
Brian Cairns
Aerosol Polarimetry Sensor Instrument Scientist
NASA Goddard Institute for Space Studies

1
00:00:07,909 --> 00:00:06,230
good afternoon

2
00:00:09,910 --> 00:00:07,919
i'm sarah dewitt from the office of

3
00:00:12,310 --> 00:00:09,920
public affairs at nasa's goddard space

4
00:00:14,230 --> 00:00:12,320
flight center in greenbelt maryland

5
00:00:16,630 --> 00:00:14,240
i'm pleased to introduce the second of

6
00:00:18,550 --> 00:00:16,640
today's three briefings which will focus

7
00:00:19,750 --> 00:00:18,560
on the science of glory

8
00:00:21,029 --> 00:00:19,760
a mission that will improve our

9
00:00:23,109 --> 00:00:21,039
understanding

10
00:00:25,509 --> 00:00:23,119
of aerosols and solar irradiance and

11
00:00:27,189 --> 00:00:25,519
their effect on earth's climate

12
00:00:29,029 --> 00:00:27,199
on the panel with me today are four

13
00:00:32,870 --> 00:00:29,039

principal members of the glory science

14
00:00:34,630 --> 00:00:32,880
team our first speaker will be hal marin

15
00:00:37,430 --> 00:00:34,640
glory program scientist from nasa

16
00:00:39,750 --> 00:00:37,440
headquarters in washington

17
00:00:41,750 --> 00:00:39,760
our second speaker is michael meschenko

18
00:00:45,029 --> 00:00:41,760
glory project scientist from nasa's

19
00:00:46,549 --> 00:00:45,039
goddard institute for space studies

20
00:00:48,869 --> 00:00:46,559
our third speaker

21
00:00:51,029 --> 00:00:48,879
is greg kopp the total irradiance

22
00:00:52,630 --> 00:00:51,039
monitor instrument scientist

23
00:00:54,229 --> 00:00:52,640
from the laboratory for atmospheric and

24
00:00:56,709 --> 00:00:54,239
space physics at the university of

25
00:00:59,750 --> 00:00:56,719
colorado in boulder

26
00:01:02,069 --> 00:00:59,760
and our final speaker is brian cairns

27
00:01:04,310 --> 00:01:02,079
aerosol polarimetry sensor instrument

28
00:01:05,990 --> 00:01:04,320
scientist from nasa's goddard institute

29
00:01:08,469 --> 00:01:06,000
for space studies

30
00:01:10,550 --> 00:01:08,479
we'll go ahead and start with pal mary

31
00:01:12,390 --> 00:01:10,560
thanks sarah

32
00:01:15,190 --> 00:01:12,400
we're really really happy to be here

33
00:01:17,910 --> 00:01:15,200
today it's been a long road with a few

34
00:01:21,350 --> 00:01:17,920
potholes but now we're very much looking

35
00:01:23,350 --> 00:01:21,360
forward to successfully launching glory

36
00:01:25,350 --> 00:01:23,360
now we know the earth's climate is

37
00:01:27,749 --> 00:01:25,360
changing and we know that the majority

38
00:01:29,109 --> 00:01:27,759

of that change is caused by human

39
00:01:31,270 --> 00:01:29,119
activities

40
00:01:33,910 --> 00:01:31,280
the grand challenge that climate

41
00:01:35,590 --> 00:01:33,920
scientists now face is to predict when

42
00:01:38,310 --> 00:01:35,600
and how much

43
00:01:40,950 --> 00:01:38,320
climate will change with enough fidelity

44
00:01:43,830 --> 00:01:40,960
to provide policy makers with reliable

45
00:01:46,710 --> 00:01:43,840
information that they need to formulate

46
00:01:47,670 --> 00:01:46,720
policies that avoid catastrophic climate

47
00:01:50,469 --> 00:01:47,680
change

48
00:01:51,990 --> 00:01:50,479
without unnecessarily damaging people's

49
00:01:54,389 --> 00:01:52,000
lives

50
00:01:56,389 --> 00:01:54,399
climate models are the tools needed to

51
00:01:58,230 --> 00:01:56,399
forecast climate

52
00:01:59,910 --> 00:01:58,240
the value of the measurements to be made

53
00:02:02,550 --> 00:01:59,920
by the glory mission

54
00:02:05,510 --> 00:02:02,560
are the improvements in climb in climate

55
00:02:06,389 --> 00:02:05,520
models that that data will enable

56
00:02:08,710 --> 00:02:06,399
now

57
00:02:10,710 --> 00:02:08,720
the sun provides the power to the engine

58
00:02:12,150 --> 00:02:10,720
that is our climate

59
00:02:15,190 --> 00:02:12,160
glory will make two kinds of

60
00:02:18,390 --> 00:02:15,200
measurements using two sensors focused

61
00:02:20,229 --> 00:02:18,400
on different aspects of the sun's energy

62
00:02:22,470 --> 00:02:20,239
to help us better understand earth's

63
00:02:24,550 --> 00:02:22,480

climate the first sensor the total

64
00:02:26,550 --> 00:02:24,560
irradiance monitor will measure the

65
00:02:29,190 --> 00:02:26,560
total amount of energy coming from the

66
00:02:31,589 --> 00:02:29,200
sun to the earth

67
00:02:33,350 --> 00:02:31,599
the tim will measure watts per square

68
00:02:35,350 --> 00:02:33,360
meter of solar energy coming to the

69
00:02:39,190 --> 00:02:35,360
earth with significantly improved

70
00:02:42,229 --> 00:02:39,200
accuracy precision and stability

71
00:02:44,949 --> 00:02:42,239
the glory tim will continue and improve

72
00:02:47,270 --> 00:02:44,959
our current 32-year record of total

73
00:02:49,350 --> 00:02:47,280
solar irradiance

74
00:02:52,470 --> 00:02:49,360
the second instrument the aerosol

75
00:02:54,390 --> 00:02:52,480
polarimeters polarimetry sensor or aps

76
00:02:56,710 --> 00:02:54,400
will measure properties of sunlight

77
00:02:59,110 --> 00:02:56,720
reflected from tiny particles called

78
00:03:00,869 --> 00:02:59,120
aerosols suspended in the earth's

79
00:03:03,270 --> 00:03:00,879
atmosphere

80
00:03:05,910 --> 00:03:03,280
the properties of this reflected light

81
00:03:09,670 --> 00:03:05,920
are related to the characteristics the

82
00:03:11,910 --> 00:03:09,680
properties of those atmospheric aerosols

83
00:03:15,670 --> 00:03:11,920
both natural processes and human

84
00:03:17,670 --> 00:03:15,680
activities produce these aerosols

85
00:03:19,830 --> 00:03:17,680
and these aerosols affect the earth's

86
00:03:22,790 --> 00:03:19,840
energy budget climate in a number of

87
00:03:24,710 --> 00:03:22,800
ways for example aerosols can scatter

88
00:03:26,789 --> 00:03:24,720

and absorb light

89
00:03:28,229 --> 00:03:26,799
higher concentrations of reflective

90
00:03:30,949 --> 00:03:28,239
aerosols

91
00:03:32,869 --> 00:03:30,959
cause more scattering and can cool the

92
00:03:35,030 --> 00:03:32,879
whole earth system

93
00:03:38,470 --> 00:03:35,040
higher concentrations of aerosols with

94
00:03:39,670 --> 00:03:38,480
color like suit or black carbon

95
00:03:41,990 --> 00:03:39,680
can cause

96
00:03:45,270 --> 00:03:42,000
atmospheric heating and

97
00:03:47,589 --> 00:03:45,280
cooling of the surface below

98
00:03:49,509 --> 00:03:47,599
aerosols also affect the radiative

99
00:03:51,750 --> 00:03:49,519
properties the reflective properties of

100
00:03:53,509 --> 00:03:51,760
clouds

101
00:03:56,149 --> 00:03:53,519
the effect of aerosols on climate is

102
00:03:58,470 --> 00:03:56,159
very complex

103
00:04:02,949 --> 00:03:58,480
and it is the greatest uncertainty in

104
00:04:08,789 --> 00:04:05,910
glory aps is aimed directly at this very

105
00:04:10,710 --> 00:04:08,799
important problem

106
00:04:13,670 --> 00:04:10,720
the earth's climate system is complex

107
00:04:17,430 --> 00:04:13,680
and integrates land ocean atmosphere and

108
00:04:20,030 --> 00:04:17,440
biological processes on a global basis

109
00:04:22,710 --> 00:04:20,040
in order to put glory measurements in a

110
00:04:24,870 --> 00:04:22,720
multi-disciplinary global context glory

111
00:04:28,310 --> 00:04:24,880
will orbit the earth

112
00:04:30,230 --> 00:04:28,320
in the so-called afternoon or a train

113
00:04:32,070 --> 00:04:30,240

with glory the a train will be a

114
00:04:33,670 --> 00:04:32,080
constellation of earth-observing

115
00:04:37,350 --> 00:04:33,680
satellites

116
00:04:40,629 --> 00:04:37,360
orbiting in close formation to provide

117
00:04:44,550 --> 00:04:40,639
coincident comprehensive and coordinated

118
00:04:45,430 --> 00:04:44,560
observations of the earth system

119
00:04:46,710 --> 00:04:45,440
sarah

120
00:04:48,550 --> 00:04:46,720
thanks al

121
00:04:50,390 --> 00:04:48,560
our next speaker is michael meschenko

122
00:04:53,030 --> 00:04:50,400
the glory project scientist from the

123
00:04:54,469 --> 00:04:53,040
nasa goddard institute for space studies

124
00:04:56,390 --> 00:04:54,479
thank you sarah

125
00:04:58,230 --> 00:04:56,400
first of all i would like to to join hal

126
00:04:59,749 --> 00:04:58,240
and say that it's it's really exciting

127
00:05:03,590 --> 00:04:59,759
to be at this

128
00:05:06,230 --> 00:05:03,600
time here when a new scientific phase in

129
00:05:09,430 --> 00:05:06,240
the glory mission is about to begin

130
00:05:12,629 --> 00:05:09,440
my graphic shows the overall scientific

131
00:05:15,430 --> 00:05:12,639
objective of the glory mission

132
00:05:20,230 --> 00:05:17,909
the earth's climate system is fueled by

133
00:05:22,150 --> 00:05:20,240
the incoming solar energy

134
00:05:24,390 --> 00:05:22,160
part of this energy is reflected back

135
00:05:27,350 --> 00:05:24,400
into space and earth

136
00:05:29,590 --> 00:05:27,360
also emits some heat energy

137
00:05:31,749 --> 00:05:29,600
if the incoming solar energy is

138
00:05:33,749 --> 00:05:31,759

perfectly balanced by the outgoing

139
00:05:36,629 --> 00:05:33,759
energy then the climate system is

140
00:05:38,550 --> 00:05:36,639
expected to be stable and not change but

141
00:05:40,310 --> 00:05:38,560
if there is a disbalance for example if

142
00:05:43,350 --> 00:05:40,320
the amount of the incoming energy

143
00:05:45,189 --> 00:05:43,360
exceeds the amount of energy going out

144
00:05:46,870 --> 00:05:45,199
then the earth's climate system is

145
00:05:48,390 --> 00:05:46,880
expected to change

146
00:05:51,830 --> 00:05:48,400
as we have been observing for the past

147
00:05:53,350 --> 00:05:51,840
50 years it is warming

148
00:05:55,990 --> 00:05:53,360
this tells you that it is extremely

149
00:05:58,309 --> 00:05:56,000
important to know how much solar energy

150
00:06:00,550 --> 00:05:58,319
is entering the earth's climate system

151
00:06:02,550 --> 00:06:00,560
and the objective of the total solar

152
00:06:05,430 --> 00:06:02,560
irradiance monitor

153
00:06:07,270 --> 00:06:05,440
on the glory mission is to measure this

154
00:06:09,830 --> 00:06:07,280
incoming solar energy with extremely

155
00:06:13,990 --> 00:06:09,840
high accuracy and stability

156
00:06:16,309 --> 00:06:14,000
and in fact to continue the uh 32-year

157
00:06:18,230 --> 00:06:16,319
uninterrupted record of solar energy

158
00:06:20,629 --> 00:06:18,240
measurements from space

159
00:06:24,469 --> 00:06:20,639
once the solar energy enters the

160
00:06:26,710 --> 00:06:24,479
earth's system it it gets reprocessed in

161
00:06:29,350 --> 00:06:26,720
in several ways it can be reflected back

162
00:06:31,510 --> 00:06:29,360
into space or it can be absorbed in the

163
00:06:33,350 --> 00:06:31,520

atmosphere and at the surface

164
00:06:35,430 --> 00:06:33,360
and a very important role in this

165
00:06:37,830 --> 00:06:35,440
redistribution of the solar energies

166
00:06:39,430 --> 00:06:37,840
played by tiny particles

167
00:06:41,189 --> 00:06:39,440
which are airborne they're called

168
00:06:42,629 --> 00:06:41,199
aerosols

169
00:06:44,550 --> 00:06:42,639
most of them are so small that it would

170
00:06:46,230 --> 00:06:44,560
be invisible to a naked eye and yet

171
00:06:48,309 --> 00:06:46,240
there are so many of them that their

172
00:06:49,990 --> 00:06:48,319
effect on climate is estimated to be

173
00:06:51,589 --> 00:06:50,000
quite significant

174
00:06:54,309 --> 00:06:51,599
the problem with these particles is that

175
00:06:56,870 --> 00:06:54,319
they can be natural as well as man-made

176
00:06:58,710 --> 00:06:56,880
so we need a global understanding of the

177
00:07:00,950 --> 00:06:58,720
distribution of these particles and of

178
00:07:04,070 --> 00:07:00,960
their composition this can be done only

179
00:07:06,950 --> 00:07:04,080
from space my next graphic is an

180
00:07:09,350 --> 00:07:06,960
animation which was created using a

181
00:07:11,029 --> 00:07:09,360
theoretical computer model of aerosol

182
00:07:16,150 --> 00:07:11,039
transport

183
00:07:17,909 --> 00:07:16,160
suit particles so we have these

184
00:07:19,909 --> 00:07:17,919
theoretical tools

185
00:07:22,309 --> 00:07:19,919
how to evaluate the transport of

186
00:07:24,390 --> 00:07:22,319
aerosols and yet we know that these

187
00:07:26,390 --> 00:07:24,400
theoretical tools are still not accurate

188
00:07:27,990 --> 00:07:26,400

enough the accuracy must be improved

189
00:07:29,749 --> 00:07:28,000
quite a bit for us to better understand

190
00:07:30,870 --> 00:07:29,759
the climate and predict the future

191
00:07:32,710 --> 00:07:30,880
climate

192
00:07:34,870 --> 00:07:32,720
again this can be done only from space

193
00:07:37,270 --> 00:07:34,880
but it's not easy because the aerosol

194
00:07:38,629 --> 00:07:37,280
particles come in all shapes sizes and

195
00:07:40,469 --> 00:07:38,639
compositions

196
00:07:41,830 --> 00:07:40,479
and different types of particles can

197
00:07:44,070 --> 00:07:41,840
co-exist

198
00:07:46,390 --> 00:07:44,080
so this really calls for a very special

199
00:07:48,309 --> 00:07:46,400
satellite instrument capable of

200
00:07:51,029 --> 00:07:48,319
addressing the aerosol problem with the

201
00:07:53,589 --> 00:07:51,039
requisite accuracy and specificity

202
00:07:55,749 --> 00:07:53,599
and in fact the glory aps the aerosol

203
00:07:57,270 --> 00:07:55,759
polarimetry sensor is the first

204
00:07:59,749 --> 00:07:57,280
instrument of its kind

205
00:08:02,710 --> 00:07:59,759
it will measure not just the reflected

206
00:08:04,950 --> 00:08:02,720
intensity or brightness of sunlight but

207
00:08:06,230 --> 00:08:04,960
it will also measure its state of

208
00:08:09,830 --> 00:08:06,240
polarization

209
00:08:12,309 --> 00:08:09,840
it will accumulate 250 views of the same

210
00:08:14,790 --> 00:08:12,319
piece of real estate from space and it

211
00:08:17,589 --> 00:08:14,800
will do that in nine special channels so

212
00:08:20,390 --> 00:08:17,599
it will provide a wealth of information

213
00:08:21,670 --> 00:08:20,400

measurement data about each scene it's

214
00:08:23,350 --> 00:08:21,680
going to look at

215
00:08:25,430 --> 00:08:23,360
and we expect that this wealth of

216
00:08:27,589 --> 00:08:25,440
information will allow us to

217
00:08:30,710 --> 00:08:27,599
determine the properties of aerosols and

218
00:08:33,430 --> 00:08:30,720
the underlying surface as well as clouds

219
00:08:36,630 --> 00:08:33,440
with the requisite accuracy

220
00:08:38,870 --> 00:08:36,640
my next graphic shows you that the

221
00:08:40,870 --> 00:08:38,880
glory spacecraft will become part of the

222
00:08:43,430 --> 00:08:40,880
so-called afternoon constellation of

223
00:08:45,030 --> 00:08:43,440
satellites it will be the sixth car in

224
00:08:47,750 --> 00:08:45,040
this a train

225
00:08:49,670 --> 00:08:47,760
and for the team instruments it doesn't

226
00:08:52,310 --> 00:08:49,680
matter how we fly the spacecraft because

227
00:08:53,269 --> 00:08:52,320
all it does is to look at the sun at all

228
00:08:55,990 --> 00:08:53,279
times

229
00:08:58,310 --> 00:08:56,000
but for the glory aps it is quite

230
00:09:00,150 --> 00:08:58,320
advantageous to be part of the a train

231
00:09:02,150 --> 00:09:00,160
because different satellites in this a

232
00:09:03,670 --> 00:09:02,160
train carry numerous instruments looking

233
00:09:05,590 --> 00:09:03,680
at the same scenes

234
00:09:07,269 --> 00:09:05,600
underneath at about the same time and

235
00:09:08,470 --> 00:09:07,279
they provide a detailed view of the

236
00:09:10,550 --> 00:09:08,480
climate system

237
00:09:12,949 --> 00:09:10,560
the addition of the aps

238
00:09:14,949 --> 00:09:12,959

is expected to provide even a more

239
00:09:16,710 --> 00:09:14,959
comprehensive view of the system by

240
00:09:18,550 --> 00:09:16,720
combining measurements from aps and

241
00:09:22,070 --> 00:09:18,560
other instruments

242
00:09:24,470 --> 00:09:22,080
we will be able to say much more than we

243
00:09:26,310 --> 00:09:24,480
would otherwise using these instruments

244
00:09:29,030 --> 00:09:26,320
separately i'll give you just one

245
00:09:30,870 --> 00:09:29,040
example aps will be flying right behind

246
00:09:32,710 --> 00:09:30,880
the calypso lidar

247
00:09:35,590 --> 00:09:32,720
and the lidar is a very capable

248
00:09:36,550 --> 00:09:35,600
instrument using a very powerful

249
00:09:38,630 --> 00:09:36,560
laser

250
00:09:40,790 --> 00:09:38,640
it can determine the vertical profile of

251
00:09:42,630 --> 00:09:40,800
the aerosol uh composition in the

252
00:09:44,389 --> 00:09:42,640
atmosphere with very high accuracy on

253
00:09:46,230 --> 00:09:44,399
the other hand it doesn't have this

254
00:09:49,030 --> 00:09:46,240
exquisite sensitivity to the

255
00:09:51,350 --> 00:09:49,040
microphysical properties of particles as

256
00:09:53,750 --> 00:09:51,360
aps does and by combining the

257
00:09:54,790 --> 00:09:53,760
measurements from eps and from calypso

258
00:09:56,070 --> 00:09:54,800
lidar

259
00:09:57,430 --> 00:09:56,080
we will

260
00:09:58,949 --> 00:09:57,440
determine for the first time the

261
00:10:00,949 --> 00:09:58,959
vertical distribution of the

262
00:10:03,269 --> 00:10:00,959
microphysical properties of aerosols and

263
00:10:05,750 --> 00:10:03,279

this is extremely important to improve

264
00:10:08,389 --> 00:10:05,760
our understanding of the climate system

265
00:10:11,190 --> 00:10:08,399
back to you sarah thank you

266
00:10:13,269 --> 00:10:11,200
our next speaker today is greg kopp he's

267
00:10:15,030 --> 00:10:13,279
the total irradiance monitor instrument

268
00:10:16,870 --> 00:10:15,040
scientist from the university of

269
00:10:19,190 --> 00:10:16,880
colorado at boulder's laboratory for

270
00:10:21,190 --> 00:10:19,200
atmospheric and space physics

271
00:10:23,590 --> 00:10:21,200
thank you sarah

272
00:10:26,069 --> 00:10:23,600
so the total irradiance monitor on glory

273
00:10:28,470 --> 00:10:26,079
is looking at the sun and the reason is

274
00:10:30,470 --> 00:10:28,480
that the sun's providing all the energy

275
00:10:32,389 --> 00:10:30,480
input essentially that's driving the

276
00:10:34,150 --> 00:10:32,399
earth's climate system

277
00:10:35,829 --> 00:10:34,160
we'll look at the sun in a minute if you

278
00:10:37,829 --> 00:10:35,839
could please start rolling the first

279
00:10:38,710 --> 00:10:37,839
animation but let's not go to it just

280
00:10:39,750 --> 00:10:38,720
yet

281
00:10:41,509 --> 00:10:39,760
um

282
00:10:42,630 --> 00:10:41,519
the sun's providing all the energy input

283
00:10:45,430 --> 00:10:42,640
to the earth's climate system it's

284
00:10:46,550 --> 00:10:45,440
providing 10 000 times as much energy as

285
00:10:48,630 --> 00:10:46,560
the next

286
00:10:50,550 --> 00:10:48,640
input energy source four thousand times

287
00:10:52,790 --> 00:10:50,560
the amount of energy of all the other

288
00:10:54,949 --> 00:10:52,800

input sources together

289
00:10:57,430 --> 00:10:54,959
now this animation shows in the blue

290
00:10:59,110 --> 00:10:57,440
line here which incidentally is taken

291
00:11:00,710 --> 00:10:59,120
with the predecessor to the total

292
00:11:02,550 --> 00:11:00,720
irradiance monitor that's going to be

293
00:11:04,870 --> 00:11:02,560
flying in glory this one's flying on

294
00:11:07,509 --> 00:11:04,880
nasa's source spacecraft blue line is

295
00:11:09,269 --> 00:11:07,519
showing variations in tsi or total solar

296
00:11:10,630 --> 00:11:09,279
irradiance the total amount of energy

297
00:11:12,150 --> 00:11:10,640
coming from the sun that's heating the

298
00:11:13,590 --> 00:11:12,160
earth's climate system and you can see

299
00:11:15,990 --> 00:11:13,600
that it varies

300
00:11:18,389 --> 00:11:16,000
here with the passage of a large sunspot

301
00:11:21,110 --> 00:11:18,399
region and the formation of another one

302
00:11:22,790 --> 00:11:21,120
as solar activity changes the total

303
00:11:24,470 --> 00:11:22,800
solar irradiance the amount of energy

304
00:11:25,509 --> 00:11:24,480
we're getting from the sun varies with

305
00:11:27,430 --> 00:11:25,519
time

306
00:11:29,829 --> 00:11:27,440
now these are fluctuations that are on

307
00:11:32,069 --> 00:11:29,839
the order of 0.1 to 0.3 percent and

308
00:11:34,470 --> 00:11:32,079
they're occurring over days to weeks

309
00:11:36,470 --> 00:11:34,480
this entire animation here lasts about

310
00:11:37,990 --> 00:11:36,480
three months

311
00:11:39,990 --> 00:11:38,000
the earth's climate system doesn't

312
00:11:42,550 --> 00:11:40,000
really respond that quickly to these

313
00:11:43,509 --> 00:11:42,560

fluctuations what we're more interested

314
00:11:45,910 --> 00:11:43,519
in

315
00:11:47,829 --> 00:11:45,920
is long term how does the sun vary

316
00:11:49,750 --> 00:11:47,839
knowing that it changes this much on

317
00:11:51,750 --> 00:11:49,760
short time scales we'd like to know over

318
00:11:53,509 --> 00:11:51,760
decades over centuries

319
00:11:55,350 --> 00:11:53,519
how does the sun vary because those are

320
00:11:56,949 --> 00:11:55,360
time scales that can be influencing

321
00:11:58,629 --> 00:11:56,959
climate

322
00:12:01,269 --> 00:11:58,639
that also means that you're going to

323
00:12:03,190 --> 00:12:01,279
need a long-term record of what the sun

324
00:12:04,310 --> 00:12:03,200
is doing it's got to be extremely

325
00:12:06,069 --> 00:12:04,320
accurate

326
00:12:08,310 --> 00:12:06,079
being able to measure climate drives

327
00:12:11,110 --> 00:12:08,320
real stringent requirements on accuracy

328
00:12:14,470 --> 00:12:11,120
and stability of these measurements

329
00:12:16,389 --> 00:12:14,480
now nasa noaa and the european space

330
00:12:17,430 --> 00:12:16,399
agency if we could go to the next

331
00:12:19,990 --> 00:12:17,440
graphic

332
00:12:22,470 --> 00:12:20,000
have acquired a 32-year record that

333
00:12:24,069 --> 00:12:22,480
scientists now have taken by several

334
00:12:25,670 --> 00:12:24,079
different instruments the dozen or so

335
00:12:28,310 --> 00:12:25,680
instruments that contribute to this

336
00:12:30,550 --> 00:12:28,320
total solar irradiance record shown here

337
00:12:32,470 --> 00:12:30,560
are shown in different colors

338
00:12:33,990 --> 00:12:32,480

you'll immediately see that each of the

339
00:12:35,910 --> 00:12:34,000
instruments is following the same

340
00:12:37,509 --> 00:12:35,920
behavior in the sun kind of a gradual

341
00:12:38,870 --> 00:12:37,519
11-year cycle where the sun will get a

342
00:12:40,389 --> 00:12:38,880
little brighter and a little dimmer it

343
00:12:41,910 --> 00:12:40,399
also has these very short-term

344
00:12:43,750 --> 00:12:41,920
fluctuations

345
00:12:45,110 --> 00:12:43,760
that i showed you each of these

346
00:12:46,870 --> 00:12:45,120
instruments measures those same

347
00:12:48,550 --> 00:12:46,880
variations very well but you'll see that

348
00:12:49,509 --> 00:12:48,560
there are offsets between each of these

349
00:12:51,670 --> 00:12:49,519
instruments and those are due to

350
00:12:53,509 --> 00:12:51,680
calibration differences something that

351
00:12:55,590 --> 00:12:53,519
we're aiming to be improving with glory

352
00:12:57,350 --> 00:12:55,600
by having an improved accurate

353
00:12:59,910 --> 00:12:57,360
instrument

354
00:13:01,590 --> 00:12:59,920
but it's been because of overlap of each

355
00:13:04,069 --> 00:13:01,600
of these instruments in each of these

356
00:13:06,389 --> 00:13:04,079
measurements where following instruments

357
00:13:08,389 --> 00:13:06,399
will overlap with their predecessors

358
00:13:11,110 --> 00:13:08,399
that you can offset each of the

359
00:13:13,509 --> 00:13:11,120
measurements shown in this plot as we'll

360
00:13:16,389 --> 00:13:13,519
see in the next graphic

361
00:13:18,629 --> 00:13:16,399
to form one continuous record of what

362
00:13:20,949 --> 00:13:18,639
the sun is doing over time

363
00:13:22,470 --> 00:13:20,959

and it's from this continuous record how

364
00:13:24,389 --> 00:13:22,480
the sun is varying and how that

365
00:13:26,790 --> 00:13:24,399
correlates to temperature changes on the

366
00:13:29,670 --> 00:13:26,800
earth that we can infer the climate

367
00:13:31,509 --> 00:13:29,680
sensitivity of the earth to solar

368
00:13:34,150 --> 00:13:31,519
influences

369
00:13:36,150 --> 00:13:34,160
so glory is now going to be continuing

370
00:13:38,550 --> 00:13:36,160
this record it's very important that we

371
00:13:40,230 --> 00:13:38,560
have this overlap with preceding

372
00:13:42,629 --> 00:13:40,240
instruments and preceding measurements

373
00:13:45,030 --> 00:13:42,639
glory is going to be continuing this

374
00:13:46,870 --> 00:13:45,040
record into the near future for us

375
00:13:50,629 --> 00:13:46,880
following on to the total irradiance

376
00:13:53,509 --> 00:13:50,639
monitor currently operating on source

377
00:13:54,629 --> 00:13:53,519
so we'll be extending this record with

378
00:13:56,790 --> 00:13:54,639
time

379
00:13:58,790 --> 00:13:56,800
we'll be improving the accuracy of this

380
00:14:01,269 --> 00:13:58,800
record and that will that will take care

381
00:14:03,829 --> 00:14:01,279
of some of the offsets that i showed you

382
00:14:05,670 --> 00:14:03,839
in one of the previous plots improve the

383
00:14:07,269 --> 00:14:05,680
record by not having those offsets that

384
00:14:09,189 --> 00:14:07,279
that mitigates a little bit against a

385
00:14:10,870 --> 00:14:09,199
potential future data gap if we were to

386
00:14:12,389 --> 00:14:10,880
have a gap in data and come back with a

387
00:14:13,910 --> 00:14:12,399
following instrument

388
00:14:15,350 --> 00:14:13,920

and it reads a little bit higher or a

389
00:14:17,110 --> 00:14:15,360
little bit lower than what we'd seen

390
00:14:19,269 --> 00:14:17,120
before is that due to the sun changing

391
00:14:21,350 --> 00:14:19,279
or due to an instrument change by having

392
00:14:23,030 --> 00:14:21,360
improved accuracy glory is going to be

393
00:14:25,030 --> 00:14:23,040
improving on that record making it a

394
00:14:27,269 --> 00:14:25,040
little more robust against

395
00:14:29,509 --> 00:14:27,279
against gaps in the data

396
00:14:31,750 --> 00:14:29,519
so there are basically four things wise

397
00:14:33,990 --> 00:14:31,760
that we're looking to get from glory

398
00:14:35,910 --> 00:14:34,000
we're looking to know what the true

399
00:14:37,590 --> 00:14:35,920
total solar radiance value is on an

400
00:14:39,269 --> 00:14:37,600
absolute scale

401
00:14:40,949 --> 00:14:39,279
by extending the record we're going to

402
00:14:43,269 --> 00:14:40,959
be able to better tell what solar

403
00:14:44,949 --> 00:14:43,279
features are causing variations in the

404
00:14:46,870 --> 00:14:44,959
sun's output

405
00:14:48,230 --> 00:14:46,880
we want to know again by lengthening

406
00:14:51,030 --> 00:14:48,240
this record

407
00:14:52,389 --> 00:14:51,040
how the sun changes over decades over

408
00:14:55,030 --> 00:14:52,399
centuries

409
00:14:57,750 --> 00:14:55,040
and this extended record will then tell

410
00:14:59,829 --> 00:14:57,760
us with better certainty how the sun is

411
00:15:01,189 --> 00:14:59,839
contributing to climate change on the

412
00:15:04,310 --> 00:15:01,199
earth and how sensitive the earth's

413
00:15:05,910 --> 00:15:04,320

climate system is to solar inputs

414
00:15:07,590 --> 00:15:05,920
thank you and back to you sarah all

415
00:15:09,350 --> 00:15:07,600
right thanks greg

416
00:15:11,189 --> 00:15:09,360
our final speaker on the panel today is

417
00:15:13,509 --> 00:15:11,199
brian cairns he's the aerosol

418
00:15:15,590 --> 00:15:13,519
polarimetry sensor instrument scientist

419
00:15:17,110 --> 00:15:15,600
from nasa's goddard institute for space

420
00:15:19,910 --> 00:15:17,120
studies

421
00:15:22,710 --> 00:15:19,920
uh good afternoon um thank you sarah

422
00:15:25,030 --> 00:15:22,720
for some people it's been a long road

423
00:15:27,189 --> 00:15:25,040
to get this glory mission but for me

424
00:15:30,389 --> 00:15:27,199
this started before dawn in april of

425
00:15:31,829 --> 00:15:30,399
1998 on a mountain above santa barbara

426
00:15:33,829 --> 00:15:31,839
where we made the first measurements

427
00:15:35,990 --> 00:15:33,839
with an airborne prototype of the

428
00:15:37,670 --> 00:15:36,000
aerosol polarimetry sensor

429
00:15:39,430 --> 00:15:37,680
it was those measurements that convinced

430
00:15:40,790 --> 00:15:39,440
us that we could make measurements in

431
00:15:42,150 --> 00:15:40,800
the real world that were just as

432
00:15:43,509 --> 00:15:42,160
accurate as the ones we made in the

433
00:15:45,110 --> 00:15:43,519
laboratory

434
00:15:47,990 --> 00:15:45,120
so i've not actually come very far but

435
00:15:49,189 --> 00:15:48,000
it's taken a while to get here

436
00:15:53,110 --> 00:15:49,199
so

437
00:15:55,030 --> 00:15:53,120
before dawn is that i was setting up a

438
00:15:56,629 --> 00:15:55,040

sun photometer to make measurements of

439
00:15:57,829 --> 00:15:56,639
these little airborne particles called

440
00:15:59,829 --> 00:15:57,839
aerosols

441
00:16:01,749 --> 00:15:59,839
sun photometers look at how much the sun

442
00:16:03,110 --> 00:16:01,759
is dimmed by the little particles and

443
00:16:04,790 --> 00:16:03,120
are a really good way of making that

444
00:16:06,310 --> 00:16:04,800
kind of measurement

445
00:16:09,350 --> 00:16:06,320
the reason that we can't use sun

446
00:16:10,710 --> 00:16:09,360
photometers to do the job that the aps

447
00:16:12,629 --> 00:16:10,720
is going to do is that you'd have to

448
00:16:14,389 --> 00:16:12,639
have half a million of them uniformly

449
00:16:15,829 --> 00:16:14,399
distributed around the world and it's

450
00:16:18,310 --> 00:16:15,839
kind of awkward to stick them in the

451
00:16:20,870 --> 00:16:18,320
middle of the southern oceans

452
00:16:23,189 --> 00:16:20,880
um can i have my first graphic please

453
00:16:25,670 --> 00:16:23,199
so what the aerosol polarimetry sensor

454
00:16:27,910 --> 00:16:25,680
will do in the afternoon constellation

455
00:16:30,470 --> 00:16:27,920
is we'll have six hundred thousand

456
00:16:32,310 --> 00:16:30,480
observations spread around the globe

457
00:16:34,949 --> 00:16:32,320
and at each one of those points we take

458
00:16:36,790 --> 00:16:34,959
ten thousand measurements

459
00:16:38,710 --> 00:16:36,800
and the reason that we take 10 000

460
00:16:40,790 --> 00:16:38,720
measurements is because aerosols and

461
00:16:42,389 --> 00:16:40,800
clouds are kind of a mess if you look at

462
00:16:44,550 --> 00:16:42,399
the the graphic

463
00:16:47,110 --> 00:16:44,560

this is a picture of the pico de arizaba

464
00:16:48,949 --> 00:16:47,120
which is the highest mountain in mexico

465
00:16:51,350 --> 00:16:48,959
and on the left you can see pollution

466
00:16:53,590 --> 00:16:51,360
flowing out from mexico city and on the

467
00:16:55,110 --> 00:16:53,600
right there are cumulus clouds in the

468
00:16:57,990 --> 00:16:55,120
coastal range

469
00:16:59,430 --> 00:16:58,000
and so as greg said the sun is the thing

470
00:17:01,430 --> 00:16:59,440
that's heating the earth it's the

471
00:17:02,550 --> 00:17:01,440
dominant source of energy coming into

472
00:17:04,949 --> 00:17:02,560
the system

473
00:17:06,949 --> 00:17:04,959
and what aps tells you is what what

474
00:17:09,189 --> 00:17:06,959
energy is coming back out

475
00:17:11,669 --> 00:17:09,199
but more than that it tells you what is

476
00:17:13,510 --> 00:17:11,679
coming out and what caused it to come

477
00:17:15,189 --> 00:17:13,520
out because you really want to know

478
00:17:17,110 --> 00:17:15,199
whether you have these little particles

479
00:17:18,789 --> 00:17:17,120
that are going to absorb light

480
00:17:20,309 --> 00:17:18,799
sending it back to space

481
00:17:23,029 --> 00:17:20,319
because they'll send it back to space

482
00:17:24,549 --> 00:17:23,039
but also absorb in the in the atmosphere

483
00:17:26,789 --> 00:17:24,559
or if it's something like a cloud which

484
00:17:28,549 --> 00:17:26,799
doesn't absorb very much so you reflect

485
00:17:31,190 --> 00:17:28,559
it out there's not much absorbed in the

486
00:17:33,590 --> 00:17:31,200
cloud and it gets to the surface and and

487
00:17:35,590 --> 00:17:33,600
heats the surface

488
00:17:36,470 --> 00:17:35,600

and the way in which we diagnose whether

489
00:17:38,470 --> 00:17:36,480
we have

490
00:17:41,190 --> 00:17:38,480
small aerosol particles big aerosol

491
00:17:44,230 --> 00:17:41,200
particles non-spherical particles ice

492
00:17:46,950 --> 00:17:44,240
particles or cloud droplets is primarily

493
00:17:48,789 --> 00:17:46,960
using the polarization um could you show

494
00:17:51,909 --> 00:17:48,799
the next graphic please

495
00:17:53,669 --> 00:17:51,919
this is um sort of the most obvious and

496
00:17:55,590 --> 00:17:53,679
and

497
00:17:58,310 --> 00:17:55,600
visually enticing

498
00:17:59,669 --> 00:17:58,320
example of polarization on the left is a

499
00:18:02,070 --> 00:17:59,679
picture taken

500
00:18:03,430 --> 00:18:02,080
it shows a rainbow and a polarizer was

501
00:18:06,150 --> 00:18:03,440
used so you can actually see that

502
00:18:07,990 --> 00:18:06,160
rainbow on the right there's no rainbow

503
00:18:08,789 --> 00:18:08,000
because there was no polarizer used and

504
00:18:11,190 --> 00:18:08,799
the

505
00:18:12,470 --> 00:18:11,200
reflected light is so bright you simply

506
00:18:14,310 --> 00:18:12,480
can't see the rainbow without a

507
00:18:15,669 --> 00:18:14,320
polarizer

508
00:18:17,830 --> 00:18:15,679
why do we want to measure things like

509
00:18:20,710 --> 00:18:17,840
rainbows it's because the angular

510
00:18:23,029 --> 00:18:20,720
distribution and color of that light

511
00:18:25,190 --> 00:18:23,039
tells you exactly how big those cloud

512
00:18:27,029 --> 00:18:25,200
droplets are and it tells you what the

513
00:18:27,750 --> 00:18:27,039

width of the droplet size distribution

514
00:18:31,190 --> 00:18:27,760
is

515
00:18:33,430 --> 00:18:31,200
use when we're trying to diagnose

516
00:18:35,430 --> 00:18:33,440
whether aerosols have changed

517
00:18:39,350 --> 00:18:35,440
how those clouds are formed

518
00:18:42,630 --> 00:18:40,470
so

519
00:18:44,390 --> 00:18:42,640
we're interested in trying to understand

520
00:18:47,110 --> 00:18:44,400
whether it's natural

521
00:18:49,909 --> 00:18:47,120
aerosols or and or aerosols that we make

522
00:18:50,870 --> 00:18:49,919
that are dominating the uh the climate

523
00:18:52,390 --> 00:18:50,880
signal

524
00:18:54,549 --> 00:18:52,400
and obviously when you take a picture of

525
00:18:56,789 --> 00:18:54,559
los angeles it's really easy to know

526
00:18:58,310 --> 00:18:56,799
where the aerosols came from

527
00:19:00,710 --> 00:18:58,320
we know that most the ones over los

528
00:19:01,990 --> 00:19:00,720
angeles they're they're ones we made

529
00:19:04,150 --> 00:19:02,000
the reason that we have something like

530
00:19:06,470 --> 00:19:04,160
the aerosol polarimetry sensor making

531
00:19:07,990 --> 00:19:06,480
ten thousand measurements of these

532
00:19:10,390 --> 00:19:08,000
six hundred thousand points around the

533
00:19:12,390 --> 00:19:10,400
globe is to diagnose the composition of

534
00:19:14,150 --> 00:19:12,400
the aerosols in those locations so that

535
00:19:16,710 --> 00:19:14,160
we can distinguish between the

536
00:19:18,549 --> 00:19:16,720
contributions from natural

537
00:19:20,390 --> 00:19:18,559
sources of aerosols and anthropogenic

538
00:19:22,549 --> 00:19:20,400

aerosols

539
00:19:23,669 --> 00:19:22,559
and can you show my last graphic

540
00:19:27,270 --> 00:19:23,679
and

541
00:19:30,070 --> 00:19:27,280
is just a

542
00:19:32,630 --> 00:19:30,080
cartoon showing that

543
00:19:35,270 --> 00:19:32,640
every every cloud droplet every ice

544
00:19:36,870 --> 00:19:35,280
particle in a serous cloud forms on an

545
00:19:38,789 --> 00:19:36,880
aerosol particle

546
00:19:40,950 --> 00:19:38,799
that's the energetically

547
00:19:43,350 --> 00:19:40,960
easiest way for them to form

548
00:19:45,350 --> 00:19:43,360
so if you put a lot of little particles

549
00:19:46,710 --> 00:19:45,360
um in the atmosphere and then you lift a

550
00:19:47,990 --> 00:19:46,720
parcel of air

551
00:19:50,310 --> 00:19:48,000
then what's going to happen is you'll

552
00:19:51,669 --> 00:19:50,320
form more little droplets

553
00:19:53,029 --> 00:19:51,679
and what that can do is it can make your

554
00:19:54,549 --> 00:19:53,039
cloud brighter

555
00:19:56,390 --> 00:19:54,559
it can also mean that the cloud will

556
00:19:58,549 --> 00:19:56,400
last longer because it's less likely to

557
00:20:00,789 --> 00:19:58,559
grow large enough to rain out

558
00:20:02,710 --> 00:20:00,799
and so again this is why we need the

559
00:20:04,310 --> 00:20:02,720
aerosol polarimetry sensor to do these

560
00:20:07,270 --> 00:20:04,320
very accurate measurements of the

561
00:20:10,310 --> 00:20:07,280
droplet sizes of droplets in clouds and

562
00:20:12,470 --> 00:20:10,320
also understand how many aerosols were

563
00:20:14,710 --> 00:20:12,480

present um and

564
00:20:15,990 --> 00:20:14,720
when the cloud was formed

565
00:20:17,590 --> 00:20:16,000
um so

566
00:20:19,590 --> 00:20:17,600
to summarize the aerosol polar imagery

567
00:20:21,190 --> 00:20:19,600
sensor were like

568
00:20:22,070 --> 00:20:21,200
sun photometers spread all over the

569
00:20:24,149 --> 00:20:22,080
world

570
00:20:26,789 --> 00:20:24,159
making ten thousand measurements at each

571
00:20:27,750 --> 00:20:26,799
point around around the globe

572
00:20:30,470 --> 00:20:27,760
and

573
00:20:32,470 --> 00:20:30,480
we're really trying to nail down exactly

574
00:20:34,470 --> 00:20:32,480
what the contribution of aerosols and

575
00:20:36,230 --> 00:20:34,480
clouds is to the

576
00:20:38,070 --> 00:20:36,240
amount of radiation that's reflected out

577
00:20:39,270 --> 00:20:38,080
of the atmosphere and how much gets the

578
00:20:40,630 --> 00:20:39,280
surface

579
00:20:42,549 --> 00:20:40,640
back to you

580
00:20:44,549 --> 00:20:42,559
all right thank you brian and thanks to

581
00:20:46,230 --> 00:20:44,559
each of our speakers today on this glory

582
00:20:47,830 --> 00:20:46,240
mission science briefing

583
00:20:49,909 --> 00:20:47,840
at this point i'm going to go ahead and

584
00:20:52,149 --> 00:20:49,919
take some questions we'll start here

585
00:20:53,830 --> 00:20:52,159
with uh news media in the room and then

586
00:20:56,070 --> 00:20:53,840
we'll go to the phones for questions

587
00:20:57,270 --> 00:20:56,080
from kennedy if you could state your

588
00:20:59,430 --> 00:20:57,280

name and affiliation when you get the

589
00:21:01,510 --> 00:20:59,440
microphone janine scully santa maria

590
00:21:03,430 --> 00:21:01,520
times the long poke record

591
00:21:05,270 --> 00:21:03,440
it's kind of been touched on but we're

592
00:21:06,630 --> 00:21:05,280
writing for joe citizen can someone

593
00:21:08,950 --> 00:21:06,640
explain

594
00:21:10,789 --> 00:21:08,960
why joe citizen should care about this

595
00:21:12,310 --> 00:21:10,799
mission and what it's going to really

596
00:21:14,950 --> 00:21:12,320
bring to

597
00:21:19,669 --> 00:21:14,960
a teacher and the local schools or

598
00:21:24,230 --> 00:21:22,390
well ultimately it is about our climate

599
00:21:28,149 --> 00:21:24,240
whether it changes or not

600
00:21:31,190 --> 00:21:28,159
need to know the components of the

601
00:21:33,029 --> 00:21:31,200
energy that go in and go out with an

602
00:21:35,669 --> 00:21:33,039
extremely high accuracy which at this

603
00:21:38,149 --> 00:21:35,679
point we simply don't have that accuracy

604
00:21:40,230 --> 00:21:38,159
except for the incoming solar light we

605
00:21:42,310 --> 00:21:40,240
know that energy accurately and we'll

606
00:21:45,750 --> 00:21:42,320
know that even more accurately as soon

607
00:21:48,070 --> 00:21:45,760
as glory is launched but the ways energy

608
00:21:49,909 --> 00:21:48,080
is reprocessed in the atmosphere are so

609
00:21:52,470 --> 00:21:49,919
complex and there's so many different

610
00:21:54,070 --> 00:21:52,480
mechanisms that affect it

611
00:21:57,110 --> 00:21:54,080
we need to address each of these

612
00:21:59,830 --> 00:21:57,120
mechanisms separately and aps

613
00:22:02,310 --> 00:21:59,840

will do that with respect to aerosols

614
00:22:04,390 --> 00:22:02,320
so ultimately it is about our lifestyle

615
00:22:06,390 --> 00:22:04,400
and the conditions in which we live and

616
00:22:08,390 --> 00:22:06,400
whether climate is changing

617
00:22:10,630 --> 00:22:08,400
and how accurately we can predict

618
00:22:13,350 --> 00:22:10,640
climate changes and to do that we need

619
00:22:16,149 --> 00:22:13,360
to know this energy budget equation with

620
00:22:21,909 --> 00:22:16,159
a very high accuracy and without aps

621
00:22:26,789 --> 00:22:22,950
if

622
00:22:32,870 --> 00:22:30,230
as brian mentioned that aerosols do

623
00:22:34,390 --> 00:22:32,880
impact clouds and one of the examples he

624
00:22:36,950 --> 00:22:34,400
used was that

625
00:22:40,390 --> 00:22:36,960
increased numbers of aerosols will

626
00:22:42,789 --> 00:22:40,400
create clouds with um

627
00:22:45,110 --> 00:22:42,799
larger numbers of droplets that are

628
00:22:47,590 --> 00:22:45,120
smaller and less likely to precipitate

629
00:22:50,230 --> 00:22:47,600
and so as climate changes due to

630
00:22:52,630 --> 00:22:50,240
increased concentrations of aerosols you

631
00:22:54,630 --> 00:22:52,640
could see redistribution of rainfall or

632
00:22:59,190 --> 00:22:54,640
even reductions in rainfall and climate

633
00:23:02,549 --> 00:23:01,029
something that farmers

634
00:23:05,750 --> 00:23:02,559
for example would be very very

635
00:23:08,470 --> 00:23:05,760
interested in in knowing about

636
00:23:11,350 --> 00:23:08,480
i guess the last comment i would have is

637
00:23:15,029 --> 00:23:13,750
right now we don't really know um

638
00:23:17,830 --> 00:23:15,039

what the

639
00:23:20,070 --> 00:23:17,840
effect of aerosols is on climate very

640
00:23:21,990 --> 00:23:20,080
well it could be fifty percent larger or

641
00:23:24,070 --> 00:23:22,000
fifty percent smaller than the current

642
00:23:26,470 --> 00:23:24,080
best guess

643
00:23:29,510 --> 00:23:26,480
and what the aerosols do is they

644
00:23:31,270 --> 00:23:29,520
mask the greenhouse gas warming

645
00:23:34,149 --> 00:23:31,280
so depending on what you assume about

646
00:23:34,950 --> 00:23:34,159
aerosols you can either have

647
00:24:15,110 --> 00:23:34,960
a

648
00:24:17,029 --> 00:24:15,120
know

649
00:24:18,310 --> 00:24:17,039
what that sensitivity is and the

650
00:24:19,590 --> 00:24:18,320
measurements that we're going to make

651
00:24:22,870 --> 00:24:19,600
will help to

652
00:24:24,710 --> 00:24:22,880
constrain and reduce that uncertainty

653
00:24:26,710 --> 00:24:24,720
and janine this also ties back to

654
00:24:29,269 --> 00:24:26,720
something that hell said early on we

655
00:24:30,870 --> 00:24:29,279
touched on see one thing glory does is

656
00:24:33,669 --> 00:24:30,880
it really spans kind of the

657
00:24:35,909 --> 00:24:33,679
anthropogenic or the human-caused

658
00:24:37,750 --> 00:24:35,919
reasons for climate change but it also

659
00:24:39,669 --> 00:24:37,760
addresses some of the natural effects

660
00:24:41,669 --> 00:24:39,679
the things that we have no control over

661
00:24:44,549 --> 00:24:41,679
such as the sun

662
00:24:48,230 --> 00:24:44,559
and as we try to set policy

663
00:24:49,190 --> 00:24:48,240

in the future joe citizen pays joe taxes

664
00:24:51,669 --> 00:24:49,200
and

665
00:24:53,510 --> 00:24:51,679
as we try to decide what policies are

666
00:24:55,590 --> 00:24:53,520
going to be needed to mitigate or

667
00:24:57,190 --> 00:24:55,600
control climate change we need to be

668
00:24:59,190 --> 00:24:57,200
able to distinguish how much of it we

669
00:25:02,149 --> 00:24:59,200
have control over versus how much we

670
00:25:04,230 --> 00:25:03,190
all right i think we have another

671
00:25:05,830 --> 00:25:04,240
question here in the room i'm going to

672
00:25:07,909 --> 00:25:05,840
try my question again norah wallace

673
00:25:10,070 --> 00:25:07,919
santa barbara news press so in terms of

674
00:25:12,549 --> 00:25:10,080
understanding global climate change can

675
00:25:15,909 --> 00:25:12,559
can anyone rank glory's importance in

676
00:25:19,110 --> 00:25:17,510
well maybe it's it's it's this question

677
00:25:20,870 --> 00:25:19,120
is a little unfair

678
00:25:23,830 --> 00:25:20,880
to all of these instruments we might be

679
00:25:25,830 --> 00:25:23,840
a little biased that's right

680
00:25:28,230 --> 00:25:25,840
just a bit

681
00:25:30,710 --> 00:25:28,240
but for example if you look at the

682
00:25:33,029 --> 00:25:30,720
forces of climate physical and chemical

683
00:25:34,310 --> 00:25:33,039
mechanisms that change climates we can

684
00:25:35,750 --> 00:25:34,320
estimate them

685
00:25:37,750 --> 00:25:35,760
and we did

686
00:25:40,149 --> 00:25:37,760
and it turns out that the estimate of

687
00:25:41,830 --> 00:25:40,159
the aerosol forcing of climate

688
00:25:44,070 --> 00:25:41,840

is large it's comparable to the force

689
00:25:46,390 --> 00:25:44,080
and due to the greenhouse gases but if

690
00:25:48,470 --> 00:25:46,400
you look at the uncertainty in this

691
00:25:50,630 --> 00:25:48,480
estimate this uncertainty is as big as

692
00:25:53,350 --> 00:25:50,640
the estimate which tells us that we

693
00:25:55,909 --> 00:25:53,360
don't know much about aerosols at all

694
00:25:58,310 --> 00:25:55,919
and then if we look at the anthropogenic

695
00:26:00,149 --> 00:25:58,320
or man-made forcing of climate

696
00:26:01,750 --> 00:26:00,159
it also has an uncertainty comparable to

697
00:26:03,830 --> 00:26:01,760
the estimate

698
00:26:05,830 --> 00:26:03,840
and almost all of this uncertainty comes

699
00:26:07,750 --> 00:26:05,840
from aerosols from the poor knowledge of

700
00:26:09,510 --> 00:26:07,760
aerosols so to

701
00:26:11,909 --> 00:26:09,520
it's difficult to overestimate the

702
00:26:13,750 --> 00:26:11,919
importance of the glory mission but it's

703
00:26:15,350 --> 00:26:13,760
not to say that we can underestimate the

704
00:26:19,350 --> 00:26:15,360
importance of the other components of

705
00:26:20,230 --> 00:26:19,360
the a train or other satellites

706
00:26:22,789 --> 00:26:20,240
and

707
00:26:25,590 --> 00:26:22,799
just to amplify the

708
00:26:28,149 --> 00:26:25,600
the value of glory goes up substantially

709
00:26:29,510 --> 00:26:28,159
because it's in the a train and as

710
00:26:31,750 --> 00:26:29,520
michael indicated earlier the

711
00:26:34,470 --> 00:26:31,760
combination of calypso

712
00:26:36,710 --> 00:26:34,480
and glory is much more powerful than

713
00:26:37,590 --> 00:26:36,720

either of those two alone and add to

714
00:26:40,149 --> 00:26:37,600
that

715
00:26:42,630 --> 00:26:40,159
cloud sat and and the aqua satellite

716
00:26:45,350 --> 00:26:42,640
with modis on it these are all

717
00:26:47,510 --> 00:26:45,360
really important and valuable um data

718
00:26:49,350 --> 00:26:47,520
sets that when combined give us much

719
00:26:53,590 --> 00:26:49,360
more capability than any one of those

720
00:26:59,269 --> 00:26:55,190
all right i believe we have a question

721
00:27:03,430 --> 00:27:02,310
yeah this is denise ciao from space.com

722
00:27:05,430 --> 00:27:03,440
um

723
00:27:07,590 --> 00:27:05,440
my question is it's a two-part question

724
00:27:09,510 --> 00:27:07,600
actually um how important is it that

725
00:27:11,430 --> 00:27:09,520
glory will be launched at a time when

726
00:27:14,390 --> 00:27:11,440
the sun's activity is ramping up toward

727
00:27:16,470 --> 00:27:14,400
the solar maximum and then second

728
00:27:18,230 --> 00:27:16,480
with the 32-year record that we already

729
00:27:19,350 --> 00:27:18,240
have

730
00:27:21,350 --> 00:27:19,360
what is already known about the

731
00:27:22,789 --> 00:27:21,360
correlation between solar activity and

732
00:27:25,269 --> 00:27:22,799
the concentration of aerosols in the

733
00:27:26,070 --> 00:27:25,279
atmosphere

734
00:27:28,230 --> 00:27:26,080
okay

735
00:27:29,269 --> 00:27:28,240
the first question is how important is

736
00:27:31,909 --> 00:27:29,279
it that we're

737
00:27:35,669 --> 00:27:31,919
we're starting to monitor with glory the

738
00:27:37,269 --> 00:27:35,679

sun as it's ramping up that's not

739
00:27:38,870 --> 00:27:37,279
critically important what is more

740
00:27:41,590 --> 00:27:38,880
critical is that we get very good

741
00:27:43,909 --> 00:27:41,600
overlap with the total irradiance

742
00:27:45,750 --> 00:27:43,919
monitor that's flying on source so

743
00:27:47,750 --> 00:27:45,760
there's a good 32-year record that i've

744
00:27:51,590 --> 00:27:47,760
shown now but it does rely on continuity

745
00:27:52,789 --> 00:27:51,600
and overlap of each of these instruments

746
00:27:55,190 --> 00:27:52,799
the glory

747
00:27:57,350 --> 00:27:55,200
total radiance monitor has a better

748
00:27:59,350 --> 00:27:57,360
absolute calibration on it than anything

749
00:28:01,430 --> 00:27:59,360
that's been launched before

750
00:28:03,750 --> 00:28:01,440
and by getting that instrument

751
00:28:05,909 --> 00:28:03,760
on orbit and able to overlap with the

752
00:28:08,789 --> 00:28:05,919
predecessors will be able to link some

753
00:28:09,990 --> 00:28:08,799
of that historical 32-year record tie it

754
00:28:12,950 --> 00:28:10,000
down better

755
00:28:15,510 --> 00:28:12,960
to with better absolute accuracy via the

756
00:28:16,549 --> 00:28:15,520
glory total irradiance monitor

757
00:28:23,269 --> 00:28:16,559
so

758
00:28:25,110 --> 00:28:23,279
isn't very important but getting that

759
00:28:26,710 --> 00:28:25,120
overlap with the existing record and

760
00:28:30,630 --> 00:28:26,720
particularly with the total irradiance

761
00:28:32,630 --> 00:28:30,640
monitor and source is very important

762
00:28:34,630 --> 00:28:32,640
in terms of

763
00:28:35,750 --> 00:28:34,640

links between

764
00:28:37,029 --> 00:28:35,760
the sun

765
00:28:38,789 --> 00:28:37,039
and

766
00:28:40,549 --> 00:28:38,799
climate

767
00:28:42,230 --> 00:28:40,559
this is this is not directly addressing

768
00:28:43,990 --> 00:28:42,240
the aerosols yet

769
00:28:45,990 --> 00:28:44,000
there are good correlations between

770
00:28:47,510 --> 00:28:46,000
solar activity and that 11-year cycle

771
00:28:49,669 --> 00:28:47,520
we've been able to see about three of

772
00:28:51,510 --> 00:28:49,679
them so far with good spacecraft

773
00:28:54,549 --> 00:28:51,520
measurements there are good links

774
00:28:57,669 --> 00:28:54,559
between temperature and solar activity

775
00:28:59,430 --> 00:28:57,679
the the links to aerosols are a little

776
00:29:01,590 --> 00:28:59,440
more tenuous and something that we will

777
00:29:03,909 --> 00:29:01,600
be improving a bit with glory but

778
00:29:05,430 --> 00:29:03,919
perhaps michael you'd be able to

779
00:29:07,590 --> 00:29:05,440
to say anything that you you'd know

780
00:29:09,830 --> 00:29:07,600
about correlations between solar

781
00:29:13,110 --> 00:29:09,840
activity and aerosols

782
00:29:13,909 --> 00:29:13,120
probably there's no direct correlation

783
00:29:16,310 --> 00:29:13,919
but

784
00:29:19,750 --> 00:29:16,320
there was this global phenomenon called

785
00:29:21,029 --> 00:29:19,760
global dimming which was occurring 50

786
00:29:22,870 --> 00:29:21,039
20 years ago

787
00:29:24,710 --> 00:29:22,880
which means that with time the amount of

788
00:29:27,190 --> 00:29:24,720

solar energy penetrating all the way

789
00:29:29,990 --> 00:29:27,200
down to the surface was decreasing

790
00:29:32,230 --> 00:29:30,000
and one of the hypothesis was that it is

791
00:29:34,310 --> 00:29:32,240
because the amount of aerosols in the

792
00:29:36,470 --> 00:29:34,320
atmosphere was increasing

793
00:29:38,870 --> 00:29:36,480
and so they were reflecting more

794
00:29:40,710 --> 00:29:38,880
sunlight back into space

795
00:29:42,470 --> 00:29:40,720
just because of their numbers

796
00:29:45,029 --> 00:29:42,480
and then this global dimming was

797
00:29:47,269 --> 00:29:45,039
replaced by global brightening which is

798
00:29:48,950 --> 00:29:47,279
happening now so more sunlight

799
00:29:50,470 --> 00:29:48,960
penetrates all the way to the surface

800
00:29:52,470 --> 00:29:50,480
and warms it

801
00:29:54,789 --> 00:29:52,480
we don't know exactly what the physical

802
00:29:56,789 --> 00:29:54,799
mechanisms of this phenomena are

803
00:29:58,789 --> 00:29:56,799
but no doubt aerosols contribute quite a

804
00:30:01,029 --> 00:29:58,799
bit to both phenomena

805
00:30:03,669 --> 00:30:01,039
we need to study this phenomena and also

806
00:30:05,750 --> 00:30:03,679
we need to study the human-made

807
00:30:08,630 --> 00:30:05,760
contribution to this phenomena for

808
00:30:11,510 --> 00:30:08,640
example there have been several

809
00:30:14,470 --> 00:30:11,520
laws adopted in the late 1970s in europe

810
00:30:16,549 --> 00:30:14,480
and the united states clean air acts and

811
00:30:18,710 --> 00:30:16,559
eventually they took effect and we now

812
00:30:20,149 --> 00:30:18,720
know that the amount of aerosols over

813
00:30:21,669 --> 00:30:20,159

europe and the united states has

814
00:30:23,029 --> 00:30:21,679
decreased quite a bit

815
00:30:25,190 --> 00:30:23,039
of course this is not true of other

816
00:30:27,830 --> 00:30:25,200
parts of the globe including china and

817
00:30:30,230 --> 00:30:27,840
india and other developing countries so

818
00:30:32,549 --> 00:30:30,240
we need to know what these countries do

819
00:30:34,630 --> 00:30:32,559
to contribute to the aerosol population

820
00:30:36,789 --> 00:30:34,640
in the atmosphere and how this affects

821
00:30:40,630 --> 00:30:36,799
climate and this is what the glory aps

822
00:30:44,470 --> 00:30:42,149
thank you greg and michael do we have

823
00:30:45,909 --> 00:30:44,480
follow-up questions here in the room

824
00:30:47,510 --> 00:30:45,919
one more i wonder if anybody would be

825
00:30:48,549 --> 00:30:47,520
willing to address what you think of

826
00:30:51,669 --> 00:30:48,559
having the

827
00:30:56,230 --> 00:30:51,679
hitchhiker payload going on your your

828
00:30:56,240 --> 00:31:03,190
good for them

829
00:31:09,990 --> 00:31:06,070
no it's been very carefully um analyzed

830
00:31:12,470 --> 00:31:10,000
and and the the risk to glory from

831
00:31:14,310 --> 00:31:12,480
from their edition is negligible

832
00:31:15,830 --> 00:31:14,320
so we're fine with it

833
00:31:17,590 --> 00:31:15,840
and they may be helping our future

834
00:31:19,669 --> 00:31:17,600
instruments because they're going to be

835
00:31:21,750 --> 00:31:19,679
improving perhaps communications that

836
00:31:23,350 --> 00:31:21,760
we'd be able to get from from future

837
00:31:27,590 --> 00:31:23,360
spacecraft

838
00:31:31,590 --> 00:31:29,590

can you characterize how much more

839
00:31:33,269 --> 00:31:31,600
improved the instrument on glory will be

840
00:31:35,350 --> 00:31:33,279
for measuring uh

841
00:31:37,190 --> 00:31:35,360
solar radiance compared to what you have

842
00:31:39,830 --> 00:31:37,200
been using before on source is there a

843
00:31:42,470 --> 00:31:39,840
way to characterize just how much neater

844
00:31:44,549 --> 00:31:42,480
and cooler this one is

845
00:31:46,310 --> 00:31:44,559
this one that the one flying in source i

846
00:31:48,310 --> 00:31:46,320
should say is about a factor of three

847
00:31:49,509 --> 00:31:48,320
better in accuracy than anything that's

848
00:31:51,029 --> 00:31:49,519
flown before

849
00:31:52,870 --> 00:31:51,039
now you notice i

850
00:31:53,990 --> 00:31:52,880
probably remember the offsets on those

851
00:31:56,230 --> 00:31:54,000
graphs

852
00:31:58,149 --> 00:31:56,240
the source being the the newest

853
00:31:59,830 --> 00:31:58,159
instrument to be producing data for

854
00:32:00,710 --> 00:31:59,840
total solar radiance is a fair amount

855
00:32:03,269 --> 00:32:00,720
lower

856
00:32:04,950 --> 00:32:03,279
than the preceding instruments

857
00:32:06,310 --> 00:32:04,960
um and we'd spent quite a while trying

858
00:32:08,149 --> 00:32:06,320
to understand that and getting the

859
00:32:10,149 --> 00:32:08,159
entire total solar ratings community

860
00:32:12,070 --> 00:32:10,159
together the you know it sounds like a

861
00:32:13,029 --> 00:32:12,080
big community but it's smaller than the

862
00:32:14,870 --> 00:32:13,039
group

863
00:32:17,350 --> 00:32:14,880

worldwide

864
00:32:19,830 --> 00:32:17,360
that we have in this room right now

865
00:32:21,750 --> 00:32:19,840
but what we're learning is that

866
00:32:23,669 --> 00:32:21,760
an improved instrument design that we

867
00:32:25,669 --> 00:32:23,679
have with the total irradiance monitor

868
00:32:27,590 --> 00:32:25,679
that went up on source

869
00:32:29,509 --> 00:32:27,600
allows a lot less scattered light into

870
00:32:31,909 --> 00:32:29,519
the instrument so the preceding

871
00:32:34,310 --> 00:32:31,919
instruments had additional light that

872
00:32:37,029 --> 00:32:34,320
made them read erroneously high we

873
00:32:39,750 --> 00:32:37,039
recently got a paper published to that

874
00:32:41,430 --> 00:32:39,760
effect that explains the scatter and why

875
00:32:43,029 --> 00:32:41,440
those instruments read higher than the

876
00:32:44,789 --> 00:32:43,039
total irradiance monitor does but it

877
00:32:47,269 --> 00:32:44,799
does look like the total radiance

878
00:32:48,870 --> 00:32:47,279
monitor on source is at least a factor

879
00:32:50,230 --> 00:32:48,880
or three better than the preceding

880
00:32:53,110 --> 00:32:50,240
instruments

881
00:32:54,950 --> 00:32:53,120
now with some design changes mostly to

882
00:32:56,630 --> 00:32:54,960
the electronics and the glory total

883
00:32:58,549 --> 00:32:56,640
irradiance monitor

884
00:33:02,149 --> 00:32:58,559
and with the new calibration facility

885
00:33:03,830 --> 00:33:02,159
that we've built under the glory program

886
00:33:06,230 --> 00:33:03,840
partly because

887
00:33:08,070 --> 00:33:06,240
when i first started off on source

888
00:33:09,909 --> 00:33:08,080

every time i would show that plot of all

889
00:33:11,190 --> 00:33:09,919
these offset instruments someone would

890
00:33:13,029 --> 00:33:11,200
say

891
00:33:14,070 --> 00:33:13,039
why didn't you guys calibrate these

892
00:33:16,230 --> 00:33:14,080
things

893
00:33:17,590 --> 00:33:16,240
and it's not that simple the offsets on

894
00:33:19,350 --> 00:33:17,600
there they look large but they're

895
00:33:21,190 --> 00:33:19,360
actually fairly small on the scale

896
00:33:22,950 --> 00:33:21,200
that's shown there

897
00:33:25,110 --> 00:33:22,960
every one of those instruments really is

898
00:33:27,590 --> 00:33:25,120
calibrated as well as people could do in

899
00:33:30,470 --> 00:33:27,600
the labs at the time

900
00:33:33,190 --> 00:33:30,480
but there has been over these 32 years

901
00:33:35,190 --> 00:33:33,200
no facility on the ground that could

902
00:33:37,830 --> 00:33:35,200
calibrate one of these instruments end

903
00:33:40,549 --> 00:33:37,840
to end for measuring irradiance

904
00:33:42,470 --> 00:33:40,559
something at solar power levels

905
00:33:44,870 --> 00:33:42,480
on glory we decided to address that

906
00:33:47,269 --> 00:33:44,880
problem and we created a facility

907
00:33:49,110 --> 00:33:47,279
that would bring any instrument

908
00:33:50,950 --> 00:33:49,120
any total solar radiance instrument in

909
00:33:52,950 --> 00:33:50,960
the world into our facility and be able

910
00:33:54,950 --> 00:33:52,960
to compare it against a nist calibrated

911
00:33:57,269 --> 00:33:54,960
cryogenic radiometer kind of the gold

912
00:33:59,269 --> 00:33:57,279
standard in doing radiometry

913
00:34:02,230 --> 00:33:59,279

so we created a new facility to be able

914
00:34:04,230 --> 00:34:02,240
to end and validate these instruments

915
00:34:05,830 --> 00:34:04,240
and the glory

916
00:34:08,470 --> 00:34:05,840
instrument is the first flight

917
00:34:10,389 --> 00:34:08,480
instrument to be calibrated on that

918
00:34:11,349 --> 00:34:10,399
facility so not only have we improved

919
00:34:17,669 --> 00:34:11,359
the

920
00:34:19,430 --> 00:34:17,679
we've also kind of validated that with

921
00:34:21,430 --> 00:34:19,440
this good nist

922
00:34:23,270 --> 00:34:21,440
certified cryogenic radiometer in

923
00:34:24,550 --> 00:34:23,280
comparisons against that with the new

924
00:34:27,270 --> 00:34:24,560
facility

925
00:34:27,990 --> 00:34:27,280
that gives about a factor of three or

926
00:34:32,069 --> 00:34:28,000
the

927
00:34:33,909 --> 00:34:32,079
electronics and calibrations gives about

928
00:34:36,389 --> 00:34:33,919
a factor of three improvement over what

929
00:34:37,909 --> 00:34:36,399
we've achieved on source

930
00:34:39,829 --> 00:34:37,919
so i am

931
00:34:42,230 --> 00:34:39,839
really looking forward to seeing glory

932
00:34:43,190 --> 00:34:42,240
go up and seeing it match very closely

933
00:34:44,790 --> 00:34:43,200
with

934
00:34:48,869 --> 00:34:44,800
the measurements that we're getting from

935
00:34:50,389 --> 00:34:48,879
the total radiance monitor on source

936
00:34:51,589 --> 00:34:50,399
thank you greg

937
00:34:53,109 --> 00:34:51,599
we're going to go ahead and conclude

938
00:34:55,510 --> 00:34:53,119

this briefing now because we do have

939
00:34:57,109 --> 00:34:55,520
another one coming up shortly and we

940
00:34:58,470 --> 00:34:57,119
need to make sure that we have enough

941
00:35:00,150 --> 00:34:58,480
time for all the questions on that

942
00:35:01,589 --> 00:35:00,160
briefing as well

943
00:35:03,190 --> 00:35:01,599
so at this point i just want to thank

944
00:35:04,790 --> 00:35:03,200
our panelists again one more time for

945
00:35:06,870 --> 00:35:04,800
being with us today and all of our

946
00:35:08,710 --> 00:35:06,880
guests on the phone and here in the room

947
00:35:10,470 --> 00:35:08,720
uh stay tuned for the next briefing