1
00:00:00,001 --> 00:00:03,449
[MUSIC]

2
00:00:03,449 --> 00:00:04,911
This is a story about heat.

3
00:00:06,934 --> 00:00:10,275
Heat in our atmosphere, oceans, and land.

4
00:00:10,750 --> 00:00:15,519
When you think about it, events like drought,
hurricanes, fires - all of those are just

5
00:00:15,519 --> 00:00:19,720
different ways we see heat expressed throughout
the Earth's system.

6
00:00:24,610 --> 00:00:28,680
You've probably been bombarded with a lot
of intense headlines in 2020.

7
00:00:28,680 --> 00:00:32,720
"Hottest temperature recorded here, largest
wildfires there.."

8
00:00:34,584 --> 00:00:37,520
It's been a lot to take in.

9
00:00:37,520 --> 00:00:42,079
My name is Lesley Ott and I am a research
meteorologist at NASA's Goddard Space Flight Center

10
00:00:42,340 --> 00:00:45,470
So, the reality is the stage was set many
years ago for these events.

11
00:00:46,349 --> 00:00:50,280
Over the last century, human activities have
increased the concentration of greenhouse

12
00:00:50,280 --> 00:00:51,550
gases in our atmosphere.

13
00:00:51,690 --> 00:00:56,646
These gasses act like a blanket, trapping
heat and leading to overall warming of the planet.

14
00:00:56,921 --> 00:01:00,326
Many of these gases remain in the atmosphere
for a long time, meaning that we'll be feeling

15
00:01:00,326 --> 00:01:04,100
the consequences of this trapped heat for
many years to come.

16
00:01:04,100 --> 00:01:08,819
Which, unfortunately, means next year
is probably going to bring a lot of the same kinds

17
00:01:08,819 --> 00:01:12,289
of stories that we saw in 2020.

18
00:01:12,289 --> 00:01:15,729
But taking a look at all the different ways
our planet responds to the variations and

19
00:01:15,729 --> 00:01:19,981
movement of heat can help us better prepare
for the future.

20
00:01:25,733 --> 00:01:30,702
Maybe one of the most obvious ways we saw
heat this year was through fire.

21
00:01:33,305 --> 00:01:35,990
I know the Australian bush fires were big
news last January.

22

00:01:35,990 --> 00:01:40,329
And, when you think about it, years of prolonged
hot temperatures and drought really set the

23
00:01:40,329 --> 00:01:44,002
stage for these fires to be more likely and
more severe.

24
00:01:45,938 --> 00:01:49,948
With drought and heat waves, we typically
see an increase in the availability of dry

25
00:01:49,948 --> 00:01:52,389
fuels, which leads to more powerful fires.

26
00:01:52,389 --> 00:01:56,939
So when you have multiple years of intense
heat, it’s not surprising to have significant

27
00:01:56,939 --> 00:01:59,469
fire events like we saw in Australia.

28
00:01:59,469 --> 00:02:04,539
These fires were so extreme, that we saw smoke
injected as high as 18 miles above the surface

29
00:02:04,539 --> 00:02:09,369
- that’s really important because when smoke
is injected that high, it can have the same

30
00:02:09,369 --> 00:02:14,480
type of effect as a volcano, having these
very very broad impacts across whole hemispheres

31
00:02:14,480 --> 00:02:15,828
of the planet.

32
00:02:17,834 --> 00:02:22,384
At NASA, we use computer models like the Goddard
Earth Observing System to help us study how

33
00:02:22,384 --> 00:02:25,360
aerosols and particulate matter move through
the atmosphere.

34
00:02:25,360 --> 00:02:30,780
So we take these models and input real-world
observations and data to track fire emissions

35
00:02:30,780 --> 00:02:35,030
to help understand how they are forming, where
they are going, and how much of an impact

36
00:02:35,030 --> 00:02:37,280
they will have on you and me.

37
00:02:46,313 --> 00:02:52,523
In California, heat waves have increased fire
risk, and as a result, we saw a lot of synchronized

38
00:02:52,523 --> 00:02:56,239
fire activity, that is, many dangerous wildfires
burning at the same time.

39
00:02:58,095 --> 00:03:02,750
And unfortunately, these types of huge fire
events are becoming more and more common across

40
00:03:02,750 --> 00:03:04,341
the western United States.

41
00:03:04,481 --> 00:03:06,826
And that’s a big problem.

42
00:03:11,543 --> 00:03:15,053
This year, Siberia also had a remarkable and
active fire season.

43
00:03:15,510 --> 00:03:20,090

What we saw was that temperatures in the region
were much higher than normal for this time

44
00:03:20,090 --> 00:03:21,640
of year.

45
00:03:21,640 --> 00:03:25,510
In fact, the temperatures above the Arctic
Circle broke records in many of the same regions

46
00:03:25,510 --> 00:03:27,565
where fires were burning actively.

47
00:03:29,342 --> 00:03:33,665
In the Arctic and boreal forest ecosystems,
heat waves can exacerbate fires.

48
00:03:34,878 --> 00:03:38,890
And in the Arctic you also have to factor
in permafrost, which is soil that's

49
00:03:38,890 --> 00:03:43,430
frozen for long periods of time, and that
can make the impact of fires in high latitudes

50
00:03:43,430 --> 00:03:44,706
even more complex.

51
00:03:45,972 --> 00:03:51,287
When severe fires burn in areas with permafrost,
we lose this important insulating organic

52
00:03:51,287 --> 00:03:55,720
soil layer, which accelerates thawing, and
its potentially releasing carbon that’s

53
00:03:55,720 --> 00:04:00,370
been stored in the soil for hundreds and in
some cases, even thousands of years.

54
00:04:02,322 --> 00:04:06,650
And then you sometimes see these ‘zombie
fires’, which happen when wildfires burn

55
00:04:06,650 --> 00:04:10,150
in deep peatlands or smolder in forests under
snowfall.

56
00:04:10,150 --> 00:04:14,430
If that temperature doesn't get cold enough
to extinguish the fire, they can continue

57
00:04:14,430 --> 00:04:19,400
to burn over the winter even long after the
visible fires have been extinguished at the surface.

58
00:04:20,259 --> 00:04:24,735
So come spring, they reemerge and they continue
to burn back on the surface again.

59
00:04:28,253 --> 00:04:31,890
Studying what happens in the Arctic is really
important because it’s warming about three

60
00:04:31,890 --> 00:04:33,810
times faster than the rest of the planet.

61
00:04:33,810 --> 00:04:38,560
And all those aerosols and carbon that come
out of the Arctic doesn't necessarily stay

62
00:04:38,560 --> 00:04:43,381
there, they affect the heating and air pollution
in much larger regions of the planet.

63
00:04:53,707 --> 00:04:57,510
Another part of the planet affected by heat,
of course, is ice.

64

00:04:57,510 --> 00:05:01,200
Land ice in the form of ice sheets and glaciers,
where we've seen significant melt in recent

65
00:05:01,200 --> 00:05:04,385
decades, and frozen ocean water, or sea ice.

66
00:05:06,000 --> 00:05:09,810
This year, the Arctic sea ice minimum almost
reached a new record low.

67
00:05:09,810 --> 00:05:13,890
It was second only to 2012's extent -- which
was an anomalously low year in part due to

68
00:05:13,890 --> 00:05:15,150
unusual weather conditions.

69
00:05:16,029 --> 00:05:18,510
Sea ice shrinks and grows with the
seasons.

70
00:05:18,510 --> 00:05:22,760
After reaching an annual minimum extent in
September, Arctic sea ice begins to grow again

71
00:05:22,760 --> 00:05:24,950
as sea temperatures cool off for the winter.

72
00:05:24,950 --> 00:05:29,373
This year, Arctic sea ice had an unusually
slow start to the regrowth period.

73
00:05:30,270 --> 00:05:33,470
In particular, the Laptev Sea, which is
called sometimes called a sea ice nursery

74
00:05:33,470 --> 00:05:37,530
because much of the Arctic sea ice initially
forms there, was too warm for meaningful

75
00:05:37,530 --> 00:05:40,501
sea ice growth until much later in the season
than usual.

76
00:05:48,000 --> 00:05:53,370
Oceans absorb heat from the sun and our atmosphere
prevents this heat from escaping back to space.

77
00:05:53,370 --> 00:05:58,158
The movement of this heat is one of the primary
drivers of circulation and global weather patterns.

78
00:05:59,721 --> 00:06:03,540
We can measure the temperature of the ocean
and what we saw this year was unusually high

79
00:06:03,540 --> 00:06:06,590
surface temperatures across the Atlantic.

80
00:06:06,590 --> 00:06:09,990
The warm moisture that comes off of the ocean
acts as fuel to storms.

81
00:06:09,990 --> 00:06:14,860
So, as this layer of the ocean gets even warmer,
we’re seeing that storms are becoming more

82
00:06:14,860 --> 00:06:17,090
and more intense over time.

83
00:06:18,000 --> 00:06:24,190
In fact, 2020's sea surface temperature contributed
to an exceptional year in terms of Atlantic hurricanes.

84
00:06:24,190 --> 00:06:30,122
We saw 30 named storms - a new record, and
12 of these storms made landfall in the US.

85

00:06:34,572 --> 00:06:39,239
What's really interesting is that many of
these storms intensified really really rapidly.

86
00:06:42,300 --> 00:06:46,180
Not only are storms intensifying more quickly,
but what we're also seeing is that they

87
00:06:46,180 --> 00:06:51,437
are stalling near coastal regions more often, which is devastating in terms of floods and storm surge.

88
00:06:57,974 --> 00:07:02,900
While we're not 100% sure what is causing
these storms to stall, it may have to do with

89
00:07:02,900 --> 00:07:06,571
climate patterns shifting in response to rising
global temperatures.

90
00:07:11,057 --> 00:07:15,090
It's always really tough for a scientist
to say any particular fire or any particular

91
00:07:15,090 --> 00:07:16,890
event was because of climate change.

92
00:07:16,890 --> 00:07:21,730
But we're getting to a point where we're
starting to see season after season of record-breaking

93
00:07:21,730 --> 00:07:27,480
wildfire, season after season of really intense
storms, that it becomes much easier to understand

94
00:07:27,480 --> 00:07:30,890
that this is likely the result of long-term
climate change.

95
00:07:32,033 --> 00:07:35,340
In general, more heat means more energy in

the Earth system.

96
00:07:35,340 --> 00:07:40,060
So, while 2020 was a significant year, it’s
important to know that this probably wasn’t

97
00:07:40,060 --> 00:07:41,510
an anomaly of a year.

98
00:07:41,510 --> 00:07:45,810
We’re likely to experience many similar
years as the Earth’s climate gets warmer.

99
00:07:46,866 --> 00:07:51,723
So, while we saw a small dip in emissions
this year due to COVID shutdowns, it was pretty short-lived.

100
00:07:52,120 --> 00:07:55,920
The vast majority of our greenhouse gas emissions
come from things like electricity generation,

101
00:07:55,920 --> 00:07:59,769
which were less affected by the shutdowns
than emissions from cars and airplanes.

102
00:08:01,159 --> 00:08:05,460
But we know that human activities have a powerful
impact on our environment.

103
00:08:05,460 --> 00:08:09,330
Long term strategies to curb human-induced
climate change would have to focus on implementing

104
00:08:09,330 --> 00:08:14,117
cleaner technologies so we can reduce
emissions without affecting people’s daily lives.

105
00:08:16,313 --> 00:08:18,973
So while this is a story about heat, it is
also a story about connections.

106
00:08:18,973 --> 00:08:21,610
Nothing on our planet happens in a vacuum,
and our actions today impact our tomorrow.

107
00:08:21,751 --> 00:08:23,908
The choices we make now can make the difference
between continued increases in greenhouse