

June 7



June 10



1
00:00:03,470 --> 00:00:02,720
and last name today's conference is

2
00:00:05,059 --> 00:00:03,480
being recorded

3
00:00:07,460 --> 00:00:05,069
if there are any objections you may

4
00:00:08,900 --> 00:00:07,470
disconnect at this time now I'd like to

5
00:00:10,040 --> 00:00:08,910
turn the conference over to the Jet

6
00:00:12,799 --> 00:00:10,050
Propulsion Laboratory

7
00:00:15,680 --> 00:00:12,809
thank you you may begin thank you very

8
00:00:18,200 --> 00:00:15,690
much I'm Jane Platt in the JPL Media

9
00:00:20,929 --> 00:00:18,210
Relations office in Pasadena California

10
00:00:23,870 --> 00:00:20,939
today's topic is the dust storm that's

11
00:00:25,609 --> 00:00:23,880
currently raging on Mars and we'll be

12
00:00:26,300 --> 00:00:25,619
talking about how it's affecting the

13
00:00:28,490 --> 00:00:26,310

long-lived

14

00:00:31,130 --> 00:00:28,500

opportunity Rover and how it's also

15

00:00:33,560 --> 00:00:31,140

providing interesting possibilities for

16

00:00:35,569 --> 00:00:33,570

various missions to study the science of

17

00:00:37,400 --> 00:00:35,579

the storm we're going to be hearing from

18

00:00:39,560 --> 00:00:37,410

three speakers today and we'll take

19

00:00:42,080 --> 00:00:39,570

questions from reporters on the line and

20

00:00:44,569 --> 00:00:42,090

we'll try to take some from people who

21

00:00:47,690 --> 00:00:44,579

are asking questions on social media as

22

00:00:54,850 --> 00:00:47,700

well you can follow along with visuals

23

00:00:59,420 --> 00:00:54,860

at HTTP colon slash slash w w NS a govt

24

00:01:03,520 --> 00:00:59,430

slash Mars dust storm telecon once more

25

00:01:10,310 --> 00:01:06,310

www.nasa.gov/twan

26

00:01:12,050 --> 00:01:10,320

Telecom and again as was mentioned by

27

00:01:14,030 --> 00:01:12,060

dory our operator if you want to ask a

28

00:01:16,429 --> 00:01:14,040

question later on as we get to that

29

00:01:19,340 --> 00:01:16,439

point press star-1 and we'll put you in

30

00:01:21,710 --> 00:01:19,350

the queue like to introduce our panel we

31

00:01:24,020 --> 00:01:21,720

have with us here at JPL this morning

32

00:01:28,100 --> 00:01:24,030

John Kallis the opportunity project

33

00:01:30,499 --> 00:01:28,110

manager at JPL we also have rich Zurich

34

00:01:34,190 --> 00:01:30,509

the Mars program office chief scientist

35

00:01:37,130 --> 00:01:34,200

at JPL and at NASA headquarters we have

36

00:01:40,760 --> 00:01:37,140

Jim Watson the director of the Mars

37

00:01:42,560 --> 00:01:40,770

exploration program at NASA and we do

38

00:01:45,080 --> 00:01:42,570

have one other person who will be with

39

00:01:47,569 --> 00:01:45,090

us and available to answer questions and

40

00:01:50,060 --> 00:01:47,579

that's Dave Lavery the program executive

41

00:01:52,940 --> 00:01:50,070

at NASA headquarters for the opportunity

42

00:01:55,520 --> 00:01:52,950

and curiosity Rover's we're going to

43

00:01:58,310 --> 00:01:55,530

start now with John Kallis John Thank

44

00:02:01,039 --> 00:01:58,320

You Jane there's a severe dust storm on

45

00:02:02,990 --> 00:02:01,049

Mars that's threatening opportunity as a

46

00:02:05,179 --> 00:02:03,000

result the rover has fallen asleep and

47

00:02:06,980 --> 00:02:05,189

is waiting out the storm the project

48

00:02:08,419 --> 00:02:06,990

team is very concerned we're watching

49

00:02:11,150 --> 00:02:08,429

the weather can we're listening with the

50

00:02:12,800 --> 00:02:11,160

Deep Space Network for signals but let

51
00:02:13,740 --> 00:02:12,810
me give you a timeline of what brought

52
00:02:19,320 --> 00:02:13,750
us up to this

53
00:02:21,300 --> 00:02:19,330
point today back on May 30th MRO

54
00:02:23,550 --> 00:02:21,310
the Mars Reconnaissance Orbiter saw the

55
00:02:27,900 --> 00:02:23,560
first indications of a dust storm on

56
00:02:31,560 --> 00:02:27,910
Mars they notified the MA our project on

57
00:02:34,020 --> 00:02:31,570
Friday evening that the dust storm was

58
00:02:37,170 --> 00:02:34,030
headed in a direction that may affect

59
00:02:39,390 --> 00:02:37,180
the opportunity Rover at that time we

60
00:02:41,520 --> 00:02:39,400
already had a three day plan on the

61
00:02:44,820 --> 00:02:41,530
rover that was running over the weekend

62
00:02:47,340 --> 00:02:44,830
over the weekend we did see increases in

63
00:02:49,400 --> 00:02:47,350

atmospheric opacity which is a measure

64

00:02:51,870 --> 00:02:49,410

of the amount of dust in the atmosphere

65

00:02:54,900 --> 00:02:51,880

there's a graphic online that you can

66

00:02:58,170 --> 00:02:54,910

refer to its labeled Calais one and it

67

00:03:00,420 --> 00:02:58,180

shows the subsequent atmospheric opacity

68

00:03:03,449 --> 00:03:00,430

measurements starting with what we call

69

00:03:05,640 --> 00:03:03,459

a tower tower one three five seven nine

70

00:03:07,500 --> 00:03:05,650

and eleven all the way on the right-hand

71

00:03:10,979 --> 00:03:07,510

side so we can use that for reference as

72

00:03:16,050 --> 00:03:10,989

I refer to these numbers so on the

73

00:03:18,180 --> 00:03:16,060

weekend on June second we observed an

74

00:03:19,979 --> 00:03:18,190

atmosphere capacity of 0.6 which is

75

00:03:24,539 --> 00:03:19,989

about normal for this time of year the

76
00:03:27,479 --> 00:03:24,549
rover was generating 645 watt hours the

77
00:03:29,340 --> 00:03:27,489
next day of the atmosphere capacity

78
00:03:31,949 --> 00:03:29,350
jumped to 1.5 so that's a pretty

79
00:03:35,699 --> 00:03:31,959
significant increase in one day not

80
00:03:38,100 --> 00:03:35,709
uncommon for the onset of a storm we

81
00:03:41,850 --> 00:03:38,110
continue to watch things as over the

82
00:03:43,500 --> 00:03:41,860
weekend and then on Monday morning we

83
00:03:45,900 --> 00:03:43,510
began our next planning day for the

84
00:03:48,270 --> 00:03:45,910
rover and we at that point decided that

85
00:03:50,910 --> 00:03:48,280
we needed to see science operations and

86
00:03:54,270 --> 00:03:50,920
to configure the rover for a lower power

87
00:03:56,789 --> 00:03:54,280
operation as this dust storms it was

88
00:04:00,600 --> 00:03:56,799

increasing and looked to be more

89
00:04:03,449 --> 00:04:00,610
threatening so on Monday we measured the

90
00:04:05,370 --> 00:04:03,459
atmospheric capacity at a little over

91
00:04:07,620 --> 00:04:05,380
two and at that point the energy

92
00:04:09,030 --> 00:04:07,630
production the rover had dropped by

93
00:04:12,090 --> 00:04:09,040
almost half to three hundred and

94
00:04:14,340 --> 00:04:12,100
forty-five watt hours we continued on

95
00:04:18,060 --> 00:04:14,350
the next day with another low power plan

96
00:04:19,949 --> 00:04:18,070
and we were unable to get a measurement

97
00:04:22,290 --> 00:04:19,959
of atmospheric capacity on the next day

98
00:04:25,050 --> 00:04:22,300
because it had likely increased is such

99
00:04:26,540 --> 00:04:25,060
a high level that our ability to measure

100
00:04:29,390 --> 00:04:26,550
it is

101
00:04:30,920 --> 00:04:29,400
diminish but we did measure the energy

102
00:04:32,900 --> 00:04:30,930
production of the rover and it dropped

103
00:04:35,330 --> 00:04:32,910
to about a hundred and thirty three watt

104
00:04:38,869 --> 00:04:35,340
hours so again by more than a factor of

105
00:04:42,710 --> 00:04:38,879
two in one day

106
00:04:45,680 --> 00:04:42,720
so uh our concern level continued to

107
00:04:49,999 --> 00:04:45,690
increase so on on the next planning day

108
00:04:51,710 --> 00:04:50,009
which was Wednesday June 6 we decided

109
00:04:55,129 --> 00:04:51,720
that we were going to do a three day

110
00:04:57,680 --> 00:04:55,139
actually a two day plan and we chose not

111
00:04:59,480 --> 00:04:57,690
to have the rover communicate to us on

112
00:05:01,820 --> 00:04:59,490
the first day but wait until the second

113
00:05:04,070 --> 00:05:01,830

day and this is a power saving measure

114

00:05:05,870 --> 00:05:04,080

so essentially the rover just wakes up

115

00:05:07,969 --> 00:05:05,880

in the morning receives the commands go

116

00:05:10,670 --> 00:05:07,979

back goes back to sleep sleeps through

117

00:05:12,290 --> 00:05:10,680

the night into the next day a brief wake

118

00:05:14,570 --> 00:05:12,300

up in the morning going back to sleep

119

00:05:16,879 --> 00:05:14,580

and then wakes up in the afternoon tries

120

00:05:19,209 --> 00:05:16,889

a measurement of atmospheric opacity

121

00:05:22,670 --> 00:05:19,219

communicates with one of our orbiting

122

00:05:25,240 --> 00:05:22,680

relay satellites and then goes back to

123

00:05:27,469 --> 00:05:25,250

sleep so very short duration of up time

124

00:05:29,240 --> 00:05:27,479

however we do want to maintain some

125

00:05:31,010 --> 00:05:29,250

level of activity on the rover because

126

00:05:33,170 --> 00:05:31,020

that's what keeps the rover warm so

127

00:05:35,779 --> 00:05:33,180

we're trying to not only manage power

128

00:05:39,830 --> 00:05:35,789

consumption but manage the temperatures

129

00:05:43,430 --> 00:05:39,840

on the rover so on Friday we we planned

130

00:05:45,950 --> 00:05:43,440

a three saw plan to carry us through the

131

00:05:48,170 --> 00:05:45,960

weekend again we were implementing a

132

00:05:51,350 --> 00:05:48,180

very low power plan where we essentially

133

00:05:53,450 --> 00:05:51,360

shut everything down except a one wakeup

134

00:05:57,370 --> 00:05:53,460

for measurement of atmospheric opacity

135

00:06:00,589 --> 00:05:57,380

and the coincident communication with a

136

00:06:03,320 --> 00:06:00,599

relay orbiter in that case was the Mars

137

00:06:05,059 --> 00:06:03,330

Reconnaissance Orbiter so we did get

138

00:06:08,480 --> 00:06:05,069

that data down on the ground that was on

139

00:06:11,330 --> 00:06:08,490

on Sunday June 10th the rover was still

140

00:06:14,390 --> 00:06:11,340

active at that point but the atmospheric

141

00:06:16,670 --> 00:06:14,400

opacity was estimated at ten point eight

142

00:06:18,620 --> 00:06:16,680

and that is a record high for

143

00:06:21,529 --> 00:06:18,630

measurements on Mars and that would

144

00:06:24,230 --> 00:06:21,539

correspond to the graphic the right-hand

145

00:06:27,170 --> 00:06:24,240

panel so it's it's completely black on

146

00:06:28,670 --> 00:06:27,180

Mars it's completely dark the energy

147

00:06:34,820 --> 00:06:28,680

production of the rover was measured at

148

00:06:36,290 --> 00:06:34,830

only 22 watt hours so even though we

149

00:06:38,089 --> 00:06:36,300

heard from the rover the rover was under

150

00:06:39,879 --> 00:06:38,099

master sequence control I made the

151
00:06:41,679 --> 00:06:39,889
decision to declare space crab

152
00:06:43,420 --> 00:06:41,689
emergency because it wasn't enough

153
00:06:45,999 --> 00:06:43,430
energy for the rover to sustain

154
00:06:48,580 --> 00:06:46,009
activities and it would be dropping into

155
00:06:50,559 --> 00:06:48,590
what we refer to as a low-power fault

156
00:06:53,429 --> 00:06:50,569
this is where the rover senses it

157
00:06:56,080 --> 00:06:53,439
doesn't have enough energy to maintain

158
00:06:58,689 --> 00:06:56,090
activities and it essentially turns

159
00:07:02,230 --> 00:06:58,699
everything off with only the master

160
00:07:03,580 --> 00:07:02,240
clock connected to the batteries so all

161
00:07:06,249 --> 00:07:03,590
energy that's coming out of the solar

162
00:07:08,200 --> 00:07:06,259
rays is going into the batteries and the

163
00:07:10,689 --> 00:07:08,210

master clock that was the last

164

00:07:13,149 --> 00:07:10,699

communication we had from the rover we

165

00:07:16,209 --> 00:07:13,159

did listen for a fault window on the

166

00:07:18,189 --> 00:07:16,219

rover we also sent commands to elicit a

167

00:07:22,059 --> 00:07:18,199

response from the rover and we've heard

168

00:07:24,879 --> 00:07:22,069

nothing since then so our expectation at

169

00:07:27,070 --> 00:07:24,889

this point is that the rover has gone to

170

00:07:29,019 --> 00:07:27,080

sleep it's in this low-power mode and

171

00:07:30,820 --> 00:07:29,029

that will remain in that low-power mode

172

00:07:33,010 --> 00:07:30,830

until there's sufficient energy to

173

00:07:34,929 --> 00:07:33,020

charge the batteries back above a

174

00:07:37,570 --> 00:07:34,939

certain threshold at that point the

175

00:07:40,320 --> 00:07:37,580

rover will autonomously try to wake up

176
00:07:45,010 --> 00:07:40,330
and communicate with us so at this point

177
00:07:47,260 --> 00:07:45,020
we're in a waiting mode we're listening

178
00:07:50,519 --> 00:07:47,270
everyday for possible signals from the

179
00:07:53,709 --> 00:07:50,529
rover and be prepared to respond to that

180
00:07:55,659 --> 00:07:53,719
going forward though the concern is

181
00:07:57,219 --> 00:07:55,669
temperature on the rover because the

182
00:08:00,550 --> 00:07:57,229
rover is not active it will be getting

183
00:08:02,379 --> 00:08:00,560
colder the good news there is that the

184
00:08:05,139 --> 00:08:02,389
dust storm has warm temperatures on Mars

185
00:08:09,209 --> 00:08:05,149
we're also going into the summer season

186
00:08:12,610 --> 00:08:09,219
and so the rover will not get as cold as

187
00:08:14,139 --> 00:08:12,620
as we would normally we've done an

188
00:08:17,170 --> 00:08:14,149

estimate that shows that the rover

189

00:08:19,480 --> 00:08:17,180

should stay above its minimum allowable

190

00:08:22,719 --> 00:08:19,490

operating temperatures for the long term

191

00:08:25,149 --> 00:08:22,729

so we should be able to ride out the

192

00:08:27,850 --> 00:08:25,159

storm when the Stockland the skies clear

193

00:08:29,379 --> 00:08:27,860

and the rover begins to power up it

194

00:08:32,589 --> 00:08:29,389

should begin to communicate with us

195

00:08:35,589 --> 00:08:32,599

there's one last complexity that we'll

196

00:08:37,810 --> 00:08:35,599

have to deal with and that if the rover

197

00:08:40,389 --> 00:08:37,820

is generating less than 22 watt hours of

198

00:08:42,550 --> 00:08:40,399

energy that we won't have enough energy

199

00:08:43,930 --> 00:08:42,560

even to sustain the mission clock and

200

00:08:45,490 --> 00:08:43,940

we'll have what's also called a clock

201
00:08:47,650 --> 00:08:45,500
fault which means the rover doesn't know

202
00:08:49,480 --> 00:08:47,660
what time it is and so that at that

203
00:08:51,220 --> 00:08:49,490
point the rover goes into an autonomous

204
00:08:51,730 --> 00:08:51,230
mode that when it does have power to

205
00:08:53,800 --> 00:08:51,740
wake up

206
00:08:55,720 --> 00:08:53,810
it sets timers at regular end

207
00:08:58,509 --> 00:08:55,730
just to wake up to see if it can

208
00:09:00,220 --> 00:08:58,519
communicate to earth it waits until

209
00:09:01,420 --> 00:09:00,230
there's sufficient energy on the solar

210
00:09:03,939 --> 00:09:01,430
array so it's going to use the solar

211
00:09:05,559 --> 00:09:03,949
arrays to know when it's daytime and we

212
00:09:08,379 --> 00:09:05,569
will be prepared to listen and respond

213
00:09:11,730 --> 00:09:08,389

to the rover when that happens so we're

214

00:09:16,119 --> 00:09:11,740

concerned but we're we're hopeful that

215

00:09:18,069 --> 00:09:16,129

things will the storm will clear and the

216

00:09:21,519 --> 00:09:18,079

rover will begin to communicate to us

217

00:09:23,439 --> 00:09:21,529

we're supported by a great team we're

218

00:09:24,879 --> 00:09:23,449

very appreciative of all the assets at

219

00:09:26,710 --> 00:09:24,889

Mars that are looking out for us and

220

00:09:28,600 --> 00:09:26,720

providing communication services to the

221

00:09:29,949 --> 00:09:28,610

entire Mars program and then the deep

222

00:09:33,639 --> 00:09:29,959

space network is providing us with

223

00:09:37,139 --> 00:09:33,649

excellent support so at this point I'll

224

00:09:39,910 --> 00:09:37,149

turn it over to research Thank You Jon

225

00:09:43,030 --> 00:09:39,920

the situation on Mars really highlights

226

00:09:45,579 --> 00:09:43,040

a key question about Mars today which is

227

00:09:47,679 --> 00:09:45,589

why do these massive widespread dust

228

00:09:50,439 --> 00:09:47,689

events occur in some years but not in

229

00:09:51,519 --> 00:09:50,449

other years local dust storms similar to

230

00:09:52,929 --> 00:09:51,529

those that occur in the American

231

00:09:55,480 --> 00:09:52,939

Southwest from the Middle East for

232

00:09:57,369 --> 00:09:55,490

instance can occur in any season on Mars

233

00:09:59,920 --> 00:09:57,379

but they typically grow to continental

234

00:10:01,809 --> 00:09:59,930

size only during the southern spring and

235

00:10:04,569 --> 00:10:01,819

summer when Mars is a little closer to

236

00:10:07,420 --> 00:10:04,579

the Sun as those regional storms that do

237

00:10:09,210 --> 00:10:07,430

occur only a dozen so have ever in the

238

00:10:11,799 --> 00:10:09,220

historical record or the modern record

239

00:10:14,290 --> 00:10:11,809

expanded to encircle the planet or cover

240

00:10:16,299 --> 00:10:14,300

the globe thanks to the ongoing Mars

241

00:10:18,280 --> 00:10:16,309

exploration program Mars has been

242

00:10:20,379 --> 00:10:18,290

monitored by a series of spacecraft

243

00:10:23,319 --> 00:10:20,389

orbiting the planet on essentially a

244

00:10:26,230 --> 00:10:23,329

daily basis for nearly 20 years planet

245

00:10:29,920 --> 00:10:26,240

encircling storms were observed in 2001

246

00:10:31,900 --> 00:10:29,930

in 2007 however in the five Mars years

247

00:10:34,600 --> 00:10:31,910

since then no regional storm had grown

248

00:10:37,240 --> 00:10:34,610

to planetary scale but the current storm

249

00:10:39,309 --> 00:10:37,250

on Mars is just days away from meeting

250

00:10:42,879 --> 00:10:39,319

that classification of a planet and

251
00:10:44,740 --> 00:10:42,889
circling dust event each observation of

252
00:10:46,389 --> 00:10:44,750
these large storms raises closer to

253
00:10:48,220 --> 00:10:46,399
being able to model these events and

254
00:10:50,590 --> 00:10:48,230
perhaps even one day to forecast them

255
00:10:52,389 --> 00:10:50,600
this would be like forecasting El Nino

256
00:10:54,790 --> 00:10:52,399
events on earth or the severity of

257
00:10:56,710 --> 00:10:54,800
upcoming hurricane seasons there are

258
00:11:00,040 --> 00:10:56,720
ideas about how to do this but we need

259
00:11:02,650 --> 00:11:00,050
data to test and refine them the first

260
00:11:04,269 --> 00:11:02,660
set of images Zurich one it shows you

261
00:11:06,519 --> 00:11:04,279
the evolution of the storm from an

262
00:11:07,630 --> 00:11:06,529
initial dust cloud the storm here is

263
00:11:09,610 --> 00:11:07,640

covered in red food

264

00:11:11,620 --> 00:11:09,620

ability so that you can see its

265

00:11:14,740 --> 00:11:11,630

expansion as it goes across the planet

266

00:11:17,200 --> 00:11:14,750

on May 30th there was just a small local

267

00:11:19,840 --> 00:11:17,210

storm that had appeared and was spotted

268

00:11:22,240 --> 00:11:19,850

by the Mars Reconnaissance orbiters Mars

269

00:11:24,430 --> 00:11:22,250

color imager team and they put together

270

00:11:27,550 --> 00:11:24,440

these global maps which are formed by a

271

00:11:29,950 --> 00:11:27,560

mosaic of 13 color strips that show the

272

00:11:32,320 --> 00:11:29,960

entire globe but each portion of the

273

00:11:34,150 --> 00:11:32,330

planet is viewed as if it were at 3 p.m.

274

00:11:37,390 --> 00:11:34,160

because that's when the orbiter over

275

00:11:39,220 --> 00:11:37,400

flies that area of the planet the black

276

00:11:42,520 --> 00:11:39,230

areas are poorly lit polar regions at

277

00:11:44,860 --> 00:11:42,530

the top and bottom the diagrams and

278

00:11:46,300 --> 00:11:44,870

there are a number of data Gore's that

279

00:11:48,190 --> 00:11:46,310

are due to spacecraft walls for

280

00:11:50,650 --> 00:11:48,200

high-resolution imaging of the surface

281

00:11:54,070 --> 00:11:50,660

or to data loss during transmission to

282

00:11:55,840 --> 00:11:54,080

earth as you can see that the time

283

00:11:58,510 --> 00:11:55,850

series shows that the storm headed south

284

00:12:00,850 --> 00:11:58,520

towards opportunity and that happened on

285

00:12:02,740 --> 00:12:00,860

June 1st and that was the moment when it

286

00:12:05,020 --> 00:12:02,750

was realized that there was an event

287

00:12:08,320 --> 00:12:05,030

that could potentially affect the rover

288

00:12:10,990 --> 00:12:08,330

closer to the equator you also see that

289

00:12:13,510 --> 00:12:11,000

there's bands of white cloud that go off

290

00:12:15,730 --> 00:12:13,520

and stretch across the planet and the

291

00:12:18,670 --> 00:12:15,740

entire dust haze is now spread over

292

00:12:21,280 --> 00:12:18,680

about a quarter of Mars and remember

293

00:12:23,320 --> 00:12:21,290

that Mars has got the same area is the

294

00:12:26,320 --> 00:12:23,330

land area of the earth so this is a very

295

00:12:27,850 --> 00:12:26,330

wide spread of them these active areas

296

00:12:31,180 --> 00:12:27,860

and associated deaths are collectively

297

00:12:32,860 --> 00:12:31,190

called the dusk to bend and the original

298

00:12:34,360 --> 00:12:32,870

star eventually emerged before Chris

299

00:12:36,820 --> 00:12:34,370

Jones that originated in the southern

300

00:12:38,140 --> 00:12:36,830

hemisphere and that haze is now spread

301
00:12:40,090 --> 00:12:38,150
over Gale Crater where the

302
00:12:43,150 --> 00:12:40,100
nuclear-powered Curiosity rover has

303
00:12:44,830 --> 00:12:43,160
major increased opacity and seeing

304
00:12:47,350 --> 00:12:44,840
greater haziness within the six

305
00:12:52,570 --> 00:12:47,360
kilometer deep crater itself as seen in

306
00:12:55,090 --> 00:12:52,580
the next chart at Zurich - and there you

307
00:12:57,130 --> 00:12:55,100
can see the change in visibility of the

308
00:13:00,460 --> 00:12:57,140
rover as it looks out across the floor

309
00:13:02,260 --> 00:13:00,470
of Gale Crater as the destron expands

310
00:13:04,810 --> 00:13:02,270
the dusty atmosphere absorbs sunlight

311
00:13:06,610 --> 00:13:04,820
producing a powerful feedback because

312
00:13:08,800 --> 00:13:06,620
the heating changes temperatures and

313
00:13:10,540 --> 00:13:08,810

pressures those drive winds and thereby

314

00:13:13,000 --> 00:13:10,550

expand the regions where dust can be

315

00:13:15,220 --> 00:13:13,010

raised when dusk is higher in the

316

00:13:18,190 --> 00:13:15,230

atmosphere this feedback can change the

317

00:13:20,350 --> 00:13:18,200

global circulation and the MRO Mars

318

00:13:21,040 --> 00:13:20,360

climate sounder has seen it go several

319

00:13:23,680 --> 00:13:21,050

tens

320

00:13:25,540 --> 00:13:23,690

into the atmosphere although the dust

321

00:13:28,540 --> 00:13:25,550

reached those altitudes more slowly in

322

00:13:31,240 --> 00:13:28,550

this storm that is typically the case in

323

00:13:33,280 --> 00:13:31,250

the final chart Zurich 3 you can also

324

00:13:36,480 --> 00:13:33,290

see the integrated observations by the

325

00:13:39,550 --> 00:13:36,490

NASA spacecraft MRO maven Mars Odyssey

326

00:13:41,200 --> 00:13:39,560

curiosity and Opportunity Rovers that

327

00:13:43,690 --> 00:13:41,210

are working to characterize this rare

328

00:13:46,600 --> 00:13:43,700

event knowing wait dust orange grouse

329

00:13:48,400 --> 00:13:46,610

large in some years but not in other

330

00:13:50,710 --> 00:13:48,410

years is important to understanding the

331

00:13:53,440 --> 00:13:50,720

climate of Mars past and present and

332

00:13:55,120 --> 00:13:53,450

also to supporting future missions to

333

00:13:57,280 --> 00:13:55,130

tell more about the program let me turn

334

00:14:01,140 --> 00:13:57,290

it over to Jim Watson director of NASA's

335

00:14:03,790 --> 00:14:01,150

Mars exploration program thank you rich

336

00:14:05,770 --> 00:14:03,800

the current dust storm is providing us

337

00:14:07,660 --> 00:14:05,780

with an unprecedented opportunity to

338

00:14:09,340 --> 00:14:07,670

learn more about Mars and the many

339

00:14:12,190 --> 00:14:09,350

challenges that it presents for

340

00:14:13,810 --> 00:14:12,200

exploration we are fortunate there we

341

00:14:15,820 --> 00:14:13,820

have a record number of operational

342

00:14:17,350 --> 00:14:15,830

spacecraft at Mars enabling us to

343

00:14:19,750 --> 00:14:17,360

observe the storm from many different

344

00:14:21,670 --> 00:14:19,760

perspectives we also have another

345

00:14:24,280 --> 00:14:21,680

spacecraft on the way to Mars the

346

00:14:26,650 --> 00:14:24,290

insight Lander and it will be useful for

347

00:14:29,530 --> 00:14:26,660

us to be as prepared as we can for its

348

00:14:32,200 --> 00:14:29,540

arrival at at Mars in the end of

349

00:14:33,820 --> 00:14:32,210

November this year knowing and

350

00:14:35,590 --> 00:14:33,830

understanding how these storms behave

351

00:14:37,480 --> 00:14:35,600

will be critically important for our

352

00:14:39,490 --> 00:14:37,490

more ambitious missions that are being

353

00:14:41,950 --> 00:14:39,500

planned for the future such as Mars

354

00:14:44,530 --> 00:14:41,960

sample return which is envisioned to be

355

00:14:46,960 --> 00:14:44,540

solar powered as we work to pave the way

356

00:14:48,790 --> 00:14:46,970

for when human explorers arrive it will

357

00:14:51,370 --> 00:14:48,800

be essential that we learn to monitor

358

00:14:53,200 --> 00:14:51,380

and hopefully predict these storms in

359

00:14:55,960 --> 00:14:53,210

order to help ensure the safety of the

360

00:14:58,600 --> 00:14:55,970

crew turning to the present we're all

361

00:15:00,600 --> 00:14:58,610

pulling for opportunity as you know it's

362

00:15:03,640 --> 00:15:00,610

been a remarkably resilient Rover

363

00:15:07,090 --> 00:15:03,650

lasting 15 years well beyond its

364

00:15:08,680 --> 00:15:07,100

original design life of just 90 days its

365

00:15:10,950 --> 00:15:08,690

longevity has taught us much about

366

00:15:13,840 --> 00:15:10,960

operating on the surface of Mars

367

00:15:15,340 --> 00:15:13,850

regardless of how this turns out this

368

00:15:17,980 --> 00:15:15,350

little Rover has proven to be an

369

00:15:20,200 --> 00:15:17,990

invaluable investment that has greatly

370

00:15:21,210 --> 00:15:20,210

increased our ability to explore the Red

371

00:15:27,760 --> 00:15:21,220

Planet

372

00:15:30,700 --> 00:15:27,770

thank you all right thank you to all our

373

00:15:34,560 --> 00:15:30,710

panelists and we're going to start with

374

00:15:35,880 --> 00:15:34,570

the Q&A portion of the atelic on

375

00:15:37,500 --> 00:15:35,890

again if you would like to ask a

376

00:15:38,850 --> 00:15:37,510

question please press star 1 and give

377

00:15:41,850 --> 00:15:38,860

the operator your name and your

378

00:15:46,260 --> 00:15:41,860

affiliation we're going to start first

379

00:15:49,680 --> 00:15:46,270

with Mike wall from space comm Mike good

380

00:15:52,320 --> 00:15:49,690

morning good morning thank you guys for

381

00:15:54,240 --> 00:15:52,330

doing this just like a couple of quick

382

00:15:56,640 --> 00:15:54,250

questions I mean how many days do you

383

00:15:59,070 --> 00:15:56,650

reckon opportunity has before you really

384

00:16:01,080 --> 00:15:59,080

will get really really concerned about

385

00:16:03,660 --> 00:16:01,090

like whether it's going to be able to

386

00:16:05,880 --> 00:16:03,670

kind of pull out at us and and how like

387

00:16:08,850 --> 00:16:05,890

low can the temperatures go before

388

00:16:10,110 --> 00:16:08,860

things get really kind of dicey and kind

389

00:16:13,110 --> 00:16:10,120

of how does that compare to what spirit

390

00:16:15,450 --> 00:16:13,120

went through in 2010 okay well first

391

00:16:17,880 --> 00:16:15,460

okay let me address the second part

392

00:16:19,770 --> 00:16:17,890

first the big difference between now and

393

00:16:22,290 --> 00:16:19,780

what spirit went through back in March

394

00:16:25,020 --> 00:16:22,300

in 2010 is spirit was going through

395

00:16:27,150 --> 00:16:25,030

winter so the temperatures were a lot

396

00:16:30,360 --> 00:16:27,160

colder and there was a lot less sunlight

397

00:16:32,190 --> 00:16:30,370

here we're approaching summer and as

398

00:16:35,700 --> 00:16:32,200

soon as the skies clear we'll have ample

399

00:16:38,160 --> 00:16:35,710

energy production the question is how

400

00:16:40,500 --> 00:16:38,170

long can the rover go right now our

401
00:16:41,820 --> 00:16:40,510
thermal predictions is we have a you

402
00:16:43,710 --> 00:16:41,830
know a detailed thermal model of the

403
00:16:45,750 --> 00:16:43,720
rover or set in the environment and we

404
00:16:48,210 --> 00:16:45,760
use the last recorded information from

405
00:16:51,090 --> 00:16:48,220
Mars and we've run that model out for

406
00:16:52,740 --> 00:16:51,100
for many many days and what we find is

407
00:16:57,360 --> 00:16:52,750
that the rover hits a steady state

408
00:16:59,610 --> 00:16:57,370
temperature where there's a balance

409
00:17:01,560 --> 00:16:59,620
between what little energy is coming out

410
00:17:03,720 --> 00:17:01,570
of the rover and being lost in the

411
00:17:07,740 --> 00:17:03,730
environment I should remind you that the

412
00:17:11,520 --> 00:17:07,750
rover has on board eight plutonium RH

413
00:17:12,600 --> 00:17:11,530

use each generate about one watt so even

414

00:17:14,699 --> 00:17:12,610

though we're not getting any solar

415

00:17:16,740 --> 00:17:14,709

energy on the rover there is still about

416

00:17:21,990 --> 00:17:16,750

eight watts of thermal energy inside the

417

00:17:24,030 --> 00:17:22,000

insulated box of the rover and so in a

418

00:17:26,220 --> 00:17:24,040

couple of days we should hit that steady

419

00:17:27,920 --> 00:17:26,230

state point and we should be able to sit

420

00:17:30,720 --> 00:17:27,930

there for an extended period of time

421

00:17:33,150 --> 00:17:30,730

until either the skies clear and we get

422

00:17:34,920 --> 00:17:33,160

power or if this storm persists it's

423

00:17:39,390 --> 00:17:34,930

expected that these temperatures would

424

00:17:41,580 --> 00:17:39,400

persist around the vehicle and then you

425

00:17:45,060 --> 00:17:41,590

know how cold can the rover go well it

426

00:17:47,640 --> 00:17:45,070

was designed to go to minus 55 degrees C

427

00:17:48,240 --> 00:17:47,650

it's flight allowable temperatures minus

428

00:17:50,820 --> 00:17:48,250

42

429

00:17:54,870 --> 00:17:50,830

reisi and so the coldest temperature we

430

00:17:57,060 --> 00:17:54,880

expect to see predicta C is minus 36

431

00:18:00,350 --> 00:17:57,070

degrees C so we think we can ride this

432

00:18:04,140 --> 00:18:00,360

out for for a a while

433

00:18:06,960 --> 00:18:04,150

alright thanks John to two things first

434

00:18:08,910 --> 00:18:06,970

of all we do have quite a few reporters

435

00:18:10,680 --> 00:18:08,920

who are waiting to ask questions so on

436

00:18:12,750 --> 00:18:10,690

this first round we're going to limit it

437

00:18:15,090 --> 00:18:12,760

to one question and if needed one quick

438

00:18:18,530 --> 00:18:15,100

follow-up and time allowing we'll go

439

00:18:21,120 --> 00:18:18,540

back also to our panelists or speakers

440

00:18:24,090 --> 00:18:21,130

if you could identify yourself since

441

00:18:25,560 --> 00:18:24,100

people can't see you and you might

442

00:18:29,010 --> 00:18:25,570

accidentally get attributed with

443

00:18:30,840 --> 00:18:29,020

somebody else's quote so anyway we're

444

00:18:33,540 --> 00:18:30,850

gonna take our next question from Marcia

445

00:18:35,700 --> 00:18:33,550

Dunn of Associated Press Marcia yes

446

00:18:38,250 --> 00:18:35,710

thank you what's the chances of

447

00:18:40,620 --> 00:18:38,260

opportunity being buried under dust like

448

00:18:43,080 --> 00:18:40,630

under a big dune and buried also buried

449

00:18:48,000 --> 00:18:43,090

alive so to speak and is there any risk

450

00:18:49,620 --> 00:18:48,010

to curiosity um this is John Kallis well

451
00:18:53,790 --> 00:18:49,630
I'll take that a baby rich might follow

452
00:18:56,430 --> 00:18:53,800
up the the physical volume of deaths

453
00:18:58,920 --> 00:18:56,440
that would fall on the rover is really

454
00:19:01,050 --> 00:18:58,930
tiny we're talking about a monolayer a

455
00:19:04,310 --> 00:19:01,060
literally a single layer of dust that

456
00:19:06,900 --> 00:19:04,320
could accumulate on the rover so that's

457
00:19:09,450 --> 00:19:06,910
so it's not a concern of the rover being

458
00:19:11,250 --> 00:19:09,460
buried there is a concern that once the

459
00:19:12,630 --> 00:19:11,260
skies clear we may have a lot of dust on

460
00:19:15,900 --> 00:19:12,640
this vehicle that we'll have to deal

461
00:19:18,900 --> 00:19:15,910
with rich did you want to sow curiosity

462
00:19:21,060 --> 00:19:18,910
being nuclear-powered and the fact that

463
00:19:24,470 --> 00:19:21,070

the dust haze has not been as great as

464

00:19:27,150 --> 00:19:24,480

thick there as over opportunity is

465

00:19:29,010 --> 00:19:27,160

actually trying to do some science by

466

00:19:31,710 --> 00:19:29,020

looking to see if there's dust movement

467

00:19:35,040 --> 00:19:31,720

inside the crater itself and they're not

468

00:19:37,700 --> 00:19:35,050

too worried at this point and I'll just

469

00:19:39,990 --> 00:19:37,710

repeat what John said which is that

470

00:19:42,660 --> 00:19:40,000

we're talking if you took all the dust

471

00:19:46,020 --> 00:19:42,670

out of the atmosphere here it's a very

472

00:19:47,640 --> 00:19:46,030

thin cover and in fact in many respects

473

00:19:51,720 --> 00:19:47,650

is kind of like what falls out on your

474

00:19:53,700 --> 00:19:51,730

car on a summer days sometimes but in

475

00:19:55,440 --> 00:19:53,710

the atmosphere it's very absorbent and

476

00:19:56,850 --> 00:19:55,450

that's what's producing the darkness

477

00:20:00,330 --> 00:19:56,860

with the service and scattering the

478

00:20:06,310 --> 00:20:02,680

okay thank you we're gonna take our next

479

00:20:08,560 --> 00:20:06,320

question from bill Harwood CBS News yeah

480

00:20:09,820 --> 00:20:08,570

hi this is for John Kallis I I might

481

00:20:11,440 --> 00:20:09,830

have just misunderstood you I wanted to

482

00:20:13,510 --> 00:20:11,450

make sure I understood what power level

483

00:20:15,280 --> 00:20:13,520

you you thought you were at when you

484

00:20:16,930 --> 00:20:15,290

last heard from it in other words this

485

00:20:18,760 --> 00:20:16,940

the clocks still running or do you think

486

00:20:20,920 --> 00:20:18,770

you're in that mode you were talking

487

00:20:22,990 --> 00:20:20,930

about I was confused between 22 what

488

00:20:26,200 --> 00:20:23,000

hours and 24 Thanks

489

00:20:27,790 --> 00:20:26,210

right yeah so our last measurement of

490

00:20:29,950 --> 00:20:27,800

energy which was from last time we heard

491

00:20:31,720 --> 00:20:29,960

from the rover was approximately around

492

00:20:33,340 --> 00:20:31,730

22 watt hours there's a fair amount of

493

00:20:35,860 --> 00:20:33,350

uncertainty of it because you know these

494

00:20:37,330 --> 00:20:35,870

numbers are so low and that's roughly

495

00:20:40,180 --> 00:20:37,340

the amount of energy you need to

496

00:20:44,920 --> 00:20:40,190

maintain them the mission clock so if

497

00:20:46,630 --> 00:20:44,930

we've had a minimum in an energy

498

00:20:49,210 --> 00:20:46,640

production then we should be able to

499

00:20:51,970 --> 00:20:49,220

maintain the clock however if the storm

500

00:20:54,280 --> 00:20:51,980

gets you know worse if the atmosphere

501
00:20:55,990 --> 00:20:54,290
capacity is increasing that energy level

502
00:20:58,600 --> 00:20:56,000
will drop and we won't be able to

503
00:21:00,010 --> 00:20:58,610
sustain that the clock and at some point

504
00:21:04,690 --> 00:21:00,020
we'll have a mission clock fall which

505
00:21:06,460 --> 00:21:04,700
will be a more complicated recovery all

506
00:21:10,390 --> 00:21:06,470
right next the next question comes from

507
00:21:12,340 --> 00:21:10,400
Dan Bergen Oh at BuzzFeed Dan hi thanks

508
00:21:13,870 --> 00:21:12,350
very much could you talk a little bit

509
00:21:15,280 --> 00:21:13,880
about that more complicated recovery if

510
00:21:16,840 --> 00:21:15,290
that's what happens how many days and

511
00:21:19,530 --> 00:21:16,850
watching and waiting are we talking

512
00:21:25,450 --> 00:21:19,540
about and sort of how will that play out

513
00:21:27,790 --> 00:21:25,460

okay so this is John again we likely are

514

00:21:29,530 --> 00:21:27,800

in a low-power fault right now which

515

00:21:31,720 --> 00:21:29,540

means that the rubber just shuts

516

00:21:33,430 --> 00:21:31,730

everything off and it waits for power to

517

00:21:35,950 --> 00:21:33,440

come back and when power comes back it

518

00:21:38,170 --> 00:21:35,960

knows to communicate during a very

519

00:21:40,660 --> 00:21:38,180

specific time in the middle of the day

520

00:21:42,820 --> 00:21:40,670

essentially noon time and so we know -

521

00:21:45,460 --> 00:21:42,830

when to listen for the rover so if we

522

00:21:47,170 --> 00:21:45,470

come back when the skies clear we would

523

00:21:49,060 --> 00:21:47,180

expect to hear the rover in one of these

524

00:21:50,560 --> 00:21:49,070

fault windows if there's a mission clock

525

00:21:51,850 --> 00:21:50,570

fault

526
00:21:55,030 --> 00:21:51,860
it means the rubber doesn't know what

527
00:21:58,240 --> 00:21:55,040
time it is and so the river then starts

528
00:22:00,930 --> 00:21:58,250
to set a series of check our alarm

529
00:22:02,830 --> 00:22:00,940
clocks at regular intervals to wake up

530
00:22:05,260 --> 00:22:02,840
actually not really to wake up but

531
00:22:07,360 --> 00:22:05,270
actually to see if the Sun is up if the

532
00:22:09,130 --> 00:22:07,370
Sun is up then it attempts to wake up if

533
00:22:11,410 --> 00:22:09,140
it's not then it's another one of these

534
00:22:14,080 --> 00:22:11,420
alarm clocks to check roughly four hours

535
00:22:17,620 --> 00:22:14,090
later so it tries to

536
00:22:19,930 --> 00:22:17,630
look for the sunny time of day and then

537
00:22:21,430 --> 00:22:19,940
to wake up and so the timing of that is

538
00:22:23,940 --> 00:22:21,440

uncertain because we don't know when

539

00:22:27,610 --> 00:22:23,950

that for our alarm clock will expire

540

00:22:29,440 --> 00:22:27,620

within the you know solar illuminated

541

00:22:31,210 --> 00:22:29,450

time of the day of the rover so it means

542

00:22:33,370 --> 00:22:31,220

we have to attitude to watch them you

543

00:22:37,240 --> 00:22:33,380

vigilant and that's the complexity they

544

00:22:37,810 --> 00:22:37,250

are just uncertainly on the time thanks

545

00:22:40,180 --> 00:22:37,820

very much

546

00:22:44,140 --> 00:22:40,190

all right the next question is from Joe

547

00:22:45,970 --> 00:22:44,150

Kalka from NPR hi thanks um two

548

00:22:49,030 --> 00:22:45,980

questions I guess one did how did

549

00:22:52,030 --> 00:22:49,040

opportunity do in the 2000 dust storm

550

00:22:53,790 --> 00:22:52,040

and the second is as you're modeling of

551
00:22:56,080 --> 00:22:53,800
how long things are going to work

552
00:22:59,080 --> 00:22:56,090
complicated by the fact that the battery

553
00:23:02,880 --> 00:22:59,090
is now 14 years old on Mars and may be

554
00:23:06,490 --> 00:23:02,890
behaving differently let's say so the

555
00:23:09,640 --> 00:23:06,500
2007 dust storm opportunity you know

556
00:23:12,610 --> 00:23:09,650
fared well through that we were able to

557
00:23:14,380 --> 00:23:12,620
maintain sequence control the entire

558
00:23:16,600 --> 00:23:14,390
time through that dust storm but we did

559
00:23:18,340 --> 00:23:16,610
have periods of time where we didn't

560
00:23:21,640 --> 00:23:18,350
hear from the rover four or four days

561
00:23:24,250 --> 00:23:21,650
where we chose to have it minimize

562
00:23:27,550 --> 00:23:24,260
activities and then communicate with us

563
00:23:29,290 --> 00:23:27,560

on the fourth day so we were able to

564

00:23:33,240 --> 00:23:29,300

ride that out but we were always under

565

00:23:35,170 --> 00:23:33,250

sequence control here as of today our

566

00:23:37,360 --> 00:23:35,180

expectation is that we've already done

567

00:23:40,180 --> 00:23:37,370

not into low-power fault these are just

568

00:23:42,390 --> 00:23:40,190

historic low energy levels for the

569

00:23:44,710 --> 00:23:42,400

vehicle

570

00:23:46,330 --> 00:23:44,720

I'm sorry remember you see your second

571

00:23:49,500 --> 00:23:46,340

question second part of your battery

572

00:23:52,450 --> 00:23:49,510

behavior for bite for prediction yeah

573

00:23:55,270 --> 00:23:52,460

you know even though these batteries are

574

00:23:57,880 --> 00:23:55,280

15 years old and they have over 5,000

575

00:24:01,540 --> 00:23:57,890

charge/discharge cycles they still have

576

00:24:03,490 --> 00:24:01,550

about 85 percent of their capacity they

577

00:24:05,320 --> 00:24:03,500

are really the finest batteries in the

578

00:24:07,870 --> 00:24:05,330

solar system I mean I only wish my cell

579

00:24:10,510 --> 00:24:07,880

phone battery had half of that so we

580

00:24:13,090 --> 00:24:10,520

actually have a fairly robust batteries

581

00:24:14,620 --> 00:24:13,100

at this time I mean there is uncertainty

582

00:24:17,800 --> 00:24:14,630

there's likely higher internal

583

00:24:22,240 --> 00:24:17,810

resistance but we think the batteries

584

00:24:23,620 --> 00:24:22,250

will will ride this out well this is

585

00:24:25,210 --> 00:24:23,630

Richard Rico I want to point out that

586

00:24:27,080 --> 00:24:25,220

there's tremendous variability in the

587

00:24:30,019 --> 00:24:27,090

opacity across the planet

588

00:24:32,989 --> 00:24:30,029

whereas opportunity is seeing members of

589

00:24:35,779 --> 00:24:32,999

this towel as a measure of that opacity

590

00:24:37,549 --> 00:24:35,789

at 14 curiosity is seeing more like two

591

00:24:40,460 --> 00:24:37,559

to three at the moment although that

592

00:24:42,289 --> 00:24:40,470

members rising we hope that maybe it

593

00:24:45,799 --> 00:24:42,299

will open up and clear skies over the

594

00:24:48,619 --> 00:24:45,809

Rover one of the unusual things about

595

00:24:51,289 --> 00:24:48,629

this storm was the fact that it started

596

00:24:53,090 --> 00:24:51,299

as a local storm which grew normally

597

00:24:55,249 --> 00:24:53,100

those local storms kind of sweep on by

598

00:24:57,200 --> 00:24:55,259

opportunity site and go down into the

599

00:24:59,659 --> 00:24:57,210

southern hemisphere before spreading out

600

00:25:01,430 --> 00:24:59,669

into a much bigger event that didn't

601
00:25:04,070 --> 00:25:01,440
happen this time the storm sort of

602
00:25:07,279 --> 00:25:04,080
stalled over the site and has produced

603
00:25:11,509 --> 00:25:07,289
this record measurement of an opacity of

604
00:25:12,830 --> 00:25:11,519
about ten okay the next question we're

605
00:25:16,430 --> 00:25:12,840
going take is we're in the Washington

606
00:25:17,600 --> 00:25:16,440
Post and Sarah Caplan hi I'm wondering

607
00:25:19,039 --> 00:25:17,610
if you guys can talk a little bit more

608
00:25:23,899 --> 00:25:19,049
about what we know about what causes

609
00:25:28,039 --> 00:25:23,909
these storms and how I mean and also how

610
00:25:32,119 --> 00:25:28,049
long this one is expected to last this

611
00:25:33,730 --> 00:25:32,129
is rich god the storms are starting out

612
00:25:36,100 --> 00:25:33,740
as a local storm and that's pretty much

613
00:25:38,930 --> 00:25:36,110

similar to our experience here on earth

614

00:25:42,619 --> 00:25:38,940

where you have strong winds may be

615

00:25:44,480 --> 00:25:42,629

associated with a storm system front

616

00:25:46,460 --> 00:25:44,490

moving through an area and you have

617

00:25:49,669 --> 00:25:46,470

moveable dust on the surface and that's

618

00:25:52,190 --> 00:25:49,679

all you need for a dust storm once it

619

00:25:53,680 --> 00:25:52,200

begins to go however the dust can get

620

00:25:56,450 --> 00:25:53,690

lifted higher into the atmosphere

621

00:25:58,639 --> 00:25:56,460

because the dust sort of box itself

622

00:26:01,730 --> 00:25:58,649

because it absorbs the sunlight coming

623

00:26:03,379 --> 00:26:01,740

in heats up and that changes the

624

00:26:04,279 --> 00:26:03,389

circulation to raise it higher into the

625

00:26:08,749 --> 00:26:04,289

atmosphere

626

00:26:11,389 --> 00:26:08,759

does it go because once the storm is not

627

00:26:14,149 --> 00:26:11,399

raising dust anymore the dust begins to

628

00:26:15,830 --> 00:26:14,159

fall out but the higher elevation it is

629

00:26:18,200 --> 00:26:15,840

the longer it will take to do that

630

00:26:20,869 --> 00:26:18,210

so there's sort of a correlation between

631

00:26:24,350 --> 00:26:20,879

howl peak and how high the dust goes and

632

00:26:27,799 --> 00:26:24,360

how long the storm will last typically

633

00:26:30,139 --> 00:26:27,809

you get back-to-back on levels and a few

634

00:26:33,230 --> 00:26:30,149

weeks for the very largest storms that

635

00:26:34,639 --> 00:26:33,240

could be a few months and the reason we

636

00:26:38,359 --> 00:26:34,649

don't get storms like this on earth is

637

00:26:40,030 --> 00:26:38,369

just there's not as much dust or the

638

00:26:42,220 --> 00:26:40,040

Mars atmosphere is pretty

639

00:26:44,170 --> 00:26:42,230

and so when you get something that can

640

00:26:47,620 --> 00:26:44,180

absorb radiation in the atmosphere and

641

00:26:48,700 --> 00:26:47,630

heat it up it responds very quickly on

642

00:26:51,190 --> 00:26:48,710

the earth there's a lot of heat

643

00:26:54,130 --> 00:26:51,200

reservoir oceans water in the ground the

644

00:26:57,310 --> 00:26:54,140

ground itself and that tends to kind of

645

00:27:00,370 --> 00:26:57,320

modulate the response to it it's not as

646

00:27:05,590 --> 00:27:00,380

immediate or as large Mars will sort of

647

00:27:07,840 --> 00:27:05,600

extreme in that regard Thanks take a

648

00:27:11,800 --> 00:27:07,850

question now from Tom rising from

649

00:27:14,440 --> 00:27:11,810

aerospace America thank you for doing

650

00:27:16,780 --> 00:27:14,450

the call this is Tom I'm wondering if

651
00:27:18,390 --> 00:27:16,790
this I know you thought that dust was

652
00:27:20,710 --> 00:27:18,400
going to be a problem for solar power

653
00:27:22,810 --> 00:27:20,720
when you got into this but did this

654
00:27:25,270 --> 00:27:22,820
catch your engineers by surprise does

655
00:27:31,030 --> 00:27:25,280
this had any Endon C to produce more

656
00:27:32,050 --> 00:27:31,040
plutonium for spacecraft power I think

657
00:27:35,980 --> 00:27:32,060
that's probably a question for

658
00:27:38,140 --> 00:27:35,990
headquarters yes this is Jim D I think

659
00:27:40,300 --> 00:27:38,150
when we started out with our systems on

660
00:27:43,600 --> 00:27:40,310
a solar powered design we were fully

661
00:27:47,800 --> 00:27:43,610
aware that this possibly exists as rich

662
00:27:50,740 --> 00:27:47,810
explained storms occur but they did not

663
00:27:52,720 --> 00:27:50,750

occur with a regularity that we can

664

00:27:55,570 --> 00:27:52,730

count on or coverage that we can count

665

00:27:57,370 --> 00:27:55,580

on so that in the balance of finding an

666

00:27:59,680 --> 00:27:57,380

engineering solution that works and

667

00:28:02,320 --> 00:27:59,690

that's affordable we settled on solar

668

00:28:04,810 --> 00:28:02,330

power for the initial machines the

669

00:28:06,670 --> 00:28:04,820

larger Rovers we're not able to support

670

00:28:08,980 --> 00:28:06,680

the kind of ambitious operations that

671

00:28:11,020 --> 00:28:08,990

we're doing with them using solar power

672

00:28:12,910 --> 00:28:11,030

the arrays are just prohibitive in size

673

00:28:17,920 --> 00:28:12,920

and so that's fundamentally why are we

674

00:28:19,660 --> 00:28:17,930

switched over to the nuclear power all

675

00:28:22,140 --> 00:28:19,670

right thanks we're going to take a

676
00:28:25,870 --> 00:28:22,150
question now from nature magazine and

677
00:28:28,240 --> 00:28:25,880
Alexander witzzy hi thanks for taking my

678
00:28:31,030 --> 00:28:28,250
call my question is about insight on its

679
00:28:33,940 --> 00:28:31,040
way is there any chance this storm if it

680
00:28:36,130 --> 00:28:33,950
goes global could last until its landing

681
00:28:42,000 --> 00:28:36,140
and if so how would that affect EDL for

682
00:28:44,980 --> 00:28:42,010
insight I think that the inside itself

683
00:28:48,100 --> 00:28:44,990
uses inertial measurement using it unit

684
00:28:50,140 --> 00:28:48,110
if you will or gyroscopes to provide his

685
00:28:52,990 --> 00:28:50,150
primary guidance and then on touchdown

686
00:28:53,650 --> 00:28:53,000
it uses radar for the final phase of the

687
00:28:55,810 --> 00:28:53,660
landing

688
00:28:58,150 --> 00:28:55,820

neither one of those are bothered by the

689

00:29:00,670 --> 00:28:58,160

dust so if we were to happen to end up

690

00:29:02,440 --> 00:29:00,680

in a situation that there was a dust

691

00:29:04,990 --> 00:29:02,450

storm at the time of landing we could

692

00:29:06,880 --> 00:29:05,000

fly right through it I think rich can

693

00:29:08,770 --> 00:29:06,890

comment in terms of the longevity of the

694

00:29:11,440 --> 00:29:08,780

storm I don't think we would expect this

695

00:29:15,030 --> 00:29:11,450

storm to last much longer than a month

696

00:29:19,240 --> 00:29:15,040

or two but it is unprecedented in the

697

00:29:21,430 --> 00:29:19,250

pace at which it has grown and spread

698

00:29:23,740 --> 00:29:21,440

across the globe but in the November

699

00:29:26,920 --> 00:29:23,750

November 26th if I recall riotous is

700

00:29:29,440 --> 00:29:26,930

when the insight landing it so this

701

00:29:31,960 --> 00:29:29,450

storm is not expected to last the

702

00:29:34,000 --> 00:29:31,970

question is is well a second storm

703

00:29:37,480 --> 00:29:34,010

developed later in the year because we

704

00:29:39,820 --> 00:29:37,490

have seen that in previous Mars years it

705

00:29:41,920 --> 00:29:39,830

is a rare event but we did see that

706

00:29:44,380 --> 00:29:41,930

during both the Mariner 9 spacecraft

707

00:29:47,380 --> 00:29:44,390

encounter and the biking mission back in

708

00:29:52,270 --> 00:29:50,470

insight has prepared for looking at what

709

00:29:54,850 --> 00:29:52,280

that does to the environment and how

710

00:29:56,920 --> 00:29:54,860

that might affect things like EDL is

711

00:29:59,620 --> 00:29:56,930

that descends to the surface and such

712

00:30:02,020 --> 00:29:59,630

and they have considered all those

713

00:30:04,450 --> 00:30:02,030

situations with a global dust storm a

714

00:30:06,130 --> 00:30:04,460

regional best storm and they think they

715

00:30:10,180 --> 00:30:06,140

had margin to adequately deal with all

716

00:30:14,350 --> 00:30:10,190

those we're gonna hop over to London now

717

00:30:16,300 --> 00:30:14,360

Johnathan Amos for the BBC Thank You

718

00:30:19,390 --> 00:30:16,310

Jane for the opportunity can you just

719

00:30:21,790 --> 00:30:19,400

give us a quick update on the health oh

720

00:30:23,530 --> 00:30:21,800

yeah okay I presume we're still driving

721

00:30:28,000 --> 00:30:23,540

backwards and they've got a through

722

00:30:32,440 --> 00:30:28,010

arthritic joints so yeah this is John

723

00:30:34,290 --> 00:30:32,450

Kallis prior to this storm the vehicle

724

00:30:36,700 --> 00:30:34,300

is in actually remarkably good health

725

00:30:38,680 --> 00:30:36,710

yeah you were recalling that we at a

726

00:30:40,660 --> 00:30:38,690

time had to drive the rover backwards

727

00:30:43,270 --> 00:30:40,670

because we were concerned about where on

728

00:30:45,520 --> 00:30:43,280

one of the steering drive actuators

729

00:30:47,440 --> 00:30:45,530

that's actually been well behaved we've

730

00:30:50,320 --> 00:30:47,450

been doing that for now I'm almost a

731

00:30:52,360 --> 00:30:50,330

decade yeah there is one arthritic joint

732

00:30:55,120 --> 00:30:52,370

on the robotic arm but we've been able

733

00:30:56,500 --> 00:30:55,130

to compensate for that we did have a

734

00:30:59,050 --> 00:30:56,510

challenge with one of the steering

735

00:31:00,820 --> 00:30:59,060

mechanisms so we've actually stopped

736

00:31:03,700 --> 00:31:00,830

using that steering mechanism so we're

737

00:31:05,530 --> 00:31:03,710

now at two wheel a two wheel steering

738

00:31:09,080 --> 00:31:05,540

vehicle instead of a four wheel steering

739

00:31:11,909 --> 00:31:09,090

vehicle so we drive more like a

740

00:31:13,529 --> 00:31:11,919

but other than that the vehicles it was

741

00:31:15,210 --> 00:31:13,539

in remarkably good health the cameras

742

00:31:16,710 --> 00:31:15,220

were in excellent shape the alpha

743

00:31:19,350 --> 00:31:16,720

particle x-ray spectrometer was

744

00:31:21,120 --> 00:31:19,360

collecting excellent data so we're eager

745

00:31:22,320 --> 00:31:21,130

for this storm to clear recover the

746

00:31:25,440 --> 00:31:22,330

rover and continue on with our

747

00:31:28,950 --> 00:31:25,450

exploration so you've got still got all

748

00:31:32,190 --> 00:31:28,960

your instruments yes

749

00:31:33,930 --> 00:31:32,200

I mean dust will be a concern will

750

00:31:36,360 --> 00:31:33,940

likely have some dust on the optics but

751

00:31:38,340 --> 00:31:36,370

our experience from last dust storm is

752

00:31:40,890 --> 00:31:38,350

that the dust actually sheds off the

753

00:31:43,770 --> 00:31:40,900

optics over a short period of time and

754

00:31:51,210 --> 00:31:43,780

we can calibrate out any remaining specs

755

00:31:54,600 --> 00:31:51,220

on the glass Irene class at Aviation

756

00:31:56,220 --> 00:31:54,610

Week all right thanks very much um can

757

00:31:58,470 --> 00:31:56,230

you give us an update on the science

758

00:32:03,270 --> 00:31:58,480

that opportunity was doing tired of the

759

00:32:06,360 --> 00:32:03,280

disjoin yes is John Kallis I'll start

760

00:32:08,279 --> 00:32:06,370

that maybe rich might head into it we're

761

00:32:10,980 --> 00:32:08,289

at this feature called perseverance

762

00:32:14,220 --> 00:32:10,990

Valley which is a channel that's carved

763

00:32:16,350 --> 00:32:14,230

in the rim of Endeavour crater from

764

00:32:18,360 --> 00:32:16,360

orbit it looked like it might be falou

765

00:32:20,850 --> 00:32:18,370

Viall carved I mean some fluid may have

766

00:32:22,710 --> 00:32:20,860

carved this feature and so we're in the

767

00:32:24,510 --> 00:32:22,720

process of exploring that or about

768

00:32:27,210 --> 00:32:24,520

halfway down and we're testing several

769

00:32:28,950 --> 00:32:27,220

hypotheses to its origin whether it was

770

00:32:31,169 --> 00:32:28,960

flowing water that might have carved

771

00:32:34,500 --> 00:32:31,179

this or whether it might have been wind

772

00:32:36,029 --> 00:32:34,510

erosion or a combination of factors so

773

00:32:39,600 --> 00:32:36,039

that was our that's our primary science

774

00:32:41,310 --> 00:32:39,610

objective right now once we're done with

775

00:32:43,320 --> 00:32:41,320

that we intend to move further down into

776

00:32:45,450 --> 00:32:43,330

the crater along the inside rim and look

777

00:32:49,440 --> 00:32:45,460

at the different layers of the crater to

778

00:32:53,220 --> 00:32:49,450

assess the different geological epochs

779

00:32:54,510 --> 00:32:53,230

that are revealed on the inner edge rich

780

00:32:56,310 --> 00:32:54,520

I don't know if you wanted to add

781

00:32:58,649 --> 00:32:56,320

anything more to that well I think the

782

00:33:01,470 --> 00:32:58,659

exploration that opportunity was doing

783

00:33:02,789 --> 00:33:01,480

here shows the example of you know it's

784

00:33:04,500 --> 00:33:02,799

pretty easy when you look at something

785

00:33:06,120 --> 00:33:04,510

from orbit to say I think I know what

786

00:33:08,340 --> 00:33:06,130

that is and then you get down on the

787

00:33:11,190 --> 00:33:08,350

ground and you begin to see it's a lot

788

00:33:13,230 --> 00:33:11,200

more complex and the testing of the

789

00:33:15,480 --> 00:33:13,240

hypothesis is would still be going on

790

00:33:18,180 --> 00:33:15,490

once opportunity to recovers from this

791

00:33:19,040 --> 00:33:18,190

storm getting down to the floor of the

792

00:33:20,540 --> 00:33:19,050

crater

793

00:33:22,130 --> 00:33:20,550

seeing some of the debris that would

794

00:33:24,890 --> 00:33:22,140

there would really help us understand

795

00:33:27,350 --> 00:33:24,900

whether these are wind card or fluid

796

00:33:30,320 --> 00:33:27,360

carved or exactly what we're looking at

797

00:33:35,690 --> 00:33:30,330

it just shows that you ground truth is a

798

00:33:37,970 --> 00:33:35,700

good thing quite a few people from the

799

00:33:39,830 --> 00:33:37,980

reporter lines waiting to ask questions

800

00:33:41,600 --> 00:33:39,840

and we have some people on social media

801
00:33:43,970 --> 00:33:41,610
as well so right now we'll take one more

802
00:33:45,350 --> 00:33:43,980
from a reporter and then we'll have to a

803
00:33:48,830 --> 00:33:45,360
couple some social and then we'll come

804
00:33:53,930 --> 00:33:48,840
back to the reporters so the next one is

805
00:33:56,650 --> 00:33:53,940
from alan boyle at peak wire oh hi thank

806
00:33:59,270 --> 00:33:56,660
you for taking the question I wanted to

807
00:34:00,530 --> 00:33:59,280
hear a little bit more about the effect

808
00:34:03,350 --> 00:34:00,540
on the team itself

809
00:34:06,410 --> 00:34:03,360
I've seen some tweets where people are

810
00:34:08,600 --> 00:34:06,420
really concerned have you had to

811
00:34:10,609 --> 00:34:08,610
reassure members of the team that it's

812
00:34:13,609 --> 00:34:10,619
all going to be alright or what's the

813
00:34:18,230 --> 00:34:13,619

mood of the team yeah it is concerning I

814

00:34:20,240 --> 00:34:18,240

mean this team has a very strong bond

815

00:34:22,250 --> 00:34:20,250

with the rover you know we have a very

816

00:34:24,470 --> 00:34:22,260

tight emotional connection with it and

817

00:34:27,020 --> 00:34:24,480

and we're concerned about it I mean

818

00:34:29,780 --> 00:34:27,030

obviously you know we anthropomorphize

819

00:34:31,639 --> 00:34:29,790

this rover and you know the analogy I

820

00:34:34,730 --> 00:34:31,649

would use right now it's like you have a

821

00:34:36,080 --> 00:34:34,740

loved one in a coma in the hospital you

822

00:34:38,359 --> 00:34:36,090

know the doctors are telling you that

823

00:34:41,060 --> 00:34:38,369

okay you just got to give it time and

824

00:34:41,810 --> 00:34:41,070

she'll wake up you know all the vital

825

00:34:44,419 --> 00:34:41,820

signs are good

826

00:34:46,580 --> 00:34:44,429

so it's just waiting it out but you know

827

00:34:48,800 --> 00:34:46,590

if it's your 97 year old grandmother

828

00:34:52,220 --> 00:34:48,810

you're going to be very concerned and so

829

00:34:54,800 --> 00:34:52,230

we are and and you know by no means are

830

00:34:57,800 --> 00:34:54,810

we out of the woods here the storm is is

831

00:35:01,190 --> 00:34:57,810

threatening it's and we don't know how

832

00:35:02,930 --> 00:35:01,200

long it will last and we don't know what

833

00:35:06,770 --> 00:35:02,940

the environment will be like once it

834

00:35:08,690 --> 00:35:06,780

clears so yeah we are all concerned and

835

00:35:12,170 --> 00:35:08,700

you know you can see it in the team

836

00:35:13,880 --> 00:35:12,180

members okay the first question we're

837

00:35:16,190 --> 00:35:13,890

going to take from social media is from

838

00:35:18,109 --> 00:35:16,200

Twitter Kevin asks are there any

839

00:35:20,390 --> 00:35:18,119

concerns that dust will accumulate

840

00:35:22,880 --> 00:35:20,400

around the wheels possibly preventing

841

00:35:29,150 --> 00:35:25,999

no again you know the amount of dust in

842

00:35:31,490 --> 00:35:29,160

this storm is will correspond to just a

843

00:35:34,940 --> 00:35:31,500

you know a single layer of dust on the

844

00:35:36,380 --> 00:35:34,950

rover and the terrain around it so we're

845

00:35:38,809 --> 00:35:36,390

not concerned about the mobility

846

00:35:40,579 --> 00:35:38,819

limitations I think our biggest concern

847

00:35:43,910 --> 00:35:40,589

is you know how much power will the

848

00:35:47,539 --> 00:35:43,920

rover produce and whether the dust has

849

00:35:51,349 --> 00:35:47,549

you know put a lot of particles on the

850

00:35:52,940 --> 00:35:51,359

optics of the cameras but we're not

851

00:35:56,120 --> 00:35:52,950

concerned about mobility at this point

852

00:35:57,849 --> 00:35:56,130

that this is rich like the opportunity

853

00:36:00,319 --> 00:35:57,859

Rover is on the rim of Endeavour crater

854

00:36:02,390 --> 00:36:00,329

perseverance Valley is that's kind of a

855

00:36:05,150 --> 00:36:02,400

windy area as long as dusters are being

856

00:36:07,009 --> 00:36:05,160

raised locally transported in the wind

857

00:36:09,440 --> 00:36:07,019

will actually help clean off the arrays

858

00:36:13,940 --> 00:36:09,450

an opportunity has seen several of those

859

00:36:16,730 --> 00:36:13,950

events in the past the next question for

860

00:36:19,730 --> 00:36:16,740

social media is from David on Facebook

861

00:36:21,230 --> 00:36:19,740

and he's asking if you have an idea how

862

00:36:24,829 --> 00:36:21,240

long the dust particles will be

863

00:36:26,329 --> 00:36:24,839

suspended in the atmosphere well this is

864

00:36:26,900 --> 00:36:26,339

Rachel Erick again that's a good

865

00:36:30,859 --> 00:36:26,910

question

866

00:36:32,809 --> 00:36:30,869

and it's typically how high are they

867

00:36:35,150 --> 00:36:32,819

going to go why will they get locked it

868

00:36:36,799 --> 00:36:35,160

in this big event that's actually

869

00:36:39,920 --> 00:36:36,809

changing the global circulation and

870

00:36:43,099 --> 00:36:39,930

taking things may be far outside the

871

00:36:45,650 --> 00:36:43,109

active dust raising area in a global

872

00:36:48,650 --> 00:36:45,660

storm that is the biggest largest storms

873

00:36:50,660 --> 00:36:48,660

that we've seen the desk can be taken up

874

00:36:52,579 --> 00:36:50,670

about 70 kilometres and it takes two or

875

00:36:54,980 --> 00:36:52,589

three months to fallout from those

876

00:36:57,980 --> 00:36:54,990

altitudes so I just kind of think of it

877

00:37:00,710 --> 00:36:57,990

it's kind of like when a cloud goes over

878

00:37:03,319 --> 00:37:00,720

there's a settling out of the materials

879

00:37:05,210 --> 00:37:03,329

and stuff and that of course depends

880

00:37:07,460 --> 00:37:05,220

upon the winds whether it's raised again

881

00:37:10,160 --> 00:37:07,470

locally or sites but normally in these

882

00:37:11,990 --> 00:37:10,170

storms there's a long decayed phase of

883

00:37:18,109 --> 00:37:12,000

clearing out at the atmosphere again

884

00:37:19,849 --> 00:37:18,119

taking several weeks to a few months I

885

00:37:23,240 --> 00:37:19,859

think I just want to you know state

886

00:37:24,890 --> 00:37:23,250

again having this best storm occur under

887

00:37:28,160 --> 00:37:24,900

the visibility of the whole fleet of

888

00:37:30,769 --> 00:37:28,170

orbiters that we have and eventually

889

00:37:32,599 --> 00:37:30,779

here curiosity participating in the

890

00:37:33,980 --> 00:37:32,609

research as well is going to teach us a

891

00:37:36,200 --> 00:37:33,990

whole lot about how the

892

00:37:39,230 --> 00:37:36,210

storms behave and what the consistency

893

00:37:41,780 --> 00:37:39,240

of these are this is I not like a Desert

894

00:37:46,760 --> 00:37:41,790

Storm that shifts major sand dunes in

895

00:37:50,060 --> 00:37:46,770

the year on earth but this is more like

896

00:37:51,380 --> 00:37:50,070

talcum powder that's lofted into the

897

00:37:53,300 --> 00:37:51,390

atmosphere and eventually gets

898

00:37:56,690 --> 00:37:53,310

distributed across the globe but exactly

899

00:37:59,570 --> 00:37:56,700

how all that behaves as rich alluded to

900

00:38:01,040 --> 00:37:59,580

we understand some of the principles but

901
00:38:02,840 --> 00:38:01,050
we need a lot more in a way of

902
00:38:06,080 --> 00:38:02,850
observations and this storm is going to

903
00:38:07,490 --> 00:38:06,090
provide us with more answers a lot of

904
00:38:08,930 --> 00:38:07,500
the questions that you're asking here

905
00:38:10,609 --> 00:38:08,940
right now we're kind of giving you

906
00:38:14,450 --> 00:38:10,619
generalities but that's where our state

907
00:38:16,130 --> 00:38:14,460
of knowledge is right now thanks we're

908
00:38:17,540 --> 00:38:16,140
gonna we'll try to get back to some more

909
00:38:20,330 --> 00:38:17,550
social media questions for right now

910
00:38:23,990 --> 00:38:20,340
we're going to go to Leo and right at

911
00:38:26,570 --> 00:38:24,000
Irish television hey Leo thanks thanks

912
00:38:28,550 --> 00:38:26,580
very much Jane for doing this I'm just

913
00:38:31,580 --> 00:38:28,560

wondering about collateral damage to

914

00:38:33,530 --> 00:38:31,590

other missions I mean for instance maven

915

00:38:36,950 --> 00:38:33,540

are there where their plans are are

916

00:38:39,770 --> 00:38:36,960

there plans for a deep dip into the

917

00:38:41,090 --> 00:38:39,780

upper atmosphere at this particular time

918

00:38:41,960 --> 00:38:41,100

is that something that would be a

919

00:38:44,060 --> 00:38:41,970

concern

920

00:38:46,280 --> 00:38:44,070

I know it's somewhat higher but not all

921

00:38:49,370 --> 00:38:46,290

that much higher than what you're

922

00:38:52,250 --> 00:38:49,380

talking about for the the dust ice and I

923

00:38:55,609 --> 00:38:52,260

also do wonder a little bit about

924

00:38:57,349 --> 00:38:55,619

curiosity is there is there anything on

925

00:38:59,870 --> 00:38:57,359

that Rover that is potentially at risk

926
00:39:04,690 --> 00:38:59,880
from a heavy dust fall are there any

927
00:39:10,700 --> 00:39:08,510
Dave yeah this is Dave Lavery with

928
00:39:12,859 --> 00:39:10,710
regard to the orbiters we don't

929
00:39:14,660 --> 00:39:12,869
anticipate any hazardous effects from

930
00:39:16,550 --> 00:39:14,670
the dust storm they're at a high enough

931
00:39:18,859 --> 00:39:16,560
altitude that they'll be able to orbit

932
00:39:20,990 --> 00:39:18,869
safely above it and conduct observations

933
00:39:24,050 --> 00:39:21,000
all the way through the process and give

934
00:39:26,120 --> 00:39:24,060
us a lot of observational data and it

935
00:39:27,740 --> 00:39:26,130
will inform us quite a bit more about

936
00:39:29,720 --> 00:39:27,750
how these storms actually operating

937
00:39:33,800 --> 00:39:29,730
function but but we don't expect any

938
00:39:36,260 --> 00:39:33,810

hazards there as for curiosity we have

939

00:39:39,109 --> 00:39:36,270

noticed already a darkening of the skies

940

00:39:40,550 --> 00:39:39,119

above the curiosity's landing site all

941

00:39:44,500 --> 00:39:40,560

the way on the other side of the planet

942

00:39:47,630 --> 00:39:44,510

from opportunity's locations but because

943

00:39:49,190 --> 00:39:47,640

curiosity is a nuclear-powered Rover

944

00:39:50,630 --> 00:39:49,200

we're not having the same concerns with

945

00:39:52,790 --> 00:39:50,640

regard to the power generation so

946

00:39:55,070 --> 00:39:52,800

there's no issue there the only thing

947

00:39:57,680 --> 00:39:55,080

that realistically could possibly be a

948

00:39:59,390 --> 00:39:57,690

concern would be if the storm goes on

949

00:40:01,190 --> 00:39:59,400

long enough and if there were high

950

00:40:04,370 --> 00:40:01,200

enough wind velocities would there be

951
00:40:06,110 --> 00:40:04,380
any issue associated with dusting to

952
00:40:08,450 --> 00:40:06,120
cause it on the optics we've already

953
00:40:10,010 --> 00:40:08,460
taken a look at that based on past

954
00:40:12,080 --> 00:40:10,020
experiences with these farms we don't

955
00:40:13,490 --> 00:40:12,090
expect anything to happen there so the

956
00:40:18,710 --> 00:40:13,500
short version of that answer is

957
00:40:20,450 --> 00:40:18,720
curiosity should be fine okay and I want

958
00:40:22,250 --> 00:40:20,460
to thank all the reporters and people on

959
00:40:24,830 --> 00:40:22,260
social media for being patient we do

960
00:40:26,900 --> 00:40:24,840
have a lot of questions today and we're

961
00:40:29,690 --> 00:40:26,910
going to try to get as many as we

962
00:40:31,910 --> 00:40:29,700
possibly can in before we before our

963
00:40:35,810 --> 00:40:31,920

time is up so the next one will come

964

00:40:37,820 --> 00:40:35,820

from Ken Kramer at space up close hi

965

00:40:41,120 --> 00:40:37,830

thank you for doing for doing this I'm

966

00:40:42,740 --> 00:40:41,130

taking my question for Richards Earth I

967

00:40:44,720 --> 00:40:42,750

guess it sounds like you're saying that

968

00:40:47,560 --> 00:40:44,730

the dust storm is still going to get

969

00:40:50,240 --> 00:40:47,570

worse so can you make some projection

970

00:40:53,510 --> 00:40:50,250

even a guess how long that might be

971

00:40:56,030 --> 00:40:53,520

and then for John Kallis are we talking

972

00:40:58,970 --> 00:40:56,040

about the rover being able to survive

973

00:41:04,070 --> 00:40:58,980

then for weeks and months on end at this

974

00:41:07,010 --> 00:41:04,080

at this low power mode thanks okay this

975

00:41:09,020 --> 00:41:07,020

is a rich Derek and in some sense the

976

00:41:10,510 --> 00:41:09,030

storm is not going to get a whole lot

977

00:41:14,060 --> 00:41:10,520

worse at a given site like that

978

00:41:16,580 --> 00:41:14,070

opportunity what is changing is the

979

00:41:18,860 --> 00:41:16,590

storm is producing a dust days that is

980

00:41:22,010 --> 00:41:18,870

spreading over the planet and getting

981

00:41:23,660 --> 00:41:22,020

raised higher into the atmosphere that

982

00:41:27,100 --> 00:41:23,670

can lengthen is we've been talking about

983

00:41:30,710 --> 00:41:27,110

how long it takes for the storm to clear

984

00:41:32,750 --> 00:41:30,720

we're not expecting the opacities over

985

00:41:33,980 --> 00:41:32,760

opportunity to get a lot worse but it

986

00:41:35,660 --> 00:41:33,990

doesn't really matter because there's

987

00:41:38,660 --> 00:41:35,670

almost no sunlight reaching the ground

988

00:41:42,890 --> 00:41:38,670

now anyway except a little bit scattered

989

00:41:45,950 --> 00:41:42,900

in a very dusty sky so that's not going

990

00:41:48,710 --> 00:41:45,960

to change very much how long the storm

991

00:41:50,720 --> 00:41:48,720

will last that we're not certain about

992

00:41:52,820 --> 00:41:50,730

that is one of the issues that we're

993

00:41:54,590 --> 00:41:52,830

trying to understand about it as Jim

994

00:41:57,260 --> 00:41:54,600

Watson said this is one of the things we

995

00:42:00,200 --> 00:41:57,270

want to learn what initiates that

996

00:42:00,920 --> 00:42:00,210

so-called decay phase where the dust

997

00:42:05,660 --> 00:42:00,930

areas

998

00:42:08,299 --> 00:42:05,670

stop being active raising dust into the

999

00:42:10,940 --> 00:42:08,309

atmosphere and everything just begins to

1000

00:42:13,790 --> 00:42:10,950

fall out now part of that can be the

1001
00:42:17,089 --> 00:42:13,800
storm itself as I spread dust all around

1002
00:42:18,859 --> 00:42:17,099
in the atmosphere it's sort of I smooths

1003
00:42:20,690 --> 00:42:18,869
out some of the pressure gradients that

1004
00:42:24,200 --> 00:42:20,700
drive the winds and such and the winds

1005
00:42:25,760 --> 00:42:24,210
will eventually die down and exactly

1006
00:42:27,710 --> 00:42:25,770
when that's going to happen whether it's

1007
00:42:33,170 --> 00:42:27,720
next week or two weeks from now we don't

1008
00:42:34,790 --> 00:42:33,180
know John yeah thanks rich yeah so yeah

1009
00:42:36,680 --> 00:42:34,800
this is John Kallis the question about

1010
00:42:40,700 --> 00:42:36,690
how long the rover can go in this

1011
00:42:42,620 --> 00:42:40,710
situation as long as the rover stays

1012
00:42:46,160 --> 00:42:42,630
warm enough and our predictions are that

1013
00:42:48,290 --> 00:42:46,170

it will that we can go you know any

1014

00:42:49,880 --> 00:42:48,300

number of days you know we are

1015

00:42:53,150 --> 00:42:49,890

approaching summer so we haven't even

1016

00:42:56,390 --> 00:42:53,160

hit the warmest part of the year for the

1017

00:42:59,660 --> 00:42:56,400

rover at this site and in terms of this

1018

00:43:01,910 --> 00:42:59,670

low power mode that we're in the rover

1019

00:43:04,099 --> 00:43:01,920

actually goes into that every single day

1020

00:43:06,440 --> 00:43:04,109

we have a process we which we called

1021

00:43:08,900 --> 00:43:06,450

deep sleep in which once we're done with

1022

00:43:11,089 --> 00:43:08,910

activities on the day we disconnect the

1023

00:43:13,730 --> 00:43:11,099

batteries from the rover and only the

1024

00:43:16,490 --> 00:43:13,740

mission clock is connected and so we've

1025

00:43:19,220 --> 00:43:16,500

been deep sleeping now for thousands of

1026

00:43:20,930 --> 00:43:19,230

Sol's and so this is just like deep

1027

00:43:22,760 --> 00:43:20,940

sleeping except we're doing it

1028

00:43:26,809 --> 00:43:22,770

throughout the entire day not just at

1029

00:43:31,010 --> 00:43:26,819

night next we're going to space news and

1030

00:43:32,510 --> 00:43:31,020

Jeff's out the call I've heard a lot of

1031

00:43:33,950 --> 00:43:32,520

discussion about this storm being

1032

00:43:36,349 --> 00:43:33,960

unprecedented I wonder if there's any

1033

00:43:38,480 --> 00:43:36,359

way to quantify the intensity of the

1034

00:43:40,549 --> 00:43:38,490

storm and compare it to some past global

1035

00:43:40,970 --> 00:43:40,559

dust storms that had been observed on

1036

00:43:44,030 --> 00:43:40,980

Mars

1037

00:43:46,190 --> 00:43:44,040

thanks well there are a couple of

1038

00:43:49,730 --> 00:43:46,200

metrics that we use one of them is just

1039

00:43:51,530 --> 00:43:49,740

how much of the planet does it cover if

1040

00:43:55,130 --> 00:43:51,540

you will the most global of those storms

1041

00:43:57,020 --> 00:43:55,140

occurred back in 1971 when Mariner 9 was

1042

00:43:58,609 --> 00:43:57,030

approaching March to go into orbit be

1043

00:44:01,220 --> 00:43:58,619

the first spacecraft going a little bit

1044

00:44:03,170 --> 00:44:01,230

around another planet and the entire

1045

00:44:06,400 --> 00:44:03,180

surface except for a little bit up

1046

00:44:08,809 --> 00:44:06,410

around the poles was obscured in fact

1047

00:44:10,789 --> 00:44:08,819

they noted that they were seeing things

1048

00:44:13,339 --> 00:44:10,799

that they call North spot middle spot

1049

00:44:14,570 --> 00:44:13,349

south spot and those were the summits of

1050

00:44:16,580 --> 00:44:14,580

the Tharsis volcano

1051
00:44:18,920 --> 00:44:16,590
which stands some 20 kilometers above

1052
00:44:21,890 --> 00:44:18,930
the surrounding claims so that was a

1053
00:44:25,130 --> 00:44:21,900
very massive storm this has not reached

1054
00:44:28,520 --> 00:44:25,140
that it has not spread over that large

1055
00:44:30,350 --> 00:44:28,530
an area however there are some areas as

1056
00:44:33,830 --> 00:44:30,360
we've seen over opportunity that are

1057
00:44:36,770 --> 00:44:33,840
incredibly dense and that's interesting

1058
00:44:39,470 --> 00:44:36,780
in itself the other aspects of the storm

1059
00:44:42,050 --> 00:44:39,480
are is that it didn't seem to raise dust

1060
00:44:44,930 --> 00:44:42,060
into the upper atmosphere higher into

1061
00:44:46,670 --> 00:44:44,940
the atmosphere it was more slow than

1062
00:44:49,840 --> 00:44:46,680
that has happened in previous storms

1063
00:44:52,460 --> 00:44:49,850

another aspect is is that although these

1064

00:44:55,520 --> 00:44:52,470

storms tend to go big during southern

1065

00:44:58,850 --> 00:44:55,530

spring and summer it's just barely into

1066

00:45:01,210 --> 00:44:58,860

southern spring and this is the earliest

1067

00:45:04,220 --> 00:45:01,220

except for the 2001 storm

1068

00:45:06,740 --> 00:45:04,230

however this storm pretty much spread in

1069

00:45:08,960 --> 00:45:06,750

the northern tropics where as that storm

1070

00:45:11,090 --> 00:45:08,970

went into the southern hemisphere and

1071

00:45:13,610 --> 00:45:11,100

that's where it encircled the planet

1072

00:45:17,240 --> 00:45:13,620

eventually so it's those kinds of

1073

00:45:19,910 --> 00:45:17,250

features its extent it's the opacity of

1074

00:45:23,480 --> 00:45:19,920

the most active areas of dust raising

1075

00:45:26,030 --> 00:45:23,490

and it's how high material gets lopped

1076

00:45:27,950 --> 00:45:26,040

around the planet and of course what

1077

00:45:30,320 --> 00:45:27,960

we'd really like to understand is what

1078

00:45:32,990 --> 00:45:30,330

are the triggers that say this is going

1079

00:45:35,900 --> 00:45:33,000

to happen at this time in the season or

1080

00:45:39,050 --> 00:45:35,910

even in this year as opposed to some

1081

00:45:41,480 --> 00:45:39,060

other year rich this is John cows let me

1082

00:45:44,720 --> 00:45:41,490

just add from the rover's perspective

1083

00:45:47,120 --> 00:45:44,730

the 2007 storm it actually took several

1084

00:45:49,490 --> 00:45:47,130

weeks for the atmospheric opacity to

1085

00:45:51,980 --> 00:45:49,500

build up to somewhere around five point

1086

00:45:54,560 --> 00:45:51,990

five this storm for us where we're

1087

00:45:56,810 --> 00:45:54,570

located on Mars took just a few days to

1088

00:45:59,780 --> 00:45:56,820

go to opacity of you know greater than

1089

00:46:02,120 --> 00:45:59,790

ten so this one had an onset for

1090

00:46:04,100 --> 00:46:02,130

opportunity that was an order of

1091

00:46:05,600 --> 00:46:04,110

magnitude faster and more intense than

1092

00:46:11,090 --> 00:46:05,610

2007 storm

1093

00:46:12,950 --> 00:46:11,100

more like what curiosity is seeing where

1094

00:46:15,260 --> 00:46:12,960

it's taken several days for the opacity

1095

00:46:17,630 --> 00:46:15,270

and to start to build up about the sign

1096

00:46:20,630 --> 00:46:17,640

and again part of that is because

1097

00:46:23,480 --> 00:46:20,640

this time around the local storm that

1098

00:46:25,670 --> 00:46:23,490

served as the original core of the event

1099

00:46:28,410 --> 00:46:25,680

kind of parked right over the

1100

00:46:31,480 --> 00:46:28,420

opportunity sign

1101

00:46:34,630 --> 00:46:31,490

our next question is from science news

1102

00:46:36,190 --> 00:46:34,640

Lisa Grossman Lisa hi thanks for taking

1103

00:46:37,540 --> 00:46:36,200

my question I was wondering if you could

1104

00:46:39,099 --> 00:46:37,550

tell us a little bit more about the

1105

00:46:43,180 --> 00:46:39,109

specific data you'll be collecting to

1106

00:46:43,839 --> 00:46:43,190

study how the storm work this is Rachel

1107

00:46:49,690 --> 00:46:43,849

Eric again

1108

00:46:53,050 --> 00:46:49,700

so we had the graphic suruc three that

1109

00:46:54,940 --> 00:46:53,060

showed the fleet of spacecraft so what

1110

00:46:56,800 --> 00:46:54,950

we're doing is well what opportunity is

1111

00:47:00,250 --> 00:46:56,810

already done which is take a look at the

1112

00:47:03,490 --> 00:47:00,260

opacity of these of the atmosphere

1113

00:47:04,900 --> 00:47:03,500

itself we've also got looking at the

1114

00:47:07,450 --> 00:47:04,910

spread of the storm with our weather

1115

00:47:10,030 --> 00:47:07,460

cameras and such and we're looking at

1116

00:47:12,160 --> 00:47:10,040

that both in the visible images that

1117

00:47:14,410 --> 00:47:12,170

you've seen here but also in the

1118

00:47:16,300 --> 00:47:14,420

infrared because that tells us something

1119

00:47:18,849 --> 00:47:16,310

about the particle size and the

1120

00:47:21,460 --> 00:47:18,859

composition of the material that's in

1121

00:47:23,829 --> 00:47:21,470

the dust we're also looking at how the

1122

00:47:26,740 --> 00:47:23,839

atmosphere is affected by looking at the

1123

00:47:29,020 --> 00:47:26,750

temperatures and such we don't have many

1124

00:47:31,630 --> 00:47:29,030

Wynne direct wind measurements we do

1125

00:47:34,150 --> 00:47:31,640

very high in the atmosphere in another

1126
00:47:36,520 --> 00:47:34,160
aspect of what we look at is how does it

1127
00:47:38,260 --> 00:47:36,530
affect the upper atmosphere were may

1128
00:47:40,030 --> 00:47:38,270
even is dipping down to about a hundred

1129
00:47:43,720 --> 00:47:40,040
and sixty kilometers about a hundred

1130
00:47:46,120 --> 00:47:43,730
miles up they're safe they're able to do

1131
00:47:48,460 --> 00:47:46,130
that but it's very interesting to see

1132
00:47:50,680 --> 00:47:48,470
the response of the upper atmosphere to

1133
00:47:52,530 --> 00:47:50,690
the lower atmosphere and we can fold

1134
00:47:57,060 --> 00:47:52,540
that into future missions that may

1135
00:47:59,410 --> 00:47:57,070
aerobrake or aerocapture in the future

1136
00:48:02,650 --> 00:47:59,420
and our next question is from Jackie

1137
00:48:04,740 --> 00:48:02,660
daughters at The Times of London hello

1138
00:48:07,210 --> 00:48:04,750

thank you what would be the possible

1139

00:48:10,240 --> 00:48:07,220

implications of a storm like this for a

1140

00:48:11,829 --> 00:48:10,250

potential human settlement on Mars what

1141

00:48:13,720 --> 00:48:11,839

are some of those questions or answers

1142

00:48:16,150 --> 00:48:13,730

that you can take away from this to

1143

00:48:20,200 --> 00:48:16,160

possibly need to adapt potential future

1144

00:48:23,740 --> 00:48:20,210

manned missions this is Jim Watson at

1145

00:48:25,180 --> 00:48:23,750

headquarters I think the big takeaway

1146

00:48:28,270 --> 00:48:25,190

here is that we really need to

1147

00:48:30,160 --> 00:48:28,280

understand these storms to the degree

1148

00:48:32,700 --> 00:48:30,170

that we can have some level of

1149

00:48:35,440 --> 00:48:32,710

forecasting capabilities so clearly

1150

00:48:37,900 --> 00:48:35,450

operations outside the shelter for human

1151
00:48:40,450 --> 00:48:37,910
exploration would clearly have some

1152
00:48:41,230 --> 00:48:40,460
constraints on them we would not want to

1153
00:48:44,109 --> 00:48:41,240
have

1154
00:48:46,090 --> 00:48:44,119
Kru if you will operating remotely from

1155
00:48:47,920 --> 00:48:46,100
their base and be caught off guard with

1156
00:48:50,260 --> 00:48:47,930
a storm like this and have difficulty

1157
00:48:52,330 --> 00:48:50,270
getting back home and things like that

1158
00:48:54,670 --> 00:48:52,340
that you can imagine so I think the

1159
00:48:57,310 --> 00:48:54,680
primary thing the takeaway from this is

1160
00:48:59,770 --> 00:48:57,320
in order to support humans safely just

1161
00:49:01,990 --> 00:48:59,780
as you do with difficult operations here

1162
00:49:03,880 --> 00:49:02,000
on earth is you need to be able to have

1163
00:49:05,410 --> 00:49:03,890

an understanding in the circumstances in

1164

00:49:07,030 --> 00:49:05,420

which they're going to work and being

1165

00:49:08,830 --> 00:49:07,040

able to forecast the weather and

1166

00:49:10,480 --> 00:49:08,840

environmental conditions just one of the

1167

00:49:12,670 --> 00:49:10,490

most fundamental things that we want to

1168

00:49:15,730 --> 00:49:12,680

be able to support the crew Sweatt thank

1169

00:49:18,190 --> 00:49:15,740

you thank you and we're going to take a

1170

00:49:19,750 --> 00:49:18,200

question from Emily lakhta Walla with a

1171

00:49:21,280 --> 00:49:19,760

planetary report and then we'll get a

1172

00:49:25,090 --> 00:49:21,290

couple from social media

1173

00:49:27,310 --> 00:49:25,100

Emily go ahead hi thank you

1174

00:49:29,470 --> 00:49:27,320

I'm wondering I know that Jim Shirley

1175

00:49:31,000 --> 00:49:29,480

predicted a global dust storm for last

1176

00:49:33,250 --> 00:49:31,010

year and then for this year I'm

1177

00:49:35,140 --> 00:49:33,260

wondering how much advance planning went

1178

00:49:37,450 --> 00:49:35,150

into the coordinated observations that

1179

00:49:39,609 --> 00:49:37,460

you're doing and if it changed any of

1180

00:49:43,510 --> 00:49:39,619

the way you were operating opportunity

1181

00:49:46,510 --> 00:49:43,520

even before the storm started well let

1182

00:49:48,220 --> 00:49:46,520

me take the question about opportunity

1183

00:49:53,260 --> 00:49:48,230

then I think there's a further question

1184

00:49:57,940 --> 00:49:53,270

for rich later we didn't do have to make

1185

00:49:59,530 --> 00:49:57,950

any changes so we had very good dust

1186

00:50:01,420 --> 00:49:59,540

factor which is the amount of dust on

1187

00:50:04,030 --> 00:50:01,430

the solar array so our energy production

1188

00:50:07,120 --> 00:50:04,040

was excellent going into this period of

1189

00:50:09,130 --> 00:50:07,130

time we already had taken steps to

1190

00:50:11,349 --> 00:50:09,140

maximize energy production anyways just

1191

00:50:15,400 --> 00:50:11,359

so we can do this much science as

1192

00:50:18,099 --> 00:50:15,410

possible so there were no real measures

1193

00:50:22,450 --> 00:50:18,109

to take and in hindsight there wasn't

1194

00:50:24,040 --> 00:50:22,460

really anything we could do to set us up

1195

00:50:27,910 --> 00:50:24,050

any better than we are going into the

1196

00:50:29,950 --> 00:50:27,920

storm and we've sort of been expecting

1197

00:50:31,710 --> 00:50:29,960

to have one of these storms if you

1198

00:50:34,120 --> 00:50:31,720

looked at the historical record

1199

00:50:37,510 --> 00:50:34,130

telescopic observations and early

1200

00:50:40,540 --> 00:50:37,520

spacecraft observations you would expect

1201
00:50:42,700 --> 00:50:40,550
maybe a period in those terms of about

1202
00:50:45,460 --> 00:50:42,710
three to four years based on that record

1203
00:50:49,930 --> 00:50:45,470
well we're five Mars years away from

1204
00:50:52,390 --> 00:50:49,940
that and so we've been trying to be

1205
00:50:54,220 --> 00:50:52,400
prepared for this storm we've defined

1206
00:50:55,060 --> 00:50:54,230
observation sequences that we had

1207
00:50:57,910 --> 00:50:55,070
implemented

1208
00:51:01,120 --> 00:50:57,920
the dust got high in the atmosphere for

1209
00:51:03,340 --> 00:51:01,130
instance and a lot of it is is just to

1210
00:51:05,890 --> 00:51:03,350
continue the standard monitoring of the

1211
00:51:08,140 --> 00:51:05,900
planet because that's what enables us to

1212
00:51:10,510 --> 00:51:08,150
catch those early stages which we're

1213
00:51:13,450 --> 00:51:10,520

really interested in yes there have been

1214

00:51:15,430 --> 00:51:13,460

a number of hypotheses put forward for

1215

00:51:18,940 --> 00:51:15,440

white dust storms occur in some years

1216

00:51:21,280 --> 00:51:18,950

and not others the problem is we're

1217

00:51:23,350 --> 00:51:21,290

dealing with a small number of events

1218

00:51:26,020 --> 00:51:23,360

and it's difficult to correlate that

1219

00:51:28,510 --> 00:51:26,030

well we have one more event in that

1220

00:51:30,130 --> 00:51:28,520

family now and that may help us

1221

00:51:33,760 --> 00:51:30,140

illuminate and test some of these

1222

00:51:35,110 --> 00:51:33,770

hypotheses okay we're gonna go to social

1223

00:51:38,410 --> 00:51:35,120

and then we'll hop back for the

1224

00:51:41,200 --> 00:51:38,420

remaining reporter questions we've got

1225

00:51:43,390 --> 00:51:41,210

one from Twitter Chris is asking has it

1226

00:51:45,700 --> 00:51:43,400

been considered for future missions to

1227

00:51:49,900 --> 00:51:45,710

have a method for the rover to clean the

1228

00:51:51,940 --> 00:51:49,910

panel's oh well this is John Kallis I'll

1229

00:51:56,860 --> 00:51:51,950

I'll address that that's a question that

1230

00:51:59,200 --> 00:51:56,870

we get a lot and that was considered at

1231

00:52:01,270 --> 00:51:59,210

the time that we were developing the MIR

1232

00:52:04,720 --> 00:52:01,280

rovers but again we were and we were

1233

00:52:06,250 --> 00:52:04,730

planning for a 90-day mission some of

1234

00:52:08,920 --> 00:52:06,260

the challenges that you have with that

1235

00:52:10,750 --> 00:52:08,930

is that suddenly you have a another

1236

00:52:11,890 --> 00:52:10,760

mechanism that's mission-critical you

1237

00:52:14,020 --> 00:52:11,900

know whether it's you know windshield

1238

00:52:16,300 --> 00:52:14,030

wipers or vibrators or a tilt table

1239

00:52:17,770 --> 00:52:16,310

solar array and so you have to account

1240

00:52:20,170 --> 00:52:17,780

for the possibilities well what if those

1241

00:52:21,910 --> 00:52:20,180

break and so for us the simplest

1242

00:52:24,790 --> 00:52:21,920

solution was just make the solar arrays

1243

00:52:27,520 --> 00:52:24,800

bigger and that's what we did for M er

1244

00:52:29,860 --> 00:52:27,530

future missions I know do this analysis

1245

00:52:32,170 --> 00:52:29,870

as well and give consideration to what

1246

00:52:35,140 --> 00:52:32,180

review the right approach but you know

1247

00:52:36,910 --> 00:52:35,150

so far the the design we have has has

1248

00:52:41,410 --> 00:52:36,920

worked really well for 14 and a half

1249

00:52:43,630 --> 00:52:41,420

years from headquarters let me just add

1250

00:52:46,390 --> 00:52:43,640

to that the the Rovers have been

1251
00:52:50,020 --> 00:52:46,400
machines of discovery landed on the

1252
00:52:51,730 --> 00:52:50,030
surface and set free to explore as long

1253
00:52:54,310 --> 00:52:51,740
as they can last and we can support

1254
00:52:56,110 --> 00:52:54,320
their operations as we go into the

1255
00:52:58,930 --> 00:52:56,120
future with more specific and targeted

1256
00:53:01,840 --> 00:52:58,940
missions one other consideration is when

1257
00:53:03,250 --> 00:53:01,850
we operate the mission as rich mentioned

1258
00:53:06,670 --> 00:53:03,260
there is some degree of predictability

1259
00:53:08,290 --> 00:53:06,680
there is a dust storm season and so one

1260
00:53:09,940 --> 00:53:08,300
tool that the engineers have in

1261
00:53:12,100 --> 00:53:09,950
planning the mission operations is to

1262
00:53:14,290 --> 00:53:12,110
plan the critical operations at that

1263
00:53:18,370 --> 00:53:14,300

time of the year whether or not a high

1264

00:53:20,260 --> 00:53:18,380

likelihood of a storm to occur one more

1265

00:53:22,630 --> 00:53:20,270

question from social nimesh command

1266

00:53:24,610 --> 00:53:22,640

danke on YouTube asks are the particles

1267

00:53:31,780 --> 00:53:24,620

in the Martian Deathstorm heavier than

1268

00:53:34,810 --> 00:53:31,790

those on earth yes interesting question

1269

00:53:36,910 --> 00:53:34,820

I would say no the density of the

1270

00:53:38,590 --> 00:53:36,920

particles are about the same and such so

1271

00:53:42,070 --> 00:53:38,600

if you weighed him on a scale they would

1272

00:53:44,440 --> 00:53:42,080

be much like dust on the earth there may

1273

00:53:47,860 --> 00:53:44,450

be differences in particle size from

1274

00:53:49,720 --> 00:53:47,870

because not all dust is the same it

1275

00:53:52,570 --> 00:53:49,730

generated in different sources on the

1276

00:53:57,130 --> 00:53:52,580

planet but by and large you'd recognize

1277

00:53:59,920 --> 00:53:57,140

it as dust okay and the next question

1278

00:54:06,100 --> 00:53:59,930

comes from Jason Ryan who's with Space

1279

00:54:09,940 --> 00:54:06,110

Flight Insider I guess thanks for taking

1280

00:54:12,000 --> 00:54:09,950

my question today real quick I noticed

1281

00:54:14,440 --> 00:54:12,010

that there it states that the

1282

00:54:17,080 --> 00:54:14,450

opportunity's batteries had to look if

1283

00:54:18,550 --> 00:54:17,090

they dip below 24 volts at that

1284

00:54:20,560 --> 00:54:18,560

threshold the rover's designed to turn

1285

00:54:23,170 --> 00:54:20,570

off all subsystems except for the

1286

00:54:26,410 --> 00:54:23,180

mission clock does this include the

1287

00:54:31,440 --> 00:54:26,420

vehicles in electronics heaters oh and

1288

00:54:34,540 --> 00:54:31,450

yes it this is John Kallis yes it does

1289

00:54:36,490 --> 00:54:34,550

we actually turn off all the electronics

1290

00:54:38,350 --> 00:54:36,500

every day on the rover and we allow for

1291

00:54:40,540 --> 00:54:38,360

the thermal inertia of the electronics

1292

00:54:42,910 --> 00:54:40,550

to stay warm enough until the next

1293

00:54:45,760 --> 00:54:42,920

morning when we power things back up so

1294

00:54:48,070 --> 00:54:45,770

right now everything is turned off on

1295

00:54:50,020 --> 00:54:48,080

the vehicle and we are in the

1296

00:54:53,470 --> 00:54:50,030

temperatures and determined solely by

1297

00:54:57,310 --> 00:54:53,480

the environment and those 8rh shoes that

1298

00:55:00,670 --> 00:54:57,320

are inside the rover okay the next

1299

00:55:03,760 --> 00:55:00,680

question is from Tony rice WRAL TV in

1300

00:55:06,490 --> 00:55:03,770

Raleigh North Carolina thanks for taking

1301
00:55:08,620 --> 00:55:06,500
my question so the word dust storm

1302
00:55:10,420 --> 00:55:08,630
creates a certain visual and imagine

1303
00:55:11,800 --> 00:55:10,430
many are probably envisioning what was

1304
00:55:13,780 --> 00:55:11,810
portrayed in the first couple of scenes

1305
00:55:15,670 --> 00:55:13,790
of the Martian could somebody describe

1306
00:55:17,470 --> 00:55:15,680
the current environment opportunities in

1307
00:55:20,450 --> 00:55:17,480
particularly the winds that are being

1308
00:55:25,130 --> 00:55:23,089
to raise dust off the Mars surface you

1309
00:55:27,530 --> 00:55:25,140
need wind speeds we think of about 30

1310
00:55:31,099 --> 00:55:27,540
meters per second that's I around 70

1311
00:55:32,990 --> 00:55:31,109
miles per hour and such I you know this

1312
00:55:34,220 --> 00:55:33,000
atmosphere is very thin though it's only

1313
00:55:35,000 --> 00:55:34,230

about a percent of the Earth's

1314

00:55:36,980 --> 00:55:35,010

atmosphere

1315

00:55:40,160 --> 00:55:36,990

you're not going to blow spacecraft over

1316

00:55:42,710 --> 00:55:40,170

with it even though you're able to raise

1317

00:55:44,480 --> 00:55:42,720

dust off the surface no wait we think

1318

00:55:47,150 --> 00:55:44,490

that happens actually is you take

1319

00:55:49,430 --> 00:55:47,160

somewhat larger particles that sort of

1320

00:55:54,890 --> 00:55:49,440

sandblast across and dislodge the finer

1321

00:55:57,920 --> 00:55:54,900

particles into the environment it looks

1322

00:55:59,690 --> 00:55:57,930

like you can look at the images of the

1323

00:56:01,790 --> 00:55:59,700

storm and such and you can see a sort of

1324

00:56:04,400 --> 00:56:01,800

modeling what we'd call convective

1325

00:56:06,170 --> 00:56:04,410

activity and such so it looks like that

1326

00:56:08,060 --> 00:56:06,180

there is still dust being raised in the

1327

00:56:11,030 --> 00:56:08,070

vicinity although it might not be

1328

00:56:13,970 --> 00:56:11,040

exactly at the rotor side itself and

1329

00:56:17,230 --> 00:56:13,980

some of that's falling out some of it is

1330

00:56:20,570 --> 00:56:17,240

getting suspended again the temperatures

1331

00:56:22,010 --> 00:56:20,580

when you have such a thick dust haze the

1332

00:56:24,260 --> 00:56:22,020

nighttime temperatures are actually

1333

00:56:26,570 --> 00:56:24,270

warmer and that's helping out

1334

00:56:28,520 --> 00:56:26,580

opportunity and it's sort of a

1335

00:56:30,589 --> 00:56:28,530

greenhouse effect in which the radiation

1336

00:56:33,380 --> 00:56:30,599

that otherwise would be lost to space is

1337

00:56:36,200 --> 00:56:33,390

trapped by this haze and radiated back

1338

00:56:38,570 --> 00:56:36,210

to the surface during the day the air

1339

00:56:42,560 --> 00:56:38,580

temperatures near the surface are lower

1340

00:56:44,900 --> 00:56:42,570

because much of the sunlight has been

1341

00:56:47,690 --> 00:56:44,910

absorbed by the dust cloud above your

1342

00:56:50,410 --> 00:56:47,700

surface so there's probably still some

1343

00:56:52,849 --> 00:56:50,420

winds in the vicinity of opportunity

1344

00:56:55,250 --> 00:56:52,859

many of the other areas the surface

1345

00:56:56,630 --> 00:56:55,260

winds may not be very strong but the

1346

00:56:58,550 --> 00:56:56,640

winds are typically stronger and

1347

00:57:01,790 --> 00:56:58,560

altitude and that's what's spreading the

1348

00:57:04,370 --> 00:57:01,800

dust haze around the planet we're gonna

1349

00:57:07,250 --> 00:57:04,380

take one really quick question and then

1350

00:57:09,290 --> 00:57:07,260

we're gonna wrap up a hopefully Sally

1351
00:57:10,220 --> 00:57:09,300
rail Planetary Society I hope you have a

1352
00:57:14,480 --> 00:57:10,230
quick question

1353
00:57:16,070 --> 00:57:14,490
I do do actually can you hear me yes we

1354
00:57:20,599 --> 00:57:16,080
can hear you fine okay great thank you

1355
00:57:22,820 --> 00:57:20,609
um is the storm still parsed or stalled

1356
00:57:25,520 --> 00:57:22,830
over endeavour and I just wanted to

1357
00:57:28,550 --> 00:57:25,530
confirm this the estimate is while the

1358
00:57:32,660 --> 00:57:28,560
is about two days for the storm to

1359
00:57:36,590 --> 00:57:32,670
become planet and circling thank you

1360
00:57:38,780 --> 00:57:36,600
at this rich Larrick yes we're expecting

1361
00:57:40,970 --> 00:57:38,790
if you look at the images again you

1362
00:57:43,550 --> 00:57:40,980
notice that in the northern latitudes

1363
00:57:45,470 --> 00:57:43,560

it's just about wrapped around except

1364

00:57:48,350 --> 00:57:45,480

for a small part of the planet above

1365

00:57:51,200 --> 00:57:48,360

parses the southern area it looks very

1366

00:57:54,080 --> 00:57:51,210

active as well and we expect that at the

1367

00:57:58,190 --> 00:57:54,090

speeds the dust haze is expanding that

1368

00:58:02,230 --> 00:57:58,200

it will wrap around the planet in three

1369

00:58:05,120 --> 00:58:02,240

or two or three days something like that

1370

00:58:08,390 --> 00:58:05,130

let's see what was the other part of

1371

00:58:11,600 --> 00:58:08,400

your question is the storm still stalled

1372

00:58:13,280 --> 00:58:11,610

or parked over endeavor crater well

1373

00:58:16,460 --> 00:58:13,290

there's still an active just raising

1374

00:58:18,470 --> 00:58:16,470

region over it the storm is now expanded

1375

00:58:21,080 --> 00:58:18,480

so that there are many other dust

1376

00:58:24,490 --> 00:58:21,090

raising areas across the planet and

1377

00:58:26,990 --> 00:58:24,500

together those are contributing to this

1378

00:58:31,730 --> 00:58:27,000

almost planet and circling death days

1379

00:58:35,020 --> 00:58:31,740

now alright thanks Sally and thank you

1380

00:58:37,580 --> 00:58:35,030

to all of our panelists and to all the

1381

00:58:40,480 --> 00:58:37,590

reporters and to the post on social

1382

00:58:44,060 --> 00:58:40,490

media who has some excellent questions

1383

00:58:46,280 --> 00:58:44,070

we do have a replay that will be

1384

00:58:49,370 --> 00:58:46,290

available it's generally up about an

1385

00:58:50,960 --> 00:58:49,380

hour after the telecon ends give you a

1386

00:58:54,410 --> 00:58:50,970

couple of phone numbers that's eight

1387

00:58:57,260 --> 00:58:54,420

eight eight five six two four nine one

1388

00:59:01,280 --> 00:58:57,270

three the International line is four

1389

00:59:05,450 --> 00:59:01,290

zero two five three zero seven six seven

1390

00:59:09,380 --> 00:59:05,460

zero and the passcode is for eight nine

1391

00:59:12,170 --> 00:59:09,390

five four one I think we'll try to put

1392

00:59:14,630 --> 00:59:12,180

those numbers up on the other website

1393

00:59:16,340 --> 00:59:14,640

that you're viewing today and speaking

1394

00:59:20,260 --> 00:59:16,350

of websites if you do want more

1395

00:59:22,580 --> 00:59:20,270

information you can go to Lars nasa.gov

1396

00:59:25,250 --> 00:59:22,590

there is a lot of information there

1397

00:59:28,460 --> 00:59:25,260

including a new section is visible under

1398

00:59:30,980 --> 00:59:28,470

the front page called large storm watch

1399

00:59:33,260 --> 00:59:30,990

it's all about the this dust storm and

1400

00:59:34,570 --> 00:59:33,270

dust storms in general and if you want

1401
00:59:39,650 --> 00:59:34,580
to get there directly that's Mars

1402
00:59:43,400 --> 00:59:39,660
nasa.gov slash weather and I could just

1403
00:59:45,440 --> 00:59:43,410
make one comment in conclusion this is

1404
00:59:46,309 --> 00:59:45,450
Jim and headquarters just up a wonderful

1405
00:59:48,769 --> 00:59:46,319
has been

1406
00:59:52,039 --> 00:59:48,779
this telecom and how remarkable the

1407
00:59:53,599 --> 00:59:52,049
conversation has been keep in mind we're

1408
00:59:56,029 --> 00:59:53,609
talking about a rover that's been

1409
00:59:57,079 --> 00:59:56,039
working at Mars hanging in there for 15

1410
00:59:59,719 --> 00:59:57,089
years

1411
01:00:01,670 --> 00:59:59,729
when designed just for 90 days it just

1412
01:00:04,699 --> 01:00:01,680
doesn't get any better than that thank

1413
01:00:05,930 --> 01:00:04,709

you for your time thanks Jim that was a

1414

01:00:08,180 --> 01:00:05,940

perfect wrap-up

1415

01:00:12,559 --> 01:00:08,190

all right thanks again everybody and

1416

01:00:14,209 --> 01:00:12,569

have a great day thank you for joining

1417

01:00:16,279 --> 01:00:14,219

today's conference that does conclude