



1
00:00:03,429 --> 00:00:01,510
[Music]

2
00:00:05,030 --> 00:00:03,439
nasa's jet propulsion laboratory

3
00:00:07,670 --> 00:00:05,040
presents

4
00:00:09,750 --> 00:00:07,680
the von carmen lecture a series of talks

5
00:00:13,030 --> 00:00:09,760
by scientists and engineers who are

6
00:00:21,109 --> 00:00:13,040
exploring our planet our solar system

7
00:00:26,870 --> 00:00:23,509
hello and welcome to another edition of

8
00:00:28,550 --> 00:00:26,880
the 2022 mon carmen talks i am nikki

9
00:00:31,029 --> 00:00:28,560
weirich from jpl's office of

10
00:00:33,510 --> 00:00:31,039
communications and education and i will

11
00:00:35,590 --> 00:00:33,520
be your host for our topic this evening

12
00:00:37,270 --> 00:00:35,600
a look at nasa's earth system

13
00:00:42,150 --> 00:00:37,280

observatory

14

00:00:44,869 --> 00:00:42,160

provide key information to guide efforts

15

00:00:47,670 --> 00:00:44,879

related to climate change natural hazard

16

00:00:50,150 --> 00:00:47,680

mitigation fighting forest fires and

17

00:00:51,670 --> 00:00:50,160

improving real-time agricultural

18

00:00:53,990 --> 00:00:51,680

processes

19

00:00:56,389 --> 00:00:54,000

each uniquely designed satellite in the

20

00:01:00,069 --> 00:00:56,399

observatory will work in tandem to

21

00:01:02,549 --> 00:01:00,079

create a 3d holistic view of earth from

22

00:01:04,710 --> 00:01:02,559

bedrock to atmosphere

23

00:01:07,270 --> 00:01:04,720

joining us as co-host this evening is

24

00:01:09,830 --> 00:01:07,280

lindsay mclaurin an outreach specialist

25

00:01:11,030 --> 00:01:09,840

from earth public engagement hiya

26

00:01:12,950 --> 00:01:11,040

lindsey

27

00:01:15,030 --> 00:01:12,960

hi nikki thank you so much for letting

28

00:01:16,630 --> 00:01:15,040

me join you tonight and to everybody

29

00:01:18,149 --> 00:01:16,640

watching us from home we're looking

30

00:01:20,310 --> 00:01:18,159

forward to having you be a part of

31

00:01:22,550 --> 00:01:20,320

tonight's conversation so from wherever

32

00:01:24,230 --> 00:01:22,560

you're joining us use the chat feature

33

00:01:25,749 --> 00:01:24,240

and one of our amazing social media

34

00:01:27,749 --> 00:01:25,759

specialists will pass along the

35

00:01:29,830 --> 00:01:27,759

questions to us if you're having trouble

36

00:01:31,510 --> 00:01:29,840

finding the chat feature refresh

37

00:01:34,310 --> 00:01:31,520

wherever you're joining and it should

38

00:01:36,469 --> 00:01:34,320

pop back up back to you nikki

39

00:01:38,630 --> 00:01:36,479

awesome thank you so much lindsay

40

00:01:40,870 --> 00:01:38,640

as always if we run into any technical

41

00:01:42,550 --> 00:01:40,880

difficulties or small failures tonight

42

00:01:44,469 --> 00:01:42,560

we ask for your patience and please

43

00:01:46,789 --> 00:01:44,479

stick with us we'll get them sorted out

44

00:01:49,350 --> 00:01:46,799

as soon as we can

45

00:01:51,990 --> 00:01:49,360

our speaker this evening dr erica podest

46

00:01:54,710 --> 00:01:52,000

is a scientist with the carbon cycle and

47

00:01:55,749 --> 00:01:54,720

ecosystems group in jpl's earth science

48

00:01:57,749 --> 00:01:55,759

division

49

00:01:59,990 --> 00:01:57,759

her research focuses on using earth

50

00:02:02,630 --> 00:02:00,000

observing satellites particularly

51
00:02:04,550 --> 00:02:02,640
microwave sensors to better understand

52
00:02:05,990 --> 00:02:04,560
how climate change is altering

53
00:02:09,350 --> 00:02:06,000
ecosystems

54
00:02:14,869 --> 00:02:12,229
hi nikki great to be here

55
00:02:16,869 --> 00:02:14,879
we're so excited to have you so erica

56
00:02:19,589 --> 00:02:16,879
what is nasa currently doing to study

57
00:02:22,710 --> 00:02:19,599
planet earth

58
00:02:24,949 --> 00:02:22,720
so nasa is observing our planet from

59
00:02:27,430 --> 00:02:24,959
space in different ways

60
00:02:30,790 --> 00:02:27,440
so we can bring up the first video and

61
00:02:33,830 --> 00:02:30,800
it shows nasa's earth observing fleet

62
00:02:35,830 --> 00:02:33,840
it currently has 23 earth science

63
00:02:37,990 --> 00:02:35,840

observing missions in orbit

64

00:02:40,309 --> 00:02:38,000

including six instruments on the

65

00:02:42,550 --> 00:02:40,319

international space station

66

00:02:44,949 --> 00:02:42,560

and these different

67

00:02:47,190 --> 00:02:44,959

satellites and instruments measure the

68

00:02:49,270 --> 00:02:47,200

different components of our earth's

69

00:02:52,470 --> 00:02:49,280

environment as related to

70

00:02:53,910 --> 00:02:52,480

the oceans the atmosphere and the land

71

00:02:56,229 --> 00:02:53,920

the continents

72

00:02:59,430 --> 00:02:56,239

and they measure things like

73

00:03:01,110 --> 00:02:59,440

sea level rise or atmospheric sea co2

74

00:03:02,470 --> 00:03:01,120

concentrations or

75

00:03:05,509 --> 00:03:02,480

soil moisture

76
00:03:08,710 --> 00:03:05,519
and together they provide a big picture

77
00:03:11,270 --> 00:03:08,720
perspective of our earth as a system

78
00:03:12,949 --> 00:03:11,280
and help better understand our changing

79
00:03:16,470 --> 00:03:12,959
planet

80
00:03:18,470 --> 00:03:16,480
the study of earth from space started in

81
00:03:21,670 --> 00:03:18,480
the 1970s

82
00:03:24,149 --> 00:03:21,680
and it has really revolutionized the way

83
00:03:27,430 --> 00:03:24,159
we study our planets because we can

84
00:03:30,630 --> 00:03:27,440
collect information with the same sensor

85
00:03:33,830 --> 00:03:30,640
and methods on a continuous basis

86
00:03:38,630 --> 00:03:33,840
over our entire planet including very

87
00:03:44,630 --> 00:03:41,030
so over 20 missions how do these

88
00:03:49,110 --> 00:03:46,550

we're looking at our planet in different

89

00:03:52,149 --> 00:03:49,120

ways and these instruments use different

90

00:03:54,630 --> 00:03:52,159

technologies to measure specific parts

91

00:03:56,550 --> 00:03:54,640

of our planet so let me first talk about

92

00:03:59,509 --> 00:03:56,560

the electromagnetic spectrum we could

93

00:04:01,830 --> 00:03:59,519

bring up the next image please

94

00:04:04,550 --> 00:04:01,840

we're making measurements in specific

95

00:04:06,710 --> 00:04:04,560

parts of the electromagnetic spectrum

96

00:04:08,869 --> 00:04:06,720

and some sensors collect information

97

00:04:10,949 --> 00:04:08,879

about our planet using the optical

98

00:04:13,350 --> 00:04:10,959

portion of the spectrum

99

00:04:16,390 --> 00:04:13,360

those collected within for example the

100

00:04:18,710 --> 00:04:16,400

visible range of the optical portion

101
00:04:20,069 --> 00:04:18,720
are images similar to those that you see

102
00:04:21,590 --> 00:04:20,079
on google earth

103
00:04:23,670 --> 00:04:21,600
there are other parts of the optical

104
00:04:24,870 --> 00:04:23,680
spectrum that are beyond what the human

105
00:04:27,749 --> 00:04:24,880
eye can see

106
00:04:29,670 --> 00:04:27,759
and these data help identify things like

107
00:04:32,950 --> 00:04:29,680
specific types of plants

108
00:04:33,830 --> 00:04:32,960
ocean color the reflectivity of ice

109
00:04:37,110 --> 00:04:33,840
or

110
00:04:39,270 --> 00:04:37,120
gases and aerosols in the atmosphere

111
00:04:41,749 --> 00:04:39,280
now there are other sensors that measure

112
00:04:44,390 --> 00:04:41,759
the thermal energy or the heat that's

113
00:04:48,310 --> 00:04:44,400

emitted from the planets and that helps

114

00:04:51,430 --> 00:04:48,320

for example to detect wildfires or to

115

00:04:53,110 --> 00:04:51,440

monitor the urban heat island effect

116

00:04:55,110 --> 00:04:53,120

and then there are other sensors that

117

00:04:57,270 --> 00:04:55,120

make measurements in the microwave part

118

00:05:00,150 --> 00:04:57,280

of the spectrum which can provide

119

00:05:01,670 --> 00:05:00,160

information about the atmosphere such as

120

00:05:03,670 --> 00:05:01,680

precipitation

121

00:05:05,110 --> 00:05:03,680

about the ocean such as

122

00:05:07,830 --> 00:05:05,120

sea level height

123

00:05:09,270 --> 00:05:07,840

and about the land surface such as soil

124

00:05:11,350 --> 00:05:09,280

moisture

125

00:05:14,710 --> 00:05:11,360

and then finally there's another

126

00:05:17,110 --> 00:05:14,720

category of sensors that do not rely on

127

00:05:19,909 --> 00:05:17,120

measuring energy from a specific part of

128

00:05:22,710 --> 00:05:19,919

the electromagnetic spectrum but they

129

00:05:24,550 --> 00:05:22,720

measure the gravitational pull of

130

00:05:27,189 --> 00:05:24,560

different parts of the earth and provide

131

00:05:28,870 --> 00:05:27,199

information about mass gain or loss and

132

00:05:30,230 --> 00:05:28,880

i'll talk about that a little bit

133

00:05:31,909 --> 00:05:30,240

further ahead

134

00:05:33,670 --> 00:05:31,919

now one thing to note about the

135

00:05:35,430 --> 00:05:33,680

electromagnetic spectrum

136

00:05:39,029 --> 00:05:35,440

is that most of the energy on the

137

00:05:41,909 --> 00:05:39,039

spectrum is not visible to our eyes and

138

00:05:44,070 --> 00:05:41,919

visible light is really just a small

139

00:05:45,430 --> 00:05:44,080

sliver of all of the energy that

140

00:05:47,830 --> 00:05:45,440

surrounds us

141

00:05:49,510 --> 00:05:47,840

so these advanced sensors and

142

00:05:52,150 --> 00:05:49,520

instruments in space

143

00:05:56,309 --> 00:05:52,160

are providing information about things

144

00:06:00,550 --> 00:05:58,230

i mean it's just incredible to think of

145

00:06:03,029 --> 00:06:00,560

what we can already do and see

146

00:06:04,870 --> 00:06:03,039

or see with these instruments what are

147

00:06:07,830 --> 00:06:04,880

nasa's next steps to better

148

00:06:10,230 --> 00:06:07,840

understanding our earth

149

00:06:13,110 --> 00:06:10,240

so it's very exciting the future because

150

00:06:15,990 --> 00:06:13,120

nasa is planning to launch a new set of

151
00:06:18,870 --> 00:06:16,000
earth-focused satellites before the end

152
00:06:21,590 --> 00:06:18,880
of the decade and these are called the

153
00:06:24,950 --> 00:06:21,600
earth system observatory also known as

154
00:06:27,830 --> 00:06:24,960
eso as shown in this next image

155
00:06:29,590 --> 00:06:27,840
and the observatory will consist of five

156
00:06:31,830 --> 00:06:29,600
core satellites

157
00:06:33,749 --> 00:06:31,840
and these satellites are going to

158
00:06:35,830 --> 00:06:33,759
provide key information to better

159
00:06:38,870 --> 00:06:35,840
understand things that affect our daily

160
00:06:40,710 --> 00:06:38,880
lives for example climate change

161
00:06:43,189 --> 00:06:40,720
things like melting glaciers and ice

162
00:06:44,870 --> 00:06:43,199
sheets warming oceans or loss of

163
00:06:47,350 --> 00:06:44,880

biodiversity

164

00:06:49,749 --> 00:06:47,360

another example are desire disasters

165

00:06:52,390 --> 00:06:49,759

we're already seeing a

166

00:06:56,150 --> 00:06:52,400

larger occurrence a higher occurrence

167

00:06:57,990 --> 00:06:56,160

and intensity of disasters wildfires

168

00:07:00,390 --> 00:06:58,000

floods droughts

169

00:07:03,029 --> 00:07:00,400

and these new satellites will provide

170

00:07:05,589 --> 00:07:03,039

more precise information about these

171

00:07:07,990 --> 00:07:05,599

events that can help not only in

172

00:07:10,870 --> 00:07:08,000

mitigation strategies but

173

00:07:12,950 --> 00:07:10,880

they can help inform disaster response

174

00:07:15,670 --> 00:07:12,960

and recovery efforts

175

00:07:17,749 --> 00:07:15,680

a final example is agriculture

176

00:07:20,150 --> 00:07:17,759

we'll be able to better

177

00:07:23,270 --> 00:07:20,160

inform on events that affect

178

00:07:26,070 --> 00:07:23,280

agricultural processes such as droughts

179

00:07:28,550 --> 00:07:26,080

or diseased crops

180

00:07:30,950 --> 00:07:28,560

and provide this information to relevant

181

00:07:32,870 --> 00:07:30,960

agencies so that they can implement

182

00:07:34,790 --> 00:07:32,880

better crop or water management

183

00:07:37,430 --> 00:07:34,800

strategies

184

00:07:39,909 --> 00:07:37,440

so the earth system observatory it

185

00:07:42,710 --> 00:07:39,919

builds on the capabilities of nasa's

186

00:07:45,510 --> 00:07:42,720

current 23 operating missions and past

187

00:07:48,550 --> 00:07:45,520

technologies as well and each satellite

188

00:07:50,710 --> 00:07:48,560

will have a unique design and complement

189

00:07:53,670 --> 00:07:50,720

the other to create

190

00:07:56,469 --> 00:07:53,680

a 3d view of our planet from the

191

00:07:58,629 --> 00:07:56,479

atmosphere to the surface to even what's

192

00:08:01,510 --> 00:07:58,639

underneath the surface

193

00:08:04,230 --> 00:08:01,520

and so they'll not only help better

194

00:08:07,029 --> 00:08:04,240

understand the interactions between the

195

00:08:09,749 --> 00:08:07,039

atmosphere the land the oceans the ice

196

00:08:14,790 --> 00:08:09,759

but most importantly how a change in one

197

00:08:19,029 --> 00:08:16,309

the way these missions are going to work

198

00:08:21,350 --> 00:08:19,039

together it sounds impressive but where

199

00:08:23,909 --> 00:08:21,360

did this idea come from and how will the

200

00:08:25,510 --> 00:08:23,919

focus of the earth system observatory be

201
00:08:27,990 --> 00:08:25,520
different from the current satellite

202
00:08:32,709 --> 00:08:29,510
so there's something called the earth

203
00:08:34,230 --> 00:08:32,719
science decatal survey and that survey

204
00:08:36,709 --> 00:08:34,240
identified

205
00:08:39,430 --> 00:08:36,719
five high priority observing

206
00:08:41,269 --> 00:08:39,440
capabilities that were needed for future

207
00:08:43,589 --> 00:08:41,279
earth missions

208
00:08:46,230 --> 00:08:43,599
and this survey is undertaken by the

209
00:08:49,110 --> 00:08:46,240
scientific community every 10 years

210
00:08:50,150 --> 00:08:49,120
to look out 10 years or more into the

211
00:08:50,949 --> 00:08:50,160
future

212
00:08:53,350 --> 00:08:50,959
and

213
00:08:56,389 --> 00:08:53,360

really prioritize not only research

214

00:08:59,030 --> 00:08:56,399

areas but observations and the notional

215

00:09:02,389 --> 00:08:59,040

missions to make those observations

216

00:09:04,550 --> 00:09:02,399

and the last survey came out in 2017

217

00:09:06,710 --> 00:09:04,560

and identified five

218

00:09:08,790 --> 00:09:06,720

observing capabilities as key

219

00:09:11,750 --> 00:09:08,800

observations for future satellite

220

00:09:14,790 --> 00:09:11,760

missions so these are shown in the next

221

00:09:16,630 --> 00:09:14,800

video and these are clouds convection

222

00:09:18,630 --> 00:09:16,640

and precipitation

223

00:09:20,389 --> 00:09:18,640

aerosols

224

00:09:23,430 --> 00:09:20,399

mass change

225

00:09:26,470 --> 00:09:23,440

surface biology and geology

226

00:09:28,150 --> 00:09:26,480

and surface deformation and change

227

00:09:30,550 --> 00:09:28,160

and these are

228

00:09:32,710 --> 00:09:30,560

critical components to measure in even

229

00:09:35,430 --> 00:09:32,720

greater detail than we've done in the

230

00:09:37,829 --> 00:09:35,440

past in order to better understand and

231

00:09:40,230 --> 00:09:37,839

predict the impacts of climate change

232

00:09:41,190 --> 00:09:40,240

and answer questions about our earth

233

00:09:43,110 --> 00:09:41,200

system

234

00:09:44,470 --> 00:09:43,120

that we've never been able to answer

235

00:09:47,190 --> 00:09:44,480

before

236

00:09:50,790 --> 00:09:47,200

so what is unique about the earth system

237

00:09:53,030 --> 00:09:50,800

observatory is that in the past nasa

238

00:09:54,790 --> 00:09:53,040

missions have been built around

239

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

the science question

240

00:09:58,949 --> 00:09:56,080

in the case of the earth system

241

00:10:01,350 --> 00:09:58,959

observatory it's being built not only to

242

00:10:03,670 --> 00:10:01,360

address science but also applications

243

00:10:06,069 --> 00:10:03,680

and open science and what do i mean by

244

00:10:08,230 --> 00:10:06,079

applications in open science

245

00:10:10,710 --> 00:10:08,240

applications refers to

246

00:10:13,509 --> 00:10:10,720

applying the data and the science for

247

00:10:15,910 --> 00:10:13,519

decision making so for example how can

248

00:10:18,710 --> 00:10:15,920

we use soil moisture information to

249

00:10:21,910 --> 00:10:18,720

inform farmers on when is the optimal

250

00:10:24,710 --> 00:10:21,920

time to plant their crops

251
00:10:25,750 --> 00:10:24,720
and then open science is open sharing of

252
00:10:28,550 --> 00:10:25,760
data

253
00:10:30,870 --> 00:10:28,560
methods algorithms software

254
00:10:33,269 --> 00:10:30,880
results just general knowledge not only

255
00:10:34,550 --> 00:10:33,279
within the scientific community but with

256
00:10:37,829 --> 00:10:34,560
the wider

257
00:10:41,990 --> 00:10:39,829
so this set of satellites will each have

258
00:10:44,790 --> 00:10:42,000
a different set of observing

259
00:10:46,310 --> 00:10:44,800
capabilities like aerosols and clouds

260
00:10:50,150 --> 00:10:46,320
why is it important to understand

261
00:10:54,870 --> 00:10:52,630
so let's start with aerosols they are

262
00:10:57,829 --> 00:10:54,880
one of the most important and still

263
00:11:00,470 --> 00:10:57,839

uncertain elements of the climate system

264

00:11:02,790 --> 00:11:00,480

and a better understanding of aerosols

265

00:11:05,509 --> 00:11:02,800

and how they affect the global energy

266

00:11:07,910 --> 00:11:05,519

balance will help better understand

267

00:11:11,430 --> 00:11:07,920

climate variability and change as well

268

00:11:12,230 --> 00:11:11,440

as air quality and weather

269

00:11:17,509 --> 00:11:12,240

so

270

00:11:19,829 --> 00:11:17,519

the atmosphere that have a profound

271

00:11:21,829 --> 00:11:19,839

effect on our environment and these

272

00:11:25,590 --> 00:11:21,839

particles can come from natural

273

00:11:27,670 --> 00:11:25,600

processes such as sea spray or

274

00:11:30,389 --> 00:11:27,680

dust or fires

275

00:11:33,030 --> 00:11:30,399

but a large source comes from human

276

00:11:35,350 --> 00:11:33,040

activities from fossil fuel burning

277

00:11:37,750 --> 00:11:35,360

and aerosols influence climate and

278

00:11:40,790 --> 00:11:37,760

weather in two main ways

279

00:11:43,829 --> 00:11:40,800

so first they can reflect or absorb the

280

00:11:45,829 --> 00:11:43,839

sun's energy influencing the temperature

281

00:11:47,670 --> 00:11:45,839

not only in the atmosphere but on the

282

00:11:50,389 --> 00:11:47,680

surface as well

283

00:11:53,110 --> 00:11:50,399

and then second they can act as seeds

284

00:11:55,750 --> 00:11:53,120

for cloud formation affecting the way

285

00:11:58,069 --> 00:11:55,760

that clouds form and the amount of rain

286

00:12:00,389 --> 00:11:58,079

that falls from those clouds

287

00:12:03,190 --> 00:12:00,399

and clouds and rainfall can be quite

288

00:12:05,269 --> 00:12:03,200

different in polluted areas as opposed

289

00:12:07,910 --> 00:12:05,279

to clean areas

290

00:12:11,670 --> 00:12:07,920

aerosols are also pollutants and they

291

00:12:14,550 --> 00:12:11,680

affect air quality and if inhaled some

292

00:12:16,310 --> 00:12:14,560

aerosols can have a harmful effect on

293

00:12:18,310 --> 00:12:16,320

people's health especially the really

294

00:12:20,230 --> 00:12:18,320

tiny particles

295

00:12:21,430 --> 00:12:20,240

so let's bring up the next animation

296

00:12:23,750 --> 00:12:21,440

please

297

00:12:26,069 --> 00:12:23,760

this animation shows the global

298

00:12:28,069 --> 00:12:26,079

distribution of aerosols in the second

299

00:12:30,389 --> 00:12:28,079

half of 2019

300

00:12:32,310 --> 00:12:30,399

and note a couple things note the dust

301

00:12:34,790 --> 00:12:32,320

blowing from west africa across the

302

00:12:37,590 --> 00:12:34,800

atlantic in brown

303

00:12:41,110 --> 00:12:37,600

note the smoke from wildfires especially

304

00:12:45,030 --> 00:12:41,120

in australia this was a particularly

305

00:12:47,030 --> 00:12:45,040

intense wildfire season in australia

306

00:12:49,350 --> 00:12:47,040

and those are in bread and then sea salt

307

00:12:50,870 --> 00:12:49,360

in blue and sulfates in purple for

308

00:12:51,750 --> 00:12:50,880

example

309

00:12:54,150 --> 00:12:51,760

and

310

00:12:56,870 --> 00:12:54,160

note how some of these aerosols are

311

00:12:58,069 --> 00:12:56,880

transported really long distances across

312

00:13:00,230 --> 00:12:58,079

our planets

313

00:13:03,350 --> 00:13:00,240

and i'll focus on one of them

314

00:13:06,389 --> 00:13:03,360

which is black carbon it's also known as

315

00:13:08,389 --> 00:13:06,399

suit and this is emitted from fires and

316

00:13:10,389 --> 00:13:08,399

it can amplify warming because these

317

00:13:12,230 --> 00:13:10,399

particles are dark and they absorb the

318

00:13:14,389 --> 00:13:12,240

sun's energy

319

00:13:16,150 --> 00:13:14,399

another issue with these particles is

320

00:13:18,069 --> 00:13:16,160

that they get distributed around the

321

00:13:21,110 --> 00:13:18,079

planets and

322

00:13:23,430 --> 00:13:21,120

you find them in the extreme latitudes

323

00:13:25,350 --> 00:13:23,440

in the northern high latitudes southern

324

00:13:26,230 --> 00:13:25,360

uh high latitudes and

325

00:13:27,750 --> 00:13:26,240

and

326

00:13:30,230 --> 00:13:27,760

what happens is

327

00:13:32,710 --> 00:13:30,240

they create this dark layer on top of

328

00:13:35,030 --> 00:13:32,720

either snow or ice causing

329

00:13:37,030 --> 00:13:35,040

snow or eyes to not only melt earlier

330

00:13:38,870 --> 00:13:37,040

but melt faster

331

00:13:40,870 --> 00:13:38,880

so a better understanding of how

332

00:13:43,030 --> 00:13:40,880

aerosols affect the global energy

333

00:13:44,790 --> 00:13:43,040

balance will help better predict climate

334

00:13:46,710 --> 00:13:44,800

change for sure

335

00:13:48,710 --> 00:13:46,720

and then clouds

336

00:13:50,949 --> 00:13:48,720

they're one of the biggest challenges in

337

00:13:53,509 --> 00:13:50,959

the climate change puzzle

338

00:13:56,230 --> 00:13:53,519

they're very dynamic and they can either

339

00:13:58,870 --> 00:13:56,240

act like an umbrella by reflecting

340

00:14:00,790 --> 00:13:58,880

sunlight away from the planet's surface

341

00:14:03,430 --> 00:14:00,800

and back into space

342

00:14:05,829 --> 00:14:03,440

or they can also act like a an

343

00:14:08,550 --> 00:14:05,839

insulating blanket so warming the earth

344

00:14:11,590 --> 00:14:08,560

by preventing some of the heat in the

345

00:14:15,030 --> 00:14:11,600

atmosphere to escape back to space

346

00:14:17,269 --> 00:14:15,040

and the blanket effect is especially

347

00:14:20,230 --> 00:14:17,279

noticeable during the winters when

348

00:14:22,710 --> 00:14:20,240

cloudy nights are typically much warmer

349

00:14:25,590 --> 00:14:22,720

than cloud-free ones

350

00:14:27,990 --> 00:14:25,600

and global warming is already causing

351
00:14:30,949 --> 00:14:28,000
and will continue to cause changes in

352
00:14:32,870 --> 00:14:30,959
the amount of cloud cover

353
00:14:34,310 --> 00:14:32,880
and the height and thickness of the

354
00:14:36,389 --> 00:14:34,320
clouds

355
00:14:38,710 --> 00:14:36,399
shifting that balance between the

356
00:14:40,230 --> 00:14:38,720
umbrella and the blanket effects that

357
00:14:42,470 --> 00:14:40,240
clouds have

358
00:14:44,870 --> 00:14:42,480
and small changes in cloud properties

359
00:14:46,470 --> 00:14:44,880
can have significant implications for

360
00:14:48,470 --> 00:14:46,480
global temperature

361
00:14:51,030 --> 00:14:48,480
so better understanding clouds

362
00:14:52,470 --> 00:14:51,040
convection and precipitation

363
00:14:54,310 --> 00:14:52,480

helps tackle

364

00:14:56,629 --> 00:14:54,320

really the largest sources of

365

00:14:58,470 --> 00:14:56,639

uncertainty in future projections of

366

00:15:00,629 --> 00:14:58,480

climate change

367

00:15:03,590 --> 00:15:00,639

and air quality forecasting as well as

368

00:15:06,470 --> 00:15:03,600

prediction of severe weather

369

00:15:08,790 --> 00:15:06,480

and the satellites of these

370

00:15:10,470 --> 00:15:08,800

what we call the accp so those are the

371

00:15:12,710 --> 00:15:10,480

aerosols clouds convection and

372

00:15:15,430 --> 00:15:12,720

precipitation will pick up where

373

00:15:17,590 --> 00:15:15,440

previous ones have left off but with

374

00:15:19,990 --> 00:15:17,600

even more precise measurements so for

375

00:15:22,790 --> 00:15:20,000

example they'll be able to reach closer

376

00:15:25,110 --> 00:15:22,800

to the planet's surface to quantiz

377

00:15:27,670 --> 00:15:25,120

better quantify things like

378

00:15:32,150 --> 00:15:27,680

low and high cloud feedbacks or identify

379

00:15:37,030 --> 00:15:34,710

so the accp missions will give us an

380

00:15:38,470 --> 00:15:37,040

even clearer look but can you give us

381

00:15:40,790 --> 00:15:38,480

can you tell us some of the other

382

00:15:42,949 --> 00:15:40,800

observing capabilities for instance why

383

00:15:45,670 --> 00:15:42,959

is it important to study surface biology

384

00:15:48,069 --> 00:15:45,680

and geology

385

00:15:50,629 --> 00:15:48,079

it's important because we want to know

386

00:15:52,629 --> 00:15:50,639

what is on the surface of the planet and

387

00:15:54,470 --> 00:15:52,639

understand how things are changing and

388

00:15:55,829 --> 00:15:54,480

how things react under certain

389

00:15:58,870 --> 00:15:55,839

conditions

390

00:16:01,509 --> 00:15:58,880

jpl is already working on a satellite

391

00:16:04,790 --> 00:16:01,519

mission to measure surface biology and

392

00:16:06,790 --> 00:16:04,800

geology and this mission will have an

393

00:16:09,509 --> 00:16:06,800

imaging a high resolution imaging

394

00:16:12,069 --> 00:16:09,519

spectrometer that will subdivide

395

00:16:14,790 --> 00:16:12,079

reflected light into more than

396

00:16:18,389 --> 00:16:14,800

400 wavelengths channels

397

00:16:20,790 --> 00:16:18,399

across the visible and infrared and

398

00:16:22,949 --> 00:16:20,800

it's going to be very sensitive to very

399

00:16:25,110 --> 00:16:22,959

specific features and characteristics of

400

00:16:26,790 --> 00:16:25,120

the surface so can you please bring up

401
00:16:29,189 --> 00:16:26,800
the next slide

402
00:16:31,910 --> 00:16:29,199
for example by measuring the intensity

403
00:16:34,710 --> 00:16:31,920
of green chlorophyll from plants or

404
00:16:36,629 --> 00:16:34,720
detecting characteristics of a given

405
00:16:39,110 --> 00:16:36,639
disease on a plant

406
00:16:41,910 --> 00:16:39,120
researchers will be able to evaluate the

407
00:16:43,910 --> 00:16:41,920
health of forested and agricultural

408
00:16:44,949 --> 00:16:43,920
ecosystems

409
00:16:47,430 --> 00:16:44,959
or

410
00:16:50,069 --> 00:16:47,440
by being able to identify invasive

411
00:16:53,910 --> 00:16:50,079
vegetation species researchers can

412
00:16:56,069 --> 00:16:53,920
assess biodiversity loss in a given area

413
00:16:58,710 --> 00:16:56,079

it will also allow for mapping of

414

00:17:01,590 --> 00:16:58,720

different coral and algae species and

415

00:17:02,870 --> 00:17:01,600

characterize the reflectivity of snow

416

00:17:03,670 --> 00:17:02,880

and ice

417

00:17:05,909 --> 00:17:03,680

and

418

00:17:07,750 --> 00:17:05,919

it will also have a thermal radiometer

419

00:17:09,990 --> 00:17:07,760

so i talked about the heat being emitted

420

00:17:11,590 --> 00:17:10,000

from the planet and this thermal

421

00:17:15,110 --> 00:17:11,600

radiometer can be used for many

422

00:17:17,750 --> 00:17:15,120

different things including detecting the

423

00:17:18,390 --> 00:17:17,760

temperature of leaves for example so

424

00:17:21,270 --> 00:17:18,400

when

425

00:17:23,590 --> 00:17:21,280

plants are run short of water

426
00:17:26,069 --> 00:17:23,600
their temperature changes and scientists

427
00:17:27,270 --> 00:17:26,079
are able to identify if the vegetation

428
00:17:29,510 --> 00:17:27,280
is stressed

429
00:17:31,830 --> 00:17:29,520
and in addition thermal data can also

430
00:17:35,029 --> 00:17:31,840
provide information about heat from

431
00:17:39,110 --> 00:17:35,039
wildfires volcanoes and help keep track

432
00:17:43,750 --> 00:17:41,110
so erica another focus you mentioned

433
00:17:47,669 --> 00:17:43,760
earlier is mass change so what can mass

434
00:17:49,510 --> 00:17:47,679
change tell us about earth

435
00:17:52,230 --> 00:17:49,520
mass change

436
00:17:53,590 --> 00:17:52,240
as you know has to do with large scale

437
00:17:54,950 --> 00:17:53,600
changes

438
00:18:01,190 --> 00:17:54,960

and

439

00:18:04,310 --> 00:18:01,200

loss of ice due to melting or to loss of

440

00:18:06,070 --> 00:18:04,320

water from underground aquifers due to

441

00:18:07,029 --> 00:18:06,080

increased consumption

442

00:18:11,669 --> 00:18:07,039

or

443

00:18:14,870 --> 00:18:11,679

so detecting mass change

444

00:18:17,510 --> 00:18:14,880

is important because it tells us that

445

00:18:19,430 --> 00:18:17,520

something significant is happening

446

00:18:22,070 --> 00:18:19,440

and we know that some of these

447

00:18:25,029 --> 00:18:22,080

significant changes are not going to

448

00:18:27,590 --> 00:18:25,039

recover quickly from these huge losses

449

00:18:30,710 --> 00:18:27,600

of ice or water and so we want to keep

450

00:18:32,310 --> 00:18:30,720

track of this large change and what is

451
00:18:35,990 --> 00:18:32,320
driving it

452
00:18:37,990 --> 00:18:36,000
and nasa has been monitoring mass change

453
00:18:40,390 --> 00:18:38,000
with a series of satellite missions

454
00:18:43,350 --> 00:18:40,400
called grace and grace follow-on

455
00:18:46,789 --> 00:18:43,360
and these satellites were developed in

456
00:18:49,590 --> 00:18:46,799
collaboration between jpl and the german

457
00:18:51,430 --> 00:18:49,600
space agency and the geo research center

458
00:18:53,110 --> 00:18:51,440
in germany so

459
00:18:55,750 --> 00:18:53,120
these missions

460
00:18:58,390 --> 00:18:55,760
measure the gravity field of the earth

461
00:19:01,830 --> 00:18:58,400
and that's shown in this next video

462
00:19:03,909 --> 00:19:01,840
um note how that gravity field varies

463
00:19:06,070 --> 00:19:03,919

across the planet and that depends on

464

00:19:08,630 --> 00:19:06,080

the mass so areas that have like

465

00:19:10,470 --> 00:19:08,640

mountains or a lot of mass the gravity

466

00:19:12,710 --> 00:19:10,480

field will be

467

00:19:13,510 --> 00:19:12,720

will be large in those areas

468

00:19:15,830 --> 00:19:13,520

so

469

00:19:17,270 --> 00:19:15,840

to measure this from space which is

470

00:19:20,950 --> 00:19:17,280

really amazing

471

00:19:23,830 --> 00:19:20,960

um the technology used is to have two

472

00:19:25,590 --> 00:19:23,840

satellites flying in tandem about 220

473

00:19:28,230 --> 00:19:25,600

kilometers apart

474

00:19:30,150 --> 00:19:28,240

and these satellites calculate

475

00:19:33,270 --> 00:19:30,160

very small changes in the earth's

476
00:19:35,590 --> 00:19:33,280
gravity by measuring differences

477
00:19:37,750 --> 00:19:35,600
in the distance between them right

478
00:19:40,470 --> 00:19:37,760
between those two satellites so as the

479
00:19:43,270 --> 00:19:40,480
lead satellite passes over an area

480
00:19:45,909 --> 00:19:43,280
of earth of slightly stronger gravity so

481
00:19:48,470 --> 00:19:45,919
let's say it's passing over greenland

482
00:19:52,230 --> 00:19:48,480
which has these it has a large mass it

483
00:19:54,710 --> 00:19:52,240
has kilometers of frozen ice

484
00:19:56,470 --> 00:19:54,720
that satellite detects an increased

485
00:19:58,950 --> 00:19:56,480
gravitational pull

486
00:20:01,270 --> 00:19:58,960
and so it will speed up a little bit

487
00:20:03,430 --> 00:20:01,280
just a little bit and it will increase

488
00:20:07,029 --> 00:20:03,440

that distance between

489

00:20:09,430 --> 00:20:07,039

the satellites is going to increase and

490

00:20:11,590 --> 00:20:09,440

that is a very small distance but it's

491

00:20:13,990 --> 00:20:11,600

measured by the satellite that's

492

00:20:15,990 --> 00:20:14,000

trailing it and that distance is on the

493

00:20:19,430 --> 00:20:16,000

order of a tenth

494

00:20:21,110 --> 00:20:19,440

of the width of a human hair

495

00:20:23,430 --> 00:20:21,120

so it's really it's really amazing

496

00:20:25,190 --> 00:20:23,440

technology and if the earth's mass of

497

00:20:27,990 --> 00:20:25,200

course doesn't change then that

498

00:20:30,710 --> 00:20:28,000

gravitational pull would be the same for

499

00:20:32,710 --> 00:20:30,720

different areas of earth but when a

500

00:20:35,990 --> 00:20:32,720

large change occurs

501
00:20:39,909 --> 00:20:36,000
then that gravitational pull changes and

502
00:20:42,390 --> 00:20:39,919
this next video shows ice loss measured

503
00:20:46,830 --> 00:20:42,400
in greenland and antarctica

504
00:20:50,549 --> 00:20:46,840
on a monthly monthly basis from 2002 to

505
00:20:52,950 --> 00:20:50,559
2021 as measured with grace and grace

506
00:20:56,070 --> 00:20:52,960
follow-on and we're talking about

507
00:20:59,909 --> 00:20:56,080
significant losses of ice both in these

508
00:21:03,190 --> 00:20:59,919
giants of stored ice on the order of 277

509
00:21:05,750 --> 00:21:03,200
gigatons for greenland per year

510
00:21:08,230 --> 00:21:05,760
and 151 gigatons

511
00:21:10,470 --> 00:21:08,240
for antarctica per year

512
00:21:14,310 --> 00:21:10,480
and one thing to note is that these

513
00:21:17,029 --> 00:21:14,320

observations started in 2002 so recently

514

00:21:18,630 --> 00:21:17,039

celebrating 20 years of gravity field

515

00:21:21,270 --> 00:21:18,640

measurements

516

00:21:23,430 --> 00:21:21,280

now the earth system observatory mass

517

00:21:25,909 --> 00:21:23,440

change satellite will be a continuation

518

00:21:27,830 --> 00:21:25,919

of grace follow-on but with improved

519

00:21:29,590 --> 00:21:27,840

capabilities to measure the earth's

520

00:21:31,909 --> 00:21:29,600

gravitational field

521

00:21:33,750 --> 00:21:31,919

and this information will of course

522

00:21:35,510 --> 00:21:33,760

continue to inform

523

00:21:36,950 --> 00:21:35,520

not only on the impacts of climate

524

00:21:39,909 --> 00:21:36,960

change on ice melts and their

525

00:21:42,149 --> 00:21:39,919

contribution to sea level rise but to

526

00:21:44,390 --> 00:21:42,159

continue to support things like drought

527

00:21:49,190 --> 00:21:44,400

assessment and forecasting and

528

00:21:53,270 --> 00:21:51,430

you know now we all know it is important

529

00:21:56,070 --> 00:21:53,280

to study clouds and aerosols surface

530

00:21:58,549 --> 00:21:56,080

biology and geology and mass change but

531

00:22:00,470 --> 00:21:58,559

let's make sure we hit all five today so

532

00:22:02,870 --> 00:22:00,480

how is the earth system observatory

533

00:22:05,510 --> 00:22:02,880

going to study surface deformation and

534

00:22:11,029 --> 00:22:08,390

so surface deformation refers to changes

535

00:22:13,510 --> 00:22:11,039

in the elevation of the surface and the

536

00:22:16,070 --> 00:22:13,520

first satellites that will be launched

537

00:22:18,149 --> 00:22:16,080

as part of the earth system observatory

538

00:22:21,590 --> 00:22:18,159

uh will be able to measure surface

539

00:22:23,830 --> 00:22:21,600

deformation and change and it's a jpl

540

00:22:25,750 --> 00:22:23,840

satellite called nysar and this

541

00:22:27,110 --> 00:22:25,760

satellite is actually a collaboration

542

00:22:29,510 --> 00:22:27,120

between

543

00:22:32,390 --> 00:22:29,520

nasa and the indian space agency so

544

00:22:35,029 --> 00:22:32,400

nysar stands for nasa isro which is the

545

00:22:37,510 --> 00:22:35,039

indian space agency and sar the last

546

00:22:39,190 --> 00:22:37,520

three letters stand for synthetic

547

00:22:41,350 --> 00:22:39,200

aperture radar which is a type of

548

00:22:42,549 --> 00:22:41,360

instrument on the satellite

549

00:22:44,630 --> 00:22:42,559

and

550

00:22:48,310 --> 00:22:44,640

this satellite is scheduled to be

551
00:22:51,350 --> 00:22:48,320
launched in 2024 so this next animation

552
00:22:57,669 --> 00:22:51,360
shows the deployment of nysar and how

553
00:23:02,149 --> 00:22:59,669
so one thing about nyser i talked about

554
00:23:04,630 --> 00:23:02,159
synthetic aperture radar it uses radar

555
00:23:05,830 --> 00:23:04,640
technology which is analogous to an

556
00:23:08,149 --> 00:23:05,840
ultrasound

557
00:23:09,430 --> 00:23:08,159
and the signal can penetrate through

558
00:23:11,830 --> 00:23:09,440
clouds

559
00:23:13,430 --> 00:23:11,840
allowing us to observe the surface of

560
00:23:16,149 --> 00:23:13,440
the earth

561
00:23:18,950 --> 00:23:16,159
regardless of almost any type of weather

562
00:23:20,710 --> 00:23:18,960
condition and regardless of whether it's

563
00:23:23,430 --> 00:23:20,720

day or night so these type of

564

00:23:25,590 --> 00:23:23,440

measurements are really useful for areas

565

00:23:28,149 --> 00:23:25,600

that are continually continuously cloud

566

00:23:30,950 --> 00:23:28,159

covered or areas in the

567

00:23:33,350 --> 00:23:30,960

high latitudes where it's often or a

568

00:23:35,430 --> 00:23:33,360

large part of the year it's dark

569

00:23:38,149 --> 00:23:35,440

and by measuring

570

00:23:40,549 --> 00:23:38,159

the sensor measures small changes in the

571

00:23:42,470 --> 00:23:40,559

signal received at different times

572

00:23:44,310 --> 00:23:42,480

and

573

00:23:46,230 --> 00:23:44,320

we can measure by measuring the small

574

00:23:47,590 --> 00:23:46,240

changes we can measure displacement in

575

00:23:49,110 --> 00:23:47,600

the earth's surface

576

00:23:51,590 --> 00:23:49,120

believe it or not

577

00:23:53,909 --> 00:23:51,600

on the order of centimeters and this

578

00:23:56,470 --> 00:23:53,919

sort of information on a regular basis

579

00:23:59,430 --> 00:23:56,480

can help inform on many things

580

00:24:01,590 --> 00:23:59,440

so the next slide it shows uh an example

581

00:24:03,269 --> 00:24:01,600

of things that this type of information

582

00:24:06,149 --> 00:24:03,279

can be used for

583

00:24:08,950 --> 00:24:06,159

in this case identify the discharge

584

00:24:10,149 --> 00:24:08,960

and recharge of local groundwater

585

00:24:12,950 --> 00:24:10,159

so this

586

00:24:15,029 --> 00:24:12,960

animation shows the los angeles basin

587

00:24:17,029 --> 00:24:15,039

and the color indicates the surface

588

00:24:20,070 --> 00:24:17,039

level of the basin

589

00:24:23,430 --> 00:24:20,080

or the elevation of the surface going up

590

00:24:26,310 --> 00:24:23,440

and down as groundwater is extracted and

591

00:24:28,310 --> 00:24:26,320

recharged on a seasonal basis

592

00:24:31,430 --> 00:24:28,320

so when groundwater is extracted from

593

00:24:33,830 --> 00:24:31,440

the basin that surface sinks around two

594

00:24:35,590 --> 00:24:33,840

to two and a half centimeters which is

595

00:24:37,830 --> 00:24:35,600

indicated by the

596

00:24:39,990 --> 00:24:37,840

light and dark blue colors

597

00:24:41,909 --> 00:24:40,000

and in the winter when the groundwater

598

00:24:45,269 --> 00:24:41,919

is recharged due to

599

00:24:48,149 --> 00:24:45,279

people or naturally then that surface

600

00:24:50,390 --> 00:24:48,159

rises on the order of two to

601
00:24:51,430 --> 00:24:50,400
two and a half centimeters or about one

602
00:24:56,789 --> 00:24:51,440
inch

603
00:24:58,950 --> 00:24:56,799
you it's it's about the diameter of a

604
00:25:01,029 --> 00:24:58,960
quarter a us quarter

605
00:25:03,350 --> 00:25:01,039
yes quite it's not quite one inch but

606
00:25:06,549 --> 00:25:03,360
that's more or less what we're measuring

607
00:25:08,310 --> 00:25:06,559
in terms of the surface rising and uh

608
00:25:09,750 --> 00:25:08,320
the surface sinking

609
00:25:12,549 --> 00:25:09,760
in this case

610
00:25:16,310 --> 00:25:12,559
so and and the rise of the surface is

611
00:25:19,029 --> 00:25:16,320
shown by the red and yellow colors

612
00:25:21,269 --> 00:25:19,039
and as you can imagine this type of

613
00:25:23,750 --> 00:25:21,279

measurement

614

00:25:26,710 --> 00:25:23,760

can be related to the motion

615

00:25:30,470 --> 00:25:26,720

or can be used to study other things

616

00:25:33,430 --> 00:25:30,480

such as the motion of the tectonic

617

00:25:35,590 --> 00:25:33,440

plates on the planet on our planet due

618

00:25:36,950 --> 00:25:35,600

to earthquakes for example

619

00:25:40,070 --> 00:25:36,960

or

620

00:25:42,630 --> 00:25:40,080

we can look at motion of volcanoes as

621

00:25:45,590 --> 00:25:42,640

pressure around them builds up

622

00:25:48,789 --> 00:25:45,600

or it can be used to identify areas at

623

00:25:50,870 --> 00:25:48,799

risk for landslides when there are small

624

00:25:52,230 --> 00:25:50,880

changes or small movements in the

625

00:25:55,110 --> 00:25:52,240

surface

626

00:25:57,909 --> 00:25:55,120

that lead up to a large landslide

627

00:26:00,870 --> 00:25:57,919

or it can also be used to look at single

628

00:26:03,269 --> 00:26:00,880

glaciers and how they are changing

629

00:26:05,830 --> 00:26:03,279

so in addition through a different

630

00:26:06,870 --> 00:26:05,840

technique these radar sensors can also

631

00:26:09,269 --> 00:26:06,880

measure

632

00:26:10,390 --> 00:26:09,279

changes in the land surface related to

633

00:26:13,110 --> 00:26:10,400

water so

634

00:26:16,230 --> 00:26:13,120

surface water or soil moisture and also

635

00:26:19,430 --> 00:26:16,240

to ecosystems like changes in biomass or

636

00:26:22,549 --> 00:26:19,440

agriculture or wetland ecosystems

637

00:26:26,070 --> 00:26:22,559

so this type of information supports

638

00:26:29,029 --> 00:26:26,080

water and and forest resources agencies

639

00:26:34,310 --> 00:26:29,039

uh disaster management and response

640

00:26:38,870 --> 00:26:36,230

the observatory sounds like it will give

641

00:26:41,029 --> 00:26:38,880

us an even clearer picture of what's

642

00:26:43,190 --> 00:26:41,039

really going on with our planet so tell

643

00:26:45,029 --> 00:26:43,200

us why is this research so important to

644

00:26:49,350 --> 00:26:45,039

us

645

00:26:52,310 --> 00:26:49,360

it's a capability that helps

646

00:26:55,190 --> 00:26:52,320

keep us informed about what is happening

647

00:26:56,710 --> 00:26:55,200

so understanding earth processes and our

648

00:26:59,430 --> 00:26:56,720

changing planets

649

00:27:01,110 --> 00:26:59,440

help inform on mitigation and adaptation

650

00:27:04,070 --> 00:27:01,120

strategies and

651
00:27:06,789 --> 00:27:04,080
in disaster assessment and respond but

652
00:27:09,269 --> 00:27:06,799
our health is in inextricably linked to

653
00:27:11,590 --> 00:27:09,279
the health of the planet and ultimately

654
00:27:13,029 --> 00:27:11,600
we need to be able to grow food we need

655
00:27:15,510 --> 00:27:13,039
to be able to

656
00:27:18,630 --> 00:27:15,520
breathe clean air and we need to be able

657
00:27:20,389 --> 00:27:18,640
to have access to fresh clean water so

658
00:27:22,870 --> 00:27:20,399
it's critical for us to know these

659
00:27:25,510 --> 00:27:22,880
things because we depend on them for our

660
00:27:29,669 --> 00:27:27,669
okay so we know this is important for

661
00:27:31,269 --> 00:27:29,679
understanding our planet but how did you

662
00:27:32,830 --> 00:27:31,279
get involved in this and why is it

663
00:27:36,710 --> 00:27:32,840

important to

664

00:27:39,430 --> 00:27:36,720

you so i developed a deep love

665

00:27:41,830 --> 00:27:39,440

connection and curiosity for our natural

666

00:27:43,990 --> 00:27:41,840

environment from a very young age i grew

667

00:27:46,870 --> 00:27:44,000

up in panama which is a country with

668

00:27:50,070 --> 00:27:46,880

just lush tropical rainforest beautiful

669

00:27:52,470 --> 00:27:50,080

nature and my family

670

00:27:55,430 --> 00:27:52,480

loved the outdoors every weekend without

671

00:27:58,389 --> 00:27:55,440

exception pretty much we were outdoors

672

00:28:00,230 --> 00:27:58,399

either camping or fishing or or hiking

673

00:28:02,950 --> 00:28:00,240

or just simply exploring

674

00:28:04,789 --> 00:28:02,960

and a good part of my weekends were

675

00:28:07,110 --> 00:28:04,799

spent in a place called gatun lake and

676

00:28:10,070 --> 00:28:07,120

this is a lake in the panama canal it's

677

00:28:12,389 --> 00:28:10,080

a manmade lake made for the transits of

678

00:28:14,070 --> 00:28:12,399

ships from ocean to ocean this is a

679

00:28:18,950 --> 00:28:14,080

pretty big lake

680

00:28:20,549 --> 00:28:18,960

um and in in the first slide that you

681

00:28:22,630 --> 00:28:20,559

can probably you see some of the

682

00:28:24,710 --> 00:28:22,640

activities that i was involved with uh

683

00:28:27,350 --> 00:28:24,720

exploring and

684

00:28:28,310 --> 00:28:27,360

in and one of them is in a boat so in

685

00:28:30,549 --> 00:28:28,320

this

686

00:28:32,870 --> 00:28:30,559

lake there were many rivers and creeks

687

00:28:35,590 --> 00:28:32,880

that would flow into this lake

688

00:28:37,510 --> 00:28:35,600

and the next slide shows a better

689

00:28:39,830 --> 00:28:37,520

picture of the boat and my parents in

690

00:28:41,830 --> 00:28:39,840

the boat was a small aluminum boat that

691

00:28:44,470 --> 00:28:41,840

my father had and he would love to take

692

00:28:45,430 --> 00:28:44,480

us exploring up these small creeks

693

00:28:51,669 --> 00:28:45,440

and

694

00:28:53,110 --> 00:28:51,679

just

695

00:28:55,029 --> 00:28:53,120

within minutes

696

00:28:56,950 --> 00:28:55,039

the forest would come alive and these

697

00:28:59,269 --> 00:28:56,960

creeks were so small they were covered

698

00:29:00,710 --> 00:28:59,279

by trees there was

699

00:29:03,990 --> 00:29:00,720

these are some of the most vivid

700

00:29:06,230 --> 00:29:04,000

memories i have of my early years it was

701
00:29:09,029 --> 00:29:06,240
amazing just the sounds of the forest

702
00:29:11,750 --> 00:29:09,039
and seeing small animals

703
00:29:12,870 --> 00:29:11,760
just come out

704
00:29:15,430 --> 00:29:12,880
and

705
00:29:17,430 --> 00:29:15,440
really what i do now is an extension of

706
00:29:19,750 --> 00:29:17,440
what i did back then which was

707
00:29:21,909 --> 00:29:19,760
observing nature i do it now from a

708
00:29:22,789 --> 00:29:21,919
different perspective from from space

709
00:29:24,470 --> 00:29:22,799
but

710
00:29:25,510 --> 00:29:24,480
ultimately this is important to me

711
00:29:27,669 --> 00:29:25,520
because

712
00:29:28,470 --> 00:29:27,679
every once in a while i do close my eyes

713
00:29:30,789 --> 00:29:28,480

and

714

00:29:33,430 --> 00:29:30,799

i am

715

00:29:34,389 --> 00:29:33,440

transported to those places that were so

716

00:29:38,950 --> 00:29:34,399

special

717

00:29:42,149 --> 00:29:40,549

i mean your your connection to the

718

00:29:45,029 --> 00:29:42,159

subject and everything you told us

719

00:29:47,110 --> 00:29:45,039

tonight this is all just amazing i know

720

00:29:49,669 --> 00:29:47,120

the audience has got a ton of questions

721

00:29:51,590 --> 00:29:49,679

for us so i want to take some time to do

722

00:29:53,430 --> 00:29:51,600

some q a lindsay what are they asking

723

00:29:55,510 --> 00:29:53,440

out there tonight

724

00:29:57,750 --> 00:29:55,520

thanks nikki erica everyone is so

725

00:29:59,430 --> 00:29:57,760

engaged and excited to hear you talk

726

00:30:02,710 --> 00:29:59,440

about our earth and the earth systems

727

00:30:05,350 --> 00:30:02,720

observatory so thomas from facebook asks

728

00:30:07,669 --> 00:30:05,360

which subject or specific topic do you

729

00:30:09,909 --> 00:30:07,679

find most important for the advancement

730

00:30:12,230 --> 00:30:09,919

of earth surveys and technology for

731

00:30:15,350 --> 00:30:12,240

example environmental science geology or

732

00:30:19,590 --> 00:30:17,750

wow that's a great question from thomas

733

00:30:21,909 --> 00:30:19,600

i think that they are all important i

734

00:30:23,190 --> 00:30:21,919

can't put my finger on a single thing

735

00:30:25,430 --> 00:30:23,200

because now

736

00:30:27,389 --> 00:30:25,440

our our natural environment and the

737

00:30:29,830 --> 00:30:27,399

study of our natural environment is so

738

00:30:32,389 --> 00:30:29,840

interdisciplinary and even the studies

739

00:30:35,990 --> 00:30:32,399

i'm involved with uh require many

740

00:30:39,029 --> 00:30:36,000

different experts to tackle a a given

741

00:30:43,510 --> 00:30:39,039

problem and so i work with

742

00:30:45,110 --> 00:30:43,520

people that are biologists ecologists

743

00:30:46,470 --> 00:30:45,120

geologists

744

00:30:49,269 --> 00:30:46,480

and and

745

00:30:51,190 --> 00:30:49,279

and you need all of this expertise to

746

00:30:54,630 --> 00:30:51,200

really understand

747

00:30:59,669 --> 00:30:57,029

great thank you erica also coming from

748

00:31:01,509 --> 00:30:59,679

facebook uh melanie would like to know

749

00:31:05,590 --> 00:31:01,519

where do you see the most dramatic

750

00:31:09,590 --> 00:31:07,430

the northern high latitudes are really

751
00:31:12,470 --> 00:31:09,600
ground zero for climate change those

752
00:31:14,149 --> 00:31:12,480
areas are warming about twice as fast as

753
00:31:16,950 --> 00:31:14,159
the rest of the planet

754
00:31:18,789 --> 00:31:16,960
so i would say the yes the most dramatic

755
00:31:22,149 --> 00:31:18,799
changes are

756
00:31:27,029 --> 00:31:25,269
great thank you alissa on linkedin asks

757
00:31:29,190 --> 00:31:27,039
what will happen to the satellites

758
00:31:32,549 --> 00:31:29,200
currently collecting information once

759
00:31:35,590 --> 00:31:32,559
the new observations a system isn't

760
00:31:41,669 --> 00:31:38,149
wow that's a great question so

761
00:31:43,110 --> 00:31:41,679
uh the satellites are built

762
00:31:44,870 --> 00:31:43,120
so that

763
00:31:46,789 --> 00:31:44,880

first of all there is some overlap

764

00:31:47,990 --> 00:31:46,799

between the current satellites and the

765

00:31:49,590 --> 00:31:48,000

new satellites so you can

766

00:31:51,110 --> 00:31:49,600

cross-calibrate

767

00:31:54,149 --> 00:31:51,120

and also

768

00:31:56,470 --> 00:31:54,159

they're built to have enough fuel to

769

00:31:58,389 --> 00:31:56,480

push them down to a lower orbit so that

770

00:32:00,389 --> 00:31:58,399

in a few years they

771

00:32:02,470 --> 00:32:00,399

just naturally

772

00:32:04,549 --> 00:32:02,480

burn up through the

773

00:32:07,430 --> 00:32:04,559

earth's atmosphere so

774

00:32:09,190 --> 00:32:07,440

rather than staying up there for

775

00:32:14,230 --> 00:32:09,200

tens and tens of years depending on

776

00:32:18,470 --> 00:32:16,149

thanks erica

777

00:32:21,190 --> 00:32:18,480

ben on linkedin would like to know

778

00:32:23,509 --> 00:32:21,200

how long does it take to compile a 3d

779

00:32:28,870 --> 00:32:23,519

snapshot of the earth in a moment of

780

00:32:33,190 --> 00:32:31,430

wow okay that's a

781

00:32:34,870 --> 00:32:33,200

another really great question so when

782

00:32:35,830 --> 00:32:34,880

you say 3d

783

00:32:38,549 --> 00:32:35,840

um

784

00:32:39,990 --> 00:32:38,559

so there's there's 3d from

785

00:32:41,430 --> 00:32:40,000

compiling information about the

786

00:32:43,669 --> 00:32:41,440

atmosphere and what i talked about the

787

00:32:45,590 --> 00:32:43,679

surface and underneath the surface not

788

00:32:48,549 --> 00:32:45,600

sure if you mean that or if you mean

789

00:32:50,630 --> 00:32:48,559

like surface deformation where we're

790

00:32:53,269 --> 00:32:50,640

kind of looking at at the third

791

00:32:55,509 --> 00:32:53,279

dimension right this this movement of

792

00:32:58,789 --> 00:32:55,519

the surface

793

00:33:00,549 --> 00:32:58,799

i'll refer to that um so that's done

794

00:33:02,630 --> 00:33:00,559

through a technique called

795

00:33:05,110 --> 00:33:02,640

uh interferometric synthetic aperture

796

00:33:06,950 --> 00:33:05,120

radar and that takes quite a bit of

797

00:33:10,630 --> 00:33:06,960

processing there's software up there out

798

00:33:14,070 --> 00:33:10,640

there to do it um and uh

799

00:33:16,549 --> 00:33:14,080

i i think in a couple of

800

00:33:19,029 --> 00:33:16,559

minutes once you have everything kind of

801
00:33:21,029 --> 00:33:19,039
processed you can generate these

802
00:33:24,149 --> 00:33:21,039
interferome interf what they're called

803
00:33:26,630 --> 00:33:24,159
interferograms uh in a couple of minutes

804
00:33:29,269 --> 00:33:26,640
it's it's obviously going to depend on

805
00:33:31,190 --> 00:33:29,279
how many images you have and

806
00:33:32,230 --> 00:33:31,200
how large of an area you're looking at

807
00:33:33,669 --> 00:33:32,240
and

808
00:33:36,950 --> 00:33:33,679
what are the capabilities of your

809
00:33:42,470 --> 00:33:40,149
great thanks erica user satori mystic on

810
00:33:45,509 --> 00:33:42,480
youtube would like to know when will we

811
00:33:48,070 --> 00:33:45,519
be able to see a visualization of the

812
00:33:50,470 --> 00:33:48,080
actions and reactions of aquafire

813
00:33:52,710 --> 00:33:50,480

systems the effects of soil conditions

814

00:33:56,149 --> 00:33:52,720

plant growth and other such interrelated

815

00:34:02,549 --> 00:33:59,430

so you can already see the actions and

816

00:34:04,789 --> 00:34:02,559

reactions of aquifer systems in fact the

817

00:34:05,669 --> 00:34:04,799

grace and grace follow-on satellites

818

00:34:08,069 --> 00:34:05,679

have

819

00:34:09,270 --> 00:34:08,079

quite a bit of research there's quite a

820

00:34:11,030 --> 00:34:09,280

body of

821

00:34:12,310 --> 00:34:11,040

of research and

822

00:34:13,829 --> 00:34:12,320

and results

823

00:34:15,430 --> 00:34:13,839

showing

824

00:34:17,190 --> 00:34:15,440

aquifer

825

00:34:22,710 --> 00:34:17,200

depletion in different parts of the

826

00:34:28,389 --> 00:34:25,510

great thanks again erica um sanji on

827

00:34:32,629 --> 00:34:28,399

linkedin asks can we measure entropy to

828

00:34:38,149 --> 00:34:35,190

can we measure entropy to measure how

829

00:34:40,790 --> 00:34:38,159

climate change is that's a good question

830

00:34:43,829 --> 00:34:40,800

uh so entropy would be the the

831

00:34:44,790 --> 00:34:43,839

instability of things so things going

832

00:34:46,829 --> 00:34:44,800

from

833

00:34:49,030 --> 00:34:46,839

something being homogeneous to

834

00:34:50,310 --> 00:34:49,040

inhomogeneous and that would be

835

00:34:51,669 --> 00:34:50,320

different depending on what you're

836

00:34:52,470 --> 00:34:51,679

looking at

837

00:34:54,550 --> 00:34:52,480

so

838

00:34:57,990 --> 00:34:54,560

i'm not sure i can answer that

839

00:34:59,190 --> 00:34:58,000

i'll have to think about that one

840

00:35:01,349 --> 00:34:59,200

you know that's one of my favorite

841

00:35:03,670 --> 00:35:01,359

answers the i'm not sure because that's

842

00:35:05,670 --> 00:35:03,680

what scientists are asking every day

843

00:35:07,510 --> 00:35:05,680

as brian white always likes to say you

844

00:35:09,190 --> 00:35:07,520

know that's the best question the best

845

00:35:11,430 --> 00:35:09,200

answer is i don't know let me go find

846

00:35:13,430 --> 00:35:11,440

out so this is going to be our last

847

00:35:15,510 --> 00:35:13,440

question of the evening so lindsey last

848

00:35:17,990 --> 00:35:15,520

question for us

849

00:35:20,069 --> 00:35:18,000

thanks nikki so erica alyssa will bring

850

00:35:22,790 --> 00:35:20,079

us home from linkedin and she wants to

851

00:35:25,030 --> 00:35:22,800

know in your opinion what is the most

852

00:35:27,670 --> 00:35:25,040

impressive observing capability for the

853

00:35:30,710 --> 00:35:27,680

new observation system and what data are

854

00:35:32,870 --> 00:35:30,720

you most excited to get back

855

00:35:36,069 --> 00:35:32,880

oh wow

856

00:35:39,270 --> 00:35:37,750

they're all amazing all of the

857

00:35:41,510 --> 00:35:39,280

technology that's used by these

858

00:35:44,470 --> 00:35:41,520

different satellites

859

00:35:46,870 --> 00:35:44,480

these new satellites is amazing

860

00:35:49,270 --> 00:35:46,880

however my heart is close to

861

00:35:52,390 --> 00:35:49,280

nysar because i am part of the nyser

862

00:35:56,950 --> 00:35:52,400

science team and so that's the one i am

863

00:36:00,550 --> 00:35:59,190

i know nysar is very near and dear to

864

00:36:02,630 --> 00:36:00,560

your heart and we are all looking

865

00:36:04,950 --> 00:36:02,640

forward to it so unfortunately that is

866

00:36:06,710 --> 00:36:04,960

all the time we have today for questions

867

00:36:09,270 --> 00:36:06,720

i do want to thank our wonderful speaker

868

00:36:11,349 --> 00:36:09,280

dr erica podest for joining us to

869

00:36:13,750 --> 00:36:11,359

discuss the earth system observatory and

870

00:36:16,150 --> 00:36:13,760

sharing all of your wonderful insights

871

00:36:18,630 --> 00:36:16,160

also thank you to our amazing questions

872

00:36:20,550 --> 00:36:18,640

co-host lindsay mclaurin and everyone

873

00:36:21,829 --> 00:36:20,560

working behind the scenes to make this

874

00:36:23,349 --> 00:36:21,839

possible

875

00:36:25,510 --> 00:36:23,359

to all of you watching thank you for

876

00:36:27,190 --> 00:36:25,520

taking the time to join us every month

877

00:36:29,430 --> 00:36:27,200

if you missed one or would like to

878

00:36:31,510 --> 00:36:29,440

revisit any of our von carmen talks from

879

00:36:34,310 --> 00:36:31,520

the past five years they are all

880

00:36:36,870 --> 00:36:34,320

available on jpl's youtube page and make

881

00:36:38,829 --> 00:36:36,880

sure to join us next month for nustar

882

00:36:41,510 --> 00:36:38,839

studying the universe in

883

00:36:43,750 --> 00:36:41,520

x-ray stick around for a short video

884

00:36:46,310 --> 00:36:43,760

about the earth system observatory and

885

00:36:51,270 --> 00:36:46,320

we will see you in may

886

00:36:55,510 --> 00:36:53,589

as nasa prepares to send humans to the

887

00:36:58,470 --> 00:36:55,520

moon and mars

888

00:37:01,910 --> 00:36:58,480

and pier even deeper into the universe

889

00:37:03,320 --> 00:37:01,920

we turn with a renewed focus to our home

890

00:37:07,190 --> 00:37:03,330

planet of earth

891

00:37:11,829 --> 00:37:09,510

the next generation of earth science

892

00:37:14,790 --> 00:37:11,839

begins with the new earth system

893

00:37:16,710 --> 00:37:14,800

observatory the core of the observatory

894

00:37:19,109 --> 00:37:16,720

is an array of five new satellite

895

00:37:21,270 --> 00:37:19,119

missions that will study the atmosphere

896

00:37:24,069 --> 00:37:21,280

the ground and even what's happening

897

00:37:26,470 --> 00:37:24,079

underneath the surface these spacecraft

898

00:37:28,870 --> 00:37:26,480

will look at the earth each one of them

899

00:37:32,069 --> 00:37:28,880

their own way and will integrate all the

900

00:37:35,030 --> 00:37:32,079

data in a common approach taken together

901
00:37:37,829 --> 00:37:35,040
as a single observatory we will have a

902
00:37:39,430 --> 00:37:37,839
complete three-dimensional understanding

903
00:37:42,069 --> 00:37:39,440
of our earth systems

904
00:37:45,510 --> 00:37:42,079
how they work together how one change

905
00:37:51,109 --> 00:37:48,550
it will watch our planet change driving

906
00:37:53,910 --> 00:37:51,119
solutions for better living managing

907
00:37:55,589 --> 00:37:53,920
water and food resources predicting

908
00:37:58,069 --> 00:37:55,599
natural hazards

909
00:38:00,630 --> 00:37:58,079
coping with sea level rise in coastal

910
00:38:04,390 --> 00:38:00,640
communities and heat islands in our

911
00:38:09,030 --> 00:38:07,270
every 10 years the best scientists

912
00:38:10,790 --> 00:38:09,040
in the united states and worldwide come

913
00:38:13,750 --> 00:38:10,800

together and create a strategy with the

914

00:38:16,310 --> 00:38:13,760

cable strategy and it recommended that

915

00:38:18,470 --> 00:38:16,320

we build missions that together form an

916

00:38:21,589 --> 00:38:18,480

earth system observatory we're going to

917

00:38:23,990 --> 00:38:21,599

be looking at processes at the micro

918

00:38:26,710 --> 00:38:24,000

physical scale at the large kind of

919

00:38:28,390 --> 00:38:26,720

convective scale that the at the smaller

920

00:38:31,349 --> 00:38:28,400

scale in the oceans and we're going to

921

00:38:33,829 --> 00:38:31,359

be investigating those pulling that out

922

00:38:35,589 --> 00:38:33,839

encapsulating that putting that into

923

00:38:38,230 --> 00:38:35,599

weather models and climate models and

924

00:38:40,790 --> 00:38:38,240

those are going to allow us to predict

925

00:38:42,550 --> 00:38:40,800

and project the future with far more

926
00:38:46,150 --> 00:38:42,560
confidence

927
00:38:48,630 --> 00:38:46,160
we can from space help farmers we can

928
00:38:51,589 --> 00:38:48,640
help others that grow food around the

929
00:38:54,630 --> 00:38:51,599
earth if there is an earthquake we can

930
00:38:57,349 --> 00:38:54,640
get our models better and from there we

931
00:38:59,510 --> 00:38:57,359
can predict better also in the future we

932
00:39:01,829 --> 00:38:59,520
can monitor fresh water both on the

933
00:39:04,150 --> 00:39:01,839
surface and underground to help water

934
00:39:05,410 --> 00:39:04,160
managers both for communities as well as

935
00:39:07,750 --> 00:39:05,420
agriculture

936
00:39:10,470 --> 00:39:07,760
[Music]

937
00:39:12,230 --> 00:39:10,480
to build the observatory we will expand

938
00:39:14,470 --> 00:39:12,240

our partnerships with commercial

939

00:39:17,589 --> 00:39:14,480

companies and international space

940

00:39:20,069 --> 00:39:17,599

agencies to take advantage of innovation

941

00:39:22,230 --> 00:39:20,079

and new technology we recognize because

942

00:39:23,109 --> 00:39:22,240

of the global nature of the issues at

943

00:39:24,950 --> 00:39:23,119

hand

944

00:39:26,630 --> 00:39:24,960

we want international partners to be

945

00:39:29,030 --> 00:39:26,640

part of that also

946

00:39:33,510 --> 00:39:29,040

we're working together and the science

947

00:39:36,470 --> 00:39:33,520

that we're doing has to serve all of us

948

00:39:38,470 --> 00:39:36,480

nicer is our first major partnership

949

00:39:40,950 --> 00:39:38,480

with the indian space agency in earth

950

00:39:44,390 --> 00:39:40,960

science it brings together

951
00:39:46,630 --> 00:39:44,400
two different kinds of radar systems

952
00:39:48,870 --> 00:39:46,640
that together we'll see

953
00:39:50,790 --> 00:39:48,880
changes in our earth's surface that will

954
00:39:52,950 --> 00:39:50,800
help us predict natural hazards in the

955
00:39:55,510 --> 00:39:52,960
future the nisar mission will measure

956
00:39:57,349 --> 00:39:55,520
changes in earth's surface less than a

957
00:39:59,589 --> 00:39:57,359
centimeter across

958
00:40:01,589 --> 00:39:59,599
it will measure the movement of glaciers

959
00:40:04,550 --> 00:40:01,599
and ice sheets the dynamics of

960
00:40:06,790 --> 00:40:04,560
earthquakes and volcanoes and changes in

961
00:40:09,750 --> 00:40:06,800
farmland we will

962
00:40:12,950 --> 00:40:09,760
observe the earth every 12 days exactly

963
00:40:16,470 --> 00:40:12,960

at the right repeat past orbit we can

964

00:40:20,550 --> 00:40:16,480

study small changes in the earth system

965

00:40:25,349 --> 00:40:22,870

the earth's climate is changing we have

966

00:40:28,470 --> 00:40:25,359

documented the changes that we're seeing

967

00:40:31,030 --> 00:40:28,480

over the last few decades we know that

968

00:40:34,069 --> 00:40:31,040

it's being driven by human activities

969

00:40:36,630 --> 00:40:34,079

and it's absolutely essential that we

970

00:40:39,030 --> 00:40:36,640

continue to understand what's happening

971

00:40:40,870 --> 00:40:39,040

what's changing in order to better

972

00:40:43,910 --> 00:40:40,880

predict what's going to happen and

973

00:40:45,750 --> 00:40:43,920

perhaps help people make better choices

974

00:40:48,710 --> 00:40:45,760

understanding how our planet and its

975

00:40:51,109 --> 00:40:48,720

climate are changing is the foundation

976

00:40:54,470 --> 00:40:51,119

for a more resilient and sustainable

977

00:40:57,589 --> 00:40:54,480

future nasa's earth system observatory

978

00:41:01,510 --> 00:40:57,599

is the next step in this ongoing mission

979

00:41:07,300 --> 00:41:01,520

a mission to the only planet we can call