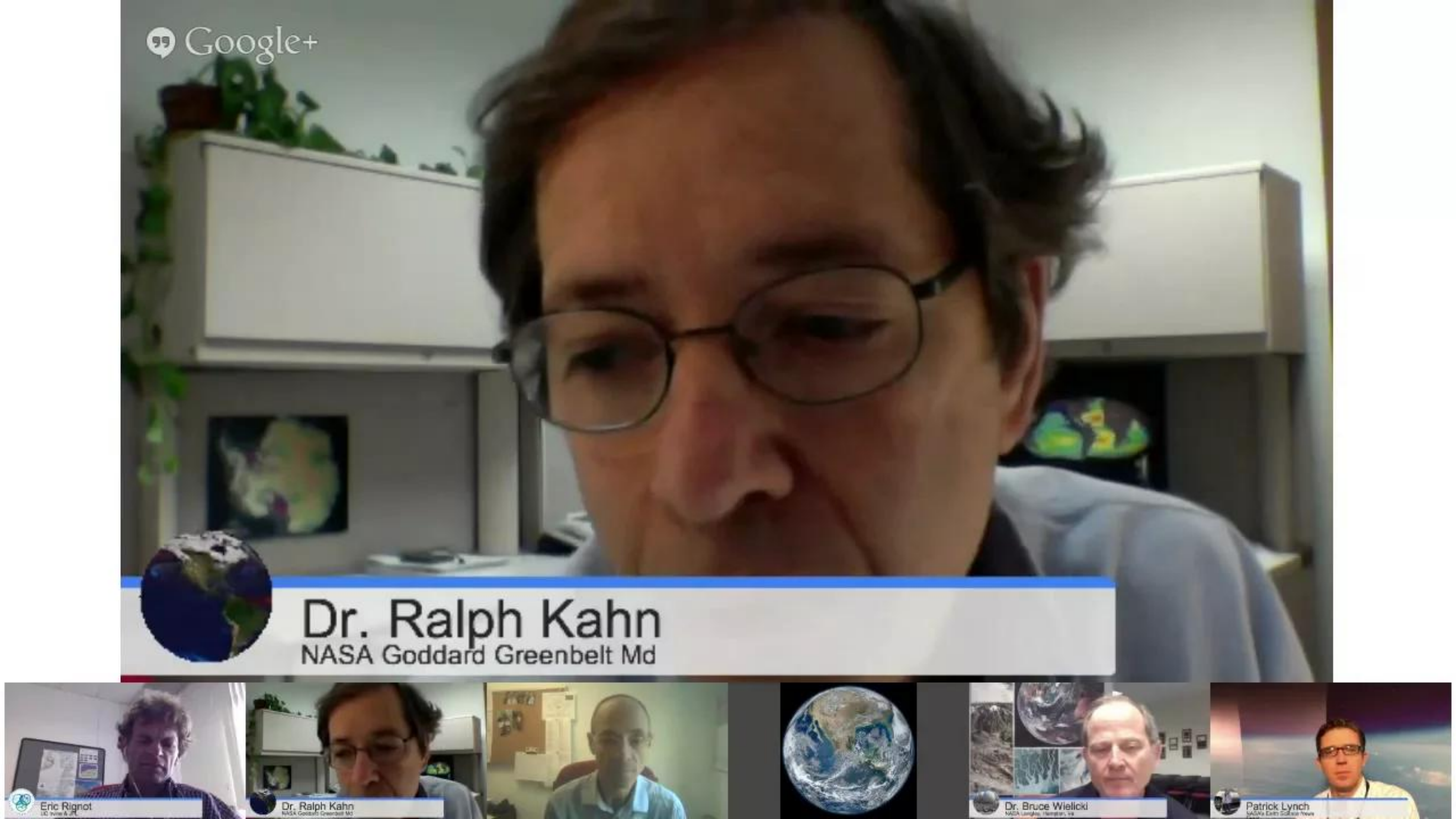
Google+
Dr. Ralph Kahn
NASA Goddard Greenbelt Md
Eric Rignot
Dr. Ralph Kahn
Dr. Bruce Wielicki
Patrick Lynch

1
00:00:10,549 --> 00:00:08,230
can you hear me patrick

2
00:00:12,870 --> 00:00:10,559
hi everyone uh thanks for joining this

3
00:00:15,829 --> 00:00:12,880
nasa google plus hangout

4
00:00:18,070 --> 00:00:15,839
we're here to talk about climate change

5
00:00:19,189 --> 00:00:18,080
with four nasa scientists and uh and

6
00:00:21,670 --> 00:00:19,199
also the

7
00:00:25,029 --> 00:00:21,680
the major ipcc report that just came out

8
00:00:29,189 --> 00:00:26,950
just want to remind everyone how you can

9
00:00:32,310 --> 00:00:29,199
participate today if you want to ask

10
00:00:34,229 --> 00:00:32,320
questions you can ask them in the google

11
00:00:35,750 --> 00:00:34,239
plus comment section you can ask them in

12
00:00:38,150 --> 00:00:35,760
the youtube comment section if you're

13
00:00:39,350 --> 00:00:38,160

watching it there also on twitter using

14
00:00:43,270 --> 00:00:39,360
the

15
00:00:46,950 --> 00:00:45,030
i'm patrick lynch i'm with nasa's earth

16
00:00:48,869 --> 00:00:46,960
science news team and let me go ahead

17
00:00:51,190 --> 00:00:48,879
and introduce our

18
00:00:53,430 --> 00:00:51,200
panelists today uh at goddard institute

19
00:00:54,869 --> 00:00:53,440
for space studies in new york we have

20
00:00:57,270 --> 00:00:54,879
drew shindel

21
00:00:58,389 --> 00:00:57,280
who's coordinating lead author of one of

22
00:01:00,630 --> 00:00:58,399
the chapters

23
00:01:03,349 --> 00:01:00,640
in the physical science basis report the

24
00:01:06,230 --> 00:01:03,359
ipcc and also a drafting author of the

25
00:01:07,750 --> 00:01:06,240
summary for policymakers

26
00:01:10,310 --> 00:01:07,760
at goddard space flight center in

27
00:01:13,910 --> 00:01:10,320
greenbelt maryland we have ralph khan i

28
00:01:14,950 --> 00:01:13,920
was a reviewer on the aerosols chapter

29
00:01:17,990 --> 00:01:14,960
um

30
00:01:19,749 --> 00:01:18,000
at jet propulsion laboratory uh and also

31
00:01:22,149 --> 00:01:19,759
a faculty member at uc irvine we have

32
00:01:23,830 --> 00:01:22,159
eric rino uh contributed to the

33
00:01:24,789 --> 00:01:23,840
cryosphere

34
00:01:27,590 --> 00:01:24,799
chapter

35
00:01:29,910 --> 00:01:27,600
uh and in hampton virginia and nasa's

36
00:01:31,670 --> 00:01:29,920
langley research center we have um bruce

37
00:01:33,749 --> 00:01:31,680
wilkie

38
00:01:35,190 --> 00:01:33,759

who contributed to or was a reviewer on

39
00:01:36,469 --> 00:01:35,200
on several of the chapters in this

40
00:01:37,590 --> 00:01:36,479
report as well

41
00:01:40,870 --> 00:01:37,600
um

42
00:01:41,830 --> 00:01:40,880
so the ipdc report is the the benchmark

43
00:01:44,310 --> 00:01:41,840
um

44
00:01:46,389 --> 00:01:44,320
climate change report and gives us a

45
00:01:47,670 --> 00:01:46,399
sort of fundamental uh

46
00:01:49,830 --> 00:01:47,680
uh

47
00:01:51,590 --> 00:01:49,840
understanding of of the state of of

48
00:01:54,630 --> 00:01:51,600
climate change science and only comes

49
00:01:57,350 --> 00:01:54,640
out every five or six years so on friday

50
00:01:58,550 --> 00:01:57,360
we we got the the summary of the latest

51
00:02:01,670 --> 00:01:58,560
version of that

52
00:02:02,950 --> 00:02:01,680
and uh drew since you were just in

53
00:02:04,709 --> 00:02:02,960
stockholm

54
00:02:05,510 --> 00:02:04,719
um

55
00:02:07,910 --> 00:02:05,520
well i

56
00:02:12,710 --> 00:02:07,920
appears you might be unmute so maybe

57
00:02:15,430 --> 00:02:14,390
okay well maybe we'll go off

58
00:02:18,070 --> 00:02:15,440
um

59
00:02:20,229 --> 00:02:18,080
ralph if you were a reviewer on it and

60
00:02:21,910 --> 00:02:20,239
obviously of following it um

61
00:02:23,510 --> 00:02:21,920
before we before we really dive into it

62
00:02:26,229 --> 00:02:23,520
i wonder if you could just give me a

63
00:02:28,630 --> 00:02:26,239

sort of big picture overview of

64
00:02:30,550 --> 00:02:28,640
uh some of the the key points of the

65
00:02:32,150 --> 00:02:30,560
report

66
00:02:33,910 --> 00:02:32,160
well i i want to start by saying

67
00:02:37,030 --> 00:02:33,920
something about the process because i

68
00:02:39,509 --> 00:02:37,040
think that's an important part of

69
00:02:42,390 --> 00:02:39,519
of what this document represents

70
00:02:44,710 --> 00:02:42,400
there were over a thousand scientists

71
00:02:46,150 --> 00:02:44,720
who participated one way or another in

72
00:02:48,309 --> 00:02:46,160
either writing

73
00:02:50,869 --> 00:02:48,319
or editing or reviewing

74
00:02:52,229 --> 00:02:50,879
the multi thousand pages

75
00:02:53,430 --> 00:02:52,239
that are involved

76
00:02:56,229 --> 00:02:53,440
um

77
00:02:57,990 --> 00:02:56,239
the material of course is

78
00:03:00,070 --> 00:02:58,000
very complex because we're dealing with

79
00:03:02,630 --> 00:03:00,080
the climate so we have experts in a

80
00:03:04,710 --> 00:03:02,640
great variety of areas and as you can

81
00:03:06,070 --> 00:03:04,720
see from the four of us here

82
00:03:07,910 --> 00:03:06,080
uh

83
00:03:09,190 --> 00:03:07,920
experts in a variety of different things

84
00:03:11,750 --> 00:03:09,200
and then there are many more there are

85
00:03:13,830 --> 00:03:11,760
people who are experts in land surfaces

86
00:03:15,270 --> 00:03:13,840
there are economists and people who do

87
00:03:16,070 --> 00:03:15,280
predictions

88
00:03:19,190 --> 00:03:16,080

of

89
00:03:22,229 --> 00:03:19,200
how society is going to respond or react

90
00:03:24,149 --> 00:03:22,239
over in in the future in terms of their

91
00:03:25,110 --> 00:03:24,159
use of energy and so on

92
00:03:26,229 --> 00:03:25,120
uh

93
00:03:27,670 --> 00:03:26,239
it's a

94
00:03:29,430 --> 00:03:27,680
an effort that

95
00:03:31,190 --> 00:03:29,440
that took more than a year

96
00:03:33,589 --> 00:03:31,200
and it involved

97
00:03:35,509 --> 00:03:33,599
writing a first draft having a set of

98
00:03:38,390 --> 00:03:35,519
reviews

99
00:03:40,789 --> 00:03:38,400
writing a second draft with responses to

100
00:03:42,229 --> 00:03:40,799
tens of thousands of comments from the

101
00:03:44,949 --> 00:03:42,239
reviewers

102
00:03:47,910 --> 00:03:44,959
and then the second draft was reviewed

103
00:03:50,229 --> 00:03:47,920
again by government officials primarily

104
00:03:51,990 --> 00:03:50,239
from about 85 countries

105
00:03:55,350 --> 00:03:52,000
and that's the report that we have it

106
00:04:00,229 --> 00:03:58,309
and bruce i wonder on the uh

107
00:04:01,670 --> 00:04:00,239
on the the sort of major benchmarks that

108
00:04:04,550 --> 00:04:01,680
we think about when we think about

109
00:04:07,670 --> 00:04:04,560
climate change um what were some of the

110
00:04:09,750 --> 00:04:07,680
changes from the previous report uh to

111
00:04:11,190 --> 00:04:09,760
this one uh or or if there weren't

112
00:04:13,030 --> 00:04:11,200
necessarily changes even if they were

113
00:04:15,429 --> 00:04:13,040

subtle um

114
00:04:17,509 --> 00:04:15,439
you know what did we

115
00:04:19,749 --> 00:04:17,519
put down on paper as sort of what we

116
00:04:22,469 --> 00:04:19,759
understand as far as how much the globe

117
00:04:24,710 --> 00:04:22,479
has warmed and how much we expect it to

118
00:04:27,030 --> 00:04:24,720
given in the range of scenarios uh going

119
00:04:29,670 --> 00:04:27,040
forward in the next century

120
00:04:31,749 --> 00:04:29,680
yeah i think uh in this new report uh

121
00:04:33,189 --> 00:04:31,759
we've gotten a longer climate record

122
00:04:35,510 --> 00:04:33,199
than we had before

123
00:04:36,870 --> 00:04:35,520
uh we've added quite a bit of

124
00:04:39,030 --> 00:04:36,880
information and i'm sure we'll talk

125
00:04:41,189 --> 00:04:39,040
about this later on on how ice sheets

126
00:04:43,430 --> 00:04:41,199
have responded that was totally missing

127
00:04:45,510 --> 00:04:43,440
in the previous report because our level

128
00:04:49,030 --> 00:04:45,520
of understanding was so poor

129
00:04:51,350 --> 00:04:49,040
um i think we've we've also looked uh

130
00:04:53,189 --> 00:04:51,360
very hard at uh validating the climate

131
00:04:54,390 --> 00:04:53,199
models trying to understand how accurate

132
00:04:56,550 --> 00:04:54,400
they are in the

133
00:04:57,909 --> 00:04:56,560
past data versus the predictions of what

134
00:05:00,070 --> 00:04:57,919
we would expect

135
00:05:01,909 --> 00:05:00,080
uh there have been some people really uh

136
00:05:04,870 --> 00:05:01,919
angst kind of about what you see in the

137
00:05:06,230 --> 00:05:04,880
media called the hiatus where uh warming

138
00:05:08,230 --> 00:05:06,240

of the last decade has slowed a little

139
00:05:10,150 --> 00:05:08,240
bit but that's really kind of within

140
00:05:11,749 --> 00:05:10,160
natural variability or noise in the

141
00:05:13,749 --> 00:05:11,759
climate system so

142
00:05:15,830 --> 00:05:13,759
we really tend to look at more like 50

143
00:05:17,510 --> 00:05:15,840
to 60 year time scales to understand

144
00:05:19,029 --> 00:05:17,520
what the climate system is doing versus

145
00:05:21,510 --> 00:05:19,039
our predictions of it

146
00:05:23,670 --> 00:05:21,520
and this report is

147
00:05:25,749 --> 00:05:23,680
again focusing on not just any one

148
00:05:27,749 --> 00:05:25,759
climate variable like temperature but

149
00:05:28,790 --> 00:05:27,759
everything from precipitation water

150
00:05:31,670 --> 00:05:28,800
vapor

151
00:05:34,550 --> 00:05:31,680
uh deep ocean temperatures um

152
00:05:36,870 --> 00:05:34,560
everything in the system basically

153
00:05:39,749 --> 00:05:36,880
right okay um

154
00:05:42,150 --> 00:05:39,759
eric on on this question of what sort of

155
00:05:44,390 --> 00:05:42,160
changed from the previous report to this

156
00:05:47,749 --> 00:05:44,400
one it seems like one of the major

157
00:05:50,070 --> 00:05:47,759
changes that has occurred um what was

158
00:05:51,189 --> 00:05:50,080
uh in a sort of better estimation of

159
00:05:53,189 --> 00:05:51,199
potential

160
00:05:55,510 --> 00:05:53,199
sea level rise and i think some of that

161
00:05:57,270 --> 00:05:55,520
was was being able to sort of better

162
00:05:58,469 --> 00:05:57,280
estimate um

163
00:06:01,029 --> 00:05:58,479

uh

164
00:06:03,029 --> 00:06:01,039
the response you know of glaciers and

165
00:06:06,390 --> 00:06:03,039
ice sheets i wonder what your thoughts

166
00:06:08,390 --> 00:06:06,400
are on on what changed from the previous

167
00:06:10,790 --> 00:06:08,400
report to this one in terms of what we

168
00:06:12,309 --> 00:06:10,800
were able to say about uh

169
00:06:15,510 --> 00:06:12,319
ice sheets glaciers and what they may

170
00:06:17,270 --> 00:06:15,520
contribute to to sea level rise

171
00:06:19,590 --> 00:06:17,280
uh yeah the

172
00:06:22,150 --> 00:06:19,600
the report summarizes all the advances

173
00:06:24,469 --> 00:06:22,160
that have been done since ar4 so the

174
00:06:25,590 --> 00:06:24,479
report started almost five years ago

175
00:06:28,550 --> 00:06:25,600
where

176
00:06:31,350 --> 00:06:28,560
the thousands of scientists that

177
00:06:32,870 --> 00:06:31,360
ralph mentioned in the beginning

178
00:06:35,749 --> 00:06:32,880
get together and look at the latest

179
00:06:37,189 --> 00:06:35,759
research and make an assessment

180
00:06:39,029 --> 00:06:37,199
it's important for the audience to

181
00:06:40,230 --> 00:06:39,039
understand that a lot of the conclusions

182
00:06:43,110 --> 00:06:40,240
that are

183
00:06:45,670 --> 00:06:43,120
reached in the report are the summary of

184
00:06:47,270 --> 00:06:45,680
multiple lines of evidence multiple

185
00:06:50,870 --> 00:06:47,280
lines of research

186
00:06:52,070 --> 00:06:50,880
uh converging to the same answer

187
00:06:54,150 --> 00:06:52,080
um

188
00:06:56,950 --> 00:06:54,160

the report is uh an update since they

189
00:06:58,710 --> 00:06:56,960
are four and and bruce emphasized a very

190
00:07:00,950 --> 00:06:58,720
important point it's that we have a

191
00:07:03,670 --> 00:07:00,960
longer time record now we have five six

192
00:07:05,589 --> 00:07:03,680
years of additional data

193
00:07:08,309 --> 00:07:05,599
and for instance in terms of looking at

194
00:07:11,510 --> 00:07:08,319
changes in the polar regions

195
00:07:13,350 --> 00:07:11,520
we have increased confidence uh in

196
00:07:14,629 --> 00:07:13,360
observations because of the longer time

197
00:07:17,029 --> 00:07:14,639
record

198
00:07:19,430 --> 00:07:17,039
and some of the changes

199
00:07:22,629 --> 00:07:19,440
in the polar regions um

200
00:07:25,749 --> 00:07:22,639
snow covers sea ice ice sheets

201
00:07:29,029 --> 00:07:25,759
uh in this report are

202
00:07:31,350 --> 00:07:29,039
larger than what we add in ar4 so it's

203
00:07:34,309 --> 00:07:31,360
it's sort of more difficult to ignore

204
00:07:36,710 --> 00:07:34,319
these changes because they're so big

205
00:07:39,510 --> 00:07:36,720
uh in terms of um

206
00:07:42,070 --> 00:07:39,520
the i sheets uh observations have

207
00:07:43,589 --> 00:07:42,080
improved like i just said uh in terms of

208
00:07:45,270 --> 00:07:43,599
characterizing what the ice sheets are

209
00:07:48,070 --> 00:07:45,280
doing

210
00:07:49,670 --> 00:07:48,080
i think in this report we recognize also

211
00:07:51,749 --> 00:07:49,680
that a lot more work needs to be done

212
00:07:53,909 --> 00:07:51,759
before we can quantify what the ice

213
00:07:55,589 --> 00:07:53,919

sheets might do in the future and this

214
00:07:58,070 --> 00:07:55,599
remains um

215
00:08:00,390 --> 00:07:58,080
a large source of uncertainty for for

216
00:08:02,309 --> 00:08:00,400
future level sea level rise the models

217
00:08:05,270 --> 00:08:02,319
have improved and they've improved

218
00:08:07,510 --> 00:08:05,280
mostly because they can be confronted to

219
00:08:10,309 --> 00:08:07,520
more observations but there's still

220
00:08:13,510 --> 00:08:10,319
still quite a long way to go before

221
00:08:15,990 --> 00:08:13,520
we can say with a good reliability what

222
00:08:17,189 --> 00:08:16,000
the ice sheets are going to do

223
00:08:18,230 --> 00:08:17,199
what the glaciers in green and

224
00:08:19,830 --> 00:08:18,240
antarctica are going to do in the

225
00:08:21,670 --> 00:08:19,840
warming world

226
00:08:23,510 --> 00:08:21,680
a lot of

227
00:08:25,670 --> 00:08:23,520
what is in the report is a is a

228
00:08:27,749 --> 00:08:25,680
consensus is some sort of compromise

229
00:08:29,990 --> 00:08:27,759
between all the recent studies

230
00:08:32,149 --> 00:08:30,000
uh it may not mean that what is in the

231
00:08:35,589 --> 00:08:32,159
report represents necessarily extreme

232
00:08:37,750 --> 00:08:35,599
scenarios in sea level rise

233
00:08:38,829 --> 00:08:37,760
so uh the report if you're looking at

234
00:08:41,670 --> 00:08:38,839
the different

235
00:08:44,630 --> 00:08:41,680
scenarios uh i think it gives a range of

236
00:08:45,750 --> 00:08:44,640
about 11 to 38 inches of potential sea

237
00:08:48,389 --> 00:08:45,760
level rise

238
00:08:49,350 --> 00:08:48,399

um by the end of this century for people

239
00:08:52,870 --> 00:08:49,360
in

240
00:08:55,110 --> 00:08:52,880
community that's about 28 to 97

241
00:08:56,790 --> 00:08:55,120
centimeters um

242
00:08:58,470 --> 00:08:56,800
so in the previous report you know there

243
00:09:00,150 --> 00:08:58,480
was we weren't able to give this

244
00:09:02,070 --> 00:09:00,160
estimate um

245
00:09:03,990 --> 00:09:02,080
or or what people thought was an

246
00:09:06,470 --> 00:09:04,000
accurate estimate because of

247
00:09:09,030 --> 00:09:06,480
uh our under present understanding of

248
00:09:10,790 --> 00:09:09,040
ice sheet response um

249
00:09:12,710 --> 00:09:10,800
how how

250
00:09:14,070 --> 00:09:12,720
far is there to go until you feel like

251
00:09:15,430 --> 00:09:14,080
there there is

252
00:09:17,829 --> 00:09:15,440
a really

253
00:09:20,550 --> 00:09:17,839
full understanding of that response in

254
00:09:23,670 --> 00:09:20,560
order to to make that number is or that

255
00:09:25,430 --> 00:09:23,680
projection is as accurate as possible

256
00:09:27,990 --> 00:09:25,440
well patrick that's a that's a very

257
00:09:30,150 --> 00:09:28,000
difficult answer i think uh the the main

258
00:09:32,150 --> 00:09:30,160
achievement of of this report is to

259
00:09:34,470 --> 00:09:32,160
recognize that um

260
00:09:36,790 --> 00:09:34,480
we still have a

261
00:09:37,509 --> 00:09:36,800
lot of uncertainty in them in the models

262
00:09:39,670 --> 00:09:37,519
uh

263
00:09:41,269 --> 00:09:39,680

that represent ice sheets there's a lot

264
00:09:43,829 --> 00:09:41,279
of uncertainties about

265
00:09:45,430 --> 00:09:43,839
how fast glaciers can flow around

266
00:09:47,509 --> 00:09:45,440
greenland and antarctica how fast

267
00:09:49,110 --> 00:09:47,519
they're going to respond

268
00:09:52,949 --> 00:09:49,120
to ocean warming

269
00:09:55,350 --> 00:09:52,959
and warming in air temperatures

270
00:09:57,590 --> 00:09:55,360
i think collectively we've realized that

271
00:09:59,829 --> 00:09:57,600
that response might be larger than what

272
00:10:01,269 --> 00:09:59,839
models have been able to replicate so

273
00:10:03,190 --> 00:10:01,279
far

274
00:10:06,310 --> 00:10:03,200
so a lot of the

275
00:10:08,470 --> 00:10:06,320
basis for projection for sea level uh

276
00:10:09,590 --> 00:10:08,480
uh including the contribution from

277
00:10:11,350 --> 00:10:09,600
issues

278
00:10:13,750 --> 00:10:11,360
uh somehow should be seen as a

279
00:10:16,389 --> 00:10:13,760
conservative scenario um

280
00:10:19,110 --> 00:10:16,399
ice sheets respond to climate forcing in

281
00:10:21,269 --> 00:10:19,120
a what we call in a non-linear way

282
00:10:23,110 --> 00:10:21,279
if you warm up the climate

283
00:10:25,110 --> 00:10:23,120
they start melting there's absolutely no

284
00:10:26,790 --> 00:10:25,120
doubt about that that in a warming

285
00:10:29,190 --> 00:10:26,800
climate the ice sheets will continue to

286
00:10:30,949 --> 00:10:29,200
melt and they will do that for centuries

287
00:10:33,750 --> 00:10:30,959
to come

288
00:10:37,910 --> 00:10:33,760

but as you warm the system more they can

289
00:10:40,470 --> 00:10:37,920
respawn even faster and um

290
00:10:42,710 --> 00:10:40,480
we we don't have enough observations and

291
00:10:44,870 --> 00:10:42,720
understanding to tell you exactly how

292
00:10:46,310 --> 00:10:44,880
much faster they're going to respond how

293
00:10:50,790 --> 00:10:46,320
much faster the glaciers are going to

294
00:10:53,670 --> 00:10:50,800
flow uh 20 30 50 years from now

295
00:10:55,670 --> 00:10:53,680
but from what we've seen for the past 24

296
00:10:57,030 --> 00:10:55,680
years of observations from satellite is

297
00:11:00,710 --> 00:10:57,040
that

298
00:11:02,710 --> 00:11:00,720
is more likely to be larger than what

299
00:11:04,870 --> 00:11:02,720
the models are estimating now than

300
00:11:06,630 --> 00:11:04,880
smaller

301
00:11:08,790 --> 00:11:06,640
the reason why this is so complex is

302
00:11:10,710 --> 00:11:08,800
because ice sheets evolve

303
00:11:11,670 --> 00:11:10,720
in in concert with the whole climate

304
00:11:13,269 --> 00:11:11,680
system

305
00:11:15,350 --> 00:11:13,279
they are affected by the ocean they're

306
00:11:17,910 --> 00:11:15,360
affected by the atmosphere

307
00:11:19,030 --> 00:11:17,920
and in order

308
00:11:21,829 --> 00:11:19,040
and they have their own internal

309
00:11:22,949 --> 00:11:21,839
dynamics so in order to really

310
00:11:24,790 --> 00:11:22,959
come up with

311
00:11:27,030 --> 00:11:24,800
good scenarios of evolution of these ice

312
00:11:29,829 --> 00:11:27,040
sheets we will have to have a good

313
00:11:31,350 --> 00:11:29,839

handle on all this system so um

314
00:11:33,430 --> 00:11:31,360
it's not an effort involving just

315
00:11:36,310 --> 00:11:33,440
glycologists like me but involving the

316
00:11:39,590 --> 00:11:36,320
whole climate modeling community at

317
00:11:42,150 --> 00:11:39,600
large and we're getting there but um

318
00:11:44,470 --> 00:11:42,160
uh it's it's gonna take a little while

319
00:11:45,829 --> 00:11:44,480
longer so i i'd like to make a point

320
00:11:48,470 --> 00:11:45,839
here um

321
00:11:51,430 --> 00:11:48,480
which is that the ipcc process has

322
00:11:53,910 --> 00:11:51,440
tended to be dominated by modelers

323
00:11:56,949 --> 00:11:53,920
who model the climate because models are

324
00:11:58,069 --> 00:11:56,959
the only way we know to make predictions

325
00:11:59,910 --> 00:11:58,079
however

326
00:12:01,990 --> 00:11:59,920
there's also the measurement component

327
00:12:03,750 --> 00:12:02,000
which is extremely important because the

328
00:12:05,110 --> 00:12:03,760
only way we know that the models are

329
00:12:07,030 --> 00:12:05,120
telling us

330
00:12:09,030 --> 00:12:07,040
what's actually going on

331
00:12:10,710 --> 00:12:09,040
that they're accurately representing the

332
00:12:12,629 --> 00:12:10,720
processes involved

333
00:12:14,389 --> 00:12:12,639
is by making measurements

334
00:12:16,389 --> 00:12:14,399
and so one of the things we've seen

335
00:12:18,710 --> 00:12:16,399
since patrick was asking about how

336
00:12:22,710 --> 00:12:18,720
things have advanced since the last

337
00:12:24,870 --> 00:12:22,720
report which was about seven years ago

338
00:12:26,150 --> 00:12:24,880

is in the area of measurements

339
00:12:26,949 --> 00:12:26,160
for example

340
00:12:28,550 --> 00:12:26,959
uh

341
00:12:30,870 --> 00:12:28,560
if you compare

342
00:12:33,910 --> 00:12:30,880
the estimates of forcing uncertainty

343
00:12:37,509 --> 00:12:33,920
between the previous what we call ar4

344
00:12:39,910 --> 00:12:37,519
and the current ar-5 you'll see that the

345
00:12:41,030 --> 00:12:39,920
direct effect of particles in the

346
00:12:43,750 --> 00:12:41,040
atmosphere

347
00:12:45,030 --> 00:12:43,760
uh has gone from a relatively high

348
00:12:50,389 --> 00:12:45,040
uncertainty

349
00:12:53,509 --> 00:12:50,399
and that's because of measurements that

350
00:12:55,910 --> 00:12:53,519
we've been making with nasa satellites

351
00:12:57,590 --> 00:12:55,920
there are still some uncertainties

352
00:12:59,509 --> 00:12:57,600
but the level of understanding that we

353
00:13:02,470 --> 00:12:59,519
feel we need

354
00:13:05,509 --> 00:13:02,480
in order to contribute quantitatively

355
00:13:07,110 --> 00:13:05,519
to validating the models is now

356
00:13:08,629 --> 00:13:07,120
within reach although it's not yet

357
00:13:10,310 --> 00:13:08,639
within grasp

358
00:13:11,990 --> 00:13:10,320
on the other hand

359
00:13:14,710 --> 00:13:12,000
particles in the atmosphere which would

360
00:13:16,230 --> 00:13:14,720
be wildfire smoke desert dust urban

361
00:13:18,069 --> 00:13:16,240
pollution

362
00:13:19,829 --> 00:13:18,079
volcanic ash

363
00:13:21,750 --> 00:13:19,839

those particles

364
00:13:23,509 --> 00:13:21,760
also have what we call an indirect

365
00:13:25,350 --> 00:13:23,519
effect on clouds

366
00:13:27,110 --> 00:13:25,360
and this is a very important process

367
00:13:29,430 --> 00:13:27,120
because to make a cloud particle you

368
00:13:30,629 --> 00:13:29,440
have to collect water vapor molecules

369
00:13:34,470 --> 00:13:30,639
from the air

370
00:13:36,389 --> 00:13:34,480
and the most common process by far for

371
00:13:38,870 --> 00:13:36,399
doing that in the earth's atmosphere is

372
00:13:41,990 --> 00:13:38,880
to have a particle that tends to attract

373
00:13:44,710 --> 00:13:42,000
the water molecules and forms the cloud

374
00:13:48,150 --> 00:13:44,720
droplets and so the presence and the

375
00:13:48,870 --> 00:13:48,160
nature of particles in the atmosphere

376
00:13:50,710 --> 00:13:48,880
is

377
00:13:53,030 --> 00:13:50,720
an important factor in determining

378
00:13:55,110 --> 00:13:53,040
clouds and clouds then

379
00:13:56,310 --> 00:13:55,120
are very important in

380
00:13:59,189 --> 00:13:56,320
mediating

381
00:14:02,710 --> 00:13:59,199
the planet's energy balance

382
00:14:05,430 --> 00:14:02,720
and one of the new things in the ipcc

383
00:14:07,269 --> 00:14:05,440
ar-5 this new report is that there is a

384
00:14:09,829 --> 00:14:07,279
chapter that deals

385
00:14:12,150 --> 00:14:09,839
to a large extent for the first time

386
00:14:13,269 --> 00:14:12,160
with the aerosol cloud interaction

387
00:14:16,550 --> 00:14:13,279
issues

388
00:14:19,269 --> 00:14:16,560

that area is one which is in its infancy

389
00:14:21,189 --> 00:14:19,279
and our ability to model

390
00:14:23,829 --> 00:14:21,199
uh aerosol cloud interactions is

391
00:14:26,310 --> 00:14:23,839
extremely primitive at this point

392
00:14:28,949 --> 00:14:26,320
uh however the fact that we now have a

393
00:14:32,310 --> 00:14:28,959
chapter that deals with that question

394
00:14:35,110 --> 00:14:32,320
uh is is a real advance and uh the next

395
00:14:36,870 --> 00:14:35,120
report in five to seven years hopefully

396
00:14:38,230 --> 00:14:36,880
will have the improvements that we've

397
00:14:39,750 --> 00:14:38,240
been able to make

398
00:14:40,870 --> 00:14:39,760
by the combination of better

399
00:14:43,590 --> 00:14:40,880
measurements

400
00:14:46,150 --> 00:14:43,600
and then the implied improvements to in

401
00:14:50,710 --> 00:14:48,629
okay great we have uh been having some i

402
00:14:53,430 --> 00:14:50,720
think some technical difficulties in new

403
00:14:55,189 --> 00:14:53,440
york but uh drew i think you may have

404
00:14:58,150 --> 00:14:55,199
been able to join us now can you hear us

405
00:15:00,069 --> 00:14:58,160
and can we hear you

406
00:15:03,030 --> 00:15:00,079
we can you can hear us but we can only

407
00:15:05,030 --> 00:15:03,040
see your lips moving right now so

408
00:15:07,430 --> 00:15:05,040
i guess keep working on that and we will

409
00:15:09,430 --> 00:15:07,440
uh we'll try to get back to you soon

410
00:15:11,030 --> 00:15:09,440
um

411
00:15:13,990 --> 00:15:11,040
ralph you were just talking a little bit

412
00:15:16,150 --> 00:15:14,000
about um

413
00:15:19,670 --> 00:15:16,160

the certainty that we know this with and

414
00:15:21,829 --> 00:15:19,680
and for either you or or bruce um

415
00:15:25,990 --> 00:15:21,839
the uncertainty and i think well it's

416
00:15:27,590 --> 00:15:26,000
here too right right um

417
00:15:29,350 --> 00:15:27,600
one of the things that they sort of got

418
00:15:31,269 --> 00:15:29,360
attention i guess it was maybe an

419
00:15:33,189 --> 00:15:31,279
incremental change in in semantics and

420
00:15:34,550 --> 00:15:33,199
the way we talk about this was that we

421
00:15:37,910 --> 00:15:34,560
go from

422
00:15:40,150 --> 00:15:37,920
90 certain that that human

423
00:15:42,710 --> 00:15:40,160
activity is is driving most of the

424
00:15:43,910 --> 00:15:42,720
warming we've seen since 1950 or so to

425
00:15:46,550 --> 00:15:43,920
95

426
00:15:48,790 --> 00:15:46,560
in this report uh bruce is there any you

427
00:15:50,069 --> 00:15:48,800
know is that a is that a material change

428
00:15:51,910 --> 00:15:50,079
there or is there

429
00:15:53,670 --> 00:15:51,920
um

430
00:15:55,430 --> 00:15:53,680
yeah that's definitely a material change

431
00:15:56,389 --> 00:15:55,440
i mean one way to think about it is that

432
00:15:58,310 --> 00:15:56,399
um

433
00:16:00,310 --> 00:15:58,320
you've cut in half the uh the

434
00:16:02,949 --> 00:16:00,320
possibility that you were wrong from ten

435
00:16:05,269 --> 00:16:02,959
percent to five and and every time you

436
00:16:07,350 --> 00:16:05,279
do that i mean if you look at um

437
00:16:09,030 --> 00:16:07,360
solid state physics like the higgs boson

438
00:16:10,949 --> 00:16:09,040

where they're trying to determine when

439
00:16:12,790 --> 00:16:10,959
they know it really they have that

440
00:16:14,710 --> 00:16:12,800
particle they're trying to drive that

441
00:16:16,629 --> 00:16:14,720
uncertainty to very small amounts and in

442
00:16:18,629 --> 00:16:16,639
climate change we're trying to do the

443
00:16:21,030 --> 00:16:18,639
same kind of thing as scientists to be

444
00:16:22,949 --> 00:16:21,040
more and more certain about what we know

445
00:16:25,110 --> 00:16:22,959
and i think in the things you're hearing

446
00:16:26,389 --> 00:16:25,120
us talk about uncertainties you've heard

447
00:16:28,069 --> 00:16:26,399
about the ice sheets you've heard about

448
00:16:29,749 --> 00:16:28,079
the aerosols

449
00:16:31,110 --> 00:16:29,759
the other thing we're working on a lot

450
00:16:33,110 --> 00:16:31,120
is the uncertainty in climate

451
00:16:35,430 --> 00:16:33,120
sensitivity you can think of this as

452
00:16:37,829 --> 00:16:35,440
kind of the volume dial on the climate

453
00:16:39,509 --> 00:16:37,839
system so for the amount of co2 we have

454
00:16:41,670 --> 00:16:39,519
in the atmosphere and

455
00:16:43,590 --> 00:16:41,680
how much warming will we get long term

456
00:16:45,509 --> 00:16:43,600
in the planet which will then

457
00:16:47,990 --> 00:16:45,519
further affect things like ice sheets

458
00:16:49,829 --> 00:16:48,000
and sea level agriculture

459
00:16:51,910 --> 00:16:49,839
everything else um

460
00:16:53,829 --> 00:16:51,920
that volume dial setting is still

461
00:16:56,470 --> 00:16:53,839
uncertain to a factor of two and a half

462
00:16:58,470 --> 00:16:56,480
with about 66 percent confidence and so

463
00:17:00,790 --> 00:16:58,480

then if we ask for 90 confidence it's

464
00:17:02,230 --> 00:17:00,800
more like a factor of four so

465
00:17:04,390 --> 00:17:02,240
those are the kind of things that we

466
00:17:06,390 --> 00:17:04,400
need longer and longer data sets more

467
00:17:08,230 --> 00:17:06,400
and more accurate data sets

468
00:17:10,230 --> 00:17:08,240
uh better theory behind some of the

469
00:17:12,390 --> 00:17:10,240
physics like aerosols that ralph was

470
00:17:14,230 --> 00:17:12,400
just talking about or glaciers that eric

471
00:17:15,750 --> 00:17:14,240
was talking about and the other thing in

472
00:17:17,669 --> 00:17:15,760
that the wild card in climate

473
00:17:18,390 --> 00:17:17,679
sensitivity is the clouds

474
00:17:20,549 --> 00:17:18,400
and

475
00:17:22,549 --> 00:17:20,559
clouds in particular low clouds are the

476
00:17:24,549 --> 00:17:22,559
ones that are kind of the wild card they

477
00:17:26,230 --> 00:17:24,559
reflect sunlight back to space to cool

478
00:17:28,470 --> 00:17:26,240
the planet they don't have a lot of

479
00:17:30,549 --> 00:17:28,480
thermal blanketing in the infrared

480
00:17:32,150 --> 00:17:30,559
greenhouse because they're so low

481
00:17:33,270 --> 00:17:32,160
they're a similar temperature to the

482
00:17:35,190 --> 00:17:33,280
surface

483
00:17:37,350 --> 00:17:35,200
but we're also working very hard to kind

484
00:17:39,110 --> 00:17:37,360
of improve understandings of what we

485
00:17:40,950 --> 00:17:39,120
know about climate sensitivity as well

486
00:17:42,710 --> 00:17:40,960
and when you put all those together how

487
00:17:44,630 --> 00:17:42,720
we're forcing the system

488
00:17:46,070 --> 00:17:44,640

what its sensitivity is

489
00:17:48,150 --> 00:17:46,080
and how the ice sheets and sea level

490
00:17:50,470 --> 00:17:48,160
will respond that's where you get a much

491
00:17:52,789 --> 00:17:50,480
better sense of um

492
00:17:55,190 --> 00:17:52,799
narrowing future uncertainties 50 to 100

493
00:17:56,789 --> 00:17:55,200
years from now

494
00:17:59,270 --> 00:17:56,799
tighter than we currently have them so

495
00:18:01,510 --> 00:17:59,280
every ipcc report is trying to push the

496
00:18:03,590 --> 00:18:01,520
envelope of what we know and make it

497
00:18:06,390 --> 00:18:03,600
more accurate so society can make more

498
00:18:09,510 --> 00:18:06,400
intelligent decisions on where we go

499
00:18:12,830 --> 00:18:09,520
so let me let me just add one thing um

500
00:18:16,070 --> 00:18:12,840
to what bruce was saying what what he

501
00:18:17,909 --> 00:18:16,080
means the volume knob is being turned

502
00:18:20,390 --> 00:18:17,919
um the the

503
00:18:21,110 --> 00:18:20,400
issue there is if you i cannot talk like

504
00:18:22,070 --> 00:18:21,120
that

505
00:18:25,029 --> 00:18:22,080
we're

506
00:18:28,230 --> 00:18:25,039
atmosphere

507
00:18:29,350 --> 00:18:28,240
by adding co2 and other greenhouse gases

508
00:18:31,350 --> 00:18:29,360
to it

509
00:18:33,909 --> 00:18:31,360
and the question is if you add a certain

510
00:18:35,430 --> 00:18:33,919
amount of co2 to the atmosphere

511
00:18:37,990 --> 00:18:35,440
how much of a change in surface

512
00:18:40,549 --> 00:18:38,000
temperature will occur and that's the

513
00:18:42,630 --> 00:18:40,559

uncertainty that bruce was talking about

514
00:18:45,510 --> 00:18:42,640
and and one of the other new things in

515
00:18:47,590 --> 00:18:45,520
this new ifcc report is there's a there

516
00:18:50,310 --> 00:18:47,600
are a few little sections on something

517
00:18:51,190 --> 00:18:50,320
called geoengineering which are attempts

518
00:18:56,549 --> 00:18:51,200
that

519
00:18:59,110 --> 00:18:56,559
deliberately make changes to the climate

520
00:19:01,669 --> 00:18:59,120
by doing one thing or another uh

521
00:19:04,070 --> 00:19:01,679
deliberately like putting sulfuric acid

522
00:19:05,830 --> 00:19:04,080
particles into the stratosphere or

523
00:19:07,430 --> 00:19:05,840
making the clouds brighter by adding

524
00:19:08,390 --> 00:19:07,440
particles to them

525
00:19:10,710 --> 00:19:08,400
and

526
00:19:12,950 --> 00:19:10,720
one of the big uncertainties as bruce

527
00:19:14,789 --> 00:19:12,960
was saying was that we really don't

528
00:19:17,350 --> 00:19:14,799
understand how

529
00:19:19,430 --> 00:19:17,360
far that dial has been turned so how big

530
00:19:21,669 --> 00:19:19,440
a change in surface temperature will get

531
00:19:24,789 --> 00:19:21,679
with a given change in

532
00:19:27,669 --> 00:19:24,799
some other environmental factors and so

533
00:19:30,470 --> 00:19:27,679
that makes the idea of making deliberate

534
00:19:32,710 --> 00:19:30,480
changes extremely risky

535
00:19:34,710 --> 00:19:32,720
i thought i'd add that here okay

536
00:19:36,630 --> 00:19:34,720
let me um

537
00:19:38,390 --> 00:19:36,640
let me go to a question that we are a

538
00:19:40,150 --> 00:19:38,400

couple questions here

539
00:19:42,950 --> 00:19:40,160
from uh that we've gotten

540
00:19:43,990 --> 00:19:42,960
from online uh first one from twitter

541
00:19:46,310 --> 00:19:44,000
from

542
00:19:49,750 --> 00:19:46,320
freedom fan um

543
00:19:51,430 --> 00:19:49,760
and this gets to the sort of uh hiatus

544
00:19:53,669 --> 00:19:51,440
bruce that you mentioned

545
00:19:54,950 --> 00:19:53,679
and and one of the big processes that

546
00:19:57,190 --> 00:19:54,960
people have been talking about so the

547
00:19:59,590 --> 00:19:57,200
question is if the quote missing heat

548
00:20:01,430 --> 00:19:59,600
crept somewhere into the deep oceans for

549
00:20:03,510 --> 00:20:01,440
the past 16 years

550
00:20:07,270 --> 00:20:03,520
why didn't it also go there in the 16

551
00:20:09,750 --> 00:20:07,280
years prior to that good good question

552
00:20:11,750 --> 00:20:09,760
and the real reason uh is something we

553
00:20:13,909 --> 00:20:11,760
call natural variability or noise in the

554
00:20:16,710 --> 00:20:13,919
climate system the climate system is a

555
00:20:18,950 --> 00:20:16,720
pretty complex non-linear system and

556
00:20:20,390 --> 00:20:18,960
there's variability we tend to think of

557
00:20:22,070 --> 00:20:20,400
day-to-day weather as one type of

558
00:20:24,870 --> 00:20:22,080
variability but even the climate system

559
00:20:26,630 --> 00:20:24,880
on time scales of years to decades has

560
00:20:29,110 --> 00:20:26,640
variability you probably know about el

561
00:20:31,190 --> 00:20:29,120
nino for example or la nina can change

562
00:20:33,029 --> 00:20:31,200
year to year what's going on the planet

563
00:20:35,110 --> 00:20:33,039

there's arctic oscillation pacific

564
00:20:37,270 --> 00:20:35,120
decadal oscillation and a lot of these

565
00:20:39,430 --> 00:20:37,280
are coupled ocean atmosphere system

566
00:20:41,510 --> 00:20:39,440
changes that mean when the ocean

567
00:20:43,510 --> 00:20:41,520
circulation changes in its own noisy

568
00:20:45,029 --> 00:20:43,520
patterns it can change how much of the

569
00:20:47,270 --> 00:20:45,039
heat gets transferred between the

570
00:20:49,510 --> 00:20:47,280
different sections of the ocean so

571
00:20:51,990 --> 00:20:49,520
basically our climate system has its own

572
00:20:54,549 --> 00:20:52,000
internal natural variability or noise

573
00:20:57,190 --> 00:20:54,559
and our job as scientists to see human

574
00:20:59,430 --> 00:20:57,200
signals is to see them above those noise

575
00:21:00,789 --> 00:20:59,440
levels and so that's why this hiatus

576
00:21:02,390 --> 00:21:00,799
which is really only over about a

577
00:21:04,789 --> 00:21:02,400
10-year time period

578
00:21:06,149 --> 00:21:04,799
is too short a time period to see

579
00:21:08,310 --> 00:21:06,159
accurately

580
00:21:10,230 --> 00:21:08,320
relative to natural variability it's

581
00:21:13,270 --> 00:21:10,240
really only when you get out to the 20

582
00:21:15,110 --> 00:21:13,280
30 40-year time scale there are some

583
00:21:16,789 --> 00:21:15,120
components of the climate system they're

584
00:21:19,590 --> 00:21:16,799
changing more rapidly like the ice

585
00:21:21,590 --> 00:21:19,600
sheets the arctic sea ice that you can

586
00:21:24,149 --> 00:21:21,600
actually see quickly enough in 10 years

587
00:21:25,750 --> 00:21:24,159
but things like temperature for example

588
00:21:27,350 --> 00:21:25,760

there's still a large enough natural

589
00:21:29,110 --> 00:21:27,360
variability that

590
00:21:30,470 --> 00:21:29,120
frankly for 10 years you really can't

591
00:21:32,230 --> 00:21:30,480
tell much about climate change from

592
00:21:37,590 --> 00:21:32,240
temperature given the other changes

593
00:21:37,600 --> 00:21:40,070
okay

594
00:21:45,590 --> 00:21:41,750
drew i think i see you trying to jump in

595
00:21:47,590 --> 00:21:45,600
i'm not sure we can we can hear you yet

596
00:21:49,110 --> 00:21:47,600
but um ralph were you about to say

597
00:21:51,270 --> 00:21:49,120
something to follow on that

598
00:21:54,549 --> 00:21:51,280
oh

599
00:21:57,430 --> 00:21:55,830
go ahead ralph

600
00:21:59,430 --> 00:21:57,440
this is making a very good point about

601
00:22:02,070 --> 00:21:59,440
the complexity of the system there are

602
00:22:03,830 --> 00:22:02,080
many different factors that are all sort

603
00:22:05,669 --> 00:22:03,840
of contributing one way or another

604
00:22:07,830 --> 00:22:05,679
either warming or cooling or making

605
00:22:09,909 --> 00:22:07,840
things wetter or drier

606
00:22:11,669 --> 00:22:09,919
and when you have multiple factors

607
00:22:13,510 --> 00:22:11,679
involved

608
00:22:15,990 --> 00:22:13,520
one has to deal with each of them

609
00:22:17,590 --> 00:22:16,000
quantitatively so it's not just a matter

610
00:22:18,950 --> 00:22:17,600
of saying well one thing's going to warm

611
00:22:21,029 --> 00:22:18,960
and another thing is going to cool you

612
00:22:21,830 --> 00:22:21,039
have to know how much

613
00:22:23,110 --> 00:22:21,840

and

614
00:22:28,710 --> 00:22:23,120
that

615
00:22:31,750 --> 00:22:28,720
what we call stem education

616
00:22:32,630 --> 00:22:31,760
science technology engineering and math

617
00:22:35,029 --> 00:22:32,640
uh

618
00:22:37,270 --> 00:22:35,039
in order to handle those kinds of

619
00:22:39,590 --> 00:22:37,280
situations or to understand

620
00:22:41,029 --> 00:22:39,600
multiple factors and and how one has to

621
00:22:43,270 --> 00:22:41,039
deal with them

622
00:22:45,190 --> 00:22:43,280
quantitatively how big each one is and

623
00:22:47,430 --> 00:22:45,200
how they compete with each other

624
00:22:49,750 --> 00:22:47,440
uh having a good education a good

625
00:22:51,510 --> 00:22:49,760
background in science and math is

626
00:22:53,750 --> 00:22:51,520
extremely important

627
00:22:55,750 --> 00:22:53,760
and so i think everybody here would

628
00:22:57,430 --> 00:22:55,760
probably agree uh from our own

629
00:22:59,669 --> 00:22:57,440
educations about

630
00:23:01,110 --> 00:22:59,679
how much insight that gives us into

631
00:23:03,590 --> 00:23:01,120
what's going on and

632
00:23:07,510 --> 00:23:03,600
and why that's been so important also in

633
00:23:11,190 --> 00:23:08,870
yeah i think the other the other thing i

634
00:23:13,190 --> 00:23:11,200
think this brings up is uh following on

635
00:23:15,029 --> 00:23:13,200
to ralph's comment is that

636
00:23:16,549 --> 00:23:15,039
when the ipcc looks at the climate

637
00:23:17,909 --> 00:23:16,559
system and tries to give us a sense of

638
00:23:20,070 --> 00:23:17,919

what's going on

639
00:23:21,669 --> 00:23:20,080
it never is doing that in the context of

640
00:23:23,590 --> 00:23:21,679
a single variable alone it's always

641
00:23:25,990 --> 00:23:23,600
doing it in the context of what's the

642
00:23:27,830 --> 00:23:26,000
entire system doing so we have many

643
00:23:29,190 --> 00:23:27,840
different ways to ocean to measure for

644
00:23:30,710 --> 00:23:29,200
example ocean heat storage we have

645
00:23:33,110 --> 00:23:30,720
satellites up in space measuring the

646
00:23:35,190 --> 00:23:33,120
energy coming into the planet we have

647
00:23:36,789 --> 00:23:35,200
ocean floats every few hundred

648
00:23:39,190 --> 00:23:36,799
kilometers of the ocean measuring all

649
00:23:40,950 --> 00:23:39,200
the way down to two thousand meters or

650
00:23:42,870 --> 00:23:40,960
six thousand feet deep

651
00:23:44,070 --> 00:23:42,880
we keep track of all those measurements

652
00:23:45,110 --> 00:23:44,080
and look at how they're all varying

653
00:23:48,070 --> 00:23:45,120
together

654
00:23:51,590 --> 00:23:48,080
uh temperature precipitation uh

655
00:23:53,510 --> 00:23:51,600
snow cover um arctic sea ice and it's as

656
00:23:55,029 --> 00:23:53,520
you put the whole story together that

657
00:23:56,950 --> 00:23:55,039
you start to see

658
00:23:58,870 --> 00:23:56,960
where the roles of natural variability

659
00:24:01,750 --> 00:23:58,880
versus anthropogenic change are so the

660
00:24:03,830 --> 00:24:01,760
certainty of mankind driving the system

661
00:24:05,669 --> 00:24:03,840
in the last 50 years primarily versus

662
00:24:07,669 --> 00:24:05,679
natural variability comes out of

663
00:24:08,870 --> 00:24:07,679

considering all of those considering

664
00:24:10,950 --> 00:24:08,880
what volcanoes have been doing

665
00:24:13,269 --> 00:24:10,960
considering what solar variability has

666
00:24:15,110 --> 00:24:13,279
been doing it's really a sum of that

667
00:24:18,230 --> 00:24:15,120
whole thing and so the stem education

668
00:24:21,110 --> 00:24:18,240
that ralph was referring to is is again

669
00:24:22,630 --> 00:24:21,120
a focus on why the ipcc needs thousands

670
00:24:26,230 --> 00:24:22,640
of scientists to do this and not just

671
00:24:28,549 --> 00:24:27,269
okay

672
00:24:30,230 --> 00:24:28,559
um

673
00:24:31,909 --> 00:24:30,240
getting getting to some of those changes

674
00:24:33,510 --> 00:24:31,919
that we have been seeing eric i want to

675
00:24:35,029 --> 00:24:33,520
bring this back to you one of them some

676
00:24:36,230 --> 00:24:35,039
of the numbers that really jumped out at

677
00:24:38,310 --> 00:24:36,240
me were

678
00:24:40,230 --> 00:24:38,320
uh looking at the

679
00:24:42,950 --> 00:24:40,240
not just the changes that we've seen in

680
00:24:44,630 --> 00:24:42,960
glaciers and night sheets but uh the

681
00:24:47,110 --> 00:24:44,640
rate of that change in the acceleration

682
00:24:50,070 --> 00:24:47,120
of that change recently so a few numbers

683
00:24:53,029 --> 00:24:50,080
the greenland ice sheet from 92 to 2001

684
00:24:55,269 --> 00:24:53,039
was losing about 34 gigatons a year of

685
00:24:57,110 --> 00:24:55,279
ice i think only glaciologists think in

686
00:25:00,870 --> 00:24:57,120
terms of gigatons but the rest of us can

687
00:25:02,950 --> 00:25:00,880
imagine that's a lot um

688
00:25:04,230 --> 00:25:02,960

in the following decade from 2002 to

689
00:25:07,669 --> 00:25:04,240
2011

690
00:25:10,230 --> 00:25:07,679
that increased to 215 gigatons a year

691
00:25:13,110 --> 00:25:10,240
antarctica losing about 30 gigatons a

692
00:25:14,549 --> 00:25:13,120
year from 92 to 2001

693
00:25:16,870 --> 00:25:14,559
and the following decade that increased

694
00:25:18,630 --> 00:25:16,880
to 147.

695
00:25:23,590 --> 00:25:18,640
what

696
00:25:25,590 --> 00:25:23,600
the the cryosphere or the ocean systems

697
00:25:27,590 --> 00:25:25,600
are are driving

698
00:25:29,350 --> 00:25:27,600
um the acceleration the rapid

699
00:25:31,990 --> 00:25:29,360
acceleration of of those changes that

700
00:25:35,190 --> 00:25:32,000
we're seeing in the ice sheets eric

701
00:25:37,110 --> 00:25:35,200
uh patrick i'll back up a little bit and

702
00:25:40,230 --> 00:25:37,120
mention that uh one of the major

703
00:25:41,830 --> 00:25:40,240
outcomes of ar-5 has been to come up

704
00:25:43,669 --> 00:25:41,840
with

705
00:25:45,029 --> 00:25:43,679
clearer answers about what's happening

706
00:25:47,669 --> 00:25:45,039
in greenland and especially in

707
00:25:49,990 --> 00:25:47,679
antarctica in in ar4 there was still a

708
00:25:52,230 --> 00:25:50,000
lot of uncertainty about uh

709
00:25:53,830 --> 00:25:52,240
what the contribution to sea level from

710
00:25:56,630 --> 00:25:53,840
antarctica was

711
00:25:57,990 --> 00:25:56,640
because we did not have long enough

712
00:25:59,430 --> 00:25:58,000
observations

713
00:26:00,950 --> 00:25:59,440

and this is referring back to the

714
00:26:03,510 --> 00:26:00,960
comments from bruce and ralph that the

715
00:26:05,510 --> 00:26:03,520
system is fairly complex and there's not

716
00:26:08,070 --> 00:26:05,520
much you can say with just 10 years of

717
00:26:09,590 --> 00:26:08,080
data you need a long term record

718
00:26:13,350 --> 00:26:09,600
of observations

719
00:26:15,909 --> 00:26:13,360
and nowadays we we have nearly

720
00:26:18,070 --> 00:26:15,919
20 to 30 years of observations of the

721
00:26:18,789 --> 00:26:18,080
ice sheets uh with various instruments

722
00:26:21,750 --> 00:26:18,799
that

723
00:26:23,750 --> 00:26:21,760
really come together nicely uh in this

724
00:26:25,350 --> 00:26:23,760
ar-5 report

725
00:26:26,630 --> 00:26:25,360
we don't have just one way to look at

726
00:26:28,310 --> 00:26:26,640
issues we have

727
00:26:29,909 --> 00:26:28,320
at least three or four different

728
00:26:32,470 --> 00:26:29,919
techniques

729
00:26:35,750 --> 00:26:32,480
looking at these complex entities and

730
00:26:37,990 --> 00:26:35,760
coming up with very similar answers

731
00:26:40,390 --> 00:26:38,000
to put the numbers in perspective i

732
00:26:43,190 --> 00:26:40,400
always use this analogy that one gigaton

733
00:26:44,149 --> 00:26:43,200
of water uh lost by the ashes into the

734
00:26:46,789 --> 00:26:44,159
ocean

735
00:26:49,029 --> 00:26:46,799
is equivalent to the conception of water

736
00:26:52,470 --> 00:26:49,039
by the city of los angeles and its eight

737
00:26:55,510 --> 00:26:52,480
million habitants for one year

738
00:26:57,110 --> 00:26:55,520

so you mentioned 215 gigatonnes of mass

739
00:26:58,710 --> 00:26:57,120
loss from greenland

740
00:27:00,390 --> 00:26:58,720
in the recent years

741
00:27:03,029 --> 00:27:00,400
so that's basically the equivalent of

742
00:27:06,070 --> 00:27:03,039
the total water supply for 200 cities

743
00:27:07,430 --> 00:27:06,080
like los angeles lost by the ice sheet

744
00:27:09,029 --> 00:27:07,440
into the ocean

745
00:27:09,909 --> 00:27:09,039
and the ice sheet is not getting that

746
00:27:13,190 --> 00:27:09,919
back

747
00:27:15,669 --> 00:27:13,200
so in terms of um

748
00:27:17,590 --> 00:27:15,679
the total volume content of these issues

749
00:27:21,029 --> 00:27:17,600
these are very small numbers the ice

750
00:27:22,149 --> 00:27:21,039
sheets are only losing a little triple

751
00:27:25,190 --> 00:27:22,159
oh

752
00:27:29,110 --> 00:27:27,029
i get a little bit of interference here

753
00:27:31,750 --> 00:27:29,120
they are using a little trickle but on

754
00:27:34,149 --> 00:27:31,760
the human scale these amounts of water

755
00:27:35,909 --> 00:27:34,159
releasing the ocean are fairly big right

756
00:27:38,149 --> 00:27:35,919
200 cities like

757
00:27:42,390 --> 00:27:38,159
los angeles

758
00:27:46,310 --> 00:27:43,990
there's been

759
00:27:48,630 --> 00:27:46,320
an increased awareness of the important

760
00:27:52,390 --> 00:27:48,640
role of the ocean on the ice sheets this

761
00:27:56,549 --> 00:27:55,190
new compared to ar4 that

762
00:27:58,470 --> 00:27:56,559
we believe that

763
00:28:00,230 --> 00:27:58,480

in greenland and in antarctica the

764
00:28:02,310 --> 00:28:00,240
warming of the ocean and changes in

765
00:28:04,310 --> 00:28:02,320
ocean circulation

766
00:28:06,310 --> 00:28:04,320
around the ice sheets which are driven

767
00:28:08,950 --> 00:28:06,320
by changes in the wind system around the

768
00:28:11,190 --> 00:28:08,960
ice sheets which are driven by the whole

769
00:28:14,830 --> 00:28:11,200
climate system

770
00:28:17,350 --> 00:28:14,840
i've had a much larger impact that

771
00:28:18,549 --> 00:28:17,360
what expected in the past i get a lot of

772
00:28:20,630 --> 00:28:18,559
uh

773
00:28:23,669 --> 00:28:20,640
background noise here

774
00:28:25,750 --> 00:28:23,679
so this is a new element of of ar5 and

775
00:28:28,389 --> 00:28:25,760
enough there's a lot of focused research

776
00:28:30,549 --> 00:28:28,399
on that new aspect of ice ocean

777
00:28:31,669 --> 00:28:30,559
interaction around the ice sheets that

778
00:28:32,950 --> 00:28:31,679
are

779
00:28:35,510 --> 00:28:32,960
gathering a lot of interest in the

780
00:28:37,669 --> 00:28:35,520
international community

781
00:28:39,029 --> 00:28:37,679
eric can i can i ask you can you put the

782
00:28:42,549 --> 00:28:39,039
ice loss

783
00:28:47,430 --> 00:28:42,559
into terms of sea level rise and how sea

784
00:28:51,350 --> 00:28:50,549
uh yes thank you ralph um

785
00:28:56,789 --> 00:28:51,360
the

786
00:28:58,389 --> 00:28:56,799
have contributing more and more to sea

787
00:29:00,710 --> 00:28:58,399
level rise

788
00:29:02,549 --> 00:29:00,720

they were probably a small fraction of

789
00:29:05,190 --> 00:29:02,559
the total sea level rise

790
00:29:07,510 --> 00:29:05,200
40 50 years ago and now they've become

791
00:29:09,350 --> 00:29:07,520
already the dominant contributor to sea

792
00:29:12,389 --> 00:29:09,360
level rise the other component is the

793
00:29:13,669 --> 00:29:12,399
thermal expansion from the ocean

794
00:29:15,510 --> 00:29:13,679
but

795
00:29:17,110 --> 00:29:15,520
the mountain glaciers and especially the

796
00:29:18,870 --> 00:29:17,120
ice sheets are contributing more and

797
00:29:20,549 --> 00:29:18,880
more every year to sea level and they

798
00:29:21,750 --> 00:29:20,559
are really driving the curve of sea

799
00:29:25,190 --> 00:29:21,760
level up

800
00:29:27,990 --> 00:29:25,200
and we expect that this will continue

801
00:29:33,590 --> 00:29:28,000
for decades and in case of ice sheets it

802
00:29:39,909 --> 00:29:36,549
okay uh drew it sounds like you were

803
00:29:41,990 --> 00:29:39,919
mike was coming live there a second um

804
00:29:44,389 --> 00:29:42,000
can you hear us now and can we hear you

805
00:29:47,350 --> 00:29:44,399
i can hear you fine can you hear me yes

806
00:29:48,630 --> 00:29:47,360
we can wow it lasts there we go

807
00:29:50,549 --> 00:29:48,640
so um

808
00:29:53,110 --> 00:29:50,559
let's uh just to reset a little bit

809
00:29:55,029 --> 00:29:53,120
since you just returned from

810
00:29:57,110 --> 00:29:55,039
stockholm uh and we're there for the

811
00:29:59,350 --> 00:29:57,120
week uh we've we've sort of been talking

812
00:30:01,750 --> 00:29:59,360
with some of the details but uh you had

813
00:30:03,590 --> 00:30:01,760

a fairly significant role uh in a couple

814
00:30:05,909 --> 00:30:03,600
of years and the summary

815
00:30:07,350 --> 00:30:05,919
this year so i wonder if if you could uh

816
00:30:10,549 --> 00:30:07,360
just being back from stockholm give us

817
00:30:13,269 --> 00:30:10,559
your your major takeaways from from the

818
00:30:15,430 --> 00:30:13,279
summary for policymakers and and how it

819
00:30:18,149 --> 00:30:15,440
has changed from the previous report and

820
00:30:19,830 --> 00:30:18,159
and what it means for us going forward

821
00:30:21,830 --> 00:30:19,840
sure well

822
00:30:23,750 --> 00:30:21,840
you know one one of the things that

823
00:30:25,590 --> 00:30:23,760
people keep asking actually since the

824
00:30:27,830 --> 00:30:25,600
report was completed was really what's

825
00:30:30,230 --> 00:30:27,840
new and what's different in this one and

826
00:30:31,590 --> 00:30:30,240
i would say that that's really well

827
00:30:33,029 --> 00:30:31,600
we're not seeing things that are

828
00:30:35,990 --> 00:30:33,039
dramatically

829
00:30:38,149 --> 00:30:36,000
different than we saw in ar4 but what we

830
00:30:41,110 --> 00:30:38,159
are seeing is that all of the things we

831
00:30:43,029 --> 00:30:41,120
talked about in ar4 so that various

832
00:30:45,990 --> 00:30:43,039
changes would take place if emissions

833
00:30:48,870 --> 00:30:46,000
can continue to increase we're seeing

834
00:30:50,789 --> 00:30:48,880
all of that unfold in front of us now so

835
00:30:53,750 --> 00:30:50,799
it's more as if we've moved to a little

836
00:30:55,590 --> 00:30:53,760
bit later stage where the emissions have

837
00:30:57,430 --> 00:30:55,600
continued to follow the highest

838
00:30:59,510 --> 00:30:57,440

scenarios that we had looked at in

839
00:31:01,510 --> 00:30:59,520
previous reports and now we're seeing

840
00:31:03,590 --> 00:31:01,520
the consequences the temperature the

841
00:31:05,590 --> 00:31:03,600
snow the ice

842
00:31:09,269 --> 00:31:05,600
etc we're seeing all these things

843
00:31:11,750 --> 00:31:09,279
changes as as we had expected they would

844
00:31:13,990 --> 00:31:11,760
but it's unfortunately all coming true

845
00:31:15,269 --> 00:31:14,000
just as just as we expected when we look

846
00:31:17,029 --> 00:31:15,279
at the future

847
00:31:19,029 --> 00:31:17,039
we see that there are you know these

848
00:31:21,590 --> 00:31:19,039
kind of changes continue

849
00:31:23,269 --> 00:31:21,600
and we've i heard the discussion from

850
00:31:24,789 --> 00:31:23,279
the others which which i would fully

851
00:31:27,830 --> 00:31:24,799
agree with there are still large

852
00:31:28,710 --> 00:31:27,840
uncertainties with aerosols clouds these

853
00:31:30,630 --> 00:31:28,720
uh

854
00:31:32,710 --> 00:31:30,640
prevent us from really constraining

855
00:31:34,789 --> 00:31:32,720
climate sensitivity exactly but

856
00:31:35,750 --> 00:31:34,799
nonetheless with various scenarios we

857
00:31:37,990 --> 00:31:35,760
can see

858
00:31:41,190 --> 00:31:38,000
where in general we're going and i think

859
00:31:43,269 --> 00:31:41,200
the key message there is that well many

860
00:31:45,909 --> 00:31:43,279
of these consequences will continue to

861
00:31:48,149 --> 00:31:45,919
take place no matter what society still

862
00:31:50,710 --> 00:31:48,159
does have a major role to play and that

863
00:31:52,149 --> 00:31:50,720

the low emission scenarios are certainly

864
00:31:53,830 --> 00:31:52,159
much less damaging than the high

865
00:31:55,350 --> 00:31:53,840
emission scenarios

866
00:31:57,190 --> 00:31:55,360
so it was

867
00:31:59,350 --> 00:31:57,200
you know it was really an interesting

868
00:32:01,029 --> 00:31:59,360
process to participate in

869
00:32:03,430 --> 00:32:01,039
and i think the report is really

870
00:32:05,909 --> 00:32:03,440
comprehensive and informative on all of

871
00:32:08,149 --> 00:32:05,919
these things but it's really in many

872
00:32:11,590 --> 00:32:08,159
ways confirming the kind of things that

873
00:32:13,110 --> 00:32:11,600
have been said before by the ipt student

874
00:32:15,029 --> 00:32:13,120
great let's

875
00:32:16,950 --> 00:32:15,039
just remind people so one second ralph

876
00:32:18,549 --> 00:32:16,960
that's uh drew shindel from goddard

877
00:32:20,549 --> 00:32:18,559
institute for space studies just joining

878
00:32:21,750 --> 00:32:20,559
us in new york i also want to remind

879
00:32:23,590 --> 00:32:21,760
people that if you do want to ask

880
00:32:26,070 --> 00:32:23,600
questions you can do it on the google

881
00:32:28,389 --> 00:32:26,080
plus page or the youtube comments or on

882
00:32:29,909 --> 00:32:28,399
twitter using the hashtag

883
00:32:33,029 --> 00:32:29,919
askclimate

884
00:32:36,549 --> 00:32:33,039
um ralph go ahead so yeah drew drew was

885
00:32:38,230 --> 00:32:36,559
making making the comment uh about how

886
00:32:40,710 --> 00:32:38,240
the scenario that we happen to be

887
00:32:44,070 --> 00:32:40,720
following now based on the last six or

888
00:32:45,830 --> 00:32:44,080

seven years of additional data is the

889
00:32:47,110 --> 00:32:45,840
what we call the business as usual

890
00:32:49,509 --> 00:32:47,120
scenario

891
00:32:51,830 --> 00:32:49,519
uh one of the things that following one

892
00:32:52,549 --> 00:32:51,840
of the more conservative scenarios would

893
00:32:55,750 --> 00:32:52,559
do

894
00:32:58,789 --> 00:32:55,760
is it buys us time because the changes

895
00:33:00,470 --> 00:32:58,799
are would be taking place more slowly

896
00:33:02,950 --> 00:33:00,480
and so

897
00:33:05,029 --> 00:33:02,960
that would that would give ecosystems

898
00:33:07,110 --> 00:33:05,039
and civilizations

899
00:33:08,310 --> 00:33:07,120
more opportunity to adjust to the

900
00:33:10,070 --> 00:33:08,320
changes

901
00:33:11,990 --> 00:33:10,080
and one of the things we see is such

902
00:33:13,909 --> 00:33:12,000
rapid changes in certain

903
00:33:15,830 --> 00:33:13,919
attributes of the climate system as eric

904
00:33:17,990 --> 00:33:15,840
was talking about earlier

905
00:33:20,149 --> 00:33:18,000
and it's much harder for

906
00:33:23,750 --> 00:33:20,159
us to respond to civilizations and it's

907
00:33:26,230 --> 00:33:23,760
also very difficult for the flora and

908
00:33:29,990 --> 00:33:26,240
fauna for the biota to respond when

909
00:33:36,149 --> 00:33:31,509
following uh

910
00:33:38,549 --> 00:33:36,159
on that a little bit um drew is there

911
00:33:39,990 --> 00:33:38,559
is there an easy way to say so so let me

912
00:33:41,990 --> 00:33:40,000
back up a second there are four

913
00:33:43,269 --> 00:33:42,000

different scenarios that end up with

914
00:33:45,430 --> 00:33:43,279
different

915
00:33:47,590 --> 00:33:45,440
carbon dioxide concentrations sort of at

916
00:33:48,630 --> 00:33:47,600
the end of the 21st century among

917
00:33:53,430 --> 00:33:48,640
different

918
00:33:56,070 --> 00:33:53,440
which if you're to sort of look at our

919
00:33:58,070 --> 00:33:56,080
rate of of um

920
00:34:00,149 --> 00:33:58,080
increase in terms of carbon dioxide

921
00:34:01,509 --> 00:34:00,159
concentrations the atmosphere now is is

922
00:34:04,070 --> 00:34:01,519
one of those

923
00:34:05,830 --> 00:34:04,080
more representative of of just the rate

924
00:34:07,190 --> 00:34:05,840
that we are on now obviously many things

925
00:34:08,230 --> 00:34:07,200
can change in between now and the end of

926
00:34:09,430 --> 00:34:08,240
the century

927
00:34:10,790 --> 00:34:09,440
but

928
00:34:12,310 --> 00:34:10,800
is there one of those scenarios that's

929
00:34:14,310 --> 00:34:12,320
more accurate in terms of the rate that

930
00:34:16,069 --> 00:34:14,320
we are on right now

931
00:34:18,869 --> 00:34:16,079
well unfortunately the rate we've been

932
00:34:21,109 --> 00:34:18,879
on now has been setting new records most

933
00:34:23,990 --> 00:34:21,119
every year other than and during the

934
00:34:26,389 --> 00:34:24,000
global financial downturn but aside from

935
00:34:29,750 --> 00:34:26,399
that it's the increase keeps growing

936
00:34:31,190 --> 00:34:29,760
extremely rapidly so we tend to be on

937
00:34:36,790 --> 00:34:31,200
the

938
00:34:39,109 --> 00:34:36,800

emission scenario uh from compared to

939
00:34:40,950 --> 00:34:39,119
both the older set of scenarios used in

940
00:34:42,069 --> 00:34:40,960
previous reports and the new set of

941
00:34:44,149 --> 00:34:42,079
scenarios

942
00:34:45,510 --> 00:34:44,159
so it's really showing that we are we

943
00:34:48,310 --> 00:34:45,520
are nowhere near

944
00:34:50,869 --> 00:34:48,320
the paths that we need to be on to avoid

945
00:34:52,470 --> 00:34:50,879
the worst consequences

946
00:34:54,230 --> 00:34:52,480
okay great uh

947
00:34:55,510 --> 00:34:54,240
i'm gonna i'm gonna go quickly to a

948
00:34:58,069 --> 00:34:55,520
bunch of different questions that we've

949
00:35:00,310 --> 00:34:58,079
gotten from online i don't know if

950
00:35:01,990 --> 00:35:00,320
some of these may be for disciplines

951
00:35:03,829 --> 00:35:02,000
that you aren't specialized in so i'll

952
00:35:05,910 --> 00:35:03,839
just throw them out there for the group

953
00:35:08,870 --> 00:35:05,920
um the first question was from jack

954
00:35:12,310 --> 00:35:08,880
whitman on twitter he asked about the

955
00:35:14,230 --> 00:35:12,320
potential impact on water resources in

956
00:35:17,349 --> 00:35:14,240
the eastern u.s in particular but i'll

957
00:35:19,510 --> 00:35:17,359
broaden that to ask about it um i guess

958
00:35:21,190 --> 00:35:19,520
sort of more around the globe is that is

959
00:35:27,270 --> 00:35:21,200
that something that was

960
00:35:31,190 --> 00:35:28,710
and i'm asking a bunch of atmosphere

961
00:35:32,870 --> 00:35:31,200
guys

962
00:35:34,550 --> 00:35:32,880
the models are telling us and this is

963
00:35:36,790 --> 00:35:34,560

something that either drew or eric might

964
00:35:38,230 --> 00:35:36,800
want to comment on further uh they're

965
00:35:40,470 --> 00:35:38,240
telling us that the wet places are

966
00:35:41,990 --> 00:35:40,480
likely to get a bit wetter and the dry

967
00:35:43,430 --> 00:35:42,000
places are likely to get a whole lot

968
00:35:45,910 --> 00:35:43,440
drier

969
00:35:47,510 --> 00:35:45,920
and that's kind of what the model seemed

970
00:35:49,510 --> 00:35:47,520
to be saying and that's certainly

971
00:35:51,270 --> 00:35:49,520
reflected in the report

972
00:35:52,870 --> 00:35:51,280
uh the one thing that's changed since

973
00:35:56,150 --> 00:35:52,880
the previous report is that the

974
00:35:57,750 --> 00:35:56,160
confidence in that pattern has increased

975
00:35:59,430 --> 00:35:57,760
and that was a point bruce was making

976
00:36:01,670 --> 00:35:59,440
earlier

977
00:36:03,829 --> 00:36:01,680
right okay i'll jump to the next one

978
00:36:06,550 --> 00:36:03,839
this is a youtube comment from eric

979
00:36:09,270 --> 00:36:06,560
charland um is the added fresh water

980
00:36:10,230 --> 00:36:09,280
from melting glaciers having an effect

981
00:36:16,310 --> 00:36:10,240
on

982
00:36:18,390 --> 00:36:16,320
and i would broaden that to say or

983
00:36:20,550 --> 00:36:18,400
salinity as well

984
00:36:23,349 --> 00:36:20,560
yeah so the it's a good question the the

985
00:36:25,349 --> 00:36:23,359
freshwater uh dumping from the ice

986
00:36:27,750 --> 00:36:25,359
sheets has been

987
00:36:29,750 --> 00:36:27,760
suggested as a potential disturbance to

988
00:36:32,150 --> 00:36:29,760

ocean circulation if you

989
00:36:33,510 --> 00:36:32,160
dump fresh water from greenland into the

990
00:36:35,670 --> 00:36:33,520
north atlantic

991
00:36:37,750 --> 00:36:35,680
uh you may prevent the turmoil and

992
00:36:39,829 --> 00:36:37,760
circulation from the north atlantic to

993
00:36:41,670 --> 00:36:39,839
proceed you may eventually shut down

994
00:36:43,109 --> 00:36:41,680
things like the gulf stream

995
00:36:45,349 --> 00:36:43,119
and there's been a lot of work done

996
00:36:46,710 --> 00:36:45,359
along these lines but i think

997
00:36:49,430 --> 00:36:46,720
the results

998
00:36:51,510 --> 00:36:49,440
from these models concur that

999
00:36:54,150 --> 00:36:51,520
in order for the system to be perturbed

1000
00:36:55,750 --> 00:36:54,160
you need to inject a lot more fresh

1001
00:36:58,390 --> 00:36:55,760
water into the system than what we're

1002
00:37:00,230 --> 00:36:58,400
doing right now

1003
00:37:02,790 --> 00:37:00,240
we call that these uh these hosing

1004
00:37:04,950 --> 00:37:02,800
experiments that doesn't mean that the

1005
00:37:07,349 --> 00:37:04,960
freshwater injected by the ice sheets

1006
00:37:10,069 --> 00:37:07,359
into the ocean system right now

1007
00:37:12,150 --> 00:37:10,079
do not matter they do

1008
00:37:14,950 --> 00:37:12,160
but this is probably a longer term

1009
00:37:16,550 --> 00:37:14,960
change a longer-term concern

1010
00:37:18,950 --> 00:37:16,560
than something that's going to happen in

1011
00:37:20,390 --> 00:37:18,960
the next 20 years

1012
00:37:22,870 --> 00:37:20,400
you probably need

1013
00:37:24,470 --> 00:37:22,880

10 100 times more fresh water dumping in

1014
00:37:25,349 --> 00:37:24,480
the ocean to start really affecting

1015
00:37:29,510 --> 00:37:25,359
things

1016
00:37:32,069 --> 00:37:29,520
uh but there again um this is

1017
00:37:33,910 --> 00:37:32,079
only a matter of time and time is the

1018
00:37:35,109 --> 00:37:33,920
essence here in in a lot of these

1019
00:37:37,589 --> 00:37:35,119
discussions

1020
00:37:39,589 --> 00:37:37,599
uh as uh the other invitees on this

1021
00:37:41,510 --> 00:37:39,599
hangout pointed out a lot of the

1022
00:37:42,790 --> 00:37:41,520
observations that we have show that the

1023
00:37:46,950 --> 00:37:42,800
system

1024
00:37:48,870 --> 00:37:46,960
pace and some of the worst case

1025
00:37:51,990 --> 00:37:48,880
scenarios we've been looking at and i

1026
00:37:54,630 --> 00:37:52,000
think for the ice sheets the change in

1027
00:37:57,910 --> 00:37:54,640
sea ice in the polar regions

1028
00:38:00,630 --> 00:37:57,920
each year we have new measurements

1029
00:38:03,109 --> 00:38:00,640
it raises eyebrows of surprise on how

1030
00:38:05,430 --> 00:38:03,119
fast the system can change rather than

1031
00:38:06,790 --> 00:38:05,440
signs of content that there's some

1032
00:38:09,109 --> 00:38:06,800
negative feedback that comes to

1033
00:38:11,190 --> 00:38:09,119
stabilize the system the changes are

1034
00:38:12,550 --> 00:38:11,200
sustained there's always variability

1035
00:38:15,190 --> 00:38:12,560
from one year to the next but they

1036
00:38:17,349 --> 00:38:15,200
sustain and they're going one way

1037
00:38:19,190 --> 00:38:17,359
eric could i could i ask you a follow-up

1038
00:38:21,430 --> 00:38:19,200

question here on this which is you

1039
00:38:23,670 --> 00:38:21,440
mentioned that the fresh water dumping

1040
00:38:25,030 --> 00:38:23,680
into the ocean is probably not going to

1041
00:38:26,630 --> 00:38:25,040
have a big effect on the ocean

1042
00:38:28,310 --> 00:38:26,640
circulation but what about the sea

1043
00:38:30,790 --> 00:38:28,320
surface temperature change that's

1044
00:38:35,109 --> 00:38:33,589
uh in the proximity of the ice sheets um

1045
00:38:38,150 --> 00:38:35,119
well in general

1046
00:38:39,030 --> 00:38:38,160
we know that the ocean's warming

1047
00:38:40,390 --> 00:38:39,040
uh

1048
00:38:43,270 --> 00:38:40,400
yeah the

1049
00:38:45,430 --> 00:38:43,280
i think the the bigger uh question in

1050
00:38:47,430 --> 00:38:45,440
terms of uh the interaction and iso

1051
00:38:49,670 --> 00:38:47,440
ocean is how much the ocean is going to

1052
00:38:51,990 --> 00:38:49,680
influence the ice sheets that's really

1053
00:38:53,910 --> 00:38:52,000
uh the way the signal is going right now

1054
00:38:55,589 --> 00:38:53,920
the warmer ocean is helping and

1055
00:38:58,310 --> 00:38:55,599
contributing to the melting of the ice

1056
00:39:00,390 --> 00:38:58,320
sheets in in a complex way

1057
00:39:02,069 --> 00:39:00,400
we understand the basic physics but the

1058
00:39:04,550 --> 00:39:02,079
details are

1059
00:39:06,950 --> 00:39:04,560
quite complex and operates on the

1060
00:39:09,829 --> 00:39:06,960
range of time scales and spatial scales

1061
00:39:11,910 --> 00:39:09,839
that we do not fully comprehend yeah

1062
00:39:13,510 --> 00:39:11,920
um also as a note

1063
00:39:15,750 --> 00:39:13,520

to our auditor

1064
00:39:17,349 --> 00:39:15,760
this this is a different issues from

1065
00:39:19,829 --> 00:39:17,359
ocean acidification and ocean

1066
00:39:21,349 --> 00:39:19,839
acidification has to do with the uptake

1067
00:39:23,349 --> 00:39:21,359
of a co2

1068
00:39:25,270 --> 00:39:23,359
in the ocean and that's a separate issue

1069
00:39:26,150 --> 00:39:25,280
from the fresh water dumping

1070
00:39:27,190 --> 00:39:26,160
okay

1071
00:39:29,990 --> 00:39:27,200
um

1072
00:39:31,510 --> 00:39:30,000
next question also from twitter uh and i

1073
00:39:33,910 --> 00:39:31,520
read about this a little bit and was

1074
00:39:35,349 --> 00:39:33,920
kind of surprised to see this um drew

1075
00:39:36,790 --> 00:39:35,359
this may be a good one for you what

1076
00:39:38,230 --> 00:39:36,800
impact to increase levels of

1077
00:39:39,589 --> 00:39:38,240
tropospheric

1078
00:39:42,630 --> 00:39:39,599
um

1079
00:39:44,230 --> 00:39:42,640
ozone over urban centers have on climate

1080
00:39:46,470 --> 00:39:44,240
and i'll flip that around because the

1081
00:39:49,349 --> 00:39:46,480
part that i saw in the report was the

1082
00:39:50,470 --> 00:39:49,359
impact the climate change might have on

1083
00:39:53,589 --> 00:39:50,480
levels of

1084
00:39:55,670 --> 00:39:53,599
of surface ozone in the future

1085
00:39:58,710 --> 00:39:55,680
that's right that's it that interaction

1086
00:40:01,510 --> 00:39:58,720
goes both ways and urban areas even

1087
00:40:03,990 --> 00:40:01,520
though certainly important for uh most

1088
00:40:05,990 --> 00:40:04,000

people living there now are still a

1089
00:40:08,470 --> 00:40:06,000
small fraction of the surface area of

1090
00:40:10,550 --> 00:40:08,480
the earth so the particular value of

1091
00:40:13,510 --> 00:40:10,560
ozone in urban levels doesn't have an

1092
00:40:15,510 --> 00:40:13,520
enormous effect on climate

1093
00:40:17,670 --> 00:40:15,520
however tropospheric ozone in general

1094
00:40:19,670 --> 00:40:17,680
does have a large effect on climate so

1095
00:40:22,069 --> 00:40:19,680
in addition to having differences in the

1096
00:40:24,710 --> 00:40:22,079
co2 under these different scenarios if

1097
00:40:26,069 --> 00:40:24,720
you look at a scenario that say has a

1098
00:40:28,630 --> 00:40:26,079
high

1099
00:40:30,630 --> 00:40:28,640
emissions projected for methane that

1100
00:40:32,470 --> 00:40:30,640
leads to greater tropospheric ozone and

1101
00:40:33,910 --> 00:40:32,480
that certainly does lead to more warming

1102
00:40:36,870 --> 00:40:33,920
in that scenario

1103
00:40:39,349 --> 00:40:36,880
than in another scenario the converse of

1104
00:40:42,150 --> 00:40:39,359
this is that as climate gets warmer

1105
00:40:43,990 --> 00:40:42,160
generally that warmth tends to speed up

1106
00:40:45,589 --> 00:40:44,000
reactions of

1107
00:40:47,109 --> 00:40:45,599
the chemical reactions that lead to

1108
00:40:50,069 --> 00:40:47,119
ozone formation

1109
00:40:52,390 --> 00:40:50,079
in uh polluted areas so

1110
00:40:54,790 --> 00:40:52,400
you would expect that in general you

1111
00:40:57,349 --> 00:40:54,800
would get more instances where you have

1112
00:40:59,829 --> 00:40:57,359
stagnant conditions heat waves you get

1113
00:41:01,829 --> 00:40:59,839

more episodes of very high ozone

1114
00:41:02,790 --> 00:41:01,839
pollution

1115
00:41:04,150 --> 00:41:02,800
okay

1116
00:41:06,470 --> 00:41:04,160
um

1117
00:41:08,790 --> 00:41:06,480
another question from twitter here

1118
00:41:11,190 --> 00:41:08,800
is there an alternative to reduce global

1119
00:41:14,630 --> 00:41:11,200
warming without cutting down on

1120
00:41:19,270 --> 00:41:15,510
um

1121
00:41:22,230 --> 00:41:19,280
i i don't think there's an easy way out

1122
00:41:23,870 --> 00:41:22,240
um the proposals that have been put

1123
00:41:27,030 --> 00:41:23,880
forward regarding

1124
00:41:30,390 --> 00:41:27,040
geoengineering and things like that

1125
00:41:31,510 --> 00:41:30,400
come with large uncertainties

1126
00:41:33,589 --> 00:41:31,520
and

1127
00:41:35,910 --> 00:41:33,599
to the extent that people have been able

1128
00:41:37,750 --> 00:41:35,920
to look at it so far

1129
00:41:40,309 --> 00:41:37,760
not only are their large uncertainties

1130
00:41:42,309 --> 00:41:40,319
but there are real possibilities that

1131
00:41:43,670 --> 00:41:42,319
those mechanisms could either back could

1132
00:41:45,990 --> 00:41:43,680
backfire

1133
00:41:48,150 --> 00:41:46,000
and actually make conditions worse

1134
00:41:50,069 --> 00:41:48,160
rather than better one of the reasons

1135
00:41:51,109 --> 00:41:50,079
for this is that the earth is very

1136
00:41:53,510 --> 00:41:51,119
diverse

1137
00:41:54,710 --> 00:41:53,520
and so any solution you try to make that

1138
00:41:55,750 --> 00:41:54,720

might

1139
00:41:58,470 --> 00:41:55,760
perhaps

1140
00:41:59,829 --> 00:41:58,480
improve things in one area you could you

1141
00:42:02,309 --> 00:41:59,839
can't confine

1142
00:42:04,550 --> 00:42:02,319
those impacts to just one area and in

1143
00:42:06,790 --> 00:42:04,560
other areas it will get worse so for

1144
00:42:09,349 --> 00:42:06,800
example if you put particles somewhere

1145
00:42:11,430 --> 00:42:09,359
and it brightens up the clouds there

1146
00:42:14,150 --> 00:42:11,440
other changes will take place there are

1147
00:42:16,630 --> 00:42:14,160
no clear boundaries that the climate

1148
00:42:18,150 --> 00:42:16,640
that the atmosphere will respect

1149
00:42:19,589 --> 00:42:18,160
and the result of that will be that

1150
00:42:21,750 --> 00:42:19,599
there can be a lot of unintended

1151
00:42:23,670 --> 00:42:21,760
consequences

1152
00:42:25,349 --> 00:42:23,680
let me follow up on that question and

1153
00:42:26,150 --> 00:42:25,359
tweak it in a slightly different way and

1154
00:42:27,510 --> 00:42:26,160
then

1155
00:42:28,790 --> 00:42:27,520
other than

1156
00:42:31,910 --> 00:42:28,800
reducing

1157
00:42:34,790 --> 00:42:31,920
for large-scale co2 emissions

1158
00:42:36,230 --> 00:42:34,800
is there anything we can do in the short

1159
00:42:38,790 --> 00:42:36,240
term

1160
00:42:41,270 --> 00:42:38,800
with other kinds of emissions

1161
00:42:43,349 --> 00:42:41,280
aerosol pollution that kind of thing

1162
00:42:46,390 --> 00:42:43,359
that could help to

1163
00:42:48,950 --> 00:42:46,400

reduce or or mitigate warming

1164
00:42:51,030 --> 00:42:48,960
well generally aerosols cool the earth

1165
00:42:53,270 --> 00:42:51,040
under most circumstances there are some

1166
00:42:54,630 --> 00:42:53,280
exceptions but in general that's what

1167
00:42:55,910 --> 00:42:54,640
they do

1168
00:42:56,829 --> 00:42:55,920
so

1169
00:42:59,349 --> 00:42:56,839
if

1170
00:43:01,910 --> 00:42:59,359
we were to

1171
00:43:04,630 --> 00:43:01,920
increase aerosol concentrations then

1172
00:43:06,309 --> 00:43:04,640
perhaps it would cool things

1173
00:43:08,630 --> 00:43:06,319
uh you were suggesting kind of the

1174
00:43:11,430 --> 00:43:08,640
opposite that reducing aerosol pollution

1175
00:43:13,270 --> 00:43:11,440
in some way would

1176
00:43:14,630 --> 00:43:13,280
cool but that it would tend to go the

1177
00:43:15,670 --> 00:43:14,640
other way

1178
00:43:17,510 --> 00:43:15,680
um

1179
00:43:18,470 --> 00:43:17,520
on the other hand

1180
00:43:20,950 --> 00:43:18,480
uh

1181
00:43:23,190 --> 00:43:20,960
the unintended consequences of doing

1182
00:43:25,589 --> 00:43:23,200
something deliberate like that uh could

1183
00:43:27,910 --> 00:43:25,599
be devastating and our understanding of

1184
00:43:28,950 --> 00:43:27,920
the processes involved is is really not

1185
00:43:31,589 --> 00:43:28,960
good enough

1186
00:43:34,630 --> 00:43:31,599
uh for us to

1187
00:43:37,190 --> 00:43:34,640
comment definitively in any way

1188
00:43:38,630 --> 00:43:37,200

on what effect that would have so i

1189
00:43:40,309 --> 00:43:38,640
think the short answer is there's no

1190
00:43:41,670 --> 00:43:40,319
easy way out that we know of at this

1191
00:43:43,829 --> 00:43:41,680
point

1192
00:43:46,630 --> 00:43:43,839
well if i could just add to that i mean

1193
00:43:49,109 --> 00:43:46,640
so ralph is just alluding to

1194
00:43:51,349 --> 00:43:49,119
uh you know that some aerosols warm and

1195
00:43:53,349 --> 00:43:51,359
those are primarily the absorbing the

1196
00:43:55,030 --> 00:43:53,359
black ones which usually call black

1197
00:43:56,950 --> 00:43:55,040
carbon and we just talked about

1198
00:43:58,950 --> 00:43:56,960
tropospheric ozone and methane one of

1199
00:44:01,589 --> 00:43:58,960
its precursors so certainly targeting

1200
00:44:04,230 --> 00:44:01,599
all of those things could bring benefits

1201
00:44:05,990 --> 00:44:04,240
in the short term and slow down the rate

1202
00:44:09,670 --> 00:44:06,000
of climate change over the next several

1203
00:44:11,589 --> 00:44:09,680
decades but they don't

1204
00:44:14,069 --> 00:44:11,599
compensate for

1205
00:44:15,589 --> 00:44:14,079
co2 emissions so they're not trading one

1206
00:44:17,349 --> 00:44:15,599
between the other they're a separate

1207
00:44:19,430 --> 00:44:17,359
thing which is good to do for the sake

1208
00:44:22,069 --> 00:44:19,440
of slowing down near-term climate but

1209
00:44:24,069 --> 00:44:22,079
the carbon dioxide accumulates in the

1210
00:44:26,470 --> 00:44:24,079
atmosphere unlike these shorter lived

1211
00:44:28,630 --> 00:44:26,480
things and so really if you want to deal

1212
00:44:29,990 --> 00:44:28,640
with long-term climate change which of

1213
00:44:31,430 --> 00:44:30,000

course we should

1214
00:44:33,750 --> 00:44:31,440
be trying to do

1215
00:44:35,589 --> 00:44:33,760
you have to reduce the co2 so you can do

1216
00:44:38,710 --> 00:44:35,599
these other things it's a good thing to

1217
00:44:40,550 --> 00:44:38,720
do for public health as well as climate

1218
00:44:43,430 --> 00:44:40,560
but it's not a substitute for action on

1219
00:44:46,470 --> 00:44:44,710
yeah patrick maybe one of the other

1220
00:44:47,910 --> 00:44:46,480
things i can bring up is that uh you

1221
00:44:49,750 --> 00:44:47,920
know there have been studies of

1222
00:44:51,990 --> 00:44:49,760
basically trying to take co2 out of the

1223
00:44:53,990 --> 00:44:52,000
atmosphere out of coal burning power

1224
00:44:56,390 --> 00:44:54,000
plant smoke stacks and basically putting

1225
00:44:58,550 --> 00:44:56,400
in the ground carbon sequestration

1226
00:45:00,230 --> 00:44:58,560
the main challenges there are really

1227
00:45:02,630 --> 00:45:00,240
cost and technology i mean right now

1228
00:45:04,470 --> 00:45:02,640
it's it's more costly to do that than it

1229
00:45:05,829 --> 00:45:04,480
is to reduce emissions so

1230
00:45:08,069 --> 00:45:05,839
uh it's certainly one of the things

1231
00:45:10,550 --> 00:45:08,079
people are looking at but right now the

1232
00:45:11,589 --> 00:45:10,560
the most effective path uh certainly

1233
00:45:13,270 --> 00:45:11,599
looks like

1234
00:45:15,510 --> 00:45:13,280
address some of the short-term things we

1235
00:45:17,829 --> 00:45:15,520
can but in the long term the as as we

1236
00:45:20,870 --> 00:45:17,839
were just hearing the lifetime of carbon

1237
00:45:23,270 --> 00:45:20,880
dioxide is is is basically once it's up

1238
00:45:25,109 --> 00:45:23,280

there literally thousands of years

1239
00:45:26,230 --> 00:45:25,119
uh whereas aerosols will disappear in a

1240
00:45:28,870 --> 00:45:26,240
couple weeks

1241
00:45:30,790 --> 00:45:28,880
so uh you really can't make short-term

1242
00:45:32,950 --> 00:45:30,800
solutions to carbon dioxide

1243
00:45:35,670 --> 00:45:32,960
right well let me add one thing uh to

1244
00:45:37,910 --> 00:45:35,680
what bruce was saying the cost of carbon

1245
00:45:39,349 --> 00:45:37,920
sequestration or removing carbon from

1246
00:45:41,430 --> 00:45:39,359
the atmosphere

1247
00:45:43,510 --> 00:45:41,440
one of the costs is the amount of energy

1248
00:45:44,630 --> 00:45:43,520
it takes to actually do that

1249
00:45:46,630 --> 00:45:44,640
and

1250
00:45:49,349 --> 00:45:46,640
many of the mechanisms involved are not

1251
00:45:51,109 --> 00:45:49,359
only economically costly but they might

1252
00:45:52,870 --> 00:45:51,119
actually be counterproductive because

1253
00:45:56,470 --> 00:45:52,880
they take so much energy in order to

1254
00:45:57,510 --> 00:45:56,480
actually affect the removal

1255
00:45:58,870 --> 00:45:57,520
okay

1256
00:46:01,670 --> 00:45:58,880
so i think we have we have about 10

1257
00:46:03,910 --> 00:46:01,680
minutes to go here i have a one

1258
00:46:05,990 --> 00:46:03,920
question one more question to go from

1259
00:46:07,430 --> 00:46:06,000
twitter and then maybe we can can go

1260
00:46:09,750 --> 00:46:07,440
around and you all could just kind of

1261
00:46:12,550 --> 00:46:09,760
give closing thoughts on on your biggest

1262
00:46:15,829 --> 00:46:12,560
takeaway from from the report um the

1263
00:46:19,109 --> 00:46:15,839

question is uh from detroit on twitter

1264
00:46:21,750 --> 00:46:19,119
uh has man over the past 150 years

1265
00:46:23,430 --> 00:46:21,760
caused more change in the climate than

1266
00:46:27,109 --> 00:46:23,440
all the volcanoes

1267
00:46:31,030 --> 00:46:27,119
fires storms and weather of the past 100

1268
00:46:35,270 --> 00:46:33,270
i think the answer to that is is

1269
00:46:38,230 --> 00:46:35,280
certainly no if you look at some of the

1270
00:46:39,589 --> 00:46:38,240
very very largest volcanic eruptions for

1271
00:46:42,309 --> 00:46:39,599
example

1272
00:46:44,790 --> 00:46:42,319
but i'm not quite sure how valuable it

1273
00:46:47,910 --> 00:46:44,800
is to know that uh that answer you know

1274
00:46:50,069 --> 00:46:47,920
there were ice ages and it was a hugely

1275
00:46:51,750 --> 00:46:50,079
different planet right ice sheets came

1276
00:46:54,390 --> 00:46:51,760
all the way down over northern north

1277
00:46:57,030 --> 00:46:54,400
america covered almost all of canada all

1278
00:46:59,109 --> 00:46:57,040
the way down into the us that's a vastly

1279
00:47:01,109 --> 00:46:59,119
different world but just because it can

1280
00:47:02,870 --> 00:47:01,119
naturally happen doesn't mean it

1281
00:47:05,109 --> 00:47:02,880
wouldn't cause a lot of

1282
00:47:08,390 --> 00:47:05,119
hardship obviously if suddenly you know

1283
00:47:11,750 --> 00:47:08,400
new york was under a couple miles of ice

1284
00:47:14,870 --> 00:47:11,760
that's a pretty big big deal so

1285
00:47:17,349 --> 00:47:14,880
just because natural changes can happen

1286
00:47:19,510 --> 00:47:17,359
uh it doesn't mean that they're

1287
00:47:21,510 --> 00:47:19,520
not necessarily something that we want

1288
00:47:24,230 --> 00:47:21,520

to have happen on our planet now now

1289
00:47:26,630 --> 00:47:24,240
that we have a whole bunch of systems of

1290
00:47:28,390 --> 00:47:26,640
civilization that are all designed for

1291
00:47:30,230 --> 00:47:28,400
the current climate where we've had a

1292
00:47:32,870 --> 00:47:30,240
remarkably stable climate for the last

1293
00:47:34,630 --> 00:47:32,880
10 000 years or so we are adjusted to

1294
00:47:36,710 --> 00:47:34,640
that and so even if there are large

1295
00:47:38,630 --> 00:47:36,720
changes if one occurred naturally if

1296
00:47:41,190 --> 00:47:38,640
there was an enormous volcanic eruption

1297
00:47:44,710 --> 00:47:41,200
tomorrow that would still be a disaster

1298
00:47:48,470 --> 00:47:47,670
or a meteor impact

1299
00:47:50,790 --> 00:47:48,480
true

1300
00:47:52,630 --> 00:47:50,800
also possible so

1301
00:47:54,470 --> 00:47:52,640
with a few minutes then eric maybe we'll

1302
00:47:55,510 --> 00:47:54,480
we'll start with you and and go around

1303
00:47:57,589 --> 00:47:55,520
uh

1304
00:47:59,750 --> 00:47:57,599
just just wonder what your sort of

1305
00:48:02,150 --> 00:47:59,760
biggest biggest takeaway point that you

1306
00:48:04,069 --> 00:48:02,160
would want to to tell people about

1307
00:48:05,589 --> 00:48:04,079
um from this report and the sort of

1308
00:48:06,390 --> 00:48:05,599
current state of

1309
00:48:07,670 --> 00:48:06,400
of

1310
00:48:09,349 --> 00:48:07,680
you know studying the earth's polar

1311
00:48:10,309 --> 00:48:09,359
regions

1312
00:48:12,550 --> 00:48:10,319
uh

1313
00:48:14,630 --> 00:48:12,560

follow on a little bit on what drew said

1314
00:48:17,030 --> 00:48:14,640
i think one one of the remarkable

1315
00:48:19,030 --> 00:48:17,040
achievement of the ipcc report remodels

1316
00:48:21,109 --> 00:48:19,040
has been to show that

1317
00:48:24,069 --> 00:48:21,119
you cannot even explain the recent

1318
00:48:26,470 --> 00:48:24,079
record of earth temperature ocean

1319
00:48:27,589 --> 00:48:26,480
temperature without involving human

1320
00:48:28,309 --> 00:48:27,599
impact

1321
00:48:29,990 --> 00:48:28,319
so

1322
00:48:32,150 --> 00:48:30,000
even though it's true that

1323
00:48:34,069 --> 00:48:32,160
natural variability can be much bigger

1324
00:48:35,990 --> 00:48:34,079
than what

1325
00:48:38,710 --> 00:48:36,000
human society has inflicted on the

1326
00:48:40,309 --> 00:48:38,720
climate system the changes caused by

1327
00:48:42,870 --> 00:48:40,319
humans

1328
00:48:45,589 --> 00:48:42,880
on the earth system are large enough

1329
00:48:47,430 --> 00:48:45,599
today that we can clearly separate them

1330
00:48:49,190 --> 00:48:47,440
from natural variability

1331
00:48:51,109 --> 00:48:49,200
there's no doubt

1332
00:48:52,790 --> 00:48:51,119
uh in the scientific community about

1333
00:48:58,390 --> 00:48:52,800
that

1334
00:48:59,750 --> 00:48:58,400
if the confidence level was 95 percent

1335
00:49:01,349 --> 00:48:59,760
that didn't seem

1336
00:49:03,910 --> 00:49:01,359
high enough

1337
00:49:06,390 --> 00:49:03,920
for some of us to believe like

1338
00:49:08,790 --> 00:49:06,400

there was an analogy to

1339
00:49:11,030 --> 00:49:08,800
someone boarding a plane in an airport

1340
00:49:13,430 --> 00:49:11,040
and the pilot would tell them we have 95

1341
00:49:16,790 --> 00:49:13,440
chance of landing at destination you

1342
00:49:18,790 --> 00:49:16,800
probably would not go on that plane but

1343
00:49:21,589 --> 00:49:18,800
for scientists

1344
00:49:24,069 --> 00:49:21,599
95 confidence is

1345
00:49:27,349 --> 00:49:24,079
it's just as good as it ever gets that's

1346
00:49:30,470 --> 00:49:27,359
uh that's a golden standard

1347
00:49:33,109 --> 00:49:30,480
of confidence in science and that's a

1348
00:49:35,589 --> 00:49:33,119
remarkable achievement of of these

1349
00:49:37,510 --> 00:49:35,599
models and all these measurements

1350
00:49:39,430 --> 00:49:37,520
um eric let me let me stop you right

1351
00:49:40,870 --> 00:49:39,440
there we've got about just a few minutes

1352
00:49:42,790 --> 00:49:40,880
left

1353
00:49:44,630 --> 00:49:42,800
that was a good point

1354
00:49:46,549 --> 00:49:44,640
ralph let me get a quick closing thought

1355
00:49:48,390 --> 00:49:46,559
from you and then and then bruce since

1356
00:49:49,510 --> 00:49:48,400
we just heard from drew and and we'll

1357
00:49:51,510 --> 00:49:49,520
wrap up

1358
00:49:54,950 --> 00:49:51,520
sure well i think the single biggest

1359
00:49:57,430 --> 00:49:54,960
factor in the future of climate

1360
00:49:59,910 --> 00:49:57,440
in our system here on our earth

1361
00:50:01,510 --> 00:49:59,920
is the choices we'll make

1362
00:50:02,950 --> 00:50:01,520
and i think that would be the single

1363
00:50:04,230 --> 00:50:02,960

point the choices we'll make as a

1364
00:50:06,630 --> 00:50:04,240
civilization

1365
00:50:10,470 --> 00:50:06,640
about burning fossil fuels

1366
00:50:11,670 --> 00:50:10,480
and consuming in various ways

1367
00:50:13,270 --> 00:50:11,680
okay

1368
00:50:15,670 --> 00:50:13,280
great bruce

1369
00:50:18,150 --> 00:50:15,680
yeah i think uh as you look at this ipcc

1370
00:50:21,030 --> 00:50:18,160
report in the last few it's very clear

1371
00:50:23,030 --> 00:50:21,040
now that uh with high confidence that

1372
00:50:25,109 --> 00:50:23,040
basically mankind is running the climate

1373
00:50:26,950 --> 00:50:25,119
system now it's not really being run by

1374
00:50:29,030 --> 00:50:26,960
net by the natural system we are

1375
00:50:30,309 --> 00:50:29,040
dominating it now and we're going to be

1376
00:50:31,670 --> 00:50:30,319
running it as long as we're on the

1377
00:50:33,270 --> 00:50:31,680
planet so

1378
00:50:35,990 --> 00:50:33,280
we have to get better at understanding

1379
00:50:38,309 --> 00:50:36,000
the science we have to get better at

1380
00:50:40,790 --> 00:50:38,319
understanding how to manage uh

1381
00:50:42,309 --> 00:50:40,800
responsibly the earth's climb system is

1382
00:50:44,470 --> 00:50:42,319
part of the environment

1383
00:50:46,309 --> 00:50:44,480
and not just sort of wait to see what

1384
00:50:48,150 --> 00:50:46,319
happens we know

1385
00:50:50,069 --> 00:50:48,160
that the changes we're making are going

1386
00:50:53,190 --> 00:50:50,079
to last for hundreds of thousands of

1387
00:50:55,430 --> 00:50:53,200
years and we could be basically

1388
00:50:57,670 --> 00:50:55,440

setting up civilization for challenges

1389
00:50:59,270 --> 00:50:57,680
100 or 200 years from now that

1390
00:51:00,470 --> 00:50:59,280
you'd have a hard time even conceiving

1391
00:51:03,430 --> 00:51:00,480
of today

1392
00:51:06,790 --> 00:51:03,440
to even think about them

1393
00:51:08,710 --> 00:51:06,800
okay great well i want to thank everyone

1394
00:51:10,150 --> 00:51:08,720
out there for watching today and i want

1395
00:51:12,790 --> 00:51:10,160
to go through and thank our panelists

1396
00:51:15,109 --> 00:51:12,800
again eric regneau at uc irvine and the

1397
00:51:17,030 --> 00:51:15,119
jet propulsion lab ralph khan at goddard

1398
00:51:19,349 --> 00:51:17,040
space flight center drew shindel at the

1399
00:51:21,349 --> 00:51:19,359
goddard institute for space studies and

1400
00:51:23,430 --> 00:51:21,359
bruce wilkie at nasa's langley research

1401
00:51:25,190 --> 00:51:23,440
center thanks again for taking part

1402
00:51:28,150 --> 00:51:25,200
and telling us

1403
00:51:29,670 --> 00:51:28,160
your thoughts on on the new ipcc report

1404
00:51:32,069 --> 00:51:29,680
and everyone watching if you want to

1405
00:51:34,470 --> 00:51:32,079
continue to post your questions online

1406
00:51:36,630 --> 00:51:34,480
using the hashtag askclimate

1407
00:51:38,790 --> 00:51:36,640
we'll see how many of them we can get to