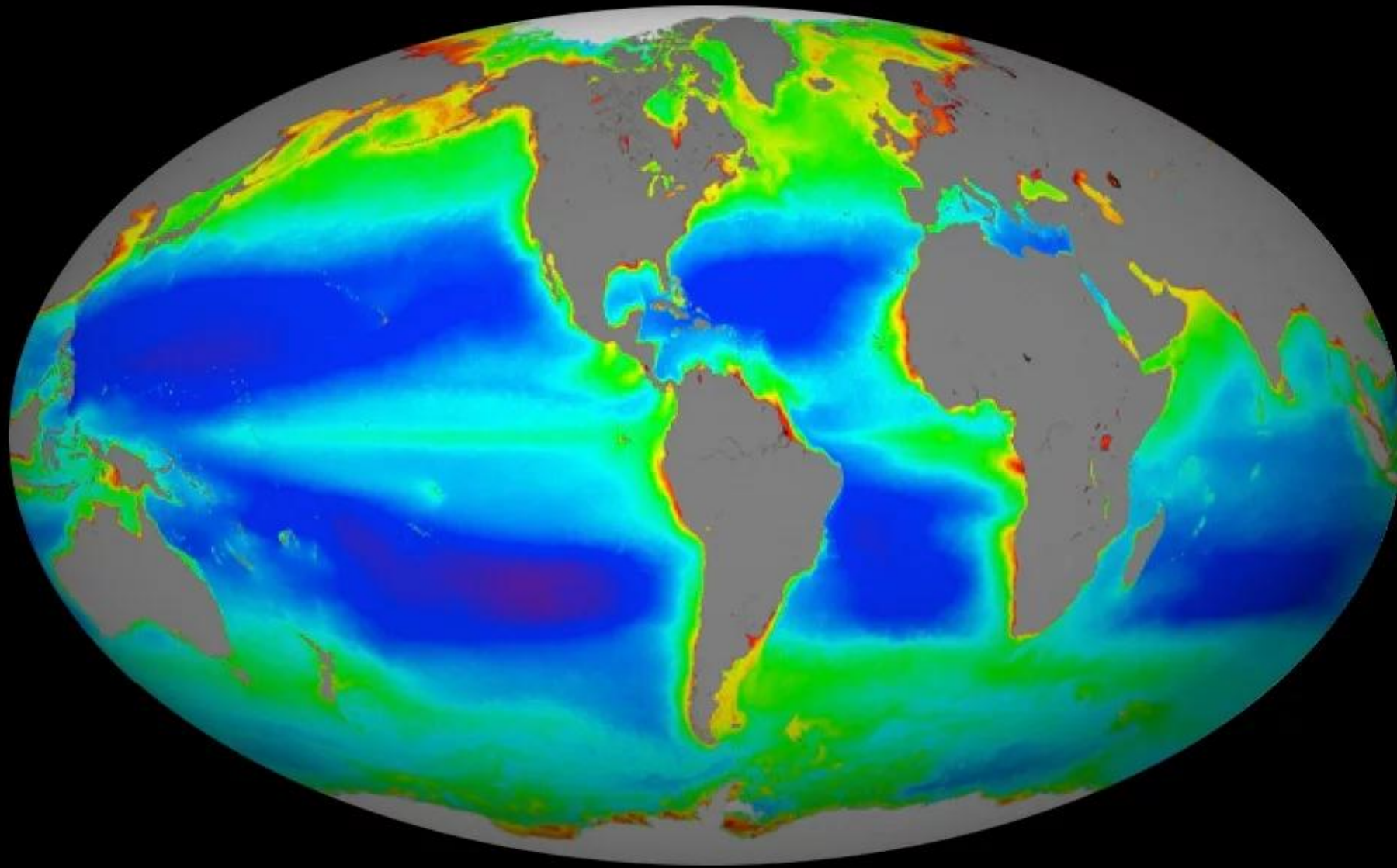

1
00:00:03,510 --> 00:00:01,750
and thank you for standing by at this

2
00:00:05,110 --> 00:00:03,520
time all participants will be on listen

3
00:00:06,950 --> 00:00:05,120
only until the question and answer

4
00:00:09,350 --> 00:00:06,960
session of today's conference at which

5
00:00:11,430 --> 00:00:09,360
time you press star one to ask a

6
00:00:13,190 --> 00:00:11,440
question today's conference is being

7
00:00:15,190 --> 00:00:13,200
recorded if you have any objections

8
00:00:16,230 --> 00:00:15,200
please disconnect at this time i now

9
00:00:19,910 --> 00:00:16,240
like to turn the meeting over to your

10
00:00:21,910 --> 00:00:19,920
host mr steve cole sir you may begin

11
00:00:24,550 --> 00:00:21,920
okay thank you and welcome to today's

12
00:00:26,950 --> 00:00:24,560
nasa media teleconference on carbon and

13
00:00:30,230 --> 00:00:26,960

climate this is steve cole at nasa's

14
00:00:32,229 --> 00:00:30,240
office of communications in washington

15
00:00:34,310 --> 00:00:32,239
we have a panel of nasa and university

16
00:00:37,350 --> 00:00:34,320
scientists here today to discuss new

17
00:00:39,430 --> 00:00:37,360
insights and agency research initiatives

18
00:00:40,709 --> 00:00:39,440
into key carbon and climate change

19
00:00:42,389 --> 00:00:40,719
questions

20
00:00:44,630 --> 00:00:42,399
nasa is ramping up its efforts to

21
00:00:47,990 --> 00:00:44,640
understand how earth's oceans

22
00:00:50,709 --> 00:00:48,000
forest and land ecosystems observe

23
00:00:53,110 --> 00:00:50,719
absorb i'm sorry on average

24
00:00:54,150 --> 00:00:53,120
nearly half of emitted carbon dioxide

25
00:00:59,830 --> 00:00:54,160
today

26
00:01:01,670 --> 00:00:59,840
first speaker will be michael freilich

27
00:01:03,830 --> 00:01:01,680
director of nasa's earth science

28
00:01:05,910 --> 00:01:03,840
division at nasa's headquarters in

29
00:01:08,230 --> 00:01:05,920
washington

30
00:01:11,030 --> 00:01:08,240
mike berenfeld who is actually joining

31
00:01:13,109 --> 00:01:11,040
us from the north atlantic

32
00:01:15,190 --> 00:01:13,119
who is principal investigator on one of

33
00:01:16,870 --> 00:01:15,200
our field campaigns going on right now

34
00:01:19,510 --> 00:01:16,880
in the north atlantic

35
00:01:21,510 --> 00:01:19,520
and from oregon state university in

36
00:01:23,830 --> 00:01:21,520
corvallis

37
00:01:25,830 --> 00:01:23,840
george hurt lead for nasa's carbon

38
00:01:28,469 --> 00:01:25,840

monitoring system from the university of

39
00:01:31,190 --> 00:01:28,479
maryland in college park

40
00:01:33,190 --> 00:01:31,200
ann marie eldering deputy project

41
00:01:36,069 --> 00:01:33,200
scientist for nasa's

42
00:01:38,870 --> 00:01:36,079
orbiting carbon observatory 2 mission at

43
00:01:41,030 --> 00:01:38,880
the agency's jet propulsion laboratory

44
00:01:43,590 --> 00:01:41,040
in pasadena

45
00:01:45,510 --> 00:01:43,600
and finally leslie ott research

46
00:01:47,830 --> 00:01:45,520
scientist in the global modeling and

47
00:01:49,830 --> 00:01:47,840
assimilation office at nasa's goddard

48
00:01:51,109 --> 00:01:49,840
space flight center in greenbelt

49
00:01:52,630 --> 00:01:51,119
maryland

50
00:01:55,670 --> 00:01:52,640
our panelists will give you their

51
00:01:58,310 --> 00:01:55,680
remarks for about 25-30 minutes and then

52
00:02:00,630 --> 00:01:58,320
we'll open it to questions

53
00:02:02,789 --> 00:02:00,640
if you're listening online and would

54
00:02:05,190 --> 00:02:02,799
like to ask a question

55
00:02:09,910 --> 00:02:05,200
you can do so via twitter

56
00:02:12,229 --> 00:02:09,920
by using using the hashtag ask nasa

57
00:02:15,510 --> 00:02:12,239
we'll get to those questions about about

58
00:02:16,710 --> 00:02:15,520
halfway through our our briefing

59
00:02:18,949 --> 00:02:16,720
and if you'd like to see more

60
00:02:20,470 --> 00:02:18,959
information about this topic we have

61
00:02:22,710 --> 00:02:20,480
quite a bit of information online

62
00:02:29,030 --> 00:02:22,720
already and you can

63
00:02:33,509 --> 00:02:30,309

slash

64
00:02:35,430 --> 00:02:33,519
carbon climate

65
00:02:37,910 --> 00:02:35,440
okay and we'll begin with our first

66
00:02:39,589 --> 00:02:37,920
speaker mike frylett

67
00:02:42,150 --> 00:02:39,599
thanks steve

68
00:02:44,470 --> 00:02:42,160
and thanks to all for joining

69
00:02:47,509 --> 00:02:44,480
carbon is an essential element for life

70
00:02:50,070 --> 00:02:47,519
on earth in the atmosphere carbon plays

71
00:02:53,030 --> 00:02:50,080
important roles in the earth's radiation

72
00:02:55,990 --> 00:02:53,040
balance and climate since methane and

73
00:02:57,270 --> 00:02:56,000
carbon dioxide are potent greenhouse

74
00:03:00,150 --> 00:02:57,280
gases

75
00:03:02,229 --> 00:03:00,160
in a few weeks senior representatives of

76
00:03:05,430 --> 00:03:02,239
nations around the world will be meeting

77
00:03:08,070 --> 00:03:05,440
in paris at the cop21 conference to

78
00:03:10,470 --> 00:03:08,080
discuss atmospheric carbon levels their

79
00:03:12,949 --> 00:03:10,480
connections to the changing climate and

80
00:03:15,750 --> 00:03:12,959
actions that humans can take should we

81
00:03:18,149 --> 00:03:15,760
wish to to influence future atmospheric

82
00:03:20,070 --> 00:03:18,159
carbon concentrations and the earth's

83
00:03:22,710 --> 00:03:20,080
climate trajectory

84
00:03:25,110 --> 00:03:22,720
today we're here to talk about nasa's

85
00:03:27,030 --> 00:03:25,120
work on a related question

86
00:03:30,070 --> 00:03:27,040
how will potential changes to the

87
00:03:31,430 --> 00:03:30,080
natural world namely the ocean and land

88
00:03:34,550 --> 00:03:31,440

ecosystems

89
00:03:36,070 --> 00:03:34,560
also influence future atmospheric carbon

90
00:03:37,430 --> 00:03:36,080
concentrations

91
00:03:40,229 --> 00:03:37,440
if we're going to improve our

92
00:03:43,030 --> 00:03:40,239
predictions of earth's evolving climate

93
00:03:46,710 --> 00:03:43,040
we need to improve our understanding of

94
00:03:49,350 --> 00:03:46,720
the answer of this question now after

95
00:03:51,990 --> 00:03:49,360
years of development and testing nasa's

96
00:03:54,390 --> 00:03:52,000
orbiting carbon observatory 2 mission is

97
00:03:57,589 --> 00:03:54,400
making first-ever global satellite

98
00:04:00,470 --> 00:03:57,599
measurements of atmospheric co2 levels

99
00:04:03,910 --> 00:04:00,480
with the accuracies precisions and

100
00:04:06,869 --> 00:04:03,920
spatial resolutions needed to shed light

101
00:04:10,550 --> 00:04:06,879
on natural ocean atmosphere and land

102
00:04:13,030 --> 00:04:10,560
atmosphere carbon exchange processes

103
00:04:16,069 --> 00:04:13,040
we in nasa have new satellite missions

104
00:04:18,870 --> 00:04:16,079
that are in development now and plans in

105
00:04:21,749 --> 00:04:18,880
the longer term to continue global

106
00:04:23,270 --> 00:04:21,759
space-borne co2 measurements into the

107
00:04:24,790 --> 00:04:23,280
future

108
00:04:27,749 --> 00:04:24,800
in addition

109
00:04:30,790 --> 00:04:27,759
nasa is now sponsoring and conducting

110
00:04:33,909 --> 00:04:30,800
focused oceanic atmospheric and

111
00:04:37,430 --> 00:04:33,919
land-based field campaigns to probe

112
00:04:40,550 --> 00:04:37,440
never before measured aspects of air sea

113
00:04:43,590 --> 00:04:40,560

and land air carbon exchange processes

114
00:04:46,150 --> 00:04:43,600
in critically climate climatically

115
00:04:48,950 --> 00:04:46,160
critical locations

116
00:04:52,150 --> 00:04:48,960
these field campaigns are using advanced

117
00:04:54,950 --> 00:04:52,160
instruments mounted on ships in research

118
00:04:56,390 --> 00:04:54,960
aircraft and at land sites and are

119
00:04:59,189 --> 00:04:56,400
bringing together the very best

120
00:05:01,990 --> 00:04:59,199
scientists in the and engineers in the

121
00:05:04,550 --> 00:05:02,000
nation and indeed the world

122
00:05:07,270 --> 00:05:04,560
at the direction of congress nasa has

123
00:05:10,310 --> 00:05:07,280
also developed and initiated a carbon

124
00:05:13,189 --> 00:05:10,320
monitoring system combining measurements

125
00:05:16,390 --> 00:05:13,199
and models to improve the accuracy of

126
00:05:19,029 --> 00:05:16,400
our estimates of land carbon on space

127
00:05:21,909 --> 00:05:19,039
scales that are important to human life

128
00:05:25,029 --> 00:05:21,919
and land use decision making scales of

129
00:05:26,950 --> 00:05:25,039
neighborhoods and fields and forest

130
00:05:29,510 --> 00:05:26,960
patches

131
00:05:32,310 --> 00:05:29,520
before my colleagues discuss information

132
00:05:35,270 --> 00:05:32,320
on recent results and plans i'd like to

133
00:05:38,469 --> 00:05:35,280
briefly summarize for you high points of

134
00:05:40,870 --> 00:05:38,479
what we do know and what we don't know

135
00:05:42,150 --> 00:05:40,880
about the carbon cycle in the atmosphere

136
00:05:45,189 --> 00:05:42,160
today

137
00:05:48,469 --> 00:05:45,199
we do know from ice core and other

138
00:05:49,990 --> 00:05:48,479

analyses that from the pre-industrial

139
00:05:54,629 --> 00:05:50,000
1800s

140
00:05:57,189 --> 00:05:54,639
back for more than 400 000 years

141
00:06:01,270 --> 00:05:57,199
natural processes somehow kept

142
00:06:04,629 --> 00:06:01,280
atmospheric co2 levels between about 180

143
00:06:07,350 --> 00:06:04,639
and 280 parts per million

144
00:06:09,350 --> 00:06:07,360
and over a span of ten thousand years

145
00:06:10,710 --> 00:06:09,360
leading up to the industrial resolute

146
00:06:14,189 --> 00:06:10,720
revolution

147
00:06:17,590 --> 00:06:14,199
co2 levels were nearly constant at about

148
00:06:19,830 --> 00:06:17,600
270 parts per million

149
00:06:21,909 --> 00:06:19,840
we know with certainty

150
00:06:24,550 --> 00:06:21,919
that globally averaged atmospheric

151
00:06:26,870 --> 00:06:24,560
carbon dioxide levels have increased

152
00:06:28,629 --> 00:06:26,880
substantially since the start of the

153
00:06:31,510 --> 00:06:28,639
industrial revolution

154
00:06:35,350 --> 00:06:31,520
from about 280 parts per million in the

155
00:06:38,309 --> 00:06:35,360
late 1800s to more than 400 parts per

156
00:06:41,029 --> 00:06:38,319
million at present and currently the

157
00:06:44,390 --> 00:06:41,039
atmospheric co2 concentration is

158
00:06:46,950 --> 00:06:44,400
increasing by on average about two parts

159
00:06:49,990 --> 00:06:46,960
per million each year

160
00:06:51,590 --> 00:06:50,000
we do know with certainty that burning

161
00:06:54,390 --> 00:06:51,600
fossil fuel

162
00:06:57,909 --> 00:06:54,400
adds long sequestered carbon to the

163
00:06:59,270 --> 00:06:57,919

active land ocean atmosphere carbon

164
00:07:01,909 --> 00:06:59,280
cycle

165
00:07:05,110 --> 00:07:01,919
we know that there are large

166
00:07:07,670 --> 00:07:05,120
year-to-year variations in how much

167
00:07:09,589 --> 00:07:07,680
fossil fuel carbon remains in the

168
00:07:12,950 --> 00:07:09,599
atmosphere

169
00:07:15,990 --> 00:07:12,960
generally about half of the added carbon

170
00:07:18,390 --> 00:07:16,000
uh from fossil fuel burning stays in the

171
00:07:22,070 --> 00:07:18,400
air but ground-based measurements

172
00:07:24,710 --> 00:07:22,080
suggest that some years almost all of it

173
00:07:27,189 --> 00:07:24,720
stays in the atmosphere and some years

174
00:07:29,909 --> 00:07:27,199
almost none of the carbon from fossil

175
00:07:32,710 --> 00:07:29,919
fuel burning remains in the atmosphere

176
00:07:35,670 --> 00:07:32,720
so those years it must all be absorbed

177
00:07:38,469 --> 00:07:35,680
into the ocean and the land

178
00:07:40,870 --> 00:07:38,479
we don't know key details about the

179
00:07:44,070 --> 00:07:40,880
individual natural processes that

180
00:07:45,350 --> 00:07:44,080
control carbon transfers to and from the

181
00:07:48,469 --> 00:07:45,360
atmosphere

182
00:07:49,510 --> 00:07:48,479
these processes operate at very low

183
00:07:52,070 --> 00:07:49,520
levels

184
00:07:53,670 --> 00:07:52,080
when measured say on a square meter or a

185
00:07:56,390 --> 00:07:53,680
square kilometer but they're

186
00:07:58,710 --> 00:07:56,400
tremendously important over areas of

187
00:08:01,830 --> 00:07:58,720
millions of square kilometers like the

188
00:08:04,550 --> 00:08:01,840

oceans and the boreal forests

189
00:08:07,749 --> 00:08:04,560
we don't know how these land and ocean

190
00:08:11,510 --> 00:08:07,759
carbon exchange processes interact with

191
00:08:14,070 --> 00:08:11,520
and impact each other today

192
00:08:17,189 --> 00:08:14,080
and we don't know how effective these

193
00:08:20,469 --> 00:08:17,199
processes and their interactions will be

194
00:08:23,110 --> 00:08:20,479
as ecosystems and their relationships

195
00:08:25,830 --> 00:08:23,120
change with changing climate

196
00:08:28,550 --> 00:08:25,840
some processes may end up removing more

197
00:08:30,790 --> 00:08:28,560
carbon from the atmosphere in a future

198
00:08:33,670 --> 00:08:30,800
climate and some may become less

199
00:08:35,829 --> 00:08:33,680
effective than they are today

200
00:08:37,430 --> 00:08:35,839
our nasa satellite

201
00:08:40,469 --> 00:08:37,440
field campaign

202
00:08:43,670 --> 00:08:40,479
research and modeling programs are

203
00:08:46,870 --> 00:08:43,680
focused on allowing us to understand

204
00:08:50,070 --> 00:08:46,880
better the roles of natural processes in

205
00:08:52,550 --> 00:08:50,080
determining atmospheric carbon levels

206
00:08:55,110 --> 00:08:52,560
to understand better the connections

207
00:08:57,350 --> 00:08:55,120
between these natural processes

208
00:08:59,269 --> 00:08:57,360
and to understand better how these

209
00:09:01,910 --> 00:08:59,279
processes may change

210
00:09:04,790 --> 00:09:01,920
positively and negatively as our

211
00:09:07,030 --> 00:09:04,800
planet's climate evolves

212
00:09:09,910 --> 00:09:07,040
gaining a greater understanding of our

213
00:09:12,389 --> 00:09:09,920

planet's carbon cycle is essential to

214
00:09:14,550 --> 00:09:12,399
furthering our knowledge of the earth as

215
00:09:17,030 --> 00:09:14,560
an integrated system

216
00:09:19,910 --> 00:09:17,040
gaining this understanding is key to

217
00:09:22,630 --> 00:09:19,920
providing policy makers with objective

218
00:09:25,990 --> 00:09:22,640
facts and accurate predictions

219
00:09:28,870 --> 00:09:26,000
and their uncertainties so that informed

220
00:09:31,590 --> 00:09:28,880
decisions and policies can be made

221
00:09:35,350 --> 00:09:31,600
and gaining this understanding is indeed

222
00:09:37,910 --> 00:09:35,360
a key objective of our nasa earth

223
00:09:40,310 --> 00:09:37,920
science program

224
00:09:43,670 --> 00:09:40,320
so now i'd like to introduce mike

225
00:09:44,790 --> 00:09:43,680
berenfeld of oregon state university to

226
00:09:47,829 --> 00:09:44,800
discuss

227
00:09:49,430 --> 00:09:47,839
some ongoing carbon field campaigns from

228
00:09:54,470 --> 00:09:49,440
the north atlantic

229
00:09:57,750 --> 00:09:56,150
thank you dr farna can you hear me all

230
00:10:01,110 --> 00:09:57,760
right

231
00:10:02,949 --> 00:10:01,120
you have it you're coming through great

232
00:10:05,829 --> 00:10:02,959
oh great okay again this is michael

233
00:10:08,710 --> 00:10:05,839
berenfeld from oregon state university

234
00:10:10,630 --> 00:10:08,720
and i'm actually talking to you all from

235
00:10:12,870 --> 00:10:10,640
satellite phone from the research ship

236
00:10:15,030 --> 00:10:12,880
atlantis and we are

237
00:10:16,790 --> 00:10:15,040
in the middle of the north atlantic um

238
00:10:18,630 --> 00:10:16,800

sub-arctic region just south of

239
00:10:19,990 --> 00:10:18,640
greenland and i'm here with 31 other

240
00:10:22,150 --> 00:10:20,000
scientists

241
00:10:24,470 --> 00:10:22,160
and uh taking us six days of pounding

242
00:10:25,910 --> 00:10:24,480
through 10 to 20 foot seed to get here

243
00:10:28,710 --> 00:10:25,920
and we're here to study ocean

244
00:10:31,269 --> 00:10:28,720
phytoplankton and also how plankton

245
00:10:32,470 --> 00:10:31,279
influence aerosols and clouds in the

246
00:10:34,389 --> 00:10:32,480
atmosphere

247
00:10:36,630 --> 00:10:34,399
um just for a little background figure

248
00:10:39,190 --> 00:10:36,640
one in your package uh is a picture of

249
00:10:40,630 --> 00:10:39,200
phytoplankton these are diatoms that

250
00:10:42,949 --> 00:10:40,640
form a chain

251
00:10:45,350 --> 00:10:42,959
and they are the microscopic plants of

252
00:10:46,550 --> 00:10:45,360
the ocean that's on the base of the food

253
00:10:48,310 --> 00:10:46,560
wet

254
00:10:49,990 --> 00:10:48,320
right now we're out here and the seas

255
00:10:53,269 --> 00:10:50,000
are pretty clear and pretty rough and

256
00:10:55,030 --> 00:10:53,279
cold um not very productive but in a few

257
00:10:56,630 --> 00:10:55,040
months this very spot is going to be

258
00:10:58,470 --> 00:10:56,640
part of one of the largest language

259
00:10:59,350 --> 00:10:58,480
rooms on earth that happens every single

260
00:11:01,430 --> 00:10:59,360
year

261
00:11:03,110 --> 00:11:01,440
and what we're doing out here is we're

262
00:11:05,750 --> 00:11:03,120
trying to get out here in time to

263
00:11:12,790 --> 00:11:05,760

witness the very first stages of this

264
00:11:16,870 --> 00:11:14,389
so despite the fact that plankton are

265
00:11:19,110 --> 00:11:16,880
microscopic um they play a very critical

266
00:11:21,350 --> 00:11:19,120
role in earth's carbon fiber and like

267
00:11:23,110 --> 00:11:21,360
michael pilot alluded to this

268
00:11:25,190 --> 00:11:23,120
um about each year

269
00:11:26,470 --> 00:11:25,200
about each year about half of the carbon

270
00:11:28,389 --> 00:11:26,480
dioxide

271
00:11:31,190 --> 00:11:28,399
emitted from the atmosphere that does

272
00:11:33,509 --> 00:11:31,200
not remain in the atmosphere this is on

273
00:11:34,949 --> 00:11:33,519
average is taken up by the oceans

274
00:11:37,269 --> 00:11:34,959
and the plankton including the

275
00:11:39,269 --> 00:11:37,279
phytoplankton play an important role in

276
00:11:42,069 --> 00:11:39,279
this ocean carbon cycle

277
00:11:43,990 --> 00:11:42,079
and the first step in that role is the

278
00:11:46,389 --> 00:11:44,000
process of photosynthesis which is what

279
00:11:48,389 --> 00:11:46,399
the phytoplankton do um i think you've

280
00:11:50,389 --> 00:11:48,399
shown figure one shows some of those

281
00:11:52,870 --> 00:11:50,399
organisms

282
00:11:54,710 --> 00:11:52,880
over the annual cycle so every year if

283
00:11:55,990 --> 00:11:54,720
you if you look at the entire global

284
00:11:58,550 --> 00:11:56,000
oceans

285
00:12:01,110 --> 00:11:58,560
this process of photosynthesis produces

286
00:12:03,509 --> 00:12:01,120
about half of the oxygen

287
00:12:05,190 --> 00:12:03,519
created on earth each year and at the

288
00:12:07,670 --> 00:12:05,200

same time

289
00:12:11,110 --> 00:12:07,680
that process is producing oxygen and

290
00:12:14,069 --> 00:12:11,120
then taking carbon equivalent to 50

291
00:12:16,790 --> 00:12:14,079
petagrams of co2 and converting that

292
00:12:19,190 --> 00:12:16,800
into organic matter which is feeding our

293
00:12:20,389 --> 00:12:19,200
fisheries and removing carbon from the

294
00:12:23,350 --> 00:12:20,399
atmosphere

295
00:12:27,190 --> 00:12:23,360
and a pedogram is approximately 50

296
00:12:29,030 --> 00:12:27,200
billion tons of carbon

297
00:12:31,350 --> 00:12:29,040
one of the really amazing things that's

298
00:12:33,190 --> 00:12:31,360
happened over the last say 20 years is

299
00:12:34,870 --> 00:12:33,200
that nasa and other countries have

300
00:12:37,030 --> 00:12:34,880
launched satellite sensors that have

301
00:12:39,750 --> 00:12:37,040
allowed us to actually monitor the

302
00:12:41,829 --> 00:12:39,760
activity of these phytoplankton and

303
00:12:43,509 --> 00:12:41,839
figure two in your package

304
00:12:45,269 --> 00:12:43,519
shows an example of this kind of

305
00:12:47,910 --> 00:12:45,279
satellite data and what you're looking

306
00:12:50,949 --> 00:12:47,920
at here this is just one example this is

307
00:12:53,190 --> 00:12:50,959
the yearly average concentration

308
00:12:54,710 --> 00:12:53,200
of a photosynthetic pigment called

309
00:12:56,790 --> 00:12:54,720
chlorophyll

310
00:12:59,030 --> 00:12:56,800
and by looking at this pigment over

311
00:12:59,990 --> 00:12:59,040
years and years over 20 years what we've

312
00:13:02,310 --> 00:13:00,000
learned

313
00:13:04,310 --> 00:13:02,320

is that

314
00:13:05,430 --> 00:13:04,320
when the ocean surface temperatures

315
00:13:07,430 --> 00:13:05,440
increase

316
00:13:08,949 --> 00:13:07,440
we generally see that the concentration

317
00:13:10,949 --> 00:13:08,959
of these phytoplankton chlorophyll

318
00:13:13,829 --> 00:13:10,959
pigments decreases and in regions where

319
00:13:15,430 --> 00:13:13,839
it cools it increases

320
00:13:17,670 --> 00:13:15,440
and from this information we can

321
00:13:20,949 --> 00:13:17,680
estimate how ocean photosynthesis and

322
00:13:22,870 --> 00:13:20,959
thus carbon cycle things change

323
00:13:23,829 --> 00:13:22,880
as a function of temperature from year

324
00:13:26,150 --> 00:13:23,839
to year

325
00:13:27,829 --> 00:13:26,160
and what's amazing is that from year to

326
00:13:29,670 --> 00:13:27,839
year we can see changes in this

327
00:13:32,150 --> 00:13:29,680
photosynthetic carbon uptake on the

328
00:13:33,509 --> 00:13:32,160
order of two billion tons of carbon per

329
00:13:35,430 --> 00:13:33,519
year

330
00:13:38,389 --> 00:13:35,440
what we really hope to learn from these

331
00:13:40,790 --> 00:13:38,399
kinds of analyses is how the oceans

332
00:13:43,030 --> 00:13:40,800
function today so that we can make some

333
00:13:45,269 --> 00:13:43,040
better predictions how they might change

334
00:13:48,230 --> 00:13:45,279
in the future how ocean ecosystems might

335
00:13:53,509 --> 00:13:48,240
be affected by as well as affect their

336
00:13:57,430 --> 00:13:55,110
so one of the things you'll notice if

337
00:13:59,350 --> 00:13:57,440
you look at that satellite figure figure

338
00:14:01,670 --> 00:13:59,360

2 is that the amount of chlorophyll is

339
00:14:03,430 --> 00:14:01,680
very different from place to place

340
00:14:05,750 --> 00:14:03,440
and in particular what you'll see if you

341
00:14:07,910 --> 00:14:05,760
look the green and red colors

342
00:14:09,750 --> 00:14:07,920
those are largely limited to coastal

343
00:14:11,430 --> 00:14:09,760
upwelling areas and high latitudes i

344
00:14:12,949 --> 00:14:11,440
hope you can see that

345
00:14:15,829 --> 00:14:12,959
and these are these areas of high

346
00:14:18,069 --> 00:14:15,839
concentration that we call balloons

347
00:14:20,790 --> 00:14:18,079
i put in figure three of your package a

348
00:14:22,550 --> 00:14:20,800
close-up satellite image of a globe um

349
00:14:24,790 --> 00:14:22,560
and what you're looking at here is

350
00:14:27,350 --> 00:14:24,800
what's called the bloom of organisms

351
00:14:29,829 --> 00:14:27,360
called coca-lipophorics and they're kind

352
00:14:32,790 --> 00:14:29,839
of cool critters um they have these

353
00:14:34,150 --> 00:14:32,800
chalk like scales on the outside of them

354
00:14:35,910 --> 00:14:34,160
and that's what gives that picture

355
00:14:37,269 --> 00:14:35,920
you're looking at kind of that milky

356
00:14:39,350 --> 00:14:37,279
white color

357
00:14:41,990 --> 00:14:39,360
and these organisms are really important

358
00:14:44,629 --> 00:14:42,000
in the carbon cycle because they um

359
00:14:46,470 --> 00:14:44,639
these these calcite are chalk plates

360
00:14:48,150 --> 00:14:46,480
when they sink and carry lots of carbon

361
00:14:49,829 --> 00:14:48,160
to the deep sea

362
00:14:51,670 --> 00:14:49,839
so one of the very exciting things we've

363
00:14:54,389 --> 00:14:51,680

learned recently from satellites is that

364
00:14:56,790 --> 00:14:54,399
blues like this um and other types of

365
00:14:58,629 --> 00:14:56,800
looms are behaving very differently than

366
00:15:00,389 --> 00:14:58,639
what we've thought in the past and what

367
00:15:02,949 --> 00:15:00,399
you'll find in textbooks

368
00:15:04,870 --> 00:15:02,959
it now actually appears that these rooms

369
00:15:06,629 --> 00:15:04,880
are to believe actually start in the

370
00:15:08,870 --> 00:15:06,639
winter when the growth conditions are at

371
00:15:10,470 --> 00:15:08,880
their very worst and this is one of the

372
00:15:12,870 --> 00:15:10,480
reasons i'm sitting out here in this

373
00:15:14,550 --> 00:15:12,880
boat in the north atlantic kind of

374
00:15:16,470 --> 00:15:14,560
stuttered steady blooms we're trying to

375
00:15:18,710 --> 00:15:16,480
caption this very first stage of the

376
00:15:20,550 --> 00:15:18,720
globe

377
00:15:22,310 --> 00:15:20,560
um if you'd like to learn more about

378
00:15:24,230 --> 00:15:22,320
this project we're doing right now this

379
00:15:27,030 --> 00:15:24,240
project is called the north atlantic

380
00:15:28,150 --> 00:15:27,040
aerosol and marine ecosystem study or

381
00:15:30,629 --> 00:15:28,160
names

382
00:15:32,870 --> 00:15:30,639
and it's part of the nasa earth venture

383
00:15:34,870 --> 00:15:32,880
suborbital mission and dr pilot had

384
00:15:37,189 --> 00:15:34,880
mentioned this as well

385
00:15:39,910 --> 00:15:37,199
and the name study involves both ships

386
00:15:42,710 --> 00:15:39,920
and aircraft so we have a c-130 hercules

387
00:15:44,629 --> 00:15:42,720
flying over us had that happen today and

388
00:15:47,509 --> 00:15:44,639

we're studying not only blooms but how

389
00:15:49,910 --> 00:15:47,519
the plane can produce organic compounds

390
00:15:52,150 --> 00:15:49,920
to get lifted into the atmosphere become

391
00:15:54,550 --> 00:15:52,160
aerosols and effect clouds

392
00:15:56,470 --> 00:15:54,560
and you'll see in figure four a banner

393
00:15:58,949 --> 00:15:56,480
of the names project and at the bottom

394
00:16:01,030 --> 00:15:58,959
is a website that you can look at um for

395
00:16:03,430 --> 00:16:01,040
more details

396
00:16:06,389 --> 00:16:03,440
the last comment i wanted to make and

397
00:16:08,150 --> 00:16:06,399
mike frylick also um alluded to this is

398
00:16:10,310 --> 00:16:08,160
that i think a lot of people in public

399
00:16:12,150 --> 00:16:10,320
think that nasa is all about satellites

400
00:16:14,230 --> 00:16:12,160
and space exploration

401
00:16:17,110 --> 00:16:14,240
but in fact there's also a lot of

402
00:16:18,790 --> 00:16:17,120
groundwork that has to be done and nasa

403
00:16:20,389 --> 00:16:18,800
invests heavily in this so that we can

404
00:16:23,030 --> 00:16:20,399
understand what our satellites are

405
00:16:24,790 --> 00:16:23,040
telling us and also do the groundwork

406
00:16:26,470 --> 00:16:24,800
necessary to prepare for future

407
00:16:28,470 --> 00:16:26,480
satellite missions

408
00:16:30,230 --> 00:16:28,480
with respect to the ocean carbon cycle

409
00:16:31,110 --> 00:16:30,240
this next big step will be the pace

410
00:16:32,629 --> 00:16:31,120
mission

411
00:16:35,030 --> 00:16:32,639
and that will have unmatched

412
00:16:37,590 --> 00:16:35,040
capabilities of observing the ocean from

413
00:16:40,230 --> 00:16:37,600

space so we can dig much deeper into how

414
00:16:41,910 --> 00:16:40,240
these ocean ecosystems work

415
00:16:47,030 --> 00:16:41,920
with that i'll stop and pass the

416
00:16:50,470 --> 00:16:48,870
thank you very much mike i hope everyone

417
00:16:51,430 --> 00:16:50,480
can hear me

418
00:16:53,350 --> 00:16:51,440
uh

419
00:16:55,110 --> 00:16:53,360
i want to turn your attention to slide

420
00:16:57,670 --> 00:16:55,120
five or figure five

421
00:16:59,030 --> 00:16:57,680
uh and note that the land stores a large

422
00:17:00,949 --> 00:16:59,040
amount of carbon and vegetation and

423
00:17:02,550 --> 00:17:00,959
soils together

424
00:17:04,470 --> 00:17:02,560
roughly three to four times the amount

425
00:17:05,909 --> 00:17:04,480
present in the atmosphere

426
00:17:08,630 --> 00:17:05,919
in the context of the global carbon

427
00:17:10,069 --> 00:17:08,640
cycle there are large exchanges of co2

428
00:17:11,590 --> 00:17:10,079
between the atmosphere and ocean as mike

429
00:17:13,189 --> 00:17:11,600
was commenting about

430
00:17:14,789 --> 00:17:13,199
the atmosphere and land

431
00:17:18,069 --> 00:17:14,799
and also large emissions to the human

432
00:17:19,990 --> 00:17:18,079
activity as illustrated in this figure

433
00:17:21,429 --> 00:17:20,000
thankfully as you've heard only about

434
00:17:23,029 --> 00:17:21,439
half of human emissions on average

435
00:17:24,710 --> 00:17:23,039
remain in the atmosphere due to

436
00:17:27,350 --> 00:17:24,720
processes in the land

437
00:17:29,430 --> 00:17:27,360
and in the ocean's equestrian carbon

438
00:17:31,510 --> 00:17:29,440

we know the land currently absorbs about

439
00:17:33,029 --> 00:17:31,520
half of that or a quarter of total human

440
00:17:34,950 --> 00:17:33,039
emissions if there are large

441
00:17:36,950 --> 00:17:34,960
uncertainties in these estimates

442
00:17:38,710 --> 00:17:36,960
and these and uncertainties in turn

443
00:17:39,669 --> 00:17:38,720
affect our understanding of the major

444
00:17:42,230 --> 00:17:39,679
question

445
00:17:43,750 --> 00:17:42,240
will this uptake continue

446
00:17:45,430 --> 00:17:43,760
at nasa we are innovating ways to

447
00:17:47,750 --> 00:17:45,440
measure and monitor carbon on land to

448
00:17:49,430 --> 00:17:47,760
better reduce these uncertainties

449
00:17:51,190 --> 00:17:49,440
and conducting new studies focused on

450
00:17:53,430 --> 00:17:51,200
improving our understanding

451
00:17:54,710 --> 00:17:53,440
of changes in the most sensitive regions

452
00:17:56,950 --> 00:17:54,720
i'd like to give just a couple of

453
00:17:58,710 --> 00:17:56,960
examples

454
00:18:00,870 --> 00:17:58,720
if you turn to the next slide figure 6

455
00:18:02,150 --> 00:18:00,880
which is an animation

456
00:18:04,789 --> 00:18:02,160
we can start by looking back to the

457
00:18:06,630 --> 00:18:04,799
1980s just roughly 30 years ago

458
00:18:08,470 --> 00:18:06,640
where land carbon was mapped at very

459
00:18:10,390 --> 00:18:08,480
coarse spatial resolution

460
00:18:11,510 --> 00:18:10,400
about 50 kilometers

461
00:18:13,830 --> 00:18:11,520
resolution

462
00:18:15,669 --> 00:18:13,840
and in just 32 broad categories as shown

463
00:18:17,830 --> 00:18:15,679

in this figure

464
00:18:19,510 --> 00:18:17,840
in 2010 congress directed nasa to

465
00:18:21,750 --> 00:18:19,520
develop the carbon monitoring system to

466
00:18:24,070 --> 00:18:21,760
increase the accuracy precision and

467
00:18:26,070 --> 00:18:24,080
resolution of carbon data to potentially

468
00:18:28,630 --> 00:18:26,080
support decision making and there are

469
00:18:30,310 --> 00:18:28,640
already many accomplishments as you can

470
00:18:31,830 --> 00:18:30,320
see in the second frame of this

471
00:18:34,390 --> 00:18:31,840
animation

472
00:18:36,470 --> 00:18:34,400
by 2011 nasa was able to produce a

473
00:18:38,470 --> 00:18:36,480
continuous map of carbon and vegetation

474
00:18:41,750 --> 00:18:38,480
for large areas of the world

475
00:18:44,070 --> 00:18:41,760
at 100 meter resolution shown here for

476
00:18:45,750 --> 00:18:44,080
the u s with green areas indicating

477
00:18:47,669 --> 00:18:45,760
higher levels of storage

478
00:18:49,350 --> 00:18:47,679
and light areas indicating lower levels

479
00:18:51,190 --> 00:18:49,360
of storage

480
00:18:52,789 --> 00:18:51,200
and just a year later in the third frame

481
00:18:55,029 --> 00:18:52,799
of this animation

482
00:18:57,190 --> 00:18:55,039
uh we illustrate that we produce maps

483
00:18:59,669 --> 00:18:57,200
for some large areas including the state

484
00:19:01,190 --> 00:18:59,679
of maryland as shown here at 30 meter

485
00:19:05,909 --> 00:19:01,200
resolution

486
00:19:07,909 --> 00:19:05,919
times that available just 30 years ago

487
00:19:10,230 --> 00:19:07,919
we are able to quantify land carbon now

488
00:19:11,909 --> 00:19:10,240

at the scale of land parcels forest

489
00:19:13,830 --> 00:19:11,919
patches

490
00:19:16,070 --> 00:19:13,840
neighborhoods enough detail to

491
00:19:18,230 --> 00:19:16,080
fundamentally advance both science

492
00:19:20,710 --> 00:19:18,240
and the applicability of carbon data to

493
00:19:22,789 --> 00:19:20,720
support potential decision making on

494
00:19:24,549 --> 00:19:22,799
land

495
00:19:26,390 --> 00:19:24,559
a key to this technology if you look at

496
00:19:30,230 --> 00:19:26,400
the next figure figure 7

497
00:19:32,390 --> 00:19:30,240
is lidar measurement now lidar refers to

498
00:19:34,230 --> 00:19:32,400
light detection and ranging

499
00:19:36,390 --> 00:19:34,240
and it's an active measurement made from

500
00:19:38,150 --> 00:19:36,400
planes or satellites

501
00:19:40,789 --> 00:19:38,160
that make a distance measurement to

502
00:19:42,549 --> 00:19:40,799
vegetation that is precise enough to

503
00:19:44,870 --> 00:19:42,559
effectively image the three-dimensional

504
00:19:46,230 --> 00:19:44,880
structure of vegetation from the top

505
00:19:48,630 --> 00:19:46,240
down

506
00:19:50,070 --> 00:19:48,640
the images in this figure

507
00:19:53,029 --> 00:19:50,080
illustrate the kind of data that's

508
00:19:55,350 --> 00:19:53,039
possible in the top left you can see

509
00:19:56,390 --> 00:19:55,360
looking down on a patch of deciduous

510
00:19:58,390 --> 00:19:56,400
forest

511
00:19:59,909 --> 00:19:58,400
3d structure vegetation

512
00:20:01,909 --> 00:19:59,919
the colors indicate different heights of

513
00:20:04,230 --> 00:20:01,919

the vegetation with red showing the tops

514
00:20:06,630 --> 00:20:04,240
of forest canopies and blue

515
00:20:08,230 --> 00:20:06,640
low-lying areas of the ground you can

516
00:20:10,150 --> 00:20:08,240
clearly see the forest canopy and in

517
00:20:12,470 --> 00:20:10,160
some areas you can see understory of

518
00:20:13,909 --> 00:20:12,480
vegetation and make out even individual

519
00:20:16,549 --> 00:20:13,919
trees

520
00:20:18,470 --> 00:20:16,559
in the bottom right a similar image

521
00:20:20,470 --> 00:20:18,480
shows the kind of data that's possible

522
00:20:22,630 --> 00:20:20,480
of a coniferous forest where individual

523
00:20:26,390 --> 00:20:22,640
trees are now clearly more apparent due

524
00:20:29,110 --> 00:20:27,590
well if you look at the next slide

525
00:20:30,710 --> 00:20:29,120
figure 8

526
00:20:32,789 --> 00:20:30,720
nasa is

527
00:20:34,950 --> 00:20:32,799
interested in scaling this technology up

528
00:20:37,430 --> 00:20:34,960
and with more than 3 trillion

529
00:20:38,710 --> 00:20:37,440
trees on the planet

530
00:20:39,830 --> 00:20:38,720
we're using

531
00:20:52,470 --> 00:20:39,840
a

532
00:20:53,750 --> 00:20:52,480
2018

533
00:20:55,669 --> 00:20:53,760
jedi will provide the first

534
00:20:57,590 --> 00:20:55,679
comprehensive high-resolution data set

535
00:20:59,350 --> 00:20:57,600
of vegetation structure

536
00:21:00,789 --> 00:20:59,360
these data will be critical to answering

537
00:21:02,870 --> 00:21:00,799
questions about the carbon balance of

538
00:21:04,950 --> 00:21:02,880

the earth's forest now

539
00:21:06,710 --> 00:21:04,960
as well as to inform new models that

540
00:21:08,870 --> 00:21:06,720
will address how the land surface could

541
00:21:11,110 --> 00:21:08,880
potentially help mitigate atmospheric

542
00:21:13,270 --> 00:21:11,120
co2 in the future

543
00:21:15,430 --> 00:21:13,280
these data are so useful they will also

544
00:21:17,430 --> 00:21:15,440
help address critical related questions

545
00:21:21,350 --> 00:21:17,440
on the role of force and habitat and

546
00:21:25,590 --> 00:21:24,310
in the next figure figure 9

547
00:21:26,630 --> 00:21:25,600
in addition to these innovative

548
00:21:27,990 --> 00:21:26,640
monitoring

549
00:21:29,830 --> 00:21:28,000
approaches

550
00:21:31,590 --> 00:21:29,840
we're all also focused on reducing

551
00:21:34,070 --> 00:21:31,600
uncertainties regarding potential

552
00:21:35,510 --> 00:21:34,080
changes in land carbon that may manifest

553
00:21:37,510 --> 00:21:35,520
in the future

554
00:21:39,830 --> 00:21:37,520
in this regard the arctic boreal zone is

555
00:21:41,190 --> 00:21:39,840
especially important region to consider

556
00:21:43,510 --> 00:21:41,200
where climate change is occurring

557
00:21:45,590 --> 00:21:43,520
fastest and large quantities of carbon

558
00:21:46,789 --> 00:21:45,600
are presently locked in permafrost or at

559
00:21:48,390 --> 00:21:46,799
the risk of being released to the

560
00:21:50,789 --> 00:21:48,400
atmosphere as they saw

561
00:21:52,390 --> 00:21:50,799
in warmer conditions

562
00:21:54,149 --> 00:21:52,400
in figure 9 you can see the phenomena

563
00:21:56,070 --> 00:21:54,159

i'm describing

564
00:21:58,149 --> 00:21:56,080
focus on the left part of the figure

565
00:22:00,070 --> 00:21:58,159
where you see the global warming

566
00:22:01,669 --> 00:22:00,080
potentially leads to faster organic

567
00:22:03,750 --> 00:22:01,679
matter decomposition

568
00:22:06,390 --> 00:22:03,760
which in turn comes right back

569
00:22:08,710 --> 00:22:06,400
and increases co2 further

570
00:22:11,350 --> 00:22:08,720
leading to further warming

571
00:22:12,950 --> 00:22:11,360
a new field campaign begun this year the

572
00:22:15,990 --> 00:22:12,960
arctic boreal

573
00:22:18,470 --> 00:22:16,000
vulnerability experiment known as above

574
00:22:20,070 --> 00:22:18,480
already has some dozens of projects and

575
00:22:21,590 --> 00:22:20,080
more than 100 investigators studying

576
00:22:22,789 --> 00:22:21,600
this region with new measurements and

577
00:22:24,630 --> 00:22:22,799
models

578
00:22:25,990 --> 00:22:24,640
all part of an ambitious field campaign

579
00:22:29,669 --> 00:22:26,000
that will utilize nasa's unique

580
00:22:33,029 --> 00:22:31,350
in closing through new innovative

581
00:22:35,430 --> 00:22:33,039
approaches to carbon monitoring like the

582
00:22:37,510 --> 00:22:35,440
carbon monitoring system and jedi

583
00:22:39,510 --> 00:22:37,520
an ambitious new fuel campaign like

584
00:22:40,549 --> 00:22:39,520
above focus on an extremely sensitive

585
00:22:42,310 --> 00:22:40,559
region

586
00:22:43,590 --> 00:22:42,320
nasa is taking major steps to improve

587
00:22:45,029 --> 00:22:43,600
our understanding

588
00:22:46,710 --> 00:22:45,039

and reduce uncertainties of the

589
00:22:47,990 --> 00:22:46,720
terrestrial carbon cycle both now and

590
00:22:49,669 --> 00:22:48,000
for the future

591
00:22:52,070 --> 00:22:49,679
in ways that promise to revolutionize

592
00:22:53,669 --> 00:22:52,080
both our scientific understanding

593
00:22:56,950 --> 00:22:53,679
and the information with which we can

594
00:23:00,630 --> 00:22:58,470
now i'd like to turn things over to anne

595
00:23:02,789 --> 00:23:00,640
marie from the nasa's jet propulsion

596
00:23:04,470 --> 00:23:02,799
laboratory

597
00:23:06,950 --> 00:23:04,480
thanks george

598
00:23:09,590 --> 00:23:06,960
so each one of us has reminded you that

599
00:23:11,430 --> 00:23:09,600
we know on average 50 percent of the

600
00:23:13,990 --> 00:23:11,440
carbon dioxide that's released in the

601
00:23:16,789 --> 00:23:14,000
atmosphere each year from burning fossil

602
00:23:19,830 --> 00:23:16,799
fuels is removed by the earth's ocean

603
00:23:21,750 --> 00:23:19,840
and land ecosystem the plants and trees

604
00:23:23,830 --> 00:23:21,760
but we still have questions where is

605
00:23:25,510 --> 00:23:23,840
that happening exactly how is it

606
00:23:27,510 --> 00:23:25,520
changing from year to year and what's

607
00:23:30,470 --> 00:23:27,520
driving that change

608
00:23:33,510 --> 00:23:30,480
nasa's orbiting carbon observatory 2 or

609
00:23:35,830 --> 00:23:33,520
oco-2 is gathering data that's required

610
00:23:38,070 --> 00:23:35,840
to answer these questions

611
00:23:40,310 --> 00:23:38,080
oco-2 is focused on quantifying the

612
00:23:42,230 --> 00:23:40,320
sources and sinks of carbon dioxide the

613
00:23:44,549 --> 00:23:42,240

regions where the carbon dioxide is

614
00:23:46,310 --> 00:23:44,559
released into earth's atmosphere and

615
00:23:48,310 --> 00:23:46,320
where it's absorbed from the atmosphere

616
00:23:50,470 --> 00:23:48,320
back into the earth system

617
00:23:53,270 --> 00:23:50,480
we seek to do that on regions that are

618
00:23:55,110 --> 00:23:53,280
the size of large states and on monthly

619
00:23:56,549 --> 00:23:55,120
time scales

620
00:23:59,029 --> 00:23:56,559
and we've just reached a really

621
00:24:01,350 --> 00:23:59,039
important milestone for oco2 we now have

622
00:24:03,350 --> 00:24:01,360
our first full year of atmospheric

623
00:24:05,350 --> 00:24:03,360
carbon dioxide from the space based

624
00:24:09,669 --> 00:24:05,360
mission

625
00:24:11,750 --> 00:24:09,679
oco-2 gathers nearly 100 000

626
00:24:14,870 --> 00:24:11,760
high-quality measurements of atmospheric

627
00:24:17,029 --> 00:24:14,880
carbon dioxide each day across the globe

628
00:24:19,350 --> 00:24:17,039
this is at least 100 times the amount of

629
00:24:21,190 --> 00:24:19,360
data that we had on a daily basis

630
00:24:22,789 --> 00:24:21,200
previously

631
00:24:24,789 --> 00:24:22,799
and they're tricky measurements we only

632
00:24:26,630 --> 00:24:24,799
just began this type of work because it

633
00:24:28,390 --> 00:24:26,640
took quite some time to develop an

634
00:24:30,149 --> 00:24:28,400
instrument that had the sensitivity we

635
00:24:32,230 --> 00:24:30,159
needed

636
00:24:33,750 --> 00:24:32,240
the animation that you'll see in figure

637
00:24:35,909 --> 00:24:33,760
10 here

638
00:24:39,830 --> 00:24:35,919

illustrates some of the uh features of

639
00:24:41,830 --> 00:24:39,840
oco 2 data collection so this animation

640
00:24:43,669 --> 00:24:41,840
puts dots on the map where we collect

641
00:24:46,310 --> 00:24:43,679
data they're a little bit exaggerated so

642
00:24:48,789 --> 00:24:46,320
that you can see them with your eye each

643
00:24:50,789 --> 00:24:48,799
measurement from oco2 is quite precise

644
00:24:53,510 --> 00:24:50,799
we can see change of a quarter of a

645
00:24:55,510 --> 00:24:53,520
percent or one out of 400 part per

646
00:24:58,390 --> 00:24:55,520
million

647
00:25:01,029 --> 00:24:58,400
and this graphic uses a color range that

648
00:25:02,310 --> 00:25:01,039
spans only 15 parts per million or just

649
00:25:04,230 --> 00:25:02,320
four percent of the overall

650
00:25:06,710 --> 00:25:04,240
concentrations

651
00:25:09,669 --> 00:25:06,720
the mist may seem like a small number of

652
00:25:11,590 --> 00:25:09,679
carbon dioxide but carbon dioxide's such

653
00:25:13,510 --> 00:25:11,600
a powerful heat trapping gas these

654
00:25:15,350 --> 00:25:13,520
changes are important

655
00:25:17,110 --> 00:25:15,360
and in addition

656
00:25:19,110 --> 00:25:17,120
when we want to learn about the sources

657
00:25:21,110 --> 00:25:19,120
and the sinks we need to be able to see

658
00:25:23,510 --> 00:25:21,120
where the concentration has changed by

659
00:25:26,630 --> 00:25:23,520
just one or two parts per million

660
00:25:29,029 --> 00:25:26,640
we aggregate data over 16 days to create

661
00:25:30,789 --> 00:25:29,039
the smooth map that you see here that's

662
00:25:32,710 --> 00:25:30,799
the amount of time it takes for our

663
00:25:35,830 --> 00:25:32,720

spacecraft to get back to where it had

664
00:25:38,310 --> 00:25:35,840
started uh 16 days before

665
00:25:39,990 --> 00:25:38,320
and our instrument requires sunlight to

666
00:25:41,909 --> 00:25:40,000
be reflected off of earth for this

667
00:25:44,310 --> 00:25:41,919
measurement so you'll see that the

668
00:25:46,950 --> 00:25:44,320
latitudes we measure at cover

669
00:25:49,029 --> 00:25:46,960
change a bit over the seasons

670
00:25:51,269 --> 00:25:49,039
and if we move to the next figure figure

671
00:25:53,430 --> 00:25:51,279
11 this is just a still map of our

672
00:25:55,350 --> 00:25:53,440
carbon dioxide field

673
00:25:57,269 --> 00:25:55,360
in march

674
00:25:59,029 --> 00:25:57,279
and march is the time of the year in the

675
00:26:00,950 --> 00:25:59,039
northern hemisphere that winter is

676
00:26:03,269 --> 00:26:00,960
fading away but spring has not yet

677
00:26:06,549 --> 00:26:03,279
really arrived in full force

678
00:26:07,669 --> 00:26:06,559
so the trees are not yet building up

679
00:26:09,830 --> 00:26:07,679
leaves

680
00:26:11,510 --> 00:26:09,840
no carbon dioxide has been removed from

681
00:26:13,590 --> 00:26:11,520
the atmosphere by that process all

682
00:26:14,950 --> 00:26:13,600
winter so you see these elevated

683
00:26:16,789 --> 00:26:14,960
concentrations in the northern

684
00:26:19,669 --> 00:26:16,799
hemisphere

685
00:26:22,310 --> 00:26:19,679
in the next figure figure 12

686
00:26:24,710 --> 00:26:22,320
we're showing you the first half of june

687
00:26:26,710 --> 00:26:24,720
and at this time things have changed

688
00:26:28,950 --> 00:26:26,720

quite a bit we have what we call the

689
00:26:31,750 --> 00:26:28,960
spring drawdown so the leaves and the

690
00:26:33,590 --> 00:26:31,760
trees are starting to be active trees

691
00:26:35,990 --> 00:26:33,600
are taking carbon dioxide out of the

692
00:26:38,390 --> 00:26:36,000
atmosphere and building leaves and we

693
00:26:40,149 --> 00:26:38,400
see changes of the order of 10 parts per

694
00:26:42,149 --> 00:26:40,159
million in carbon dioxide over the

695
00:26:43,510 --> 00:26:42,159
region of eurasia because of this

696
00:26:45,110 --> 00:26:43,520
activity

697
00:26:48,230 --> 00:26:45,120
so this spring drawdown is one of the

698
00:26:50,070 --> 00:26:48,240
big obvious features in our data set

699
00:26:52,310 --> 00:26:50,080
and now that we have more than a year of

700
00:26:54,310 --> 00:26:52,320
data covering all seasons and a wide

701
00:26:57,990 --> 00:26:54,320
range of latitudes we can really begin

702
00:26:59,830 --> 00:26:58,000
investigating a lot of science questions

703
00:27:01,830 --> 00:26:59,840
some other big features we've seen and

704
00:27:03,830 --> 00:27:01,840
are investigating are signals from

705
00:27:06,310 --> 00:27:03,840
biomass burning

706
00:27:08,630 --> 00:27:06,320
in africa this seasonal burning emits a

707
00:27:10,390 --> 00:27:08,640
large amount of carbon dioxide we can

708
00:27:12,149 --> 00:27:10,400
see that in our measurement data set and

709
00:27:14,230 --> 00:27:12,159
we're starting to quantify how much is

710
00:27:17,029 --> 00:27:14,240
released from the fires

711
00:27:19,029 --> 00:27:17,039
we also see some panelizing clues about

712
00:27:21,830 --> 00:27:19,039
enhancements over cities because the

713
00:27:23,510 --> 00:27:21,840

data's so precise we can pick this out

714
00:27:25,350 --> 00:27:23,520
many of you familiar with the way that

715
00:27:27,830 --> 00:27:25,360
the mountains of los angeles and the

716
00:27:30,149 --> 00:27:27,840
large population result in pollution

717
00:27:32,789 --> 00:27:30,159
being trapped over our city the same

718
00:27:35,029 --> 00:27:32,799
principle holds with carbon dioxide and

719
00:27:37,830 --> 00:27:35,039
with oco 2 we're taking a peek at how

720
00:27:39,669 --> 00:27:37,840
much extra carbon dioxide we see in la

721
00:27:41,190 --> 00:27:39,679
relative to the oceans and deserts

722
00:27:43,190 --> 00:27:41,200
nearby

723
00:27:45,110 --> 00:27:43,200
there's other questions we seek to study

724
00:27:47,350 --> 00:27:45,120
such as how the drought in the western

725
00:27:48,630 --> 00:27:47,360
u.s might be changing the carbon uptake

726
00:27:51,350 --> 00:27:48,640
this year

727
00:27:53,669 --> 00:27:51,360
or alaska had a very warm summer as well

728
00:27:55,590 --> 00:27:53,679
as some large fires this last year can

729
00:27:57,350 --> 00:27:55,600
we quantify how much that changed the

730
00:27:59,350 --> 00:27:57,360
carbon uptake

731
00:28:01,350 --> 00:27:59,360
and the current el nino conditions and

732
00:28:03,909 --> 00:28:01,360
very warm ocean temperatures are likely

733
00:28:05,830 --> 00:28:03,919
to change the exchange of carbon dioxide

734
00:28:07,430 --> 00:28:05,840
between the ocean and the atmosphere can

735
00:28:09,190 --> 00:28:07,440
we say how much

736
00:28:11,669 --> 00:28:09,200
to answer these and other science

737
00:28:13,350 --> 00:28:11,679
questions we'll use global models and

738
00:28:16,070 --> 00:28:13,360

leslie will tell you a little bit more

739
00:28:18,549 --> 00:28:16,080
about that in just a moment

740
00:28:21,110 --> 00:28:18,559
in addition to measuring carbon dioxide

741
00:28:22,310 --> 00:28:21,120
oco 2 sees some of the light that plants

742
00:28:23,909 --> 00:28:22,320
release when they're performing

743
00:28:26,149 --> 00:28:23,919
photosynthesis

744
00:28:27,990 --> 00:28:26,159
we call this solar induced fluorescence

745
00:28:29,909 --> 00:28:28,000
or sif

746
00:28:31,750 --> 00:28:29,919
there's a host of observations and clues

747
00:28:33,350 --> 00:28:31,760
that show us that sif is very closely

748
00:28:35,269 --> 00:28:33,360
related to the plant health and

749
00:28:37,669 --> 00:28:35,279
productivity

750
00:28:39,830 --> 00:28:37,679
and to understand the role of plants in

751
00:28:42,389 --> 00:28:39,840
the carbon cycle ultimately we want to

752
00:28:45,430 --> 00:28:42,399
use not just co2 which is taken up and

753
00:28:48,070 --> 00:28:45,440
released by the plants and sift from oco

754
00:28:49,990 --> 00:28:48,080
to a measure of activity but other

755
00:28:51,750 --> 00:28:50,000
measurements from nasa mission such as

756
00:28:54,710 --> 00:28:51,760
how much water is available for those

757
00:28:57,110 --> 00:28:54,720
plants how much plant material is there

758
00:28:59,590 --> 00:28:57,120
like what george showed us and even what

759
00:29:02,070 --> 00:28:59,600
type of plants exist

760
00:29:03,990 --> 00:29:02,080
the last figure figure 13 is just a map

761
00:29:05,430 --> 00:29:04,000
of the shift measurements that we've

762
00:29:07,590 --> 00:29:05,440
made recently

763
00:29:09,430 --> 00:29:07,600

and again these measurements integrated

764
00:29:12,310 --> 00:29:09,440
with other will help us study

765
00:29:14,549 --> 00:29:12,320
the role of plants in the carbon cycle

766
00:29:16,789 --> 00:29:14,559
so we're very excited to have over a

767
00:29:19,269 --> 00:29:16,799
full year of atmospheric carbon dioxide

768
00:29:21,510 --> 00:29:19,279
and sift measurements from oco2 and the

769
00:29:23,430 --> 00:29:21,520
science community is now using this data

770
00:29:26,470 --> 00:29:23,440
to begin investigating

771
00:29:28,310 --> 00:29:26,480
questions about earth's carbon cycle

772
00:29:29,909 --> 00:29:28,320
now i'll turn things over to leslie ott

773
00:29:31,990 --> 00:29:29,919
my colleague from the goddard space

774
00:29:34,310 --> 00:29:32,000
flight center

775
00:29:36,149 --> 00:29:34,320
okay thanks anne marie so you've just

776
00:29:37,909 --> 00:29:36,159
heard a lot about the breadth of

777
00:29:39,269 --> 00:29:37,919
satellite and field observations that

778
00:29:40,389 --> 00:29:39,279
nasa makes to try to understand the

779
00:29:41,990 --> 00:29:40,399
carbon cycle

780
00:29:43,750 --> 00:29:42,000
i'm going to talk a little bit about how

781
00:29:45,990 --> 00:29:43,760
we're using models to pull all those

782
00:29:47,830 --> 00:29:46,000
observations together and ultimately

783
00:29:49,669 --> 00:29:47,840
advance our understanding

784
00:29:51,350 --> 00:29:49,679
but before i start and get into things i

785
00:29:53,750 --> 00:29:51,360
want to just give a brief definition of

786
00:29:55,909 --> 00:29:53,760
what i mean when i say model a model is

787
00:29:58,950 --> 00:29:55,919
really just a set of equations that

788
00:30:01,110 --> 00:29:58,960

describe physical processes in the earth

789
00:30:03,590 --> 00:30:01,120
system so our models now have gotten

790
00:30:05,830 --> 00:30:03,600
quite advanced they allow us to simulate

791
00:30:08,230 --> 00:30:05,840
processes more realistically and to look

792
00:30:09,990 --> 00:30:08,240
at finer scales than we ever have before

793
00:30:11,510 --> 00:30:10,000
but in essence the concept of a model is

794
00:30:14,070 --> 00:30:11,520
pretty simple it's just a mathematical

795
00:30:15,750 --> 00:30:14,080
description of physical processes as

796
00:30:16,630 --> 00:30:15,760
well as scientists currently understand

797
00:30:19,110 --> 00:30:16,640
them

798
00:30:20,789 --> 00:30:19,120
so if you look at figure 14 we have a

799
00:30:22,470 --> 00:30:20,799
movie of atmospheric co2 that

800
00:30:24,310 --> 00:30:22,480
illustrates the complexity that we're

801
00:30:26,789 --> 00:30:24,320
capable of simulating with current

802
00:30:29,190 --> 00:30:26,799
models this was produced using nasa's

803
00:30:31,590 --> 00:30:29,200
geos5 model at a resolution

804
00:30:33,510 --> 00:30:31,600
about a thousand times greater than

805
00:30:36,070 --> 00:30:33,520
previous generations of models which is

806
00:30:37,830 --> 00:30:36,080
about the same spatial resolution used

807
00:30:40,070 --> 00:30:37,840
in today's best weather forecasting

808
00:30:42,070 --> 00:30:40,080
models this movie shows us atmospheric

809
00:30:43,750 --> 00:30:42,080
co2 during northern hemisphere spring

810
00:30:45,830 --> 00:30:43,760
into summer when the plants are drawing

811
00:30:47,430 --> 00:30:45,840
huge amounts of carbon out of the

812
00:30:48,870 --> 00:30:47,440
atmosphere which is the same period that

813
00:30:51,029 --> 00:30:48,880

anne marie just highlighted in the

814
00:30:52,549 --> 00:30:51,039
observations from oco2

815
00:30:54,470 --> 00:30:52,559
and the quantity that this movie is

816
00:30:56,389 --> 00:30:54,480
showing you is column averaged

817
00:30:59,110 --> 00:30:56,399
atmospheric co2 so this is the same

818
00:31:02,230 --> 00:30:59,120
quantity that oco-2 is observing and as

819
00:31:04,230 --> 00:31:02,240
we watch co2 move through the atmosphere

820
00:31:06,870 --> 00:31:04,240
you see some strong emissions from

821
00:31:08,710 --> 00:31:06,880
cities places like l.a uh you also see

822
00:31:10,230 --> 00:31:08,720
the seasonal cycle of carbon that comes

823
00:31:12,710 --> 00:31:10,240
from the land biosphere and plants

824
00:31:14,470 --> 00:31:12,720
drawing co2 out of the atmosphere but we

825
00:31:16,470 --> 00:31:14,480
see a strong signal of weather fronts

826
00:31:18,950 --> 00:31:16,480
moving carbon around and you get a sense

827
00:31:21,029 --> 00:31:18,960
of all of the variability and complexity

828
00:31:23,590 --> 00:31:21,039
of the processes controlling atmospheric

829
00:31:25,750 --> 00:31:23,600
co2 we have to try to understand all of

830
00:31:27,510 --> 00:31:25,760
these processes together in order to

831
00:31:28,789 --> 00:31:27,520
understand the atmospheric observations

832
00:31:31,350 --> 00:31:28,799
that we're getting from our satellites

833
00:31:33,029 --> 00:31:31,360
which is quite a big task

834
00:31:35,029 --> 00:31:33,039
so in addition to the atmosphere we

835
00:31:36,470 --> 00:31:35,039
spend a lot of time and effort on models

836
00:31:38,310 --> 00:31:36,480
that describe the carbon cycle as a

837
00:31:40,549 --> 00:31:38,320
whole including the land and ocean

838
00:31:42,789 --> 00:31:40,559

components models play a really really

839
00:31:44,149 --> 00:31:42,799
important role here because the quantity

840
00:31:46,630 --> 00:31:44,159
that we really want to know about the

841
00:31:49,350 --> 00:31:46,640
carbon cycle which is the total amount

842
00:31:51,909 --> 00:31:49,360
of carbon moving between the atmosphere

843
00:31:53,269 --> 00:31:51,919
the land and the oceans as scientists we

844
00:31:55,269 --> 00:31:53,279
call this flux

845
00:31:56,950 --> 00:31:55,279
this isn't observable directly at least

846
00:31:59,669 --> 00:31:56,960
not at a global scale so we have to rely

847
00:32:01,110 --> 00:31:59,679
on our models to ingest the observations

848
00:32:02,789 --> 00:32:01,120
and get the information out of them that

849
00:32:05,269 --> 00:32:02,799
we really really need

850
00:32:06,710 --> 00:32:05,279
if you move on to figure 15

851
00:32:08,549 --> 00:32:06,720
we'll see that our new ops our new

852
00:32:09,990 --> 00:32:08,559
measurements from oco 2 complement some

853
00:32:13,110 --> 00:32:10,000
of the observations that nasa has been

854
00:32:14,950 --> 00:32:13,120
making for a very long time so for

855
00:32:17,909 --> 00:32:14,960
instance we've had observations of ocean

856
00:32:19,509 --> 00:32:17,919
color since about 1997 and those give us

857
00:32:21,350 --> 00:32:19,519
some important information about ocean

858
00:32:23,430 --> 00:32:21,360
productivity although as mike mentioned

859
00:32:25,350 --> 00:32:23,440
it's not the whole picture we also have

860
00:32:26,710 --> 00:32:25,360
satellite observations of vegetation

861
00:32:28,630 --> 00:32:26,720
greenness which kind of fill in the

862
00:32:31,269 --> 00:32:28,640
northern hemisphere and those go all the

863
00:32:33,430 --> 00:32:31,279

way back to the 1970s providing a lot of

864
00:32:35,909 --> 00:32:33,440
valuable information about how

865
00:32:37,509 --> 00:32:35,919
vegetation stores carbon and how that's

866
00:32:39,190 --> 00:32:37,519
changed over time

867
00:32:41,029 --> 00:32:39,200
some of those same satellites even

868
00:32:42,789 --> 00:32:41,039
provide information about fires and

869
00:32:44,710 --> 00:32:42,799
about the distribution of night lights

870
00:32:46,950 --> 00:32:44,720
which give us information about where

871
00:32:49,190 --> 00:32:46,960
humans are emitting co2 so we have some

872
00:32:51,669 --> 00:32:49,200
constraint on every aspect of the carbon

873
00:32:53,669 --> 00:32:51,679
cycle from nasa satellite measurements

874
00:32:55,590 --> 00:32:53,679
our models combine all of this with

875
00:32:57,590 --> 00:32:55,600
millions of observations of weather per

876
00:32:59,029 --> 00:32:57,600
day to give us a look at that carbon

877
00:33:01,590 --> 00:32:59,039
flux that we really want and that's

878
00:33:03,590 --> 00:33:01,600
illustrated in figure 16. and you can

879
00:33:06,230 --> 00:33:03,600
see that our models help us understand

880
00:33:08,710 --> 00:33:06,240
how this carbon flux is changing both

881
00:33:11,190 --> 00:33:08,720
over the course of a day and over longer

882
00:33:13,669 --> 00:33:11,200
time periods like seasons and years and

883
00:33:15,509 --> 00:33:13,679
we need to understand all of that

884
00:33:17,269 --> 00:33:15,519
our models then transport these flux

885
00:33:19,190 --> 00:33:17,279
distributions in the atmosphere like you

886
00:33:21,190 --> 00:33:19,200
saw in the first movie and now that we

887
00:33:23,509 --> 00:33:21,200
have oco 2 we can actually use those

888
00:33:25,909 --> 00:33:23,519

atmospheric observations to tell us how

889
00:33:28,149 --> 00:33:25,919
good our model based short source and

890
00:33:30,149 --> 00:33:28,159
sync estimates were to begin with we

891
00:33:31,909 --> 00:33:30,159
know that they're not perfect so the

892
00:33:33,830 --> 00:33:31,919
atmospheric data are a really important

893
00:33:35,750 --> 00:33:33,840
check that helps us figure out where the

894
00:33:38,149 --> 00:33:35,760
models are doing a good job and where we

895
00:33:39,990 --> 00:33:38,159
need to work more to improve them so the

896
00:33:41,750 --> 00:33:40,000
motivation of all of this and tying this

897
00:33:43,190 --> 00:33:41,760
all together with models is to

898
00:33:45,110 --> 00:33:43,200
ultimately make models that are more

899
00:33:47,110 --> 00:33:45,120
reliable for predicting how the carbon

900
00:33:50,230 --> 00:33:47,120
cycle and climate are going to change

901
00:33:55,190 --> 00:33:52,789
so if you move on to slide 17 i'll show

902
00:33:56,950 --> 00:33:55,200
you one other thing about models that is

903
00:33:59,110 --> 00:33:56,960
really neat um they're helping us

904
00:34:01,909 --> 00:33:59,120
understand what we're seeing in the new

905
00:34:04,230 --> 00:34:01,919
oco-2 data so this is a model simulation

906
00:34:06,710 --> 00:34:04,240
that's actually keeping track of co2

907
00:34:08,470 --> 00:34:06,720
emitted by fires and by big cities

908
00:34:10,790 --> 00:34:08,480
separately if we just looked at the

909
00:34:12,710 --> 00:34:10,800
satellite data we would see that co2 was

910
00:34:14,629 --> 00:34:12,720
enhanced over a certain region but we

911
00:34:16,950 --> 00:34:14,639
wouldn't know why or where the process

912
00:34:18,389 --> 00:34:16,960
is controlling that so by combining the

913
00:34:20,470 --> 00:34:18,399

satellite observations with more

914
00:34:21,909 --> 00:34:20,480
detailed model simulations we can work

915
00:34:24,230 --> 00:34:21,919
to figure out what the signals that

916
00:34:25,669 --> 00:34:24,240
we're seeing in the atmosphere actually

917
00:34:27,909 --> 00:34:25,679
mean

918
00:34:29,430 --> 00:34:27,919
in addition to oco2 we're really excited

919
00:34:31,030 --> 00:34:29,440
to have a field campaign beginning this

920
00:34:33,190 --> 00:34:31,040
summer called act america that uses

921
00:34:34,869 --> 00:34:33,200
aircraft to study the carbon cycle over

922
00:34:36,550 --> 00:34:34,879
north america in greater detail and

923
00:34:38,389 --> 00:34:36,560
we're also working to design new

924
00:34:40,470 --> 00:34:38,399
satellites in the future that will help

925
00:34:42,869 --> 00:34:40,480
us see in the dark and actually fill in

926
00:34:44,550 --> 00:34:42,879
some of those oco 2 pictures at high

927
00:34:46,230 --> 00:34:44,560
latitudes where we weren't able to get

928
00:34:47,829 --> 00:34:46,240
observations

929
00:34:49,510 --> 00:34:47,839
so all of this progress in remote

930
00:34:51,669 --> 00:34:49,520
sensing of atmospheric co2 is really

931
00:34:53,190 --> 00:34:51,679
exciting because along with the land and

932
00:34:55,190 --> 00:34:53,200
the ocean observations that we've had

933
00:34:57,270 --> 00:34:55,200
for a longer time we now have a much

934
00:34:59,670 --> 00:34:57,280
more complete picture of carbon in the

935
00:35:01,589 --> 00:34:59,680
earth system than we've ever had before

936
00:35:03,829 --> 00:35:01,599
for instance we've never before viewed

937
00:35:05,190 --> 00:35:03,839
the spring drawdown of co2 with the

938
00:35:07,030 --> 00:35:05,200

observations that actually show us how

939
00:35:09,430 --> 00:35:07,040
vegetation and atmospheric carbon

940
00:35:12,310 --> 00:35:09,440
interact that's really exciting and it's

941
00:35:14,390 --> 00:35:12,320
a really big innovation and all of these

942
00:35:16,630 --> 00:35:14,400
observations are helping us to develop

943
00:35:19,190 --> 00:35:16,640
more reliable models so that we can move

944
00:35:20,630 --> 00:35:19,200
from doing just the science to actually

945
00:35:23,270 --> 00:35:20,640
supporting the work that's done by

946
00:35:24,950 --> 00:35:23,280
policy makers as george mentioned

947
00:35:26,390 --> 00:35:24,960
so with that thank you all for your

948
00:35:28,950 --> 00:35:26,400
attention and i'm going to pass it back

949
00:35:30,870 --> 00:35:28,960
to steve for the q a

950
00:35:34,310 --> 00:35:30,880
okay thank you leslie and thank you all

951
00:35:36,230 --> 00:35:34,320
of our panelists um just as a reminder

952
00:35:38,950 --> 00:35:36,240
um if you're media on the call and you'd

953
00:35:40,069 --> 00:35:38,960
like to ask a question it's star one on

954
00:35:42,710 --> 00:35:40,079
your phone

955
00:35:44,790 --> 00:35:42,720
and for the others uh listening um you

956
00:35:47,670 --> 00:35:44,800
can ask a question via

957
00:35:50,470 --> 00:35:47,680
social media on twitter with the hashtag

958
00:35:52,390 --> 00:35:50,480
ask nasa

959
00:35:55,510 --> 00:35:52,400
okay our first call comes from the phone

960
00:35:58,390 --> 00:35:55,520
lines uh peter king at cbs news

961
00:36:00,150 --> 00:35:58,400
thank you steve and anyone who knows me

962
00:36:02,550 --> 00:36:00,160
probably knows what kind of question i'm

963
00:36:04,230 --> 00:36:02,560

going to ask here and here goes you know

964
00:36:06,150 --> 00:36:04,240
you've all told us about models you've

965
00:36:08,310 --> 00:36:06,160
told us about the technology you've told

966
00:36:10,310 --> 00:36:08,320
us about some of the findings and a lot

967
00:36:12,630 --> 00:36:10,320
of what you hope to learn

968
00:36:14,230 --> 00:36:12,640
but in your best layman's terms i need

969
00:36:16,150 --> 00:36:14,240
somebody to explain

970
00:36:18,790 --> 00:36:16,160
exactly what what you think the main

971
00:36:25,430 --> 00:36:18,800
takeaway of what you found already

972
00:36:29,349 --> 00:36:27,430
okay uh we'll go to mike freilich on

973
00:36:31,750 --> 00:36:29,359
that question

974
00:36:32,710 --> 00:36:31,760
so thank thanks very much uh for the

975
00:36:34,950 --> 00:36:32,720
question

976
00:36:37,109 --> 00:36:34,960
uh the main takeaway

977
00:36:37,910 --> 00:36:37,119
uh there there are a couple of points i

978
00:36:40,069 --> 00:36:37,920
think

979
00:36:41,910 --> 00:36:40,079
one of them is that

980
00:36:42,870 --> 00:36:41,920
the carbon cycle

981
00:36:45,510 --> 00:36:42,880
is

982
00:36:48,069 --> 00:36:45,520
quite complex

983
00:36:49,270 --> 00:36:48,079
there are processes

984
00:36:55,990 --> 00:36:49,280
that

985
00:36:58,069 --> 00:36:56,000
occurring in the ocean

986
00:36:59,349 --> 00:36:58,079
all of them are

987
00:37:02,710 --> 00:36:59,359
impacting

988
00:37:06,390 --> 00:37:02,720

how much of our fossil fuel

989
00:37:09,349 --> 00:37:06,400
co2 remains in the atmosphere all of

990
00:37:13,829 --> 00:37:09,359
them are impacting the future climate

991
00:37:17,349 --> 00:37:13,839
trajectory the second takeaway is that

992
00:37:18,950 --> 00:37:17,359
we in nasa with the research community

993
00:37:21,190 --> 00:37:18,960
have harnessed

994
00:37:23,510 --> 00:37:21,200
advanced technology

995
00:37:25,990 --> 00:37:23,520
cutting edge research

996
00:37:28,950 --> 00:37:26,000
and top flight models

997
00:37:31,510 --> 00:37:28,960
to make the observations

998
00:37:32,950 --> 00:37:31,520
to do the analyses

999
00:37:38,390 --> 00:37:32,960
to

1000
00:37:42,230 --> 00:37:38,400
understanding

1001
00:37:45,910 --> 00:37:42,240
and then to put ourselves in a position

1002
00:37:50,470 --> 00:37:45,920
of beginning to make predictions

1003
00:37:54,150 --> 00:37:50,480
based on the objective analyses and

1004
00:37:56,950 --> 00:37:54,160
and observations that can then be used

1005
00:38:00,470 --> 00:37:56,960
by the political process to decide what

1006
00:38:01,990 --> 00:38:00,480
we as a species want to do

1007
00:38:03,190 --> 00:38:02,000
in order to

1008
00:38:05,829 --> 00:38:03,200
both

1009
00:38:08,710 --> 00:38:05,839
capitalize on the opportunities and to

1010
00:38:12,870 --> 00:38:08,720
meet the challenges of increased

1011
00:38:14,790 --> 00:38:12,880
atmospheric co2 and finally

1012
00:38:16,550 --> 00:38:14,800
we're not talking about things that have

1013
00:38:19,589 --> 00:38:16,560

happened in the past

1014
00:38:22,470 --> 00:38:19,599
these observations this research and

1015
00:38:25,510 --> 00:38:22,480
this modeling is continuing

1016
00:38:28,790 --> 00:38:25,520
into the future so that we are actually

1017
00:38:31,910 --> 00:38:28,800
for the first time able to see

1018
00:38:33,670 --> 00:38:31,920
and to begin to understand how things

1019
00:38:36,710 --> 00:38:33,680
are changing

1020
00:38:40,470 --> 00:38:36,720
relative to carbon dioxide in the

1021
00:38:43,030 --> 00:38:40,480
atmosphere not simply what the status is

1022
00:38:48,069 --> 00:38:45,190
okay our next question

1023
00:38:49,349 --> 00:38:48,079
chris mooney washington post

1024
00:38:51,430 --> 00:38:49,359
hi thank you

1025
00:38:53,750 --> 00:38:51,440
so as you know decision makers are

1026
00:38:55,990 --> 00:38:53,760
already making decisions based on their

1027
00:38:58,870 --> 00:38:56,000
understanding of the carbon cycle and in

1028
00:39:00,950 --> 00:38:58,880
fact there is a carbon budget that is

1029
00:39:02,630 --> 00:39:00,960
what we think we can burn uh to not go

1030
00:39:03,510 --> 00:39:02,640
over two degrees c

1031
00:39:04,710 --> 00:39:03,520
um

1032
00:39:06,710 --> 00:39:04,720
based on all the uncertainties you

1033
00:39:08,390 --> 00:39:06,720
highlighted should we trust

1034
00:39:15,670 --> 00:39:08,400
the current carbon budget which is the

1035
00:39:19,190 --> 00:39:18,230
um let's see uh anybody on the other

1036
00:39:24,950 --> 00:39:19,200
panelists

1037
00:39:29,430 --> 00:39:27,270
i'll try it again okay yeah this is

1038
00:39:33,430 --> 00:39:29,440

scott dhoni i can take a shot oh okay

1039
00:39:35,430 --> 00:39:33,440
great guy um so there are a number of

1040
00:39:38,630 --> 00:39:35,440
uh just so everybody's aware scott doney

1041
00:39:39,750 --> 00:39:38,640
is a colleague of mike berenfeld he's at

1042
00:39:43,430 --> 00:39:39,760
woods hole

1043
00:39:45,829 --> 00:39:43,440
oceanographic institution go ahead scott

1044
00:39:47,990 --> 00:39:45,839
so the the question really comes down to

1045
00:39:50,710 --> 00:39:48,000
how much more carbon can we put into the

1046
00:39:52,310 --> 00:39:50,720
atmosphere to meet certain climate you

1047
00:39:54,069 --> 00:39:52,320
know if you were to put a threshold of

1048
00:39:55,670 --> 00:39:54,079
this is how much climate change we want

1049
00:39:57,270 --> 00:39:55,680
to have

1050
00:39:59,910 --> 00:39:57,280
and so

1051
00:40:01,430 --> 00:39:59,920
the uncertainties are twofold one is

1052
00:40:03,430 --> 00:40:01,440
for a certain amount of carbon in the

1053
00:40:04,790 --> 00:40:03,440
atmosphere how big is climate change

1054
00:40:07,349 --> 00:40:04,800
going to be

1055
00:40:09,430 --> 00:40:07,359
and the other is for a certain amount of

1056
00:40:11,349 --> 00:40:09,440
you know how much carbon can we put in

1057
00:40:12,470 --> 00:40:11,359
and really know that we'll have a

1058
00:40:14,710 --> 00:40:12,480
certain amount of carbon in the

1059
00:40:16,630 --> 00:40:14,720
atmosphere

1060
00:40:18,950 --> 00:40:16,640
the problems that we've been alluding to

1061
00:40:20,950 --> 00:40:18,960
today are that about only about half of

1062
00:40:22,470 --> 00:40:20,960
the carbon stays in the atmosphere that

1063
00:40:24,950 --> 00:40:22,480

we emit

1064
00:40:27,349 --> 00:40:24,960
and the models we're trying to build and

1065
00:40:29,349 --> 00:40:27,359
what a lot of the work that's gone into

1066
00:40:30,710 --> 00:40:29,359
the satellite missions and these field

1067
00:40:33,109 --> 00:40:30,720
missions

1068
00:40:35,109 --> 00:40:33,119
eventually will improve those models of

1069
00:40:36,870 --> 00:40:35,119
the future carbon cycle

1070
00:40:39,349 --> 00:40:36,880
and i'd say right now we have a sense

1071
00:40:41,430 --> 00:40:39,359
for what the biggest uncertainties are

1072
00:40:43,030 --> 00:40:41,440
and probably the one that george

1073
00:40:44,550 --> 00:40:43,040
highlighted what's going to happen to

1074
00:40:46,550 --> 00:40:44,560
the tundras

1075
00:40:48,790 --> 00:40:46,560
is something that's not in a lot of the

1076
00:40:50,950 --> 00:40:48,800
models that were that are currently

1077
00:40:52,950 --> 00:40:50,960
being used as the basis for policy

1078
00:40:54,710 --> 00:40:52,960
discussions

1079
00:40:56,550 --> 00:40:54,720
there are also big uncertainties about

1080
00:40:58,550 --> 00:40:56,560
parts of the ocean carbon cycle and

1081
00:41:01,270 --> 00:40:58,560
that's what's motivating a lot of the

1082
00:41:04,950 --> 00:41:01,280
research that's going on now either out

1083
00:41:07,829 --> 00:41:04,960
in the atlantic or up in the arctic

1084
00:41:09,589 --> 00:41:07,839
does that help

1085
00:41:10,790 --> 00:41:09,599
okay anybody else want to respond to

1086
00:41:12,630 --> 00:41:10,800
that

1087
00:41:14,790 --> 00:41:12,640
otherwise we'll go on to our next

1088
00:41:17,670 --> 00:41:14,800

question this is this is mike fry like

1089
00:41:18,790 --> 00:41:17,680
i'll just add to scott's uh excellent

1090
00:41:21,109 --> 00:41:18,800
answer

1091
00:41:23,829 --> 00:41:21,119
the measurements that we are making now

1092
00:41:26,230 --> 00:41:23,839
and the models that we are building now

1093
00:41:29,510 --> 00:41:26,240
uh are indeed global

1094
00:41:30,630 --> 00:41:29,520
that's the unique vantage point uh that

1095
00:41:32,309 --> 00:41:30,640
space

1096
00:41:34,470 --> 00:41:32,319
affords for us

1097
00:41:37,990 --> 00:41:34,480
actually many of the

1098
00:41:40,710 --> 00:41:38,000
land measurements that have historically

1099
00:41:43,430 --> 00:41:40,720
been made have been made in areas which

1100
00:41:44,790 --> 00:41:43,440
are not necessarily climatically

1101
00:41:46,630 --> 00:41:44,800
critical

1102
00:41:49,030 --> 00:41:46,640
not real sensitive

1103
00:41:51,990 --> 00:41:49,040
now we are making the measurements

1104
00:41:54,710 --> 00:41:52,000
across the entire globe so

1105
00:41:57,430 --> 00:41:54,720
that we can understand

1106
00:42:00,630 --> 00:41:57,440
uh what is going on in climatically

1107
00:42:03,670 --> 00:42:00,640
critical not simply easy to measure

1108
00:42:10,790 --> 00:42:06,309
okay our next question is from brian

1109
00:42:10,800 --> 00:42:16,390
go ahead brian

1110
00:42:19,829 --> 00:42:18,470
all right i think we've

1111
00:42:20,870 --> 00:42:19,839
brian you may want to check your mu

1112
00:42:22,390 --> 00:42:20,880
button

1113
00:42:24,309 --> 00:42:22,400

okay i'm sorry about that i just

1114
00:42:26,150 --> 00:42:24,319
realized yep i was on view sorry about

1115
00:42:27,750 --> 00:42:26,160
that okay

1116
00:42:29,990 --> 00:42:27,760
um so this question is somewhat related

1117
00:42:31,990 --> 00:42:30,000
to chris's question um you know you guys

1118
00:42:34,470 --> 00:42:32,000
have mentioned a lot about talking

1119
00:42:35,910 --> 00:42:34,480
um how this kind of work can move from

1120
00:42:37,030 --> 00:42:35,920
science to helping policymakers so i'm

1121
00:42:39,190 --> 00:42:37,040
wondering if you can describe any

1122
00:42:40,309 --> 00:42:39,200
specific ways that you envision

1123
00:42:42,230 --> 00:42:40,319
you know these different monitoring

1124
00:42:44,390 --> 00:42:42,240
techniques and improve modeling how

1125
00:42:46,309 --> 00:42:44,400
exactly

1126
00:42:51,270 --> 00:42:46,319
do you hope or envision helping policy

1127
00:42:54,870 --> 00:42:52,790
all right george would you i'd like to

1128
00:42:55,829 --> 00:42:54,880
take a crack at that one sure i'll i'll

1129
00:42:58,150 --> 00:42:55,839
do that

1130
00:42:59,670 --> 00:42:58,160
and i can comment maybe on the previous

1131
00:43:01,829 --> 00:42:59,680
add to the previous question too which

1132
00:43:03,910 --> 00:43:01,839
which i thought was answered very well

1133
00:43:05,910 --> 00:43:03,920
uh i mean i would start by saying that

1134
00:43:06,950 --> 00:43:05,920
it's it's probably

1135
00:43:10,150 --> 00:43:06,960
common

1136
00:43:11,750 --> 00:43:10,160
that policymakers are are challenged

1137
00:43:13,670 --> 00:43:11,760
with making decisions with imperfect

1138
00:43:16,470 --> 00:43:13,680

information

1139
00:43:18,550 --> 00:43:16,480
and given the what we know about climate

1140
00:43:20,630 --> 00:43:18,560
change

1141
00:43:22,710 --> 00:43:20,640
i think there's a strong case to to make

1142
00:43:25,109 --> 00:43:22,720
decisions based on that

1143
00:43:27,589 --> 00:43:25,119
current knowledge but at the same time

1144
00:43:29,430 --> 00:43:27,599
what we're showcasing here is

1145
00:43:30,950 --> 00:43:29,440
uh dramatic efforts to improve that

1146
00:43:32,870 --> 00:43:30,960
knowledge base and i think that will

1147
00:43:35,030 --> 00:43:32,880
lead to

1148
00:43:37,670 --> 00:43:35,040
even better and more detailed decision

1149
00:43:39,510 --> 00:43:37,680
making in the future

1150
00:43:41,270 --> 00:43:39,520
in the carbon monitoring system we have

1151
00:43:42,870 --> 00:43:41,280
a specific charge of

1152
00:43:44,870 --> 00:43:42,880
working to

1153
00:43:46,150 --> 00:43:44,880
provide data products that

1154
00:43:47,829 --> 00:43:46,160
support

1155
00:43:49,829 --> 00:43:47,839
decision makers and

1156
00:43:51,270 --> 00:43:49,839
although we're a relatively new program

1157
00:43:53,589 --> 00:43:51,280
we already have

1158
00:43:55,190 --> 00:43:53,599
some some

1159
00:43:57,349 --> 00:43:55,200
examples

1160
00:43:59,829 --> 00:43:57,359
of note

1161
00:44:01,910 --> 00:43:59,839
one that i showed in my illustration was

1162
00:44:03,190 --> 00:44:01,920
a very high resolution map of

1163
00:44:04,870 --> 00:44:03,200

forest

1164
00:44:05,910 --> 00:44:04,880
carbon over the state of maryland and in

1165
00:44:07,430 --> 00:44:05,920
fact

1166
00:44:10,870 --> 00:44:07,440
the products we've generated out of this

1167
00:44:13,589 --> 00:44:10,880
product are actually supporting uh state

1168
00:44:15,670 --> 00:44:13,599
decision making in maryland regarding

1169
00:44:19,430 --> 00:44:15,680
the management of the extent of forested

1170
00:44:22,390 --> 00:44:19,440
land and also the state's effort to

1171
00:44:24,309 --> 00:44:22,400
regulate or limit its carbon emissions

1172
00:44:26,630 --> 00:44:24,319
but this is just one of many examples we

1173
00:44:28,470 --> 00:44:26,640
have multiple projects as we are

1174
00:44:32,790 --> 00:44:28,480
continuing to expand the carbon

1175
00:44:37,190 --> 00:44:34,630
okay thank you george

1176
00:44:40,550 --> 00:44:37,200
our next question is from irene klotz at

1177
00:44:42,950 --> 00:44:41,910
you know the questions from my

1178
00:44:44,550 --> 00:44:42,960
colleagues are interesting because i

1179
00:44:46,309 --> 00:44:44,560
think what we're all trying to grapple

1180
00:44:47,589 --> 00:44:46,319
with is

1181
00:44:49,990 --> 00:44:47,599
given your

1182
00:44:52,069 --> 00:44:50,000
very excellent and detailed explanations

1183
00:44:53,910 --> 00:44:52,079
of how complicated and

1184
00:44:59,270 --> 00:44:53,920
variable

1185
00:45:03,510 --> 00:45:01,430
what sort of

1186
00:45:05,190 --> 00:45:03,520
impact will that have on specifically

1187
00:45:09,030 --> 00:45:05,200
you've mentioned this un

1188
00:45:09,990 --> 00:45:09,040

conference in in paris um coming up soon

1189
00:45:13,430 --> 00:45:10,000
uh

1190
00:45:16,309 --> 00:45:13,440
what what sort of information can be fed

1191
00:45:19,750 --> 00:45:16,319
into something as imminent as that

1192
00:45:22,069 --> 00:45:19,760
in uh trying to you know set policy and

1193
00:45:24,950 --> 00:45:22,079
regulations that affect you know huge

1194
00:45:28,069 --> 00:45:24,960
numbers of industries people everything

1195
00:45:30,069 --> 00:45:28,079
and then on a more specific note um

1196
00:45:33,030 --> 00:45:30,079
it's also interesting that you've said

1197
00:45:34,870 --> 00:45:33,040
that these um the take-up reabsorption

1198
00:45:37,670 --> 00:45:34,880
of carbon varies

1199
00:45:39,349 --> 00:45:37,680
tremendously from zero sometimes to a

1200
00:45:41,910 --> 00:45:39,359
hundred percent others

1201
00:45:45,829 --> 00:45:41,920
is there anything that you've seen

1202
00:45:47,030 --> 00:45:45,839
that you can point to as why some years

1203
00:45:50,710 --> 00:45:47,040
all of the

1204
00:45:54,870 --> 00:45:50,720
carbon is reabsorbed and why some years

1205
00:45:58,870 --> 00:45:57,270
okay thank you uh i am marie would you

1206
00:46:00,790 --> 00:45:58,880
want to tackle that second part of that

1207
00:46:02,870 --> 00:46:00,800
question

1208
00:46:05,670 --> 00:46:02,880
great hi this is ann marie

1209
00:46:08,710 --> 00:46:05,680
um so this question of why each year is

1210
00:46:11,349 --> 00:46:08,720
so different from another uh i think at

1211
00:46:12,829 --> 00:46:11,359
this point we can say that

1212
00:46:15,030 --> 00:46:12,839
we've seen some

1213
00:46:16,790 --> 00:46:15,040

connections but we don't have

1214
00:46:19,109 --> 00:46:16,800
quantitative proof that they are the

1215
00:46:21,510 --> 00:46:19,119
explanation and for example in years

1216
00:46:23,430 --> 00:46:21,520
that uh el ninos occur

1217
00:46:26,309 --> 00:46:23,440
are often quite different from the years

1218
00:46:28,630 --> 00:46:26,319
that they don't occur but we now want to

1219
00:46:30,470 --> 00:46:28,640
go and actually understand why is that

1220
00:46:32,870 --> 00:46:30,480
how much is that related to temperature

1221
00:46:34,710 --> 00:46:32,880
changes how much is it related to more

1222
00:46:37,190 --> 00:46:34,720
rain in some regions how much is it

1223
00:46:39,750 --> 00:46:37,200
related to the ocean temperatures

1224
00:46:41,190 --> 00:46:39,760
so that's an example of some large

1225
00:46:42,870 --> 00:46:41,200
phenomena that

1226
00:46:44,950 --> 00:46:42,880
impacts a lot of regions around the

1227
00:46:46,550 --> 00:46:44,960
globe and therefore must be impacting

1228
00:46:48,790 --> 00:46:46,560
the carbon cycle and now we want to put

1229
00:46:51,430 --> 00:46:48,800
numbers to why that's happening

1230
00:46:53,109 --> 00:46:51,440
there are other ways that our weathering

1231
00:46:55,430 --> 00:46:53,119
climate can be different from year to

1232
00:46:56,950 --> 00:46:55,440
year we can remember how

1233
00:46:58,790 --> 00:46:56,960
sometimes the

1234
00:47:00,630 --> 00:46:58,800
circulation around the pole is quite

1235
00:47:03,030 --> 00:47:00,640
different in winter time can be colder

1236
00:47:05,190 --> 00:47:03,040
than usual in some of regions of europe

1237
00:47:07,030 --> 00:47:05,200
and north america similar global

1238
00:47:08,870 --> 00:47:07,040

patterns of the winds are likely to also

1239
00:47:11,589 --> 00:47:08,880
impact the carbon cycle and if we have

1240
00:47:14,470 --> 00:47:11,599
now this denser data set we can better

1241
00:47:18,710 --> 00:47:14,480
connect what we observe to those larger

1242
00:47:24,710 --> 00:47:19,990
thanks

1243
00:47:26,630 --> 00:47:24,720
tackle those questions

1244
00:47:28,150 --> 00:47:26,640
okay we'll go on to our next question

1245
00:47:30,630 --> 00:47:28,160
this is from

1246
00:47:32,710 --> 00:47:30,640
twitter christina reid

1247
00:47:35,190 --> 00:47:32,720
what's the current best explanation for

1248
00:47:38,069 --> 00:47:35,200
the methane stagnation during the early

1249
00:47:39,030 --> 00:47:38,079
21st century and the reason now for its

1250
00:47:43,430 --> 00:47:39,040
rise

1251
00:47:47,510 --> 00:47:45,349
okay oh i'm sorry was that

1252
00:47:49,510 --> 00:47:47,520
real

1253
00:47:52,150 --> 00:47:49,520
that's uh so

1254
00:47:54,230 --> 00:47:52,160
or is that more for you leslie

1255
00:47:56,390 --> 00:47:54,240
i can try to i can try to speak to that

1256
00:47:57,430 --> 00:47:56,400
that's um so that's a good question and

1257
00:47:59,430 --> 00:47:57,440
i think it's another one of those

1258
00:48:01,510 --> 00:47:59,440
lingering mysteries that we really

1259
00:48:03,109 --> 00:48:01,520
need some better observations to sort

1260
00:48:05,430 --> 00:48:03,119
out um

1261
00:48:07,589 --> 00:48:05,440
one of the theories

1262
00:48:10,470 --> 00:48:07,599
is that there may be changes

1263
00:48:13,190 --> 00:48:10,480

in the removal of methane the the

1264
00:48:15,190 --> 00:48:13,200
chemical loss which affects the lifetime

1265
00:48:17,109 --> 00:48:15,200
another theory

1266
00:48:19,910 --> 00:48:17,119
is that you could have changes in

1267
00:48:22,790 --> 00:48:19,920
methane because of changes

1268
00:48:25,270 --> 00:48:22,800
in tundras and high latitudes which is a

1269
00:48:27,510 --> 00:48:25,280
theme you've heard from a couple people

1270
00:48:28,390 --> 00:48:27,520
and and the other i think prevailing

1271
00:48:32,309 --> 00:48:28,400
theory

1272
00:48:35,510 --> 00:48:32,319
is that um you might be seeing impacts

1273
00:48:36,950 --> 00:48:35,520
of um changes in wetlands which are a

1274
00:48:39,349 --> 00:48:36,960
major source of methane to the

1275
00:48:42,390 --> 00:48:39,359
atmosphere and how those are responding

1276
00:48:44,549 --> 00:48:42,400
to climate influencing um

1277
00:48:46,549 --> 00:48:44,559
some of the the trends but there's no

1278
00:48:50,309 --> 00:48:46,559
clear answer and so that's a very active

1279
00:48:55,109 --> 00:48:52,549
um this is scott dhoni i should just add

1280
00:48:57,829 --> 00:48:55,119
there there are concerns about human

1281
00:48:59,750 --> 00:48:57,839
emissions of methane as well

1282
00:49:01,829 --> 00:48:59,760
and whether

1283
00:49:03,990 --> 00:49:01,839
you know as we tap natural gas fields

1284
00:49:05,829 --> 00:49:04,000
there are problems with leakage

1285
00:49:07,510 --> 00:49:05,839
and so there are concerns about whether

1286
00:49:09,670 --> 00:49:07,520
that's changed over time and could be

1287
00:49:14,710 --> 00:49:09,680
affecting the growth rate of atmospheric

1288
00:49:18,390 --> 00:49:16,710

okay thank you another question from

1289
00:49:20,630 --> 00:49:18,400
social media

1290
00:49:23,510 --> 00:49:20,640
if the ocean is consuming much of the

1291
00:49:25,510 --> 00:49:23,520
co2 from the atmosphere at some point it

1292
00:49:27,750 --> 00:49:25,520
may become full and then

1293
00:49:30,390 --> 00:49:27,760
we would have a large accumulation of

1294
00:49:32,549 --> 00:49:30,400
co2 in the atmosphere causing serious

1295
00:49:36,150 --> 00:49:32,559
damage to the planet if this is true

1296
00:49:38,870 --> 00:49:36,160
could we predict when it would occur

1297
00:49:40,870 --> 00:49:38,880
or also how would that affect ecosystems

1298
00:49:46,950 --> 00:49:40,880
in the ocean mike berenfeld or scott

1299
00:49:52,069 --> 00:49:49,990
yeah this is uh mike barenfeld again um

1300
00:49:54,309 --> 00:49:52,079
so i think actually scott would be the

1301
00:49:57,589 --> 00:49:54,319
best position to answer that question a

1302
00:50:00,870 --> 00:49:57,599
lot of the carbon dioxide uptake by the

1303
00:50:03,030 --> 00:50:00,880
oceans is a physical chemical process

1304
00:50:05,670 --> 00:50:03,040
um certainly one of the big concerns

1305
00:50:07,589 --> 00:50:05,680
from an ecological standpoint is that as

1306
00:50:09,030 --> 00:50:07,599
co2 builds up in the atmosphere and

1307
00:50:11,750 --> 00:50:09,040
final forms

1308
00:50:13,750 --> 00:50:11,760
that will have an impact on the plankton

1309
00:50:16,870 --> 00:50:13,760
and then that would create feedbacks to

1310
00:50:19,430 --> 00:50:16,880
the biological carbon cycle um but scott

1311
00:50:21,510 --> 00:50:19,440
would you like to maybe address that to

1312
00:50:23,109 --> 00:50:21,520
that issue of the capacity of the oceans

1313
00:50:27,190 --> 00:50:23,119

to take up co2

1314
00:50:29,430 --> 00:50:27,200
sure um as mike said most of the current

1315
00:50:30,630 --> 00:50:29,440
uptake into the ocean we think is

1316
00:50:32,710 --> 00:50:30,640
because of

1317
00:50:33,829 --> 00:50:32,720
dissolution chemical dissolution into

1318
00:50:34,790 --> 00:50:33,839
the water

1319
00:50:37,190 --> 00:50:34,800
and then

1320
00:50:39,190 --> 00:50:37,200
physical processes that transport carbon

1321
00:50:40,790 --> 00:50:39,200
away from the ocean surface into the

1322
00:50:42,950 --> 00:50:40,800
deep interior

1323
00:50:44,630 --> 00:50:42,960
so two things will likely happen in the

1324
00:50:46,390 --> 00:50:44,640
future one is

1325
00:50:48,710 --> 00:50:46,400
as the ocean takes up more carbon

1326
00:50:49,910 --> 00:50:48,720
dioxide the water actually becomes more

1327
00:50:52,470 --> 00:50:49,920
acidic

1328
00:50:54,710 --> 00:50:52,480
and it becomes less effective it doesn't

1329
00:50:57,030 --> 00:50:54,720
reach a threshold where it stops but it

1330
00:50:58,950 --> 00:50:57,040
just it's like a sponge that's already

1331
00:51:00,710 --> 00:50:58,960
pretty damp it can take up less

1332
00:51:02,950 --> 00:51:00,720
additional water so

1333
00:51:05,349 --> 00:51:02,960
that's pretty well understood

1334
00:51:07,109 --> 00:51:05,359
with a warmer climate you also change

1335
00:51:08,950 --> 00:51:07,119
ocean circulation

1336
00:51:11,109 --> 00:51:08,960
and we think that will also make the

1337
00:51:13,750 --> 00:51:11,119
ocean less effective

1338
00:51:16,390 --> 00:51:13,760

over time and as mike said there might

1339
00:51:18,630 --> 00:51:16,400
be changes in the biology

1340
00:51:20,230 --> 00:51:18,640
and that could work in either direction

1341
00:51:22,950 --> 00:51:20,240
that could either make the ocean more

1342
00:51:25,430 --> 00:51:22,960
effective or less effective we don't we

1343
00:51:27,829 --> 00:51:25,440
there's many different processes but

1344
00:51:30,390 --> 00:51:27,839
for the chemical and physical processes

1345
00:51:33,109 --> 00:51:30,400
we think we have a pretty good handle

1346
00:51:35,030 --> 00:51:33,119
at least on the size of the problem

1347
00:51:37,589 --> 00:51:35,040
that the ocean will continue to take up

1348
00:51:41,030 --> 00:51:37,599
carbon dioxide but less effectively with

1349
00:51:45,109 --> 00:51:41,040
time with rising atmospheric levels and

1350
00:51:49,589 --> 00:51:47,270
okay our next question back to the

1351
00:51:50,630 --> 00:51:49,599
phone lines is frank mooring aviation

1352
00:51:52,069 --> 00:51:50,640
week

1353
00:51:54,309 --> 00:51:52,079
thank you

1354
00:51:57,030 --> 00:51:54,319
for this presentation i have kind of a

1355
00:51:58,870 --> 00:51:57,040
two-part question and

1356
00:52:00,549 --> 00:51:58,880
i guess the first part is for michael

1357
00:52:02,470 --> 00:52:00,559
freilich about

1358
00:52:03,589 --> 00:52:02,480
how some of the question is how would

1359
00:52:06,150 --> 00:52:03,599
some of the

1360
00:52:07,349 --> 00:52:06,160
future projects and um that you're

1361
00:52:09,589 --> 00:52:07,359
working on

1362
00:52:11,030 --> 00:52:09,599
fill holes in this model that are these

1363
00:52:13,030 --> 00:52:11,040

models that you're developing if you

1364
00:52:15,430 --> 00:52:13,040
could give an example or two and the

1365
00:52:17,910 --> 00:52:15,440
other part of this is i'm sure as you're

1366
00:52:19,349 --> 00:52:17,920
aware and this is for anybody i guess

1367
00:52:21,109 --> 00:52:19,359
that there are some investigations

1368
00:52:22,549 --> 00:52:21,119
underway um

1369
00:52:26,630 --> 00:52:22,559
at the political level into the

1370
00:52:29,030 --> 00:52:26,640
possibility that oil companies have um

1371
00:52:32,390 --> 00:52:29,040
have influenced the study of climate

1372
00:52:34,710 --> 00:52:32,400
change and i just wonder if

1373
00:52:36,390 --> 00:52:34,720
the the future projects are adequately

1374
00:52:38,230 --> 00:52:36,400
funded

1375
00:52:40,710 --> 00:52:38,240
and if you see some kind of

1376
00:52:43,030 --> 00:52:40,720
of pushback or or

1377
00:52:46,069 --> 00:52:43,040
resistance to funding this kind of

1378
00:52:47,750 --> 00:52:46,079
research thank you

1379
00:52:49,829 --> 00:52:47,760
okay frank unfortunately mike freilich

1380
00:52:52,470 --> 00:52:49,839
had to step away but we have ken jux

1381
00:52:54,710 --> 00:52:52,480
here who is our program scientist in

1382
00:52:56,870 --> 00:52:54,720
this area at nasa headquarters he can

1383
00:52:59,109 --> 00:52:56,880
talk to you about that yeah thanks so we

1384
00:53:00,870 --> 00:52:59,119
do have a number of future observations

1385
00:53:03,109 --> 00:53:00,880
the first thing i'll say is all the

1386
00:53:04,549 --> 00:53:03,119
observations we're making right now will

1387
00:53:06,309 --> 00:53:04,559
continue to make them from the

1388
00:53:08,870 --> 00:53:06,319

spacecraft that they're on as long as

1389
00:53:10,390 --> 00:53:08,880
they continue to work effectively

1390
00:53:12,150 --> 00:53:10,400
as you heard earlier from a number of

1391
00:53:13,030 --> 00:53:12,160
the presentations we do have a lot of

1392
00:53:15,430 --> 00:53:13,040
other

1393
00:53:18,230 --> 00:53:15,440
observations coming in the future so for

1394
00:53:20,390 --> 00:53:18,240
understanding changes in biomass

1395
00:53:22,470 --> 00:53:20,400
across the entire globe we have the jedi

1396
00:53:24,230 --> 00:53:22,480
mission which is coming up we'll

1397
00:53:25,670 --> 00:53:24,240
continue the landsat series of

1398
00:53:27,750 --> 00:53:25,680
observations which are important for

1399
00:53:29,670 --> 00:53:27,760
understanding carbon cycle and then we

1400
00:53:32,309 --> 00:53:29,680
have the pace mission for understanding

1401
00:53:34,630 --> 00:53:32,319
changes in the ocean biology and further

1402
00:53:38,309 --> 00:53:34,640
we are currently uh hopefully going to

1403
00:53:39,510 --> 00:53:38,319
get up a uh some future co2 observing uh

1404
00:53:43,109 --> 00:53:39,520
up uh

1405
00:53:45,030 --> 00:53:43,119
satellites uh follow on to oco 2 is

1406
00:53:46,950 --> 00:53:45,040
currently

1407
00:53:49,670 --> 00:53:46,960
one of our desired missions and we're

1408
00:53:51,670 --> 00:53:49,680
doing some pre-planning for a follow-on

1409
00:53:53,990 --> 00:53:51,680
with a different type of technology for

1410
00:53:55,510 --> 00:53:54,000
co2 so those are the types of missions

1411
00:53:57,190 --> 00:53:55,520
that we are

1412
00:53:59,349 --> 00:53:57,200
looking to do and they're all well

1413
00:54:02,470 --> 00:53:59,359

supported by nasa right now and those

1414
00:54:04,870 --> 00:54:02,480
will as assuming

1415
00:54:06,790 --> 00:54:04,880
no issues arise we will do those in the

1416
00:54:09,510 --> 00:54:06,800
near future

1417
00:54:13,430 --> 00:54:09,520
okay thank you our next question is from

1418
00:54:15,829 --> 00:54:13,440
steve varagona at voice of america

1419
00:54:18,630 --> 00:54:15,839
go ahead steve yeah hi uh thanks for

1420
00:54:20,150 --> 00:54:18,640
doing the call um i'm uh i guess i'm

1421
00:54:21,670 --> 00:54:20,160
kind of putting a finer point on the

1422
00:54:23,670 --> 00:54:21,680
question that's uh that's that's been

1423
00:54:26,150 --> 00:54:23,680
coming up uh in terms of kind of

1424
00:54:28,950 --> 00:54:26,160
specifics on where these data might be

1425
00:54:31,829 --> 00:54:28,960
used in uh in climate negotiations uh

1426
00:54:33,670 --> 00:54:31,839
we've got things like the um the indcs i

1427
00:54:35,109 --> 00:54:33,680
mean will you be able to kind of monitor

1428
00:54:37,910 --> 00:54:35,119
whether countries are doing what they

1429
00:54:40,870 --> 00:54:37,920
say they're doing uh we'll be able to

1430
00:54:43,750 --> 00:54:40,880
kind of put uh precise figures on things

1431
00:54:45,589 --> 00:54:43,760
like uh you know if there's uh some like

1432
00:54:47,750 --> 00:54:45,599
a price on carbon if you're able to

1433
00:54:49,589 --> 00:54:47,760
quantify those numbers better if you can

1434
00:54:51,030 --> 00:54:49,599
you know give us some some things that

1435
00:54:52,309 --> 00:54:51,040
we're hearing about the negotiations

1436
00:54:55,750 --> 00:54:52,319
where these might be uh might be

1437
00:54:59,190 --> 00:54:57,190
can that sounds like another question

1438
00:55:02,230 --> 00:54:59,200

that is of george's

1439
00:55:06,390 --> 00:55:04,309
um sure well i'll i'll

1440
00:55:07,430 --> 00:55:06,400
take a crack of that um

1441
00:55:10,309 --> 00:55:07,440
um

1442
00:55:13,030 --> 00:55:10,319
uh and maybe ann marie can can uh fill

1443
00:55:15,670 --> 00:55:13,040
in as well on what

1444
00:55:17,190 --> 00:55:15,680
one of the most challenging areas to

1445
00:55:21,349 --> 00:55:17,200
previous climate

1446
00:55:22,549 --> 00:55:21,359
negotiations has been the land carbon

1447
00:55:24,549 --> 00:55:22,559
flux

1448
00:55:26,069 --> 00:55:24,559
and that's because the land has proven

1449
00:55:28,549 --> 00:55:26,079
to be incredibly

1450
00:55:31,589 --> 00:55:28,559
complex and heterogeneous and

1451
00:55:32,870 --> 00:55:31,599
difficult to uh you know access with a

1452
00:55:35,349 --> 00:55:32,880
consistent

1453
00:55:38,309 --> 00:55:35,359
methodology because it's distributed

1454
00:55:40,069 --> 00:55:38,319
over different countries and et cetera

1455
00:55:41,670 --> 00:55:40,079
and so

1456
00:55:43,030 --> 00:55:41,680
at the present you know that's still

1457
00:55:45,109 --> 00:55:43,040
currently

1458
00:55:47,270 --> 00:55:45,119
probably the case but the

1459
00:55:48,789 --> 00:55:47,280
what nasa is doing and what we showed

1460
00:55:50,549 --> 00:55:48,799
some examples of is innovating new

1461
00:55:51,750 --> 00:55:50,559
technologies that are going to allow us

1462
00:55:55,190 --> 00:55:51,760
to

1463
00:55:57,589 --> 00:55:55,200

observe carbon on land with globally

1464
00:55:58,870 --> 00:55:57,599
with unprecedented detail and spatial

1465
00:56:01,990 --> 00:55:58,880
resolution

1466
00:56:04,390 --> 00:56:02,000
so that hopefully this information base

1467
00:56:05,990 --> 00:56:04,400
will provide the basis for

1468
00:56:06,870 --> 00:56:06,000
the land carbon

1469
00:56:08,069 --> 00:56:06,880
to be

1470
00:56:10,630 --> 00:56:08,079
managed

1471
00:56:15,030 --> 00:56:10,640
or addressed under policy and not just

1472
00:56:19,109 --> 00:56:17,829
i add a couple comments george

1473
00:56:20,710 --> 00:56:19,119
yes

1474
00:56:21,510 --> 00:56:20,720
yeah i was just going to say that when

1475
00:56:23,910 --> 00:56:21,520
we

1476
00:56:25,829 --> 00:56:23,920
talk about oco2 measurements being

1477
00:56:28,069 --> 00:56:25,839
focused on measuring sources and sinks

1478
00:56:30,870 --> 00:56:28,079
around the globe we certainly will try

1479
00:56:34,069 --> 00:56:30,880
to tell people about the total flux of

1480
00:56:35,190 --> 00:56:34,079
carbon dioxide on country scale sizes of

1481
00:56:37,430 --> 00:56:35,200
the world

1482
00:56:39,349 --> 00:56:37,440
now remember that that number is the net

1483
00:56:42,390 --> 00:56:39,359
of what the land is doing the ocean is

1484
00:56:43,990 --> 00:56:42,400
doing in fossil fuels co2 emissions so

1485
00:56:45,990 --> 00:56:44,000
we don't separate out into those

1486
00:56:48,630 --> 00:56:46,000
categories but we see what they do as an

1487
00:56:50,230 --> 00:56:48,640
integrated way and certainly oco2 has

1488
00:56:52,230 --> 00:56:50,240

been an important step to demonstrate

1489
00:56:54,549 --> 00:56:52,240
that you can measure oco2 with the

1490
00:56:56,470 --> 00:56:54,559
precision you need from space we're a

1491
00:56:58,390 --> 00:56:56,480
sampling mission where we only see a

1492
00:57:00,549 --> 00:56:58,400
small fraction of the land each day so

1493
00:57:03,270 --> 00:57:00,559
we're not designed for the questions

1494
00:57:05,270 --> 00:57:03,280
of compliance one certainly could think

1495
00:57:06,630 --> 00:57:05,280
about building something focused on that

1496
00:57:08,789 --> 00:57:06,640
now that we've seen that we can make

1497
00:57:11,190 --> 00:57:08,799
measure it from space

1498
00:57:12,870 --> 00:57:11,200
so i think we have some new capabilities

1499
00:57:14,630 --> 00:57:12,880
but not designed for that particular

1500
00:57:16,630 --> 00:57:14,640
question

1501
00:57:19,190 --> 00:57:16,640
so this is ken chucks i have one other

1502
00:57:21,349 --> 00:57:19,200
thing i would like to add as far as

1503
00:57:23,349 --> 00:57:21,359
potential users of all of our data and

1504
00:57:26,470 --> 00:57:23,359
the ideas that we get from these data

1505
00:57:29,030 --> 00:57:26,480
our data are free and open and available

1506
00:57:32,150 --> 00:57:29,040
to everybody who wants to use them

1507
00:57:34,630 --> 00:57:32,160
and we do not constrain how people use

1508
00:57:36,789 --> 00:57:34,640
these data and many people come up with

1509
00:57:38,950 --> 00:57:36,799
very creative ideas of how to use the

1510
00:57:41,270 --> 00:57:38,960
data and come up with science questions

1511
00:57:44,069 --> 00:57:41,280
that these data sets were never intended

1512
00:57:47,109 --> 00:57:44,079
initially to answer yet people do use

1513
00:57:49,190 --> 00:57:47,119

those data and answer them uh to do very

1514
00:57:51,270 --> 00:57:49,200
creative both scientific and potential

1515
00:57:53,430 --> 00:57:51,280
policy related things so

1516
00:57:56,630 --> 00:57:53,440
there's quite a breath of types of

1517
00:57:59,829 --> 00:57:56,640
people who will end up using these data

1518
00:58:03,030 --> 00:57:59,839
and just to follow up on related to cop

1519
00:58:03,990 --> 00:58:03,040
most of what we presented to you today

1520
00:58:05,589 --> 00:58:04,000
are

1521
00:58:07,510 --> 00:58:05,599
really going to be relevant once we

1522
00:58:08,870 --> 00:58:07,520
start getting better understanding of

1523
00:58:10,150 --> 00:58:08,880
all these science questions that we're

1524
00:58:13,030 --> 00:58:10,160
trying to attack

1525
00:58:15,270 --> 00:58:13,040
for future policy in the near term

1526
00:58:17,030 --> 00:58:15,280
within a couple of weeks is probably not

1527
00:58:19,910 --> 00:58:17,040
going to have a huge impact but it will

1528
00:58:23,270 --> 00:58:19,920
have an impact for future uh potential

1529
00:58:25,109 --> 00:58:23,280
policy relevant meetings

1530
00:58:27,829 --> 00:58:25,119
okay our next question was emailed in

1531
00:58:29,109 --> 00:58:27,839
from david schlom at north state public

1532
00:58:31,349 --> 00:58:29,119
radio

1533
00:58:33,589 --> 00:58:31,359
what was what has oco 2 been able to

1534
00:58:35,990 --> 00:58:33,599
measure regarding the rate

1535
00:58:36,950 --> 00:58:36,000
of co2 absorption in the pacific this

1536
00:58:38,230 --> 00:58:36,960
year

1537
00:58:40,390 --> 00:58:38,240
and whether there is a strong

1538
00:58:41,670 --> 00:58:40,400

correlation with the strong el nino

1539
00:58:43,750 --> 00:58:41,680
happening there

1540
00:58:46,710 --> 00:58:43,760
anne marie and then maybe mike uh

1541
00:58:49,270 --> 00:58:46,720
barefoot would like to tackle that yeah

1542
00:58:52,069 --> 00:58:49,280
that's a great question in fact we have

1543
00:58:55,030 --> 00:58:52,079
one researcher who's leading an effort

1544
00:58:56,789 --> 00:58:55,040
to look at the pacific and specifically

1545
00:58:59,349 --> 00:58:56,799
find out if the carbon

1546
00:59:01,510 --> 00:58:59,359
exchange is different this year

1547
00:59:03,430 --> 00:59:01,520
what i can say is he's noticed that

1548
00:59:05,030 --> 00:59:03,440
before february and march there appears

1549
00:59:06,710 --> 00:59:05,040
to be less carbon dioxide in the

1550
00:59:09,190 --> 00:59:06,720
atmosphere in that region than is

1551
00:59:10,150 --> 00:59:09,200
typical for the previous say five six

1552
00:59:12,390 --> 00:59:10,160
years

1553
00:59:14,069 --> 00:59:12,400
and after that period the carbon dioxide

1554
00:59:15,270 --> 00:59:14,079
concentrations look to be a little bit

1555
00:59:16,950 --> 00:59:15,280
larger

1556
00:59:19,190 --> 00:59:16,960
this analysis a little bit tricky

1557
00:59:21,030 --> 00:59:19,200
because you don't have a long record of

1558
00:59:23,190 --> 00:59:21,040
detailed observations in the region so

1559
00:59:25,109 --> 00:59:23,200
it's hard to say if anything has changed

1560
00:59:26,470 --> 00:59:25,119
but based on what information we have it

1561
00:59:28,630 --> 00:59:26,480
does look like this year is a little

1562
00:59:30,309 --> 00:59:28,640
different than the years before and now

1563
00:59:31,990 --> 00:59:30,319

what he's doing is working with folks

1564
00:59:33,030 --> 00:59:32,000
like leslie and others who can run

1565
00:59:35,349 --> 00:59:33,040
models

1566
00:59:37,910 --> 00:59:35,359
to try to understand a little bit more

1567
00:59:39,430 --> 00:59:37,920
of what the influencing factors are this

1568
00:59:41,030 --> 00:59:39,440
works a little bit tricky because you

1569
00:59:43,109 --> 00:59:41,040
might remember there's big fires in

1570
00:59:46,150 --> 00:59:43,119
indonesia and they themselves have an

1571
00:59:48,150 --> 00:59:46,160
impact and then the growth of the land

1572
00:59:50,230 --> 00:59:48,160
era trees in

1573
00:59:52,309 --> 00:59:50,240
amazon also can influence things so

1574
00:59:53,910 --> 00:59:52,319
there's a few factors we're looking at i

1575
00:59:57,589 --> 00:59:53,920
don't know if mike or george want to add

1576
01:00:02,069 --> 00:59:59,510
so this is mike bernfield on one of the

1577
01:00:03,829 --> 01:00:02,079
things i could add to this is that

1578
01:00:06,390 --> 01:00:03,839
if you look at the

1579
01:00:09,990 --> 01:00:06,400
satellite record to date which is going

1580
01:00:12,829 --> 01:00:10,000
on 20 years in length now unbroken

1581
01:00:15,430 --> 01:00:12,839
and we look at the

1582
01:00:17,030 --> 01:00:15,440
estimated productivity the ocean

1583
01:00:19,190 --> 01:00:17,040
over that record

1584
01:00:21,990 --> 01:00:19,200
what we can see is that one of the

1585
01:00:26,309 --> 01:00:22,000
largest anomalies within that record is

1586
01:00:28,630 --> 01:00:26,319
associated with a large el nino

1587
01:00:31,589 --> 01:00:28,640
el nino la nina transition that occurred

1588
01:00:34,069 --> 01:00:31,599

in 1999-2000

1589
01:00:37,030 --> 01:00:34,079
and what you see during an el nino from

1590
01:00:38,789 --> 01:00:37,040
a ecological perspective is that in

1591
01:00:41,349 --> 01:00:38,799
certain regions of the ocean you

1592
01:00:43,270 --> 01:00:41,359
actually see increases in production and

1593
01:00:44,630 --> 01:00:43,280
in other regions of the ocean you see

1594
01:00:46,789 --> 01:00:44,640
decreases

1595
01:00:50,309 --> 01:00:46,799
um when i was doing my five-minute

1596
01:00:52,789 --> 01:00:50,319
overview i mentioned that we can see

1597
01:00:55,349 --> 01:00:52,799
inter-annual or year-to-year changes in

1598
01:01:00,150 --> 01:00:55,359
ocean production on the order of two

1599
01:01:02,230 --> 01:01:00,160
billion tons of carbon and that largest

1600
01:01:05,030 --> 01:01:02,240
anomaly that we've seen was associated

1601
01:01:07,750 --> 01:01:05,040
with the el nino la nina that i talked

1602
01:01:10,470 --> 01:01:07,760
about in 1999 to 2000.

1603
01:01:12,230 --> 01:01:10,480
with the la nina seen a high time of

1604
01:01:19,510 --> 01:01:12,240
production in the el nino being

1605
01:01:25,910 --> 01:01:22,309
okay thank you our next uh call from the

1606
01:01:28,230 --> 01:01:25,920
phone lines is from voice of america i'm

1607
01:01:31,990 --> 01:01:28,240
sorry from climate wire gayatri

1608
01:01:33,750 --> 01:01:32,000
vaidyanathan please go ahead

1609
01:01:36,390 --> 01:01:33,760
yes thanks for taking my question uh

1610
01:01:38,549 --> 01:01:36,400
could you tell me how useful the oco2

1611
01:01:39,589 --> 01:01:38,559
satellite and also the future jedi

1612
01:01:41,270 --> 01:01:39,599
project

1613
01:01:43,349 --> 01:01:41,280

will be at resolving uncertainties about

1614
01:01:47,430 --> 01:01:43,359
the tropical carbon sink especially

1615
01:01:52,069 --> 01:01:49,829
hi this is ann marie so

1616
01:01:53,349 --> 01:01:52,079
indeed the tropics are cloudy and that's

1617
01:01:54,870 --> 01:01:53,359
a little bit frustrating because it's

1618
01:01:57,589 --> 01:01:54,880
where a lot of the action is with the

1619
01:02:00,230 --> 01:01:57,599
carbon cycle one of the ways that we

1620
01:02:02,069 --> 01:02:00,240
design uh our mission was to have

1621
01:02:05,349 --> 01:02:02,079
footprints that are on the scale of sort

1622
01:02:07,589 --> 01:02:05,359
of say a kilometer by a kilometer half

1623
01:02:09,750 --> 01:02:07,599
in size and the reason we did this was

1624
01:02:10,630 --> 01:02:09,760
to try to make it so that we could see

1625
01:02:13,190 --> 01:02:10,640
through

1626
01:02:15,589 --> 01:02:13,200
regions that had patchy clouds

1627
01:02:17,510 --> 01:02:15,599
we do have successful retrievals in the

1628
01:02:19,190 --> 01:02:17,520
tropical regions

1629
01:02:22,309 --> 01:02:19,200
we

1630
01:02:24,870 --> 01:02:22,319
have some limitations over the amazon at

1631
01:02:26,549 --> 01:02:24,880
the moment but we are improving some of

1632
01:02:28,870 --> 01:02:26,559
the ways we process the data so i think

1633
01:02:30,710 --> 01:02:28,880
we'll have a higher data yield so so far

1634
01:02:33,109 --> 01:02:30,720
the carbon cycle scientists that we've

1635
01:02:34,390 --> 01:02:33,119
spoken to who are interested in looking

1636
01:02:36,390 --> 01:02:34,400
at that data

1637
01:02:37,589 --> 01:02:36,400
do find that there's information to work

1638
01:02:38,950 --> 01:02:37,599

with

1639
01:02:41,109 --> 01:02:38,960
although we like to feed them a little

1640
01:02:42,789 --> 01:02:41,119
bit more so i think in the long run we

1641
01:02:45,030 --> 01:02:42,799
will say something about the carbon

1642
01:02:46,710 --> 01:02:45,040
exchange in the tropics

1643
01:02:50,870 --> 01:02:46,720
because we did design this instrument

1644
01:02:54,230 --> 01:02:52,470
this is george here i would like to add

1645
01:02:57,349 --> 01:02:54,240
to that

1646
01:02:59,030 --> 01:02:57,359
the tropics as you point out is a is a

1647
01:03:02,470 --> 01:02:59,040
is a region of land that has

1648
01:03:05,190 --> 01:03:02,480
particularly high uncertainty uh to date

1649
01:03:07,510 --> 01:03:05,200
uh and that's primarily because of the

1650
01:03:10,390 --> 01:03:07,520
relatively limited access to many

1651
01:03:12,390 --> 01:03:10,400
areas in the tropics um and as you point

1652
01:03:13,829 --> 01:03:12,400
out the cloud cover that that that

1653
01:03:15,349 --> 01:03:13,839
enters uh

1654
01:03:16,630 --> 01:03:15,359
to some extent remote sensing of that

1655
01:03:17,349 --> 01:03:16,640
area

1656
01:03:19,270 --> 01:03:17,359
but

1657
01:03:21,029 --> 01:03:19,280
in that context the jedi mission as i

1658
01:03:23,589 --> 01:03:21,039
was describing is going to i think

1659
01:03:25,750 --> 01:03:23,599
provide uh qualitative advance in our

1660
01:03:27,589 --> 01:03:25,760
information of that area

1661
01:03:29,430 --> 01:03:27,599
because

1662
01:03:30,630 --> 01:03:29,440
for example jedi will be on the

1663
01:03:32,230 --> 01:03:30,640

international space station the

1664
01:03:34,390 --> 01:03:32,240
international space station orbits the

1665
01:03:36,230 --> 01:03:34,400
earth about every 92 minutes

1666
01:03:37,670 --> 01:03:36,240
and so over the course of jedi's mission

1667
01:03:40,069 --> 01:03:37,680
there'll be literally

1668
01:03:41,190 --> 01:03:40,079
billions of uh so-called footprints

1669
01:03:42,870 --> 01:03:41,200
these are these

1670
01:03:44,390 --> 01:03:42,880
top-down

1671
01:03:46,789 --> 01:03:44,400
lidar

1672
01:03:48,230 --> 01:03:46,799
signals that image vegetation 3d

1673
01:03:50,150 --> 01:03:48,240
structure will have literally billions

1674
01:03:52,950 --> 01:03:50,160
of those over the course of the jedi

1675
01:03:53,829 --> 01:03:52,960
mission and many of those but not all

1676
01:03:56,470 --> 01:03:53,839
will

1677
01:03:57,670 --> 01:03:56,480
bypass cloud cover given the high orbit

1678
01:04:01,029 --> 01:03:57,680
rate

1679
01:04:05,109 --> 01:04:03,430
okay thank you one more question from

1680
01:04:07,750 --> 01:04:05,119
social media

1681
01:04:09,750 --> 01:04:07,760
why does it appear that there's more co2

1682
01:04:12,549 --> 01:04:09,760
in the northern hemisphere wouldn't that

1683
01:04:13,910 --> 01:04:12,559
have been globally mixed by now since it

1684
01:04:15,190 --> 01:04:13,920
has such a long lifetime in the

1685
01:04:17,990 --> 01:04:15,200
atmosphere

1686
01:04:19,510 --> 01:04:18,000
leslie could you address that

1687
01:04:21,270 --> 01:04:19,520
sure um

1688
01:04:24,150 --> 01:04:21,280

it depends on the time scale you're

1689
01:04:25,829 --> 01:04:24,160
looking at is the short answer

1690
01:04:27,430 --> 01:04:25,839
you do see

1691
01:04:30,470 --> 01:04:27,440
during particularly during the northern

1692
01:04:32,549 --> 01:04:30,480
hemisphere winter when the net flux of

1693
01:04:34,230 --> 01:04:32,559
co2 is moving

1694
01:04:36,870 --> 01:04:34,240
to the atmosphere so you have both

1695
01:04:37,990 --> 01:04:36,880
emissions from fossil fuel and you also

1696
01:04:40,549 --> 01:04:38,000
have

1697
01:04:42,470 --> 01:04:40,559
plants releasing carbon during winter

1698
01:04:45,510 --> 01:04:42,480
months so during during the winter in

1699
01:04:47,670 --> 01:04:45,520
the northern hemisphere you see high co2

1700
01:04:50,069 --> 01:04:47,680
in the northern hemisphere and you see

1701
01:04:51,829 --> 01:04:50,079
that slowly getting mixed throughout the

1702
01:04:54,069 --> 01:04:51,839
globe but that that mixing is a little

1703
01:04:55,670 --> 01:04:54,079
bit slow that takes on average about a

1704
01:04:57,589 --> 01:04:55,680
year for all of that carbon to sort of

1705
01:04:59,430 --> 01:04:57,599
be mixed down to the southern hemisphere

1706
01:05:01,270 --> 01:04:59,440
away from the source region so you do

1707
01:05:06,150 --> 01:05:01,280
see that happening but you also see that

1708
01:05:10,710 --> 01:05:08,309
okay thanks leslie and that's all the

1709
01:05:11,750 --> 01:05:10,720
time we have for uh the press briefing

1710
01:05:14,710 --> 01:05:11,760
today

1711
01:05:17,430 --> 01:05:14,720
it's uh you'd like to ask more questions

1712
01:05:19,910 --> 01:05:17,440
please we'll uh send them to twitter or

1713
01:05:21,829 --> 01:05:19,920

ask nasa or to our media office and

1714
01:05:24,069 --> 01:05:21,839
we'll get back to you and just as a

1715
01:05:26,470 --> 01:05:24,079
reminder we do have a lot of information

1716
01:05:27,829 --> 01:05:26,480
on the visuals online

1717
01:05:33,750 --> 01:05:27,839
right now so you can take a look at

1718
01:05:39,510 --> 01:05:36,789
carbon climate one word thank you all

1719
01:05:40,950 --> 01:05:39,520
for listening have a great day

1720
01:05:42,549 --> 01:05:40,960
that concludes today's conference thank