1
00:00:06,789 --> 00:00:04,230
welcome to nasa headquarters in

2
00:00:08,870 --> 00:00:06,799
washington dc i'm steve cole from the

3
00:00:10,390 --> 00:00:08,880
office of communications we're here

4
00:00:12,870 --> 00:00:10,400
today to tell you about the start of a

5
00:00:15,270 --> 00:00:12,880
new era in how nasa studies our home

6
00:00:17,349 --> 00:00:15,280
planet from space this month we will

7
00:00:19,830 --> 00:00:17,359
launch the first of a series of earth

8
00:00:21,830 --> 00:00:19,840
observing sensors to be mounted on the

9
00:00:24,630 --> 00:00:21,840
exterior of the international space

10
00:00:26,310 --> 00:00:24,640
station by the end of the decade nasa

11
00:00:27,990 --> 00:00:26,320
will have six instruments on this

12
00:00:30,150 --> 00:00:28,000
station helping scientists better

13
00:00:32,950 --> 00:00:30,160

understanding to better understand our

14
00:00:34,790 --> 00:00:32,960
home planet today we have key leaders of

15
00:00:37,590 --> 00:00:34,800
this new enterprise here to talk with

16
00:00:39,590 --> 00:00:37,600
you along with the lead scientists on

17
00:00:41,270 --> 00:00:39,600
the first two instruments scheduled to

18
00:00:43,750 --> 00:00:41,280
launch this year

19
00:00:45,110 --> 00:00:43,760
let me introduce our panelists here in

20
00:00:47,350 --> 00:00:45,120
washington

21
00:00:50,229 --> 00:00:47,360
are julie robinson

22
00:00:52,470 --> 00:00:50,239
chief scientist for the iss program from

23
00:00:55,110 --> 00:00:52,480
johnson space center

24
00:00:57,430 --> 00:00:55,120
steve volts associate director for

25
00:01:00,549 --> 00:00:57,440
flight programs in the earth science

26
00:01:03,029 --> 00:01:00,559
division at nasa headquarters

27
00:01:05,830 --> 00:01:03,039
and at our field centers we have at

28
00:01:07,990 --> 00:01:05,840
johnson space center melanie miller

29
00:01:10,550 --> 00:01:08,000
lead robotics officer for the next

30
00:01:12,710 --> 00:01:10,560
spacex launch

31
00:01:15,270 --> 00:01:12,720
from the jet propulsion laboratory in

32
00:01:18,469 --> 00:01:15,280
pasadena california california we have

33
00:01:21,510 --> 00:01:18,479
ernesto rodriguez project scientist for

34
00:01:23,510 --> 00:01:21,520
the iss rapid scat instrument

35
00:01:25,109 --> 00:01:23,520
and from goddard space flight center in

36
00:01:26,390 --> 00:01:25,119
greenbelt maryland

37
00:01:28,870 --> 00:01:26,400
matthew mcgill

38
00:01:32,149 --> 00:01:28,880

principal investigator for the cloud

39
00:01:34,149 --> 00:01:32,159
aerosol transport system instrument or

40
00:01:35,910 --> 00:01:34,159
cats

41
00:01:37,910 --> 00:01:35,920
after today's presentations we'll be

42
00:01:40,710 --> 00:01:37,920
taking questions from the media here in

43
00:01:42,950 --> 00:01:40,720
washington and on the phone lines if

44
00:01:44,069 --> 00:01:42,960
you're listening on the phone lines

45
00:01:47,429 --> 00:01:44,079
media

46
00:01:50,950 --> 00:01:47,439
to ask a question please press star one

47
00:01:53,590 --> 00:01:50,960
we'll also be taking questions online

48
00:01:55,109 --> 00:01:53,600
all you need to do is to post a question

49
00:01:57,190 --> 00:01:55,119
with the hashtag

50
00:01:59,190 --> 00:01:57,200
asknasa

51
00:02:01,270 --> 00:01:59,200
for more information on how nasa will be

52
00:02:03,910 --> 00:02:01,280
studying earth from the space station we

53
00:02:06,789 --> 00:02:03,920
have a new web page put together with

54
00:02:12,550 --> 00:02:06,799
lots of information so please visit that

55
00:02:19,350 --> 00:02:16,390
iss earth science one word

56
00:02:21,910 --> 00:02:19,360
okay let's begin our presentations first

57
00:02:24,150 --> 00:02:21,920
julie robinson julie well thanks steve

58
00:02:26,550 --> 00:02:24,160
you know we're really observing a

59
00:02:28,390 --> 00:02:26,560
maturing of the space station as an

60
00:02:29,750 --> 00:02:28,400
earth science platform

61
00:02:31,830 --> 00:02:29,760
these instruments that we're going to be

62
00:02:33,910 --> 00:02:31,840
talking about today began being built

63
00:02:35,350 --> 00:02:33,920

right after the assembly of the nasa

64
00:02:38,070 --> 00:02:35,360
components of the international space

65
00:02:39,509 --> 00:02:38,080
station were completed in 2011

66
00:02:41,350 --> 00:02:39,519
and they're harmonious of the

67
00:02:44,070 --> 00:02:41,360
instruments that are going to be coming

68
00:02:47,110 --> 00:02:44,080
forward over subsequent years until we

69
00:02:49,190 --> 00:02:47,120
have all 25 external sites are

70
00:02:50,869 --> 00:02:49,200
completely full in this graphic this

71
00:02:52,630 --> 00:02:50,879
first graphic i'll show you gives you a

72
00:02:54,309 --> 00:02:52,640
sense of where all those external sites

73
00:02:56,309 --> 00:02:54,319
are on the space station

74
00:02:58,309 --> 00:02:56,319
the space station has a great capability

75
00:03:00,470 --> 00:02:58,319
to support power and data and thermal

76
00:03:02,550 --> 00:03:00,480
protection we have

77
00:03:04,630 --> 00:03:02,560
sites on the trusses which have

78
00:03:06,550 --> 00:03:04,640
something we call our external logistics

79
00:03:08,710 --> 00:03:06,560
carriers on them there are four of those

80
00:03:11,190 --> 00:03:08,720
carriers and um

81
00:03:13,430 --> 00:03:11,200
they are able to support both our spares

82
00:03:15,030 --> 00:03:13,440
as well as earth and space science

83
00:03:16,869 --> 00:03:15,040
instruments you can see the alpha

84
00:03:18,869 --> 00:03:16,879
magnetic spectrometer which is directly

85
00:03:20,869 --> 00:03:18,879
mounted to a service site on the truss

86
00:03:22,949 --> 00:03:20,879
then on the columbus facility we have

87
00:03:25,589 --> 00:03:22,959
external payloads being capable of being

88
00:03:28,070 --> 00:03:25,599

mounted and also on the japanese

89
00:03:30,630 --> 00:03:28,080
experiment module exposed facility which

90
00:03:32,710 --> 00:03:30,640
we call the gem ef

91
00:03:35,350 --> 00:03:32,720
the space station has really unique

92
00:03:37,750 --> 00:03:35,360
orbit capabilities compared to a typical

93
00:03:40,149 --> 00:03:37,760
earth remote sensing satellite

94
00:03:42,309 --> 00:03:40,159
we have what we call a 51.6 degree

95
00:03:43,430 --> 00:03:42,319
inclination and in the video that you'll

96
00:03:47,750 --> 00:03:43,440
see

97
00:03:50,309 --> 00:03:47,760
those orbits it's really a set of orbits

98
00:03:52,309 --> 00:03:50,319
across a day now we call it a 51.6

99
00:03:54,070 --> 00:03:52,319
degree inclination because the space

100
00:03:57,030 --> 00:03:54,080
station never goes further north than

101
00:03:59,429 --> 00:03:57,040
51.6 degrees north or further south than

102
00:04:00,550 --> 00:03:59,439
51.6 degrees south so it never goes over

103
00:04:02,470 --> 00:04:00,560
the poles

104
00:04:03,750 --> 00:04:02,480
it also means that it goes over

105
00:04:05,830 --> 00:04:03,760
different parts of the earth at

106
00:04:08,550 --> 00:04:05,840
different times each day and with a

107
00:04:10,229 --> 00:04:08,560
precessing solar cycle so over a long

108
00:04:12,149 --> 00:04:10,239
period of time you can see different

109
00:04:14,710 --> 00:04:12,159
parts of the earth at any possible time

110
00:04:17,110 --> 00:04:14,720
of day that's very different than our

111
00:04:18,949 --> 00:04:17,120
polar orbiting satellites which see

112
00:04:21,189 --> 00:04:18,959
basically cross the equator at exactly

113
00:04:22,950 --> 00:04:21,199

the same time every day

114
00:04:24,070 --> 00:04:22,960
the space station is also at 400

115
00:04:29,110 --> 00:04:24,080
kilometers

116
00:04:31,030 --> 00:04:29,120
typical polar orbiting satellite

117
00:04:33,350 --> 00:04:31,040
and that means it's much closer to the

118
00:04:35,110 --> 00:04:33,360
earth it can observe things with less

119
00:04:36,710 --> 00:04:35,120
magnification required to see the same

120
00:04:37,510 --> 00:04:36,720
spatial resolution

121
00:04:39,350 --> 00:04:37,520
and

122
00:04:41,830 --> 00:04:39,360
the space station itself provides

123
00:04:43,510 --> 00:04:41,840
support systems it provides power the

124
00:04:45,909 --> 00:04:43,520
entire data system the thermal

125
00:04:48,469 --> 00:04:45,919
protection system and so it makes it

126
00:04:50,230 --> 00:04:48,479
possible to in a cost-effective way

127
00:04:51,270 --> 00:04:50,240
launch a satellite or launch an

128
00:04:52,950 --> 00:04:51,280
instrument

129
00:04:54,310 --> 00:04:52,960
and put it on the space station use all

130
00:04:56,070 --> 00:04:54,320
of those resources without having to

131
00:04:58,629 --> 00:04:56,080
build all of those things into a brand

132
00:05:00,230 --> 00:04:58,639
new satellite and that can let you test

133
00:05:02,230 --> 00:05:00,240
a new technology before making an

134
00:05:03,909 --> 00:05:02,240
investment in a free flyer

135
00:05:06,390 --> 00:05:03,919
the space station transportation

136
00:05:09,189 --> 00:05:06,400
capacity is integrated so when we launch

137
00:05:12,070 --> 00:05:09,199
a vehicle like spacex we launch both

138
00:05:13,909 --> 00:05:12,080

internal things from food for the crew

139
00:05:15,510 --> 00:05:13,919
spare clothes for the crew all of our

140
00:05:17,270 --> 00:05:15,520
research supplies for the crew to use

141
00:05:19,590 --> 00:05:17,280
inside the cabin and we can launch

142
00:05:20,950 --> 00:05:19,600
external instruments in the dragon trunk

143
00:05:23,029 --> 00:05:20,960
and so that means the transportation

144
00:05:25,670 --> 00:05:23,039
capability is also built into the space

145
00:05:28,070 --> 00:05:25,680
station program

146
00:05:29,510 --> 00:05:28,080
there are two major instruments on orbit

147
00:05:31,029 --> 00:05:29,520
today on the space station that are

148
00:05:33,430 --> 00:05:31,039
observing the earth and i want to tell

149
00:05:35,270 --> 00:05:33,440
you a little bit about those hico the

150
00:05:37,430 --> 00:05:35,280
hyperspectral imager for the coastal

151
00:05:39,430 --> 00:05:37,440
ocean was originally developed by the

152
00:05:42,550 --> 00:05:39,440
office of naval research which is one of

153
00:05:45,270 --> 00:05:42,560
our iss national laboratory users and it

154
00:05:48,390 --> 00:05:45,280
was as an innovative naval prototype but

155
00:05:50,469 --> 00:05:48,400
it's since been transferred to uh

156
00:05:52,230 --> 00:05:50,479
to nasa support because of the science

157
00:05:54,870 --> 00:05:52,240
value of the data for a broad variety of

158
00:05:57,510 --> 00:05:54,880
users both those funded by nasa and also

159
00:06:01,110 --> 00:05:57,520
iss national lab users it was launched

160
00:06:02,629 --> 00:06:01,120
in september of 2009 and over 10 000

161
00:06:04,629 --> 00:06:02,639
images have been collected for

162
00:06:06,309 --> 00:06:04,639
scientists to date

163
00:06:08,150 --> 00:06:06,319

in the next graphic you'll see some

164
00:06:09,510 --> 00:06:08,160
color renditions in sort of red green

165
00:06:10,870 --> 00:06:09,520
and blue color

166
00:06:13,270 --> 00:06:10,880
of some of the coastal features that

167
00:06:16,230 --> 00:06:13,280
were measured in 2014

168
00:06:18,150 --> 00:06:16,240
but this is almost misleading in a way

169
00:06:20,070 --> 00:06:18,160
because these three colors represent

170
00:06:22,309 --> 00:06:20,080
only a fraction of the information about

171
00:06:25,270 --> 00:06:22,319
the earth that is in each hyperspectral

172
00:06:27,110 --> 00:06:25,280
image a hyperspectral imager like heiko

173
00:06:29,029 --> 00:06:27,120
has about a hundred different bands of

174
00:06:31,430 --> 00:06:29,039
information and that compares to ten

175
00:06:32,790 --> 00:06:31,440
different bands in landsat or just three

176
00:06:34,070 --> 00:06:32,800
bands in the color image like you're

177
00:06:36,950 --> 00:06:34,080
seeing

178
00:06:38,629 --> 00:06:36,960
in in in the picture you see right now

179
00:06:40,950 --> 00:06:38,639
i wanted to give you one example of some

180
00:06:43,189 --> 00:06:40,960
recent data that's been collected from

181
00:06:46,150 --> 00:06:43,199
hico and how that data is being used so

182
00:06:49,909 --> 00:06:46,160
in the next graphic you'll see a data

183
00:06:51,510 --> 00:06:49,919
analysis for monterey bay california and

184
00:06:53,110 --> 00:06:51,520
on the left-hand image you see the sea

185
00:06:55,589 --> 00:06:53,120
surface temperature measurements the

186
00:06:57,430 --> 00:06:55,599
purple areas represent the coldest sea

187
00:06:59,350 --> 00:06:57,440
surface temperatures and that's a zone

188
00:07:01,909 --> 00:06:59,360

of coastal upwelling where deep ocean

189
00:07:03,270 --> 00:07:01,919
waters loaded with nutrients is rising

190
00:07:04,790 --> 00:07:03,280
up to the surface

191
00:07:07,510 --> 00:07:04,800
on the right-hand image you see the

192
00:07:09,430 --> 00:07:07,520
analysis from hico where hico's been

193
00:07:11,350 --> 00:07:09,440
able to distinguish sediments from

194
00:07:13,350 --> 00:07:11,360
chlorophyll chlorophyll are the pigments

195
00:07:15,510 --> 00:07:13,360
in the algae and they're a sign of those

196
00:07:18,309 --> 00:07:15,520
productive waters so these kinds of

197
00:07:20,070 --> 00:07:18,319
analysis in shallow near-shore areas are

198
00:07:22,790 --> 00:07:20,080
very difficult to perform with other

199
00:07:24,390 --> 00:07:22,800
sensors and this is a way that hico can

200
00:07:26,070 --> 00:07:24,400
really give us priceless information

201
00:07:27,670 --> 00:07:26,080
about unique and important coastal

202
00:07:29,510 --> 00:07:27,680
habitats

203
00:07:31,189 --> 00:07:29,520
another instrument active on the

204
00:07:34,309 --> 00:07:31,199
international space station today is

205
00:07:36,230 --> 00:07:34,319
iserv which stands for iss severe

206
00:07:37,510 --> 00:07:36,240
environmental research and visualization

207
00:07:39,270 --> 00:07:37,520
system

208
00:07:42,790 --> 00:07:39,280
i serve is linked to a joint venture

209
00:07:44,790 --> 00:07:42,800
between nasa and usaid which the agency

210
00:07:46,230 --> 00:07:44,800
for international development which is

211
00:07:47,990 --> 00:07:46,240
focused on

212
00:07:49,990 --> 00:07:48,000
using remote sensing imagery to help

213
00:07:52,070 --> 00:07:50,000

respond to environmental change and to

214
00:07:53,110 --> 00:07:52,080
national natural disasters around the

215
00:07:55,430 --> 00:07:53,120
world

216
00:07:57,189 --> 00:07:55,440
this was a technology prototype and we

217
00:07:59,110 --> 00:07:57,199
didn't even put it outside the space

218
00:08:01,430 --> 00:07:59,120
station in the next graphic you'll see a

219
00:08:03,749 --> 00:08:01,440
picture of commander chris hadfield when

220
00:08:07,029 --> 00:08:03,759
the iserv was first installed

221
00:08:09,189 --> 00:08:07,039
back in 2012 and what iserv is is

222
00:08:11,350 --> 00:08:09,199
basically a high-end digital camera with

223
00:08:13,110 --> 00:08:11,360
a telescope mounting attached to it so

224
00:08:15,749 --> 00:08:13,120
that it can look in very high spatial

225
00:08:17,110 --> 00:08:15,759
resolution back at the earth and it's

226
00:08:18,469 --> 00:08:17,120
inside the shirt sleeve environment of

227
00:08:20,710 --> 00:08:18,479
the space station looking out the

228
00:08:22,629 --> 00:08:20,720
optical quality window this is a quick

229
00:08:24,230 --> 00:08:22,639
way to do a technology demonstration and

230
00:08:26,230 --> 00:08:24,240
test and see if something works well

231
00:08:30,150 --> 00:08:26,240
before investing even in an external

232
00:08:32,310 --> 00:08:30,160
instrument for iss or for satellite

233
00:08:34,149 --> 00:08:32,320
and i wanted to show you an example of

234
00:08:36,870 --> 00:08:34,159
some recent results from the iserv

235
00:08:39,909 --> 00:08:36,880
project as well in the next graphic

236
00:08:41,190 --> 00:08:39,919
you'll see an iserv image of calgary

237
00:08:43,190 --> 00:08:41,200
canada

238
00:08:46,870 --> 00:08:43,200

after the floods that occurred in june

239
00:08:48,710 --> 00:08:46,880
of 2013. this imagery was taken on the

240
00:08:50,470 --> 00:08:48,720
space station down linked and rapidly

241
00:08:52,230 --> 00:08:50,480
distributed to the officials in calgary

242
00:08:54,310 --> 00:08:52,240
so they could use the mapping of the

243
00:08:56,710 --> 00:08:54,320
flood water extent to help them in

244
00:08:58,790 --> 00:08:56,720
managing their real-time response to the

245
00:09:01,190 --> 00:08:58,800
disaster

246
00:09:03,269 --> 00:09:01,200
so with those two examples and in that

247
00:09:06,150 --> 00:09:03,279
bigger picture of there are a number of

248
00:09:08,070 --> 00:09:06,160
users coming to the space station and

249
00:09:10,389 --> 00:09:08,080
all of these 25 different sites will be

250
00:09:11,670 --> 00:09:10,399
full as we get to the end of the decade

251
00:09:13,670 --> 00:09:11,680
the rest of the briefing is going to be

252
00:09:15,590 --> 00:09:13,680
focused on the instruments that are

253
00:09:17,190 --> 00:09:15,600
coming up right away and the instruments

254
00:09:19,910 --> 00:09:17,200
that are planned for the future that are

255
00:09:22,389 --> 00:09:19,920
being funded by nasa science mission

256
00:09:23,910 --> 00:09:22,399
directorate or science division and so

257
00:09:25,750 --> 00:09:23,920
steve volts will be able to tell you a

258
00:09:26,790 --> 00:09:25,760
little bit more about that steve thank

259
00:09:28,790 --> 00:09:26,800
you julie

260
00:09:30,870 --> 00:09:28,800
um within nasa's earth science division

261
00:09:32,630 --> 00:09:30,880
we're engaged in conducting a real

262
00:09:34,470 --> 00:09:32,640
comprehensive earth system science which

263
00:09:36,790 --> 00:09:34,480

means observing the earth from many

264
00:09:38,790 --> 00:09:36,800
different perspectives many different

265
00:09:40,710 --> 00:09:38,800
phenomena at the same time to get the

266
00:09:42,630 --> 00:09:40,720
best search system we can you see here

267
00:09:44,550 --> 00:09:42,640
on the first graphic uh we already have

268
00:09:45,750 --> 00:09:44,560
an impressive array of 17 different

269
00:09:47,430 --> 00:09:45,760
earth absorbing satellites these are

270
00:09:49,430 --> 00:09:47,440
just the ones nasa has built and flown

271
00:09:51,670 --> 00:09:49,440
there are others that we use as well

272
00:09:53,190 --> 00:09:51,680
and uh with allowing us giving us that

273
00:09:55,110 --> 00:09:53,200
perspective from space

274
00:09:56,870 --> 00:09:55,120
to this will be added in the very near

275
00:09:58,470 --> 00:09:56,880
term and the next slide you see the

276
00:10:00,550 --> 00:09:58,480
evolution of that which is

277
00:10:02,470 --> 00:10:00,560
the iss as an instrument platform and

278
00:10:03,990 --> 00:10:02,480
these are other satellites that polar

279
00:10:06,069 --> 00:10:04,000
satellites earth observing satellites

280
00:10:08,710 --> 00:10:06,079
and that we are flying within nasa but

281
00:10:10,550 --> 00:10:08,720
the iss is an introduction now as a new

282
00:10:12,470 --> 00:10:10,560
and very capable platform

283
00:10:14,230 --> 00:10:12,480
um you've already heard julie talk about

284
00:10:17,269 --> 00:10:14,240
the capabilities the resources that the

285
00:10:19,110 --> 00:10:17,279
iss provides and what it allows us to do

286
00:10:20,710 --> 00:10:19,120
in our science as we develop address the

287
00:10:23,030 --> 00:10:20,720
science questions is to look

288
00:10:24,310 --> 00:10:23,040

specifically to utilize those resources

289
00:10:26,470 --> 00:10:24,320
to design the measurements to take

290
00:10:28,710 --> 00:10:26,480
advantage of the high power capabilities

291
00:10:30,470 --> 00:10:28,720
of the high the low altitude close

292
00:10:32,310 --> 00:10:30,480
observing capabilities that the iss

293
00:10:33,910 --> 00:10:32,320
provides and the um the frequent

294
00:10:35,590 --> 00:10:33,920
servicing and revisiting which allows us

295
00:10:37,509 --> 00:10:35,600
to put an instrument up for a shorter

296
00:10:40,069 --> 00:10:37,519
relatively short period of time test it

297
00:10:41,269 --> 00:10:40,079
out and then go to a longer durations

298
00:10:43,430 --> 00:10:41,279
free flyer satellite with that

299
00:10:45,190 --> 00:10:43,440
measurement if we so decide the the

300
00:10:47,269 --> 00:10:45,200
capability of the iss as a platform

301
00:10:48,949 --> 00:10:47,279
allows us to test out an instrument type

302
00:10:50,550 --> 00:10:48,959
in a way that is more cost effective

303
00:10:52,710 --> 00:10:50,560
that we can check it out could be higher

304
00:10:54,550 --> 00:10:52,720
risk but high return as well in a way

305
00:10:57,030 --> 00:10:54,560
that in space that allows us to to move

306
00:10:58,550 --> 00:10:57,040
forward with our other satellites the uh

307
00:11:00,310 --> 00:10:58,560
the precessing orbit that julie

308
00:11:02,150 --> 00:11:00,320
mentioned she mentioned the the low

309
00:11:05,430 --> 00:11:02,160
inclination or the 51 degree inclination

310
00:11:07,350 --> 00:11:05,440
of the iss under flies and and re and

311
00:11:08,870 --> 00:11:07,360
flies at different solar viewing angles

312
00:11:10,710 --> 00:11:08,880
the same phenomenon we're observing with

313
00:11:12,630 --> 00:11:10,720

our polar satellites and that really

314
00:11:14,470 --> 00:11:12,640
allows us to to look at the same

315
00:11:16,550 --> 00:11:14,480
phenomena at different perspectives

316
00:11:18,310 --> 00:11:16,560
different angles different times of day

317
00:11:19,670 --> 00:11:18,320
it gives us a much more complete picture

318
00:11:20,790 --> 00:11:19,680
of the environment that we're trying to

319
00:11:21,750 --> 00:11:20,800
measure

320
00:11:23,509 --> 00:11:21,760
so

321
00:11:25,590 --> 00:11:23,519
what you'll see if you queue up the next

322
00:11:27,350 --> 00:11:25,600
one you see here is the iss the iserv

323
00:11:29,430 --> 00:11:27,360
and heiko instruments that julia already

324
00:11:31,430 --> 00:11:29,440
mentioned that's the start of of what

325
00:11:33,110 --> 00:11:31,440
we'll see in the near future coming up

326
00:11:35,509 --> 00:11:33,120
this year we will have both the

327
00:11:38,470 --> 00:11:35,519
rapidscat and in this image you see

328
00:11:40,389 --> 00:11:38,480
rapidscat and cats which is the the um

329
00:11:41,990 --> 00:11:40,399
the cloud aerosol transport system

330
00:11:43,990 --> 00:11:42,000
saddle instrument will be launched in

331
00:11:45,509 --> 00:11:44,000
this calendar year which will be added

332
00:11:47,269 --> 00:11:45,519
to the two that are already there you'll

333
00:11:48,949 --> 00:11:47,279
hear a lot more about both rapid scout

334
00:11:50,710 --> 00:11:48,959
and cats from the project scientists who

335
00:11:52,629 --> 00:11:50,720
will be presenting in a few moments so i

336
00:11:55,509 --> 00:11:52,639
won't go into more detail on those

337
00:11:59,110 --> 00:11:55,519
following these two we'll have in 2016

338
00:12:00,870 --> 00:11:59,120

the launch of a sage 3 and lis sage 3 is

339
00:12:02,949 --> 00:12:00,880
the stratospheric aerosol and gas

340
00:12:04,550 --> 00:12:02,959
experiment which measures basically

341
00:12:06,310 --> 00:12:04,560
ozone but a lot of other atmospheric

342
00:12:08,069 --> 00:12:06,320
aerosols it was an instrument actually

343
00:12:09,430 --> 00:12:08,079
designed for the iss 10 years ago and

344
00:12:12,629 --> 00:12:09,440
now finally getting into place where it

345
00:12:14,470 --> 00:12:12,639
belongs the lighting imaging sensor lis

346
00:12:16,230 --> 00:12:14,480
is in a follow-on of a typical of a

347
00:12:18,310 --> 00:12:16,240
measurement flown on solar on polar

348
00:12:21,030 --> 00:12:18,320
satellites and it will be launched in

349
00:12:22,790 --> 00:12:21,040
2016. it allows it measures the the

350
00:12:24,949 --> 00:12:22,800
frequency and and occurrence of

351
00:12:26,629 --> 00:12:24,959
lightning and complements again the

352
00:12:28,870 --> 00:12:26,639
polar and the geostationary satellites

353
00:12:31,190 --> 00:12:28,880
looking at the same phenomenon

354
00:12:34,069 --> 00:12:31,200
following the delivery of those in and

355
00:12:35,990 --> 00:12:34,079
in 2017 and 18 we have two new ones just

356
00:12:37,829 --> 00:12:36,000
this summer um the earth science

357
00:12:39,509 --> 00:12:37,839
division selected two new satellite

358
00:12:40,790 --> 00:12:39,519
instruments designed specifically for

359
00:12:43,590 --> 00:12:40,800
the iss

360
00:12:44,790 --> 00:12:43,600
contrary as julie mentioned before the

361
00:12:46,629 --> 00:12:44,800
other instruments have been built or

362
00:12:48,550 --> 00:12:46,639
designed over the last few years these

363
00:12:51,030 --> 00:12:48,560

are two that are starting from scratch

364
00:12:53,269 --> 00:12:51,040
with the iss as their base pla as their

365
00:12:54,949 --> 00:12:53,279
pla platform of choice so they're being

366
00:12:56,870 --> 00:12:54,959
starting just now just selected in july

367
00:12:59,509 --> 00:12:56,880
and are going forward with development

368
00:13:01,430 --> 00:12:59,519
in the coming years the ecostress one

369
00:13:03,829 --> 00:13:01,440
and launching in 2017 stands for the

370
00:13:06,629 --> 00:13:03,839
ecosystem spaceborne thermal radiometer

371
00:13:08,710 --> 00:13:06,639
experiment on the station on the iss and

372
00:13:10,470 --> 00:13:08,720
you'll see in this next slide an example

373
00:13:12,870 --> 00:13:10,480
of what it can do this is a picture from

374
00:13:14,710 --> 00:13:12,880
landsat which shows the it measures

375
00:13:16,870 --> 00:13:14,720
water content and water

376
00:13:18,870 --> 00:13:16,880
availability to vegetation systems and

377
00:13:21,350 --> 00:13:18,880
this is a picture from landsat which is

378
00:13:23,350 --> 00:13:21,360
showing the relative water stress uh in

379
00:13:24,870 --> 00:13:23,360
vegetation and where there you can

380
00:13:27,269 --> 00:13:24,880
clearly see in the center of the u.s

381
00:13:29,030 --> 00:13:27,279
here drought areas where the water is

382
00:13:30,870 --> 00:13:29,040
you can see the plants are dry the soil

383
00:13:32,230 --> 00:13:30,880
moisture is low whereas in the other

384
00:13:34,230 --> 00:13:32,240
where you see the green and the darker

385
00:13:35,750 --> 00:13:34,240
green there is relatively low water

386
00:13:38,069 --> 00:13:35,760
stress this is a derived product from

387
00:13:39,910 --> 00:13:38,079
landsat ecostress will add to this but

388
00:13:41,750 --> 00:13:39,920

also added at different times of day

389
00:13:42,949 --> 00:13:41,760
with different spectrum multiple bands

390
00:13:45,350 --> 00:13:42,959
which can look at it in many more

391
00:13:47,509 --> 00:13:45,360
different characteristics ecostress is

392
00:13:49,269 --> 00:13:47,519
designed with a project principal

393
00:13:50,790 --> 00:13:49,279
investigator is from the jet propulsion

394
00:13:51,990 --> 00:13:50,800
lab and the instrument is being built

395
00:13:53,509 --> 00:13:52,000
there as well

396
00:13:55,189 --> 00:13:53,519
the other instrument that has just been

397
00:13:58,069 --> 00:13:55,199
selected is the global ecosystem

398
00:14:00,470 --> 00:13:58,079
dynamics investigation this uses what's

399
00:14:03,110 --> 00:14:00,480
called a laser-based system for for

400
00:14:06,470 --> 00:14:03,120
measuring the forest canopy and and and

401
00:14:09,269 --> 00:14:06,480
co2 or biological content of of

402
00:14:10,710 --> 00:14:09,279
vegetation systems the it fires a laser

403
00:14:12,790 --> 00:14:10,720
is similar to what you'll hear about on

404
00:14:14,470 --> 00:14:12,800
cats in a little bit which bounces off

405
00:14:15,750 --> 00:14:14,480
the canopy and gets multiple reflections

406
00:14:17,350 --> 00:14:15,760
from various spots in the canopy and

407
00:14:19,430 --> 00:14:17,360
allows you to measure not just the

408
00:14:22,069 --> 00:14:19,440
forest height but also the content the

409
00:14:22,870 --> 00:14:22,079
carbon content of the of the vegetation

410
00:14:28,949 --> 00:14:22,880
an

411
00:14:30,710 --> 00:14:28,959
health of the system

412
00:14:33,110 --> 00:14:30,720
with the two of these added we will have

413
00:14:35,430 --> 00:14:33,120

an excellent platform showing multiple

414
00:14:36,949 --> 00:14:35,440
views of ecosystem health and dynamics

415
00:14:38,550 --> 00:14:36,959
within the earth

416
00:14:40,150 --> 00:14:38,560
now with that i'll turn that i'll turn

417
00:14:42,389 --> 00:14:40,160
the platform over to melanie miller from

418
00:14:43,590 --> 00:14:42,399
the iss program office who will talk

419
00:14:47,509 --> 00:14:43,600
about how these instruments will be

420
00:14:50,550 --> 00:14:49,269
thank you steve

421
00:14:52,550 --> 00:14:50,560
so i'm going to talk about how we

422
00:14:54,470 --> 00:14:52,560
transfer earth science instruments to

423
00:14:55,990 --> 00:14:54,480
the space station

424
00:14:58,790 --> 00:14:56,000
and first as an example i'm going to

425
00:15:01,269 --> 00:14:58,800
talk about rapid scat and cats they're

426
00:15:02,310 --> 00:15:01,279
both brought as external cargo on two

427
00:15:04,230 --> 00:15:02,320
different

428
00:15:06,470 --> 00:15:04,240
dragon missions

429
00:15:09,030 --> 00:15:06,480
the drag how this works is the dragon

430
00:15:10,870 --> 00:15:09,040
approaches space station

431
00:15:14,389 --> 00:15:10,880
and our astronauts

432
00:15:16,949 --> 00:15:14,399
capture dragon using canada arm 2 we

433
00:15:18,710 --> 00:15:16,959
usually just call it the big arm

434
00:15:20,550 --> 00:15:18,720
after the astronauts have completed the

435
00:15:23,430 --> 00:15:20,560
capture they hand it over to the robo

436
00:15:25,590 --> 00:15:23,440
flight controllers that's what i do

437
00:15:27,910 --> 00:15:25,600
and we fly the rest of the robotics for

438
00:15:31,269 --> 00:15:27,920

the mission from the ground commanding

439
00:15:36,470 --> 00:15:34,069
while we then are unpacking the external

440
00:15:38,629 --> 00:15:36,480
cargo on the dragon spacecraft the

441
00:15:41,350 --> 00:15:38,639
astronauts are unpacking the internal

442
00:15:43,509 --> 00:15:41,360
cargo we can make the best use of our

443
00:15:46,790 --> 00:15:43,519
docked mission time this way

444
00:15:48,790 --> 00:15:46,800
so first for rapidscat rapidscat is

445
00:15:51,430 --> 00:15:48,800
coming up on the dragon mission that we

446
00:15:54,069 --> 00:15:51,440
call spacex4

447
00:15:56,389 --> 00:15:54,079
after we're done with that installation

448
00:15:58,389 --> 00:15:56,399
of dragon on the iss

449
00:16:01,110 --> 00:15:58,399
i will pick up

450
00:16:03,509 --> 00:16:01,120
our little robot his name is dexter and

451
00:16:05,269 --> 00:16:03,519
he's also a canadian

452
00:16:07,430 --> 00:16:05,279
he's going to help us

453
00:16:10,629 --> 00:16:07,440
do the transfer of rapid scat to

454
00:16:12,310 --> 00:16:10,639
columbus to a site we call sdx

455
00:16:15,590 --> 00:16:12,320
and this will be the first time we've

456
00:16:18,629 --> 00:16:15,600
used the sdx site

457
00:16:21,110 --> 00:16:18,639
rapid scat comes up in two parts

458
00:16:23,110 --> 00:16:21,120
and i have a graphic here showing

459
00:16:25,269 --> 00:16:23,120
those two parts there's a nader adapter

460
00:16:28,310 --> 00:16:25,279
the nader adapter helps

461
00:16:30,470 --> 00:16:28,320
point the instrument towards the earth

462
00:16:32,230 --> 00:16:30,480
and then we also have a rapid scat

463
00:16:34,829 --> 00:16:32,240

instrument where the majority of the

464
00:16:39,990 --> 00:16:38,230
conducted this will be our first time to

465
00:16:40,790 --> 00:16:40,000
assemble

466
00:16:43,110 --> 00:16:40,800
a

467
00:16:46,150 --> 00:16:43,120
instrument on orbit coming up in two

468
00:16:47,910 --> 00:16:46,160
pieces using dexter

469
00:16:49,509 --> 00:16:47,920
and now i have a video of how this works

470
00:16:52,710 --> 00:16:49,519
so you can see

471
00:16:54,790 --> 00:16:52,720
dexter reaching into the dragon trunk

472
00:16:56,870 --> 00:16:54,800
and we call this the little arm this is

473
00:16:58,629 --> 00:16:56,880
one of dexter's arms it's going to grasp

474
00:17:01,110 --> 00:16:58,639
the nader adapter

475
00:17:02,870 --> 00:17:01,120
and carefully pull it out there's some

476
00:17:04,710 --> 00:17:02,880
tight clearances in there so we have to

477
00:17:07,110 --> 00:17:04,720
do a rotation to make sure we stay clear

478
00:17:09,510 --> 00:17:07,120
of the instrument before pulling it all

479
00:17:11,909 --> 00:17:09,520
the way out

480
00:17:13,590 --> 00:17:11,919
and then we have some big arm maneuvers

481
00:17:16,549 --> 00:17:13,600
that we're going to perform to get

482
00:17:19,110 --> 00:17:16,559
completely clear before we get all set

483
00:17:25,110 --> 00:17:19,120
up for the installation on

484
00:17:30,710 --> 00:17:28,150
and now you can see the little arm is

485
00:17:33,110 --> 00:17:30,720
performing a reconfiguration maneuver to

486
00:17:39,909 --> 00:17:33,120
get all set up to install the nader

487
00:17:46,789 --> 00:17:43,669
and the nader adapter has a common uh

488
00:17:49,029 --> 00:17:46,799

attach mechanism we call a fram

489
00:17:50,150 --> 00:17:49,039
that we use all over station for all of

490
00:17:53,110 --> 00:17:50,160
our

491
00:17:54,870 --> 00:17:53,120
external science

492
00:17:56,070 --> 00:17:54,880
so that's the installation of the nader

493
00:17:59,029 --> 00:17:56,080
adapter

494
00:18:01,110 --> 00:17:59,039
so dexter releases it at its home site

495
00:18:03,190 --> 00:18:01,120
on columbus and goes back and reaches in

496
00:18:10,390 --> 00:18:03,200
the trunk

497
00:18:13,830 --> 00:18:12,310
now the instrument has a five hour

498
00:18:15,750 --> 00:18:13,840
thermal clock which is going to be a

499
00:18:17,350 --> 00:18:15,760
challenge for us we usually have a

500
00:18:19,110 --> 00:18:17,360
little bit more time

501
00:18:21,590 --> 00:18:19,120
to transfer it these

502
00:18:24,150 --> 00:18:21,600
these videos are made using the tool

503
00:18:26,549 --> 00:18:24,160
that we use to design the trajectories

504
00:18:28,470 --> 00:18:26,559
but we actually go quite a bit slower to

505
00:18:30,470 --> 00:18:28,480
make sure that we don't damage anything

506
00:18:31,990 --> 00:18:30,480
or cause any loads

507
00:18:33,350 --> 00:18:32,000
on either the

508
00:18:36,310 --> 00:18:33,360
instrument or

509
00:18:39,190 --> 00:18:36,320
the space station

510
00:18:41,669 --> 00:18:39,200
so there you just saw us get the

511
00:18:43,350 --> 00:18:41,679
part of the base of the

512
00:18:46,150 --> 00:18:43,360
dexter out of the way so that we can

513
00:18:48,710 --> 00:18:46,160

install the instrument

514
00:18:51,990 --> 00:18:48,720
if we don't get the instrument installed

515
00:18:55,110 --> 00:18:52,000
in our first attempt we will put it back

516
00:18:57,750 --> 00:18:55,120
in the trunk and reheat it for 20 hours

517
00:18:59,350 --> 00:18:57,760
and then try again on another day so

518
00:19:01,590 --> 00:18:59,360
since we have that short clock we've

519
00:19:03,909 --> 00:19:01,600
already developed a bingo time

520
00:19:08,310 --> 00:19:03,919
and there's the instrument installed on

521
00:19:13,270 --> 00:19:10,789
and so that's that's it for the rapid

522
00:19:14,470 --> 00:19:13,280
scat operations after that after it's

523
00:19:15,750 --> 00:19:14,480
installed

524
00:19:18,310 --> 00:19:15,760
then

525
00:19:20,950 --> 00:19:18,320
the jpl and

526
00:19:23,270 --> 00:19:20,960
marshall will take over with operating

527
00:19:26,470 --> 00:19:23,280
it and powering it up

528
00:19:31,669 --> 00:19:28,150
the next one i wanted to talk about is

529
00:19:33,669 --> 00:19:31,679
cats now cats is brought up on spacex

530
00:19:36,549 --> 00:19:33,679
five and here's an image of the spacex

531
00:19:38,950 --> 00:19:36,559
five trunk and you can see cats is off

532
00:19:42,230 --> 00:19:38,960
to the side there that is so on future

533
00:19:46,150 --> 00:19:42,240
missions we could bring up multiple

534
00:19:53,430 --> 00:19:48,710
cats is going to be picked up also by

535
00:19:54,310 --> 00:19:53,440
dexter and here's a graphic of that

536
00:19:56,310 --> 00:19:54,320
and

537
00:19:57,990 --> 00:19:56,320
dexter spins his arm around because he's

538
00:20:00,070 --> 00:19:58,000

trying to come in as far away from the

539
00:20:01,750 --> 00:20:00,080
sides of the trunk as he can those

540
00:20:03,830 --> 00:20:01,760
latches you see there

541
00:20:08,230 --> 00:20:03,840
were developed four cats but will be

542
00:20:11,430 --> 00:20:08,240
reused for other instruments

543
00:20:14,390 --> 00:20:11,440
that are of that are meant to go on the

544
00:20:21,430 --> 00:20:14,400
gem ef that's the japanese experiment

545
00:20:25,350 --> 00:20:23,430
in this case we're going to we're not

546
00:20:28,390 --> 00:20:25,360
going to do the installation on the gem

547
00:20:30,950 --> 00:20:28,400
ef ourselves with dexter we're going to

548
00:20:32,789 --> 00:20:30,960
hand it off to the japanese arm that's

549
00:20:35,750 --> 00:20:32,799
called the gem arm

550
00:20:38,470 --> 00:20:35,760
so this is a a graphic of us setting up

551
00:20:41,510 --> 00:20:38,480
for that and you can see

552
00:20:43,830 --> 00:20:41,520
uh we've now parked and we're all lined

553
00:20:47,029 --> 00:20:43,840
up with the gem arm the jam arm will

554
00:20:49,750 --> 00:20:47,039
then do the final installation into site

555
00:20:51,270 --> 00:20:49,760
three on the exposed facility where cats

556
00:20:53,110 --> 00:20:51,280
will be nestled in between other

557
00:20:57,909 --> 00:20:53,120
instruments that are already up on space

558
00:21:03,430 --> 00:21:00,789
and now i'd like to introduce uh ernesto

559
00:21:06,630 --> 00:21:03,440
rodriguez from jpl to talk more about

560
00:21:10,390 --> 00:21:08,230
thank you melanie and thank you for

561
00:21:12,070 --> 00:21:10,400
those wonderful videos they

562
00:21:14,470 --> 00:21:12,080
really make me excited to see what's

563
00:21:17,029 --> 00:21:14,480

going to happen later on this year

564
00:21:19,669 --> 00:21:17,039
so rapidscat or iss rapist cat as we

565
00:21:22,310 --> 00:21:19,679
call it is a radar instrument that

566
00:21:25,110 --> 00:21:22,320
measures the wind direction and

567
00:21:26,310 --> 00:21:25,120
magnitude over the oceans

568
00:21:27,909 --> 00:21:26,320
these are

569
00:21:29,990 --> 00:21:27,919
essential climate variables that the

570
00:21:31,590 --> 00:21:30,000
scientific community has identified

571
00:21:34,310 --> 00:21:31,600
because they push the ocean around and

572
00:21:36,149 --> 00:21:34,320
they regulate the transfer between gases

573
00:21:38,870 --> 00:21:36,159
between the atmosphere and the oceans

574
00:21:40,549 --> 00:21:38,880
and of course they're also critical for

575
00:21:43,110 --> 00:21:40,559
weather forecasting

576
00:21:45,669 --> 00:21:43,120
now winds over the ocean tend to change

577
00:21:47,909 --> 00:21:45,679
very quickly just as winds overland do

578
00:21:49,990 --> 00:21:47,919
one of the challenges that we've had is

579
00:21:51,029 --> 00:21:50,000
to maintain a constellation of

580
00:21:52,870 --> 00:21:51,039
instruments

581
00:21:55,110 --> 00:21:52,880
across many different space agencies

582
00:21:56,789 --> 00:21:55,120
that are able to monitor the changes of

583
00:21:58,470 --> 00:21:56,799
wind variability

584
00:21:59,990 --> 00:21:58,480
in a daily basis

585
00:22:03,590 --> 00:22:00,000
so in the first figure that you see in

586
00:22:06,310 --> 00:22:03,600
the lower panel you'll see the coverage

587
00:22:08,310 --> 00:22:06,320
the daily coverage of the a-scat mission

588
00:22:09,270 --> 00:22:08,320

that's a european

589
00:22:10,870 --> 00:22:09,280
spay

590
00:22:12,390 --> 00:22:10,880
humidisat

591
00:22:14,390 --> 00:22:12,400
instrument

592
00:22:16,310 --> 00:22:14,400
that's another scatterometer

593
00:22:17,190 --> 00:22:16,320
in a polar orbit and what you'll see is

594
00:22:18,950 --> 00:22:17,200
that

595
00:22:21,750 --> 00:22:18,960
although we get global coverage there

596
00:22:23,029 --> 00:22:21,760
are many holes in the coverage

597
00:22:25,190 --> 00:22:23,039
in the upper

598
00:22:27,909 --> 00:22:25,200
slide or the upper graph that you see

599
00:22:31,190 --> 00:22:27,919
there you'll see the coverage of the iss

600
00:22:34,230 --> 00:22:31,200
rapid scat so because the orbit is lower

601
00:22:36,390 --> 00:22:34,240
as julie mentioned has lower inclination

602
00:22:38,630 --> 00:22:36,400
we get much better

603
00:22:41,350 --> 00:22:38,640
equatorial coverage than does

604
00:22:43,510 --> 00:22:41,360
the human side instrument they scat

605
00:22:45,110 --> 00:22:43,520
when we put the two together as you see

606
00:22:47,270 --> 00:22:45,120
in the next graph

607
00:22:48,390 --> 00:22:47,280
in the next figure

608
00:22:50,470 --> 00:22:48,400
so we could have

609
00:22:52,789 --> 00:22:50,480
yeah if we put the two of them together

610
00:22:55,029 --> 00:22:52,799
we actually see that over 90 of the

611
00:22:56,070 --> 00:22:55,039
earth will be covered every day

612
00:22:58,630 --> 00:22:56,080
and so

613
00:23:00,710 --> 00:22:58,640

this is really exciting for us

614
00:23:03,190 --> 00:23:00,720
there are many phenomena that change on

615
00:23:04,789 --> 00:23:03,200
a daily basis and as you see in the next

616
00:23:06,630 --> 00:23:04,799
figure

617
00:23:09,590 --> 00:23:06,640
this is a

618
00:23:13,190 --> 00:23:09,600
view of the katrina hurricane as it

619
00:23:14,789 --> 00:23:13,200
approached new orleans in 2005.

620
00:23:17,029 --> 00:23:14,799
during that time katrina was

621
00:23:20,630 --> 00:23:17,039
intensifying rather quickly and it was

622
00:23:22,710 --> 00:23:20,640
very important to get daily glimpses at

623
00:23:24,630 --> 00:23:22,720
the changes in katrina and

624
00:23:26,549 --> 00:23:24,640
the same is true for many other

625
00:23:28,470 --> 00:23:26,559
hurricanes that tend to change from day

626
00:23:30,870 --> 00:23:28,480
to day by combining the two the

627
00:23:32,710 --> 00:23:30,880
capabilities of these two scatterometers

628
00:23:35,190 --> 00:23:32,720
we'll be able to get global monitoring

629
00:23:36,390 --> 00:23:35,200
every day and be able to provide better

630
00:23:37,990 --> 00:23:36,400
forecasting

631
00:23:41,190 --> 00:23:38,000
capabilities to

632
00:23:44,630 --> 00:23:41,200
operational agencies such as noaa

633
00:23:47,669 --> 00:23:44,640
if you go to the next animation please

634
00:23:49,830 --> 00:23:47,679
one of the things that we do beyond

635
00:23:52,310 --> 00:23:49,840
getting better numerical weather

636
00:23:54,870 --> 00:23:52,320
forecasts and beyond whether better

637
00:23:57,029 --> 00:23:54,880
weather prediction is we provide a

638
00:23:58,789 --> 00:23:57,039

global picture and this is really a

639
00:24:01,190 --> 00:23:58,799
unique thing that you can do from space

640
00:24:02,789 --> 00:24:01,200
we provide the first ever global

641
00:24:04,470 --> 00:24:02,799
understanding of what the winds over the

642
00:24:06,870 --> 00:24:04,480
ocean look like

643
00:24:09,990 --> 00:24:06,880
what you see in this in this movie

644
00:24:12,549 --> 00:24:10,000
is the wind speed as color

645
00:24:14,789 --> 00:24:12,559
going from zero to 10 meters per second

646
00:24:16,789 --> 00:24:14,799
or if you're a sailor from about zero to

647
00:24:19,190 --> 00:24:16,799
about 22 knots

648
00:24:22,549 --> 00:24:19,200
and the arrows in the animation

649
00:24:24,549 --> 00:24:22,559
are the direction that the wind takes

650
00:24:25,510 --> 00:24:24,559
and what we've done here is average

651
00:24:27,510 --> 00:24:25,520
those

652
00:24:29,510 --> 00:24:27,520
uh snapshots that we've gotten over 10

653
00:24:32,710 --> 00:24:29,520
years from the quick scout mission and

654
00:24:35,110 --> 00:24:32,720
made what we call a climatology that's a

655
00:24:37,029 --> 00:24:35,120
view of what the earth does every month

656
00:24:39,830 --> 00:24:37,039
for throughout the entire year

657
00:24:42,470 --> 00:24:39,840
before the advent of space-borne

658
00:24:44,230 --> 00:24:42,480
measurements we really had no

659
00:24:46,149 --> 00:24:44,240
information over a large part of the

660
00:24:48,549 --> 00:24:46,159
ocean and we couldn't understand the

661
00:24:50,870 --> 00:24:48,559
processes that were really determining

662
00:24:53,190 --> 00:24:50,880
how the energy from the sun goes into

663
00:24:54,950 --> 00:24:53,200

the winds and goes into the water of the

664
00:24:55,990 --> 00:24:54,960
ocean

665
00:24:57,669 --> 00:24:56,000
the

666
00:25:00,310 --> 00:24:57,679
next slide

667
00:25:02,310 --> 00:25:00,320
shows one of the unique capabilities of

668
00:25:04,710 --> 00:25:02,320
the iss rapidscat

669
00:25:07,190 --> 00:25:04,720
as julie mentioned earlier

670
00:25:08,789 --> 00:25:07,200
iss rabbitscat can monitor

671
00:25:09,909 --> 00:25:08,799
every place on the earth at a different

672
00:25:11,990 --> 00:25:09,919
time of day

673
00:25:13,590 --> 00:25:12,000
now why is that important for the winds

674
00:25:17,029 --> 00:25:13,600
is very important because winds are

675
00:25:18,870 --> 00:25:17,039
driven by the sun and the sun rises

676
00:25:20,789 --> 00:25:18,880
heats up the atmosphere once the

677
00:25:23,430 --> 00:25:20,799
atmosphere is hot winds start to

678
00:25:25,669 --> 00:25:23,440
circulate and they start to go up into

679
00:25:29,190 --> 00:25:25,679
the atmosphere carrying water moisture

680
00:25:32,870 --> 00:25:29,200
and organizing precipitation and the the

681
00:25:35,190 --> 00:25:32,880
overall dance so between the ocean the

682
00:25:37,110 --> 00:25:35,200
atmosphere the rainfall and so forth

683
00:25:39,990 --> 00:25:37,120
this is one of the critical

684
00:25:41,190 --> 00:25:40,000
processes in the tropics

685
00:25:42,950 --> 00:25:41,200
so far

686
00:25:45,350 --> 00:25:42,960
as shown in this picture we've been able

687
00:25:47,830 --> 00:25:45,360
to get a very short glimpse of what was

688
00:25:48,789 --> 00:25:47,840

going on uh for a small region of the

689
00:25:51,029 --> 00:25:48,799
earth

690
00:25:52,470 --> 00:25:51,039
uh what we hope from uh rapidscat is

691
00:25:54,470 --> 00:25:52,480
that we'll be able to get a much better

692
00:25:56,470 --> 00:25:54,480
glimpse of what's going on so what you

693
00:25:58,870 --> 00:25:56,480
see in that picture is the daily

694
00:26:00,789 --> 00:25:58,880
variability of the winds and basically

695
00:26:02,390 --> 00:26:00,799
the winds will trace

696
00:26:04,470 --> 00:26:02,400
an ellipse over the period of a day

697
00:26:05,269 --> 00:26:04,480
they'll reverse directions

698
00:26:06,149 --> 00:26:05,279
and

699
00:26:09,110 --> 00:26:06,159
they'll

700
00:26:11,029 --> 00:26:09,120
those processes help to train the winds

701
00:26:13,350 --> 00:26:11,039
to move

702
00:26:15,510 --> 00:26:13,360
moisture up into the atmosphere and they

703
00:26:17,430 --> 00:26:15,520
also regulate the wind transfer between

704
00:26:19,990 --> 00:26:17,440
land and the ocean

705
00:26:21,510 --> 00:26:20,000
so we hope to be able to do to study the

706
00:26:24,630 --> 00:26:21,520
seasonal variability of these wind

707
00:26:26,549 --> 00:26:24,640
changes as well as the variability over

708
00:26:29,590 --> 00:26:26,559
a period of two years

709
00:26:31,990 --> 00:26:29,600
and with that i'll uh pass on the baton

710
00:26:35,350 --> 00:26:32,000
to matt so he can talk to you

711
00:26:38,149 --> 00:26:36,310
thank you

712
00:26:39,990 --> 00:26:38,159
the cloud air assault transport system

713
00:26:41,430 --> 00:26:40,000

or cats is a new instrument for the

714
00:26:43,590 --> 00:26:41,440
space station

715
00:26:45,510 --> 00:26:43,600
that will measure and characterize the

716
00:26:47,830 --> 00:26:45,520
worldwide distribution of clouds and

717
00:26:49,669 --> 00:26:47,840
tiny aerosol particles or tiny

718
00:26:50,870 --> 00:26:49,679
atmospheric particles in the earth's

719
00:26:53,029 --> 00:26:50,880
atmosphere

720
00:26:55,590 --> 00:26:53,039
cats is a spectacular opportunity to

721
00:26:57,190 --> 00:26:55,600
utilize the space station infrastructure

722
00:26:59,750 --> 00:26:57,200
to obtain important earth science

723
00:27:01,590 --> 00:26:59,760
measurements at a modest cost

724
00:27:03,669 --> 00:27:01,600
as the first instrument for earth

725
00:27:05,190 --> 00:27:03,679
science to be developed at goddard space

726
00:27:07,430 --> 00:27:05,200
flight center and installed on space

727
00:27:09,110 --> 00:27:07,440
station cats will provide capabilities

728
00:27:10,549 --> 00:27:09,120
that haven't been demonstrated before

729
00:27:12,070 --> 00:27:10,559
from space

730
00:27:13,990 --> 00:27:12,080
cats is a laser remote sensing

731
00:27:15,590 --> 00:27:14,000
instrument or lidar that provides

732
00:27:18,070 --> 00:27:15,600
measurements of clouds and particles in

733
00:27:20,310 --> 00:27:18,080
the earth's atmosphere lidar works a lot

734
00:27:22,389 --> 00:27:20,320
like radar except we use low energy

735
00:27:24,470 --> 00:27:22,399
pulses of visible and near visible laser

736
00:27:26,070 --> 00:27:24,480
light the cat's instrument consists of

737
00:27:28,549 --> 00:27:26,080
two lasers each having different

738
00:27:31,110 --> 00:27:28,559

characteristics a receiving telescope

739
00:27:33,510 --> 00:27:31,120
and special photon counting detectors

740
00:27:35,269 --> 00:27:33,520
overall cats packs a significant

741
00:27:37,590 --> 00:27:35,279
scientific capability and a lot of

742
00:27:39,830 --> 00:27:37,600
technology into a package about the size

743
00:27:42,389 --> 00:27:39,840
of a household refrigerator

744
00:27:44,389 --> 00:27:42,399
lidar works by sending discrete pulses

745
00:27:45,990 --> 00:27:44,399
of laser light into the atmosphere and

746
00:27:48,389 --> 00:27:46,000
then detecting the small fraction of

747
00:27:50,230 --> 00:27:48,399
light that scatters from particles

748
00:27:51,750 --> 00:27:50,240
cats will generate profiles of clouds

749
00:27:53,430 --> 00:27:51,760
and particles in the earth's atmosphere

750
00:27:55,750 --> 00:27:53,440
to identify the presence and height of

751
00:27:57,430 --> 00:27:55,760
clouds and particulate layers

752
00:27:58,950 --> 00:27:57,440
detailed observations of clouds and

753
00:28:01,190 --> 00:27:58,960
particles in the earth's atmosphere are

754
00:28:03,750 --> 00:28:01,200
important for many reasons but three key

755
00:28:05,750 --> 00:28:03,760
uses are for providing information on

756
00:28:08,470 --> 00:28:05,760
real-time hazard events such as volcanic

757
00:28:10,549 --> 00:28:08,480
eruptions for studies of energy balance

758
00:28:12,310 --> 00:28:10,559
at climate change and for examining the

759
00:28:14,870 --> 00:28:12,320
effects of man-made and natural

760
00:28:16,549 --> 00:28:14,880
pollutants on air quality health effects

761
00:28:17,430 --> 00:28:16,559
let's take each of these three points in

762
00:28:19,430 --> 00:28:17,440
order

763
00:28:21,990 --> 00:28:19,440

for example cats can determine the top

764
00:28:23,909 --> 00:28:22,000
and bottom height of volcanic plumes

765
00:28:25,990 --> 00:28:23,919
that information can be used to make

766
00:28:28,389 --> 00:28:26,000
better decisions on airplane routings

767
00:28:31,590 --> 00:28:28,399
and cancellations the volcanic eruption

768
00:28:33,110 --> 00:28:31,600
in iceland in 2010 resulted in almost a

769
00:28:35,029 --> 00:28:33,120
hundred thousand cancelled flights and

770
00:28:37,190 --> 00:28:35,039
cost nearly two billion dollars because

771
00:28:39,750 --> 00:28:37,200
airlines dare not send planes anywhere

772
00:28:41,269 --> 00:28:39,760
into or near plumes for fear of damaging

773
00:28:44,310 --> 00:28:41,279
the engines

774
00:28:45,510 --> 00:28:44,320
second cats permit studies of clouds

775
00:28:47,430 --> 00:28:45,520
clouds are one of the largest

776
00:28:49,110 --> 00:28:47,440
uncertainties in predicting climate

777
00:28:50,630 --> 00:28:49,120
change because clouds are the key

778
00:28:51,830 --> 00:28:50,640
regulator of the planet's average

779
00:28:53,430 --> 00:28:51,840
temperature

780
00:28:55,029 --> 00:28:53,440
for scientists to create more accurate

781
00:28:57,269 --> 00:28:55,039
climate models they have to include

782
00:28:58,710 --> 00:28:57,279
better representations of clouds which

783
00:29:00,549 --> 00:28:58,720
means they need more information on

784
00:29:02,630 --> 00:29:00,559
which to base their models

785
00:29:05,029 --> 00:29:02,640
and third small particles such as dust

786
00:29:07,110 --> 00:29:05,039
blown from deserts smoke from intense

787
00:29:09,269 --> 00:29:07,120
forest fires or man-made pollutants can

788
00:29:11,190 --> 00:29:09,279

have significant impact on the earth's

789
00:29:12,710 --> 00:29:11,200
climate and on human health and air

790
00:29:15,269 --> 00:29:12,720
quality

791
00:29:17,110 --> 00:29:15,279
cat's data will also be used to improve

792
00:29:18,149 --> 00:29:17,120
computer models of clouds and aerosol

793
00:29:19,990 --> 00:29:18,159
particles

794
00:29:21,990 --> 00:29:20,000
right now the vertical distributions and

795
00:29:23,830 --> 00:29:22,000
the microphysical properties of

796
00:29:26,470 --> 00:29:23,840
atmospheric particles are often poorly

797
00:29:27,990 --> 00:29:26,480
resolved by computer models

798
00:29:30,230 --> 00:29:28,000
to improve the quality of the

799
00:29:32,230 --> 00:29:30,240
simulations requires real-time data

800
00:29:34,070 --> 00:29:32,240
about the particle type and height

801
00:29:36,070 --> 00:29:34,080
lidar can provide that vertical

802
00:29:38,070 --> 00:29:36,080
distribution and we know that will

803
00:29:40,230 --> 00:29:38,080
address one of the biggest weaknesses in

804
00:29:42,310 --> 00:29:40,240
the models at this moment the space

805
00:29:44,070 --> 00:29:42,320
station orbit is a good fit for cats

806
00:29:46,149 --> 00:29:44,080
because the station transits over and

807
00:29:47,750 --> 00:29:46,159
along primary aerosol transport routes

808
00:29:49,510 --> 00:29:47,760
in the atmosphere

809
00:29:51,750 --> 00:29:49,520
data from cats will be transmitted to

810
00:29:54,389 --> 00:29:51,760
the ground continuously and in near real

811
00:29:56,549 --> 00:29:54,399
time to be promptly assimilated into

812
00:29:58,549 --> 00:29:56,559
computer models to create improvements

813
00:30:01,909 --> 00:29:58,559

in those models that real-time data

814
00:30:04,789 --> 00:30:01,919
capability is made possible by the space

815
00:30:07,269 --> 00:30:04,799
station communications infrastructure

816
00:30:09,269 --> 00:30:07,279
on the whole cats is a cost-effective

817
00:30:11,430 --> 00:30:09,279
way to demonstrate new technologies and

818
00:30:13,750 --> 00:30:11,440
new measurements that will inform future

819
00:30:15,750 --> 00:30:13,760
satellite missions the build to cost

820
00:30:18,070 --> 00:30:15,760
approach embraced by the cats team is a

821
00:30:19,990 --> 00:30:18,080
fiscally responsible way to obtain

822
00:30:21,830 --> 00:30:20,000
important earth science measurements and

823
00:30:23,830 --> 00:30:21,840
being able to utilize the space station

824
00:30:25,750 --> 00:30:23,840
as a platform begins a new and exciting

825
00:30:28,070 --> 00:30:25,760
era for earth science

826
00:30:30,470 --> 00:30:28,080
and that in a nutshell is the why and

827
00:30:32,789 --> 00:30:30,480
the wherefore of cats cats is set to

828
00:30:34,710 --> 00:30:32,799
launch later this year on spacex five

829
00:30:36,470 --> 00:30:34,720
and we are very much looking forward to

830
00:30:37,750 --> 00:30:36,480
this exciting new earth science

831
00:30:39,990 --> 00:30:37,760
capability

832
00:30:42,310 --> 00:30:40,000
and with that we go back to steve cole

833
00:30:43,909 --> 00:30:42,320
at nasa headquarters

834
00:30:45,990 --> 00:30:43,919
okay thank you matt and thank you to all

835
00:30:49,350 --> 00:30:46,000
our presenters uh we'll now take

836
00:30:50,389 --> 00:30:49,360
questions from media uh here in the nasa

837
00:30:52,710 --> 00:30:50,399
headquarters

838
00:30:55,110 --> 00:30:52,720

on the phone lines if you're a media on

839
00:30:56,789 --> 00:30:55,120
the phone line again to ask a question

840
00:30:58,710 --> 00:30:56,799
press star one

841
00:31:01,669 --> 00:30:58,720
on social media if you'd like to post a

842
00:31:04,950 --> 00:31:01,679
question uh using twitter

843
00:31:07,269 --> 00:31:04,960
use the hashtag ask nasa

844
00:31:10,070 --> 00:31:07,279
we'll start here with questions in the

845
00:31:12,710 --> 00:31:10,080
audience dan leone space news

846
00:31:14,710 --> 00:31:12,720
hey everybody dan leone with space news

847
00:31:16,549 --> 00:31:14,720
so when you're doing earth science and

848
00:31:18,230 --> 00:31:16,559
you want to get global coverage and you

849
00:31:20,549 --> 00:31:18,240
want to see the same spot in the same

850
00:31:22,310 --> 00:31:20,559
condition there's an orbit for that

851
00:31:24,630 --> 00:31:22,320
if you want to do earth science and you

852
00:31:27,110 --> 00:31:24,640
want to just look down at the same place

853
00:31:29,509 --> 00:31:27,120
for as long as your satellite has gas in

854
00:31:31,909 --> 00:31:29,519
it there's an orbit for that it seems

855
00:31:33,830 --> 00:31:31,919
like the iss despite the convenient

856
00:31:36,149 --> 00:31:33,840
centralization of power thermal

857
00:31:37,990 --> 00:31:36,159
protection crew time and communications

858
00:31:41,029 --> 00:31:38,000
is

859
00:31:42,950 --> 00:31:41,039
possibly an unhappy

860
00:31:45,350 --> 00:31:42,960
medium and a compromise orbit for

861
00:31:47,029 --> 00:31:45,360
looking down at the planet but i've also

862
00:31:49,350 --> 00:31:47,039
heard a lot of good reasons today for

863
00:31:51,190 --> 00:31:49,360

why people like this so in a nutshell

864
00:31:53,269 --> 00:31:51,200
why not just build a polar orbiting

865
00:31:54,950 --> 00:31:53,279
satellite or geosynchronous satellites

866
00:31:56,789 --> 00:31:54,960
aren't you going to get

867
00:31:58,830 --> 00:31:56,799
scientifically better data compared with

868
00:32:01,430 --> 00:31:58,840
what you'll get from the space station

869
00:32:02,950 --> 00:32:01,440
orbit i'll take that one i think

870
00:32:04,549 --> 00:32:02,960
um as i mentioned at the start we're

871
00:32:06,070 --> 00:32:04,559
looking at earth system science and

872
00:32:08,549 --> 00:32:06,080
earth system science requires you to do

873
00:32:10,549 --> 00:32:08,559
a global view um and global is not just

874
00:32:12,630 --> 00:32:10,559
global look at the whole earth from any

875
00:32:14,549 --> 00:32:12,640
one perspective it's it's global looking

876
00:32:16,149 --> 00:32:14,559
at how it evolves over time and the

877
00:32:17,509 --> 00:32:16,159
diurnal cycle is a pretty critical

878
00:32:19,830 --> 00:32:17,519
element of that time

879
00:32:22,070 --> 00:32:19,840
the uh the soil moisture at six am if

880
00:32:24,230 --> 00:32:22,080
you walk in your grass is full of dew at

881
00:32:25,669 --> 00:32:24,240
four pm it may be dry so if i have a sun

882
00:32:27,430 --> 00:32:25,679
synchronous orbiter looking at it at

883
00:32:29,590 --> 00:32:27,440
four pm i have one measurement of some

884
00:32:31,430 --> 00:32:29,600
of the soil moisture than i have at six

885
00:32:33,350 --> 00:32:31,440
a.m and both of them are true but

886
00:32:35,350 --> 00:32:33,360
they're not they're not resp telling you

887
00:32:37,590 --> 00:32:35,360
about the entire system if you have a

888
00:32:39,990 --> 00:32:37,600

combination of multiple views at

889
00:32:41,350 --> 00:32:40,000
multiple angles or perspectives the

890
00:32:42,789 --> 00:32:41,360
geosynchronous gives you the stair

891
00:32:44,630 --> 00:32:42,799
feature as you mentioned the eu

892
00:32:47,029 --> 00:32:44,640
stationary i mean the polar orbit gives

893
00:32:48,710 --> 00:32:47,039
you across a constant variable constant

894
00:32:50,230 --> 00:32:48,720
measurement of particular time which

895
00:32:51,909 --> 00:32:50,240
allows you to look at long-term

896
00:32:54,230 --> 00:32:51,919
variations at that particular time of

897
00:32:57,190 --> 00:32:54,240
day the precessing orbit the variable

898
00:32:58,789 --> 00:32:57,200
angle orbit allows you to see the how it

899
00:33:00,230 --> 00:32:58,799
how that particular phenomenon in

900
00:33:02,070 --> 00:33:00,240
particular form varies from different

901
00:33:05,830 --> 00:33:02,080
hours of the day takes a lot longer to

902
00:33:07,509 --> 00:33:05,840
get us a massive database at 6am 7am 8am

903
00:33:09,350 --> 00:33:07,519
etc but it gives you a different

904
00:33:11,750 --> 00:33:09,360
perspective which allows you to sort of

905
00:33:14,149 --> 00:33:11,760
leverage and see how what you see at one

906
00:33:16,789 --> 00:33:14,159
period of point of view varies from time

907
00:33:18,630 --> 00:33:16,799
to time and this is and then soil

908
00:33:20,710 --> 00:33:18,640
moisture just one wind speeds vary by

909
00:33:22,549 --> 00:33:20,720
the day the the way the vegetation

910
00:33:23,990 --> 00:33:22,559
reflects light is highly variable with a

911
00:33:25,750 --> 00:33:24,000
light angle so seeing it from different

912
00:33:28,070 --> 00:33:25,760
angles you get different perspectives on

913
00:33:30,230 --> 00:33:28,080

how the vegetation health is as well so

914
00:33:32,470 --> 00:33:30,240
i don't see it as a as a compromise as

915
00:33:33,990 --> 00:33:32,480
much as a complement to the various to

916
00:33:35,990 --> 00:33:34,000
the different features that we have from

917
00:33:38,389 --> 00:33:36,000
the polar and from the geostationary you

918
00:33:40,630 --> 00:33:38,399
need multiple angles to get a complex

919
00:33:42,950 --> 00:33:40,640
system understood and by having the

920
00:33:45,190 --> 00:33:42,960
station adds another variable which we

921
00:33:47,029 --> 00:33:45,200
don't have in other ways we do have some

922
00:33:48,870 --> 00:33:47,039
precessing orbit satellites the trim

923
00:33:51,269 --> 00:33:48,880
satellite for example the gpm global

924
00:33:53,430 --> 00:33:51,279
position precipitation measurement also

925
00:33:54,630 --> 00:33:53,440
use variable sun angles variable times

926
00:33:56,710 --> 00:33:54,640
the day not sun angles because they're

927
00:33:58,149 --> 00:33:56,720
radars to measure the phenomena they

928
00:34:00,470 --> 00:33:58,159
have but they're addressing a different

929
00:34:02,789 --> 00:34:00,480
piece of science so the the precessing

930
00:34:04,389 --> 00:34:02,799
variable crossing orbit time is another

931
00:34:07,190 --> 00:34:04,399
tool in the toolbox that we use for

932
00:34:09,510 --> 00:34:07,200
measuring our system science

933
00:34:12,389 --> 00:34:09,520
okay we have a couple of questions on

934
00:34:15,270 --> 00:34:12,399
the phone lines we'll go to those next

935
00:34:18,069 --> 00:34:15,280
first mariam cramer from space.com go

936
00:34:23,430 --> 00:34:20,389
hi thanks so much um yeah this question

937
00:34:26,310 --> 00:34:23,440
might be for melanie or whoever uh would

938
00:34:29,589 --> 00:34:26,320

like to answer it uh so i'm just curious

939
00:34:32,310 --> 00:34:29,599
is is spacex 4 still targeted for

940
00:34:34,389 --> 00:34:32,320
um no earlier than the 19th and is there

941
00:34:37,750 --> 00:34:34,399
any rumors or any news on the launch

942
00:34:39,669 --> 00:34:37,760
date and also um when when is spacex 5

943
00:34:42,149 --> 00:34:39,679
expected to go assuming everything

944
00:34:45,109 --> 00:34:42,159
remains on the schedule it is now

945
00:34:47,349 --> 00:34:45,119
so i'll take that one spacex4 as you

946
00:34:49,750 --> 00:34:47,359
probably know was

947
00:34:51,510 --> 00:34:49,760
no earlier than uh september 19th

948
00:34:53,109 --> 00:34:51,520
waiting for the successful asiasat

949
00:34:55,430 --> 00:34:53,119
launch their commercial launch provider

950
00:34:57,829 --> 00:34:55,440
and they got to work those launches in

951
00:34:58,950 --> 00:34:57,839
sequence that was a successful launch

952
00:35:00,790 --> 00:34:58,960
and so

953
00:35:03,190 --> 00:35:00,800
they're expecting to announce their

954
00:35:04,870 --> 00:35:03,200
confirmed launch date probably tomorrow

955
00:35:06,069 --> 00:35:04,880
but certainly the 19th is still a

956
00:35:07,750 --> 00:35:06,079
possibility

957
00:35:09,750 --> 00:35:07,760
as are several days right after that so

958
00:35:13,190 --> 00:35:09,760
we will hear that from them i think

959
00:35:17,670 --> 00:35:16,710
okay we have the next question oh yeah

960
00:35:19,589 --> 00:35:17,680
that's that's right the second about

961
00:35:22,470 --> 00:35:19,599
those basics um you know the further you

962
00:35:24,470 --> 00:35:22,480
get out the less certainty there is um

963
00:35:26,710 --> 00:35:24,480

and and so we're still targeting late in

964
00:35:29,270 --> 00:35:26,720
the year for spacex five and we'll pin

965
00:35:30,870 --> 00:35:29,280
that down much more closely as we get

966
00:35:33,349 --> 00:35:30,880
information from spacex and is after

967
00:35:35,190 --> 00:35:33,359
they get space x4 under their belt

968
00:35:37,349 --> 00:35:35,200
okay thank you julie our next question

969
00:35:41,030 --> 00:35:37,359
from the phone lines is from frank mori

970
00:35:42,710 --> 00:35:41,040
at aviation week go ahead frank

971
00:35:44,390 --> 00:35:42,720
thank you um

972
00:35:46,790 --> 00:35:44,400
i was interested in what dr robinson

973
00:35:48,950 --> 00:35:46,800
said about using the station as a as a

974
00:35:51,670 --> 00:35:48,960
sort of a test platform

975
00:35:52,950 --> 00:35:51,680
for um earth-based earth observation

976
00:35:54,230 --> 00:35:52,960
sensors

977
00:35:55,670 --> 00:35:54,240
um

978
00:35:58,069 --> 00:35:55,680
that could lead to free-flying

979
00:36:00,710 --> 00:35:58,079
satellites i wonder and i guess i should

980
00:36:01,589 --> 00:36:00,720
address this to steve bowles if there

981
00:36:04,470 --> 00:36:01,599
are

982
00:36:06,150 --> 00:36:04,480
plans in any of the planned

983
00:36:07,349 --> 00:36:06,160
earth observation instruments going to

984
00:36:08,230 --> 00:36:07,359
the station

985
00:36:12,950 --> 00:36:08,240
to

986
00:36:15,190 --> 00:36:12,960
they work out on the station

987
00:36:17,030 --> 00:36:15,200
and also if there are other

988
00:36:18,950 --> 00:36:17,040

sensors planned to go on the station

989
00:36:23,349 --> 00:36:18,960
besides the ones that have been

990
00:36:27,910 --> 00:36:25,750
i'll take the first part um as we talked

991
00:36:29,910 --> 00:36:27,920
about the the value of the station as a

992
00:36:31,990 --> 00:36:29,920
place to test out technologies before

993
00:36:34,230 --> 00:36:32,000
maybe a major multi hundred million

994
00:36:36,069 --> 00:36:34,240
dollar investment or in an instrument or

995
00:36:36,870 --> 00:36:36,079
a fully free flame satellite

996
00:36:39,349 --> 00:36:36,880
um

997
00:36:41,190 --> 00:36:39,359
the the space station provides the

998
00:36:42,150 --> 00:36:41,200
really the strong initial step in that

999
00:36:44,470 --> 00:36:42,160
now

1000
00:36:45,670 --> 00:36:44,480
there are no specific plans to take an

1001
00:36:47,829 --> 00:36:45,680
instrument of any of the ones we

1002
00:36:49,829 --> 00:36:47,839
mentioned and make and follow it up with

1003
00:36:50,950 --> 00:36:49,839
a more capable more long-duration

1004
00:36:52,310 --> 00:36:50,960
satellite

1005
00:36:53,990 --> 00:36:52,320
on the other hand the measurement

1006
00:36:55,670 --> 00:36:54,000
techniques that are being that will be

1007
00:36:59,349 --> 00:36:55,680
demonstrated by cats

1008
00:37:02,069 --> 00:36:59,359
or by uh the jedi or or um

1009
00:37:03,670 --> 00:37:02,079
or ecostress are highly desirable

1010
00:37:05,670 --> 00:37:03,680
measurements that we hope that will

1011
00:37:08,470 --> 00:37:05,680
provide providing critical information

1012
00:37:09,589 --> 00:37:08,480
for us and and if you if you've

1013
00:37:11,030 --> 00:37:09,599

you might have noticed they're very

1014
00:37:13,030 --> 00:37:11,040
similar to some of the other measurement

1015
00:37:14,870 --> 00:37:13,040
concepts that have been in work and

1016
00:37:16,550 --> 00:37:14,880
viewed in our decadal surveys and our

1017
00:37:18,630 --> 00:37:16,560
other strategic science objectives for

1018
00:37:20,230 --> 00:37:18,640
example and i'll speak specifically to

1019
00:37:21,910 --> 00:37:20,240
ecostress

1020
00:37:23,589 --> 00:37:21,920
multi-spectral measurements of the

1021
00:37:25,750 --> 00:37:23,599
thermal ir

1022
00:37:28,150 --> 00:37:25,760
imagery of the earth is a feature of our

1023
00:37:30,310 --> 00:37:28,160
long-standing landsat satellites uh two

1024
00:37:31,670 --> 00:37:30,320
bits one band on landsat 7 two bands on

1025
00:37:33,190 --> 00:37:31,680
landsat 8.

1026
00:37:35,510 --> 00:37:33,200
looking at it from multiple bands with a

1027
00:37:36,470 --> 00:37:35,520
new technology is definitely part of

1028
00:37:37,910 --> 00:37:36,480
nasa's

1029
00:37:39,829 --> 00:37:37,920
efforts to

1030
00:37:41,750 --> 00:37:39,839
invest in new technologies to get

1031
00:37:43,510 --> 00:37:41,760
enhanced views of the phenomena that

1032
00:37:45,750 --> 00:37:43,520
we've been studying for many years

1033
00:37:47,589 --> 00:37:45,760
so successful demonstration by any or

1034
00:37:49,109 --> 00:37:47,599
all of these instruments would certainly

1035
00:37:51,349 --> 00:37:49,119
lead to

1036
00:37:53,109 --> 00:37:51,359
desires to you know the

1037
00:37:54,550 --> 00:37:53,119
would influence our decisions on how to

1038
00:37:56,150 --> 00:37:54,560

go about getting the longer term

1039
00:37:57,589 --> 00:37:56,160
measurements i wouldn't say though

1040
00:38:01,990 --> 00:37:57,599
specifically any one of these is a

1041
00:38:05,670 --> 00:38:04,470
sure so just some examples of some other

1042
00:38:07,430 --> 00:38:05,680
instruments that are going up of course

1043
00:38:10,230 --> 00:38:07,440
we've been focused on

1044
00:38:12,710 --> 00:38:10,240
nasa earth science funded instruments

1045
00:38:15,270 --> 00:38:12,720
today but there are instruments in

1046
00:38:16,470 --> 00:38:15,280
astrophysics instruments in heliophysics

1047
00:38:18,069 --> 00:38:16,480
there are instruments from our

1048
00:38:20,550 --> 00:38:18,079
international partners and they're

1049
00:38:22,470 --> 00:38:20,560
instruments from commercial users of iss

1050
00:38:24,310 --> 00:38:22,480
as a national laboratory all in the

1051
00:38:26,310 --> 00:38:24,320
suite of things that will go up and fill

1052
00:38:29,109 --> 00:38:26,320
all these external sites a couple

1053
00:38:30,870 --> 00:38:29,119
examples of that noaa recently selected

1054
00:38:32,390 --> 00:38:30,880
thesis the total solar irradiance

1055
00:38:34,310 --> 00:38:32,400
spectrometer

1056
00:38:36,470 --> 00:38:34,320
for iss we haven't got that pinned down

1057
00:38:38,710 --> 00:38:36,480
to location yet but but that's in work

1058
00:38:40,069 --> 00:38:38,720
in the planning stages there are two

1059
00:38:41,190 --> 00:38:40,079
commercially

1060
00:38:43,270 --> 00:38:41,200
partnered

1061
00:38:45,030 --> 00:38:43,280
external platforms that are designed for

1062
00:38:47,829 --> 00:38:45,040
rapidly switching out smaller

1063
00:38:49,270 --> 00:38:47,839

instruments as a test bed concept and

1064
00:38:51,030 --> 00:38:49,280
one is called muses developed by

1065
00:38:54,390 --> 00:38:51,040
teledyne brown engineering and the other

1066
00:38:56,550 --> 00:38:54,400
is called nrap nanoracks experimental

1067
00:38:58,470 --> 00:38:56,560
pla or external platform and those will

1068
00:39:00,470 --> 00:38:58,480
be able to robotically install small

1069
00:39:03,190 --> 00:39:00,480
instruments host them for say one to two

1070
00:39:06,230 --> 00:39:03,200
years and uh and prove out something

1071
00:39:08,470 --> 00:39:06,240
ahead of a larger instrument development

1072
00:39:10,550 --> 00:39:08,480
project they also will be supporting a

1073
00:39:14,230 --> 00:39:10,560
number of commercial users particularly

1074
00:39:17,030 --> 00:39:14,240
in areas of

1075
00:39:19,750 --> 00:39:17,040
oil and in natural resource exploration

1076
00:39:21,109 --> 00:39:19,760
and also in areas of high precision crop

1077
00:39:22,950 --> 00:39:21,119
management so there are specific

1078
00:39:24,950 --> 00:39:22,960
instruments and commercial partnerships

1079
00:39:27,750 --> 00:39:24,960
that will use those platforms as well so

1080
00:39:29,510 --> 00:39:27,760
those are just some examples

1081
00:39:32,390 --> 00:39:29,520
thank you and i believe we have a few

1082
00:39:35,910 --> 00:39:32,400
questions on social media uh felicia

1083
00:39:38,069 --> 00:39:35,920
yes steve um so bob asks how much more

1084
00:39:39,430 --> 00:39:38,079
can we learn studying the earth from the

1085
00:39:42,950 --> 00:39:39,440
outside in

1086
00:39:45,510 --> 00:39:42,960
and the iss is a modern wonder can it

1087
00:39:47,030 --> 00:39:45,520
continue indefinitely

1088
00:39:48,710 --> 00:39:47,040

that sounds like two different questions

1089
00:39:52,150 --> 00:39:48,720
there you take the first i'll take you

1090
00:39:57,750 --> 00:39:54,550
um so just for the for the lifespan of

1091
00:39:59,109 --> 00:39:57,760
iss um you know we we built it and

1092
00:40:01,829 --> 00:39:59,119
certified it from an engineering

1093
00:40:04,950 --> 00:40:01,839
perspective to last for 30 years and

1094
00:40:06,150 --> 00:40:04,960
that 30-year time frame comes up in 2028

1095
00:40:08,150 --> 00:40:06,160
and that doesn't necessarily mean

1096
00:40:09,589 --> 00:40:08,160
congress has funded us to operate until

1097
00:40:11,349 --> 00:40:09,599
2028.

1098
00:40:14,390 --> 00:40:11,359
right now the entire partnership is

1099
00:40:16,470 --> 00:40:14,400
committed to operate until at least 2020

1100
00:40:17,829 --> 00:40:16,480
and our direction in the congressional

1101
00:40:19,750 --> 00:40:17,839
language is not to do anything that

1102
00:40:21,109 --> 00:40:19,760
would keep us from extending

1103
00:40:23,829 --> 00:40:21,119
early this year

1104
00:40:25,510 --> 00:40:23,839
the the president's office announced

1105
00:40:28,390 --> 00:40:25,520
that they would like to extend iss to at

1106
00:40:30,150 --> 00:40:28,400
least 2024 and that's still in work with

1107
00:40:31,750 --> 00:40:30,160
congress but certainly from an

1108
00:40:34,309 --> 00:40:31,760
engineering perspective we could

1109
00:40:35,030 --> 00:40:34,319
definitely go to 2028 and perhaps longer

1110
00:40:37,109 --> 00:40:35,040
so

1111
00:40:39,349 --> 00:40:37,119
when you see all of these instruments go

1112
00:40:41,510 --> 00:40:39,359
up this is a huge opportunity as these

1113
00:40:43,829 --> 00:40:41,520

instruments become important parts of

1114
00:40:45,430 --> 00:40:43,839
our data collection system it's not just

1115
00:40:47,270 --> 00:40:45,440
a one or a two year thing these could

1116
00:40:49,109 --> 00:40:47,280
extend out for and provide service for a

1117
00:40:51,030 --> 00:40:49,119
really long period of time

1118
00:40:58,470 --> 00:40:51,040
and i quite not i confess i don't quite

1119
00:41:02,390 --> 00:41:00,870
observe earth from space

1120
00:41:04,390 --> 00:41:02,400
well it's really only from space that

1121
00:41:07,270 --> 00:41:04,400
you can get the global perspective the

1122
00:41:08,870 --> 00:41:07,280
the earth as a system we know that the

1123
00:41:10,790 --> 00:41:08,880
measuring a particular phenomenon the

1124
00:41:13,109 --> 00:41:10,800
air quality the air weather heat you

1125
00:41:14,710 --> 00:41:13,119
know temperature etc is variable from

1126
00:41:16,309 --> 00:41:14,720
place to place and by looking at it from

1127
00:41:18,309 --> 00:41:16,319
a system and you saw one of the models

1128
00:41:20,950 --> 00:41:18,319
that that matt mcgill showed looking at

1129
00:41:22,309 --> 00:41:20,960
the aerosol models the earth operates as

1130
00:41:23,910 --> 00:41:22,319
an integrated system so you have to

1131
00:41:26,309 --> 00:41:23,920
observe it that way and in multiple

1132
00:41:28,309 --> 00:41:26,319
frequencies multiple phenomena at once

1133
00:41:30,069 --> 00:41:28,319
to understand how the sea surface

1134
00:41:31,910 --> 00:41:30,079
temperature affects the

1135
00:41:34,150 --> 00:41:31,920
the moisture in the air affects the

1136
00:41:35,990 --> 00:41:34,160
cloud formation the aerosols affect the

1137
00:41:38,069 --> 00:41:36,000
winds affect how these are distributed

1138
00:41:39,510 --> 00:41:38,079

so you only see that from space and and

1139
00:41:40,950 --> 00:41:39,520
you really need that integrated view to

1140
00:41:43,910 --> 00:41:40,960
get an idea of how all these different

1141
00:41:47,430 --> 00:41:46,069
thank you and the other question we have

1142
00:41:50,470 --> 00:41:47,440
is from wim

1143
00:41:52,950 --> 00:41:50,480
he asks if cats is capable of detecting

1144
00:41:54,710 --> 00:41:52,960
the cirrus clouds that produce sun dogs

1145
00:41:56,470 --> 00:41:54,720
with sufficient precision to predict

1146
00:42:01,109 --> 00:41:56,480
where they are visible it's a very

1147
00:42:04,150 --> 00:42:02,870
yep that would be a question for you

1148
00:42:06,470 --> 00:42:04,160
matt

1149
00:42:08,790 --> 00:42:06,480
that guy any in any

1150
00:42:11,589 --> 00:42:08,800
yes any lidar instrument like cats is

1151
00:42:13,510 --> 00:42:11,599
perfectly suited to uh observing ice

1152
00:42:15,270 --> 00:42:13,520
clouds ice clouds are the ones that make

1153
00:42:16,870 --> 00:42:15,280
create the sun dogs when the sun shines

1154
00:42:19,430 --> 00:42:16,880
through them

1155
00:42:21,670 --> 00:42:19,440
and those are a primary focus of lidar

1156
00:42:23,430 --> 00:42:21,680
and measurements because the ice clouds

1157
00:42:26,069 --> 00:42:23,440
have a big impact on radiative balance

1158
00:42:28,230 --> 00:42:26,079
of the atmosphere

1159
00:42:29,589 --> 00:42:28,240
the i think what he's the the person is

1160
00:42:31,670 --> 00:42:29,599
asking is can we tell the difference

1161
00:42:33,990 --> 00:42:31,680
between visible and subvisible cirrus

1162
00:42:35,910 --> 00:42:34,000
and the answer is yes we can

1163
00:42:38,790 --> 00:42:35,920

with the lidar data

1164
00:42:40,470 --> 00:42:38,800
and so that is exactly what cats likes

1165
00:42:43,030 --> 00:42:40,480
to do and that's exactly what the lidars

1166
00:42:45,270 --> 00:42:43,040
are good at doing

1167
00:42:47,109 --> 00:42:45,280
okay thank you for that uh matt uh we

1168
00:42:48,950 --> 00:42:47,119
have one more question on the phone

1169
00:42:53,030 --> 00:42:48,960
lines uh frank mooring again from

1170
00:42:56,630 --> 00:42:55,270
thanks steve uh this one is for melanie

1171
00:42:58,150 --> 00:42:56,640
miller done it

1172
00:43:00,710 --> 00:42:58,160
jsc i just wanted to make sure i

1173
00:43:02,390 --> 00:43:00,720
understood is this the first time

1174
00:43:05,190 --> 00:43:02,400
that um

1175
00:43:06,950 --> 00:43:05,200
y'all have used dexter and the big arm

1176
00:43:08,069 --> 00:43:06,960
in in um

1177
00:43:09,990 --> 00:43:08,079
conjunction

1178
00:43:12,630 --> 00:43:10,000
to extract payload and install it

1179
00:43:14,309 --> 00:43:12,640
somewhere or has that been done before

1180
00:43:15,670 --> 00:43:14,319
and also

1181
00:43:17,829 --> 00:43:15,680
if you have any

1182
00:43:22,870 --> 00:43:17,839
examples looking ahead of other times

1183
00:43:22,880 --> 00:43:26,710
melania jsc

1184
00:43:31,430 --> 00:43:29,190
uh yes actually this will be the second

1185
00:43:34,470 --> 00:43:31,440
time we've used dexter in the trunk

1186
00:43:37,430 --> 00:43:34,480
um on spacex3 we pulled out hdev and

1187
00:43:40,150 --> 00:43:37,440
opals and installed them on station

1188
00:43:42,309 --> 00:43:40,160

so spacex4 will be the second time we do

1189
00:43:43,829 --> 00:43:42,319
an extraction from the trunk

1190
00:43:46,309 --> 00:43:43,839
it will be the first time that we've

1191
00:43:48,309 --> 00:43:46,319
assembled a payload using dexter and

1192
00:43:51,190 --> 00:43:48,319
also the first time we've built

1193
00:43:53,349 --> 00:43:51,200
procedures and are prepared to reinstall

1194
00:43:55,990 --> 00:43:53,359
something into the trunk and that's only

1195
00:43:57,430 --> 00:43:56,000
if we exceed the instrument's thermal

1196
00:44:00,550 --> 00:43:57,440
clock we'll go ahead and put it back

1197
00:44:03,829 --> 00:44:00,560
heat it up and try us another time so we

1198
00:44:05,670 --> 00:44:03,839
had to develop that installation

1199
00:44:06,710 --> 00:44:05,680
as far as future missions there's

1200
00:44:09,670 --> 00:44:06,720
several

1201
00:44:11,829 --> 00:44:09,680
other spacex missions um

1202
00:44:14,069 --> 00:44:11,839
that are manifested that ha that we use

1203
00:44:17,030 --> 00:44:14,079
dexter to pull things out

1204
00:44:19,670 --> 00:44:17,040
some of them are for station cargo like

1205
00:44:22,470 --> 00:44:19,680
the docking adapters that we're going to

1206
00:44:25,109 --> 00:44:22,480
bring up in the trunk

1207
00:44:26,790 --> 00:44:25,119
every spacex mission has a cargo some of

1208
00:44:28,870 --> 00:44:26,800
the cargo's being pulled out by the big

1209
00:44:31,109 --> 00:44:28,880
arm and some of the cargo is being

1210
00:44:32,630 --> 00:44:31,119
pulled out by dexter

1211
00:44:34,870 --> 00:44:32,640
but it's pretty full pretty full

1212
00:44:36,790 --> 00:44:34,880
manifest

1213
00:44:38,870 --> 00:44:36,800

okay thank you melanie we have one more

1214
00:44:40,390 --> 00:44:38,880
question on social media

1215
00:44:43,510 --> 00:44:40,400
felicia

1216
00:44:46,150 --> 00:44:43,520
so ryan asks how much data is stored by

1217
00:44:48,550 --> 00:44:46,160
cats and how is it transmitted and kind

1218
00:44:50,790 --> 00:44:48,560
of related to that once the instruments

1219
00:44:52,230 --> 00:44:50,800
are installed how long will it take to

1220
00:44:54,870 --> 00:44:52,240
start collecting data and sending it

1221
00:44:56,230 --> 00:44:54,880
back to earth

1222
00:44:59,829 --> 00:44:56,240
so maybe matt should start with the

1223
00:45:04,230 --> 00:45:01,270
sure

1224
00:45:06,710 --> 00:45:04,240
cats generates on average about 2

1225
00:45:08,870 --> 00:45:06,720
megabits per second of data which is

1226
00:45:12,069 --> 00:45:08,880
well within the continuous downlink

1227
00:45:14,630 --> 00:45:12,079
capability of the space station

1228
00:45:17,910 --> 00:45:14,640
and we are one of the first ones to do

1229
00:45:20,870 --> 00:45:17,920
continuous and big data flow from the

1230
00:45:24,069 --> 00:45:20,880
space station using their comlink so

1231
00:45:25,430 --> 00:45:24,079
it's been a forcing function there

1232
00:45:26,950 --> 00:45:25,440
and the

1233
00:45:29,030 --> 00:45:26,960
i guess julie do you want to answer the

1234
00:45:30,470 --> 00:45:29,040
question about how quickly after we're

1235
00:45:33,109 --> 00:45:30,480
installed

1236
00:45:35,750 --> 00:45:33,119
yeah so um i don't have the numbers in

1237
00:45:37,910 --> 00:45:35,760
front of me for cats in particular but

1238
00:45:40,230 --> 00:45:37,920

each instrument has its own startup and

1239
00:45:41,829 --> 00:45:40,240
checkout phase that um

1240
00:45:44,470 --> 00:45:41,839
that is set by the specifics of the

1241
00:45:46,710 --> 00:45:44,480
instrument um once it's in you know once

1242
00:45:48,470 --> 00:45:46,720
it's installed then it's connected to

1243
00:45:49,990 --> 00:45:48,480
all thermal connections and so forth so

1244
00:45:51,910 --> 00:45:50,000
it's in a safe configuration and then

1245
00:45:53,349 --> 00:45:51,920
they'll take their time to do a series

1246
00:45:54,950 --> 00:45:53,359
of checkouts and things like that make

1247
00:45:56,790 --> 00:45:54,960
sure the instrument's communicating its

1248
00:45:57,990 --> 00:45:56,800
health and status back before they start

1249
00:46:00,150 --> 00:45:58,000
up and then a lot of times people will

1250
00:46:02,069 --> 00:46:00,160
call that first image down first light

1251
00:46:03,430 --> 00:46:02,079
when the first data collection comes and

1252
00:46:05,190 --> 00:46:03,440
that can be

1253
00:46:06,710 --> 00:46:05,200
anywhere from a few weeks to a few

1254
00:46:08,870 --> 00:46:06,720
months after the instrument gets on

1255
00:46:10,230 --> 00:46:08,880
orbit depending on how things go

1256
00:46:12,150 --> 00:46:10,240
one other thing i should mention about

1257
00:46:14,790 --> 00:46:12,160
the iss is

1258
00:46:16,309 --> 00:46:14,800
unlike any other satellite where you

1259
00:46:18,390 --> 00:46:16,319
launch it and it's up there we can

1260
00:46:19,910 --> 00:46:18,400
upgrade our our data system so we've

1261
00:46:21,829 --> 00:46:19,920
already done several data system

1262
00:46:24,390 --> 00:46:21,839
upgrades over the years and that allows

1263
00:46:25,829 --> 00:46:24,400

us to expand our data capability so it

1264
00:46:27,270 --> 00:46:25,839
can support these different multiple

1265
00:46:29,109 --> 00:46:27,280
instruments and so we keep looking and

1266
00:46:30,710 --> 00:46:29,119
talking with our users about what

1267
00:46:32,470 --> 00:46:30,720
they're going to need and get ahead of

1268
00:46:34,550 --> 00:46:32,480
that just like at home you've got to

1269
00:46:35,510 --> 00:46:34,560
upgrade your router at home every now

1270
00:46:36,870 --> 00:46:35,520
and then because you get more and more

1271
00:46:39,030 --> 00:46:36,880
devices we're doing the same thing on

1272
00:46:41,510 --> 00:46:39,040
the space station

1273
00:46:44,790 --> 00:46:41,520
and ernesto at jpl i think wanted to

1274
00:46:48,470 --> 00:46:45,670
yes

1275
00:46:50,950 --> 00:46:48,480
we actually will be getting

1276
00:46:53,109 --> 00:46:50,960
data from the from the instrument uh

1277
00:46:54,309 --> 00:46:53,119
a few days after the mechanical

1278
00:46:55,750 --> 00:46:54,319
installation

1279
00:46:57,990 --> 00:46:55,760
we don't expect that data to be

1280
00:46:59,829 --> 00:46:58,000
immediately useful we'll be tuning it to

1281
00:47:02,470 --> 00:46:59,839
get the better calibration

1282
00:47:03,430 --> 00:47:02,480
uh so that period may take uh one or two

1283
00:47:05,589 --> 00:47:03,440
months

1284
00:47:07,030 --> 00:47:05,599
but uh given the fact that

1285
00:47:08,790 --> 00:47:07,040
the rapid scat instrument is very

1286
00:47:10,790 --> 00:47:08,800
similar to the quickscan instrument

1287
00:47:12,950 --> 00:47:10,800
we're very hopeful to get useful data to

1288
00:47:15,109 --> 00:47:12,960

the science community early on after our

1289
00:47:16,950 --> 00:47:15,119
turn on

1290
00:47:19,109 --> 00:47:16,960
okay thank you ernesto and that's all

1291
00:47:21,030 --> 00:47:19,119
the questions we have for today so we'll

1292
00:47:22,790 --> 00:47:21,040
wrap up the briefing

1293
00:47:25,670 --> 00:47:22,800
as you're probably aware this is a very

1294
00:47:28,230 --> 00:47:25,680
busy year for nasa earth science

1295
00:47:31,109 --> 00:47:28,240
including the rat cats and

1296
00:47:33,190 --> 00:47:31,119
rapidscat launches we have five launches

1297
00:47:34,150 --> 00:47:33,200
scheduled in one 12-month period which

1298
00:47:35,910 --> 00:47:34,160
is

1299
00:47:37,270 --> 00:47:35,920
pretty unusual

1300
00:47:39,510 --> 00:47:37,280
we have a website where you can keep up

1301
00:47:41,270 --> 00:47:39,520
with all this activity as well as the

1302
00:47:44,230 --> 00:47:41,280
new research results and airborne

1303
00:47:48,950 --> 00:47:44,240
campaigns nasa has going this year that

1304
00:47:52,470 --> 00:47:50,630
earthrightnow

1305
00:47:54,309 --> 00:47:52,480
and of course you can follow along with

1306
00:47:56,950 --> 00:47:54,319
all the nasa activities and human

1307
00:47:59,990 --> 00:47:56,960
exploration and scientific discovery on

1308
00:48:03,030 --> 00:48:00,000
social media on all the channels that we

1309
00:48:04,549 --> 00:48:03,040
have out there to keep you updated on

1310
00:48:05,750 --> 00:48:04,559
all this activity

1311
00:48:07,990 --> 00:48:05,760
well thanks everybody for your