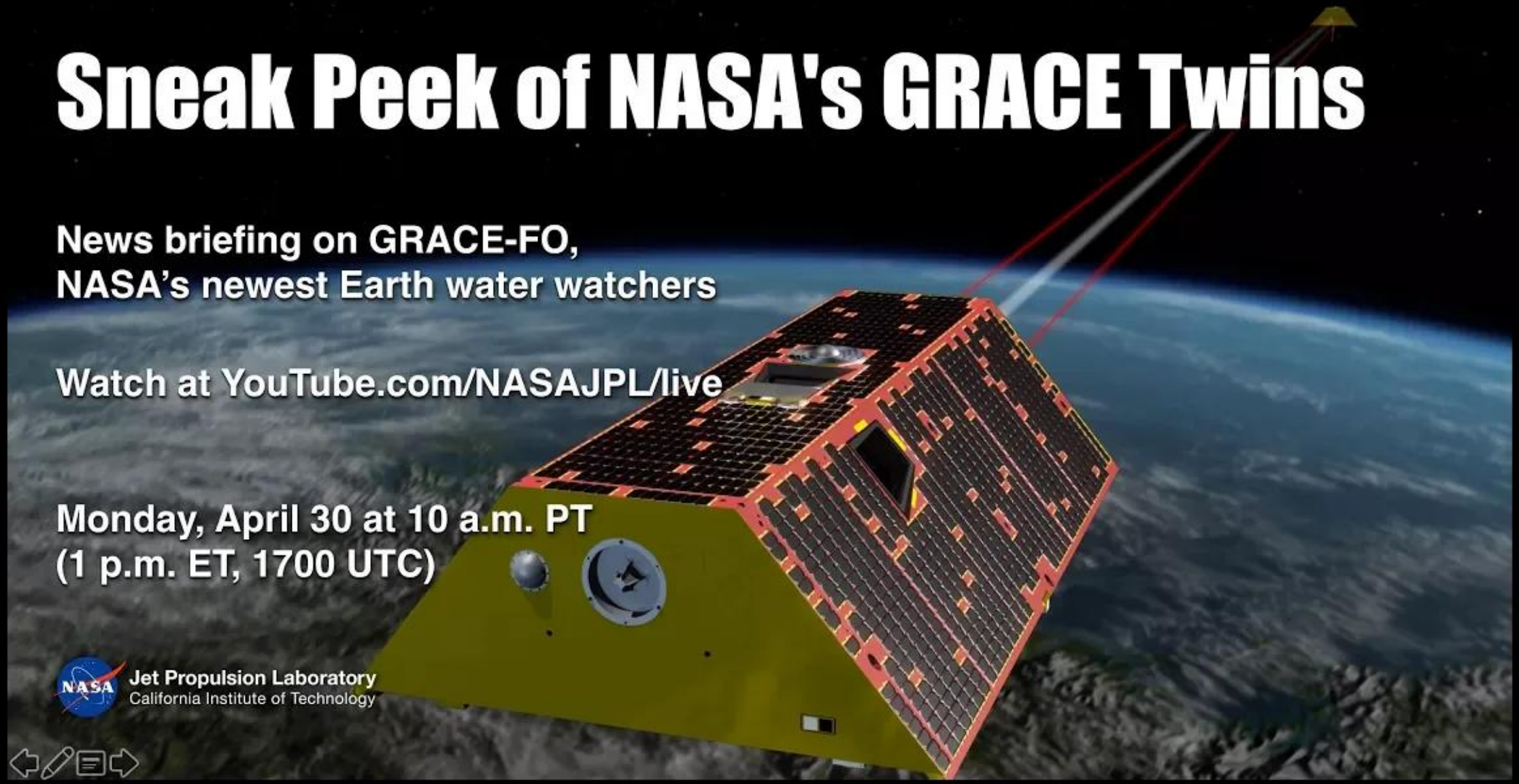
Sneak Peek of NASA's GRACE Twins



News briefing on GRACE-FO,
NASA's newest Earth water watchers

Watch at YouTube.com/NASAJPL/live

Monday, April 30 at 10 a.m. PT
(1 p.m. ET, 1700 UTC)

Jet Propulsion Laboratory
California Institute of Technology

1
00:00:08,270 --> 00:00:05,630
welcome to NASA headquarters in

2
00:00:10,160 --> 00:00:08,280
Washington we are less than three weeks

3
00:00:12,169 --> 00:00:10,170
away from launching a pair of earth

4
00:00:14,240 --> 00:00:12,179
orbiting spacecraft they're literally

5
00:00:16,970 --> 00:00:14,250
going to take on the weight of the world

6
00:00:30,710 --> 00:00:16,980
it's the grace follow-on mission or

7
00:00:33,440 --> 00:00:30,720
grace fo take a look water is one of the

8
00:00:36,799 --> 00:00:33,450
main indicators of how the planet is

9
00:00:38,840 --> 00:00:36,809
responding to our evolving climate we

10
00:00:40,160 --> 00:00:38,850
build our civilization around the

11
00:00:42,170 --> 00:00:40,170
climate that we had and the water

12
00:00:43,970 --> 00:00:42,180
resources that we have and if those are

13
00:00:48,080 --> 00:00:43,980

changing that can have a profound impact

14
00:00:50,240 --> 00:00:48,090
on how we operate our society grace and

15
00:00:51,830 --> 00:00:50,250
grace follow on measure the motion of

16
00:00:53,810 --> 00:00:51,840
water around the earth and they measure

17
00:00:55,700 --> 00:00:53,820
that in all forms of water water that's

18
00:00:57,350 --> 00:00:55,710
stored underground water in the ocean

19
00:00:59,540 --> 00:00:57,360
water that's frozen in the form of

20
00:01:08,450 --> 00:00:59,550
glaciers so all of that together grace

21
00:01:11,960 --> 00:01:08,460
can measure grace fall one is a mission

22
00:01:13,399 --> 00:01:11,970
to measure how water is distributed on

23
00:01:15,469 --> 00:01:13,409
the planet and how that changes from

24
00:01:17,630 --> 00:01:15,479
month to month grace stands for Gravity

25
00:01:18,890 --> 00:01:17,640
Recovery and climate experiment it's a

26
00:01:22,100 --> 00:01:18,900
follow-on mission to this mission called

27
00:01:23,840 --> 00:01:22,110
grace that we launched in 2002 and that

28
00:01:25,249 --> 00:01:23,850
mission just ended a few months ago and

29
00:01:26,270 --> 00:01:25,259
grace phone's gonna pick up and continue

30
00:01:28,520 --> 00:01:26,280
that science legacy

31
00:01:30,080 --> 00:01:28,530
even though grace flew for 15 years

32
00:01:32,600 --> 00:01:30,090
climbing is one of those things which

33
00:01:33,890 --> 00:01:32,610
takes place on decadal timescales

34
00:01:35,749 --> 00:01:33,900
it's really important that we look at

35
00:01:37,700 --> 00:01:35,759
these trends over longer time period

36
00:01:41,300 --> 00:01:37,710
where we can establish the forces which

37
00:01:44,510 --> 00:01:41,310
are driving them one follows the other

38
00:01:46,399 --> 00:01:44,520

and between them they accurately track

39
00:01:51,080 --> 00:01:46,409
the distance between the two satellites

40
00:01:52,240 --> 00:01:51,090
and as they fly over changes in mass on

41
00:01:53,710 --> 00:01:52,250
the earth and

42
00:01:56,380 --> 00:01:53,720
back and forth then we track those

43
00:01:58,060 --> 00:01:56,390
little changes very accurate and we do

44
00:02:00,670 --> 00:01:58,070
that with Global Positioning System

45
00:02:02,440 --> 00:02:00,680
satellite information and with star

46
00:02:06,880 --> 00:02:02,450
cameras that are onboard the two

47
00:02:10,270 --> 00:02:06,890
spacecraft I think there's an increasing

48
00:02:12,699 --> 00:02:10,280
awareness and consciousness around the

49
00:02:15,100 --> 00:02:12,709
earth that water is a critical resource

50
00:02:17,170 --> 00:02:15,110
and that the sea level is rising the

51
00:02:20,380 --> 00:02:17,180
polar caps are melting and that all

52
00:02:23,290 --> 00:02:20,390
these have long-term ramifications on

53
00:02:25,360 --> 00:02:23,300
how we live the grace following

54
00:02:27,160 --> 00:02:25,370
measurements give us very clear and

55
00:02:28,720 --> 00:02:27,170
tangible information so we can make

56
00:02:36,400 --> 00:02:28,730
sound decisions in the future of how we

57
00:02:38,979 --> 00:02:36,410
manage our resources hi I'm Karen Fox

58
00:02:40,750 --> 00:02:38,989
and welcome to this NASA media briefing

59
00:02:43,810 --> 00:02:40,760
on our next Earth observing mission

60
00:02:45,970 --> 00:02:43,820
grace follow-on grace stands for the

61
00:02:48,520 --> 00:02:45,980
Gravity Recovery and climate experiment

62
00:02:51,250 --> 00:02:48,530
it's a joint mission between NASA and

63
00:02:53,530 --> 00:02:51,260

Germany grace follow-on will carry on

64
00:02:55,120 --> 00:02:53,540
from a former mission grace together a

65
00:02:57,660 --> 00:02:55,130
unique data record that tracks our

66
00:03:00,820 --> 00:02:57,670
planets water cycle ice sheets and more

67
00:03:02,350 --> 00:03:00,830
our briefing is in two parts today first

68
00:03:04,090 --> 00:03:02,360
we'll look at the amazing science the

69
00:03:06,280 --> 00:03:04,100
mission will enable and how that will

70
00:03:07,750 --> 00:03:06,290
benefit people around the world then

71
00:03:10,000 --> 00:03:07,760
we'll switch to talking about between

72
00:03:11,530 --> 00:03:10,010
spacecraft themselves and how launch

73
00:03:14,320 --> 00:03:11,540
preparations are progressing in

74
00:03:15,820 --> 00:03:14,330
California after each part we'll be

75
00:03:18,250 --> 00:03:15,830
taking questions from the press both

76
00:03:19,750 --> 00:03:18,260
here and on the phone and if you're

77
00:03:21,580 --> 00:03:19,760
watching on NASA TV you can ask

78
00:03:23,470 --> 00:03:21,590
questions to just post it on social

79
00:03:27,940 --> 00:03:23,480
media during the briefing with the

80
00:03:30,759 --> 00:03:27,950
hashtag ask NASA let's get started first

81
00:03:33,250 --> 00:03:30,769
up the science we have three experts

82
00:03:35,890 --> 00:03:33,260
here today in our studio is Michael

83
00:03:37,210 --> 00:03:35,900
Watkins the grace follow-on science lead

84
00:03:40,900 --> 00:03:37,220
and director of NASA's Jet Propulsion

85
00:03:43,590 --> 00:03:40,910
Laboratory Frank Webb the grace

86
00:03:47,380 --> 00:03:43,600
follow-on project scientist at JPL and

87
00:03:50,289 --> 00:03:47,390
joining us via Skype from over 15 -

88
00:03:52,390 --> 00:03:50,299

Germany is Frank Flexner the grace

89
00:03:54,610 --> 00:03:52,400
follow-on project manager at the German

90
00:03:57,789 --> 00:03:54,620
Research Center for geosciences also

91
00:03:59,920 --> 00:03:57,799
known as G FZ which is NASA's primary

92
00:04:00,790 --> 00:03:59,930
mission partner we're going to start

93
00:04:03,670 --> 00:04:00,800
with the basics

94
00:04:05,890 --> 00:04:03,680
Michael tell me about grace follow-on

95
00:04:06,100 --> 00:04:05,900
and also its predecessor grace what did

96
00:04:07,690 --> 00:04:06,110
they

97
00:04:10,060 --> 00:04:07,700
- well thanks Karen it's a pleasure to

98
00:04:12,730 --> 00:04:10,070
be here so grace and grace follow-on are

99
00:04:13,900 --> 00:04:12,740
some of NASA's most unique missions so

100
00:04:15,820 --> 00:04:13,910
what grace has done and what grace

101
00:04:19,060 --> 00:04:15,830
fallin will do shortly after its launch

102
00:04:20,320 --> 00:04:19,070
is map the Earth's water in motion now

103
00:04:22,120 --> 00:04:20,330
what's fascinating about grace is it

104
00:04:23,920 --> 00:04:22,130
does it not by looking at the surface of

105
00:04:26,380 --> 00:04:23,930
the earth not by looking at water or

106
00:04:27,880 --> 00:04:26,390
bouncing a radar off off the water but

107
00:04:30,400 --> 00:04:27,890
by actually measuring the weight of the

108
00:04:32,710 --> 00:04:30,410
water so it actually is able to tell how

109
00:04:34,120 --> 00:04:32,720
much water is in a given location on the

110
00:04:36,340 --> 00:04:34,130
earth and how that's changing over time

111
00:04:37,600 --> 00:04:36,350
and what grace was able to observe from

112
00:04:39,280 --> 00:04:37,610
that is because water takes many

113
00:04:40,770 --> 00:04:39,290

different forms sometimes it's in the

114
00:04:42,640 --> 00:04:40,780
form of ground water deep underground

115
00:04:45,640 --> 00:04:42,650
sometimes it's in the form of polar

116
00:04:47,620 --> 00:04:45,650
icecaps sometimes it could be in the

117
00:04:48,850 --> 00:04:47,630
form of ocean water moving around winds

118
00:04:50,920 --> 00:04:48,860
and circle oh sure circles you can't

119
00:04:52,990 --> 00:04:50,930
pile water up and another more in one

120
00:04:54,640 --> 00:04:53,000
place in another place and grace

121
00:04:56,170 --> 00:04:54,650
observes all of that complete water

122
00:04:57,910 --> 00:04:56,180
cycle of the earth and how it changes

123
00:04:59,680 --> 00:04:57,920
over time and it's very unique in that

124
00:05:01,990 --> 00:04:59,690
sense because it measures water in all

125
00:05:04,150 --> 00:05:02,000
forms and because it does it with this

126
00:05:06,580 --> 00:05:04,160
bathroom scale methodology of actually

127
00:05:09,160 --> 00:05:06,590
weighing the weight of the water as it

128
00:05:10,930 --> 00:05:09,170
moves around the earth so we've had 15

129
00:05:13,180 --> 00:05:10,940
years now of this kind of data that

130
00:05:14,710 --> 00:05:13,190
you're talking about what has grace told

131
00:05:16,870 --> 00:05:14,720
us about the earth that we didn't know

132
00:05:18,460 --> 00:05:16,880
before so let's take a look at the at

133
00:05:22,270 --> 00:05:18,470
this graphic so as you said we have 15

134
00:05:24,400 --> 00:05:22,280
years of gray's data and and what grace

135
00:05:26,650 --> 00:05:24,410
has shown us is there's significant

136
00:05:28,270 --> 00:05:26,660
changes in every part of the world and

137
00:05:30,190 --> 00:05:28,280
how much water is stored in each part of

138
00:05:32,170 --> 00:05:30,200

the world now one of the unique things

139
00:05:34,659 --> 00:05:32,180
about this plot is that you notice

140
00:05:35,980 --> 00:05:34,669
Grace's has measurements of everywhere

141
00:05:37,480 --> 00:05:35,990
in the world everywhere on land and

142
00:05:39,760 --> 00:05:37,490
fight a little in the oceans as well and

143
00:05:41,409 --> 00:05:39,770
what you can see is sometimes that again

144
00:05:43,690 --> 00:05:41,419
that's ice ice sheets that have changed

145
00:05:45,190 --> 00:05:43,700
sometimes it's it's aquifer storage but

146
00:05:46,840 --> 00:05:45,200
almost every part of the world has been

147
00:05:48,610 --> 00:05:46,850
observed by grace and has a story to

148
00:05:50,440 --> 00:05:48,620
tell and that's actually resulted in

149
00:05:52,330 --> 00:05:50,450
grace coming up with some of the the

150
00:05:54,580 --> 00:05:52,340
most scientific findings of seismic

151
00:05:56,740 --> 00:05:54,590
publications of any mission in recent

152
00:05:58,540 --> 00:05:56,750
years in earth science because it's just

153
00:06:00,760 --> 00:05:58,550
so broad in what he can tell us about

154
00:06:05,200 --> 00:06:00,770
about the earth so we take a look at

155
00:06:07,000 --> 00:06:05,210
this here this is the average trend that

156
00:06:09,719 --> 00:06:07,010
grace has seen over the 15 years that it

157
00:06:12,520 --> 00:06:09,729
was in orbit from 2002 through 2017

158
00:06:14,290 --> 00:06:12,530
the biggest signals are actually up in

159
00:06:16,510 --> 00:06:14,300
the poles so the areas that are reddish

160
00:06:19,029 --> 00:06:16,520
in color are areas where water mass has

161
00:06:19,570 --> 00:06:19,039
gone away from those regions and so the

162
00:06:21,189 --> 00:06:19,580
the area

163
00:06:23,350 --> 00:06:21,199

have the most water mass loss are

164
00:06:25,240 --> 00:06:23,360
actually in Greenland for example you

165
00:06:26,890 --> 00:06:25,250
see all the red colors there in in

166
00:06:28,629 --> 00:06:26,900
Greenland that's actually ice that's

167
00:06:30,520 --> 00:06:28,639
melted off the Greenland ice caps and

168
00:06:33,219 --> 00:06:30,530
you can see the same thing over in

169
00:06:35,200 --> 00:06:33,229
Alaska and and and down in the West

170
00:06:37,089 --> 00:06:35,210
Antarctic Peninsula and so those have

171
00:06:38,679 --> 00:06:37,099
been contributing a significant amount

172
00:06:41,080 --> 00:06:38,689
about one third of sea-level rise that

173
00:06:42,610 --> 00:06:41,090
we observe comes from polar ice melting

174
00:06:44,170 --> 00:06:42,620
that good that grace has observed and it

175
00:06:45,580 --> 00:06:44,180
was actually not well known before we

176
00:06:47,589 --> 00:06:45,590
launched grace it was it was not clear

177
00:06:48,820 --> 00:06:47,599
how much that was contributing to sea

178
00:06:51,159 --> 00:06:48,830
level and and how much the ice sheets

179
00:06:53,170 --> 00:06:51,169
were changing but it's also fascinating

180
00:06:55,809 --> 00:06:53,180
that you see a lot of blobs of green and

181
00:06:57,730 --> 00:06:55,819
and red that of course are not ice and

182
00:06:59,320 --> 00:06:57,740
that's areas where it's either been a

183
00:07:01,149 --> 00:06:59,330
drought and folks have been using

184
00:07:03,580 --> 00:07:01,159
groundwater pumping groundwater for

185
00:07:06,100 --> 00:07:03,590
agriculture for human use for for other

186
00:07:08,499 --> 00:07:06,110
purposes for irrigation in other cases

187
00:07:10,510 --> 00:07:08,509
we have it green areas where it's been

188
00:07:12,519 --> 00:07:10,520

heavy rain it's been it's been flooded

189
00:07:13,689 --> 00:07:12,529
even in some cases so we all know some

190
00:07:14,830 --> 00:07:13,699
years sometimes you have a couple years

191
00:07:16,930 --> 00:07:14,840
that are drying a couple years that are

192
00:07:18,550 --> 00:07:16,940
wet what you can't always tell us how

193
00:07:20,379 --> 00:07:18,560
did that how did that how did that water

194
00:07:21,640 --> 00:07:20,389
get deep into the earth you know it was

195
00:07:23,230 --> 00:07:21,650
a drought that I just lose water from

196
00:07:25,420 --> 00:07:23,240
the surface or did I lose it very deep

197
00:07:26,589 --> 00:07:25,430
down and what do I do about replenishing

198
00:07:29,619 --> 00:07:26,599
that and it can they observe it being

199
00:07:30,490 --> 00:07:29,629
replenished when we have wetter years so

200
00:07:32,170 --> 00:07:30,500
if you look at the areas that are

201
00:07:34,230 --> 00:07:32,180
greenish those tend to be areas where

202
00:07:36,579 --> 00:07:34,240
it's been heavy rainfall and replenished

203
00:07:38,469 --> 00:07:36,589
areas where it's red are areas where

204
00:07:41,170 --> 00:07:38,479
there's been significant drought and use

205
00:07:43,600 --> 00:07:41,180
of a fairly precious groundwater and

206
00:07:45,189 --> 00:07:43,610
some of these areas are here in the

207
00:07:47,589 --> 00:07:45,199
United States the Texas drought in

208
00:07:48,969 --> 00:07:47,599
California some of them are in parts of

209
00:07:50,950 --> 00:07:48,979
the developing world where where the

210
00:07:52,600 --> 00:07:50,960
infrastructure may not be able to to

211
00:07:54,579 --> 00:07:52,610
respond as quickly to that too those

212
00:07:55,959 --> 00:07:54,589
droughts and loss of ground water so

213
00:07:57,820 --> 00:07:55,969

this is very important data and it's

214
00:07:59,680 --> 00:07:57,830
it's very important to how we understand

215
00:08:01,899 --> 00:07:59,690
our home planet and and how it's

216
00:08:03,700 --> 00:08:01,909
changing thank you very much

217
00:08:05,680 --> 00:08:03,710
Frank I'm going to ask you to do a

218
00:08:07,390 --> 00:08:05,690
deeper dive into some of these areas but

219
00:08:09,430 --> 00:08:07,400
Michael has been telling us about let's

220
00:08:11,769 --> 00:08:09,440
start off with the global water cycle

221
00:08:15,249 --> 00:08:11,779
tell us what it is and how great is fall

222
00:08:17,260 --> 00:08:15,259
inside that area so so the water in the

223
00:08:19,390 --> 00:08:17,270
water cycle play an important role in

224
00:08:21,189 --> 00:08:19,400
the earth system you know water you know

225
00:08:23,980 --> 00:08:21,199
it's it's necessary for sustaining life

226
00:08:27,070 --> 00:08:23,990
it's an important media for transporting

227
00:08:29,800 --> 00:08:27,080
you know heat on the planet and it's a

228
00:08:32,620 --> 00:08:29,810
vital resource for our civilization now

229
00:08:33,380 --> 00:08:32,630
in these charts these charts are just

230
00:08:35,030 --> 00:08:33,390
going to illustrate

231
00:08:37,580 --> 00:08:35,040
you know water comes in many forms to us

232
00:08:41,450 --> 00:08:37,590
it's like rain falls as rain it falls as

233
00:08:46,280 --> 00:08:41,460
snow its surface water in rivers and

234
00:08:48,500 --> 00:08:46,290
lakes it's also you know locked up his

235
00:08:51,020 --> 00:08:48,510
frozen water and ice and ice sheets as

236
00:08:53,920 --> 00:08:51,030
well as water in the ground that we pump

237
00:08:56,060 --> 00:08:53,930
out for irrigation and for drinking and

238
00:08:57,830 --> 00:08:56,070

understanding and also water in the

239
00:09:00,860 --> 00:08:57,840
ocean as well and understanding you know

240
00:09:02,290 --> 00:09:00,870
the water cycle and the trends in the

241
00:09:04,580 --> 00:09:02,300
water cycle is very important for us to

242
00:09:07,550 --> 00:09:04,590
understand this resource and manage it

243
00:09:09,260 --> 00:09:07,560
for our use so you mentioned a number of

244
00:09:10,910 --> 00:09:09,270
different types of water we're tracking

245
00:09:12,740 --> 00:09:10,920
let's go into frozen water it tell us

246
00:09:14,990 --> 00:09:12,750
what the ice sheets and the glaciers so

247
00:09:16,790 --> 00:09:15,000
so ice sheets and glaciers are the

248
00:09:19,490 --> 00:09:16,800
largest you know freshwater resources on

249
00:09:20,960 --> 00:09:19,500
the planet they took tens to hundreds of

250
00:09:23,060 --> 00:09:20,970
thousands of years to develop they

251
00:09:24,050 --> 00:09:23,070
developed in places where the planet you

252
00:09:25,880 --> 00:09:24,060
know where there's were more

253
00:09:27,920 --> 00:09:25,890
precipitation or snow fell every year

254
00:09:31,250 --> 00:09:27,930
then was lost through melts during

255
00:09:33,500 --> 00:09:31,260
during that year and so snow in in water

256
00:09:35,480 --> 00:09:33,510
or snow accumulated they're accumulating

257
00:09:38,540 --> 00:09:35,490
this water resource now in this video

258
00:09:40,580 --> 00:09:38,550
clip here this is a animation of grace

259
00:09:42,080 --> 00:09:40,590
data and as Mike mentioned you know

260
00:09:44,180 --> 00:09:42,090
about the trends and the trends and

261
00:09:47,150 --> 00:09:44,190
trends around the globe here we can see

262
00:09:50,030 --> 00:09:47,160
more detail how the grace data allows us

263
00:09:52,180 --> 00:09:50,040

to see how Greenland won these the

264
00:09:55,340 --> 00:09:52,190
largest frozen ice reservoir that we

265
00:09:57,410 --> 00:09:55,350
that is melting right now is evolving we

266
00:09:59,180 --> 00:09:57,420
can see on a month-to-month basis the

267
00:10:01,760 --> 00:09:59,190
variations the seasonal variations we

268
00:10:03,020 --> 00:10:01,770
can see geographically where the changes

269
00:10:04,790 --> 00:10:03,030
are taking place where it's draining

270
00:10:07,160 --> 00:10:04,800
from and all this data helps scientists

271
00:10:10,340 --> 00:10:07,170
understand the forces which are driving

272
00:10:12,680 --> 00:10:10,350
the the loss of ice from Greenland the

273
00:10:14,060 --> 00:10:12,690
melting of water that is going into the

274
00:10:17,780 --> 00:10:14,070
oceans right now and contributing a

275
00:10:19,940 --> 00:10:17,790
sea-level rise so from there oh there's

276
00:10:21,110 --> 00:10:19,950
more oh yeah and so there's also in this

277
00:10:23,720 --> 00:10:21,120
clip who this is similarly for

278
00:10:25,490 --> 00:10:23,730
Antarctica you can see that we again we

279
00:10:28,760 --> 00:10:25,500
have you know monthly measurements from

280
00:10:30,770 --> 00:10:28,770
grace of how Antarctica is losing you

281
00:10:32,780 --> 00:10:30,780
know ice ice mass and that's going to

282
00:10:35,330 --> 00:10:32,790
the oceans you guys to see again the the

283
00:10:37,400 --> 00:10:35,340
geographical distribution means that you

284
00:10:39,950 --> 00:10:37,410
know in some parts of Antarctica are

285
00:10:42,560 --> 00:10:39,960
accumulating snow and some are losing

286
00:10:44,720 --> 00:10:42,570
it's physically Western Antarctica but

287
00:10:46,809 --> 00:10:44,730
the net effect is most is our crow is

288
00:10:49,929 --> 00:10:46,819

losing water losing water mass and

289
00:10:53,199 --> 00:10:49,939
going into the oceans we you know it's

290
00:10:55,840 --> 00:10:53,209
you know it's like 280 Giga tons of

291
00:10:57,489 --> 00:10:55,850
water per year from Greenland and 120

292
00:11:00,519 --> 00:10:57,499
Giga tons of water per year from

293
00:11:02,919 --> 00:11:00,529
Antarctica what's a good time so a Giga

294
00:11:05,169 --> 00:11:02,929
ton is a cube of water a kilometer in

295
00:11:07,150 --> 00:11:05,179
size and this graphic here just shows

296
00:11:09,579 --> 00:11:07,160
what that cube looks like sitting on

297
00:11:12,179 --> 00:11:09,589
Manhattan it's equivalent to about

298
00:11:15,099 --> 00:11:12,189
400,000 Olympic sized swimming pools and

299
00:11:17,469 --> 00:11:15,109
you know the ice mass loss from

300
00:11:20,199 --> 00:11:17,479
Greenland alone contributes about a

301
00:11:23,259 --> 00:11:20,209
third of the sea-level rise right that

302
00:11:25,210 --> 00:11:23,269
we were seeing these currently all right

303
00:11:27,609 --> 00:11:25,220
so we just did the ice let's bring it a

304
00:11:30,639 --> 00:11:27,619
little closer to home can you tell us a

305
00:11:32,379 --> 00:11:30,649
little bit about the kind of water that

306
00:11:34,359 --> 00:11:32,389
people are relying on every day what is

307
00:11:35,979 --> 00:11:34,369
what's going on with that sure so some

308
00:11:39,189 --> 00:11:35,989
of the trends that Mike showed in his in

309
00:11:40,449 --> 00:11:39,199
his chart were were for not only ice but

310
00:11:43,409 --> 00:11:40,459
also for ground water and ground water

311
00:11:46,989 --> 00:11:43,419
depletion and this this animation here

312
00:11:49,659 --> 00:11:46,999
video shows the loss of water mass in

313
00:11:52,149 --> 00:11:49,669

the western United States from 2003 at

314
00:11:54,189 --> 00:11:52,159
about 2013 and this was a period during

315
00:11:55,629 --> 00:11:54,199
some some droughts in California in the

316
00:11:57,819 --> 00:11:55,639
western US and you can see on a monthly

317
00:11:59,499 --> 00:11:57,829
basis we were able to sort of track how

318
00:12:01,179 --> 00:11:59,509
much you know water was stored in

319
00:12:03,309 --> 00:12:01,189
California in the western US we can

320
00:12:05,439 --> 00:12:03,319
actually weigh it with the grace data

321
00:12:06,699 --> 00:12:05,449
and you can see sort of variations in

322
00:12:07,749 --> 00:12:06,709
the amount of water was there some years

323
00:12:09,939 --> 00:12:07,759
a little wetter sand there's a little

324
00:12:11,679 --> 00:12:09,949
drier and this allows us to track you

325
00:12:14,349 --> 00:12:11,689
know the water changes and help to

326
00:12:17,859 --> 00:12:14,359
establish you know the causes of the

327
00:12:20,859 --> 00:12:17,869
water scarcity in this region thank you

328
00:12:22,960 --> 00:12:20,869
so much Frank scientists have also put

329
00:12:24,519 --> 00:12:22,970
grace data to other uses that directly

330
00:12:27,249 --> 00:12:24,529
impact everyday life around the world

331
00:12:28,899 --> 00:12:27,259
we're going to go now to Frank Flexner

332
00:12:31,029 --> 00:12:28,909
in Germany to talk about those

333
00:12:34,239 --> 00:12:31,039
specifically flood monitoring and

334
00:12:35,979 --> 00:12:34,249
weather forecasting Frank can you start

335
00:12:38,799 --> 00:12:35,989
out telling us how you've been using

336
00:12:42,749 --> 00:12:38,809
Frank Det sorry using grace data for

337
00:12:46,029 --> 00:12:42,759
tracking floods yes of course Karen

338
00:12:48,189 --> 00:12:46,039

flood forecasting systems require new

339
00:12:50,559 --> 00:12:48,199
real-time data to estimate the

340
00:12:54,249 --> 00:12:50,569
likeliness of flood events and to

341
00:12:56,409 --> 00:12:54,259
predict the evolution typically times

342
00:12:59,620 --> 00:12:56,419
for larger river basins are a few days

343
00:13:01,660 --> 00:12:59,630
and challenging the conventional ways

344
00:13:03,780 --> 00:13:01,670
data processing for the application and

345
00:13:06,100 --> 00:13:03,790
risk and Emergency Management

346
00:13:08,980 --> 00:13:06,110
therefore members of the European

347
00:13:10,930 --> 00:13:08,990
science team developed within a European

348
00:13:13,720 --> 00:13:10,940
Commission funded object which was

349
00:13:16,870 --> 00:13:13,730
called European gravity service for

350
00:13:19,090 --> 00:13:16,880
improved Emergency Management gravity

351
00:13:22,690 --> 00:13:19,100
field solutions which are provided in

352
00:13:25,690 --> 00:13:22,700
near real-time and with daily resolution

353
00:13:27,280 --> 00:13:25,700
from this gravity solutions we have them

354
00:13:30,400 --> 00:13:27,290
derived grace based

355
00:13:34,330 --> 00:13:30,410
wetness indices so if you start the

356
00:13:37,900 --> 00:13:34,340
video you see that with this innovative

357
00:13:40,750 --> 00:13:37,910
data we could drag the generation and

358
00:13:43,440 --> 00:13:40,760
the development of historical flood

359
00:13:47,800 --> 00:13:43,450
events for example what is shown here

360
00:13:50,560 --> 00:13:47,810
the April 2006 flood in the Danube Basin

361
00:13:53,560 --> 00:13:50,570
was a lead time of about six weeks

362
00:13:56,470 --> 00:13:53,570
compared to the river flow data at the

363
00:13:59,020 --> 00:13:56,480

outlet of the basin and operational test

364
00:14:02,350 --> 00:13:59,030
runs were also performed between April

365
00:14:04,780 --> 00:14:02,360
and June 2017 within the German space

366
00:14:07,750 --> 00:14:04,790
agency center for satellite-based crisis

367
00:14:11,440 --> 00:14:07,760
information and he turned out that this

368
00:14:14,440 --> 00:14:11,450
near real-time data are really extremely

369
00:14:17,860 --> 00:14:14,450
useful for early warning so if you look

370
00:14:21,010 --> 00:14:17,870
to the next slide you see this gray

371
00:14:23,740 --> 00:14:21,020
space to our wetness indices which have

372
00:14:26,320 --> 00:14:23,750
been P operationally implemented in the

373
00:14:29,110 --> 00:14:26,330
global flood awareness system of the

374
00:14:31,210 --> 00:14:29,120
European Commission in red you can see

375
00:14:35,350 --> 00:14:31,220
drier and in blue wetter than normal

376
00:14:39,030 --> 00:14:35,360
conditions so we are really trying to

377
00:14:41,500 --> 00:14:39,040
make a service out of the grace data and

378
00:14:44,070 --> 00:14:41,510
how will grace follow on continue

379
00:14:48,160 --> 00:14:44,080
helping with weather forecasts as well

380
00:14:52,450 --> 00:14:48,170
yeah so to explains this please start

381
00:14:54,640 --> 00:14:52,460
the next video so while the main Global

382
00:14:56,710 --> 00:14:54,650
Positioning System receivers on the top

383
00:14:59,710 --> 00:14:56,720
of the gray satellites were used for

384
00:15:02,200 --> 00:14:59,720
precise orbit determination a set of

385
00:15:04,510 --> 00:15:02,210
secondary GPS antenna sides the take

386
00:15:06,130 --> 00:15:04,520
sides of satellites and which are

387
00:15:08,470 --> 00:15:06,140
measuring the bending of the signals

388
00:15:11,650 --> 00:15:08,480

between Grace and the GPS satellites

389
00:15:13,150 --> 00:15:11,660
that were low offers arising and this

390
00:15:14,980 --> 00:15:13,160
way is a GPS signal

391
00:15:17,680 --> 00:15:14,990
it's grace and pass through the Earth's

392
00:15:18,550 --> 00:15:17,690
atmosphere which is also known as the

393
00:15:22,269 --> 00:15:18,560
occultation

394
00:15:24,939 --> 00:15:22,279
the GPS radio waves are added slightly

395
00:15:28,329 --> 00:15:24,949
as a pass through the atmosphere due to

396
00:15:30,610 --> 00:15:28,339
refractive effects and these changes can

397
00:15:33,309 --> 00:15:30,620
also be analyzed to create atmosphere

398
00:15:36,460 --> 00:15:33,319
for fights including RAF activity

399
00:15:41,410 --> 00:15:36,470
temperature or humidity what you can see

400
00:15:44,499 --> 00:15:41,420
on the slide left Champa's gfz satellite

401
00:15:47,309 --> 00:15:44,509
launched in 2000 with objectives of

402
00:15:50,740 --> 00:15:47,319
gravity and magnetic field ordering and

403
00:15:54,730 --> 00:15:50,750
atmospheric sounding so tram can be seen

404
00:15:57,009 --> 00:15:54,740
as a precursor of grace since 2006 gfz

405
00:15:59,619 --> 00:15:57,019
provides his temperature and humidity

406
00:16:02,889 --> 00:15:59,629
profiles operationally to various

407
00:16:06,009 --> 00:16:02,899
numerical weather services on a 24/7

408
00:16:08,530 --> 00:16:06,019
basis and an average delay of less than

409
00:16:11,860 --> 00:16:08,540
two hours to improve weather forecasts

410
00:16:15,220 --> 00:16:11,870
and to reach this stringent requirement

411
00:16:18,910 --> 00:16:15,230
of the weather services we have also

412
00:16:21,249 --> 00:16:18,920
implemented a receiving station with two

413
00:16:23,170 --> 00:16:21,259

antennas in Spitsbergen ears in aw spoil

414
00:16:27,309 --> 00:16:23,180
which you could see at the right of this

415
00:16:29,319 --> 00:16:27,319
plot and which I a ballute outload the

416
00:16:32,410 --> 00:16:29,329
echo occultation measurements nearly

417
00:16:35,050 --> 00:16:32,420
every orbit and this station will also

418
00:16:37,210 --> 00:16:35,060
become the primary downlink station for

419
00:16:39,699 --> 00:16:37,220
queries follow-on so one of the

420
00:16:42,939 --> 00:16:39,709
secondary objectives of the graceful on

421
00:16:46,059 --> 00:16:42,949
mission will be to derive at least 200

422
00:16:50,259 --> 00:16:46,069
of these daily temperature and humidity

423
00:16:52,210 --> 00:16:50,269
profiles thank you so much Frank that

424
00:16:54,460 --> 00:16:52,220
wraps up our discussion of the science

425
00:16:56,559 --> 00:16:54,470
of grace follow-on thank you so much to

426
00:16:59,199 --> 00:16:56,569
all of our experts here we're now going

427
00:17:00,850 --> 00:16:59,209
to take your questions remember that if

428
00:17:02,740 --> 00:17:00,860
you are watching on NASA TV all you have

429
00:17:07,960 --> 00:17:02,750
to do to ask a question via social media

430
00:17:10,929 --> 00:17:07,970
is to use the hashtag ask NASA and with

431
00:17:15,579 --> 00:17:10,939
that we have our first question from one

432
00:17:16,120 --> 00:17:15,589
of the media in our studio from science

433
00:17:18,699 --> 00:17:16,130
magazine

434
00:17:20,470 --> 00:17:18,709
I was wondering originally grace and

435
00:17:22,990 --> 00:17:20,480
grace follow-on were planned to overlap

436
00:17:24,460 --> 00:17:23,000
to aid in data calibration between them

437
00:17:26,470 --> 00:17:24,470
to get those long-term measures and

438
00:17:26,740 --> 00:17:26,480

since they won't overlap I'm wondering

439
00:17:30,610 --> 00:17:26,750
how

440
00:17:32,530 --> 00:17:30,620
you'll handle that let's take a crack at

441
00:17:34,900 --> 00:17:32,540
that so this is a good question

442
00:17:35,650 --> 00:17:34,910
we like you always like overlap because

443
00:17:37,060 --> 00:17:35,660
you want to make sure that the

444
00:17:39,640 --> 00:17:37,070
measurements are not in some way biased

445
00:17:41,200 --> 00:17:39,650
in some unpredictable way and that

446
00:17:42,430 --> 00:17:41,210
everything's consistent between the two

447
00:17:44,890 --> 00:17:42,440
measurement systems particularly for

448
00:17:47,170 --> 00:17:44,900
things like long term continuity in the

449
00:17:48,430 --> 00:17:47,180
case of grace and grace follow on the

450
00:17:50,740 --> 00:17:48,440
measurement because it's a change

451
00:17:52,960 --> 00:17:50,750
measurement it doesn't lend itself to

452
00:17:55,210 --> 00:17:52,970
being biased in in convey many

453
00:17:57,070 --> 00:17:55,220
conventional measurements are so the

454
00:17:58,810 --> 00:17:57,080
requirement for overlap is less critical

455
00:18:00,190 --> 00:17:58,820
than it might be for some other types of

456
00:18:01,510 --> 00:18:00,200
missions and grace is really measuring

457
00:18:04,300 --> 00:18:01,520
the derivative of things how fast things

458
00:18:06,400 --> 00:18:04,310
are changing and it's not the absolute

459
00:18:07,540 --> 00:18:06,410
amount of water but really the change

460
00:18:10,990 --> 00:18:07,550
and that's that's something that's

461
00:18:12,520 --> 00:18:11,000
harder to be biased but but but we want

462
00:18:14,860 --> 00:18:12,530
to double check anyway and the way we

463
00:18:17,380 --> 00:18:14,870

double check is by looking at other

464
00:18:18,490 --> 00:18:17,390
satellites less precise than grace that

465
00:18:22,140 --> 00:18:18,500
have been observed in the gravity field

466
00:18:24,880 --> 00:18:22,150
that very very long wavelength recourse

467
00:18:26,740 --> 00:18:24,890
spatial scales so they can kind of see

468
00:18:28,270 --> 00:18:26,750
yes Greenland was doing about this or

469
00:18:30,610 --> 00:18:28,280
Antarctic was doing about that or there

470
00:18:32,650 --> 00:18:30,620
were large scale changes in the northern

471
00:18:34,600 --> 00:18:32,660
hemisphere or southern hemisphere due to

472
00:18:35,920 --> 00:18:34,610
water storage and we can compare those

473
00:18:37,770 --> 00:18:35,930
and make sure that that when you

474
00:18:40,030 --> 00:18:37,780
interpolate the last grace data point

475
00:18:41,680 --> 00:18:40,040
those intermediate course points and the

476
00:18:44,530 --> 00:18:41,690
first grace follow-on point that those

477
00:18:46,360 --> 00:18:44,540
all look consistent so we believe it

478
00:18:48,310 --> 00:18:46,370
will be it will be satisfactory to have

479
00:18:51,040 --> 00:18:48,320
this fairly short gap of about a year

480
00:18:52,510 --> 00:18:51,050
year and a half all right we have

481
00:18:55,180 --> 00:18:52,520
another question from the room

482
00:18:57,220 --> 00:18:55,190
Randy Shostak reporter with a us at the

483
00:18:59,110 --> 00:18:57,230
American Geophysical Union thanks very

484
00:19:01,330 --> 00:18:59,120
much for doing this briefing I wonder if

485
00:19:03,370 --> 00:19:01,340
you could just tell me what in your

486
00:19:05,770 --> 00:19:03,380
estimation is the most startling most

487
00:19:07,360 --> 00:19:05,780
important findings that you've gotten

488
00:19:11,680 --> 00:19:07,370

from grace and what are your biggest

489
00:19:13,540 --> 00:19:11,690
hopes from grace follow-on associ from

490
00:19:17,050 --> 00:19:13,550
grace I think I think the rate of which

491
00:19:18,130 --> 00:19:17,060
the polar caps were were losing mass was

492
00:19:20,110 --> 00:19:18,140
something that was a little surprising

493
00:19:22,840 --> 00:19:20,120
to folks you know when we launched grace

494
00:19:24,040 --> 00:19:22,850
it wasn't clear how fast the polar

495
00:19:26,110 --> 00:19:24,050
sheets were changing

496
00:19:28,360 --> 00:19:26,120
I think grace was give the first clear

497
00:19:29,200 --> 00:19:28,370
picture with what's going on and of

498
00:19:31,630 --> 00:19:29,210
course that's been followed up with

499
00:19:33,820 --> 00:19:31,640
other more precise measurements for

500
00:19:36,580 --> 00:19:33,830
local areas like with radar or the

501
00:19:38,169 --> 00:19:36,590
upcoming icesat-2 mission but I think

502
00:19:39,520 --> 00:19:38,179
generally understanding how the how the

503
00:19:40,720 --> 00:19:39,530
polar caps are evolving is probably the

504
00:19:42,850 --> 00:19:40,730
biggest surprise from grace

505
00:19:44,920 --> 00:19:42,860
along with just the clarity that grace

506
00:19:46,780 --> 00:19:44,930
gave for the for the hydrological basins

507
00:19:47,800 --> 00:19:46,790
around the world for for groundwater and

508
00:19:50,950 --> 00:19:47,810
Frankie won't talk about Gracie

509
00:19:52,780 --> 00:19:50,960
following yeah and let me just add to

510
00:19:55,030 --> 00:19:52,790
that Mike to me one of the most

511
00:19:58,480 --> 00:19:55,040
interesting and saying exciting things

512
00:19:59,950 --> 00:19:58,490
was you know the understanding of how

513
00:20:01,780 --> 00:19:59,960

when you know the ice caps are melting

514
00:20:04,480 --> 00:20:01,790
and they're contributing you know mass

515
00:20:05,980 --> 00:20:04,490
to the oceans but you know in two

516
00:20:08,110 --> 00:20:05,990
thousand ten or eleven there was a

517
00:20:09,910 --> 00:20:08,120
slight sort of like you know dip in the

518
00:20:11,740 --> 00:20:09,920
rate of rise and actually reversal and

519
00:20:13,930 --> 00:20:11,750
rate of rise of sea level and that was

520
00:20:15,670 --> 00:20:13,940
related to more water being stored on

521
00:20:17,970 --> 00:20:15,680
land and so we could see mass was being

522
00:20:20,950 --> 00:20:17,980
lost from the ice caps nice sheets

523
00:20:22,360 --> 00:20:20,960
Greenland Antarctica corny and going but

524
00:20:24,790 --> 00:20:22,370
it wasn't all going to the ocean so it

525
00:20:26,980 --> 00:20:24,800
was getting stored on land it was later

526
00:20:28,930 --> 00:20:26,990
released you know through you know just

527
00:20:30,940 --> 00:20:28,940
normal processes for water running off

528
00:20:32,530 --> 00:20:30,950
land I think one thing that's important

529
00:20:35,200 --> 00:20:32,540
to follow up on that is the fact that

530
00:20:36,790 --> 00:20:35,210
grace observes what happens in many

531
00:20:38,530 --> 00:20:36,800
components of the hydrological cycle

532
00:20:40,720 --> 00:20:38,540
allows you to actually answer the

533
00:20:43,120 --> 00:20:40,730
question water left here where did it go

534
00:20:44,530 --> 00:20:43,130
and in the case for that Frank's talking

535
00:20:46,150 --> 00:20:44,540
about her or other case we actually see

536
00:20:47,920 --> 00:20:46,160
it go from one place and show up

537
00:20:49,510 --> 00:20:47,930
somewhere else and that allow scientists

538
00:20:51,190 --> 00:20:49,520

to really try to unfold exactly how

539
00:20:52,630 --> 00:20:51,200
water is transported at what rate and

540
00:20:55,440 --> 00:20:52,640
what are the most important processes

541
00:20:57,520 --> 00:20:55,450
that govern the water cycle on the earth

542
00:21:00,520 --> 00:20:57,530
alright we now have some questions from

543
00:21:02,260 --> 00:21:00,530
social media a user on Twitter has the

544
00:21:03,970 --> 00:21:02,270
following question if the grace

545
00:21:05,830 --> 00:21:03,980
follow-on mission can measure water

546
00:21:08,140 --> 00:21:05,840
underground does that mean you can also

547
00:21:11,800 --> 00:21:08,150
find and track new underground lakes and

548
00:21:13,420 --> 00:21:11,810
rivers it can so the first thing to

549
00:21:16,000 --> 00:21:13,430
remember always about grace is that it

550
00:21:17,800 --> 00:21:16,010
senses the change in water and not the

551
00:21:19,570 --> 00:21:17,810
absolute content of water so it doesn't

552
00:21:21,340 --> 00:21:19,580
tell you you have ten feet of water in

553
00:21:24,190 --> 00:21:21,350
that well it tells you you use 10 feet

554
00:21:26,890 --> 00:21:24,200
of water since last month so in areas

555
00:21:28,990 --> 00:21:26,900
where the aquifers are are varying quite

556
00:21:31,060 --> 00:21:29,000
a bit it is possible to actually go and

557
00:21:33,760 --> 00:21:31,070
look for areas of water storage or water

558
00:21:35,350 --> 00:21:33,770
depletion that are that have not

559
00:21:37,240 --> 00:21:35,360
currently been known and and there

560
00:21:39,370 --> 00:21:37,250
actually have been a few aquifers found

561
00:21:40,510 --> 00:21:39,380
using various techniques you know in

562
00:21:43,540 --> 00:21:40,520
parts of the world that are they're not

563
00:21:46,060 --> 00:21:43,550

widely used for irrigation and and not

564
00:21:49,660 --> 00:21:46,070
not widely used haven't have a lot of

565
00:21:51,730 --> 00:21:49,670
wells in them are already we have

566
00:21:53,860 --> 00:21:51,740
another question for social media now

567
00:21:55,690 --> 00:21:53,870
Tricia Patterson will like to know how

568
00:21:57,220 --> 00:21:55,700
and when will data from this mission be

569
00:21:59,049 --> 00:21:57,230
share it with the public is there an

570
00:22:02,740 --> 00:21:59,059
option for ongoing sharing of the

571
00:22:04,510 --> 00:22:02,750
findings so the the mission will be

572
00:22:06,669 --> 00:22:04,520
shared immediately as soon as we we get

573
00:22:08,590 --> 00:22:06,679
it and analyze it so the mission

574
00:22:11,740 --> 00:22:08,600
launches and we have about a 90 day

575
00:22:13,120 --> 00:22:11,750
period of checkout and then during that

576
00:22:14,980 --> 00:22:13,130
period we'll be collecting data we're

577
00:22:16,000 --> 00:22:14,990
collecting gravity data we'll be making

578
00:22:17,919 --> 00:22:16,010
sure the instruments are working and

579
00:22:19,480 --> 00:22:17,929
everything's you know operating well and

580
00:22:21,519 --> 00:22:19,490
then shortly after that we'll start

581
00:22:23,590 --> 00:22:21,529
releasing maybe 120 days after the

582
00:22:25,630 --> 00:22:23,600
initial check-out our first data

583
00:22:27,519 --> 00:22:25,640
products and that will then you'll be

584
00:22:30,159 --> 00:22:27,529
able to add those to the existing sort

585
00:22:32,169 --> 00:22:30,169
of database of grace data and move

586
00:22:33,970 --> 00:22:32,179
forward so it all be you know freely

587
00:22:37,500 --> 00:22:33,980
available Populi available as soon as I

588
00:22:40,000 --> 00:22:37,510

you know 120 days or so after launch

589
00:22:42,850 --> 00:22:40,010
thank you we have one last question

590
00:22:44,980 --> 00:22:42,860
coming in from social media Twitter user

591
00:22:48,850 --> 00:22:44,990
Jaimie Meyer wants to know which rocket

592
00:22:51,909 --> 00:22:48,860
will launch grace follow-on so so grace

593
00:22:55,299 --> 00:22:51,919
followings being launched on a balcony

594
00:22:57,060 --> 00:22:55,309
from Vandenberg on on May 19th is the

595
00:23:00,760 --> 00:22:57,070
scheduled date it's part of a rideshare

596
00:23:02,560 --> 00:23:00,770
with the Iridium communications so we'll

597
00:23:03,940 --> 00:23:02,570
be you know riding along with five of

598
00:23:05,680 --> 00:23:03,950
their satellites and then we'll be will

599
00:23:06,730 --> 00:23:05,690
be a release first and then they will go

600
00:23:08,440 --> 00:23:06,740
into their orbit and release their

601
00:23:09,820 --> 00:23:08,450
satellites we wouldn't talk quite a bit

602
00:23:13,960 --> 00:23:09,830
more about that in the in the second

603
00:23:16,210 --> 00:23:13,970
part of this briefing we had some great

604
00:23:17,950 --> 00:23:16,220
questions thank you so much now we're

605
00:23:19,289 --> 00:23:17,960
going to switch gears we're gonna start

606
00:23:21,820 --> 00:23:19,299
talking about the twin spacecraft

607
00:23:22,899 --> 00:23:21,830
themselves and how they work we're also

608
00:23:25,060 --> 00:23:22,909
going to take a look at launch

609
00:23:30,570 --> 00:23:25,070
preparations in California so stay with

610
00:25:15,639 --> 00:23:35,810
[Music]

611
00:25:21,019 --> 00:25:18,560
we are back with more on the grace

612
00:25:23,180 --> 00:25:21,029
follow-on mission which as we speak is

613
00:25:24,259 --> 00:25:23,190

currently at Vandenberg Air Force Base

614
00:25:26,830 --> 00:25:24,269
in California

615
00:25:28,759 --> 00:25:26,840
getting ready for a launch on May 19th

616
00:25:30,889 --> 00:25:28,769
here with us to talk about the

617
00:25:33,739 --> 00:25:30,899
spacecraft and mission operations our

618
00:25:35,810 --> 00:25:33,749
David Jarrett who is the grace follow-on

619
00:25:37,369 --> 00:25:35,820
program executive in the earth science

620
00:25:40,789 --> 00:25:37,379
division at NASA headquarters

621
00:25:43,940 --> 00:25:40,799
we have Phil Morton the grace follow-on

622
00:25:46,249 --> 00:25:43,950
project manager at JPL and again joining

623
00:25:48,349 --> 00:25:46,259
us from Germany via Skype we have Frank

624
00:25:50,119 --> 00:25:48,359
Flexner who is the grace follow-on

625
00:25:53,509 --> 00:25:50,129
project manager at the German Research

626
00:25:54,169 --> 00:25:53,519
Center for geosciences so Dave let's

627
00:25:56,450 --> 00:25:54,179
start with you

628
00:25:58,190 --> 00:25:56,460
I understand that grace follow-on is

629
00:26:00,649 --> 00:25:58,200
really very different from the typical

630
00:26:02,570 --> 00:26:00,659
earth-observing spacecraft that we have

631
00:26:04,759 --> 00:26:02,580
can you tell us a little bit about how

632
00:26:06,769 --> 00:26:04,769
it compares to some of the other things

633
00:26:08,869 --> 00:26:06,779
in NASA's science fleet that's right

634
00:26:11,570 --> 00:26:08,879
Karen we have a variety of Earth

635
00:26:13,759 --> 00:26:11,580
observing satellites circling the earth

636
00:26:16,969 --> 00:26:13,769
right now that are measuring different

637
00:26:20,899 --> 00:26:16,979
aspects of the earth from particles

638
00:26:23,539 --> 00:26:20,909

circling the earth to land masses to

639
00:26:26,690 --> 00:26:23,549
even the clouds that are circling the

640
00:26:29,719 --> 00:26:26,700
planet if you go to take a look at this

641
00:26:32,839 --> 00:26:29,729
animation here you can see that NASA

642
00:26:35,329 --> 00:26:32,849
currently has about 17 different

643
00:26:38,049 --> 00:26:35,339
satellites orbiting the Earth in many

644
00:26:42,379 --> 00:26:38,059
different orbits most of these

645
00:26:47,599 --> 00:26:42,389
satellites are in GOC or low-earth orbit

646
00:26:50,749 --> 00:26:47,609
and they generally measure things in

647
00:26:55,149 --> 00:26:50,759
certain ways if you could go to the next

648
00:26:58,339 --> 00:26:55,159
graphic the two ways that these

649
00:27:01,609 --> 00:26:58,349
spacecraft measure different

650
00:27:05,060 --> 00:27:01,619
characteristics are a passive way which

651
00:27:07,609 --> 00:27:05,070
acts like a camera and collects the

652
00:27:09,709 --> 00:27:07,619
reflected light off of the planet and

653
00:27:11,659 --> 00:27:09,719
then the instruments break these down

654
00:27:13,030 --> 00:27:11,669
into various wavelengths that are then

655
00:27:16,030 --> 00:27:13,040
analyzed for

656
00:27:21,610 --> 00:27:16,040
the different characteristics that we're

657
00:27:23,950 --> 00:27:21,620
looking for second type of instrument is

658
00:27:26,980 --> 00:27:23,960
an active instrument like radar or lidar

659
00:27:29,799 --> 00:27:26,990
that sends out an active pulse or an

660
00:27:31,690 --> 00:27:29,809
active later laser pulse that then

661
00:27:34,539 --> 00:27:31,700
rebounce is back off of whatever

662
00:27:38,500 --> 00:27:34,549
particle it reflects off of and then

663
00:27:43,390 --> 00:27:38,510

that beam is an analyzed for different

664
00:27:44,919 --> 00:27:43,400
characteristics unlike these two ways of

665
00:27:47,260 --> 00:27:44,929
collecting data

666
00:27:50,070 --> 00:27:47,270
grace follow-on is not your average

667
00:27:53,320 --> 00:27:50,080
everyday or science type of mission

668
00:27:55,510 --> 00:27:53,330
spacecraft don't essentially see

669
00:27:58,150 --> 00:27:55,520
anything on the ground or measure

670
00:28:00,580 --> 00:27:58,160
anything on the ground the actual of the

671
00:28:04,000 --> 00:28:00,590
two spacecraft are actually the science

672
00:28:07,750 --> 00:28:04,010
instrument when you combine them as can

673
00:28:09,940 --> 00:28:07,760
be seen in this video here the way the

674
00:28:12,640 --> 00:28:09,950
the major measurement or prime

675
00:28:15,520 --> 00:28:12,650
measurement of the grace follow-on

676
00:28:17,100 --> 00:28:15,530
mission is a very precise measurement of

677
00:28:22,390 --> 00:28:17,110
the distance between the two satellites

678
00:28:24,130 --> 00:28:22,400
and as the as the satellites pass over

679
00:28:26,440 --> 00:28:24,140
different portions of the earth the

680
00:28:28,799 --> 00:28:26,450
distance between the satellites change

681
00:28:32,680 --> 00:28:28,809
based on the current pull of gravity

682
00:28:35,500 --> 00:28:32,690
below them for instance when the first

683
00:28:37,900 --> 00:28:35,510
spacecraft passes over a mountain range

684
00:28:40,120 --> 00:28:37,910
such as the Himalayas it'll speed up

685
00:28:43,630 --> 00:28:40,130
slightly and increase the distance

686
00:28:46,120 --> 00:28:43,640
between the two satellites as the second

687
00:28:48,370 --> 00:28:46,130
satellite approaches the same mountain

688
00:28:51,370 --> 00:28:48,380

range it'll it too will increase speed

689
00:28:53,980 --> 00:28:51,380
and therefore decrease the space between

690
00:28:56,500 --> 00:28:53,990
the two satellites and this goes on and

691
00:28:59,860 --> 00:28:56,510
on as the both satellites orbit the

692
00:29:02,350 --> 00:28:59,870
earth and from this data scientists can

693
00:29:06,100 --> 00:29:02,360
estimate the gravity field to great

694
00:29:09,310 --> 00:29:06,110
precision for the entire planet thank

695
00:29:12,010 --> 00:29:09,320
you very much now let's go to Phil can

696
00:29:13,000 --> 00:29:12,020
you step us through the kinds of things

697
00:29:14,860 --> 00:29:13,010
Dave was telling us about tell us

698
00:29:16,450 --> 00:29:14,870
exactly how grace follow-on does its

699
00:29:18,430 --> 00:29:16,460
work and what are the key components I'm

700
00:29:20,890 --> 00:29:18,440
sure Karen and we brought these models

701
00:29:23,590 --> 00:29:20,900
to show you the various pieces and parts

702
00:29:26,260 --> 00:29:23,600
of the satellite on the outside on the

703
00:29:26,980 --> 00:29:26,270
front end here you can see the microwave

704
00:29:28,840 --> 00:29:26,990
instrument

705
00:29:31,659 --> 00:29:28,850
antenna these are the two antennas that

706
00:29:34,419 --> 00:29:31,669
the two spacecraft point at each other

707
00:29:36,519 --> 00:29:34,429
they used to microwave frequencies to

708
00:29:39,549 --> 00:29:36,529
measure the distance between the two

709
00:29:43,029 --> 00:29:39,559
spacecraft they fly about a hundred and

710
00:29:44,950 --> 00:29:43,039
thirty seven miles apart at that kind of

711
00:29:46,990 --> 00:29:44,960
a distance we can measure distance

712
00:29:51,730 --> 00:29:47,000
changes about the thickness of a blood

713
00:29:53,649 --> 00:29:51,740

cell you can also see two ports here

714
00:29:55,480 --> 00:29:53,659
these are baffles for the laser ranging

715
00:29:56,950 --> 00:29:55,490
interferometer this is a technology

716
00:29:59,710 --> 00:29:56,960
demonstration instrument that we've

717
00:30:02,950 --> 00:29:59,720
added to great follow on and there we'll

718
00:30:05,440 --> 00:30:02,960
use a laser beam bouncing between the

719
00:30:07,510 --> 00:30:05,450
two satellites to essentially accomplish

720
00:30:11,169 --> 00:30:07,520
this same measurement as the microwave

721
00:30:13,419 --> 00:30:11,179
but more accurately some other things to

722
00:30:16,779 --> 00:30:13,429
notice about the spacecraft solar arrays

723
00:30:20,169 --> 00:30:16,789
on the top and the two sides give us the

724
00:30:22,029 --> 00:30:20,179
power that we need these cutouts here or

725
00:30:25,240 --> 00:30:22,039
there on the top and the two sides are

726
00:30:28,480 --> 00:30:25,250
forced our camera baffles we use three

727
00:30:31,360 --> 00:30:28,490
star cameras to map our location in

728
00:30:33,220 --> 00:30:31,370
space as we're flying and taking these

729
00:30:36,220 --> 00:30:33,230
measurements we also have on top a

730
00:30:39,370 --> 00:30:36,230
precision GPS antenna and we use GPS

731
00:30:42,220 --> 00:30:39,380
data to also map the distance changes

732
00:30:45,010 --> 00:30:42,230
relative to earth and then finally on

733
00:30:47,500 --> 00:30:45,020
the back side you can see the GPS

734
00:30:51,639 --> 00:30:47,510
occultation tena that Frank was talking

735
00:30:53,500 --> 00:30:51,649
about earlier this we use to look at GPS

736
00:30:55,480 --> 00:30:53,510
signals as they rise and set over the

737
00:30:58,570 --> 00:30:55,490
horizon to measure moisture in the

738
00:31:01,539 --> 00:30:58,580

atmosphere and how do you put a complex

739
00:31:03,909 --> 00:31:01,549
spacecraft like this together oh well it

740
00:31:08,529 --> 00:31:03,919
is complicated we have a video here you

741
00:31:13,600 --> 00:31:08,539
can see this is film of the spacecraft

742
00:31:15,340 --> 00:31:13,610
being assembled at Airbus Airbus is

743
00:31:17,620 --> 00:31:15,350
located in southern Germany in

744
00:31:19,029 --> 00:31:17,630
Friedreich's - they're our primary

745
00:31:23,620 --> 00:31:19,039
contractor for the build of the two

746
00:31:26,590 --> 00:31:23,630
satellites it's quite a compact inside

747
00:31:31,000 --> 00:31:26,600
you can see the fuel tanks the solar

748
00:31:33,159 --> 00:31:31,010
arrays being added here one of the

749
00:31:35,950 --> 00:31:33,169
challenges we had was integrating the

750
00:31:38,560 --> 00:31:35,960
laser ranging interferometer into the

751
00:31:39,970 --> 00:31:38,570
system as its stood for grace or is it

752
00:31:42,370 --> 00:31:39,980
was done on grace

753
00:31:44,610 --> 00:31:42,380
here's a shot of the accelerometer this

754
00:31:48,370 --> 00:31:44,620
is a key component inside the spacecraft

755
00:31:49,750 --> 00:31:48,380
very carefully aligned with the triple

756
00:31:53,530 --> 00:31:49,760
mirror assembly part of the laser

757
00:31:56,680 --> 00:31:53,540
instrument also the star cameras all the

758
00:31:59,580 --> 00:31:56,690
optical alignments are very critical and

759
00:32:01,930 --> 00:31:59,590
then you can see the whole unit being

760
00:32:05,710 --> 00:32:01,940
dropped down into the very heart of the

761
00:32:07,390 --> 00:32:05,720
spacecraft these alignments are critical

762
00:32:10,150 --> 00:32:07,400
so critical they're done first and then

763
00:32:12,070 --> 00:32:10,160

we align the rest of the instruments to

764
00:32:14,919 --> 00:32:12,080
those make sure everything's properly

765
00:32:17,950 --> 00:32:14,929
and mechanically aligned thank you so

766
00:32:21,100 --> 00:32:17,960
much ville we are going to turn back now

767
00:32:22,260 --> 00:32:21,110
to frank fleckner in germany phil just

768
00:32:24,400 --> 00:32:22,270
explained that there's a new technology

769
00:32:26,440 --> 00:32:24,410
demonstration instrument that wasn't on

770
00:32:27,850 --> 00:32:26,450
the first grade's mission Frank can you

771
00:32:32,289 --> 00:32:27,860
tell us more about that and what do you

772
00:32:36,010 --> 00:32:32,299
hope to achieve with it yeah sure so on

773
00:32:39,010 --> 00:32:36,020
the next image you can see a sketch of a

774
00:32:41,860 --> 00:32:39,020
laser ranging interferometer as you have

775
00:32:44,110 --> 00:32:41,870
heard in Phil's overview it was a real

776
00:32:46,450 --> 00:32:44,120
challenge to implement another

777
00:32:49,150 --> 00:32:46,460
instrument into the already fully

778
00:32:51,100 --> 00:32:49,160
equipped satellite the laser ranging

779
00:32:54,100 --> 00:32:51,110
interferometer is a technology

780
00:32:56,950 --> 00:32:54,110
demonstrator for future next-generation

781
00:32:59,680 --> 00:32:56,960
gravity missions to improve the accuracy

782
00:33:02,320 --> 00:32:59,690
of the inter-satellite ranging it is

783
00:33:04,450 --> 00:33:02,330
important to mention that the success of

784
00:33:07,299 --> 00:33:04,460
grace follow-on will not rely on this

785
00:33:09,070 --> 00:33:07,309
technology demonstrator if it should not

786
00:33:11,799 --> 00:33:09,080
work as planned the gravity field

787
00:33:14,500 --> 00:33:11,809
modeling will be based on the microwave

788
00:33:15,789 --> 00:33:14,510

instrument only and grace follow-on will

789
00:33:18,669 --> 00:33:15,799
it still be successful

790
00:33:20,980 --> 00:33:18,679
the laser ranging interferometer is an

791
00:33:22,570 --> 00:33:20,990
excellent example to my opinion of a

792
00:33:23,740 --> 00:33:22,580
cooperative project was a great

793
00:33:26,980 --> 00:33:23,750
partnership

794
00:33:29,530 --> 00:33:26,990
u.s. focuses on very electronics the

795
00:33:32,620 --> 00:33:29,540
cavity and the procurement of the laser

796
00:33:34,510 --> 00:33:32,630
from Germany and Germany is focusing on

797
00:33:36,700 --> 00:33:34,520
the optical paths for example the

798
00:33:40,030 --> 00:33:36,710
optical range of a triple mirror

799
00:33:42,130 --> 00:33:40,040
assembly on the optical bench assembly

800
00:33:45,220 --> 00:33:42,140
the receive beam from the distant

801
00:33:46,740 --> 00:33:45,230
spacecraft is infinite with a small

802
00:33:49,560 --> 00:33:46,750
fraction

803
00:33:51,840 --> 00:33:49,570
for local oscillator being the larger

804
00:33:54,180 --> 00:33:51,850
fraction of the local oscillator beam is

805
00:33:57,120 --> 00:33:54,190
rate all deflected by a triple mirror

806
00:34:00,270 --> 00:33:57,130
assembly and sent back to the distant

807
00:34:03,060 --> 00:34:00,280
spacecraft the assembly consists of

808
00:34:06,060 --> 00:34:03,070
three perpendicular murals mounted into

809
00:34:09,570 --> 00:34:06,070
a rigid structure and works like a conic

810
00:34:13,200 --> 00:34:09,580
you reflect on the cavity is used for

811
00:34:16,889 --> 00:34:13,210
frequency stabilization of a laser and

812
00:34:20,369 --> 00:34:16,899
with all these components implemented on

813
00:34:23,610 --> 00:34:20,379

both satellites as a so-called racetrack

814
00:34:26,340 --> 00:34:23,620
configuration is established between the

815
00:34:29,100 --> 00:34:26,350
satellite and the inter-satellite range

816
00:34:33,270 --> 00:34:29,110
is continuously measured with a position

817
00:34:36,659 --> 00:34:33,280
of about 80 nanometer which is twice the

818
00:34:39,659 --> 00:34:36,669
size of a hepatitis-b viewers over

819
00:34:43,200 --> 00:34:39,669
distance of Los Angeles to San Diego for

820
00:34:43,950 --> 00:34:43,210
example so on the next slide you see top

821
00:34:46,320 --> 00:34:43,960
left

822
00:34:49,230 --> 00:34:46,330
these are little reflectors which have

823
00:34:51,600 --> 00:34:49,240
been provided by G of Z and which are

824
00:34:54,899 --> 00:34:51,610
mounted on the bottom of each of the two

825
00:34:57,240 --> 00:34:54,909
satellites we use a network of about 20

826
00:34:59,850 --> 00:34:57,250
ground stations which centrales a beam

827
00:35:02,610 --> 00:34:59,860
to the later reflector on the bottom

828
00:35:05,820 --> 00:35:02,620
right you see as an example the G of Z

829
00:35:07,560 --> 00:35:05,830
station in Potsdam Germany by comparing

830
00:35:10,170 --> 00:35:07,570
the time delay when the signal was sent

831
00:35:12,690 --> 00:35:10,180
and again received at relays our station

832
00:35:15,360 --> 00:35:12,700
the two-way range can be obtained with

833
00:35:18,060 --> 00:35:15,370
millimeter precision this serves for an

834
00:35:22,380 --> 00:35:18,070
independent control of a GPS derived of

835
00:35:24,330 --> 00:35:22,390
it now in addition to the important

836
00:35:26,490 --> 00:35:24,340
science it will do and the technology it

837
00:35:29,100 --> 00:35:26,500
uses we're excited here at NASA about

838
00:35:30,450 --> 00:35:29,110

grace follow-on for other reasons - the

839
00:35:34,230 --> 00:35:30,460
mission marks the continuation of a

840
00:35:35,550 --> 00:35:34,240
major u.s. German collaboration Dave can

841
00:35:36,830 --> 00:35:35,560
you talk a little bit about that

842
00:35:38,610 --> 00:35:36,840
collaboration and tell us in general

843
00:35:41,250 --> 00:35:38,620
what these kinds of international

844
00:35:43,620 --> 00:35:41,260
partnerships bring to NASA absolutely

845
00:35:45,930 --> 00:35:43,630
nASA has been working for many many

846
00:35:49,220 --> 00:35:45,940
years with our international partners in

847
00:35:52,320 --> 00:35:49,230
collaboration to conduct earth science

848
00:35:53,880 --> 00:35:52,330
measurements it is indeed a global

849
00:35:57,329 --> 00:35:53,890
effort and

850
00:35:59,699 --> 00:35:57,339
the data is very important to everyone

851
00:36:02,609 --> 00:35:59,709
around the world as this graphic shows

852
00:36:03,390 --> 00:36:02,619
here we have several missions both

853
00:36:06,779 --> 00:36:03,400
on-orbit

854
00:36:11,519 --> 00:36:06,789
and in development in cooperation with

855
00:36:12,900 --> 00:36:11,529
our many international partners part of

856
00:36:16,890 --> 00:36:12,910
the reason for international

857
00:36:19,910 --> 00:36:16,900
collaboration is to be able to reduce

858
00:36:25,529 --> 00:36:19,920
the costs for each contributing country

859
00:36:29,449 --> 00:36:25,539
for instance for grace follow-on we're

860
00:36:30,749 --> 00:36:29,459
working with gfz on this we worked on

861
00:36:36,719 --> 00:36:30,759
grace

862
00:36:39,420 --> 00:36:36,729
Agency and what we both get out of this

863
00:36:44,729 --> 00:36:39,430

essentially is more bang for the buck or

864
00:36:46,640 --> 00:36:44,739
an euro in this case for the investments

865
00:36:52,140 --> 00:36:46,650
that these different countries have made

866
00:36:53,370 --> 00:36:52,150
for for the measured gravity

867
00:36:56,400 --> 00:36:53,380
measurements we've been working with

868
00:36:59,519 --> 00:36:56,410
Germany since the 1990s first on the

869
00:37:02,249 --> 00:36:59,529
grace mission starting in 1998 and now

870
00:37:06,239 --> 00:37:02,259
continuing this successful partnership

871
00:37:10,079 --> 00:37:06,249
with gfz with Frank fleckner as the lead

872
00:37:15,089 --> 00:37:10,089
of the German side with their

873
00:37:18,239 --> 00:37:15,099
contributions together we look forward

874
00:37:20,609 --> 00:37:18,249
to a very good mission as Frank

875
00:37:24,329 --> 00:37:20,619
fleckner ed said earlier the Germans are

876
00:37:28,819 --> 00:37:24,339
contributing the launch mission

877
00:37:33,890 --> 00:37:28,829
operations the optics of the laser

878
00:37:38,299 --> 00:37:33,900
ranging interferometer and the laser

879
00:37:41,609 --> 00:37:38,309
retroreflectors the u.s. is providing

880
00:37:49,289 --> 00:37:41,619
overall project management the two

881
00:37:50,689 --> 00:37:49,299
spacecraft the accelerometers and and

882
00:37:53,579 --> 00:37:50,699
that's about it

883
00:37:55,199 --> 00:37:53,589
wonderful thank you so much Dave let's

884
00:37:56,910 --> 00:37:55,209
hear from the German side - we're gonna

885
00:37:59,630 --> 00:37:56,920
go again to Frank to hear about the

886
00:38:03,059 --> 00:37:59,640
partnership from the German perspective

887
00:38:05,430 --> 00:38:03,069
yes OG fzy has a long tradition in

888
00:38:07,140 --> 00:38:05,440

gravity field determination for example

889
00:38:11,520 --> 00:38:07,150
jet has buried

890
00:38:14,330 --> 00:38:11,530
operator hm with giant satellite in 2000

891
00:38:18,060 --> 00:38:14,340
which was a kind of precursor of grace

892
00:38:20,400 --> 00:38:18,070
this first time continuous high-low

893
00:38:23,970 --> 00:38:20,410
satellite to satellite tracking between

894
00:38:26,310 --> 00:38:23,980
champ and the GPS satellites and for the

895
00:38:28,860 --> 00:38:26,320
very first time flown accelerometer for

896
00:38:32,040 --> 00:38:28,870
gravity field improvement the

897
00:38:35,130 --> 00:38:32,050
collaboration in the u.s. German science

898
00:38:38,910 --> 00:38:35,140
data system and between the US and

899
00:38:41,550 --> 00:38:38,920
European science data teams helps gfz to

900
00:38:44,310 --> 00:38:41,560
improve gravity field and earth system

901
00:38:46,470 --> 00:38:44,320
modeling expertise the technology

902
00:38:49,710 --> 00:38:46,480
demonstrator of the laser ranging

903
00:38:52,980 --> 00:38:49,720
interferometer will enable German Space

904
00:38:55,680 --> 00:38:52,990
Agency DLR and German industry to

905
00:38:58,380 --> 00:38:55,690
prepare for next-generation gravity

906
00:39:01,440 --> 00:38:58,390
field missions and it's also a win-win

907
00:39:04,020 --> 00:39:01,450
situation for the German taxpayer as the

908
00:39:07,350 --> 00:39:04,030
cost was german contributed items like

909
00:39:10,110 --> 00:39:07,360
free alive a science data system to

910
00:39:12,660 --> 00:39:10,120
launch or mission operations or we

911
00:39:15,120 --> 00:39:12,670
funded as between graceful on satellites

912
00:39:19,320 --> 00:39:15,130
has been bought by cheap air from Airbus

913
00:39:21,210 --> 00:39:19,330

in Germany thank you very much now it's

914
00:39:24,330 --> 00:39:21,220
time to focus on an essential part of

915
00:39:25,650 --> 00:39:24,340
any space mission the launch and of

916
00:39:27,480 --> 00:39:25,660
course after that comes the mission

917
00:39:29,880 --> 00:39:27,490
operations to maintain the spacecraft

918
00:39:32,250 --> 00:39:29,890
once it's on orbit and doing its work so

919
00:39:35,670 --> 00:39:32,260
Frank can you step us through these key

920
00:39:38,610 --> 00:39:35,680
elements yes of course

921
00:39:40,770 --> 00:39:38,620
so gfz has signed the right track

922
00:39:43,440 --> 00:39:40,780
contract with the Iridium to launch the

923
00:39:45,630 --> 00:39:43,450
graceful on together with five-year

924
00:39:49,170 --> 00:39:45,640
idiom next satellites on the spacings

925
00:39:51,240 --> 00:39:49,180
provided Feb 9 rocket so could you

926
00:39:57,780 --> 00:39:51,250
please start the videos to explain it a

927
00:40:01,220 --> 00:39:57,790
little bit so the launch site is fen

928
00:40:04,590 --> 00:40:01,230
Berk Air Force Base in California as

929
00:40:07,290 --> 00:40:04,600
mentioned before by frank webb the cont

930
00:40:10,260 --> 00:40:07,300
target launch date is May 19

931
00:40:13,230 --> 00:40:10,270
so 707 seconds after liftoff a

932
00:40:15,420 --> 00:40:13,240
separation system will fire Pyrus to

933
00:40:17,910 --> 00:40:15,430
deploy between graceful on satellites

934
00:40:19,150 --> 00:40:17,920
and then nearly the same nominal orbit

935
00:40:23,050 --> 00:40:19,160
at 490

936
00:40:25,150 --> 00:40:23,060
meters and 89 degrees inclination the

937
00:40:28,270 --> 00:40:25,160
separation empires as we push the truth

938
00:40:30,520 --> 00:40:28,280

spacecraft in opposite directions the

939
00:40:33,400 --> 00:40:30,530
fan Berg air force base will confirm a

940
00:40:37,240 --> 00:40:33,410
successful separation using downlink

941
00:40:41,790 --> 00:40:37,250
telemetry data from the upper stage so

942
00:40:44,770 --> 00:40:41,800
less than a minute later the boom that

943
00:40:47,710 --> 00:40:44,780
holds each satellites radio frequency

944
00:40:50,350 --> 00:40:47,720
s-band antenna it is deployed and the

945
00:40:53,140 --> 00:40:50,360
low rate radio transmitter is activated

946
00:40:56,710 --> 00:40:53,150
the first data from the spacecraft are

947
00:40:59,770 --> 00:40:56,720
expected about 23 minutes later to be

948
00:41:03,090 --> 00:40:59,780
received through the first pass of our

949
00:41:05,950 --> 00:41:03,100
NASA's tracking station at McMurdo at

950
00:41:06,910 --> 00:41:05,960
Antarctica and to talk about mission

951
00:41:12,910 --> 00:41:06,920
operations

952
00:41:15,580 --> 00:41:12,920
please start the next video so for this

953
00:41:18,250 --> 00:41:15,590
activities gf that has subcontracted

954
00:41:20,680 --> 00:41:18,260
force nominal mission lifetime or 5

955
00:41:24,120 --> 00:41:20,690
years with German space operation center

956
00:41:26,770 --> 00:41:24,130
of the German space agency s for grace

957
00:41:28,750 --> 00:41:26,780
the German Space Operations Center is

958
00:41:30,520 --> 00:41:28,760
providing the ground data system to

959
00:41:32,800 --> 00:41:30,530
monitor and control the satellites

960
00:41:35,620 --> 00:41:32,810
perform initial processing of a

961
00:41:37,360 --> 00:41:35,630
telemetry data and to deliver all the

962
00:41:40,000 --> 00:41:37,370
data to the science data system for

963
00:41:44,230 --> 00:41:40,010

further processing and generation of

964
00:41:45,640 --> 00:41:44,240
science products so Phil can you tell us

965
00:41:49,060 --> 00:41:45,650
a bit more about launch preparations

966
00:41:51,070 --> 00:41:49,070
right now at Vandenberg absolutely after

967
00:41:54,280 --> 00:41:51,080
we continued or finished up our

968
00:41:56,260 --> 00:41:54,290
environmental testing just outside of

969
00:41:59,910 --> 00:41:56,270
Munich at a test facility there called a

970
00:42:02,350 --> 00:41:59,920
ABG we loaded all of our equipment

971
00:42:06,910 --> 00:42:02,360
transported to Vandenberg Air Force Base

972
00:42:10,720 --> 00:42:06,920
have a video here shows the arrival when

973
00:42:14,440 --> 00:42:10,730
we landed we got help from the US Air

974
00:42:15,970 --> 00:42:14,450
Force to unload all of our equipment

975
00:42:19,870 --> 00:42:15,980
that equipment included the two

976
00:42:22,690 --> 00:42:19,880
satellites or our multi satellite launch

977
00:42:24,850 --> 00:42:22,700
dispenser all the ground support

978
00:42:27,670 --> 00:42:24,860
equipment we trucked everything over to

979
00:42:29,830 --> 00:42:27,680
a facility called astra tech and there

980
00:42:32,050 --> 00:42:29,840
we do a full check out

981
00:42:32,800 --> 00:42:32,060
completed a full check out of the two

982
00:42:34,000 --> 00:42:32,810
satellites

983
00:42:36,430 --> 00:42:34,010
sure everything survived the

984
00:42:39,580 --> 00:42:36,440
transportation and everything was

985
00:42:44,980 --> 00:42:39,590
working perfectly we fuel the satellites

986
00:42:49,300 --> 00:42:44,990
and then get them already mounted them

987
00:42:52,480 --> 00:42:49,310
on our launch dispenser and then we've

988
00:42:53,950 --> 00:42:52,490

transported the entire combination of

989
00:42:56,050 --> 00:42:53,960
the two satellites and the launch

990
00:43:00,520 --> 00:42:56,060
dispenser what we call the stack the

991
00:43:03,160 --> 00:43:00,530
grace fo stack over to SpaceX where

992
00:43:06,910 --> 00:43:03,170
we've been waiting to do integration

993
00:43:09,100 --> 00:43:06,920
with iridium and with SpaceX those

994
00:43:11,830 --> 00:43:09,110
activities are scheduled to start up

995
00:43:14,140 --> 00:43:11,840
this week come in the end of the week

996
00:43:16,840 --> 00:43:14,150
here so we're very excited about this

997
00:43:19,210 --> 00:43:16,850
and getting very close to launch it is

998
00:43:20,440 --> 00:43:19,220
exciting let's keep going what happens

999
00:43:25,750 --> 00:43:20,450
once it launches when can we expect

1000
00:43:29,320 --> 00:43:25,760
science so as Frank spoke of once we

1001
00:43:33,040 --> 00:43:29,330
finish that first pass over McMurdo we

1002
00:43:35,590 --> 00:43:33,050
start our 90 minute polar orbits the

1003
00:43:39,520 --> 00:43:35,600
earth is rotating underneath us we focus

1004
00:43:41,410 --> 00:43:39,530
the first few days with north polar and

1005
00:43:43,900 --> 00:43:41,420
south polar stations to get the maximum

1006
00:43:46,630 --> 00:43:43,910
amount of data that we can we do about

1007
00:43:48,490 --> 00:43:46,640
five days of checkout on all of the

1008
00:43:51,340 --> 00:43:48,500
avionics and the science instruments

1009
00:43:54,610 --> 00:43:51,350
themselves then we go into a

1010
00:43:56,260 --> 00:43:54,620
commissioning phase where we get the

1011
00:43:59,950 --> 00:43:56,270
instruments up and running we do

1012
00:44:03,100 --> 00:43:59,960
calibrations we verify our very first

1013
00:44:05,110 --> 00:44:03,110

gravity fields make sure the quality of

1014
00:44:07,660 --> 00:44:05,120
everything is working well do any

1015
00:44:10,450 --> 00:44:07,670
fine-tuning that we need and then we'll

1016
00:44:13,780 --> 00:44:10,460
go into our science operations phase at

1017
00:44:16,240 --> 00:44:13,790
about 90 days after launch fantastic

1018
00:44:18,370 --> 00:44:16,250
thank you so much to all of our experts

1019
00:44:20,680 --> 00:44:18,380
here today we are now ready to take some

1020
00:44:23,110 --> 00:44:20,690
more questions again if you are watching

1021
00:44:25,660 --> 00:44:23,120
on NASA TV you can ask a question via

1022
00:44:28,900 --> 00:44:25,670
social media with the hashtag ask NASA

1023
00:44:31,810 --> 00:44:28,910
and our first question will be from the

1024
00:44:34,630 --> 00:44:31,820
studio Paul verson from science again if

1025
00:44:36,310 --> 00:44:34,640
the laser ranging works as hoped what

1026
00:44:38,170 --> 00:44:36,320
types of mass changes might you be able

1027
00:44:42,160 --> 00:44:38,180
to detect that the original grace did

1028
00:44:45,090 --> 00:44:42,170
not that might be a good question for

1029
00:44:49,750 --> 00:44:45,100
Mike Hawkins to answer

1030
00:44:51,580 --> 00:44:49,760
I can take a crack at that so first of

1031
00:44:53,320 --> 00:44:51,590
all as Frank fleckner noted the laser is

1032
00:44:54,940 --> 00:44:53,330
kind of a demonstration that we can make

1033
00:44:57,100 --> 00:44:54,950
this kind of measurement it's a very

1034
00:44:58,510 --> 00:44:57,110
complicated measurement to make it's a

1035
00:44:59,800 --> 00:44:58,520
very precise measurement it's never been

1036
00:45:02,230 --> 00:44:59,810
done in space before between two

1037
00:45:04,120 --> 00:45:02,240
spacecraft from you know this precision

1038
00:45:05,620 --> 00:45:04,130

so we want to really just make sure we

1039
00:45:06,790 --> 00:45:05,630
can actually make this measurement and

1040
00:45:09,610 --> 00:45:06,800
that and that we understand the

1041
00:45:13,540 --> 00:45:09,620
measurement if it works it could be up

1042
00:45:14,740 --> 00:45:13,550
to several times better than a microwave

1043
00:45:16,150 --> 00:45:14,750
measurement in terms of accuracy it

1044
00:45:18,220 --> 00:45:16,160
could be as much as maybe 10 times

1045
00:45:19,540 --> 00:45:18,230
better or even even a little bit more

1046
00:45:22,360 --> 00:45:19,550
depending on exactly how the system

1047
00:45:24,100 --> 00:45:22,370
performs so if that continues to work we

1048
00:45:26,100 --> 00:45:24,110
will produce gravity fields from the

1049
00:45:28,450 --> 00:45:26,110
laser and from the microwave system

1050
00:45:29,980 --> 00:45:28,460
until the laser stops functioning so we

1051
00:45:31,990 --> 00:45:29,990
intend to actually go and produce those

1052
00:45:34,120 --> 00:45:32,000
science products if the system is all

1053
00:45:35,920 --> 00:45:34,130
working but the baseline for continuity

1054
00:45:37,840 --> 00:45:35,930
to continue the 15 years is really the

1055
00:45:39,070 --> 00:45:37,850
identical system for grace the micro

1056
00:45:40,900 --> 00:45:39,080
system but as long as the laser is

1057
00:45:44,860 --> 00:45:40,910
working well we will analyze those and

1058
00:45:46,930 --> 00:45:44,870
produce them but although the ranging

1059
00:45:49,360 --> 00:45:46,940
measurement is more accurate that the

1060
00:45:51,250 --> 00:45:49,370
the resolution of the physical

1061
00:45:53,290 --> 00:45:51,260
phenomenon the earth may not be anywhere

1062
00:45:55,600 --> 00:45:53,300
it's not a linear relationship so the

1063
00:45:57,160 --> 00:45:55,610

laser measurement is 2 times better you

1064
00:45:58,330 --> 00:45:57,170
might only get 10 percent better spatial

1065
00:45:59,830 --> 00:45:58,340
resolution because there's a lot of

1066
00:46:01,840 --> 00:45:59,840
other factors that go into it how the

1067
00:46:04,210 --> 00:46:01,850
drag is measured and and other other

1068
00:46:06,010 --> 00:46:04,220
technologies but if the laser successful

1069
00:46:08,590 --> 00:46:06,020
then that means future missions we could

1070
00:46:13,060 --> 00:46:08,600
we could we could have a more accurate

1071
00:46:15,150 --> 00:46:13,070
mission we have one more question from

1072
00:46:18,670 --> 00:46:15,160
the studio from the press

1073
00:46:20,140 --> 00:46:18,680
Randy Shostak again with EOS is the

1074
00:46:22,090 --> 00:46:20,150
addition of the laser ranging

1075
00:46:23,500 --> 00:46:22,100
interferometer the only significant

1076
00:46:26,530 --> 00:46:23,510
difference between Grace and the

1077
00:46:29,560 --> 00:46:26,540
follow-on I'll take a crack at that it

1078
00:46:32,440 --> 00:46:29,570
is a very significant difference to add

1079
00:46:35,220 --> 00:46:32,450
it but we also took advantage of lessons

1080
00:46:38,230 --> 00:46:35,230
learned from the grace mission and we

1081
00:46:39,550 --> 00:46:38,240
fine-tuned some of the construction

1082
00:46:42,520 --> 00:46:39,560
techniques that were used on the

1083
00:46:46,390 --> 00:46:42,530
spacecraft to eliminate noise background

1084
00:46:49,270 --> 00:46:46,400
noise and then of because of the

1085
00:46:52,000 --> 00:46:49,280
timeframe between Grace and grace

1086
00:46:55,090 --> 00:46:52,010
follow-on we've had to include more

1087
00:46:56,110 --> 00:46:55,100
advanced avionics and things so there

1088
00:46:58,160 --> 00:46:56,120

have been a number of improvements

1089
00:46:59,600 --> 00:46:58,170
inside this spacecraft

1090
00:47:01,190 --> 00:46:59,610
it was a real challenge to keep the

1091
00:47:03,830 --> 00:47:01,200
outside of the spacecraft looking very

1092
00:47:06,560 --> 00:47:03,840
much the same size as grace flying the

1093
00:47:09,290 --> 00:47:06,570
same way but inside we've made

1094
00:47:11,600 --> 00:47:09,300
adjustments as we needed to make sure

1095
00:47:14,900 --> 00:47:11,610
that we have a kind of mission that we

1096
00:47:15,950 --> 00:47:14,910
want we also have some questions from

1097
00:47:18,800 --> 00:47:15,960
social media

1098
00:47:20,750 --> 00:47:18,810
are you sure watching via space TV ask

1099
00:47:23,510 --> 00:47:20,760
why is Grace follow on the shape that it

1100
00:47:26,390 --> 00:47:23,520
is can you explain that for us sure I'll

1101
00:47:30,980 --> 00:47:26,400
take a crack at this the it's partly

1102
00:47:32,690 --> 00:47:30,990
it's the aerodynamics it's and it's a

1103
00:47:35,630 --> 00:47:32,700
combination of the aerodynamics of the

1104
00:47:37,280 --> 00:47:35,640
body which allow it to do the kind of

1105
00:47:40,940 --> 00:47:37,290
mission that we do without being

1106
00:47:44,930 --> 00:47:40,950
influenced too heavily by other effects

1107
00:47:48,320 --> 00:47:44,940
in space but also we have a very tightly

1108
00:47:50,510 --> 00:47:48,330
controlled thermal control system inside

1109
00:47:52,370 --> 00:47:50,520
and we monitor very closely and control

1110
00:47:55,460 --> 00:47:52,380
the temperature of all the elements

1111
00:47:58,250 --> 00:47:55,470
inside so that we make sure we don't

1112
00:48:00,500 --> 00:47:58,260
have any influence from flying in and

1113
00:48:02,270 --> 00:48:00,510

out of the Sun for instance that would

1114
00:48:08,510 --> 00:48:02,280
affect the gravity field measurement

1115
00:48:10,490 --> 00:48:08,520
itself there's so much excitement on

1116
00:48:12,650 --> 00:48:10,500
social media and related to this topic

1117
00:48:14,660 --> 00:48:12,660
on YouTube gunney asks will the grace

1118
00:48:19,490 --> 00:48:14,670
follow-on launch in deployment be shown

1119
00:48:22,940 --> 00:48:19,500
live and if so how can you watch it it

1120
00:48:26,150 --> 00:48:22,950
will be shown alive I think it'll be

1121
00:48:30,760 --> 00:48:26,160
Nassif gov slash NASA TV is definitely

1122
00:48:34,820 --> 00:48:33,080
great we have no more questions at this

1123
00:48:36,770 --> 00:48:34,830
point so that concludes our briefing for

1124
00:48:38,690 --> 00:48:36,780
today thanks to everyone who's been

1125
00:48:40,430 --> 00:48:38,700
watching if you'd like to learn more

1126
00:48:44,090 --> 00:48:40,440
about the grace follow-on mission go to

1127
00:48:46,010 --> 00:48:44,100
nasa.gov slash grace fo and don't miss