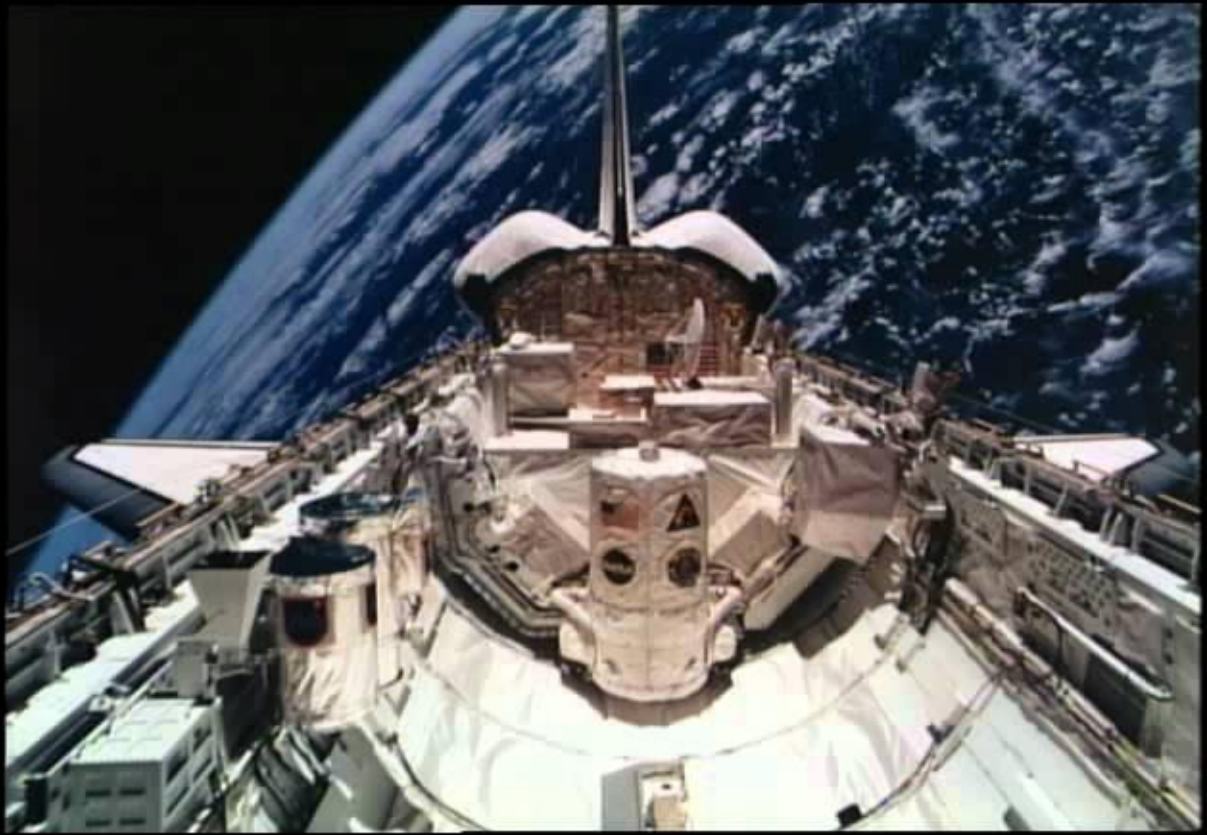

1
00:00:19,750 --> 00:00:16,870
uh every crew

2
00:00:21,590 --> 00:00:19,760
gets to design their own patch uh in

3
00:00:23,509 --> 00:00:21,600
this next uh scene here you'll see our

4
00:00:25,589 --> 00:00:23,519
patch which has the entire globe as well

5
00:00:27,109 --> 00:00:25,599
as the sun on it symbolizing the global

6
00:00:28,150 --> 00:00:27,119
nature of looking at atmospheric

7
00:00:29,669 --> 00:00:28,160
research

8
00:00:31,669 --> 00:00:29,679
and the effect the sun has on the

9
00:00:33,990 --> 00:00:31,679
chemistry of our atmosphere

10
00:00:35,670 --> 00:00:34,000
we had the opportunity to launch midday

11
00:00:38,150 --> 00:00:35,680
on november 3rd which made it a very

12
00:00:40,229 --> 00:00:38,160
comfortable wake up for half of our crew

13
00:00:41,910 --> 00:00:40,239

waking up at 7 00 in the morning however

14
00:00:44,069 --> 00:00:41,920
because we were a dual shift flight and

15
00:00:46,310 --> 00:00:44,079
conducted operations around the clock

16
00:00:48,549 --> 00:00:46,320
the other three members of the crew had

17
00:00:50,630 --> 00:00:48,559
sleep shifted themselves to wake up

18
00:00:52,310 --> 00:00:50,640
at 10 o'clock the previous evening so

19
00:00:54,150 --> 00:00:52,320
they'd been awake about 12 hours

20
00:00:55,910 --> 00:00:54,160
be or actually 14 hours before we

21
00:00:58,229 --> 00:00:55,920
launched

22
00:00:59,510 --> 00:00:58,239
we checked the integrity of our suits

23
00:01:01,110 --> 00:00:59,520
and then we walk out

24
00:01:03,029 --> 00:01:01,120
of the onc building at the cape to get

25
00:01:04,710 --> 00:01:03,039
on the astrovan for the seven mile drive

26
00:01:06,070 --> 00:01:04,720
out to the pad

27
00:01:07,830 --> 00:01:06,080
we had a beautiful morning for the

28
00:01:08,230 --> 00:01:07,840
launch the skies were crystal clear not

29
00:01:11,510 --> 00:01:08,240
a

30
00:01:13,109 --> 00:01:11,520
the

31
00:01:14,950 --> 00:01:13,119
shuttle main engine start sequence began

32
00:01:16,789 --> 00:01:14,960
and moments later we're on our way

33
00:01:18,630 --> 00:01:16,799
to 66th mission of the space shuttle

34
00:01:19,990 --> 00:01:18,640
program and the 13th mission of space

35
00:01:21,670 --> 00:01:20,000
shuttle atlantis

36
00:01:23,030 --> 00:01:21,680
we were already over 100 miles an hour

37
00:01:24,710 --> 00:01:23,040
as we cleared the tower and we began our

38
00:01:25,109 --> 00:01:24,720

roll maneuver to the attitude required

39
00:01:29,030 --> 00:01:25,119
for our

40
00:01:30,630 --> 00:01:29,040
57 degree high inclination orbit

41
00:01:32,870 --> 00:01:30,640
our trajectory actually took us up the

42
00:01:36,390 --> 00:01:32,880
eastern seaboard of the united states

43
00:01:38,390 --> 00:01:36,400
just off the coast at this time the

44
00:01:39,990 --> 00:01:38,400
orbit liftoff the orbiter weighed around

45
00:01:41,429 --> 00:01:40,000
4 million pounds and our thrust is

46
00:01:42,469 --> 00:01:41,439
around seven million pounds so the

47
00:01:44,469 --> 00:01:42,479
thrust to weight was

48
00:01:47,510 --> 00:01:44,479
pretty nice and we were getting out of

49
00:01:48,870 --> 00:01:47,520
town in quite a hurry as you can see

50
00:01:50,789 --> 00:01:48,880
the orbiter was burning about three

51
00:01:52,789 --> 00:01:50,799
thousand pounds of fuel per second and

52
00:01:55,030 --> 00:01:52,799
as that weight decreased

53
00:01:56,230 --> 00:01:55,040
the acceleration increased up to about

54
00:01:58,630 --> 00:01:56,240
three g's or three times

55
00:02:00,469 --> 00:01:58,640
earth's gravity at two minutes into the

56
00:02:01,990 --> 00:02:00,479
flight we had expended all the energy

57
00:02:02,870 --> 00:02:02,000
out of the solid rocket boosters so they

58
00:02:04,469 --> 00:02:02,880
were jettisoned

59
00:02:06,830 --> 00:02:04,479
to be picked up by the recovery ships

60
00:02:09,510 --> 00:02:06,840
waiting about 50 miles off the kennedy

61
00:02:11,270 --> 00:02:09,520
coast it's hard to imagine we sit on the

62
00:02:13,110 --> 00:02:11,280
pad and then

63
00:02:15,350 --> 00:02:13,120

just a few moments later later we're at

64
00:02:16,630 --> 00:02:15,360
orbital speed just under 18 000 miles an

65
00:02:18,390 --> 00:02:16,640
hour and we did all that in eight

66
00:02:20,070 --> 00:02:18,400
minutes and 42 seconds

67
00:02:23,430 --> 00:02:20,080
so you can imagine the ride and the

68
00:02:25,190 --> 00:02:23,440
acceleration was quite unbelievable

69
00:02:26,710 --> 00:02:25,200
at main engine cutoff we went from three

70
00:02:28,550 --> 00:02:26,720
g's to almost zero g

71
00:02:30,309 --> 00:02:28,560
uh instantaneously it was quite a

72
00:02:32,229 --> 00:02:30,319
spectacular sensation

73
00:02:34,390 --> 00:02:32,239
my first job was to film the external

74
00:02:36,309 --> 00:02:34,400
tank which was flying in close

75
00:02:37,670 --> 00:02:36,319
formation with us for post-flight

76
00:02:39,509 --> 00:02:37,680
analysis before it re-entered the

77
00:02:40,630 --> 00:02:39,519
earth's atmosphere

78
00:02:42,550 --> 00:02:40,640
and one of the first things we do when

79
00:02:43,830 --> 00:02:42,560
we get to orbit is open the payload bay

80
00:02:45,509 --> 00:02:43,840
doors and we do that

81
00:02:46,949 --> 00:02:45,519
for thermal reasons but it's also a

82
00:02:48,550 --> 00:02:46,959
pretty exciting event for the crew

83
00:02:51,509 --> 00:02:48,560
because it gives us our first

84
00:02:53,670 --> 00:02:51,519
real view of the earth from space the

85
00:02:54,949 --> 00:02:53,680
first day was very busy with activation

86
00:02:56,070 --> 00:02:54,959
of all the payloads including the

87
00:02:57,750 --> 00:02:56,080
crystal spa

88
00:02:59,990 --> 00:02:57,760

you see kurt and joe in the fourth

89
00:03:01,270 --> 00:03:00,000
flight deck controlling the digital

90
00:03:03,190 --> 00:03:01,280
autopilot and also

91
00:03:04,470 --> 00:03:03,200
keeping the big picture of all on all

92
00:03:06,790 --> 00:03:04,480
the systems

93
00:03:07,589 --> 00:03:06,800
while on the aft flight deck ellen is

94
00:03:10,309 --> 00:03:07,599
flying the

95
00:03:12,869 --> 00:03:10,319
robot arm to grapple the crystal spa

96
00:03:15,430 --> 00:03:12,879
with a special electrical connector

97
00:03:17,030 --> 00:03:15,440
to activate the batteries you see the

98
00:03:19,589 --> 00:03:17,040
arm closing to the payload

99
00:03:21,270 --> 00:03:19,599
you can see the target which is a very

100
00:03:22,790 --> 00:03:21,280
important visual cue for the arm

101
00:03:25,190 --> 00:03:22,800
operator to center

102
00:03:27,190 --> 00:03:25,200
the end effector and the snares around

103
00:03:30,070 --> 00:03:27,200
the grapple fixture

104
00:03:32,070 --> 00:03:30,080
then comes time for the deploy and

105
00:03:35,430 --> 00:03:32,080
starting with the unbirth of the payload

106
00:03:37,270 --> 00:03:35,440
very smoothly to prevent any uh

107
00:03:38,630 --> 00:03:37,280
saturation of the gyros on board the

108
00:03:41,270 --> 00:03:38,640
crystal spa

109
00:03:42,949 --> 00:03:41,280
and then maneuver from the low hover to

110
00:03:45,110 --> 00:03:42,959
the release attitude

111
00:03:47,509 --> 00:03:45,120
you can see the mass antenna moving

112
00:03:49,270 --> 00:03:47,519
scanning the atmosphere

113
00:03:51,670 --> 00:03:49,280

this is quite a long maneuver from the

114
00:03:54,470 --> 00:03:51,680
low hover to read his attitude

115
00:03:56,630 --> 00:03:54,480
crystal spa is a composition of the

116
00:03:57,270 --> 00:03:56,640
platform spa and the instrument christa

117
00:03:59,990 --> 00:03:57,280
and marcy

118
00:04:01,830 --> 00:04:00,000
krista stands for cryogenic infrared

119
00:04:02,789 --> 00:04:01,840
spectrometers and telescope for the

120
00:04:05,190 --> 00:04:02,799
atmosphere

121
00:04:06,229 --> 00:04:05,200
and with the three telescopes on board

122
00:04:09,350 --> 00:04:06,239
and

123
00:04:11,670 --> 00:04:09,360
very high speed sensors it collects a

124
00:04:14,630 --> 00:04:11,680
very high space resolution data of the

125
00:04:16,949 --> 00:04:14,640
middle atmosphere

126
00:04:19,909 --> 00:04:16,959
and when we get ready on the opposite

127
00:04:23,670 --> 00:04:19,919
side as well as on crystal for release

128
00:04:26,629 --> 00:04:23,680
i check the trigger to open the snares

129
00:04:30,550 --> 00:04:26,639
in order to start the release and you

130
00:04:35,830 --> 00:04:34,230
backing away from the payload

131
00:04:37,270 --> 00:04:35,840
very nice view of the earth from the

132
00:04:40,390 --> 00:04:37,280
background and

133
00:04:41,430 --> 00:04:40,400
when the arm stops at a few feet from

134
00:04:44,469 --> 00:04:41,440
the payload

135
00:04:45,030 --> 00:04:44,479
down from the aft flight deck will fire

136
00:04:59,430 --> 00:04:45,040
the

137
00:05:01,430 --> 00:04:59,440
deployment

138
00:05:03,670 --> 00:05:01,440

here's a view of the payload bay showing

139
00:05:04,870 --> 00:05:03,680
the atmospheric and solar science

140
00:05:06,469 --> 00:05:04,880
instruments

141
00:05:08,629 --> 00:05:06,479
the main structure that you see is the

142
00:05:11,430 --> 00:05:08,639
space lab pallet with these six

143
00:05:13,189 --> 00:05:11,440
atlas instruments on board as well as a

144
00:05:15,189 --> 00:05:13,199
lot of the support equipment

145
00:05:16,790 --> 00:05:15,199
this is a close-up of some of the solar

146
00:05:18,950 --> 00:05:16,800
instruments and you see the door opening

147
00:05:21,430 --> 00:05:18,960
on solcon which measures the

148
00:05:23,110 --> 00:05:21,440
amount of energy coming from the sun and

149
00:05:24,710 --> 00:05:23,120
this is another view of the payload bay

150
00:05:27,990 --> 00:05:24,720
taken from the camera that's on the

151
00:05:30,150 --> 00:05:28,000
elbow joint of the robotic arm

152
00:05:32,070 --> 00:05:30,160
here's a view of ssbuv an ozone

153
00:05:33,830 --> 00:05:32,080
measuring instrument as the door opens

154
00:05:34,390 --> 00:05:33,840
and it begins to measure the back

155
00:05:36,629 --> 00:05:34,400
scattered

156
00:05:37,990 --> 00:05:36,639
ultraviolet light from the earth which

157
00:05:41,029 --> 00:05:38,000
will allow it to measure

158
00:05:42,790 --> 00:05:41,039
ozone this is the escape payload a solar

159
00:05:44,310 --> 00:05:42,800
physics experiment sponsored by the

160
00:05:45,990 --> 00:05:44,320
university of colorado

161
00:05:49,430 --> 00:05:46,000
and it took advantage of four solar

162
00:05:53,670 --> 00:05:51,270
this is the assembly of one of the

163
00:05:55,990 --> 00:05:53,680

biggest secondary period in the mid deck

164
00:05:57,830 --> 00:05:56,000
heat pipe performance experiment

165
00:05:59,189 --> 00:05:57,840
dedicated to testing the heat pipes

166
00:06:02,070 --> 00:05:59,199
extensively used on both

167
00:06:03,350 --> 00:06:02,080
automatic satellites to cool electronics

168
00:06:05,909 --> 00:06:03,360
elen is

169
00:06:06,710 --> 00:06:05,919
currently running a spin test where

170
00:06:09,670 --> 00:06:06,720
pipes are

171
00:06:11,510 --> 00:06:09,680
spinning to see how centrifugal force

172
00:06:12,950 --> 00:06:11,520
prevents the heat pipe to work properly

173
00:06:15,510 --> 00:06:12,960
and we could set the

174
00:06:18,150 --> 00:06:15,520
power as well as the spin rate we had

175
00:06:19,749 --> 00:06:18,160
also pgac to help collecting data

176
00:06:21,830 --> 00:06:19,759
this is the protein crystal growth

177
00:06:25,350 --> 00:06:21,840
experiment we had two on board

178
00:06:26,950 --> 00:06:25,360
and we've been told that uh we had uh

179
00:06:29,189 --> 00:06:26,960
the highest yield of some of the highest

180
00:06:30,070 --> 00:06:29,199
quality protein crystals they've ever

181
00:06:31,830 --> 00:06:30,080
seen since uh

182
00:06:33,430 --> 00:06:31,840
protein crystal growth experiments have

183
00:06:35,830 --> 00:06:33,440
flown on shuttle

184
00:06:36,710 --> 00:06:35,840
and the crystals will ultimately be used

185
00:06:39,270 --> 00:06:36,720
to determine

186
00:06:41,830 --> 00:06:39,280
their three-dimensional structure and

187
00:06:44,629 --> 00:06:41,840
ultimately lead to

188
00:06:45,670 --> 00:06:44,639

better pharmaceutical development and

189
00:06:48,070 --> 00:06:45,680
this is a

190
00:06:48,790 --> 00:06:48,080
close-up of one of the chambers showing

191
00:06:54,150 --> 00:06:48,800
some beautiful

192
00:06:57,830 --> 00:06:56,390
three gold boxes that you'll see in the

193
00:06:59,270 --> 00:06:57,840
frame here on the locker doors where the

194
00:07:01,189 --> 00:06:59,280
accelerometers for the shuttle

195
00:07:03,350 --> 00:07:01,199
acceleration monument system

196
00:07:04,870 --> 00:07:03,360
sams and we used that equipment to

197
00:07:05,909 --> 00:07:04,880
document the micro gravity environment

198
00:07:07,350 --> 00:07:05,919
on the orbiter

199
00:07:10,070 --> 00:07:07,360
this is a piece of equipment called

200
00:07:11,589 --> 00:07:10,080
albert that jean francois and i used

201
00:07:13,749 --> 00:07:11,599
to position ourselves when we were

202
00:07:15,510 --> 00:07:13,759
operating the robotic arm for the deploy

203
00:07:17,589 --> 00:07:15,520
and the retrieve

204
00:07:18,710 --> 00:07:17,599
our galley was the focal point of life

205
00:07:20,870 --> 00:07:18,720
on orbit

206
00:07:23,110 --> 00:07:20,880
we hydrate some of our food with hot or

207
00:07:24,629 --> 00:07:23,120
cold water as indicated on the package

208
00:07:27,430 --> 00:07:24,639
then we cut the package open and eat the

209
00:07:28,870 --> 00:07:27,440
food with a spoon

210
00:07:30,550 --> 00:07:28,880
even after all those years of being told

211
00:07:32,150 --> 00:07:30,560
not to play with your food when eating

212
00:07:36,950 --> 00:07:32,160
in space it's almost too much fun to

213
00:07:42,150 --> 00:07:38,950

jeans francois invented a new dish

214
00:07:44,550 --> 00:07:42,160
shrimp cocktail on a tortilla

215
00:07:46,230 --> 00:07:44,560
i think building the trim fajita was

216
00:07:53,510 --> 00:07:46,240
half the fun

217
00:07:56,950 --> 00:07:55,350
we had plenty of cameras on board to

218
00:07:59,029 --> 00:07:56,960
document not only our in-cabin

219
00:08:01,110 --> 00:07:59,039
activities but also the extensive earth

220
00:08:03,029 --> 00:08:01,120
obs potential we had on our 57 degree

221
00:08:05,430 --> 00:08:03,039
inclination flight

222
00:08:07,029 --> 00:08:05,440
we took over 6 000 frames of film on our

223
00:08:08,869 --> 00:08:07,039
11 day mission

224
00:08:10,790 --> 00:08:08,879
and it's a it's a great opportunity to

225
00:08:12,950 --> 00:08:10,800
see the world without boundaries

226
00:08:13,909 --> 00:08:12,960
and also to get a better feel for

227
00:08:16,869 --> 00:08:13,919
meteorology

228
00:08:18,550 --> 00:08:16,879
oceanography and geology this is a

229
00:08:21,110 --> 00:08:18,560
tremendous view

230
00:08:22,230 --> 00:08:21,120
of plate tectonics in action this is the

231
00:08:25,029 --> 00:08:22,240
indian plate

232
00:08:27,110 --> 00:08:25,039
meeting asia arising in the himalaya

233
00:08:29,270 --> 00:08:27,120
range and in the foreground

234
00:08:31,270 --> 00:08:29,280
you can see the ganges river here

235
00:08:31,830 --> 00:08:31,280
several of its tributaries and alluvial

236
00:08:34,149 --> 00:08:31,840
fans

237
00:08:36,310 --> 00:08:34,159
that feed into the ganges and the

238
00:08:37,990 --> 00:08:36,320

foothills to the himalaya range

239
00:08:40,230 --> 00:08:38,000
this is literally the roof of the world

240
00:08:42,949 --> 00:08:40,240
there are several eight 000 meter peaks

241
00:08:44,470 --> 00:08:42,959
in this field of view here including

242
00:08:47,670 --> 00:08:44,480
mount everest and

243
00:08:49,350 --> 00:08:47,680
annapurna uh just a gorgeous uh

244
00:08:51,430 --> 00:08:49,360
sight that the blue shift had a chance

245
00:08:53,350 --> 00:08:51,440
to see on several passes

246
00:08:55,110 --> 00:08:53,360
uh up at the top of the the field here

247
00:08:57,030 --> 00:08:55,120
is bowtie lake

248
00:08:59,750 --> 00:08:57,040
one of the landmarks that we use to

249
00:09:02,070 --> 00:08:59,760
identify mount everest as we go by

250
00:09:03,110 --> 00:09:02,080
and now in the field is the tibetan

251
00:09:05,350 --> 00:09:03,120
highland

252
00:09:09,829 --> 00:09:05,360
it's a very arid land with a mean

253
00:09:11,110 --> 00:09:09,839
altitude of 14 000 feet above sea level

254
00:09:12,870 --> 00:09:11,120
this is a beautiful scene of the great

255
00:09:14,070 --> 00:09:12,880
barrier reef off the northeast coast of

256
00:09:16,389 --> 00:09:14,080
australia

257
00:09:17,590 --> 00:09:16,399
you can see the coral formations the

258
00:09:19,590 --> 00:09:17,600
different color

259
00:09:21,350 --> 00:09:19,600
water indicating different depths

260
00:09:24,389 --> 00:09:21,360
several plankton blooms and the ocean

261
00:09:26,070 --> 00:09:24,399
currents in the sun clint to the right

262
00:09:27,990 --> 00:09:26,080
we had the opportunity to see several

263
00:09:29,750 --> 00:09:28,000

major storms while we were on orbit

264
00:09:31,509 --> 00:09:29,760
this one was hurricane florence that

265
00:09:33,590 --> 00:09:31,519
occurred early in our flight

266
00:09:35,910 --> 00:09:33,600
we had to had the opportunity to pass by

267
00:09:40,550 --> 00:09:35,920
and zoom in on the eye of the hurricane

268
00:09:43,750 --> 00:09:42,150
we had the opportunity to exercise

269
00:09:44,389 --> 00:09:43,760
almost every day on orbit and here you

270
00:09:47,030 --> 00:09:44,399
can see

271
00:09:47,990 --> 00:09:47,040
jean francois enjoying the exercise the

272
00:09:51,190 --> 00:09:48,000
music and the view

273
00:09:52,389 --> 00:09:51,200
it was pretty spectacular to do that

274
00:09:55,030 --> 00:09:52,399
this is a view of the inner limb

275
00:09:56,870 --> 00:09:55,040
resistance device an exercise

276
00:09:58,070 --> 00:09:56,880
device that i developed when i was out

277
00:10:00,230 --> 00:09:58,080
at ames with one of my

278
00:10:02,150 --> 00:10:00,240
colleagues there and it allows us to

279
00:10:04,069 --> 00:10:02,160
exercise all of our anti-gravity muscles

280
00:10:05,269 --> 00:10:04,079
while we're in space with minimal impact

281
00:10:06,870 --> 00:10:05,279
to the orbiter

282
00:10:08,630 --> 00:10:06,880
in addition it allows us to preserve

283
00:10:09,750 --> 00:10:08,640
some of our neuromuscular coordination

284
00:10:11,990 --> 00:10:09,760
when we return

285
00:10:15,910 --> 00:10:12,000
back home we can also reconfigure for

286
00:10:19,910 --> 00:10:18,069
during our half day off we had a chance

287
00:10:21,430 --> 00:10:19,920
to play with zero gravity

288
00:10:22,710 --> 00:10:21,440

and perhaps my drill instructor from

289
00:10:29,350 --> 00:10:22,720
officer school would be impressed with

290
00:10:32,710 --> 00:10:31,430
another big challenge during our little

291
00:10:35,430 --> 00:10:32,720
free time on orbit was

292
00:10:38,310 --> 00:10:35,440
with scott and i trying to rendezvous

293
00:10:40,069 --> 00:10:38,320
two big bubbles of water together and uh

294
00:10:42,230 --> 00:10:40,079
we managed to do that also it's very

295
00:10:47,350 --> 00:10:42,240
difficult to handle this uh

296
00:10:49,030 --> 00:10:47,360
soft uh big bubble in the mid deck

297
00:10:53,269 --> 00:10:49,040
and even when you want to take a cd you

298
00:10:58,829 --> 00:10:55,190
this is me being attacked by the morning

299
00:11:00,069 --> 00:10:58,839
mail messages from mission control one

300
00:11:01,590 --> 00:11:00,079
day

301
00:11:02,870 --> 00:11:01,600
are frequently asked how we sleep in

302
00:11:04,230 --> 00:11:02,880
space and though on different shifts

303
00:11:05,910 --> 00:11:04,240
here the three rookies

304
00:11:08,310 --> 00:11:05,920
are demonstrating the use of our sleep

305
00:11:10,389 --> 00:11:08,320
stations

306
00:11:12,150 --> 00:11:10,399
we had a peculiar phenomena occur during

307
00:11:13,990 --> 00:11:12,160
one of our supply water dumps we dump

308
00:11:15,750 --> 00:11:14,000
water overboard that's either not

309
00:11:17,590 --> 00:11:15,760
needed for cooling or consumption by the

310
00:11:19,269 --> 00:11:17,600
crew you can see in the upper left

311
00:11:21,590 --> 00:11:19,279
corner here is the supply water dump

312
00:11:23,269 --> 00:11:21,600
nozzle with a stream of water coming out

313
00:11:25,750 --> 00:11:23,279

what's building here is an icicle that

314
00:11:28,389 --> 00:11:25,760
formed on the

315
00:11:30,230 --> 00:11:28,399
outside of the cargo bay door which is

316
00:11:33,030 --> 00:11:30,240
off the picture to the right

317
00:11:35,110 --> 00:11:33,040
and the icicle formed and would have

318
00:11:36,790 --> 00:11:35,120
continued formation probably right up to

319
00:11:38,389 --> 00:11:36,800
the dump nozzle had we not stopped the

320
00:11:42,310 --> 00:11:38,399
dump at about this time now watch the

321
00:11:44,790 --> 00:11:42,320
plug here

322
00:11:46,550 --> 00:11:44,800
this is a look at the entire uh icicle

323
00:11:48,069 --> 00:11:46,560
after it had formed about six feet long

324
00:11:49,509 --> 00:11:48,079
off the payload door and that part of

325
00:11:51,030 --> 00:11:49,519
that ice remained all the way through

326
00:11:52,949 --> 00:11:51,040
the entry until post landing it was

327
00:11:54,470 --> 00:11:52,959
still on the vehicle

328
00:11:55,990 --> 00:11:54,480
here we have the flight deck crew don

329
00:11:57,910 --> 00:11:56,000
myself and joe preparing to do a

330
00:11:59,990 --> 00:11:57,920
procedure called flight control checkout

331
00:12:01,509 --> 00:12:00,000
where we crank up one of the auxiliary

332
00:12:02,710 --> 00:12:01,519
power units for hydraulics and we move

333
00:12:04,389 --> 00:12:02,720
all the flight controls and check all

334
00:12:05,910 --> 00:12:04,399
the implementation and displays out for

335
00:12:06,790 --> 00:12:05,920
our trip home make sure atlantis is

336
00:12:09,829 --> 00:12:06,800
ready to come home

337
00:12:11,670 --> 00:12:09,839
standard procedure we do every

338
00:12:13,750 --> 00:12:11,680

and after uh eight days of free flight

339
00:12:14,790 --> 00:12:13,760
it was time to join back up with spas to

340
00:12:16,949 --> 00:12:14,800
bring it home

341
00:12:19,430 --> 00:12:16,959
it is a beautiful sight here against the

342
00:12:21,030 --> 00:12:19,440
deep black of space

343
00:12:22,470 --> 00:12:21,040
kurt uh monitored the rendezvous and

344
00:12:23,110 --> 00:12:22,480
performed the final burns from the left

345
00:12:24,790 --> 00:12:23,120
seat

346
00:12:26,470 --> 00:12:24,800
while i manage the various sensors used

347
00:12:27,829 --> 00:12:26,480
to display our approach on a portal

348
00:12:29,910 --> 00:12:27,839
portable computer

349
00:12:31,750 --> 00:12:29,920
don flew the final stages from the app

350
00:12:34,470 --> 00:12:31,760
station taking inputs from us

351
00:12:36,310 --> 00:12:34,480
and the computer program but ultimately

352
00:12:39,590 --> 00:12:36,320
using the best sensors we had on board

353
00:12:41,269 --> 00:12:39,600
his very own eyes

354
00:12:42,870 --> 00:12:41,279
we worked our way in until we had we

355
00:12:44,710 --> 00:12:42,880
could see every detail the surface of

356
00:12:47,030 --> 00:12:44,720
the crystal spas

357
00:12:48,710 --> 00:12:47,040
finally for the grapple sean francois

358
00:12:50,150 --> 00:12:48,720
operated the handheld laser

359
00:12:51,750 --> 00:12:50,160
and gave don and curt very accurate

360
00:12:53,190 --> 00:12:51,760
range and range rate measurements that

361
00:12:55,829 --> 00:12:53,200
allowed us to make our rendezvous time

362
00:12:57,350 --> 00:12:55,839
almost down to the second

363
00:12:59,590 --> 00:12:57,360

here's a little closer view of crystal

364
00:13:00,949 --> 00:12:59,600
spas as don is flying the final part of

365
00:13:03,269 --> 00:13:00,959
the approach

366
00:13:11,190 --> 00:13:03,279
and i'm getting ready to use the robotic

367
00:13:15,190 --> 00:13:12,949
and this is a view of the arm as it's

368
00:13:17,509 --> 00:13:15,200
coming in over the grapple pin

369
00:13:19,350 --> 00:13:17,519
and then i initiate the capture sequence

370
00:13:29,269 --> 00:13:19,360
which pulls the payload

371
00:13:33,110 --> 00:13:31,509
here's a view after we've captured it

372
00:13:35,590 --> 00:13:33,120
and before we've bursted in the payload

373
00:13:37,430 --> 00:13:35,600
bay looking out the overhead windows

374
00:13:38,949 --> 00:13:37,440
and the rendezvous was accomplished on

375
00:13:40,790 --> 00:13:38,959
flight day 10 on

376
00:13:42,470 --> 00:13:40,800
flight day 11 we went into our final

377
00:13:44,069 --> 00:13:42,480
solar viewing attitude the last

378
00:13:45,509 --> 00:13:44,079
opportunity for the solar instruments to

379
00:13:47,110 --> 00:13:45,519
take measurements

380
00:13:49,350 --> 00:13:47,120
and then flight day 12 was our day to

381
00:13:49,990 --> 00:13:49,360
come home and this is us preparing to

382
00:13:51,509 --> 00:13:50,000
come home

383
00:13:55,750 --> 00:13:51,519
and one of the last things we do is

384
00:13:59,030 --> 00:13:57,110
once we have the payload bay doors

385
00:13:59,509 --> 00:13:59,040
closed it's time to reconfigure atlantis

386
00:14:02,310 --> 00:13:59,519
for the

387
00:14:03,670 --> 00:14:02,320
trip home we get back in our orange

388
00:14:05,750 --> 00:14:03,680

pumpkin suits and

389
00:14:07,350 --> 00:14:05,760
we prepare for the the burn we use our

390
00:14:08,790 --> 00:14:07,360
engines to slow the orbiter back down to

391
00:14:10,230 --> 00:14:08,800
re-enter the atmosphere

392
00:14:11,829 --> 00:14:10,240
it's time to turn some of that kinetic

393
00:14:12,470 --> 00:14:11,839
energy we gain during launch back into

394
00:14:13,990 --> 00:14:12,480
heat

395
00:14:15,350 --> 00:14:14,000
and joe's pointing out the windows so

396
00:14:15,990 --> 00:14:15,360
jean-francois takes a look and you can

397
00:14:18,310 --> 00:14:16,000
see the plasma

398
00:14:19,269 --> 00:14:18,320
behind us as we stream through the

399
00:14:21,189 --> 00:14:19,279
atmosphere

400
00:14:22,710 --> 00:14:21,199
converting that energy back into heat

401
00:14:24,230 --> 00:14:22,720
out my right window here you can see the

402
00:14:26,150 --> 00:14:24,240
glow around the water also as we're

403
00:14:27,990 --> 00:14:26,160
penetrating the atmosphere don's

404
00:14:29,590 --> 00:14:28,000
managing managing the energy

405
00:14:31,110 --> 00:14:29,600
make sure we have good energy state and

406
00:14:32,150 --> 00:14:31,120
here's a long-range camera from edwards

407
00:14:33,990 --> 00:14:32,160
picking up our

408
00:14:36,150 --> 00:14:34,000
yaw jet thrusters still firing to

409
00:14:38,230 --> 00:14:36,160
maintain attitude

410
00:14:40,150 --> 00:14:38,240
this is a look at kurt's right window

411
00:14:42,550 --> 00:14:40,160
there as we make about a 90-degree turn

412
00:14:45,670 --> 00:14:42,560
to final at edwards

413
00:14:48,310 --> 00:14:45,680

as we roll out on final we had one

414
00:14:50,790 --> 00:14:48,320
final test to perform before we landed

415
00:14:53,910 --> 00:14:50,800
it was a subsonic aero test to

416
00:14:55,829 --> 00:14:53,920
roll the vehicle left and right and to

417
00:14:57,350 --> 00:14:55,839
yaw the vehicle left and right to look

418
00:14:58,470 --> 00:14:57,360
at control power in those control

419
00:15:01,509 --> 00:14:58,480
surfaces

420
00:15:03,910 --> 00:15:01,519
to see if there's a potential for more

421
00:15:06,069 --> 00:15:03,920
crosswind capability in the vehicle

422
00:15:08,310 --> 00:15:06,079
once that was complete we rolled

423
00:15:10,069 --> 00:15:08,320
ourselves back out on final approach

424
00:15:11,350 --> 00:15:10,079
we fly the approach now at about 300

425
00:15:14,949 --> 00:15:11,360
knots equivalent airspeed

426
00:15:16,949 --> 00:15:14,959
at 2000 feet or so we begin to

427
00:15:19,189 --> 00:15:16,959
decrease our glide angle from 20 degrees

428
00:15:21,590 --> 00:15:19,199
to just over 1 degree

429
00:15:22,550 --> 00:15:21,600
at 300 feet kurt extended the gear for

430
00:15:24,949 --> 00:15:22,560
us

431
00:15:26,389 --> 00:15:24,959
and as we continually decelerate we

432
00:15:28,230 --> 00:15:26,399
crossed the threshold of the runway at

433
00:15:30,870 --> 00:15:28,240
about 225 knots

434
00:15:34,150 --> 00:15:30,880
17 feet in the air and targeting a

435
00:15:36,550 --> 00:15:34,160
touchdown speed of 195 knots

436
00:15:37,269 --> 00:15:36,560
we touched down about 3 200 feet down

437
00:15:39,030 --> 00:15:37,279
the runway

438
00:15:41,030 --> 00:15:39,040

and immediately after touchdown we

439
00:15:43,509 --> 00:15:41,040
deployed drag chute we had the first

440
00:15:44,629 --> 00:15:43,519
reusable drag shoot of the space shuttle

441
00:15:46,550 --> 00:15:44,639
program

442
00:15:48,470 --> 00:15:46,560
the drag chute helps us decelerate as

443
00:15:49,829 --> 00:15:48,480
well as lowers the slap down rates on

444
00:15:51,509 --> 00:15:49,839
the nose gear

445
00:15:53,350 --> 00:15:51,519
the deceleration we get out of the drag

446
00:15:57,110 --> 00:15:53,360
chute reduces the amount of runway we

447
00:15:59,110 --> 00:15:57,120
use by about 1500 to 2000 feet

448
00:16:00,710 --> 00:15:59,120
at about 60 knots we release the drag

449
00:16:03,269 --> 00:16:00,720
chute so we don't have to contend with

450
00:16:06,550 --> 00:16:03,279
that hardware post wheel stop

451
00:16:09,670 --> 00:16:06,560
and by this time we had

452
00:16:11,910 --> 00:16:09,680
flown about 175 revolutions of the earth

453
00:16:13,509 --> 00:16:11,920
and we'd been in space almost 11 days

454
00:16:15,910 --> 00:16:13,519
and flown four and a half

455
00:16:22,790 --> 00:16:15,920
million miles and we badly needed a

456
00:16:24,470 --> 00:16:22,800
shower and a comb-cooked meal

457
00:16:26,150 --> 00:16:24,480
no shuttle presentation would be

458
00:16:28,790 --> 00:16:26,160
complete without

459
00:16:31,350 --> 00:16:28,800
a shot of our launch it's a very

460
00:16:33,749 --> 00:16:31,360
exciting beginning to the mission and

461
00:16:35,749 --> 00:16:33,759
this is a view from the base of pad 39

462
00:16:38,389 --> 00:16:35,759
bravo

463
00:16:40,870 --> 00:16:38,399

basically sea level and just a few

464
00:16:42,710 --> 00:16:40,880
seconds after the order has lifted off

465
00:16:44,389 --> 00:16:42,720
again we had a beautiful day that day

466
00:16:45,990 --> 00:16:44,399
crystal clear blue skies i don't think

467
00:16:48,949 --> 00:16:46,000
i've ever seen it any bluer

468
00:16:50,629 --> 00:16:48,959
and it was quite an accent a few days

469
00:16:53,030 --> 00:16:50,639
later however we had another chance to

470
00:16:55,910 --> 00:16:53,040
look at pad 39 bravo from a different

471
00:16:57,749 --> 00:16:55,920
perspective from about 165 miles

472
00:16:59,990 --> 00:16:57,759
directly overhead

473
00:17:01,590 --> 00:17:00,000
and you probably recognize uh most of

474
00:17:03,670 --> 00:17:01,600
the things here in the slide we have

475
00:17:04,870 --> 00:17:03,680
this pad right here is 39 bravo where we

476
00:17:06,949 --> 00:17:04,880
left off

477
00:17:09,029 --> 00:17:06,959
did our lift off and you can see the

478
00:17:10,870 --> 00:17:09,039
southern pad and also the crawler track

479
00:17:12,230 --> 00:17:10,880
where we maneuver the orbiter from the

480
00:17:14,230 --> 00:17:12,240
vertical assembly building and the

481
00:17:16,309 --> 00:17:14,240
orbital processing facility here

482
00:17:18,470 --> 00:17:16,319
out to the pads the shuttle landing

483
00:17:19,909 --> 00:17:18,480
facility is right in here as we see

484
00:17:21,669 --> 00:17:19,919
and if you take a bigger view you can

485
00:17:24,870 --> 00:17:21,679
see down here the skid strip

486
00:17:26,390 --> 00:17:24,880
at cape canaveral complex

487
00:17:28,309 --> 00:17:26,400
and also the beginning of our space

488
00:17:29,430 --> 00:17:28,319

program the very historic pads we have

489
00:17:31,590 --> 00:17:29,440
here for the mercury

490
00:17:33,510 --> 00:17:31,600
and the gemini program along with some

491
00:17:33,909 --> 00:17:33,520
of our expendable pads that we use to

492
00:17:35,909 --> 00:17:33,919
launch

493
00:17:37,110 --> 00:17:35,919
the expendable payloads or expendable

494
00:17:40,630 --> 00:17:37,120
rockets i should say

495
00:17:41,270 --> 00:17:40,640
into orbit cape canaveral seaport is

496
00:17:43,510 --> 00:17:41,280
down here

497
00:17:46,230 --> 00:17:43,520
and if you come on find cocoa beach down

498
00:17:46,549 --> 00:17:46,240
to patrick air force base is here on up

499
00:17:49,669 --> 00:17:46,559
through

500
00:17:51,270 --> 00:17:49,679
cocoa and we have titusville airport and

501
00:17:53,590 --> 00:17:51,280
titusville up in here so it's quite a

502
00:17:55,909 --> 00:17:53,600
view again very clear for florida

503
00:17:57,430 --> 00:17:55,919
and this is where we're supposed to land

504
00:17:59,190 --> 00:17:57,440
november 14th obviously

505
00:18:01,510 --> 00:17:59,200
tropical storm gordon had had other

506
00:18:04,070 --> 00:18:01,520
plans so we we wound up in

507
00:18:05,909 --> 00:18:04,080
edwards here's another view of our

508
00:18:07,110 --> 00:18:05,919
payload bay and i wanted to point out uh

509
00:18:08,230 --> 00:18:07,120
some of the instruments that we were

510
00:18:10,549 --> 00:18:08,240
carrying on board

511
00:18:13,029 --> 00:18:10,559
we had three atmospheric instruments two

512
00:18:14,950 --> 00:18:13,039
of them on the atlas pallet

513
00:18:17,029 --> 00:18:14,960

one of them here atmos and then you can

514
00:18:18,630 --> 00:18:17,039
see the moz antenna over here

515
00:18:20,549 --> 00:18:18,640
then up here on the starboard sill the

516
00:18:22,310 --> 00:18:20,559
ssbuv instrument

517
00:18:24,230 --> 00:18:22,320
all three of those instruments measure

518
00:18:26,150 --> 00:18:24,240
ozone and one of the

519
00:18:28,789 --> 00:18:26,160
exciting results was to compare the

520
00:18:30,310 --> 00:18:28,799
ozone measurements between all three

521
00:18:32,390 --> 00:18:30,320
instruments which we were able to do in

522
00:18:35,750 --> 00:18:32,400
some of the northern hemisphere

523
00:18:37,590 --> 00:18:35,760
measurements atmos and ssbuv were also

524
00:18:38,549 --> 00:18:37,600
of course focusing on the antarctic

525
00:18:40,230 --> 00:18:38,559
ozone hole

526
00:18:42,710 --> 00:18:40,240
which was present during our flight and

527
00:18:44,950 --> 00:18:42,720
was just beginning to recover

528
00:18:46,789 --> 00:18:44,960
and they were measuring the ozone within

529
00:18:48,390 --> 00:18:46,799
the hole at about half the level of the

530
00:18:51,830 --> 00:18:48,400
ozone outside the

531
00:18:53,110 --> 00:18:51,840
antarctic ozone hole atmos also measures

532
00:18:55,430 --> 00:18:53,120
about three dozen

533
00:18:57,590 --> 00:18:55,440
other trace molecules in the atmosphere

534
00:19:00,310 --> 00:18:57,600
to get a much more complete picture of

535
00:19:02,230 --> 00:19:00,320
how the ozone depletion process occurs

536
00:19:04,789 --> 00:19:02,240
it measures chlorine which is the

537
00:19:06,549 --> 00:19:04,799
primary catalyst for ozone depletion

538
00:19:08,549 --> 00:19:06,559

and a lot of the reactive nitrogen

539
00:19:11,029 --> 00:19:08,559
species which can bind with chlorine and

540
00:19:13,830 --> 00:19:11,039
prevent it from depleting ozone

541
00:19:15,909 --> 00:19:13,840
and we were able to get to what the

542
00:19:18,150 --> 00:19:15,919
concentrations of those chemicals were

543
00:19:20,630 --> 00:19:18,160
as a function of altitude both within

544
00:19:22,470 --> 00:19:20,640
the hole and outside the hole and they

545
00:19:24,310 --> 00:19:22,480
also found that chlorine exists in

546
00:19:25,750 --> 00:19:24,320
different reservoir species at different

547
00:19:28,870 --> 00:19:25,760
altitudes which was a new and

548
00:19:31,669 --> 00:19:28,880
interesting result for the scientists

549
00:19:33,029 --> 00:19:31,679
they also measure atmos also measured in

550
00:19:36,470 --> 00:19:33,039
the mid-latitudes

551
00:19:37,430 --> 00:19:36,480
uh one of the freons freon 22 at a value

552
00:19:40,310 --> 00:19:37,440
that had doubled

553
00:19:41,669 --> 00:19:40,320
over the measurement that it took in

554
00:19:42,870 --> 00:19:41,679
1985

555
00:19:45,510 --> 00:19:42,880
and we really still don't know the

556
00:19:47,110 --> 00:19:45,520
significance of what that might be

557
00:19:49,029 --> 00:19:47,120
some of the solar science instruments

558
00:19:50,789 --> 00:19:49,039
there's three solar science

559
00:19:53,029 --> 00:19:50,799
instruments in the center of the palette

560
00:19:54,549 --> 00:19:53,039
acr sulcon and soul spec

561
00:19:56,310 --> 00:19:54,559
and there's one on the far side of the

562
00:19:57,350 --> 00:19:56,320
pallet that's hidden from view called

563
00:19:59,190 --> 00:19:57,360

susim

564
00:20:00,950 --> 00:19:59,200
two of those measure the total amount of

565
00:20:02,149 --> 00:20:00,960
energy coming from the sun

566
00:20:04,070 --> 00:20:02,159
they were very pleased with their

567
00:20:05,750 --> 00:20:04,080
results they were able to get

568
00:20:06,070 --> 00:20:05,760
measurements with a precision of less

569
00:20:09,510 --> 00:20:06,080
than

570
00:20:11,510 --> 00:20:09,520
0.05 percent the other two

571
00:20:12,630 --> 00:20:11,520
measure the solar spectrum as a function

572
00:20:15,510 --> 00:20:12,640
of wavelength

573
00:20:15,990 --> 00:20:15,520
and along with ssbuv uh three of the

574
00:20:20,230 --> 00:20:16,000
measure

575
00:20:21,990 --> 00:20:20,240
the ultraviolet solar spectrum

576
00:20:23,990 --> 00:20:22,000
which is a difficult measurement to make

577
00:20:27,270 --> 00:20:24,000
because ultraviolet light

578
00:20:29,430 --> 00:20:27,280
affects the optics of the instruments so

579
00:20:31,430 --> 00:20:29,440
they were very pleased at that result

580
00:20:33,110 --> 00:20:31,440
and the final instrument on board is way

581
00:20:33,669 --> 00:20:33,120
in the back and you can just barely see

582
00:20:36,230 --> 00:20:33,679
the door

583
00:20:36,870 --> 00:20:36,240
open behind the atmos that's the escape

584
00:20:38,789 --> 00:20:36,880
instrument

585
00:20:40,310 --> 00:20:38,799
and it's a solar physics experiment

586
00:20:41,190 --> 00:20:40,320
looking at the sun in the extreme

587
00:20:44,230 --> 00:20:41,200
ultraviolet

588
00:20:45,830 --> 00:20:44,240

uh wavelength region this is our other

589
00:20:47,430 --> 00:20:45,840
primary payload you've seen in some of

590
00:20:50,470 --> 00:20:47,440
the other shots that christa spa

591
00:20:52,390 --> 00:20:50,480
satellite and krista is the main

592
00:20:53,510 --> 00:20:52,400
instrument that you see here the big

593
00:20:55,430 --> 00:20:53,520
white cylinder

594
00:20:56,870 --> 00:20:55,440
and it's cooled by cryogenic helium

595
00:20:58,149 --> 00:20:56,880
which is what takes up a lot of that

596
00:20:59,830 --> 00:20:58,159
space there

597
00:21:01,510 --> 00:20:59,840
christa's primary objective is to

598
00:21:03,830 --> 00:21:01,520
understand more about whether in the

599
00:21:04,950 --> 00:21:03,840
stratosphere or the middle atmosphere

600
00:21:06,710 --> 00:21:04,960
of course we're all familiar with

601
00:21:07,590 --> 00:21:06,720
weather in the troposphere which is what

602
00:21:09,909 --> 00:21:07,600
we experience

603
00:21:11,590 --> 00:21:09,919
every day but there are a lot of

604
00:21:13,110 --> 00:21:11,600
phenomena that are very similar in the

605
00:21:16,230 --> 00:21:13,120
middle atmosphere winds

606
00:21:18,230 --> 00:21:16,240
turbulence large temperature changes and

607
00:21:19,990 --> 00:21:18,240
not very much is known about that

608
00:21:21,750 --> 00:21:20,000
and by measuring different chemicals

609
00:21:23,350 --> 00:21:21,760
that can act as tracers

610
00:21:25,830 --> 00:21:23,360
they hope to understand quite a bit more

611
00:21:28,310 --> 00:21:25,840
about that as they go through their data

612
00:21:30,390 --> 00:21:28,320
they're also producing the first global

613
00:21:32,390 --> 00:21:30,400

map of atomic oxygen

614
00:21:34,149 --> 00:21:32,400
in our atmosphere which scientists think

615
00:21:36,630 --> 00:21:34,159
helped cool the earth

616
00:21:38,549 --> 00:21:36,640
the other primary instrument marcy is

617
00:21:41,270 --> 00:21:38,559
sitting right here under these

618
00:21:43,669 --> 00:21:41,280
insulating blankets and it was measuring

619
00:21:44,870 --> 00:21:43,679
hydroxyl and nitric oxide which are two

620
00:21:48,549 --> 00:21:44,880
important chemicals

621
00:21:50,310 --> 00:21:48,559
in the ozone depletion process we had

622
00:21:51,990 --> 00:21:50,320
as i mentioned opportunity to see three

623
00:21:55,430 --> 00:21:52,000
different storms one of them was

624
00:21:56,390 --> 00:21:55,440
a super cyclone zelda that was out in

625
00:21:58,870 --> 00:21:56,400
the pacific

626
00:21:59,669 --> 00:21:58,880
we also saw a tropical storm gordon

627
00:22:01,270 --> 00:21:59,679
develop

628
00:22:03,590 --> 00:22:01,280
off the coast of the yucatan which

629
00:22:05,430 --> 00:22:03,600
eventually became a hurricane and

630
00:22:07,990 --> 00:22:05,440
caused some pretty heavy rains in

631
00:22:09,510 --> 00:22:08,000
florida and severe damage

632
00:22:11,270 --> 00:22:09,520
gordon was also one of the reasons

633
00:22:12,710 --> 00:22:11,280
obviously that we did not land at the

634
00:22:15,110 --> 00:22:12,720
kennedy space center because it was

635
00:22:18,149 --> 00:22:15,120
affecting the peninsula at that time

636
00:22:19,510 --> 00:22:18,159
this is again hurricane florence which

637
00:22:22,549 --> 00:22:19,520
developed

638
00:22:23,830 --> 00:22:22,559

southeast of bermuda it eventually moved

639
00:22:25,350 --> 00:22:23,840
north and became

640
00:22:27,430 --> 00:22:25,360
extra tropical and never reached

641
00:22:28,870 --> 00:22:27,440
landfall as a hurricane but the moisture

642
00:22:31,750 --> 00:22:28,880
from this storm

643
00:22:33,510 --> 00:22:31,760
combined with a storm over europe and

644
00:22:35,990 --> 00:22:33,520
caused some fairly severe flooding over

645
00:22:38,070 --> 00:22:36,000
france and spain

646
00:22:39,110 --> 00:22:38,080
this is the indonesia or part of the

647
00:22:41,590 --> 00:22:39,120
indonesia chain

648
00:22:43,190 --> 00:22:41,600
looking from the north to the south the

649
00:22:46,390 --> 00:22:43,200
large island here of

650
00:22:49,830 --> 00:22:46,400
java is present as well as the

651
00:22:51,750 --> 00:22:49,840
islands of bali here and lombok

652
00:22:53,990 --> 00:22:51,760
on bali and lombok there were some

653
00:22:58,710 --> 00:22:54,000
fairly severe eruptions of volcanoes

654
00:23:01,350 --> 00:22:58,720
in the summer of 1993. there are two

655
00:23:02,070 --> 00:23:01,360
volcanoes on java that are venting steam

656
00:23:05,270 --> 00:23:02,080
right now

657
00:23:06,390 --> 00:23:05,280
one of them is arjuna which is near the

658
00:23:08,070 --> 00:23:06,400
center of the screen

659
00:23:10,310 --> 00:23:08,080
and it's difficult to see the venting

660
00:23:11,750 --> 00:23:10,320
that's occurring also over on the right

661
00:23:12,390 --> 00:23:11,760
side of the screen which is difficult to

662
00:23:16,310 --> 00:23:12,400
see here

663
00:23:17,909 --> 00:23:16,320

is marapai marapai

664
00:23:19,830 --> 00:23:17,919
three weeks after this photograph was

665
00:23:21,029 --> 00:23:19,840
taken had a major eruption which caused

666
00:23:25,110 --> 00:23:21,039
some fairly deadly

667
00:23:26,870 --> 00:23:25,120
mudslides to occur on the island of java

668
00:23:28,630 --> 00:23:26,880
this is the ganges river delta the

669
00:23:29,990 --> 00:23:28,640
largest delta in the world

670
00:23:31,830 --> 00:23:30,000
this photograph is centered on the

671
00:23:35,270 --> 00:23:31,840
country of bangladesh

672
00:23:37,909 --> 00:23:35,280
and what you can see here at the base

673
00:23:39,270 --> 00:23:37,919
is massive amounts of silt and clay

674
00:23:40,870 --> 00:23:39,280
sediment

675
00:23:42,950 --> 00:23:40,880
originating from the ganges and

676
00:23:46,549 --> 00:23:42,960
brahmaputra rivers uh

677
00:23:50,549 --> 00:23:46,559
far upstream it's a an ecological

678
00:23:54,710 --> 00:23:50,559
area of key importance because all this

679
00:23:57,669 --> 00:23:54,720
is mangrove habitat it's a

680
00:23:58,710 --> 00:23:57,679
area where many aquatic and landforms

681
00:24:00,789 --> 00:23:58,720
live

682
00:24:01,830 --> 00:24:00,799
notably in the remaining forested

683
00:24:05,269 --> 00:24:01,840
mangroves

684
00:24:08,470 --> 00:24:05,279
here at the bottom of the view

685
00:24:11,430 --> 00:24:08,480
the asian tiger resides

686
00:24:13,190 --> 00:24:11,440
unfortunately other pressures have

687
00:24:16,549 --> 00:24:13,200
caused a

688
00:24:19,750 --> 00:24:16,559

significant amount of deforestation and

689
00:24:20,789 --> 00:24:19,760
movement towards uh converting mangroves

690
00:24:23,029 --> 00:24:20,799
into

691
00:24:24,230 --> 00:24:23,039
rice paddies and so the shuttle

692
00:24:26,390 --> 00:24:24,240
photography

693
00:24:27,510 --> 00:24:26,400
helps scientists document the rate of

694
00:24:30,470 --> 00:24:27,520
environmental change

695
00:24:31,750 --> 00:24:30,480
as well as geologic change including

696
00:24:32,950 --> 00:24:31,760
delta growth because of all the

697
00:24:36,470 --> 00:24:32,960
sediments coming from

698
00:24:38,549 --> 00:24:36,480
the rivers upstream this is a

699
00:24:40,230 --> 00:24:38,559
gorgeous shot of the highest mountain in

700
00:24:44,390 --> 00:24:40,240
the world this is the summit

701
00:24:45,269 --> 00:24:44,400
of mount everest it stands at 8848

702
00:24:47,510 --> 00:24:45,279
meters

703
00:24:49,909 --> 00:24:47,520
or for those of you who aren't metric

704
00:24:53,269 --> 00:24:49,919
it's uh 29 000 feet and

705
00:24:56,070 --> 00:24:53,279
change it is an area of

706
00:24:57,990 --> 00:24:56,080
special significance for me because had

707
00:24:58,950 --> 00:24:58,000
i not been selected as an astronaut two

708
00:25:00,149 --> 00:24:58,960
years ago

709
00:25:02,310 --> 00:25:00,159
i would have been on a climbing

710
00:25:04,470 --> 00:25:02,320
expedition and probably

711
00:25:05,510 --> 00:25:04,480
or hopefully would have been standing on

712
00:25:09,510 --> 00:25:05,520
the summit as my

713
00:25:12,630 --> 00:25:09,520

sts-66 compatriots flew overhead

714
00:25:13,510 --> 00:25:12,640
this is a tremendous synoptic view a low

715
00:25:14,870 --> 00:25:13,520
oblique

716
00:25:16,630 --> 00:25:14,880
of the region that we've just been

717
00:25:19,350 --> 00:25:16,640
talking about

718
00:25:21,269 --> 00:25:19,360
off in the distance here you can see the

719
00:25:23,430 --> 00:25:21,279
beginnings of the ganges river delta

720
00:25:24,470 --> 00:25:23,440
you can see the foothills of the

721
00:25:27,110 --> 00:25:24,480
himalaya

722
00:25:29,510 --> 00:25:27,120
the roof of the world and the tibetan

723
00:25:31,430 --> 00:25:29,520
plateau

724
00:25:33,110 --> 00:25:31,440
in this view you can see bow tie lake

725
00:25:35,510 --> 00:25:33,120
which we pointed out in our movie

726
00:25:37,269 --> 00:25:35,520
you can also see the everest region and

727
00:25:38,950 --> 00:25:37,279
the annapurna region

728
00:25:41,990 --> 00:25:38,960
you can see several tributaries and

729
00:25:44,149 --> 00:25:42,000
alluvial fans feeding the ganges river

730
00:25:46,470 --> 00:25:44,159
and this uh this view really

731
00:25:49,350 --> 00:25:46,480
demonstrates the rain shadow effect

732
00:25:50,149 --> 00:25:49,360
and what i mean by that is uh warm uh

733
00:25:52,630 --> 00:25:50,159
moist air

734
00:25:55,029 --> 00:25:52,640
emanating from the indian ocean meets

735
00:25:56,710 --> 00:25:55,039
the himalaya and as that air rises

736
00:25:58,870 --> 00:25:56,720
it drops all of its moisture in the form

737
00:26:02,390 --> 00:25:58,880
of precipitation and so we have

738
00:26:07,830 --> 00:26:02,400

green lowlands and very snowy high peaks

739
00:26:13,669 --> 00:26:11,909
one of the more nice places where the

740
00:26:15,669 --> 00:26:13,679
new places take photos from orbit is the

741
00:26:17,750 --> 00:26:15,679
middle east because it's always clear

742
00:26:19,590 --> 00:26:17,760
hardly ever a cloud in in the sky and

743
00:26:21,110 --> 00:26:19,600
what we're looking at here is the uh

744
00:26:22,950 --> 00:26:21,120
sinai peninsula pretty much in the

745
00:26:25,110 --> 00:26:22,960
center of the frame with egypt and

746
00:26:28,950 --> 00:26:25,120
africa to to the top

747
00:26:31,350 --> 00:26:28,960
and the land form here that we see

748
00:26:33,269 --> 00:26:31,360
we take photos from orbit for many

749
00:26:34,149 --> 00:26:33,279
different reasons a lot of them are

750
00:26:36,710 --> 00:26:34,159
taken just due to

751
00:26:37,669 --> 00:26:36,720
the sheer beauty however we do take a

752
00:26:40,390 --> 00:26:37,679
lot to

753
00:26:40,870 --> 00:26:40,400
to study the earth geology is a major

754
00:26:43,909 --> 00:26:40,880
issue

755
00:26:46,310 --> 00:26:43,919
meteorology how humans are affecting the

756
00:26:47,990 --> 00:26:46,320
climate and how they're using the land

757
00:26:50,950 --> 00:26:48,000
so give example this slide

758
00:26:52,310 --> 00:26:50,960
has a lot of those issues in it the dead

759
00:26:54,230 --> 00:26:52,320
sea fault right here

760
00:26:55,750 --> 00:26:54,240
with the dead sea sitting here is the

761
00:26:58,149 --> 00:26:55,760
lowest place in the world

762
00:26:59,750 --> 00:26:58,159
uh over 300 meters below sea level

763
00:27:01,190 --> 00:26:59,760

everything flows in there pretty much

764
00:27:04,070 --> 00:27:01,200
nothing flows out obviously

765
00:27:05,590 --> 00:27:04,080
at that sea level uh it represents the

766
00:27:07,909 --> 00:27:05,600
geology that we look for

767
00:27:09,269 --> 00:27:07,919
is to we from space we can see the big

768
00:27:11,269 --> 00:27:09,279
picture of how

769
00:27:13,269 --> 00:27:11,279
different plates of the planet are

770
00:27:15,269 --> 00:27:13,279
moving around and tearing apart

771
00:27:17,269 --> 00:27:15,279
and we've been studying that in a lot of

772
00:27:19,350 --> 00:27:17,279
different areas of the world

773
00:27:20,789 --> 00:27:19,360
vegetation and how we use the land the

774
00:27:22,310 --> 00:27:20,799
little vegetation streak you see right

775
00:27:25,750 --> 00:27:22,320
here separates egypt to the

776
00:27:27,190 --> 00:27:25,760
south from the gaza strip and also

777
00:27:28,870 --> 00:27:27,200
if you look right in this area is the

778
00:27:31,190 --> 00:27:28,880
river now delta

779
00:27:32,950 --> 00:27:31,200
where is highly cultivated and the

780
00:27:34,389 --> 00:27:32,960
ribbon of the now which is very historic

781
00:27:37,110 --> 00:27:34,399
both in religion and history

782
00:27:38,710 --> 00:27:37,120
as it flows or comes from southern

783
00:27:41,350 --> 00:27:38,720
africa there

784
00:27:41,909 --> 00:27:41,360
again we can study these areas using uh

785
00:27:46,230 --> 00:27:41,919
color

786
00:27:47,029 --> 00:27:46,240
infrared which you'll see here in a few

787
00:27:49,110 --> 00:27:47,039
moments

788
00:27:50,710 --> 00:27:49,120

and we can understand how the

789
00:27:52,870 --> 00:27:50,720
inhabitants are using that land whether

790
00:27:54,710 --> 00:27:52,880
they're over using it or under using it

791
00:27:56,149 --> 00:27:54,720
how the irrigation and water system is

792
00:27:58,389 --> 00:27:56,159
working

793
00:28:00,230 --> 00:27:58,399
also meteorology from this slide if you

794
00:28:00,710 --> 00:28:00,240
look down in the left part here you can

795
00:28:02,549 --> 00:28:00,720
see

796
00:28:04,230 --> 00:28:02,559
basically streaks caused by high winds

797
00:28:06,310 --> 00:28:04,240
and sand dunes and

798
00:28:07,669 --> 00:28:06,320
different materials moving around

799
00:28:10,230 --> 00:28:07,679
another example

800
00:28:12,070 --> 00:28:10,240
of this is western africa over in here

801
00:28:15,029 --> 00:28:12,080
we wind up seeing a lot of sand

802
00:28:16,789 --> 00:28:15,039
and material blowing off the western

803
00:28:18,789 --> 00:28:16,799
deserts of africa

804
00:28:21,029 --> 00:28:18,799
in the same systems that bring us the

805
00:28:23,590 --> 00:28:21,039
hurricanes

806
00:28:24,149 --> 00:28:23,600
across the atlantic to central america

807
00:28:26,710 --> 00:28:24,159
and to the

808
00:28:27,510 --> 00:28:26,720
united states area we have documented

809
00:28:29,510 --> 00:28:27,520
results that show

810
00:28:31,909 --> 00:28:29,520
material maybe off your car in the

811
00:28:32,789 --> 00:28:31,919
mornings of sand and dust that has

812
00:28:34,630 --> 00:28:32,799
really come from

813
00:28:36,549 --> 00:28:34,640

the african continent and has just been

814
00:28:39,350 --> 00:28:36,559
carried into upper level winds

815
00:28:39,990 --> 00:28:39,360
halfway around the world another photo

816
00:28:42,710 --> 00:28:40,000
here showing

817
00:28:44,149 --> 00:28:42,720
the effects of humans on the environment

818
00:28:46,870 --> 00:28:44,159
this is the okavango

819
00:28:49,669 --> 00:28:46,880
river delta in uh northern botswana

820
00:28:51,430 --> 00:28:49,679
which is in the southern tip of africa

821
00:28:53,510 --> 00:28:51,440
uh it's an inland delta it's kind of

822
00:28:55,190 --> 00:28:53,520
unique in that the river flows into this

823
00:28:56,070 --> 00:28:55,200
delta usually we think of deltas being

824
00:28:58,789 --> 00:28:56,080
into the ocean

825
00:29:00,230 --> 00:28:58,799
like new orleans but this is an inland

826
00:29:03,669 --> 00:29:00,240
delta

827
00:29:05,669 --> 00:29:03,679
heavy rains and wetlands in northern

828
00:29:07,110 --> 00:29:05,679
or in angola flow down the river and

829
00:29:09,190 --> 00:29:07,120
enter the delta at this point

830
00:29:10,710 --> 00:29:09,200
and due to a bunch of faults and risks

831
00:29:13,669 --> 00:29:10,720
again geology wise

832
00:29:14,470 --> 00:29:13,679
causes the river to dam up and perform

833
00:29:19,350 --> 00:29:14,480
and

834
00:29:20,710 --> 00:29:19,360
delta is kind of unbelievable from here

835
00:29:22,070 --> 00:29:20,720
to the tip of it down here where it

836
00:29:25,110 --> 00:29:22,080
enters the kalahari desert

837
00:29:26,549 --> 00:29:25,120
is about 90 95 miles long

838
00:29:28,950 --> 00:29:26,559

and it takes over six months from the

839
00:29:30,310 --> 00:29:28,960
water to move from this area to maybe

840
00:29:32,070 --> 00:29:30,320
the tip of the delta

841
00:29:33,510 --> 00:29:32,080
during that time it's absorbed used by

842
00:29:36,070 --> 00:29:33,520
the plant life

843
00:29:37,350 --> 00:29:36,080
or evaporated and some of the

844
00:29:38,549 --> 00:29:37,360
civilizations around here are trying to

845
00:29:40,549 --> 00:29:38,559
pump water out of this area

846
00:29:41,830 --> 00:29:40,559
to mining operations to cities again

847
00:29:44,549 --> 00:29:41,840
which will destroy

848
00:29:45,830 --> 00:29:44,559
this um area which is very similar to

849
00:29:48,630 --> 00:29:45,840
the south american

850
00:29:49,590 --> 00:29:48,640
rainforest it is one of the more wilder

851
00:29:52,549 --> 00:29:49,600
regions of the

852
00:29:53,190 --> 00:29:52,559
african continent huge herds of buffalo

853
00:29:57,269 --> 00:29:53,200
elephant

854
00:30:00,549 --> 00:29:57,279
and zebras and other animals roam there

855
00:30:02,710 --> 00:30:00,559
quite often we photograph this area

856
00:30:04,789 --> 00:30:02,720
almost every shuttle flight if we can to

857
00:30:07,830 --> 00:30:04,799
help document the changes in this delta

858
00:30:09,590 --> 00:30:07,840
because it's kind of a miniature uh

859
00:30:10,789 --> 00:30:09,600
model of how other areas of the world

860
00:30:12,389 --> 00:30:10,799
are working

861
00:30:14,230 --> 00:30:12,399
a lot of times in these areas up here we

862
00:30:16,070 --> 00:30:14,240
see forest or

863
00:30:18,470 --> 00:30:16,080

see fires where people are burning off

864
00:30:19,269 --> 00:30:18,480
the uh the wetlands so they can use the

865
00:30:20,950 --> 00:30:19,279
um

866
00:30:22,470 --> 00:30:20,960
the area for grazing since cattle

867
00:30:24,950 --> 00:30:22,480
herding and

868
00:30:26,310 --> 00:30:24,960
cattle is the biggest industry for the

869
00:30:28,389 --> 00:30:26,320
local population

870
00:30:29,830 --> 00:30:28,399
and over the past hundred years we've uh

871
00:30:31,110 --> 00:30:29,840
we've documented the changes in this

872
00:30:33,430 --> 00:30:31,120
river delta how

873
00:30:34,549 --> 00:30:33,440
a different weather phenomenon and how

874
00:30:39,669 --> 00:30:34,559
humans are affecting it

875
00:30:42,710 --> 00:30:42,070
this is an oblique view of lake charles

876
00:30:46,310 --> 00:30:42,720
lake chad

877
00:30:47,190 --> 00:30:46,320
is located at the border of chad nigeria

878
00:30:50,230 --> 00:30:47,200
niger and

879
00:30:52,230 --> 00:30:50,240
cameroon it's also a very good subject

880
00:30:52,630 --> 00:30:52,240
for photography on each shuttle flights

881
00:30:55,830 --> 00:30:52,640
as

882
00:30:56,470 --> 00:30:55,840
it is a very shallow lake less than 25

883
00:30:58,470 --> 00:30:56,480
feet deep

884
00:31:00,230 --> 00:30:58,480
and that's why the size varies

885
00:31:02,870 --> 00:31:00,240
seasonally very much

886
00:31:05,750 --> 00:31:02,880
the picture shows the water on the

887
00:31:08,549 --> 00:31:05,760
southern basin the picture is looking uh

888
00:31:09,990 --> 00:31:08,559

south we have the water on the south

889
00:31:13,029 --> 00:31:10,000
basin and

890
00:31:16,070 --> 00:31:13,039
you can see also very big dunes

891
00:31:17,350 --> 00:31:16,080
covering the eastern and the northern

892
00:31:20,389 --> 00:31:17,360
edges of the lake

893
00:31:23,830 --> 00:31:20,399
where water used to stand before

894
00:31:25,830 --> 00:31:23,840
and also can be seen the prevailing

895
00:31:27,350 --> 00:31:25,840
wind direction very easily with the

896
00:31:32,470 --> 00:31:27,360
agricultural

897
00:31:35,029 --> 00:31:32,480
burning blowing to the west

898
00:31:36,549 --> 00:31:35,039
this uh near vertical falls color

899
00:31:39,830 --> 00:31:36,559
infrared picture

900
00:31:42,230 --> 00:31:39,840
shows a very unique agricultural pattern

901
00:31:44,310 --> 00:31:42,240
south of khartoum between the white and

902
00:31:46,070 --> 00:31:44,320
the blue nile rivers

903
00:31:47,750 --> 00:31:46,080
of course it's in like that's why

904
00:31:49,269 --> 00:31:47,760
everything green looks red on the

905
00:31:52,710 --> 00:31:49,279
picture

906
00:31:56,389 --> 00:31:52,720
uh hundreds of rectangular

907
00:31:58,950 --> 00:31:56,399
fields can be seen over a

908
00:32:00,310 --> 00:31:58,960
size of about 100 miles and also

909
00:32:02,470 --> 00:32:00,320
straight lines

910
00:32:03,669 --> 00:32:02,480
that are the water filled canals

911
00:32:07,350 --> 00:32:03,679
irrigating this

912
00:32:11,110 --> 00:32:07,360
region this is a by very far the biggest

913
00:32:14,070 --> 00:32:11,120

irrigation project in north africa

914
00:32:15,029 --> 00:32:14,080
in a periodic cycle throughout the year

915
00:32:17,029 --> 00:32:15,039
half of the

916
00:32:18,870 --> 00:32:17,039
fields are in crops essentially of

917
00:32:21,750 --> 00:32:18,880
cotton and the other half

918
00:32:23,269 --> 00:32:21,760
is fallow for resting soil and also for

919
00:32:25,430 --> 00:32:23,279
pest control

920
00:32:27,590 --> 00:32:25,440
this is also an oblique view of the

921
00:32:30,870 --> 00:32:27,600
strait of gibraltar looking

922
00:32:32,310 --> 00:32:30,880
south east mediterranean sea is on the

923
00:32:34,149 --> 00:32:32,320
upper left corner and you have the

924
00:32:36,630 --> 00:32:34,159
atlantic ocean on the right

925
00:32:37,669 --> 00:32:36,640
this is africa on the top and spain on

926
00:32:40,870 --> 00:32:37,679
the left

927
00:32:41,269 --> 00:32:40,880
the sunglint highlights very much the

928
00:32:44,549 --> 00:32:41,279
high

929
00:32:47,509 --> 00:32:44,559
currents through the strait and also

930
00:32:48,149 --> 00:32:47,519
current shears along those straight

931
00:32:51,669 --> 00:32:48,159
lines

932
00:32:53,029 --> 00:32:51,679
starting from coast of spain also we can

933
00:32:55,909 --> 00:32:53,039
see

934
00:32:56,870 --> 00:32:55,919
very easily surface waters patterns

935
00:33:00,070 --> 00:32:56,880
thanks to the

936
00:33:02,950 --> 00:33:00,080
the glint and also some very small

937
00:33:04,789 --> 00:33:02,960
shipwrecks the sunglint highlights also

938
00:33:07,830 --> 00:33:04,799

the town of tange here in

939
00:33:11,990 --> 00:33:07,840
morocco africa and also

940
00:33:14,149 --> 00:33:12,000
the bay of callis in spain and also

941
00:33:18,310 --> 00:33:14,159
you can see very long contrails on the

942
00:33:24,549 --> 00:33:21,350
this is a nice public view looking north

943
00:33:27,750 --> 00:33:24,559
east of the whole alps

944
00:33:28,870 --> 00:33:27,760
mountains chain which is a natural

945
00:33:32,230 --> 00:33:28,880
border

946
00:33:34,389 --> 00:33:32,240
of binding the some of the main european

947
00:33:36,870 --> 00:33:34,399
space agency countries participating in

948
00:33:39,190 --> 00:33:36,880
the international space station program

949
00:33:41,269 --> 00:33:39,200
france on the left italy on the right

950
00:33:44,149 --> 00:33:41,279
germany on the upper right corner

951
00:33:44,630 --> 00:33:44,159
and switzerland in the middle can be

952
00:33:48,230 --> 00:33:44,640
seen

953
00:33:48,870 --> 00:33:48,240
very easily the pattern of the rhone

954
00:33:51,509 --> 00:33:48,880
valley

955
00:33:52,310 --> 00:33:51,519
with the famous curve the inverted l

956
00:33:54,310 --> 00:33:52,320
shape

957
00:33:55,750 --> 00:33:54,320
and the 90 degrees angle here leading to

958
00:33:59,509 --> 00:33:55,760
the geneva lake

959
00:34:02,710 --> 00:33:59,519
and also it's very easy to see those

960
00:34:03,830 --> 00:34:02,720
big valleys here on the italian side as

961
00:34:07,029 --> 00:34:03,840
they have been

962
00:34:07,990 --> 00:34:07,039
shaped as a you letter by a glaciers

963
00:34:10,710 --> 00:34:08,000

during the last

964
00:34:12,869 --> 00:34:10,720
ice age this is the austral valley and

965
00:34:15,669 --> 00:34:12,879
this is a valley leading to terrain

966
00:34:17,669 --> 00:34:15,679
and here you see the izair and mauryan

967
00:34:20,149 --> 00:34:17,679
where a lot of very famous

968
00:34:22,550 --> 00:34:20,159
french and italian skiing resorts are

969
00:34:24,869 --> 00:34:22,560
located

970
00:34:26,550 --> 00:34:24,879
this is a view of greenland and because

971
00:34:28,550 --> 00:34:26,560
of the time of day that we launched

972
00:34:30,149 --> 00:34:28,560
we had sunrises usually in the very

973
00:34:31,190 --> 00:34:30,159
southern part of our orbit and then we

974
00:34:34,069 --> 00:34:31,200
had sunlit

975
00:34:34,869 --> 00:34:34,079
as we ascended in our orbit and had

976
00:34:36,550 --> 00:34:34,879
sunsets

977
00:34:38,550 --> 00:34:36,560
at the top of our orbit so this is kind

978
00:34:40,310 --> 00:34:38,560
of a late afternoon shot

979
00:34:42,710 --> 00:34:40,320
and of course it's easy to pick out all

980
00:34:44,790 --> 00:34:42,720
the fjords along the coastlines

981
00:34:47,349 --> 00:34:44,800
which were created during the last great

982
00:34:49,669 --> 00:34:47,359
ice age about ten thousand years ago

983
00:34:51,109 --> 00:34:49,679
it's interesting to find out that the

984
00:34:52,950 --> 00:34:51,119
ice particularly in the center of

985
00:34:53,669 --> 00:34:52,960
greenland is about ten thousand feet

986
00:34:55,430 --> 00:34:53,679
thick

987
00:34:57,829 --> 00:34:55,440
that there are still rivers of ice that

988
00:34:59,910 --> 00:34:57,839

are flowing towards the oceans

989
00:35:02,870 --> 00:34:59,920
where the ice then either melts or form

990
00:35:05,109 --> 00:35:02,880
forms icebergs

991
00:35:07,990 --> 00:35:05,119
this is a view of volcanic terrain in

992
00:35:10,150 --> 00:35:08,000
the central andes in south america

993
00:35:11,510 --> 00:35:10,160
and i like this view because it's very

994
00:35:12,550 --> 00:35:11,520
exotic looking and if you didn't know

995
00:35:14,870 --> 00:35:12,560
you were looking at the earth you might

996
00:35:16,470 --> 00:35:14,880
think we were exploring another planet

997
00:35:18,390 --> 00:35:16,480
the geologists are interested in

998
00:35:18,870 --> 00:35:18,400
pictures like this not only because of

999
00:35:20,870 --> 00:35:18,880
the

1000
00:35:22,470 --> 00:35:20,880
many different types of volcanic

1001
00:35:23,349 --> 00:35:22,480
landforms that they can pick out in the

1002
00:35:25,270 --> 00:35:23,359
picture

1003
00:35:26,390 --> 00:35:25,280
but also because there are a lot of dry

1004
00:35:28,069 --> 00:35:26,400
lake beds and they can

1005
00:35:29,589 --> 00:35:28,079
pick out ancient shorelines and some of

1006
00:35:31,990 --> 00:35:29,599
the alluvial fans

1007
00:35:33,589 --> 00:35:32,000
and they can also chart to changing

1008
00:35:35,430 --> 00:35:33,599
water levels in some of the lakes and

1009
00:35:37,190 --> 00:35:35,440
there's a very small

1010
00:35:39,430 --> 00:35:37,200
turquoise lake if you can see it up here

1011
00:35:41,990 --> 00:35:39,440
in the upper right

1012
00:35:44,790 --> 00:35:42,000
this near vertical photograph of

1013
00:35:46,950 --> 00:35:44,800

deforestation in brazil was one of our

1014
00:35:47,990 --> 00:35:46,960
earth obs targets that we were asked to

1015
00:35:50,069 --> 00:35:48,000
study and shows

1016
00:35:51,510 --> 00:35:50,079
two distinctly different agricultural

1017
00:35:52,550 --> 00:35:51,520
land use patterns in terms of their

1018
00:35:55,349 --> 00:35:52,560
maturity

1019
00:35:56,390 --> 00:35:55,359
the larger rectangular shapes on the

1020
00:35:59,589 --> 00:35:56,400
bottom of the

1021
00:36:01,670 --> 00:35:59,599
of the view represent

1022
00:36:02,950 --> 00:36:01,680
an older and more fully developed

1023
00:36:04,550 --> 00:36:02,960
agricultural environment while the

1024
00:36:08,069 --> 00:36:04,560
smaller

1025
00:36:09,990 --> 00:36:08,079
less developed areas are more recent

1026
00:36:12,390 --> 00:36:10,000
agricultural development this scene is

1027
00:36:14,870 --> 00:36:12,400
fairly typical of the landscape in

1028
00:36:16,630 --> 00:36:14,880
southwestern brazil by the way

1029
00:36:18,950 --> 00:36:16,640
photographs such as these are

1030
00:36:21,430 --> 00:36:18,960
are excellent tools to illustrate the

1031
00:36:24,790 --> 00:36:21,440
areas of change that are occurring

1032
00:36:26,950 --> 00:36:24,800
in some more remote areas of our world

1033
00:36:28,230 --> 00:36:26,960
they provide the scientists with insight

1034
00:36:30,630 --> 00:36:28,240
into the rate at which these

1035
00:36:32,710 --> 00:36:30,640
tropical rain forests and the transition

1036
00:36:35,750 --> 00:36:32,720
zones of the tropical rainforest

1037
00:36:38,470 --> 00:36:35,760
are being altered and in some cases as

1038
00:36:41,510 --> 00:36:38,480

shown here in a very dramatic way

1039
00:36:43,270 --> 00:36:41,520
this is a uh a photograph that

1040
00:36:45,829 --> 00:36:43,280
shows the southern part of the luthera

1041
00:36:47,750 --> 00:36:45,839
island in the northern bahamas

1042
00:36:48,790 --> 00:36:47,760
looks like a nice place to visit as a

1043
00:36:50,230 --> 00:36:48,800
matter of fact if you look again in

1044
00:36:52,790 --> 00:36:50,240
about 20 years you may see me on a

1045
00:36:54,470 --> 00:36:52,800
sailboat down there someplace

1046
00:36:55,990 --> 00:36:54,480
uh the hook-shaped island encloses a

1047
00:36:58,310 --> 00:36:56,000
relatively shallow platform

1048
00:37:01,270 --> 00:36:58,320
as evidenced by the lighter blue color

1049
00:37:04,550 --> 00:37:01,280
which is surrounded by the dark blue

1050
00:37:07,670 --> 00:37:04,560
much deeper water the feathery pattern

1051
00:37:13,990 --> 00:37:11,670
is a uh platform of sandbars and

1052
00:37:15,670 --> 00:37:14,000
sand channels created by the tidal

1053
00:37:18,550 --> 00:37:15,680
currents that are moving in and out

1054
00:37:21,270 --> 00:37:18,560
uh and off of the platform the channels

1055
00:37:23,430 --> 00:37:21,280
serve as a funnel

1056
00:37:24,310 --> 00:37:23,440
to move large amounts of of the

1057
00:37:25,750 --> 00:37:24,320
limestone

1058
00:37:28,390 --> 00:37:25,760
off of the platform and down into the

1059
00:37:30,630 --> 00:37:28,400
deeper water

1060
00:37:32,710 --> 00:37:30,640
this of course is uh is a fantastic view

1061
00:37:34,950 --> 00:37:32,720
of of the grand canyon

1062
00:37:35,750 --> 00:37:34,960
created by the colorado river that that

1063
00:37:37,349 --> 00:37:35,760

starts

1064
00:37:39,510 --> 00:37:37,359
in rocky mountain national park in

1065
00:37:42,230 --> 00:37:39,520
colorado and then

1066
00:37:43,670 --> 00:37:42,240
works its way down into into lake powell

1067
00:37:45,670 --> 00:37:43,680
right here

1068
00:37:47,430 --> 00:37:45,680
created by the glen canyon dam there and

1069
00:37:50,710 --> 00:37:47,440
then cuts the

1070
00:37:52,550 --> 00:37:50,720
grand canyon 227 miles

1071
00:37:54,069 --> 00:37:52,560
long in total most of it that you can

1072
00:37:57,030 --> 00:37:54,079
see in this view

1073
00:37:57,829 --> 00:37:57,040
and uh averages about 10 miles wide and

1074
00:37:59,750 --> 00:37:57,839
a mile deep

1075
00:38:01,109 --> 00:37:59,760
now if you've ever visited the grand

1076
00:38:03,670 --> 00:38:01,119
canyon you probably

1077
00:38:05,829 --> 00:38:03,680
stood at the village on the rim right

1078
00:38:06,870 --> 00:38:05,839
there and marvel at how magnificent the

1079
00:38:09,670 --> 00:38:06,880
site was

1080
00:38:11,510 --> 00:38:09,680
looked across to the to the north rim

1081
00:38:12,630 --> 00:38:11,520
that is in the kaibab plateau that is

1082
00:38:15,670 --> 00:38:12,640
covered by

1083
00:38:19,670 --> 00:38:15,680
snow here and it's just equally a

1084
00:38:22,790 --> 00:38:19,680
marvelous sight from space the malospina

1085
00:38:26,069 --> 00:38:22,800
glacier in in southern

1086
00:38:27,349 --> 00:38:26,079
alaska is a classic example of a of a

1087
00:38:29,109 --> 00:38:27,359
piedmont

1088
00:38:31,589 --> 00:38:29,119

glacier line along the foot of a

1089
00:38:33,190 --> 00:38:31,599
mountain and then flowing into the sea

1090
00:38:34,950 --> 00:38:33,200
the principal source of ice for this

1091
00:38:37,270 --> 00:38:34,960
glacier is provided by the

1092
00:38:38,870 --> 00:38:37,280
seward ice field that is up in the

1093
00:38:39,829 --> 00:38:38,880
northern area here and then the ice

1094
00:38:41,750 --> 00:38:39,839
flows in

1095
00:38:43,910 --> 00:38:41,760
to the glacier through these three three

1096
00:38:46,950 --> 00:38:43,920
channels

1097
00:38:48,710 --> 00:38:46,960
the glacier moves and surges

1098
00:38:50,230 --> 00:38:48,720
and that moves the earlier formed

1099
00:38:53,270 --> 00:38:50,240
moraines outward

1100
00:38:53,670 --> 00:38:53,280
and in expanding uh concentric circles

1101
00:38:55,990 --> 00:38:53,680
and

1102
00:38:58,950 --> 00:38:56,000
creates these patterns that you see here

1103
00:39:02,790 --> 00:38:58,960
as it moves into the ocean

1104
00:39:04,310 --> 00:39:02,800
going to the other end of the globe from

1105
00:39:06,470 --> 00:39:04,320
north to south we're down here near

1106
00:39:07,510 --> 00:39:06,480
antarctica this is heard island which is

1107
00:39:11,030 --> 00:39:07,520
down near uh

1108
00:39:12,310 --> 00:39:11,040
antarctica and the the special part of

1109
00:39:13,829 --> 00:39:12,320
this picture is the

1110
00:39:16,550 --> 00:39:13,839
wind patterns that you can see in the

1111
00:39:18,390 --> 00:39:16,560
clouds here as the

1112
00:39:20,230 --> 00:39:18,400
wind flows past the island it creates

1113
00:39:21,670 --> 00:39:20,240

these vortices called von carmen

1114
00:39:26,150 --> 00:39:21,680
vortices

1115
00:39:29,109 --> 00:39:26,160
the cloud patterns develop and dissipate

1116
00:39:30,710 --> 00:39:29,119
causing these opposing vortices in the

1117
00:39:32,310 --> 00:39:30,720
wind pattern so not only do we see the

1118
00:39:35,270 --> 00:39:32,320
wind patterns but i also see the cloud

1119
00:39:37,670 --> 00:39:35,280
formations develop there as well

1120
00:39:39,510 --> 00:39:37,680
we were very fortunate to have several

1121
00:39:41,109 --> 00:39:39,520
crystal clear passes over japan

1122
00:39:43,670 --> 00:39:41,119
and this is the southern end of the

1123
00:39:45,750 --> 00:39:43,680
island of kyushu in japan

1124
00:39:47,430 --> 00:39:45,760
and up near the top of the frame you can

1125
00:39:50,150 --> 00:39:47,440
see the volcanic

1126
00:39:51,589 --> 00:39:50,160
volcano sakurajima with a little bit of

1127
00:39:55,030 --> 00:39:51,599
steam plume

1128
00:39:57,270 --> 00:39:55,040
emanating from the top you can also see

1129
00:39:58,230 --> 00:39:57,280
quite a bit of ash collection near the

1130
00:40:01,190 --> 00:39:58,240
summit

1131
00:40:01,910 --> 00:40:01,200
and also what's striking on every pass

1132
00:40:04,150 --> 00:40:01,920
over japan

1133
00:40:05,349 --> 00:40:04,160
is the population density i think you

1134
00:40:11,109 --> 00:40:05,359
can appreciate

1135
00:40:13,829 --> 00:40:11,119
in this view several areas of

1136
00:40:16,870 --> 00:40:13,839
population density several large cities

1137
00:40:19,349 --> 00:40:16,880
including just to the west of sakurajima

1138
00:40:20,309 --> 00:40:19,359

a town called kagoshima and it's

1139
00:40:22,230 --> 00:40:20,319
interesting that

1140
00:40:23,750 --> 00:40:22,240
the school children there have grown so

1141
00:40:25,990 --> 00:40:23,760
accustomed to

1142
00:40:28,870 --> 00:40:26,000
volcanic activity that they often wear

1143
00:40:30,790 --> 00:40:28,880
hard hats to school

1144
00:40:32,550 --> 00:40:30,800
this is our last picture in our series

1145
00:40:34,390 --> 00:40:32,560
of slides this

1146
00:40:36,150 --> 00:40:34,400
clearly is a mission that was dedicated

1147
00:40:37,430 --> 00:40:36,160
to looking at the health of our planet

1148
00:40:39,349 --> 00:40:37,440
and if there's anything