
EPISODE TWO
DESIGNING FOR THE FUTURE

1
00:00:00,550 --> 00:00:01,980
(on-screen text) Landsat 9: Continuing the Legacy

2
00:00:02,000 --> 00:00:04,530
Matt Bromley: Absolutely. As a native Nevadan,

3
00:00:04,550 --> 00:00:06,980
we're aware of the value of water.

4
00:00:07,000 --> 00:00:11,200
(on-screen text) Episode Two: Designing for the Future

5
00:00:13,710 --> 00:00:15,010
Narrator: This is Matt Bromley.

6
00:00:15,030 --> 00:00:18,330
Understanding water scarcity? That's his second nature.

7
00:00:18,350 --> 00:00:20,730
He's one of the key players tracking water usage

8
00:00:20,750 --> 00:00:23,970
in Nevada and the western United States from space.

9
00:00:23,990 --> 00:00:26,380
Matt Bromley: Everything from public service commercials

10
00:00:26,400 --> 00:00:29,500
telling you to turn off your faucet while you're brushing your teeth

11
00:00:29,520 --> 00:00:32,880
to knowing which days you're allowed to water your lawn

12
00:00:32,900 --> 00:00:36,360
based off of whether or not you have an odd or even address.\h

13
00:00:37,800 --> 00:00:42,120

There's years where the water in the river is very, very low,

14
00:00:42,140 --> 00:00:44,530
and then there's years where it's really plentiful.

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00:00:44,550 --> 00:00:49,150
And so we're really tied into that variability from year to year.

16
00:00:49,640 --> 00:00:51,680
Narrator: For a state like Nevada, somewhere between

17
00:00:51,700 --> 00:00:55,540
70 and 80% of the water in the state is used for agriculture.\h

18
00:00:55,560 --> 00:00:59,360
Matt Bromley: And so if we can do better with managing irrigation water

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00:00:59,380 --> 00:01:03,510
agricultural water, it goes a long way with water conservation.\h\h

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00:01:03,530 --> 00:01:07,480
Narrator: The Landsat program has had its eyes in the sky for almost 50 years.

21
00:01:07,500 --> 00:01:10,080
Remember how USGS and NASA teamed up,

22
00:01:10,100 --> 00:01:12,750
made a revolutionary satellite and launched into space?\h

23
00:01:12,770 --> 00:01:14,790
Yeah, that was great.

24
00:01:14,810 --> 00:01:17,990
The point is, Landsat's success is due in large part

25
00:01:18,010 --> 00:01:19,700
to its forwarding-thinking tech.

26
00:01:19,720 --> 00:01:22,700
Each new generation produces better and better measurements.

27
00:01:22,720 --> 00:01:25,190
And you can't conserve what you can't measure.

28
00:01:25,210 --> 00:01:29,430
Phil Dabney: Just in agriculture, the ability to

29
00:01:29,450 --> 00:01:31,770
look at the consumption of water...

30
00:01:31,790 --> 00:01:37,610
the economic value of Landsat to agriculture alone

31
00:01:37,630 --> 00:01:42,360
is several times the cost, or a few times the cost, of the entire system.

32
00:01:42,380 --> 00:01:44,430
And that's pretty significant.

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00:01:44,450 --> 00:01:46,320
Narrator: That's Phil Dabney.

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00:01:46,340 --> 00:01:49,600
A self proclaimed dinosaur, Phil has worked for Landsat

35
00:01:49,620 --> 00:01:51,890
since Landsat 7 back in the nineties.

36
00:01:51,910 --> 00:01:54,240
Phil Dabney: It's always been about the detector,

37
00:01:54,260 --> 00:01:56,660
I actually had a bumper sticker that people tease me

38
00:01:56,680 --> 00:01:59,850

that only, uh, the nerds at NASA would understand.

39
00:01:59,870 --> 00:02:01,710
And that was "it's the detector stupid!"

40
00:02:01,730 --> 00:02:03,730
And that's been our limitation.

41
00:02:03,750 --> 00:02:05,610
Narrator: The detector that Phil is talking about

42
00:02:05,630 --> 00:02:09,410
is basically the most important piece of technology on the entire satellite.

43
00:02:09,430 --> 00:02:11,790
It's where light gets turned into data.

44
00:02:11,810 --> 00:02:14,780
In the early days, the detector was made out of just silicon,

45
00:02:14,800 --> 00:02:17,900
the same material you'd find in your smartphone camera today.

46
00:02:17,920 --> 00:02:20,790
Technological limitations prevented Landsat

47
00:02:20,810 --> 00:02:24,130
from seeing anything too far beyond the visible light spectrum.\h

48
00:02:24,150 --> 00:02:28,820
Fast forward to today, when our detectors span infrared frequencies.

49
00:02:28,840 --> 00:02:31,200
Landsat 8's thermal sensor is so sensitive,

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00:02:31,220 --> 00:02:35,180
scientists can calculate Earth's temperatures down to a fraction of a degree.\h

51
00:02:35,200 --> 00:02:38,510
Phil Dabney: The addition of thermal is a major addition.

52
00:02:38,530 --> 00:02:41,900
And then things came out of that like evapotransporation,

53
00:02:41,920 --> 00:02:46,340
the ability to estimate how much water the plants are taking out of the ground

54
00:02:46,360 --> 00:02:51,010
based on how well they can cool themselves by sweating essentially.

55
00:02:51,030 --> 00:02:55,420
And, and that's been used a lot in agriculture water managment.

56
00:02:55,440 --> 00:02:58,170
Narrator: This detector seems to be a pretty big deal.

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00:02:58,190 --> 00:02:59,820
But what does it do?

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00:02:59,840 --> 00:03:01,700
I'm so glad you asked.

59
00:03:01,720 --> 00:03:04,160
There are two instruments aboard Landsat 9.

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00:03:04,180 --> 00:03:06,020
So that means there are different detectors.

61
00:03:06,040 --> 00:03:07,960
Let's start with OLI.

62
00:03:07,980 --> 00:03:09,670
When you're building hardware for space flight,

63
00:03:09,690 --> 00:03:13,310

you have to keep it in a clean room to protect it from any dust that might block light

64
00:03:13,330 --> 00:03:15,780
…and OLI is all about light.

65
00:03:15,800 --> 00:03:19,410
Once in orbit, OLI collects sunlight reflected off Earth's surface.

66
00:03:19,430 --> 00:03:21,690
The reflected light bounces between a few mirrors

67
00:03:21,710 --> 00:03:24,760
to focus the beam on a plane of detectors, all lined up in a row.

68
00:03:24,780 --> 00:03:26,610
The light passes through a set of filters,

69
00:03:26,630 --> 00:03:29,090
to separate out nine specific wavelength bands,

70
00:03:29,110 --> 00:03:31,800
in visible and infrared frequencies.

71
00:03:31,820 --> 00:03:35,060
Each band provides different pieces of information about the land cover.

72
00:03:36,260 --> 00:03:40,070
The second instrument aboard Landsat 9, called TIRS, is a little different.

73
00:03:40,090 --> 00:03:42,290
It collects the thermal infrared wavelengths,

74
00:03:42,310 --> 00:03:45,040
or "temperature signatures" emitted by the Earth itself.

75
00:03:45,060 --> 00:03:47,250
But to accurately calculate the temperature,

76
00:03:47,270 --> 00:03:50,480
the detector needs to be much colder than what it is measuring from Earth.

77
00:03:50,500 --> 00:03:52,500
So along with the lenses and the detectors,

78
00:03:52,520 --> 00:03:56,440
TIRS carries a condenser that cools the detectors down to 43 Kelvin.

79
00:03:57,400 --> 00:04:00,620
That's -382 degrees Fahrenheit!

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00:04:00,640 --> 00:04:03,300
To put it all together, let's go to an engineer.

81
00:04:03,320 --> 00:04:07,820
Melody Djam: The spacecraft is not just a piece of structure

82
00:04:07,840 --> 00:04:09,160
that holds this instrument.

83
00:04:09,180 --> 00:04:14,400
The spacecraft responsibility is to provide the juice or information

84
00:04:14,420 --> 00:04:17,580
or power that the instrument needs in order to function.

85
00:04:17,600 --> 00:04:21,340
Narrator: Melody's right. The detector may be the most important part of the spacecraft,

86
00:04:21,360 --> 00:04:24,080
but it's far from being only tech on board.

87
00:04:24,100 --> 00:04:27,800
As the TIRS-2 Deputy Project Manager and systems engineer by trade,

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00:04:27,820 --> 00:04:31,570

she understands first hand what kinds of life-support systems are required

89
00:04:31,590 --> 00:04:34,190
to keep these two instruments operational.

90
00:04:34,210 --> 00:04:38,240
Picture this: The entire satellite stands about 15 feet tall

91
00:04:38,260 --> 00:04:40,590
and is the length of a school bus.

92
00:04:40,610 --> 00:04:44,300
TIRS-2 and OLI-2 occupy about this much space.

93
00:04:44,320 --> 00:04:47,270
The rest is occupied by other critical systems

94
00:04:47,290 --> 00:04:50,520
that power the satellite, cool the instruments down, package the data,

95
00:04:50,540 --> 00:04:53,670
send it back to Earth, along with many other duties.

96
00:04:56,230 --> 00:05:00,890
Melody Djam: And looking at the data and seeing the smile from the scientists

97
00:05:00,910 --> 00:05:02,350
that they're getting the right data,

98
00:05:02,370 --> 00:05:07,700
that by itself is great, a great experience.

99
00:05:07,720 --> 00:05:09,980
Matt Bromley: Yeah, so I don't know if you noticed,

100
00:05:10,000 --> 00:05:12,800
but I get kind of a smile when I start thinking of this Landsat data,

101
00:05:12,820 --> 00:05:14,630
because it is very unique.

102
00:05:14,650 --> 00:05:18,800
It's very special and it feels good to be part of work like this.

103
00:05:20,440 --> 00:05:23,060
Phil Dabney: Yeah, it's being surrounded by people that can do,

104
00:05:23,080 --> 00:05:27,660
you know, failure is not an option, which is a famous NASA phrase.

105
00:05:27,680 --> 00:05:32,400
We can do that. We'll make it happen. [chuckles]

106
00:05:32,420 --> 00:05:37,860
Narrator: It's clear that Landsat tech is delivering on its promise to provide game-changing data.

107
00:05:37,880 --> 00:05:41,580
Landsat 9 represents the best of what NASA has to offer.

108
00:05:41,600 --> 00:05:45,160
But what happens when your satellite works so well

109
00:05:45,180 --> 00:05:47,840
that keeping up with all the information it's sending back to Earth

110
00:05:47,860 --> 00:05:50,960
becomes its own monumental challenge?

111
00:05:52,080 --> 00:05:52,800
(on-screen text) Coming Next…

112
00:05:52,820 --> 00:05:55,300
Jeff Masek: You're seeing before your eyes, you know,

113
00:05:55,320 --> 00:05:59,540

how the environment of forest change, how agriculture changes,

114
00:05:59,560 --> 00:06:02,040
urban expansion, the whole, the whole thing,

115
00:06:02,060 --> 00:06:04,620
how the planet has changed over 50 years.

116
00:06:04,640 --> 00:06:08,880
So it's, to me, it's that historical perspective that I find really fascinating.