
EARTH'S LEAKY
ATMOSPHERE

1
00:00:05,349 --> 00:00:03,030
there's one thing that stands between us

2
00:00:07,430 --> 00:00:05,359
and the harsh environment of space our

3
00:00:10,549 --> 00:00:07,440
atmosphere the part of earth that

4
00:00:12,709 --> 00:00:10,559
sustains all life

5
00:00:17,430 --> 00:00:12,719
but here in the closest town to the

6
00:00:19,590 --> 00:00:17,440
north pole it's slowly leaking away

7
00:00:21,429 --> 00:00:19,600
a team headed there to launch rockets

8
00:00:23,429 --> 00:00:21,439
into the leak but it's not the lack of

9
00:00:25,589 --> 00:00:23,439
atmosphere that they're concerned about

10
00:00:27,670 --> 00:00:25,599
the leak is a natural process that will

11
00:00:30,230 --> 00:00:27,680
take billions of years so we're not

12
00:00:32,310 --> 00:00:30,240
going to run out anytime soon it's part

13
00:00:34,790 --> 00:00:32,320

of the larger story of how a planet's

14
00:00:36,630 --> 00:00:34,800
atmosphere changes over time a key

15
00:00:39,750 --> 00:00:36,640
factor in the search for life on other

16
00:00:45,270 --> 00:00:42,869
we have 35 residents and 60 of our team

17
00:00:46,869 --> 00:00:45,280
together in a town that is completely

18
00:00:49,029 --> 00:00:46,879
isolated there's a plane twice a week

19
00:00:49,990 --> 00:00:49,039
and there's a thousand polar bears

20
00:00:52,630 --> 00:00:50,000
nearby

21
00:00:54,869 --> 00:00:52,640
this is doug roland a nasa scientist

22
00:00:56,790 --> 00:00:54,879
who's taken his team to niallison on the

23
00:00:58,790 --> 00:00:56,800
island of svalbard

24
00:01:00,790 --> 00:00:58,800
the island lies beneath one of two

25
00:01:01,830 --> 00:01:00,800
regions near earth's poles called the

26
00:01:03,910 --> 00:01:01,840
cusps

27
00:01:05,990 --> 00:01:03,920
it's where we can access space directly

28
00:01:08,630 --> 00:01:06,000
and where a hundred tons of atmosphere

29
00:01:10,630 --> 00:01:08,640
escapes into space each day this escape

30
00:01:12,950 --> 00:01:10,640
gives clues to how long an atmosphere

31
00:01:15,510 --> 00:01:12,960
will last and ultimately whether it

32
00:01:17,429 --> 00:01:15,520
stays around long enough to sustain life

33
00:01:19,510 --> 00:01:17,439
we're trying to understand is how did

34
00:01:21,190 --> 00:01:19,520
earth's atmosphere evolve over time and

35
00:01:23,190 --> 00:01:21,200
how do other planets that might be like

36
00:01:25,990 --> 00:01:23,200
earth or more dissimilar to earth how

37
00:01:28,870 --> 00:01:26,000
did their atmospheres evolve

38
00:01:31,109 --> 00:01:28,880

so doug joined forces with joran mohan a

39
00:01:33,350 --> 00:01:31,119
professor at the university of oslo who

40
00:01:34,310 --> 00:01:33,360
started the grand challenge initiative

41
00:01:36,310 --> 00:01:34,320
cusp

42
00:01:38,469 --> 00:01:36,320
it's an international mission to launch

43
00:01:41,270 --> 00:01:38,479
12 rockets into the earth's northern

44
00:01:42,710 --> 00:01:41,280
cusp and doug he's the mission leader

45
00:01:43,630 --> 00:01:42,720
for the first two rockets of the

46
00:01:48,870 --> 00:01:43,640
campaign

47
00:01:50,469 --> 00:01:48,880
[Music]

48
00:01:51,910 --> 00:01:50,479
we don't want to waste our rocket it

49
00:01:53,510 --> 00:01:51,920
takes three years to make the rocket

50
00:01:56,069 --> 00:01:53,520
only 15 minutes to use it and i don't

51
00:01:57,510 --> 00:01:56,079
waste my shot here he's using a sounding

52
00:01:59,510 --> 00:01:57,520
rocket which is different from the

53
00:02:01,510 --> 00:01:59,520
bigger rockets that carry satellites and

54
00:02:03,670 --> 00:02:01,520
humans into space it's a small

55
00:02:05,990 --> 00:02:03,680
suborbital rocket that flies briefly

56
00:02:08,150 --> 00:02:06,000
into space collects real-time data for

57
00:02:09,029 --> 00:02:08,160
around 15 minutes then falls back to

58
00:02:11,430 --> 00:02:09,039
earth

59
00:02:13,750 --> 00:02:11,440
it's affordable quick to build and can

60
00:02:15,990 --> 00:02:13,760
launch towards a precise point the major

61
00:02:18,229 --> 00:02:16,000
advantage is that you can launch

62
00:02:20,390 --> 00:02:18,239
into a target on the sky but there's a

63
00:02:23,910 --> 00:02:20,400

limited launch window and only one

64
00:02:27,670 --> 00:02:26,150
we have these unguided rockets

65
00:02:28,710 --> 00:02:27,680
they go where you point them unless the

66
00:02:30,070 --> 00:02:28,720
wind is blowing because the wind

67
00:02:31,509 --> 00:02:30,080
literally just blows them over we don't

68
00:02:33,430 --> 00:02:31,519
launch when there's high wind so to

69
00:02:36,150 --> 00:02:33,440
measure the winds they launch balloons

70
00:02:38,630 --> 00:02:36,160
with gps trackers they're released every

71
00:02:40,949 --> 00:02:38,640
15 to 30 minutes and then they're

72
00:02:46,309 --> 00:02:40,959
monitored to see how fast the winds are

73
00:02:53,670 --> 00:02:49,509
the ground winds were 12 13 meters per

74
00:02:55,110 --> 00:02:53,680
second gusting 17 which is way off

75
00:02:57,190 --> 00:02:55,120
you're filled with trepidation oh my

76
00:03:02,790 --> 00:02:57,200
gosh this thing that i built is it going

77
00:03:05,350 --> 00:03:04,149
so i think we're going to scrub for

78
00:03:06,630 --> 00:03:05,360
today

79
00:03:09,430 --> 00:03:06,640
i'd like to thank everyone i think it

80
00:03:11,430 --> 00:03:09,440
was a great performance thanks a lot

81
00:03:13,910 --> 00:03:11,440
this means that we are scrubbing this

82
00:03:18,149 --> 00:03:13,920
operation for today and try again

83
00:03:23,589 --> 00:03:20,550
the mission is named visualizing ion

84
00:03:25,910 --> 00:03:23,599
outflow via neutral atom sensing 2 or

85
00:03:28,229 --> 00:03:25,920
visions 2. in short they're looking at

86
00:03:30,229 --> 00:03:28,239
how oxygen is getting enough energy to

87
00:03:32,390 --> 00:03:30,239
escape it's a good test of how

88
00:03:34,550 --> 00:03:32,400

atmospheric escape works earth's gravity

89
00:03:37,030 --> 00:03:34,560
should hold on to the oxygen and yet we

90
00:03:38,390 --> 00:03:37,040
see this gas shooting off into space

91
00:03:40,710 --> 00:03:38,400
we're trying to figure out how that

92
00:03:41,830 --> 00:03:40,720
works that is a science question that

93
00:03:44,229 --> 00:03:41,840
has been

94
00:03:46,550 --> 00:03:44,239
hanging around for four decades

95
00:03:48,949 --> 00:03:46,560
fortunately anyone can see atmospheric

96
00:03:50,710 --> 00:03:48,959
escape at the right place and time in

97
00:03:54,229 --> 00:03:50,720
svalbard we have the so-called polar

98
00:03:56,789 --> 00:03:54,239
night it's dark all 24 hours his

99
00:03:59,750 --> 00:03:56,799
continual darkness is key for witnessing

100
00:04:01,750 --> 00:03:59,760
this this is the cuspara it's a type of

101
00:04:04,309 --> 00:04:01,760
northern lights that appears between 8

102
00:04:06,149 --> 00:04:04,319
am and noon and you can only see it when

103
00:04:07,910 --> 00:04:06,159
it's dark during the day it looks

104
00:04:10,149 --> 00:04:07,920
similar to the aurora that occurs at

105
00:04:12,789 --> 00:04:10,159
night but when these iridescent colors

106
00:04:15,589 --> 00:04:12,799
dance at this hour each day 100 tons of

107
00:04:17,110 --> 00:04:15,599
oxygen escapes from earth's atmosphere

108
00:04:19,349 --> 00:04:17,120
into space

109
00:04:21,509 --> 00:04:19,359
this is our sport node to

110
00:04:24,469 --> 00:04:21,519
to chase the aurora

111
00:04:26,710 --> 00:04:24,479
working with them is the iscat radar and

112
00:04:28,310 --> 00:04:26,720
chell henriksen observatory they have

113
00:04:29,350 --> 00:04:28,320

additional instruments to find the

114
00:04:32,310 --> 00:04:29,360
aurora

115
00:04:35,749 --> 00:04:32,320
sometimes it's cloudy so we use radars

116
00:04:38,469 --> 00:04:35,759
to track the cusp we can give advice

117
00:04:40,790 --> 00:04:38,479
that this is the right type of aurora

118
00:04:42,550 --> 00:04:40,800
this is the wall of science a collection

119
00:04:44,390 --> 00:04:42,560
of data from satellites and ground

120
00:04:46,469 --> 00:04:44,400
instruments that helps them predict

121
00:04:47,749 --> 00:04:46,479
where the cusp aurora will be

122
00:04:49,270 --> 00:04:47,759
so the cusp

123
00:04:50,870 --> 00:04:49,280
actually isn't a fixed point in space it

124
00:04:53,110 --> 00:04:50,880
kind of moves around

125
00:04:55,749 --> 00:04:53,120
what's controlling the cusps movement is

126
00:04:58,070 --> 00:04:55,759
the sun interacting with earth

127
00:04:59,909 --> 00:04:58,080
our planet is surrounded by a magnetic

128
00:05:01,990 --> 00:04:59,919
field that helps us hold on to our

129
00:05:04,550 --> 00:05:02,000
atmosphere but at the north and south

130
00:05:06,390 --> 00:05:04,560
poles the magnetic field bends inwards

131
00:05:07,430 --> 00:05:06,400
creating a corridor between earth and

132
00:05:10,390 --> 00:05:07,440
space

133
00:05:12,950 --> 00:05:10,400
when energy is released from the sun via

134
00:05:14,469 --> 00:05:12,960
a solar flare or coronal mass ejection

135
00:05:16,710 --> 00:05:14,479
all of that energy in the form of

136
00:05:18,870 --> 00:05:16,720
radiation rides down the magnetic field

137
00:05:21,670 --> 00:05:18,880
lines of the earth and is transferred

138
00:05:23,510 --> 00:05:21,680

and dumped into the earth's atmosphere

139
00:05:25,830 --> 00:05:23,520
electrons cascade into earth's

140
00:05:28,230 --> 00:05:25,840
atmosphere they accelerate and collide

141
00:05:30,710 --> 00:05:28,240
with oxygen particles giving them energy

142
00:05:32,150 --> 00:05:30,720
to release light and sometimes enough

143
00:05:35,029 --> 00:05:32,160
energy to escape

144
00:05:37,670 --> 00:05:35,039
collectively this forms the cusp aurora

145
00:05:40,790 --> 00:05:37,680
and streams of escaping oxygen

146
00:05:42,310 --> 00:05:40,800
this cusp is in constant motion and

147
00:05:44,230 --> 00:05:42,320
we've got a fixed trajectory we really

148
00:05:45,670 --> 00:05:44,240
can't aim where the cusp is we have to

149
00:05:47,830 --> 00:05:45,680
wait for the cusp to come across our

150
00:05:49,189 --> 00:05:47,840
line of sight can you guys hear gelimer

151
00:05:50,390 --> 00:05:49,199
we'd like you as soon as you see an

152
00:05:52,390 --> 00:05:50,400
indication that crosstalk is moving

153
00:05:55,270 --> 00:05:52,400
close to move it the radar dish if we

154
00:06:02,629 --> 00:05:55,280
can this is ice cat it's been very quiet

155
00:06:02,639 --> 00:06:08,070
do you think

156
00:06:08,080 --> 00:06:14,790
probably about a 60 chance of launching

157
00:06:18,309 --> 00:06:16,150
when we started seeing this really good

158
00:06:20,469 --> 00:06:18,319
data this clock started counting down

159
00:06:23,110 --> 00:06:20,479
and that's when everyone realized this

160
00:06:25,510 --> 00:06:23,120
is going to happen we're going to launch

161
00:06:27,510 --> 00:06:25,520
we're doing everything we can to to get

162
00:06:28,710 --> 00:06:27,520
that launch off before the aurora goes

163
00:06:30,950 --> 00:06:28,720

away

164
00:06:32,950 --> 00:06:30,960
it is really really challenging and

165
00:06:36,150 --> 00:06:32,960
nerve-racking at that point

166
00:06:37,670 --> 00:06:36,160
you can see the tension just rise

167
00:06:40,469 --> 00:06:37,680
and everybody when that when that

168
00:06:42,469 --> 00:06:40,479
happens and so everyone's watching their

169
00:06:44,790 --> 00:06:42,479
instruments getting really excited and

170
00:06:45,830 --> 00:06:44,800
then at t minus one minute

171
00:06:48,000 --> 00:06:45,840
all of us

172
00:06:58,950 --> 00:06:48,010
ran out to go see the launch happen

173
00:07:00,870 --> 00:06:58,960
[Music]

174
00:07:03,029 --> 00:07:00,880
then we immediately turned around and

175
00:07:05,270 --> 00:07:03,039
ran right back in to look at all the

176
00:07:07,350 --> 00:07:05,280
data that was coming back from the

177
00:07:09,909 --> 00:07:07,360
instruments

178
00:07:11,749 --> 00:07:09,919
you know how much time and effort went

179
00:07:13,749 --> 00:07:11,759
into it because

180
00:07:14,950 --> 00:07:13,759
we all worked on it and there's just

181
00:07:17,270 --> 00:07:14,960
nothing

182
00:07:19,110 --> 00:07:17,280
that compares to that feeling

183
00:07:22,070 --> 00:07:19,120
everybody in every one of those little

184
00:07:24,550 --> 00:07:22,080
places you know really just so happy to

185
00:07:25,430 --> 00:07:24,560
contribute to uh to getting the science

186
00:07:28,469 --> 00:07:25,440
uh

187
00:07:30,390 --> 00:07:28,479
it's really an incredible experience

188
00:07:32,550 --> 00:07:30,400

this is a story about what it takes to

189
00:07:34,309 --> 00:07:32,560
launch science instruments into space

190
00:07:36,070 --> 00:07:34,319
but the real adventure will be in the

191
00:07:37,749 --> 00:07:36,080
data they sent back

192
00:07:40,469 --> 00:07:37,759
hidden within the numbers will be

193
00:07:42,150 --> 00:07:40,479
answers that reach far beyond earth

194
00:07:44,629 --> 00:07:42,160
shedding light on how atmospheres

195
00:07:46,150 --> 00:07:44,639
throughout the universe change evolve

196
00:07:48,010 --> 00:07:46,160
and perhaps