
EPISODE TWO:
THE SNOW BELOW

1
00:00:00,020 --> 00:00:04,030
VO: What we think of snow depends a lot on where it falls.

2
00:00:04,050 --> 00:00:08,070
If you live in the eastern U.S., maybe it's fun.

3
00:00:08,090 --> 00:00:12,120
Or, maybe it's just a pain.

4
00:00:12,140 --> 00:00:16,210
Kim: But if you live in parts of the world where they

5
00:00:16,230 --> 00:00:20,240
depend on the water that's in the snow for a large

6
00:00:20,260 --> 00:00:24,320
fraction of their total water that they use for drinking, agriculture,

7
00:00:24,340 --> 00:00:28,370
for industry or for hydropower, the snow is

8
00:00:28,390 --> 00:00:32,400
a very important natural resource. For example, in the western part of the United States,

9
00:00:32,420 --> 00:00:36,450
80 to 90 percent of their renewable water comes from snow.

10
00:01:00,630 --> 00:00:40,480
[music]

11
00:01:00,650 --> 00:01:04,680
have actually encountered before. But it also plays a critical role in

12
00:01:04,700 --> 00:01:08,700
regulating the Earth's climate. Through decades of remote sensing,

13
00:01:08,720 --> 00:01:12,720

NASA has kept a close eye on the ebb and flow of snow cover.

14
00:01:12,740 --> 00:01:16,740
Hall: We now have a 52-year record of

15
00:01:16,760 --> 00:01:20,780
snow cover in the Northern Hemisphere, and we can see

16
00:01:20,800 --> 00:01:24,820
changes in the extent of snow cover over the

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00:01:24,840 --> 00:01:28,840
time period--particularly in the last few decades--where we can see that the snow

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00:01:28,860 --> 00:01:32,860
cover has been retreating. It's been melting a lot earlier in the springtime.

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00:01:32,880 --> 00:01:36,880
Osmanoglu: The extent is relatively easy to do and it has been done over the

20
00:01:36,900 --> 00:01:40,950
years. What's tricky is though how thick is that snow. And

21
00:01:40,970 --> 00:01:44,960
it's even trickier how much water is in that snow.

22
00:01:44,980 --> 00:01:49,000
VO: That tricky part is known as the snow water equivalent, or how much water would actually

23
00:01:49,020 --> 00:01:53,050
be in a layer of snow if it melted. NASA and its partners have taken

24
00:01:53,070 --> 00:01:57,080
to the air to help solve this elusive mystery. First there's the

25
00:01:57,100 --> 00:02:01,130
Airborne Snow Observatory, or ASO, a small

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00:02:01,150 --> 00:02:05,170
plane outfitted with a couple of instruments, one of which measures snow depth using

27
00:02:05,190 --> 00:02:09,200
lidar. Lidar measures distance using light from lasers. Since

28
00:02:09,220 --> 00:02:13,240
2014, ASO has flown over basins in California and

29
00:02:13,260 --> 00:02:17,270
Colorado, taking before and after looks at snow depth.

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00:02:17,290 --> 00:02:21,300
Scientists subtract the snow-free summer data from the snow-on winter

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00:02:21,320 --> 00:02:25,350
data to get an idea of the snow depth. There's no single way to

32
00:02:25,370 --> 00:02:29,390
measure all types of snow across the globe, and so NASA's other airborne

33
00:02:29,410 --> 00:02:33,430
campaign, SnowEx, is testing different combinations of sensors.

34
00:02:33,450 --> 00:02:37,460
This winter, SnowEx will test a new instrument, the Snow

35
00:02:37,480 --> 00:02:41,490
Water Equivalent Synthetic Aperture Radar and Radiometer, or SWESARR.

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00:02:41,510 --> 00:02:45,510
Osmanoglu: SWESARR consists of two main components,

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00:02:45,530 --> 00:02:49,560
one of them being the radar and the second one being the radiometer.

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00:02:49,580 --> 00:02:53,600

Bonds: So with the radar providing the depth of the snow and the radiometer

39
00:02:53,620 --> 00:02:57,680
providing the density of the snow, we can put those two things together and get the

40
00:02:57,700 --> 00:03:01,700
snow water equivalent. Here in the chamber we're going to measure different radiation

41
00:03:01,720 --> 00:03:05,740
patterns that are different frequencies and do some full system testing,

42
00:03:05,760 --> 00:03:09,800
in this chamber. This chamber kind of enables us to isolate

43
00:03:09,820 --> 00:03:13,840
various types of radiation and interference. In about a month,

44
00:03:13,860 --> 00:03:17,880
we're going to take the instrument and mount it on a Twin Otter in the Grand Mesa in Colorado.

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00:03:17,900 --> 00:03:21,900
We're going to fly it over the Grand Mesa and take various different measurements.

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00:03:21,920 --> 00:03:25,950
This is what we call our engineering flight.
VO: Making sure the sensors are calibrated

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00:03:25,970 --> 00:03:29,980
is key in order to face the challenges nature will throw at them.

48
00:03:30,000 --> 00:03:34,000
Kim: Half of the area that gets covered by snow every winter contains trees

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00:03:34,020 --> 00:03:38,060
and forest. And the trees make it difficult for the sensors to

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00:03:38,080 --> 00:03:42,090
see the snow that's underneath the trees so it makes it difficult for us to measure

51
00:03:42,110 --> 00:03:46,110
how much snow there is. After the snow has had a chance to sit on the

52
00:03:46,130 --> 00:03:50,160
ground for a while, it gets denser and denser and denser over time and it changes.

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00:03:50,180 --> 00:03:54,240
Which is another reason why snow is very challenging to remotely sense,

54
00:03:54,260 --> 00:03:58,290
it doesn't stay the same. It's constantly changing.
[shovel digging]

55
00:03:58,310 --> 00:04:02,330
Kim: One of the things that we often do in the field is go dig what we call

56
00:04:02,350 --> 00:04:06,360
a snow pit. You literally dig a pit in the snow so we can see all the different

57
00:04:06,380 --> 00:04:10,380
layers. The layering is very important.
VO: All this digging is part of ground

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00:04:10,400 --> 00:04:14,420
truthing SnowEx, a way of matching up what the airborne instruments see and what

59
00:04:14,440 --> 00:04:18,460
is actually sitting on the surface. The ultimate

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00:04:18,480 --> 00:04:22,500
goal of SnowEx is to figure out what the best combination of instruments

61
00:04:22,520 --> 00:04:26,570
would be for a future satellite mission in order to get a global picture

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00:04:26,590 --> 00:04:30,610
of snow.

Hall: We need to know how much snow is in a

63
00:04:30,630 --> 00:04:34,640
snowpack. Because if we have too much snow and the snow melts

64
00:04:34,660 --> 00:04:38,690
too fast, then you can get flooding. And if you don't

65
00:04:38,710 --> 00:04:42,720
have enough snow or if the snow melts too early, that can lead

66
00:04:42,740 --> 00:04:46,750
to a longer wildfire season, a more

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00:04:46,770 --> 00:04:50,830
intense drought, and we need to know these things for water resource

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00:04:50,850 --> 00:04:55,030
planning.
[music]

69
00:04:55,050 --> 00:04:59,210
Parkinson: After we

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00:04:59,230 --> 00:05:03,270
had a record that was about 15, 20 years long,

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00:05:03,290 --> 00:05:07,460
we started noticing that the extent of

72
00:05:07,480 --> 00:05:11,550
the ice in the Arctic was getting smaller over time.