1
00:00:05,870 --> 00:00:08,530
[Narrator] NASA and the USGS are preparing a new satellite,

2
00:00:08,550 --> 00:00:12,710
the Landsat Data Continuity Mission, called LDCM.

3
00:00:12,730 --> 00:00:16,840
Landsat satellites have been orbiting earth since 1972,

4
00:00:16,860 --> 00:00:20,940
taking scientific measurements of land cover and land use. LDCM is the eighth Landsat satellite

5
00:00:25,260 --> 00:00:21,070
and will continue the world's longest global data record of changes of the Earth's land surfaces.

6
00:00:25,280 --> 00:00:29,440
LDCM data will also play a critical role in monitoring, understanding, and managing

7
00:00:29,460 --> 00:00:33,820
the world's forests, agriculture and water.
[Betsy Forsbacka] What this data is useful for

8
00:00:33,840 --> 00:00:38,000
is to provide information to the scientists, particularly

9
00:00:38,020 --> 00:00:42,180
out in the Western states where water is a very

10
00:00:42,200 --> 00:00:46,360
big deal. This data, this remote data allows them to determine

11
00:00:46,380 --> 00:00:50,540
where areas are being irrigated, and how much and how often.

12
00:00:50,560 --> 00:00:54,710
[Jim Irons] TIRS is the Thermal Infrared Sensor

13

00:00:54,730 --> 00:00:58,840
that is being built and tested here at Goddard Space Flight Center for flight on the

14
00:00:58,860 --> 00:01:02,990
next Landsat mission. It's designed to measure the amount of

15
00:01:03,010 --> 00:01:07,110
thermal radiation emitted by the surface of the earth as a function of the earth's temperature.

16
00:01:07,130 --> 00:01:11,220
All objects that are warmer than zero,

17
00:01:11,240 --> 00:01:15,240
absolute zero, emit radiation.

18
00:01:15,260 --> 00:01:19,290
The hotter an object is, the shorter in wavelength is the peak radiation.

19
00:01:19,310 --> 00:01:23,330
[Narrator] For example, the sun is very hot, about 10,000 degrees,

20
00:01:23,350 --> 00:01:27,460
and its radiation peaks at about 0.5 micrometers. That's exactly in the region

21
00:01:27,480 --> 00:01:31,560
our eyes can see. Earth is much cooler, so its radiation has a much longer

22
00:01:31,580 --> 00:01:35,650
wavelength, about 10 micrometers. And that's in the far infrared region, well beyond

23
00:01:35,670 --> 00:01:39,830
what we can see.
[Jim Irons] So, basically what the Thermal Infrared

24
00:01:39,850 --> 00:01:44,020
Sensor allows us to do is to determine

25
00:01:44,040 --> 00:01:48,330

the temperature of the surface of the earth at different locations around the globe.

26
00:01:48,350 --> 00:01:52,410
[Narrator] Using these surface temperatures, resource managers can determine how fast

27
00:01:52,430 --> 00:01:56,500
a field uses water. Rain or irrigation starts a cycle

28
00:01:56,520 --> 00:02:00,570
in which water ultimately returns to the atmosphere. Evaporation of water

29
00:02:00,590 --> 00:02:05,480
from the ground, and the transpiration of water from leaves, cools off both the soil and the plants.

30
00:02:05,500 --> 00:02:08,560
[Betsy Forsbacka] You put those two words together and you have

31
00:02:08,580 --> 00:02:12,620
the science term, evapotranspiration, and that's precisely what TIRS is measuring.

32
00:02:12,640 --> 00:02:16,660
These hot and cold signatures, that give us

33
00:02:16,680 --> 00:02:20,840
information on evapotranspiration where

34
00:02:20,860 --> 00:02:25,010
the water is transpiring through the plants and evaporating into the atmosphere

35
00:02:25,030 --> 00:02:29,190
The instrument is going to pick that up as a cool signature in areas that are not

36
00:02:29,210 --> 00:02:33,360
irrigated well will come across as a warm area to the instrument.

37
00:02:33,380 --> 00:02:36,450
[Narrator] To measure these warm areas and cool signatures, the TIRS instrument

38
00:02:36,470 --> 00:02:39,620
uses a technology array developed primarily

39
00:02:39,640 --> 00:02:42,670
at NASA's Goddard Space Flight Center, called

40
00:02:42,690 --> 00:02:45,830
Quantum Well Infrared Photodetectors. These QWIPS are

41
00:02:45,850 --> 00:02:48,860
more sensitive and precise than the thermal detectors used on previous

42
00:02:48,880 --> 00:02:52,000
Landsat satellites. But to operate correctly they need to be kept very cold.

43
00:02:52,020 --> 00:02:55,190
[Betsy Forsbacka] They have to be cooled to less than

44
00:02:55,210 --> 00:02:58,310
43 degrees Kelvin and so that's only

45
00:02:58,330 --> 00:03:01,500
43 degrees above absolute zero

46
00:03:01,520 --> 00:03:04,650
which is the coldest you can get. Very, very cold.

47
00:03:04,670 --> 00:03:07,840
[Veronica Otero] The interesting thing about TIRS is we have

48
00:03:07,860 --> 00:03:10,950
different thermal zones, you know like

49
00:03:10,970 --> 00:03:14,120
our detectors are around 43 Kelvin

50
00:03:14,140 --> 00:03:17,220

and then you have our telescope at 180 Kelvin

51
00:03:17,240 --> 00:03:20,400
and then you go to the warmer end of our instrument which is the

52
00:03:20,420 --> 00:03:23,490
structure and some other components that are around,

53
00:03:23,510 --> 00:03:26,670
you know, zero C or 273 Kelvin.

54
00:03:26,690 --> 00:03:29,720
[Narrator] Keeping these different TIRS components at these different temperatures

55
00:03:29,740 --> 00:03:32,850
is challenging because as the satellite orbits the earth every

56
00:03:32,870 --> 00:03:35,890
90 minutes its either being blasted by the heat of the sun or being frozen

57
00:03:35,910 --> 00:03:39,030
by the cold of space.
[Veronica Otero] So you're exposing the

58
00:03:39,050 --> 00:03:42,210
instrument to these two harsh conditions

59
00:03:42,230 --> 00:03:45,360
and you're cycling it from one to the other.

60
00:03:45,380 --> 00:03:48,540
One of the things that we do on our sensor unit is we have multi-

61
00:03:48,560 --> 00:03:51,670
layer insulation blankets. These work really well

62
00:03:51,690 --> 00:03:54,840
in space because there's no

63
00:03:54,860 --> 00:03:57,940
environment, there's no air.

64
00:03:57,960 --> 00:04:01,120
The blankets protect us from these extreme conditions

65
00:04:01,140 --> 00:04:04,230
The other thing we use is we have an earth shield.

66
00:04:04,250 --> 00:04:07,410
[Betsy Forsbacka] It is basically a five foot door.

67
00:04:07,430 --> 00:04:10,510
It's about five feet long and it shields much of the instrument

68
00:04:10,530 --> 00:04:13,670
from the earth, from parts of the earth

69
00:04:13,690 --> 00:04:16,740
that we're not imaging. That's a tremendous help

70
00:04:16,760 --> 00:04:19,920
in trying to make sure that we only detect the signals that we're interested in.

71
00:04:19,940 --> 00:04:22,950
The heat sources that we're interested in.
[Narrator] And detecting those heat

72
00:04:22,970 --> 00:04:27,480
sources accurately helps to monitor water use in irrigated fields.

73
00:04:27,500 --> 00:04:29,160
[Jim Irons] Observations that are collected with

74
00:04:29,180 --> 00:04:32,300
Landsat sensors are much more than pretty pictures.

75
00:04:32,320 --> 00:04:35,480
They are accurate,

76
00:04:35,500 --> 00:04:38,620
well calibrated, precise

77
00:04:38,640 --> 00:04:42,280
scientific measurements. One of the things we're learning

78
00:04:42,300 --> 00:04:44,930
with thermal data and will continue to learn more about

79
00:04:44,950 --> 00:04:48,120
with TIRS is just how much water

80
00:04:48,140 --> 00:04:51,230
is being used for

81
00:04:51,250 --> 00:04:54,410
food production and how much more

82
00:04:54,430 --> 00:04:57,510
might be needed in the future to increase food production

83
00:04:57,530 --> 00:05:00,700
to keep up with a growing population.