1
00:00:07,670 --> 00:00:05,190
today april 22nd represents earth day

2
00:00:09,750 --> 00:00:07,680
around the world and uh there's no

3
00:00:12,789 --> 00:00:09,760
better way for us here in mission

4
00:00:15,990 --> 00:00:12,799
control to uh celebrate earth day than

5
00:00:18,710 --> 00:00:16,000
to have a special guest joining us for

6
00:00:21,670 --> 00:00:18,720
the uh i guess we can call it a

7
00:00:23,990 --> 00:00:21,680
celebration and that is dr william

8
00:00:26,390 --> 00:00:24,000
stefanoff he is the associate space

9
00:00:29,269 --> 00:00:26,400
station program scientist for earth

10
00:00:31,669 --> 00:00:29,279
observations you're also the lead for

11
00:00:33,910 --> 00:00:31,679
earth science and remote sensing unit

12
00:00:36,069 --> 00:00:33,920
here at the johnson space center

13
00:00:38,229 --> 00:00:36,079

welcome will thanks kyle good to have

14
00:00:40,869 --> 00:00:38,239
you here

15
00:00:42,709 --> 00:00:40,879
we know that for years and years the

16
00:00:44,549 --> 00:00:42,719
one of the tasks that the crew loves to

17
00:00:46,389 --> 00:00:44,559
do is look out the window but it's a lot

18
00:00:48,790 --> 00:00:46,399
more important to that for the for the

19
00:00:50,709 --> 00:00:48,800
team here on the ground but why is it so

20
00:00:51,830 --> 00:00:50,719
valuable to to look at the earth from

21
00:00:53,750 --> 00:00:51,840
the ground

22
00:00:55,750 --> 00:00:53,760
well it's it's part of a long-standing

23
00:00:57,510 --> 00:00:55,760
tradition of looking at our planet from

24
00:00:59,670 --> 00:00:57,520
space

25
00:01:01,670 --> 00:00:59,680
the perspective from orbit allows us to

26
00:01:03,750 --> 00:01:01,680
see things that you can't really see

27
00:01:05,830 --> 00:01:03,760
from the ground it also allows you to

28
00:01:08,070 --> 00:01:05,840
collect data that you you our eyes

29
00:01:09,830 --> 00:01:08,080
necessarily can't recognize by looking

30
00:01:12,550 --> 00:01:09,840
at different wavelength regions

31
00:01:14,710 --> 00:01:12,560
and uh also enables us to collect data

32
00:01:16,950 --> 00:01:14,720
over remote parts of the earth on a very

33
00:01:19,109 --> 00:01:16,960
regular basis that might be impossible

34
00:01:20,390 --> 00:01:19,119
or difficult to get out on the ground to

35
00:01:22,310 --> 00:01:20,400
actually take

36
00:01:24,789 --> 00:01:22,320
specific samples or specimens or

37
00:01:26,870 --> 00:01:24,799
measurements of right so talk a little

38
00:01:28,870 --> 00:01:26,880

bit about the the different kinds of

39
00:01:31,109 --> 00:01:28,880
cameras we see earth views all the time

40
00:01:32,789 --> 00:01:31,119
obviously but talk to us about the

41
00:01:34,469 --> 00:01:32,799
different kind of cameras the sensors

42
00:01:36,550 --> 00:01:34,479
that are aboard the space station right

43
00:01:39,030 --> 00:01:36,560
now that that are pointed down or

44
00:01:40,710 --> 00:01:39,040
looking at us here on the earth okay

45
00:01:42,149 --> 00:01:40,720
right now i'm going to focus on the nasa

46
00:01:43,990 --> 00:01:42,159
sensors although our international

47
00:01:45,749 --> 00:01:44,000
partners also have their own systems on

48
00:01:47,510 --> 00:01:45,759
board i'll start on the exterior of the

49
00:01:49,830 --> 00:01:47,520
station what you're looking at right now

50
00:01:52,950 --> 00:01:49,840
is the japanese experiment module and

51
00:01:54,710 --> 00:01:52,960
its exposed facility and if you follow

52
00:01:56,950 --> 00:01:54,720
the the canadian arm at the bottom of

53
00:01:58,310 --> 00:01:56,960
the image out to its end and then look

54
00:02:00,389 --> 00:01:58,320
pretty much straight up towards the top

55
00:02:02,069 --> 00:02:00,399
of the photo you see a white box that

56
00:02:04,069 --> 00:02:02,079
looks like its front is cut out right

57
00:02:06,230 --> 00:02:04,079
and there's a sort of a mylar wrapped

58
00:02:08,229 --> 00:02:06,240
instrument package in there inside that

59
00:02:09,749 --> 00:02:08,239
instrument package sits the the hico the

60
00:02:10,630 --> 00:02:09,759
hyperspectral imager for the coastal

61
00:02:12,790 --> 00:02:10,640
ocean

62
00:02:14,869 --> 00:02:12,800
and that is a a sensor that is

63
00:02:16,869 --> 00:02:14,879

specifically tasked as its name suggests

64
00:02:19,430 --> 00:02:16,879
on looking at oceanic processes along

65
00:02:22,070 --> 00:02:19,440
the coasts it's a hyperspectral sensor

66
00:02:24,309 --> 00:02:22,080
which means it looks at a large portion

67
00:02:26,309 --> 00:02:24,319
of the electromagnetic spectrum broader

68
00:02:29,910 --> 00:02:26,319
than our own eyes can see

69
00:02:32,550 --> 00:02:29,920
but it chops that spectrum up into 128

70
00:02:34,150 --> 00:02:32,560
different little slices and by looking

71
00:02:35,910 --> 00:02:34,160
at the energy that returns back to the

72
00:02:38,150 --> 00:02:35,920
sensor from the earth's surface in each

73
00:02:40,470 --> 00:02:38,160
of those little slices you can actually

74
00:02:42,070 --> 00:02:40,480
build uh image spectra these can be

75
00:02:44,790 --> 00:02:42,080
thought of as fingerprints if you will

76
00:02:46,710 --> 00:02:44,800
for specific chemicals or materials on

77
00:02:47,670 --> 00:02:46,720
the earth's surface so

78
00:02:49,589 --> 00:02:47,680
some of the things that they've used

79
00:02:51,750 --> 00:02:49,599
that sensor for are

80
00:02:54,309 --> 00:02:51,760
the epa in particular has looked at

81
00:02:55,990 --> 00:02:54,319
water clarity and water quality for one

82
00:02:57,670 --> 00:02:56,000
thing and they've been developing apps

83
00:02:59,670 --> 00:02:57,680
that people can use to see what the

84
00:03:01,509 --> 00:02:59,680
water quality is at a particular spot

85
00:03:03,270 --> 00:03:01,519
that they might be say wanting to go to

86
00:03:04,790 --> 00:03:03,280
swim in or so

87
00:03:06,309 --> 00:03:04,800
now we're going to move inside the space

88
00:03:08,229 --> 00:03:06,319

station because we have sensors both

89
00:03:10,550 --> 00:03:08,239
exterior and interior here you see a

90
00:03:13,110 --> 00:03:10,560
picture of a former iss commander chris

91
00:03:15,750 --> 00:03:13,120
hadfield and floating there in front of

92
00:03:18,550 --> 00:03:15,760
him is the iserv camera system and this

93
00:03:20,710 --> 00:03:18,560
is the iss severe environmental and

94
00:03:22,949 --> 00:03:20,720
research visualization system it was

95
00:03:25,430 --> 00:03:22,959
specifically built to support the nasa

96
00:03:27,430 --> 00:03:25,440
surveyor program which collects data and

97
00:03:29,190 --> 00:03:27,440
helps developing countries develop

98
00:03:31,110 --> 00:03:29,200
things like maps of agriculture respond

99
00:03:33,030 --> 00:03:31,120
to disasters and things of that nature

100
00:03:35,030 --> 00:03:33,040
this is the iserv camera system mounted

101
00:03:37,190 --> 00:03:35,040
in the wharf which is the window

102
00:03:39,670 --> 00:03:37,200
observational research facility this is

103
00:03:41,350 --> 00:03:39,680
inside the u.s destiny lab module and

104
00:03:43,030 --> 00:03:41,360
it's specifically designed for remote

105
00:03:45,350 --> 00:03:43,040
sensing instruments to be positioned

106
00:03:48,229 --> 00:03:45,360
inside and look through the destiny lab

107
00:03:50,390 --> 00:03:48,239
window and that's a very polished window

108
00:03:52,070 --> 00:03:50,400
compared to other windows on the station

109
00:03:54,470 --> 00:03:52,080
right specifically for this type of

110
00:03:56,149 --> 00:03:54,480
observation exactly in fact it's uh it's

111
00:03:59,190 --> 00:03:56,159
the finest optical quality window that's

112
00:04:01,429 --> 00:03:59,200
ever been sent up on a manned spacecraft

113
00:04:03,270 --> 00:04:01,439

and the icer what the icer system is

114
00:04:04,710 --> 00:04:03,280
it's kind of an innovative design it's a

115
00:04:06,149 --> 00:04:04,720
it's a high-end commercial off-the-shelf

116
00:04:07,350 --> 00:04:06,159
digital camera

117
00:04:08,949 --> 00:04:07,360
mated to

118
00:04:10,630 --> 00:04:08,959
a casa grain

119
00:04:12,149 --> 00:04:10,640
astronomers telescope very similar to

120
00:04:14,550 --> 00:04:12,159
what an amateur astronomer might buy at

121
00:04:16,229 --> 00:04:14,560
home and putting those two together

122
00:04:17,830 --> 00:04:16,239
allows this camera system to collect

123
00:04:19,749 --> 00:04:17,840
very very high resolution data on the

124
00:04:20,949 --> 00:04:19,759
earth's surface about three meters per

125
00:04:22,710 --> 00:04:20,959
pixel

126
00:04:23,749 --> 00:04:22,720
still inside the other sensor system

127
00:04:26,230 --> 00:04:23,759
that we have

128
00:04:27,990 --> 00:04:26,240
is the crew earth observations facility

129
00:04:29,350 --> 00:04:28,000
and this is the this is the kind of data

130
00:04:31,350 --> 00:04:29,360
that's been collected for the longest

131
00:04:33,430 --> 00:04:31,360
time period on space station uh

132
00:04:35,430 --> 00:04:33,440
astronaut photos taken with handheld

133
00:04:37,830 --> 00:04:35,440
digital cameras out the station windows

134
00:04:40,469 --> 00:04:37,840
has been collected since 2000 and here

135
00:04:43,270 --> 00:04:40,479
you see nasa astronaut don pettit in the

136
00:04:44,629 --> 00:04:43,280
cupola and he actually has a dual camera

137
00:04:47,030 --> 00:04:44,639
system that he rigged up where he's

138
00:04:48,390 --> 00:04:47,040

taking infrared data with one camera and

139
00:04:49,909 --> 00:04:48,400
visible wavelength data with the other

140
00:04:51,749 --> 00:04:49,919
camera

141
00:04:53,670 --> 00:04:51,759
and so all these systems put together

142
00:04:55,189 --> 00:04:53,680
enabled the iss to collect a wide

143
00:04:56,390 --> 00:04:55,199
variety of data

144
00:04:58,550 --> 00:04:56,400
for a number of different surface

145
00:04:59,830 --> 00:04:58,560
processes we're also going to have

146
00:05:02,310 --> 00:04:59,840
actually going up this year being

147
00:05:03,749 --> 00:05:02,320
installed this year two new sensors the

148
00:05:06,070 --> 00:05:03,759
the cat system the cloud aerosol

149
00:05:08,550 --> 00:05:06,080
transport system and the iss rapid scat

150
00:05:10,550 --> 00:05:08,560
system and what cats will do is an

151
00:05:12,310 --> 00:05:10,560
atmospheric sensor and what it does is

152
00:05:14,950 --> 00:05:12,320
uses a laser system to look at aerosol

153
00:05:16,790 --> 00:05:14,960
concentrations in the earth's atmosphere

154
00:05:19,110 --> 00:05:16,800
and that relates directly to climate

155
00:05:21,110 --> 00:05:19,120
change investigations it provides data

156
00:05:22,469 --> 00:05:21,120
useful for determining how much energy

157
00:05:24,150 --> 00:05:22,479
is absorbed

158
00:05:25,270 --> 00:05:24,160
by the atmosphere and reflected back

159
00:05:27,749 --> 00:05:25,280
into space

160
00:05:29,189 --> 00:05:27,759
um the the rapid scat system looks at

161
00:05:30,710 --> 00:05:29,199
the sea surface looks at wind patterns

162
00:05:33,270 --> 00:05:30,720
on the sea surface and that also gets

163
00:05:35,990 --> 00:05:33,280

back to looking at how in a warming

164
00:05:37,430 --> 00:05:36,000
global climate how surface circulation

165
00:05:38,390 --> 00:05:37,440
patterns change

166
00:05:39,590 --> 00:05:38,400
well

167
00:05:40,950 --> 00:05:39,600
now you've talked a little bit about

168
00:05:43,110 --> 00:05:40,960
some of the instrumentation on this

169
00:05:45,430 --> 00:05:43,120
station but let's talk now

170
00:05:48,629 --> 00:05:45,440
about maybe show us or talk to us about

171
00:05:50,230 --> 00:05:48,639
some examples of of what we've learned

172
00:05:51,670 --> 00:05:50,240
thanks to some of those instruments on

173
00:05:52,950 --> 00:05:51,680
the station okay

174
00:05:55,189 --> 00:05:52,960
this slide what you're seeing right now

175
00:05:57,270 --> 00:05:55,199
this is a hico scene

176
00:05:59,110 --> 00:05:57,280
uh of galveston bay

177
00:06:00,309 --> 00:05:59,120
and uh fortunately jsc is just off the

178
00:06:01,670 --> 00:06:00,319
edge of the image there we're not we're

179
00:06:04,070 --> 00:06:01,680
not quite there yet but about the

180
00:06:05,909 --> 00:06:04,080
greater galveston-based system and i

181
00:06:07,830 --> 00:06:05,919
mentioned earlier this kind of data is

182
00:06:09,029 --> 00:06:07,840
being used by groups like the epa also

183
00:06:10,629 --> 00:06:09,039
other groups

184
00:06:11,670 --> 00:06:10,639
particularly a group that i lead here at

185
00:06:14,230 --> 00:06:11,680
jsc

186
00:06:16,309 --> 00:06:14,240
looking at regional climate change and

187
00:06:18,710 --> 00:06:16,319
hazard and potential

188
00:06:21,510 --> 00:06:18,720

sustainability issues for the center

189
00:06:22,550 --> 00:06:21,520
itself uh this is a hyperspectral sensor

190
00:06:24,230 --> 00:06:22,560
but right now you're looking at a

191
00:06:25,830 --> 00:06:24,240
visible camera sort of a visible

192
00:06:28,150 --> 00:06:25,840
wavelength view

193
00:06:30,230 --> 00:06:28,160
so it's more intuitive to our eyes

194
00:06:32,230 --> 00:06:30,240
but if you go into that each pixel on

195
00:06:34,230 --> 00:06:32,240
that image you can pull out spectra

196
00:06:36,309 --> 00:06:34,240
that's useful for looking at things like

197
00:06:37,590 --> 00:06:36,319
like i said water turbidity or presence

198
00:06:39,029 --> 00:06:37,600
of algae

199
00:06:41,029 --> 00:06:39,039
certain bacteria different chemical

200
00:06:43,029 --> 00:06:41,039
constituents and plants all things that

201
00:06:45,110 --> 00:06:43,039
are useful for looking at how climate

202
00:06:46,309 --> 00:06:45,120
reacts different changes right

203
00:06:47,270 --> 00:06:46,319
this is a

204
00:06:49,029 --> 00:06:47,280
image

205
00:06:49,990 --> 00:06:49,039
on the right taken by the isrf camera

206
00:06:52,790 --> 00:06:50,000
system

207
00:06:55,110 --> 00:06:52,800
during floods during 2013 that happened

208
00:06:56,550 --> 00:06:55,120
up in calgary canada

209
00:06:59,110 --> 00:06:56,560
and what you see on the left is a

210
00:07:00,870 --> 00:06:59,120
pre-flood image taken by uh from the

211
00:07:02,150 --> 00:07:00,880
google earth software environment and on

212
00:07:04,309 --> 00:07:02,160
the right you have the isurf camera

213
00:07:07,189 --> 00:07:04,319

system and this was data collected in

214
00:07:08,469 --> 00:07:07,199
response to this this hazard event and

215
00:07:10,150 --> 00:07:08,479
the data was sent directly to the

216
00:07:12,309 --> 00:07:10,160
canadian response

217
00:07:14,070 --> 00:07:12,319
agencies for use in their in their

218
00:07:15,110 --> 00:07:14,080
mapping of the flooded areas

219
00:07:16,790 --> 00:07:15,120
and uh

220
00:07:19,510 --> 00:07:16,800
sending aid to the proper parts of

221
00:07:21,990 --> 00:07:19,520
calgary and this is actually an activity

222
00:07:23,029 --> 00:07:22,000
that all of the nasa iss sensors

223
00:07:25,189 --> 00:07:23,039
including some of the international

224
00:07:26,950 --> 00:07:25,199
partner sensors are engaged in as part

225
00:07:28,950 --> 00:07:26,960
of the international disaster charter

226
00:07:30,629 --> 00:07:28,960
where uh if there's a global natural

227
00:07:33,029 --> 00:07:30,639
hazard that takes place

228
00:07:34,710 --> 00:07:33,039
the iss sensors if they can they can

229
00:07:36,629 --> 00:07:34,720
collect data that is then given to the

230
00:07:38,230 --> 00:07:36,639
people in those countries for their use

231
00:07:40,710 --> 00:07:38,240
and their hazard response

232
00:07:42,230 --> 00:07:40,720
and this is a image sequence taken by

233
00:07:44,550 --> 00:07:42,240
the crew earth observations facility the

234
00:07:46,950 --> 00:07:44,560
handheld digital cameras of the uppsala

235
00:07:48,710 --> 00:07:46,960
glacier in south america and what we're

236
00:07:50,550 --> 00:07:48,720
seeing is three time periods and what

237
00:07:52,309 --> 00:07:50,560
we're looking at is the snout the end of

238
00:07:54,790 --> 00:07:52,319

the glacier where it goes off into that

239
00:07:56,830 --> 00:07:54,800
fjord into the water and being able to

240
00:08:00,070 --> 00:07:56,840
track how that has moved backwards in

241
00:08:01,990 --> 00:08:00,080
time primarily due to loss of glacial

242
00:08:03,670 --> 00:08:02,000
ice due to warming in the region and

243
00:08:04,629 --> 00:08:03,680
these images were all taken at the same

244
00:08:05,990 --> 00:08:04,639
season

245
00:08:07,189 --> 00:08:06,000
so we can control that we're not just

246
00:08:08,309 --> 00:08:07,199
looking at a seasonal variation we're

247
00:08:10,150 --> 00:08:08,319
actually seeing

248
00:08:13,830 --> 00:08:10,160
actual retreat of that sensor that

249
00:08:15,350 --> 00:08:13,840
sensor excuse me that glacier over time

250
00:08:17,110 --> 00:08:15,360
well um

251
00:08:19,670 --> 00:08:17,120
there are obviously other earth

252
00:08:20,869 --> 00:08:19,680
observing spacecraft up there satellites

253
00:08:22,710 --> 00:08:20,879
and such but

254
00:08:24,550 --> 00:08:22,720
are there advantages

255
00:08:26,390 --> 00:08:24,560
obviously there are but can you talk a

256
00:08:29,029 --> 00:08:26,400
little bit about the advantages that we

257
00:08:30,469 --> 00:08:29,039
have with the systems on the station

258
00:08:32,790 --> 00:08:30,479
compared to those

259
00:08:35,190 --> 00:08:32,800
well the main advantage right now

260
00:08:36,870 --> 00:08:35,200
is in the iss orbit itself

261
00:08:38,469 --> 00:08:36,880
most of the the traditional remote

262
00:08:40,389 --> 00:08:38,479
sensing systems that nasa and other

263
00:08:42,469 --> 00:08:40,399

countries have are polar orbiting

264
00:08:44,470 --> 00:08:42,479
satellites so they're designed to cover

265
00:08:46,389 --> 00:08:44,480
the whole whole surface of the earth at

266
00:08:48,310 --> 00:08:46,399
approximately the same time of day so

267
00:08:49,509 --> 00:08:48,320
the sun's illuminating it at the same

268
00:08:51,030 --> 00:08:49,519
time

269
00:08:52,550 --> 00:08:51,040
and what this does for most of these

270
00:08:54,470 --> 00:08:52,560
satellites that means you only go over

271
00:08:56,230 --> 00:08:54,480
the same spot on the earth about every

272
00:08:57,829 --> 00:08:56,240
two weeks or so

273
00:08:59,910 --> 00:08:57,839
that's changing with pointable sensors

274
00:09:01,509 --> 00:08:59,920
now in sensor constellations but that's

275
00:09:03,509 --> 00:09:01,519
really good for developing a nice

276
00:09:05,269 --> 00:09:03,519
regular time series of data

277
00:09:07,110 --> 00:09:05,279
but if you're interested in taking data

278
00:09:09,350 --> 00:09:07,120
at other times of day or you're looking

279
00:09:11,350 --> 00:09:09,360
at things that don't happen to happen at

280
00:09:12,790 --> 00:09:11,360
the time the sensor passes over you

281
00:09:14,470 --> 00:09:12,800
can't really get that with these sensors

282
00:09:16,630 --> 00:09:14,480
what the iss does because of its

283
00:09:18,310 --> 00:09:16,640
inclined equatorial orbit it has the

284
00:09:20,310 --> 00:09:18,320
capability to pass over different spots

285
00:09:22,310 --> 00:09:20,320
of the earth between 52 north and 52

286
00:09:25,110 --> 00:09:22,320
south latitude at different times of day

287
00:09:26,949 --> 00:09:25,120
or night so we the sensors on iss can

288
00:09:29,509 --> 00:09:26,959

collect really a fundamentally different

289
00:09:31,750 --> 00:09:29,519
kind of data different data set well

290
00:09:32,630 --> 00:09:31,760
yeah and i'm sorry but you've got one

291
00:09:35,110 --> 00:09:32,640
more

292
00:09:36,949 --> 00:09:35,120
advantage i guess and that is you have

293
00:09:39,030 --> 00:09:36,959
humans in the loop you have crew members

294
00:09:40,550 --> 00:09:39,040
on board that can help you as well can

295
00:09:42,949 --> 00:09:40,560
you talk a little just for a minute

296
00:09:44,230 --> 00:09:42,959
about that sure yeah the iss is a unique

297
00:09:45,990 --> 00:09:44,240
remote sensing platform and that there

298
00:09:48,550 --> 00:09:46,000
are humans on it and so what that gives

299
00:09:50,550 --> 00:09:48,560
you the ability to do is uh serendipity

300
00:09:52,949 --> 00:09:50,560
basically the the crew can look out the

301
00:09:54,470 --> 00:09:52,959
window and see something happening and

302
00:09:56,470 --> 00:09:54,480
take imagery of it just decide on the

303
00:09:57,750 --> 00:09:56,480
spots take imagery of it where all the

304
00:10:00,310 --> 00:09:57,760
the automated sensors the ground

305
00:10:01,829 --> 00:10:00,320
commanded sensors they get a daily set

306
00:10:03,350 --> 00:10:01,839
of targets that they that are up linked

307
00:10:05,430 --> 00:10:03,360
to them and they collect data whether

308
00:10:07,350 --> 00:10:05,440
there's something going on or not

309
00:10:08,870 --> 00:10:07,360
the crew can also look out the window

310
00:10:10,230 --> 00:10:08,880
and say all right we're taking a shot of

311
00:10:11,509 --> 00:10:10,240
this particular image that's flooded but

312
00:10:13,190 --> 00:10:11,519
it's completely cloud covered we're not

313
00:10:14,710 --> 00:10:13,200

going to get any data so they can decide

314
00:10:16,389 --> 00:10:14,720
well there's no point in taking that

315
00:10:18,710 --> 00:10:16,399
image whereas the automated sensor will

316
00:10:20,550 --> 00:10:18,720
take the data regardless so it gives you

317
00:10:22,630 --> 00:10:20,560
it gives you that added human and loop

318
00:10:24,389 --> 00:10:22,640
ability to respond immediately to

319
00:10:27,110 --> 00:10:24,399
something that's unfolding

320
00:10:28,949 --> 00:10:27,120
well well i appreciate it we we all

321
00:10:32,069 --> 00:10:28,959
appreciate you stopping by on this

322
00:10:34,630 --> 00:10:32,079
special day earth day 2014. my pleasure