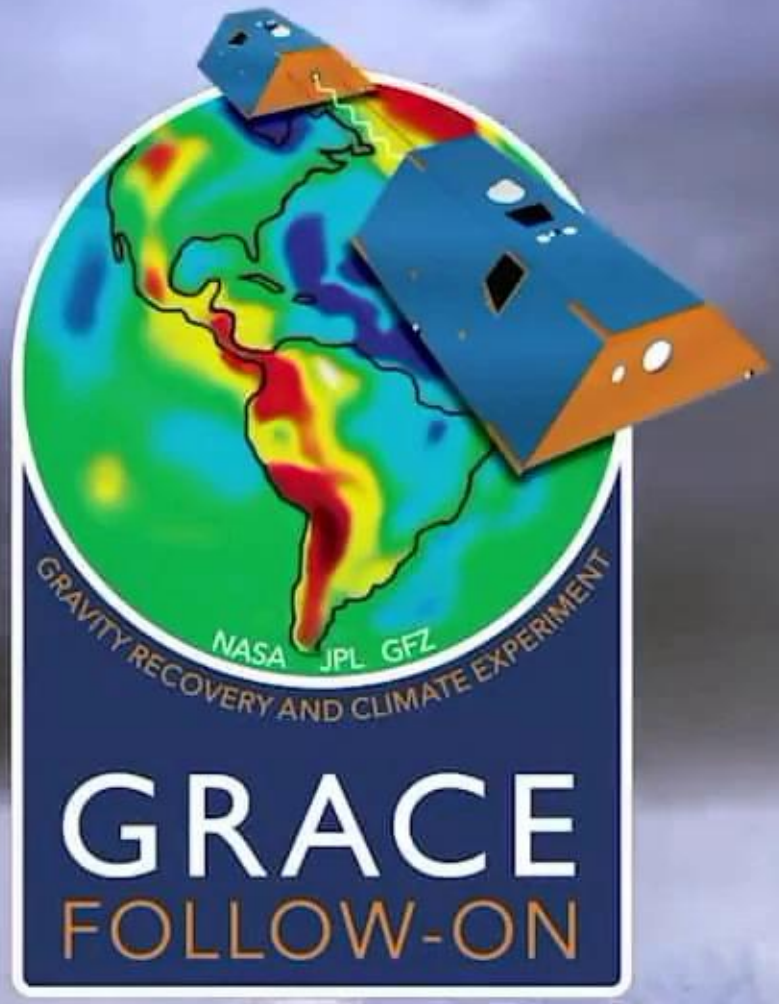

NASA

TRACKING EARTH'S WATER IN MOTION

1
00:00:00,020 --> 00:00:29,300
[Music]

2
00:00:33,650 --> 00:00:31,670
welcome to Vandenberg Air Force Base in

3
00:00:35,660 --> 00:00:33,660
California and our pre-launch briefing

4
00:00:37,760 --> 00:00:35,670
for the grace follow-on mission I'm

5
00:00:40,430 --> 00:00:37,770
Steve Cole from NASA communications

6
00:00:42,080 --> 00:00:40,440
we're here today to tell you about the

7
00:00:44,230 --> 00:00:42,090
grace follow-on mission that stands for

8
00:00:46,820 --> 00:00:44,240
the Gravity Recovery and climate

9
00:00:49,040 --> 00:00:46,830
experiment mission follow-on because

10
00:00:51,740 --> 00:00:49,050
this is the second of the grace missions

11
00:00:52,160 --> 00:00:51,750
that we've flown we're all set to launch

12
00:00:54,880 --> 00:00:52,170
today

13
00:00:58,880 --> 00:00:54,890

I'm sorry launch tomorrow May 22nd at

14
00:01:00,979 --> 00:00:58,890
12:47 p.m. Pacific time we'll be sharing

15
00:01:03,009 --> 00:01:00,989
the ride into space with five iridium

16
00:01:06,710 --> 00:01:03,019
next communication satellites on a

17
00:01:08,870 --> 00:01:06,720
SpaceX Falcon 9 rocket grace follow-on

18
00:01:12,050 --> 00:01:08,880
is a joint mission between NASA and the

19
00:01:13,250 --> 00:01:12,060
German Research Center for geosciences

20
00:01:15,500 --> 00:01:13,260
or gfz

21
00:01:17,570 --> 00:01:15,510
we have five panelists for you today to

22
00:01:19,850 --> 00:01:17,580
tell you more about the mission so let

23
00:01:22,550 --> 00:01:19,860
me introduce you to them our first

24
00:01:24,649 --> 00:01:22,560
panelist will be David Jarrett grace

25
00:01:27,580 --> 00:01:24,659
follow-on program executive in the earth

26
00:01:30,380 --> 00:01:27,590
science division at NASA headquarters

27
00:01:32,030 --> 00:01:30,390
Frank Webb grace follow-on project

28
00:01:36,800 --> 00:01:32,040
scientist at NASA's Jet Propulsion

29
00:01:38,990 --> 00:01:36,810
Laboratory Frank fleckner grace

30
00:01:43,219 --> 00:01:39,000
follow-on project manager at the German

31
00:01:45,709 --> 00:01:43,229
Research Center for geosciences Phil

32
00:01:48,639 --> 00:01:45,719
Morton grace follow-on project manager

33
00:01:51,230 --> 00:01:48,649
at the Jet Propulsion Laboratory and

34
00:01:53,480 --> 00:01:51,240
finally captain Jennifer Hayden weather

35
00:01:56,569 --> 00:01:53,490
officer for the 30th Space Wing at

36
00:01:58,550 --> 00:01:56,579
Vandenberg after our presentations we'll

37
00:02:01,609 --> 00:01:58,560
have questions from the media both here

38
00:02:03,499 --> 00:02:01,619

in the auditorium on the phone lines and

39
00:02:05,480 --> 00:02:03,509
on social media if you're watching on

40
00:02:07,730 --> 00:02:05,490
NASA television you can ask a question

41
00:02:12,230 --> 00:02:07,740
with social media by using the hashtag

42
00:02:14,420 --> 00:02:12,240
ask NASA so we're ready to begin Dave

43
00:02:16,790 --> 00:02:14,430
over to you good morning and thank you

44
00:02:19,460 --> 00:02:16,800
for joining us we're very excited today

45
00:02:23,570 --> 00:02:19,470
to discuss the grace follow-on mission

46
00:02:25,940 --> 00:02:23,580
with you grace will continue the legacy

47
00:02:28,760 --> 00:02:25,950
of the original grace mission which

48
00:02:32,150 --> 00:02:28,770
ended just not long ago last year

49
00:02:35,140 --> 00:02:32,160
bringing us 15 years worth of exciting

50
00:02:39,020 --> 00:02:35,150
data and making many new discoveries

51
00:02:42,110 --> 00:02:39,030
NASA a science program studies earth as

52
00:02:43,550 --> 00:02:42,120
a complete system in this animation you

53
00:02:47,180 --> 00:02:43,560
can see that NASA

54
00:02:50,630 --> 00:02:47,190
currently has 17 satellites in orbit

55
00:02:54,500 --> 00:02:50,640
measuring everything from gases and

56
00:02:58,370 --> 00:02:54,510
clouds in the atmosphere to rainfall and

57
00:03:02,150 --> 00:02:58,380
soil moisture to land surface change and

58
00:03:04,370 --> 00:03:02,160
the water cycle grace fought tomorrow

59
00:03:07,040 --> 00:03:04,380
grace follow-on will be the two new kids

60
00:03:10,430 --> 00:03:07,050
on the block to continue to measure the

61
00:03:12,650 --> 00:03:10,440
mass of the Earth's mass mass changes of

62
00:03:15,710 --> 00:03:12,660
the Earth's system from the storage of

63
00:03:19,789 --> 00:03:15,720

water and aquifers to the changes in ice

64
00:03:21,590 --> 00:03:19,799
sheets and glaciers and without the help

65
00:03:24,970 --> 00:03:21,600
of our international partners the

66
00:03:31,160 --> 00:03:24,980
Germans we wouldn't be here today

67
00:03:35,930 --> 00:03:31,170
GF Zed is contributing the launch

68
00:03:39,710 --> 00:03:35,940
vehicle mission operations the laser ray

69
00:03:41,390 --> 00:03:39,720
laser radar reflectors and the optical

70
00:03:43,880 --> 00:03:41,400
components of the laser arranging

71
00:03:47,390 --> 00:03:43,890
interferometer technology development

72
00:03:50,060 --> 00:03:47,400
experiment NASA is providing the two

73
00:03:53,720 --> 00:03:50,070
satellites microwave instruments the

74
00:03:56,620 --> 00:03:53,730
accelerometers and the electronic

75
00:03:59,890 --> 00:03:56,630
components of the laser ranging

76
00:04:03,380 --> 00:03:59,900
interferometer this kind of cost-sharing

77
00:04:05,900 --> 00:04:03,390
brings more bang to the buck and euro in

78
00:04:09,710 --> 00:04:05,910
the case of grace follow-on to the

79
00:04:11,479 --> 00:04:09,720
American and German people as well as

80
00:04:14,080 --> 00:04:11,489
benefiting research from around

81
00:04:17,150 --> 00:04:14,090
researchers from around the world

82
00:04:19,670 --> 00:04:17,160
the next image shows NASA's current

83
00:04:21,529 --> 00:04:19,680
fleet with missions involving our

84
00:04:24,740 --> 00:04:21,539
international partners highlighted in

85
00:04:28,460 --> 00:04:24,750
red this type of collaboration is very

86
00:04:30,260 --> 00:04:28,470
important to us because we were able to

87
00:04:33,650 --> 00:04:30,270
share the cost of the missions and

88
00:04:36,860 --> 00:04:33,660

thereby enabling us to do a whole lot

89
00:04:40,070 --> 00:04:36,870
more for less it's a win-win situation

90
00:04:42,050 --> 00:04:40,080
for everyone because all countries

91
00:04:44,980 --> 00:04:42,060
benefit from the wealth of data that we

92
00:04:48,379 --> 00:04:44,990
gather about our Complex every

93
00:04:53,089 --> 00:04:48,389
ever-changing world and the impacts it

94
00:04:57,560 --> 00:04:55,159
grace follow-on is unique

95
00:05:01,760 --> 00:04:57,570
most of our satellites and

96
00:05:05,240 --> 00:05:01,770
use imagers that collect light reflected

97
00:05:07,790 --> 00:05:05,250
from the surface or the atmosphere grace

98
00:05:10,060 --> 00:05:07,800
follow-on for grace follow-on the

99
00:05:14,180 --> 00:05:10,070
instrument is really the two satellites

100
00:05:15,770 --> 00:05:14,190
together as a as a system the critical

101
00:05:19,070 --> 00:05:15,780
measurement that's made by grace

102
00:05:21,340 --> 00:05:19,080
follow-on is the very small changes in

103
00:05:24,320 --> 00:05:21,350
distance between the two satellites as

104
00:05:27,470 --> 00:05:24,330
they orbit the Earth and these changes

105
00:05:29,810 --> 00:05:27,480
are caused by the pull of gravity as it

106
00:05:33,800 --> 00:05:29,820
changes very minutely caused by

107
00:05:35,180 --> 00:05:33,810
different things and before we get into

108
00:05:37,250 --> 00:05:35,190
discussing exactly how those

109
00:05:39,650 --> 00:05:37,260
measurements are taken

110
00:05:42,350 --> 00:05:39,660
Frank Webb will describe the science of

111
00:05:46,700 --> 00:05:42,360
the mission and its impacts on our daily

112
00:05:48,710 --> 00:05:46,710
lives thanks Dave so I start out by

113
00:05:50,510 --> 00:05:48,720

saying just a little bit about the grace

114
00:05:52,550 --> 00:05:50,520
mission which were the following - so

115
00:05:55,100 --> 00:05:52,560
grace was really a revolutionary mission

116
00:05:57,920 --> 00:05:55,110
for us understanding the water cycle and

117
00:05:58,970 --> 00:05:57,930
how the climate behaves in the trends

118
00:06:03,380 --> 00:05:58,980
which were taking place over the last

119
00:06:05,720 --> 00:06:03,390
you know 10 or 15 years and it did this

120
00:06:07,760 --> 00:06:05,730
in a very unique way by you know making

121
00:06:09,290 --> 00:06:07,770
measurements of how the mask it's

122
00:06:11,180 --> 00:06:09,300
redistributed on the surface of the

123
00:06:13,700 --> 00:06:11,190
earth and these were this was a view

124
00:06:16,550 --> 00:06:13,710
that we didn't have before of the water

125
00:06:18,620 --> 00:06:16,560
on Earth we were able to see how water

126
00:06:20,420 --> 00:06:18,630
has moved from different parts of the

127
00:06:21,440 --> 00:06:20,430
earth by actually measuring its mass

128
00:06:23,060 --> 00:06:21,450
which is not something you see with your

129
00:06:24,410 --> 00:06:23,070
eyes something you you have to feel with

130
00:06:25,940 --> 00:06:24,420
this a light system and we'll hear a

131
00:06:28,340 --> 00:06:25,950
little bit more about that later so if

132
00:06:31,760 --> 00:06:28,350
we go to the first animation which shows

133
00:06:35,180 --> 00:06:31,770
some of the results from the 15 years of

134
00:06:39,440 --> 00:06:35,190
grace measurements this is a map of mass

135
00:06:41,510 --> 00:06:39,450
trends seen by Grace and you know as

136
00:06:42,980 --> 00:06:41,520
this animation goes forward there's it's

137
00:06:44,720 --> 00:06:42,990
pointing out several regions of the

138
00:06:46,730 --> 00:06:44,730

world both on the land and in the ocean

139
00:06:49,460 --> 00:06:46,740
and the ice sheets where with grace

140
00:06:52,700 --> 00:06:49,470
we're able to detect things like loss of

141
00:06:56,000 --> 00:06:52,710
a loss of ice mass from glaciers ice

142
00:06:59,300 --> 00:06:56,010
sheets Greenland places like that we

143
00:07:02,000 --> 00:06:59,310
only see storage of water on land areas

144
00:07:03,290 --> 00:07:02,010
where there is floods or or depletion of

145
00:07:04,970 --> 00:07:03,300
water on land where there's large

146
00:07:07,220 --> 00:07:04,980
aquifers and we've been pumping water

147
00:07:08,390 --> 00:07:07,230
out or there's been droughts where you

148
00:07:10,700 --> 00:07:08,400
have more water than has been

149
00:07:11,450 --> 00:07:10,710
accumulating we can also see from the

150
00:07:13,820 --> 00:07:11,460
grace data

151
00:07:16,219 --> 00:07:13,830
I'm still amount of mass actually went

152
00:07:17,629 --> 00:07:16,229
into the oceans you know not just

153
00:07:19,040 --> 00:07:17,639
measuring the sea low but yesterday's in

154
00:07:22,189 --> 00:07:19,050
mastering the ocean because sea level is

155
00:07:24,230 --> 00:07:22,199
a is a is a sea level rise it has

156
00:07:25,879 --> 00:07:24,240
basically two components its but it's

157
00:07:28,339 --> 00:07:25,889
the mass which goes into the ocean the

158
00:07:29,990 --> 00:07:28,349
volume change from that but also the

159
00:07:31,879 --> 00:07:30,000
volume change from thermal expansion of

160
00:07:33,499 --> 00:07:31,889
the water so there's those two things

161
00:07:36,230 --> 00:07:33,509
which actually total to make the whole

162
00:07:38,029 --> 00:07:36,240
sea level rise and by measuring with

163
00:07:40,189 --> 00:07:38,039

grace the mass change we actually

164
00:07:41,089 --> 00:07:40,199
measure how much of that is is water in

165
00:07:42,320 --> 00:07:41,099
the ocean how much is actually you know

166
00:07:43,610 --> 00:07:42,330
heating of the ocean and thermal

167
00:07:45,980 --> 00:07:43,620
expansion which is very important for

168
00:07:48,070 --> 00:07:45,990
understanding climate processes and

169
00:07:51,249 --> 00:07:48,080
predicting of the future of

170
00:07:53,749 --> 00:07:51,259
understanding how where they're headed

171
00:07:55,670 --> 00:07:53,759
so if you go to the the next animation

172
00:07:57,110 --> 00:07:55,680
I'll look in a little more detail for

173
00:08:00,170 --> 00:07:57,120
some of this the things shown on the

174
00:08:02,210 --> 00:08:00,180
previous chart and this just shows mass

175
00:08:03,439 --> 00:08:02,220
loss in Greenland so you can see on the

176
00:08:04,700 --> 00:08:03,449
left you can see Greenland on the right

177
00:08:06,800 --> 00:08:04,710
you can see what's the monthly

178
00:08:08,629 --> 00:08:06,810
measurements of mass change the monthly

179
00:08:10,700 --> 00:08:08,639
measure of water mass change or ice mass

180
00:08:12,260 --> 00:08:10,710
change in Greenland and you see you know

181
00:08:13,969 --> 00:08:12,270
there's a bit of a seasonal cycle there

182
00:08:15,980 --> 00:08:13,979
we see overall you know Greenland is

183
00:08:17,600 --> 00:08:15,990
actually losing has been losing mass

184
00:08:20,510 --> 00:08:17,610
over the last fifteen years and it's a

185
00:08:22,909 --> 00:08:20,520
little bit you know it's fairly linear

186
00:08:25,279 --> 00:08:22,919
it's about 281 Giga tons per year of

187
00:08:26,839 --> 00:08:25,289
mass loss and with the grace data we

188
00:08:27,560 --> 00:08:26,849

were able to see actually where that's

189
00:08:30,320 --> 00:08:27,570
coming from

190
00:08:31,580 --> 00:08:30,330
Greenland overall you can see that

191
00:08:33,469 --> 00:08:31,590
mostly in that in that figure it's

192
00:08:35,149 --> 00:08:33,479
coming from mostly the southern part of

193
00:08:37,279 --> 00:08:35,159
Greenland and that's led to other

194
00:08:39,409 --> 00:08:37,289
studies where we've looked at what we're

195
00:08:42,380 --> 00:08:39,419
looking at how or the influence of

196
00:08:43,550 --> 00:08:42,390
oceans in accelerating that mass loss of

197
00:08:45,620 --> 00:08:43,560
warming of the oceans around Greenland

198
00:08:47,329 --> 00:08:45,630
and how they you know you know interact

199
00:08:49,220 --> 00:08:47,339
with the ice or in the fioor the

200
00:08:52,130 --> 00:08:49,230
glaciers which pour into the into the

201
00:08:53,720 --> 00:08:52,140
seas so that's a very you know

202
00:08:55,850 --> 00:08:53,730
significant finding there and the amount

203
00:08:57,079 --> 00:08:55,860
of mass being lost as well as fact that

204
00:08:58,850 --> 00:08:57,089
mass was being lost when we first

205
00:09:01,250 --> 00:08:58,860
started grace you know it wasn't clear

206
00:09:03,079 --> 00:09:01,260
what the sign of the mass change in

207
00:09:05,360 --> 00:09:03,089
Greenland was was mass gaining ice or

208
00:09:06,980 --> 00:09:05,370
gaining no mass be any ice gain water

209
00:09:08,269 --> 00:09:06,990
gain snow or is it losing it but it's

210
00:09:10,880 --> 00:09:08,279
pretty clear from the 15 years of great

211
00:09:13,880 --> 00:09:10,890
data that it's been losing mass now if

212
00:09:15,829 --> 00:09:13,890
you start the next animation so in that

213
00:09:18,290 --> 00:09:15,839

animation I said we're it's losing 281

214
00:09:19,760 --> 00:09:18,300
Giga tons of water a year and this

215
00:09:21,530 --> 00:09:19,770
animation is just because a good ton is

216
00:09:24,090 --> 00:09:21,540
kind of a strange unit for people

217
00:09:25,949 --> 00:09:24,100
understand a Gaytan is a is a

218
00:09:28,710 --> 00:09:25,959
cube of water a kilometer on a side and

219
00:09:30,480 --> 00:09:28,720
this just shows it here in in in

220
00:09:32,850 --> 00:09:30,490
graphical form next to the Empire State

221
00:09:36,090 --> 00:09:32,860
Building just for reference that's you

222
00:09:38,040 --> 00:09:36,100
know 1,400 feet high or 0.4 you know

223
00:09:39,509 --> 00:09:38,050
kilometers high so that's you know

224
00:09:41,249 --> 00:09:39,519
that's what a Giga ton is and so

225
00:09:43,800 --> 00:09:41,259
Greenland loses two hundred eighty one

226
00:09:46,519 --> 00:09:43,810
of those a year if we go to the next

227
00:09:49,170 --> 00:09:46,529
animation this is a nation that is of

228
00:09:50,790 --> 00:09:49,180
Antarctica another another place where

229
00:09:52,740 --> 00:09:50,800
we have a large ice mass which is which

230
00:09:55,559 --> 00:09:52,750
is changing as climate is changing and

231
00:09:57,749 --> 00:09:55,569
evolving and this again you see you know

232
00:09:59,400 --> 00:09:57,759
the the loss of mass from Antarctica on

233
00:10:01,559 --> 00:09:59,410
the monthly scale you can see you know

234
00:10:03,509 --> 00:10:01,569
as it's every month is counting out from

235
00:10:05,160 --> 00:10:03,519
the grace data and you see in the colors

236
00:10:06,210 --> 00:10:05,170
you can see where it's being lost he's

237
00:10:07,740 --> 00:10:06,220
mostly being lost in the Western

238
00:10:11,400 --> 00:10:07,750

Antarctica that's a little bit of gain

239
00:10:13,769 --> 00:10:11,410
in Eastern Antarctica and and that that

240
00:10:15,660 --> 00:10:13,779
you know is you know interesting though

241
00:10:16,889 --> 00:10:15,670
overall from the standpoint of the mass

242
00:10:18,600 --> 00:10:16,899
balance of Antarctica they're not of

243
00:10:20,699 --> 00:10:18,610
water that's being an ice it's remaining

244
00:10:22,949 --> 00:10:20,709
at arctica and our cars losing more ice

245
00:10:24,840 --> 00:10:22,959
than it's gaining and and here it's a

246
00:10:28,170 --> 00:10:24,850
hundred and twenty Giga tons of water a

247
00:10:30,269 --> 00:10:28,180
year and you know combined Antarctica

248
00:10:33,389 --> 00:10:30,279
and Greenland account the amount of mass

249
00:10:35,900 --> 00:10:33,399
being lost that's about it's a four

250
00:10:38,069 --> 00:10:35,910
hundred and something Giga tons a year

251
00:10:40,199 --> 00:10:38,079
and that's equivalent to about a meet a

252
00:10:42,569 --> 00:10:40,209
millimeter or more of sea level rise per

253
00:10:45,569 --> 00:10:42,579
year just coming from those two ice ice

254
00:10:46,860 --> 00:10:45,579
masses and and and and this is something

255
00:10:48,509 --> 00:10:46,870
we that we've learned from from the

256
00:10:49,620 --> 00:10:48,519
great state of last fifteen years it's

257
00:10:51,090 --> 00:10:49,630
something that you know with grace

258
00:10:53,100 --> 00:10:51,100
falling we will be extending this data

259
00:10:54,929 --> 00:10:53,110
record so you better understand you know

260
00:10:56,639 --> 00:10:54,939
if these trends are continuing and

261
00:10:58,439 --> 00:10:56,649
better understand you know what the

262
00:10:59,610 --> 00:10:58,449
drivers of them are because it's very

263
00:11:02,220 --> 00:10:59,620

important for us to understand you know

264
00:11:03,870 --> 00:11:02,230
with the data we collect at NASA you

265
00:11:06,179 --> 00:11:03,880
know one of the weather more important

266
00:11:08,309 --> 00:11:06,189
things about the data for for society is

267
00:11:09,720 --> 00:11:08,319
that it helps inform us and help us

268
00:11:13,620 --> 00:11:09,730
understand these processes or make

269
00:11:16,290 --> 00:11:13,630
informed decisions the next animation so

270
00:11:18,509 --> 00:11:16,300
it's not just about ice or mass loss

271
00:11:20,009 --> 00:11:18,519
from that this is mass loss from you

272
00:11:21,269 --> 00:11:20,019
know water on the surface this is

273
00:11:23,429 --> 00:11:21,279
actually this is the navigation from

274
00:11:26,550 --> 00:11:23,439
western United States which shows a mass

275
00:11:28,980 --> 00:11:26,560
loss from from basically a large aquifer

276
00:11:30,600 --> 00:11:28,990
in this in central California so we use

277
00:11:33,210 --> 00:11:30,610
a lot of ground water in California and

278
00:11:35,269 --> 00:11:33,220
we had it we had a drought you know a

279
00:11:38,410 --> 00:11:35,279
few years ago and during that drought

280
00:11:40,690 --> 00:11:38,420
California loss wate water

281
00:11:42,700 --> 00:11:40,700
as farmers and agriculture pumped out

282
00:11:44,800 --> 00:11:42,710
more water to meet the needs that

283
00:11:47,260 --> 00:11:44,810
weren't being met by the snowpack in the

284
00:11:49,180 --> 00:11:47,270
mountains with a rainfall and with the

285
00:11:50,890 --> 00:11:49,190
grace data we could see clearly that you

286
00:11:52,420 --> 00:11:50,900
know it was losing weight and that was

287
00:11:54,910 --> 00:11:52,430
coming from this region of California

288
00:11:57,190 --> 00:11:54,920

where we have our large aquifer and into

289
00:11:59,500 --> 00:11:57,200
that series of grace measurements was

290
00:12:01,390 --> 00:11:59,510
from the end of the grace time series we

291
00:12:03,220 --> 00:12:01,400
had had a large rain storm and there was

292
00:12:05,680 --> 00:12:03,230
some recovery in the amount of mass

293
00:12:07,810 --> 00:12:05,690
amount of water in the ground it remains

294
00:12:10,900 --> 00:12:07,820
to be seen you know since you know grace

295
00:12:13,630 --> 00:12:10,910
ended in 2017 you know how that recovery

296
00:12:15,760 --> 00:12:13,640
you know goes forward but in a years in

297
00:12:17,590 --> 00:12:15,770
you know once grace launches tomorrow

298
00:12:18,910 --> 00:12:17,600
we'll have we'll start getting data and

299
00:12:21,160 --> 00:12:18,920
we'll have about a one-year gap we're

300
00:12:23,170 --> 00:12:21,170
able to see how much that water in that

301
00:12:24,970 --> 00:12:23,180
fell as a precipitation California

302
00:12:26,440 --> 00:12:24,980
actually stayed in the ground and went

303
00:12:27,730 --> 00:12:26,450
into storage or you know you can better

304
00:12:30,580 --> 00:12:27,740
understand how much you actually ran off

305
00:12:32,560 --> 00:12:30,590
and went into the oceans I wasn't more

306
00:12:35,650 --> 00:12:32,570
for us to understand the whole water

307
00:12:37,480 --> 00:12:35,660
process there and so you know that's

308
00:12:40,360 --> 00:12:37,490
just a little bit about the the the

309
00:12:43,090 --> 00:12:40,370
science of that we've learned from grace

310
00:12:44,560 --> 00:12:43,100
and this is science that we will be you

311
00:12:46,750 --> 00:12:44,570
know continuing with the grace follow-on

312
00:12:48,340 --> 00:12:46,760
and to better understand these trends

313
00:12:50,920 --> 00:12:48,350

understand if these trends are just

314
00:12:52,930 --> 00:12:50,930
short-term trends or more short-term

315
00:12:54,550 --> 00:12:52,940
variability and or longer term translate

316
00:12:56,260 --> 00:12:54,560
it's or you know our evolving climate

317
00:12:57,520 --> 00:12:56,270
and with that I'm going to head off to

318
00:12:59,020 --> 00:12:57,530
Frank who's gonna explain a little bit

319
00:13:02,770 --> 00:12:59,030
more about how the measurement actually

320
00:13:06,760 --> 00:13:02,780
works so Frank thanks so this I would

321
00:13:08,800 --> 00:13:06,770
shortly explain by an animation which

322
00:13:11,070 --> 00:13:08,810
shows you that grace follow-on is a

323
00:13:14,470 --> 00:13:11,080
constellation of two satellites

324
00:13:16,780 --> 00:13:14,480
separated by about 220 kilometres and

325
00:13:20,440 --> 00:13:16,790
the measurement of this inter-satellite

326
00:13:23,620 --> 00:13:20,450
range is the most critical data on grace

327
00:13:26,890 --> 00:13:23,630
and grace follow-on it is a function how

328
00:13:29,230 --> 00:13:26,900
the mass is distributed and on ground so

329
00:13:32,860 --> 00:13:29,240
if mass changes on ground like in

330
00:13:34,090 --> 00:13:32,870
aquifers or melting glaciers or in the

331
00:13:37,650 --> 00:13:34,100
oceans and so on

332
00:13:41,260 --> 00:13:37,660
you see it immediately in a range change

333
00:13:44,230 --> 00:13:41,270
which we measure very very precisely my

334
00:13:47,320 --> 00:13:44,240
microwave tracking system with a

335
00:13:49,630 --> 00:13:47,330
precision of about 1 micrometer that is

336
00:13:51,790 --> 00:13:49,640
about a tenth of human hair

337
00:13:55,960 --> 00:13:51,800
offers distance between Los Angeles and

338
00:13:58,390 --> 00:13:55,970

San Diego so this instrument is used as

339
00:14:00,910 --> 00:13:58,400
a let's say primary objective to

340
00:14:03,880 --> 00:14:00,920
continue the time series which we have

341
00:14:07,120 --> 00:14:03,890
started with grace and to continue with

342
00:14:10,720 --> 00:14:07,130
grace follow-on but we have also another

343
00:14:14,110 --> 00:14:10,730
secondary objective is graceful on which

344
00:14:16,420 --> 00:14:14,120
is explained on the next figure so to

345
00:14:20,530 --> 00:14:16,430
improve the spatial and the temporal

346
00:14:23,400 --> 00:14:20,540
resolution of our mass observations for

347
00:14:25,900 --> 00:14:23,410
Futura grace like missions we will fly a

348
00:14:29,820 --> 00:14:25,910
technology demonstrator called laser

349
00:14:34,510 --> 00:14:29,830
rangering interferometer so due to the

350
00:14:37,120 --> 00:14:34,520
shorter wavelengths of the laser ranging

351
00:14:39,760 --> 00:14:37,130
interferometer we will be able to

352
00:14:42,190 --> 00:14:39,770
observe a separation change at least a

353
00:14:45,450 --> 00:14:42,200
factor of 10 better than we do it with a

354
00:14:48,370 --> 00:14:45,460
microwave instrument which is a prime

355
00:14:50,740 --> 00:14:48,380
instrument on bot of grace follow-on and

356
00:14:53,560 --> 00:14:50,750
fillets arranging interferometer is

357
00:14:56,130 --> 00:14:53,570
really an excellent example of our great

358
00:14:59,940 --> 00:14:56,140
partnership between the US and Germany

359
00:15:03,370 --> 00:14:59,950
so for the Li is a cavity and the

360
00:15:06,220 --> 00:15:03,380
electronics are provided by our us

361
00:15:08,500 --> 00:15:06,230
partners and we in Germany have provided

362
00:15:11,320 --> 00:15:08,510
all the objects like the optical bench

363
00:15:14,680 --> 00:15:11,330

assembly a triple mirror assembly and

364
00:15:18,460 --> 00:15:14,690
others and the partners in Germany are

365
00:15:23,910 --> 00:15:18,470
the Albert Einstein Institute space Tech

366
00:15:26,140 --> 00:15:23,920
and DLR German Space Agency and we have

367
00:15:28,300 --> 00:15:26,150
implemented the laser ranging

368
00:15:31,630 --> 00:15:28,310
interferometer and a so-called racetrack

369
00:15:34,110 --> 00:15:31,640
confi configuration as you have seen the

370
00:15:38,710 --> 00:15:34,120
satellite was already filled by all the

371
00:15:41,560 --> 00:15:38,720
nominal instrumentation by the tanks in

372
00:15:43,930 --> 00:15:41,570
inside of a satellite so we had to

373
00:15:47,260 --> 00:15:43,940
choose a way how to route the laser beam

374
00:15:49,690 --> 00:15:47,270
inside of a satellite and for that the

375
00:15:52,960 --> 00:15:49,700
triple mirror assembly is most important

376
00:15:56,440 --> 00:15:52,970
to route it by 180 degrees back to the

377
00:15:59,710 --> 00:15:56,450
opposite satellite but we have also

378
00:16:02,440 --> 00:15:59,720
another secondary objective which is

379
00:16:05,860 --> 00:16:02,450
explained in the next video

380
00:16:07,900 --> 00:16:05,870
so here we use the so called radio or

381
00:16:09,850 --> 00:16:07,910
quotation principle which was first

382
00:16:13,810 --> 00:16:09,860
developed for the champ satellite

383
00:16:15,400 --> 00:16:13,820
launched in 2000 satellite launched by

384
00:16:20,590 --> 00:16:15,410
my Institute gfz

385
00:16:23,170 --> 00:16:20,600
and we have not only prime antenna on

386
00:16:25,840 --> 00:16:23,180
top of the satellites to perform the

387
00:16:28,090 --> 00:16:25,850
navigation of grace follow-on but we

388
00:16:31,329 --> 00:16:28,100

have also another second secondary

389
00:16:35,380 --> 00:16:31,339
antenna on the back side of each of

390
00:16:39,400 --> 00:16:35,390
these satellites which observe these

391
00:16:42,310 --> 00:16:39,410
signals between low altitude GPS

392
00:16:44,920 --> 00:16:42,320
satellite disappearing or coming up over

393
00:16:48,450 --> 00:16:44,930
the horizon of the earth and these

394
00:16:51,190 --> 00:16:48,460
signals are altered by refractive

395
00:16:54,340 --> 00:16:51,200
effects within the atmosphere and this

396
00:16:57,460 --> 00:16:54,350
we can observe and derive temperature

397
00:17:01,350 --> 00:16:57,470
and humidity profiles which we provide

398
00:17:05,439 --> 00:17:01,360
to the weather services on a 24/7 basis

399
00:17:07,270 --> 00:17:05,449
with a time delay of lessons we our so

400
00:17:12,520 --> 00:17:07,280
therefore we have installed a ground

401
00:17:17,230 --> 00:17:12,530
station in Spitsbergen on at the knee of

402
00:17:19,750 --> 00:17:17,240
the North Pole and use this station to

403
00:17:22,569 --> 00:17:19,760
fulfill the stringent requirements of

404
00:17:26,079 --> 00:17:22,579
the weather services we have another

405
00:17:29,040 --> 00:17:26,089
instrument onboard of graceful on and we

406
00:17:33,100 --> 00:17:29,050
added on on grace which is ELISA

407
00:17:36,030 --> 00:17:33,110
retroreflector provided by my Institute

408
00:17:39,070 --> 00:17:36,040
and we shoot from a network of about

409
00:17:42,040 --> 00:17:39,080
20-25 globally distributed ground

410
00:17:44,560 --> 00:17:42,050
stations you see an example the potsdam

411
00:17:47,710 --> 00:17:44,570
ground station by a laser - this laser

412
00:17:50,260 --> 00:17:47,720
little reflectors receives a beam back

413
00:17:53,470 --> 00:17:50,270

from the reflector and from the two-way

414
00:17:55,390 --> 00:17:53,480
travel time you can derive the orbit

415
00:17:57,520 --> 00:17:55,400
with millimeter precision and this

416
00:18:01,690 --> 00:17:57,530
Earth's one independent control of the

417
00:18:05,350 --> 00:18:01,700
GPS derived orbit of Grace and graceful

418
00:18:08,590 --> 00:18:05,360
on how mission operations will be

419
00:18:10,540 --> 00:18:08,600
performed after launch is shown in the

420
00:18:15,040 --> 00:18:10,550
next video

421
00:18:15,820 --> 00:18:15,050
gfz has subcontracted the Drummond space

422
00:18:19,120 --> 00:18:15,830
operation

423
00:18:21,070 --> 00:18:19,130
Center in Omaha often because they have

424
00:18:23,289 --> 00:18:21,080
a lot of experience from the grace

425
00:18:26,380 --> 00:18:23,299
mission they are running the Mission

426
00:18:29,080 --> 00:18:26,390
Control Center in Omaha often which you

427
00:18:31,299 --> 00:18:29,090
can see here in the video they operate

428
00:18:35,049 --> 00:18:31,309
two ground station in Vail Heim and

429
00:18:37,539 --> 00:18:35,059
noise trail it's and in which trail it's

430
00:18:39,669 --> 00:18:37,549
VI falls over raw data center which

431
00:18:42,490 --> 00:18:39,679
collects all the downlink data and

432
00:18:45,159 --> 00:18:42,500
provided service science data system for

433
00:18:47,200 --> 00:18:45,169
further processing and finally we will

434
00:18:50,350 --> 00:18:47,210
use the station which I have introduced

435
00:18:52,629 --> 00:18:50,360
with the radio or quotation for grace

436
00:18:55,149 --> 00:18:52,639
this is a primary downlink station on

437
00:18:58,750 --> 00:18:55,159
Spitsbergen so therefore we have now

438
00:19:01,600 --> 00:18:58,760

every orbit every 90 minutes telemetry

439
00:19:04,029 --> 00:19:01,610
data from the satellites which have

440
00:19:06,990 --> 00:19:04,039
helps to improve the tracking of the

441
00:19:10,120 --> 00:19:07,000
health status of grace follow-on and

442
00:19:12,820 --> 00:19:10,130
finally I would like to mention we are

443
00:19:16,389 --> 00:19:12,830
here for the launch it will be performed

444
00:19:18,190 --> 00:19:16,399
in 26 hours from now and therefore we

445
00:19:21,310 --> 00:19:18,200
have signed a contract or itray a

446
00:19:24,669 --> 00:19:21,320
contract with iridium which is shown

447
00:19:27,159 --> 00:19:24,679
here on the next video we will use a

448
00:19:31,720 --> 00:19:27,169
fake nine here from Vandenberg Air Force

449
00:19:34,210 --> 00:19:31,730
Base together with five you read your

450
00:19:37,029 --> 00:19:34,220
next satellites graceful on on top of

451
00:19:40,000 --> 00:19:37,039
this five we will be separated about

452
00:19:42,940 --> 00:19:40,010
eleven and a half minutes after launch

453
00:19:45,129 --> 00:19:42,950
and the two satellites will then be

454
00:19:49,870 --> 00:19:45,139
separated into two opposite directions

455
00:19:51,789 --> 00:19:49,880
and flying towards South owned medium

456
00:19:55,120 --> 00:19:51,799
village can device I gave them on mine

457
00:19:59,169 --> 00:19:55,130
point on partner Phil Martin sitting

458
00:20:01,060 --> 00:19:59,179
beside me thank you for a I'm going to

459
00:20:04,090 --> 00:20:01,070
give you a little more information about

460
00:20:06,549 --> 00:20:04,100
the satellites themselves we have to

461
00:20:09,009 --> 00:20:06,559
scale models here they are one-tenth

462
00:20:12,820 --> 00:20:09,019
scale so think of the actual satellite

463
00:20:15,190 --> 00:20:12,830

sizes about the size of a sports car as

464
00:20:17,289 --> 00:20:15,200
they mentioned before one in Los Angeles

465
00:20:20,950 --> 00:20:17,299
and one in San Diego that's how far

466
00:20:24,820 --> 00:20:20,960
apart they're flying and typically they

467
00:20:27,370 --> 00:20:24,830
have a unique shape we took great care

468
00:20:28,669 --> 00:20:27,380
to make sure that the satellite size and

469
00:20:30,289 --> 00:20:28,679
shape was identical to

470
00:20:31,940 --> 00:20:30,299
because we want to make sure that we

471
00:20:34,730 --> 00:20:31,950
have a continuity mission and that we

472
00:20:36,499 --> 00:20:34,740
try to do everything we can to collect

473
00:20:39,680 --> 00:20:36,509
the same kind of data that we took on

474
00:20:41,029 --> 00:20:39,690
Grace and there's some characteristics

475
00:20:43,940 --> 00:20:41,039
in the shape that help with the

476
00:20:45,769 --> 00:20:43,950
aerodynamics of they're orbiting we want

477
00:20:48,799 --> 00:20:45,779
to put the two satellites in orbit we

478
00:20:50,810 --> 00:20:48,809
want to do as little as possible to keep

479
00:20:53,090 --> 00:20:50,820
them perturbing them we let them float

480
00:20:55,159 --> 00:20:53,100
and we want them to react to the gravity

481
00:20:58,430 --> 00:20:55,169
field and the changes in mass and then

482
00:21:01,779 --> 00:20:58,440
measure those very fine fine finally

483
00:21:04,519 --> 00:21:01,789
precisely measured distances of a micron

484
00:21:09,230 --> 00:21:04,529
in order to do that the business end

485
00:21:12,200 --> 00:21:09,240
when in has the dual kak band microwave

486
00:21:13,759 --> 00:21:12,210
a signal that we use to is the primary

487
00:21:17,090 --> 00:21:13,769
instrument to measure this distance

488
00:21:19,820 --> 00:21:17,100

between the two satellites and then

489
00:21:24,049 --> 00:21:19,830
you'll see two ports here that these are

490
00:21:25,789 --> 00:21:24,059
the laser baffles and laser kind of

491
00:21:29,080 --> 00:21:25,799
think of it as a racetrack there's one

492
00:21:34,869 --> 00:21:29,090
laser that's a master that we cycle that

493
00:21:39,560 --> 00:21:37,639
the outside of the satellite was covered

494
00:21:43,549 --> 00:21:39,570
with solar arrays it's kind of a sleek

495
00:21:45,080 --> 00:21:43,559
look that this provides our power there

496
00:21:47,600 --> 00:21:45,090
are some cutouts here these are the

497
00:21:51,049 --> 00:21:47,610
stark camera baffles we use star cameras

498
00:21:53,749 --> 00:21:51,059
and a precision GPS antenna on top to

499
00:21:56,600 --> 00:21:53,759
map very precisely the location of these

500
00:21:59,389 --> 00:21:56,610
little changes and in the distance

501
00:22:00,889 --> 00:21:59,399
between the two spacecraft and then

502
00:22:02,659 --> 00:22:00,899
again as Frank mentioned on the back

503
00:22:05,210 --> 00:22:02,669
side of the spacecraft we have a radio

504
00:22:07,249 --> 00:22:05,220
occultation antenna and that's what we

505
00:22:09,350 --> 00:22:07,259
use to look at GPS signals moving

506
00:22:13,570 --> 00:22:09,360
through the atmosphere and use those to

507
00:22:16,460 --> 00:22:13,580
measure humidity in the atmosphere um

508
00:22:18,980 --> 00:22:16,470
and also underneath there's an S band

509
00:22:20,629 --> 00:22:18,990
boom when it's deployed it deploys early

510
00:22:22,850 --> 00:22:20,639
on in the mission and that's what we use

511
00:22:27,499 --> 00:22:22,860
for radio transmission to the ground

512
00:22:29,600 --> 00:22:27,509
stations I have a video here to kind of

513
00:22:31,519 --> 00:22:29,610

give you an idea of the inside of the

514
00:22:37,580 --> 00:22:31,529
spacecraft it was a it's it's quite

515
00:22:41,180 --> 00:22:37,590
compact but you can see as it was put

516
00:22:42,750 --> 00:22:41,190
together at Airbus it's quite

517
00:22:46,230 --> 00:22:42,760
complicated inside

518
00:22:49,710 --> 00:22:46,240
took essentially the grace design did

519
00:22:52,350 --> 00:22:49,720
upgrades for avionics and various bits

520
00:22:55,250 --> 00:22:52,360
of equipment that we could no longer get

521
00:22:59,190 --> 00:22:55,260
because of the 15 year lifetime which

522
00:23:00,960 --> 00:22:59,200
improved our avionics our electronics in

523
00:23:02,280 --> 00:23:00,970
the very heart of the spacecraft you can

524
00:23:04,350 --> 00:23:02,290
see in the video here is an

525
00:23:07,549 --> 00:23:04,360
accelerometer that's very sensitive we

526
00:23:11,400 --> 00:23:07,559
use that to remove gravitational effects

527
00:23:13,620 --> 00:23:11,410
and that piece of equipment is is

528
00:23:16,049 --> 00:23:13,630
aligned very precisely with the triple

529
00:23:18,870 --> 00:23:16,059
mirror assembly and the star cameras so

530
00:23:20,490 --> 00:23:18,880
that we make sure there's a particular

531
00:23:22,409 --> 00:23:20,500
reference for all the measurements that

532
00:23:25,080 --> 00:23:22,419
are made that's in the heart of the

533
00:23:26,940 --> 00:23:25,090
proof mass of the accelerometer so you

534
00:23:28,799 --> 00:23:26,950
can see that whole assembly being

535
00:23:30,630 --> 00:23:28,809
lowered into the middle of the

536
00:23:32,640 --> 00:23:30,640
spacecraft there it's kind of in the

537
00:23:35,070 --> 00:23:32,650
heart and the very center of mass of the

538
00:23:37,650 --> 00:23:35,080

spacecraft once we were done with

539
00:23:40,230 --> 00:23:37,660
environmental testing we transported all

540
00:23:43,220 --> 00:23:40,240
of our equipment the satellites out here

541
00:23:48,299 --> 00:23:43,230
demandin Berg this was sauced December

542
00:23:49,950 --> 00:23:48,309
and Air Force helped us unload and move

543
00:23:50,909 --> 00:23:49,960
all of our equipment it was quite a

544
00:23:53,789 --> 00:23:50,919
process

545
00:23:55,440 --> 00:23:53,799
we brought the two satellites or multi

546
00:23:57,960 --> 00:23:55,450
satellite dispenser and all of our

547
00:23:59,400 --> 00:23:57,970
ground support equipment we moved

548
00:24:03,000 --> 00:23:59,410
everything over to the Astrotech

549
00:24:06,049 --> 00:24:03,010
facility here did our functional checks

550
00:24:09,000 --> 00:24:06,059
are fueling of our nitrogen tanks

551
00:24:10,620 --> 00:24:09,010
battery charging and then we moved over

552
00:24:12,510 --> 00:24:10,630
to the Harris facility and you can see a

553
00:24:14,520 --> 00:24:12,520
time-lapse here of us lifting the

554
00:24:18,210 --> 00:24:14,530
satellites and putting them on the multi

555
00:24:20,880 --> 00:24:18,220
satellite dispenser so we had teams from

556
00:24:23,970 --> 00:24:20,890
Madrid Spain from Germany

557
00:24:26,909 --> 00:24:23,980
JPL all working together here to get

558
00:24:30,570 --> 00:24:26,919
these satellites put on the satellite

559
00:24:34,380 --> 00:24:30,580
dispenser properly mounted so that we

560
00:24:37,320 --> 00:24:34,390
can separate absolutely as we need to so

561
00:24:41,909 --> 00:24:37,330
it was quite a bit of work once we were

562
00:24:45,120 --> 00:24:41,919
done here at Harris we packed up that

563
00:24:48,150 --> 00:24:45,130

whole stack we call it the stack and we

564
00:24:49,560 --> 00:24:48,160
transported it over to SpaceX and when

565
00:24:52,770 --> 00:24:49,570
we started doing our integration

566
00:24:54,149 --> 00:24:52,780
activities with iridium I've got a

567
00:24:54,930 --> 00:24:54,159
couple of images here I'll just go

568
00:24:56,279 --> 00:24:54,940
through it just

569
00:24:59,219 --> 00:24:56,289
and give you an idea of the work that

570
00:25:02,450 --> 00:24:59,229
was done that was quite complicated and

571
00:25:04,710 --> 00:25:02,460
very interesting here you can see us

572
00:25:07,529 --> 00:25:04,720
removing the top of our shipping

573
00:25:09,779 --> 00:25:07,539
container the two spacecraft are mounted

574
00:25:11,509 --> 00:25:09,789
on the multi satellite dispenser but

575
00:25:16,560 --> 00:25:11,519
they're protected under a protective

576
00:25:19,169 --> 00:25:16,570
cover next image please you can see us

577
00:25:20,999 --> 00:25:19,179
now we've uncovered the satellites we

578
00:25:22,830 --> 00:25:21,009
made sure they're now they're stepping

579
00:25:26,489 --> 00:25:22,840
towards getting more and more flight

580
00:25:29,519 --> 00:25:26,499
ready as we remove protective covers we

581
00:25:31,889 --> 00:25:29,529
lift the whole assembly up and we mount

582
00:25:34,169 --> 00:25:31,899
the base of our multi satellite

583
00:25:37,409 --> 00:25:34,179
dispenser onto this adapter ring this

584
00:25:40,409 --> 00:25:37,419
was built by SpaceX to mate us directly

585
00:25:44,669 --> 00:25:40,419
along to the dispenser for the Iridium

586
00:25:47,820 --> 00:25:44,679
stack you go to the next picture you can

587
00:25:52,229 --> 00:25:47,830
see here below is the stack of five

588
00:25:55,859 --> 00:25:52,239

iridium satellites and we are lifting

589
00:25:58,139 --> 00:25:55,869
our stack assembly and then dropping it

590
00:26:01,349 --> 00:25:58,149
on top and then we will meet it to the

591
00:26:04,710 --> 00:26:01,359
top of the derivative stack the next

592
00:26:08,759 --> 00:26:04,720
image and again you can see here the

593
00:26:10,169 --> 00:26:08,769
combined set of payloads the Iridium

594
00:26:13,830 --> 00:26:10,179
stack on the bottom and the grace

595
00:26:15,450 --> 00:26:13,840
satellites on the top so this is a quite

596
00:26:18,149 --> 00:26:15,460
a spectacular view of what the

597
00:26:22,879 --> 00:26:18,159
satellites look like if you go to the

598
00:26:25,019 --> 00:26:22,889
next image this was a very interesting

599
00:26:28,080 --> 00:26:25,029
piece of procedure that we had to

600
00:26:31,499 --> 00:26:28,090
execute we lifted our stack and the

601
00:26:36,149 --> 00:26:31,509
Iridium stack together and then moved

602
00:26:39,389 --> 00:26:36,159
the whole thing over to this adapter the

603
00:26:42,560 --> 00:26:39,399
payload adaptor that is what mounts on

604
00:26:47,279 --> 00:26:42,570
the top of the second stage so you know

605
00:26:49,979 --> 00:26:47,289
an interesting very delicate and very

606
00:26:51,629 --> 00:26:49,989
precise movement of all the equipment to

607
00:26:52,019 --> 00:26:51,639
line it up and get it ready to go for

608
00:26:56,070 --> 00:26:52,029
launch

609
00:26:58,200 --> 00:26:56,080
next image and you'll see here the final

610
00:27:01,080 --> 00:26:58,210
stack as it is now the current status

611
00:27:02,249 --> 00:27:01,090
all of this now is encapsulated in the

612
00:27:05,039 --> 00:27:02,259
fairing

613
00:27:06,720 --> 00:27:05,049

we finished up that work end of last

614
00:27:09,900 --> 00:27:06,730
week and over the week

615
00:27:12,660 --> 00:27:09,910
the fairing now is is tipped

616
00:27:14,490 --> 00:27:12,670
horizontally and the whole assembly then

617
00:27:17,250 --> 00:27:14,500
mounted on the second stage of the

618
00:27:20,190 --> 00:27:17,260
rocket which is in the hangar over at

619
00:27:22,980 --> 00:27:20,200
SpaceX and should be rolling out this

620
00:27:25,560 --> 00:27:22,990
morning so we'll do our final testing

621
00:27:26,910 --> 00:27:25,570
over there today and and finish our

622
00:27:32,910 --> 00:27:26,920
checkouts and get ready for launch

623
00:27:34,530 --> 00:27:32,920
tomorrow so very exciting time a little

624
00:27:35,820 --> 00:27:34,540
to have another video here I just want

625
00:27:37,590 --> 00:27:35,830
to talk a little bit about what happens

626
00:27:39,510 --> 00:27:37,600
after separation give you an idea of

627
00:27:44,360 --> 00:27:39,520
what's going to happen right after we

628
00:27:48,060 --> 00:27:44,370
separate we come away from the dispenser

629
00:27:50,580 --> 00:27:48,070
about 50 seconds after we separate we

630
00:27:53,370 --> 00:27:50,590
have a boom deployment you see a little

631
00:27:56,340 --> 00:27:53,380
bit of an animation here of it and then

632
00:27:58,590 --> 00:27:56,350
about five minutes after that we start

633
00:28:01,530 --> 00:27:58,600
our attitude control system up we start

634
00:28:03,450 --> 00:28:01,540
pointing the s-band booms towards the

635
00:28:07,100 --> 00:28:03,460
earth we want them to fly in this kind

636
00:28:10,310 --> 00:28:07,110
of a configuration the spacecraft's

637
00:28:14,340 --> 00:28:10,320
spacecrafts aren't moving slowly apart

638
00:28:17,280 --> 00:28:14,350

and heading towards the South Pole takes

639
00:28:19,830 --> 00:28:17,290
about 23 minutes before we get to the

640
00:28:23,370 --> 00:28:19,840
first ground station which is McMurdo

641
00:28:26,310 --> 00:28:23,380
and Antarctica and when we pass over

642
00:28:28,550 --> 00:28:26,320
McMurdo we'll do a very quick check on

643
00:28:32,490 --> 00:28:28,560
both satellites to make sure we get

644
00:28:36,000 --> 00:28:32,500
telemetry do a dump of some data check

645
00:28:38,220 --> 00:28:36,010
on their health very quickly and we have

646
00:28:39,900 --> 00:28:38,230
every expectation of getting both

647
00:28:42,690 --> 00:28:39,910
satellites if for some reason we only

648
00:28:45,600 --> 00:28:42,700
get one in about 45 minutes later we

649
00:28:48,870 --> 00:28:45,610
come over another ground station that's

650
00:28:53,190 --> 00:28:48,880
all barred that's up toward the North

651
00:28:57,000 --> 00:28:53,200
Pole and then we have essentially or

652
00:28:58,860 --> 00:28:57,010
passes every orbit so that will continue

653
00:29:00,450 --> 00:28:58,870
to get more and more data and check on

654
00:29:04,550 --> 00:29:00,460
the health and we'll fire the spacecraft

655
00:29:06,960 --> 00:29:04,560
so we're all set all the ground stations

656
00:29:10,200 --> 00:29:06,970
ground ops that everything's ready to go

657
00:29:17,130 --> 00:29:10,210
for tomorrow so looking forward to the

658
00:29:18,840 --> 00:29:17,140
big day and captain Hayden thank you so

659
00:29:19,650 --> 00:29:18,850
I'll be going over and speaking to the

660
00:29:22,350 --> 00:29:19,660
weather and what

661
00:29:23,580 --> 00:29:22,360
expect tomorrow for day of launch for

662
00:29:25,260 --> 00:29:23,590
those who don't know here in central

663
00:29:27,960 --> 00:29:25,270

California and May we tend to see this

664
00:29:30,000 --> 00:29:27,970
daily pattern of fog and low Stratus in

665
00:29:32,190 --> 00:29:30,010
the morning we'll refer to as our marine

666
00:29:34,710 --> 00:29:32,200
layer and in the afternoon that breaks

667
00:29:36,930 --> 00:29:34,720
up gradually in the district us tier

668
00:29:38,340 --> 00:29:36,940
winds due to our sea breeze now

669
00:29:40,560 --> 00:29:38,350
currently however we're seeing a slight

670
00:29:42,300 --> 00:29:40,570
disruption to that typical pattern we

671
00:29:43,760 --> 00:29:42,310
have a late season low-pressure system

672
00:29:46,950 --> 00:29:43,770
that has moved in and really dug into

673
00:29:48,600 --> 00:29:46,960
Central and Southern California what

674
00:29:50,910 --> 00:29:48,610
this low-pressure system has done is

675
00:29:52,500 --> 00:29:50,920
simply thickened our marine layer up

676
00:29:54,930 --> 00:29:52,510
it'll make it a little bit more stubborn

677
00:29:56,580 --> 00:29:54,940
to burn off tomorrow and as yielded some

678
00:29:59,970 --> 00:29:56,590
drizzle this early this afternoon this

679
00:30:01,950 --> 00:29:59,980
morning as we look to the satellite we

680
00:30:03,510 --> 00:30:01,960
can see abundant low and mid-level

681
00:30:05,010 --> 00:30:03,520
clouds as they circulate

682
00:30:06,960 --> 00:30:05,020
counterclockwise around that

683
00:30:09,690 --> 00:30:06,970
low-pressure Center as it makes its way

684
00:30:11,310 --> 00:30:09,700
over California as this satellite

685
00:30:13,080 --> 00:30:11,320
imagery continues to loop you can see

686
00:30:16,650 --> 00:30:13,090
that these clouds will continue to push

687
00:30:18,330 --> 00:30:16,660
east as the day progresses what this

688
00:30:20,130 --> 00:30:18,340

means for tomorrow's forecast

689
00:30:22,320 --> 00:30:20,140
the high pressure won't quite have had

690
00:30:23,850 --> 00:30:22,330
time to build in just yet so our marine

691
00:30:25,230 --> 00:30:23,860
layer will continue to be elevated for

692
00:30:27,690 --> 00:30:25,240
launch day much like we're seeing this

693
00:30:30,840 --> 00:30:27,700
morning this will result in cloudy

694
00:30:33,870 --> 00:30:30,850
conditions at t0 from approximately 800

695
00:30:35,580 --> 00:30:33,880
to 1600 feet however visibility will be

696
00:30:38,280 --> 00:30:35,590
unrestricted which is good news for

697
00:30:41,670 --> 00:30:38,290
launch viewing and temperatures will be

698
00:30:43,920 --> 00:30:41,680
in the mid to high 50s surface winds

699
00:30:46,050 --> 00:30:43,930
will be slightly elevated out of the

700
00:30:48,180 --> 00:30:46,060
West at 8 to 12 knots which will drive

701
00:30:51,240 --> 00:30:48,190
our overall probability of violation for

702
00:30:52,770 --> 00:30:51,250
t0 to be less than 10% with that only

703
00:30:55,050 --> 00:30:52,780
constraint of concerned being ground

704
00:30:57,000 --> 00:30:55,060
winds what that means is that we're

705
00:30:58,650 --> 00:30:57,010
assessing a less than 10% chance that

706
00:31:01,740 --> 00:30:58,660
weather conditions will be a factor at

707
00:31:03,630 --> 00:31:01,750
takeoff as we move to the scrub day

708
00:31:05,340 --> 00:31:03,640
forecast the low will continue to shift

709
00:31:06,870 --> 00:31:05,350
further to the east and will finally

710
00:31:08,940 --> 00:31:06,880
allow our high pressure to settle back

711
00:31:10,850 --> 00:31:08,950
into place and return us to that more

712
00:31:12,870 --> 00:31:10,860
typical pattern as I mentioned earlier

713
00:31:14,790 --> 00:31:12,880

daytime heating will scatter out our

714
00:31:17,750 --> 00:31:14,800
marine layer and lead to just a few

715
00:31:19,800 --> 00:31:17,760
clouds and unrestricted visibility at t0

716
00:31:21,750 --> 00:31:19,810
temperatures will increase slightly as

717
00:31:23,970 --> 00:31:21,760
we get more heating in the day to the

718
00:31:26,430 --> 00:31:23,980
upper 50s to low 60s and winds will turn

719
00:31:29,040 --> 00:31:26,440
out of the west and decrease slightly to

720
00:31:32,150 --> 00:31:29,050
7 to 10 knots what this will do is drop

721
00:31:34,370 --> 00:31:32,160
our POV or probability of violation to 0

722
00:31:37,070 --> 00:31:34,380
for a scrub day we have no areas of

723
00:31:40,340 --> 00:31:37,080
concern for weather and that is all for

724
00:31:42,140 --> 00:31:40,350
weather back to you Steve okay thank you

725
00:31:44,660 --> 00:31:42,150
captain Hayden and to all our panelists

726
00:31:46,670 --> 00:31:44,670
we'll start with questions now as a

727
00:31:49,430 --> 00:31:46,680
reminder for those watching on NASA TV

728
00:31:53,000 --> 00:31:49,440
you can post a question to social media

729
00:31:54,590 --> 00:31:53,010
using the hashtag ask NASA and we have

730
00:31:57,740 --> 00:31:54,600
reporters in the room reporters on the

731
00:31:58,910 --> 00:31:57,750
phone line please if you're stating a

732
00:32:01,760 --> 00:31:58,920
question give us your name and

733
00:32:03,770 --> 00:32:01,770
affiliation I think we have some on

734
00:32:07,250 --> 00:32:03,780
social media so Katelyn we'll start with

735
00:32:08,930 --> 00:32:07,260
you sure Manisha on Twitter asks what

736
00:32:10,880 --> 00:32:08,940
type of research will be done from this

737
00:32:16,010 --> 00:32:10,890
mission and how would we benefit from it

738
00:32:19,000 --> 00:32:16,020

so I'll take that question so the top

739
00:32:22,010 --> 00:32:19,010
researcher be dumping this mission is is

740
00:32:25,070 --> 00:32:22,020
mostly related to climate and hydrology

741
00:32:27,050 --> 00:32:25,080
we'll be able to understand the trends

742
00:32:28,760 --> 00:32:27,060
that we've seen from grace how those

743
00:32:31,280 --> 00:32:28,770
trends are continuing and whether or not

744
00:32:32,780 --> 00:32:31,290
you know the factors which are driving

745
00:32:34,550 --> 00:32:32,790
those trends whether they're due to

746
00:32:36,620 --> 00:32:34,560
short-term variability or sort of longer

747
00:32:38,000 --> 00:32:36,630
term climate trends and that of course

748
00:32:39,800 --> 00:32:38,010
is very important for us to understand

749
00:32:42,740 --> 00:32:39,810
you know a number of things about the

750
00:32:44,150 --> 00:32:42,750
Earth System one one for example is just

751
00:32:47,240 --> 00:32:44,160
understanding how we manage our water

752
00:32:48,890 --> 00:32:47,250
resources because with grace we can

753
00:32:51,110 --> 00:32:48,900
grace and grace fall and we're able to

754
00:32:53,870 --> 00:32:51,120
see you know depletion of aquifers in

755
00:32:56,930 --> 00:32:53,880
the ground and in the rising of sea and

756
00:32:58,280 --> 00:32:56,940
in the in the addition of water mass to

757
00:33:00,020 --> 00:32:58,290
the oceans and those are very important

758
00:33:04,540 --> 00:33:00,030
for society because we're just trying to

759
00:33:10,490 --> 00:33:07,190
okay I guess we can keep going with

760
00:33:12,800 --> 00:33:10,500
social media questions planet by on

761
00:33:17,000 --> 00:33:12,810
Twitter asks how identical are the grace

762
00:33:19,940 --> 00:33:17,010
of Oh twins they are absolutely

763
00:33:21,500 --> 00:33:19,950

identical the only thing the only

764
00:33:23,600 --> 00:33:21,510
difference is they have an ID that

765
00:33:24,950 --> 00:33:23,610
separates them for our communications to

766
00:33:26,930 --> 00:33:24,960
the ground but we built them and took

767
00:33:34,880 --> 00:33:26,940
great care to make sure that they're

768
00:33:36,890 --> 00:33:34,890
absolutely identical hi Michael Baylor

769
00:33:39,770 --> 00:33:36,900
for NASA space flight I was wondering if

770
00:33:41,060 --> 00:33:39,780
the laser works as expected then it

771
00:33:43,580 --> 00:33:41,070
would be better than the microwave

772
00:33:45,260 --> 00:33:43,590
instrument I believe so well then that'd

773
00:33:48,020 --> 00:33:45,270
be used instead even though it's a

774
00:33:54,290 --> 00:33:48,030
secondary mission or we still use both

775
00:33:56,090 --> 00:33:54,300
how that work thank you we will of

776
00:33:58,130 --> 00:33:56,100
course rely first of all on the

777
00:34:00,080 --> 00:33:58,140
microwave instruments that's clear we

778
00:34:02,480 --> 00:34:00,090
want to follow on the mission it's a

779
00:34:04,160 --> 00:34:02,490
technology demonstrator we will try to

780
00:34:07,310 --> 00:34:04,170
switch on relays arranging

781
00:34:09,740 --> 00:34:07,320
interferometer quite soon and we can

782
00:34:12,260 --> 00:34:09,750
also operate both instruments in

783
00:34:15,740 --> 00:34:12,270
parallel so we will make inspections if

784
00:34:18,320 --> 00:34:15,750
you want of both instruments during our

785
00:34:20,360 --> 00:34:18,330
in orbit checkout face and so on and

786
00:34:24,350 --> 00:34:20,370
then we will see how it operates we can

787
00:34:26,390 --> 00:34:24,360
derive gravity fields from both kind of

788
00:34:28,040 --> 00:34:26,400

measurements and if he really would

789
00:34:30,320 --> 00:34:28,050
cease at release or arranging

790
00:34:34,280 --> 00:34:30,330
interferometer behaves as it was

791
00:34:35,630 --> 00:34:34,290
designed I would see there's no doubt to

792
00:34:39,440 --> 00:34:35,640
switch to the laser ranging

793
00:34:44,900 --> 00:34:39,450
interferometer that's clear okay we have

794
00:34:46,790 --> 00:34:44,910
a question here in the room a little

795
00:34:47,990 --> 00:34:46,800
more mundane question but are curious

796
00:34:50,720 --> 00:34:48,000
about the rideshare

797
00:34:52,340 --> 00:34:50,730
arrangement this isn't like you just

798
00:34:55,340 --> 00:34:52,350
stick out your thumb and hitch a ride on

799
00:34:59,000 --> 00:34:55,350
a rocket launch so who talks to who and

800
00:35:01,970 --> 00:34:59,010
how do you get together on this question

801
00:35:04,310 --> 00:35:01,980
to me so part of let's say our contract

802
00:35:07,850 --> 00:35:04,320
with NASA is that Germany is responsible

803
00:35:10,220 --> 00:35:07,860
for providing the launcher and we have

804
00:35:12,470 --> 00:35:10,230
sciences right ray our contract because

805
00:35:15,860 --> 00:35:12,480
it is part of the cost sharing between

806
00:35:16,740 --> 00:35:15,870
Germany and the US we also share our

807
00:35:19,890 --> 00:35:16,750
costs

808
00:35:22,790 --> 00:35:19,900
iridium it's of course nothing what

809
00:35:25,470 --> 00:35:22,800
happens every day but we have

810
00:35:28,110 --> 00:35:25,480
experienced a very very good partnership

811
00:35:30,180 --> 00:35:28,120
with iridium and SpaceX and we are

812
00:35:34,170 --> 00:35:30,190
totally confident that we have a

813
00:35:35,640 --> 00:35:34,180

successful launch tomorrow okay I think

814
00:35:38,820 --> 00:35:35,650
we have another question in the room

815
00:35:40,950 --> 00:35:38,830
right up front here I antthony why's Mad

816
00:35:43,050 --> 00:35:40,960
River Union I have two questions I read

817
00:35:44,850 --> 00:35:43,060
in the media pack that the satellites

818
00:35:46,650 --> 00:35:44,860
will change orientation a couple times

819
00:35:49,530 --> 00:35:46,660
through the mission and I was wondering

820
00:35:52,080 --> 00:35:49,540
about that and then why the solar panels

821
00:35:56,520 --> 00:35:52,090
have the little voids in them the little

822
00:36:00,330 --> 00:35:56,530
red marks on them yeah - so the first

823
00:36:03,840 --> 00:36:00,340
question when the spacecraft are moving

824
00:36:08,700 --> 00:36:03,850
in orbit one end of them is is mom

825
00:36:10,500 --> 00:36:08,710
bartered by atomic oxygen and so we it's

826
00:36:12,900 --> 00:36:10,510
this kind of a strategy of hours to

827
00:36:16,230 --> 00:36:12,910
reduce impacts to the end of the

828
00:36:18,420 --> 00:36:16,240
material on the end and so about halfway

829
00:36:20,430 --> 00:36:18,430
through the mission we will swap

830
00:36:21,930 --> 00:36:20,440
positions and so then the other

831
00:36:28,880 --> 00:36:21,940
satellite will take them take some of

832
00:36:31,290 --> 00:36:28,890
that the atomic oxygen impact and then

833
00:36:33,330 --> 00:36:31,300
depending on how long we go and we hope

834
00:36:36,690 --> 00:36:33,340
to go but longer than our five-year

835
00:36:40,410 --> 00:36:36,700
mission we'll work our strategy for the

836
00:36:42,840 --> 00:36:40,420
best times to do the exchange this is

837
00:36:44,280 --> 00:36:42,850
just a maneuver that we do similar to

838
00:36:45,990 --> 00:36:44,290

the maneuvers where we do

839
00:36:47,700 --> 00:36:46,000
station-keeping between the satellites

840
00:36:52,650 --> 00:36:47,710
and try and keep them about 220

841
00:36:54,450 --> 00:36:52,660
kilometers apart with respect to the

842
00:36:55,860 --> 00:36:54,460
voids in the solar arrays are you

843
00:36:59,190 --> 00:36:55,870
talking about these little tiny marks

844
00:37:03,470 --> 00:36:59,200
are you talking about these now this is

845
00:37:06,290 --> 00:37:03,480
just an interpretation on the model of

846
00:37:08,640 --> 00:37:06,300
how the solar panels are laid down

847
00:37:10,800 --> 00:37:08,650
there's a certain number of cells per

848
00:37:13,050 --> 00:37:10,810
string and so it's more of a

849
00:37:15,870 --> 00:37:13,060
manufacturing issue there's some gaps

850
00:37:17,520 --> 00:37:15,880
between some cell blocks as they're

851
00:37:21,810 --> 00:37:17,530
placed on the spacecraft and so it just

852
00:37:23,790 --> 00:37:21,820
it comes out not perfectly covered but

853
00:37:27,540 --> 00:37:23,800
again it's just been a matter of how

854
00:37:30,210 --> 00:37:27,550
it's laid down on the cells okay we have

855
00:37:32,160 --> 00:37:30,220
a question from the phone lines from

856
00:37:33,330 --> 00:37:32,170
porter at the verge go ahead please

857
00:37:36,930 --> 00:37:33,340
identify yourself

858
00:37:38,280 --> 00:37:36,940
hi this is Alison representative Virgil

859
00:37:40,740 --> 00:37:38,290
I was just wondering if one of us could

860
00:37:43,370 --> 00:37:40,750
explain how the decent change between

861
00:37:46,530 --> 00:37:43,380
the two satellites results in

862
00:37:54,530 --> 00:37:46,540
measurement of the mass change down on

863
00:37:58,339 --> 00:37:54,540

earth so we observe this distance

864
00:38:02,130 --> 00:37:58,349
measurements together with other

865
00:38:04,470 --> 00:38:02,140
observations which have been highlighted

866
00:38:06,390 --> 00:38:04,480
by a field for example from the

867
00:38:09,060 --> 00:38:06,400
accelerometer we measure all the

868
00:38:13,680 --> 00:38:09,070
non-gravitational measurements due to

869
00:38:16,710 --> 00:38:13,690
dry air drag or solar radiation and we

870
00:38:19,560 --> 00:38:16,720
invert all these measurements are doing

871
00:38:22,859 --> 00:38:19,570
orbit determination young we solve for

872
00:38:26,370 --> 00:38:22,869
large linear equation system with which

873
00:38:29,310 --> 00:38:26,380
it was about ten thousand unknowns there

874
00:38:32,670 --> 00:38:29,320
are over one months to solve for

875
00:38:37,260 --> 00:38:32,680
representation of the gravity field for

876
00:38:39,780 --> 00:38:37,270
one month okay we have another question

877
00:38:46,140 --> 00:38:39,790
on their phone lines from space like

878
00:38:49,170 --> 00:38:46,150
space flight now go ahead please

879
00:38:53,309 --> 00:38:49,180
I thanks for taking my call I did one of

880
00:38:54,779 --> 00:38:53,319
you please give me the target orbit when

881
00:38:58,230 --> 00:38:54,789
you separate from the talking nine you

882
00:38:59,549 --> 00:38:58,240
know Apogee Parrish inclination and is

883
00:39:01,289 --> 00:38:59,559
there any maneuvering the satellites

884
00:39:02,309 --> 00:39:01,299
have to do to reach their final clients

885
00:39:04,829 --> 00:39:02,319
orbit can you walk me through that

886
00:39:07,970 --> 00:39:04,839
commissioning and when you anticipate

887
00:39:11,490 --> 00:39:07,980
starting the science mission and

888
00:39:12,990 --> 00:39:11,500

secondly I could one of you provide the

889
00:39:15,870 --> 00:39:13,000
total cost of the grace follow-on

890
00:39:18,750 --> 00:39:15,880
mission with both the German and US

891
00:39:22,710 --> 00:39:18,760
contributions thank you I'll take the

892
00:39:28,440 --> 00:39:22,720
first part of that question we launch

893
00:39:30,720 --> 00:39:28,450
into 490 kilometres plus or minus 10 so

894
00:39:34,980 --> 00:39:30,730
we're approximately 500 kilometers in

895
00:39:37,799 --> 00:39:34,990
altitude at 89 degrees inclination when

896
00:39:40,440 --> 00:39:37,809
we separate were angled down at 30

897
00:39:42,269 --> 00:39:40,450
degrees so one comes off a little higher

898
00:39:45,890 --> 00:39:42,279
altitude one comes off a little lower

899
00:39:49,920 --> 00:39:45,900
this causes them to begin to drift apart

900
00:39:52,260 --> 00:39:49,930
and we are injecting directly towards

901
00:39:55,470 --> 00:39:52,270
the South Pole at 89 degrees so we don't

902
00:39:59,460 --> 00:39:55,480
do any particular maneuvering other than

903
00:40:02,970 --> 00:39:59,470
to get them in a safe state and get them

904
00:40:05,460 --> 00:40:02,980
nadir pointed on the bottom panel and

905
00:40:07,170 --> 00:40:05,470
then we let them naturally drift apart

906
00:40:08,609 --> 00:40:07,180
over a couple of days until they get

907
00:40:12,059 --> 00:40:08,619
about the right distance apart

908
00:40:14,579 --> 00:40:12,069
approximately 220 kilometers and this is

909
00:40:16,769 --> 00:40:14,589
a very kind of natural process and so we

910
00:40:21,750 --> 00:40:16,779
will just head toward the South Pole

911
00:40:22,859 --> 00:40:21,760
it's a fairly simple process that we go

912
00:40:25,740 --> 00:40:22,869
through we don't do any particular

913
00:40:29,069 --> 00:40:25,750

maneuver maneuvering other than when we

914
00:40:30,720 --> 00:40:29,079
reach our distance we do a station stop

915
00:40:33,839 --> 00:40:30,730
maneuver where we we slow things down

916
00:40:39,210 --> 00:40:33,849
and try and drift at around 220

917
00:40:41,579 --> 00:40:39,220
kilometers or the second part of that

918
00:40:43,920 --> 00:40:41,589
question the NASA contribution to this

919
00:40:47,069 --> 00:40:43,930
mission is approximately 430 million

920
00:40:48,800 --> 00:40:47,079
dollars and I'll let Frank answer the

921
00:40:52,850 --> 00:40:48,810
question for the German country

922
00:40:57,470 --> 00:40:52,860
I can answer that clearly it's about 77

923
00:41:00,890 --> 00:40:57,480
million euro for the German contributed

924
00:41:05,230 --> 00:41:00,900
items okay thank you I guess we have

925
00:41:09,170 --> 00:41:05,240
another let's see another question here

926
00:41:10,760 --> 00:41:09,180
how quickly the two great satellites

927
00:41:12,920 --> 00:41:10,770
have to get away from the Falcon nine

928
00:41:14,900 --> 00:41:12,930
second stage before I prefer performs

929
00:41:20,180 --> 00:41:14,910
the second burn for the Iridium

930
00:41:23,930 --> 00:41:20,190
satellites thank you don't look at the

931
00:41:25,640 --> 00:41:23,940
time line I think the the state I mean

932
00:41:27,530 --> 00:41:25,650
once we separate we start moving away

933
00:41:29,780 --> 00:41:27,540
and it's I think about two minutes but I

934
00:41:32,420 --> 00:41:29,790
have to check on that before they fire

935
00:41:35,360 --> 00:41:32,430
to move into their orbit that's

936
00:41:38,330 --> 00:41:35,370
something we'll have to check yeah we

937
00:41:39,830 --> 00:41:38,340
can get to that information we have

938
00:41:42,650 --> 00:41:39,840

another question on social media okay

939
00:41:45,050 --> 00:41:42,660
then on Twitter mari Takahashi from

940
00:41:47,300 --> 00:41:45,060
Smosh asks how soon will the data be

941
00:41:52,460 --> 00:41:47,310
collected and made available to the

942
00:41:54,260 --> 00:41:52,470
public I'll take that so the after after

943
00:41:55,910 --> 00:41:54,270
launch we have about a 90 day period of

944
00:41:56,720 --> 00:41:55,920
in orbit checkout and during that period

945
00:41:58,990 --> 00:41:56,730
we'll be collecting

946
00:42:01,670 --> 00:41:59,000
turnaround systems from instruments

947
00:42:05,300 --> 00:42:01,680
getting the spacecraft thermally stable

948
00:42:08,300 --> 00:42:05,310
I started collecting the first data it

949
00:42:10,850 --> 00:42:08,310
takes about 30 days of data to do one

950
00:42:13,640 --> 00:42:10,860
gravity field so during that 90-day

951
00:42:15,290 --> 00:42:13,650
period if all goes as expected we'll

952
00:42:18,380 --> 00:42:15,300
probably collect our first you know a

953
00:42:19,850 --> 00:42:18,390
couple of 30 day periods and then when

954
00:42:23,120 --> 00:42:19,860
we start generating gravity fields after

955
00:42:24,860 --> 00:42:23,130
that so expect you know the first source

956
00:42:28,070 --> 00:42:24,870
science fields to come you know 90 days

957
00:42:30,650 --> 00:42:28,080
or so after launch and then the the the

958
00:42:33,500 --> 00:42:30,660
goal is that have releases to you know

959
00:42:37,910 --> 00:42:33,510
the science community about 180 days

960
00:42:39,800 --> 00:42:37,920
after in order to check out gave me

961
00:42:42,800 --> 00:42:39,810
another question in the room the record

962
00:42:44,840 --> 00:42:42,810
matter of regaining newspaper for the

963
00:42:48,680 --> 00:42:44,850

original grace mission and the follow-on

964
00:42:50,090 --> 00:42:48,690
mission was we were you expecting the

965
00:42:52,480 --> 00:42:50,100
information that you got were you

966
00:42:54,760 --> 00:42:52,490
planning for this or were there any

967
00:42:56,960 --> 00:42:54,770
information there that was a surprise

968
00:42:58,220 --> 00:42:56,970
you know that you found particularly

969
00:43:00,770 --> 00:42:58,230
useful

970
00:43:03,320 --> 00:43:00,780
I like this question because I think

971
00:43:05,630 --> 00:43:03,330
because the original grace mission was

972
00:43:07,520 --> 00:43:05,640
was a competed mission to a NASA SSP

973
00:43:09,380 --> 00:43:07,530
program and it was a proposal that was

974
00:43:10,820 --> 00:43:09,390
ridden forth and people asked this

975
00:43:13,160 --> 00:43:10,830
question a lot of all sorts of prizes we

976
00:43:14,060 --> 00:43:13,170
had from from Grace and we actually have

977
00:43:16,910 --> 00:43:14,070
gone back and looked at the original

978
00:43:19,460 --> 00:43:16,920
proposal and almost all the things we

979
00:43:21,260 --> 00:43:19,470
saw with grace were were predicted to

980
00:43:23,330 --> 00:43:21,270
have to have been seen we didn't know

981
00:43:25,970 --> 00:43:23,340
how much we knew that the mission would

982
00:43:27,530 --> 00:43:25,980
be able to sense mass law you'd be able

983
00:43:29,030 --> 00:43:27,540
to detect mass loss from the ice sheets

984
00:43:31,370 --> 00:43:29,040
you know mass gained in the oceans

985
00:43:33,950 --> 00:43:31,380
underground ground ground water mass

986
00:43:36,740 --> 00:43:33,960
changes changes in the solid earth from

987
00:43:38,420 --> 00:43:36,750
large earthquakes and and I think almost

988
00:43:40,660 --> 00:43:38,430

all of these were predicting the

989
00:43:43,970 --> 00:43:40,670
proposals and were saying now the the

990
00:43:46,160 --> 00:43:43,980
the sort of you know the part that that

991
00:43:48,640 --> 00:43:46,170
wasn't in the proposal course was how

992
00:43:50,900 --> 00:43:48,650
much those changes were what they meant

993
00:43:52,250 --> 00:43:50,910
where they were occurring and how fast

994
00:43:54,680 --> 00:43:52,260
they were occurring and those were

995
00:43:57,590 --> 00:43:54,690
really the really revolutionary parts or

996
00:43:59,540 --> 00:43:57,600
results from the grace mission and you

997
00:44:01,850 --> 00:43:59,550
know we could see you know you can see

998
00:44:04,130 --> 00:44:01,860
for example you know ice sheets you know

999
00:44:05,450 --> 00:44:04,140
losing and losing ice and losing mass

1000
00:44:06,520 --> 00:44:05,460
and we could see it going into the

1001
00:44:08,900 --> 00:44:06,530
oceans and then we could actually

1002
00:44:11,510 --> 00:44:08,910
compare that with altimetry data and see

1003
00:44:13,310 --> 00:44:11,520
how much actual energy or expansion was

1004
00:44:14,660 --> 00:44:13,320
taking place in the oceans which is

1005
00:44:18,260 --> 00:44:14,670
something that you know we were not you

1006
00:44:21,410 --> 00:44:18,270
know able to see the discriminants

1007
00:44:24,770 --> 00:44:21,420
before also when there was a period in

1008
00:44:26,660 --> 00:44:24,780
2000 2011 when a sea-level sort of you

1009
00:44:27,890 --> 00:44:26,670
know slow see Oliver ice slow down slow

1010
00:44:29,150 --> 00:44:27,900
down a little bit and actually kind of

1011
00:44:32,240 --> 00:44:29,160
you know went the other direction very

1012
00:44:34,670 --> 00:44:32,250
briefly and from from the grace data one

1013
00:44:35,960 --> 00:44:34,680

could see or where we could see that you

1014
00:44:38,270 --> 00:44:35,970
know the ice sheets were still losing

1015
00:44:39,650 --> 00:44:38,280
ice at the same rate you know sea level

1016
00:44:41,690 --> 00:44:39,660
kind of slowed down rising a little bit

1017
00:44:43,820 --> 00:44:41,700
and that was also seen in the grace a

1018
00:44:45,590 --> 00:44:43,830
was that during that period there was

1019
00:44:47,720 --> 00:44:45,600
more water being stored on land there

1020
00:44:49,520 --> 00:44:47,730
was some heavier rain you know rainy

1021
00:44:51,140 --> 00:44:49,530
seasons in Australia and South America

1022
00:44:52,670 --> 00:44:51,150
and that that sort of equivalent of mass

1023
00:44:54,710 --> 00:44:52,680
was actually going to storage on land

1024
00:44:56,060 --> 00:44:54,720
very briefly instead of going into the

1025
00:44:57,410 --> 00:44:56,070
oceans and it was eventually you know at

1026
00:45:01,300 --> 00:44:57,420
least in the oceans and you know the

1027
00:45:03,350 --> 00:45:01,310
rate of civil rights you know continued

1028
00:45:06,380 --> 00:45:03,360
okay I think we have some additional

1029
00:45:08,930 --> 00:45:06,390
questions on social media katelyn from

1030
00:45:11,210 --> 00:45:08,940
twitter ivan corona of AFP asks what

1031
00:45:11,990 --> 00:45:11,220
other kinds of mass besides water may be

1032
00:45:14,180 --> 00:45:12,000
protected

1033
00:45:17,930 --> 00:45:14,190
may be detected by grace fo satellites

1034
00:45:20,090 --> 00:45:17,940
so I think so so the satellites are you

1035
00:45:22,400 --> 00:45:20,100
know the detect are since it all mass

1036
00:45:25,700 --> 00:45:22,410
change around around around the globe

1037
00:45:26,360 --> 00:45:25,710
and then we make measurements every 30

1038
00:45:29,210 --> 00:45:26,370

days

1039
00:45:31,520 --> 00:45:29,220
and so we see atmospheric ocean tides

1040
00:45:34,910 --> 00:45:31,530
you know solid earth changes you know

1041
00:45:36,380 --> 00:45:34,920
water ice you know moving around on the

1042
00:45:37,700 --> 00:45:36,390
30-day time scale there are a lot of

1043
00:45:39,020 --> 00:45:37,710
things which don't change very rapidly

1044
00:45:40,250 --> 00:45:39,030
and then you know solid earth is

1045
00:45:43,040 --> 00:45:40,260
changing rapidly on us we have an

1046
00:45:45,830 --> 00:45:43,050
earthquake and for atmospheric mass

1047
00:45:47,210 --> 00:45:45,840
changes we we tend to to calibrate that

1048
00:45:49,760 --> 00:45:47,220
out because we want to see sort of you

1049
00:45:51,440 --> 00:45:49,770
know sort of water so we have some

1050
00:45:54,080 --> 00:45:51,450
models based on atmospheric models yeah

1051
00:45:55,280 --> 00:45:54,090
how much mass is in the atmosphere so we

1052
00:45:57,260 --> 00:45:55,290
can calibrate that and really get down

1053
00:46:00,530 --> 00:45:57,270
to sort of you know mass change from

1054
00:46:02,180 --> 00:46:00,540
water in the ground in the surface in

1055
00:46:07,640 --> 00:46:02,190
source material in the oceans in the ice

1056
00:46:09,200 --> 00:46:07,650
sheets okay if we let's see do we have

1057
00:46:11,690 --> 00:46:09,210
any other additional questions here in

1058
00:46:13,010 --> 00:46:11,700
the room on social media okay well with

1059
00:46:14,960 --> 00:46:13,020
no further questions that'll end our

1060
00:46:17,630 --> 00:46:14,970
briefing for today just want to remind

1061
00:46:21,020 --> 00:46:17,640
everyone to tune into our live launch

1062
00:46:23,660 --> 00:46:21,030
broadcast starts tomorrow at 12:15

1063
00:46:26,330 --> 00:46:23,670

Pacific 3:15 Eastern and you can also

1064
00:46:30,590 --> 00:46:26,340
follow along on the launch blog which is

1065
00:46:31,850 --> 00:46:30,600
online at nasa.gov slash grace fo where

1066
00:46:34,010 --> 00:46:31,860
you can find a lot more information

1067
00:46:36,470 --> 00:46:34,020
about this unique and important mission