1
00:00:06,630 --> 00:00:05,030
nasa's jet propulsion laboratory

2
00:00:09,270 --> 00:00:06,640
presents

3
00:00:11,350 --> 00:00:09,280
the von carmen lecture a series of talks

4
00:00:14,629 --> 00:00:11,360
by scientists and engineers who are

5
00:00:16,299 --> 00:00:14,639
exploring our planet our solar system

6
00:00:24,550 --> 00:00:16,309
and all that lies beyond

7
00:00:27,269 --> 00:00:24,560
[Music]

8
00:00:29,349 --> 00:00:27,279
good evening folks wherever you may be i

9
00:00:31,990 --> 00:00:29,359
am brian white from jpl's office of

10
00:00:34,229 --> 00:00:32,000
communications and education and welcome

11
00:00:35,990 --> 00:00:34,239
to the von carmen series our first talk

12
00:00:37,990 --> 00:00:36,000
of 2022

13
00:00:39,670 --> 00:00:38,000

this is an opportunity for us to engage

14
00:00:41,750 --> 00:00:39,680
in the public now this is your space

15
00:00:44,389 --> 00:00:41,760
program so if we have any technical

16
00:00:47,270 --> 00:00:44,399
difficulties we ask for your patience

17
00:00:49,350 --> 00:00:47,280
jpl is great at landing on mars but

18
00:00:50,549 --> 00:00:49,360
sometimes i personally have trouble with

19
00:00:53,189 --> 00:00:50,559
my wi-fi

20
00:00:55,189 --> 00:00:53,199
tonight we'll be discussing swat surface

21
00:00:57,670 --> 00:00:55,199
water and ocean topography the first

22
00:01:00,869 --> 00:00:57,680
mission that is specifically designed to

23
00:01:03,189 --> 00:01:00,879
measure lakes reservoirs wetlands and

24
00:01:05,509 --> 00:01:03,199
rivers it will also observe the oceans

25
00:01:07,270 --> 00:01:05,519
and benefits from a 30-year legacy of

26
00:01:09,270 --> 00:01:07,280
ocean observing satellites

27
00:01:13,429 --> 00:01:09,280
joining us this evening is our questions

28
00:01:16,149 --> 00:01:13,439
co-host jocelyn argeta hi jocelyn

29
00:01:17,590 --> 00:01:16,159
hi friends great to be here tonight and

30
00:01:19,670 --> 00:01:17,600
i just want to remind everyone that's

31
00:01:21,830 --> 00:01:19,680
watching that as this is your space

32
00:01:23,910 --> 00:01:21,840
program we want you involved in the

33
00:01:25,910 --> 00:01:23,920
conversation so please add your

34
00:01:28,710 --> 00:01:25,920
questions to to the chat throughout the

35
00:01:30,870 --> 00:01:28,720
discussion and our amazing social media

36
00:01:32,870 --> 00:01:30,880
team will get those to us we'll try to

37
00:01:35,109 --> 00:01:32,880
answer as many as we can and if you

38
00:01:37,830 --> 00:01:35,119

can't see the chat just hit refresh and

39
00:01:39,990 --> 00:01:37,840
it should pop up

40
00:01:41,910 --> 00:01:40,000
thank you very much jocelyn now our

41
00:01:44,469 --> 00:01:41,920
speaker tonight serves as the supervisor

42
00:01:46,310 --> 00:01:44,479
of the water and ecosystems group at the

43
00:01:49,270 --> 00:01:46,320
jet propulsion laboratory he has worked

44
00:01:51,270 --> 00:01:49,280
at jpl since 2014 his research interests

45
00:01:53,429 --> 00:01:51,280
relate to earth's water cycle and he

46
00:01:54,389 --> 00:01:53,439
never misses an opportunity to swim in

47
00:01:58,230 --> 00:01:54,399
an ocean

48
00:02:02,469 --> 00:01:58,240
lake river or cave no matter how cold

49
00:02:05,830 --> 00:02:02,479
please welcome dr cedric david hi cedric

50
00:02:08,469 --> 00:02:05,840
uh hi brian hi uh jocelyn and and hi

51
00:02:10,070 --> 00:02:08,479
everyone out there on the interwebs real

52
00:02:12,630 --> 00:02:10,080
pleasure to be here thank you so much

53
00:02:14,070 --> 00:02:12,640
for for having me it's a it's an honor

54
00:02:15,830 --> 00:02:14,080
it's so wonderful to have you with us

55
00:02:18,150 --> 00:02:15,840
today let's just start off easy who are

56
00:02:20,790 --> 00:02:18,160
you what do you do

57
00:02:24,550 --> 00:02:20,800
um well brian that's a that's a great

58
00:02:27,190 --> 00:02:24,560
place to start um so who am i i am uh

59
00:02:28,390 --> 00:02:27,200
just an ordinary guy who happens to be a

60
00:02:30,790 --> 00:02:28,400
scientist

61
00:02:33,190 --> 00:02:30,800
uh an immigrant and just someone who

62
00:02:35,830 --> 00:02:33,200
really uh cares about water

63
00:02:37,670 --> 00:02:35,840

so i i grew up on the mediterranean

64
00:02:39,270 --> 00:02:37,680
coast of france in a in a city called

65
00:02:40,470 --> 00:02:39,280
marseille

66
00:02:43,509 --> 00:02:40,480
and

67
00:02:45,430 --> 00:02:43,519
i moved to the united states about 17

68
00:02:47,750 --> 00:02:45,440
years ago for graduate school

69
00:02:49,670 --> 00:02:47,760
ended up moving to los angeles about

70
00:02:54,869 --> 00:02:49,680
seven years ago and maybe we can start

71
00:02:59,670 --> 00:02:57,110
yeah so i i really like these two images

72
00:03:01,430 --> 00:02:59,680
uh the one on the left is is my hometown

73
00:03:04,070 --> 00:03:01,440
as seen from the international space

74
00:03:06,309 --> 00:03:04,080
station uh this is marseille of france

75
00:03:08,390 --> 00:03:06,319
and then on the right hand side is los

76
00:03:11,270 --> 00:03:08,400
angeles where i live now as seen from

77
00:03:13,030 --> 00:03:11,280
the uh terra satellite and uh what's

78
00:03:14,470 --> 00:03:13,040
pretty great about these two pictures is

79
00:03:16,869 --> 00:03:14,480
you can see a lot of geographic

80
00:03:19,190 --> 00:03:16,879
similarities between these two places

81
00:03:21,750 --> 00:03:19,200
that i've called home at different parts

82
00:03:23,830 --> 00:03:21,760
of of my life and you know from above it

83
00:03:25,350 --> 00:03:23,840
all looks just the same

84
00:03:27,270 --> 00:03:25,360
and they also happen to have very

85
00:03:30,149 --> 00:03:27,280
similar climates

86
00:03:34,070 --> 00:03:30,159
um so now you know as far as what what

87
00:03:36,630 --> 00:03:34,080
do i do i am a hydrologist which means i

88
00:03:39,270 --> 00:03:36,640

study the earth's water cycle

89
00:03:42,550 --> 00:03:39,280
and specifically i i like to look at

90
00:03:44,789 --> 00:03:42,560
rivers uh but also other things like

91
00:03:47,670 --> 00:03:44,799
lakes and and reservoirs so

92
00:03:49,750 --> 00:03:47,680
overall surface waters and uh and

93
00:03:52,149 --> 00:03:49,760
perhaps we could show uh image number

94
00:03:54,550 --> 00:03:52,159
two please

95
00:03:56,309 --> 00:03:54,560
um yeah so i uh this is an animation of

96
00:03:59,110 --> 00:03:56,319
some of the work that i do i spent some

97
00:04:01,350 --> 00:03:59,120
time uh simulating how water moves down

98
00:04:03,670 --> 00:04:01,360
river systems throughout the world

99
00:04:05,670 --> 00:04:03,680
a mix of equations and observations

100
00:04:07,990 --> 00:04:05,680
whether it be from observations on the

101
00:04:08,949 --> 00:04:08,000
ground or observations from space

102
00:04:11,589 --> 00:04:08,959
and

103
00:04:13,750 --> 00:04:11,599
so what you're looking at here is the

104
00:04:15,830 --> 00:04:13,760
thickness of the blue lines varies as a

105
00:04:18,069 --> 00:04:15,840
function of how water is propagating

106
00:04:19,590 --> 00:04:18,079
from upstream to downstream and and

107
00:04:21,749 --> 00:04:19,600
we're looking at the river of the

108
00:04:23,909 --> 00:04:21,759
mississippi river basin which is the

109
00:04:26,070 --> 00:04:23,919
largest river basin in the united states

110
00:04:29,270 --> 00:04:26,080
covers about a third of the united

111
00:04:30,629 --> 00:04:29,280
states in an area now one thing that i i

112
00:04:33,510 --> 00:04:30,639
find really special about these

113
00:04:35,510 --> 00:04:33,520

animations is that they um give you an

114
00:04:37,350 --> 00:04:35,520
indication that you know the earth is a

115
00:04:39,590 --> 00:04:37,360
living planet perhaps water is flowing

116
00:04:43,110 --> 00:04:39,600
through um the

117
00:04:45,590 --> 00:04:43,120
continental arteries and so overall yes

118
00:04:47,749 --> 00:04:45,600
i'm a hydrologist and i study surface

119
00:04:51,990 --> 00:04:47,759
water

120
00:04:57,110 --> 00:04:52,000
why

121
00:05:01,350 --> 00:04:59,350
i think that's a great place to start uh

122
00:05:04,310 --> 00:05:01,360
and and perhaps we should

123
00:05:06,150 --> 00:05:04,320
state the obvious first uh brian so

124
00:05:08,710 --> 00:05:06,160
water is essential to life

125
00:05:11,510 --> 00:05:08,720
and um as a matter of fact when nasa

126
00:05:13,590 --> 00:05:11,520
looks for life in other worlds uh you

127
00:05:15,990 --> 00:05:13,600
know one of the first things that we

128
00:05:19,110 --> 00:05:16,000
look for is is the presence of water or

129
00:05:21,430 --> 00:05:19,120
the potential for water now of course

130
00:05:23,990 --> 00:05:21,440
water is also essential for us

131
00:05:26,710 --> 00:05:24,000
on earth for humans but also for for

132
00:05:31,029 --> 00:05:26,720
ecosystems and uh perhaps we could we

133
00:05:33,749 --> 00:05:31,039
could bring up image number three please

134
00:05:35,510 --> 00:05:33,759
so i i really like uh this image we can

135
00:05:39,110 --> 00:05:35,520
start on the left hand side this is the

136
00:05:41,189 --> 00:05:39,120
blue marble as seen by apollo 17 in the

137
00:05:42,550 --> 00:05:41,199
early 1970s

138
00:05:44,950 --> 00:05:42,560

so the first thing that you notice is

139
00:05:46,550 --> 00:05:44,960
that this is the blue planet right and

140
00:05:48,950 --> 00:05:46,560
of course it's blue because we have lots

141
00:05:51,510 --> 00:05:48,960
of water and that makes our planet very

142
00:05:53,830 --> 00:05:51,520
special compared to other places uh in

143
00:05:55,350 --> 00:05:53,840
the universe now the blue planet also

144
00:05:57,670 --> 00:05:55,360
has a lot of white

145
00:05:59,990 --> 00:05:57,680
and uh the white turns out to be water

146
00:06:02,469 --> 00:06:00,000
as well whether it be clouds

147
00:06:03,749 --> 00:06:02,479
or uh ice caps in this particular case

148
00:06:06,870 --> 00:06:03,759
uh the uh

149
00:06:09,990 --> 00:06:06,880
uh antarctic uh the ice caps in

150
00:06:12,309 --> 00:06:10,000
antarctica here in in the southern pole

151
00:06:14,629 --> 00:06:12,319
and so lots of water blue water and and

152
00:06:17,029 --> 00:06:14,639
white water now if you take all of the

153
00:06:18,950 --> 00:06:17,039
water of the earth uh you know water in

154
00:06:21,590 --> 00:06:18,960
the oceans in lakes reservoirs

155
00:06:22,790 --> 00:06:21,600
groundwater watering people in trees and

156
00:06:25,189 --> 00:06:22,800
animals

157
00:06:27,189 --> 00:06:25,199
and you put it all in a big sphere you

158
00:06:29,270 --> 00:06:27,199
end up with the big sphere that is on

159
00:06:31,510 --> 00:06:29,280
the right hand side here just above the

160
00:06:33,029 --> 00:06:31,520
state of utah so this is an image that

161
00:06:35,189 --> 00:06:33,039
was produced by our colleagues at the

162
00:06:37,830 --> 00:06:35,199
u.s geological survey which i think is

163
00:06:40,550 --> 00:06:37,840

very powerful so you know it might seem

164
00:06:42,070 --> 00:06:40,560
when you look on the left hand side that

165
00:06:44,550 --> 00:06:42,080
we have tons of water but when you put

166
00:06:46,150 --> 00:06:44,560
it all together maybe not as much as as

167
00:06:48,629 --> 00:06:46,160
we might have thought

168
00:06:50,710 --> 00:06:48,639
so this big sphere here is all of the

169
00:06:53,350 --> 00:06:50,720
water on earth right but the vast

170
00:06:55,110 --> 00:06:53,360
majority of it is salty that makes it

171
00:06:57,270 --> 00:06:55,120
kind of not great when you try to drink

172
00:06:59,510 --> 00:06:57,280
it and it's not perfect if you try to

173
00:07:01,270 --> 00:06:59,520
irrigate crops either

174
00:07:03,110 --> 00:07:01,280
so another way to look at it is if you

175
00:07:05,909 --> 00:07:03,120
only look if you take away all the

176
00:07:07,909 --> 00:07:05,919
oceans and seas and you take away

177
00:07:11,270 --> 00:07:07,919
another notable portion which is frozen

178
00:07:13,670 --> 00:07:11,280
water same thing not the best to drink

179
00:07:15,990 --> 00:07:13,680
um now you end up with that with that

180
00:07:18,070 --> 00:07:16,000
little bubble to the right of the of the

181
00:07:21,110 --> 00:07:18,080
big sphere and the bubble that is just

182
00:07:24,390 --> 00:07:21,120
above the state of kentucky now this is

183
00:07:27,189 --> 00:07:24,400
liquid fresh water so not the salty uh

184
00:07:28,950 --> 00:07:27,199
just fresh water and uh and and and not

185
00:07:32,070 --> 00:07:28,960
frozen all liquid

186
00:07:32,950 --> 00:07:32,080
so a little smaller of a bubble

187
00:07:34,950 --> 00:07:32,960
and

188
00:07:37,110 --> 00:07:34,960

now the vast majority of this little

189
00:07:40,230 --> 00:07:37,120
bubble is actually groundwater now

190
00:07:42,230 --> 00:07:40,240
groundwater is great because it helps us

191
00:07:44,550 --> 00:07:42,240
in times of needs you know if it gets

192
00:07:46,869 --> 00:07:44,560
pretty dry in case of a drought

193
00:07:48,469 --> 00:07:46,879
it is a nice source of water but you do

194
00:07:50,710 --> 00:07:48,479
have to go

195
00:07:53,029 --> 00:07:50,720
pump it so you got to go extract it from

196
00:07:54,469 --> 00:07:53,039
the ground and that takes effort and

197
00:07:55,909 --> 00:07:54,479
energy

198
00:07:57,830 --> 00:07:55,919
the other

199
00:08:00,629 --> 00:07:57,840
inconvenience with the groundwater is

200
00:08:02,950 --> 00:08:00,639
that it takes hundreds of years to

201
00:08:05,029 --> 00:08:02,960
replenish so that means when you take it

202
00:08:06,950 --> 00:08:05,039
away then it's likely not going to come

203
00:08:09,350 --> 00:08:06,960
back any time soon

204
00:08:11,430 --> 00:08:09,360
and we've seen from a variety of other

205
00:08:13,110 --> 00:08:11,440
nasa satellites that basically

206
00:08:14,230 --> 00:08:13,120
groundwater has been depleting around

207
00:08:16,230 --> 00:08:14,240
the world

208
00:08:19,270 --> 00:08:16,240
and so you can think of groundwater as a

209
00:08:21,270 --> 00:08:19,280
savings account for water and uh and

210
00:08:23,110 --> 00:08:21,280
we've been withdrawing quite a bit from

211
00:08:24,710 --> 00:08:23,120
the savings account which which can be

212
00:08:26,790 --> 00:08:24,720
concerning

213
00:08:29,110 --> 00:08:26,800

now if you pay attention just underneath

214
00:08:31,189 --> 00:08:29,120
that little bubble is a tiny pinpoint

215
00:08:33,509 --> 00:08:31,199
dot a blue dot just above the state of

216
00:08:35,990 --> 00:08:33,519
georgia now this is

217
00:08:37,750 --> 00:08:36,000
all of the liquid fresh water that is

218
00:08:40,790 --> 00:08:37,760
within earth's rivers lakes and

219
00:08:42,550 --> 00:08:40,800
reservoirs so now what makes this tiny

220
00:08:44,870 --> 00:08:42,560
dot very special

221
00:08:46,310 --> 00:08:44,880
is that um the water in earth's reverse

222
00:08:50,389 --> 00:08:46,320
lakes and reservoirs is the most

223
00:08:53,590 --> 00:08:50,399
renewable and the most accessible source

224
00:08:55,750 --> 00:08:53,600
of fresh water and so that also

225
00:08:58,550 --> 00:08:55,760
because these two together it makes it

226
00:09:01,829 --> 00:08:58,560
the most sustainable uh source of fresh

227
00:09:05,590 --> 00:09:01,839
water and uh this tiny dot is also uh

228
00:09:07,990 --> 00:09:05,600
special for for us humans because uh uh

229
00:09:10,630 --> 00:09:08,000
most of the ancient human civilizations

230
00:09:13,190 --> 00:09:10,640
were born in great river valleys and so

231
00:09:14,870 --> 00:09:13,200
you know the proximity to to this uh uh

232
00:09:16,630 --> 00:09:14,880
easily accessible and renewable source

233
00:09:19,910 --> 00:09:16,640
of fresh water

234
00:09:23,030 --> 00:09:19,920
has been a uh an important factor in

235
00:09:24,550 --> 00:09:23,040
basically the birth of of humanity

236
00:09:26,550 --> 00:09:24,560
but so one thing to remember here is

237
00:09:28,070 --> 00:09:26,560
that you know that's basically all the

238
00:09:29,910 --> 00:09:28,080

water we got

239
00:09:31,269 --> 00:09:29,920
all right and uh it might change from

240
00:09:33,750 --> 00:09:31,279
you know one bubble to the next

241
00:09:36,630 --> 00:09:33,760
depending on on the uh evolution of the

242
00:09:39,190 --> 00:09:36,640
water cycle but that's all we got

243
00:09:42,389 --> 00:09:39,200
and another thing that um i think is

244
00:09:44,389 --> 00:09:42,399
important to look at is uh is how many

245
00:09:45,750 --> 00:09:44,399
people we are

246
00:09:48,470 --> 00:09:45,760
and

247
00:09:52,310 --> 00:09:48,480
perhaps we could bring up image

248
00:09:54,790 --> 00:09:52,320
image number six which number six please

249
00:09:56,389 --> 00:09:54,800
um so yeah this is this is a chart that

250
00:09:58,230 --> 00:09:56,399
shows uh the

251
00:10:00,389 --> 00:09:58,240
variation of uh the

252
00:10:04,069 --> 00:10:00,399
the growth of human population

253
00:10:05,509 --> 00:10:04,079
uh starting 10 000 before common era to

254
00:10:07,269 --> 00:10:05,519
now

255
00:10:09,829 --> 00:10:07,279
uh and uh

256
00:10:12,870 --> 00:10:11,110
brian did you did you want to say

257
00:10:15,350 --> 00:10:12,880
something

258
00:10:16,949 --> 00:10:15,360
yeah okay all right um so what you can

259
00:10:19,030 --> 00:10:16,959
see what you can see is that there is a

260
00:10:21,910 --> 00:10:19,040
big rise in population right we started

261
00:10:25,190 --> 00:10:21,920
with basically nobody and uh and and

262
00:10:29,269 --> 00:10:25,200
it's been rising very quickly uh up to

263
00:10:31,590 --> 00:10:29,279

uh up to now so for reference in in 1800

264
00:10:33,670 --> 00:10:31,600
it was just about a billion uh human

265
00:10:37,269 --> 00:10:33,680
beings on earth and uh and right now in

266
00:10:39,430 --> 00:10:37,279
2021 almost seven billion uh human

267
00:10:40,310 --> 00:10:39,440
beings on earth almost eight billion

268
00:10:42,150 --> 00:10:40,320
actually

269
00:10:44,310 --> 00:10:42,160
over seven billion so that's billion

270
00:10:45,750 --> 00:10:44,320
with a b and so we only have this much

271
00:10:47,110 --> 00:10:45,760
water

272
00:10:48,550 --> 00:10:47,120
and uh

273
00:10:50,550 --> 00:10:48,560
and the human population has been

274
00:10:53,110 --> 00:10:50,560
growing very rapidly

275
00:10:55,350 --> 00:10:53,120
and so what this tells you is that the

276
00:10:56,550 --> 00:10:55,360
amount of water per person has been

277
00:11:00,389 --> 00:10:56,560
decreasing

278
00:11:03,750 --> 00:11:01,829
now there is another portion of the

279
00:11:05,430 --> 00:11:03,760
story and if you don't mind would you

280
00:11:08,630 --> 00:11:05,440
would you please bring up uh image

281
00:11:13,269 --> 00:11:11,190
yeah so um

282
00:11:15,750 --> 00:11:13,279
rivers don't care about political

283
00:11:17,430 --> 00:11:15,760
boundaries right so rivers flow across

284
00:11:19,590 --> 00:11:17,440
national borders

285
00:11:21,509 --> 00:11:19,600
and uh and water is also a shared

286
00:11:23,509 --> 00:11:21,519
resource so what we're looking at here

287
00:11:26,150 --> 00:11:23,519
is a map of the world and and those

288
00:11:29,269 --> 00:11:26,160

polygons here in in green yellowish

289
00:11:31,829 --> 00:11:29,279
colors um are what's called river basins

290
00:11:34,310 --> 00:11:31,839
all right a river basin is basically an

291
00:11:35,990 --> 00:11:34,320
area where if it rains there the water

292
00:11:38,710 --> 00:11:36,000
is only the surface water is only going

293
00:11:40,230 --> 00:11:38,720
to stay within this um this polygon and

294
00:11:41,590 --> 00:11:40,240
will flow eventually all the way

295
00:11:44,389 --> 00:11:41,600
downstream

296
00:11:47,110 --> 00:11:44,399
to the nearby ocean

297
00:11:48,710 --> 00:11:47,120
and uh and so now the river basins that

298
00:11:50,470 --> 00:11:48,720
we're showing here are all of the

299
00:11:51,430 --> 00:11:50,480
world's river basins that happen to

300
00:11:53,190 --> 00:11:51,440
touch

301
00:11:55,350 --> 00:11:53,200
multiple countries

302
00:11:58,069 --> 00:11:55,360
all right so um

303
00:11:59,190 --> 00:11:58,079
surface water is a shared resource and

304
00:12:01,750 --> 00:11:59,200
uh

305
00:12:04,470 --> 00:12:01,760
what's important to recognize is that of

306
00:12:06,230 --> 00:12:04,480
course water is is is is vital for

307
00:12:08,710 --> 00:12:06,240
everyone now if you're lucky and you

308
00:12:10,949 --> 00:12:08,720
happen to be living upstream of one of

309
00:12:13,509 --> 00:12:10,959
these river basin basins

310
00:12:15,590 --> 00:12:13,519
basically you have first dibs

311
00:12:18,069 --> 00:12:15,600
first dibs on the water all right so you

312
00:12:20,470 --> 00:12:18,079
know that's great lucky you uh and water

313
00:12:22,150 --> 00:12:20,480

is vital for you i get it but if you

314
00:12:23,750 --> 00:12:22,160
happen to be living downstream of a

315
00:12:25,350 --> 00:12:23,760
river basin and perhaps somebody else

316
00:12:27,590 --> 00:12:25,360
grabbed it before you had access to it

317
00:12:29,190 --> 00:12:27,600
then it could become a problem so you

318
00:12:31,030 --> 00:12:29,200
know water is vital it's a sensitive

319
00:12:31,990 --> 00:12:31,040
resource because it's shared across

320
00:12:34,230 --> 00:12:32,000
nations

321
00:12:35,990 --> 00:12:34,240
and uh and again there is only so much

322
00:12:40,629 --> 00:12:36,000
of it

323
00:12:42,230 --> 00:12:40,639
so an old adage is is you can't

324
00:12:44,470 --> 00:12:42,240
uh manage

325
00:12:46,150 --> 00:12:44,480
what you don't measure right and so

326
00:12:49,030 --> 00:12:46,160
so we have to manage this precious

327
00:12:49,990 --> 00:12:49,040
resource and uh perhaps we could bring

328
00:12:54,310 --> 00:12:50,000
up

329
00:12:56,870 --> 00:12:55,590
all right so this is how we've been

330
00:12:59,509 --> 00:12:56,880
measuring uh

331
00:13:01,509 --> 00:12:59,519
surface waters around around the earth

332
00:13:03,829 --> 00:13:01,519
basically you put a stick in the water

333
00:13:05,110 --> 00:13:03,839
or maybe a ruler and you measure how

334
00:13:07,509 --> 00:13:05,120
high

335
00:13:09,590 --> 00:13:07,519
the water is if you add to that little

336
00:13:11,350 --> 00:13:09,600
knowledge of how deep the water body is

337
00:13:14,470 --> 00:13:11,360
the shape of the bottom of the water

338
00:13:16,949 --> 00:13:14,480

body what we call bathymetry uh and some

339
00:13:19,030 --> 00:13:16,959
physical equations of hydraulics then

340
00:13:21,509 --> 00:13:19,040
you are able to determine how much water

341
00:13:23,030 --> 00:13:21,519
you have and perhaps even how fast water

342
00:13:25,430 --> 00:13:23,040
is flowing

343
00:13:27,750 --> 00:13:25,440
which is uh it's pretty great so you

344
00:13:29,910 --> 00:13:27,760
know the old-school ways to use a ruler

345
00:13:32,470 --> 00:13:29,920
like the image on the on on the left a

346
00:13:35,990 --> 00:13:32,480
more modern way is to

347
00:13:38,550 --> 00:13:36,000
use a radar perhaps mounted on a bridge

348
00:13:41,269 --> 00:13:38,560
just above a a water body and then the

349
00:13:43,829 --> 00:13:41,279
radar will shoot a radar signal straight

350
00:13:45,430 --> 00:13:43,839
down and the and that signal bounces on

351
00:13:47,350 --> 00:13:45,440
the water comes back and by measuring

352
00:13:49,670 --> 00:13:47,360
the distance between

353
00:13:51,189 --> 00:13:49,680
the radar and uh

354
00:13:53,750 --> 00:13:51,199
and if by measuring the time that it

355
00:13:55,750 --> 00:13:53,760
takes for the signal to come back we

356
00:13:57,430 --> 00:13:55,760
know how high the water is and that

357
00:13:59,590 --> 00:13:57,440
little antenna that is at the top allows

358
00:14:02,870 --> 00:13:59,600
you to share the the data on on the

359
00:14:04,629 --> 00:14:02,880
internet so um that's pretty cool

360
00:14:06,550 --> 00:14:04,639
now

361
00:14:09,670 --> 00:14:06,560
there's a problem there

362
00:14:12,629 --> 00:14:09,680
and if you could bring up image number

363
00:14:14,949 --> 00:14:12,639

number five please

364
00:14:17,350 --> 00:14:14,959
so this is a map of where

365
00:14:19,750 --> 00:14:17,360
river gauges so like the ones that we

366
00:14:22,150 --> 00:14:19,760
just discussed are located around the

367
00:14:25,269 --> 00:14:22,160
around the world and so all the dots

368
00:14:27,430 --> 00:14:25,279
here whether they're dark or light blue

369
00:14:31,670 --> 00:14:27,440
uh are a place where at some point there

370
00:14:33,350 --> 00:14:31,680
was a a a gauge a river gauge in uh in

371
00:14:36,069 --> 00:14:33,360
the world's rivers

372
00:14:37,910 --> 00:14:36,079
and lakes now first thing you notice is

373
00:14:41,189 --> 00:14:37,920
that in some places there just never has

374
00:14:43,750 --> 00:14:41,199
been one okay so that could be an issue

375
00:14:46,629 --> 00:14:43,760
the other thing to note here is that

376
00:14:49,910 --> 00:14:46,639
those rivers those gauges that are

377
00:14:52,629 --> 00:14:49,920
light blue basically have not been

378
00:14:54,710 --> 00:14:52,639
accessible data has not been accessible

379
00:14:56,870 --> 00:14:54,720
since the year 2000

380
00:14:58,550 --> 00:14:56,880
either because the people taking the

381
00:14:59,990 --> 00:14:58,560
measurements i'm not sharing them or

382
00:15:01,990 --> 00:15:00,000
because they're just not paying for the

383
00:15:04,790 --> 00:15:02,000
measurement um at all

384
00:15:05,750 --> 00:15:04,800
and uh and those gauges which are darker

385
00:15:07,750 --> 00:15:05,760
blue

386
00:15:10,790 --> 00:15:07,760
are uh gauges that are that are still

387
00:15:13,269 --> 00:15:10,800
available past the year 2000 and so what

388
00:15:15,430 --> 00:15:13,279

basically uh what we're learning from

389
00:15:17,509 --> 00:15:15,440
this map is that river

390
00:15:19,910 --> 00:15:17,519
gauges are disappearing

391
00:15:22,710 --> 00:15:19,920
so let me summarize the whole story for

392
00:15:24,870 --> 00:15:22,720
you we only have this much water

393
00:15:26,389 --> 00:15:24,880
and then we have so many more people

394
00:15:28,470 --> 00:15:26,399
than we've had in history and that's

395
00:15:30,069 --> 00:15:28,480
growing and growing

396
00:15:32,710 --> 00:15:30,079
surface water is a very precious

397
00:15:34,629 --> 00:15:32,720
resource that is shared across nations

398
00:15:37,430 --> 00:15:34,639
and now we're realizing that the

399
00:15:39,269 --> 00:15:37,440
measurements that were that we need to

400
00:15:41,749 --> 00:15:39,279
manage to properly manage the precious

401
00:15:43,110 --> 00:15:41,759
resource are going away

402
00:15:45,990 --> 00:15:43,120
and that

403
00:15:50,069 --> 00:15:47,990
i love how you

404
00:15:51,749 --> 00:15:50,079
very succinctly kind of are able to just

405
00:15:52,870 --> 00:15:51,759
talk about that of

406
00:15:55,110 --> 00:15:52,880
this is

407
00:15:57,509 --> 00:15:55,120
what we need to be monitoring so what i

408
00:15:59,269 --> 00:15:57,519
want to then ask is what is

409
00:16:01,030 --> 00:15:59,279
swot and how is swat going to help with

410
00:16:02,470 --> 00:16:01,040
this and why should we all be talking

411
00:16:04,310 --> 00:16:02,480
about this too

412
00:16:05,910 --> 00:16:04,320
that's uh yeah thanks brian that's a

413
00:16:10,069 --> 00:16:05,920

very good question so you know what is

414
00:16:12,790 --> 00:16:10,079
nasa doing about this um and so maybe if

415
00:16:15,910 --> 00:16:12,800
you don't mind would you bring up uh

416
00:16:18,550 --> 00:16:15,920
picture number eight

417
00:16:20,230 --> 00:16:18,560
so we have a plan we have a plan that

418
00:16:22,949 --> 00:16:20,240
plan is called the surface water and

419
00:16:24,949 --> 00:16:22,959
ocean topography mission of which we're

420
00:16:26,790 --> 00:16:24,959
only seeing the instrument here so this

421
00:16:29,350 --> 00:16:26,800
is a picture that was taken

422
00:16:31,030 --> 00:16:29,360
about six months ago uh in one of the

423
00:16:32,470 --> 00:16:31,040
clean rooms at the jet propulsion

424
00:16:35,350 --> 00:16:32,480
laboratory so this is the main

425
00:16:37,189 --> 00:16:35,360
instrument on a mission that has been in

426
00:16:39,189 --> 00:16:37,199
development

427
00:16:42,470 --> 00:16:39,199
for over 15 years

428
00:16:45,269 --> 00:16:42,480
it's a joint effort by uh nasa and by

429
00:16:47,670 --> 00:16:45,279
the french space agency ness uh with

430
00:16:50,470 --> 00:16:47,680
contributions from the uk and canadian

431
00:16:52,629 --> 00:16:50,480
space agencies and uh so you know

432
00:16:55,670 --> 00:16:52,639
there's a little bit of a of a personal

433
00:16:57,670 --> 00:16:55,680
thing here for me is you know it's it's

434
00:16:59,110 --> 00:16:57,680
been primarily developed by the country

435
00:17:01,189 --> 00:16:59,120
where i was born

436
00:17:03,590 --> 00:17:01,199
and the country where i live and work

437
00:17:05,350 --> 00:17:03,600
and have done so for many years now so

438
00:17:07,110 --> 00:17:05,360

very special mission

439
00:17:09,510 --> 00:17:07,120
but uh let's talk about what it's going

440
00:17:10,949 --> 00:17:09,520
to do exactly and if if you don't mind

441
00:17:12,470 --> 00:17:10,959
would you would you please bring up

442
00:17:16,549 --> 00:17:12,480
image number

443
00:17:22,150 --> 00:17:19,510
so so here it is an animation of of

444
00:17:24,309 --> 00:17:22,160
what's what will do so um this is

445
00:17:26,230 --> 00:17:24,319
something that exists for real right the

446
00:17:28,710 --> 00:17:26,240
animation the picture that i just showed

447
00:17:30,470 --> 00:17:28,720
you is the instrument that will be built

448
00:17:32,470 --> 00:17:30,480
is just the instrument we shipped it to

449
00:17:34,470 --> 00:17:32,480
france uh so that

450
00:17:36,310 --> 00:17:34,480
they put it on a spacecraft and then

451
00:17:38,549 --> 00:17:36,320
ship it back to us and we're hoping to

452
00:17:41,270 --> 00:17:38,559
launch it the plan is to launch it at

453
00:17:44,150 --> 00:17:41,280
the end of the year end of 2022 so it's

454
00:17:46,549 --> 00:17:44,160
happening this year it's super exciting

455
00:17:48,390 --> 00:17:46,559
so this is a satellite that will be um

456
00:17:51,750 --> 00:17:48,400
at about

457
00:17:53,029 --> 00:17:51,760
800 or 900 kilometers in altitude above

458
00:17:55,909 --> 00:17:53,039
the ground

459
00:17:58,630 --> 00:17:55,919
and will orbit around the earth every 21

460
00:18:01,590 --> 00:17:58,640
days approximately 21 days repeat its

461
00:18:05,110 --> 00:18:01,600
cycle every 21 days

462
00:18:06,070 --> 00:18:05,120
now on the spacecraft is a radar

463
00:18:09,110 --> 00:18:06,080

that

464
00:18:11,510 --> 00:18:09,120
is is is specifically tailored using a

465
00:18:13,669 --> 00:18:11,520
frequency so that when the signal that

466
00:18:15,990 --> 00:18:13,679
is being sent from the spacecraft hits

467
00:18:18,870 --> 00:18:16,000
the ground it bounces if it happens to

468
00:18:21,510 --> 00:18:18,880
be water and not so much if it's not

469
00:18:24,150 --> 00:18:21,520
water so that allows us to map where

470
00:18:26,549 --> 00:18:24,160
water is which is pretty cool

471
00:18:28,630 --> 00:18:26,559
and now by measuring the time that it

472
00:18:31,029 --> 00:18:28,640
takes for the signal to do a round trip

473
00:18:33,830 --> 00:18:31,039
between the spacecraft and the ground

474
00:18:35,190 --> 00:18:33,840
uh we're able to estimate how high the

475
00:18:38,230 --> 00:18:35,200
water is

476
00:18:40,070 --> 00:18:38,240
now this is uh this is great for two

477
00:18:41,750 --> 00:18:40,080
reasons so the mission is going to do

478
00:18:44,470 --> 00:18:41,760
two things as you said brian in your

479
00:18:46,710 --> 00:18:44,480
introduction the portion of it is ocean

480
00:18:49,669 --> 00:18:46,720
topography and we've been doing ocean

481
00:18:51,990 --> 00:18:49,679
topography for over 30 years

482
00:18:54,070 --> 00:18:52,000
at nasa and so basically

483
00:18:55,909 --> 00:18:54,080
measuring the top of the ocean allows us

484
00:18:57,909 --> 00:18:55,919
to measure things like sea level rise

485
00:18:59,909 --> 00:18:57,919
and so this mission is going to

486
00:19:00,710 --> 00:18:59,919
keep the legacy of these measurements

487
00:19:02,789 --> 00:19:00,720
but

488
00:19:04,789 --> 00:19:02,799

the uh what's transformative about the

489
00:19:08,230 --> 00:19:04,799
measurements above the ocean

490
00:19:10,789 --> 00:19:08,240
here is is that um we will be able to

491
00:19:12,789 --> 00:19:10,799
get a much better understanding of ocean

492
00:19:14,950 --> 00:19:12,799
circulation globally

493
00:19:16,870 --> 00:19:14,960
so we won't be talking too much about

494
00:19:19,430 --> 00:19:16,880
the oceans uh today because that's not

495
00:19:21,430 --> 00:19:19,440
my expertise uh but perhaps let's spend

496
00:19:22,950 --> 00:19:21,440
some time looking at what it means for

497
00:19:23,909 --> 00:19:22,960
surface water so of course we're flying

498
00:19:25,830 --> 00:19:23,919
above

499
00:19:27,430 --> 00:19:25,840
the state of florida here and you'll

500
00:19:29,590 --> 00:19:27,440
notice that when the

501
00:19:31,990 --> 00:19:29,600
radar signal hits some of the surface

502
00:19:33,990 --> 00:19:32,000
water body we detect them

503
00:19:36,310 --> 00:19:34,000
and and so knowing where they are and

504
00:19:39,510 --> 00:19:36,320
how high the water bodies are in a way

505
00:19:41,270 --> 00:19:39,520
that is very similar to those uh local

506
00:19:43,350 --> 00:19:41,280
uh you know ground gauges that we

507
00:19:45,669 --> 00:19:43,360
discussed earlier we'll be able to

508
00:19:48,310 --> 00:19:45,679
determine the variability and how much

509
00:19:50,390 --> 00:19:48,320
water is being stored within surface

510
00:19:52,310 --> 00:19:50,400
water and again remember this is the

511
00:19:54,390 --> 00:19:52,320
most renewable and most accessible

512
00:19:56,549 --> 00:19:54,400
source of fresh water

513
00:19:59,590 --> 00:19:56,559

so we'll be able to monitor that and

514
00:20:01,909 --> 00:19:59,600
then by uh combining things like the

515
00:20:04,070 --> 00:20:01,919
width of rivers and the high and slopes

516
00:20:07,430 --> 00:20:04,080
we'll be able to also get a pretty good

517
00:20:09,350 --> 00:20:07,440
estimate of how fast water is flowing

518
00:20:12,070 --> 00:20:09,360
and how much water is flowing through

519
00:20:14,230 --> 00:20:12,080
river systems now what's really exciting

520
00:20:16,310 --> 00:20:14,240
is that this is a global mission right i

521
00:20:19,190 --> 00:20:16,320
mean we fly spacecraft above the entire

522
00:20:22,470 --> 00:20:19,200
uh earth and all continents and the data

523
00:20:24,870 --> 00:20:22,480
will be easily accessible and freely

524
00:20:26,630 --> 00:20:24,880
accessible to anyone on this planet

525
00:20:28,789 --> 00:20:26,640
which means that all the data that we

526
00:20:31,350 --> 00:20:28,799
haven't had or that has disappeared is

527
00:20:33,270 --> 00:20:31,360
now coming back now of course you can't

528
00:20:34,710 --> 00:20:33,280
make a direct comparison between space

529
00:20:36,310 --> 00:20:34,720
measurements and some of the

530
00:20:38,710 --> 00:20:36,320
measurements that we would be taking

531
00:20:42,149 --> 00:20:38,720
from the ground but this is going to be

532
00:20:44,630 --> 00:20:42,159
a great ally to a lot of the in-situ

533
00:20:46,230 --> 00:20:44,640
measuring networks that we've had

534
00:20:48,470 --> 00:20:46,240
acknowledging that you know a lot of

535
00:20:51,430 --> 00:20:48,480
these have been going away so a true

536
00:20:53,430 --> 00:20:51,440
transformation for uh for hydrology and

537
00:20:55,590 --> 00:20:53,440
for understanding of the earth system

538
00:20:58,549 --> 00:20:55,600

and great potential for helping with

539
00:21:00,950 --> 00:20:58,559
water management throughout the world

540
00:21:02,070 --> 00:21:00,960
that's very cool um i imagine a question

541
00:21:06,149 --> 00:21:02,080
we're getting in the chat and we'll get

542
00:21:07,990 --> 00:21:06,159
to those really shortly uh is how many

543
00:21:10,789 --> 00:21:08,000
really how is this different than other

544
00:21:13,669 --> 00:21:10,799
missions that we have out there

545
00:21:16,789 --> 00:21:13,679
um well that's a great question uh brian

546
00:21:19,270 --> 00:21:16,799
and so perhaps some some uh folks in the

547
00:21:21,190 --> 00:21:19,280
audience might be familiar with landsat

548
00:21:23,909 --> 00:21:21,200
images the kind of thing that that you

549
00:21:24,870 --> 00:21:23,919
would see on google maps for example

550
00:21:28,149 --> 00:21:24,880
now

551
00:21:30,230 --> 00:21:28,159
like the one you might have on your

552
00:21:32,149 --> 00:21:30,240
phone that on a spacecraft and that are

553
00:21:34,549 --> 00:21:32,159
taking pictures of the ground visible

554
00:21:36,710 --> 00:21:34,559
images of the ground now if you'd like

555
00:21:38,710 --> 00:21:36,720
to see where water is and i'll focus my

556
00:21:40,630 --> 00:21:38,720
answer on on the consonants here uh

557
00:21:42,070 --> 00:21:40,640
brian because that's my expertise but so

558
00:21:43,750 --> 00:21:42,080
if you'd like to know where water is

559
00:21:46,149 --> 00:21:43,760
with those images from you know

560
00:21:48,390 --> 00:21:46,159
basically was a camera on a satellite uh

561
00:21:50,870 --> 00:21:48,400
well it has to be during the day right

562
00:21:52,470 --> 00:21:50,880
now 50 of the time it's not the day it's

563
00:21:55,590 --> 00:21:52,480

just it is what it is

564
00:21:57,669 --> 00:21:55,600
and now if you happen to have a a cloud

565
00:21:59,990 --> 00:21:57,679
in front of you then you can't see the

566
00:22:01,990 --> 00:22:00,000
rivers in the lakes and and you might

567
00:22:04,149 --> 00:22:02,000
recall from the from that blue marble

568
00:22:06,789 --> 00:22:04,159
picture earlier that we have lots of

569
00:22:09,190 --> 00:22:06,799
clouds on on the earth about 70 of the

570
00:22:13,110 --> 00:22:09,200
earth is covered by clouds and so you

571
00:22:16,070 --> 00:22:13,120
know 50 of the time it's night 70 of the

572
00:22:17,750 --> 00:22:16,080
of the space you have clouds and now the

573
00:22:20,470 --> 00:22:17,760
beauty of the radar measurements that

574
00:22:22,630 --> 00:22:20,480
we're using here um is that it doesn't

575
00:22:24,549 --> 00:22:22,640
care for day or night doesn't care for

576
00:22:26,870 --> 00:22:24,559
clouds it's just going to go through and

577
00:22:29,029 --> 00:22:26,880
be able to measure um any time that it

578
00:22:31,190 --> 00:22:29,039
basically flies above

579
00:22:33,990 --> 00:22:31,200
an area of interest so that's something

580
00:22:35,830 --> 00:22:34,000
that that that's really uh special

581
00:22:39,430 --> 00:22:35,840
now another portion and if you wouldn't

582
00:22:42,950 --> 00:22:39,440
mind animating this uh this video again

583
00:22:45,510 --> 00:22:42,960
so we have a history of of knowing where

584
00:22:47,270 --> 00:22:45,520
rivers are right and and where lakes are

585
00:22:48,710 --> 00:22:47,280
now we also have a history of measuring

586
00:22:50,230 --> 00:22:48,720
ocean topography that's what we're

587
00:22:51,990 --> 00:22:50,240
talking about earlier

588
00:22:54,070 --> 00:22:52,000

but the vast majority of the missions

589
00:22:55,750 --> 00:22:54,080
that we've had for 30 years have only

590
00:22:58,070 --> 00:22:55,760
measured directly underneath the

591
00:22:59,990 --> 00:22:58,080
spacecraft and you might see a little

592
00:23:01,590 --> 00:23:00,000
red dot that goes up and down between

593
00:23:04,149 --> 00:23:01,600
the satellite and the ground here and

594
00:23:05,909 --> 00:23:04,159
now that basically only measures the

595
00:23:08,549 --> 00:23:05,919
line that is directly under the

596
00:23:10,950 --> 00:23:08,559
spacecraft and not the swaths that you

597
00:23:13,430 --> 00:23:10,960
see further away from it and so the

598
00:23:14,950 --> 00:23:13,440
measurements that this new mesh mission

599
00:23:16,070 --> 00:23:14,960
will provide

600
00:23:17,909 --> 00:23:16,080
basically

601
00:23:20,390 --> 00:23:17,919
will give us images of not only where

602
00:23:22,390 --> 00:23:20,400
the water is but how high the water is

603
00:23:25,270 --> 00:23:22,400
and now the problem with those you know

604
00:23:27,590 --> 00:23:25,280
lines from historical traditional uh

605
00:23:30,549 --> 00:23:27,600
missions is that they may or may not

606
00:23:32,870 --> 00:23:30,559
cross a water body on continents

607
00:23:34,230 --> 00:23:32,880
and and if they don't then basically

608
00:23:36,789 --> 00:23:34,240
you're out of luck

609
00:23:39,590 --> 00:23:36,799
now uh what swat will do is it will

610
00:23:43,110 --> 00:23:39,600
basically touch every one of these water

611
00:23:46,950 --> 00:23:43,120
bodies with its images and so uh makes

612
00:23:48,230 --> 00:23:46,960
it a really transformative uh mission

613
00:23:50,390 --> 00:23:48,240

that's

614
00:23:51,750 --> 00:23:50,400
wonderful when i when i think about this

615
00:23:53,830 --> 00:23:51,760
and a lot of times when people think of

616
00:23:55,350 --> 00:23:53,840
nasa they think of looking out they

617
00:23:57,750 --> 00:23:55,360
think of looking up they don't

618
00:23:59,669 --> 00:23:57,760
necessarily think of looking back

619
00:24:00,950 --> 00:23:59,679
um

620
00:24:03,669 --> 00:24:00,960
talk can you talk a little bit more

621
00:24:05,350 --> 00:24:03,679
about that yeah what's up with that i

622
00:24:06,950 --> 00:24:05,360
agree and brian

623
00:24:08,390 --> 00:24:06,960
brian i feel the same you know what i

624
00:24:10,230 --> 00:24:08,400
tell you when i meet people talk to

625
00:24:11,669 --> 00:24:10,240
friends and say you happen to work at

626
00:24:13,669 --> 00:24:11,679
the propulsion laboratory the first

627
00:24:15,110 --> 00:24:13,679
thing that people bring up would be the

628
00:24:17,669 --> 00:24:15,120
mars rovers

629
00:24:20,070 --> 00:24:17,679
or you know the mars helicopter or you

630
00:24:23,510 --> 00:24:20,080
know the voyager spacecraft that have

631
00:24:25,590 --> 00:24:23,520
left the solar system people think of uh

632
00:24:27,110 --> 00:24:25,600
telescopes particularly these days

633
00:24:29,510 --> 00:24:27,120
tesco's looking

634
00:24:32,390 --> 00:24:29,520
deep into the universe and and back in

635
00:24:34,630 --> 00:24:32,400
time and and so of course nasa is

636
00:24:37,269 --> 00:24:34,640
interested in uh the exploration of the

637
00:24:39,269 --> 00:24:37,279
universe now just so happens that our

638
00:24:42,470 --> 00:24:39,279

solar system is part of that

639
00:24:44,470 --> 00:24:42,480
and our home planet is plan a

640
00:24:46,470 --> 00:24:44,480
it's part of the solar system and you

641
00:24:48,070 --> 00:24:46,480
know as far as we know this the only

642
00:24:50,950 --> 00:24:48,080
place where we can live

643
00:24:53,510 --> 00:24:50,960
right now and and what's great about our

644
00:24:55,190 --> 00:24:53,520
ability to ship satellites in orbit

645
00:24:58,070 --> 00:24:55,200
around the earth and basically take

646
00:25:00,710 --> 00:24:58,080
earth selfies is that they bring a

647
00:25:02,070 --> 00:25:00,720
global view the big picture

648
00:25:04,070 --> 00:25:02,080
of of

649
00:25:06,549 --> 00:25:04,080
very important processes happening on

650
00:25:09,350 --> 00:25:06,559
the earth and so you know in our

651
00:25:12,070 --> 00:25:09,360
exploration of the universe and beyond

652
00:25:14,710 --> 00:25:12,080
nasa has the ability to basically

653
00:25:16,470 --> 00:25:14,720
look back at the earth and and and we

654
00:25:18,149 --> 00:25:16,480
learn a tremendous amount while doing

655
00:25:20,870 --> 00:25:18,159
that and that helps us

656
00:25:22,310 --> 00:25:20,880
uh take care of plant a you know we

657
00:25:23,990 --> 00:25:22,320
don't have a plan b

658
00:25:25,750 --> 00:25:24,000
for where we're going to be and so it's

659
00:25:29,510 --> 00:25:25,760
incredibly important for for nasa to

660
00:25:31,669 --> 00:25:29,520
look back at the earth that's such a

661
00:25:33,669 --> 00:25:31,679
deep answer with kind of the grand

662
00:25:35,909 --> 00:25:33,679
scheme of everything but what i love

663
00:25:37,510 --> 00:25:35,919

about these talks is we get to know

664
00:25:39,350 --> 00:25:37,520
the people that are doing these a little

665
00:25:40,789 --> 00:25:39,360
bit more and and

666
00:25:43,510 --> 00:25:40,799
i'm curious if you don't mind talking

667
00:25:46,470 --> 00:25:43,520
about it why water is important to you

668
00:25:49,269 --> 00:25:47,269
yeah

669
00:25:51,190 --> 00:25:49,279
brian let me let me take a deep breath

670
00:25:53,029 --> 00:25:51,200
before before i answer this question and

671
00:25:56,950 --> 00:25:53,039
perhaps in the meantime we could bring

672
00:25:59,190 --> 00:25:56,960
up um image number 10 please um

673
00:26:01,750 --> 00:25:59,200
and so you know the short version of it

674
00:26:03,830 --> 00:26:01,760
is that is that water is my friend you

675
00:26:06,070 --> 00:26:03,840
know water's been my happy place

676
00:26:08,070 --> 00:26:06,080
for as long as i can remember

677
00:26:10,789 --> 00:26:08,080
and the reason for that

678
00:26:12,070 --> 00:26:10,799
is uh i i was born with a physical

679
00:26:15,190 --> 00:26:12,080
disability

680
00:26:18,230 --> 00:26:15,200
that affected both of my legs and at

681
00:26:20,630 --> 00:26:18,240
birth basically the forecast was most

682
00:26:23,430 --> 00:26:20,640
likely i was never going to walk

683
00:26:25,029 --> 00:26:23,440
and so now fortunately um you know after

684
00:26:26,950 --> 00:26:25,039
surgeries and i'm not including any

685
00:26:29,590 --> 00:26:26,960
pre-surgery picture because they're not

686
00:26:32,390 --> 00:26:29,600
pretty to watch uh but you know surgery

687
00:26:34,310 --> 00:26:32,400
and and years of physical therapy and

688
00:26:37,110 --> 00:26:34,320

you know braces the picture that you see

689
00:26:39,510 --> 00:26:37,120
on the top left uh is is part of that

690
00:26:41,669 --> 00:26:39,520
story um so i'm lucky that i've been

691
00:26:43,110 --> 00:26:41,679
able to walk this earth and i feel

692
00:26:45,190 --> 00:26:43,120
fortunate and that's something that i

693
00:26:47,110 --> 00:26:45,200
that i celebrate every day

694
00:26:49,269 --> 00:26:47,120
now to tell you the truth you know

695
00:26:50,830 --> 00:26:49,279
walking's never been fun

696
00:26:53,430 --> 00:26:50,840
never has it's always a little

697
00:26:54,950 --> 00:26:53,440
uncomfortable and basically a constant

698
00:26:56,950 --> 00:26:54,960
reminder of

699
00:26:57,990 --> 00:26:56,960
being a little different

700
00:27:00,230 --> 00:26:58,000
and

701
00:27:02,630 --> 00:27:00,240
the beauty of water is from the youngest

702
00:27:04,630 --> 00:27:02,640
age you know swimming was the place

703
00:27:07,830 --> 00:27:04,640
where i felt that i was just a normal

704
00:27:10,390 --> 00:27:07,840
kid or i could do things like

705
00:27:12,310 --> 00:27:10,400
any other kid could do and so uh you

706
00:27:14,950 --> 00:27:12,320
know throughout my life this has been a

707
00:27:15,990 --> 00:27:14,960
very special place for me a place of

708
00:27:18,230 --> 00:27:16,000
peace

709
00:27:20,549 --> 00:27:18,240
and uh and so of course i'm curious

710
00:27:23,029 --> 00:27:20,559
about the natural environment and i am

711
00:27:25,590 --> 00:27:23,039
excited to you know contribute to

712
00:27:28,149 --> 00:27:25,600
fostering sustainability on our earth

713
00:27:29,190 --> 00:27:28,159

but but i have a much deeper

714
00:27:31,190 --> 00:27:29,200
uh

715
00:27:33,110 --> 00:27:31,200
emotional personal connection to to

716
00:27:35,750 --> 00:27:33,120
water as a medium that

717
00:27:37,990 --> 00:27:35,760
has also driven me uh in in part of my

718
00:27:40,630 --> 00:27:38,000
of my career but you know a quick

719
00:27:42,310 --> 00:27:40,640
summary of mosaic of of how water has

720
00:27:44,149 --> 00:27:42,320
been uh important to me throughout my

721
00:27:45,750 --> 00:27:44,159
life

722
00:27:47,669 --> 00:27:45,760
i'm grateful that you have shared that

723
00:27:50,149 --> 00:27:47,679
expertise and that passion that you have

724
00:27:51,430 --> 00:27:50,159
for water with us today

725
00:27:53,190 --> 00:27:51,440
i know there are people out there who

726
00:27:56,230 --> 00:27:53,200
have some great questions for you so

727
00:27:57,909 --> 00:27:56,240
let's throw it over to jocelyn

728
00:27:59,909 --> 00:27:57,919
yeah there's a lot of really great

729
00:28:02,710 --> 00:27:59,919
questions coming in on all of our social

730
00:28:05,510 --> 00:28:02,720
media platforms um to kick it off we

731
00:28:07,990 --> 00:28:05,520
have luz maria on youtube that's asking

732
00:28:11,110 --> 00:28:08,000
what models or patterns do you think

733
00:28:14,230 --> 00:28:11,120
swat will see can swat surprise us by

734
00:28:16,789 --> 00:28:14,240
discovering something unexpected

735
00:28:18,310 --> 00:28:16,799
oh wow hey lose maria this is such a

736
00:28:21,029 --> 00:28:18,320
good question

737
00:28:24,630 --> 00:28:21,039
and that's part of the beauty of of

738
00:28:26,630 --> 00:28:24,640

space exploration and space missions is

739
00:28:27,669 --> 00:28:26,640
there are things that we think we will

740
00:28:29,909 --> 00:28:27,679
see

741
00:28:32,549 --> 00:28:29,919
and and that's what drives the design of

742
00:28:34,389 --> 00:28:32,559
the vast majority of space missions

743
00:28:36,149 --> 00:28:34,399
and then there are the things that you

744
00:28:38,870 --> 00:28:36,159
didn't know you were going to discover

745
00:28:40,230 --> 00:28:38,880
so that's the unknown unknowns and so i

746
00:28:42,710 --> 00:28:40,240
mean what i can tell you is that we're

747
00:28:44,549 --> 00:28:42,720
hoping to learn about you know

748
00:28:46,230 --> 00:28:44,559
how much water is flowing through the

749
00:28:48,630 --> 00:28:46,240
world's rivers we're hoping to learn

750
00:28:51,269 --> 00:28:48,640
about the variability

751
00:28:54,230 --> 00:28:51,279
of a storage in earth's lakes reservoirs

752
00:28:56,630 --> 00:28:54,240
and wetlands and and hopefully this will

753
00:28:58,310 --> 00:28:56,640
help shed some light on the connection

754
00:29:00,389 --> 00:28:58,320
between you know basically the same

755
00:29:03,029 --> 00:29:00,399
water cycle that we've been

756
00:29:05,110 --> 00:29:03,039
told about since middle school water

757
00:29:06,870 --> 00:29:05,120
evaporating from the oceans and you know

758
00:29:08,630 --> 00:29:06,880
precipitating on the land and flowing

759
00:29:10,470 --> 00:29:08,640
through the rivers part of it goes

760
00:29:12,630 --> 00:29:10,480
underground part of it goes back to the

761
00:29:15,430 --> 00:29:12,640
ocean so we're hoping to

762
00:29:17,590 --> 00:29:15,440
get some key nuggets of that water cycle

763
00:29:19,029 --> 00:29:17,600

with with the mission and of course what

764
00:29:20,710 --> 00:29:19,039
is going to do a whole lot about ocean

765
00:29:22,549 --> 00:29:20,720
circulation

766
00:29:24,870 --> 00:29:22,559
but there are things like

767
00:29:26,950 --> 00:29:24,880
you know are we are we going to discover

768
00:29:28,950 --> 00:29:26,960
maybe that tiny pinpoint is a little

769
00:29:32,149 --> 00:29:28,960
bigger than we thought or maybe it's

770
00:29:33,350 --> 00:29:32,159
smaller you know so there is a lot of of

771
00:29:36,310 --> 00:29:33,360
of

772
00:29:38,070 --> 00:29:36,320
tbd as to what we will discover and

773
00:29:39,510 --> 00:29:38,080
that's that's part of what gets me so

774
00:29:42,230 --> 00:29:39,520
excited about the mission that was a

775
00:29:44,470 --> 00:29:42,240
great question thanks so much

776
00:29:47,110 --> 00:29:44,480
and our next question comes from kalai

777
00:29:49,430 --> 00:29:47,120
on youtube that wants to know how much

778
00:29:51,510 --> 00:29:49,440
of the earth's surface will swop be able

779
00:29:53,669 --> 00:29:51,520
to get measurements of

780
00:29:55,990 --> 00:29:53,679
oh that's that's another great question

781
00:29:58,950 --> 00:29:56,000
and so i think

782
00:30:01,830 --> 00:29:58,960
that the area that will be covered

783
00:30:04,789 --> 00:30:01,840
uh is is nearly a hundred percent i mean

784
00:30:07,110 --> 00:30:04,799
there are very small polygons near the

785
00:30:08,389 --> 00:30:07,120
equator that we uh that we may not see

786
00:30:10,549 --> 00:30:08,399
you know actually perhaps it would be a

787
00:30:12,789 --> 00:30:10,559
good time to bring up image uh the

788
00:30:14,230 --> 00:30:12,799

animation number 12. i don't know if you

789
00:30:16,789 --> 00:30:14,240
have a way to speed it up a little bit

790
00:30:20,070 --> 00:30:16,799
and bring it closer to the end but we

791
00:30:23,590 --> 00:30:20,080
will see a a view of

792
00:30:25,990 --> 00:30:23,600
all the earth's oceans being covered uh

793
00:30:28,630 --> 00:30:26,000
by the measurement and so every 21 days

794
00:30:31,510 --> 00:30:28,640
we should get a full picture of the

795
00:30:34,149 --> 00:30:31,520
entire earth and in the process of doing

796
00:30:36,230 --> 00:30:34,159
that there will be some overlaps between

797
00:30:37,590 --> 00:30:36,240
some of the measurements and so yeah

798
00:30:39,190 --> 00:30:37,600
here's a that's what you will see

799
00:30:41,830 --> 00:30:39,200
basically the entire earth will be

800
00:30:43,750 --> 00:30:41,840
covered by the measurements every 21

801
00:30:47,909 --> 00:30:43,760
days for at least three years and we

802
00:30:52,789 --> 00:30:49,990
and our next question from modal mixture

803
00:30:55,350 --> 00:30:52,799
on youtube asks will the data be high

804
00:30:57,190 --> 00:30:55,360
resolution enough to use for reservoir

805
00:30:59,590 --> 00:30:57,200
management

806
00:31:02,470 --> 00:30:59,600
oh yes another great question and and

807
00:31:04,549 --> 00:31:02,480
the answer to that is absolutely we were

808
00:31:07,830 --> 00:31:04,559
talking about you know pixel sizes on

809
00:31:11,430 --> 00:31:07,840
the order of 10 to 17 meters

810
00:31:14,230 --> 00:31:11,440
and uh and so uh

811
00:31:17,430 --> 00:31:14,240
play we we should be able to

812
00:31:20,230 --> 00:31:17,440
um well we will be able to observe lakes

813
00:31:23,669 --> 00:31:20,240

and reservoirs that are at least 250 by

814
00:31:26,149 --> 00:31:23,679
250 meters that's relatively small we

815
00:31:28,149 --> 00:31:26,159
are hoping to even be able to go all the

816
00:31:30,870 --> 00:31:28,159
way down to observing those surface

817
00:31:34,149 --> 00:31:30,880
water bodies that are a hundred by a

818
00:31:38,149 --> 00:31:34,159
hundred uh meters that would be 300 by

819
00:31:41,909 --> 00:31:38,159
300 feet and so there is plenty of of

820
00:31:43,909 --> 00:31:41,919
capability for helping um surface water

821
00:31:45,669 --> 00:31:43,919
management in in lakes and in reservoirs

822
00:31:47,830 --> 00:31:45,679
around the world now of course you know

823
00:31:49,990 --> 00:31:47,840
some of these water bodies already have

824
00:31:52,549 --> 00:31:50,000
measurements and and those measurements

825
00:31:54,710 --> 00:31:52,559
are great but a lot of places do not and

826
00:31:56,710 --> 00:31:54,720
and so this mission will

827
00:31:59,350 --> 00:31:56,720
will bring some truly transformative

828
00:32:03,509 --> 00:31:59,360
observations that we've never had before

829
00:32:07,430 --> 00:32:05,269
yeah and and looking a little bit bigger

830
00:32:09,269 --> 00:32:07,440
picture here james on linkedin wants to

831
00:32:11,750 --> 00:32:09,279
know what are some of the ways that this

832
00:32:13,269 --> 00:32:11,760
satellite will help us navigate

833
00:32:17,990 --> 00:32:13,279
something like climate change in the

834
00:32:23,430 --> 00:32:20,149
that's um that's a that's a very good

835
00:32:24,389 --> 00:32:23,440
question uh let me um step back a second

836
00:32:26,470 --> 00:32:24,399
and you know

837
00:32:28,630 --> 00:32:26,480
acknowledge that basically rising

838
00:32:31,269 --> 00:32:28,640

temperatures

839
00:32:33,350 --> 00:32:31,279
physically what this allows is for

840
00:32:34,230 --> 00:32:33,360
the atmosphere to be able to hold more

841
00:32:36,710 --> 00:32:34,240
water

842
00:32:38,870 --> 00:32:36,720
and what this is going to lead to the

843
00:32:41,190 --> 00:32:38,880
vast majority of people think that this

844
00:32:43,669 --> 00:32:41,200
will lead to an intensification

845
00:32:46,230 --> 00:32:43,679
of the water cycle so this might mean

846
00:32:49,830 --> 00:32:46,240
more extremes more droughts uh more

847
00:32:52,389 --> 00:32:49,840
floods and so by measuring the flow in

848
00:32:54,950 --> 00:32:52,399
the earth's rivers and lakes

849
00:32:57,190 --> 00:32:54,960
we will be able to and and basically

850
00:32:59,269 --> 00:32:57,200
because rivers is serve as an integrator

851
00:33:00,950 --> 00:32:59,279
it's the great sum of everything that

852
00:33:03,029 --> 00:33:00,960
happens upstream

853
00:33:05,830 --> 00:33:03,039
and so it's it's going to be a great

854
00:33:08,549 --> 00:33:05,840
indicator of potential variability

855
00:33:10,789 --> 00:33:08,559
if um if

856
00:33:13,350 --> 00:33:10,799
that we would see from space now

857
00:33:15,350 --> 00:33:13,360
i'm saying if because the mission is

858
00:33:17,190 --> 00:33:15,360
planned for three years and then we have

859
00:33:19,750 --> 00:33:17,200
a history of successful missions that

860
00:33:23,110 --> 00:33:19,760
last for much longer than than they

861
00:33:25,669 --> 00:33:23,120
would but um you know like three years

862
00:33:28,230 --> 00:33:25,679
of measurements would not be enough

863
00:33:31,269 --> 00:33:28,240

to infer any long-term potential

864
00:33:33,590 --> 00:33:31,279
long-term changes now the mission was to

865
00:33:35,190 --> 00:33:33,600
last 10 or 15 years

866
00:33:36,710 --> 00:33:35,200
that would be pretty great and and

867
00:33:38,950 --> 00:33:36,720
perhaps it could shed some light on some

868
00:33:41,750 --> 00:33:38,960
of these processes uh yeah thank you

869
00:33:43,909 --> 00:33:41,760
that was a great question

870
00:33:46,070 --> 00:33:43,919
and we're getting um a couple questions

871
00:33:48,630 --> 00:33:46,080
so i'll end with this one from youtube

872
00:33:51,509 --> 00:33:48,640
comes that says can you tell the quality

873
00:33:55,590 --> 00:33:51,519
of water with swat

874
00:33:58,149 --> 00:33:55,600
oh that's such a great question uh uh no

875
00:34:00,710 --> 00:33:58,159
so the the the short of it is no so this

876
00:34:04,149 --> 00:34:00,720
is really a water quantity mission

877
00:34:06,710 --> 00:34:04,159
and uh and so we'll be able to uh infer

878
00:34:09,190 --> 00:34:06,720
the changes in volume uh and the changes

879
00:34:10,790 --> 00:34:09,200
in storage of water and and changes in

880
00:34:13,909 --> 00:34:10,800
and how much water flows down down

881
00:34:16,470 --> 00:34:13,919
networks uh but this will not measure

882
00:34:19,510 --> 00:34:16,480
the color of water now we do have other

883
00:34:21,190 --> 00:34:19,520
satellites that help us with uh

884
00:34:23,430 --> 00:34:21,200
estimating water temperature which is

885
00:34:25,349 --> 00:34:23,440
very important for water quality

886
00:34:26,710 --> 00:34:25,359
and and other satellites including some

887
00:34:29,349 --> 00:34:26,720
of the imagery satellites that i

888
00:34:31,270 --> 00:34:29,359

mentioned earlier and and uh nasa

889
00:34:33,270 --> 00:34:31,280
actually even has plans for

890
00:34:35,510 --> 00:34:33,280
next generation cameras by the end of

891
00:34:38,470 --> 00:34:35,520
the decade that will give us a lot of

892
00:34:40,790 --> 00:34:38,480
information on water quality so

893
00:34:42,550 --> 00:34:40,800
um there are missions that uh that give

894
00:34:44,470 --> 00:34:42,560
information water quality that could be

895
00:34:46,470 --> 00:34:44,480
used along with the measurements from

896
00:34:49,430 --> 00:34:46,480
the from the swat mission

897
00:34:51,270 --> 00:34:49,440
and and we absolutely ought to do that

898
00:34:52,710 --> 00:34:51,280
and then we can look to towards the end

899
00:34:54,629 --> 00:34:52,720
of the decade for even better

900
00:34:56,470 --> 00:34:54,639
measurements of water quality that could

901
00:34:58,069 --> 00:34:56,480
be used with swat if swat is still

902
00:35:00,310 --> 00:34:58,079
flying or with

903
00:35:02,790 --> 00:35:00,320
you know the next generation of swat

904
00:35:06,069 --> 00:35:02,800
mission should we have one another great

905
00:35:09,829 --> 00:35:07,910
well that is all the time we have thank

906
00:35:11,030 --> 00:35:09,839
you all so much for your great wonderful

907
00:35:12,630 --> 00:35:11,040
questions

908
00:35:14,790 --> 00:35:12,640
please join us next month for our talk

909
00:35:16,950 --> 00:35:14,800
roving with perseverance findings from

910
00:35:18,630 --> 00:35:16,960
one year on mars with jennifer trosper

911
00:35:20,230 --> 00:35:18,640
and katie stack morgan from the mars

912
00:35:22,310 --> 00:35:20,240
2020 team

913
00:35:24,790 --> 00:35:22,320

i'd like to thank our speaker dr cedric

914
00:35:27,670 --> 00:35:24,800
david for his exuberance and his

915
00:35:29,510 --> 00:35:27,680
expertise i want to thank jocelyn and

916
00:35:31,109 --> 00:35:29,520
everyone behind the scenes for making

917
00:35:34,150 --> 00:35:31,119
these talks possible particularly this

918
00:35:35,910 --> 00:35:34,160
one today and finally a big thank you to

919
00:35:37,030 --> 00:35:35,920
all of you who join us each and every

920
00:35:40,790 --> 00:35:37,040
month

921
00:35:45,830 --> 00:35:40,800
please stay safe stay kind stay curious