SIMULATIONS OF MOIST CONVECTION ON TIDALLY-LOCKED ROCKY EXOPLANETS

DENIS SERGEEV

1
00:00:09,699 --> 00:00:06,660
[Music]

2
00:00:11,650 --> 00:00:09,709
laura1 thank you for giving me the

3
00:00:15,160 --> 00:00:11,660
opportunity to present at this great

4
00:00:19,359 --> 00:00:15,170
conference so I work on the simulations

5
00:00:21,910 --> 00:00:19,369
of moist convection on rocky travelogue

6
00:00:25,179 --> 00:00:21,920
planets and this is work I've been doing

7
00:00:28,359 --> 00:00:25,189
with Google on roads and next man at the

8
00:00:31,359 --> 00:00:28,369
University and also in vertol at the UK

9
00:00:34,900 --> 00:00:31,369
Met Office so today I'm gonna remind you

10
00:00:37,540 --> 00:00:34,910
what the circulation looks like on a

11
00:00:42,069 --> 00:00:37,550
title locked rocky exoplanets I'm going

12
00:00:44,260 --> 00:00:42,079
to show you some what how important the

13
00:00:48,369 --> 00:00:44,270

dayside convection is for the global

14
00:00:50,310 --> 00:00:48,379
climate of these planets I'll talk

15
00:00:52,990 --> 00:00:50,320
briefly about some challenges in

16
00:00:55,389 --> 00:00:53,000
modeling convection in terrestrial

17
00:00:58,420 --> 00:00:55,399
atmospheres and also show you some

18
00:01:00,810 --> 00:00:58,430
exciting results of convection resolving

19
00:01:04,180 --> 00:01:00,820
experience

20
00:01:07,440 --> 00:01:04,190
so what planets

21
00:01:12,550 --> 00:01:07,450
I've been looking so far these are

22
00:01:17,380 --> 00:01:12,560
well-known terrestrial exoplanets namely

23
00:01:21,520 --> 00:01:17,390
Trappist 1e and chakras 1f but also

24
00:01:27,120 --> 00:01:21,530
Proxima Centauri and as you can see from

25
00:01:28,949 --> 00:01:27,130
this table in terms of their orbital and

26
00:01:31,960 --> 00:01:28,959
[Music]

27
00:01:36,850 --> 00:01:31,970
size characteristics they're fairly

28
00:01:40,479 --> 00:01:36,860
close to each other but they do vary in

29
00:01:42,639 --> 00:01:40,489
terms of their rotation period and of

30
00:01:48,130 --> 00:01:42,649
course sharvani receives more radiation

31
00:01:53,589 --> 00:01:48,140
than epsilon F while Proxima B is quite

32
00:01:56,770 --> 00:01:53,599
close in this regard and so for this

33
00:01:58,540 --> 00:01:56,780
simulations I just assume for now and

34
00:02:02,080 --> 00:01:58,550
that's like atmosphere which is nitrogen

35
00:02:05,290 --> 00:02:02,090
dominated with water as main condensable

36
00:02:09,010 --> 00:02:05,300
species and I ran this as an a-cup liner

37
00:02:13,690 --> 00:02:09,020
simulation with a slab ocean at the

38
00:02:18,250 --> 00:02:13,700

bottom so imagine this rocky exoplanets

39
00:02:21,830 --> 00:02:18,260
orbiting an M dwarf we can imagine the

40
00:02:25,280 --> 00:02:21,840
represent the circulation on such a

41
00:02:27,140 --> 00:02:25,290
planet using a static so this is a

42
00:02:33,140 --> 00:02:27,150
vertical cross section along the equator

43
00:02:38,059 --> 00:02:33,150
on this planet and you have the solar

44
00:02:40,759 --> 00:02:38,069
radiation coming from its host star to

45
00:02:44,360 --> 00:02:40,769
the day side of the planet and then the

46
00:02:46,190 --> 00:02:44,370
cloud loses heat in a form of long wave

47
00:02:49,400 --> 00:02:46,200
radiation from both from day side and

48
00:02:51,050 --> 00:02:49,410
night side and the strong heating at the

49
00:02:54,259 --> 00:02:51,060
day side and the heating of the surface

50
00:02:59,470 --> 00:02:54,269
of the planet makes the atmosphere

51
00:03:01,940 --> 00:02:59,480
conductive the unstable and this gives

52
00:03:04,520 --> 00:03:01,950
this leads to the rising connection

53
00:03:08,390 --> 00:03:04,530
motions the day side and the formation

54
00:03:12,979 --> 00:03:08,400
of thick layer of clouds and this heat

55
00:03:16,640 --> 00:03:12,989
and moisture on sport eventually merges

56
00:03:21,259 --> 00:03:16,650
with the upper atmosphere equatorial jet

57
00:03:23,180 --> 00:03:21,269
and it's being transported to the night

58
00:03:26,210 --> 00:03:23,190
side of the planet and the in the

59
00:03:28,520 --> 00:03:26,220
absence of the dynamical auction this

60
00:03:32,030 --> 00:03:28,530
heat this Atma started heat transport is

61
00:03:36,470 --> 00:03:32,040
was the only source of energy for the

62
00:03:40,910 --> 00:03:36,480
night side and this is indeed what we

63
00:03:43,729 --> 00:03:40,920

see from a GCM output so this is a UK

64
00:03:48,740 --> 00:03:43,739
Met Office unified model output for

65
00:03:52,300 --> 00:03:48,750
Travis Ronnie you have the strong you

66
00:03:55,339 --> 00:03:52,310
have very one atmosphere at the surface

67
00:03:56,809 --> 00:03:55,349
on this in the on the day side of the

68
00:03:59,089 --> 00:03:56,819
planet

69
00:04:02,780 --> 00:03:59,099
that's zoom in where all the interesting

70
00:04:05,979 --> 00:04:02,790
stuff is happening then if you plot the

71
00:04:11,240 --> 00:04:05,989
wind vectors over its you you see the

72
00:04:15,670 --> 00:04:11,250
raising oceans and then the eastward jet

73
00:04:20,199 --> 00:04:15,680
and when we if you overlay that with the

74
00:04:22,820 --> 00:04:20,209
specific humidity contours you see how

75
00:04:24,680 --> 00:04:22,830
its concentrated on the day side where

76
00:04:27,380 --> 00:04:24,690
they all the vibration is happening and

77
00:04:31,190 --> 00:04:27,390
then if you rescale it to a photogenic

78
00:04:31,890 --> 00:04:31,200
scale you see that it eventually being

79
00:04:36,800 --> 00:04:31,900
transported to

80
00:04:40,640 --> 00:04:36,810
the night side as well as well as clouds

81
00:04:43,499 --> 00:04:40,650
so for a situation like that you can

82
00:04:45,390 --> 00:04:43,509
both size that convection should

83
00:04:49,499 --> 00:04:45,400
regulate the climate on the title locked

84
00:04:54,210 --> 00:04:49,509
planet and how can you attest this so we

85
00:04:59,779 --> 00:04:54,220
can run again this 3d GCM with different

86
00:05:03,420 --> 00:04:59,789
options for convection and so we can use

87
00:05:05,159 --> 00:05:03,430
sophisticated mass flux convection

88
00:05:08,879 --> 00:05:05,169

scheme which is used for weather in

89
00:05:10,050 --> 00:05:08,889
climate prediction on earth and I'm

90
00:05:12,060 --> 00:05:10,060
going to show I'm gonna call this

91
00:05:16,710 --> 00:05:12,070
experiments control and then we can use

92
00:05:19,520 --> 00:05:16,720
a simple moist adjustment scheme which

93
00:05:22,890 --> 00:05:19,530
I'm gonna call LCS for Lambert and Lewis

94
00:05:24,420 --> 00:05:22,900
connection scheme and then I can also

95
00:05:26,939 --> 00:05:24,430
switch off the convection scheme

96
00:05:32,460 --> 00:05:26,949
completely and then the let the model

97
00:05:34,370 --> 00:05:32,470
handle the convection itself without any

98
00:05:36,480 --> 00:05:34,380
help from the planet ization

99
00:05:40,050 --> 00:05:36,490
so in the next few slides I'm going to

100
00:05:43,320 --> 00:05:40,060
show you the view global maps of surface

101
00:05:46,290 --> 00:05:43,330
temperature for control simulation and

102
00:05:52,100 --> 00:05:46,300
also since TV runs both the Trappist 1e

103
00:05:58,290 --> 00:05:52,110
and Proxima B so starting with Trappist

104
00:06:01,350 --> 00:05:58,300
this is the global map of C search

105
00:06:03,810 --> 00:06:01,360
temperature just surface temperature and

106
00:06:07,260 --> 00:06:03,820
you see that's the of course the dayside

107
00:06:10,560 --> 00:06:07,270
is much much warmer than the night side

108
00:06:13,110 --> 00:06:10,570
and the difference is quite large and

109
00:06:16,409 --> 00:06:13,120
have this called traps on the night side

110
00:06:20,310 --> 00:06:16,419
where the Crosby dryers occur in the

111
00:06:22,770 --> 00:06:20,320
wind field for approximately in this

112
00:06:25,830 --> 00:06:22,780
conditions the situation is fairly

113
00:06:28,890 --> 00:06:25,840

similar and then when we run this

114
00:06:31,879 --> 00:06:28,900
simulation with a simple adjustment

115
00:06:35,159 --> 00:06:31,889
scheme instead of the mass flux scheme

116
00:06:37,890 --> 00:06:35,169
you see that it has quite a significant

117
00:06:41,750 --> 00:06:37,900
impact on the surface temperature of the

118
00:06:45,510 --> 00:06:41,760
planet so the night side especially

119
00:06:50,939 --> 00:06:45,520
warmed significantly by up to 40 degrees

120
00:06:53,999 --> 00:06:50,949
or the chocolate one case however then

121
00:06:57,839 --> 00:06:54,009
we can also run a similar sort of

122
00:07:00,960 --> 00:06:57,849
simulation but now switching off the

123
00:07:04,170 --> 00:07:00,970
convention scheme completely and this is

124
00:07:07,080 --> 00:07:04,180
the simulation result for epsilon team

125
00:07:09,689 --> 00:07:07,090
and it's a fairly similar picture you

126
00:07:11,999 --> 00:07:09,699
have the slight cooling of the dayside

127
00:07:15,390 --> 00:07:12,009
and warming on the night side however

128
00:07:18,960 --> 00:07:15,400
for approximate be the situation is

129
00:07:22,320 --> 00:07:18,970
almost reversed and you have the night

130
00:07:24,689 --> 00:07:22,330
side cooling quite significantly so for

131
00:07:28,710 --> 00:07:24,699
for this too quite similar cases you

132
00:07:31,110 --> 00:07:28,720
have opposite effects by just swapping a

133
00:07:35,100 --> 00:07:31,120
convection scheme to a simple one or

134
00:07:38,370 --> 00:07:35,110
switching off completely and this is so

135
00:07:40,020 --> 00:07:38,380
this is interesting and I'm still trying

136
00:07:43,980 --> 00:07:40,030
to wrap my head around while it happens

137
00:07:49,020 --> 00:07:43,990
but looking at the large-scale

138
00:07:54,209 --> 00:07:49,030

circulation so you see that so this is a

139
00:07:57,060 --> 00:07:54,219
horizontal wind speed shown by vectors

140
00:08:06,990 --> 00:07:57,070
and the magnitude of the wind is shown

141
00:08:07,900 --> 00:08:07,000
by colors and this is what so this is

142
00:08:28,450 --> 00:08:07,910
the

143
00:08:31,030 --> 00:08:28,460
approximately simulation doesn't change

144
00:08:35,370 --> 00:08:31,040
much and the magnitude of the wind stays

145
00:08:37,659 --> 00:08:35,380
fairly similar but for Travis Lonnie the

146
00:08:40,290 --> 00:08:37,669
large-scale circulation changes quite

147
00:08:43,990 --> 00:08:40,300
dramatically and you don't have this

148
00:08:45,780 --> 00:08:44,000
branches around the subsoil point and

149
00:08:51,580 --> 00:08:45,790
instead you have a very strong

150
00:08:54,910 --> 00:08:51,590
equatorial jet and the you can expect

151
00:08:57,160 --> 00:08:54,920
that because the wind increased wind

152
00:09:01,300 --> 00:08:57,170
speed increased at the Eastern

153
00:09:05,380 --> 00:09:01,310
Terminator and decreased at the Western

154
00:09:10,240 --> 00:09:05,390
Terminator the net moisture export from

155
00:09:14,410 --> 00:09:10,250
the dayside is larger so that this is is

156
00:09:17,940 --> 00:09:14,420
likely the the biggest G visitor to the

157
00:09:20,800 --> 00:09:17,950
change in the Nightside conditions while

158
00:09:23,050 --> 00:09:20,810
radiation and turbulence fluxes from the

159
00:09:27,880 --> 00:09:23,060
night side up probably cancel each other

160
00:09:30,600 --> 00:09:27,890
out and play a minor role so yeah so the

161
00:09:33,610 --> 00:09:30,610
sort of take-home message one is that

162
00:09:35,470 --> 00:09:33,620
convection in GCMs regulates the climate

163
00:09:38,280 --> 00:09:35,480

not only on the day site where all the

164
00:09:40,950 --> 00:09:38,290
connection is happening but perhaps

165
00:09:46,930 --> 00:09:40,960
contrary counter-intuitively

166
00:09:48,820 --> 00:09:46,940
on the night side and also the second a

167
00:09:50,320 --> 00:09:48,830
take-home message is that using a simple

168
00:09:53,680 --> 00:09:50,330
connection scheme can have different

169
00:09:57,490 --> 00:09:53,690
effects for different planets

170
00:10:00,390 --> 00:09:57,500
so why modeling convection has such a

171
00:10:04,140 --> 00:10:00,400
big impact well because as we heard from

172
00:10:06,070 --> 00:10:04,150
Allison this morning

173
00:10:08,920 --> 00:10:06,080
modeling convection is quite challenging

174
00:10:11,230 --> 00:10:08,930
it has a lot of feedbacks and also

175
00:10:14,020 --> 00:10:11,240
involves a wide spectrum of spatial and

176
00:10:16,329 --> 00:10:14,030
temporal scales and so it is

177
00:10:19,450 --> 00:10:16,339
computationally expensive to run global

178
00:10:21,290 --> 00:10:19,460
circulation models at convection

179
00:10:23,300 --> 00:10:21,300
resolving simulation

180
00:10:25,490 --> 00:10:23,310
lucien especially when they are coupled

181
00:10:29,690 --> 00:10:25,500
to radiation and chemistry and other

182
00:10:31,340 --> 00:10:29,700
stuff so what we do we run this GCM

183
00:10:33,620 --> 00:10:31,350
that's very coarse resolution instead

184
00:10:38,000 --> 00:10:33,630
and so the all the convective processes

185
00:10:40,160 --> 00:10:38,010
fall into sub grade scale size and we we

186
00:10:44,060 --> 00:10:40,170
have to use para positions to account

187
00:10:46,250 --> 00:10:44,070
for the net effect of them but

188
00:10:48,889 --> 00:10:46,260

unfortunately we don't have any in situ

189
00:10:50,180 --> 00:10:48,899
measurements on exoplanets at least not

190
00:10:54,380 --> 00:10:50,190
yet

191
00:10:56,569 --> 00:10:54,390
and so we have to our next best option

192
00:10:59,090 --> 00:10:56,579
to test this parent is Asians is to run

193
00:11:01,280 --> 00:10:59,100
a convection resolving model the very

194
00:11:04,310 --> 00:11:01,290
high resolution which does not need a

195
00:11:05,660 --> 00:11:04,320
parameterization to handle convection so

196
00:11:10,970 --> 00:11:05,670
this is what we can do with the unified

197
00:11:14,329 --> 00:11:10,980
model and we use a global model just as

198
00:11:19,190 --> 00:11:14,339
I showed before as a as a parent model

199
00:11:22,400 --> 00:11:19,200
to to supply boundary conditions but

200
00:11:26,720 --> 00:11:22,410
then we put a nested grid inside of the

201
00:11:29,240 --> 00:11:26,730
of that model and run this model at much

202
00:11:30,680 --> 00:11:29,250
higher resolution so I'm using a sort of

203
00:11:34,610 --> 00:11:30,690
convection permitting resolution of

204
00:11:39,560 --> 00:11:34,620
about 4 kilometers and in this case of

205
00:11:41,060 --> 00:11:39,570
course we have convection explicit so

206
00:11:47,240 --> 00:11:41,070
the convection organization is switched

207
00:11:50,569 --> 00:11:47,250
off so and when we look at the the

208
00:11:53,840 --> 00:11:50,579
outputs of of the simulations so this is

209
00:11:55,670 --> 00:11:53,850
so far just the global model again at

210
00:11:59,180 --> 00:11:55,680
the course resolution with convective

211
00:12:02,139 --> 00:11:59,190
compensation and this is just a chunk

212
00:12:05,900 --> 00:12:02,149
cut out of the of the global model

213
00:12:08,930 --> 00:12:05,910

around this nested region and you see

214
00:12:12,980 --> 00:12:08,940
that in terms of updrafts the the the

215
00:12:18,860 --> 00:12:12,990
rising motions the upward velocity field

216
00:12:21,410 --> 00:12:18,870
is quite washed out and and weak but

217
00:12:24,590 --> 00:12:21,420
when we run this model at high

218
00:12:26,480 --> 00:12:24,600
resolution you can start to see all the

219
00:12:30,260 --> 00:12:26,490
convection cells in individual

220
00:12:31,790 --> 00:12:30,270
convective cells being resolved and also

221
00:12:34,639 --> 00:12:31,800
some mesoscale circulations

222
00:12:36,710 --> 00:12:34,649
emerging on this planet

223
00:12:40,160 --> 00:12:36,720
and also the magnitude of updrafts and

224
00:12:43,129 --> 00:12:40,170
downdrafts is much greater than in the

225
00:12:45,859 --> 00:12:43,139
global model and this is what it looks

226
00:12:50,299 --> 00:12:45,869
like in terms of cloud fields so this is

227
00:12:54,559 --> 00:12:50,309
the reflected shortwave radiation and

228
00:12:56,869 --> 00:12:54,569
you see again that the convection

229
00:13:01,280 --> 00:12:56,879
resolving simulation gives you much more

230
00:13:05,780 --> 00:13:01,290
detail and much more in homogeneity in

231
00:13:08,299 --> 00:13:05,790
terms of cloud field and this is what

232
00:13:11,780 --> 00:13:08,309
the participation looks like so relation

233
00:13:16,009 --> 00:13:11,790
falling from this convective clouds okay

234
00:13:17,769 --> 00:13:16,019
but does it make a difference for for

235
00:13:20,179 --> 00:13:17,779
the mean state of the region and

236
00:13:22,730 --> 00:13:20,189
actually I should say that the global

237
00:13:25,460 --> 00:13:22,740
model with this mass flux parent

238
00:13:28,129 --> 00:13:25,470

connective translation is doing a pretty

239
00:13:31,910 --> 00:13:28,139
good job at least for earth-like

240
00:13:34,900 --> 00:13:31,920
atmosphere in in accounting for all the

241
00:13:38,840 --> 00:13:34,910
great convection and so in terms of

242
00:13:41,389 --> 00:13:38,850
temperature or specific humidity overall

243
00:13:43,759 --> 00:13:41,399
the curves are quite similar to each

244
00:13:45,919 --> 00:13:43,769
other from so the liquors from the

245
00:13:48,619 --> 00:13:45,929
global model and the regional model and

246
00:13:51,650 --> 00:13:48,629
the Wiccans difference is actually in

247
00:13:55,400 --> 00:13:51,660
the structure of the clouds on the day

248
00:13:58,460 --> 00:13:55,410
side and you can you can see this in

249
00:14:00,710 --> 00:13:58,470
terms of cloud condensate so this is

250
00:14:03,519 --> 00:14:00,720
average vertical profiles of cloud water

251
00:14:05,989 --> 00:14:03,529
on the left and called ice on the right

252
00:14:09,699 --> 00:14:05,999
so this is from the global model and

253
00:14:12,530 --> 00:14:09,709
this is the the orange curve is from the

254
00:14:14,119 --> 00:14:12,540
nested run simulation and you can see

255
00:14:17,269 --> 00:14:14,129
that the global model overestimates the

256
00:14:20,929 --> 00:14:17,279
cold water and underestimates cloud ice

257
00:14:25,039 --> 00:14:20,939
this can have an impact on the radiative

258
00:14:27,590 --> 00:14:25,049
forcing of clouds and also it can impact

259
00:14:32,600 --> 00:14:27,600
the formation of rain and/or snow

260
00:14:34,539 --> 00:14:32,610
precipitation but so the another

261
00:14:37,189 --> 00:14:34,549
take-home messages are compared to a

262
00:14:39,079 --> 00:14:37,199
convection resolving model cm may

263
00:14:41,090 --> 00:14:39,089

incorrectly represent cloud structure

264
00:14:43,480 --> 00:14:41,100
and they are radiative effects on the

265
00:14:47,199 --> 00:14:43,490
day side

266
00:14:50,380 --> 00:14:47,209
but I should say that one caveat of our

267
00:14:53,050 --> 00:14:50,390
study is that we use this model you know

268
00:14:55,570 --> 00:14:53,060
one-way nesting set up so even though

269
00:14:57,759 --> 00:14:55,580
the the regional model has the boundary

270
00:14:59,860 --> 00:14:57,769
conditions from the parent model it

271
00:15:02,050 --> 00:14:59,870
doesn't there's no feedback to the

272
00:15:05,440 --> 00:15:02,060
global model from these hires of

273
00:15:10,509 --> 00:15:05,450
simulations so one way to account for

274
00:15:13,120 --> 00:15:10,519
this impact is what I'm suggesting to do

275
00:15:15,340 --> 00:15:13,130
is basically what I'm doing now is to

276
00:15:17,350 --> 00:15:15,350
run a series of global experiments with

277
00:15:21,699 --> 00:15:17,360
different convection schemes then

278
00:15:27,460 --> 00:15:21,709
calculates the flux of moisture upward

279
00:15:31,690 --> 00:15:27,470
flux on the dayside as a metric for

280
00:15:33,310 --> 00:15:31,700
convection and then somehow find a

281
00:15:34,810 --> 00:15:33,320
correlation with some Nightside

282
00:15:37,870 --> 00:15:34,820
parameters such as the minimum

283
00:15:41,590 --> 00:15:37,880
temperature or the amount of moisture on

284
00:15:43,509 --> 00:15:41,600
the night side and if we find a good

285
00:15:47,470 --> 00:15:43,519
correlation between these parameters

286
00:15:50,410 --> 00:15:47,480
then we can run a nested simulation find

287
00:15:55,240 --> 00:15:50,420
the same integrated vertical flux of

288
00:15:57,579 --> 00:15:55,250

moisture and then infer from that what

289
00:15:59,460 --> 00:15:57,589
difference would it make for the night

290
00:16:01,990 --> 00:15:59,470
sight if we run the simulation as a

291
00:16:07,120 --> 00:16:02,000
convection resolving model for the for

292
00:16:09,069 --> 00:16:07,130
the whole planet and with this is my

293
00:16:11,110 --> 00:16:09,079
final take-home message so these

294
00:16:13,860 --> 00:16:11,120
simulations at high resolution relations

295
00:16:16,569 --> 00:16:13,870
might be used to assess the convection

296
00:16:19,750 --> 00:16:16,579
schemes and they impact on the Erika

297
00:16:23,160 --> 00:16:19,760
planet's climate and this is the summary

298
00:16:39,169 --> 00:16:23,170
of the messages and this I'll leave you

299
00:16:44,509 --> 00:16:41,599
hey Daniel from MIT and this is very

300
00:16:45,829 --> 00:16:44,519
exciting do you have a way for

301
00:16:48,439 --> 00:16:45,839
understanding the different schemes

302
00:16:50,269 --> 00:16:48,449
maybe in terms of a convective

303
00:16:52,639 --> 00:16:50,279
detainment or n treatment have you

304
00:16:57,819 --> 00:16:52,649
thought about that yes I am thinking

305
00:17:00,619 --> 00:16:57,829
about that and one of my next step is to

306
00:17:03,019 --> 00:17:00,629
run a series of sensitivity experience

307
00:17:04,699 --> 00:17:03,029
for the mass flux scheme and just change

308
00:17:07,460 --> 00:17:04,709
entrainment and D training parameters

309
00:17:09,620 --> 00:17:07,470
because for earth-like simulations for

310
00:17:11,829 --> 00:17:09,630
simulations of Earth convection it has

311
00:17:15,590 --> 00:17:11,839
been shown that this this is indeed

312
00:17:19,069 --> 00:17:15,600
probably the most important parameter in

313
00:17:20,980 --> 00:17:19,079

in the convection formulations but we

314
00:17:23,299 --> 00:17:20,990
also have a sort of first it's

315
00:17:29,110 --> 00:17:23,309
statistical framework in the making by

316
00:17:32,779 --> 00:17:31,250
differences between diffe completely

317
00:17:35,690 --> 00:17:32,789
different convection schemes so we can

318
00:17:43,549 --> 00:17:35,700
probably apply that to yeah thank you

319
00:17:45,350 --> 00:17:43,559
a nice talk tag to my sake Chicago so

320
00:17:46,490 --> 00:17:45,360
how do you choose the scale for your

321
00:17:48,169 --> 00:17:46,500
nested box

322
00:17:49,850 --> 00:17:48,179
have you tried like different box sizes

323
00:17:51,200 --> 00:17:49,860
does that affect the connection on the

324
00:17:55,310 --> 00:17:51,210
day side yeah that's that's a good

325
00:17:56,990 --> 00:17:55,320
question and I've been I spend like many

326
00:17:59,120 --> 00:17:57,000
months of simulations of trying to shift

327
00:18:04,789 --> 00:17:59,130
that box around and see what difference

328
00:18:08,090 --> 00:18:04,799
it makes and basically well first of all

329
00:18:11,810 --> 00:18:08,100
you have to probably choose the position

330
00:18:17,419 --> 00:18:11,820
correctly because on some planets the

331
00:18:19,730 --> 00:18:17,429
the most the hot spot is shifted a bit

332
00:18:22,190 --> 00:18:19,740
to the air to East and this happens on

333
00:18:26,690 --> 00:18:22,200
terrestrial plants as well so you can

334
00:18:30,080 --> 00:18:26,700
you should account for that and also of

335
00:18:35,000 --> 00:18:30,090
course this smaller box is in the

336
00:18:38,480 --> 00:18:35,010
simulation the more this regional model

337
00:18:39,710 --> 00:18:38,490
is sort of dominated by the boundary

338
00:18:42,260 --> 00:18:39,720

flow from the

339
00:18:45,440 --> 00:18:42,270
parent model so you have to to make this

340
00:18:50,870 --> 00:18:45,450
box sufficiently large so far it's

341
00:19:02,350 --> 00:18:50,880
around 60 degrees in the side of the box

342
00:19:08,500 --> 00:19:05,450
Manitoba Ontario Geneva did you make

343
00:19:11,529 --> 00:19:08,510
some experiments for rotate or

344
00:19:14,480 --> 00:19:11,539
synchronous ballot and you see any

345
00:19:18,049 --> 00:19:14,490
indication of self aggregation in these

346
00:19:21,700 --> 00:19:18,059
simulations yes one thing that we're

347
00:19:24,649 --> 00:19:21,710
thinking about too but I would say that

348
00:19:27,159 --> 00:19:24,659
it's probably not exactly self

349
00:19:31,850 --> 00:19:27,169
aggregation because there are so many

350
00:19:34,850 --> 00:19:31,860
external disturbances that can affect us

351
00:19:36,680 --> 00:19:34,860
so the the convection probably organizes

352
00:19:38,419 --> 00:19:36,690
but it's probably not exactly self

353
00:19:41,390 --> 00:19:38,429
aggregation because you have quite a

354
00:19:43,640 --> 00:19:41,400
large wind shear in this region and it's

355
00:19:45,409 --> 00:19:43,650
but the wind she'll come is because the

356
00:19:47,750 --> 00:19:45,419
do planet you are working it off quite

357
00:19:51,500 --> 00:19:47,760
fast rotate alright but yeah what if the

358
00:19:53,600 --> 00:19:51,510
planet were merged over with it oh I

359
00:19:56,299 --> 00:19:53,610
haven't looked at super slow rotating

360
00:19:56,630 --> 00:19:56,309
planets but yeah that's that's a good