**You might remember back in mid-September I reported that the annual arctic sea ice minimum for this year was the second lowest on record, and only the second time in recent history that the total surface area had dropped below four million square kilometres.**

**The main thrust of that program was that this kind of low sea ice cover is really quite bad news for the arctic, and…every species on the planet.**

**If you’re not sure what I’m on about then click up there to jump back and have a look at that video.**

**Generally though, as soon as that minimum is reached each year, the change in the season very quickly brings much colder temperatures to the arctic region that begin to rapidly restore the ice cover towards the winter maximum.**

**But this year was different. This year the ice didn’t start coming back in September as quickly as expected. And by mid-October there was sea ice less cover than any other previous year, including the record low minimum year of 2012.**

**That shortfall got scientists crawling all over the data and all over the arctic ocean, trying to work out exactly what was going on. They realised that for various reasons, not least the record Siberian heatwave this summer, the region of the arctic ocean that usually kicks off the growth of new ice – an area called the Laptev Sea, just off the coast of Siberia, was experiencing abnormally high temperatures – well above freezing point – and those high temperatures were inhibiting the formation of new ice. But that wasn’t all they discovered. As they went deeper and deeper below the surface, down to depths of about three hundred and fifty metres, they ran into huge plumes of bubbles rising up from the seabed. Those bubbles were methane gas escaping from melting permafrost. And the concentrations were found to be four hundred times higher than had previously been expected.**

**And that, IS a problem.**

**Hello and welcome to Just Have a Think,**

**Quick recap on why methane is a bad idea? Yeah why not.**

**Earth’s average temperature has been remarkably stable since the end of the last ice age about ten thousand years ago. And that’s because until very recently the planet radiated pretty much the same amount of heat out into space as it received from the sun each day. The sunlight that warms us up is the bit in the very short ultraviolet wavelengths. The bit that bounces back into space is in the very long infra-red wavelengths. Greenhouse gases like carbon dioxide have molecular structures that just happen to interact perfectly with light in the infrared wavelengths. They literally absorb a photon of infrared light and use that energy to vibrate their atoms. In the case of CO2, it’s the two oxygen atoms either side of the carbon atom that do the vibrating. While it’s in this excited state it’s more likely to bump into other molecules in the air like nitrogen and oxygen and transfer a bit of it’s energy to them, which heats those other molecules up a tiny bit. Eventually when the vibrating settles down, the photon of infrared light gets released, but there’s no guarantee which direction it’ll be released in – it might get fired upwards back into space, or it might be sent back down to earth. That greenhouse gas interaction with infrared light is why our atmosphere is getting warmer. A methane molecule is one carbon and four hydrogen atoms. Those four hydrogen atoms can vibrate in all sorts of different combinations, and for reasons that involve proper scientists and lectures featuring wavelength absorption charts like these, that means that over a twenty year timescale, methane is eighty four times more effective at trapping heat than CO2. The only slightly good news is that methane breaks down much more quickly than carbon dioxide, so it’s effects are much more short lived. Over a one hundred year timescale it’s only about twenty eight times more potent than CO2.**

**So, what we don’t want is a bunch of methane in the atmosphere. Right now there’s just under nineteen hundred parts per billion up there, which doesn’t sound like a lot, but that’s up from only seven hundred and twenty two parts per billion in pre-industrial times, so it’s definitely going in the wrong direction.**

**And that brings us back to the arctic, and permafrost.**

**This fantastic interactive site created by some extremely talented people at the Reuters news agency explains the various ways that permafrost was created and how it’s being affected by global warming. I’ll leave a link to the site down in the description box below this video, and I’d highly recommend you take a closer look – it’s based on scientific data from a range of very reputable research papers, all translated into everyday language that you and I can get our heads round.**

**They show us this view of earth looking straight down onto the north pole. About two thirds of the circumference is basically Canada, Alaska and Russia. And then they show us where all the permafrost is found.**

**It’s a lot isn’t it? In fact no less than twenty five percent of the entire Northern Hemisphere is covered by permafrost. And just to really cheer you up, there’s more than three times as much carbon locked up in permafrost as there is in all the trees on the planet.**

**Most of it, sadly, is melting to a greater or lesser extent. That’s already causing structural problems in many areas because permanently frozen ground has always been a rock solid substrate to fix foundations to, so of course we’ve built lots of infrastructure directly on top of it.**

**According to a 2018 study in Nature, sixty-nine percent of all arctic infrastructure could be at risk of damage by mid-century due to thawing permafrost. And those areas have more than 3.6 million inhabitants.**

**But it’s the permafrost underwater over here in the Laptev sea and the East Siberian Arctic shelf, that’s really got the scientists spooked.**

**The methane down here comes in the form of hydrates, because, you know they’re underwater. I looked at the science of methane hydrates in an earlier video, so if you’re keen to get a fuller understanding of how the process of formation and disintegration of sub-sea permafrost works then you can click up there somewhere to jump back to that program. Suffice to say, if the water surrounding permafrost stays consistently above freezing for any length of time, then that permafrost is going to get significantly less frosty, if you know what I mean. And when the permafrost wakes up, all the tiny little microbes wake up too, and they start feasting on the now chewable organic matter that’s thawing out in the warming earth. That process mainly happens in the absence of oxygen, and just like the anaerobic digester at your local waste disposal centre, the by-product is methane gas. And make no mistake, this is a big deal. The United States Geological Survey themselves list Arctic Hydrate destabilisation as one of the four most serious scenarios for climate change.**

**These latest findings come from a scientific research team called the International Shelf Study Expedition.**

**The sixty strong team aboard the Russian research ship Akademik Keldysh reckon they’re the first scientific research group to observationally confirm the release of methane gas across a wide area of the arctic shelf. At six monitoring points over a slope area one hundred and fifty kilometres long and ten kilometres wide they saw clouds of bubbles released from sediment.**

**Normally when methane hydrates get released from the bottom of the ocean, they get dissolved in the deep waters before they reach the surface. And that’s certainly happening in this case too, but the concentrations are now so high that a really significant amount of gas is still reaching the surface and venting up into the atmosphere. The research team were regularly measuring surface concentrations up to eight times higher than normal. And the water isn’t three hundred and fifty metres deep across that whole area either. As you get onto the main part of the East Siberian Arctic shelf, the water can be as shallow as fifty metres. The expedition’s chief scientist, Igor Semiletov said that for the second year in a row, they’ve found crater-like pockmarks in the shallower parts of the Laptev Sea and East Siberian Sea that are discharging bubble jets of methane, which are reaching the sea surface at levels tens to hundreds of times higher than normal.**

**There are estimated to be around fourteen hundred billion tonnes of carbon locked up in sub-sea hydrates. Some projections suggest there’s a risk of a sudden and catastrophic release of something like fifty billion tonnes of methane that could add as much as zero point six degrees Celsius of warming to the average global atmospheric temperature within just a few months. And when we’ve seen the impact that just one degree Celsius of temperature rise over the course of a century has caused to our weather patterns, adding another nought point six degrees in less than a single year would obviously be pretty dramatic and possibly existentially threatening for most large species on the planet, including humans.**

**It’s important not to get too carried away with hypothetical hyperbole though. Örjan Gustafsson, a Swedish scientist taking part in the expedition, said**

**“At this moment, there is unlikely to be any major impact on global warming, but the point is that this process has now been triggered. This East Siberian slope methane hydrate system has been perturbed and the process will be ongoing,”**

**The team still need to get all their data and samples back to dry land so they can conduct properly controlled analysis and publish their findings in peer reviewed journals, but there’s no doubt that these preliminary findings represent a very worrying trend with serious potential to accelerate the warming of our atmosphere. As the Arctic sea ice cover dwindles, more warm water is seeping into the arctic ocean in a kind of pincer movement from the Atlantic on one side and the Pacific on the other.**

**The entire arctic region is warming as much as three times faster than anywhere else on the planet. Siberia was five degrees Celsius warmer than normal between January and June this year, causing the same kinds of collapsing permafrost craters that the expedition team witnessed under the Laptev Sea. All these things are positive feedback loops that reinforce each other and continue to increase the rate of warming, not just in the arctic, but across the planet.**

**At the time of making this video, in mid-November 2020, the autumn arctic temperatures are finally kicking in and the sea ice is rapidly returning, forcing the Russian research ship out of the region and back to base, so we should be getting published data at some point in 2021. But the scientists on that boat are in no doubt that the geological ecosystem at the top of the world has reached yet another tipping point, and the question is no longer if methane will be released into our atmosphere in large volume, but when.**

**Now I know this is a subject that many of you have very strong opinions on, so do feel free to dive down to the comments section below to leave your thoughts there. And in keeping with the philosophy of the newly elected United States President, lets try and aim for a civilised and constructive exchange of views.**

**That’s it for this week.**

**Don’t forget to check out the Just Have a Think app if you get the chance. It’s a nice handy way to get daily news and articles from thousands of sources around the world on climate and sustainable technology matters and you can grab it from the Apple Store or from Google Play.**

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**As always, thanks very much for watching, have a great week, and remember to Just Have a Think.
See you next week**