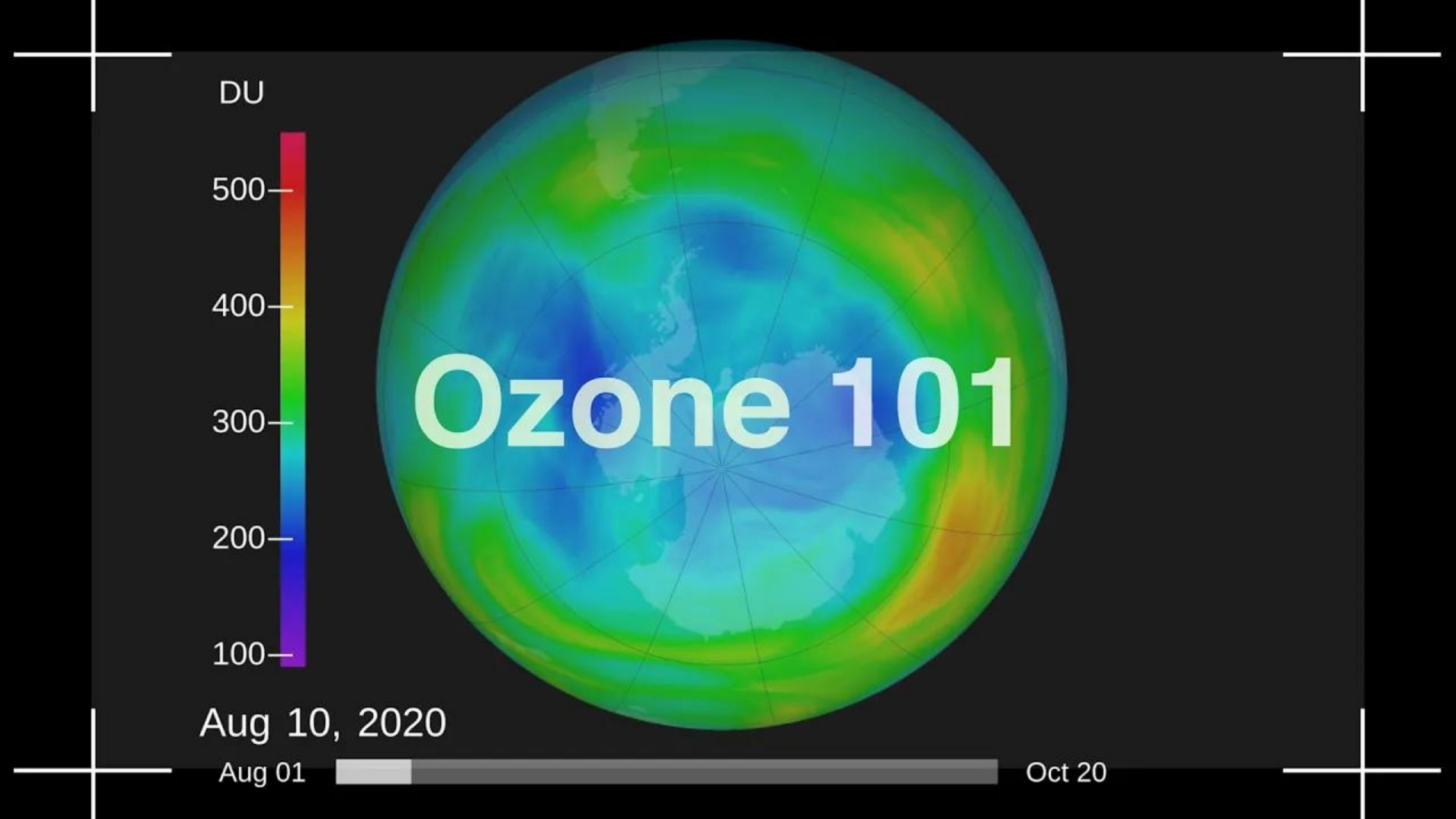
DU
500
400
300
200
100
Ozone 101
Aug 10, 2020
Aug 01
Oct 20

1
00:00:05,829 --> 00:00:03,429
have you ever heard that something

2
00:00:07,590 --> 00:00:05,839
called the ozone layer is thinning or

3
00:00:09,669 --> 00:00:07,600
that your aerosol hairspray is what's

4
00:00:12,310 --> 00:00:09,679
causing it or that it leads to more

5
00:00:14,549 --> 00:00:12,320
severe sunburns and uv rays this is

6
00:00:16,550 --> 00:00:14,559
referring to the ozone hole but what

7
00:00:21,189 --> 00:00:16,560
exactly does it all mean

8
00:00:25,589 --> 00:00:23,429
the ozone hull's proper name is actually

9
00:00:28,230 --> 00:00:25,599
the antarctic ozone hole because when it

10
00:00:30,310 --> 00:00:28,240
forms it forms over antarctica

11
00:00:32,709 --> 00:00:30,320
but before we get into what that is

12
00:00:33,830 --> 00:00:32,719
let's first talk about what ozone itself

13
00:00:39,670 --> 00:00:33,840

is

14
00:00:41,830 --> 00:00:39,680
atoms about 90 of the earth's ozone

15
00:00:43,830 --> 00:00:41,840
exists in the stratosphere the layer of

16
00:00:46,470 --> 00:00:43,840
the atmosphere that extends from 8 to

17
00:00:48,470 --> 00:00:46,480
about 30 miles above the earth's surface

18
00:00:51,270 --> 00:00:48,480
in fact the stratosphere is often

19
00:00:53,270 --> 00:00:51,280
referred to as the ozone layer ozone

20
00:00:55,350 --> 00:00:53,280
acts as a sunscreen around the earth

21
00:00:57,990 --> 00:00:55,360
filtering out harmful ultraviolet

22
00:00:59,990 --> 00:00:58,000
radiation or uv rays which are mainly

23
00:01:02,630 --> 00:01:00,000
absorbed in the stratosphere

24
00:01:05,350 --> 00:01:02,640
without an ozone layer uv radiation

25
00:01:07,270 --> 00:01:05,360
would sterilize the earth with a damaged

26
00:01:09,590 --> 00:01:07,280
but still present ozone layer there

27
00:01:12,230 --> 00:01:09,600
would be more sunburns more skin cancer

28
00:01:14,550 --> 00:01:12,240
cases increased cases of eye damage the

29
00:01:16,710 --> 00:01:14,560
wilting and loss of trees and plants and

30
00:01:18,789 --> 00:01:16,720
significantly lessened crop yields

31
00:01:21,429 --> 00:01:18,799
suffice it to say ozone is pretty

32
00:01:23,270 --> 00:01:21,439
important for the planet so what causes

33
00:01:25,429 --> 00:01:23,280
the ozone hole

34
00:01:27,510 --> 00:01:25,439
there are several major factors that

35
00:01:31,030 --> 00:01:27,520
together lead to the destruction of

36
00:01:32,390 --> 00:01:31,040
ozone thus creating the ozone hole those

37
00:01:35,030 --> 00:01:32,400
factors are

38
00:01:37,670 --> 00:01:35,040

one very strong winds around the south

39
00:01:41,670 --> 00:01:37,680
pole or the polar vortex

40
00:01:43,830 --> 00:01:41,680
two the sun's rays three chlorine and

41
00:01:45,109 --> 00:01:43,840
bromine compounds from ozone-depleting

42
00:01:46,230 --> 00:01:45,119
substances

43
00:01:48,789 --> 00:01:46,240
and four

44
00:01:50,950 --> 00:01:48,799
cold temperatures below negative 109

45
00:01:53,270 --> 00:01:50,960
degrees fahrenheit in the stratosphere

46
00:01:55,830 --> 00:01:53,280
which form a specific kind of cloud

47
00:01:57,990 --> 00:01:55,840
polar stratospheric clouds

48
00:01:59,590 --> 00:01:58,000
the polar vortex forms in the southern

49
00:02:01,910 --> 00:01:59,600
hemisphere stratosphere during the

50
00:02:03,830 --> 00:02:01,920
winter as temperatures drop and when

51
00:02:06,149 --> 00:02:03,840
sunlight returns to antarctica in late

52
00:02:07,749 --> 00:02:06,159
winter and early spring temperatures are

53
00:02:09,830 --> 00:02:07,759
still cold enough to form polar

54
00:02:11,430 --> 00:02:09,840
stratospheric clouds and now there's

55
00:02:13,350 --> 00:02:11,440
also sunlight

56
00:02:15,670 --> 00:02:13,360
chemical reactions take place on the

57
00:02:17,990 --> 00:02:15,680
cloud particle surfaces converting

58
00:02:20,550 --> 00:02:18,000
unreactive forms of chlorine and bromine

59
00:02:23,270 --> 00:02:20,560
into reactive chemicals

60
00:02:25,350 --> 00:02:23,280
the vortex acts as a sort of container

61
00:02:27,670 --> 00:02:25,360
confining the contents of the antarctic

62
00:02:29,270 --> 00:02:27,680
stratosphere within its bounds allowing

63
00:02:32,229 --> 00:02:29,280

the reactive chlorine and bromine

64
00:02:33,990 --> 00:02:32,239
compounds to destroy ozone molecules

65
00:02:35,509 --> 00:02:34,000
that's when depletion can occur on a

66
00:02:37,430 --> 00:02:35,519
large scale

67
00:02:39,589 --> 00:02:37,440
with the presence of sunlight the

68
00:02:41,670 --> 00:02:39,599
reactive chlorine and bromine compounds

69
00:02:43,750 --> 00:02:41,680
produced during winter begin to deplete

70
00:02:46,790 --> 00:02:43,760
ozone molecules by stealing one of their

71
00:02:48,790 --> 00:02:46,800
oxygen atoms leaving just oxygen gas or

72
00:02:50,790 --> 00:02:48,800
o2 in its wake

73
00:02:52,869 --> 00:02:50,800
as long as the polar stratosphere clouds

74
00:02:55,589 --> 00:02:52,879
are present these reactions will occur

75
00:02:58,149 --> 00:02:55,599
over and over again until the ozone is

76
00:03:01,110 --> 00:02:58,159
nearly gone this forms what we call the

77
00:03:04,470 --> 00:03:01,120
ozone hole but that's really a misnomer

78
00:03:06,869 --> 00:03:04,480
it's actually more of a thinned layer

79
00:03:09,190 --> 00:03:06,879
in mid to late spring the vortex begins

80
00:03:11,430 --> 00:03:09,200
to break up and the polar air depleted

81
00:03:13,509 --> 00:03:11,440
of ozone is mixed back into the rest of

82
00:03:15,910 --> 00:03:13,519
the southern hemisphere

83
00:03:18,550 --> 00:03:15,920
the ozone hole is gone

84
00:03:20,790 --> 00:03:18,560
ozone depletion has still occurred it's

85
00:03:22,949 --> 00:03:20,800
just no longer all concentrated in one

86
00:03:24,070 --> 00:03:22,959
small area it's spread around the

87
00:03:26,070 --> 00:03:24,080
atmosphere

88
00:03:28,390 --> 00:03:26,080

so why is the ozone hole bigger and

89
00:03:31,030 --> 00:03:28,400
longer lasting in certain years

90
00:03:33,030 --> 00:03:31,040
well it all comes down to weather just

91
00:03:34,789 --> 00:03:33,040
like some winters are colder and longer

92
00:03:35,910 --> 00:03:34,799
than others on the earth's surface the

93
00:03:37,270 --> 00:03:35,920
same goes for weather in the

94
00:03:42,149 --> 00:03:37,280
stratosphere

95
00:03:44,470 --> 00:03:42,159
the polar vortex and the ozone hole

96
00:03:46,149 --> 00:03:44,480
within it will persist

97
00:03:48,070 --> 00:03:46,159
and in years with cold springtime

98
00:03:50,869 --> 00:03:48,080
temperatures the polar vortex and the

99
00:03:53,270 --> 00:03:50,879
ozone hole are large

100
00:03:55,270 --> 00:03:53,280
make no mistake ozone depletion is not a

101
00:03:56,789 --> 00:03:55,280
natural thing it stems from human

102
00:03:58,309 --> 00:03:56,799
emissions of chemicals called

103
00:04:00,470 --> 00:03:58,319
chlorofluorocarbons

104
00:04:03,350 --> 00:04:00,480
or cfcs

105
00:04:05,429 --> 00:04:03,360
in the early 1900s refrigerators used

106
00:04:07,830 --> 00:04:05,439
toxic gases like ammonia and methyl

107
00:04:09,910 --> 00:04:07,840
chloride as refrigerants unfortunately

108
00:04:12,309 --> 00:04:09,920
this led to fatalities as the toxic

109
00:04:14,630 --> 00:04:12,319
gases leaked out of the appliances

110
00:04:16,310 --> 00:04:14,640
so the search began for a non-toxic and

111
00:04:19,030 --> 00:04:16,320
non-flammable chemical that could be

112
00:04:22,150 --> 00:04:19,040
used as a refrigerant thus the cfc was

113
00:04:26,870 --> 00:04:22,160

born there are many types of cfcs but

114
00:04:29,030 --> 00:04:26,880
the two most common are cfc11 and cfc12

115
00:04:32,550 --> 00:04:29,040
in the 1930s the production and

116
00:04:35,430 --> 00:04:32,560
consumption of cfcs began to skyrocket

117
00:04:37,990 --> 00:04:35,440
by the early 1980s over 300 million

118
00:04:41,510 --> 00:04:38,000
pounds of cfc-11 alone were being

119
00:04:44,469 --> 00:04:41,520
released into the atmosphere each year

120
00:04:46,310 --> 00:04:44,479
then in 1985 british researcher joe

121
00:04:48,310 --> 00:04:46,320
farman and his colleagues published

122
00:04:50,310 --> 00:04:48,320
their research on large seasonal ozone

123
00:04:51,990 --> 00:04:50,320
losses over antarctica

124
00:04:54,310 --> 00:04:52,000
thanks to the combined efforts of the

125
00:04:56,870 --> 00:04:54,320
quick acting science community industry

126
00:04:59,590 --> 00:04:56,880
and policy makers the montreal protocol

127
00:05:02,710 --> 00:04:59,600
was signed in 1987 restricting the

128
00:05:04,469 --> 00:05:02,720
production and consumption of cfcs every

129
00:05:06,070 --> 00:05:04,479
nation on earth has now signed the

130
00:05:08,310 --> 00:05:06,080
montreal protocol

131
00:05:10,230 --> 00:05:08,320
so for the record your hairspray and

132
00:05:12,310 --> 00:05:10,240
aerosol deodorant hasn't been harming

133
00:05:14,230 --> 00:05:12,320
ozone since these laws went into effect

134
00:05:16,310 --> 00:05:14,240
in the 80s

135
00:05:17,590 --> 00:05:16,320
but why do we still see an ozone hole

136
00:05:21,189 --> 00:05:17,600
today

137
00:05:22,870 --> 00:05:21,199
first cfcs have lifetimes of 50 to 100

138
00:05:24,790 --> 00:05:22,880

plus years and it will take some time

139
00:05:27,350 --> 00:05:24,800
for the concentration of cfcs in the

140
00:05:29,430 --> 00:05:27,360
atmosphere to drastically decline

141
00:05:31,749 --> 00:05:29,440
second there are still cfcs being

142
00:05:34,390 --> 00:05:31,759
released into the atmosphere today

143
00:05:36,230 --> 00:05:34,400
for example as an old refrigerator or

144
00:05:38,950 --> 00:05:36,240
air conditioning unit deteriorates in a

145
00:05:40,629 --> 00:05:38,960
landfill the cfcs within are slowly

146
00:05:45,110 --> 00:05:40,639
released

147
00:05:47,270 --> 00:05:45,120
air it takes about five years for its

148
00:05:49,270 --> 00:05:47,280
impact to be felt over antarctica where

149
00:05:51,270 --> 00:05:49,280
depletion will occur

150
00:05:53,029 --> 00:05:51,280
the cfc's emitted at the surface

151
00:05:54,390 --> 00:05:53,039
eventually rise into the tropical

152
00:05:58,790 --> 00:05:54,400
stratosphere

153
00:06:01,110 --> 00:05:58,800
most of the sun's uv radiation

154
00:06:03,189 --> 00:06:01,120
so the cfcs have to rise above most of

155
00:06:05,189 --> 00:06:03,199
the ozone layer before sunlight can then

156
00:06:06,950 --> 00:06:05,199
break them down

157
00:06:09,189 --> 00:06:06,960
once they get high enough solar

158
00:06:11,189 --> 00:06:09,199
radiation releases the chlorine most of

159
00:06:13,189 --> 00:06:11,199
which eventually goes into ozone safe

160
00:06:15,110 --> 00:06:13,199
forms like hydrochloric acid and

161
00:06:16,550 --> 00:06:15,120
chlorine nitrate

162
00:06:18,710 --> 00:06:16,560
when these compounds make their way to

163
00:06:19,830 --> 00:06:18,720

antarctica those chemical reactions

164
00:06:21,909 --> 00:06:19,840
start up

165
00:06:23,749 --> 00:06:21,919
and if you're wondering why antarctica

166
00:06:25,590 --> 00:06:23,759
these reactions are unique to the polar

167
00:06:27,430 --> 00:06:25,600
regions because of their extreme low

168
00:06:29,909 --> 00:06:27,440
temperatures and presence of polar

169
00:06:32,150 --> 00:06:29,919
stratospheric clouds

170
00:06:35,189 --> 00:06:32,160
one chlorine atom can destroy thousands

171
00:06:37,749 --> 00:06:35,199
of ozone molecules and millions of tons

172
00:06:41,749 --> 00:06:37,759
of cfcs were pumped into the atmosphere

173
00:06:44,150 --> 00:06:41,759
from the 1920s through the early 1990s

174
00:06:46,550 --> 00:06:44,160
as cfc concentrations in the atmosphere

175
00:06:49,029 --> 00:06:46,560
continue to decline the ozone hole is

176
00:06:51,029 --> 00:06:49,039
expected to gradually become less severe

177
00:06:53,270 --> 00:06:51,039
and scientists expect the antarctic

178
00:06:55,230 --> 00:06:53,280
ozone to recover back to healthy levels