
U.S. AIR FORCE

1
00:00:10,310 --> 00:00:08,790
good morning

2
00:00:12,150 --> 00:00:10,320
i'm john yeper with nasa's office of

3
00:00:14,870 --> 00:00:12,160
communications we're here today at

4
00:00:17,109 --> 00:00:14,880
vandenberg air force base in california

5
00:00:20,070 --> 00:00:17,119
to preview the launch of the orbiting

6
00:00:23,429 --> 00:00:20,080
carbon observatory 2 which is slated to

7
00:00:26,390 --> 00:00:23,439
launch tomorrow at 2 56 a.m pacific time

8
00:00:28,550 --> 00:00:26,400
here at vandenberg this event is a nasa

9
00:00:30,950 --> 00:00:28,560
social which is

10
00:00:32,870 --> 00:00:30,960
the us taking nasa taking that online

11
00:00:35,590 --> 00:00:32,880
experience of people following us on

12
00:00:37,590 --> 00:00:35,600
social media on the web offline to give

13
00:00:40,549 --> 00:00:37,600

you behind the scenes access of our

14
00:00:43,590 --> 00:00:40,559
missions of exploration and discovery

15
00:00:46,150 --> 00:00:43,600
this is our 81st nasa social we've done

16
00:00:47,910 --> 00:00:46,160
as an agency we started back in january

17
00:00:49,590 --> 00:00:47,920
2009 doing these and they've been

18
00:00:51,590 --> 00:00:49,600
tremendously successful if you're

19
00:00:54,950 --> 00:00:51,600
interested in ever be part of a nasa

20
00:00:58,150 --> 00:00:54,960
social you can uh follow us on at nasa

21
00:00:59,430 --> 00:00:58,160
social or go to the web at nasa.gov

22
00:01:01,189 --> 00:00:59,440
social

23
00:01:03,590 --> 00:01:01,199
today we'll be taking questions here at

24
00:01:05,189 --> 00:01:03,600
the audience folks from social media but

25
00:01:08,789 --> 00:01:05,199
also from those at home that want to ask

26
00:01:12,070 --> 00:01:08,799
questions the hashtag is poundastnasa if

27
00:01:14,630 --> 00:01:12,080
you want to follow us on the web um on

28
00:01:18,469 --> 00:01:14,640
twitter the account is at nasa social

29
00:01:21,990 --> 00:01:18,479
and i am at i am oco2

30
00:01:25,590 --> 00:01:22,000
oco2 is a is going to provide

31
00:01:27,749 --> 00:01:25,600
space-based observations of atmospheric

32
00:01:28,870 --> 00:01:27,759
carbon dioxide and here with us to tell

33
00:01:30,469 --> 00:01:28,880
us a little bit more about that and give

34
00:01:32,950 --> 00:01:30,479
you a big picture overview of the earth

35
00:01:34,390 --> 00:01:32,960
science division at nasa is ken jux who

36
00:01:35,670 --> 00:01:34,400
is the program scientist at nasa

37
00:01:37,109 --> 00:01:35,680
headquarters let me introduce ken to you

38
00:01:41,350 --> 00:01:37,119

thank you

39
00:01:42,950 --> 00:01:41,360
truly an honor for me to be here to talk

40
00:01:45,350 --> 00:01:42,960
with you i happen to be the program

41
00:01:47,270 --> 00:01:45,360
scientist for the original oco so i'm

42
00:01:49,190 --> 00:01:47,280
really excited to be here today

43
00:01:51,910 --> 00:01:49,200
so i want to ask you all raise your hand

44
00:01:54,870 --> 00:01:51,920
if you have never taken an earth science

45
00:01:56,950 --> 00:01:54,880
course in your life

46
00:01:58,469 --> 00:01:56,960
there's a few hands up notice my hands

47
00:01:59,990 --> 00:01:58,479
up

48
00:02:02,550 --> 00:02:00,000
i'm a nurse scientist and i never took

49
00:02:04,149 --> 00:02:02,560
an ear science course in my life but i

50
00:02:05,270 --> 00:02:04,159
did study chemistry and physics back

51
00:02:07,030 --> 00:02:05,280
when i was in graduate school so that

52
00:02:09,589 --> 00:02:07,040
was kind of the basis for it i remember

53
00:02:12,229 --> 00:02:09,599
one day in graduate school we had a

54
00:02:15,589 --> 00:02:12,239
group meeting and my thesis advisor came

55
00:02:17,190 --> 00:02:15,599
up and talked about the ozone hole

56
00:02:18,869 --> 00:02:17,200
and he started showing all these

57
00:02:21,270 --> 00:02:18,879
theories about what people thought was

58
00:02:23,350 --> 00:02:21,280
going on is before we really understood

59
00:02:24,949 --> 00:02:23,360
and i was seeing all these chemistry

60
00:02:27,430 --> 00:02:24,959
equations and how all these things

61
00:02:29,670 --> 00:02:27,440
interconnected and i said man

62
00:02:31,350 --> 00:02:29,680
that is really complicated

63
00:02:33,110 --> 00:02:31,360

well it turns out the entire earth

64
00:02:35,110 --> 00:02:33,120
science system is even more complicated

65
00:02:37,270 --> 00:02:35,120
and if you guys can pull up the first

66
00:02:38,630 --> 00:02:37,280
graphic that i have i'll try to explain

67
00:02:40,309 --> 00:02:38,640
that to you some

68
00:02:42,150 --> 00:02:40,319
actually it's the graphic uh different

69
00:02:44,470 --> 00:02:42,160
graphic than that one it's the one on

70
00:02:46,710 --> 00:02:44,480
the ear science system

71
00:02:47,990 --> 00:02:46,720
you can go back one

72
00:02:49,670 --> 00:02:48,000
but what happens with the with your

73
00:02:51,190 --> 00:02:49,680
science system we have a coupling we've

74
00:02:53,509 --> 00:02:51,200
got the sun

75
00:02:55,509 --> 00:02:53,519
we've got the earth's atmosphere we've

76
00:02:57,589 --> 00:02:55,519
got the earth surface we have the

77
00:02:58,869 --> 00:02:57,599
earth's ocean and all of these things

78
00:03:00,949 --> 00:02:58,879
interconnect

79
00:03:02,390 --> 00:03:00,959
in ways that um

80
00:03:03,670 --> 00:03:02,400
it's really created here's the graphic

81
00:03:05,509 --> 00:03:03,680
right here so you can see we have all

82
00:03:07,110 --> 00:03:05,519
these cycles that go on where the sun

83
00:03:08,229 --> 00:03:07,120
provides the heat to the earth's

84
00:03:12,790 --> 00:03:08,239
atmosphere

85
00:03:14,550 --> 00:03:12,800
surface it heats the ocean and the earth

86
00:03:15,670 --> 00:03:14,560
is trying to get rid of all of that heat

87
00:03:17,750 --> 00:03:15,680
as well

88
00:03:20,149 --> 00:03:17,760

and also we have things like trees and

89
00:03:22,710 --> 00:03:20,159
we have agriculture all those things are

90
00:03:24,149 --> 00:03:22,720
exchanging with the earth's atmosphere

91
00:03:25,910 --> 00:03:24,159
they're all putting things into the

92
00:03:28,149 --> 00:03:25,920
ocean the ocean circulating it's

93
00:03:29,990 --> 00:03:28,159
exchanging all these things around

94
00:03:31,910 --> 00:03:30,000
so in order to really understand the

95
00:03:34,710 --> 00:03:31,920
system you need a lot of data and you

96
00:03:36,949 --> 00:03:34,720
need a lot of different types of data

97
00:03:38,309 --> 00:03:36,959
and just an example of how we do some of

98
00:03:39,910 --> 00:03:38,319
these things let's go to the next one

99
00:03:40,869 --> 00:03:39,920
and i'll bring you back to the ozone

100
00:03:42,869 --> 00:03:40,879
hole

101
00:03:45,030 --> 00:03:42,879
because turns out when i left graduate

102
00:03:47,589 --> 00:03:45,040
school i got a job where i started to

103
00:03:49,990 --> 00:03:47,599
study ozone i was doing

104
00:03:51,430 --> 00:03:50,000
observations from nasa aircraft and from

105
00:03:53,509 --> 00:03:51,440
high altitude balloons which is kind of

106
00:03:55,110 --> 00:03:53,519
a poor manned satellite and we're trying

107
00:03:57,030 --> 00:03:55,120
to study and understand the processes

108
00:03:58,710 --> 00:03:57,040
that affected the ozone layer

109
00:04:02,390 --> 00:03:58,720
so you can see these are images that we

110
00:04:03,750 --> 00:04:02,400
got from a nasa satellite called toms

111
00:04:05,429 --> 00:04:03,760
over the years it was one of the first

112
00:04:08,149 --> 00:04:05,439
things that told us about what the ozone

113
00:04:10,470 --> 00:04:08,159

hole was how it developed but the

114
00:04:12,229 --> 00:04:10,480
satellite data alone wasn't enough

115
00:04:13,670 --> 00:04:12,239
so in order to really understand those

116
00:04:15,830 --> 00:04:13,680
questions what nasa did is we put

117
00:04:17,749 --> 00:04:15,840
together an aircraft campaign and we

118
00:04:20,390 --> 00:04:17,759
have a graphic here showing what some of

119
00:04:23,350 --> 00:04:21,909
our nasa earth science airborne

120
00:04:24,790 --> 00:04:23,360
observations have get going that's

121
00:04:26,150 --> 00:04:24,800
actually how i cut my teeth the very

122
00:04:28,230 --> 00:04:26,160
first thing i did when i left graduate

123
00:04:29,990 --> 00:04:28,240
school was to go on that plane right

124
00:04:32,230 --> 00:04:30,000
there you see flying

125
00:04:34,070 --> 00:04:32,240
and it was it was an experience that was

126
00:04:35,030 --> 00:04:34,080
like no other i was hooked i wasn't sure

127
00:04:37,590 --> 00:04:35,040
whether i wanted to stay in earth

128
00:04:40,070 --> 00:04:37,600
science after i did that campaign i was

129
00:04:42,230 --> 00:04:40,080
a nurse scientist i stuck at it and we

130
00:04:43,270 --> 00:04:42,240
were doing measurements over the north

131
00:04:44,870 --> 00:04:43,280
pole all the time we're trying to

132
00:04:46,790 --> 00:04:44,880
understand why there wasn't an ozone

133
00:04:48,950 --> 00:04:46,800
hole over the north pole at that time

134
00:04:50,870 --> 00:04:48,960
and we also there was a big volcano that

135
00:04:52,950 --> 00:04:50,880
occurred around that time

136
00:04:55,110 --> 00:04:52,960
and it put up a lot of aerosols way up

137
00:04:56,629 --> 00:04:55,120
in the stratosphere and a satellite we

138
00:04:58,230 --> 00:04:56,639

had up at that time was saying ooh

139
00:05:00,469 --> 00:04:58,240
something strange is going on over the

140
00:05:02,870 --> 00:05:00,479
equator so we got to go fly over the

141
00:05:05,029 --> 00:05:02,880
equator landed in tahiti a really tough

142
00:05:07,430 --> 00:05:05,039
place to go spend a day

143
00:05:09,029 --> 00:05:07,440
and go back but um

144
00:05:11,670 --> 00:05:09,039
doing all of that work

145
00:05:13,350 --> 00:05:11,680
helped me to fully realize that we need

146
00:05:14,870 --> 00:05:13,360
a lot of data in order to fully

147
00:05:16,150 --> 00:05:14,880
understand what's going on in your

148
00:05:17,270 --> 00:05:16,160
system

149
00:05:18,550 --> 00:05:17,280
actually you can see all these people

150
00:05:19,590 --> 00:05:18,560
working on here actually know some of

151
00:05:21,350 --> 00:05:19,600
these people

152
00:05:23,510 --> 00:05:21,360
so i got to spend a couple hundred hours

153
00:05:27,350 --> 00:05:23,520
flying around the world doing things

154
00:05:30,870 --> 00:05:29,350
but

155
00:05:32,950 --> 00:05:30,880
eventually i started working more and

156
00:05:35,270 --> 00:05:32,960
more with nasa and started to understand

157
00:05:36,710 --> 00:05:35,280
all of the satellite data that we have

158
00:05:38,310 --> 00:05:36,720
and

159
00:05:39,830 --> 00:05:38,320
i was first playing with just data from

160
00:05:41,909 --> 00:05:39,840
a few satellites and then over time

161
00:05:43,749 --> 00:05:41,919
became a few more and a few more

162
00:05:45,510 --> 00:05:43,759
nasa has a lot of satellites up right

163
00:05:47,510 --> 00:05:45,520

now and they're designed primarily to

164
00:05:48,710 --> 00:05:47,520
try to understand this big complicated

165
00:05:49,909 --> 00:05:48,720
earth system and if you can show this

166
00:05:52,629 --> 00:05:49,919
next graphic

167
00:05:54,629 --> 00:05:52,639
it actually shows you all of the

168
00:05:56,390 --> 00:05:54,639
satellites that nasa has up orbiting the

169
00:05:59,029 --> 00:05:56,400
earth right now

170
00:06:00,230 --> 00:05:59,039
and we're going to put one more up there

171
00:06:01,830 --> 00:06:00,240
in the morning

172
00:06:03,510 --> 00:06:01,840
and we're very excited about that you

173
00:06:05,830 --> 00:06:03,520
can see all of those going on and each

174
00:06:08,390 --> 00:06:05,840
one of those satellites has anywhere

175
00:06:09,830 --> 00:06:08,400
from one to five instruments on board

176
00:06:11,830 --> 00:06:09,840
and some of those instruments measure

177
00:06:12,950 --> 00:06:11,840
many parameters at a time some measure

178
00:06:15,029 --> 00:06:12,960
just one

179
00:06:15,990 --> 00:06:15,039
all of them are critical all of them are

180
00:06:17,749 --> 00:06:16,000
important

181
00:06:19,670 --> 00:06:17,759
what we don't have up right now in

182
00:06:21,830 --> 00:06:19,680
nasa's system is a satellite that

183
00:06:23,510 --> 00:06:21,840
measures co2 near the surface which is

184
00:06:25,350 --> 00:06:23,520
something that we really need to

185
00:06:26,390 --> 00:06:25,360
understand and

186
00:06:27,590 --> 00:06:26,400
fortunately for you all you're going to

187
00:06:29,110 --> 00:06:27,600
have one of my colleagues here at the

188
00:06:31,029 --> 00:06:29,120

ann ann marie eldering is going to tell

189
00:06:32,390 --> 00:06:31,039
you a lot of the critical elements of

190
00:06:34,550 --> 00:06:32,400
what they're going to do with the oco

191
00:06:35,990 --> 00:06:34,560
data i'll leave that to her

192
00:06:37,909 --> 00:06:36,000
but

193
00:06:40,390 --> 00:06:37,919
by combining all of these data if we can

194
00:06:42,550 --> 00:06:40,400
go back to that original slide that i

195
00:06:43,990 --> 00:06:42,560
had just to show you um

196
00:06:45,350 --> 00:06:44,000
at least what some of these satellites

197
00:06:47,510 --> 00:06:45,360
are actually doing so if you look in

198
00:06:50,230 --> 00:06:47,520
there we show you the carbon cycle we

199
00:06:51,749 --> 00:06:50,240
have the trees and the forest we have

200
00:06:54,070 --> 00:06:51,759
satellites that actually image that

201
00:06:56,870 --> 00:06:54,080
surface all the time when you see things

202
00:06:59,350 --> 00:06:56,880
in a newspaper about things going on you

203
00:07:01,430 --> 00:06:59,360
see these nasa images it's probably from

204
00:07:03,830 --> 00:07:01,440
that one particular instrument that's on

205
00:07:07,670 --> 00:07:03,840
one of the satellites called modis

206
00:07:10,070 --> 00:07:07,680
which is a very uh important instrument

207
00:07:11,430 --> 00:07:10,080
we have a number of uh instruments that

208
00:07:12,950 --> 00:07:11,440
look at the earth's atmosphere that's

209
00:07:14,550 --> 00:07:12,960
primarily what i used to do there's the

210
00:07:16,390 --> 00:07:14,560
aura satellite which is up right now

211
00:07:17,589 --> 00:07:16,400
which looks a lot at the entire

212
00:07:19,110 --> 00:07:17,599
atmosphere system i'm actually the

213
00:07:20,710 --> 00:07:19,120

program scientist for that one as well

214
00:07:21,589 --> 00:07:20,720
so i'm very excited

215
00:07:23,670 --> 00:07:21,599
about

216
00:07:26,469 --> 00:07:23,680
the people who i know in the ore science

217
00:07:28,950 --> 00:07:26,479
community who want to use oco data

218
00:07:30,870 --> 00:07:28,960
so i hope i gave you a good idea as the

219
00:07:32,790 --> 00:07:30,880
big picture of what we try to do in our

220
00:07:34,870 --> 00:07:32,800
science and the types of hard questions

221
00:07:38,629 --> 00:07:34,880
we try to go after so i'll stop right

222
00:07:42,390 --> 00:07:40,950
any questions yes

223
00:07:47,350 --> 00:07:42,400
hold on please wait for the michael on a

224
00:07:50,230 --> 00:07:49,029
you showed us that graphic of all the

225
00:07:51,830 --> 00:07:50,240
satellites that are going around the

226
00:07:53,110 --> 00:07:51,840
earth right now that nasa has up how

227
00:07:55,749 --> 00:07:53,120
many are there up there right now we

228
00:07:58,869 --> 00:07:55,759
have 17 up right now soon to be 18.

229
00:08:02,309 --> 00:08:00,230
and for those at home if you have any

230
00:08:04,469 --> 00:08:02,319
questions you can use the hashtag on

231
00:08:05,670 --> 00:08:04,479
social media ask nasa we'd be happy to

232
00:08:12,070 --> 00:08:05,680
can be happy to answer those for you as

233
00:08:12,080 --> 00:08:15,270
second

234
00:08:20,230 --> 00:08:18,550
hi christina walsh uh with ofa i'm

235
00:08:22,070 --> 00:08:20,240
very interested in how long before

236
00:08:24,869 --> 00:08:22,080
you'll be able to collect data you have

237
00:08:26,550 --> 00:08:24,879
to catch this a train yeah and practice

238
00:08:28,230 --> 00:08:26,560

steering or something yes that's right

239
00:08:29,990 --> 00:08:28,240
we're going to put this satellite at the

240
00:08:31,510 --> 00:08:30,000
very front when you saw that graphic of

241
00:08:33,110 --> 00:08:31,520
the orbiting satellites you saw a bunch

242
00:08:34,949 --> 00:08:33,120
of that right together it's going to go

243
00:08:35,909 --> 00:08:34,959
on the front end of that and it's going

244
00:08:36,709 --> 00:08:35,919
to take

245
00:08:39,190 --> 00:08:36,719
um

246
00:08:41,350 --> 00:08:39,200
anywhere from a few weeks to a month or

247
00:08:43,110 --> 00:08:41,360
so to get to that right spot

248
00:08:45,190 --> 00:08:43,120
the less time the better because we're

249
00:08:46,550 --> 00:08:45,200
all eager to get the data and then after

250
00:08:48,550 --> 00:08:46,560
that we're going to have to cool down

251
00:08:50,870 --> 00:08:48,560
the instrument cool down the detectors

252
00:08:52,949 --> 00:08:50,880
make sure everything's working okay it's

253
00:08:55,430 --> 00:08:52,959
going to take us

254
00:08:57,110 --> 00:08:55,440
two or three months in order to really

255
00:08:58,630 --> 00:08:57,120
have the data and start streaming it out

256
00:09:00,790 --> 00:08:58,640
for scientists around the world to

257
00:09:02,630 --> 00:09:00,800
actually start using and my colleague

258
00:09:04,790 --> 00:09:02,640
randy is going to come up shortly a

259
00:09:06,230 --> 00:09:04,800
couple speakers from now he's the real

260
00:09:07,670 --> 00:09:06,240
instrument geek behind this instrument

261
00:09:09,829 --> 00:09:07,680
so he's going to tell you a lot of fun

262
00:09:13,990 --> 00:09:09,839
stuff about that as well

263
00:09:18,790 --> 00:09:15,590

like that randy i called you a geek i'm

264
00:09:23,350 --> 00:09:21,590
question i have the data that you get

265
00:09:25,990 --> 00:09:23,360
is it going to be coupled with any other

266
00:09:27,350 --> 00:09:26,000
nasa data or other space agency data

267
00:09:30,630 --> 00:09:27,360
always

268
00:09:33,269 --> 00:09:30,640
all of nasa's data we posted on these um

269
00:09:35,110 --> 00:09:33,279
data portals which called dax don't ask

270
00:09:36,630 --> 00:09:35,120
me what dak stands for it's an acronym

271
00:09:38,150 --> 00:09:36,640
we're at nasa we like lots of our

272
00:09:40,389 --> 00:09:38,160
acronyms but these data are free and

273
00:09:42,070 --> 00:09:40,399
open for everybody to use

274
00:09:43,750 --> 00:09:42,080
and the data from all the other

275
00:09:45,350 --> 00:09:43,760
satellites are on these same dacs as

276
00:09:48,310 --> 00:09:45,360
well and they interconnect

277
00:09:50,550 --> 00:09:48,320
and we also on these dacs we connect to

278
00:09:52,710 --> 00:09:50,560
data from space agencies in europe and

279
00:09:54,070 --> 00:09:52,720
japan so we share a lot of our data

280
00:09:55,910 --> 00:09:54,080
around because

281
00:09:57,190 --> 00:09:55,920
like i said earlier to fully understand

282
00:09:59,190 --> 00:09:57,200
your system

283
00:10:00,550 --> 00:09:59,200
you need a lot of data so taking

284
00:10:02,949 --> 00:10:00,560
advantage of all the data that's out

285
00:10:04,069 --> 00:10:02,959
there is the only way to really go after

286
00:10:05,910 --> 00:10:04,079
the questions that we're trying to

287
00:10:09,190 --> 00:10:05,920
answer

288
00:10:10,790 --> 00:10:09,200

okay yes hi matt campbell at cbsla can

289
00:10:11,829 --> 00:10:10,800
you touch really briefly on what it's

290
00:10:14,150 --> 00:10:11,839
like when

291
00:10:16,630 --> 00:10:14,160
when you have the data compiled

292
00:10:18,389 --> 00:10:16,640
other organizations such as noaa or epa

293
00:10:20,949 --> 00:10:18,399
what's the communication like with that

294
00:10:22,710 --> 00:10:20,959
data well the communications are on a

295
00:10:25,110 --> 00:10:22,720
lot of levels

296
00:10:26,949 --> 00:10:25,120
from scientists to scientists we we call

297
00:10:28,630 --> 00:10:26,959
each other up and but people will

298
00:10:30,310 --> 00:10:28,640
download the data but to truly

299
00:10:31,430 --> 00:10:30,320
understand how to use the data sometimes

300
00:10:32,470 --> 00:10:31,440
you need to talk to the people who

301
00:10:34,230 --> 00:10:32,480
produce it

302
00:10:35,670 --> 00:10:34,240
because that really helps you to make

303
00:10:36,630 --> 00:10:35,680
sure you're using the data in the right

304
00:10:39,190 --> 00:10:36,640
way

305
00:10:41,190 --> 00:10:39,200
there are operational agencies who like

306
00:10:42,949 --> 00:10:41,200
to take data and put it into their

307
00:10:45,829 --> 00:10:42,959
models for forecasts and things like

308
00:10:47,590 --> 00:10:45,839
that and they work out systems with our

309
00:10:49,190 --> 00:10:47,600
with our data portals to directly

310
00:10:51,110 --> 00:10:49,200
downlink the data so you just call them

311
00:10:52,870 --> 00:10:51,120
up we work out a mechanism so they get

312
00:10:54,389 --> 00:10:52,880
the data fast and they plug it straight

313
00:11:01,350 --> 00:10:54,399

into their models and that's how it

314
00:11:01,360 --> 00:11:06,150
any other questions yeah one more here

315
00:11:10,630 --> 00:11:08,389
yeah ken what's the timeline for the

316
00:11:12,710 --> 00:11:10,640
public dissemination of the of the

317
00:11:14,150 --> 00:11:12,720
research results uh whenever this guy

318
00:11:15,990 --> 00:11:14,160
comes out i'm from the lunar lion team

319
00:11:17,430 --> 00:11:16,000
and yeah we are totally interested in

320
00:11:19,590 --> 00:11:17,440
everything that has to do with the oco2

321
00:11:21,910 --> 00:11:19,600
results so when the the data will be out

322
00:11:23,990 --> 00:11:21,920
probably by the end of the year and then

323
00:11:26,230 --> 00:11:24,000
it's going to it's going to take the

324
00:11:29,750 --> 00:11:26,240
scientists some time to start truly

325
00:11:31,590 --> 00:11:29,760
understanding the data so i would

326
00:11:33,190 --> 00:11:31,600
anticipate a lot of the initial results

327
00:11:34,949 --> 00:11:33,200
people are going to be looking at the

328
00:11:36,870 --> 00:11:34,959
easier questions you can answer over the

329
00:11:39,350 --> 00:11:36,880
shorter period time and some of those

330
00:11:41,110 --> 00:11:39,360
papers could be submitted to journals

331
00:11:43,430 --> 00:11:41,120
in a matter of months after the data are

332
00:11:46,230 --> 00:11:43,440
out some of the analyses are going to

333
00:11:47,910 --> 00:11:46,240
take years worth of data in order to

334
00:11:49,590 --> 00:11:47,920
truly put them into their models in

335
00:11:51,030 --> 00:11:49,600
order to try to answer different types

336
00:11:53,030 --> 00:11:51,040
of science questions so

337
00:11:55,590 --> 00:11:53,040
that i would suspect that we're going to

338
00:11:57,190 --> 00:11:55,600

be getting papers from oco2 data coming

339
00:11:58,470 --> 00:11:57,200
out over the next decade or two great

340
00:12:00,550 --> 00:11:58,480
and where can we find these papers when

341
00:12:02,629 --> 00:12:00,560
they come out um they'll be in all sorts

342
00:12:04,790 --> 00:12:02,639
of scientific journals so

343
00:12:06,069 --> 00:12:04,800
everywhere and and ones that people feel

344
00:12:07,509 --> 00:12:06,079
are really important there's usually a

345
00:12:12,150 --> 00:12:07,519
press release that goes out with them as

346
00:12:14,870 --> 00:12:13,350
okay for those in the room if you could

347
00:12:18,629 --> 00:12:14,880
leave your hand up until we make uh till

348
00:12:21,750 --> 00:12:19,430
okay

349
00:12:24,389 --> 00:12:21,760
another question for you um

350
00:12:26,790 --> 00:12:24,399
do you all have a hypothesis as to

351
00:12:28,389 --> 00:12:26,800
what's currently going on and how it

352
00:12:30,230 --> 00:12:28,399
might be fixed or how we can improve the

353
00:12:31,670 --> 00:12:30,240
situation scientists always have

354
00:12:33,750 --> 00:12:31,680
hypotheses

355
00:12:35,590 --> 00:12:33,760
that's what we do we ask questions and

356
00:12:37,110 --> 00:12:35,600
we take the data and

357
00:12:38,870 --> 00:12:37,120
hope that the data will help to answer

358
00:12:40,629 --> 00:12:38,880
the question they usually answer it at

359
00:12:43,110 --> 00:12:40,639
about the 70 percent level sometimes a

360
00:12:44,949 --> 00:12:43,120
90 level it's rarely the 100 percent

361
00:12:47,269 --> 00:12:44,959
level

362
00:12:49,269 --> 00:12:47,279
there are hypotheses right now about how

363
00:12:50,790 --> 00:12:49,279

co2 is being taken out of the atmosphere

364
00:12:54,069 --> 00:12:50,800
there's a lot of natural processes that

365
00:12:54,790 --> 00:12:54,079
go on quantifying what the major drivers

366
00:12:57,190 --> 00:12:54,800
are

367
00:12:59,269 --> 00:12:57,200
is a real problem right now and we hope

368
00:13:01,269 --> 00:12:59,279
that because of the coverage that oco2

369
00:13:02,949 --> 00:13:01,279
is going to get around the globe and the

370
00:13:05,910 --> 00:13:02,959
breadth of the data and the precision of

371
00:13:07,190 --> 00:13:05,920
the data that we'll be able to take

372
00:13:08,870 --> 00:13:07,200
what people are currently trying to

373
00:13:11,269 --> 00:13:08,880
answer those questions at a cotton like

374
00:13:11,990 --> 00:13:11,279
a 30 or 40 percent level and raise that

375
00:13:13,670 --> 00:13:12,000
up

376
00:13:16,069 --> 00:13:13,680
so that's the type of thing we want to

377
00:13:18,310 --> 00:13:16,079
do but scientists are

378
00:13:20,150 --> 00:13:18,320
we're greedy we like data there's never

379
00:13:23,750 --> 00:13:20,160
enough you always need more data to

380
00:13:28,069 --> 00:13:26,069
hi my name is derek letellier my

381
00:13:30,310 --> 00:13:28,079
question for you is uh what's the next

382
00:13:32,069 --> 00:13:30,320
step after oco2 what would you like to

383
00:13:33,590 --> 00:13:32,079
see maybe

384
00:13:35,190 --> 00:13:33,600
some other kind of measurements maybe i

385
00:13:36,550 --> 00:13:35,200
don't know methane is there anything

386
00:13:39,189 --> 00:13:36,560
else you would like to see after the end

387
00:13:41,750 --> 00:13:39,199
of the program or the next step nasa has

388
00:13:43,670 --> 00:13:41,760

a lot of missions in the queue right now

389
00:13:45,590 --> 00:13:43,680
so we have a soil moisture mission

390
00:13:47,350 --> 00:13:45,600
coming up later this year there's a

391
00:13:49,750 --> 00:13:47,360
couple missions that will go up onto the

392
00:13:51,430 --> 00:13:49,760
international space station soon

393
00:13:53,350 --> 00:13:51,440
nasa recently through a competitively

394
00:13:55,269 --> 00:13:53,360
selected process have an air quality

395
00:13:57,590 --> 00:13:55,279
mission that we'll be launching uh in

396
00:13:59,910 --> 00:13:57,600
about four years that's going to go on

397
00:14:01,750 --> 00:13:59,920
to a commercial communication satellite

398
00:14:03,269 --> 00:14:01,760
from geostationary orbit the first time

399
00:14:04,389 --> 00:14:03,279
nasa has tried to do something like that

400
00:14:07,269 --> 00:14:04,399
and that's going to stare at north

401
00:14:09,030 --> 00:14:07,279
america and look at pollution events

402
00:14:10,790 --> 00:14:09,040
so for things like methane there's

403
00:14:13,189 --> 00:14:10,800
actually a mission that our colleagues

404
00:14:15,350 --> 00:14:13,199
in europe are launching very soon which

405
00:14:17,990 --> 00:14:15,360
is going to have a channel to measure

406
00:14:20,870 --> 00:14:18,000
methane as well so a lot of scientists

407
00:14:22,230 --> 00:14:20,880
are anticipating combining that um

408
00:14:24,629 --> 00:14:22,240
methane data from the european

409
00:14:27,110 --> 00:14:24,639
instrument with the oco 2 data because i

410
00:14:28,470 --> 00:14:27,120
think combining those two data sets

411
00:14:29,509 --> 00:14:28,480
could answer a lot of very important

412
00:14:31,269 --> 00:14:29,519
questions

413
00:14:33,590 --> 00:14:31,279

excellent thank you okay

414
00:14:36,230 --> 00:14:33,600
okay yes all right ryan mallet

415
00:14:38,629 --> 00:14:36,240
earthtorian.com um i guess i kind of

416
00:14:40,949 --> 00:14:38,639
have a two-part question okay um

417
00:14:42,629 --> 00:14:40,959
so as we all know the first oco mission

418
00:14:45,189 --> 00:14:42,639
failed in 2009 and that's about five

419
00:14:46,870 --> 00:14:45,199
years ago right so i wanted to know if

420
00:14:48,550 --> 00:14:46,880
the technology or the mission has

421
00:14:50,790 --> 00:14:48,560
progressed or changed in any way since

422
00:14:53,350 --> 00:14:50,800
the five years has passed and also do

423
00:14:55,189 --> 00:14:53,360
you find it a happy coincidence that co2

424
00:14:56,710 --> 00:14:55,199
is now in the name of the second uh

425
00:15:00,069 --> 00:14:56,720
satellite

426
00:15:02,870 --> 00:15:00,079
by design

427
00:15:05,670 --> 00:15:02,880
um the oco the orbiting carbon

428
00:15:07,910 --> 00:15:05,680
observatory is oxygen carbon oxygen so

429
00:15:09,030 --> 00:15:07,920
that was by design that was a nice funny

430
00:15:10,389 --> 00:15:09,040
thing with the people who came up with

431
00:15:11,110 --> 00:15:10,399
the original name

432
00:15:15,189 --> 00:15:11,120
um

433
00:15:18,710 --> 00:15:15,199
similar to the original

434
00:15:19,910 --> 00:15:18,720
um there are a few minor tweaks to it um

435
00:15:21,110 --> 00:15:19,920
we learned some things when we did the

436
00:15:23,110 --> 00:15:21,120
first one

437
00:15:24,790 --> 00:15:23,120
when we went through testing and and the

438
00:15:26,629 --> 00:15:24,800

pre-launch stuff that we said you know

439
00:15:28,389 --> 00:15:26,639
we're going to do this better a few

440
00:15:29,990 --> 00:15:28,399
small changes here and there are going

441
00:15:31,189 --> 00:15:30,000
to make this better and randy you're

442
00:15:33,350 --> 00:15:31,199
going to hear about

443
00:15:35,910 --> 00:15:33,360
from later he was kind of the brains

444
00:15:37,350 --> 00:15:35,920
behind doing all these small tweaks then

445
00:15:39,189 --> 00:15:37,360
there's just some other small changes

446
00:15:40,870 --> 00:15:39,199
because computers were obsolete so we

447
00:15:42,389 --> 00:15:40,880
had to replace some things like that

448
00:15:44,150 --> 00:15:42,399
this is kind of a blessing in disguise

449
00:15:47,749 --> 00:15:44,160
then that you're

450
00:15:49,670 --> 00:15:47,759
having more advanced equipment up there

451
00:15:50,870 --> 00:15:49,680
we wanted the data then and we want the

452
00:15:52,829 --> 00:15:50,880
bid now

453
00:15:54,949 --> 00:15:52,839
having a launch failure is never a

454
00:16:03,509 --> 00:15:54,959
blessing so

455
00:16:09,430 --> 00:16:06,949
hi um how long do you expect the oco2

456
00:16:12,150 --> 00:16:09,440
probe to function

457
00:16:14,069 --> 00:16:12,160
it's designed to last for two years in

458
00:16:15,590 --> 00:16:14,079
orbit

459
00:16:18,150 --> 00:16:15,600
with all of our missions there's usually

460
00:16:20,550 --> 00:16:18,160
a design lifetime and

461
00:16:22,310 --> 00:16:20,560
if at the end of that time the mission

462
00:16:24,790 --> 00:16:22,320
is still producing good scientific data

463
00:16:26,389 --> 00:16:24,800

we keep it up so most of that those

464
00:16:28,470 --> 00:16:26,399
orbiting satellites you saw there are

465
00:16:29,910 --> 00:16:28,480
all well passer design lifetime i

466
00:16:31,749 --> 00:16:29,920
mentioned the aura satellite it was

467
00:16:33,670 --> 00:16:31,759
designed for five years

468
00:16:35,670 --> 00:16:33,680
later this month i get to go up and

469
00:16:37,670 --> 00:16:35,680
celebrate the 10-year anniversary of

470
00:16:39,269 --> 00:16:37,680
aura being at launch so i'm very excited

471
00:16:40,949 --> 00:16:39,279
about that as well and we hope that we

472
00:16:42,870 --> 00:16:40,959
could have oco up for that long as well

473
00:16:43,829 --> 00:16:42,880
it's possible that it could if we're

474
00:16:48,790 --> 00:16:43,839
lucky

475
00:16:52,150 --> 00:16:49,670
yes

476
00:16:53,670 --> 00:16:52,160
hi good morning uh i actually work in

477
00:16:55,269 --> 00:16:53,680
high schools and so you were talking

478
00:16:58,710 --> 00:16:55,279
about the fact that the data will start

479
00:17:00,310 --> 00:16:58,720
to be available towards the end of 2014.

480
00:17:02,870 --> 00:17:00,320
is there any

481
00:17:04,630 --> 00:17:02,880
plan to put together curricular

482
00:17:06,150 --> 00:17:04,640
components that teachers could be able

483
00:17:09,189 --> 00:17:06,160
to use in their schools for things like

484
00:17:11,990 --> 00:17:09,199
the carbon footprint question

485
00:17:14,630 --> 00:17:12,000
nasa does have education programs that

486
00:17:16,069 --> 00:17:14,640
do disseminate data out for teachers in

487
00:17:18,470 --> 00:17:16,079
the communities and things like that i

488
00:17:19,909 --> 00:17:18,480

would recommend that you interact with

489
00:17:22,309 --> 00:17:19,919
them and they can work with a scientist

490
00:17:24,069 --> 00:17:22,319
to help try to get data like that out

491
00:17:28,549 --> 00:17:24,079
for a teacher such as yourself who are

492
00:17:31,430 --> 00:17:30,150
okay i think we have time for one more

493
00:17:37,190 --> 00:17:31,440
question i think we have some on social

494
00:17:40,470 --> 00:17:39,029
all right we have a lot of questions

495
00:17:42,870 --> 00:17:40,480
coming in over twitter and for those of

496
00:17:44,549 --> 00:17:42,880
you on twitter um if we can't ask them

497
00:17:46,710 --> 00:17:44,559
all out loud we will just try to respond

498
00:17:48,390 --> 00:17:46,720
to you through twitter but i'll ask you

499
00:17:50,789 --> 00:17:48,400
um

500
00:17:52,710 --> 00:17:50,799
let's see dr heidi mastin asked at what

501
00:17:54,630 --> 00:17:52,720
point did you get really excited when

502
00:17:56,870 --> 00:17:54,640
you realized solutions to the big

503
00:18:00,630 --> 00:17:56,880
questions of carbon data were within

504
00:18:03,830 --> 00:18:02,150
people are always excited when they hear

505
00:18:06,549 --> 00:18:03,840
them the mission is coming that's going

506
00:18:07,990 --> 00:18:06,559
to get the data so that's kind of where

507
00:18:11,029 --> 00:18:08,000
the excitement comes from so when the

508
00:18:13,350 --> 00:18:11,039
original oco mission was selected it was

509
00:18:14,870 --> 00:18:13,360
through a competitively selected process

510
00:18:16,789 --> 00:18:14,880
all the people in those communities who

511
00:18:18,070 --> 00:18:16,799
had been thinking about that and trying

512
00:18:20,630 --> 00:18:18,080
to help the people who wrote the

513
00:18:22,230 --> 00:18:20,640

proposal come up with a a measurement

514
00:18:23,270 --> 00:18:22,240
design system that could actually answer

515
00:18:25,270 --> 00:18:23,280
the questions

516
00:18:27,029 --> 00:18:25,280
as soon as soon as they get a yes on

517
00:18:28,470 --> 00:18:27,039
that that's when the excitement starts

518
00:18:30,150 --> 00:18:28,480
and the same thing happened with oco 2

519
00:18:31,830 --> 00:18:30,160
when we got

520
00:18:33,270 --> 00:18:31,840
allowance from the federal u.s federal

521
00:18:37,350 --> 00:18:33,280
government to actually refly this

522
00:18:39,510 --> 00:18:37,360
mission again that excitement comes back

523
00:18:41,110 --> 00:18:39,520
another one here is

524
00:18:43,669 --> 00:18:41,120
from ag hub

525
00:18:47,430 --> 00:18:43,679
will the data gathered from the oco2

526
00:18:48,390 --> 00:18:47,440
satellite help farmers in any way

527
00:18:50,310 --> 00:18:48,400
um

528
00:18:52,150 --> 00:18:50,320
in some ways it could in some ways it

529
00:18:53,190 --> 00:18:52,160
couldn't so the measurements aren't

530
00:18:55,990 --> 00:18:53,200
going to

531
00:18:58,310 --> 00:18:56,000
map over farms per se that's too fine of

532
00:19:00,549 --> 00:18:58,320
a scale for something like co2 that has

533
00:19:03,590 --> 00:19:00,559
a very long lifetime

534
00:19:06,310 --> 00:19:03,600
however what it can tell us is the

535
00:19:07,830 --> 00:19:06,320
amount of exchange of co2 over larger

536
00:19:09,909 --> 00:19:07,840
scale so if you have an area that's

537
00:19:11,909 --> 00:19:09,919
either getting a lot of rainfall or

538
00:19:13,909 --> 00:19:11,919

going through serious drought

539
00:19:16,470 --> 00:19:13,919
we should be able to get some type of

540
00:19:18,150 --> 00:19:16,480
picture as to how much carbon dioxide is

541
00:19:20,310 --> 00:19:18,160
exchanging with

542
00:19:21,510 --> 00:19:20,320
that type of area

543
00:19:23,990 --> 00:19:21,520
you're going to hear from ann marie a

544
00:19:25,430 --> 00:19:24,000
little bit later about one of the side

545
00:19:26,310 --> 00:19:25,440
benefit measurements we're going to get

546
00:19:29,350 --> 00:19:26,320
from

547
00:19:31,590 --> 00:19:29,360
oco2 and there's a measurement called

548
00:19:33,669 --> 00:19:31,600
solar induced fluorescence and what that

549
00:19:35,430 --> 00:19:33,679
measurement tells you is how active

550
00:19:36,630 --> 00:19:35,440
photosynthesis is

551
00:19:39,110 --> 00:19:36,640
that's going to be a side measurement

552
00:19:41,029 --> 00:19:39,120
we're going to get out of oco2

553
00:19:42,870 --> 00:19:41,039
and in some of these

554
00:19:44,630 --> 00:19:42,880
certain types of environments where you

555
00:19:46,070 --> 00:19:44,640
either have drought or a lot of rain

556
00:19:48,310 --> 00:19:46,080
we'll be able to tell

557
00:19:49,830 --> 00:19:48,320
how active the photosynthesis is in

558
00:19:50,870 --> 00:19:49,840
those particular areas which does

559
00:19:56,549 --> 00:19:50,880
directly

560
00:20:00,230 --> 00:19:59,029
thanks thanks ken i think that's uh all

561
00:20:01,830 --> 00:20:00,240
the time we've got i really appreciate

562
00:20:03,190 --> 00:20:01,840
you coming out today oh great it was a

563
00:20:10,870 --> 00:20:03,200

pleasure

564
00:20:13,990 --> 00:20:12,070
for those in the room if you have a

565
00:20:15,190 --> 00:20:14,000
question please uh raise your hand and

566
00:20:17,350 --> 00:20:15,200
hold it up and we'll try to get to you

567
00:20:19,669 --> 00:20:17,360
as quickly as possible for those at home

568
00:20:20,950 --> 00:20:19,679
you can use the hashtag

569
00:20:22,630 --> 00:20:20,960
we'll try to get to your question as

570
00:20:24,230 --> 00:20:22,640
soon as possible if we can't get it to

571
00:20:26,390 --> 00:20:24,240
uh here in the room we'll try to answer

572
00:20:28,070 --> 00:20:26,400
it for you on twitter or on other social

573
00:20:29,190 --> 00:20:28,080
media accounts that you're asking on our

574
00:20:30,950 --> 00:20:29,200
next speakers are going to talk a little

575
00:20:32,549 --> 00:20:30,960
bit about the launch itself the vehicle

576
00:20:33,830 --> 00:20:32,559
uh what the conditions are for launch

577
00:20:35,830 --> 00:20:33,840
tomorrow

578
00:20:37,430 --> 00:20:35,840
let me introduce colonel keith baltz

579
00:20:39,270 --> 00:20:37,440
with the 30th space wing commander and

580
00:20:40,870 --> 00:20:39,280
launch decision authority

581
00:20:42,470 --> 00:20:40,880
and mick waltman with the launch

582
00:20:49,669 --> 00:20:42,480
services program the vehicle systems

583
00:20:53,270 --> 00:20:51,669
well good morning how's everybody doing

584
00:20:55,350 --> 00:20:53,280
good how many of you is this your first

585
00:20:56,630 --> 00:20:55,360
trip to vandenberg air force base

586
00:20:57,669 --> 00:20:56,640
all right well let me be as a base

587
00:20:58,950 --> 00:20:57,679
commander let me welcome you to

588
00:21:01,190 --> 00:20:58,960

vandenberg air force base i know you

589
00:21:02,470 --> 00:21:01,200
just got started here this morning with

590
00:21:04,310 --> 00:21:02,480
the social kick off you're going to get

591
00:21:06,710 --> 00:21:04,320
a chance to see a space launch complex

592
00:21:08,230 --> 00:21:06,720
or slick later this morning slick 2

593
00:21:09,830 --> 00:21:08,240
cachio park so we're excited we love

594
00:21:12,149 --> 00:21:09,840
this base third largest air force base

595
00:21:14,070 --> 00:21:12,159
in the inventory is spread out 100 000

596
00:21:16,549 --> 00:21:14,080
acres because our job is to launch

597
00:21:18,310 --> 00:21:16,559
rockets and the test missiles and so

598
00:21:19,430 --> 00:21:18,320
tonight we get to launch a rocket and so

599
00:21:21,909 --> 00:21:19,440
we're pretty happy we haven't launched a

600
00:21:23,270 --> 00:21:21,919
delta ii since october of 2011 so it's

601
00:21:26,070 --> 00:21:23,280
been a few years for this particular

602
00:21:27,990 --> 00:21:26,080
rocket we just had a very successful

603
00:21:29,909 --> 00:21:28,000
missile defense agency intercept test

604
00:21:31,350 --> 00:21:29,919
last week if you saw that on the news

605
00:21:33,110 --> 00:21:31,360
that was launched from one of our launch

606
00:21:35,029 --> 00:21:33,120
facilities on the north part of base and

607
00:21:36,789 --> 00:21:35,039
so here we are a week later now getting

608
00:21:39,350 --> 00:21:36,799
to work with another fantastic mission

609
00:21:40,870 --> 00:21:39,360
partner in nasa uh and their partner

610
00:21:43,590 --> 00:21:40,880
with jpl and this

611
00:21:45,350 --> 00:21:43,600
satellite to put that on orbit tonight

612
00:21:46,789 --> 00:21:45,360
so before i get into my job not just as

613
00:21:48,390 --> 00:21:46,799

a base commander but later on as the

614
00:21:50,390 --> 00:21:48,400
launch decision authority for tonight's

615
00:21:51,830 --> 00:21:50,400
launch as the owner of the range i want

616
00:21:53,029 --> 00:21:51,840
to hand it over to mick waltman we'll

617
00:21:54,950 --> 00:21:53,039
talk a little bit more about the launch

618
00:21:57,110 --> 00:21:54,960
flow as the rock and the payload come

619
00:21:59,590 --> 00:21:57,120
here on vandenberg what do you make

620
00:22:01,190 --> 00:21:59,600
thanks colonel baltz uh on top of that

621
00:22:03,990 --> 00:22:01,200
i'll ask how many of you this is your

622
00:22:05,350 --> 00:22:04,000
first time seeing a delta ii

623
00:22:06,870 --> 00:22:05,360
all right that's great because i can

624
00:22:09,270 --> 00:22:06,880
tell you from launch services program

625
00:22:11,110 --> 00:22:09,280
which we're from kennedy space center

626
00:22:12,950 --> 00:22:11,120
we're very excited to be back in the

627
00:22:14,470 --> 00:22:12,960
delta ii business as as colonel bald

628
00:22:16,310 --> 00:22:14,480
said it's been about three years since

629
00:22:20,310 --> 00:22:16,320
our last launch npp

630
00:22:22,789 --> 00:22:20,320
and uh oco2 is a very special uh special

631
00:22:24,630 --> 00:22:22,799
vehicle to us uh due to the reflight and

632
00:22:26,630 --> 00:22:24,640
all but on top of that also i'm going to

633
00:22:28,950 --> 00:22:26,640
just start off with saying you'll notice

634
00:22:30,549 --> 00:22:28,960
when you do your tour today you'll see a

635
00:22:31,990 --> 00:22:30,559
special placard out on the fixed

636
00:22:34,070 --> 00:22:32,000
umbilical tower

637
00:22:36,549 --> 00:22:34,080
that's a special for us is one of our

638
00:22:38,710 --> 00:22:36,559

analysts lori walls recently passed away

639
00:22:40,310 --> 00:22:38,720
and we've dedicated this flight to lori

640
00:22:42,630 --> 00:22:40,320
so i send that out to lori and her

641
00:22:45,110 --> 00:22:42,640
family and we're looking for a great

642
00:22:47,270 --> 00:22:45,120
launch this evening so with that

643
00:22:48,950 --> 00:22:47,280
enjoy the launch this evening um a

644
00:22:50,310 --> 00:22:48,960
little bit about launch services program

645
00:22:52,710 --> 00:22:50,320
as i said we're from kennedy space

646
00:22:54,470 --> 00:22:52,720
center in florida we do launch here on

647
00:22:57,110 --> 00:22:54,480
the west coast at vandenberg air force

648
00:22:59,590 --> 00:22:57,120
base and at kennedy space center

649
00:23:01,590 --> 00:22:59,600
very happy to be with the delta ii

650
00:23:03,909 --> 00:23:01,600
as we move forward our engineers are

651
00:23:06,310 --> 00:23:03,919
analysts we bring a great vast knowledge

652
00:23:08,149 --> 00:23:06,320
of delta ii forward on this vehicle and

653
00:23:09,750 --> 00:23:08,159
are ready to go i'm going to show you a

654
00:23:11,430 --> 00:23:09,760
little video here of the launch flow

655
00:23:12,630 --> 00:23:11,440
it's about a minute long talk that real

656
00:23:14,630 --> 00:23:12,640
quick

657
00:23:16,470 --> 00:23:14,640
and if i can get the video

658
00:23:18,710 --> 00:23:16,480
there it is if you look at this you'll

659
00:23:21,190 --> 00:23:18,720
see the first stage booster coming into

660
00:23:23,350 --> 00:23:21,200
slick 2 space launch complex 2 is we're

661
00:23:25,350 --> 00:23:23,360
getting ready to erect it into the

662
00:23:27,029 --> 00:23:25,360
mobile service tower there

663
00:23:29,830 --> 00:23:27,039

being lifted up by the mobile crane

664
00:23:32,789 --> 00:23:29,840
there's a great picture of the rs27 main

665
00:23:34,470 --> 00:23:32,799
engine for the delta ii is about 237 000

666
00:23:36,630 --> 00:23:34,480
pounds of thrust

667
00:23:39,669 --> 00:23:36,640
for that and the vehicle going into the

668
00:23:42,070 --> 00:23:39,679
mobile tower here's a very early morning

669
00:23:44,310 --> 00:23:42,080
getting ready to uh erect the second

670
00:23:47,269 --> 00:23:44,320
stage which is powered by an aerojet

671
00:23:49,590 --> 00:23:47,279
rocketdyne aj10 engine which is about 9

672
00:23:52,149 --> 00:23:49,600
300 pounds of thrust again lifting the

673
00:23:54,549 --> 00:23:52,159
second stage up into the mobile tower

674
00:23:56,390 --> 00:23:54,559
and coming back down mating it onto the

675
00:23:58,710 --> 00:23:56,400
first stage which has already had the

676
00:24:00,549 --> 00:23:58,720
solid rocket motors placed great view of

677
00:24:02,470 --> 00:24:00,559
oco two in the payload processing

678
00:24:05,430 --> 00:24:02,480
facility getting ready for transport

679
00:24:07,750 --> 00:24:05,440
we're putting a can on top of oco2 to

680
00:24:11,110 --> 00:24:07,760
protect it it's more from a for cleaning

681
00:24:13,190 --> 00:24:11,120
for clean uh environment and

682
00:24:15,269 --> 00:24:13,200
shock as it transports down the road the

683
00:24:17,350 --> 00:24:15,279
payload processing facility it's only

684
00:24:20,470 --> 00:24:17,360
about two miles from slick two here you

685
00:24:22,789 --> 00:24:20,480
see it coming into slick 2 in the can we

686
00:24:24,789 --> 00:24:22,799
get ready to lift it up into the clean

687
00:24:27,990 --> 00:24:24,799
room on slick 2.

688
00:24:30,950 --> 00:24:28,000

that's a very slow and

689
00:24:32,549 --> 00:24:30,960
methodical process there as the ula nasa

690
00:24:34,390 --> 00:24:32,559
team brings the

691
00:24:35,909 --> 00:24:34,400
can down in they made it on top of the

692
00:24:38,310 --> 00:24:35,919
second stage and then we get ready to

693
00:24:40,950 --> 00:24:38,320
remove the can

694
00:24:42,549 --> 00:24:40,960
and close up the clean room so the oco-2

695
00:24:44,310 --> 00:24:42,559
vehicle is now mated to the launch

696
00:24:46,149 --> 00:24:44,320
vehicle we bring in the 10-foot

697
00:24:48,470 --> 00:24:46,159
composite fairings there you see the one

698
00:24:51,830 --> 00:24:48,480
half already on it's made by atk and

699
00:24:54,070 --> 00:24:51,840
iuka and we bring in the second half of

700
00:24:55,830 --> 00:24:54,080
the 10 foot composite fairing do an

701
00:24:57,510 --> 00:24:55,840
inspection of the separation scene there

702
00:24:59,990 --> 00:24:57,520
make sure everything is ready to go and

703
00:25:03,029 --> 00:25:00,000
now we have a fully encapsulated oco-2

704
00:25:04,710 --> 00:25:03,039
on top of the launch vehicle

705
00:25:06,149 --> 00:25:04,720
in the clean room there that's a really

706
00:25:09,350 --> 00:25:06,159
nice view

707
00:25:11,269 --> 00:25:09,360
of the of the top of the rocket

708
00:25:12,549 --> 00:25:11,279
i think that's it yeah from the

709
00:25:14,630 --> 00:25:12,559
from the from the launch vehicle

710
00:25:16,390 --> 00:25:14,640
processing standpoint

711
00:25:18,630 --> 00:25:16,400
i will say the team's been really busy

712
00:25:21,590 --> 00:25:18,640
we did range beacon checks yesterday we

713
00:25:22,789 --> 00:25:21,600

finished up our launch readiness review

714
00:25:26,710 --> 00:25:22,799
with the

715
00:25:28,630 --> 00:25:26,720
senior management and uaa senior

716
00:25:30,950 --> 00:25:28,640
management and we're looking really good

717
00:25:33,430 --> 00:25:30,960
for this evening and moving forward so i

718
00:25:34,870 --> 00:25:33,440
appreciate that and back to you

719
00:25:36,710 --> 00:25:34,880
thanks man good take team here we got a

720
00:25:38,630 --> 00:25:36,720
lot of great partners here our job here

721
00:25:39,990 --> 00:25:38,640
at the 30th space swing at vandenberg is

722
00:25:41,830 --> 00:25:40,000
to launch safely whether we're doing a

723
00:25:43,830 --> 00:25:41,840
missile test or in the case of tonight

724
00:25:45,830 --> 00:25:43,840
put a satellite in orbit my primary

725
00:25:47,269 --> 00:25:45,840
responsibility is public safety and so

726
00:25:49,269 --> 00:25:47,279
we have different launch customers come

727
00:25:51,110 --> 00:25:49,279
into the range my job is to make sure

728
00:25:52,710 --> 00:25:51,120
that this uh with that kind of explosive

729
00:25:54,310 --> 00:25:52,720
power on that rocket that it doesn't

730
00:25:56,630 --> 00:25:54,320
affect our local folks in santa maria

731
00:25:58,470 --> 00:25:56,640
lompoc the base population as long as

732
00:25:59,990 --> 00:25:58,480
folks up and down the seaboard so if you

733
00:26:01,510 --> 00:26:00,000
ever look at the geography of california

734
00:26:03,590 --> 00:26:01,520
in this little elbow of california that

735
00:26:05,190 --> 00:26:03,600
sticks out we put a polar launch into

736
00:26:06,789 --> 00:26:05,200
orbit like we are tonight

737
00:26:08,390 --> 00:26:06,799
we have a lot of things in play that

738
00:26:10,149 --> 00:26:08,400

have to come together for launch day the

739
00:26:12,149 --> 00:26:10,159
weather has to be good and it's looking

740
00:26:13,669 --> 00:26:12,159
good tonight not so much for visibility

741
00:26:16,310 --> 00:26:13,679
so i apologize for those that may see

742
00:26:20,310 --> 00:26:18,630
yeah it is good it is good weather uh

743
00:26:21,830 --> 00:26:20,320
but some some fog tonight so visibility

744
00:26:23,110 --> 00:26:21,840
may be low for the actual launch but as

745
00:26:24,789 --> 00:26:23,120
far as meeting our launch commit

746
00:26:26,390 --> 00:26:24,799
criteria the weather's looking good zero

747
00:26:27,510 --> 00:26:26,400
probability of violation so that's good

748
00:26:28,789 --> 00:26:27,520
news for us

749
00:26:30,149 --> 00:26:28,799
uh in addition to that we have to make

750
00:26:31,909 --> 00:26:30,159
sure the area is clear so there are no

751
00:26:34,390 --> 00:26:31,919
people in the launch area that includes

752
00:26:35,990 --> 00:26:34,400
boats trains planes and people on the

753
00:26:37,110 --> 00:26:36,000
ground even though we're near the ocean

754
00:26:38,230 --> 00:26:37,120
so we have sweep teams that are out

755
00:26:39,909 --> 00:26:38,240
there making that happen along with

756
00:26:41,350 --> 00:26:39,919
surveillance radars

757
00:26:43,029 --> 00:26:41,360
in addition to that we have safety

758
00:26:44,710 --> 00:26:43,039
equipment on these rockets so that when

759
00:26:46,470 --> 00:26:44,720
we track it if it's not going where it

760
00:26:48,390 --> 00:26:46,480
should be we crack it and so we have

761
00:26:50,070 --> 00:26:48,400
telemetry and radars and if we need to

762
00:26:51,190 --> 00:26:50,080
command transmitters to make sure that

763
00:26:52,789 --> 00:26:51,200

if it's going in the wrong direction

764
00:26:54,710 --> 00:26:52,799
which i don't expect it to tonight we

765
00:26:56,149 --> 00:26:54,720
haven't had that occur in several

766
00:26:58,310 --> 00:26:56,159
several years

767
00:26:59,909 --> 00:26:58,320
uh we're there to keep the public safe

768
00:27:02,230 --> 00:26:59,919
and ultimately that's our goal of the

769
00:27:03,430 --> 00:27:02,240
range and we're excited because uh well

770
00:27:05,350 --> 00:27:03,440
we never have to do that part of our

771
00:27:07,190 --> 00:27:05,360
mission we're always ready if we need to

772
00:27:08,870 --> 00:27:07,200
and in the end we get to watch rock

773
00:27:10,230 --> 00:27:08,880
watch rocket launches for a living and

774
00:27:11,269 --> 00:27:10,240
be a part of great teams to make that

775
00:27:12,710 --> 00:27:11,279
happen

776
00:27:13,909 --> 00:27:12,720
i think that's good for opening comments

777
00:27:15,110 --> 00:27:13,919
uh if you guys are ready we'll take

778
00:27:17,110 --> 00:27:15,120
questions and we'll pass the mic back

779
00:27:18,549 --> 00:27:17,120
and forth depending on

780
00:27:19,669 --> 00:27:18,559
who you're addressing we have one back

781
00:27:22,149 --> 00:27:19,679
here

782
00:27:23,909 --> 00:27:22,159
hi i'm kat at kat robinson uh just a

783
00:27:25,350 --> 00:27:23,919
question about if you talk a little bit

784
00:27:27,510 --> 00:27:25,360
about the launch window it's a very

785
00:27:30,549 --> 00:27:27,520
narrow time frame so just talk about you

786
00:27:32,310 --> 00:27:30,559
know maybe for for ula and and choosing

787
00:27:34,710 --> 00:27:32,320
launch windows trajectories putting it

788
00:27:36,789 --> 00:27:34,720

into the right orbit

789
00:27:39,029 --> 00:27:36,799
so yeah we have a very short window this

790
00:27:42,149 --> 00:27:39,039
evening 30-second window

791
00:27:43,990 --> 00:27:42,159
that's mainly chosen due to the science

792
00:27:45,430 --> 00:27:44,000
opportunity that you heard from

793
00:27:46,230 --> 00:27:45,440
previously

794
00:27:48,310 --> 00:27:46,240
so

795
00:27:50,870 --> 00:27:48,320
once the science is determined in what

796
00:27:52,389 --> 00:27:50,880
orbit we need to put the satellite into

797
00:27:54,310 --> 00:27:52,399
then the analysts and the team get

798
00:27:56,389 --> 00:27:54,320
together our flight design team they

799
00:27:58,470 --> 00:27:56,399
determine trajectory and how long our

800
00:28:01,350 --> 00:27:58,480
window can be and so for this mission

801
00:28:03,269 --> 00:28:01,360
yes a very short window but we've had

802
00:28:05,430 --> 00:28:03,279
shorter ones on delta ii before and the

803
00:28:08,870 --> 00:28:05,440
team is very uh we're ready to go and

804
00:28:13,669 --> 00:28:11,269
um actually the shortest one we've had

805
00:28:20,950 --> 00:28:13,679
has been one second

806
00:28:24,389 --> 00:28:22,710
for colonel baltz hi matt campbell at

807
00:28:26,950 --> 00:28:24,399
cbsla

808
00:28:28,630 --> 00:28:26,960
for a rocket such as the delta ii how

809
00:28:31,510 --> 00:28:28,640
far away will folks be able to either

810
00:28:32,950 --> 00:28:31,520
see or hear the rocket

811
00:28:34,630 --> 00:28:32,960
at launch time

812
00:28:36,710 --> 00:28:34,640
uh depends the variant levels this has

813
00:28:37,909 --> 00:28:36,720

three solid rocket motors on the side so

814
00:28:39,590 --> 00:28:37,919
that's good those are crowd pleasers

815
00:28:41,190 --> 00:28:39,600
because solid rockets are

816
00:28:43,190 --> 00:28:41,200
reverberate on the chest a lot more than

817
00:28:45,909 --> 00:28:43,200
just the solid or excuse me just the

818
00:28:48,310 --> 00:28:45,919
liquid fueled uh stage one uh so it

819
00:28:49,750 --> 00:28:48,320
varies uh we certainly in our operations

820
00:28:51,590 --> 00:28:49,760
centers which are a good five to ten

821
00:28:53,190 --> 00:28:51,600
miles away from the launch site feel it

822
00:28:54,310 --> 00:28:53,200
inside the buildings those that are

823
00:28:56,070 --> 00:28:54,320
gonna be at the golf course i know

824
00:28:57,669 --> 00:28:56,080
tonight or at the media location perhaps

825
00:28:59,350 --> 00:28:57,679
where you're gonna be at certainly see

826
00:29:00,950 --> 00:28:59,360
it even if it's foggy at least the fog

827
00:29:01,669 --> 00:29:00,960
will get bright for a few seconds before

828
00:29:08,789 --> 00:29:01,679
it

829
00:29:10,389 --> 00:29:08,799
while since we've launched a delta ii

830
00:29:12,470 --> 00:29:10,399
with three solids on so i don't have a

831
00:29:14,870 --> 00:29:12,480
good mile distance but certainly uh

832
00:29:16,710 --> 00:29:14,880
santa maria 15 miles away in long poke

833
00:29:18,950 --> 00:29:16,720
they'll feel it i may not wake folks up

834
00:29:20,789 --> 00:29:18,960
at three in the morning uh won't be that

835
00:29:22,310 --> 00:29:20,799
quite reverberate that much

836
00:29:24,310 --> 00:29:22,320
but sometimes weather plays too if we

837
00:29:26,389 --> 00:29:24,320
have an inversion layer and it pushes

838
00:29:28,149 --> 00:29:26,399

some of that vibration it'll it'll

839
00:29:30,630 --> 00:29:28,159
be felt a lot deeper into the into the

840
00:29:31,909 --> 00:29:30,640
coast or off the coast uh but the cities

841
00:29:33,110 --> 00:29:31,919
will feel a little bit of it tonight and

842
00:29:34,870 --> 00:29:33,120
certainly if it's clear you're higher

843
00:29:37,029 --> 00:29:34,880
above the fog you'll see it all the way

844
00:29:38,710 --> 00:29:37,039
through stage one uh

845
00:29:46,070 --> 00:29:38,720
cut off and stage two ignition and then

846
00:29:52,070 --> 00:29:49,350
hi i'm clayton elder from uc irvine

847
00:29:54,870 --> 00:29:52,080
what advantages does the delta ii rocket

848
00:30:00,310 --> 00:29:54,880
have over the last rocket that was used

849
00:30:00,320 --> 00:30:03,269
wow

850
00:30:07,510 --> 00:30:05,110
well having being being a vehicle

851
00:30:09,590 --> 00:30:07,520
systems engineer working for lsp one of

852
00:30:12,710 --> 00:30:09,600
the nice things is we do get to work

853
00:30:16,310 --> 00:30:12,720
with all the vehicles in our fleet

854
00:30:18,389 --> 00:30:16,320
so advantages uh or disadvantages i will

855
00:30:20,389 --> 00:30:18,399
say that the one one big advantage with

856
00:30:24,070 --> 00:30:20,399
the delta ii is it has been a real

857
00:30:25,990 --> 00:30:24,080
workhorse for nasa over the years

858
00:30:27,510 --> 00:30:26,000
i'm actually going to defer real quick

859
00:30:29,909 --> 00:30:27,520
because my numbers man is in the back

860
00:30:33,990 --> 00:30:29,919
our nasa launch manager tim dunn

861
00:30:37,669 --> 00:30:35,909
42nd

862
00:30:40,070 --> 00:30:37,679
launch from vandenberg so it has been a

863
00:30:41,909 --> 00:30:40,080

real workhorse for uh

864
00:30:45,190 --> 00:30:41,919
del for for us in launch services

865
00:30:47,190 --> 00:30:45,200
program um as you saw in the video a lot

866
00:30:50,710 --> 00:30:47,200
of room in the payload fairing 10 10

867
00:30:54,549 --> 00:30:50,720
foot composite fairing with oco2

868
00:30:56,470 --> 00:30:54,559
and all so very proven system very uh

869
00:30:58,630 --> 00:30:56,480
able to meet our requirements and work

870
00:31:01,750 --> 00:30:58,640
so it's a larger rocket than what was

871
00:31:02,789 --> 00:31:01,760
previously used uh for the oco2 or oco

872
00:31:04,870 --> 00:31:02,799
mission

873
00:31:06,070 --> 00:31:04,880
and we're really looking forward to

874
00:31:08,310 --> 00:31:06,080
tonight it's uh like i said our

875
00:31:09,669 --> 00:31:08,320
workhorse and our fleet excellent thank

876
00:31:12,549 --> 00:31:09,679
you

877
00:31:14,789 --> 00:31:12,559
hey um another question about the the uh

878
00:31:16,950 --> 00:31:14,799
the 30 second window colonel you said

879
00:31:19,190 --> 00:31:16,960
you were the launch launch decision

880
00:31:20,549 --> 00:31:19,200
authority does that mean that you

881
00:31:22,230 --> 00:31:20,559
literally make the call or is it a

882
00:31:23,590 --> 00:31:22,240
civilian military decision or is it

883
00:31:25,509 --> 00:31:23,600
entirely in your hands to press the

884
00:31:27,029 --> 00:31:25,519
button uh no it's a mutual decision when

885
00:31:28,710 --> 00:31:27,039
it comes to launches to the launch

886
00:31:29,990 --> 00:31:28,720
decision if i've got a good range and

887
00:31:31,350 --> 00:31:30,000
the public is going to be safe and the

888
00:31:32,630 --> 00:31:31,360

weather is good and my systems are

889
00:31:33,990 --> 00:31:32,640
working correctly

890
00:31:36,070 --> 00:31:34,000
and i'm ready to go i give the final

891
00:31:37,430 --> 00:31:36,080
clear launch at around l minus 12. the

892
00:31:38,789 --> 00:31:37,440
problem is i'm not going to compel the

893
00:31:40,630 --> 00:31:38,799
rocket and the satellite to launch if

894
00:31:42,310 --> 00:31:40,640
they're not ready

895
00:31:43,509 --> 00:31:42,320
conversely if the the rocket and the

896
00:31:44,630 --> 00:31:43,519
satellite are ready to go all the

897
00:31:45,750 --> 00:31:44,640
technical things are worked out their

898
00:31:47,350 --> 00:31:45,760
checklists are running smoothly and

899
00:31:49,029 --> 00:31:47,360
they're go for launch they're not going

900
00:31:50,789 --> 00:31:49,039
to launch without my clear launch if the

901
00:31:53,029 --> 00:31:50,799
range isn't ready to keep the public

902
00:31:54,789 --> 00:31:53,039
safe and to meet our criteria

903
00:31:56,389 --> 00:31:54,799
so there is a series of goes from the

904
00:31:59,029 --> 00:31:56,399
chief of safety from our operations

905
00:32:00,389 --> 00:31:59,039
director on our side we get one from the

906
00:32:02,470 --> 00:32:00,399
nasa launch manager and the launch

907
00:32:03,669 --> 00:32:02,480
director to make sure this uh launch

908
00:32:04,549 --> 00:32:03,679
vehicle and the satellite are ready to

909
00:32:06,470 --> 00:32:04,559
go

910
00:32:08,470 --> 00:32:06,480
and so it's a it's a dual vote system if

911
00:32:09,590 --> 00:32:08,480
you will and one can veto the other they

912
00:32:11,190 --> 00:32:09,600
can't launch without the range being

913
00:32:12,470 --> 00:32:11,200

ready and if my range is ready i'm not

914
00:32:14,710 --> 00:32:12,480
gonna compel them to launch if they're

915
00:32:15,990 --> 00:32:14,720
not ready and they both come together

916
00:32:17,350 --> 00:32:16,000
and i do want to do one follow-up and

917
00:32:18,710 --> 00:32:17,360
where to see it i'm not sure about the

918
00:32:20,070 --> 00:32:18,720
delta ii but i know you've got a lot of

919
00:32:21,830 --> 00:32:20,080
folks out on the

920
00:32:23,350 --> 00:32:21,840
out on the blogosphere today uh they

921
00:32:25,669 --> 00:32:23,360
have seen some launch especially space

922
00:32:27,029 --> 00:32:25,679
launches from as far away as las vegas

923
00:32:29,830 --> 00:32:27,039
that far inland certainly along the

924
00:32:31,509 --> 00:32:29,840
coast on the southerly direct trajectory

925
00:32:33,110 --> 00:32:31,519
down by l.a santa barbara they can see

926
00:32:35,430 --> 00:32:33,120
it too if the weather's clear so it's

927
00:32:37,029 --> 00:32:35,440
not just a local santa barbara county

928
00:32:37,990 --> 00:32:37,039
activity tonight do you want to add to

929
00:32:39,830 --> 00:32:38,000
it yeah actually i was just going to

930
00:32:42,230 --> 00:32:39,840
follow up to her question

931
00:32:43,590 --> 00:32:42,240
being the lda for the air force side as

932
00:32:45,909 --> 00:32:43,600
i mentioned we have our nasa launch

933
00:32:47,830 --> 00:32:45,919
manager back here in the back tim dunn

934
00:32:50,070 --> 00:32:47,840
he's uh with the authority for us on the

935
00:32:52,710 --> 00:32:50,080
nasa side and then standing next to tim

936
00:32:54,470 --> 00:32:52,720
is mr ralph basilio who is the launch

937
00:32:57,750 --> 00:32:54,480
authority for the spacecraft side so it

938
00:32:59,509 --> 00:32:57,760

takes a really a diverse team to bring

939
00:33:05,110 --> 00:32:59,519
this all together and of course we won't

940
00:33:08,630 --> 00:33:06,630
mitchell brockman from union grove high

941
00:33:09,750 --> 00:33:08,640
school in wisconsin question in regards

942
00:33:11,830 --> 00:33:09,760
to the rocket you said the rocket had

943
00:33:13,669 --> 00:33:11,840
been a workhorse for

944
00:33:15,509 --> 00:33:13,679
both nasa and used a bunch at the air

945
00:33:17,029 --> 00:33:15,519
force base and

946
00:33:18,789 --> 00:33:17,039
that it was kind of getting phased out

947
00:33:20,470 --> 00:33:18,799
what is the next rocket that's on the

948
00:33:22,830 --> 00:33:20,480
way and what would be the reasons for

949
00:33:24,789 --> 00:33:22,840
phasing it out if it has been so

950
00:33:26,070 --> 00:33:24,799
successful colonel balt says it's my

951
00:33:28,630 --> 00:33:26,080
rocket

952
00:33:31,310 --> 00:33:28,640
go ahead and answer so to to answer that

953
00:33:33,430 --> 00:33:31,320
question it has this is a delta 367 so

954
00:33:35,190 --> 00:33:33,440
367 deltas

955
00:33:36,950 --> 00:33:35,200
delta 2's that have launched it has been

956
00:33:39,350 --> 00:33:36,960
a real workhorse not only for nasa but

957
00:33:41,350 --> 00:33:39,360
also for the air force in their gps

958
00:33:43,750 --> 00:33:41,360
constellation

959
00:33:45,190 --> 00:33:43,760
unfortunately as things happen in the

960
00:33:47,750 --> 00:33:45,200
launch business

961
00:33:50,149 --> 00:33:47,760
suppliers and parts become obsolete and

962
00:33:52,950 --> 00:33:50,159
things get shut down and that's the case

963
00:33:54,310 --> 00:33:52,960

in with delta ii is uh things are

964
00:33:57,029 --> 00:33:54,320
starting to come towards the end of the

965
00:33:59,350 --> 00:33:57,039
program uh the nice thing for nasa is we

966
00:34:02,310 --> 00:33:59,360
do have uh four missions left counting

967
00:34:03,110 --> 00:34:02,320
oco two so for us our next one is uh s

968
00:34:04,870 --> 00:34:03,120
map

969
00:34:07,750 --> 00:34:04,880
uh and don't ask me the acronym right

970
00:34:10,069 --> 00:34:07,760
off top of my head soil moisture

971
00:34:12,069 --> 00:34:10,079
yeah somebody said it there you go

972
00:34:14,710 --> 00:34:12,079
that's november 5th

973
00:34:16,790 --> 00:34:14,720
here in vandenberg also so that's really

974
00:34:19,270 --> 00:34:16,800
the reason the delta ii program is

975
00:34:22,230 --> 00:34:19,280
starting to fade off is just attrition

976
00:34:24,869 --> 00:34:22,240
and design how it goes and ula has made

977
00:34:27,510 --> 00:34:24,879
a business decision uh to move on to

978
00:34:30,389 --> 00:34:27,520
other rockets so from that case we'll be

979
00:34:33,109 --> 00:34:30,399
looking at some atlas fives some delta

980
00:34:35,349 --> 00:34:33,119
fours some other vehicles we have in our

981
00:34:37,669 --> 00:34:35,359
in our fleet uh for launch services

982
00:34:43,430 --> 00:34:37,679
program on how we would meet the needs

983
00:34:48,470 --> 00:34:46,069
hi um following on to the question about

984
00:34:50,470 --> 00:34:48,480
uh the launch decision and who actually

985
00:34:51,270 --> 00:34:50,480
gets to quote unquote press the button

986
00:34:54,790 --> 00:34:51,280
um

987
00:34:57,670 --> 00:34:54,800
is there actually a button is it red

988
00:35:01,910 --> 00:34:57,680

and can i press it there so so let me

989
00:35:06,470 --> 00:35:04,390
there is actually a button uh i will say

990
00:35:09,190 --> 00:35:06,480
that there is actually a button

991
00:35:12,310 --> 00:35:09,200
so just briefly giving you the overview

992
00:35:13,670 --> 00:35:12,320
of how the last few seconds of the count

993
00:35:17,829 --> 00:35:13,680
go

994
00:35:19,829 --> 00:35:17,839
last few minutes of the count to get

995
00:35:22,230 --> 00:35:19,839
down to that point where they press the

996
00:35:24,550 --> 00:35:22,240
button for launch colonel baltz on his

997
00:35:26,870 --> 00:35:24,560
side has a whole team that's working

998
00:35:29,030 --> 00:35:26,880
with him that he's polling and as he

999
00:35:30,870 --> 00:35:29,040
said getting ready for go tim dunn our

1000
00:35:33,109 --> 00:35:30,880
nasa launch manager has a whole team

1001
00:35:35,030 --> 00:35:33,119
including his engineering team his chief

1002
00:35:37,510 --> 00:35:35,040
engineer his management all that he's

1003
00:35:38,550 --> 00:35:37,520
pulling ula the launch director don

1004
00:35:40,390 --> 00:35:38,560
mullen

1005
00:35:42,230 --> 00:35:40,400
has a whole ula engineering team and

1006
00:35:44,230 --> 00:35:42,240
management team behind him that he is

1007
00:35:46,310 --> 00:35:44,240
polling and once all those people feed

1008
00:35:48,390 --> 00:35:46,320
in they've reviewed all the data they've

1009
00:35:52,230 --> 00:35:48,400
looked at everything and everything's go

1010
00:35:54,790 --> 00:35:52,240
for launch then colonel baltz tim and uh

1011
00:35:57,829 --> 00:35:54,800
brought facility smd give a final go to

1012
00:35:59,910 --> 00:35:57,839
the ld permission to launch and the ld

1013
00:36:02,470 --> 00:35:59,920

is the one who gets to

1014
00:36:04,790 --> 00:36:02,480
you know tell us we're going so it's

1015
00:36:06,950 --> 00:36:04,800
it's a really big team effort and those

1016
00:36:08,550 --> 00:36:06,960
last few minutes are are really exciting

1017
00:36:10,069 --> 00:36:08,560
for the team because

1018
00:36:11,750 --> 00:36:10,079
you're finishing up your last preps

1019
00:36:14,310 --> 00:36:11,760
looking at all your data making sure all

1020
00:36:16,390 --> 00:36:14,320
your systems are ready to support and uh

1021
00:36:18,630 --> 00:36:16,400
it gets really hectic there when the you

1022
00:36:20,470 --> 00:36:18,640
know you start hearing the go go go go

1023
00:36:22,630 --> 00:36:20,480
and it's that's really exciting time for

1024
00:36:23,910 --> 00:36:22,640
the launch team all around

1025
00:36:26,150 --> 00:36:23,920
did you wanna

1026
00:36:27,910 --> 00:36:26,160
i'm just gonna add uh as we get our

1027
00:36:29,510 --> 00:36:27,920
polls as we go through on each side it

1028
00:36:31,190 --> 00:36:29,520
is it is amazing to watch this team i

1029
00:36:32,390 --> 00:36:31,200
equate it to an orchestra i mean we're

1030
00:36:34,069 --> 00:36:32,400
all practicing our individual

1031
00:36:35,589 --> 00:36:34,079
instruments during a given day or given

1032
00:36:37,510 --> 00:36:35,599
set of monsters in some cases years to

1033
00:36:38,950 --> 00:36:37,520
get to launch day and to see it all come

1034
00:36:40,550 --> 00:36:38,960
together make beautiful music if you

1035
00:36:42,710 --> 00:36:40,560
will and crescendo at the same time is

1036
00:36:44,069 --> 00:36:42,720
just eye watering not just in our op

1037
00:36:45,750 --> 00:36:44,079
centers but there's other op centers i

1038
00:36:47,990 --> 00:36:45,760

mean there's young airmen out there on

1039
00:36:49,589 --> 00:36:48,000
sf security forces patrols making sure

1040
00:36:51,190 --> 00:36:49,599
the area is safe we've got young airmen

1041
00:36:53,430 --> 00:36:51,200
that are watching the area

1042
00:36:55,510 --> 00:36:53,440
for planes trains and boats as i like to

1043
00:36:57,349 --> 00:36:55,520
say we've got young airmen on council

1044
00:36:59,349 --> 00:36:57,359
along with our contractor teammates

1045
00:37:01,109 --> 00:36:59,359
along with some senior civilians and

1046
00:37:02,470 --> 00:37:01,119
junior civilian government civilians

1047
00:37:03,910 --> 00:37:02,480
that help

1048
00:37:05,190 --> 00:37:03,920
operate the equipment or at least

1049
00:37:06,950 --> 00:37:05,200
provide

1050
00:37:08,630 --> 00:37:06,960
expert engineering advice

1051
00:37:11,030 --> 00:37:08,640
and so in the end the final clear launch

1052
00:37:12,710 --> 00:37:11,040
at l minus 12 minutes comes from the

1053
00:37:14,630 --> 00:37:12,720
chief of safety my policy on public

1054
00:37:16,069 --> 00:37:14,640
safety my operations director who's

1055
00:37:17,910 --> 00:37:16,079
putting all those instrumentation making

1056
00:37:19,990 --> 00:37:17,920
sure that's good and then the launch

1057
00:37:20,829 --> 00:37:20,000
director which is a combined vote

1058
00:37:24,069 --> 00:37:20,839
from

1059
00:37:25,670 --> 00:37:24,079
nasa and ula just prior to that they all

1060
00:37:27,589 --> 00:37:25,680
get to say go i don't get to say go i

1061
00:37:29,589 --> 00:37:27,599
get to say clear to launch

1062
00:37:31,430 --> 00:37:29,599
so that's my three words uh that sets

1063
00:37:32,710 --> 00:37:31,440

things in motion for those final minutes

1064
00:37:34,950 --> 00:37:32,720
as the

1065
00:37:36,630 --> 00:37:34,960
automated countdown timers and buttons

1066
00:37:38,630 --> 00:37:36,640
if you will uh start executing at the

1067
00:37:40,310 --> 00:37:38,640
launch pad just for numbers real quick

1068
00:37:42,950 --> 00:37:40,320
40 second delta ii launch from here i

1069
00:37:45,109 --> 00:37:42,960
think it's the 50 first time nasa's

1070
00:37:47,349 --> 00:37:45,119
used a delta ii uh we have a great

1071
00:37:50,550 --> 00:37:47,359
partnership we've launched 117 things or

1072
00:37:52,870 --> 00:37:50,560
will tonight from nasa here on on the

1073
00:37:54,870 --> 00:37:52,880
western range as we like to call it so

1074
00:37:57,190 --> 00:37:54,880
this is certainly a a partnership that's

1075
00:37:59,349 --> 00:37:57,200
long lasting

1076
00:38:01,750 --> 00:37:59,359
um okay so that was totally the same

1077
00:38:02,710 --> 00:38:01,760
question i had but so i guess i might

1078
00:38:04,310 --> 00:38:02,720
say

1079
00:38:06,630 --> 00:38:04,320
no no numbers don't change yeah i guess

1080
00:38:09,270 --> 00:38:06,640
what i might i might ask is okay in a in

1081
00:38:12,550 --> 00:38:09,280
uh one or two words what's it like when

1082
00:38:14,069 --> 00:38:12,560
you get to say clear to launch launch uh

1083
00:38:15,430 --> 00:38:14,079
enormous responsibility i'll tell you

1084
00:38:16,870 --> 00:38:15,440
some launches like i hope happens

1085
00:38:18,790 --> 00:38:16,880
tonight when everything's green and

1086
00:38:20,230 --> 00:38:18,800
clean through the launch it's just fun

1087
00:38:21,349 --> 00:38:20,240
to watch to be honest with you i know

1088
00:38:23,270 --> 00:38:21,359

that there's a lot of hard work that

1089
00:38:25,670 --> 00:38:23,280
went into it there's other times that

1090
00:38:28,550 --> 00:38:25,680
it's been pretty give and take right up

1091
00:38:30,069 --> 00:38:28,560
to launch time a 30 second window is not

1092
00:38:31,349 --> 00:38:30,079
not exciting for us right that doesn't

1093
00:38:33,510 --> 00:38:31,359
give us a lot of wiggle room if we have

1094
00:38:35,030 --> 00:38:33,520
some problems with boats planes trains

1095
00:38:36,390 --> 00:38:35,040
or instrumentation

1096
00:38:38,310 --> 00:38:36,400
it's either going to happen tonight or

1097
00:38:41,430 --> 00:38:38,320
it's not some of our other launches have

1098
00:38:42,950 --> 00:38:41,440
six hour windows starting at 3am

1099
00:38:44,950 --> 00:38:42,960
and so while that gives us a lot of

1100
00:38:46,790 --> 00:38:44,960
margin throughout the night and we've

1101
00:38:48,790 --> 00:38:46,800
launched late in that window too

1102
00:38:49,990 --> 00:38:48,800
uh it can make for a long night but

1103
00:38:51,670 --> 00:38:50,000
either way we get down to launch we've

1104
00:38:52,870 --> 00:38:51,680
done been down to 16 seconds before

1105
00:38:54,550 --> 00:38:52,880
launch at least ones that i've been on

1106
00:38:55,910 --> 00:38:54,560
and we've had to abort

1107
00:38:57,670 --> 00:38:55,920
and because of a window we're able to do

1108
00:39:00,390 --> 00:38:57,680
it that night other cases we've had to

1109
00:39:02,150 --> 00:39:00,400
wait until the next day i will say about

1110
00:39:03,270 --> 00:39:02,160
45 minutes out we dim the lights in my

1111
00:39:04,950 --> 00:39:03,280
op center just to kind of get

1112
00:39:06,470 --> 00:39:04,960
everybody's head in the game and then

1113
00:39:07,990 --> 00:39:06,480

about a one minute out you'll see a

1114
00:39:09,910 --> 00:39:08,000
bunch of us stand up

1115
00:39:11,589 --> 00:39:09,920
my job is done a few minutes previous to

1116
00:39:13,430 --> 00:39:11,599
that when i give the clearance uh and

1117
00:39:14,710 --> 00:39:13,440
then we get to we get to watch it go and

1118
00:39:15,829 --> 00:39:14,720
we're inside a building so it's not as

1119
00:39:18,150 --> 00:39:15,839
much fun

1120
00:39:19,670 --> 00:39:18,160
to be as it is to be outside

1121
00:39:21,270 --> 00:39:19,680
but it's still neat to really see the

1122
00:39:24,790 --> 00:39:21,280
team come together

1123
00:39:27,589 --> 00:39:24,800
yep question hi i'm lenoir look

1124
00:39:30,310 --> 00:39:27,599
i met jim norman yesterday the director

1125
00:39:31,829 --> 00:39:30,320
launched services from washington dc

1126
00:39:35,270 --> 00:39:31,839
and he told me that it takes eight

1127
00:39:39,430 --> 00:39:35,280
minutes to go from zero to mach 22.

1128
00:39:42,870 --> 00:39:39,440
so when does that 30-second window start

1129
00:39:44,630 --> 00:39:42,880
during those eight minutes

1130
00:39:46,550 --> 00:39:44,640
so the eight minutes that jim talked

1131
00:39:49,510 --> 00:39:46,560
about is from liftoff

1132
00:39:52,150 --> 00:39:49,520
the the the time we start the engine

1133
00:39:54,390 --> 00:39:52,160
until we get to the mock all right so

1134
00:39:57,510 --> 00:39:54,400
the time actually starts right as when

1135
00:39:59,589 --> 00:39:57,520
we ignite the uh rs27 and the ground lit

1136
00:40:01,750 --> 00:39:59,599
solids that's our zero mark that's t

1137
00:40:04,309 --> 00:40:01,760
zero so from there to there's that eight

1138
00:40:07,349 --> 00:40:04,319

minute time frame and the thirty second

1139
00:40:10,470 --> 00:40:07,359
window is a time in uh time that we can

1140
00:40:12,950 --> 00:40:10,480
get oco two into its proper orbit during

1141
00:40:16,230 --> 00:40:12,960
the day today so we have to target our

1142
00:40:18,710 --> 00:40:16,240
t0 time to be within that 30 second

1143
00:40:21,270 --> 00:40:18,720
window does that make sense so we have

1144
00:40:23,349 --> 00:40:21,280
so we have a 30 second window today and

1145
00:40:25,910 --> 00:40:23,359
we have to target when as we count down

1146
00:40:28,390 --> 00:40:25,920
we have to target our ignition within

1147
00:40:31,030 --> 00:40:28,400
that 30-second window to be able to hit

1148
00:40:34,150 --> 00:40:31,040
the spot that we need to put oco-2 into

1149
00:40:36,829 --> 00:40:34,160
orbit taking into account uh all of our

1150
00:40:39,510 --> 00:40:36,839
thrust and orbital trajectory

1151
00:40:41,750 --> 00:40:39,520
trajectories and flight design

1152
00:40:43,910 --> 00:40:41,760
so the 30 second window doesn't really

1153
00:40:45,990 --> 00:40:43,920
play into that eight minutes at all that

1154
00:40:48,790 --> 00:40:46,000
eight minutes is a separate from when we

1155
00:40:50,950 --> 00:40:48,800
ignite the rocket

1156
00:40:55,109 --> 00:40:50,960
she's looking confused

1157
00:40:57,190 --> 00:40:55,119
yeah i'm usually confused

1158
00:40:58,950 --> 00:40:57,200
all right so at what point is the

1159
00:40:59,990 --> 00:40:58,960
project team going to start to relax and

1160
00:41:04,150 --> 00:41:00,000
go

1161
00:41:05,589 --> 00:41:04,160
on pins and needles all the way out to

1162
00:41:08,950 --> 00:41:05,599
two full hours till the end of the

1163
00:41:10,550 --> 00:41:08,960

second stage so i i would say um from

1164
00:41:12,150 --> 00:41:10,560
the project team perspective i would let

1165
00:41:13,750 --> 00:41:12,160
them answer that but from what i know

1166
00:41:15,349 --> 00:41:13,760
from pre past

1167
00:41:17,910 --> 00:41:15,359
missions and i would say it's no

1168
00:41:19,670 --> 00:41:17,920
different for oco two today is the

1169
00:41:21,670 --> 00:41:19,680
launch team and the project team are

1170
00:41:24,710 --> 00:41:21,680
going to relax once the solar arrays are

1171
00:41:27,109 --> 00:41:24,720
deployed and the v and the satellite is

1172
00:41:29,430 --> 00:41:27,119
uh in good health and they report back

1173
00:41:31,990 --> 00:41:29,440
that they're they're charging and and

1174
00:41:35,430 --> 00:41:32,000
getting good signal back saying and if i

1175
00:41:37,270 --> 00:41:35,440
recall that's actually um

1176
00:41:40,150 --> 00:41:37,280
about an hour right an hour after

1177
00:41:45,910 --> 00:41:40,160
liftoff so we'll we'll still be a little

1178
00:41:49,990 --> 00:41:48,309
rodney mason rod moose on twitter i have

1179
00:41:51,510 --> 00:41:50,000
two questions for you the first question

1180
00:41:53,430 --> 00:41:51,520
how do you choose the location where the

1181
00:41:55,349 --> 00:41:53,440
launch takes place

1182
00:41:57,270 --> 00:41:55,359
so that that is based on the flight

1183
00:41:59,430 --> 00:41:57,280
design and trajectory that's needed for

1184
00:42:02,710 --> 00:41:59,440
the satellite in this case it's a polar

1185
00:42:04,309 --> 00:42:02,720
orbit to get into oco2 will be the lead

1186
00:42:06,630 --> 00:42:04,319
satellite in the a train or the

1187
00:42:08,470 --> 00:42:06,640
afternoon train which is a number of

1188
00:42:10,870 --> 00:42:08,480

satellites orbiting the earth for earth

1189
00:42:12,950 --> 00:42:10,880
sciences so to get it into that spot we

1190
00:42:14,069 --> 00:42:12,960
actually require a polar orbit to get

1191
00:42:15,990 --> 00:42:14,079
there so

1192
00:42:19,750 --> 00:42:16,000
we choose vandenberg air force station

1193
00:42:21,510 --> 00:42:19,760
for that inclination and uh polar orbit

1194
00:42:22,630 --> 00:42:21,520
great second question

1195
00:42:23,750 --> 00:42:22,640
yeah let me just follow up because i

1196
00:42:25,190 --> 00:42:23,760
think it's important you're all familiar

1197
00:42:26,870 --> 00:42:25,200
with cape canaveral and not to get into

1198
00:42:27,910 --> 00:42:26,880
physics and normal dynamics but when

1199
00:42:29,670 --> 00:42:27,920
you're trying to put a satellite that

1200
00:42:31,430 --> 00:42:29,680
goes around the equator like directv and

1201
00:42:33,030 --> 00:42:31,440
communication satellites you want to be

1202
00:42:34,309 --> 00:42:33,040
close to the equator and you want to

1203
00:42:36,230 --> 00:42:34,319
face east to take advantage of the

1204
00:42:37,750 --> 00:42:36,240
earth's rotation hence cape canaveral

1205
00:42:39,589 --> 00:42:37,760
down and down in florida right it's

1206
00:42:41,430 --> 00:42:39,599
pretty far south that we can get in the

1207
00:42:43,349 --> 00:42:41,440
conus in the united states and then they

1208
00:42:45,270 --> 00:42:43,359
can face east over that ocean so they

1209
00:42:46,790 --> 00:42:45,280
don't put anybody in harm's way when you

1210
00:42:48,230 --> 00:42:46,800
want to go into north-south orbit

1211
00:42:49,990 --> 00:42:48,240
meaning around the poles or as we call

1212
00:42:51,349 --> 00:42:50,000
polar orbits you want to launch north

1213
00:42:52,950 --> 00:42:51,359

and south and i mentioned this briefly

1214
00:42:55,430 --> 00:42:52,960
up front there's not many places if you

1215
00:42:56,870 --> 00:42:55,440
look at the geography of the u.s that

1216
00:42:58,950 --> 00:42:56,880
you can launch north or south without

1217
00:43:01,109 --> 00:42:58,960
overflying other land masses either us

1218
00:43:03,190 --> 00:43:01,119
property or even our countries to our

1219
00:43:04,630 --> 00:43:03,200
south or canada to the north and so this

1220
00:43:07,109 --> 00:43:04,640
little elbow of california why

1221
00:43:09,589 --> 00:43:07,119
vandenberg exists and why we'll be here

1222
00:43:11,990 --> 00:43:09,599
is that we can launch due south as santa

1223
00:43:14,630 --> 00:43:12,000
barbara and los angeles fade away to the

1224
00:43:16,470 --> 00:43:14,640
to the east and do that safely

1225
00:43:17,670 --> 00:43:16,480
without uh without putting anybody else

1226
00:43:18,710 --> 00:43:17,680
in harm's way

1227
00:43:19,589 --> 00:43:18,720
that's the physics lesson for the day

1228
00:43:21,190 --> 00:43:19,599
that's all you're going to get so there

1229
00:43:23,109 --> 00:43:21,200
we go yeah no that's an excellent answer

1230
00:43:25,510 --> 00:43:23,119
and i never knew that so i appreciate it

1231
00:43:27,510 --> 00:43:25,520
second question i have the first oco

1232
00:43:29,910 --> 00:43:27,520
launch there were complications can you

1233
00:43:31,829 --> 00:43:29,920
speak to that just briefly and what

1234
00:43:32,710 --> 00:43:31,839
precautions or measures are taking place

1235
00:43:35,030 --> 00:43:32,720
so that

1236
00:43:36,710 --> 00:43:35,040
this is a successful launch so briefly

1237
00:43:39,270 --> 00:43:36,720
i'll just tell you i think it's most

1238
00:43:41,430 --> 00:43:39,280

people know the original oco launch

1239
00:43:43,829 --> 00:43:41,440
did not make orbit due to a payload

1240
00:43:44,790 --> 00:43:43,839
fairing not separating that's what

1241
00:43:46,150 --> 00:43:44,800
occurred

1242
00:43:48,630 --> 00:43:46,160
precautions and things that have been

1243
00:43:50,630 --> 00:43:48,640
taken taken since then is of course

1244
00:43:52,390 --> 00:43:50,640
we're on a delta ii vehicle which is a

1245
00:43:54,150 --> 00:43:52,400
completely different fairing system

1246
00:43:56,390 --> 00:43:54,160
completely different sep system and

1247
00:43:58,550 --> 00:43:56,400
everything so again as i stated before

1248
00:44:00,790 --> 00:43:58,560
delta ii has been a workhorse for us in

1249
00:44:03,349 --> 00:44:00,800
the launch services program we're very

1250
00:44:05,190 --> 00:44:03,359
confident in the delta ii vehicle and

1251
00:44:07,670 --> 00:44:05,200
and all of its systems and and we're

1252
00:44:09,910 --> 00:44:07,680
very familiar with this vehicle and

1253
00:44:12,630 --> 00:44:09,920
we've done a lot of work to get to this

1254
00:44:13,829 --> 00:44:12,640
point and and be ready to go for launch

1255
00:44:15,510 --> 00:44:13,839
this evening

1256
00:44:17,109 --> 00:44:15,520
i i will tell you as colonel was saying

1257
00:44:18,790 --> 00:44:17,119
earlier about being on console the

1258
00:44:20,309 --> 00:44:18,800
gentleman's question over here for me

1259
00:44:21,750 --> 00:44:20,319
this is a special one because i was also

1260
00:44:24,870 --> 00:44:21,760
the vehicle systems engineer for the

1261
00:44:26,950 --> 00:44:24,880
prior oco launch and so for me it'll be

1262
00:44:29,990 --> 00:44:26,960
a little emotional this evening when i

1263
00:44:32,470 --> 00:44:30,000

give my go to my chief engineer

1264
00:44:34,470 --> 00:44:32,480
not only from that aspect but again very

1265
00:44:36,950 --> 00:44:34,480
proud to be back launching delta 2s here

1266
00:44:38,390 --> 00:44:36,960
on the west coast so tonight might be a

1267
00:44:40,069 --> 00:44:38,400
little more emotional than an engineer

1268
00:44:44,230 --> 00:44:40,079
is used to so

1269
00:44:48,550 --> 00:44:45,510
hi um

1270
00:44:50,630 --> 00:44:48,560
so like every other photographer here my

1271
00:44:53,190 --> 00:44:50,640
followers are are looking for visual

1272
00:44:54,950 --> 00:44:53,200
impact and so when i hear about

1273
00:44:56,550 --> 00:44:54,960
the fog conditions we're anticipating

1274
00:44:58,790 --> 00:44:56,560
the first question that comes to mind is

1275
00:45:01,670 --> 00:44:58,800
do our weather models give us

1276
00:45:03,190 --> 00:45:01,680
uh any insights as far as where the top

1277
00:45:05,589 --> 00:45:03,200
of the fog layer might be or there

1278
00:45:07,430 --> 00:45:05,599
vantage spots i can choose as a backup

1279
00:45:08,950 --> 00:45:07,440
to shoot from above the fog

1280
00:45:10,470 --> 00:45:08,960
even further away no that's great i have

1281
00:45:12,550 --> 00:45:10,480
to go i have to go down and chase that

1282
00:45:14,630 --> 00:45:12,560
information i know uh fog layers vary

1283
00:45:15,910 --> 00:45:14,640
it's one to two mile visibility for at

1284
00:45:17,349 --> 00:45:15,920
the surface

1285
00:45:19,190 --> 00:45:17,359
there are some places around here though

1286
00:45:21,190 --> 00:45:19,200
that get you some elevation

1287
00:45:22,790 --> 00:45:21,200
to see so uh picking a spot may be

1288
00:45:24,630 --> 00:45:22,800

beneficial but i'm not sure what the

1289
00:45:26,230 --> 00:45:24,640
cloud tops are

1290
00:45:28,390 --> 00:45:26,240
yeah 900

1291
00:45:30,710 --> 00:45:28,400
go ahead you got it about not about nine

1292
00:45:32,550 --> 00:45:30,720
no no not weatherman about 900 feet is

1293
00:45:34,790 --> 00:45:32,560
what the colonel's airmen told us at our

1294
00:45:36,870 --> 00:45:34,800
launch briefing this morning

1295
00:45:37,589 --> 00:45:36,880
all right thank you good uh

1296
00:46:09,670 --> 00:45:37,599
a

1297
00:46:11,750 --> 00:46:09,680
in

1298
00:46:13,750 --> 00:46:11,760
as my nasa launch manager would very

1299
00:46:15,990 --> 00:46:13,760
much appreciate

1300
00:46:17,430 --> 00:46:16,000
probably three holes to the right you

1301
00:46:18,470 --> 00:46:17,440
want to hit your putt

1302
00:46:24,230 --> 00:46:18,480
so

1303
00:46:25,750 --> 00:46:24,240
probably is where you'll you'll see it

1304
00:46:28,069 --> 00:46:25,760
unfortunately we don't have any more

1305
00:46:30,069 --> 00:46:28,079
time for any additional questions but if

1306
00:46:31,510 --> 00:46:30,079
you guys can stick around uh afterward i

1307
00:46:32,710 --> 00:46:31,520
think we have like 30 minutes though

1308
00:46:34,309 --> 00:46:32,720
those in the audience have additional

1309
00:46:36,710 --> 00:46:34,319
questions they'd be happy to answer for

1310
00:46:38,630 --> 00:46:36,720
you i'm assuming we'd love to great

1311
00:46:46,950 --> 00:46:38,640
thank you thank you colonel

1312
00:46:50,150 --> 00:46:48,230
next we're going to talk a little bit

1313
00:46:52,710 --> 00:46:50,160

about uh the engineering that went

1314
00:46:55,030 --> 00:46:52,720
behind oc02 let me introduce our next

1315
00:46:57,589 --> 00:46:55,040
speakers we have randy pollock who is

1316
00:47:00,069 --> 00:46:57,599
the project architect with oco2 and

1317
00:47:13,349 --> 00:47:00,079
pavani padata who is the verification

1318
00:47:17,109 --> 00:47:15,750
so good morning everyone um

1319
00:47:17,990 --> 00:47:17,119
am i on

1320
00:47:20,710 --> 00:47:18,000
okay

1321
00:47:23,030 --> 00:47:20,720
uh my name is randy i

1322
00:47:24,390 --> 00:47:23,040
am the project architect as my latest

1323
00:47:26,790 --> 00:47:24,400
title but i've been involved in this

1324
00:47:28,549 --> 00:47:26,800
project for 13 and a half years helped

1325
00:47:30,150 --> 00:47:28,559
write the original proposal

1326
00:47:33,990 --> 00:47:30,160
and i think i had the best job on the

1327
00:47:37,430 --> 00:47:35,750
i have worked on the instrument i work

1328
00:47:39,589 --> 00:47:37,440
with the science team

1329
00:47:42,069 --> 00:47:39,599
i get to lead tests

1330
00:47:43,670 --> 00:47:42,079
i've been working operations lately

1331
00:47:45,109 --> 00:47:43,680
so i've gotten to do a little bit of

1332
00:47:47,349 --> 00:47:45,119
everything on this mission and really

1333
00:47:49,270 --> 00:47:47,359
enjoyed it

1334
00:47:50,390 --> 00:47:49,280
my personal milestone going back 13 and

1335
00:47:52,549 --> 00:47:50,400
a half years

1336
00:47:54,069 --> 00:47:52,559
is when i started on this job my son was

1337
00:47:56,470 --> 00:47:54,079
in kindergarten

1338
00:47:58,309 --> 00:47:56,480

he's an intern at jpl this summer so

1339
00:47:59,349 --> 00:47:58,319
it's been a few years working on this

1340
00:48:00,470 --> 00:47:59,359
job

1341
00:48:04,309 --> 00:48:00,480
um

1342
00:48:06,390 --> 00:48:04,319
uh we are measuring

1343
00:48:09,349 --> 00:48:06,400
three absorption lines

1344
00:48:11,510 --> 00:48:09,359
one of oxygen and two of co2 in the near

1345
00:48:13,670 --> 00:48:11,520
infrared so just out past where your eye

1346
00:48:15,190 --> 00:48:13,680
responds to red light

1347
00:48:18,630 --> 00:48:15,200
um

1348
00:48:21,349 --> 00:48:18,640
were to look at a diagram and there are

1349
00:48:22,470 --> 00:48:21,359
plenty of papers out there you'll see

1350
00:48:23,589 --> 00:48:22,480
an instrument that wouldn't have been

1351
00:48:25,589 --> 00:48:23,599
out of place

1352
00:48:26,790 --> 00:48:25,599
in an optics textbook textbook in the

1353
00:48:28,549 --> 00:48:26,800
1800s

1354
00:48:30,470 --> 00:48:28,559
it is a very simple instrument in

1355
00:48:32,390 --> 00:48:30,480
principle but to make a measurement

1356
00:48:34,630 --> 00:48:32,400
that's good to a part per million on

1357
00:48:37,510 --> 00:48:34,640
carbon dioxide it had to be one of the

1358
00:48:39,109 --> 00:48:37,520
best instruments like it ever built

1359
00:48:39,990 --> 00:48:39,119
we have plenty of things

1360
00:48:42,150 --> 00:48:40,000
where

1361
00:48:44,710 --> 00:48:42,160
our tolerances are measured in a few

1362
00:48:45,910 --> 00:48:44,720
microns the focus of this instrument has

1363
00:48:47,750 --> 00:48:45,920

to be known

1364
00:48:50,470 --> 00:48:47,760
to a couple of microns you know a few

1365
00:48:52,549 --> 00:48:50,480
percent of the thickness of a human hair

1366
00:48:54,069 --> 00:48:52,559
and that has when we measured it on the

1367
00:48:55,430 --> 00:48:54,079
ground

1368
00:48:56,710 --> 00:48:55,440
we have to be sure that that's going to

1369
00:48:57,910 --> 00:48:56,720
still be the same when we get up into

1370
00:48:59,910 --> 00:48:57,920
space

1371
00:49:01,349 --> 00:48:59,920
and so pavani will talk a little bit

1372
00:49:02,950 --> 00:49:01,359
later about the test program to make

1373
00:49:04,470 --> 00:49:02,960
sure that that happened

1374
00:49:05,910 --> 00:49:04,480
and that then we can trust that when we

1375
00:49:07,829 --> 00:49:05,920
get up there it's going to

1376
00:49:08,790 --> 00:49:07,839
work well

1377
00:49:10,069 --> 00:49:08,800
it's

1378
00:49:12,710 --> 00:49:10,079
the part per million that we're trying

1379
00:49:14,230 --> 00:49:12,720
to measure carbon dioxide

1380
00:49:16,150 --> 00:49:14,240
when it comes down to those engineering

1381
00:49:17,670 --> 00:49:16,160
requirements you know some of them are

1382
00:49:19,750 --> 00:49:17,680
are kind of easy we only need to know

1383
00:49:21,670 --> 00:49:19,760
how bright the lights are you know

1384
00:49:23,109 --> 00:49:21,680
you know if we see a signal we don't

1385
00:49:25,109 --> 00:49:23,119
know how bright that signal is to just a

1386
00:49:26,630 --> 00:49:25,119
couple of percent which doesn't sound

1387
00:49:28,470 --> 00:49:26,640
like it's that hard

1388
00:49:30,870 --> 00:49:28,480

but for each point on the ground we

1389
00:49:32,150 --> 00:49:30,880
measure 3000 separate colors

1390
00:49:33,589 --> 00:49:32,160
and if we make a mistake on one of them

1391
00:49:35,270 --> 00:49:33,599
we have to make the same mistake to a

1392
00:49:37,109 --> 00:49:35,280
fraction of a fraction of a fraction of

1393
00:49:39,109 --> 00:49:37,119
percent on all of them so all three

1394
00:49:40,390 --> 00:49:39,119
thousand can be wrong but all three

1395
00:49:42,150 --> 00:49:40,400
thousand of them have to be wrong

1396
00:49:43,910 --> 00:49:42,160
precisely together

1397
00:49:45,190 --> 00:49:43,920
to a factor of about four orders of

1398
00:49:47,030 --> 00:49:45,200
magnitude

1399
00:49:49,430 --> 00:49:47,040
we have to measure the color

1400
00:49:51,190 --> 00:49:49,440
to under one part per million know the

1401
00:49:52,870 --> 00:49:51,200
center wavelength response of each of

1402
00:49:54,069 --> 00:49:52,880
those three thousand colors

1403
00:49:56,069 --> 00:49:54,079
so it's

1404
00:49:58,710 --> 00:49:56,079
it's an instrument that is not so much

1405
00:49:59,990 --> 00:49:58,720
about the uniqueness and the high

1406
00:50:02,150 --> 00:50:00,000
technology

1407
00:50:04,109 --> 00:50:02,160
that so much of what nasa does is about

1408
00:50:07,990 --> 00:50:04,119
it's about just doing something

1409
00:50:09,589 --> 00:50:08,000
unbelievably precisely and accurately

1410
00:50:11,109 --> 00:50:09,599
so it's been quite a challenge to get it

1411
00:50:12,390 --> 00:50:11,119
put together

1412
00:50:15,430 --> 00:50:12,400
there were some questions earlier about

1413
00:50:16,309 --> 00:50:15,440

what we did differently on oc02

1414
00:50:18,549 --> 00:50:16,319
so

1415
00:50:22,549 --> 00:50:18,559
osiyo when i started on it

1416
00:50:24,230 --> 00:50:22,559
launch was december 2005.

1417
00:50:25,270 --> 00:50:24,240
and i was so excited about working on a

1418
00:50:26,950 --> 00:50:25,280
mission that was going to be over

1419
00:50:27,990 --> 00:50:26,960
quickly it's going to be great we're

1420
00:50:29,190 --> 00:50:28,000
going to get it put together we're going

1421
00:50:31,109 --> 00:50:29,200
to get a test we're going to get it up

1422
00:50:32,710 --> 00:50:31,119
there we're going to get data and as

1423
00:50:34,069 --> 00:50:32,720
often happens on these sorts of programs

1424
00:50:35,109 --> 00:50:34,079
nasa called us

1425
00:50:36,630 --> 00:50:35,119
after we went through about a year and a

1426
00:50:38,069 --> 00:50:36,640
half proposal process where they were

1427
00:50:39,510 --> 00:50:38,079
reviewing whether they really thought we

1428
00:50:41,990 --> 00:50:39,520
could do it and they said

1429
00:50:43,510 --> 00:50:42,000
congratulations you've been selected

1430
00:50:45,349 --> 00:50:43,520
don't quit your day job

1431
00:50:47,030 --> 00:50:45,359
uh we had about a year before we really

1432
00:50:48,390 --> 00:50:47,040
got money going and then there were

1433
00:50:50,309 --> 00:50:48,400
other issues as we went along that

1434
00:50:51,829 --> 00:50:50,319
stretched the launch out a couple more

1435
00:50:53,510 --> 00:50:51,839
years until we were all of a sudden in

1436
00:50:56,069 --> 00:50:53,520
early 2009

1437
00:50:58,630 --> 00:50:56,079
and then as all of you know by now the

1438
00:51:00,549 --> 00:50:58,640

rocket did not get us into orbit

1439
00:51:01,750 --> 00:51:00,559
and so we spent about another year

1440
00:51:03,829 --> 00:51:01,760
putting together what it would take to

1441
00:51:05,510 --> 00:51:03,839
build another one uh the original

1442
00:51:07,510 --> 00:51:05,520
mission we tried to do very cheaply so

1443
00:51:08,630 --> 00:51:07,520
we had no spare parts to speak of so we

1444
00:51:10,549 --> 00:51:08,640
had to go out and call all the

1445
00:51:12,710 --> 00:51:10,559
manufacturers find the ones that were

1446
00:51:14,790 --> 00:51:12,720
still in business in a few cases

1447
00:51:15,990 --> 00:51:14,800
and if they weren't uh

1448
00:51:17,510 --> 00:51:16,000
find somebody else who could build the

1449
00:51:20,470 --> 00:51:17,520
parts and so it was a little bit of a

1450
00:51:21,829 --> 00:51:20,480
challenge the goal was to

1451
00:51:23,349 --> 00:51:21,839
not change anything because we were

1452
00:51:25,270 --> 00:51:23,359
trying to do it quickly

1453
00:51:27,910 --> 00:51:25,280
um but because

1454
00:51:29,510 --> 00:51:27,920
the second the next mission that was on

1455
00:51:31,270 --> 00:51:29,520
the same rocket oco was on had the

1456
00:51:33,109 --> 00:51:31,280
similar failure nasa made the decision

1457
00:51:34,309 --> 00:51:33,119
to move us to the delta ii what was

1458
00:51:36,390 --> 00:51:34,319
supposed to be about two and a half or

1459
00:51:37,670 --> 00:51:36,400
three years has now turned into five

1460
00:51:40,150 --> 00:51:37,680
so

1461
00:51:41,430 --> 00:51:40,160
it's been a while a couple of other

1462
00:51:42,710 --> 00:51:41,440
things

1463
00:51:45,190 --> 00:51:42,720

there was a little bit of discussion

1464
00:51:47,190 --> 00:51:45,200
about early in the mission i thought i'd

1465
00:51:48,870 --> 00:51:47,200
add a little more detail

1466
00:51:50,790 --> 00:51:48,880
right after launch

1467
00:51:52,230 --> 00:51:50,800
we have about an hour where we're still

1468
00:51:53,990 --> 00:51:52,240
attached to the rocket

1469
00:51:56,870 --> 00:51:54,000
at that point we'll come off somewhere

1470
00:51:58,790 --> 00:51:56,880
over the coast of uh africa

1471
00:52:00,150 --> 00:51:58,800
and a few minutes later the solar panel

1472
00:52:01,910 --> 00:52:00,160
should be released which is a big deal

1473
00:52:03,670 --> 00:52:01,920
for us our battery

1474
00:52:05,109 --> 00:52:03,680
is we're running on battery that first

1475
00:52:06,870 --> 00:52:05,119
hour and we need those solar powers out

1476
00:52:09,030 --> 00:52:06,880
to start collecting charge

1477
00:52:10,470 --> 00:52:09,040
um but that's just the first step it's

1478
00:52:11,910 --> 00:52:10,480
going to take about a week to check out

1479
00:52:14,309 --> 00:52:11,920
the engineering systems on the

1480
00:52:16,549 --> 00:52:14,319
spacecraft uh we're going into a

1481
00:52:18,309 --> 00:52:16,559
formation with several other spacecraft

1482
00:52:19,990 --> 00:52:18,319
and so until we're until we've shown

1483
00:52:22,470 --> 00:52:20,000
that the spacecraft works we're going to

1484
00:52:24,790 --> 00:52:22,480
launch about 15 kilometers below

1485
00:52:26,470 --> 00:52:24,800
all of the spacecraft we want to be with

1486
00:52:28,710 --> 00:52:26,480
so that first week is checking out the

1487
00:52:30,710 --> 00:52:28,720
spacecraft works and then we have to

1488
00:52:31,990 --> 00:52:30,720

essentially merge with traffic and

1489
00:52:34,150 --> 00:52:32,000
you're merging with traffic that's going

1490
00:52:36,150 --> 00:52:34,160
17 000 miles an hour

1491
00:52:37,430 --> 00:52:36,160
so it takes a little while and it takes

1492
00:52:40,470 --> 00:52:37,440
a lot of precision so that's going to be

1493
00:52:42,630 --> 00:52:40,480
a few weeks of very gentle nudges with

1494
00:52:43,670 --> 00:52:42,640
our thrusters to get us up into that

1495
00:52:45,270 --> 00:52:43,680
position

1496
00:52:46,790 --> 00:52:45,280
and then it'll be a couple more weeks of

1497
00:52:48,790 --> 00:52:46,800
checking out the instrument and starting

1498
00:52:52,069 --> 00:52:48,800
to see the first science data so we'll

1499
00:52:53,990 --> 00:52:52,079
probably be releasing the first

1500
00:52:56,950 --> 00:52:54,000
the first

1501
00:52:59,510 --> 00:52:56,960
images images the wrong word spectra the

1502
00:53:01,109 --> 00:52:59,520
first data a few weeks out from that as

1503
00:53:03,270 --> 00:53:01,119
a press conference so probably september

1504
00:53:05,190 --> 00:53:03,280
october will be our first light

1505
00:53:06,230 --> 00:53:05,200
equivalent and then over the next

1506
00:53:07,829 --> 00:53:06,240
several months there will be more and

1507
00:53:10,390 --> 00:53:07,839
more data coming out that shows more and

1508
00:53:11,910 --> 00:53:10,400
more of the scientific results leading

1509
00:53:13,750 --> 00:53:11,920
up to what ken was talking about late

1510
00:53:16,069 --> 00:53:13,760
this year of getting the first real

1511
00:53:18,470 --> 00:53:16,079
detailed co2 measurements out and with

1512
00:53:20,069 --> 00:53:18,480
that i'll hand it off to pawnee

1513
00:53:21,030 --> 00:53:20,079

good morning it's nice to see everyone

1514
00:53:24,150 --> 00:53:21,040
out here

1515
00:53:26,230 --> 00:53:24,160
um just a few highlights or key things

1516
00:53:28,790 --> 00:53:26,240
about i started this project not 13

1517
00:53:31,109 --> 00:53:28,800
years ago more like four years ago

1518
00:53:33,670 --> 00:53:31,119
or 2010 of august and it's been an

1519
00:53:36,630 --> 00:53:33,680
amazing ride working with some really

1520
00:53:38,470 --> 00:53:36,640
great engineers and talent

1521
00:53:41,190 --> 00:53:38,480
you know everyone thinks it's easy to

1522
00:53:42,630 --> 00:53:41,200
build instruments or to you know come up

1523
00:53:44,710 --> 00:53:42,640
with ideas

1524
00:53:47,670 --> 00:53:44,720
it's not it's pretty tough and

1525
00:53:49,750 --> 00:53:47,680
challenging and the people who've put in

1526
00:53:53,349 --> 00:53:49,760
hundreds of hours of work have really

1527
00:53:55,510 --> 00:53:53,359
given it their all and uh besides randy

1528
00:53:57,990 --> 00:53:55,520
i mean ev the entire team is looking

1529
00:54:00,390 --> 00:53:58,000
forward to seeing the success of oco2

1530
00:54:01,829 --> 00:54:00,400
tonight so there's a lot of excitement

1531
00:54:03,990 --> 00:54:01,839
and nervousness

1532
00:54:05,510 --> 00:54:04,000
right now

1533
00:54:07,670 --> 00:54:05,520
like i said

1534
00:54:10,470 --> 00:54:07,680
i've been on oco2 for four years i'm the

1535
00:54:12,790 --> 00:54:10,480
project verification and validation lead

1536
00:54:14,950 --> 00:54:12,800
what that means is effectively i have to

1537
00:54:16,710 --> 00:54:14,960
take a look at all the requirements that

1538
00:54:18,309 --> 00:54:16,720

are needed to make sure that we have the

1539
00:54:20,790 --> 00:54:18,319
right instrument we have the right

1540
00:54:22,790 --> 00:54:20,800
interfaces to our spacecraft our launch

1541
00:54:24,390 --> 00:54:22,800
vehicle and

1542
00:54:25,829 --> 00:54:24,400
confirm that we're doing the right thing

1543
00:54:27,510 --> 00:54:25,839
we're building the right instrument

1544
00:54:29,510 --> 00:54:27,520
we're not just you know

1545
00:54:32,390 --> 00:54:29,520
building something and not know how it

1546
00:54:34,309 --> 00:54:32,400
interacts or how we actually verify our

1547
00:54:36,230 --> 00:54:34,319
level one science requirement

1548
00:54:38,789 --> 00:54:36,240
the final goal is to make sure we can

1549
00:54:41,190 --> 00:54:38,799
actually produce the science that we've

1550
00:54:43,589 --> 00:54:41,200
signed up to do so there's a lot of work

1551
00:54:45,510 --> 00:54:43,599
that goes into it that is the testing we

1552
00:54:48,150 --> 00:54:45,520
have such a comprehensive testing

1553
00:54:50,150 --> 00:54:48,160
program that are put together and that

1554
00:54:53,109 --> 00:54:50,160
are done at various levels at the

1555
00:54:55,990 --> 00:54:53,119
component level a subsystem level

1556
00:54:56,870 --> 00:54:56,000
instrument level spacecraft team has its

1557
00:54:58,870 --> 00:54:56,880
own

1558
00:55:01,349 --> 00:54:58,880
set of comprehensive tests that are

1559
00:55:03,270 --> 00:55:01,359
performed and then and finally the

1560
00:55:05,589 --> 00:55:03,280
observatory testing which is when when

1561
00:55:07,270 --> 00:55:05,599
we integrate both the instrument and the

1562
00:55:09,109 --> 00:55:07,280
spacecraft together

1563
00:55:11,510 --> 00:55:09,119

some of the key testing that you'll see

1564
00:55:13,510 --> 00:55:11,520
or i don't know if you've heard of is

1565
00:55:14,390 --> 00:55:13,520
thermal vacuum testing what this is to

1566
00:55:16,630 --> 00:55:14,400
mimic

1567
00:55:19,349 --> 00:55:16,640
uh space environment to see how our

1568
00:55:21,109 --> 00:55:19,359
instrument performs uh to the diff to

1569
00:55:22,870 --> 00:55:21,119
the different temperatures what happens

1570
00:55:24,870 --> 00:55:22,880
do we have any failures

1571
00:55:27,109 --> 00:55:24,880
do we understand our thermal profile in

1572
00:55:28,630 --> 00:55:27,119
our system and how do we deal with if we

1573
00:55:30,230 --> 00:55:28,640
see a problem come up how do we deal

1574
00:55:31,750 --> 00:55:30,240
with it um so there's a lot of

1575
00:55:41,670 --> 00:55:31,760
baselining happening

1576
00:55:46,150 --> 00:55:44,150
we have redundant systems

1577
00:55:48,789 --> 00:55:46,160
yes well i know co2

1578
00:55:50,150 --> 00:55:48,799
not so much um it's a single string

1579
00:55:51,670 --> 00:55:50,160
instrument so

1580
00:55:53,510 --> 00:55:51,680
uh

1581
00:55:55,910 --> 00:55:53,520
one of the key aspects is we do

1582
00:55:58,390 --> 00:55:55,920
something called uh

1583
00:55:59,829 --> 00:55:58,400
a vibe test and the vibe test is really

1584
00:56:01,750 --> 00:55:59,839
important there's two sets we do one at

1585
00:56:03,829 --> 00:56:01,760
the instrument level and then once we're

1586
00:56:06,150 --> 00:56:03,839
integrated to the spacecraft

1587
00:56:08,470 --> 00:56:06,160
we have some test equipment that we're

1588
00:56:10,470 --> 00:56:08,480

integrated with for the launch vehicle

1589
00:56:13,430 --> 00:56:10,480
and this is to mimic launch loads which

1590
00:56:15,349 --> 00:56:13,440
is really important the observatory in

1591
00:56:17,750 --> 00:56:15,359
its entirety will see the toughest

1592
00:56:20,069 --> 00:56:17,760
launch loads when we launch tonight and

1593
00:56:23,589 --> 00:56:20,079
if it can survive that can get through

1594
00:56:25,270 --> 00:56:23,599
anything so it's really really important

1595
00:56:27,510 --> 00:56:25,280
for a test program to be very

1596
00:56:29,670 --> 00:56:27,520
comprehensive and a lot of that is not

1597
00:56:31,829 --> 00:56:29,680
just testing we actually have a really

1598
00:56:33,670 --> 00:56:31,839
good analysis to base this off of we

1599
00:56:35,750 --> 00:56:33,680
have to start off with analysis before

1600
00:56:38,150 --> 00:56:35,760
we can even have predictions saying okay

1601
00:56:40,710 --> 00:56:38,160
these are our predictions and we map it

1602
00:56:42,710 --> 00:56:40,720
and we correlate it so the final report

1603
00:56:44,710 --> 00:56:42,720
that we receive is not just your

1604
00:56:46,710 --> 00:56:44,720
analysis and the test data we have

1605
00:56:49,030 --> 00:56:46,720
engineers correlating all of this to

1606
00:56:50,470 --> 00:56:49,040
make sure that it's correct and we're

1607
00:56:52,309 --> 00:56:50,480
within our margins

1608
00:56:53,829 --> 00:56:52,319
if something is off well we need to go

1609
00:56:55,670 --> 00:56:53,839
back and look and see you know what's

1610
00:56:56,630 --> 00:56:55,680
happened

1611
00:56:59,670 --> 00:56:56,640
so

1612
00:57:01,349 --> 00:56:59,680
overall the oco2 program

1613
00:57:03,510 --> 00:57:01,359

there's a lot of testing that's happened

1614
00:57:06,710 --> 00:57:03,520
over the number of years and it's been

1615
00:57:08,710 --> 00:57:06,720
refined requirements have been looked at

1616
00:57:10,789 --> 00:57:08,720
and looked at more closely and working

1617
00:57:12,630 --> 00:57:10,799
with randy

1618
00:57:14,150 --> 00:57:12,640
there's been a lot of back and forth i

1619
00:57:16,150 --> 00:57:14,160
think so

1620
00:57:18,950 --> 00:57:16,160
um well we're looking forward to

1621
00:57:21,829 --> 00:57:20,549
thank you we now have some time to take

1622
00:57:23,829 --> 00:57:21,839
some questions let's start right here in

1623
00:57:26,950 --> 00:57:23,839
the back room

1624
00:57:28,390 --> 00:57:26,960
hi um i said before i'm cat kat robison

1625
00:57:30,470 --> 00:57:28,400
but i also work with a website geek

1626
00:57:32,470 --> 00:57:30,480
girls night out one thing that we love

1627
00:57:34,309 --> 00:57:32,480
about nasa is women are so well

1628
00:57:36,150 --> 00:57:34,319
represented here so i wonder if you

1629
00:57:37,910 --> 00:57:36,160
would just take a minute and talk a

1630
00:57:39,910 --> 00:57:37,920
little bit about your journey how you

1631
00:57:41,190 --> 00:57:39,920
got into what you're doing something

1632
00:57:43,829 --> 00:57:41,200
like that just because it's very

1633
00:57:45,589 --> 00:57:43,839
encouraging you know for not only

1634
00:57:47,750 --> 00:57:45,599
someone my age but for young women to

1635
00:57:49,750 --> 00:57:47,760
have to see women doing well in

1636
00:57:52,789 --> 00:57:49,760
engineering fields so

1637
00:57:55,430 --> 00:57:52,799
it's funny because i was 16 years old

1638
00:57:57,589 --> 00:57:55,440

i came to jpl for an open house uh at

1639
00:57:59,750 --> 00:57:57,599
that time with a with a friend or a

1640
00:58:02,150 --> 00:57:59,760
neighbor and that's when i knew i was

1641
00:58:04,470 --> 00:58:02,160
coming back so i graduated high school

1642
00:58:07,190 --> 00:58:04,480
19 at 19 i got my first internship at

1643
00:58:09,030 --> 00:58:07,200
jpl and end of this year december will

1644
00:58:10,630 --> 00:58:09,040
be 20 years since i've been there

1645
00:58:12,390 --> 00:58:10,640
so for me

1646
00:58:15,109 --> 00:58:12,400
i knew i was coming back there was no

1647
00:58:17,109 --> 00:58:15,119
doubt about it i love what i do

1648
00:58:19,750 --> 00:58:17,119
there's good days there's bad days but

1649
00:58:22,390 --> 00:58:19,760
it has always been an amazing journey

1650
00:58:24,069 --> 00:58:22,400
as a hardware engineer i love tinkering

1651
00:58:26,549 --> 00:58:24,079
with stuff so

1652
00:58:28,630 --> 00:58:26,559
if there are you know kids out there

1653
00:58:30,950 --> 00:58:28,640
little girls boys it doesn't matter if

1654
00:58:33,349 --> 00:58:30,960
you enjoy doing something go after it it

1655
00:58:36,470 --> 00:58:33,359
is so much fun um

1656
00:58:38,950 --> 00:58:36,480
space especially working at jpl for me

1657
00:58:41,510 --> 00:58:38,960
it's all about you know we're doing

1658
00:58:43,670 --> 00:58:41,520
unique things science in a way that we

1659
00:58:45,990 --> 00:58:43,680
haven't seen before it's one of a kind

1660
00:58:48,150 --> 00:58:46,000
it's not your everyday thing so i

1661
00:58:50,150 --> 00:58:48,160
definitely encourage you know young

1662
00:58:52,710 --> 00:58:50,160
people out there to go after it when

1663
00:58:55,510 --> 00:58:52,720

you're in college go after internships

1664
00:58:57,270 --> 00:58:55,520
don't waste your summer go get in there

1665
00:58:59,190 --> 00:58:57,280
do hands-on stuff even if you're in high

1666
00:59:01,750 --> 00:58:59,200
school if you can get an opportunity go

1667
00:59:03,910 --> 00:59:01,760
in trust me my first interview at jpl

1668
00:59:05,829 --> 00:59:03,920
was actually in public affairs and my

1669
00:59:07,829 --> 00:59:05,839
then supervisor he couldn't make up his

1670
00:59:10,309 --> 00:59:07,839
mind i called him every

1671
00:59:12,150 --> 00:59:10,319
week same time same day saying have you

1672
00:59:15,270 --> 00:59:12,160
made your decision yet he finally got so

1673
00:59:17,030 --> 00:59:15,280
fed up he gave me the job so that was my

1674
00:59:18,950 --> 00:59:17,040
introduction into i knew i was going to

1675
00:59:21,190 --> 00:59:18,960
stay there for a short time but from

1676
00:59:23,349 --> 00:59:21,200
there i went on to different things and

1677
00:59:25,589 --> 00:59:23,359
i knew exactly where i wanted to be by

1678
00:59:29,030 --> 00:59:25,599
the time i was done so best part is

1679
00:59:31,829 --> 00:59:30,069
hi

1680
00:59:33,829 --> 00:59:31,839
i'm emily with mission control

1681
00:59:36,390 --> 00:59:33,839
communications i'm interested in the

1682
00:59:39,829 --> 00:59:36,400
solar power system on

1683
00:59:41,510 --> 00:59:39,839
um on the satellite um can you tell me

1684
00:59:43,990 --> 00:59:41,520
what the similarities and differences

1685
00:59:45,910 --> 00:59:44,000
are in the solar panel technology versus

1686
00:59:49,030 --> 00:59:45,920
what would be on the ground on earth and

1687
00:59:51,109 --> 00:59:49,040
then second are you going to be storing

1688
00:59:53,829 --> 00:59:51,119

the energy in any kind of battery or

1689
00:59:55,190 --> 00:59:53,839
storage system all right so the solar

1690
00:59:56,230 --> 00:59:55,200
arrays on board the spacecraft are a

1691
00:59:57,670 --> 00:59:56,240
little different than you'd have on your

1692
00:59:59,750 --> 00:59:57,680
house

1693
01:00:01,270 --> 00:59:59,760
first of all there's no rain

1694
01:00:02,390 --> 01:00:01,280
there's no dust so they're not

1695
01:00:03,990 --> 01:00:02,400
weatherproof

1696
01:00:06,069 --> 01:00:04,000
if you walk up to them

1697
01:00:07,430 --> 01:00:06,079
they don't look nearly as rugged as what

1698
01:00:09,030 --> 01:00:07,440
you would expect to see you just see

1699
01:00:09,910 --> 01:00:09,040
these little pieces of

1700
01:00:12,390 --> 01:00:09,920
of

1701
01:00:15,190 --> 01:00:12,400
crystal glued onto an aluminum

1702
01:00:19,349 --> 01:00:15,200
very thin aluminum sheet

1703
01:00:23,190 --> 01:00:21,829
not silicon they're germanium

1704
01:00:25,670 --> 01:00:23,200
they're more efficient but they're much

1705
01:00:27,589 --> 01:00:25,680
more expensive but when it costs so much

1706
01:00:29,589 --> 01:00:27,599
to put things into space

1707
01:00:31,430 --> 01:00:29,599
everything we can we light weight

1708
01:00:33,510 --> 01:00:31,440
there is a battery on the spacecraft our

1709
01:00:35,270 --> 01:00:33,520
orbit is uh something called a sun

1710
01:00:36,870 --> 01:00:35,280
synchronous orbit so we always are

1711
01:00:38,390 --> 01:00:36,880
orbiting the earth if we're on the day

1712
01:00:40,150 --> 01:00:38,400
side of the earth it's about 1 30 in the

1713
01:00:42,230 --> 01:00:40,160

afternoon if we're on the night side of

1714
01:00:44,150 --> 01:00:42,240
the earth it's about 1 30 in the morning

1715
01:00:46,470 --> 01:00:44,160
and we stay in the same geometry with

1716
01:00:47,990 --> 01:00:46,480
the sun the entire time and the earth

1717
01:00:50,470 --> 01:00:48,000
spins underneath us

1718
01:00:52,630 --> 01:00:50,480
so that you we you always you'll

1719
01:00:54,630 --> 01:00:52,640
eventually see the whole planet as it

1720
01:00:55,990 --> 01:00:54,640
spins but we always see it at the same

1721
01:00:57,510 --> 01:00:56,000
time of day which helps the measurement

1722
01:00:58,870 --> 01:00:57,520
because the geometry of the sunlight

1723
01:01:00,950 --> 01:00:58,880
hitting the earth and going back up to

1724
01:01:02,470 --> 01:01:00,960
the spacecraft is always the same

1725
01:01:04,390 --> 01:01:02,480
wherever you are

1726
01:01:06,390 --> 01:01:04,400
it's a very popular orbit

1727
01:01:08,470 --> 01:01:06,400
the animation that ken showed earlier

1728
01:01:09,589 --> 01:01:08,480
with all of the earth science orbit

1729
01:01:11,430 --> 01:01:09,599
orbiters

1730
01:01:12,710 --> 01:01:11,440
you'd see there were five or six of them

1731
01:01:14,069 --> 01:01:12,720
that sort of were going together and

1732
01:01:15,030 --> 01:01:14,079
that's the formation that we're going

1733
01:01:15,910 --> 01:01:15,040
into

1734
01:01:18,230 --> 01:01:15,920
um

1735
01:01:19,430 --> 01:01:18,240
so with our orbit you end up with about

1736
01:01:21,670 --> 01:01:19,440
uh

1737
01:01:23,270 --> 01:01:21,680
60 minutes a day 65 minutes a day in

1738
01:01:24,470 --> 01:01:23,280

sunlight and then we have a battery to

1739
01:01:28,150 --> 01:01:24,480
carry us through the time we're in

1740
01:01:31,750 --> 01:01:29,990
hi liam knight from the lunar lion team

1741
01:01:33,190 --> 01:01:31,760
at penn state we're a google lunar

1742
01:01:36,630 --> 01:01:33,200
express competitor a bunch of students

1743
01:01:38,870 --> 01:01:36,640
working on a spacecraft um so we

1744
01:01:40,390 --> 01:01:38,880
do a lot of this stuff every day but one

1745
01:01:41,829 --> 01:01:40,400
of my questions is what's the most

1746
01:01:43,670 --> 01:01:41,839
technically worrisome portion of this

1747
01:01:44,950 --> 01:01:43,680
mission from an engineering perspective

1748
01:01:46,470 --> 01:01:44,960
because that's stuff we think about all

1749
01:01:48,309 --> 01:01:46,480
the times

1750
01:01:49,589 --> 01:01:48,319
i'll start with the easy answer all of

1751
01:01:51,190 --> 01:01:49,599
it

1752
01:01:53,270 --> 01:01:51,200
you know if you're going to be in this

1753
01:01:55,750 --> 01:01:53,280
job you're one of those people that says

1754
01:01:57,750 --> 01:01:55,760
what can go wrong and then go hmm and

1755
01:01:59,670 --> 01:01:57,760
have a very long

1756
01:02:02,230 --> 01:01:59,680
thought process to go okay what could go

1757
01:02:03,750 --> 01:02:02,240
wrong uh you know a good engineer is

1758
01:02:05,829 --> 01:02:03,760
rarely an optimist

1759
01:02:07,750 --> 01:02:05,839
you're always thinking about all of the

1760
01:02:09,750 --> 01:02:07,760
things that could go wrong and how to

1761
01:02:13,029 --> 01:02:09,760
plan for them how to make the design

1762
01:02:14,950 --> 01:02:13,039
robust so that if it happens

1763
01:02:17,349 --> 01:02:14,960

at this point we've gone and tested the

1764
01:02:19,750 --> 01:02:17,359
hardware over and over and over we're

1765
01:02:20,789 --> 01:02:19,760
confident in it i i can't pick any one

1766
01:02:22,870 --> 01:02:20,799
moment

1767
01:02:25,670 --> 01:02:22,880
uh more than any others to say that's a

1768
01:02:28,230 --> 01:02:25,680
critical event they're all important

1769
01:02:30,549 --> 01:02:28,240
i don't know if you want to add to that

1770
01:02:31,349 --> 01:02:30,559
you know randy is absolutely right it's

1771
01:02:33,270 --> 01:02:31,359
uh

1772
01:02:36,710 --> 01:02:33,280
everything is important

1773
01:02:38,549 --> 01:02:36,720
and it may seem you know that little

1774
01:02:40,309 --> 01:02:38,559
aluminum satellite build right there

1775
01:02:42,230 --> 01:02:40,319
looks you know oh it shouldn't be that

1776
01:02:44,789 --> 01:02:42,240
complicated well it you know overall

1777
01:02:47,190 --> 01:02:44,799
design is not complicated but trust me

1778
01:02:50,309 --> 01:02:47,200
making sure that the science we get uh

1779
01:02:52,710 --> 01:02:50,319
it is very complicated and every single

1780
01:02:56,069 --> 01:02:52,720
aspect all the testing that we did is to

1781
01:02:57,589 --> 01:02:56,079
make sure that we can survive uh any

1782
01:02:59,829 --> 01:02:57,599
well almost anything that can be thrown

1783
01:03:02,870 --> 01:02:59,839
at us except micrometeoroids so we don't

1784
01:03:04,390 --> 01:03:02,880
have control over that so actually while

1785
01:03:05,829 --> 01:03:04,400
i'm holding the model i do want to say a

1786
01:03:07,349 --> 01:03:05,839
couple of things about it

1787
01:03:08,710 --> 01:03:07,359
i've heard now for a couple of years

1788
01:03:09,990 --> 01:03:08,720

since we were picked on the delta ii

1789
01:03:12,230 --> 01:03:10,000
that this was going to be the smallest

1790
01:03:15,190 --> 01:03:12,240
spacecraft that they've ever launched

1791
01:03:17,670 --> 01:03:15,200
this is not quite how small it is

1792
01:03:21,270 --> 01:03:17,680
uh this is a one-tenth scale model

1793
01:03:23,190 --> 01:03:21,280
so i've struggled for years on what the

1794
01:03:24,230 --> 01:03:23,200
size to tell people to get a scale for

1795
01:03:26,630 --> 01:03:24,240
it was

1796
01:03:28,950 --> 01:03:26,640
and for years i would say a phone booth

1797
01:03:30,309 --> 01:03:28,960
other people would say you know

1798
01:03:31,990 --> 01:03:30,319
one of the original scientists on the

1799
01:03:34,230 --> 01:03:32,000
project would talk about two oil barrels

1800
01:03:35,510 --> 01:03:34,240
stacked on top of each other

1801
01:03:37,829 --> 01:03:35,520
and a couple of weeks ago there was

1802
01:03:39,029 --> 01:03:37,839
actually a nice event for uh family

1803
01:03:40,549 --> 01:03:39,039
members of the people working on the

1804
01:03:42,470 --> 01:03:40,559
team to come see the spacecraft just

1805
01:03:44,309 --> 01:03:42,480
before it went to the launch pad

1806
01:03:45,589 --> 01:03:44,319
and one of my colleagues daughter who's

1807
01:03:47,829 --> 01:03:45,599
about 10

1808
01:03:49,270 --> 01:03:47,839
walked out and was so excited

1809
01:03:50,789 --> 01:03:49,280
because she convinced me what the phone

1810
01:03:52,230 --> 01:03:50,799
booth really was

1811
01:03:54,789 --> 01:03:52,240
so for those of you out there who are

1812
01:03:57,750 --> 01:03:54,799
science fiction fans it's the size of a

1813
01:04:01,670 --> 01:03:59,589

and unfortunately

1814
01:04:04,630 --> 01:04:01,680
as someone who had to shove all of this

1815
01:04:06,870 --> 01:04:04,640
hardware into this little box it is not

1816
01:04:09,510 --> 01:04:06,880
bigger on the inside

1817
01:04:11,430 --> 01:04:09,520
so it's a uh it's a pretty small

1818
01:04:13,829 --> 01:04:11,440
spacecraft but

1819
01:04:14,789 --> 01:04:13,839
we're really excited about it

1820
01:04:16,390 --> 01:04:14,799
thank you

1821
01:04:18,390 --> 01:04:16,400
hi again mitchell brockman union grove

1822
01:04:20,309 --> 01:04:18,400
high school uh my question is perfect

1823
01:04:22,069 --> 01:04:20,319
lead in is in regards to the the

1824
01:04:24,069 --> 01:04:22,079
satellite itself i think obviously we

1825
01:04:25,589 --> 01:04:24,079
all know what the solar panels look like

1826
01:04:27,349 --> 01:04:25,599
but i'm looking at the image behind you

1827
01:04:28,230 --> 01:04:27,359
guys and i think i see a thruster on

1828
01:04:29,589 --> 01:04:28,240
there

1829
01:04:31,589 --> 01:04:29,599
and it just kind of makes sense to me

1830
01:04:33,589 --> 01:04:31,599
like the outside of the satellite would

1831
01:04:35,750 --> 01:04:33,599
be smooth but i see a lot of stuff

1832
01:04:37,109 --> 01:04:35,760
that's kind of like built out of it is

1833
01:04:38,630 --> 01:04:37,119
that because it is so small on the

1834
01:04:39,910 --> 01:04:38,640
inside all right well i'll walk you

1835
01:04:41,029 --> 01:04:39,920
through some of the things on this

1836
01:04:42,789 --> 01:04:41,039
picture because these are probably

1837
01:04:44,309 --> 01:04:42,799
easier to work with

1838
01:04:46,710 --> 01:04:44,319

first of all you see the solar panels

1839
01:04:48,309 --> 01:04:46,720
for launch right now they're folded up

1840
01:04:50,150 --> 01:04:48,319
and these four

1841
01:04:51,829 --> 01:04:50,160
circles are part of the mechanism to

1842
01:04:53,349 --> 01:04:51,839
hold the solar panel tight during launch

1843
01:04:54,789 --> 01:04:53,359
so the vibration doesn't damage these

1844
01:04:55,910 --> 01:04:54,799
because they are very flimsy when they

1845
01:04:56,789 --> 01:04:55,920
come out

1846
01:04:58,710 --> 01:04:56,799
uh

1847
01:05:00,069 --> 01:04:58,720
you'll also see several of these dark

1848
01:05:01,190 --> 01:05:00,079
areas on the spacecraft that are a

1849
01:05:02,710 --> 01:05:01,200
little rough

1850
01:05:04,390 --> 01:05:02,720
those are radiators

1851
01:05:05,990 --> 01:05:04,400
so they're designed to

1852
01:05:07,910 --> 01:05:06,000
get rid of the heat that all of the

1853
01:05:10,630 --> 01:05:07,920
electronics and board the spacecraft are

1854
01:05:12,549 --> 01:05:10,640
generating so that we don't overheat

1855
01:05:15,029 --> 01:05:12,559
a lot of the other gray material here

1856
01:05:16,789 --> 01:05:15,039
are thermal blankets to keep the

1857
01:05:19,750 --> 01:05:16,799
sunshine and the heat from the earth

1858
01:05:22,150 --> 01:05:19,760
from coming in so the ratio of how much

1859
01:05:23,670 --> 01:05:22,160
is radiator to how much is blanket helps

1860
01:05:25,829 --> 01:05:23,680
us maintain the temperature at about

1861
01:05:28,069 --> 01:05:25,839
room temperature most of the hardware on

1862
01:05:29,829 --> 01:05:28,079
this system wants to work

1863
01:05:31,589 --> 01:05:29,839

about the temperature of this room right

1864
01:05:32,630 --> 01:05:31,599
now there are a handful of components

1865
01:05:34,549 --> 01:05:32,640
that don't

1866
01:05:36,390 --> 01:05:34,559
these two radiators are specific to the

1867
01:05:38,630 --> 01:05:36,400
instrument one of them cools the optics

1868
01:05:40,230 --> 01:05:38,640
down to probably about 20 degrees

1869
01:05:42,150 --> 01:05:40,240
fahrenheit

1870
01:05:44,150 --> 01:05:42,160
we are so sensitive

1871
01:05:46,789 --> 01:05:44,160
that the noise we have to be able to

1872
01:05:49,109 --> 01:05:46,799
measure the signal to a few electrons on

1873
01:05:51,029 --> 01:05:49,119
each pixel on the detector and to do

1874
01:05:53,190 --> 01:05:51,039
that we had to get the glow that just

1875
01:05:54,549 --> 01:05:53,200
comes from the optics being if they were

1876
01:05:56,069 --> 01:05:54,559
at room temperature it would swamp the

1877
01:05:57,910 --> 01:05:56,079
measurement we're trying to make so we

1878
01:05:59,589 --> 01:05:57,920
had to cool them down a little the other

1879
01:06:01,589 --> 01:05:59,599
radiator helps cool our detectors and

1880
01:06:03,109 --> 01:06:01,599
our detectors have to run

1881
01:06:06,069 --> 01:06:03,119
sorry i'm used to thinking about this in

1882
01:06:09,109 --> 01:06:06,079
centigrade 100 about 150 below zero

1883
01:06:10,870 --> 01:06:09,119
centigrade uh so quite cold and again

1884
01:06:12,150 --> 01:06:10,880
it's to get the noise down so that

1885
01:06:13,190 --> 01:06:12,160
there's very little

1886
01:06:14,710 --> 01:06:13,200
uh

1887
01:06:16,309 --> 01:06:14,720
randomness in the measurement we're

1888
01:06:18,549 --> 01:06:16,319

really looking at the signal

1889
01:06:20,549 --> 01:06:18,559
a few other things here this device up

1890
01:06:21,829 --> 01:06:20,559
here is a small telescope it looks at

1891
01:06:23,510 --> 01:06:21,839
the stars

1892
01:06:25,510 --> 01:06:23,520
so it can look out and it has a computer

1893
01:06:27,589 --> 01:06:25,520
that will recognize the star patterns

1894
01:06:29,510 --> 01:06:27,599
and therefore tell the spacecraft how

1895
01:06:30,870 --> 01:06:29,520
it's pointed what attitude it's in in

1896
01:06:34,150 --> 01:06:30,880
space

1897
01:06:37,510 --> 01:06:34,160
uh a few of these other things are sun

1898
01:06:39,990 --> 01:06:37,520
sensors so if the spacecraft ever resets

1899
01:06:41,430 --> 01:06:40,000
the computer resets it will allow the

1900
01:06:43,589 --> 01:06:41,440
spacecraft to figure out where the sun

1901
01:06:45,109 --> 01:06:43,599
is so the solar panels on the sun to

1902
01:06:46,390 --> 01:06:45,119
protect the battery

1903
01:06:48,870 --> 01:06:46,400
while it's waiting for further

1904
01:06:50,950 --> 01:06:48,880
instructions from the ground

1905
01:06:52,710 --> 01:06:50,960
this is one of our antennas to

1906
01:06:54,789 --> 01:06:52,720
communicate with the earth

1907
01:06:55,990 --> 01:06:54,799
the telescope for the instrument is down

1908
01:06:58,069 --> 01:06:56,000
here

1909
01:06:59,270 --> 01:06:58,079
this is actually we are so sensitive to

1910
01:07:01,109 --> 01:06:59,280
water

1911
01:07:02,549 --> 01:07:01,119
that occasionally and early in the

1912
01:07:05,109 --> 01:07:02,559
mission the first several weeks we run

1913
01:07:07,029 --> 01:07:05,119

the instrument quite warm and

1914
01:07:08,230 --> 01:07:07,039
what little bit of water is trapped in

1915
01:07:09,750 --> 01:07:08,240
all of the blankets and all the

1916
01:07:12,390 --> 01:07:09,760
materials

1917
01:07:14,549 --> 01:07:12,400
adhesives all of that water is slowly

1918
01:07:16,710 --> 01:07:14,559
evaporating and so this is a path to get

1919
01:07:18,309 --> 01:07:16,720
it out to space so it won't frost and

1920
01:07:21,589 --> 01:07:18,319
create frost on our hardware when it

1921
01:07:25,750 --> 01:07:23,750
yeah we have time for one more question

1922
01:07:27,750 --> 01:07:25,760
over here in the back

1923
01:07:29,589 --> 01:07:27,760
hi i'm karen allen um i was just

1924
01:07:31,750 --> 01:07:29,599
wondering how do you keep the satellite

1925
01:07:33,190 --> 01:07:31,760
safe when it's in orbit how do you keep

1926
01:07:35,190 --> 01:07:33,200
it from bumping into utter other

1927
01:07:37,270 --> 01:07:35,200
satellites and just general space junk

1928
01:07:39,750 --> 01:07:37,280
and what do you do if it does get hit

1929
01:07:42,069 --> 01:07:39,760
so we actually uh one of the first

1930
01:07:44,470 --> 01:07:42,079
things that happens after launch is

1931
01:07:46,549 --> 01:07:44,480
within about two hours the

1932
01:07:48,309 --> 01:07:46,559
ula folks the people here who are

1933
01:07:49,829 --> 01:07:48,319
launching the rocket will give us the

1934
01:07:51,510 --> 01:07:49,839
injection orbit

1935
01:07:53,270 --> 01:07:51,520
so the spacecraft's still warming up its

1936
01:07:55,510 --> 01:07:53,280
gps system's not running we don't know

1937
01:07:57,589 --> 01:07:55,520
where it is until they tell us at that

1938
01:07:59,190 --> 01:07:57,599

moment there's another group at nasa

1939
01:08:00,950 --> 01:07:59,200
that will take that orbit and project it

1940
01:08:02,789 --> 01:08:00,960
out several days and tell us if there's

1941
01:08:05,029 --> 01:08:02,799
anything that's likely to be in our way

1942
01:08:07,430 --> 01:08:05,039
if it is we stop the normal process of

1943
01:08:09,109 --> 01:08:07,440
of booting up the spacecraft and divert

1944
01:08:10,789 --> 01:08:09,119
to another path to allow us to get the

1945
01:08:13,109 --> 01:08:10,799
thrusters running as soon as possible so

1946
01:08:16,390 --> 01:08:13,119
that we can move the satellite from that

1947
01:08:18,470 --> 01:08:16,400
point on every time we update the orbit

1948
01:08:20,309 --> 01:08:18,480
and get a more refined orbit it goes

1949
01:08:22,309 --> 01:08:20,319
back to this group at nasa that is

1950
01:08:24,229 --> 01:08:22,319
tracking all of the space junk and they

1951
01:08:26,950 --> 01:08:24,239
will let us know if there is a risk of a

1952
01:08:28,870 --> 01:08:26,960
collision and if so we'll look at how

1953
01:08:31,030 --> 01:08:28,880
likely it is what's going on you know

1954
01:08:32,390 --> 01:08:31,040
how big the particle is and make a

1955
01:08:37,590 --> 01:08:32,400
decision on whether we need to move with

1956
01:08:40,390 --> 01:08:39,110
yeah there are you can't see them

1957
01:08:41,910 --> 01:08:40,400
they're on the back side here but there

1958
01:08:43,510 --> 01:08:41,920
are small thrusters

1959
01:08:44,950 --> 01:08:43,520
uh in fact that's how we have to merge

1960
01:08:46,789 --> 01:08:44,960
with the constellation after checkout in

1961
01:08:49,590 --> 01:08:46,799
the next couple of weeks so we have a

1962
01:08:51,910 --> 01:08:49,600
small amount of ability to reposition

1963
01:08:53,910 --> 01:08:51,920

the spacecraft and in fact the question

1964
01:08:55,349 --> 01:08:53,920
earlier about how long it would last

1965
01:08:56,870 --> 01:08:55,359
it's the fuel to do those sorts of

1966
01:08:58,550 --> 01:08:56,880
maneuvers that's our limiting life and

1967
01:09:00,309 --> 01:08:58,560
we expect we have enough fuel for

1968
01:09:02,229 --> 01:09:00,319
probably about 12 years if things go

1969
01:09:04,149 --> 01:09:02,239
smoothly

1970
01:09:10,870 --> 01:09:04,159
thank you randy thank you pavani

1971
01:09:14,149 --> 01:09:12,470
so you've learned a big overview picture

1972
01:09:15,590 --> 01:09:14,159
we've learned about the launch vehicle

1973
01:09:16,470 --> 01:09:15,600
and we've learned about the spacecraft

1974
01:09:18,789 --> 01:09:16,480
now we're going to learn a little more

1975
01:09:20,390 --> 01:09:18,799
about the science let me introduce

1976
01:09:22,709 --> 01:09:20,400
anne marie eldering who is the deputy

1977
01:09:26,309 --> 01:09:22,719
project scientist for oco2

1978
01:09:30,950 --> 01:09:28,390
so you guys as excited as i am i'm

1979
01:09:32,470 --> 01:09:30,960
almost out of control

1980
01:09:33,990 --> 01:09:32,480
i'm serious we're going to get this

1981
01:09:35,590 --> 01:09:34,000
thing up into space everything we've

1982
01:09:36,870 --> 01:09:35,600
been working for for years and years and

1983
01:09:38,709 --> 01:09:36,880
years is finally going to start

1984
01:09:40,229 --> 01:09:38,719
happening and we're just so jazzed i

1985
01:09:42,550 --> 01:09:40,239
started my day at the science team

1986
01:09:44,950 --> 01:09:42,560
meeting this morning we've got 70 folks

1987
01:09:48,470 --> 01:09:44,960
who are in town to work with us these

1988
01:09:49,990 --> 01:09:48,480

are people from u.s france japan all

1989
01:09:51,990 --> 01:09:50,000
over the globe and they do the science

1990
01:09:54,390 --> 01:09:52,000
with the data so this is their last

1991
01:09:56,790 --> 01:09:54,400
chance to hear the story prepare for the

1992
01:09:58,550 --> 01:09:56,800
data and just get pumped and i have to

1993
01:10:00,870 --> 01:09:58,560
tell you in that room it was electric

1994
01:10:02,870 --> 01:10:00,880
this morning these are a group of those

1995
01:10:05,030 --> 01:10:02,880
folks were there in 2009 when things

1996
01:10:07,030 --> 01:10:05,040
didn't work so well so the expectations

1997
01:10:08,070 --> 01:10:07,040
are super high and they're super excited

1998
01:10:09,590 --> 01:10:08,080
and it's just

1999
01:10:10,550 --> 01:10:09,600
i can't wait to get this thing off the

2000
01:10:13,750 --> 01:10:10,560
space

2001
01:10:16,310 --> 01:10:13,760
so i heard that you talked with dr ken

2002
01:10:18,390 --> 01:10:16,320
jux and heard about nasa things you got

2003
01:10:21,189 --> 01:10:18,400
ralph basilio

2004
01:10:22,950 --> 01:10:21,199
pav randy so they left me to clean up

2005
01:10:24,070 --> 01:10:22,960
the crumbs so

2006
01:10:25,590 --> 01:10:24,080
what do you want to know a little bit

2007
01:10:27,990 --> 01:10:25,600
about the global carbon cycle why we're

2008
01:10:30,070 --> 01:10:28,000
doing this crazy thing anyway

2009
01:10:32,709 --> 01:10:30,080
yeah all right let's see what we got

2010
01:10:35,030 --> 01:10:32,719
pull up my first graphic here we go the

2011
01:10:36,390 --> 01:10:35,040
global carbon cycle so this is just a

2012
01:10:38,470 --> 01:10:36,400
little

2013
01:10:40,950 --> 01:10:38,480

simplified way to show you about how

2014
01:10:42,070 --> 01:10:40,960
carbon dioxide is moving around and then

2015
01:10:43,510 --> 01:10:42,080
i'll tell you a little bit more about

2016
01:10:45,750 --> 01:10:43,520
why there's something interesting that

2017
01:10:48,070 --> 01:10:45,760
we don't know yet so you can see on the

2018
01:10:49,189 --> 01:10:48,080
top we've got the atmosphere

2019
01:10:51,669 --> 01:10:49,199
that's the part of the world we're going

2020
01:10:53,189 --> 01:10:51,679
to measure when we burn all our fuel and

2021
01:10:55,030 --> 01:10:53,199
our gas and our coal that's where the

2022
01:10:57,110 --> 01:10:55,040
carbon dioxide goes

2023
01:10:58,950 --> 01:10:57,120
but it doesn't just sit there all alone

2024
01:11:01,110 --> 01:10:58,960
right it interacts with other parts of

2025
01:11:02,550 --> 01:11:01,120
the system so we've got the oceans over

2026
01:11:05,110 --> 01:11:02,560
there on the side

2027
01:11:07,590 --> 01:11:05,120
and the oceans can actually absorb and

2028
01:11:09,830 --> 01:11:07,600
dissolve carbon dioxide and dave chris

2029
01:11:11,590 --> 01:11:09,840
has a great analogy he talks about when

2030
01:11:13,669 --> 01:11:11,600
he opens his beer at the end of the day

2031
01:11:15,750 --> 01:11:13,679
and he puts it on the counter and you

2032
01:11:17,430 --> 01:11:15,760
know it's kind of bubbly and fizzy and

2033
01:11:19,430 --> 01:11:17,440
if he forgets about it and the thing

2034
01:11:21,430 --> 01:11:19,440
warms up it gets all flat and that's the

2035
01:11:23,270 --> 01:11:21,440
carbon dioxide that doesn't like to be

2036
01:11:26,149 --> 01:11:23,280
in the warm stuff but it likes to be in

2037
01:11:28,070 --> 01:11:26,159
cold stuff so the oceans of the earth

2038
01:11:29,590 --> 01:11:28,080

both because of the volume of them and

2039
01:11:31,430 --> 01:11:29,600
because of the temperatures will

2040
01:11:33,030 --> 01:11:31,440
dissolve the carbon dioxide and release

2041
01:11:35,830 --> 01:11:33,040
it and you can see some numbers there

2042
01:11:38,070 --> 01:11:35,840
there's something like 330 gigatons

2043
01:11:39,990 --> 01:11:38,080
that's the number we think of gigatons

2044
01:11:42,149 --> 01:11:40,000
of carbon dioxide that move in and move

2045
01:11:44,229 --> 01:11:42,159
out of that ocean every year but they're

2046
01:11:46,070 --> 01:11:44,239
also about the same size right so it's a

2047
01:11:48,950 --> 01:11:46,080
balanced system

2048
01:11:51,270 --> 01:11:48,960
same thing you see the trees over here

2049
01:11:53,310 --> 01:11:51,280
remember back when we were kids in grade

2050
01:11:55,990 --> 01:11:53,320
school our teachers were telling about

2051
01:11:57,910 --> 01:11:56,000
photosynthesis and trees growing and so

2052
01:11:59,510 --> 01:11:57,920
when that photosynthesis happens and the

2053
01:12:01,590 --> 01:11:59,520
trees grow they actually take carbon

2054
01:12:03,750 --> 01:12:01,600
dioxide out of the atmosphere and use it

2055
01:12:05,750 --> 01:12:03,760
to build themselves to build the leaves

2056
01:12:08,310 --> 01:12:05,760
and the stems and the roots and then

2057
01:12:10,390 --> 01:12:08,320
when they fall down in the fall and they

2058
01:12:12,630 --> 01:12:10,400
just degrade they put that carbon

2059
01:12:14,950 --> 01:12:12,640
dioxide back up so again you see kind of

2060
01:12:17,189 --> 01:12:14,960
a balance you see what is it 440

2061
01:12:19,189 --> 01:12:17,199
gigatons of carbon going up 450 coming

2062
01:12:21,030 --> 01:12:19,199
down so these things are imbalanced but

2063
01:12:23,350 --> 01:12:21,040

the little one in the bottom that's you

2064
01:12:24,709 --> 01:12:23,360
and me and the whole wide world that's

2065
01:12:26,390 --> 01:12:24,719
burning stuff

2066
01:12:29,189 --> 01:12:26,400
digging up the coal burning it we put

2067
01:12:31,110 --> 01:12:29,199
the fossil fuel co2 up in the atmosphere

2068
01:12:32,310 --> 01:12:31,120
but there's no balance to that coming

2069
01:12:33,910 --> 01:12:32,320
out so

2070
01:12:36,709 --> 01:12:33,920
we are changing the overall

2071
01:12:38,709 --> 01:12:36,719
concentration in this system

2072
01:12:40,470 --> 01:12:38,719
and that's part of the big driver of

2073
01:12:42,229 --> 01:12:40,480
climate change so that's your global

2074
01:12:43,990 --> 01:12:42,239
global carbon cycle and i can put those

2075
01:12:46,630 --> 01:12:44,000
numbers up there but that's kind of for

2076
01:12:48,709 --> 01:12:46,640
the integrated globe we have a 100

2077
01:12:50,630 --> 01:12:48,719
measurements or so the atmosphere we've

2078
01:12:53,030 --> 01:12:50,640
got a small set of measurements of the

2079
01:12:55,669 --> 01:12:53,040
ocean and we use that to say on average

2080
01:12:57,510 --> 01:12:55,679
what's happening around the globe

2081
01:12:58,870 --> 01:12:57,520
and if we look at the next graphic i'll

2082
01:13:00,630 --> 01:12:58,880
tell you about one of the other things

2083
01:13:02,709 --> 01:13:00,640
that's bizarre

2084
01:13:03,750 --> 01:13:02,719
okay so this is just showing you over

2085
01:13:05,669 --> 01:13:03,760
time

2086
01:13:06,470 --> 01:13:05,679
we've made these measurements and we can

2087
01:13:08,470 --> 01:13:06,480
see

2088
01:13:10,870 --> 01:13:08,480

in the red you kind of looks like a

2089
01:13:13,350 --> 01:13:10,880
sawtooth and that's the seasons that's

2090
01:13:14,870 --> 01:13:13,360
the leaves taking up carbon dioxide in

2091
01:13:16,630 --> 01:13:14,880
the summer and then releasing it in the

2092
01:13:18,229 --> 01:13:16,640
winter so it goes down in the summer and

2093
01:13:21,270 --> 01:13:18,239
up in the winter down and up and down

2094
01:13:24,310 --> 01:13:21,280
and up but it's also going to higher and

2095
01:13:26,470 --> 01:13:24,320
higher concentrations so back

2096
01:13:29,270 --> 01:13:26,480
when i was born concentrations were

2097
01:13:31,030 --> 01:13:29,280
about 320 parts per million so you took

2098
01:13:34,070 --> 01:13:31,040
a million molecules of the atmosphere

2099
01:13:36,709 --> 01:13:34,080
320 were carbon dioxide when we do that

2100
01:13:39,510 --> 01:13:36,719
these days we're looking at 400

2101
01:13:40,990 --> 01:13:39,520
so think of that we went from 320 to 400

2102
01:13:42,950 --> 01:13:41,000
so we're really increasing the

2103
01:13:46,790 --> 01:13:42,960
concentrations

2104
01:13:48,870 --> 01:13:46,800
we know it's moving around between the

2105
01:13:52,550 --> 01:13:48,880
land and the atmosphere and the ocean

2106
01:13:57,030 --> 01:13:54,390
okay and one of the mysteries this is

2107
01:13:59,270 --> 01:13:57,040
okay mystery number one

2108
01:14:00,550 --> 01:13:59,280
i told you we're burning carbon dioxide

2109
01:14:02,790 --> 01:14:00,560
that's driving the increase in

2110
01:14:04,630 --> 01:14:02,800
concentrations but if i look at what i

2111
01:14:07,270 --> 01:14:04,640
find in the atmosphere every year it's

2112
01:14:10,229 --> 01:14:07,280
not always the same some years what i

2113
01:14:12,950 --> 01:14:10,239

add in in there almost all stays and

2114
01:14:14,790 --> 01:14:12,960
some years what i add in barely stays so

2115
01:14:17,270 --> 01:14:14,800
the atmosphere doesn't do the same thing

2116
01:14:18,790 --> 01:14:17,280
every single year it kind of

2117
01:14:20,310 --> 01:14:18,800
has different behavior and we don't know

2118
01:14:23,030 --> 01:14:20,320
exactly why so that's one of the

2119
01:14:24,550 --> 01:14:23,040
mysteries when we want to figure out

2120
01:14:26,229 --> 01:14:24,560
and the other mystery which i don't have

2121
01:14:27,510 --> 01:14:26,239
a good map for but i can tell you with

2122
01:14:29,830 --> 01:14:27,520
words

2123
01:14:31,510 --> 01:14:29,840
is that if you said

2124
01:14:33,430 --> 01:14:31,520
okay you know the forest they're taking

2125
01:14:34,790 --> 01:14:33,440
up carbon dioxide but which forest can

2126
01:14:36,229 --> 01:14:34,800
you think of some of the big forests

2127
01:14:38,870 --> 01:14:36,239
around the globe

2128
01:14:41,750 --> 01:14:38,880
you've got the amazon is massive right

2129
01:14:43,350 --> 01:14:41,760
these rain forests trees the jungle a

2130
01:14:44,550 --> 01:14:43,360
huge amount of carbon gets stored in

2131
01:14:46,390 --> 01:14:44,560
those trees

2132
01:14:47,910 --> 01:14:46,400
but then if you go to north america and

2133
01:14:50,470 --> 01:14:47,920
canada we have

2134
01:14:52,709 --> 01:14:50,480
huge forests over big swaths of land

2135
01:14:54,790 --> 01:14:52,719
they also have a large amount of carbon

2136
01:14:57,990 --> 01:14:54,800
the northern reaches of

2137
01:14:59,910 --> 01:14:58,000
russia and asia again huge forest so

2138
01:15:02,550 --> 01:14:59,920

which one of those forests is taking it

2139
01:15:03,750 --> 01:15:02,560
up and that's what we don't exactly know

2140
01:15:05,430 --> 01:15:03,760
and the fact that it's a little

2141
01:15:07,350 --> 01:15:05,440
different from year to year it might be

2142
01:15:09,830 --> 01:15:07,360
maybe the amazon's really active one

2143
01:15:11,830 --> 01:15:09,840
year and then less so another year maybe

2144
01:15:13,669 --> 01:15:11,840
north america is really active one year

2145
01:15:15,830 --> 01:15:13,679
or less so the part of the puzzle we

2146
01:15:18,229 --> 01:15:15,840
don't have the answer to is which parts

2147
01:15:19,750 --> 01:15:18,239
of the ocean which parts of the forest

2148
01:15:21,910 --> 01:15:19,760
and how are they going to behave in the

2149
01:15:24,310 --> 01:15:21,920
future can they always be taking up all

2150
01:15:27,270 --> 01:15:24,320
this carbon dioxide or if this thing

2151
01:15:29,030 --> 01:15:27,280
goes up twice as high as it is

2152
01:15:31,510 --> 01:15:29,040
will the lands and oceans kind of have

2153
01:15:33,830 --> 01:15:31,520
some limit to what they can do for us or

2154
01:15:35,350 --> 01:15:33,840
will they always go up and up so that's

2155
01:15:37,189 --> 01:15:35,360
kind of questions we want to answer and

2156
01:15:38,870 --> 01:15:37,199
the oco 2 data is going to help us do

2157
01:15:43,669 --> 01:15:38,880
that

2158
01:15:45,350 --> 01:15:43,679
this kind of lecture format so why don't

2159
01:15:47,189 --> 01:15:45,360
you bring up some questions you have or

2160
01:15:48,149 --> 01:15:47,199
tell me what i didn't tell you

2161
01:15:50,070 --> 01:15:48,159
and

2162
01:15:52,390 --> 01:15:50,080
we can help you get excited about our

2163
01:15:54,630 --> 01:15:52,400

oco2 mission and be ready to get

2164
01:15:57,750 --> 01:15:54,640
your hands on some of the new info we

2165
01:15:59,590 --> 01:15:57,760
send out we'll start at the back

2166
01:16:01,110 --> 01:15:59,600
hi uh thanks so much for talking to us

2167
01:16:04,070 --> 01:16:01,120
today about the science it's really

2168
01:16:06,390 --> 01:16:04,080
interesting stuff um so

2169
01:16:09,750 --> 01:16:06,400
randy pollock was talking to us about

2170
01:16:11,030 --> 01:16:09,760
how you can measure about one ppm co2 in

2171
01:16:12,390 --> 01:16:11,040
the atmosphere so i take that as that

2172
01:16:15,510 --> 01:16:12,400
that's the instrument's resolution which

2173
01:16:17,189 --> 01:16:15,520
is very impressive by the way um

2174
01:16:18,709 --> 01:16:17,199
so my question is a what's your

2175
01:16:21,430 --> 01:16:18,719
detection limit what's the smallest

2176
01:16:23,030 --> 01:16:21,440
amount of co2 you can measure and b is

2177
01:16:24,550 --> 01:16:23,040
that combined with your spatial

2178
01:16:26,390 --> 01:16:24,560
resolution good enough to be able to

2179
01:16:29,350 --> 01:16:26,400
measure something like say

2180
01:16:31,430 --> 01:16:29,360
low low level volcanic emissions

2181
01:16:33,430 --> 01:16:31,440
wow that's a pretty detailed question

2182
01:16:36,550 --> 01:16:33,440
all right let's see we can do

2183
01:16:38,390 --> 01:16:36,560
so one part per million that is the aim

2184
01:16:41,030 --> 01:16:38,400
for our sensitivity

2185
01:16:42,390 --> 01:16:41,040
and randy remembers that well because he

2186
01:16:45,189 --> 01:16:42,400
had to build the darn instrument that

2187
01:16:46,950 --> 01:16:45,199
was going to do it so we were aiming at

2188
01:16:50,950 --> 01:16:46,960

measuring to one part per million out of

2189
01:16:53,189 --> 01:16:50,960
that 400 or about 0.3 percent and all

2190
01:16:55,270 --> 01:16:53,199
the information we have to date from

2191
01:16:57,270 --> 01:16:55,280
other data sets we've worked with from

2192
01:16:59,430 --> 01:16:57,280
the characterization of the instrument

2193
01:17:00,790 --> 01:16:59,440
and how little noise we have on those

2194
01:17:03,270 --> 01:17:00,800
detectors

2195
01:17:05,110 --> 01:17:03,280
suggests that we should be able to

2196
01:17:06,709 --> 01:17:05,120
meet those requirements and it's

2197
01:17:09,110 --> 01:17:06,719
basically

2198
01:17:11,990 --> 01:17:09,120
you know the the level of light that you

2199
01:17:12,870 --> 01:17:12,000
see gets impacted by these molecules and

2200
01:17:14,550 --> 01:17:12,880
so

2201
01:17:16,870 --> 01:17:14,560
we have to be able to see these very

2202
01:17:18,950 --> 01:17:16,880
small light level changes and then also

2203
01:17:21,430 --> 01:17:18,960
not get confused by other things like

2204
01:17:24,229 --> 01:17:21,440
the clouds that are in the atmosphere or

2205
01:17:26,790 --> 01:17:24,239
perhaps the aerosols and pollution

2206
01:17:28,470 --> 01:17:26,800
and so on but we feel like we've we've

2207
01:17:30,310 --> 01:17:28,480
got good information that suggests we'll

2208
01:17:32,550 --> 01:17:30,320
meet the one part per million from the

2209
01:17:34,950 --> 01:17:32,560
data that we collect and will it be

2210
01:17:37,510 --> 01:17:34,960
enough to see volcanic emissions

2211
01:17:40,149 --> 01:17:37,520
one of the guys on our team just loves

2212
01:17:41,990 --> 01:17:40,159
volcanoes and he's always out there

2213
01:17:43,910 --> 01:17:42,000

telling us about him telling us about

2214
01:17:46,229 --> 01:17:43,920
his field measurements showing us on the

2215
01:17:48,870 --> 01:17:46,239
maps and he's been trying to find out

2216
01:17:50,870 --> 01:17:48,880
when we're going to pass by a volcano

2217
01:17:52,310 --> 01:17:50,880
and i think he's convinced that a couple

2218
01:17:54,070 --> 01:17:52,320
of the big ones

2219
01:17:56,390 --> 01:17:54,080
you maybe will see the problem with

2220
01:17:58,790 --> 01:17:56,400
volcanoes is they also put a lot of junk

2221
01:18:01,669 --> 01:17:58,800
usually right you have volcanic ash you

2222
01:18:03,830 --> 01:18:01,679
got water vapor sulfuric acid so those

2223
01:18:06,709 --> 01:18:03,840
things might get in the way

2224
01:18:08,390 --> 01:18:06,719
but perhaps we'll catch a plume or if it

2225
01:18:10,470 --> 01:18:08,400
erupts in just the right way we might

2226
01:18:11,510 --> 01:18:10,480
see it so i think it's an opportunistic

2227
01:18:12,950 --> 01:18:11,520
thing and people will be trolling

2228
01:18:16,149 --> 01:18:12,960
through the data to see if they can do

2229
01:18:20,229 --> 01:18:18,790
hi um i'd like to kind of repeat i have

2230
01:18:22,229 --> 01:18:20,239
two questions but first of all if you

2231
01:18:23,990 --> 01:18:22,239
could talk to us a little bit

2232
01:18:25,830 --> 01:18:24,000
kind of like pavani did about how you as

2233
01:18:29,189 --> 01:18:25,840
a woman got involved and how your

2234
01:18:31,030 --> 01:18:29,199
experience has been and then also um

2235
01:18:32,870 --> 01:18:31,040
one thing that that stuff i don't know

2236
01:18:34,790 --> 01:18:32,880
where she went but stephanie went

2237
01:18:37,750 --> 01:18:34,800
on that she likes to say that

2238
01:18:40,149 --> 01:18:37,760

uh jpl's missions are unmanned but the

2239
01:18:42,149 --> 01:18:40,159
people aren't and that they carry the

2240
01:18:44,310 --> 01:18:42,159
rockets carry your hopes and dreams so

2241
01:18:45,750 --> 01:18:44,320
just talk a little bit about your team

2242
01:18:47,510 --> 01:18:45,760
and kind of like what's your biggest

2243
01:18:48,390 --> 01:18:47,520
hope that you accomplish with this

2244
01:18:50,709 --> 01:18:48,400
science

2245
01:18:52,070 --> 01:18:50,719
wow okay these are great questions you

2246
01:18:55,510 --> 01:18:52,080
guys are a little more relaxed and

2247
01:18:57,669 --> 01:18:55,520
asking real things so this is fun um

2248
01:19:01,590 --> 01:18:57,679
yeah so being a woman in science is an

2249
01:19:03,830 --> 01:19:01,600
interesting experience i'm um

2250
01:19:05,430 --> 01:19:03,840
i always was kind of interested in math

2251
01:19:07,590 --> 01:19:05,440
and science i love that stuff when i was

2252
01:19:09,510 --> 01:19:07,600
a kid i never knew anyone who is a

2253
01:19:10,950 --> 01:19:09,520
professional mathematician so i thought

2254
01:19:14,070 --> 01:19:10,960
well that's probably not something real

2255
01:19:16,470 --> 01:19:14,080
people do but my dad was an engineer and

2256
01:19:18,470 --> 01:19:16,480
a society of women engineers used to run

2257
01:19:20,149 --> 01:19:18,480
these programs if you were interested in

2258
01:19:21,669 --> 01:19:20,159
engineering you find out more and

2259
01:19:24,229 --> 01:19:21,679
understand what's mechanical what's

2260
01:19:26,470 --> 01:19:24,239
civil what's electrical etc so i did

2261
01:19:28,149 --> 01:19:26,480
chemical engineering as an undergrad i

2262
01:19:29,510 --> 01:19:28,159
went to cooper union anyone heard of

2263
01:19:32,470 --> 01:19:29,520

cooper union

2264
01:19:34,149 --> 01:19:32,480
holy cow yes okay so cooper uni tiny

2265
01:19:36,229 --> 01:19:34,159
tiny school in new york city art

2266
01:19:38,149 --> 01:19:36,239
architecture engineering very few people

2267
01:19:41,110 --> 01:19:38,159
know about it i went down there and i

2268
01:19:43,430 --> 01:19:41,120
saw my future unveiling in new jersey

2269
01:19:45,510 --> 01:19:43,440
and i thought oh maybe not in the power

2270
01:19:47,110 --> 01:19:45,520
of you know the pharmaceutical plants

2271
01:19:48,950 --> 01:19:47,120
the refineries the et cetera that's

2272
01:19:50,630 --> 01:19:48,960
where chemical engineers work so i came

2273
01:19:53,030 --> 01:19:50,640
to la and you

2274
01:19:55,510 --> 01:19:53,040
wouldn't believe in 1988 when you landed

2275
01:19:57,830 --> 01:19:55,520
at caltech in pasadena and you looked

2276
01:19:59,669 --> 01:19:57,840
towards the mountains you saw nothing

2277
01:20:01,830 --> 01:19:59,679
because there was smog and junk and it

2278
01:20:05,110 --> 01:20:01,840
was so polluted so i studied this moga

2279
01:20:06,629 --> 01:20:05,120
valet as a phd and it was really really

2280
01:20:08,950 --> 01:20:06,639
interesting stuff and what was cool was

2281
01:20:09,830 --> 01:20:08,960
environmental engineering in my graduate

2282
01:20:12,149 --> 01:20:09,840
work

2283
01:20:14,149 --> 01:20:12,159
fifty percent of that class was female

2284
01:20:15,830 --> 01:20:14,159
so i noticed that electrical engineering

2285
01:20:17,510 --> 01:20:15,840
didn't have that many women chemical

2286
01:20:20,149 --> 01:20:17,520
engineering environmental engineering

2287
01:20:23,750 --> 01:20:20,159
was actually pretty balanced and i found

2288
01:20:25,590 --> 01:20:23,760

in my career at jpl we actually have

2289
01:20:27,910 --> 01:20:25,600
engineers that pretty much reflect the

2290
01:20:30,390 --> 01:20:27,920
graduation rates we have good numbers

2291
01:20:32,229 --> 01:20:30,400
and the coolest thing about jpl is if

2292
01:20:34,870 --> 01:20:32,239
you can get the job done the job is

2293
01:20:37,350 --> 01:20:34,880
yours nobody cares about have you been

2294
01:20:39,510 --> 01:20:37,360
here 10 years or 20 years or what nobody

2295
01:20:40,950 --> 01:20:39,520
cares or you know

2296
01:20:42,709 --> 01:20:40,960
your background is chemical engineering

2297
01:20:44,550 --> 01:20:42,719
and now you're working on climate it's

2298
01:20:46,149 --> 01:20:44,560
just about getting the job done and that

2299
01:20:48,070 --> 01:20:46,159
makes for like an awesome awesome

2300
01:20:49,590 --> 01:20:48,080
workplace not everything i've ever done

2301
01:20:54,870 --> 01:20:49,600
was that experience but jpl has been

2302
01:21:00,070 --> 01:20:58,550
hi matt campbell at cbs los angeles

2303
01:21:01,910 --> 01:21:00,080
given the increase in carbon

2304
01:21:03,189 --> 01:21:01,920
concentration numbers over the past 50

2305
01:21:06,070 --> 01:21:03,199
years

2306
01:21:07,430 --> 01:21:06,080
oco2 obviously has the potential to

2307
01:21:09,910 --> 01:21:07,440
predict some fairly alarming

2308
01:21:13,350 --> 01:21:09,920
temperatures for our future

2309
01:21:16,070 --> 01:21:13,360
how much temperature change are humans

2310
01:21:18,470 --> 01:21:16,080
capable of adjusting to

2311
01:21:20,470 --> 01:21:18,480
okay so that is a good question matt how

2312
01:21:21,990 --> 01:21:20,480
much temperature change are we capable

2313
01:21:24,149 --> 01:21:22,000

of adjusting to

2314
01:21:27,590 --> 01:21:24,159
and as you know with everything it's

2315
01:21:29,189 --> 01:21:27,600
it's a question of priorities if we

2316
01:21:30,790 --> 01:21:29,199
decided we were going to burn all our

2317
01:21:32,310 --> 01:21:30,800
fossil fuel and have these massive

2318
01:21:34,229 --> 01:21:32,320
temperature increases we'd better be

2319
01:21:36,470 --> 01:21:34,239
willing to spend a whole bunch of money

2320
01:21:38,070 --> 01:21:36,480
to make our infrastructure safe to make

2321
01:21:40,629 --> 01:21:38,080
sure we can grow the food we need to

2322
01:21:42,709 --> 01:21:40,639
make sure the water is available so

2323
01:21:45,030 --> 01:21:42,719
you know in my mind

2324
01:21:46,310 --> 01:21:45,040
for the good of all the people on the

2325
01:21:47,830 --> 01:21:46,320
planet

2326
01:21:49,510 --> 01:21:47,840
the sooner we can cut down on the

2327
01:21:51,669 --> 01:21:49,520
concentrations the better off we're

2328
01:21:54,550 --> 01:21:51,679
going to be

2329
01:21:56,790 --> 01:21:54,560
so i'd like to see this information

2330
01:21:58,629 --> 01:21:56,800
help us understand these natural cycles

2331
01:22:00,629 --> 01:21:58,639
make better predictions of the future

2332
01:22:03,030 --> 01:22:00,639
and then keep on putting pressure on the

2333
01:22:05,030 --> 01:22:03,040
global community to make good decisions

2334
01:22:07,750 --> 01:22:05,040
about cutting down on fossil fuel use as

2335
01:22:09,350 --> 01:22:07,760
soon as we possibly can

2336
01:22:12,550 --> 01:22:09,360
thanks let's set let's take one from

2337
01:22:15,590 --> 01:22:12,560
social media real quick over here

2338
01:22:18,070 --> 01:22:15,600

okay um from uh the real dj flux on

2339
01:22:19,430 --> 01:22:18,080
twitter he asks is there a dated

2340
01:22:21,830 --> 01:22:19,440
description language that will

2341
01:22:24,149 --> 01:22:21,840
self-describe the data from oco-2 or

2342
01:22:25,350 --> 01:22:24,159
other nasa earth observing satellites

2343
01:22:27,510 --> 01:22:25,360
all right somebody who's ready to

2344
01:22:30,229 --> 01:22:27,520
actually put their hands on our data so

2345
01:22:31,830 --> 01:22:30,239
yeah we've actually with nasa all the

2346
01:22:33,669 --> 01:22:31,840
data that we provide to the public

2347
01:22:36,709 --> 01:22:33,679
through our data distribution is in

2348
01:22:39,510 --> 01:22:36,719
something called hdf or a hierarchical

2349
01:22:41,590 --> 01:22:39,520
data format so it actually has

2350
01:22:43,189 --> 01:22:41,600
descriptions of the data that are

2351
01:22:44,709 --> 01:22:43,199
embedded in the file so if you get a

2352
01:22:47,990 --> 01:22:44,719
file you should be able to read it all

2353
01:22:52,709 --> 01:22:48,000
out so the hdf in hdf5 right now is the

2354
01:22:55,590 --> 01:22:53,510
hi

2355
01:22:58,950 --> 01:22:55,600
um could you talk a little bit about the

2356
01:23:01,110 --> 01:22:58,960
um the fluorescence of vegetation um

2357
01:23:03,669 --> 01:23:01,120
that i i saw on one of the other um

2358
01:23:05,590 --> 01:23:03,679
broadcasts and then could you also maybe

2359
01:23:07,189 --> 01:23:05,600
um talk about

2360
01:23:09,350 --> 01:23:07,199
what are you going to be looking for in

2361
01:23:10,390 --> 01:23:09,360
terms of other serendipitous

2362
01:23:11,510 --> 01:23:10,400
stuff that's going to come out of the

2363
01:23:13,830 --> 01:23:11,520

data stream

2364
01:23:15,350 --> 01:23:13,840
okay so the first question was about the

2365
01:23:17,189 --> 01:23:15,360
solar induced fluorescence and then

2366
01:23:19,270 --> 01:23:17,199
other discoveries we think we might find

2367
01:23:20,950 --> 01:23:19,280
in our data okay

2368
01:23:22,550 --> 01:23:20,960
so solar induced fluorescence has

2369
01:23:23,669 --> 01:23:22,560
anybody told you about that yet this

2370
01:23:25,110 --> 01:23:23,679
morning

2371
01:23:27,030 --> 01:23:25,120
no okay

2372
01:23:29,030 --> 01:23:27,040
so i mentioned that when plants

2373
01:23:30,790 --> 01:23:29,040
photosynthesize they absorb carbon

2374
01:23:33,590 --> 01:23:30,800
dioxide and actually in the

2375
01:23:35,910 --> 01:23:33,600
photosynthetic synthesis process they do

2376
01:23:38,149 --> 01:23:35,920
something else they have heat and energy

2377
01:23:40,390 --> 01:23:38,159
they have to get rid of so they actually

2378
01:23:43,270 --> 01:23:40,400
send a little bit of light back out

2379
01:23:45,510 --> 01:23:43,280
and and one of the good analogies is if

2380
01:23:47,669 --> 01:23:45,520
you've ever been in a museum that has

2381
01:23:49,590 --> 01:23:47,679
minerals sometimes there's a place where

2382
01:23:51,510 --> 01:23:49,600
you turn off the regular lights and you

2383
01:23:53,430 --> 01:23:51,520
shine a uv and you can see this light

2384
01:23:55,990 --> 01:23:53,440
coming out of the rocks same sort of

2385
01:23:57,510 --> 01:23:56,000
thing it's fluorescing or emitting and a

2386
01:23:59,189 --> 01:23:57,520
couple of folks

2387
01:24:01,430 --> 01:23:59,199
one of our team members christian and

2388
01:24:04,149 --> 01:24:01,440

then joanna out at goddard realized that

2389
01:24:06,470 --> 01:24:04,159
we have wavelengths that see that light

2390
01:24:08,229 --> 01:24:06,480
so they've developed a technique and

2391
01:24:10,310 --> 01:24:08,239
this is showing a map of what we expect

2392
01:24:12,390 --> 01:24:10,320
to see from oco2

2393
01:24:14,310 --> 01:24:12,400
of basically a measurement of light that

2394
01:24:16,709 --> 01:24:14,320
leaves are giving off when they

2395
01:24:18,629 --> 01:24:16,719
photosynthesize so this is important

2396
01:24:20,870 --> 01:24:18,639
because it gives you another little

2397
01:24:22,550 --> 01:24:20,880
lever another way to look at what plants

2398
01:24:25,669 --> 01:24:22,560
are doing and what they're doing in the

2399
01:24:27,590 --> 01:24:25,679
carbon cycle um so we sh we

2400
01:24:28,950 --> 01:24:27,600
if you wanted to just look at that you

2401
01:24:30,390 --> 01:24:28,960
might actually design things a little

2402
01:24:32,070 --> 01:24:30,400
bit different but we'll actually have a

2403
01:24:34,390 --> 01:24:32,080
pretty useful piece of information out

2404
01:24:36,790 --> 01:24:34,400
of here and other discoveries we might

2405
01:24:38,229 --> 01:24:36,800
have that's always hard to predict

2406
01:24:40,149 --> 01:24:38,239
um

2407
01:24:41,990 --> 01:24:40,159
you know we really we do this sampling

2408
01:24:43,669 --> 01:24:42,000
we don't map the whole world so there's

2409
01:24:45,510 --> 01:24:43,679
going to be places we never looked at

2410
01:24:48,070 --> 01:24:45,520
but maybe in some of the places we look

2411
01:24:50,390 --> 01:24:48,080
at we'll you know find out there's hot

2412
01:24:52,390 --> 01:24:50,400
spots we hadn't thought about we'll get

2413
01:24:54,870 --> 01:24:52,400

to maybe quantify something about how

2414
01:24:56,629 --> 01:24:54,880
much la emits relative to the background

2415
01:24:58,310 --> 01:24:56,639
people started doing that with the gosat

2416
01:24:59,590 --> 01:24:58,320
data but we'll get some more information

2417
01:25:01,430 --> 01:24:59,600
on that

2418
01:25:03,110 --> 01:25:01,440
but i it's hard to imagine what the

2419
01:25:05,590 --> 01:25:03,120
science community might end up doing

2420
01:25:07,270 --> 01:25:05,600
plus we're in that a train there's other

2421
01:25:10,149 --> 01:25:07,280
pollution measurements there's other

2422
01:25:12,470 --> 01:25:10,159
water vapor clouds etc someone's going

2423
01:25:13,830 --> 01:25:12,480
to stir that stuff together and tell me

2424
01:25:16,229 --> 01:25:13,840
something i hadn't thought about

2425
01:25:19,030 --> 01:25:16,239
probably about emissions from humans and

2426
01:25:21,110 --> 01:25:19,040
the co2 as well as the carbon monoxide

2427
01:25:22,950 --> 01:25:21,120
and some of the other chemicals so who

2428
01:25:26,149 --> 01:25:22,960
knows come back in a year we'll have

2429
01:25:28,790 --> 01:25:26,159
some new answers

2430
01:25:31,430 --> 01:25:28,800
hi hi uh christina walsh from los

2431
01:25:33,910 --> 01:25:31,440
angeles uh with organizing for action um

2432
01:25:35,030 --> 01:25:33,920
i'm thrilled to hear this exciting news

2433
01:25:36,229 --> 01:25:35,040
about what we're going to learn about

2434
01:25:37,590 --> 01:25:36,239
carbon

2435
01:25:39,430 --> 01:25:37,600
what um

2436
01:25:41,030 --> 01:25:39,440
with the car with the carbon pollution

2437
01:25:42,149 --> 01:25:41,040
standards that have just been uh

2438
01:25:44,149 --> 01:25:42,159

published

2439
01:25:45,350 --> 01:25:44,159
and there's a lot of political pushback

2440
01:25:46,149 --> 01:25:45,360
on that

2441
01:25:48,390 --> 01:25:46,159
um

2442
01:25:50,629 --> 01:25:48,400
what do you see as a way to

2443
01:25:53,189 --> 01:25:50,639
validate this data to

2444
01:25:55,189 --> 01:25:53,199
the naysayers in congress and and

2445
01:25:56,790 --> 01:25:55,199
throughout the world how

2446
01:25:59,110 --> 01:25:56,800
how can that be done especially with

2447
01:26:01,669 --> 01:25:59,120
this time lag between now and when we

2448
01:26:03,910 --> 01:26:01,679
see confirmed data right right

2449
01:26:05,270 --> 01:26:03,920
so it's always interesting when we try

2450
01:26:08,310 --> 01:26:05,280
to think about the experiment we're

2451
01:26:09,990 --> 01:26:08,320
running and the like politics of the

2452
01:26:13,030 --> 01:26:10,000
year and what's going on with carbon

2453
01:26:15,270 --> 01:26:13,040
dioxide in our government and so we're

2454
01:26:18,149 --> 01:26:15,280
first and foremost a science experiment

2455
01:26:20,149 --> 01:26:18,159
and remember this was pitched 14 years

2456
01:26:21,669 --> 01:26:20,159
ago and the science question is still

2457
01:26:23,350 --> 01:26:21,679
not answered so we're still really

2458
01:26:25,189 --> 01:26:23,360
focused on the science question but you

2459
01:26:26,390 --> 01:26:25,199
can't ignore the context of other stuff

2460
01:26:28,310 --> 01:26:26,400
going on

2461
01:26:30,550 --> 01:26:28,320
and i actually i ran some calculations

2462
01:26:32,870 --> 01:26:30,560
recently and i took a map of where the

2463
01:26:33,910 --> 01:26:32,880

there's 16 000 big power plants around

2464
01:26:36,390 --> 01:26:33,920
the globe

2465
01:26:38,550 --> 01:26:36,400
but actually because we see the total

2466
01:26:40,470 --> 01:26:38,560
column we only see like the really big

2467
01:26:43,270 --> 01:26:40,480
ones probably five or six hundred have

2468
01:26:45,189 --> 01:26:43,280
enough emissions that any remote sensing

2469
01:26:47,030 --> 01:26:45,199
thing like ours would see it but then

2470
01:26:49,270 --> 01:26:47,040
because of where we fly around and what

2471
01:26:51,030 --> 01:26:49,280
we bump into we'll actually only cross

2472
01:26:53,110 --> 01:26:51,040
the path of a small set of the power

2473
01:26:55,030 --> 01:26:53,120
plants so just like you asked what we

2474
01:26:56,550 --> 01:26:55,040
might discover somebody's going to look

2475
01:26:58,950 --> 01:26:56,560
at the volcano somebody's going to look

2476
01:27:00,550 --> 01:26:58,960
at the power plants but only a few of

2477
01:27:02,070 --> 01:27:00,560
them will ever pop up if the wind's

2478
01:27:03,990 --> 01:27:02,080
blowing right and the clouds aren't

2479
01:27:05,510 --> 01:27:04,000
there we might actually see the

2480
01:27:07,750 --> 01:27:05,520
trace of the plume

2481
01:27:09,750 --> 01:27:07,760
passing by

2482
01:27:11,669 --> 01:27:09,760
but in terms of sort of convincing the

2483
01:27:14,550 --> 01:27:11,679
policy makers of how important this

2484
01:27:16,550 --> 01:27:14,560
stuff is i feel like

2485
01:27:18,390 --> 01:27:16,560
our me our mission isn't going to be the

2486
01:27:20,870 --> 01:27:18,400
right kind of data to sell them

2487
01:27:22,310 --> 01:27:20,880
on anything they don't know already

2488
01:27:24,629 --> 01:27:22,320

i think we're much more about the

2489
01:27:26,229 --> 01:27:24,639
implications of those emissions and and

2490
01:27:27,590 --> 01:27:26,239
if that's where their question is that's

2491
01:27:30,390 --> 01:27:27,600
where we're going to have new info to

2492
01:27:31,350 --> 01:27:30,400
really convince them about stuff

2493
01:27:33,189 --> 01:27:31,360
yeah

2494
01:27:35,590 --> 01:27:33,199
can you have one over there

2495
01:27:37,270 --> 01:27:35,600
yeah um yeah hi thank you ryan malady

2496
01:27:39,669 --> 01:27:37,280
thank you so much for being here and

2497
01:27:40,950 --> 01:27:39,679
everything you do i believe you uh i

2498
01:27:43,189 --> 01:27:40,960
kind of raised my hand before you

2499
01:27:45,110 --> 01:27:43,199
answered the last question but yeah

2500
01:27:47,350 --> 01:27:45,120
it's uh it's basically a lot of the

2501
01:27:48,870 --> 01:27:47,360
questions i'm getting from twitter and

2502
01:27:49,990 --> 01:27:48,880
everywhere else is

2503
01:27:52,790 --> 01:27:50,000
yeah

2504
01:27:54,629 --> 01:27:52,800
can you speculate as to the kind of data

2505
01:27:55,510 --> 01:27:54,639
that you're going to get and how that

2506
01:27:57,910 --> 01:27:55,520
will

2507
01:28:00,709 --> 01:27:57,920
affect global policy

2508
01:28:02,790 --> 01:28:00,719
when it comes to carbon dioxide and

2509
01:28:04,950 --> 01:28:02,800
emissions and the human and the kind of

2510
01:28:06,310 --> 01:28:04,960
uh effect that you know

2511
01:28:08,709 --> 01:28:06,320
the discussion

2512
01:28:10,149 --> 01:28:08,719
of the human role in climate change

2513
01:28:11,750 --> 01:28:10,159

that we'll have so

2514
01:28:13,750 --> 01:28:11,760
if you've answered it already i mean

2515
01:28:15,030 --> 01:28:13,760
maybe try to say it in a

2516
01:28:16,870 --> 01:28:15,040
succinct

2517
01:28:19,110 --> 01:28:16,880
way when we discuss this amongst

2518
01:28:21,510 --> 01:28:19,120
ourselves and of course we do we talk

2519
01:28:23,590 --> 01:28:21,520
about the fact that

2520
01:28:25,270 --> 01:28:23,600
we we don't understand how the land

2521
01:28:27,430 --> 01:28:25,280
masses and the oceans are taking up the

2522
01:28:29,350 --> 01:28:27,440
carbon dioxide and if you think about

2523
01:28:30,870 --> 01:28:29,360
the conversation in the international

2524
01:28:32,390 --> 01:28:30,880
level right now

2525
01:28:34,629 --> 01:28:32,400
right we want to try to come up with

2526
01:28:37,350 --> 01:28:34,639
this scheme where countries can say

2527
01:28:39,750 --> 01:28:37,360
this is my carbon emission rate this is

2528
01:28:42,310 --> 01:28:39,760
the carbon dioxide i'm taking up and for

2529
01:28:44,870 --> 01:28:42,320
example if i don't cut down my forest

2530
01:28:47,510 --> 01:28:44,880
you should recognize that and and not

2531
01:28:49,030 --> 01:28:47,520
count that as a carbon release and so

2532
01:28:51,189 --> 01:28:49,040
when people are trying to think about

2533
01:28:53,590 --> 01:28:51,199
those policies if we understood better

2534
01:28:56,790 --> 01:28:53,600
how forests behave they could do a

2535
01:28:59,669 --> 01:28:56,800
better job with that kind of analysis so

2536
01:29:01,510 --> 01:28:59,679
i i think in the big picture

2537
01:29:03,030 --> 01:29:01,520
the more we can understand how the

2538
01:29:06,310 --> 01:29:03,040

natural

2539
01:29:08,390 --> 01:29:06,320
role how long they're going to take up

2540
01:29:10,550 --> 01:29:08,400
half that carbon dioxide and how forests

2541
01:29:12,790 --> 01:29:10,560
are behaving at us more a more detailed

2542
01:29:14,470 --> 01:29:12,800
level that can be helpful to the folks

2543
01:29:16,709 --> 01:29:14,480
who are trying to really figure this out

2544
01:29:18,470 --> 01:29:16,719
on the international plannings level of

2545
01:29:20,229 --> 01:29:18,480
things thank you very much

2546
01:29:27,590 --> 01:29:20,239
thank you and mariel during thank you

2547
01:29:30,790 --> 01:29:29,270
okay for those in the room i think that

2548
01:29:31,990 --> 01:29:30,800
we still uh our speakers are gonna stick

2549
01:29:34,229 --> 01:29:32,000
around answering additional questions

2550
01:29:37,910 --> 01:29:34,239
you may have uh for those at home just a

2551
01:29:40,229 --> 01:29:37,920
quick programming note that at 2 56 a.m

2552
01:29:42,709 --> 01:29:40,239
tonight tomorrow morning is uh the oco-2

2553
01:29:46,229 --> 01:29:42,719
launch you can watch live on nasa

2554
01:29:48,149 --> 01:29:46,239
television at www.nasa.gov

2555
01:29:52,470 --> 01:29:48,159
nasha television you can also follow us

2556
01:29:55,669 --> 01:29:52,480
on social media on at nasa at i am oco2