
THE SCIENCE
OF SNOW
DIGGING FOR DATA

1
00:00:03,889 --> 00:00:01,429
laughs

2
00:00:10,730 --> 00:00:03,899
I didn't think I was tired but I think

3
00:00:10,740 --> 00:00:15,550
yeah Frozen granola

4
00:00:20,750 --> 00:00:18,890
I'm Carrie voyevich I'm a research

5
00:00:25,009 --> 00:00:20,760
scientist at Nasa Goddard I'm a project

6
00:00:27,950 --> 00:00:25,019
scientist for NASA snowx 2023 we're here

7
00:00:36,220 --> 00:00:27,960
in Alaska in Fairbanks measuring snow in

8
00:00:36,230 --> 00:00:54,310
[Music]

9
00:01:08,590 --> 00:00:56,100
hold on to your breakfast

10
00:01:14,270 --> 00:01:11,690
we're in creamers field Farmers Loop

11
00:01:16,609 --> 00:01:14,280
research site right now we have three

12
00:01:18,469 --> 00:01:16,619
sites here in Fairbanks and then we have

13
00:01:20,630 --> 00:01:18,479

two sites on the North Slope in the

14
00:01:24,530 --> 00:01:20,640
tundra

15
00:01:26,770 --> 00:01:24,540
the goal for snowx is to improve our

16
00:01:29,690 --> 00:01:26,780
remote sensing capabilities of snow

17
00:01:31,310 --> 00:01:29,700
different properties of snow in

18
00:01:33,170 --> 00:01:31,320
different environments and at different

19
00:01:35,749 --> 00:01:33,180
times of the season

20
00:01:38,990 --> 00:01:35,759
water is so important to the Western U.S

21
00:01:41,630 --> 00:01:39,000
and they've had some snow droughts over

22
00:01:43,609 --> 00:01:41,640
the past decade and so understanding how

23
00:01:45,830 --> 00:01:43,619
much water is stored in the snow is

24
00:01:48,590 --> 00:01:45,840
super important right now that means

25
00:01:50,510 --> 00:01:48,600
either Airborne measurements or sending

26
00:01:52,550 --> 00:01:50,520
people out to make manual measurements

27
00:01:55,249 --> 00:01:52,560
which doesn't cover the entire Western

28
00:01:56,569 --> 00:01:55,259
U.S so what we're hoping is that our

29
00:01:58,730 --> 00:01:56,579
measurements will help us understand

30
00:02:00,830 --> 00:01:58,740
what technology could be used on a

31
00:02:02,510 --> 00:02:00,840
satellite mission that could then

32
00:02:04,630 --> 00:02:02,520
collect measurements over that entire

33
00:02:07,370 --> 00:02:04,640
area

34
00:02:10,669 --> 00:02:07,380
so kind of core measurements take place

35
00:02:12,470 --> 00:02:10,679
at these the pit locations we take very

36
00:02:15,050 --> 00:02:12,480
detailed profile measurements of the

37
00:02:17,990 --> 00:02:15,060
snow in those pits including temperature

38
00:02:20,630 --> 00:02:18,000

and density liquid water content and

39
00:02:23,449 --> 00:02:20,640
then around those plots we're taking

40
00:02:25,190 --> 00:02:23,459
very detailed depth profiles and then

41
00:02:28,130 --> 00:02:25,200
further out from there we're taking just

42
00:02:30,710 --> 00:02:28,140
a lot more depth measurements

43
00:02:33,190 --> 00:02:30,720
all of that is within the flight lines

44
00:02:36,350 --> 00:02:33,200
of the the radar and the lidar

45
00:02:37,850 --> 00:02:36,360
observations so that we can connect what

46
00:02:41,809 --> 00:02:37,860
those observations see with what we

47
00:02:45,470 --> 00:02:43,729
we're headed to Bonanza Creek

48
00:02:47,930 --> 00:02:45,480
experimental

49
00:02:49,430 --> 00:02:47,940
forest and we're gonna do a bunch of pit

50
00:02:50,750 --> 00:02:49,440
measurements out there and depth

51
00:02:53,990 --> 00:02:50,760
measurements where we characterize

52
00:02:56,150 --> 00:02:54,000
snowpack in different locations and that

53
00:02:58,850 --> 00:02:56,160
will be used for ground Truth for the

54
00:03:02,570 --> 00:02:58,860
air Airborne flights and instruments

55
00:03:05,449 --> 00:03:02,580
that we have flying over the same area

56
00:03:07,190 --> 00:03:05,459
about minus 20 Fahrenheit here right now

57
00:03:09,770 --> 00:03:07,200
and I'm continuing to put on clothes

58
00:03:13,550 --> 00:03:09,780
because I just got out of the truck and

59
00:03:17,110 --> 00:03:13,560
that was pretty warm and I'm changing

60
00:03:20,630 --> 00:03:17,120
body temperature very quickly

61
00:03:23,350 --> 00:03:20,640
and I'm with the USDA natural resources

62
00:03:25,970 --> 00:03:23,360
conservation service we actually are

63
00:03:28,190 --> 00:03:25,980

tasked with making water supply

64
00:03:30,470 --> 00:03:28,200
forecasts for the entire Western United

65
00:03:33,229 --> 00:03:30,480
States we have about 600 different

66
00:03:35,750 --> 00:03:33,239
watersheds that we model and deliver

67
00:03:39,770 --> 00:03:35,760
seasonal runoff forecasts for the reason

68
00:03:42,770 --> 00:03:39,780
why we look at snow density is so that

69
00:03:45,830 --> 00:03:42,780
if you have a given snowpack five feet

70
00:03:48,649 --> 00:03:45,840
tall the amount of water when you melt

71
00:03:50,449 --> 00:03:48,659
it all down could be close to one glass

72
00:03:52,369 --> 00:03:50,459
full of water or it could be more like

73
00:03:53,990 --> 00:03:52,379
three gallons we gotta do these

74
00:03:55,490 --> 00:03:54,000
measurements in the field because even

75
00:03:57,770 --> 00:03:55,500
though there's a lot of technology that

76
00:03:59,930 --> 00:03:57,780
allow us to look at it from a satellite

77
00:04:03,229 --> 00:03:59,940
or a Global Perspective they have

78
00:04:05,089 --> 00:04:03,239
various ranges of accuracy and so doing

79
00:04:08,570 --> 00:04:05,099
it in the field is one of the most

80
00:04:12,530 --> 00:04:10,850
at this site we measure that snow water

81
00:04:15,530 --> 00:04:12,540
equivalent so the snow water equivalence

82
00:04:18,170 --> 00:04:15,540
is the amount of snow you have in one

83
00:04:22,310 --> 00:04:18,180
spot if you melted it into water so it's

84
00:04:25,010 --> 00:04:22,320
the snow water equivalent and that's the

85
00:04:26,450 --> 00:04:25,020
the fundamental Holy Grail parameter

86
00:04:28,550 --> 00:04:26,460
that we're after if we knew how much

87
00:04:30,290 --> 00:04:28,560
water was spatially distributed over the

88
00:04:34,550 --> 00:04:30,300

entire planet that would allow us to

89
00:04:37,430 --> 00:04:34,560
forecast spring runoff much better

90
00:04:39,430 --> 00:04:37,440
all right water resources are just so

91
00:04:42,230 --> 00:04:39,440
critical especially out west

92
00:04:44,030 --> 00:04:42,240
and I think it's really cool to try to

93
00:04:47,390 --> 00:04:44,040
do the science to figure out how much

94
00:04:48,890 --> 00:04:47,400
water we have looking at the snow depths

95
00:04:51,710 --> 00:04:48,900
or the height of the snow from the

96
00:04:53,629 --> 00:04:51,720
ground I'm putting my ruler in the same

97
00:04:55,550 --> 00:04:53,639
spot we took the other measurement so

98
00:04:57,950 --> 00:04:55,560
that we can have two data sets and I

99
00:04:59,570 --> 00:04:57,960
also then look up and note if we have

100
00:05:02,450 --> 00:04:59,580
canopy

101
00:05:05,150 --> 00:05:02,460
um kind of covering the surface we're

102
00:05:07,550 --> 00:05:05,160
intercepting the surface because that's

103
00:05:09,530 --> 00:05:07,560
an important note for our pilots who are

104
00:05:15,110 --> 00:05:09,540
looking over and trying to measure the

105
00:05:20,629 --> 00:05:17,629
the part of snow eggs we are conducting

106
00:05:23,749 --> 00:05:20,639
these Airborne experiments collecting

107
00:05:25,670 --> 00:05:23,759
activate path to microwave radar later

108
00:05:29,450 --> 00:05:25,680
and we are only one part of the tall

109
00:05:32,270 --> 00:05:29,460
effort you see the uh lines on the down

110
00:05:34,370 --> 00:05:32,280
below lots of lines I think that's

111
00:05:35,810 --> 00:05:34,380
essentially the handiwork of the ground

112
00:05:38,510 --> 00:05:35,820
crew

113
00:05:42,370 --> 00:05:38,520

and to validate measurements First

114
00:05:47,330 --> 00:05:44,870
my name is betsu I'm from Mr God at

115
00:05:49,790 --> 00:05:47,340
space flight center I am the pi for the

116
00:05:52,129 --> 00:05:49,800
swissar instrument it's called snow

117
00:05:54,290 --> 00:05:52,139
watery coolant synthetic aperture radar

118
00:05:56,029 --> 00:05:54,300
radiometer it's very similar to have a

119
00:05:58,790 --> 00:05:56,039
batch transmits sounds waves as it's

120
00:06:00,590 --> 00:05:58,800
flying around and then listens to The

121
00:06:03,170 --> 00:06:00,600
Echoes trying to make sense of the world

122
00:06:04,550 --> 00:06:03,180
the three-dimensional world around it we

123
00:06:06,710 --> 00:06:04,560
do the same thing with just the

124
00:06:08,270 --> 00:06:06,720
microwave so our waves travel at the

125
00:06:10,610 --> 00:06:08,280
speed of light they come back to the

126
00:06:12,770 --> 00:06:10,620
antenna we collect them and we process

127
00:06:14,390 --> 00:06:12,780
those Echoes to make sense of the 3D

128
00:06:16,550 --> 00:06:14,400
World

129
00:06:18,230 --> 00:06:16,560
it is in conjunction with the grounds

130
00:06:20,749 --> 00:06:18,240
measurements that the field teams are

131
00:06:22,790 --> 00:06:20,759
doing they're digging snow pits and

132
00:06:25,249 --> 00:06:22,800
collecting other snow observations for

133
00:06:29,210 --> 00:06:25,259
this to validate what this radar and

134
00:06:34,330 --> 00:06:31,370
we are walking to our snow pits and the

135
00:06:38,270 --> 00:06:34,340
tower radar instruments it's super cool

136
00:06:41,749 --> 00:06:38,280
the surface temperature was minus 34 35

137
00:06:45,170 --> 00:06:41,759
Celsius this morning I'm so cool to say

138
00:06:52,070 --> 00:06:47,890

foreign

139
00:06:57,770 --> 00:06:54,830
the radar sensor and so we'll compare

140
00:06:59,450 --> 00:06:57,780
this with the ongoing flights of this

141
00:07:01,309 --> 00:06:59,460
campaign the sensor is particularly

142
00:07:03,770 --> 00:07:01,319
suitable for deep snow or some of the

143
00:07:05,570 --> 00:07:03,780
other techniques are likely much more

144
00:07:07,490 --> 00:07:05,580
suitable for shallow snow so this is

145
00:07:10,610 --> 00:07:07,500
very complementary

146
00:07:12,710 --> 00:07:10,620
so this will take half an hour to finish

147
00:07:15,650 --> 00:07:12,720
so we do four of those transects so this

148
00:07:17,689 --> 00:07:15,660
takes two hours so they want to test

149
00:07:19,550 --> 00:07:17,699
instruments and all these different snow

150
00:07:20,830 --> 00:07:19,560
environments to make sure that they work

151
00:07:25,309 --> 00:07:20,840
globally

152
00:07:28,610 --> 00:07:25,319
Alaska offers a perfect snow to do this

153
00:07:31,070 --> 00:07:28,620
type of test we have arboreal forest and

154
00:07:34,070 --> 00:07:31,080
Arctic Thunder is very different it's

155
00:07:37,309 --> 00:07:34,080
generally shallow but it's much harder a

156
00:07:39,589 --> 00:07:37,319
lot of wind blown features and the

157
00:07:42,710 --> 00:07:39,599
variability is amazing so it was a very

158
00:07:45,550 --> 00:07:42,720
different types of snow and it's

159
00:07:47,930 --> 00:07:45,560
important to see that the

160
00:07:50,689 --> 00:07:47,940
instruments for remote sensing

161
00:07:54,110 --> 00:07:50,699
measurement of snow they do work well in

162
00:07:57,529 --> 00:07:54,120
in this differential environments it is

163
00:08:00,589 --> 00:07:57,539

a massive effort in terms of like

164
00:08:02,150 --> 00:08:00,599
Community participation we would never

165
00:08:04,610 --> 00:08:02,160
have all these measurements on the

166
00:08:06,409 --> 00:08:04,620
ground if our crews were smaller so the

167
00:08:08,270 --> 00:08:06,419
fact that we can get so many people in

168
00:08:11,930 --> 00:08:08,280
one place to take measurements is really

169
00:08:16,550 --> 00:08:14,749
the team has become really close it so

170
00:08:18,710 --> 00:08:16,560
it takes a lot of camaraderie and a lot

171
00:08:20,450 --> 00:08:18,720
of people pitching in you cannot stand

172
00:08:22,430 --> 00:08:20,460
on your heels and watch what's going on

173
00:08:27,570 --> 00:08:22,440
out here everybody has to pitch in and

174
00:08:33,170 --> 00:08:29,390
[Music]

175
00:08:35,510 --> 00:08:33,180
working out in these conditions is is

176
00:08:38,029 --> 00:08:35,520
just physically demanding it's super

177
00:08:41,329 --> 00:08:38,039
cold here in the Boreal forest

178
00:08:42,709 --> 00:08:41,339
snow was very light and fluffy and we

179
00:08:45,230 --> 00:08:42,719
were trumping around in the woods on

180
00:08:47,810 --> 00:08:45,240
snowshoes I mean really in the woods off

181
00:09:00,490 --> 00:08:47,820
Trail and it was just very physically

182
00:09:06,470 --> 00:09:04,130
I am amazed at how how much data was

183
00:09:07,750 --> 00:09:06,480
collected you are an incredible group of

184
00:09:10,420 --> 00:09:07,760
people

185
00:09:11,630 --> 00:09:10,430
this was this was super

186
00:09:15,650 --> 00:09:11,640
[Music]

187
00:09:18,050 --> 00:09:15,660
just a super opportunity and a really

188
00:09:19,850 --> 00:09:18,060

great experience to be part of so I

189
00:09:21,650 --> 00:09:19,860
appreciate all of the hard work and it

190
00:09:23,150 --> 00:09:21,660
was not easy I heard somebody say like

191
00:09:27,829 --> 00:09:23,160
wow you guys work really hard for this

192
00:09:33,300 --> 00:09:28,370
um

193
00:09:36,920 --> 00:09:35,700
[Music]

194
00:09:38,640 --> 00:09:36,930
[Applause]

195
00:09:41,590 --> 00:09:38,650
[Music]