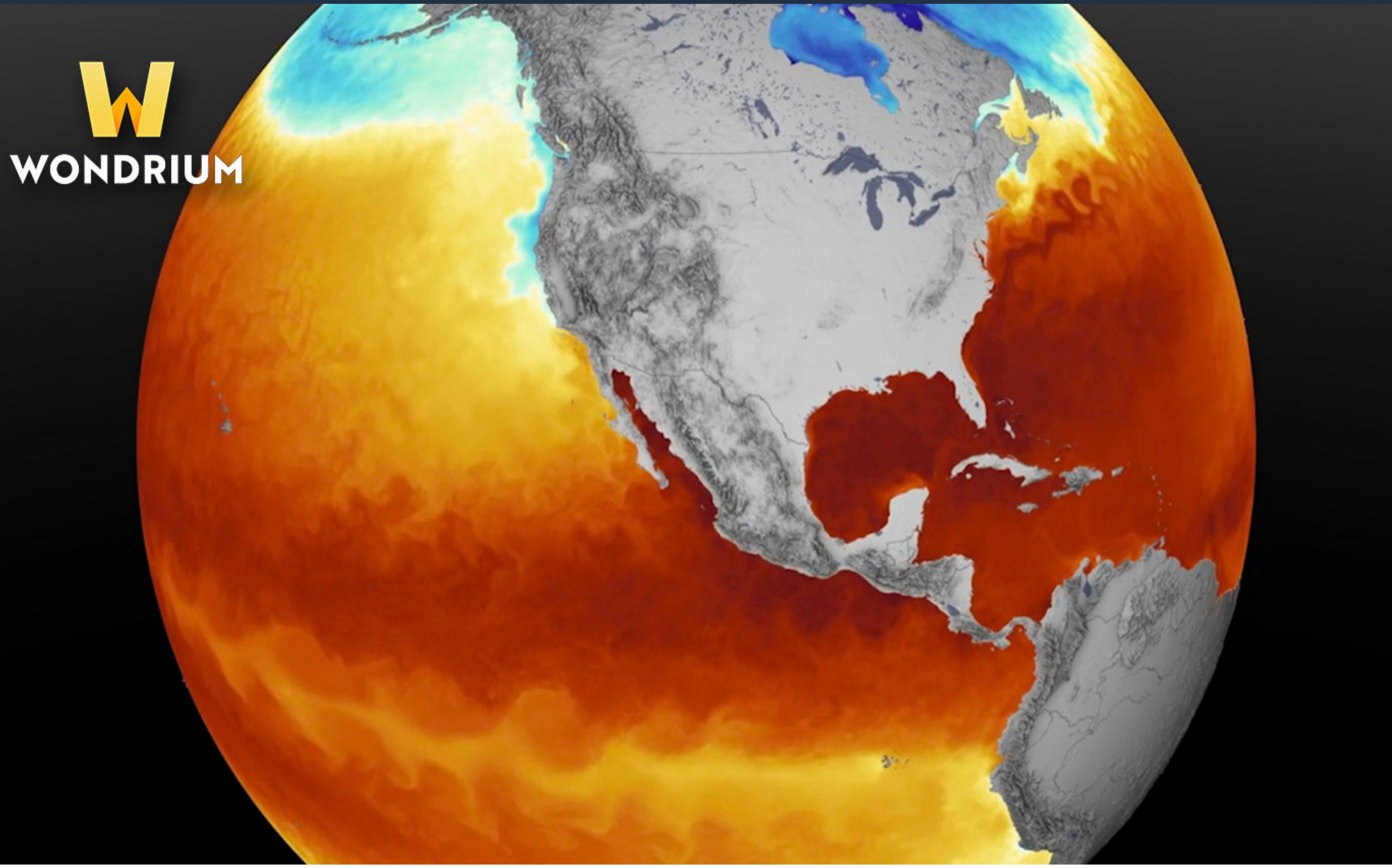

Understanding the Impact of Climate Change

The effects of climate change are happening now, and they're predicted to get much more severe in the future. Already the world has seen dangerous droughts, uncanny weather, and abnormal temperatures—all of which will only intensify if the world remains complacent and fails to act.

0:11

Narrator speaking; color-coded graphic of Earth depicting temperature changes

Let's begin with some basic facts.

Since 1880, global average temperatures have increased by 1.2 degrees Celsius or almost 2.2 degrees Fahrenheit. This may not seem like a lot, but the number is an average. Temperatures in some areas of the globe have become cooler, but others have gotten warmer, such as the Arctic, where temperatures have increased by as much as 4° C or 7.2 degrees F. This overall warming trend has started to impact the climate of the Earth, taking a system that we depend on out of balance.

Image of the top half of Earth; Arrows demonstrating greenhouse gas effects

The reason this has happened is because human related activity since about 1850 has triggered a greenhouse effect. When the Sun warms the Earth, surfaces emit infrared radiation, most of which would normally be shed back out into space.

1:06

Labels of different chemicals appear above Earth; image of a thermometer

But greenhouse gases like carbon dioxide, methane, and nitrous oxide, absorb this radiation. And the more of these gases there are in the atmosphere, the more radiation is trapped, raising the average temperature of the planet.

Clips of crowds of cars and humans; greenhouse gas infographic

Currently, humans are responsible for adding 51 billion tons of greenhouse gases to the atmosphere every year - a number that is only expected to increase should we continue along our current trajectory. If we are to avoid the more severe effects of climate change, the rise in global average temperature must be limited to between 1.5 and 2° C.

Clip of a factory emitting smoke in the air

To do this, we'll need to reduce the 51 billion tons of emissions to net zero in just a few decades.

2:04

Jonah Goldman speaking on screen; graphic showing CO2 levels on Earth

It's not like there is a date that some terrible thing is going to happen and if we get to net zero before it it won't happen and if we get to net zero after it it certainly will happen. This is a cumulative effect thing. The more CO2 and other greenhouse gas emissions that we release into the atmosphere, the worse the outcomes are going to end up being.

Labels of major countries and continents

And so, the world has agreed on a particular date of 2050 to get to net zero but as we've seen over the last decade, climate change is happening now.

Clips of the effects of climate change; clip of a globe showing temperature changes rotating

We see it certainly in wildfires and we see it in stronger hurricanes and heat waves. So, the longer it takes us to get there the worse those impacts are going to be, the shorter it takes us to get there the less damaging those impacts are going to be and we need to be realistic about how long that's going to take, and so people have targeted mid-century. But nobody should feel like there's any opportunity for complacency here.

2:59

Globe showing temperatures over time

We know now that most of the heat being retained by the planet is going into the ocean. We have instruments that detect warming even in the deep ocean so that the heat is spreading down into that huge mass.

Clips of the ocean	The atmosphere has much less mass than the oceans, so about 90% of all the heat stored by the planet is actually being stored in the ocean. What we see at the surface is what matters to us, but really, in the long term, it's the ocean that's the controlling factor and as it absorbs more and more heat, it will continue to warm the atmosphere as well, and the temperature will continue to rise.
3:48 *Clip showing a beach and other places in nature*	The particular effects of climate change are difficult to predict because the Earth is an incredibly complex system, but climate science has grown substantially in just a few decades and the computer models of today are getting much more fine-grained in their ability to make forecasts.
Photo of a weather man from the 1970s and more modern models	Whereas in the 1970s, we only had global models that could make general predictions, the high resolution models of today can predict regional changes down to a grit scale of about 50 miles. These models can now make more accurate projections about the frequency of severe weather, flooding, droughts, and rising sea levels.
Paul Edwards narrating on screen	One thing climate scientists have also learned in this report is how to do better, uh, analysis of what the relationship is between climate change and individual weather events.
4:43	So now we can look at a rain bomb or a hurricane or, uh, lots of other you know floods or things like that that happen in one place and say, this event was 30% more likely because of climate change than it would have been 20 or 30 years ago. So, as time goes on we'll be able to do more attribution like that and, uh, we'll see events that are very clearly things that could not have happened in the past without the climate changes we've experienced.
	Are there predictions that have been made in the past that have come true? Well, yes. One is, uh, the Earth temperature increase. You know, the model from the 1970s predicted what has actually happened pretty well if they're run with the uh gases that we've put into the atmosphere since that time.
5:40 *Graphic of Earth showing temperature changes over the years*	Then they had to estimate them, but now we know exactly what happened, so we can rerun those models and see that they do a pretty good job of predicting the temperature increase. But there are other things too, like nights are warming faster than days. That's a prediction of models.
Clips of Earth rotating on its axis	The height of the tropopause, which is the the place where the troposphere (the lower layer that we live in, the layer in between that and the stratosphere) the height of the tropopause is increased. That's a model prediction it's come true. The stratosphere has cooled and that was mainly under the influence of ozone depletion. Now it's stopped cooling as we have begun to get a handle on ozone depletion, so this was also predicted by models and then confirmed by observations.
	Were there any predictions that turned out to be false? Well, yeah. There have been some serious climatologists who thought that clouds might, uh, shield us from climate change with a kind of positive feedback effect.

6:37

So, you know, you get more water in the atmosphere from climate change and that means more clouds and some people theorized that those clouds would then reflect a lot of radiation back into space and kind of form a limit to how much the temperature would go up.

Clip of a giant forest

But that turned out not to be true. Yes, more clouds, but not at the right altitude, not at the right color to actually uh stop the temperature increase from happening.

Video of the sun in a blue sky

An especially concerning part of climate change has to do with tipping points and if we're close to reaching any.

Tipping Point is a place in a natural cycle where something changes so much that it can't go back.

Text box: Atlantic Meridional Overturning Circulation (AMOC)

The Atlantic Meridional Overturning Circulation—complicated phrase, we abbreviated as AMOC.

7:28

Map of Earth highlighting the Gulf Stream and the heat transferring to Europe

The AMOC phenomenon is one such tipping point. The Gulf Stream system is part of that and it is what keeps warm air flowing up from the Gulf of Mexico up along the coast of the United States and then over to Iceland and Greenland and Europe, and it carries heat. So, it moves heat from that lower latitude where a lot of heat is coming into higher latitudes in northern Europe and that's why the temperatures of northern Europe are relatively mild even though it's so far north.

That circulation system has been slowing recently. Right now we can't say for sure, but it might simply stop or slow so much that the heat flow to northern Europe would be cut off and paradoxically that would make northern Europe actually colder, heat would build up elsewhere instead.

8:24

Clip of the Arctic

Other things that have been hypothesized are a tipping point of melting permafrost in the Arctic where, you know, huge amounts of organic matter are buried and frozen in the permafrost so if enough of it were to melt and the melting were to go deep enough, that material would be exposed and then rot and turned into methane, which is very potent greenhouse gas.

There are also methane clathrates in the seabed and buried in places in Siberia and we have seen, uh, some very surprising things like methane explosions in Siberia from underground, uh, methane release.

9:11

If we were to hit one of those tipping points and large amounts of methane were to be released it would be a very serious issue because the climate would then heat much faster and we would not really be able to control it.

Video of a river running through a gulf

Um, right now, this IPCC report says that both of those things are unlikely on our current path, but they're still possible on our current path. So that's kind of where we are with it now and we may learn more that would take us one way or the other towards saying less likely or more likely.

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