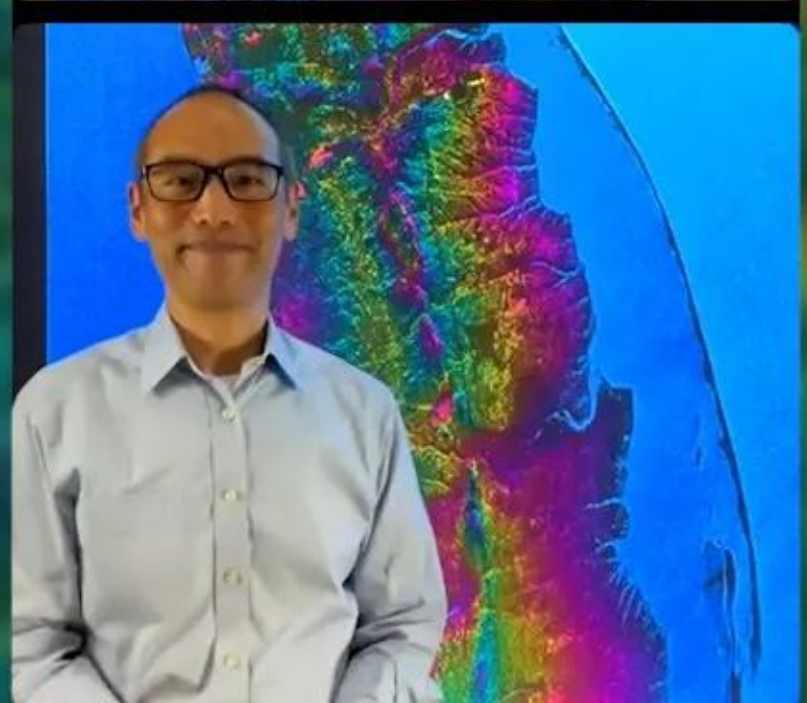

TOWS



1
00:00:06,349 --> 00:00:04,070
hello everyone I'm Marina jurika and I'm

2
00:00:08,629 --> 00:00:06,359
coming to you live from NASA's jet

3
00:00:11,750 --> 00:00:08,639
propulsion laboratory here in Southern

4
00:00:13,490 --> 00:00:11,760
California on a beautiful sunny day

5
00:00:16,010 --> 00:00:13,500
we're here to talk about the mission

6
00:00:19,849 --> 00:00:16,020
SWAT which stands for surface water

7
00:00:23,269 --> 00:00:19,859
ocean topography and SWAT is going to be

8
00:00:26,029 --> 00:00:23,279
able to track over 90 percent of the

9
00:00:28,490 --> 00:00:26,039
water on the Earth's surface and it's a

10
00:00:31,370 --> 00:00:28,500
joint Mission between NASA and kness

11
00:00:33,229 --> 00:00:31,380
which is the French space agency and

12
00:00:36,229 --> 00:00:33,239
we're going to break down

13
00:00:38,990 --> 00:00:36,239

some of the First Data images that have

14
00:00:41,630 --> 00:00:39,000
come down from SWAT with JPL engineer

15
00:00:43,970 --> 00:00:41,640
Curtis Chen he's going to be joining us

16
00:00:45,889 --> 00:00:43,980
in just a few minutes now Curtis has

17
00:00:48,529 --> 00:00:45,899
been with the swap mission for about

18
00:00:50,930 --> 00:00:48,539
eight years and he's going to show us

19
00:00:53,630 --> 00:00:50,940
some of these exciting first images that

20
00:00:56,569 --> 00:00:53,640
have come down from the satellite SWAT

21
00:01:03,410 --> 00:00:56,579
launched last December in great fashion

22
00:01:08,390 --> 00:01:06,710
hairs to do its science work so if

23
00:01:11,090 --> 00:01:08,400
you're giving me just a few minutes here

24
00:01:14,270 --> 00:01:11,100
I'm going to invite Curtis in from our

25
00:01:16,609 --> 00:01:14,280
at Nasa Earth IG station and hello

26
00:01:17,630 --> 00:01:16,619
Curtis how are you doing today good hi

27
00:01:19,490 --> 00:01:17,640
Marina

28
00:01:21,950 --> 00:01:19,500
so tell us a little bit about where

29
00:01:23,929 --> 00:01:21,960
you're joining us from well I'm here at

30
00:01:25,789 --> 00:01:23,939
the Earth Science Center at JPL and I'm

31
00:01:27,770 --> 00:01:25,799
standing in front of a really big

32
00:01:29,630 --> 00:01:27,780
display that helps us visualize our

33
00:01:31,730 --> 00:01:29,640
Fleet of Earth observing satellites and

34
00:01:33,469 --> 00:01:31,740
some of the data they provide so behind

35
00:01:35,330 --> 00:01:33,479
me right now you can see an animation of

36
00:01:37,310 --> 00:01:35,340
the SWAT spacecraft orbiting over the

37
00:01:40,490 --> 00:01:37,320
Earth at about 900 kilometers altitude

38
00:01:42,289 --> 00:01:40,500

about 550 miles giving us some of the

39
00:01:44,030 --> 00:01:42,299
some some exciting new data that we're

40
00:01:46,310 --> 00:01:44,040
going to talk about today

41
00:01:49,550 --> 00:01:46,320
oh thank you so much Curtis and it's a

42
00:01:51,710 --> 00:01:49,560
pretty cool uh scene behind you at Nasa

43
00:01:53,870 --> 00:01:51,720
eyes and a lot of people can just pick

44
00:01:55,249 --> 00:01:53,880
this up at their home computer so tell

45
00:01:57,350 --> 00:01:55,259
us a little bit about everyone get home

46
00:02:00,469 --> 00:01:57,360
can I see NASA eyes and see where SWAT

47
00:02:02,090 --> 00:02:00,479
currently is in Orbit yeah the uh yeah

48
00:02:04,850 --> 00:02:02,100
you may not have a big display like this

49
00:02:07,730 --> 00:02:04,860
at home but if you go to eyes.nasa.gov

50
00:02:09,889 --> 00:02:07,740
eyes is in your eyes uh you can you can

51
00:02:11,930 --> 00:02:09,899
interactively look at you know where

52
00:02:14,270 --> 00:02:11,940
these where these satellites are you can

53
00:02:17,150 --> 00:02:14,280
look at the data they provide and and

54
00:02:18,830 --> 00:02:17,160
just get a nice cool visualization of

55
00:02:20,869 --> 00:02:18,840
all the great things that these

56
00:02:22,430 --> 00:02:20,879
satellites are doing for us and it's

57
00:02:24,110 --> 00:02:22,440
just not SWAT you're going to be able to

58
00:02:25,790 --> 00:02:24,120
look at all of the satellites which is

59
00:02:28,130 --> 00:02:25,800
pretty cool so head over to NASA eyes

60
00:02:30,110 --> 00:02:28,140
after this live stream now tell us a

61
00:02:31,610 --> 00:02:30,120
little bit Curtis about SWAT and if

62
00:02:34,010 --> 00:02:31,620
you're just joining us watch stands for

63
00:02:36,050 --> 00:02:34,020

surface water ocean topography and we're

64
00:02:37,610 --> 00:02:36,060
here to look at the First Data images

65
00:02:39,470 --> 00:02:37,620
that have come down in just a few

66
00:02:41,570 --> 00:02:39,480
minutes but just to get us started

67
00:02:44,270 --> 00:02:41,580
Curtis what is SWAT

68
00:02:46,610 --> 00:02:44,280
a SWAT is a mission to study water on

69
00:02:48,470 --> 00:02:46,620
Earth and how it changes and how it

70
00:02:50,449 --> 00:02:48,480
moves around over time

71
00:02:52,130 --> 00:02:50,459
so water is one of those things where

72
00:02:53,869 --> 00:02:52,140
it's really hard to overstate how

73
00:02:55,850 --> 00:02:53,879
important it is right civilizations have

74
00:02:57,050 --> 00:02:55,860
risen and Fallen around it Wars have

75
00:02:59,330 --> 00:02:57,060
been fought over and it's a thing that

76
00:03:01,610 --> 00:02:59,340
makes our planet truly unique among all

77
00:03:03,050 --> 00:03:01,620
the planets that we know so SWAT is

78
00:03:05,270 --> 00:03:03,060
going to help us understand this

79
00:03:08,030 --> 00:03:05,280
precious resource better by forming

80
00:03:10,369 --> 00:03:08,040
Global high-resolution mass of water

81
00:03:12,110 --> 00:03:10,379
surface Heights and it'll give us a new

82
00:03:14,990 --> 00:03:12,120
map every three weeks so we can look for

83
00:03:17,149 --> 00:03:15,000
those changes so these water Heights are

84
00:03:19,190 --> 00:03:17,159
important because you know if you know

85
00:03:20,690 --> 00:03:19,200
how high the water is in a reservoir you

86
00:03:22,369 --> 00:03:20,700
know how much water is in it if you know

87
00:03:24,229 --> 00:03:22,379
the slope of a river you can tell how

88
00:03:26,750 --> 00:03:24,239

much water is Flowing along it and over

89
00:03:28,670 --> 00:03:26,760
the oceans the subtle variations and

90
00:03:30,470 --> 00:03:28,680
Heights over the oceans can tell us a

91
00:03:32,750 --> 00:03:30,480
lot about the ocean currents and how

92
00:03:35,030 --> 00:03:32,760
Eddies are forming and dissipating kind

93
00:03:37,610 --> 00:03:35,040
of like how if you stir a cup of coffee

94
00:03:39,229 --> 00:03:37,620
the the level of the liquid gets higher

95
00:03:41,509 --> 00:03:39,239
near the rim of your mug and it's slower

96
00:03:43,250 --> 00:03:41,519
in the middle so by sensing the height

97
00:03:45,350 --> 00:03:43,260
variations over the ocean even though

98
00:03:47,750 --> 00:03:45,360
they're really small we can get a sense

99
00:03:49,490 --> 00:03:47,760
of how things are changing over time so

100
00:03:51,350 --> 00:03:49,500
SWAT is going to vital wealth of

101
00:03:53,869 --> 00:03:51,360
information for oceanographers and

102
00:03:55,850 --> 00:03:53,879
hydrologists around the world

103
00:03:58,309 --> 00:03:55,860
so exciting and I'm sure everyone at

104
00:04:00,410 --> 00:03:58,319
home can't wait to see these images so

105
00:04:03,770 --> 00:04:00,420
recently the satellite sent back that

106
00:04:05,449 --> 00:04:03,780
first taste and we call it first light

107
00:04:07,490 --> 00:04:05,459
and can you tell us a little bit about

108
00:04:08,449 --> 00:04:07,500
what first light is and why it's so

109
00:04:11,690 --> 00:04:08,459
important

110
00:04:13,729 --> 00:04:11,700
yeah first light is for a mission like

111
00:04:16,129 --> 00:04:13,739
Squad it's the first data we get of the

112
00:04:17,629 --> 00:04:16,139
Earth from space it's an exciting

113
00:04:19,370 --> 00:04:17,639

Milestone because we've got an

114
00:04:20,870 --> 00:04:19,380
international team of Engineers and

115
00:04:23,749 --> 00:04:20,880
scientists who have been working really

116
00:04:26,870 --> 00:04:23,759
hard for many years designing and

117
00:04:29,990 --> 00:04:26,880
building and testing SWOT on Earth so

118
00:04:31,550 --> 00:04:30,000
now squat squats in space it's in action

119
00:04:34,010 --> 00:04:31,560
and we're really finally getting to see

120
00:04:35,210 --> 00:04:34,020
what you know see that real data for the

121
00:04:37,010 --> 00:04:35,220
very first time

122
00:04:38,990 --> 00:04:37,020
so to get a sense of what that's like

123
00:04:40,810 --> 00:04:39,000
imagine that you're taking a brand new

124
00:04:44,210 --> 00:04:40,820
car out for a spin for the first time

125
00:04:45,770 --> 00:04:44,220
and not only that you designed and built

126
00:04:47,390 --> 00:04:45,780
that car yourself and it's the only one

127
00:04:48,710 --> 00:04:47,400
like it in the world so you'd be pretty

128
00:04:50,749 --> 00:04:48,720
excited about that and we're pretty

129
00:04:52,490 --> 00:04:50,759
jazzed about about seeing these swap

130
00:04:54,530 --> 00:04:52,500
images today

131
00:04:56,510 --> 00:04:54,540
it's better than winning the Indy 500

132
00:04:58,670 --> 00:04:56,520
that's for sure

133
00:05:01,430 --> 00:04:58,680
all right so tell us a little bit about

134
00:05:03,710 --> 00:05:01,440
what sets SWAT apart and it's a very

135
00:05:05,450 --> 00:05:03,720
special instrument on board called Karen

136
00:05:07,249 --> 00:05:05,460
which we call the heart of the

137
00:05:09,469 --> 00:05:07,259
instrument that helps collect all of

138
00:05:13,370 --> 00:05:09,479

this data so Curtis tell us how Karen

139
00:05:16,129 --> 00:05:13,380
works all right so Karen is making uh

140
00:05:18,050 --> 00:05:16,139
measurements that are finer and

141
00:05:20,629 --> 00:05:18,060
resolution wider in coverage and better

142
00:05:22,129 --> 00:05:20,639
in accuracy than anything like it's come

143
00:05:24,950 --> 00:05:22,139
before

144
00:05:26,870 --> 00:05:24,960
um so you know the way it works the way

145
00:05:28,730 --> 00:05:26,880
it makes these measurements is really

146
00:05:29,990 --> 00:05:28,740
cool but it's also a little complicated

147
00:05:32,390 --> 00:05:30,000
so I'm going to try to take you through

148
00:05:34,430 --> 00:05:32,400
it one step at a time uh starting maybe

149
00:05:35,749 --> 00:05:34,440
with uh just kind of commenting that you

150
00:05:37,730 --> 00:05:35,759
know these first light images that we're

151
00:05:39,830 --> 00:05:37,740
about to see light is a little bit of a

152
00:05:42,890 --> 00:05:39,840
misnomer because swat's not using light

153
00:05:44,810 --> 00:05:42,900
at all it's using a radar and the way

154
00:05:46,670 --> 00:05:44,820
you measure water surface effects with

155
00:05:49,610 --> 00:05:46,680
radar is

156
00:05:51,290 --> 00:05:49,620
um is you know I think most people know

157
00:05:55,010 --> 00:05:51,300
that a radar instrument is something

158
00:05:56,990 --> 00:05:55,020
that sends out a radio wave signal and

159
00:05:58,850 --> 00:05:57,000
by listening for The Echoes of that

160
00:06:00,650 --> 00:05:58,860
signal to bounce off the Target and come

161
00:06:02,510 --> 00:06:00,660
back you can measure the time it takes

162
00:06:03,950 --> 00:06:02,520
for this Echoes to travel and come back

163
00:06:06,230 --> 00:06:03,960

and and that way you can measure

164
00:06:08,510 --> 00:06:06,240
distance between between the radar and

165
00:06:10,550 --> 00:06:08,520
then you're observing so if you put a

166
00:06:11,990 --> 00:06:10,560
radar on a satellite with the radar

167
00:06:14,510 --> 00:06:12,000
looking down you can measure the

168
00:06:17,150 --> 00:06:14,520
distance between the satellite and and

169
00:06:19,310 --> 00:06:17,160
the water surface below it now these

170
00:06:21,110 --> 00:06:19,320
satellite lights have sophisticated

171
00:06:23,210 --> 00:06:21,120
packages of equipment so that we can

172
00:06:25,909 --> 00:06:23,220
tell very precisely how high the

173
00:06:27,650 --> 00:06:25,919
satellite is and then with the radar we

174
00:06:29,390 --> 00:06:27,660
can tell where the where the water

175
00:06:31,610 --> 00:06:29,400
surface is below it and that's how we

176
00:06:34,249 --> 00:06:31,620
measure how high the water is

177
00:06:37,309 --> 00:06:34,259
so before care and that's that's pretty

178
00:06:38,629 --> 00:06:37,319
much how radar is operated but the

179
00:06:40,309 --> 00:06:38,639
caption with that is if you're looking

180
00:06:42,529 --> 00:06:40,319
straight down trying to measure the

181
00:06:44,510 --> 00:06:42,539
water height below the satellite you

182
00:06:47,749 --> 00:06:44,520
can't really tell how high the water is

183
00:06:50,090 --> 00:06:47,759
to the left or to the right and so so

184
00:06:52,909 --> 00:06:50,100
the previous generation of satellites

185
00:06:55,430 --> 00:06:52,919
before Karen uh were kind of limited in

186
00:06:59,029 --> 00:06:55,440
their resolution and coverage so Karen

187
00:07:01,909 --> 00:06:59,039
gets around that by by using the

188
00:07:03,529 --> 00:07:01,919

distance information from the radar to

189
00:07:07,189 --> 00:07:03,539
actually look off to the sides a little

190
00:07:09,529 --> 00:07:07,199
bit and form images to either side by

191
00:07:11,570 --> 00:07:09,539
using that that distance from the radar

192
00:07:13,370 --> 00:07:11,580
it can map out swaths of information

193
00:07:16,790 --> 00:07:13,380
instead of just getting these 1D

194
00:07:18,830 --> 00:07:16,800
profiles and so by forming these images

195
00:07:20,930 --> 00:07:18,840
to one side and the other of the

196
00:07:24,170 --> 00:07:20,940
spacecraft we can get these final

197
00:07:26,749 --> 00:07:24,180
resolution wide coverage images now the

198
00:07:29,210 --> 00:07:26,759
catch there is that by using the

199
00:07:30,770 --> 00:07:29,220
distance information from the radar to

200
00:07:32,809 --> 00:07:30,780
to form these images to get light

201
00:07:34,909 --> 00:07:32,819
coverage and resolution we need to do

202
00:07:38,089 --> 00:07:34,919
something else to get the water right

203
00:07:40,070 --> 00:07:38,099
now and so so what Karen does is we add

204
00:07:43,189 --> 00:07:40,080
a second antenna and use a technique

205
00:07:45,950 --> 00:07:43,199
called interferometry which I'll get to

206
00:07:48,529 --> 00:07:45,960
in a moment but yeah the the basic idea

207
00:07:50,450 --> 00:07:48,539
you can think of is that if we're

208
00:07:52,129 --> 00:07:50,460
collecting images at the same place on

209
00:07:54,110 --> 00:07:52,139
the Earth's surface from due to two

210
00:07:55,550 --> 00:07:54,120
different locations we can get a sense

211
00:07:57,170 --> 00:07:55,560
of where that you know where those

212
00:07:58,969 --> 00:07:57,180
locations on the surface are in

213
00:08:01,850 --> 00:07:58,979

three-dimensional space it's sort of

214
00:08:03,350 --> 00:08:01,860
like how with your two eyes you can you

215
00:08:05,089 --> 00:08:03,360
can sense depth because you're getting

216
00:08:07,309 --> 00:08:05,099
two images of the same thing from two

217
00:08:08,629 --> 00:08:07,319
different places the way the radar works

218
00:08:11,150 --> 00:08:08,639
is a little bit different in that the

219
00:08:12,950 --> 00:08:11,160
radar sensing distance but it's the same

220
00:08:14,990 --> 00:08:12,960
idea that if You observe the same thing

221
00:08:16,610 --> 00:08:15,000
from two locations you know the two the

222
00:08:19,189 --> 00:08:16,620
two Karen antennas you can see behind me

223
00:08:22,550 --> 00:08:19,199
one over here and and one over here

224
00:08:25,969 --> 00:08:22,560
we can we can figure they figure out

225
00:08:28,189 --> 00:08:25,979
where the surface is in 3D space uh it's

226
00:08:30,469 --> 00:08:28,199
it's also equivalent to what surveyors

227
00:08:31,850 --> 00:08:30,479
do in terms of triangulating things you

228
00:08:34,250 --> 00:08:31,860
know we're basically forming an

229
00:08:36,709 --> 00:08:34,260
imaginary triangle between the two

230
00:08:38,329 --> 00:08:36,719
current antennas and the place on the

231
00:08:40,310 --> 00:08:38,339
ground that we're trying to observe and

232
00:08:42,529 --> 00:08:40,320
we know where the two carat antennas are

233
00:08:44,089 --> 00:08:42,539
and if we can measure the the lengths of

234
00:08:45,650 --> 00:08:44,099
the legs and angles of that triangle

235
00:08:48,290 --> 00:08:45,660
then we can figure out where the point

236
00:08:50,389 --> 00:08:48,300
on the surface is and how high it is

237
00:08:52,790 --> 00:08:50,399
so here's where parent really takes it

238
00:08:55,009 --> 00:08:52,800

to the next level though if you have

239
00:08:56,449 --> 00:08:55,019
these two images and you're trying to

240
00:08:58,970 --> 00:08:56,459
measure the surface height very

241
00:09:01,910 --> 00:08:58,980
precisely you still need to get really

242
00:09:04,310 --> 00:09:01,920
precise information on on what the

243
00:09:05,690 --> 00:09:04,320
lengths of the the legs of that triangle

244
00:09:08,290 --> 00:09:05,700
are

245
00:09:10,610 --> 00:09:08,300
and so carrot uses a technique called

246
00:09:12,769 --> 00:09:10,620
interferometry where it's looking at the

247
00:09:14,870 --> 00:09:12,779
phase the electromagnetic waves coming

248
00:09:17,509 --> 00:09:14,880
back from the surface so if you just

249
00:09:18,889 --> 00:09:17,519
heard me say electromagnetic wave phase

250
00:09:20,990 --> 00:09:18,899
and interferometry in your head just

251
00:09:22,970 --> 00:09:21,000
kind of exploded a little bit it's okay

252
00:09:24,110 --> 00:09:22,980
we're going to go through that one step

253
00:09:25,610 --> 00:09:24,120
at a time

254
00:09:28,190 --> 00:09:25,620
so

255
00:09:31,370 --> 00:09:28,200
Karen is a radar and radar send radio

256
00:09:33,350 --> 00:09:31,380
waves out radio waves are are kind of

257
00:09:35,990 --> 00:09:33,360
the same basic thing as as the radio

258
00:09:38,269 --> 00:09:36,000
waves that your your computer your phone

259
00:09:40,430 --> 00:09:38,279
uses for Wi-Fi or the the cell phone

260
00:09:43,250 --> 00:09:40,440
signals that you use or Bluetooth or AM

261
00:09:45,170 --> 00:09:43,260
FM radio before that so if you've heard

262
00:09:46,790 --> 00:09:45,180
the expression of a broadcast coming to

263
00:09:48,410 --> 00:09:46,800

you over the Airways it's the same basic

264
00:09:51,050 --> 00:09:48,420
thing these these waves are around us

265
00:09:52,970 --> 00:09:51,060
you use them every day uh you can't see

266
00:09:55,790 --> 00:09:52,980
them but they're there

267
00:09:58,550 --> 00:09:55,800
and waves kind of like the waves you

268
00:09:59,990 --> 00:09:58,560
might see at the beach have crests and

269
00:10:02,329 --> 00:10:00,000
troughs right there they get higher and

270
00:10:04,070 --> 00:10:02,339
lower sometimes and when we sense these

271
00:10:05,810 --> 00:10:04,080
waves from the surface from two

272
00:10:08,389 --> 00:10:05,820
different locations the two the two

273
00:10:11,269 --> 00:10:08,399
Karen antennas sometimes the Press line

274
00:10:13,370 --> 00:10:11,279
up with each other and and when you add

275
00:10:14,750 --> 00:10:13,380
them up you get a bigger wave sometimes

276
00:10:16,670 --> 00:10:14,760
they don't line up with each other

277
00:10:18,530 --> 00:10:16,680
they're misaligned and the crests of one

278
00:10:20,810 --> 00:10:18,540
wave kind of fill in the troughs of the

279
00:10:23,570 --> 00:10:20,820
other wave and then you get some

280
00:10:25,250 --> 00:10:23,580
cancellation of the waves and so the the

281
00:10:27,290 --> 00:10:25,260
end effect is you get what's called an

282
00:10:29,570 --> 00:10:27,300
interference pattern so that's that

283
00:10:31,370 --> 00:10:29,580
sounds complicated but the intuitive way

284
00:10:33,290 --> 00:10:31,380
to think about it is to think about

285
00:10:35,150 --> 00:10:33,300
fringes on a soap bottle you know those

286
00:10:37,009 --> 00:10:35,160
colored fringes you see on soap level or

287
00:10:39,230 --> 00:10:37,019
an oil slick or maybe the back of a CD

288
00:10:41,210 --> 00:10:39,240

or a DVD or something

289
00:10:44,090 --> 00:10:41,220
the same basic thing is happening there

290
00:10:48,050 --> 00:10:44,100
because the light that our eyes see is

291
00:10:50,389 --> 00:10:48,060
also an electromagnetic wave and what

292
00:10:51,949 --> 00:10:50,399
we're seeing is the light reflecting off

293
00:10:53,990 --> 00:10:51,959
of the top surface of the soap bubble

294
00:10:56,090 --> 00:10:54,000
and the bottom surface of bubble and

295
00:10:57,650 --> 00:10:56,100
sometimes the light waves are adding up

296
00:11:00,110 --> 00:10:57,660
and sometimes they're canceling so when

297
00:11:02,810 --> 00:11:00,120
you see red on the soap bubble the the

298
00:11:04,190 --> 00:11:02,820
red light is is adding up the the crest

299
00:11:05,870 --> 00:11:04,200
of the red light are adding up and the

300
00:11:07,850 --> 00:11:05,880
other colors are canceling out when you

301
00:11:11,269 --> 00:11:07,860
see blue the blue light is adding up and

302
00:11:14,090 --> 00:11:11,279
and the red light is canceling out and

303
00:11:16,310 --> 00:11:14,100
so these interference patterns that we

304
00:11:18,889 --> 00:11:16,320
can observe on as the colored fringes on

305
00:11:20,810 --> 00:11:18,899
a soap bottle are allowing our eyes to

306
00:11:22,610 --> 00:11:20,820
see how thick the soap bubbles or the

307
00:11:23,990 --> 00:11:22,620
the variations in the thickness of the

308
00:11:26,030 --> 00:11:24,000
soap bubble now remember the soap

309
00:11:28,790 --> 00:11:26,040
bubbles are a thousand times thinner

310
00:11:32,329 --> 00:11:28,800
than a human hair and so these

311
00:11:34,370 --> 00:11:32,339
interference patterns let us sense these

312
00:11:35,990 --> 00:11:34,380
really minute changes in things and so

313
00:11:38,690 --> 00:11:36,000

Karen is using the same basic ideas

314
00:11:40,730 --> 00:11:38,700
looking at the interference patterns of

315
00:11:43,790 --> 00:11:40,740
the radio wave Echoes of The Radars from

316
00:11:46,550 --> 00:11:43,800
the surface in order to sense these

317
00:11:49,370 --> 00:11:46,560
really small changes in the geometry of

318
00:11:51,230 --> 00:11:49,380
the that imaginary triangle in order to

319
00:11:53,389 --> 00:11:51,240
get really precise measurements of How

320
00:11:56,230 --> 00:11:53,399
High the surface is and so at the end of

321
00:12:00,110 --> 00:11:56,240
the day this interferometric technique

322
00:12:02,930 --> 00:12:00,120
the the way that Karen works is able to

323
00:12:05,329 --> 00:12:02,940
measure height variations of you know

324
00:12:08,210 --> 00:12:05,339
just several centimeters or a few inches

325
00:12:10,009 --> 00:12:08,220
and it's doing that from you know up in

326
00:12:12,410 --> 00:12:10,019
space so you know I work on this stuff

327
00:12:14,569 --> 00:12:12,420
every day and that that basic idea that

328
00:12:18,170 --> 00:12:14,579
we're able to see changes like this from

329
00:12:19,910 --> 00:12:18,180
from 550 miles 900 kilometers away that

330
00:12:22,610 --> 00:12:19,920
still amazes me

331
00:12:24,769 --> 00:12:22,620
it is truly amazing so Karen to me

332
00:12:27,829 --> 00:12:24,779
sounds like a hard worker pulling double

333
00:12:29,690 --> 00:12:27,839
duty and a great listener and if you're

334
00:12:32,449 --> 00:12:29,700
just joining us in right now we're with

335
00:12:34,130 --> 00:12:32,459
JPL engineer Curtis Chen and we are

336
00:12:35,870 --> 00:12:34,140
breaking down SWAT which stands for

337
00:12:38,750 --> 00:12:35,880
surface water ocean departure so who's

338
00:12:40,250 --> 00:12:38,760

ready to see these amazing images we

339
00:12:42,710 --> 00:12:40,260
have all been waiting to see them so

340
00:12:45,410 --> 00:12:42,720
Curtis break down these images that have

341
00:12:46,730 --> 00:12:45,420
just come down from SWAT and tell us a

342
00:12:47,449 --> 00:12:46,740
little bit about what we're seeing all

343
00:12:48,889 --> 00:12:47,459
right

344
00:12:50,930 --> 00:12:48,899
let's take a look at some of these

345
00:12:53,150 --> 00:12:50,940
images uh so behind me what you're

346
00:12:55,129 --> 00:12:53,160
seeing here is

347
00:12:58,970 --> 00:12:55,139
um is one of the images from SWAT

348
00:13:01,370 --> 00:12:58,980
showing the changes in the the height of

349
00:13:03,350 --> 00:13:01,380
the ocean surface so you know here you

350
00:13:06,050 --> 00:13:03,360
see those those two swaths on either

351
00:13:08,389 --> 00:13:06,060
side of the spacecraft ground track that

352
00:13:10,430 --> 00:13:08,399
I was talking about before this is the

353
00:13:11,870 --> 00:13:10,440
ocean uh this is the east coast of the

354
00:13:13,490 --> 00:13:11,880
United States over here

355
00:13:15,650 --> 00:13:13,500
and the colors that you're seeing

356
00:13:17,629 --> 00:13:15,660
represent the height of the ocean

357
00:13:19,850 --> 00:13:17,639
surface

358
00:13:21,590 --> 00:13:19,860
um there's a there's a color bar maybe

359
00:13:23,690 --> 00:13:21,600
you can't see it down here but the the

360
00:13:26,210 --> 00:13:23,700
red colors here correspond to places

361
00:13:28,129 --> 00:13:26,220
where the ocean is about 25 centimeters

362
00:13:30,530 --> 00:13:28,139
or just about 10 inches higher than

363
00:13:32,750 --> 00:13:30,540

normal compared to the white areas here

364
00:13:35,090 --> 00:13:32,760
and the white areas here are about 25

365
00:13:36,230 --> 00:13:35,100
centimeters higher than the blue areas

366
00:13:40,009 --> 00:13:36,240
down here

367
00:13:42,230 --> 00:13:40,019
and so to get a sense of of how small

368
00:13:44,150 --> 00:13:42,240
those changes are if you were on a ship

369
00:13:47,030 --> 00:13:44,160
in the ocean

370
00:13:49,190 --> 00:13:47,040
um yeah the the distances between these

371
00:13:51,530 --> 00:13:49,200
red areas and and these white areas

372
00:13:53,030 --> 00:13:51,540
that's about 75 miles that would be way

373
00:13:55,310 --> 00:13:53,040
over the horizon right so you wouldn't

374
00:13:56,810 --> 00:13:55,320
even be able to see that but you can

375
00:13:59,329 --> 00:13:56,820
imagine that even something on the

376
00:14:01,490 --> 00:13:59,339
horizon you'd have a pretty tough time

377
00:14:03,129 --> 00:14:01,500
even with you know a really powerful set

378
00:14:05,930 --> 00:14:03,139
of binoculars or telescope or something

379
00:14:07,970 --> 00:14:05,940
seeing a variation in height of just 10

380
00:14:10,370 --> 00:14:07,980
inches or something that far away but

381
00:14:13,910 --> 00:14:10,380
SWAT is able to see these things from

382
00:14:15,230 --> 00:14:13,920
space and so for comparison since we

383
00:14:17,870 --> 00:14:15,240
were talking about the resolution and

384
00:14:20,269 --> 00:14:17,880
the coverage of squad this is a map of

385
00:14:21,110 --> 00:14:20,279
what we had before of the same

386
00:14:22,610 --> 00:14:21,120
area

387
00:14:26,090 --> 00:14:22,620
um and you can see it's just much lower

388
00:14:28,069 --> 00:14:26,100

resolution this map actually comes from

389
00:14:30,710 --> 00:14:28,079
um from a set of data from seven

390
00:14:32,690 --> 00:14:30,720
different satellites using uh Radars

391
00:14:34,970 --> 00:14:32,700
that were only looking straight down so

392
00:14:36,590 --> 00:14:34,980
if we go back to the SWAT image now what

393
00:14:39,410 --> 00:14:36,600
we can see is we just

394
00:14:41,329 --> 00:14:39,420
much better resolution and

395
00:14:43,129 --> 00:14:41,339
coverage from just a single satellite

396
00:14:46,129 --> 00:14:43,139
overpass we don't we don't need these

397
00:14:47,810 --> 00:14:46,139
seven satellites in order to see these

398
00:14:50,449 --> 00:14:47,820
details here

399
00:14:52,670 --> 00:14:50,459
so SWAT is is really just a great

400
00:14:56,689 --> 00:14:52,680
advance for this kind of ocean science

401
00:14:57,710 --> 00:14:56,699
but in this next image of Long Island

402
00:14:59,329 --> 00:14:57,720
um

403
00:15:01,370 --> 00:14:59,339
you know this is actually my favorite

404
00:15:03,590 --> 00:15:01,380
image because this image kind of

405
00:15:06,050 --> 00:15:03,600
illustrates how a SWAT is making its

406
00:15:07,670 --> 00:15:06,060
measurement and that you know what we're

407
00:15:10,069 --> 00:15:07,680
seeing those interference patterns I was

408
00:15:11,990 --> 00:15:10,079
talking about before that that look like

409
00:15:13,430 --> 00:15:12,000
those colored fringes on soap bubble but

410
00:15:15,590 --> 00:15:13,440
there's also more going on in this image

411
00:15:17,090 --> 00:15:15,600
let me take it one step at a time what

412
00:15:20,269 --> 00:15:17,100
you're seeing in this image first of all

413
00:15:22,490 --> 00:15:20,279

this is Long Island with uh with the

414
00:15:24,170 --> 00:15:22,500
Pacific Ocean or I'm sorry the Atlantic

415
00:15:26,150 --> 00:15:24,180
Ocean on this side over here Long Island

416
00:15:27,710 --> 00:15:26,160
Sound on the side this is the island

417
00:15:30,110 --> 00:15:27,720
itself

418
00:15:32,629 --> 00:15:30,120
so there are two layers in this image

419
00:15:35,750 --> 00:15:32,639
the the brightness or the grayscale part

420
00:15:37,910 --> 00:15:35,760
of the image represents the reflectivity

421
00:15:40,850 --> 00:15:37,920
of the ocean surface so how much radar

422
00:15:42,050 --> 00:15:40,860
energy gets reflected by the surface and

423
00:15:44,449 --> 00:15:42,060
I'll talk more about that in a second

424
00:15:45,769 --> 00:15:44,459
the color layer represents the

425
00:15:47,870 --> 00:15:45,779
interference pattern we were talking

426
00:15:50,090 --> 00:15:47,880
about the you know whether the the radio

427
00:15:52,129 --> 00:15:50,100
waves coming for to our two Karen

428
00:15:53,990 --> 00:15:52,139
antennas are adding up or not adding up

429
00:15:56,629 --> 00:15:54,000
and so the colored part is where the

430
00:15:58,250 --> 00:15:56,639
magic happens for estimating the heights

431
00:16:00,550 --> 00:15:58,260
of the water surfaces

432
00:16:03,170 --> 00:16:00,560
but back to the brightness for a moment

433
00:16:05,509 --> 00:16:03,180
the brightness is something we use to

434
00:16:07,009 --> 00:16:05,519
First tell where water is because you

435
00:16:08,750 --> 00:16:07,019
know over the ocean it's it's pretty

436
00:16:11,090 --> 00:16:08,760
clear water is everywhere but over land

437
00:16:13,189 --> 00:16:11,100
if what we're trying to do is measure

438
00:16:14,930 --> 00:16:13,199

how high water surfaces are the first

439
00:16:17,329 --> 00:16:14,940
thing we need to do is know where the

440
00:16:19,610 --> 00:16:17,339
water is in the first place and so what

441
00:16:22,670 --> 00:16:19,620
you can see some of these areas for

442
00:16:24,350 --> 00:16:22,680
example these brighter areas are where

443
00:16:26,990 --> 00:16:24,360
there's water on the ground you can see

444
00:16:29,090 --> 00:16:27,000
that because they're brighter or a

445
00:16:30,949 --> 00:16:29,100
little higher in the image you can see

446
00:16:32,930 --> 00:16:30,959
the Peconic River it's also it also

447
00:16:35,629 --> 00:16:32,940
appears gray and so the brightness tells

448
00:16:37,370 --> 00:16:35,639
us where the water is and the color here

449
00:16:39,970 --> 00:16:37,380
you know whether these these bright

450
00:16:42,829 --> 00:16:39,980
patches appear red or blue or purple

451
00:16:44,870 --> 00:16:42,839
that's what now that's the interference

452
00:16:47,389 --> 00:16:44,880
pattern that tells us how high those

453
00:16:50,030 --> 00:16:47,399
surfaces are so you can think about the

454
00:16:52,790 --> 00:16:50,040
colors almost like Contours on a topo

455
00:16:53,990 --> 00:16:52,800
map where you know the the phase of the

456
00:16:56,470 --> 00:16:54,000
interference pattern the the

457
00:16:59,749 --> 00:16:56,480
measurements we're making with Karen are

458
00:17:02,509 --> 00:16:59,759
you know that's what allows us to solve

459
00:17:04,549 --> 00:17:02,519
for the heights of uh these features on

460
00:17:06,770 --> 00:17:04,559
on the surface

461
00:17:09,590 --> 00:17:06,780
and if you're just joining us Curtis is

462
00:17:11,270 --> 00:17:09,600
breaking down these amazing images that

463
00:17:13,789 --> 00:17:11,280

we have gotten down here in the last few

464
00:17:15,650 --> 00:17:13,799
weeks from SWAT which launched last

465
00:17:17,630 --> 00:17:15,660
December and it's tracking over 90

466
00:17:20,390 --> 00:17:17,640
percent of the water on the Earth's

467
00:17:22,490 --> 00:17:20,400
surface and I I really love how we're

468
00:17:24,110 --> 00:17:22,500
able to see fresh water on this image as

469
00:17:25,610 --> 00:17:24,120
well and that's what also sets SWAT

470
00:17:28,549 --> 00:17:25,620
apart Curtis

471
00:17:30,350 --> 00:17:28,559
yeah it's uh we're able to see fresh

472
00:17:32,750 --> 00:17:30,360
water uh we'll be able to see ocean

473
00:17:34,970 --> 00:17:32,760
surfaces but because of that resolution

474
00:17:36,350 --> 00:17:34,980
and coverage we're able to to observe

475
00:17:38,990 --> 00:17:36,360
things and we just weren't able to

476
00:17:41,690 --> 00:17:39,000
observe before that's that's really uh

477
00:17:43,970 --> 00:17:41,700
one of the awesome things about Squad

478
00:17:46,549 --> 00:17:43,980
now for all of you amazing folks joining

479
00:17:48,590 --> 00:17:46,559
us right now these images don't come

480
00:17:50,750 --> 00:17:48,600
down looking like this do they Curtis so

481
00:17:53,029 --> 00:17:50,760
what kind of a process do you have to go

482
00:17:56,090 --> 00:17:53,039
to so that we can see images like this

483
00:17:58,549 --> 00:17:56,100
no when when the when the data first

484
00:18:00,650 --> 00:17:58,559
comes down from the spacecraft it looks

485
00:18:02,690 --> 00:18:00,660
like static on an old analog TV it

486
00:18:04,370 --> 00:18:02,700
doesn't look like this so there's a lot

487
00:18:06,289 --> 00:18:04,380
of ground processing involved in order

488
00:18:08,750 --> 00:18:06,299

to make images like this and to make

489
00:18:11,390 --> 00:18:08,760
other things as well that that people

490
00:18:13,190 --> 00:18:11,400
can can make use of you know one of the

491
00:18:15,890 --> 00:18:13,200
reasons that the data doesn't look like

492
00:18:18,350 --> 00:18:15,900
much when it comes down is that the way

493
00:18:19,549 --> 00:18:18,360
that the Karen instrument works one of

494
00:18:21,770 --> 00:18:19,559
the ways it achieves that fine

495
00:18:23,930 --> 00:18:21,780
resolution is

496
00:18:25,730 --> 00:18:23,940
um it's collecting it's collecting

497
00:18:27,409 --> 00:18:25,740
images that are not focused until they

498
00:18:28,909 --> 00:18:27,419
come down to the ground so if you think

499
00:18:31,669 --> 00:18:28,919
about the way a camera Works a camera

500
00:18:33,650 --> 00:18:31,679
usually has a lens and a sensor of some

501
00:18:35,390 --> 00:18:33,660
sort like in the old days it would be

502
00:18:37,909 --> 00:18:35,400
film now there's an electronic sensor

503
00:18:39,049 --> 00:18:37,919
the lens is focusing the light onto that

504
00:18:41,270 --> 00:18:39,059
sensor

505
00:18:43,610 --> 00:18:41,280
the way Karen Works in order to achieve

506
00:18:46,549 --> 00:18:43,620
the resolution that we want it's almost

507
00:18:48,830 --> 00:18:46,559
as if Karen is collecting data like you

508
00:18:50,930 --> 00:18:48,840
were a camera without the lens and then

509
00:18:52,909 --> 00:18:50,940
we do the focusing that the lens does on

510
00:18:54,650 --> 00:18:52,919
the ground in digital processing it

511
00:18:56,750 --> 00:18:54,660
turns out that's one of the ways that we

512
00:18:58,909 --> 00:18:56,760
can get better resolution because it's

513
00:19:00,770 --> 00:18:58,919

you know we can't actually build the

514
00:19:02,990 --> 00:19:00,780
equivalent of that camera lens big

515
00:19:04,310 --> 00:19:03,000
enough in space so we just do it all on

516
00:19:06,470 --> 00:19:04,320
the ground digitally

517
00:19:08,330 --> 00:19:06,480
but after that processing we can get

518
00:19:10,549 --> 00:19:08,340
these beautiful images we can also

519
00:19:12,110 --> 00:19:10,559
produce products that have just easy to

520
00:19:13,909 --> 00:19:12,120
understand quantities like latitude

521
00:19:17,270 --> 00:19:13,919
longitude and height to make the data

522
00:19:19,850 --> 00:19:17,280
usable by hopefully by anyone we the

523
00:19:21,890 --> 00:19:19,860
data will be available for you know to

524
00:19:23,990 --> 00:19:21,900
the public for download eventually

525
00:19:25,070 --> 00:19:24,000
um and and we want people to use data so

526
00:19:27,950 --> 00:19:25,080
we want to make it easy to understand

527
00:19:29,690 --> 00:19:27,960
for everyone yeah that was so great easy

528
00:19:31,730 --> 00:19:29,700
to understand available to the general

529
00:19:33,409 --> 00:19:31,740
public and the scientists and put into

530
00:19:35,810 --> 00:19:33,419
the hands of decision makers which is

531
00:19:37,310 --> 00:19:35,820
all what SWAT is there to do and

532
00:19:39,890 --> 00:19:37,320
speaking about the data particularly

533
00:19:41,450 --> 00:19:39,900
this is an incredibly large amount of

534
00:19:42,830 --> 00:19:41,460
data can you just put that into

535
00:19:44,210 --> 00:19:42,840
perspective for the folks at home

536
00:19:46,490 --> 00:19:44,220
especially compared to other missions

537
00:19:49,610 --> 00:19:46,500
yeah yeah we were talking about how

538
00:19:51,770 --> 00:19:49,620

Karen Karen makes you know it gets

539
00:19:53,990 --> 00:19:51,780
images why coverage and fine resolution

540
00:19:57,289 --> 00:19:54,000
but you do the math on that that's just

541
00:19:59,750 --> 00:19:57,299
a lot of pixels and so Karen produces a

542
00:20:03,049 --> 00:19:59,760
ton of data it's about 20 terabytes of

543
00:20:05,990 --> 00:20:03,059
data a day for a comparison one day of

544
00:20:07,970 --> 00:20:06,000
SWOT data is is about the equivalent of

545
00:20:09,950 --> 00:20:07,980
five years worth of data from one of

546
00:20:11,029 --> 00:20:09,960
these previous downward looking radar

547
00:20:13,430 --> 00:20:11,039
alternators

548
00:20:16,250 --> 00:20:13,440
or another way to think about it is that

549
00:20:19,310 --> 00:20:16,260
the data volume coming from the the data

550
00:20:20,690 --> 00:20:19,320
volume that swap produces is a you know

551
00:20:22,789 --> 00:20:20,700
is the equivalent of a feature-length

552
00:20:23,870 --> 00:20:22,799
movie Every 15 seconds or so so just in

553
00:20:25,310 --> 00:20:23,880
the time that we've been talking about

554
00:20:27,289 --> 00:20:25,320
this you probably could have streamed a

555
00:20:31,730 --> 00:20:27,299
few movies and

556
00:20:33,650 --> 00:20:31,740
um you know it's just a lot of data to

557
00:20:35,990 --> 00:20:33,660
and as much as we love streaming movies

558
00:20:37,970 --> 00:20:36,000
I'm sure all of us do this is much more

559
00:20:39,650 --> 00:20:37,980
productive and better for all of

560
00:20:41,930 --> 00:20:39,660
humankind as you mentioned which is

561
00:20:43,610 --> 00:20:41,940
great and we can't wait to see more of

562
00:20:46,250 --> 00:20:43,620
these images now you've worked on many

563
00:20:47,810 --> 00:20:46,260

Mars missions what is it like to work on

564
00:20:50,510 --> 00:20:47,820
an earth Mission now has it been

565
00:20:52,190 --> 00:20:50,520
rewarding it's it's been great you know

566
00:20:54,590 --> 00:20:52,200
working on Mars missions is always a lot

567
00:20:56,510 --> 00:20:54,600
of fun because it's just cool to think

568
00:20:58,190 --> 00:20:56,520
of your job as being landing something

569
00:21:00,169 --> 00:20:58,200
on another planet

570
00:21:01,909 --> 00:21:00,179
but the Earth missions have been

571
00:21:03,230 --> 00:21:01,919
rewarding in a whole new way because not

572
00:21:06,110 --> 00:21:03,240
only are there really interesting

573
00:21:07,669 --> 00:21:06,120
engineering challenges involved but you

574
00:21:09,650 --> 00:21:07,679
get a sense that you're doing something

575
00:21:12,529 --> 00:21:09,660
that that really matters that's that's

576
00:21:14,390 --> 00:21:12,539
kind of for the good of everyone for the

577
00:21:16,730 --> 00:21:14,400
good of all Humanity sounds cheesy to

578
00:21:18,230 --> 00:21:16,740
say but that's that's one of the ways

579
00:21:20,630 --> 00:21:18,240
that you know I truly think about it and

580
00:21:23,270 --> 00:21:20,640
so it's it's rewarding on a level of

581
00:21:25,909 --> 00:21:23,280
that that you know I can I can feel like

582
00:21:28,490 --> 00:21:25,919
I'm I'm addressing some of the important

583
00:21:31,370 --> 00:21:28,500
problems of the day

584
00:21:33,230 --> 00:21:31,380
oh so true and I completely agree with

585
00:21:35,149 --> 00:21:33,240
you Curtis and I'm so happy that you

586
00:21:36,350 --> 00:21:35,159
were able to join us today thank you so

587
00:21:37,909 --> 00:21:36,360
much

588
00:21:40,730 --> 00:21:37,919

thanks for having me Marina and thank

589
00:21:42,710 --> 00:21:40,740
also thank you to the whole SWAT team

590
00:21:44,149 --> 00:21:42,720
it's such a great International group of

591
00:21:46,610 --> 00:21:44,159
you and it's been a privilege to work

592
00:21:48,350 --> 00:21:46,620
with you guys so good luck and thank you

593
00:21:50,510 --> 00:21:48,360
for everything that you do with SWAT as

594
00:21:52,490 --> 00:21:50,520
more data images come down I can't wait

595
00:21:54,289 --> 00:21:52,500
to see them and share them with all of

596
00:21:56,270 --> 00:21:54,299
you at home and thank you for all of you

597
00:21:58,490 --> 00:21:56,280
for joining us today and if you want to

598
00:22:01,130 --> 00:21:58,500
learn more about swat please follow us

599
00:22:03,470 --> 00:22:01,140
at NASA JPL and at Nasa Earth those were

600
00:22:05,750 --> 00:22:03,480
the two accounts that were featured on

601
00:22:07,610 --> 00:22:05,760
Instagram today and it's just been a

602
00:22:09,289 --> 00:22:07,620
pleasure to be able to join you and

603
00:22:11,330 --> 00:22:09,299
Curtis and I have had so much fun with

604
00:22:13,310 --> 00:22:11,340
you so remember at Nasa science Earth

605
00:22:15,169 --> 00:22:13,320
your home is our mission thank you so