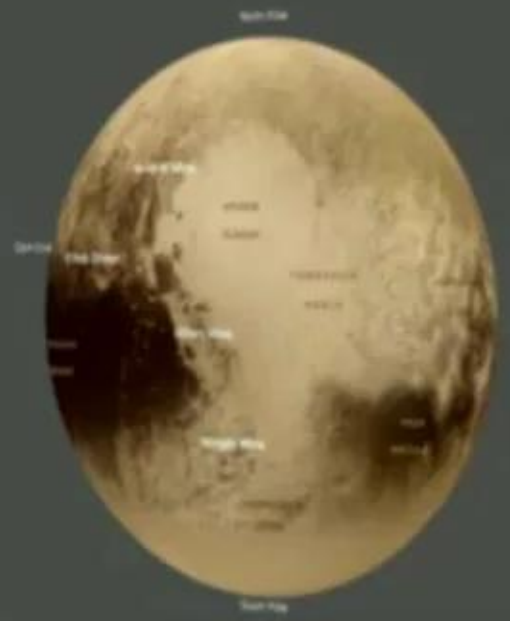
UV RADIATION



- Methane absorbs much of the UV radiation that Pluto receives.
- Methane is less volatile than N_2 or CO so it is more likely to snow down the father Pluto moves from Earth
- If the main element stopping UV radiation in the atmosphere, moves to the surface...

If methane, eventually snows down onto the surface this may change how much UV radiation Pluto receives, which may change the surface.

1
00:00:11,150 --> 00:00:09,320
so my name is my llanes I am actually an

2
00:00:14,570 --> 00:00:11,160
undergrad here and brian is my advisor

3
00:00:16,010 --> 00:00:14,580
so that's why our talks are related he

4
00:00:17,029 --> 00:00:16,020
basically passed this project on to me

5
00:00:18,560 --> 00:00:17,039
because he had some more interesting

6
00:00:21,500 --> 00:00:18,570
things to do with share on so I

7
00:00:22,820 --> 00:00:21,510
inherited Pluto what's kind of

8
00:00:24,920 --> 00:00:22,830
interesting just as some background is

9
00:00:26,420 --> 00:00:24,930
that as we just discussed ultimately the

10
00:00:28,370 --> 00:00:26,430
answer for what I'm about to ask is that

11
00:00:29,960 --> 00:00:28,380
Sharon is really tiny can't really hold

12
00:00:31,460 --> 00:00:29,970
on to all these same ball to Isis they

13
00:00:32,240 --> 00:00:31,470

can kind of just get blown away because

14
00:00:34,370 --> 00:00:32,250
it doesn't really have an atmosphere

15
00:00:36,080 --> 00:00:34,380
which is where we tend to find these but

16
00:00:37,639 --> 00:00:36,090
ultimately Pluto and Charon are really

17
00:00:38,990 --> 00:00:37,649
close together so when you compare this

18
00:00:41,900 --> 00:00:39,000
to our own earth and moon it's about a

19
00:00:44,510 --> 00:00:41,910
factor of 80 difference so put sharon's

20
00:00:47,360 --> 00:00:44,520
about 80 times closer to Pluto than our

21
00:00:49,100 --> 00:00:47,370
moon is to earth in addition there

22
00:00:51,529 --> 00:00:49,110
tidally locked and triple synchronous

23
00:00:53,810 --> 00:00:51,539
what that means is that Pluto and Charon

24
00:00:57,110 --> 00:00:53,820
are always showing the exact same side

25
00:00:59,360 --> 00:00:57,120
to each other so as Pluto orbits rotates

26
00:01:01,189 --> 00:00:59,370
Sharon orbits at the same time frame and

27
00:01:02,599 --> 00:01:01,199
the same rate so they're always facing

28
00:01:03,740 --> 00:01:02,609
each other at the exact same side which

29
00:01:05,359 --> 00:01:03,750
is pretty interesting really close

30
00:01:07,190 --> 00:01:05,369
together always facing the same side to

31
00:01:08,899 --> 00:01:07,200
each other but they're different and

32
00:01:10,719 --> 00:01:08,909
they were formed in the same giant

33
00:01:13,010 --> 00:01:10,729
impact which means that at this

34
00:01:14,660 --> 00:01:13,020
basically as Brian explained they had a

35
00:01:16,070 --> 00:01:14,670
grazing impact all the stuff gets thrown

36
00:01:17,390 --> 00:01:16,080
in the air so they all have the same

37
00:01:19,070 --> 00:01:17,400
beginning material but they evolved

38
00:01:20,800 --> 00:01:19,080

really differently ultimately answered

39
00:01:22,969 --> 00:01:20,810
by the fact that Sharon's really tiny

40
00:01:25,460 --> 00:01:22,979
but what you do see on Pluto's surface

41
00:01:27,800 --> 00:01:25,470
is basically three volatile ices and two

42
00:01:29,660 --> 00:01:27,810
carbon monoxide and methane and these

43
00:01:31,100 --> 00:01:29,670
are kind of important because that's

44
00:01:33,109 --> 00:01:31,110
basically all we see aside from water

45
00:01:34,460 --> 00:01:33,119
ice and as Brian mentioned we really

46
00:01:35,600 --> 00:01:34,470
only discovered the water ice because of

47
00:01:37,399 --> 00:01:35,610
New Horizons so based off of

48
00:01:38,420 --> 00:01:37,409
ground-based research the only things

49
00:01:39,770 --> 00:01:38,430
we're seeing are these three ball to

50
00:01:42,319 --> 00:01:39,780
Isis those are the only things we can

51
00:01:44,899 --> 00:01:42,329
really track and keep ideas of how much

52
00:01:46,760 --> 00:01:44,909
and things like that sharon has none of

53
00:01:48,170 --> 00:01:46,770
them so it's kind of interesting why are

54
00:01:50,749 --> 00:01:48,180
they form so differently once again

55
00:01:52,999 --> 00:01:50,759
Sharon's really bad so what we did was

56
00:01:54,830 --> 00:01:53,009
we obtained data from the Apache point

57
00:01:57,590 --> 00:01:54,840
observatory in New Mexico across nine

58
00:01:58,999 --> 00:01:57,600
nights throughout two years and in the

59
00:02:00,200 --> 00:01:59,009
second I'll explain why this is really

60
00:02:02,330 --> 00:02:00,210
important why we did it in a specific

61
00:02:04,429 --> 00:02:02,340
way but ultimately what we did was use a

62
00:02:06,920 --> 00:02:04,439
3.5 meter telescope I shined it up at

63
00:02:07,700 --> 00:02:06,930

Pluto we took all this data and because

64
00:02:09,350 --> 00:02:07,710
we're looking through the Earth's

65
00:02:11,059 --> 00:02:09,360
atmosphere we have a bunch of correction

66
00:02:12,110 --> 00:02:11,069
to do in reduction to do so basically we

67
00:02:13,339 --> 00:02:12,120
get really nice images

68
00:02:15,020 --> 00:02:13,349
and then we have to take those images

69
00:02:17,119 --> 00:02:15,030
and turn them into squiggly curvy lines

70
00:02:19,309 --> 00:02:17,129
that actually show us something which

71
00:02:21,050 --> 00:02:19,319
takes a while and is really nice but as

72
00:02:24,229 --> 00:02:21,060
you'll see it can sometimes make them

73
00:02:26,149 --> 00:02:24,239
kind of ugly so matched pairs what we

74
00:02:27,320 --> 00:02:26,159
did was we had a matched pair system so

75
00:02:29,930 --> 00:02:27,330
what makes this important and why this

76
00:02:32,059 --> 00:02:29,940
Pluto surface composition and results

77
00:02:34,490 --> 00:02:32,069
are more important is that we were able

78
00:02:36,410 --> 00:02:34,500
to erase some of the incidences that can

79
00:02:39,380 --> 00:02:36,420
make our data misleading and what we

80
00:02:41,119 --> 00:02:39,390
were able to do was so this is you on

81
00:02:43,220 --> 00:02:41,129
earth all smiley and happy right now

82
00:02:45,319 --> 00:02:43,230
what we call the sub observable attitude

83
00:02:48,380 --> 00:02:45,329
is that Pluto is beneath you so the

84
00:02:49,550 --> 00:02:48,390
enemy's gate is down okay and what this

85
00:02:51,020 --> 00:02:49,560
means is that for each of our matched

86
00:02:52,970 --> 00:02:51,030
pairs we were on the exact same

87
00:02:54,949 --> 00:02:52,980
hemisphere of Pluto at the exact same

88
00:02:56,270 --> 00:02:54,959

lat latitude and longitude which means

89
00:02:58,339 --> 00:02:56,280
that we were staring at the exact same

90
00:03:01,099 --> 00:02:58,349
point every time we made results and

91
00:03:03,500 --> 00:03:01,109
with that it's a 420 day cycle which

92
00:03:06,470 --> 00:03:03,510
means that June of 2013 matches with

93
00:03:09,619 --> 00:03:06,480
August of 2014 June of 2014 matches with

94
00:03:12,199 --> 00:03:09,629
August of 2015 extra etc and what this

95
00:03:13,880 --> 00:03:12,209
does is that you know puto is slightly

96
00:03:15,020 --> 00:03:13,890
more rotated or slightly tilted

97
00:03:17,900 --> 00:03:15,030
differently because we weren't doing

98
00:03:19,430 --> 00:03:17,910
this in this what 420 day cycle we would

99
00:03:20,690 --> 00:03:19,440
be able to say that oh maybe these

100
00:03:22,430 --> 00:03:20,700
changes we're seeing in surface

101
00:03:24,500 --> 00:03:22,440
composition aren't actually due to the

102
00:03:26,000 --> 00:03:24,510
fact that we're seeing changes or in

103
00:03:27,500 --> 00:03:26,010
abundance it's that we're looking at

104
00:03:29,839 --> 00:03:27,510
maybe the polar caps inside the equator

105
00:03:32,629 --> 00:03:29,849
or something like that it's that you

106
00:03:34,039 --> 00:03:32,639
know basically the latitude can change a

107
00:03:36,110 --> 00:03:34,049
little bit but you're still looking at

108
00:03:37,550 --> 00:03:36,120
the same area the same hemisphere same

109
00:03:40,069 --> 00:03:37,560
point so that we're able to erase

110
00:03:43,610 --> 00:03:40,079
viewing geometry errors and rotational

111
00:03:45,979 --> 00:03:43,620
phase errors so over the course of two

112
00:03:49,099 --> 00:03:45,989
thousand 12 2013 William Grundy made a

113
00:03:51,110 --> 00:03:49,109

series of a series of observations of

114
00:03:52,909 --> 00:03:51,120
Pluto and the average them out over the

115
00:03:56,059 --> 00:03:52,919
12 year time span which is what this is

116
00:03:58,430 --> 00:03:56,069
and we ultimately used his last set his

117
00:03:59,869 --> 00:03:58,440
last year of data in June in 2013 to

118
00:04:01,159 --> 00:03:59,879
compare with our own so this is really

119
00:04:02,689 --> 00:04:01,169
important this is great we got an

120
00:04:04,039 --> 00:04:02,699
average spectra of Pluto which means

121
00:04:05,210 --> 00:04:04,049
that we looked at Pluto we got the stuff

122
00:04:06,619 --> 00:04:05,220
we see what's absorbing on its surface

123
00:04:08,930 --> 00:04:06,629
and we can see what it's made out of

124
00:04:10,909 --> 00:04:08,940
that's great but by using our matched

125
00:04:13,460 --> 00:04:10,919
pairs we can study how it's changing

126
00:04:14,930 --> 00:04:13,470
over time on a short time scale and see

127
00:04:16,339 --> 00:04:14,940
if that's actually happening and if

128
00:04:18,529 --> 00:04:16,349
we're seeing these changes in abundances

129
00:04:20,870 --> 00:04:18,539
based off of how deep these curves get

130
00:04:22,219 --> 00:04:20,880
so that's why this is really important

131
00:04:24,409 --> 00:04:22,229
that's ultimately what we're looking for

132
00:04:25,320 --> 00:04:24,419
is can we see changes on Pluto's surface

133
00:04:27,149 --> 00:04:25,330
in the time

134
00:04:29,610 --> 00:04:27,159
of Earth years because we look at

135
00:04:30,990 --> 00:04:29,620
Pluto's orbit it's 248 years long which

136
00:04:32,309 --> 00:04:31,000
means that in the course that's existed

137
00:04:33,330 --> 00:04:32,319
which is only about 80 years that's

138
00:04:35,070 --> 00:04:33,340

about how long we've known fluid is

139
00:04:36,959 --> 00:04:35,080
discovered we haven't even seen half of

140
00:04:38,369 --> 00:04:36,969
its orbit and we've only had spectral

141
00:04:40,409 --> 00:04:38,379
data for the past 40 years from the

142
00:04:42,209 --> 00:04:40,419
1970s which means that we've only seen

143
00:04:44,189 --> 00:04:42,219
what it could possibly be made out of in

144
00:04:45,540 --> 00:04:44,199
40 years and during that time it was

145
00:04:47,279 --> 00:04:45,550
that perihelion which means it was the

146
00:04:49,290 --> 00:04:47,289
closest it can be to the Sun so we've

147
00:04:50,700 --> 00:04:49,300
only seen in approaching the closest and

148
00:04:51,629 --> 00:04:50,710
moving away from the closest the

149
00:04:53,580 --> 00:04:51,639
information we're getting from New

150
00:04:55,050 --> 00:04:53,590
Horizons and ground observing now is

151
00:04:56,490 --> 00:04:55,060
actually the farthest we've ever seen

152
00:04:58,230 --> 00:04:56,500
Pluto from the Sun and been able to get

153
00:04:59,430 --> 00:04:58,240
results so it's kind of an important

154
00:05:01,140 --> 00:04:59,440
time right now because we're seeing

155
00:05:02,490 --> 00:05:01,150
Pluto at a time we've in a place we've

156
00:05:06,029 --> 00:05:02,500
never seen before and we're seeing how

157
00:05:08,490 --> 00:05:06,039
it can be changing so pay attention to

158
00:05:11,070 --> 00:05:08,500
this there's a specific little bloop and

159
00:05:12,809 --> 00:05:11,080
then two tops okay this is a methane

160
00:05:14,159 --> 00:05:12,819
band and it's kind of important for

161
00:05:15,990 --> 00:05:14,169
specifically what we were looking for

162
00:05:16,980 --> 00:05:16,000
which was changes in methane due to the

163
00:05:18,600 --> 00:05:16,990

fact that it would be moving away

164
00:05:20,700 --> 00:05:18,610
getting colder and methane is less

165
00:05:22,290 --> 00:05:20,710
volatile which makes it more inclined to

166
00:05:23,700 --> 00:05:22,300
precipitate down so we were ultimately

167
00:05:26,790 --> 00:05:23,710
trying to see is there a change in

168
00:05:28,189 --> 00:05:26,800
methane so this is our data as I

169
00:05:30,269 --> 00:05:28,199
mentioned it could get really ugly

170
00:05:31,080 --> 00:05:30,279
that's because as I mentioned we're

171
00:05:32,939 --> 00:05:31,090
looking through Earth's atmosphere

172
00:05:35,040 --> 00:05:32,949
Earth's atmosphere has a bunch of water

173
00:05:36,959 --> 00:05:35,050
vapor that likes to gunk up our data our

174
00:05:39,420 --> 00:05:36,969
Corrections weren't going so well this

175
00:05:41,610 --> 00:05:39,430
week so because of that we have a lot of

176
00:05:43,529 --> 00:05:41,620
ugliness but you can still see the

177
00:05:45,420 --> 00:05:43,539
little blip and a double hump structure

178
00:05:46,709 --> 00:05:45,430
which is still methane so we're still

179
00:05:47,939 --> 00:05:46,719
able to use this because when we're

180
00:05:49,740 --> 00:05:47,949
comparing this to the past ones they

181
00:05:51,719 --> 00:05:49,750
also have these telluric absorption

182
00:05:53,850 --> 00:05:51,729
areas so they will cancel out eventually

183
00:05:56,339 --> 00:05:53,860
and work out to give us an answer that's

184
00:05:58,890 --> 00:05:56,349
kind of correct and can get better which

185
00:06:00,510 --> 00:05:58,900
is what we're aiming for but looking at

186
00:06:02,159 --> 00:06:00,520
that same methane hump and subtracting

187
00:06:05,279 --> 00:06:02,169
these two areas after normalizing there

188
00:06:07,230 --> 00:06:05,289

the y axis which is albedo we're able to

189
00:06:10,140 --> 00:06:07,240
get this this doesn't look very pretty

190
00:06:12,990 --> 00:06:10,150
either but if you notice right here at

191
00:06:15,930 --> 00:06:13,000
just about the same wavelength as right

192
00:06:17,550 --> 00:06:15,940
here there's a dip and what this did

193
00:06:20,339 --> 00:06:17,560
means is so that this was taken from

194
00:06:23,670 --> 00:06:20,349
subtracting data from 2014 from data

195
00:06:26,159 --> 00:06:23,680
from 2015 or vice versa data from 2015

196
00:06:28,260 --> 00:06:26,169
from data from 2014 so we're able to say

197
00:06:30,629 --> 00:06:28,270
it's because this is a negative dip we

198
00:06:32,459 --> 00:06:30,639
know that there was more methane in 2015

199
00:06:34,079 --> 00:06:32,469
than there was in 2014 and although this

200
00:06:36,360 --> 00:06:34,089
is still plenty Mary see it could

201
00:06:37,850 --> 00:06:36,370
potentially be an increase we're hoping

202
00:06:39,200 --> 00:06:37,860
that it actually is

203
00:06:40,580 --> 00:06:39,210
and what this means that we are seeing

204
00:06:42,529 --> 00:06:40,590
an increase in methane and a period of

205
00:06:44,300 --> 00:06:42,539
just one year and I mean we're looking

206
00:06:46,939 --> 00:06:44,310
at ultimately a course of three to four

207
00:06:48,350 --> 00:06:46,949
years but in one year potentially

208
00:06:49,730 --> 00:06:48,360
there's already a difference which is

209
00:06:51,529 --> 00:06:49,740
really important as I mentioned because

210
00:06:53,209 --> 00:06:51,539
we are moving away Pluto's moving away

211
00:06:54,619 --> 00:06:53,219
from the Sun that we're seeing it get

212
00:06:56,420 --> 00:06:54,629
colder we're seeing it precipitate down

213
00:06:57,890 --> 00:06:56,430

and we might actually be able to see how

214
00:06:59,830 --> 00:06:57,900
its surface is evolving over the course

215
00:07:02,420 --> 00:06:59,840
of just its orbit which is pretty cool

216
00:07:04,939 --> 00:07:02,430
so how does this really tasker biology

217
00:07:07,879 --> 00:07:04,949
so what you guys know as chin-ups I know

218
00:07:09,529 --> 00:07:07,889
a sponge which is a Mexican pastry that

219
00:07:12,409 --> 00:07:09,539
basically has jelly marshmallows on top

220
00:07:13,999 --> 00:07:12,419
of a cookie and I just like it much

221
00:07:17,300 --> 00:07:14,009
better than chin-ups cuz spunk just so

222
00:07:18,709 --> 00:07:17,310
much more fun to say so out of the six

223
00:07:20,439 --> 00:07:18,719
elements that we know are required for

224
00:07:22,760 --> 00:07:20,449
macromolecules and for life eventually

225
00:07:24,769 --> 00:07:22,770
Pluto has four of them it has methane

226
00:07:26,480 --> 00:07:24,779
carbon monoxide and nitrogen so it's

227
00:07:28,279 --> 00:07:26,490
already two-thirds of the way there and

228
00:07:30,170 --> 00:07:28,289
we know that it's not doing too much but

229
00:07:31,909 --> 00:07:30,180
we know cryovolcanism might be an idea

230
00:07:33,439 --> 00:07:31,919
we know that there's water ice we know

231
00:07:35,540 --> 00:07:33,449
that stuff's going on and with this

232
00:07:36,830 --> 00:07:35,550
increase of methane on the surface we

233
00:07:38,869 --> 00:07:36,840
might be seeing some really interesting

234
00:07:40,610 --> 00:07:38,879
things going on so it's kind of

235
00:07:42,019 --> 00:07:40,620
important that it already has these four

236
00:07:43,879 --> 00:07:42,029
and what these four could mean for the

237
00:07:45,200 --> 00:07:43,889
beginning stages of macromolecules like

238
00:07:47,629 --> 00:07:45,210

carbohydrates are non meth and

239
00:07:51,079 --> 00:07:47,639
hydrocarbons like ethylene ethane and a

240
00:07:52,519 --> 00:07:51,089
ceiling so it's pretty cool so UV

241
00:07:55,820 --> 00:07:52,529
radiation is also something really

242
00:07:57,740 --> 00:07:55,830
interesting Pluto gets about 1 900 the

243
00:07:59,269 --> 00:07:57,750
UV radiation that we that we receive and

244
00:08:00,260 --> 00:07:59,279
that's just too its atmosphere that's

245
00:08:02,809 --> 00:08:00,270
not counting what gets through its

246
00:08:04,670 --> 00:08:02,819
surface well methane does must most of

247
00:08:06,200 --> 00:08:04,680
the absorbing in its atmosphere well if

248
00:08:08,119 --> 00:08:06,210
methane is the one that's precipitating

249
00:08:09,619 --> 00:08:08,129
down what's going to happen to its

250
00:08:10,999 --> 00:08:09,629
atmosphere now the UV radiation isn't

251
00:08:12,860 --> 00:08:11,009
being blocked their the UV radiation is

252
00:08:15,350 --> 00:08:12,870
actually hitting its surface so if we

253
00:08:16,550 --> 00:08:15,360
revisit Pluto's surface there's a lot of

254
00:08:17,929 --> 00:08:16,560
funky things going on with Sputnik

255
00:08:19,100 --> 00:08:17,939
Planum we don't know what's going on

256
00:08:20,480 --> 00:08:19,110
there we just found out a bunch of

257
00:08:22,909 --> 00:08:20,490
interesting information no one else

258
00:08:24,740 --> 00:08:22,919
going on but over here which you can't

259
00:08:27,469 --> 00:08:24,750
really read it says Cthulhu reggio and

260
00:08:29,779 --> 00:08:27,479
Casula radio is basically organic goop

261
00:08:32,389 --> 00:08:29,789
so the best analogy I can come up with

262
00:08:34,279 --> 00:08:32,399
is if you have a big ol pile of snow in

263
00:08:36,230 --> 00:08:34,289

a driveway or parking lot and it melts

264
00:08:38,689 --> 00:08:36,240
away what you're left with is like black

265
00:08:40,399 --> 00:08:38,699
gunky solid goop right that's basically

266
00:08:43,040 --> 00:08:40,409
what that is except its methane instead

267
00:08:45,319 --> 00:08:43,050
of water ice and it's toxic you know

268
00:08:47,600 --> 00:08:45,329
would probably kill us but it's goop and

269
00:08:49,100 --> 00:08:47,610
it's solid goop coming from methane so

270
00:08:51,550 --> 00:08:49,110
if more of this methane is precipitating

271
00:08:54,070 --> 00:08:51,560
down in the course of its 248

272
00:08:55,990 --> 00:08:54,080
48 year orbit we could be seeing more of

273
00:08:57,610 --> 00:08:56,000
Pluto turning to goop which would be

274
00:08:59,170 --> 00:08:57,620
interesting because we know that if it's

275
00:09:00,519 --> 00:08:59,180
going to be like this it means that

276
00:09:02,200 --> 00:09:00,529
there's more absorption happening at the

277
00:09:03,880 --> 00:09:02,210
surface instead of the atmosphere which

278
00:09:06,040 --> 00:09:03,890
could potentially change other types of

279
00:09:08,530 --> 00:09:06,050
composition and cause interesting

280
00:09:09,670 --> 00:09:08,540
reactions and interesting things to

281
00:09:11,110 --> 00:09:09,680
happen on Pluto's surface that we

282
00:09:13,210 --> 00:09:11,120
haven't been able to observe before and

283
00:09:14,620 --> 00:09:13,220
this is kind of important because when

284
00:09:17,590 --> 00:09:14,630
you look at it in a big picture scale

285
00:09:19,420 --> 00:09:17,600
Kuiper belt objects far outnumber other

286
00:09:21,280 --> 00:09:19,430
types of planets like Mars or earth-like

287
00:09:22,990 --> 00:09:21,290
planets and because of that if we aren't

288
00:09:24,250 --> 00:09:23,000

studying them and seeing these changes

289
00:09:26,019 --> 00:09:24,260
and seeing these evolutions just because

290
00:09:27,610 --> 00:09:26,029
they're on a really long time scale we

291
00:09:29,350 --> 00:09:27,620
don't know what the full potential is of

292
00:09:31,060 --> 00:09:29,360
our entire universe the fact of the

293
00:09:32,110 --> 00:09:31,070
matter is is that looking at Pluto we

294
00:09:33,579 --> 00:09:32,120
know it's going to change and we've

295
00:09:35,110 --> 00:09:33,589
never seen it change this way before and

296
00:09:37,060 --> 00:09:35,120
it's a great way to look at it because

297
00:09:38,680 --> 00:09:37,070
we know that methane is precipitating we

298
00:09:40,570 --> 00:09:38,690
can study that we can see how it's

299
00:09:42,220 --> 00:09:40,580
changing over this next you know twenty

300
00:09:43,960 --> 00:09:42,230
to a hundred years as it moves farther

301
00:09:45,370 --> 00:09:43,970
and farther away and we've still never

302
00:09:47,920 --> 00:09:45,380
seen it when it's at the farthest point

303
00:09:49,540 --> 00:09:47,930
it gets from the Sun so looking at all

304
00:09:50,860 --> 00:09:49,550
of these it's really interesting because

305
00:09:52,540 --> 00:09:50,870
we just don't know what's going to

306
00:09:54,400 --> 00:09:52,550
happen and using it as an example to

307
00:09:56,980 --> 00:09:54,410
look at other you know planets and other

308
00:09:58,600 --> 00:09:56,990
galaxies or solar systems is really

309
00:10:00,820 --> 00:09:58,610
important just for understanding how our

310
00:10:02,260 --> 00:10:00,830
planets actually evolved just on a basic

311
00:10:03,490 --> 00:10:02,270
planetary evolution scale we can look at

312
00:10:05,079 --> 00:10:03,500
our earth we can look at Mars we can

313
00:10:06,940 --> 00:10:05,089

guess and make theories and figure out

314
00:10:08,110 --> 00:10:06,950
what's going on but Pluto we can

315
00:10:09,460 --> 00:10:08,120
actually see what's going on we're

316
00:10:10,750 --> 00:10:09,470
seeing it change over just the course of

317
00:10:12,850 --> 00:10:10,760
two hundred years which is really cool

318
00:10:14,770 --> 00:10:12,860
and this is just really interesting so

319
00:10:16,480 --> 00:10:14,780
this is how our images have evolved

320
00:10:18,460 --> 00:10:16,490
since the 1990s so this is like our

321
00:10:20,440 --> 00:10:18,470
first ever image of Pluto and this is

322
00:10:21,820 --> 00:10:20,450
what we got last year so just to put it

323
00:10:23,050 --> 00:10:21,830
in perspective you know in 20 years

324
00:10:24,790 --> 00:10:23,060
we're seeing a huge amount of

325
00:10:26,200 --> 00:10:24,800
information gained and we're only going

326
00:10:27,880 --> 00:10:26,210
to see more because it's moving away

327
00:10:29,620 --> 00:10:27,890
because it's getting farther away

328
00:10:31,420 --> 00:10:29,630
because we're able to already track this

329
00:10:33,460 --> 00:10:31,430
precipitation it's really cool and

330
00:10:35,650 --> 00:10:33,470
really interesting and this short-term

331
00:10:37,510 --> 00:10:35,660
scales give us a better idea of how

332
00:10:38,980 --> 00:10:37,520
things are going to evolve and give us

333
00:10:47,290 --> 00:10:38,990
an idea of what to look for in the

334
00:10:47,300 --> 00:11:01,760
questions

335
00:11:06,090 --> 00:11:04,710
hello oh um this might be a very

336
00:11:08,730 --> 00:11:06,100
ignorant question because I'm not a

337
00:11:11,280 --> 00:11:08,740
remote sensing person how do you filter

338
00:11:15,090 --> 00:11:11,290

out methane in our atmosphere vs.

339
00:11:16,949 --> 00:11:15,100
methane on Pluto so there's not what

340
00:11:18,329 --> 00:11:16,959
we're looking through the main thing

341
00:11:20,699 --> 00:11:18,339
that we actually get blocked from our

342
00:11:22,260 --> 00:11:20,709
atmosphere is water vapor everything

343
00:11:24,269 --> 00:11:22,270
else is kind of negligible because we're

344
00:11:25,470 --> 00:11:24,279
looking past it and it doesn't absorb as

345
00:11:28,710 --> 00:11:25,480
much for what we're seeing so we don't

346
00:11:30,000 --> 00:11:28,720
have to really care about it like what

347
00:11:31,500 --> 00:11:30,010
we're seeing like Pluto's atmosphere for

348
00:11:32,370 --> 00:11:31,510
instance doesn't affect our data we're

349
00:11:34,050 --> 00:11:32,380
just looking at Pluto's surface

350
00:11:36,660 --> 00:11:34,060
composition but the water vapor and our

351
00:11:38,550 --> 00:11:36,670
absorption really affects how our data

352
00:11:40,800 --> 00:11:38,560
is changing but our methane doesn't

353
00:11:47,340 --> 00:11:40,810
really as far as I know unless I'm

354
00:11:50,790 --> 00:11:47,350
totally wrong okay so this might be kind

355
00:11:53,610 --> 00:11:50,800
of out there but um you know on Titan we

356
00:11:56,699 --> 00:11:53,620
have these possible lakes of

357
00:11:58,920 --> 00:11:56,709
hydrocarbons um would you expect to see

358
00:12:01,500 --> 00:11:58,930
anything in liquid phase on the surface

359
00:12:03,630 --> 00:12:01,510
of Pluto probably not it's way too cold

360
00:12:05,699 --> 00:12:03,640
but we are seeing salmon that cthulhu

361
00:12:07,829 --> 00:12:05,709
regio we're seeing tollens so we're

362
00:12:09,389 --> 00:12:07,839
seeing a lot of non methane hydrocarbons

363
00:12:10,829 --> 00:12:09,399

which brings us to say that we'd

364
00:12:13,260 --> 00:12:10,839
probably see them in that goopy maybe

365
00:12:14,400 --> 00:12:13,270
snow ish kind of form or an ice form but

366
00:12:21,319 --> 00:12:14,410
we really wouldn't see it in a liquid

367
00:12:26,670 --> 00:12:25,199
other questions yes I had a question so

368
00:12:29,550 --> 00:12:26,680
when you were talking about how you were

369
00:12:32,370 --> 00:12:29,560
going to get more organic goop deposited

370
00:12:35,970 --> 00:12:32,380
on the surface um would you expect that

371
00:12:37,170 --> 00:12:35,980
that organic material was being was

372
00:12:38,880 --> 00:12:37,180
already made or do you think you're

373
00:12:40,500 --> 00:12:38,890
going to be making the material from

374
00:12:43,800 --> 00:12:40,510
sort of surface processes once the

375
00:12:45,870 --> 00:12:43,810
methane is um snowed out or whatever so

376
00:12:47,790 --> 00:12:45,880
the goop is coming from the UV radiation

377
00:12:49,680 --> 00:12:47,800
reacting with methane so the goop is

378
00:12:51,569 --> 00:12:49,690
just basically non methane hydrocarbons

379
00:12:53,010 --> 00:12:51,579
so it's kind of being made in the

380
00:12:54,360 --> 00:12:53,020
atmosphere and kind of being made once

381
00:12:56,310 --> 00:12:54,370
it hits the surface it's just the

382
00:12:57,480 --> 00:12:56,320
reaction of methane with UV radiation so

383
00:12:59,460 --> 00:12:57,490
it just depends on where it's heading

384
00:13:00,690 --> 00:12:59,470
but once it precipitates down that's

385
00:13:02,250 --> 00:13:00,700
just methane fall into the service

386
00:13:03,630 --> 00:13:02,260
because it's too cold so it's kind of

387
00:13:05,460 --> 00:13:03,640
already there it's more what's it going

388
00:13:06,600 --> 00:13:05,470

to do once it gets there is that's what

389
00:13:08,460 --> 00:13:06,610
we're interested out because then it's

390
00:13:09,960 --> 00:13:08,470
retaining more UV radiation and other

391
00:13:12,329 --> 00:13:09,970
types of radiation absorbing all of that

392
00:13:13,860 --> 00:13:12,339
so that so I don't know what it's going

393
00:13:14,380 --> 00:13:13,870
to do but it's kind of being made just

394
00:13:17,190 --> 00:13:14,390
by there