EQUILIBRIUM & KINETIC CLOUD MODELS IN RETRIEVAL

JASMINA BLECIC

1
00:00:09,670 --> 00:00:06,540
[Music]

2
00:00:12,570 --> 00:00:09,680
I'm working with the dr. Ian Dobbs Dixon

3
00:00:17,140 --> 00:00:12,580
at the New York University Abu Dhabi and

4
00:00:19,900 --> 00:00:17,150
today I'm gonna talk about to complex me

5
00:00:22,750 --> 00:00:19,910
scattering cloud codes implementing

6
00:00:24,580 --> 00:00:22,760
retrieval but before I start I want to

7
00:00:27,220 --> 00:00:24,590
thank the organizers for giving me a

8
00:00:29,770 --> 00:00:27,230
chance to have a talk I always the

9
00:00:32,920 --> 00:00:29,780
preferred hex appliance conferences

10
00:00:36,029 --> 00:00:32,930
because I've learned a lot and in order

11
00:00:38,020 --> 00:00:36,039
to that I'm gonna make a short intro

12
00:00:39,700 --> 00:00:38,030
about the difference between the

13
00:00:41,700 --> 00:00:39,710

retrieval and forward model for the

14
00:00:57,310 --> 00:00:41,710
graduate students present here in the

15
00:01:00,700 --> 00:00:57,320
audience okay so there are two ways how

16
00:01:03,069 --> 00:01:00,710
we can approach modeling Keene in Ag the

17
00:01:06,340 --> 00:01:03,079
planetary modeling explanatory spectra

18
00:01:09,010 --> 00:01:06,350
one is direct and the other is inverse

19
00:01:12,219 --> 00:01:09,020
if the direct or forward modeling which

20
00:01:14,559 --> 00:01:12,229
is Theory driven we usually include all

21
00:01:18,190 --> 00:01:14,569
physical and chemical processes and we

22
00:01:20,709 --> 00:01:18,200
use the grid of models to generate the

23
00:01:23,739 --> 00:01:20,719
spectra then the comparison is usually

24
00:01:26,889 --> 00:01:23,749
done with the observationally meeting

25
00:01:28,899 --> 00:01:26,899
number of parameters and it gives us

26
00:01:30,370 --> 00:01:28,909
some physical insight into the planetary

27
00:01:33,459 --> 00:01:30,380
atmospheres it's usually considered to

28
00:01:35,050 --> 00:01:33,469
be self-consistent however all those

29
00:01:36,849 --> 00:01:35,060
physical and chemical processes are

30
00:01:39,010 --> 00:01:36,859
usually introduced into the model

31
00:01:41,019 --> 00:01:39,020
without any uncertainties so manual

32
00:01:43,179 --> 00:01:41,029
tweaking of the parameters are not

33
00:01:45,730 --> 00:01:43,189
giving an answer robust estimate of the

34
00:01:47,919 --> 00:01:45,740
uncertainties so we it is always a

35
00:01:50,050 --> 00:01:47,929
question whether individual results that

36
00:01:53,679 --> 00:01:50,060
we are getting are the only plausible

37
00:01:55,949 --> 00:01:53,689
solution on the other hand retrieval

38
00:01:59,830 --> 00:01:55,959

which is observationally driven is a

39
00:02:01,749 --> 00:01:59,840
statistical lis driven algorithm that

40
00:02:03,580 --> 00:02:01,759
actually explores the facepiece of the

41
00:02:06,069 --> 00:02:03,590
parameters and provide the uncertainties

42
00:02:09,309 --> 00:02:06,079
of our parameters however it is also

43
00:02:11,320 --> 00:02:09,319
very computationally demanding and it is

44
00:02:14,680 --> 00:02:11,330
very hard to implement all the physical

45
00:02:17,380 --> 00:02:14,690
and chemical processes it is also very

46
00:02:19,059 --> 00:02:17,390
hard to rule sometimes some unphysical

47
00:02:21,280 --> 00:02:19,069
solutions and it

48
00:02:23,170 --> 00:02:21,290
depends on the quality of our data and

49
00:02:25,539 --> 00:02:23,180
the number of data points that we have

50
00:02:28,630 --> 00:02:25,549
available however using the statistical

51
00:02:30,670 --> 00:02:28,640
algorithm allows us to perform a

52
00:02:33,039 --> 00:02:30,680
thorough exploration of the parameters

53
00:02:35,259 --> 00:02:33,049
taste and to put the robust estimates of

54
00:02:37,599 --> 00:02:35,269
our uncertainties it gives us actually a

55
00:02:39,759 --> 00:02:37,609
hot confidence region it instead of the

56
00:02:42,940 --> 00:02:39,769
best fit model that we have in the

57
00:02:45,250 --> 00:02:42,950
forward modeling and it can rule out the

58
00:02:47,770 --> 00:02:45,260
solutions that are not plausible by the

59
00:02:50,830 --> 00:02:47,780
data it also gives us some correlation

60
00:02:53,890 --> 00:02:50,840
parameters and sometimes the data can

61
00:03:01,000 --> 00:02:53,900
lead us to some unknown processes not

62
00:03:03,640 --> 00:03:01,010
yet addressed by the theory so until

63
00:03:05,770 --> 00:03:03,650

very recently clouds have been one of

64
00:03:07,990 --> 00:03:05,780
the most challenging the issues in

65
00:03:09,879 --> 00:03:08,000
retrieval to implement in retrieval

66
00:03:13,080 --> 00:03:09,889
although they are fundamental to

67
00:03:16,449 --> 00:03:13,090
understanding the planetary spectra so

68
00:03:18,460 --> 00:03:16,459
they as we know affect almost every

69
00:03:20,080 --> 00:03:18,470
aspect of planetary atmosphere from the

70
00:03:22,960 --> 00:03:20,090
transport of radiation atmospheric

71
00:03:24,039 --> 00:03:22,970
chemistry dynamics the info tell the

72
00:03:27,219 --> 00:03:24,049
influence the planetary surface

73
00:03:28,629 --> 00:03:27,229
temperature and habitability and as we

74
00:03:30,099 --> 00:03:28,639
know the highly influence of the

75
00:03:32,110 --> 00:03:30,109
fertility of the planet because they

76
00:03:34,210 --> 00:03:32,120
remove the absorbers from the planetary

77
00:03:36,460 --> 00:03:34,220
atmosphere and they block the stellar

78
00:03:39,009 --> 00:03:36,470
light so we cannot see deeper below the

79
00:03:43,960 --> 00:03:39,019
cloud layers and they introduce a lot of

80
00:03:47,409 --> 00:03:43,970
scatter light until very recently clouds

81
00:03:49,629 --> 00:03:47,419
have been introduced into retrieval in a

82
00:03:52,000 --> 00:03:49,639
very simple way we used great cloud

83
00:03:55,780 --> 00:03:52,010
approximations or PAC cloud decks and

84
00:03:58,420 --> 00:03:55,790
the reason for that is one because of

85
00:04:01,420 --> 00:03:58,430
the computational intensive framework

86
00:04:03,699 --> 00:04:01,430
that doesn't allow more free parameters

87
00:04:05,589 --> 00:04:03,709
and it introduces a high penalty on

88
00:04:07,750 --> 00:04:05,599

computational penalty but the other

89
00:04:10,240 --> 00:04:07,760
reason is also because the current data

90
00:04:12,759 --> 00:04:10,250
that we have available are not of good

91
00:04:14,920 --> 00:04:12,769
quality so we can actually distinguish

92
00:04:19,930 --> 00:04:14,930
between the more complex cloud models or

93
00:04:23,140 --> 00:04:19,940
the simple ones however with the

94
00:04:26,409 --> 00:04:23,150
approach of the JWST era we are

95
00:04:28,870 --> 00:04:26,419
approaching the new times when there is

96
00:04:30,860 --> 00:04:28,880
an urge for more complex cloud models it

97
00:04:33,170 --> 00:04:30,870
is because of

98
00:04:35,840 --> 00:04:33,180
bigger Waveland coverage because of the

99
00:04:37,910 --> 00:04:35,850
higher resolution but also because we

100
00:04:41,629 --> 00:04:37,920
are at the same time developing some

101
00:04:44,659 --> 00:04:41,639
optimization techniques machine learning

102
00:04:46,310 --> 00:04:44,669
which allows us to perform millions of

103
00:04:49,490 --> 00:04:46,320
these models to generate millions of

104
00:04:51,800 --> 00:04:49,500
models in a much faster way so there is

105
00:04:55,850 --> 00:04:51,810
a high need for more complex models in

106
00:04:57,770 --> 00:04:55,860
retrieval so I also want to give you

107
00:04:59,600 --> 00:04:57,780
some short introduction about what is

108
00:05:02,200 --> 00:04:59,610
the current state in the for modeling

109
00:05:05,440 --> 00:05:02,210
concerning clouds so currently we have

110
00:05:08,030 --> 00:05:05,450
two cloud approaches one is equilibrium

111
00:05:09,770 --> 00:05:08,040
approach when we where we actually

112
00:05:11,270 --> 00:05:09,780
calculate the cloud based on the

113
00:05:13,970 --> 00:05:11,280

intersection between the temperature and

114
00:05:16,490 --> 00:05:13,980
pressure profile and the conversation

115
00:05:18,950 --> 00:05:16,500
curves and what you can see here on this

116
00:05:21,200 --> 00:05:18,960
plot are all the clouds that you can see

117
00:05:22,940 --> 00:05:21,210
I in the solar system planets which are

118
00:05:25,219 --> 00:05:22,950
calculated based on the conversation

119
00:05:27,350 --> 00:05:25,229
curves of the species that you can see

120
00:05:29,540 --> 00:05:27,360
in the solar system planets what is

121
00:05:31,400 --> 00:05:29,550
interesting about this approach is that

122
00:05:33,290 --> 00:05:31,410
it doesn't consider something which is

123
00:05:35,659 --> 00:05:33,300
fundamental for formation of clouds

124
00:05:38,060 --> 00:05:35,669
which is the formation of the nuclei

125
00:05:40,040 --> 00:05:38,070
which are the first step in the

126
00:05:42,159 --> 00:05:40,050
formation of the cloud model on the

127
00:05:44,330 --> 00:05:42,169
other hand we have another more

128
00:05:47,870 --> 00:05:44,340
self-consistent bottle to the micro

129
00:05:49,760 --> 00:05:47,880
physical kinetic model that that follows

130
00:05:51,529 --> 00:05:49,770
the formation of the particle from the

131
00:05:54,529 --> 00:05:51,539
top of the Mahatma sphere to the bottom

132
00:05:58,279 --> 00:05:54,539
of the atmosphere and it does considered

133
00:06:00,680 --> 00:05:58,289
first and foremost the nuclear nuclear

134
00:06:02,930 --> 00:06:00,690
formation at the at the at the top of

135
00:06:03,940 --> 00:06:02,940
the atmosphere after that it follows

136
00:06:09,320 --> 00:06:03,950
kinetics

137
00:06:12,380 --> 00:06:09,330
it-it-it it forms the particles by

138
00:06:15,230 --> 00:06:12,390

growing subtle ink and then depletion

139
00:06:17,480 --> 00:06:15,240
and then introducing convexity mixing li

140
00:06:19,010 --> 00:06:17,490
replenish the material from the bottom

141
00:06:22,250 --> 00:06:19,020
of the atmosphere and we have a stable

142
00:06:24,200 --> 00:06:22,260
cloud so based on this physical

143
00:06:27,110 --> 00:06:24,210
approaches that we have in cloud physics

144
00:06:28,670 --> 00:06:27,120
i decided that it would be good that we

145
00:06:31,130 --> 00:06:28,680
have both of these approaches in our

146
00:06:33,409 --> 00:06:31,140
retrieval framework and we actually

147
00:06:35,029 --> 00:06:33,419
implemented this equilibrium approach

148
00:06:37,460 --> 00:06:35,039
and we call the thermal stability cloud

149
00:06:39,399 --> 00:06:37,470
model that is actually a parameter is

150
00:06:42,409 --> 00:06:39,409
equilibrium approach and you also have

151
00:06:44,180 --> 00:06:42,419
fully self-consistent one dimensional

152
00:06:46,700 --> 00:06:44,190
micro physical cloud model which you

153
00:06:51,800 --> 00:06:46,710
called drift I applied both of these

154
00:06:53,060 --> 00:06:51,810
models on multiple JWST targets so let

155
00:06:55,370 --> 00:06:53,070
me tell you first about the thermal

156
00:06:57,320 --> 00:06:55,380
stability cloud model this model was

157
00:06:59,660 --> 00:06:57,330
initially inspired by banneker's paper

158
00:07:01,670 --> 00:06:59,670
from 2015 and Aquaman is Majerle

159
00:07:03,950 --> 00:07:01,680
approach and I also introduced some

160
00:07:06,470 --> 00:07:03,960
additional flexibility on the location

161
00:07:08,780 --> 00:07:06,480
of the cloud deck so it has five free

162
00:07:11,270 --> 00:07:08,790
parameters and it can cut it can

163
00:07:15,290 --> 00:07:11,280

actually address all the these species

164
00:07:18,920 --> 00:07:15,300
if we have available high resolution nmk

165
00:07:21,350 --> 00:07:18,930
data currently this model are addressing

166
00:07:23,920 --> 00:07:21,360
only one cloud species at a time it

167
00:07:26,540 --> 00:07:23,930
returns the crowd profile shape the

168
00:07:29,420 --> 00:07:26,550
conversating particle size distribution

169
00:07:32,060 --> 00:07:29,430
and number density the cloud extends and

170
00:07:36,500 --> 00:07:32,070
the effective particle size I apply this

171
00:07:40,220 --> 00:07:36,510
model on vast 63 be in kilpatrick at all

172
00:07:42,620 --> 00:07:40,230
2018 paper to fit ages t date map I also

173
00:07:45,830 --> 00:07:42,630
put it to ATT one at nine eighty twenty

174
00:07:48,140 --> 00:07:45,840
nine and some other perspective JWST

175
00:07:51,680 --> 00:07:48,150
targets and recently we apply this model

176
00:07:53,960 --> 00:07:51,690
in submitted venerable paper on the

177
00:07:58,070 --> 00:07:53,970
synthetic JWST Miri physical

178
00:08:01,159 --> 00:07:58,080
observations so to explain a little bit

179
00:08:03,740 --> 00:08:01,169
more about this model I use the approach

180
00:08:07,550 --> 00:08:03,750
that Beneke developed in 2015 where we

181
00:08:11,420 --> 00:08:07,560
actually can generate a different cloud

182
00:08:14,510 --> 00:08:11,430
shapes based on this equation here all

183
00:08:16,070 --> 00:08:14,520
those cloud shapes are actually covering

184
00:08:18,590 --> 00:08:16,080
the cloud shapes that we can see in the

185
00:08:21,770 --> 00:08:18,600
solar system planets brown dwarfs and

186
00:08:25,850 --> 00:08:21,780
exoplanets and even the gray cloud model

187
00:08:27,560 --> 00:08:25,860
I calculate I calculate the cloud base

188
00:08:29,030 --> 00:08:27,570

based on the intersection between the

189
00:08:31,010 --> 00:08:29,040
temperature and pressure profile and

190
00:08:33,320 --> 00:08:31,020
condensation curve and I introduce

191
00:08:36,950 --> 00:08:33,330
another free parameter here which allows

192
00:08:38,630 --> 00:08:36,960
me to shift the cloud base depending on

193
00:08:41,450 --> 00:08:38,640
the number density of the gas species

194
00:08:44,360 --> 00:08:41,460
below the cloud deck to calculate the

195
00:08:48,950 --> 00:08:44,370
cloud particle distribution I use the

196
00:08:51,800 --> 00:08:48,960
Ackermann and Marley 2001 log normal

197
00:08:54,170 --> 00:08:51,810
distribution and to introduce the cloud

198
00:08:55,790 --> 00:08:54,180
opacity in our retrieval framework to

199
00:08:58,060 --> 00:08:55,800
use the mere theory where we calculate

200
00:08:59,560 --> 00:08:58,070
the extinction coefficient

201
00:09:02,590 --> 00:08:59,570
counting for the scattering and

202
00:09:04,840 --> 00:09:02,600
absorption coefficients here I'm showing

203
00:09:07,110 --> 00:09:04,850
you the flexibility of this small or how

204
00:09:09,970 --> 00:09:07,120
well we can actually model different

205
00:09:13,389 --> 00:09:09,980
different spectra in the expo in

206
00:09:15,610 --> 00:09:13,399
electoral planets so I mean I'm here

207
00:09:18,280 --> 00:09:15,620
performing the Ford model exploration

208
00:09:20,379 --> 00:09:18,290
for the iron and enstatite clouds and

209
00:09:22,740 --> 00:09:20,389
I'm changing the particle size

210
00:09:24,970 --> 00:09:22,750
distribution a number density and the

211
00:09:27,490 --> 00:09:24,980
location of the cloud as you can see

212
00:09:29,740 --> 00:09:27,500
here for our clouds they affect the

213
00:09:32,769 --> 00:09:29,750

spectrum more in the short wavelengths

214
00:09:34,870 --> 00:09:32,779
wire for the answer type Louds we can

215
00:09:37,420 --> 00:09:34,880
see the appearance and disappearance of

216
00:09:39,370 --> 00:09:37,430
the silicate feature which is the most

217
00:09:41,889 --> 00:09:39,380
pronounced feature for the silicate

218
00:09:44,740 --> 00:09:41,899
clouds as you can see here just based on

219
00:09:48,009 --> 00:09:44,750
this simple exercise we can distinguish

220
00:09:52,090 --> 00:09:48,019
between the enstatite and iron clouds in

221
00:09:55,269 --> 00:09:52,100
EXA planetary atmospheres as I said we

222
00:09:58,600 --> 00:09:55,279
apply this model on the last four to

223
00:10:01,660 --> 00:09:58,610
three me Mary phase curves where we

224
00:10:04,389 --> 00:10:01,670
produce synthetic phase curve

225
00:10:07,629 --> 00:10:04,399
observations although this planet is one

226
00:10:09,879 --> 00:10:07,639
of the most analyzed planets so far in

227
00:10:12,009 --> 00:10:09,889
the in the recent times there are still

228
00:10:13,629 --> 00:10:12,019
some honours with questions regarding

229
00:10:16,449 --> 00:10:13,639
this planet and that is the de cider

230
00:10:18,879 --> 00:10:16,459
distribution this flyby the theoretical

231
00:10:20,170 --> 00:10:18,889
prediction should have a very efficient

232
00:10:23,139 --> 00:10:20,180
they start they not redistribution

233
00:10:26,110 --> 00:10:23,149
however the observations are telling us

234
00:10:27,759 --> 00:10:26,120
that the distribute the dayside receive

235
00:10:30,490 --> 00:10:27,769
distribution is actually very

236
00:10:33,670 --> 00:10:30,500
inefficient and one of the reasons that

237
00:10:35,139 --> 00:10:33,680
we suspect could be is the existence of

238
00:10:37,629 --> 00:10:35,149

clouds in the night side of the planet

239
00:10:39,329 --> 00:10:37,639
which would obstruct the thermal

240
00:10:43,569 --> 00:10:39,339
emission from the planetary layers

241
00:10:46,470 --> 00:10:43,579
producing dark dark flux on the night

242
00:10:48,579 --> 00:10:46,480
side so that is why we wanted to

243
00:10:51,759 --> 00:10:48,589
investigate whether this is the case for

244
00:10:56,530 --> 00:10:51,769
was 43 B however before that we

245
00:10:59,679 --> 00:10:56,540
performed a very thorough modeling

246
00:11:02,920 --> 00:10:59,689
modeling approach to predict all the

247
00:11:05,740 --> 00:11:02,930
possible properties of a 43 B we engage

248
00:11:06,910 --> 00:11:05,750
radical convective atma models to

249
00:11:09,400 --> 00:11:06,920
predict the temperature and pressure

250
00:11:10,480 --> 00:11:09,410
profile than chemical kinetics from the

251
00:11:12,850 --> 00:11:10,490
No

252
00:11:15,340 --> 00:11:12,860
then to predict the chemical composition

253
00:11:18,130 --> 00:11:15,350
then we use cloud micro physics from

254
00:11:19,270 --> 00:11:18,140
Peter Gow and using all those

255
00:11:21,730 --> 00:11:19,280
predictions

256
00:11:24,940 --> 00:11:21,740
Vivian branch's global circulation

257
00:11:27,640 --> 00:11:24,950
models without clouds and then he

258
00:11:30,970 --> 00:11:27,650
attached the passive clouds after the

259
00:11:34,210 --> 00:11:30,980
GCM run then we use some of those models

260
00:11:36,490 --> 00:11:34,220
in context so to generate the data

261
00:11:38,380 --> 00:11:36,500
evidence certainties and finally we

262
00:11:41,740 --> 00:11:38,390
perform the spectral retriever for cloud

263
00:11:45,250 --> 00:11:41,750

free quenched and cloudy models my past

264
00:11:48,550 --> 00:11:45,260
here was to do retrieval cloudy

265
00:11:51,430 --> 00:11:48,560
retrieval as I said I use Vivian's model

266
00:11:54,700 --> 00:11:51,440
with passive clouds for anti and M&S

267
00:11:57,160 --> 00:11:54,710
clouds the data were produced with

268
00:12:00,610 --> 00:11:57,170
padegzong for the particle sizes of 1

269
00:12:03,700 --> 00:12:00,620
micron at the same time we also asked

270
00:12:07,270 --> 00:12:03,710
our X group webmin at all to do the same

271
00:12:08,950 --> 00:12:07,280
exercise and the goal was to retrieve

272
00:12:11,230 --> 00:12:08,960
the correct particle size cloud number

273
00:12:13,300 --> 00:12:11,240
density and location allowed that also

274
00:12:16,050 --> 00:12:13,310
to distinguish whether we can make a

275
00:12:19,300 --> 00:12:16,060
distinction between the M&S and

276
00:12:23,650 --> 00:12:19,310
magnesium silicate clouds here I'm

277
00:12:25,840 --> 00:12:23,660
showing you the GCM models from Vivian

278
00:12:30,420 --> 00:12:25,850
for different particle sizes and for

279
00:12:34,090 --> 00:12:30,430
clear and cloudy cases for magnesium and

280
00:12:37,440 --> 00:12:34,100
M&S clouds and in dots are actually

281
00:12:40,450 --> 00:12:37,450
spitzer and edges to data while the

282
00:12:42,070 --> 00:12:40,460
triangles are JWST data and just based

283
00:12:45,790 --> 00:12:42,080
on these model we made some predictions

284
00:12:47,830 --> 00:12:45,800
that answer tie clouds we can see on the

285
00:12:49,690 --> 00:12:47,840
day and the night side while the M&S

286
00:12:52,750 --> 00:12:49,700
clouds can only be seen on the night

287
00:12:56,350 --> 00:12:52,760
side then we use some of these models to

288
00:12:59,830 --> 00:12:56,360

generate these data that i used in

289
00:13:03,430 --> 00:12:59,840
retrieval these are the uncertainties

290
00:13:07,420 --> 00:13:03,440
data with Ana certainties and in magenta

291
00:13:11,130 --> 00:13:07,430
is our Vivian models so as I said we

292
00:13:14,320 --> 00:13:11,140
also called the tower Eckstein to try to

293
00:13:18,700 --> 00:13:14,330
retrieve the particle size however their

294
00:13:21,670 --> 00:13:18,710
cloud model was not Sofia not complex

295
00:13:23,319 --> 00:13:21,680
enough to to retrieve the correct

296
00:13:25,660 --> 00:13:23,329
particle size

297
00:13:28,660 --> 00:13:25,670
and the location of the clouds so they

298
00:13:30,579 --> 00:13:28,670
were unsuccessful but on the contrary we

299
00:13:32,289 --> 00:13:30,589
were very successful in retrieving the

300
00:13:34,749 --> 00:13:32,299
correct particle size the location of

301
00:13:36,789 --> 00:13:34,759
the cloud and the number density of the

302
00:13:38,470 --> 00:13:36,799
cloud what I'm showing you here is the

303
00:13:40,479 --> 00:13:38,480
best fit model the temperature and

304
00:13:43,269 --> 00:13:40,489
pressure profile and the condensation

305
00:13:45,850 --> 00:13:43,279
curves which actually reveal you the

306
00:13:49,780 --> 00:13:45,860
location of the clouds here you can see

307
00:13:52,710 --> 00:13:49,790
the correlation plots and the histograms

308
00:13:54,939 --> 00:13:52,720
how we retrieve exactly 1 micron as

309
00:13:57,369 --> 00:13:54,949
vidiians input model and the number

310
00:14:02,350 --> 00:13:57,379
density of the particles for the mms

311
00:14:06,100 --> 00:14:02,360
clouds we have the similar results where

312
00:14:09,819 --> 00:14:06,110
we retrieve somewhat different a little

313
00:14:12,579 --> 00:14:09,829

bit larger particle size then the input

314
00:14:15,039 --> 00:14:12,589
model and we also performed two

315
00:14:17,259 --> 00:14:15,049
different retrievals there is if you

316
00:14:20,169 --> 00:14:17,269
perform the free and self assistance

317
00:14:23,710 --> 00:14:20,179
retrieval what we concluded from these

318
00:14:27,340 --> 00:14:23,720
analyses is that it's very important to

319
00:14:30,400 --> 00:14:27,350
have more flexibility in our cloud

320
00:14:36,150 --> 00:14:30,410
models so we can actually model some

321
00:14:39,759 --> 00:14:36,160
features in our data so being able to

322
00:14:42,400 --> 00:14:39,769
model to have more free parameters will

323
00:14:45,400 --> 00:14:42,410
allow us to model better the data from

324
00:14:48,429 --> 00:14:45,410
the JWST and Miri I also wanted to

325
00:14:51,009 --> 00:14:48,439
briefly talk about my other model that

326
00:14:53,889 --> 00:14:51,019
we have in retrieval we implemented

327
00:14:56,019 --> 00:14:53,899
fully self consistent one-dimensional

328
00:14:58,929 --> 00:14:56,029
micro physical kinetic model from Boyka

329
00:15:01,929 --> 00:14:58,939
and helling and helling at all 2008 this

330
00:15:04,269 --> 00:15:01,939
model has four parameters over shooting

331
00:15:05,739 --> 00:15:04,279
or mixing kilometers that defines the

332
00:15:08,289 --> 00:15:05,749
condition in the convective gravity

333
00:15:10,749 --> 00:15:08,299
boundary then convective oddity boundary

334
00:15:14,650 --> 00:15:10,759
pressure carbon oxidation and

335
00:15:19,210 --> 00:15:14,660
metallicity it can cover several nuclear

336
00:15:23,049 --> 00:15:19,220
species and many various dot species and

337
00:15:24,699 --> 00:15:23,059
it returns the nucleation rate of

338
00:15:26,650 --> 00:15:24,709

considered neutral species effective

339
00:15:28,869 --> 00:15:26,660
particle size dot for dust one in

340
00:15:31,059 --> 00:15:28,879
composition location of the different

341
00:15:32,859 --> 00:15:31,069
clouds which are spread on the vertical

342
00:15:36,309 --> 00:15:32,869
direction and depletion of the elemental

343
00:15:36,910 --> 00:15:36,319
species here I'm also showing you some

344
00:15:41,679 --> 00:15:36,920
excerpts

345
00:15:45,400 --> 00:15:41,689
on how different how changing some of

346
00:15:47,379 --> 00:15:45,410
the parameters of our drift model can

347
00:15:48,999 --> 00:15:47,389
affect the spectra as you can see here

348
00:15:51,489 --> 00:15:49,009
and we changed this is the change in

349
00:15:53,799 --> 00:15:51,499
metallicity and here we are changing

350
00:15:54,970 --> 00:15:53,809
actually the mixing coefficient and we

351
00:16:01,090 --> 00:15:54,980
can see the appearance and disappearance

352
00:16:03,549 --> 00:16:01,100
of silicate features as well I perform a

353
00:16:09,449 --> 00:16:03,559
forward modeling exercise with drift

354
00:16:17,530 --> 00:16:13,869
model and data from single 2016 paper

355
00:16:23,949 --> 00:16:17,540
and here I run drift model for cloud

356
00:16:27,789 --> 00:16:23,959
free and cloudy cloudy solution and here

357
00:16:29,889 --> 00:16:27,799
we are almost matching the spectra are

358
00:16:30,999 --> 00:16:29,899
very similar with the with the sync

359
00:16:33,519 --> 00:16:31,009
arrow model

360
00:16:35,079 --> 00:16:33,529
but these the thanks to our self

361
00:16:39,189 --> 00:16:35,089
consistency of our model we can also

362
00:16:41,289 --> 00:16:39,199
produce the location of the where the

363
00:16:43,929 --> 00:16:41,299

deflation rate or where the nuclei are

364
00:16:46,479 --> 00:16:43,939
mostly formed then we are reproduced

365
00:16:48,669 --> 00:16:46,489
also the effective particle size which

366
00:16:51,309 --> 00:16:48,679
is changing if you go deeper in the

367
00:16:54,579 --> 00:16:51,319
planetary atmosphere we also can reduce

368
00:16:56,169 --> 00:16:54,589
the cloud shape which means the where is

369
00:16:59,169 --> 00:16:56,179
most of the mass of the cloud will

370
00:17:02,739 --> 00:16:59,179
actually located then we can see here

371
00:17:04,870 --> 00:17:02,749
which clouds are actually formed in

372
00:17:06,730 --> 00:17:04,880
different parts of the atmospheres its

373
00:17:08,230 --> 00:17:06,740
which clouds species are formed in

374
00:17:10,960 --> 00:17:08,240
different parts of the atmosphere and

375
00:17:15,460 --> 00:17:10,970
finally how the elemental abundances are

376
00:17:20,549 --> 00:17:15,470
changing so as a take away message I

377
00:17:22,779 --> 00:17:20,559
just want to point out the importance of

378
00:17:26,860 --> 00:17:22,789
different cloud models that we should

379
00:17:28,690 --> 00:17:26,870
have for the for the expecting of JWST

380
00:17:32,470 --> 00:17:28,700
era which gonna have a higher resolution

381
00:17:33,970 --> 00:17:32,480
and wider wavelength courage the

382
00:17:36,159 --> 00:17:33,980
importance of the flexibility of our

383
00:17:40,899 --> 00:17:36,169
models so we can actually cover

384
00:17:45,970 --> 00:17:40,909
different features in in in our clouds

385
00:17:48,399 --> 00:17:45,980
and as I said before this model that we

386
00:17:50,710 --> 00:17:48,409
have in our material framework is

387
00:17:52,779 --> 00:17:50,720
allowing us to differentiate the

388
00:17:54,669 --> 00:17:52,789

the different cloud species seen in the

389
00:17:56,950 --> 00:17:54,679
spectra and to differentiate which is

390
00:17:59,440 --> 00:17:56,960
most dominant species seen in the

391
00:18:02,680 --> 00:17:59,450
spectra while drift model that we have

392
00:18:06,610 --> 00:18:02,690
are telling us about the aggregate

393
00:18:09,549 --> 00:18:06,620
clouds and total contribution from all

394
00:18:31,060 --> 00:18:09,559
the cloud species to the spectrum Thank

395
00:18:33,820 --> 00:18:31,070
You Nick Owen McGill University is this

396
00:18:36,700 --> 00:18:33,830
only for transmission spectroscopy or

397
00:18:37,149 --> 00:18:36,710
can you also do reflected light I can do

398
00:18:40,570 --> 00:18:37,159
both

399
00:18:43,480 --> 00:18:40,580
oh no I can do I cannot do reflexive or

400
00:18:45,130 --> 00:18:43,490
like thank you oh yeah okay can you do

401
00:18:48,010 --> 00:18:45,140
thermal emission like do these allow

402
00:18:51,789 --> 00:18:48,020
these clouds can block olr they just

403
00:18:55,720 --> 00:18:51,799
don't reflect yes surely they do have so

404
00:18:57,430 --> 00:18:55,730
if if if you saw in the in this

405
00:18:59,710 --> 00:18:57,440
parametrization the mean scattering Co

406
00:19:04,320 --> 00:18:59,720
does have the reflective contribution

407
00:19:07,270 --> 00:19:04,330
fro from scattering and and reflective

408
00:19:09,490 --> 00:19:07,280
efficiencies so we do calculate the

409
00:19:12,039 --> 00:19:09,500
scattering efficiencies in our cloud

410
00:19:20,169 --> 00:19:12,049
model for the me scattering code in the

411
00:19:22,570 --> 00:19:20,179
meniscus in Ko Olina man caracas

412
00:19:24,130 --> 00:19:22,580
jacobson returned so thank you for the

413
00:19:26,350 --> 00:19:24,140

introduction for first of all she's not

414
00:19:29,620 --> 00:19:26,360
only useful for guys she's also for

415
00:19:31,779 --> 00:19:29,630
other people like me so you always just

416
00:19:33,100 --> 00:19:31,789
say oh we and many people doing what we

417
00:19:34,899 --> 00:19:33,110
want to say the same thing that didn't

418
00:19:37,539 --> 00:19:34,909
have data and with enough quality to

419
00:19:41,760 --> 00:19:37,549
test your your Reggie Watts and but

420
00:19:45,039 --> 00:19:41,770
they're like the only order of 100 aim

421
00:19:47,470 --> 00:19:45,049
HST spectra for brand wars they have

422
00:19:49,930 --> 00:19:47,480
very good quality and that might be

423
00:19:54,549 --> 00:19:49,940
useful for you to the retrieval so I was

424
00:19:56,620 --> 00:19:54,559
wondering why then you use those so most

425
00:19:59,590 --> 00:19:56,630
of the spectral features are actually

426
00:20:01,960 --> 00:19:59,600
coming from the infrared region so we

427
00:20:03,300 --> 00:20:01,970
are actually hoping to have more insight

428
00:20:05,730 --> 00:20:03,310
into the

429
00:20:08,010 --> 00:20:05,740
longer wavelengths because the

430
00:20:09,900 --> 00:20:08,020
vibrational rotational states of the

431
00:20:12,030 --> 00:20:09,910
molecules are producing more spectral

432
00:20:14,520 --> 00:20:12,040
features in this region rather than

433
00:20:23,860 --> 00:20:14,530
where HST data are