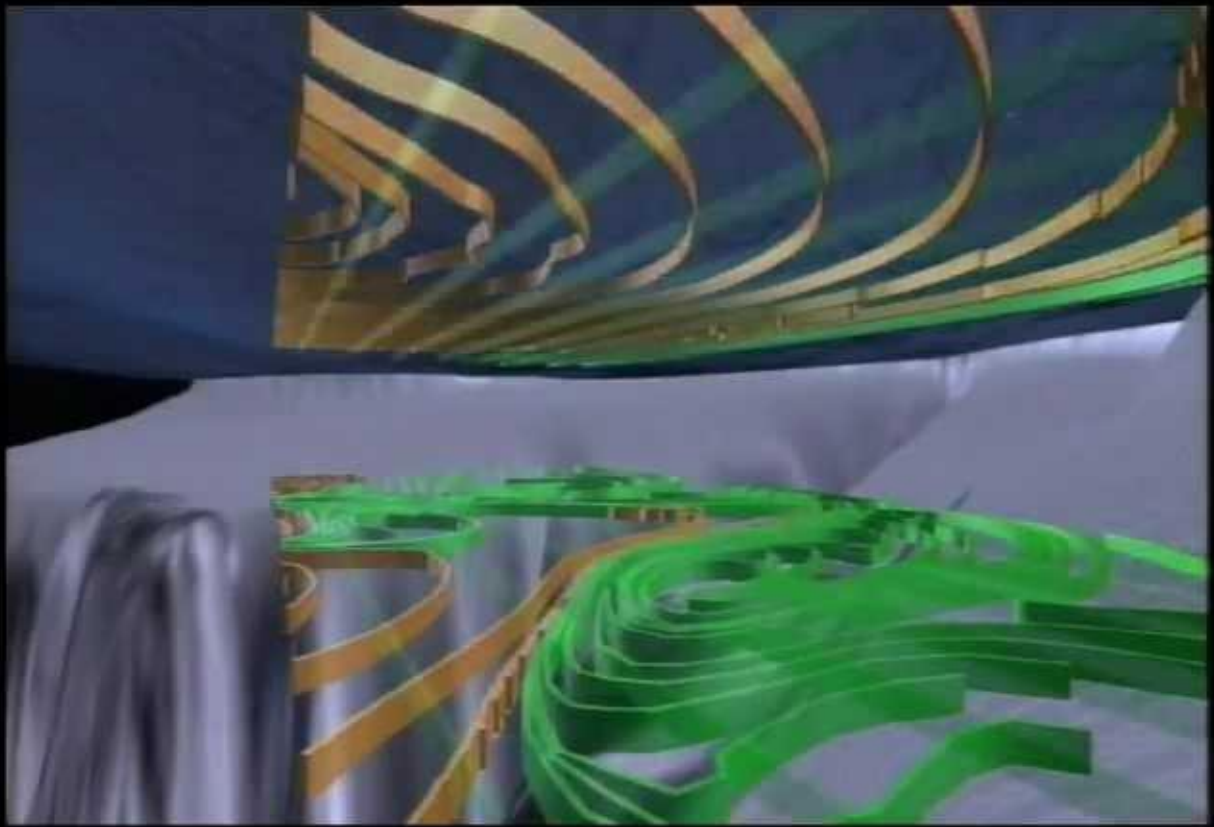

1
00:00:06,079 --> 00:00:04,039
the following computer simulation of a

2
00:00:08,210 --> 00:00:06,089
high-speed flight around the Los Angeles

3
00:00:09,919 --> 00:00:08,220
vicinity was produced to demonstrate a

4
00:00:13,129 --> 00:00:09,929
capability of scientific data

5
00:00:14,959 --> 00:00:13,139
visualization this animation is part of

6
00:00:17,660 --> 00:00:14,969
the NASA funded research being carried

7
00:00:19,519 --> 00:00:17,670
out at the Jet Propulsion Laboratory the

8
00:00:22,160 --> 00:00:19,529
entire animation was produced from one

9
00:00:24,429 --> 00:00:22,170
Landsat satellite image that was merged

10
00:00:27,740 --> 00:00:24,439
with digital elevation information

11
00:00:30,259 --> 00:00:27,750
Landsat views the earth from 570 miles

12
00:00:32,479 --> 00:00:30,269
up and is capable of seeing features

13
00:00:35,630 --> 00:00:32,489

that are approximately 30 meters square

14
00:00:38,810 --> 00:00:35,640
a 30 meter square area is approximately

15
00:00:41,530 --> 00:00:38,820
the same size as the area inside the

16
00:00:44,450 --> 00:00:41,540
basis of a professional baseball field

17
00:00:47,840 --> 00:00:44,460
this is Los Angeles California on July

18
00:00:50,569 --> 00:00:47,850
third 1985 we are not traveling toward

19
00:00:53,360 --> 00:00:50,579
the Pacific Ocean at about 200,000 miles

20
00:00:55,520 --> 00:00:53,370
an hour and will drop down behind santa

21
00:01:02,180 --> 00:00:55,530
catalina island about 26 miles off the

22
00:01:03,770 --> 00:01:02,190
coast of Los Angeles we're going to fly

23
00:01:05,780 --> 00:01:03,780
through the estimates of the island and

24
00:01:12,679 --> 00:01:05,790
then cross the coast north of the Santa

25
00:01:18,780 --> 00:01:16,830
as we head south we can see features

26
00:01:21,300 --> 00:01:18,790
such as marina del rey and Los Angeles

27
00:01:23,340 --> 00:01:21,310
International Airport we see the palos

28
00:01:25,980 --> 00:01:23,350
verdes peninsula in the center now along

29
00:01:27,889 --> 00:01:25,990
with the Long Beach harbor now we're

30
00:01:30,539 --> 00:01:27,899
moving down into the orange county area

31
00:01:34,820 --> 00:01:30,549
the bowtie shaped feature now visible

32
00:01:37,469 --> 00:01:34,830
our Balboa & Lido islands in newport bay

33
00:01:41,330 --> 00:01:37,479
we're heading toward los angeles and in

34
00:01:45,290 --> 00:01:43,679
hollywood in beverly hills are below as

35
00:01:48,660 --> 00:01:45,300
we move into the San Fernando Valley

36
00:01:56,460 --> 00:01:48,670
you'll see a v-shaped Lake appear that's

37
00:01:58,469 --> 00:01:56,470
castaic lake we will now turn and

38
00:02:05,160 --> 00:01:58,479

proceed to fly straight down the Rift

39
00:02:06,749 --> 00:02:05,170
Valley of the San Andreas Fault we're

40
00:02:08,580 --> 00:02:06,759
crossing the East Fork of the San

41
00:02:10,440 --> 00:02:08,590
Gabriel Mountains and we'll turn around

42
00:02:11,940 --> 00:02:10,450
and face those same mountains when we

43
00:02:25,930 --> 00:02:11,950
lose elevation into the Pomona Valley

44
00:02:30,590 --> 00:02:28,640
we can see Mount Baldy at the top right

45
00:02:32,150 --> 00:02:30,600
of the screen and as we pan the San

46
00:02:34,160 --> 00:02:32,160
Gabriel Mountains we can note in the

47
00:02:35,840 --> 00:02:34,170
foreground the santa fe dam and

48
00:02:42,309 --> 00:02:35,850
recreation area the Santa Anita

49
00:02:50,479 --> 00:02:44,989
you can now see the Rose Bowl with the

50
00:02:53,119 --> 00:02:50,489
surrounding golf course it took five and

51
00:02:55,220 --> 00:02:53,129
a half days of non-stop computer time on

52
00:02:58,089 --> 00:02:55,230
a machine capable of computing four

53
00:03:00,559 --> 00:02:58,099
million instructions per second over

54
00:03:03,410 --> 00:03:00,569
3000 digital frames were generated to

55
00:03:07,339 --> 00:03:03,420
make la the movie that represents more

56
00:03:10,000 --> 00:03:07,349
than 2.6 billion bytes of data that is

57
00:03:14,209 --> 00:03:10,010
equivalent to enough characters to fill

58
00:03:16,909 --> 00:03:14,219
1.3 million pages of texts that would be

59
00:03:19,699 --> 00:03:16,919
a stack of paper over forty four stories

60
00:03:22,339 --> 00:03:19,709
tall techniques developed during the

61
00:03:24,080 --> 00:03:22,349
creation of la the movie will be used to

62
00:03:25,939 --> 00:03:24,090
help scientists analyze the large

63
00:03:43,939 --> 00:03:25,949

quantities of data being sent back to

64
00:03:46,099 --> 00:03:43,949
earth by satellites the following

65
00:03:49,810 --> 00:03:46,109
animation demonstrates an application of

66
00:03:53,000 --> 00:03:49,820
scientific data visualization

67
00:03:55,730 --> 00:03:53,010
using nine images taken by the voyager 2

68
00:03:58,010 --> 00:03:55,740
spacecraft planetary geologists and

69
00:03:59,930 --> 00:03:58,020
visualization specialists created a

70
00:04:01,750 --> 00:03:59,940
computer simulated flight over the

71
00:04:03,650 --> 00:04:01,760
southern hemisphere of Miranda a

72
00:04:07,760 --> 00:04:03,660
geologically interesting moon of the

73
00:04:13,130 --> 00:04:07,770
planet Uranus the flight takes us over a

74
00:04:14,810 --> 00:04:13,140
bewildering array of landforms as we

75
00:04:17,449 --> 00:04:14,820
simulate flight over the terrain and

76
00:04:19,310 --> 00:04:17,459
altitudes of three to twenty miles keep

77
00:04:22,280 --> 00:04:19,320
in mind that Voyager tues closest

78
00:06:00,990 --> 00:04:22,290
approach to Miranda was more than 18,000

79
00:06:13,410 --> 00:06:11,400
a study of the Earth's climate must take

80
00:06:16,530 --> 00:06:13,420
into account the crucial role played by

81
00:06:18,960 --> 00:06:16,540
clouds besides delivering life-giving

82
00:06:21,960 --> 00:06:18,970
rain to the land clouds help maintain a

83
00:06:24,180 --> 00:06:21,970
proper balance in the global climate the

84
00:06:26,550 --> 00:06:24,190
following digital animation combines

85
00:06:28,830 --> 00:06:26,560
satellite cloud data and earth elevation

86
00:06:31,350 --> 00:06:28,840
data from maps to demonstrate how

87
00:06:33,960 --> 00:06:31,360
atmospheric scientists and visualization

88
00:06:36,480 --> 00:06:33,970

specialists team up to perform climatic

89
00:06:38,040 --> 00:06:36,490
research the clouds were derived from

90
00:06:46,390 --> 00:06:38,050
infrared and microwave satellite

91
00:06:52,180 --> 00:06:49,360
at first glance clouds may appear

92
00:06:55,240 --> 00:06:52,190
chaotic but closer observation reveals a

93
00:06:57,939 --> 00:06:55,250
semblance of order recognizable patterns

94
00:07:00,640 --> 00:06:57,949
show how air moves up and down while

95
00:07:01,840 --> 00:07:00,650
circulating around the globe the varied

96
00:07:04,450 --> 00:07:01,850
features of the Earth's surface

97
00:07:06,999 --> 00:07:04,460
portrayed here by color as well as

98
00:07:08,950 --> 00:07:07,009
prevailing winds have distinct effects

99
00:07:12,400 --> 00:07:08,960
on the formation and distribution of

100
00:07:14,830 --> 00:07:12,410
clouds computer animation to visualize

101
00:07:17,080 --> 00:07:14,840
clouds provides a unique insight into

102
00:07:37,159 --> 00:07:17,090
the structure and dynamics of global

103
00:07:41,970 --> 00:07:40,230
now as we add the third dimension to

104
00:07:43,980 --> 00:07:41,980
both the Earth's surface and the clouds

105
00:07:46,340 --> 00:07:43,990
we can see the relationship between

106
00:07:49,320 --> 00:07:46,350
cloud tops and the Earth's topography

107
00:07:52,320 --> 00:07:49,330
the cloud top elevations were also

108
00:07:54,240 --> 00:07:52,330
derived from satellite data the vertical

109
00:08:01,620 --> 00:07:54,250
dimensions have been exaggerated 20

110
00:08:03,690 --> 00:08:01,630
times to enhance comparison our flight

111
00:08:07,500 --> 00:08:03,700
first takes us along the west coast of

112
00:08:10,080 --> 00:08:07,510
Africa flying north of Scandinavia we

113
00:08:12,060 --> 00:08:10,090

see Europe then quickly cross the North

114
00:08:15,840 --> 00:08:12,070
Atlantic and drop below the cloud tops

115
00:08:17,879 --> 00:08:15,850
of the eastern United States we look

116
00:08:21,360 --> 00:08:17,889
west into the Amazon basin of South

117
00:08:29,170 --> 00:08:24,580
we circle Cape Horn and view the Andes

118
00:08:35,519 --> 00:08:29,180
Mountains up close Central America

119
00:08:39,219 --> 00:08:37,509
diving below the clouds in the

120
00:08:43,389 --> 00:08:39,229
mid-atlantic we fly over the

121
00:08:46,150 --> 00:08:43,399
Mediterranean turkey passes to our right

122
00:08:49,990 --> 00:08:46,160
as we fly across the Caspian Sea into

123
00:08:54,100 --> 00:08:50,000
the southern Soviet Union China and now

124
00:08:56,319 --> 00:08:54,110
Japan are below us Southeast Asia and

125
00:09:00,850 --> 00:08:56,329
Australia are seen as we head for the

126
00:09:02,980 --> 00:09:00,860
Himalayas and Indian subcontinent the

127
00:09:28,199 --> 00:09:02,990
Middle East and Africa complete our

128
00:09:40,520 --> 00:09:30,190
you

129
00:09:45,330 --> 00:09:43,200
the atmosphere can be considered a

130
00:09:48,720 --> 00:09:45,340
gigantic solar powered engine which

131
00:09:51,210 --> 00:09:48,730
controls our daily weather the Pacific

132
00:09:53,850 --> 00:09:51,220
Ocean shown here covers nearly half the

133
00:09:55,980 --> 00:09:53,860
earth it is the major storehouse of

134
00:09:59,760 --> 00:09:55,990
energy and source of water vapor for the

135
00:10:01,770 --> 00:09:59,770
planet this is the winter season in the

136
00:10:04,380 --> 00:10:01,780
northern hemisphere and we can observe

137
00:10:06,600 --> 00:10:04,390
the course of numerous storms one after

138
00:10:15,519 --> 00:10:06,610

the other approaching North America from

139
00:10:15,529 --> 00:10:19,290
I

140
00:10:24,090 --> 00:10:21,480
note the belt of clouds near the equator

141
00:10:27,210 --> 00:10:24,100
as we rotate the earth to observe the

142
00:10:29,250 --> 00:10:27,220
opposite hemisphere this belt provides

143
00:10:31,800 --> 00:10:29,260
the moisture necessary to sustain the

144
00:10:34,320 --> 00:10:31,810
equatorial rainforests of the Congo

145
00:10:39,480 --> 00:10:34,330
Basin in central Africa and the Amazon

146
00:10:41,699 --> 00:10:39,490
in South America North Africa dominated

147
00:10:46,380 --> 00:10:41,709
by the Sahara is characterized by its

148
00:10:48,720 --> 00:10:46,390
lack of clouds near the top of this

149
00:10:51,420 --> 00:10:48,730
hemisphere we can also observe winter

150
00:10:56,430 --> 00:10:51,430
storms move with regularity across the

151
00:10:58,620 --> 00:10:56,440
North Atlantic and Europe the data

152
00:11:01,230 --> 00:10:58,630
visualization techniques developed to

153
00:11:03,300 --> 00:11:01,240
produce earth the movie represent

154
00:11:05,610 --> 00:11:03,310
powerful new tools that scientists will

155
00:11:13,250 --> 00:11:05,620
use to study our complex global

156
00:12:08,349 --> 00:11:33,900
you

157
00:12:13,879 --> 00:12:11,569
Mars the fourth planet from the Sun is

158
00:12:17,269 --> 00:12:13,889
visible to the naked eye as a bright

159
00:12:19,369 --> 00:12:17,279
star in the night sky through a

160
00:12:22,069 --> 00:12:19,379
telescope it appears as a yellowish

161
00:12:25,759 --> 00:12:22,079
brown disc with indications of complex

162
00:12:27,889 --> 00:12:25,769
features however using images taken by

163
00:12:31,129 --> 00:12:27,899

cameras on the Viking orbiter spacecraft

164
00:12:37,759 --> 00:12:31,139
a simulated flight over Mars reveals

165
00:12:39,979 --> 00:12:37,769
much more detail these are shaded relief

166
00:12:43,069 --> 00:12:39,989
maps of the topography of the Earth and

167
00:12:46,489 --> 00:12:43,079
Mars rendered out of spheres the

168
00:12:49,099 --> 00:12:46,499
diameter of Mars is 4,200 2 miles or

169
00:12:51,139 --> 00:12:49,109
about fifty three percent of Earth's the

170
00:12:53,900 --> 00:12:51,149
planet's volume is about fifteen percent

171
00:12:55,970 --> 00:12:53,910
of Earth's a comparison of the relative

172
00:12:58,009 --> 00:12:55,980
size of each planet to the size of its

173
00:13:01,309 --> 00:12:58,019
surface features demonstrates the

174
00:13:02,840 --> 00:13:01,319
enormity of the Martian terrain the Mars

175
00:13:05,239 --> 00:13:02,850
elevations were derived from

176
00:13:10,159 --> 00:13:05,249
stereographic analysis are the Viking

177
00:13:11,929 --> 00:13:10,169
orbiter imagery for scale the outline of

178
00:13:14,449 --> 00:13:11,939
the continental United States is

179
00:13:22,119 --> 00:13:14,459
superimposed on a portion of the Martian

180
00:13:27,259 --> 00:13:24,559
among the most impressive features on

181
00:13:29,419 --> 00:13:27,269
Mars are the Tharsis Monty's shield

182
00:13:31,369 --> 00:13:29,429
volcanoes more than two times the height

183
00:13:34,369 --> 00:13:31,379
of Mount Everest and the Valles

184
00:13:38,359 --> 00:13:34,379
Marineris a system of enormous canyons

185
00:13:41,030 --> 00:13:38,369
over 3,000 miles long this Viking

186
00:13:43,609 --> 00:13:41,040
orbiter image mosaic was used for the

187
00:13:46,159 --> 00:13:43,619
flight simulation the lion being drawn

188
00:13:49,280 --> 00:13:46,169

follows the flight path flight

189
00:13:52,220 --> 00:13:49,290
elevations vary from 500 miles to 3

190
00:13:54,559 --> 00:13:52,230
miles above the surface the relief has

191
00:13:56,689 --> 00:13:54,569
been exaggerated 5 times and the natural

192
00:13:59,859 --> 00:13:56,699
color enhanced to allow better

193
00:14:02,779 --> 00:13:59,869
interpretation of small surface features

194
00:14:05,419 --> 00:14:02,789
for centuries Mars has captivated

195
00:14:08,329 --> 00:14:05,429
observers on earth unmanned spacecraft

196
00:14:10,279 --> 00:14:08,339
and scientific data visualization have

197
00:16:57,210 --> 00:14:10,289
increased our interest in and knowledge

198
00:17:02,369 --> 00:16:59,699
the following computer animation of the

199
00:17:04,980 --> 00:17:02,379
Monterey Bay environment was produced to

200
00:17:08,370 --> 00:17:04,990
demonstrate the fusion and visualization

201
00:17:10,620 --> 00:17:08,380
of multiple geophysical data sets both

202
00:17:12,299 --> 00:17:10,630
the United States Navy and NASA

203
00:17:14,669 --> 00:17:12,309
sponsored the development of

204
00:17:19,679 --> 00:17:14,679
visualization technology to enhance the

205
00:17:22,110 --> 00:17:19,689
understanding of environmental data this

206
00:17:24,390 --> 00:17:22,120
is a Landsat thematic mapper image of

207
00:17:27,000 --> 00:17:24,400
the Monterey Peninsula the city of

208
00:17:28,649 --> 00:17:27,010
Monterey is seen at the top pebble beach

209
00:17:30,960 --> 00:17:28,659
is visible in the southern portion of

210
00:17:33,720 --> 00:17:30,970
the peninsula large kelp beds are

211
00:17:35,580 --> 00:17:33,730
visible just offshore we now travel

212
00:17:38,130 --> 00:17:35,590
straight upward to a height of just over

213
00:17:42,330 --> 00:17:38,140

30 miles from here we can see the entire

214
00:17:44,640 --> 00:17:42,340
Monterey Bay Area the Landsat thematic

215
00:17:46,770 --> 00:17:44,650
mapper imagery of the ocean is now

216
00:17:49,230 --> 00:17:46,780
replaced with coastal zone color scanner

217
00:17:50,789 --> 00:17:49,240
imagery this instrument measures the

218
00:17:53,880 --> 00:17:50,799
varying levels of chlorophyll in the

219
00:17:56,789 --> 00:17:53,890
ocean reds and yellows indicate higher

220
00:18:00,090 --> 00:17:56,799
concentrations blues and greens indicate

221
00:18:02,520 --> 00:18:00,100
lower amounts as the coastal zone color

222
00:18:07,860 --> 00:18:02,530
scanner data is made translucent bottom

223
00:18:09,750 --> 00:18:07,870
topography features become visible we

224
00:18:12,360 --> 00:18:09,760
are now descending at a velocity of over

225
00:18:14,820 --> 00:18:12,370
18,000 miles per hour our approach

226
00:18:18,659 --> 00:18:14,830
Sloan's and he moved westward to the far

227
00:18:26,740 --> 00:18:21,490
this is a shaded relief image taken from

228
00:18:28,630 --> 00:18:26,750
sea bean bathymetric data the shaded

229
00:18:31,210 --> 00:18:28,640
relief is overlaid with geological

230
00:18:34,149 --> 00:18:31,220
long-range inclined as dick or glorious

231
00:18:36,039 --> 00:18:34,159
side scan sonar data the SONA graphs

232
00:18:43,230 --> 00:18:36,049
have been computer enhanced to show

233
00:18:47,549 --> 00:18:45,630
as we approach the shallow areas in the

234
00:18:49,470 --> 00:18:47,559
bay we have shown graphically the

235
00:18:52,530 --> 00:18:49,480
boundary which we will use in showing

236
00:18:58,090 --> 00:18:52,540
the current flow through the bay we are

237
00:19:02,770 --> 00:19:00,430
in order to show the current flow model

238
00:19:06,670 --> 00:19:02,780

we have greatly exaggerated the vertical

239
00:19:12,220 --> 00:19:09,190
the two-layer model shown here

240
00:19:16,780 --> 00:19:12,230
represents 17 days of ocean currents at

241
00:19:18,790 --> 00:19:16,790
depths 50 and 250 meters note the more

242
00:19:20,560 --> 00:19:18,800
rapid north to south flow through the

243
00:19:23,290 --> 00:19:20,570
bay in the top layer due to the

244
00:20:36,850 --> 00:19:23,300
prevailing winds the bottom / is flowing

245
00:20:42,200 --> 00:20:39,860
we now travel up and out of the water

246
00:20:48,560 --> 00:20:42,210
and toward the shore at a velocity of

247
00:20:50,840 --> 00:20:48,570
just under 8,000 miles per hour we turn

248
00:20:58,180 --> 00:20:50,850
south and move down to our starting

249
00:21:10,060 --> 00:21:01,549
the ocean has been made transparent so