00:07:58,179
for the launch vehicle, the spacecraft and
the range, so that we're all ready for liftoff

96
00:07:58,179 --> 00:07:59,239
at T-0.

97
00:07:59,720 --> 00:08:05,440
After years of careful planning, the Orbiting
Carbon Observatory-2 mission finally is about

98
00:08:05,449 --> 00:08:06,860
to begin.

99
00:08:06,860 --> 00:08:11,259
This is the most exciting period of any project
life cycle. You're counting down the days

100
00:08:11,259 --> 00:08:16,110
to get ready for launch. And then hopefully,
if everything goes successfully, you start

101
00:08:16,110 --> 00:08:23,110
seeing that data come back, and all the work
-- which is many, many years of work -- come

102
00:08:23,289 --> 00:08:27,509
to fruition.
If you look at the big scheme of where we

103
00:08:27,509 --> 00:08:34,500
are in understanding climate change, the impact
of increasing greenhouse gases in the atmosphere,

104
00:08:34,500 --> 00:08:35,789
this is really important.