what we're looking at is a legacy of the ice age from frost and methane is a time machine so what we're gonna do is walk back in time we're gonna see old carbon bold bones old environments and none of those are in equilibrium with today's climate so that's the problem that world doesn't exist anymore and it has it for 10,000 years it was nicely and very delicately separated from this modern warmer climate about this much moss and with that Moss goes away whether for fire or for human disturbance or for warming and
all hell breaks loose

[Music]

permafrost it's maybe the part of the cryosphere that's most out-of-sight and mind

it's fascinating how it formed in the first place and how it got loaded with so much carbon in a minute we'll go back underground with Matthew Sturm from the University of Alaska Fairbanks but first let's meet Peter Griffith NASA's project manager for the above campaign which supports more than 70 science projects
studying forests and tundra vegetation

wildfires animals like birds caribou and
dall sheep methane emissions from
expanding northern lakes and the impacts
of climate change on people in Alaska
Canada and around the world many of
those projects have some direct
connection to permafrost permafrost is
the hidden cryosphere it's the
permanently frozen soil that surrounds
the Arctic all across Alaska northern
Canada and then across Eurasia the
ground has been frozen during the ice
ages during the ice ages there was not
enough snowfall in the drier regions of Alaska and Canada to form glaciers there. 

so the land was suitable for vegetation. 

what happened is over thousands and thousands of years all of that plant material got compacted and frozen every winter and buried and pushed down so that today there's 300 feet deep of frozen water and dead plants and some pieces of dead animals too sometimes you find woolly mammoths up behind the permafrost. 

but most of it of the organic matter as we call it in the permafrost is frozen 

plant material some of that plant
material is now flying and decaying

releasing its ancient carbon into the atmosphere sometimes in the form of methane gas bubbling out of expanding Northern Lakes

[Music]

we started this fuel campaign because the Arctic is the part of the planet that is warming first and fastest and there are consequences to this for permafrost so during the Arctic boreal vulnerability experiment we're studying permafrost with people on the ground from aircraft flying over the region and
also from satellites in space another way to understand the permafrost is to take a walk below ground with Mathieu Sturm and into the US Army Corps of Engineers permafrost tunnel and they've dug this tunnel back into the side of a hill about 200 feet and it goes sort of sloping down so that by the end of the tunnel you're about a hundred feet underground and you're surrounded by bones sticking out of the wall from the steppe bison and mastodons that are frozen in it there's sticks that are 40,000 years old you know that you can
touch with your hand there's grass that's still green that's tens of thousands of years old because it got frozen you know right away and it's never lost the the green color but as fascinating as it is to see these relics of an ancient era or to see a tree split in half by thawing soil or even to light a ball of methane on fire from under winter ice at the end of the day Peter and his colleagues want to know just how much organic matter is frozen in that permafrost and how fast it might be released
currently we think that there is

00:04:48,620 --> 00:04:56,790
something on the order of two to three
times as much carbon locked up as frozen

00:04:52,230 --> 00:04:59,730
organic matter in permafrost as there is

00:04:56,790 --> 00:05:04,220
carbon dioxide in the atmosphere so

00:04:59,730 --> 00:05:06,900
releasing all of that organic carbon

00:05:04,220 --> 00:05:08,760
from permafrost into the atmosphere

00:05:06,899 --> 00:05:11,729
would be a real game-changer that would be a tremendous transformation of the

00:05:08,759 --> 00:05:14,159
planet's atmosphere now the good news is

00:05:11,730 --> 00:05:17,129
that it would take a very very long time

00:05:14,160 --> 00:05:19,169
for that half

00:05:17,129 --> 00:05:20,409
however we are warming the planet at a

00:05:19,168 --> 00:05:25,209
rate now that calls into question how quickly is that changing and what the
consequences in the near future and in

the far future are going to be you're in

the middle of a field somewhere in

California at 4:00 in the morning it's

sort of surreal in a way because you've

put so much time into it for so long and

actually seeing it over there it's like

well you know it's it's a big deal