1
00:00:06,230 --> 00:00:03,350
now for all the attention that's paid to

2
00:00:08,150 --> 00:00:06,240
science work done by human crew members

3
00:00:10,310 --> 00:00:08,160
there is a good bit of science research

4
00:00:12,230 --> 00:00:10,320
being conducted by instruments located

5
00:00:15,190 --> 00:00:12,240
on the outside of the international

6
00:00:17,029 --> 00:00:15,200
space station the hyperspectral imager

7
00:00:19,029 --> 00:00:17,039
for the coastal oceans has been

8
00:00:21,429 --> 00:00:19,039
gathering data for nearly five years

9
00:00:22,630 --> 00:00:21,439
about the conditions of ocean waters all

10
00:00:23,990 --> 00:00:22,640
over the world

11
00:00:26,630 --> 00:00:24,000
this morning we're going to learn more

12
00:00:29,029 --> 00:00:26,640
about it from mary kappas the hico

13
00:00:31,029 --> 00:00:29,039

facility manager who joins us from her

14
00:00:32,709 --> 00:00:31,039
office at the naval research laboratory

15
00:00:34,470 --> 00:00:32,719
in washington d.c

16
00:00:36,229 --> 00:00:34,480
mary for starters tell me about the

17
00:00:38,069 --> 00:00:36,239
hardware itself and

18
00:00:40,470 --> 00:00:38,079
when was it launched and where on the

19
00:00:41,510 --> 00:00:40,480
station is it located

20
00:00:44,310 --> 00:00:41,520
okay

21
00:00:46,549 --> 00:00:44,320
hico is a hyperspectral imager which is

22
00:00:48,790 --> 00:00:46,559
made up of a camera that is the focal

23
00:00:51,189 --> 00:00:48,800
plane that records the data

24
00:00:53,029 --> 00:00:51,199
four optics for collecting the light and

25
00:00:54,950 --> 00:00:53,039
a spectrometer for dispersing the

26
00:00:56,869 --> 00:00:54,960
broadband incoming light into separate

27
00:00:59,029 --> 00:00:56,879
wavelength bins

28
00:01:00,790 --> 00:00:59,039
hico was built as a demonstration

29
00:01:03,430 --> 00:01:00,800
project under the navy's innovative

30
00:01:04,869 --> 00:01:03,440
naval prototype program and so it had to

31
00:01:06,950 --> 00:01:04,879
incorporate innovative cost

32
00:01:08,070 --> 00:01:06,960
effectiveness and project acceleration

33
00:01:10,630 --> 00:01:08,080
methods

34
00:01:12,469 --> 00:01:10,640
to do that nrl designed hico based on

35
00:01:14,550 --> 00:01:12,479
decades of airborne hyperspectral

36
00:01:17,270 --> 00:01:14,560
experience that was focused on coastal

37
00:01:19,190 --> 00:01:17,280
oceans and they incorporated commercial

38
00:01:20,390 --> 00:01:19,200

off-the-shelf parts for most of the

39
00:01:21,830 --> 00:01:20,400
system

40
00:01:23,990 --> 00:01:21,840
we designed hico to capture the

41
00:01:26,310 --> 00:01:24,000
complexities subtleties and scale of

42
00:01:28,710 --> 00:01:26,320
ocean coastal dynamics

43
00:01:31,830 --> 00:01:28,720
heiko was built in 18 months and

44
00:01:34,630 --> 00:01:31,840
launched in september 2009 it's on the

45
00:01:36,390 --> 00:01:34,640
japanese exposed module the gem

46
00:01:38,789 --> 00:01:36,400
and it's in an enclosure that provides

47
00:01:40,789 --> 00:01:38,799
protection during iss maneuvers and a

48
00:01:42,950 --> 00:01:40,799
quite dark place for acquiring dark

49
00:01:44,630 --> 00:01:42,960
scenes needed for calibration

50
00:01:47,429 --> 00:01:44,640
there's a commercial off-the-shelf

51
00:01:49,590 --> 00:01:47,439
rotation stage also that allows heiko to

52
00:01:52,389 --> 00:01:49,600
aim side to side

53
00:01:54,550 --> 00:01:52,399
now for those of us who are scientists

54
00:01:56,550 --> 00:01:54,560
what is hyperspectral

55
00:02:01,429 --> 00:01:56,560
mean

56
00:02:03,910 --> 00:02:01,439
incoming light into separate wavelengths

57
00:02:04,870 --> 00:02:03,920
in lots of separate narrow contiguous

58
00:02:06,950 --> 00:02:04,880
bands

59
00:02:09,029 --> 00:02:06,960
the operative concept is separating the

60
00:02:11,110 --> 00:02:09,039
wavelengths so the term hyperspectral

61
00:02:12,790 --> 00:02:11,120
doesn't specify the range of wavelengths

62
00:02:14,229 --> 00:02:12,800
because that's different for different

63
00:02:16,070 --> 00:02:14,239

kinds of sensors

64
00:02:17,350 --> 00:02:16,080
now for heiko the incoming light source

65
00:02:19,030 --> 00:02:17,360
is the sun

66
00:02:21,670 --> 00:02:19,040
which covers lots of wavelengths in one

67
00:02:24,150 --> 00:02:21,680
broadband and hico records just the

68
00:02:26,470 --> 00:02:24,160
visible especially the blue through the

69
00:02:30,150 --> 00:02:26,480
near infrared specifically it goes from

70
00:02:33,270 --> 00:02:30,160
350 nanometers out to 1080 nanometers in

71
00:02:35,030 --> 00:02:33,280
128 bands that are 5.7 nanometers wide

72
00:02:37,509 --> 00:02:35,040
which is fine enough

73
00:02:39,589 --> 00:02:37,519
to resolve features of optically active

74
00:02:41,910 --> 00:02:39,599
substances in water

75
00:02:43,830 --> 00:02:41,920
now for one spot that

76
00:02:46,070 --> 00:02:43,840
that'd be one pixel in a collected image

77
00:02:47,830 --> 00:02:46,080
you can look at a spectrum

78
00:02:49,430 --> 00:02:47,840
that shows how light is reflected or

79
00:02:51,350 --> 00:02:49,440
absorbed at each wavelength and

80
00:02:52,710 --> 00:02:51,360
different materials absorb or reflect

81
00:02:54,949 --> 00:02:52,720
light differently based on their

82
00:02:57,589 --> 00:02:54,959
chemical composition particle size and

83
00:02:59,509 --> 00:02:57,599
shape etc so we're doing spectroscopy

84
00:03:01,830 --> 00:02:59,519
like chemists do in the lab only our

85
00:03:03,990 --> 00:03:01,840
samples aren't neatly prepared and all

86
00:03:05,830 --> 00:03:04,000
in one type we can tell whether there's

87
00:03:07,430 --> 00:03:05,840
a high concentration of phytoplankton or

88
00:03:09,030 --> 00:03:07,440

suspended sediments or other water

89
00:03:10,390 --> 00:03:09,040
constituents and these elements are

90
00:03:12,949 --> 00:03:10,400
indicative of the health of ocean

91
00:03:15,030 --> 00:03:12,959
ecosystems or visibility in the water or

92
00:03:18,070 --> 00:03:15,040
the dynamics of flows and is that your

93
00:03:20,149 --> 00:03:18,080
your specific target phytoplanktons

94
00:03:22,309 --> 00:03:20,159
um that's that's one of the things it's

95
00:03:25,589 --> 00:03:22,319
overall what are the what's the

96
00:03:28,229 --> 00:03:25,599
constituents of the water and we look at

97
00:03:29,750 --> 00:03:28,239
optical properties and then we convert

98
00:03:32,390 --> 00:03:29,760
that into physical properties like

99
00:03:34,949 --> 00:03:32,400
phytoplankton suspended sediments

100
00:03:36,789 --> 00:03:34,959
dissolved organic matter etc and that in

101
00:03:38,149 --> 00:03:36,799
turn can be

102
00:03:40,390 --> 00:03:38,159
converted to look at what is the

103
00:03:43,190 --> 00:03:40,400
visibility or the water depth for

104
00:03:45,910 --> 00:03:43,200
example and what is the value of doing

105
00:03:48,390 --> 00:03:45,920
this test from orbit instead of going

106
00:03:50,149 --> 00:03:48,400
down to the waterfront and and taking a

107
00:03:50,869 --> 00:03:50,159
water sample and testing it

108
00:03:52,710 --> 00:03:50,879
so

109
00:03:55,589 --> 00:03:52,720
well in addition to the the spectrum for

110
00:03:58,470 --> 00:03:55,599
each pixel we get a whole spatial array

111
00:04:02,070 --> 00:03:58,480
our our image size is 50 kilometers by

112
00:04:03,990 --> 00:04:02,080
200 kilometers so in each scene we we

113
00:04:05,910 --> 00:04:04,000

basically have a three-dimensional image

114
00:04:07,670 --> 00:04:05,920
cube so the spectra tell us about the

115
00:04:08,710 --> 00:04:07,680
material composition and the spatial

116
00:04:10,710 --> 00:04:08,720
display

117
00:04:12,550 --> 00:04:10,720
shows the pattern of that composition so

118
00:04:14,550 --> 00:04:12,560
in the coastal oceans

119
00:04:16,469 --> 00:04:14,560
that allows us to see how high

120
00:04:18,150 --> 00:04:16,479
concentrations of some component let's

121
00:04:20,469 --> 00:04:18,160
say suspended sediment

122
00:04:23,270 --> 00:04:20,479
relates to the outflows from rivers

123
00:04:25,270 --> 00:04:23,280
um the shape of the coastline etc

124
00:04:26,710 --> 00:04:25,280
so now really what that does is the

125
00:04:28,469 --> 00:04:26,720
spaceborne location gives you this

126
00:04:30,629 --> 00:04:28,479
spatial extent

127
00:04:31,830 --> 00:04:30,639
while your boat samples is very

128
00:04:33,990 --> 00:04:31,840
localized

129
00:04:35,749 --> 00:04:34,000
so that spaceborne sensor allows you to

130
00:04:37,110 --> 00:04:35,759
do repeat visits without having to stay

131
00:04:38,550 --> 00:04:37,120
on site in a boat

132
00:04:40,870 --> 00:04:38,560
but i think i should point out that

133
00:04:42,629 --> 00:04:40,880
these two approaches work best together

134
00:04:44,629 --> 00:04:42,639
we need that in-situ sampling to

135
00:04:46,230 --> 00:04:44,639
calibrate and confirm the hyperspectral

136
00:04:48,469 --> 00:04:46,240
measurements which is really the case

137
00:04:50,550 --> 00:04:48,479
for any remotely sensed measurement

138
00:04:51,430 --> 00:04:50,560

heiko met all its goals within the first

139
00:04:53,270 --> 00:04:51,440
year

140
00:04:54,870 --> 00:04:53,280
the first image transmitted to earth was

141
00:04:57,030 --> 00:04:54,880
a good clean image

142
00:04:59,430 --> 00:04:57,040
and since then we've constantly worked

143
00:05:01,350 --> 00:04:59,440
to improve our calibration and we engage

144
00:05:03,029 --> 00:05:01,360
scientists throughout academia to work

145
00:05:05,029 --> 00:05:03,039
with the data and to help advance the

146
00:05:06,790 --> 00:05:05,039
processing and conduct useful scientific

147
00:05:08,790 --> 00:05:06,800
studies

148
00:05:10,870 --> 00:05:08,800
if you want some examples um researchers

149
00:05:13,670 --> 00:05:10,880
have used hico to map

150
00:05:15,749 --> 00:05:13,680
the contents of the water and the bottom

151
00:05:17,830 --> 00:05:15,759
in areas in the bahamas and australia

152
00:05:19,590 --> 00:05:17,840
they mapped out bottom depth bottom

153
00:05:22,070 --> 00:05:19,600
types such as different types of sand

154
00:05:23,510 --> 00:05:22,080
and seagrass and water constituents such

155
00:05:25,110 --> 00:05:23,520
as chlorophyll

156
00:05:27,510 --> 00:05:25,120
other researchers looked in san

157
00:05:29,830 --> 00:05:27,520
francisco and monterey bays to determine

158
00:05:31,590 --> 00:05:29,840
the water quality and make maps showing

159
00:05:35,830 --> 00:05:31,600
the extent and concentration of

160
00:05:38,550 --> 00:05:35,840
phytoplankton blooms and sediment plumes

161
00:05:40,469 --> 00:05:38,560
now i understand that hico is now a part

162
00:05:42,629 --> 00:05:40,479
of the international space station

163
00:05:44,150 --> 00:05:42,639

national laboratory what does that mean

164
00:05:45,350 --> 00:05:44,160
for it in in terms of day-to-day

165
00:05:47,830 --> 00:05:45,360
operation

166
00:05:50,629 --> 00:05:47,840
well it's been providing some really big

167
00:05:52,629 --> 00:05:50,639
pluses the direct tie to nasa

168
00:05:54,550 --> 00:05:52,639
enabled us to get additional data

169
00:05:56,629 --> 00:05:54,560
streams to help improve our geolocation

170
00:05:59,270 --> 00:05:56,639
accuracy and we were also able to get a

171
00:06:01,430 --> 00:05:59,280
faster data transmission rate and that

172
00:06:03,590 --> 00:06:01,440
enabled us to schedule up to two images

173
00:06:04,950 --> 00:06:03,600
per orbit and in the past we've been

174
00:06:06,469 --> 00:06:04,960
limited to one

175
00:06:09,029 --> 00:06:06,479
and another thing is that all the hico

176
00:06:11,110 --> 00:06:09,039
data is now available on nasa's ocean

177
00:06:13,830 --> 00:06:11,120
color website where researchers

178
00:06:15,909 --> 00:06:13,840
worldwide can browse and download it and

179
00:06:18,790 --> 00:06:15,919
by being co-located with traditional

180
00:06:20,870 --> 00:06:18,800
ocean color sensor data such as modis

181
00:06:24,150 --> 00:06:20,880
and viirs and so forth that encourages

182
00:06:25,830 --> 00:06:24,160
new users and multi-sensor projects

183
00:06:27,909 --> 00:06:25,840
how long do you figure hico will

184
00:06:28,790 --> 00:06:27,919
continue to operate

185
00:06:30,230 --> 00:06:28,800
well

186
00:06:31,830 --> 00:06:30,240
it can operate as long as it keeps

187
00:06:33,749 --> 00:06:31,840
working and so far the health of the

188
00:06:35,510 --> 00:06:33,759

system is very good and the other

189
00:06:36,790 --> 00:06:35,520
limitation would be the real estate on

190
00:06:38,870 --> 00:06:36,800
the iss

191
00:06:40,870 --> 00:06:38,880
so high cost lifespan depends on whether

192
00:06:43,029 --> 00:06:40,880
there's other plans for that spot and

193
00:06:45,110 --> 00:06:43,039
right now there's no immediate plans

194
00:06:47,430 --> 00:06:45,120
so we look forward to several more years

195
00:06:49,110 --> 00:06:47,440
of operation from the iss well mary

196
00:06:50,870 --> 00:06:49,120
thank you very much for for those couple

197
00:06:53,749 --> 00:06:50,880
of minutes and teaching us about what

198
00:06:55,350 --> 00:06:53,759
hico is doing there i appreciate that

199
00:06:58,150 --> 00:06:55,360
thank you for the opportunity mary

200
00:06:59,830 --> 00:06:58,160
kappas is the hico facility manager at