1
00:00:08,799 --> 00:00:06,549
hello again everyone this is the mission

2
00:00:11,890 --> 00:00:08,809
science briefing for the orbiting carbon

3
00:00:14,110 --> 00:00:11,900
observatory too and here to talk about

4
00:00:18,700 --> 00:00:14,120
the science and the mission that's

5
00:00:26,020 --> 00:00:18,710
upcoming is ken jux the oco-2 program

6
00:00:29,260 --> 00:00:26,030
scientists from NASA headquarters David

7
00:00:34,290 --> 00:00:29,270
crisp the oco-2 science team leader from

8
00:00:37,660 --> 00:00:34,300
the Jet Propulsion Laboratory and

9
00:00:41,140 --> 00:00:37,670
Annemarie l during the OCIO to deputy

10
00:00:43,870 --> 00:00:41,150
project scientist from JPL so we'll

11
00:00:45,610 --> 00:00:43,880
begin first with Ken jux the oco-2

12
00:00:48,790 --> 00:00:45,620
program side us from NASA headquarters

13
00:00:50,260 --> 00:00:48,800

Kent thanks George so Dave Emory and I

14
00:00:52,300 --> 00:00:50,270
have the privilege to talk to you all

15
00:00:53,410 --> 00:00:52,310
about the scientific reasons why NASA is

16
00:00:56,380 --> 00:00:53,420
launching the orbiting carbon

17
00:00:58,690 --> 00:00:56,390
Observatory to most of you know about

18
00:01:00,069 --> 00:00:58,700
NASA in our human spaceflight program

19
00:01:01,810 --> 00:01:00,079
because that gets a lot of press but

20
00:01:03,490 --> 00:01:01,820
nASA has a strong and vibrant science

21
00:01:05,349 --> 00:01:03,500
program and in particular we have a

22
00:01:07,840 --> 00:01:05,359
strong earth science program and oco-2

23
00:01:10,569 --> 00:01:07,850
is the next important piece in your

24
00:01:13,239 --> 00:01:10,579
science program so nASA has been doing

25
00:01:14,770 --> 00:01:13,249
our science observations for about 40

26
00:01:16,330 --> 00:01:14,780
years now back in the early days of

27
00:01:17,980 --> 00:01:16,340
NASA's history and a lot of these early

28
00:01:20,199 --> 00:01:17,990
observations are trying to understand

29
00:01:22,959 --> 00:01:20,209
the Earth's atmosphere weather systems

30
00:01:25,239 --> 00:01:22,969
climate typed observations and nowadays

31
00:01:27,609 --> 00:01:25,249
nASA has expanded that program to do a

32
00:01:29,709 --> 00:01:27,619
lot more thing so we have a much more

33
00:01:32,080 --> 00:01:29,719
expansive a satellite program now we

34
00:01:34,120 --> 00:01:32,090
have a very expansive suborbital program

35
00:01:35,620 --> 00:01:34,130
in particular we use a lot of specially

36
00:01:37,660 --> 00:01:35,630
adapted airplanes to do scientific

37
00:01:39,429 --> 00:01:37,670
research we do observations from the

38
00:01:41,559 --> 00:01:39,439

ground and we have a very strong

39
00:01:43,330 --> 00:01:41,569
research program it's designed to take

40
00:01:45,580 --> 00:01:43,340
advantage of all of these observations

41
00:01:47,949 --> 00:01:45,590
to better understand your science system

42
00:01:50,379 --> 00:01:47,959
so what are the earliest success stories

43
00:01:51,819 --> 00:01:50,389
that we had at NASA in particular for

44
00:01:54,580 --> 00:01:51,829
earth science was to understand the

45
00:01:57,190 --> 00:01:54,590
ozone hole NASA had observations up to

46
00:02:00,099 --> 00:01:57,200
observe ozone for a very long time and

47
00:02:01,449 --> 00:02:00,109
when the ozone hole first started they

48
00:02:03,370 --> 00:02:01,459
sort of observed both from the ground

49
00:02:05,709 --> 00:02:03,380
and from a satellite NASA head up called

50
00:02:07,359 --> 00:02:05,719
Tom's which showed what the ozone hole

51
00:02:08,800 --> 00:02:07,369
was and it gave us an idea that

52
00:02:10,929 --> 00:02:08,810
something important was happening but we

53
00:02:13,900 --> 00:02:10,939
didn't know how to address it completely

54
00:02:15,370 --> 00:02:13,910
so NASA organized quickly some field ops

55
00:02:17,860 --> 00:02:15,380
both from the ground and from some of

56
00:02:20,440 --> 00:02:17,870
our specially adapted aircraft to go and

57
00:02:22,270 --> 00:02:20,450
look at the ozone hole self to try to

58
00:02:25,810 --> 00:02:22,280
figure that out and when you combine the

59
00:02:28,090 --> 00:02:25,820
satellite data these aircraft data and a

60
00:02:29,530 --> 00:02:28,100
research program scientists around the

61
00:02:31,540 --> 00:02:29,540
world are able to fully understand what

62
00:02:33,250 --> 00:02:31,550
was going on and that led to some very

63
00:02:34,930 --> 00:02:33,260

important international agreements that

64
00:02:36,520 --> 00:02:34,940
led to the Montreal Protocol so it's

65
00:02:40,080 --> 00:02:36,530
just one example of the type of stuff

66
00:02:42,820 --> 00:02:40,090
that we do in NASA's or science program

67
00:02:45,130 --> 00:02:42,830
so in order to really understand your

68
00:02:47,050 --> 00:02:45,140
system you need a lot of data because

69
00:02:49,600 --> 00:02:47,060
it's a very complicated and integrated

70
00:02:51,970 --> 00:02:49,610
system so the first graphic will

71
00:02:53,560 --> 00:02:51,980
demonstrate that how it works so the air

72
00:02:55,450 --> 00:02:53,570
so this kind of shows a lot of the

73
00:02:57,370 --> 00:02:55,460
pieces and all these pieces interact

74
00:02:59,320 --> 00:02:57,380
with another so we have the Sun which

75
00:03:01,300 --> 00:02:59,330
helps to drive the heating of the earth

76
00:03:03,070 --> 00:03:01,310
we have the atmosphere which is an

77
00:03:05,260 --> 00:03:03,080
important part of integrating the Sun to

78
00:03:08,290 --> 00:03:05,270
input we've got the surface which has

79
00:03:09,910 --> 00:03:08,300
oceans it has trees we have agriculture

80
00:03:12,160 --> 00:03:09,920
all of these things interact with the

81
00:03:14,230 --> 00:03:12,170
atmosphere and with each other and of

82
00:03:15,670 --> 00:03:14,240
course the ocean which collects a lot of

83
00:03:18,400 --> 00:03:15,680
the heat eventually it comes from the

84
00:03:19,750 --> 00:03:18,410
Sun and then probably one of the more

85
00:03:21,610 --> 00:03:19,760
important things especially in very

86
00:03:23,860 --> 00:03:21,620
recent history our humans were a

87
00:03:26,350 --> 00:03:23,870
critical part now of the Earth's climate

88
00:03:28,480 --> 00:03:26,360

system and in order to understand all of

89
00:03:31,060 --> 00:03:28,490
these things we need data that look at

90
00:03:33,520 --> 00:03:31,070
all of these pieces of the picture so

91
00:03:35,560 --> 00:03:33,530
how does NASA do it one of the most

92
00:03:38,800 --> 00:03:35,570
critical ways that we do that is with

93
00:03:40,090 --> 00:03:38,810
our satellite system Betsy showed you a

94
00:03:42,070 --> 00:03:40,100
slide earlier and I have a different

95
00:03:44,229 --> 00:03:42,080
animation I want to show up to show a

96
00:03:46,300 --> 00:03:44,239
lot of these are satellites that we have

97
00:03:48,490 --> 00:03:46,310
orbiting up right now so if you look at

98
00:03:50,380 --> 00:03:48,500
this graphic you see a lot of satellites

99
00:03:52,030 --> 00:03:50,390
and they're all in orbits specifically

100
00:03:55,060 --> 00:03:52,040
designed to maximize the science of

101
00:03:56,500 --> 00:03:55,070
these particular armed satellites and if

102
00:03:59,860 --> 00:03:56,510
you look closely you see a whole bunch

103
00:04:01,090 --> 00:03:59,870
of them that are in nearly is so morbid

104
00:04:03,370 --> 00:04:01,100
if you look on the right side right now

105
00:04:04,960 --> 00:04:03,380
they're all in nearly the same orbit and

106
00:04:07,690 --> 00:04:04,970
that's this constellation to heard

107
00:04:10,150 --> 00:04:07,700
earlier from Ralph called the a train

108
00:04:11,920 --> 00:04:10,160
and I could go in to tell you what all

109
00:04:14,020 --> 00:04:11,930
of these satellites do there's a lot of

110
00:04:15,699 --> 00:04:14,030
observations y'all get very critical

111
00:04:17,380 --> 00:04:15,709
pieces of information but we don't have

112
00:04:19,510 --> 00:04:17,390
all day so I'm not going to do that but

113
00:04:22,090 --> 00:04:19,520

I will touch into a few important things

114
00:04:25,300 --> 00:04:22,100
about how we do that so if you bring up

115
00:04:27,250 --> 00:04:25,310
the next still which you saw earlier

116
00:04:29,050 --> 00:04:27,260
from Ralph in the a train

117
00:04:31,030 --> 00:04:29,060
co2 is going to be on the front edge of

118
00:04:33,190 --> 00:04:31,040
the a train but all of these

119
00:04:34,780 --> 00:04:33,200
observations that you see flying with 0

120
00:04:37,240 --> 00:04:34,790
co2 are going to be very important for

121
00:04:38,350 --> 00:04:37,250
understanding o co 2 and 0 co tuesday

122
00:04:39,520 --> 00:04:38,360
they are going to be very important for

123
00:04:41,440 --> 00:04:39,530
understanding a lot of these other

124
00:04:43,330 --> 00:04:41,450
satellites in particularly if you look

125
00:04:45,970 --> 00:04:43,340
at the Aqua satellite which is to back

126
00:04:48,400 --> 00:04:45,980
it gets some very important observations

127
00:04:50,460 --> 00:04:48,410
about whether about what's going on in

128
00:04:52,870 --> 00:04:50,470
the surface with trees with the

129
00:04:55,090 --> 00:04:52,880
terrestrial biosphere and with oceans

130
00:04:57,730 --> 00:04:55,100
and combining those data with those co2

131
00:04:59,470 --> 00:04:57,740
data can be very important those two

132
00:05:01,960 --> 00:04:59,480
satellite to see right after cloud set

133
00:05:03,730 --> 00:05:01,970
and Calypso they actually have active

134
00:05:05,530 --> 00:05:03,740
light sources on there and what they

135
00:05:07,380 --> 00:05:05,540
tell us about is what's going on with

136
00:05:09,670 --> 00:05:07,390
clouds and with aerosols in the system

137
00:05:11,860 --> 00:05:09,680
understanding the oco-2 data to the

138
00:05:13,780 --> 00:05:11,870

precision that we need having those data

139
00:05:15,760 --> 00:05:13,790
with it it's going to be very important

140
00:05:17,560 --> 00:05:15,770
and the last side light you see there

141
00:05:19,300 --> 00:05:17,570
the aura satellite which I also have the

142
00:05:21,310 --> 00:05:19,310
honor of being the program scientist for

143
00:05:23,350 --> 00:05:21,320
some of its observation sells a lot

144
00:05:25,660 --> 00:05:23,360
about air quality in the lowest part of

145
00:05:26,920 --> 00:05:25,670
the atmosphere and a lot of what affects

146
00:05:28,810 --> 00:05:26,930
air quality in the lowest part of the

147
00:05:30,700 --> 00:05:28,820
atmosphere is combustion processes the

148
00:05:32,770 --> 00:05:30,710
same processes that lead to humans

149
00:05:34,210 --> 00:05:32,780
addition of co2 in the atmosphere so

150
00:05:35,770 --> 00:05:34,220
scientists are going to be combining

151
00:05:38,590 --> 00:05:35,780
those types of data as well to try to

152
00:05:40,450 --> 00:05:38,600
understand in advance our science but

153
00:05:41,650 --> 00:05:40,460
one of the more critical parts of the

154
00:05:44,140 --> 00:05:41,660
science system that we really want

155
00:05:46,030 --> 00:05:44,150
understanding as a carbon cycle and to

156
00:05:47,440 --> 00:05:46,040
do that my colleague Dave is going to

157
00:05:49,660 --> 00:05:47,450
come up to your necks and tell you about

158
00:05:51,130 --> 00:05:49,670
how ocio tues data are really going to

159
00:05:53,620 --> 00:05:51,140
help us dancer questions about the

160
00:05:56,620 --> 00:05:53,630
carbon cycle so George thanks Ken and

161
00:05:58,090 --> 00:05:56,630
now to David crisp the oco-2 science

162
00:06:00,520 --> 00:05:58,100
team leader from Jet Propulsion

163
00:06:01,630 --> 00:06:00,530

Laboratory David thank you much Trojan

164
00:06:03,940 --> 00:06:01,640
thank you much again for that excellent

165
00:06:05,530 --> 00:06:03,950
introduction to understand the

166
00:06:07,510 --> 00:06:05,540
importance of the carbon cycle and the

167
00:06:10,180 --> 00:06:07,520
importance of the measurements that Oh

168
00:06:11,920 --> 00:06:10,190
co2 will be making in the next few

169
00:06:14,020 --> 00:06:11,930
months I'm going to have to bring you

170
00:06:16,090 --> 00:06:14,030
back to grade school where your teacher

171
00:06:18,010 --> 00:06:16,100
explained to you that plants all the

172
00:06:20,890 --> 00:06:18,020
green plants on earth absorbs sunlight

173
00:06:22,960 --> 00:06:20,900
and carbon dioxide from the air to form

174
00:06:27,070 --> 00:06:22,970
all of their leaves and their stems and

175
00:06:28,240 --> 00:06:27,080
their roots and during the spring in the

176
00:06:30,100 --> 00:06:28,250
summer when they're growing really fast

177
00:06:32,500 --> 00:06:30,110
if we bring up the first graph the first

178
00:06:35,290 --> 00:06:32,510
video you'll see that they actually make

179
00:06:36,700 --> 00:06:35,300
changes that are quite dramatic so once

180
00:06:39,040 --> 00:06:36,710
again the trees absorb carbon dioxide

181
00:06:41,050 --> 00:06:39,050
and sunlight and the graph they're

182
00:06:42,970 --> 00:06:41,060
showing it shows actually the

183
00:06:45,280 --> 00:06:42,980
that they also change the amount of

184
00:06:46,960 --> 00:06:45,290
carbon dioxide in the atmosphere when

185
00:06:48,850 --> 00:06:46,970
they're growing quickly they take so

186
00:06:50,640 --> 00:06:48,860
much carbon dioxide out that we can

187
00:06:53,140 --> 00:06:50,650
actually measure it from ground-based

188
00:06:55,150 --> 00:06:53,150

stations here on earth we now have about

189
00:06:57,280 --> 00:06:55,160
150 stations that are measuring carbon

190
00:06:59,200 --> 00:06:57,290
dioxide very very precisely from the

191
00:07:02,920 --> 00:06:59,210
surface of the earth and what we see is

192
00:07:04,510 --> 00:07:02,930
during the spring in the summer we

193
00:07:07,540 --> 00:07:04,520
actually see the carbon dioxide

194
00:07:10,120 --> 00:07:07,550
abundance of the atmosphere decrease by

195
00:07:11,680 --> 00:07:10,130
a couple of percent in these

196
00:07:13,690 --> 00:07:11,690
measurements seen here from maan Aloha

197
00:07:15,370 --> 00:07:13,700
Hawaii during the fall in the winter

198
00:07:17,110 --> 00:07:15,380
when the trees lose their leaves and

199
00:07:19,870 --> 00:07:17,120
they decay they release most of that

200
00:07:22,390 --> 00:07:19,880
carbon dioxide back to the system now

201
00:07:24,340 --> 00:07:22,400
this cycle that goes on every year has

202
00:07:26,950 --> 00:07:24,350
been going on for thousands to millions

203
00:07:29,050 --> 00:07:26,960
of years now you might also notice

204
00:07:30,940 --> 00:07:29,060
though that in addition to the

205
00:07:33,310 --> 00:07:30,950
up-and-down motion that we see as the

206
00:07:35,409 --> 00:07:33,320
trees breathe in carbon dioxide and

207
00:07:37,270 --> 00:07:35,419
re-release it to the air you see that

208
00:07:41,379 --> 00:07:37,280
the curve is going up a little bit into

209
00:07:43,480 --> 00:07:41,389
the right well that's us human beings as

210
00:07:46,840 --> 00:07:43,490
Ken mentioned are now a major component

211
00:07:48,930 --> 00:07:46,850
of our environment and our all of these

212
00:07:51,219 --> 00:07:48,940
cycles including the global carbon cycle

213
00:07:53,230 --> 00:07:51,229

scientists measure carbon dioxide in

214
00:07:56,230 --> 00:07:53,240
units of parts per million and what that

215
00:07:59,860 --> 00:07:56,240
really just means is that as you as you

216
00:08:02,620 --> 00:07:59,870
see here and the 390 indicates that

217
00:08:05,080 --> 00:08:02,630
about 390 molecules out of every million

218
00:08:07,600 --> 00:08:05,090
molecules of air are actually carbon

219
00:08:10,779 --> 00:08:07,610
dioxide molecules so we refer to that as

220
00:08:13,779 --> 00:08:10,789
a 390 part per million carbon dioxide

221
00:08:16,090 --> 00:08:13,789
ratio this year earlier earlier this

222
00:08:18,969 --> 00:08:16,100
year the amount of carbon dioxide in our

223
00:08:21,610 --> 00:08:18,979
atmosphere actually hit about 400 parts

224
00:08:24,730 --> 00:08:21,620
per million for the second time it

225
00:08:26,590 --> 00:08:24,740
turned out in in the last hundred

226
00:08:28,900 --> 00:08:26,600
thousand years or i should say eight

227
00:08:30,610 --> 00:08:28,910
hundred thousand years or longer it's

228
00:08:32,440 --> 00:08:30,620
been this is the highest level we've

229
00:08:34,719 --> 00:08:32,450
seen carbon dioxide in our atmosphere in

230
00:08:36,699 --> 00:08:34,729
a very very long time and once i once

231
00:08:38,800 --> 00:08:36,709
again largely because of our

232
00:08:40,600 --> 00:08:38,810
contributions to the system now to

233
00:08:42,399 --> 00:08:40,610
understand that system a little bit more

234
00:08:43,990 --> 00:08:42,409
and understand the carbon cycle and the

235
00:08:45,790 --> 00:08:44,000
kinds of measurements and the value of

236
00:08:47,290 --> 00:08:45,800
the measurements that o co will be

237
00:08:48,790 --> 00:08:47,300
making let's introduce some of the

238
00:08:50,770 --> 00:08:48,800

characters in the carbon cycle you've

239
00:08:53,530 --> 00:08:50,780
already seen the land plants so if we

240
00:08:55,030 --> 00:08:53,540
bring up the next graphic the main

241
00:08:58,269 --> 00:08:55,040
players in this system

242
00:09:00,670 --> 00:08:58,279
include the plants on land the next of

243
00:09:02,379 --> 00:09:00,680
course are the ocean the ocean actually

244
00:09:05,590 --> 00:09:02,389
plays a major role in the carbon cycle

245
00:09:07,210 --> 00:09:05,600
taking up carbon dioxide in parts of the

246
00:09:08,769 --> 00:09:07,220
atmosphere are in parts of the world

247
00:09:10,569 --> 00:09:08,779
where it's usually colder and then

248
00:09:12,939 --> 00:09:10,579
releasing it in places where there's

249
00:09:14,530 --> 00:09:12,949
upwelling and it's warmer then finally

250
00:09:16,540 --> 00:09:14,540
the atmosphere which is the exchange

251
00:09:20,499 --> 00:09:16,550
media where they exchange carbon dioxide

252
00:09:22,689 --> 00:09:20,509
the Earth's plants emit about 440

253
00:09:24,610 --> 00:09:22,699
billion tons of carbon dioxide to the

254
00:09:26,949 --> 00:09:24,620
air every year and then reabsorb a

255
00:09:29,829 --> 00:09:26,959
little bit more than that the ocean also

256
00:09:32,139 --> 00:09:29,839
is a major player emitting about 330

257
00:09:34,240 --> 00:09:32,149
billion tons of carbon dioxide into the

258
00:09:36,730 --> 00:09:34,250
atmosphere every year and reabsorbing a

259
00:09:38,980 --> 00:09:36,740
comparable amount the new players on the

260
00:09:40,660 --> 00:09:38,990
block r us since the beginning of the

261
00:09:44,530 --> 00:09:40,670
Industrial Age we've been burning fossil

262
00:09:46,150 --> 00:09:44,540
fuels also practicing deforestation and

263
00:09:47,829 --> 00:09:46,160

other things that have been emitting

264
00:09:50,139 --> 00:09:47,839
carbon dioxide into the atmosphere and

265
00:09:53,319 --> 00:09:50,149
an ever growing rate human beings are

266
00:09:55,720 --> 00:09:53,329
now emitting about 40 billion tons of

267
00:09:58,360 --> 00:09:55,730
carbon dioxide into the atmosphere every

268
00:10:01,210 --> 00:09:58,370
year that's about five and a half tons

269
00:10:03,759 --> 00:10:01,220
for every man woman and child on the

270
00:10:06,189 --> 00:10:03,769
earth and that that as you can see from

271
00:10:09,100 --> 00:10:06,199
the graphic here that input into the

272
00:10:11,620 --> 00:10:09,110
atmosphere isn't balanced by an uptake

273
00:10:13,269 --> 00:10:11,630
like the oceans and the atmosphere so

274
00:10:14,740 --> 00:10:13,279
we're basically building up the carbon

275
00:10:18,639 --> 00:10:14,750
dioxide in the atmosphere of the earth

276
00:10:21,519 --> 00:10:18,649
slowly but at a ever ever increasing

277
00:10:23,530 --> 00:10:21,529
rate so now but that's just part of the

278
00:10:24,579 --> 00:10:23,540
story the other part of the story in the

279
00:10:26,980 --> 00:10:24,589
real mystery is shown in the next

280
00:10:29,110 --> 00:10:26,990
graphic we've been slowly but surely

281
00:10:31,689 --> 00:10:29,120
increasing the inputs of carbon dioxide

282
00:10:33,340 --> 00:10:31,699
by burning fossil fuels over time and

283
00:10:35,920 --> 00:10:33,350
this is a graph that shows that a number

284
00:10:37,990 --> 00:10:35,930
of tons of carbon dioxide we've added to

285
00:10:40,240 --> 00:10:38,000
the atmosphere since about nineteen

286
00:10:41,590 --> 00:10:40,250
sixty that's total emissions shown there

287
00:10:43,030 --> 00:10:41,600
and you see it going it's going up to

288
00:10:45,429 --> 00:10:43,040

the right we are now admitting about

289
00:10:47,319 --> 00:10:45,439
forty billion tons of carbon dioxide but

290
00:10:49,150 --> 00:10:47,329
that's only half the story because it

291
00:10:51,249 --> 00:10:49,160
turns out that not all of that carbon

292
00:10:53,410 --> 00:10:51,259
dioxide is staying in the atmosphere

293
00:10:55,329 --> 00:10:53,420
only about half of it is staying in the

294
00:10:57,189 --> 00:10:55,339
atmosphere over time the blue curve

295
00:10:59,199 --> 00:10:57,199
shows the amount of accumulation of

296
00:11:01,720 --> 00:10:59,209
carbon dioxide in the atmosphere every

297
00:11:03,699 --> 00:11:01,730
year and it's only at about half the

298
00:11:05,620 --> 00:11:03,709
level we're putting it in half of the

299
00:11:07,720 --> 00:11:05,630
carbon dioxide we're dumping into the

300
00:11:08,650 --> 00:11:07,730
atmosphere every year is disappearing

301
00:11:10,990 --> 00:11:08,660
somewhere

302
00:11:13,660 --> 00:11:11,000
it's being it's dissolving in the ocean

303
00:11:15,249 --> 00:11:13,670
waters about a quarter of it is we know

304
00:11:17,079 --> 00:11:15,259
that from our measurements and the other

305
00:11:19,090 --> 00:11:17,089
quarter we assume is going somewhere

306
00:11:21,939 --> 00:11:19,100
into the land biosphere somewhere into

307
00:11:24,460 --> 00:11:21,949
forests into trees into grasslands

308
00:11:26,740 --> 00:11:24,470
somewhere but we don't know where have

309
00:11:29,199 --> 00:11:26,750
you seen a new rain forest spring into

310
00:11:32,499 --> 00:11:29,209
existence over the last say 40 years or

311
00:11:34,210 --> 00:11:32,509
so neither of we we're looking for those

312
00:11:36,129 --> 00:11:34,220
kinds of processes because we know that

313
00:11:37,990 --> 00:11:36,139

that's what's going on that's absorbing

314
00:11:40,389 --> 00:11:38,000
this carbon dioxide it is absolutely

315
00:11:42,160 --> 00:11:40,399
critical that we learn what processes

316
00:11:44,379 --> 00:11:42,170
are absorbing carbon dioxide in our

317
00:11:46,420 --> 00:11:44,389
system today over half of the carbon

318
00:11:49,059 --> 00:11:46,430
dioxide were emitting because we need to

319
00:11:51,579 --> 00:11:49,069
understand first of all how much longer

320
00:11:53,949 --> 00:11:51,589
they might continue to do us that great

321
00:11:55,420 --> 00:11:53,959
favor the other thing though is you

322
00:11:58,449 --> 00:11:55,430
might have noticed in that previous

323
00:11:59,860 --> 00:11:58,459
curve is that the while the our inputs

324
00:12:02,079 --> 00:11:59,870
have been growing slowly and steadily

325
00:12:04,119 --> 00:12:02,089
over time the amount that stays in the

326
00:12:05,980 --> 00:12:04,129
atmosphere varies dramatically from year

327
00:12:08,199 --> 00:12:05,990
to year sometimes almost a hundred

328
00:12:09,519 --> 00:12:08,209
percent of the carbon dioxide we put

329
00:12:13,170 --> 00:12:09,529
into the atmosphere stays there

330
00:12:16,210 --> 00:12:13,180
sometimes almost none we don't know why

331
00:12:18,939 --> 00:12:16,220
we need to understand those processes as

332
00:12:20,740 --> 00:12:18,949
well in order to understand how carbon

333
00:12:22,960 --> 00:12:20,750
dioxide will build up in our system in

334
00:12:25,329 --> 00:12:22,970
the future and how we might manage

335
00:12:27,850 --> 00:12:25,339
carbon dioxide buildup if that's what

336
00:12:30,100 --> 00:12:27,860
our policymakers decides decide to do

337
00:12:31,900 --> 00:12:30,110
but we need to understand that and to

338
00:12:33,670 --> 00:12:31,910

understand that we can't do it with just

339
00:12:35,439 --> 00:12:33,680
a hundred and fifty stations making

340
00:12:37,329 --> 00:12:35,449
precise measurements on the surface of

341
00:12:39,340 --> 00:12:37,339
the earth we now have a satellite that

342
00:12:41,199 --> 00:12:39,350
you heard about earlier the Japanese

343
00:12:42,939 --> 00:12:41,209
greenhouse gases observing satellite

344
00:12:45,910 --> 00:12:42,949
that has been making measurements for

345
00:12:47,410 --> 00:12:45,920
about five years it makes another 350 to

346
00:12:50,319 --> 00:12:47,420
a thousand measurements over the earth

347
00:12:52,569 --> 00:12:50,329
every day that still isn't enough to

348
00:12:55,389 --> 00:12:52,579
find the sources emitting carbon dioxide

349
00:12:57,429 --> 00:12:55,399
into the air and the natural processes

350
00:12:59,139 --> 00:12:57,439
that are absorbing carbon dioxide out of

351
00:13:02,170 --> 00:12:59,149
the atmosphere we need far more

352
00:13:03,819 --> 00:13:02,180
measurements so just like for weather

353
00:13:05,740 --> 00:13:03,829
satellites and weather measurements that

354
00:13:07,389 --> 00:13:05,750
we're making that have revolutionized

355
00:13:10,179 --> 00:13:07,399
our ability to predict the weather we

356
00:13:12,129 --> 00:13:10,189
need satellites in space to make very

357
00:13:14,230 --> 00:13:12,139
very much very much larger number of

358
00:13:16,509 --> 00:13:14,240
measurements at much higher resolution

359
00:13:18,600 --> 00:13:16,519
over the entire globe in order to

360
00:13:21,220 --> 00:13:18,610
actually start studying these problems

361
00:13:22,210 --> 00:13:21,230
the orbiting carbon Observatory two is

362
00:13:24,010 --> 00:13:22,220
the first

363
00:13:26,410 --> 00:13:24,020

light that NASA is built that can do

364
00:13:28,090 --> 00:13:26,420
this it will actually increase by

365
00:13:30,190 --> 00:13:28,100
something like an a factor of a hundred

366
00:13:32,530 --> 00:13:30,200
the number of measurements we make over

367
00:13:34,600 --> 00:13:32,540
the earth every day and so what I'll do

368
00:13:35,980 --> 00:13:34,610
is my colleague enri eldering we'll talk

369
00:13:37,510 --> 00:13:35,990
a little bit more about that later but

370
00:13:41,080 --> 00:13:37,520
George I want to give this back to you

371
00:13:43,450 --> 00:13:41,090
all right thank you David and Emory

372
00:13:47,380 --> 00:13:43,460
elder lling is our oco-2 deputy project

373
00:13:49,300 --> 00:13:47,390
scientist Emory George so dave told you

374
00:13:51,190 --> 00:13:49,310
a bit about the carbon cycle and the

375
00:13:54,310 --> 00:13:51,200
mysteries that we want to solve with

376
00:13:56,680 --> 00:13:54,320
oco-2 but how well do we have to measure

377
00:13:58,990 --> 00:13:56,690
carbon dioxide to answer these questions

378
00:14:00,700 --> 00:13:59,000
that he's posed well he mentioned that

379
00:14:03,610 --> 00:14:00,710
the concentrations have reached up to

380
00:14:05,530 --> 00:14:03,620
400 parts per million these days and if

381
00:14:07,060 --> 00:14:05,540
oh co 2 wants to understand where that

382
00:14:09,550 --> 00:14:07,070
carbon comes and goes we need to measure

383
00:14:13,030 --> 00:14:09,560
to one part per million so that's really

384
00:14:15,220 --> 00:14:13,040
a very small change in that 402 give you

385
00:14:18,010 --> 00:14:15,230
some sense of that we made a little jar

386
00:14:19,210 --> 00:14:18,020
of beans and these represent 400 parts

387
00:14:20,890 --> 00:14:19,220
per million if I look through the

388
00:14:22,900 --> 00:14:20,900

atmosphere these might be all the carbon

389
00:14:25,540 --> 00:14:22,910
dioxide I see when there's 400 parts per

390
00:14:27,880 --> 00:14:25,550
million so if I want to add one part per

391
00:14:29,770 --> 00:14:27,890
million I just add a few beans here and

392
00:14:31,630 --> 00:14:29,780
there we go the concentration just

393
00:14:33,880 --> 00:14:31,640
changed by one part per million that's

394
00:14:35,950 --> 00:14:33,890
what I have to see happen just those few

395
00:14:38,770 --> 00:14:35,960
little beings where am I here we go with

396
00:14:40,330 --> 00:14:38,780
oco-2 so a little a little more

397
00:14:42,460 --> 00:14:40,340
information about why one part per

398
00:14:45,550 --> 00:14:42,470
million is so important we made a movie

399
00:14:47,710 --> 00:14:45,560
that will show here of a carbon dioxide

400
00:14:49,770 --> 00:14:47,720
field that was generated by a model our

401
00:14:53,170 --> 00:14:49,780
colleague leslie odd at goddard space

402
00:14:55,810 --> 00:14:53,180
space science center made this movie of

403
00:14:57,970 --> 00:14:55,820
the total column of carbon dioxide this

404
00:15:00,190 --> 00:14:57,980
is the type of information oco-2 will

405
00:15:02,830 --> 00:15:00,200
collect and you can see the colors here

406
00:15:05,130 --> 00:15:02,840
range from deep blues which are 370

407
00:15:07,840 --> 00:15:05,140
parts per million to these Reds that are

408
00:15:09,880 --> 00:15:07,850
390 but if you look at some of the

409
00:15:12,340 --> 00:15:09,890
details the Northern Hemisphere's are a

410
00:15:13,870 --> 00:15:12,350
kind of a blue down to a moderate read

411
00:15:15,730 --> 00:15:13,880
in the more southern hemisphere that's

412
00:15:17,200 --> 00:15:15,740
only a 10 part per million difference

413
00:15:19,600 --> 00:15:17,210

between the northern parts of the globe

414
00:15:21,070 --> 00:15:19,610
and the southern and if I'm trying to

415
00:15:22,720 --> 00:15:21,080
answer the question of whether the

416
00:15:25,480 --> 00:15:22,730
Karnak sides being taken up by the

417
00:15:28,120 --> 00:15:25,490
northern hemisphere or the forest over

418
00:15:30,520 --> 00:15:28,130
Asia you can see those differences are

419
00:15:32,320 --> 00:15:30,530
just small there may be one two or three

420
00:15:34,900 --> 00:15:32,330
parts per million of difference in the

421
00:15:35,980 --> 00:15:34,910
concentrations of carbon dioxide so Oh

422
00:15:37,930 --> 00:15:35,990
co2 is really

423
00:15:40,360 --> 00:15:37,940
required to have a high degree of

424
00:15:41,920 --> 00:15:40,370
sensitivity to make carbon dioxide

425
00:15:44,440 --> 00:15:41,930
measurements to see these differences

426
00:15:45,910 --> 00:15:44,450
across across the globe and you see the

427
00:15:48,070 --> 00:15:45,920
features Dave talked about how the

428
00:15:49,870 --> 00:15:48,080
northern hemisphere is very blue or low

429
00:15:52,210 --> 00:15:49,880
in concentration because the trees are

430
00:15:54,760 --> 00:15:52,220
growing and taking up the carbon dioxide

431
00:15:59,290 --> 00:15:54,770
there's areas of red where we're burning

432
00:16:01,329 --> 00:15:59,300
fossil biomass trees forest fires create

433
00:16:03,579 --> 00:16:01,339
these big carbon dioxide concentrations

434
00:16:07,420 --> 00:16:03,589
so that's what we expect to have to

435
00:16:09,760 --> 00:16:07,430
sense with the co-ceo to instrument so

436
00:16:11,139 --> 00:16:09,770
it's a challenging measurement and I

437
00:16:13,660 --> 00:16:11,149
want to tell you just a little bit more

438
00:16:15,490 --> 00:16:13,670

about how we do this so the oco-2

439
00:16:17,440 --> 00:16:15,500
instrument is actually looking at

440
00:16:19,120 --> 00:16:17,450
reflected sunlight we have a still

441
00:16:22,870 --> 00:16:19,130
graphic here just to illustrate the idea

442
00:16:25,360 --> 00:16:22,880
oh sorry that's not quite it but you can

443
00:16:27,100 --> 00:16:25,370
imagine the sun's shining reflecting off

444
00:16:28,660 --> 00:16:27,110
of the Earth's surface and then back up

445
00:16:30,070 --> 00:16:28,670
to our instrument and that's the light

446
00:16:32,440 --> 00:16:30,080
that we receive to make these

447
00:16:36,100 --> 00:16:32,450
measurements we actually split that into

448
00:16:38,170 --> 00:16:36,110
a thousand small fractions of a

449
00:16:40,840 --> 00:16:38,180
wavelength of light in three different

450
00:16:43,389 --> 00:16:40,850
bands to see the unique fingerprint of

451
00:16:44,800 --> 00:16:43,399
the absorption of carbon dioxide so we

452
00:16:47,050 --> 00:16:44,810
believe we have an instrument that's

453
00:16:49,420 --> 00:16:47,060
built it includes the technology we need

454
00:16:51,760 --> 00:16:49,430
to make this very precise measurement of

455
00:16:53,980 --> 00:16:51,770
carbon dioxide and there's been a new

456
00:16:55,720 --> 00:16:53,990
interesting discovery researchers have

457
00:16:58,030 --> 00:16:55,730
recently been looking at the unique

458
00:16:59,980 --> 00:16:58,040
fingerprints of light and in a number of

459
00:17:01,810 --> 00:16:59,990
remote sensing measurements including go

460
00:17:04,329 --> 00:17:01,820
sat they've noticed that they see

461
00:17:06,250 --> 00:17:04,339
something we hadn't looked at before and

462
00:17:08,439 --> 00:17:06,260
as Dave mentioned plants are a really

463
00:17:10,480 --> 00:17:08,449

important part of the carbon cycle and

464
00:17:12,939 --> 00:17:10,490
in fact when those plants are doing

465
00:17:14,890 --> 00:17:12,949
photosynthesis they actually give off a

466
00:17:17,140 --> 00:17:14,900
little bit of light they full arrests or

467
00:17:19,030 --> 00:17:17,150
emit light and researchers have now

468
00:17:21,610 --> 00:17:19,040
shown that they can detect this signal

469
00:17:23,290 --> 00:17:21,620
in remote sensing measurements so the

470
00:17:26,860 --> 00:17:23,300
final figure I wanted to show you is a

471
00:17:28,329 --> 00:17:26,870
simulation of the expected signal we

472
00:17:29,980 --> 00:17:28,339
should see from these plants doing

473
00:17:31,750 --> 00:17:29,990
fluorescence or the solar induced

474
00:17:34,870 --> 00:17:31,760
fluorescence this is a map of what Oh

475
00:17:36,700 --> 00:17:34,880
co2 is expected to observe and this will

476
00:17:38,140 --> 00:17:36,710
be really valuable because the carbon

477
00:17:40,360 --> 00:17:38,150
dioxide measurements are the key to

478
00:17:41,919 --> 00:17:40,370
unlocking the sources and sinks but

479
00:17:43,480 --> 00:17:41,929
additional information like the

480
00:17:45,490 --> 00:17:43,490
fluorescence from the plants that are

481
00:17:47,680 --> 00:17:45,500
photosynthesizing gives you another

482
00:17:49,180 --> 00:17:47,690
piece of information to help unlock that

483
00:17:50,380 --> 00:17:49,190
puzzle and

484
00:17:52,960 --> 00:17:50,390
figure out what's happening with the

485
00:17:55,180 --> 00:17:52,970
carbon cycle so I think I speak on the

486
00:17:57,640 --> 00:17:55,190
behalf of the team we're just incredibly

487
00:17:59,350 --> 00:17:57,650
excited about our launch we're glad the

488
00:18:02,380 --> 00:17:59,360

weather's looking good everything's a go

489
00:18:04,210 --> 00:18:02,390
for 256 a.m. on the first and we think

490
00:18:06,190 --> 00:18:04,220
that the oco-2 measurement should have

491
00:18:07,900 --> 00:18:06,200
the precision the coverage and the

492
00:18:09,940 --> 00:18:07,910
resolution that we need to really answer

493
00:18:12,040 --> 00:18:09,950
this important science question about

494
00:18:14,320 --> 00:18:12,050
the sources and sinks across the globe

495
00:18:16,720 --> 00:18:14,330
thanks back to you George thanks Anne

496
00:18:19,870 --> 00:18:16,730
Marie and we're ready now to take

497
00:18:22,480 --> 00:18:19,880
questions and once again that you can't

498
00:18:25,450 --> 00:18:22,490
ask questions on Twitter by going to

499
00:18:27,220 --> 00:18:25,460
pound ask NASA during this briefing in

500
00:18:29,740 --> 00:18:27,230
question and answer session we'll start

501
00:18:32,500 --> 00:18:29,750
here in the room and then we'll take any

502
00:18:35,740 --> 00:18:32,510
Twitter questions Justin Justin right

503
00:18:38,020 --> 00:18:35,750
with the spaceflight now calm for David

504
00:18:41,230 --> 00:18:38,030
crisp you were obviously involved in OC

505
00:18:43,300 --> 00:18:41,240
01 the first go-around what's it like to

506
00:18:45,160 --> 00:18:43,310
be back here five years later it's

507
00:18:47,170 --> 00:18:45,170
absolutely fantastic to get another

508
00:18:48,610 --> 00:18:47,180
opportunity to actually conduct these

509
00:18:50,950 --> 00:18:48,620
incredibly important scientific

510
00:18:58,140 --> 00:18:50,960
measurements it's been a long hard road

511
00:19:00,310 --> 00:18:58,150
but boy I'm glad to be back Janine

512
00:19:04,090 --> 00:19:00,320
considering the past experience how

513
00:19:08,010 --> 00:19:04,100

nervous are you for Tuesday morning are

514
00:19:10,450 --> 00:19:08,020
you lots of stomach medicine actually

515
00:19:13,750 --> 00:19:10,460
we've been we've done everything humanly

516
00:19:16,180 --> 00:19:13,760
possible this time as before to ensure a

517
00:19:17,950 --> 00:19:16,190
safe and successful launch in addition

518
00:19:21,490 --> 00:19:17,960
to that the launch vehicle that we're

519
00:19:23,680 --> 00:19:21,500
riding on this time the Delta 2 is the

520
00:19:26,470 --> 00:19:23,690
most reliable launch vehicle and NASA's

521
00:19:29,800 --> 00:19:26,480
fleet I am honored that anybody would

522
00:19:33,280 --> 00:19:29,810
consider flying such a small science

523
00:19:37,690 --> 00:19:33,290
experiment on such a highly reliable

524
00:19:39,670 --> 00:19:37,700
vehicle so I'm I'm looking forward to

525
00:19:42,340 --> 00:19:39,680
getting past this step as I mentioned

526
00:19:45,820 --> 00:19:42,350
before it's it's been a long run up to

527
00:19:48,310 --> 00:19:45,830
the starting line of this race but we're

528
00:19:50,710 --> 00:19:48,320
ready to start now and so most of us are

529
00:19:52,390 --> 00:19:50,720
looking forward planning ahead we've had

530
00:19:54,130 --> 00:19:52,400
opportunities working with the Japanese

531
00:19:56,320 --> 00:19:54,140
over the last five years on the ghost at

532
00:19:58,030 --> 00:19:56,330
mission you analyzing their data that

533
00:20:00,280 --> 00:19:58,040
have been absolutely fantastic we've

534
00:20:02,590 --> 00:20:00,290
learned so much about what we can learn

535
00:20:04,510 --> 00:20:02,600
about these data

536
00:20:07,210 --> 00:20:04,520
learn about co2 from from space based

537
00:20:09,400 --> 00:20:07,220
data with oco-2 taking about a hundred

538
00:20:12,010 --> 00:20:09,410

times as much data each day as go sat

539
00:20:14,529 --> 00:20:12,020
we're really enthusiastic and looking

540
00:20:16,960 --> 00:20:14,539
forward to the the kinds of things we

541
00:20:18,700 --> 00:20:16,970
might learn from from these data what

542
00:20:21,400 --> 00:20:18,710
kind of weeks were you able to make to

543
00:20:27,760 --> 00:20:21,410
get better data and better take

544
00:20:29,680 --> 00:20:27,770
advantage of the extra time as ralph

545
00:20:32,500 --> 00:20:29,690
said in earlier as Ralph Basilio

546
00:20:36,070 --> 00:20:32,510
mentioned this is truly a carbon copy of

547
00:20:39,700 --> 00:20:36,080
the OC OC o satellite and we basically

548
00:20:42,250 --> 00:20:39,710
used the the plans we had last time

549
00:20:44,830 --> 00:20:42,260
because it was seen as being the fastest

550
00:20:47,220 --> 00:20:44,840
and Lois risks and lowest cost method to

551
00:20:50,020 --> 00:20:47,230
get these critical measurements made so

552
00:20:52,870 --> 00:20:50,030
it turns out that as did mentioned we

553
00:20:54,549 --> 00:20:52,880
also we couldn't use we couldn't find

554
00:20:56,440 --> 00:20:54,559
all the parts we use to build the

555
00:20:58,360 --> 00:20:56,450
original spacecraft some of them are

556
00:20:59,830 --> 00:20:58,370
obsolete it's been almost a decade and a

557
00:21:01,450 --> 00:20:59,840
half since we started this mission and

558
00:21:03,279 --> 00:21:01,460
so we did have to replace some parts

559
00:21:05,890 --> 00:21:03,289
that had become obsolete or otherwise

560
00:21:08,230 --> 00:21:05,900
impossible to get but in replacing those

561
00:21:10,480 --> 00:21:08,240
parts we basically tried to duplicate

562
00:21:12,450 --> 00:21:10,490
the functionality of the original parts

563
00:21:14,799 --> 00:21:12,460

so that we could meet our requirements

564
00:21:17,940 --> 00:21:14,809
the two different systems essentially

565
00:21:23,470 --> 00:21:17,950
try to meet the same set of requirements

566
00:21:26,830 --> 00:21:23,480
ok Justin how follow up for any of the

567
00:21:28,810 --> 00:21:26,840
participants of the mission is two years

568
00:21:32,100 --> 00:21:28,820
for for a nominal mission but how long

569
00:21:35,799 --> 00:21:32,110
do you expect the mission really to last

570
00:21:37,899 --> 00:21:35,809
a lot of this will depend on how long

571
00:21:41,110 --> 00:21:37,909
each single string part of the

572
00:21:44,020 --> 00:21:41,120
instrument actually lasts NASA's history

573
00:21:45,730 --> 00:21:44,030
is these types of missions last a lot

574
00:21:49,510 --> 00:21:45,740
longer than they were planned for and

575
00:21:51,370 --> 00:21:49,520
we're hopeful that that happens there's

576
00:21:52,870 --> 00:21:51,380
the one time constraint is the amount of

577
00:21:57,100 --> 00:21:52,880
fuel that the spacecraft actually

578
00:21:59,320 --> 00:21:57,110
carries it should take us up to a decade

579
00:22:01,570 --> 00:21:59,330
we think that this instrument could stay

580
00:22:03,399 --> 00:22:01,580
up for with that one time constraint all

581
00:22:05,560 --> 00:22:03,409
the other single string components we

582
00:22:07,630 --> 00:22:05,570
don't know but history and with those as

583
00:22:11,410 --> 00:22:07,640
careful as a team has been we hope that

584
00:22:18,530 --> 00:22:15,340
and thank you for very informative

585
00:22:22,210 --> 00:22:18,540
presentation and I am very curious you

586
00:22:26,270 --> 00:22:22,220
touched on the mystery of disappearing

587
00:22:29,150 --> 00:22:26,280
act outside and I am curious do you have

588
00:22:31,250 --> 00:22:29,160

any suspicions where it's disappearing

589
00:22:34,190 --> 00:22:31,260
and will you share with us if you

590
00:22:36,440 --> 00:22:34,200
discover it as you know scientists

591
00:22:37,820 --> 00:22:36,450
usually have a working hypothesis but

592
00:22:40,070 --> 00:22:37,830
what we're trying to do usually is to

593
00:22:41,600 --> 00:22:40,080
break that hypothesis and so I could be

594
00:22:43,790 --> 00:22:41,610
a hundred percent wrong here but here we

595
00:22:45,320 --> 00:22:43,800
go we know that the ocean is taking up

596
00:22:46,820 --> 00:22:45,330
about one-quarter of all the carbon

597
00:22:49,280 --> 00:22:46,830
dioxide that we're emitting at this

598
00:22:50,960 --> 00:22:49,290
point we know that by measuring the pH

599
00:22:53,450 --> 00:22:50,970
or the acidity of the ocean water and

600
00:22:55,220 --> 00:22:53,460
watching it increase over time the rest

601
00:22:57,260 --> 00:22:55,230
must be going into the land somewhere

602
00:22:59,840 --> 00:22:57,270
but we don't know whether it's the

603
00:23:02,690 --> 00:22:59,850
rainforest like the Amazon in the

604
00:23:05,840 --> 00:23:02,700
tropics or mid latitude rainforest like

605
00:23:08,810 --> 00:23:05,850
those in Oregon or forest like those in

606
00:23:10,610 --> 00:23:08,820
very high latitudes the boreal forest it

607
00:23:12,290 --> 00:23:10,620
can be in any of those areas in there

608
00:23:14,570 --> 00:23:12,300
very good theory supporting all three

609
00:23:16,660 --> 00:23:14,580
and about every year scientists put a

610
00:23:19,160 --> 00:23:16,670
paper in science magazine or nature

611
00:23:20,840 --> 00:23:19,170
proving that it's one of those three but

612
00:23:22,310 --> 00:23:20,850
it's different every year we're hoping

613
00:23:24,380 --> 00:23:22,320

to be finally be able to discriminate

614
00:23:27,650 --> 00:23:24,390
between those different possibilities

615
00:23:31,450 --> 00:23:27,660
with oco-2 is wonderful to see a woman

616
00:23:36,500 --> 00:23:31,460
as a part of such an accomplished team

617
00:23:39,440 --> 00:23:36,510
truly a how many women are empowering

618
00:23:40,850 --> 00:23:39,450
this incredible group well that it's

619
00:23:43,549 --> 00:23:40,860
interesting because actually in

620
00:23:45,500 --> 00:23:43,559
atmospheric sciences there's a good

621
00:23:47,900 --> 00:23:45,510
representation of women in those fields

622
00:23:49,460 --> 00:23:47,910
and so we actually have the movie I

623
00:23:51,200 --> 00:23:49,470
showed you is made by one of our female

624
00:23:53,540 --> 00:23:51,210
colleagues over a Goddard and I would

625
00:23:55,460 --> 00:23:53,550
say it's a fair reflection of the

626
00:23:57,020 --> 00:23:55,470
graduation rates and the training that's

627
00:24:00,010 --> 00:23:57,030
happening these days so it's a nice

628
00:24:03,710 --> 00:24:00,020
environment for me to work and I like it

629
00:24:06,169 --> 00:24:03,720
Steve erect questions on Twitter yeah

630
00:24:08,150 --> 00:24:06,179
several some social media George first

631
00:24:14,109 --> 00:24:08,160
one how long will it take for oco-2 to

632
00:24:16,899 --> 00:24:14,119
observe the entire planet 16 days

633
00:24:18,779 --> 00:24:16,909
we don't cover the entire planet Oh co2

634
00:24:23,019 --> 00:24:18,789
makes measurements along a narrow

635
00:24:25,269 --> 00:24:23,029
measurement track that's that and and it

636
00:24:28,179 --> 00:24:25,279
basically circles the earth every every

637
00:24:30,939 --> 00:24:28,189
hundred minutes or 98.9 minutes and so

638
00:24:34,539 --> 00:24:30,949

we never actually map up the entire

639
00:24:37,359 --> 00:24:34,549
planet but we do retreat repeated our

640
00:24:39,309 --> 00:24:37,369
track about every 16 days and the

641
00:24:42,249 --> 00:24:39,319
largest distance between the tracks at

642
00:24:45,489 --> 00:24:42,259
the equator is about 152 kilometers are

643
00:24:47,079 --> 00:24:45,499
about 100 miles and each track is about

644
00:24:50,289 --> 00:24:47,089
10 miles wide at the moment our seven

645
00:24:52,299 --> 00:24:50,299
miles wide at the most so we it takes us

646
00:24:57,969 --> 00:24:52,309
we cover seven percent of the earth

647
00:24:59,949 --> 00:24:57,979
every repeat cycle every 16 days okay

648
00:25:01,089 --> 00:24:59,959
the next question the oco-2 mission I

649
00:25:03,849 --> 00:25:01,099
understand will be used to identify

650
00:25:06,579 --> 00:25:03,859
where on earth co2 is being absorbed

651
00:25:09,249 --> 00:25:06,589
from the atmosphere the carbon sinks how

652
00:25:11,679 --> 00:25:09,259
willow co2 data help figure out whether

653
00:25:20,249 --> 00:25:11,689
these sinks will continue acting as

654
00:25:22,389 --> 00:25:20,259
sinks into the future thanks Dave so one

655
00:25:24,459 --> 00:25:22,399
important thing to realize is that the

656
00:25:25,959 --> 00:25:24,469
measurements we make don't alone answer

657
00:25:27,819 --> 00:25:25,969
this question but we actually work with

658
00:25:29,949 --> 00:25:27,829
the science community in groups of

659
00:25:31,839 --> 00:25:29,959
people of science of modelers you have

660
00:25:34,479 --> 00:25:31,849
representation of all these processes

661
00:25:36,279 --> 00:25:34,489
around the globe and our thinking is

662
00:25:38,379 --> 00:25:36,289
that when we have this observational

663
00:25:40,419 --> 00:25:38,389

data they work with their global models

664
00:25:43,419 --> 00:25:40,429
they can basically test their hypotheses

665
00:25:45,579 --> 00:25:43,429
about what's driving the change over

666
00:25:47,379 --> 00:25:45,589
time and over space so the more we

667
00:25:49,989 --> 00:25:47,389
understand what the key drivers is

668
00:25:52,109 --> 00:25:49,999
perhaps its water availability perhaps

669
00:25:54,369 --> 00:25:52,119
its sunlight perhaps its other

670
00:25:55,749 --> 00:25:54,379
constraints then we can improve the way

671
00:25:57,249 --> 00:25:55,759
they represent those models and

672
00:25:59,499 --> 00:25:57,259
therefore improve the predictions of the

673
00:26:02,289 --> 00:25:59,509
future so it's a multi-step process to

674
00:26:05,859 --> 00:26:02,299
get to those predictions but we can see

675
00:26:08,169 --> 00:26:05,869
the path there okay next question how

676
00:26:11,229 --> 00:26:08,179
will L co2 data be used by environmental

677
00:26:13,239 --> 00:26:11,239
scientist to tackle pollution the

678
00:26:18,179 --> 00:26:13,249
pollution caused by emissions of

679
00:26:24,309 --> 00:26:20,979
what we will be able to see with the

680
00:26:25,100 --> 00:26:24,319
oco-2 data are areas of the globe where

681
00:26:27,650 --> 00:26:25,110
there are

682
00:26:30,020 --> 00:26:27,660
more elevated levels relative to areas

683
00:26:31,730 --> 00:26:30,030
nearby so that's one way that people

684
00:26:35,000 --> 00:26:31,740
will be able to use these data to try to

685
00:26:37,220 --> 00:26:35,010
understand pollution sources but we also

686
00:26:38,720 --> 00:26:37,230
have a number of other observations that

687
00:26:40,160 --> 00:26:38,730
tell us about what's going on with

688
00:26:42,020 --> 00:26:40,170

pollution as well and there's different

689
00:26:43,610 --> 00:26:42,030
types of pollution in the atmosphere and

690
00:26:46,220 --> 00:26:43,620
the outcome from different types of

691
00:26:48,410 --> 00:26:46,230
sources so by scientists by taking these

692
00:26:50,419 --> 00:26:48,420
combined sets of data they'll be able to

693
00:26:51,740 --> 00:26:50,429
get a much better picture of the of

694
00:26:55,270 --> 00:26:51,750
what's going on with the emission

695
00:26:58,280 --> 00:26:55,280
sources that lead to pollution a

696
00:27:01,460 --> 00:26:58,290
question from ustream will NASA use

697
00:27:03,710 --> 00:27:01,470
oco-2 data to generate images of global

698
00:27:10,010 --> 00:27:03,720
co2 concentrations that will be released

699
00:27:13,610 --> 00:27:10,020
to the public we have a group we were

700
00:27:15,740 --> 00:27:13,620
working with in a simple website co2 JPL

701
00:27:17,690 --> 00:27:15,750
nasa gov where we'll be sharing this

702
00:27:20,539 --> 00:27:17,700
information and one of the plans is to

703
00:27:22,669 --> 00:27:20,549
make images as they asked of the monthly

704
00:27:24,500 --> 00:27:22,679
concentrations of carbon dioxide but as

705
00:27:26,090 --> 00:27:24,510
Dave mentioned we don't see every

706
00:27:29,060 --> 00:27:26,100
location on the earth so there will be

707
00:27:30,560 --> 00:27:29,070
some interpolation or averaging that we

708
00:27:33,950 --> 00:27:30,570
have to do to make these maps but you

709
00:27:36,610 --> 00:27:33,960
should find those up on our website say

710
00:27:39,200 --> 00:27:36,620
2015 when the data is ready to go

711
00:27:40,880 --> 00:27:39,210
another question from ustream what

712
00:27:45,530 --> 00:27:40,890
causes levels of co2 in the atmosphere

713
00:27:48,560 --> 00:27:45,540

to rise and fall I'll take that that was

714
00:27:51,380 --> 00:27:48,570
the number of a number of different

715
00:27:54,830 --> 00:27:51,390
processes cause co2 to rise and fall in

716
00:27:58,130 --> 00:27:54,840
the atmosphere plants taking c 0 to n

717
00:27:59,960 --> 00:27:58,140
and then decaying will cause will take

718
00:28:02,390 --> 00:27:59,970
up co2 and then we release it to the

719
00:28:04,190 --> 00:28:02,400
atmosphere the ocean as you as you

720
00:28:05,990 --> 00:28:04,200
increase the atmospheric co2

721
00:28:07,520 --> 00:28:06,000
concentration carbon dioxide

722
00:28:10,310 --> 00:28:07,530
concentrations the oceans actually

723
00:28:11,720 --> 00:28:10,320
absorb more as long as they're cold as

724
00:28:13,549 --> 00:28:11,730
you know you take your your bottle of

725
00:28:15,409 --> 00:28:13,559
soda out of the frizz refrigerator and

726
00:28:18,140 --> 00:28:15,419
it's nice and fizzy that's carbon

727
00:28:20,030 --> 00:28:18,150
dioxide in the soda that bet your you're

728
00:28:21,890 --> 00:28:20,040
tasting if you leave it out on the table

729
00:28:23,810 --> 00:28:21,900
for a little while and the soda warms up

730
00:28:26,060 --> 00:28:23,820
all the carbon dioxide goes away and all

731
00:28:28,430 --> 00:28:26,070
the fizz goes away the soda becomes flat

732
00:28:31,520 --> 00:28:28,440
we're concerned that as over time the

733
00:28:33,500 --> 00:28:31,530
ocean as it warms up due to climate

734
00:28:36,260 --> 00:28:33,510
change will actually hold less carbon

735
00:28:38,450 --> 00:28:36,270
dioxide than it's holding today and that

736
00:28:38,940 --> 00:28:38,460
might be a big change so these are some

737
00:28:42,299 --> 00:28:38,950
of the car

738
00:28:46,379 --> 00:28:42,309

of things of course any time you light a

739
00:28:47,700 --> 00:28:46,389
fire start a car or even exhale you emit

740
00:28:49,259 --> 00:28:47,710
a little bit of co2 into the atmosphere

741
00:28:51,590 --> 00:28:49,269
as well so there are a number of

742
00:28:53,940 --> 00:28:51,600
processes that cause these things

743
00:28:55,950 --> 00:28:53,950
another question from ustream how soon

744
00:28:58,350 --> 00:28:55,960
will you get definitive results about

745
00:29:04,620 --> 00:28:58,360
this issue of where the carbon is going

746
00:29:09,710 --> 00:29:04,630
where the sources are this is a science

747
00:29:12,389 --> 00:29:09,720
experiment even within the first year of

748
00:29:15,120 --> 00:29:12,399
operations we're hoping to learn a

749
00:29:17,759 --> 00:29:15,130
tremendous amount about where the carbon

750
00:29:20,580 --> 00:29:17,769
dioxide is is coming from and where it

751
00:29:22,769 --> 00:29:20,590
is being absorbed but I don't think that

752
00:29:25,049 --> 00:29:22,779
will be definitive and I don't think it

753
00:29:26,700 --> 00:29:25,059
will be the final answer I think there

754
00:29:28,769 --> 00:29:26,710
will be a number of experiments and

755
00:29:30,990 --> 00:29:28,779
efforts that will have to be conducted

756
00:29:32,399 --> 00:29:31,000
into the future to study this further

757
00:29:34,440 --> 00:29:32,409
but I think will make a tremendous

758
00:29:36,539 --> 00:29:34,450
contribution to our understanding of

759
00:29:39,389 --> 00:29:36,549
these sources of carbon dioxide and

760
00:29:45,659 --> 00:29:39,399
these natural processes that absorb it

761
00:29:48,480 --> 00:29:45,669
even within a year time delay from data

762
00:29:51,539 --> 00:29:48,490
being captured by oco-2 to its

763
00:29:55,110 --> 00:29:51,549

availability for scientists and public

764
00:29:56,700 --> 00:29:55,120
to see so there there's kind of two

765
00:29:58,830 --> 00:29:56,710
answers that question there's the

766
00:30:00,690 --> 00:29:58,840
initial availability of the data so as

767
00:30:03,509 --> 00:30:00,700
Dave mentioned we have to take a number

768
00:30:05,610 --> 00:30:03,519
of steps to make sure it's of sufficient

769
00:30:08,070 --> 00:30:05,620
quality perform our calibration

770
00:30:09,990 --> 00:30:08,080
activities test out and compare against

771
00:30:12,389 --> 00:30:10,000
the ground site so that's the steps that

772
00:30:14,820 --> 00:30:12,399
will take us till early 2015 for the

773
00:30:16,470 --> 00:30:14,830
first release of data once things are

774
00:30:18,659 --> 00:30:16,480
flowing it's actually only going to be a

775
00:30:20,340 --> 00:30:18,669
probably a few days to a couple of weeks

776
00:30:22,470 --> 00:30:20,350
delay between a measurement and the

777
00:30:28,710 --> 00:30:22,480
posting of the data to the public data

778
00:30:29,940 --> 00:30:28,720
release okay I think that's all the

779
00:30:31,889 --> 00:30:29,950
questions I have at the moment or the

780
00:30:36,629 --> 00:30:31,899
other media question i'll write any

781
00:30:39,659 --> 00:30:36,639
follow-ups here in the room all right in

782
00:30:43,259 --> 00:30:39,669
that event of a couple of programming

783
00:30:47,269 --> 00:30:43,269
notes tomorrow monday morning there will

784
00:30:49,919 --> 00:30:47,279
be a social activity social media that

785
00:30:52,530 --> 00:30:49,929
everyone is invited to watch on NASA

786
00:30:55,050 --> 00:30:52,540
television and participate in

787
00:30:57,300 --> 00:30:55,060
it will be a discussion about the

788
00:30:58,860 --> 00:30:57,310

mission and the launch and what it takes

789
00:31:01,230 --> 00:30:58,870
to launch here at Vandenberg Air Force

790
00:31:02,700 --> 00:31:01,240
Base in California it'll be a very

791
00:31:04,950 --> 00:31:02,710
interesting hour and a half and you're

792
00:31:08,270 --> 00:31:04,960
invited to tune in to that on nasa TV

793
00:31:11,580 --> 00:31:08,280
starting at nine thirty pacific time and

794
00:31:13,770 --> 00:31:11,590
oco-2 is is the second of five nasa

795
00:31:17,130 --> 00:31:13,780
earth science missions that are

796
00:31:19,800 --> 00:31:17,140
scheduled for 2014 more earth-observing

797
00:31:22,560 --> 00:31:19,810
launches that we've we've had in more

798
00:31:25,230 --> 00:31:22,570
than a decade so to find out more about

799
00:31:29,460 --> 00:31:25,240
this busy year in NASA study of our home

800
00:31:35,100 --> 00:31:29,470
planet you can go online and visit w WN

801
00:31:37,230 --> 00:31:35,110
haces gov / earth right now and that

802
00:31:39,360 --> 00:31:37,240
will look include our coverage our nasa

803
00:31:43,560 --> 00:31:39,370
TV coverage of the countdown will begin