
HOW NASA DECODES THE
SECRETS OF
THE ARCTIC

1
00:00:00,600 --> 00:00:04,004
Narration: There is one place where we're seeing
climate change unfold faster

2
00:00:04,004 --> 00:00:05,338
than anywhere else on Earth.

3
00:00:05,338 --> 00:00:06,673
Here.

4
00:00:07,774 --> 00:00:10,310
In fact, temperatures
in the Arctic and boreal regions

5
00:00:10,310 --> 00:00:13,747
are rising nearly four times
as fast as those in the mid-latitudes.

6
00:00:14,214 --> 00:00:17,684
That's why NASA has teamed up
with local partners to better understand

7
00:00:17,684 --> 00:00:20,520
the vulnerability
and resilience of these ecosystems,

8
00:00:20,987 --> 00:00:24,457
while also gathering valuable data
that will help future Earth-observing

9
00:00:24,457 --> 00:00:26,226
satellites.

10
00:00:26,226 --> 00:00:28,028
From space, air
and on the ground,

11
00:00:28,328 --> 00:00:31,631
we'll see how scientists are piecing

together the story of the Arctic -

12
00:00:31,931 --> 00:00:34,768
from how it is changing to what that means
for our planet.

13
00:00:36,169 --> 00:00:39,672
Because, as they say,
what happens in the Arctic doesn't stay in

14
00:00:39,672 --> 00:00:47,847
the Arctic.

15
00:00:51,851 --> 00:00:53,820
Radio Chatter: PPA is engaged

16
00:00:53,987 --> 00:00:55,889
Radio Chatter: And we're radiating.

17
00:00:55,889 --> 00:00:58,691
Narration: One of the best ways to track
how an environment is changing

18
00:00:58,691 --> 00:01:00,593
is to observe it from above.

19
00:01:00,593 --> 00:01:01,261
But where weather

20
00:01:01,261 --> 00:01:04,664
and vegetation can make it difficult
to see the ground with the naked eye,

21
00:01:05,131 --> 00:01:08,535
specialized radar can pierce the clouds
to give us a crystal clear

22
00:01:08,535 --> 00:01:10,270
look at the landscape.

23
00:01:10,270 --> 00:01:13,006
This special device - weighing nearly
1,000 lbs -

24
00:01:13,339 --> 00:01:17,010
collects data about soil moisture,
vegetation, permafrost

25
00:01:17,010 --> 00:01:19,579
and other environmental processes
on the ground below.

26
00:01:19,879 --> 00:01:23,416
In fact, it's so precise
that NASA developed a special system

27
00:01:23,416 --> 00:01:27,020
for pilots to fly the exact same
flight path year after year

28
00:01:27,387 --> 00:01:31,024
to get an accurate reading as to
how a landscape is changing over time.

29
00:01:31,091 --> 00:01:34,861
Dr. Hoy: So with the airborne data,
we can target exactly where we want to go

30
00:01:34,861 --> 00:01:36,796
and exactly when we want to go there.

31
00:01:36,796 --> 00:01:40,166
And we get very high resolution data
so we can have a really clear picture

32
00:01:40,166 --> 00:01:41,167
of what's on the ground.

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00:01:41,167 --> 00:01:41,901
Narration: That's Dr. Liz Hoy,

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00:01:41,901 --> 00:01:45,105
Senior Scientist for NASA's
ABoVE Mission.

35
00:01:45,505 --> 00:01:49,042
ABoVE has spent the last seven years
studying environmental changes

36
00:01:49,042 --> 00:01:50,577
in the Arctic and boreal regions.

37
00:01:51,511 --> 00:01:54,013
The mission
uses satellite, airborne and ground data

38
00:01:54,013 --> 00:01:57,217
to get a complete picture
of what is unfolding in these ecosystems.

39
00:01:57,951 --> 00:02:01,254
Dr. Hoy: So our satellite data gives us
a very broad picture of what's happening

40
00:02:01,254 --> 00:02:02,956
all over the landscape.

41
00:02:02,956 --> 00:02:04,557
And then with our airborne data,

42
00:02:04,557 --> 00:02:08,528
we can target specific locations and times
when we want to get imagery.

43
00:02:08,828 --> 00:02:11,831
And then we can compare both our satellite
and our airborne data

44
00:02:11,831 --> 00:02:13,266
with what's happening on the ground.

45
00:02:13,266 --> 00:02:16,402
And we have teams actually
out on the ground making measurements.

46
00:02:16,402 --> 00:02:17,971
And putting all that together

47
00:02:17,971 --> 00:02:21,641
is really where we get a lot of the power
of what we're able to study.

48
00:02:22,308 --> 00:02:24,444
Narration: And it all gets put together in Alaska.

49
00:02:25,879 --> 00:02:26,646
On the ground,

50
00:02:26,646 --> 00:02:30,917
These large dishes are used to communicate
with NASA's Earth-observing satellites.

51
00:02:31,618 --> 00:02:34,921
Here, the data is downloaded
and made public, which helps

52
00:02:34,921 --> 00:02:39,159
scientists connect the dots between what
we see from space to on the ground.

53
00:02:39,826 --> 00:02:41,928
But why are these dishes in Alaska?

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00:02:41,928 --> 00:02:45,698
Dr. Meyer: So the reason why these stations,
like ASF, are built in Alaska

55
00:02:46,566 --> 00:02:48,835
is because Earth-observing satellites,

56
00:02:49,202 --> 00:02:52,272
if you think of their orbits,
they converge in the polar regions.

57
00:02:52,839 --> 00:02:57,177
So in Alaska, we can see the same
satellite more often than in the lower 48.

58
00:02:57,777 --> 00:03:00,480
Narration: In fact,
this facility is in the perfect position

59
00:03:00,480 --> 00:03:03,816
to receive data from one of NASA's
latest Earth-observing missions.

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00:03:04,417 --> 00:03:07,954
NISAR is an upcoming satellite
that will be launched by NASA

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00:03:07,954 --> 00:03:11,090
in collaboration with the Indian Space
Research Organization.

62
00:03:11,324 --> 00:03:14,761
It will use radar similar to
what is flown on NASA's airborne missions,

63
00:03:14,761 --> 00:03:19,199
like for ABoVE, to measure fine, centimeter-
scale, changes in Earth's surface.

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00:03:19,232 --> 00:03:23,069
Dr. Meyer: What's interesting and unique about NISAR
is that it's going to cover the globe

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00:03:23,236 --> 00:03:26,639
regularly every 12 days,
and it's going to do it at a

66
00:03:27,006 --> 00:03:31,244
a wavelength or a frequency range,
so-called L-band frequencies,

67
00:03:31,644 --> 00:03:34,013
that are very useful for doing Earth
observations.

68
00:03:34,781 --> 00:03:38,551
L-band will allow us to study ecosystem
changes

69
00:03:38,551 --> 00:03:42,322
and deformations of the Earth's surface
with higher accuracy

70
00:03:42,655 --> 00:03:46,659
and better spatial coverage
than we can with current systems in space.

71
00:03:47,227 --> 00:03:50,163
Narration: And in the Arctic,
some of the most pronounced environmental

72
00:03:50,163 --> 00:03:54,901
changes satellites can observe
are happening right down the road.

73
00:03:54,901 --> 00:03:56,536
And it all starts with this stuff.

74
00:03:57,804 --> 00:03:58,638
Permafrost is

75
00:03:58,638 --> 00:04:02,208
frozen Earth, be it ice, soil

or even organic material

76
00:04:02,375 --> 00:04:04,577
that has been frozen for two
or more years.

77
00:04:05,011 --> 00:04:06,112
Most of Alaska

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00:04:06,112 --> 00:04:10,083
and northern Canada has permafrost beneath
a thin, active layer of soil.

79
00:04:10,550 --> 00:04:13,987
Problem is, when permafrost does
thaw, it can wreak havoc

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00:04:13,987 --> 00:04:16,356
on infrastructure and upend ecosystems.

81
00:04:18,157 --> 00:04:21,127
Dr. Walter Anthony: Not all permafrost contains ice,
but here in interior

82
00:04:21,127 --> 00:04:24,631
Alaska, we have frozen soils
with massive amounts of ice.

83
00:04:24,631 --> 00:04:28,601
There are very large
ice wedges - ice wedges as big as garages.

84
00:04:29,369 --> 00:04:31,471
And so when that ice melts,

85
00:04:31,671 --> 00:04:35,241
the ground surface collapses
and the sinkholes can fill with water.

86

00:04:35,475 --> 00:04:39,178
When that happens, new little ponds
form- thermokarst ponds.

87
00:04:39,379 --> 00:04:43,283
And as thermokarst ponds form, microbes
in the soil feast

88
00:04:43,283 --> 00:04:47,687
on the newly thawed organic material,
releasing methane into the atmosphere -

89
00:04:48,288 --> 00:04:51,824
an extremely potent,
and flammable greenhouse gas.

90
00:04:52,525 --> 00:04:55,795
These newly formed thermokarst ponds
give us an insight

91
00:04:55,795 --> 00:04:58,231
as to what is going to happen in the future.

92
00:04:58,231 --> 00:05:02,502
Dr. Walter Anthony: What we're seeing at this lake
is that the emissions are ten times

93
00:05:02,502 --> 00:05:06,673
higher than the rest of the lakes
and wetlands in the Arctic,

94
00:05:07,206 --> 00:05:10,376
and it's being fueled by thawing
permafrost.

95
00:05:10,877 --> 00:05:15,448
Narration: Scientists are working with ABoVE
and NASA's UAVSAR to study

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00:05:15,448 --> 00:05:18,618

how these lakes are evolving
as the climate continues to warm.

97
00:05:19,218 --> 00:05:22,622
But it's not just thawing permafrost
that is reshaping the Arctic.

98
00:05:23,122 --> 00:05:24,457
It is also wildfire.

99
00:05:25,792 --> 00:05:26,392
In higher

100
00:05:26,392 --> 00:05:30,063
latitudes, forests are adapted to burn
about once every century.

101
00:05:30,530 --> 00:05:33,166
But with warmer temperatures
comes more fires.

102
00:05:33,933 --> 00:05:35,702
And why is this?

103
00:05:35,702 --> 00:05:39,305
Partially because of this stuff,
called duff, forest debris

104
00:05:39,305 --> 00:05:44,143
that slowly builds up on the forest floor,
about one inch every 17 years.

105
00:05:44,544 --> 00:05:47,513
And because of the cold winters,
it doesn't decompose.

106
00:05:47,880 --> 00:05:49,282
Alison: It doesn't have roots.

107

00:05:49,282 --> 00:05:52,485
So it's completely dependent
on relative humidity for moisture.

108
00:05:52,485 --> 00:05:55,988
So it actually dries very rapidly in warm,

109
00:05:55,988 --> 00:05:58,925
dry conditions
like we often have here in the summer.

110
00:05:59,192 --> 00:06:03,329
Narration: Which means of warmer temperatures, duff
becomes a potent fuel for fires.

111
00:06:03,963 --> 00:06:07,233
Alison: Most Alaskans are vulnerable
to wildland fire.

112
00:06:07,233 --> 00:06:11,270
And with climate change,
it seems that the imprint on

113
00:06:11,270 --> 00:06:14,941
the landscape is growing, and so more
and more communities are vulnerable.

114
00:06:15,241 --> 00:06:18,811
Dr. Hoy: When a wildfire comes through,
what we're really seeing is it's actually

115
00:06:18,811 --> 00:06:20,346
it's not just the trees that are burning,

116
00:06:20,346 --> 00:06:22,515
but it's the soil layer that's burning as well.

117
00:06:22,749 --> 00:06:25,752
And so when that fire comes through
and it burns that soil layer, it's

118
00:06:25,752 --> 00:06:30,022
like you're taking off the lid of a cooler
where everything is frozen below.

119
00:06:30,256 --> 00:06:33,393
And so as that soil comes off,
then we start to see the ground

120
00:06:33,393 --> 00:06:35,661
start to thaw and permafrost is thawing there.

121
00:06:36,562 --> 00:06:38,931
And so as we see those changes happening,

122
00:06:39,265 --> 00:06:42,802
we're actually creating
more climate change over time.

123
00:06:42,802 --> 00:06:46,506
So wildfires are releasing
carbon gases into the atmosphere.

124
00:06:46,506 --> 00:06:49,575
And then as permafrost thaws,
it too is releasing carbon

125
00:06:49,575 --> 00:06:53,613
gases into the air,
which then can create warmer conditions

126
00:06:53,846 --> 00:06:56,682
which can allow for more wildfire
and more thaw.

127
00:06:56,883 --> 00:07:00,787
So you really see this cycle
that continues up in boreal forest

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00:07:00,787 --> 00:07:04,023
and Arctic areas over time.

129
00:07:05,024 --> 00:07:07,693
Narration: So the bad news is that as human-caused
climate

130
00:07:07,693 --> 00:07:10,830
change continues to impact the Arctic
and boreal landscapes,

131
00:07:11,664 --> 00:07:14,834
those living both near
and far will continue to feel its effects.

132
00:07:16,035 --> 00:07:19,372
But the good news is that there is a team
of dedicated scientists,

133
00:07:19,372 --> 00:07:23,242
across a variety of disciplines,
that are working together to give us

134
00:07:23,242 --> 00:07:26,612
a complete picture of these ecosystems
and how they are changing.