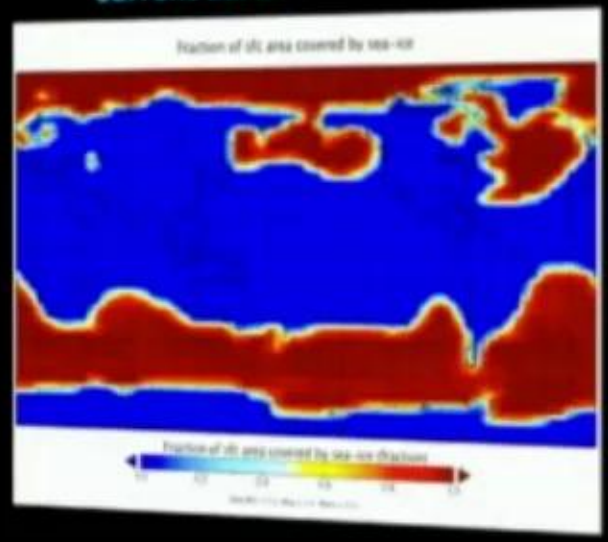
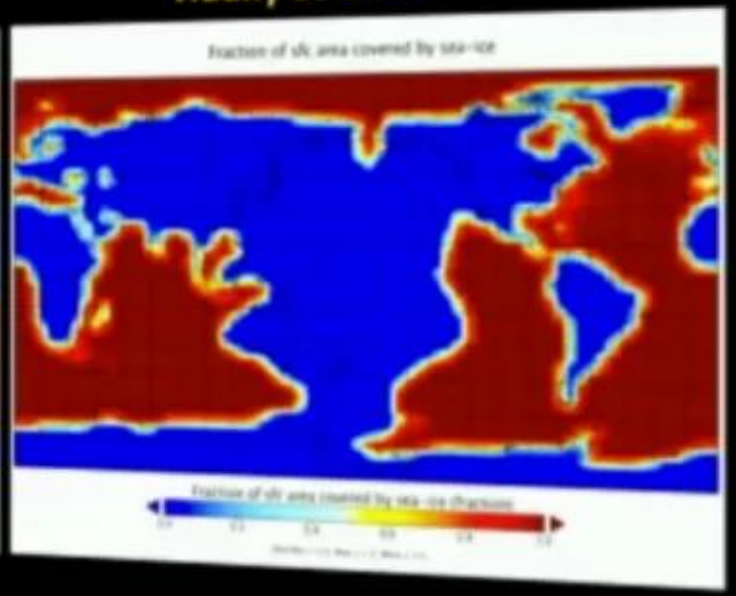
Results: Liquid Water (Ice Cover)

Current Earth



Tidally Locked



1
00:00:10,400 --> 00:00:08,210
I work at the laboratory for atmospheric

2
00:00:11,839 --> 00:00:10,410
and space physics I am in a part of the

3
00:00:13,940 --> 00:00:11,849
atmospheric and oceanic to Sciences

4
00:00:15,440 --> 00:00:13,950
Department at this university and have

5
00:00:17,720 --> 00:00:15,450
the privilege of opening up this talk on

6
00:00:19,550 --> 00:00:17,730
how astrobiology pertains to exoplanets

7
00:00:20,960 --> 00:00:19,560
and so what I've been doing for my

8
00:00:22,939 --> 00:00:20,970
project for the past several months and

9
00:00:25,370 --> 00:00:22,949
what I hope to continue to do is to take

10
00:00:26,990 --> 00:00:25,380
a look at the fairly common types of

11
00:00:29,810 --> 00:00:27,000
planets that we observe in the galaxy or

12
00:00:31,370 --> 00:00:29,820
that we think we observe and to assess

13
00:00:33,229 --> 00:00:31,380

how they might be habitable and under

14
00:00:35,000 --> 00:00:33,239
what conditions that might be true so

15
00:00:37,130 --> 00:00:35,010
I've been doing is I've been assessing

16
00:00:39,740 --> 00:00:37,140
the habitability of tidally locked

17
00:00:42,229 --> 00:00:39,750
earth-like exoplanets around m-type

18
00:00:44,030 --> 00:00:42,239
stars and as those are a lot of words

19
00:00:46,100 --> 00:00:44,040
I'm going to explain it more in depth

20
00:00:49,400 --> 00:00:46,110
what those mean and why we're interested

21
00:00:51,410 --> 00:00:49,410
in them so first you might ask what is a

22
00:00:53,959 --> 00:00:51,420
tidally locked planet I'm still glad you

23
00:00:56,150 --> 00:00:53,969
did as explained by this excellent

24
00:00:57,529 --> 00:00:56,160
diagram right here at ideologue planet

25
00:00:59,720 --> 00:00:57,539
is a planet that always has the same

26
00:01:01,760 --> 00:00:59,730
side facing its star so a great example

27
00:01:03,260 --> 00:01:01,770
of this is Earth's moon we always see

28
00:01:05,240 --> 00:01:03,270
the same side of the moon and it was

29
00:01:06,469 --> 00:01:05,250
until we sent astronauts up that we got

30
00:01:08,420 --> 00:01:06,479
a look at the dark side of the moon and

31
00:01:10,370 --> 00:01:08,430
why are we interested in this type of

32
00:01:12,560 --> 00:01:10,380
planet we're just in this type of planet

33
00:01:15,230 --> 00:01:12,570
because according to certain surveys

34
00:01:17,120 --> 00:01:15,240
some more some less title of planets may

35
00:01:18,380 --> 00:01:17,130
make up for about half of the planets we

36
00:01:20,330 --> 00:01:18,390
observe out there so some of those

37
00:01:21,950 --> 00:01:20,340
planets perhaps half those plants maybe

38
00:01:23,630 --> 00:01:21,960

more maybe less might not actually be

39
00:01:25,609 --> 00:01:23,640
rotating and a lot of studies have been

40
00:01:28,700 --> 00:01:25,619
done concerning how habitability

41
00:01:30,230 --> 00:01:28,710
pertains to earth-like planets rotate so

42
00:01:32,240 --> 00:01:30,240
we're going to expand our knowledge of

43
00:01:33,640 --> 00:01:32,250
what type of plans might be habitable we

44
00:01:37,069 --> 00:01:33,650
need to take a look at these planets

45
00:01:39,050 --> 00:01:37,079
secondly an M star so for the non

46
00:01:40,460 --> 00:01:39,060
astronomers in the room an M star is a

47
00:01:42,289 --> 00:01:40,470
main sequence star that's the most

48
00:01:44,719 --> 00:01:42,299
common star in our galaxy it's slightly

49
00:01:46,490 --> 00:01:44,729
cooler than our Sun and because the fact

50
00:01:49,310 --> 00:01:46,500
that is highly abundant we need to know

51
00:01:51,080 --> 00:01:49,320
how this sort of start its radiation the

52
00:01:53,179 --> 00:01:51,090
planets that orbit it might affect the

53
00:01:55,010 --> 00:01:53,189
habitability of these planets so taken

54
00:01:57,410 --> 00:01:55,020
together at ideologues planet and M

55
00:01:59,840 --> 00:01:57,420
stars these types of planets are fairly

56
00:02:01,370 --> 00:01:59,850
common relative to others at least in

57
00:02:03,709 --> 00:02:01,380
terrestrial type planets in our galaxy

58
00:02:05,899 --> 00:02:03,719
and those are ideal candidates for

59
00:02:07,370 --> 00:02:05,909
studying habitability simply because

60
00:02:09,650 --> 00:02:07,380
they're fairly common and because a lot

61
00:02:11,260 --> 00:02:09,660
of studies pertaining give evidence that

62
00:02:14,140 --> 00:02:11,270
they might be common in general

63
00:02:15,550 --> 00:02:14,150

and earth-like so I'm sure many people

64
00:02:17,290 --> 00:02:15,560
in this room would agree that there are

65
00:02:18,790 --> 00:02:17,300
many ways a planet might become

66
00:02:21,400 --> 00:02:18,800
habitable and that is very interesting

67
00:02:22,930 --> 00:02:21,410
for our purposes however we're trying to

68
00:02:24,490 --> 00:02:22,940
determine how a planet might stay

69
00:02:26,650 --> 00:02:24,500
habitable in the long term so we're not

70
00:02:28,150 --> 00:02:26,660
going to theorize necessarily how a

71
00:02:29,680 --> 00:02:28,160
planet might become habitable but

72
00:02:31,390 --> 00:02:29,690
whether that have ability is maintained

73
00:02:33,460 --> 00:02:31,400
so we did for a product is we simply

74
00:02:35,680 --> 00:02:33,470
took earth as it is stuck at around an M

75
00:02:37,450 --> 00:02:35,690
star made it tidally locked and ran it

76
00:02:39,190 --> 00:02:37,460
and see what happens and when I say

77
00:02:41,890 --> 00:02:39,200
earth-like I simply mean the planet has

78
00:02:44,230 --> 00:02:41,900
Earth's atmosphere its mass its

79
00:02:47,050 --> 00:02:44,240
composition which include ocean and

80
00:02:48,460 --> 00:02:47,060
continental configuration and the solar

81
00:02:49,600 --> 00:02:48,470
constant the top of the atmosphere so

82
00:02:52,150 --> 00:02:49,610
the ax radiance receives its healthy

83
00:02:55,200 --> 00:02:52,160
atmosphere all right so how are we doing

84
00:02:58,570 --> 00:02:55,210
this to do this we've been using a very

85
00:03:00,310 --> 00:02:58,580
effective and very powerful GCM which

86
00:03:02,020 --> 00:03:00,320
stands for general circulation model

87
00:03:03,490 --> 00:03:02,030
called the community Earth's systems

88
00:03:05,470 --> 00:03:03,500

model which was developed here in

89
00:03:07,360 --> 00:03:05,480
boulder at the National Center for

90
00:03:08,980 --> 00:03:07,370
Atmospheric Research and car and what

91
00:03:10,960 --> 00:03:08,990
this model does it's it's a 3d model

92
00:03:13,900 --> 00:03:10,970
which couples the various processes you

93
00:03:16,060 --> 00:03:13,910
might find on a planet's surface so for

94
00:03:17,890 --> 00:03:16,070
instance it takes the atmospheric

95
00:03:20,199 --> 00:03:17,900
processes the oceanic processes the land

96
00:03:22,330 --> 00:03:20,209
sea ice land ice processes it analyzes

97
00:03:24,400 --> 00:03:22,340
their demand dynamics individually the

98
00:03:27,370 --> 00:03:24,410
radio transfer processes individually it

99
00:03:28,810 --> 00:03:27,380
couples them message them together and

100
00:03:29,800 --> 00:03:28,820
then after running the simulation for a

101
00:03:31,030 --> 00:03:29,810
certain amount of time you get a

102
00:03:33,130 --> 00:03:31,040
snapshot of what the plan is going to be

103
00:03:35,080 --> 00:03:33,140
like in a couple of years or several

104
00:03:36,460 --> 00:03:35,090
decades depending on the scale and for

105
00:03:39,310 --> 00:03:36,470
our specific purposes we're also looking

106
00:03:41,830 --> 00:03:39,320
at a very powerful component of this GCM

107
00:03:45,040 --> 00:03:41,840
which is the whole atmosphere community

108
00:03:46,540 --> 00:03:45,050
climate model abbreviated wacom and with

109
00:03:48,250 --> 00:03:46,550
this model does is it extends the

110
00:03:50,380 --> 00:03:48,260
atmosphere all the way up past 150

111
00:03:51,880 --> 00:03:50,390
kilometers and allows for complex

112
00:03:53,260 --> 00:03:51,890
interactions between the different

113
00:03:54,699 --> 00:03:53,270

layers of the atmosphere so it allows

114
00:03:56,949 --> 00:03:54,709
for communication for example between

115
00:03:59,020 --> 00:03:56,959
the mesosphere and the stratosphere it

116
00:04:00,610 --> 00:03:59,030
analyzes the chemical constituents of

117
00:04:02,440 --> 00:04:00,620
the app of the different amounts of the

118
00:04:04,720 --> 00:04:02,450
atmosphere the rating of transfer

119
00:04:06,730 --> 00:04:04,730
processes and we're very interested in

120
00:04:08,680 --> 00:04:06,740
that because we're looking into things

121
00:04:10,690 --> 00:04:08,690
like how the planet might be properly

122
00:04:13,150 --> 00:04:10,700
shielded from UV radiation how the

123
00:04:14,320 --> 00:04:13,160
planet might out what those chemicals

124
00:04:16,120 --> 00:04:14,330
might do to influence a plant's

125
00:04:18,010 --> 00:04:16,130
radiation budget so we want to know the

126
00:04:19,810 --> 00:04:18,020
very intricate and specific components

127
00:04:20,979 --> 00:04:19,820
of the different spheres and how that

128
00:04:22,240 --> 00:04:20,989
will contribute to planetary

129
00:04:24,300 --> 00:04:22,250
habitability and it's been very

130
00:04:26,100 --> 00:04:24,310
successful the only problem however is

131
00:04:28,860 --> 00:04:26,110
this is specifically geared to earth so

132
00:04:30,990 --> 00:04:28,870
it's a hell of a pain to adjust it for a

133
00:04:33,629 --> 00:04:31,000
different type of planet nevertheless

134
00:04:36,030 --> 00:04:33,639
this has been our plan thus far we have

135
00:04:38,760 --> 00:04:36,040
these GCS we have these powerful GCM CSM

136
00:04:41,750 --> 00:04:38,770
welcome and we start off with our basic

137
00:04:45,420 --> 00:04:41,760
simulation of a rotating earth around a

138
00:04:47,490 --> 00:04:45,430

around our Sun step one of the plan has

139
00:04:49,500 --> 00:04:47,500
been to make earth tidally locked so

140
00:04:51,659 --> 00:04:49,510
this simply involves just altering the

141
00:04:54,180 --> 00:04:51,669
code such that Earth's day is equal to

142
00:04:56,670 --> 00:04:54,190
Earth's here so we have the same side of

143
00:04:58,260 --> 00:04:56,680
the earth facing the Sun run that ensure

144
00:05:00,270 --> 00:04:58,270
it remains habitable and if that is

145
00:05:02,640 --> 00:05:00,280
successful we move on to step two which

146
00:05:03,840 --> 00:05:02,650
is to adjust the radiation spectrum

147
00:05:07,650 --> 00:05:03,850
received at the top of the atmosphere

148
00:05:09,390 --> 00:05:07,660
for an M star we move it closer to the

149
00:05:11,760 --> 00:05:09,400
planets such that it has the same solar

150
00:05:14,129 --> 00:05:11,770
constant at the for this particular

151
00:05:16,850 --> 00:05:14,139
planet and we ensure that its tidally

152
00:05:20,070 --> 00:05:16,860
locked and run it and see if it works

153
00:05:21,930 --> 00:05:20,080
and just to give you an idea of what

154
00:05:23,430 --> 00:05:21,940
changing the radiation special involved

155
00:05:24,810 --> 00:05:23,440
the more complicated stuff is I'm sure

156
00:05:26,580 --> 00:05:24,820
many of you are familiar with the plank

157
00:05:28,320 --> 00:05:26,590
function here you can see the solar

158
00:05:30,480 --> 00:05:28,330
spectrum of the earth that according to

159
00:05:31,950 --> 00:05:30,490
different wavelengths if we fit of plank

160
00:05:34,050 --> 00:05:31,960
function to the Sun that coincides

161
00:05:35,670 --> 00:05:34,060
exactly with those observations but with

162
00:05:38,219 --> 00:05:35,680
an M star we're looking at peak

163
00:05:39,630 --> 00:05:38,229

wavelengths at different we're peak

164
00:05:41,520 --> 00:05:39,640
radiances at different wavelengths and

165
00:05:45,320 --> 00:05:41,530
so that's a bit more on a complicated

166
00:05:48,240 --> 00:05:45,330
process alright so due to the

167
00:05:50,040 --> 00:05:48,250
complicated nature of this project we've

168
00:05:51,360 --> 00:05:50,050
only been able to do step one and I

169
00:05:55,110 --> 00:05:51,370
assure you we have very close to doing

170
00:05:56,490 --> 00:05:55,120
step two but not today so we've been

171
00:05:59,190 --> 00:05:56,500
able to do step one which is we've

172
00:06:01,140 --> 00:05:59,200
stimulated 80 years of a current earth

173
00:06:03,779 --> 00:06:01,150
so earth as it is and we've also

174
00:06:06,360 --> 00:06:03,789
simulated 80 years worth of a tidally

175
00:06:08,340 --> 00:06:06,370
locked earth and the planets very

176
00:06:10,890 --> 00:06:08,350
fortunately are in equilibrium where

177
00:06:13,140 --> 00:06:10,900
your chance for equilibrium and we're

178
00:06:14,430 --> 00:06:13,150
comparing them to make sure that current

179
00:06:16,680 --> 00:06:14,440
or that's habitable by God we hope

180
00:06:18,930 --> 00:06:16,690
that's true and that title locked earth

181
00:06:20,730 --> 00:06:18,940
will remain habitable to look for this

182
00:06:22,680 --> 00:06:20,740
what we're looking for specifically it's

183
00:06:24,240 --> 00:06:22,690
were looking for adequate ozone

184
00:06:25,950 --> 00:06:24,250
shielding so adequate shielding and

185
00:06:28,500 --> 00:06:25,960
harmful UV radiation that might destroy

186
00:06:30,900 --> 00:06:28,510
life before it can get off habitable

187
00:06:32,640 --> 00:06:30,910
temperatures such that you know the

188
00:06:34,770 --> 00:06:32,650

planet is comfortable to surface that

189
00:06:37,529 --> 00:06:34,780
life can exist and along with that is

190
00:06:38,129 --> 00:06:37,539
presence of liquid water so we have

191
00:06:40,679 --> 00:06:38,139
results

192
00:06:42,119 --> 00:06:40,689
our first result ozone distribution so

193
00:06:44,459 --> 00:06:42,129
what you're looking at here on the left

194
00:06:46,920 --> 00:06:44,469
is current earth ozone distribution

195
00:06:49,469 --> 00:06:46,930
you're seeing a longitudinally averaged

196
00:06:52,529 --> 00:06:49,479
column ozone as a function of pressure

197
00:06:54,300 --> 00:06:52,539
ie altitude and latitude on the planet

198
00:06:55,830 --> 00:06:54,310
and on the right you're seeing the same

199
00:06:58,260 --> 00:06:55,840
thing for a tell you logged earth except

200
00:07:00,719 --> 00:06:58,270
I will point out that for current earth

201
00:07:02,850 --> 00:07:00,729
this is snapshot as the same regardless

202
00:07:04,350 --> 00:07:02,860
of which lon longitude specifically

203
00:07:06,719 --> 00:07:04,360
you're looking at how to lock earth

204
00:07:08,429 --> 00:07:06,729
however it's very different from the day

205
00:07:10,230 --> 00:07:08,439
and night side we're very interested in

206
00:07:11,580 --> 00:07:10,240
the Sun and the day side however because

207
00:07:14,309 --> 00:07:11,590
that's the portion that needs to be

208
00:07:16,950 --> 00:07:14,319
shielded from the Sun so when ruling at

209
00:07:17,909 --> 00:07:16,960
ozone concentration and on earth most of

210
00:07:19,860 --> 00:07:17,919
our ozone is concentrate in the

211
00:07:23,249 --> 00:07:19,870
stratosphere and that can reach up to 10

212
00:07:24,689 --> 00:07:23,259
parts per million so fortunately we were

213
00:07:26,790 --> 00:07:24,699

able to simulate this for current earth

214
00:07:28,890 --> 00:07:26,800
we have up to 10 parts per million in

215
00:07:30,719 --> 00:07:28,900
the stratosphere and it looks like those

216
00:07:33,899 --> 00:07:30,729
concentrations are there that's what we

217
00:07:35,279 --> 00:07:33,909
observe normally with actual with actual

218
00:07:37,950 --> 00:07:35,289
missions up to this types of

219
00:07:40,170 --> 00:07:37,960
stratosphere and fortunately using the

220
00:07:42,119 --> 00:07:40,180
same scale we see we have the same ozone

221
00:07:43,920 --> 00:07:42,129
concentration on art ideologue planet so

222
00:07:45,659 --> 00:07:43,930
it's very reasonable to conclude that

223
00:07:49,619 --> 00:07:45,669
this planet is adequately shielded from

224
00:07:51,480 --> 00:07:49,629
UV radiation brilliant ok and also going

225
00:07:52,860 --> 00:07:51,490
along with that is in addition to ozone

226
00:07:54,149 --> 00:07:52,870
an extra protection from the Sun might

227
00:07:56,450 --> 00:07:54,159
be cloud cover so what you've seen here

228
00:07:59,040 --> 00:07:56,460
is you're seeing a map of the earth

229
00:08:01,290 --> 00:07:59,050
centered around the Prime Meridian in

230
00:08:03,059 --> 00:08:01,300
the Pacific Ocean and that's fairly

231
00:08:04,320 --> 00:08:03,069
typical cloud cover for Earth on tightly

232
00:08:05,879 --> 00:08:04,330
locked earth however all the clouds are

233
00:08:07,379 --> 00:08:05,889
concentrated over the subcellar region

234
00:08:09,029 --> 00:08:07,389
so right over where the Sun is so it's

235
00:08:10,079 --> 00:08:09,039
kind of cloudy where it is but

236
00:08:12,300 --> 00:08:10,089
nevertheless this is added protection

237
00:08:14,939 --> 00:08:12,310
against advert action against any

238
00:08:16,589 --> 00:08:14,949

additional radiation our second results

239
00:08:18,209 --> 00:08:16,599
temperature so again what you're seeing

240
00:08:19,980 --> 00:08:18,219
is you're seeing a slice of the

241
00:08:24,209 --> 00:08:19,990
atmosphere from monsey student

242
00:08:26,700 --> 00:08:24,219
marginally averaged slices across the

243
00:08:28,019 --> 00:08:26,710
across the planet and fortunately the

244
00:08:29,579 --> 00:08:28,029
two planets seem to have very similar

245
00:08:32,550 --> 00:08:29,589
temperatures structures of the

246
00:08:34,170 --> 00:08:32,560
atmosphere key importance is the

247
00:08:35,339 --> 00:08:34,180
temperature on the surface of the earth

248
00:08:37,110 --> 00:08:35,349
so we're looking at comfortable

249
00:08:40,439 --> 00:08:37,120
temperatures above freezing above 273

250
00:08:42,089 --> 00:08:40,449
Kelvin but not you know 500 fortunately

251
00:08:43,620 --> 00:08:42,099
on the surface of our current earth

252
00:08:45,660 --> 00:08:43,630
that's what we observe especially around

253
00:08:47,309 --> 00:08:45,670
the equatorial regions and on our

254
00:08:48,930 --> 00:08:47,319
dialogues planet again that's what we

255
00:08:50,670 --> 00:08:48,940
observe so it's excellent so we get to

256
00:08:51,390 --> 00:08:50,680
see that much how I left Earth is in

257
00:08:53,580 --> 00:08:51,400
fact comfortable

258
00:08:55,710 --> 00:08:53,590
above the substellar region at least

259
00:08:58,590 --> 00:08:55,720
this is not true for the entire planet

260
00:09:01,080 --> 00:08:58,600
what you're seeing here for current

261
00:09:03,420 --> 00:09:01,090
earth is that you know the temperature

262
00:09:05,610 --> 00:09:03,430
across the equatorial regions all the

263
00:09:07,260 --> 00:09:05,620

way up to all the way up to the sub

264
00:09:08,850 --> 00:09:07,270
polar regions is fairly comfortable a

265
00:09:11,010 --> 00:09:08,860
jolly old time in any of the continents

266
00:09:12,810 --> 00:09:11,020
but on the target locked planet this

267
00:09:15,000 --> 00:09:12,820
comfortable temperature is only true

268
00:09:17,220 --> 00:09:15,010
over the subsolar region so the entire

269
00:09:18,630 --> 00:09:17,230
planet the entire planet is not

270
00:09:19,880 --> 00:09:18,640
necessarily habitable some of the

271
00:09:22,530 --> 00:09:19,890
contents might be covered in glaciers

272
00:09:24,210 --> 00:09:22,540
but at least it is habitable for

273
00:09:25,560 --> 00:09:24,220
specific regions which is so important

274
00:09:27,600 --> 00:09:25,570
so the planet in general is still

275
00:09:30,590 --> 00:09:27,610
habitable regarding temperature and

276
00:09:32,760 --> 00:09:30,600
finally liquid water content as I said a

277
00:09:34,980 --> 00:09:32,770
lot of the planet might be covered in

278
00:09:36,570 --> 00:09:34,990
glaciers I will a bit for current rate

279
00:09:37,800 --> 00:09:36,580
simulations it's a little bit colder

280
00:09:39,480 --> 00:09:37,810
earth might be going in a bit of an ice

281
00:09:41,700 --> 00:09:39,490
age right now but earth is still

282
00:09:43,860 --> 00:09:41,710
habitable we have liquid water present

283
00:09:45,810 --> 00:09:43,870
especially about the equatorial regions

284
00:09:49,950 --> 00:09:45,820
and a tidy locks planet it's right above

285
00:09:52,860 --> 00:09:49,960
the subcellar region and this is a map

286
00:09:55,080 --> 00:09:52,870
concerning ice cover as well so it's the

287
00:09:56,670 --> 00:09:55,090
plan it's not dry it is in fact where

288
00:09:59,100 --> 00:09:56,680

there's not liquid water here it's

289
00:10:00,900 --> 00:09:59,110
covered by ice so liquid water is still

290
00:10:01,920 --> 00:10:00,910
there at what water so there's just not

291
00:10:05,250 --> 00:10:01,930
a ser liquid throughout the entire

292
00:10:07,020 --> 00:10:05,260
planet alright so I'm not very short

293
00:10:09,600 --> 00:10:07,030
presentation what we've been able to

294
00:10:11,760 --> 00:10:09,610
conclude is that we have verified step

295
00:10:13,740 --> 00:10:11,770
one that earth that's how do a locked is

296
00:10:16,110 --> 00:10:13,750
not necessarily perfect but it does

297
00:10:18,240 --> 00:10:16,120
remain habitable on this because it does

298
00:10:19,980 --> 00:10:18,250
have that adequate UV shielding from

299
00:10:21,360 --> 00:10:19,990
ozone concentration that i mentioned

300
00:10:24,960 --> 00:10:21,370
habitable temperatures on its surface

301
00:10:27,000 --> 00:10:24,970
and it does have liquid water so I'm no

302
00:10:29,820 --> 00:10:27,010
biologist but I will say that those are

303
00:10:31,710 --> 00:10:29,830
pretty pretty good components for having

304
00:10:34,110 --> 00:10:31,720
life on the surface of the planet the

305
00:10:38,340 --> 00:10:34,120
next step will be to put it around an M

306
00:10:40,290 --> 00:10:38,350
star and see where that takes us so I

307
00:10:42,560 --> 00:10:40,300
did it end early so I can take a couple

308
00:10:57,820 --> 00:10:42,570
of questions thank you very much

309
00:11:01,430 --> 00:10:57,830
Oh God okay uh Jay uh yeah great talk um

310
00:11:03,920 --> 00:11:01,440
you pointed out uh rather you were

311
00:11:05,870 --> 00:11:03,930
tidally locked over an ocean do you get

312
00:11:08,930 --> 00:11:05,880
any changes if you tidally lock over one

313
00:11:10,670 --> 00:11:08,940

of the continents that is that is a

314
00:11:12,410 --> 00:11:10,680
brilliant question and I would love to

315
00:11:14,540 --> 00:11:12,420
give you an answer we just haven't done

316
00:11:16,730 --> 00:11:14,550
it with the subsolar region over the

317
00:11:17,900 --> 00:11:16,740
continents yet so it's it's on the way

318
00:11:26,180 --> 00:11:17,910
but I wish I'd give you a better answer

319
00:11:29,900 --> 00:11:26,190
okay I haven't been to the side of the

320
00:11:31,430 --> 00:11:29,910
room yet sorry hi so my question is is

321
00:11:33,650 --> 00:11:31,440
this is the Earth's atmosphere as it is

322
00:11:37,490 --> 00:11:33,660
now so the Earth's atmosphere has not

323
00:11:40,040 --> 00:11:37,500
been the same over its lifetime so that

324
00:11:41,840 --> 00:11:40,050
does this can it with this code can you

325
00:11:44,210 --> 00:11:41,850
change the composition of the Earth's

326
00:11:45,830 --> 00:11:44,220
atmosphere and see if you had if you

327
00:11:47,090 --> 00:11:45,840
cranked up the carbon what you would

328
00:11:49,100 --> 00:11:47,100
look like and then track that through

329
00:11:50,840 --> 00:11:49,110
time we certainly can there are many

330
00:11:54,050 --> 00:11:50,850
different components to this model CSM

331
00:11:57,200 --> 00:11:54,060
has has various compiler called comcept

332
00:11:59,810 --> 00:11:57,210
component sets spanning pre-industrial

333
00:12:03,050 --> 00:11:59,820
revolution atmospheres modern-day

334
00:12:05,090 --> 00:12:03,060
atmospheres we just chose our current

335
00:12:08,600 --> 00:12:05,100
atmosphere because we had no reason not

336
00:12:10,790 --> 00:12:08,610
to it's if the atmosphere does evolve

337
00:12:16,340 --> 00:12:10,800
that's absolutely true it just so

338
00:12:18,410 --> 00:12:16,350

happened to start with this is a great

339
00:12:21,200 --> 00:12:18,420
talk could you mind please going back to

340
00:12:23,930 --> 00:12:21,210
your temperature at that one let's order

341
00:12:29,360 --> 00:12:23,940
this one act one more please heckle that

342
00:12:31,330 --> 00:12:29,370
one okay there you go all right so it

343
00:12:35,630 --> 00:12:31,340
looks like you're under estimating the

344
00:12:36,710 --> 00:12:35,640
fraction of ocean liquid can you tell me

345
00:12:38,690 --> 00:12:36,720
a little bit more about this is you sort

346
00:12:40,070 --> 00:12:38,700
went through this quickly yes I did so

347
00:12:42,560 --> 00:12:40,080
what you're seeing here is you're seeing

348
00:12:44,360 --> 00:12:42,570
a map of Earth centered around the Prime

349
00:12:49,730 --> 00:12:44,370
Meridian so around the Pacific Ocean the

350
00:12:53,510 --> 00:12:49,740
red is well fraction out of one of the

351
00:12:56,510 --> 00:12:53,520
surface covered by ocean and the blue is

352
00:12:59,060 --> 00:12:56,520
not but as I demonstrate it from this

353
00:13:00,740 --> 00:12:59,070
other for the subsequent plot is that

354
00:13:02,360 --> 00:13:00,750
it's not necessarily dry it's just

355
00:13:04,880 --> 00:13:02,370
covered by a glacier the model treats

356
00:13:06,620 --> 00:13:04,890
glacier and land to be the same okay so

357
00:13:08,510 --> 00:13:06,630
you say glacier with it so that's pack

358
00:13:10,700 --> 00:13:08,520
ice effectively is that how you would

359
00:13:12,170 --> 00:13:10,710
interpret that for modern is that

360
00:13:14,750 --> 00:13:12,180
basically am I looking at pack ice and

361
00:13:16,220 --> 00:13:14,760
read for the modern ocean okay so your

362
00:13:19,760 --> 00:13:16,230
model actually effectively way

363
00:13:21,560 --> 00:13:19,770

underestimates the the heat capacity of

364
00:13:23,930 --> 00:13:21,570
the ocean or how the ocean atmosphere is

365
00:13:25,970 --> 00:13:23,940
reacting right so yes this is this is

366
00:13:28,670 --> 00:13:25,980
obviously not Turner no I understand but

367
00:13:30,020 --> 00:13:28,680
I'm so I'm wondering sort of that

368
00:13:31,790 --> 00:13:30,030
underestimation then gets transferred

369
00:13:36,290 --> 00:13:31,800
over to your scenario for the tightly

370
00:13:39,110 --> 00:13:36,300
locked earth in addition do you take

371
00:13:42,290 --> 00:13:39,120
into account heat transport latent heat

372
00:13:44,630 --> 00:13:42,300
transport by clouds um the model should

373
00:13:46,400 --> 00:13:44,640
I will say however that a possibility

374
00:13:48,470 --> 00:13:46,410
one of the possibilities as to why this

375
00:13:50,720 --> 00:13:48,480
is true is it treats the ocean as a slab

376
00:13:53,030 --> 00:13:50,730
it does not treat it does not treat deep

377
00:13:54,710 --> 00:13:53,040
ocean dynamics and that would be a very

378
00:13:56,750 --> 00:13:54,720
helpful step is just more

379
00:13:59,270 --> 00:13:56,760
computationally expensive so since we

380
00:14:01,460 --> 00:13:59,280
did not put ocean the ocean as we and

381
00:14:05,290 --> 00:14:01,470
this land and sea ice cover as we expect

382
00:14:12,020 --> 00:14:09,950
hi um so when something becomes tidally

383
00:14:14,240 --> 00:14:12,030
locked do you consider what happens to

384
00:14:16,220 --> 00:14:14,250
the magnetic field that it's generating

385
00:14:18,230 --> 00:14:16,230
and if so do you account for like the

386
00:14:21,950 --> 00:14:18,240
increased amount of flux that it's going

387
00:14:24,740 --> 00:14:21,960
to receive from the star from the wind

388
00:14:27,740 --> 00:14:24,750

we did not take that into consideration

389
00:14:30,560 --> 00:14:27,750
I have no idea how am I going to feel

390
00:14:37,100 --> 00:14:30,570
will be affected we have time for one

391
00:14:39,110 --> 00:14:37,110
more quick so back to the idea and

392
00:14:41,540 --> 00:14:39,120
dwarfs um they're more active than

393
00:14:44,450 --> 00:14:41,550
solar-type stars so with those title ox

394
00:14:48,860 --> 00:14:44,460
planets in the place where the house you

395
00:14:50,750 --> 00:14:48,870
radiation might make a difference yes so

396
00:14:52,820 --> 00:14:50,760
they will be closer to their host star

397
00:14:54,320 --> 00:14:52,830
to consider if we're going to keep these

398
00:14:57,380 --> 00:14:54,330
rating to the top of the atmosphere

399
00:14:59,660 --> 00:14:57,390
constant and yes they are more active

400
00:15:02,480 --> 00:14:59,670
there are a couple of papers out there

401
00:15:04,190 --> 00:15:02,490
that have analyzed solar flares and

402
00:15:10,010 --> 00:15:04,200
their effects and habitability the

403
00:15:12,920 --> 00:15:10,020
latest one I read by I think involved

404
00:15:15,740 --> 00:15:12,930
Orion Abbott he he and his group did

405
00:15:19,310 --> 00:15:15,750
show that it was not as catastrophic as

406
00:15:21,920 --> 00:15:19,320
a so affair from our Sun might be but

407
00:15:24,050 --> 00:15:21,930
that was specifically pertaining to UV

408
00:15:26,810 --> 00:15:24,060
shielding so they looked at how it

409
00:15:28,910 --> 00:15:26,820
affect ozone cover and it only reduced

410
00:15:31,670 --> 00:15:28,920
it i think by 2 percent i was wondering

411
00:15:32,930 --> 00:15:31,680
for tailgate lock planets in my you

412
00:15:35,420 --> 00:15:32,940
might be able to push the habitable zone

413
00:15:37,610 --> 00:15:35,430

further out there for the irradiation

414
00:15:41,180 --> 00:15:37,620
might not be as important this just a

415
00:15:44,300 --> 00:15:41,190
lot oh I would have to investigate