1
00:00:01,700 --> 00:00:05,480
Doug Morton: The forests of Puerto Rico are always changing.

2
00:00:05,500 --> 00:00:08,260
Following Hurricane Maria, they've changed a lot.

3
00:00:08,280 --> 00:00:10,330
But by taking measurements on the ground,

4
00:00:10,350 --> 00:00:12,250
in the air, and from space,

5
00:00:12,270 --> 00:00:14,620
we're able to not only identify those changes,

6
00:00:14,640 --> 00:00:16,340
but also follow them through time

7
00:00:16,360 --> 00:00:18,620
as these landscapes recover the lush tropical forests

8
00:00:18,640 --> 00:00:20,570
they had before the storm.

9
00:00:20,590 --> 00:00:22,410
Narrator: NASA scientists were in Puerto Rico

10
00:00:22,430 --> 00:00:26,720
in early 2017, studying how forests grow and change.

11
00:00:26,740 --> 00:00:29,760
They returned in 2018 to assess the forest recovery

12
00:00:29,780 --> 00:00:32,110
after two hurricanes hit the island.

13
00:00:32,130 --> 00:00:34,440

Doug: In many ways, Hurricane Maria has reset

14
00:00:34,460 --> 00:00:37,480
patches of forest across the island.

15
00:00:37,500 --> 00:00:40,080
Canopy trees normally have a large and

16
00:00:40,100 --> 00:00:42,160
sometimes circular crown allowing them

17
00:00:42,180 --> 00:00:44,490
to spread their leaves, photosynthesize, and

18
00:00:44,510 --> 00:00:46,280
live in the top of the canopy.

19
00:00:46,300 --> 00:00:47,680
Hurricane Maria came through and

20
00:00:47,700 --> 00:00:49,980
ripped off many of those large branches,

21
00:00:50,000 --> 00:00:53,630
leaving individuals standing almost like an individual stem.

22
00:00:53,650 --> 00:00:55,330
What that means is they'll have to regrow

23
00:00:55,350 --> 00:00:58,310
those leaves or give up that space in the canopy

24
00:00:58,330 --> 00:01:02,850
to their neighbors as they regrow beneath them.

25
00:01:02,870 --> 00:01:05,080
Narrator: The team returned to the specific plots

26
00:01:05,100 --> 00:01:06,380
they measured the previous year,

27
00:01:06,400 --> 00:01:09,080
hiking through the thick under brush that had grown

28
00:01:09,100 --> 00:01:13,380
since the hurricane opened up the canopy.

29
00:01:13,400 --> 00:01:18,590
A bit like this, Ian?

30
00:01:23,030 --> 00:01:24,480
Doug: When this large tree fell,

31
00:01:24,500 --> 00:01:26,660
it took out most of its neighbors

32
00:01:26,680 --> 00:01:29,350
and created a large gap in the forest where sunlight

33
00:01:29,370 --> 00:01:31,980
will now reach all the way down to the forest floor.

34
00:01:32,000 --> 00:01:35,870
That will allow new, young trees to grow back in its place.

35
00:01:35,890 --> 00:01:38,320
In contrast, on this side of the plot,

36
00:01:38,340 --> 00:01:41,550
many of the large trees were stripped of their large branches

37
00:01:41,570 --> 00:01:44,250
but they are still standing and most of them will recover

38
00:01:44,270 --> 00:01:49,510

those leaves and grow back into the space they left behind.

39
00:01:49,530 --> 00:01:51,740
Narrator: But with forests covering half of the island,

40
00:01:51,760 --> 00:01:58,872
walking up to every tree was not practical.

41
00:02:01,550 --> 00:02:03,210
Bruce: So, my name is Bruce Cook,

42
00:02:03,230 --> 00:02:05,000
I'm from NASA Goddard Space Flight Center.

43
00:02:05,020 --> 00:02:08,280
I'm here today in Puerto Rico, assessing damage

44
00:02:08,300 --> 00:02:10,700
that was caused by both Hurricanes Irma and Maria.

45
00:02:10,720 --> 00:02:12,940
And we're doing it with this instrument to my right,

46
00:02:12,960 --> 00:02:14,560
which is called G-LiHT.

47
00:02:14,580 --> 00:02:18,350
G-LiHT stands for Goddard's Lidar, Hyperspectral, and Thermal instrument.

48
00:02:18,370 --> 00:02:21,070
And it’s using multiple sensors to actually understand

49
00:02:21,090 --> 00:02:24,890
more about terrestrial ecosystems

50
00:02:24,910 --> 00:02:27,780
Narrator: G-LiHT is installed on a small airplane

51
00:02:27,800 --> 00:02:34,680
and flown at low altitudes to collect lots of measurements in one pass.

52
00:02:34,700 --> 00:02:38,010
Bruce: The lidar is being used to measure changes

53
00:02:38,030 --> 00:02:39,310
in the structure of the forest canopy,

54
00:02:39,330 --> 00:02:42,320
how many branches were lost, how many trees were knocked over,

55
00:02:42,340 --> 00:02:44,760
but we're also using other sensors that measure things

56
00:02:44,780 --> 00:02:48,450
such as how much, or what changes in the amount of sunlight

57
00:02:48,470 --> 00:02:50,380
that's being absorbed by these canopies and

58
00:02:50,400 --> 00:02:54,440
how that's affecting their photosynthesis and growth these days.

59
00:02:54,460 --> 00:02:57,620
Narrator: The lidar sends out five hundred thousand laser pulses

60
00:02:57,640 --> 00:02:59,070
each second and can detect the physical structure of individual trees.

61
00:03:03,760 --> 00:03:05,570
Doug: That laser energy from our lidar system

62
00:03:05,590 --> 00:03:07,520
will intersect the top of the canopy,

63
00:03:07,540 --> 00:03:09,160

smaller branches on the way down,

64
00:03:09,180 --> 00:03:10,880
and all the way down to this understory vegetation on the ground

65
00:03:10,900 --> 00:03:16,430
to help us construct a three-dimensional model of these forests

66
00:03:16,450 --> 00:03:19,190
Narrator: But even though G-LiHT collects several types of data,

67
00:03:19,210 --> 00:03:23,600
it's not enough to fully understand how forests react to changes.

68
00:03:23,620 --> 00:03:27,560
Measurements from the ground level are a necessary complement.

69
00:03:27,580 --> 00:03:29,630
Doug: The same laser technology on G-LiHT

70
00:03:29,650 --> 00:03:31,830
can be put on a tripod on the ground

71
00:03:31,850 --> 00:03:34,410
and make very detailed measurements of individual trees,

72
00:03:34,430 --> 00:03:37,550
the vines and lianas that hang from those trees

73
00:03:37,570 --> 00:03:39,470
as well as the damage that's occurred.

74
00:03:39,490 --> 00:03:41,500
Bruce: This is a partnership and it involves

75
00:03:41,520 --> 00:03:43,730
both the data from the ground,

76
00:03:43,750 --> 00:03:46,190
but also the data from the airborne instrument,

77
00:03:46,210 --> 00:03:48,040
as well as data from the satellite.

78
00:03:48,060 --> 00:03:50,010
So we call this scaling, when we can scale

79
00:03:50,030 --> 00:03:53,010
for ground measurements all the way up to satellites,

80
00:03:53,030 --> 00:03:59,009
and it just helps us understand what is going on from a larger picture.

81
00:04:01,290 --> 00:04:04,080
Doug: By being able to take information about the changes

82
00:04:04,100 --> 00:04:06,600
and the recovery of these landscapes over time,

83
00:04:06,620 --> 00:04:09,500
we're able to connect the changes in the carbon cycle,

84
00:04:09,520 --> 00:04:11,860
the changes in tropical forests and their functioning,

85
00:04:11,880 --> 00:04:14,750
even the changes in the strength and intensity of hurricanes

86
00:04:14,770 --> 00:04:17,630
and understand how those changes observed today

87
00:04:17,650 --> 00:04:20,130
help us understand and predict tomorrow's changes

88
00:04:20,150 --> 00:04:22,840

as well as the imprint of that hurricane