# Dr David Sprake

## Climate Change Exposed: Separating fact from fiction for deniers and sceptics

### *May 2025*

**Professor Anne Northcliffe:** Welcome everybody, croeso.

I'm the dean of the Faculty of Arts, Computing and Engineering and it's my pleasure to welcome the public speaker this evening, Dr David Sprake.He joined us at Wrexham University back in 2009 and has led the initiative in renewables and sustainability in the university. Instrumental actually, in us actually being one of the earliest providers in providing renewables and sustainability degrees in engineering and setting up the degree apprenticeships, which has gone on some success to success. And I know he's led three KTPs in this area,and he's pushing against an open door because businesses are gaining more and more traction and understanding being carbon neutral.

He's currently leading by request and developing another member of staff to lead the energy clinic. So if you've heard about low clinics, we've now got an energy clinic as all businesses who are bidding for public sector work have to give their carbon footprint information and you'd be amazed how many people can actually bid for that work because they haven't calculated their carbon footprint. So those opportunities are dependent on that.

It's my greatest pleasure to give this evening over to David Sprake and his talk.

**Dr David Sprake:** Thank you very much, Anne and thank you all for coming, really appreciate it.

I'm Dr David Sprake, I've been researching climate change for about 20 plus years, and I've got an engineering PhD in renewable energy smart grids, I'm a chartered energy engineer and my goal is always to understand the true state of reality with everything that I do at the university. Also, I'm not funded by fossil fuel or zero carbon people, so I'd like to think I was completely unbiased.

Okay, so, this lecture is about, climate scepticism. What the sceptics think, I'm going to unpick eight different, climate sceptic arguments, tonight. And then if you want to ask questions at the end, I'd really welcome that, about any of the eight things I'm going to talk about, but also, any other sort of climate sceptic arguments you'd, you'd like to bring up.

So, these are what the some of the newspapers have been saying, going back in the day. Also, there's been books on the subject and YouTube is full of climate sceptic videos. And the way that the algorithm works with YouTube is if you watch a climate sceptic video, you'll just be presented with more and more of them without getting a balanced view.

I think people want to know what the truth is. So here are eight common climate change sceptic views.

1. First one is the earth hasn't warmed since a certain date, and I've seen a few of these knocking around.
2. Second one is that climate has always changed naturally.
3. Third one is it's the sun, not CO2, that’s causing the climate to change.
4. Climate models are unreliable and can't predict the future.
5. It's very cold outside. Global warming must be a hoax, every time we get a cold snap.
6. Also, humans only emit a tiny fraction of CO2. A few parts per million and it perhaps can't make a difference.
7. Why should we do anything to fix climate change when China are doing nothing.
8. And finally humans, animals and ecosystems will adapt like they always have done to a warming climate.

So before I kind of unpick some of those arguments, I want to talk about an objective scientific truth. If we have a look at a consensus among climate scientists, on their opinion towards human caused climate change.

It looks a little bit like this.

And this comes from a paper called Cook et al who looked at, um, hundreds of thousands of papers in lots of different studies and found that the majority of climate scientists’ kind of took this view. And an objective scientific truth emerges when most of the people that know most about a subject kind of all agree on something.

But there are obviously sceptics and people who disagree. Some people with PhDs disagree. But what tends to happen is through social media and the emergence of AI that those, sceptic's views get amplified far beyond the actual sort of number of them. And it makes people think there's many more people actually, agree or disagree with the science.

So, who are these people and how can we be sure that we can trust them? So, all the world's governments got together and decided that they wanted to know what was happening with climate change and they created a body called the Intergovernmental Panel on Climate Change, or the IPCC, and they write several reports. And the sixth one was the last one. If we can just scroll down here and these are the people that wrote it, and I can just stop this anywhere, and you can see that the people from all around the world and all these are experts in the field, you don't actually apply to be on this, you get asked. So, the people who kind of want to know what the truth is, will search out the world's top people in certain fields, and then ask them would they like to contribute to the report.

But the truth is not always what society or scientists agree upon, it's if the theory actually matches reality. There's been sort of theories in the past that everybody agreed on and turned out to be not quite right. Like, Newton's Newtonian sort of vision was surpassed by Einstein's theory of relativity. So really, it's only if the theory matches reality. Doesn't matter who agrees with it or not.

So, the very first climate sceptic argument was the earth hasn't warmed since whatever year they decide and I saw these sort of knocking around the internet a while ago. This one's by CFACT.org or climate factor.org. So what's the actual truth of this? How do we actually know what the average global temperature of the globe is? This is live data now this is what the temperatures are on the globe right now. And if we could click on Antarctica there, we can see that right now in Antarctica it's -60 degrees C. And could we click on the Middle East there somewhere where it's bright red and it's plus 38 there. So, there's a whole lot of different temperatures going on all the time and these move about, when it's summer in the northern hemisphere, it's winter in the southern hemisphere and also there's sort of weather patterns like El Niño and La Niña that transfer the heat about and of course, throughout the day normally at night it's a little bit cooler and it warms up in the day. So what climate scientists did was gather as much data as they can, and there’s satellites circling the Earth now measuring the temperature in the atmosphere, on the surface, and in the oceans, and also there's hundreds of probably millions of weather stations all around the world. And what they do is gather all this data up and come up with an average global temperature for that month and for that year and average all those kind of different temperatures. And these are the actual sort of bodies that do that, some are private, some are academic, some are sort of governmental, but all these people are taking all those temperature measurements and condensing them into one number, the average global temperature. Here's what they have actually come up with, these are all different bodies who looked at the average data of the globe, per year. This black line here is the average of all these series and you can see the general pattern here. So, this is the best information we've got. Could we, uh, click on that, please? And it's being monitored constantly. This is the latest data from NASA and this is the famous or infamous climate spiral. And it starts off at 1880 and it gives the average global temperature per month moving forward, if we could start that, please Jack.

So I think it's conclusive what's happening? Well, hang on a minute. What about our old friends CFACTS? What would I looking at there? Well, This is a combination of temperature records and you can see it goes up and down every year and there's explanations for that. Sometimes it's a La Nina or El Nino year, which is typically hotter or cooler than previous years. Also, there's neutral years where not much happens, and there's volcanic years as well, when there's a really big volcano that goes off there’s a period of cooling and that can last 1 or 2 years if it's big enough. So, after a big volcanic eruption, the average global temperature actually drops a little bit. And so what the, CFACT has done is just taken a sort of snapshot of that graph and cherry picked. So quite smart, but basically trying to fill this.

**Okay. The climate has always changed naturally.**

This is a picture of the medieval warming period, which was a period where Europe was basked in warmer weather. There was something called the, Little Ice Age, from 1400 to 1800, where it was cooler than normal. So the average temperature has always changed. Also, if we go back a little bit further, about 15,000 years, if we go to Wrexham 15,000 years ago, there was a kilometre of ice sheets above our heads right now. So how do we actually know what the temperature was in the past? Well, sure, we can get temperature measurements maybe going back the last 100 or 200 years, but what about thousands of years? Well, we use things called proxy measurements. And what they are is certain things on the, in the biomass actually a temperature dependent. So, if it warms up, certain species of animals or insects might proliferate and if it gets cold, they will die out. So, this is all proxy data, it’s not perfect, but it gives a good indication of what the sort of average temperatures were around that time. And also, with the ice core data and these cores have been drilled now in the northern and some southern hemispheres in the poles. And the ice is really thick, it's up to like four kilometres thick, the ice sheet and when they drill a hole into it, it's with a hollow-stem auger. And what that means is that the stem of it is hollow so when they drill down, it captures a nice core and there's a temperature record stored in ice. Because what this ice is, is basically fossilised snow. And in the Arctic and Antarctic when it snows, some of it doesn't melt away during the summer. More snow goes on top of it and crushes the stuff underneath it, and it kind of gradually builds up and the stuff right at the bottom in the rock in Antarctica is almost a million years old. So there's tiny bubbles of air trapped in the ice, and scientists can crack those open and look at the sort of composition of air bubble and that's a good snapshot of what the atmosphere was when the snow fell all that time ago. Also, by a process of isotope fractionation, they can actually tell what the temperature was in the Arctic, just by comparing different atoms of isotopes of carbon and oxygen. And, also has layers of sort of pollutants as well and if there's a nuclear disaster or a big volcano, some of it ends up in the Arctic or the Antarctic and that leaves a layer of pollutants in the ice. This is what the climate scientists found when they analysed, first of all, the carbon dioxide levels going back 800,000 years and also the Antarctic temperature from the ice fractionation. And you can see there's a colouration here. Now what the climate scientists asked themselves, was what was causing the temperature to sort of go up and down. Just to get this into perspective, this is kind of the modern period here, this is the little Ice Age, and this is the medieval warming period, one of these little sorts of bleeps, this is the last ice age. So, a kilometre of ice above Wrexham down here. But the earth has gone in and out of ice ages about every hundred thousand years, of course we know about the temperature has changed in the past when we went around. The first humans appeared about 2 or 300,000 years ago, so it was changing rapidly from time to time without us. So what was causing the Earth to go in and out of ice ages for the last million years?

Could we click on the link, please? Well, when the earth travels around the sun, it's not a circle, it's elliptical and the ellipse is not fixed. One of the Milankovitch cycles is about every hundred thousand years, funnily enough, and when it's in part of a cycle, it's where the earth is close to the sun and it gets a lot more sunlight, when it's further away, it gets a lot less sunlight. There's actually three Milankovitch cycles, there's eccentricity, which is the big circle around the sun, but there's also progression, which is when the Earth spins around the sun, it kind of does that on its access and there's also tilt as well, It tilts back in two. So, if we can just take eccentricity, progression and tilt. What this is, is the difference in sunlight levels that the Earth got going back in time. This is now, this is 400,000 years ago. And this is the changes in heat energy that the Earth was getting from the sun because of the combined three different Milankovitch cycles. And what you'll notice here, but sort of over the next sort of maybe 10,000 years, the amount of sunlight we're getting and because we're going to be further away from the sun, is reducing, so really the temperature should be getting cooler. If we overlay the ice core data of temperature onto this, you can see there's a colouration there and that is what's actually kickstarted previous warm periods and glaciation periods going back in time. And this just kicked it off but then it was amplified by the carbon dioxide effect.

**Okay the next one is, it's the sun, not CO2.**

And somebody is actually spending money to put these up. This was in America, The Ffriends of Science.org, the famous light newspaper, if anyone's read it. So, some people aren't convinced that CO2 is actually making any difference, and they just think it's the sun. Well, the sun actually, as well as being sort of further and closer away from the Earth because of the amount of Milankovitch cycles, it actually increases in intensity and reduces in intensity in the cycle of 11 years. And this is the sort of way it increases and decreases every 11 years. Well, this graph here shows this increase in and decrease in 11 year cycle of the sun and you can see we're going into a sort of lower period as time goes on and this is the average global temperature from temperature measurements and you can see that there's something else going on, that his is not the cause. But all the temperature on the surface of the Earth comes from the sun, well, 99 more than 99% of it, there is small bits of energy that comes up from the molten core, you know, in Iceland and hot thermal springs and so on. Well, that's less than 1% of the heat energy that's on the surface. It all comes from the sun and it's the way that the Earth interacts with heat energy from the sun that causes the Earth to warm up or cool down. And that's because of the greenhouse effect, the sun, can travel through space and hit something on the Earth like a car bonnet it and it heats up and then that heat energy is radiated out as a longwave radiation, whereas sunlight is shortwave radiation. And critically, the greenhouse gases such as carbon dioxide, methane, and even H2O water, access and insulating layer to that long wave infrared radiation. So if you can imagine the greenhouse gases, it's like a layer of insulation around the Earth that lets sunlight in but won't let the heat energy out. And that's really what the temperature and carbon dioxide records tell us. This proves rarely that the greenhouse effect works. There's normally a small amount of warming that happens first, caused by the Milankovitch cycles. And then, carbon dioxide follows it because, the interaction between carbon and the atmosphere is temperature dependent. I'm going to talk a little bit about that in a minute.

**Number four. Climate models are unreliable and can't predict the future.**

I've seen lots of YouTube videos and websites saying that all the models are wrong. So wouldn't it be wonderful if we could go back in time and look at what the, they predicted in the 1970s, and then compare it with what actually happened. And that's what this does. If you could just sort of start that off. Okay, so what's the temperature record that we know from temperature for monitors and monitor and weather stations and so on, and satellite data. Okay. If we go ahead, please. Okay if we can stop it there. So this is one of the first climate modellers, Wally Broecker. And in 1975, this is what his model said was going to happen. And then if we start it going again, please, this was Hansen et al in 1981, this was an updated version in 1988. This is the first IPCC assessment and the second, the third, the fourth and the fifth. If we can just hold it there, please. So we can see that they had it more or less right, it was definitely in the right ballpark.

**It's very cold outside. Global warming must be a hoax.**

This was a famous tweet by, Donald Trump. Brutal extended cold blast could shatter all records. Whatever happened to global warming? Well, this was Tokyo, hit by unseasonal snow and extreme weather warning. Greek authorities urge caution ahead of extreme weather, Snow here in Greece. Strong winter storm to hit much of the U.S. with snow, ice and biting cold. And, snow blankets in New Orleans during historic Gulf Coast winter storm. So really there’s sort of weather events happening that don't really, that you would think maybe don't agree with a warming Earth. Okay. If we could click on that please. So what's happening there? Well, we've seen previously, that’s it's very cold in certain areas and very warm in of us on the globe at any one time. This, heat sometimes moves because of the Gulf streams. So, what happened in America, was that some of this cold air from the Arctic, was kind of projected down over America and as the global average temperature sort of increases, what tends to happen is the more severe an events get, more severe, and the extreme cold events actually get less. So that whole sort of bell curve of differences in temperatures actually shifts towards the hot side. So a beautiful illustration of that is this short video. And what these researchers did was they looked at all the different countries around the world. The United Kingdom's here, and they took a base year of 1900 and they called that sort of the benchmark. And then they looked at if that average temperature in that country in that year was either hotter, which is in red, or cooler which is in blue for that particular year. So if we start the clock, please. So here we go. We can see there's a lot of blue sorts of lines in there, which means that it was colder than average in that country in that year and basically that's what we would see in those cold snaps, for every one of those cold snaps, there's lots of heat waves going on in other places. But as time goes on, we can see the patterns starting to emerge. And I've been in touch with these and asked them, can they carry on, you know, up to 20, 25?, and they're working on, apparently.

**Humans only emit a tiny fraction of CO2.**

Absolutely true, the way that carbon dioxide sort of moves around from the, sort of surface and under the surface to the atmosphere is called the carbon cycle. And it's quite complicated, but these are the main sort of carbon dioxide flows that happen, for instance, photosynthesis when trees breathe in and out, 120 gigatons is taken up and it actually, through plant respiration, expels 60 gigatons of billion tonnes of carbon dioxide. So, another really important sort of part of this graph is the gassing of the ocean, and this is very temperature dependent. So, the hotter it gets, this exchange increases, and we can see that, 90 comes in, 90 comes out. But the red numbers here are from burning fossil fuels. So, nine gigatons here from fossil fuels, cement and land use and two of it is absorbed into the ocean, three of it is absorbed through photosynthesis, which means there's four left in the atmosphere. So, if we can just have a look at the carbon dioxide measurements in the atmosphere. A guy called Keeling started measuring carbon dioxide in the atmosphere, and this is from Hawaii. And Hawaii is right in the middle of the ocean, away from any strong industrial processes. So, it's a really good background record, and you can see since we started measuring in 1960s, this is what happens to, carbon dioxide levels in the atmosphere. And you'll notice it goes up and down every year and the reason for that is, is if you go to Google Earth and look down on the North Pole, you'll see that most of the landmass is in the Northern hemisphere and most of the green, and if you look up from the bottom of the earth, you'll see it's mainly ocean and the sea and Antarctica. So, when it's summer in the Northern Hemisphere, all that photosynthesis is taking carbon dioxide out of the atmosphere, and when it's winter in the Northern hemisphere, but summer in the southern hemisphere, that's when it ramps up, because there's just not that amount of green stuff in the southern hemisphere to counteract it. So it's just like the Earth is breathing, if you like. And if we could go to, 800,000 years, this is the really stark graph. This is the information of carbon dioxide from ice cores and what's happened to it since we started burning fossil fuels. So also visualising carbon dioxide, if we can imagine what a ton of carbon dioxide would look like, it's a sphere about 33ft across. And these researchers from New York decided to sort of see what New York City, carbon dioxide emissions would look like in a day and a year, so it really is quite significant. If we can sort of portray that on this graph, we've got our Antarctic temperature and our carbon dioxide in parts per million, and that is where we're at today. And this is what climate change is all about, really, because we'd expect the red line here to follow the blue line because of the greenhouse effect and that's exactly what's starting to happen with the current warming, and this isn't a case of mild summers or being able to grow grapes in Scotland. It's a fundamental shift in the Earth's climate and it's going to get very hot indeed if we allow this to carry on. So just to recap on those last few slides, this is global fossil fuel consumption going back from 1800 and you can see here about 1950 it really starts to ramp up and it's mainly of coal, oil and gas. This is the Keeling curve, of carbon dioxide in the atmosphere and I've lined these two graphs up so you can see that the dates are almost sort of under each other and you can see that just at the time humanity started burning fossil fuels, the rate of carbon dioxide in the atmosphere increased and then because of the greenhouse effect, the average global temperature is starting to rise. It's really well understood and agreed upon by the majority of climate scientists.

**Number seven. Why should we do anything when China is doing nothing?**

Well, this is a share of global CO2 emissions and you can see here in 1750 to 1800, the UK had a monopoly on it and this started off just down the road in Ironbridge with the Industrial Revolution, but then other countries caught up and we can see that China here has the biggest share of CO2 emissions. But this is really an unfair graph because China has more people than the whole of the United States and the whole of Europe put together. There's a lot of people in China, so you'd expect them to have higher carbon emissions or a bigger share of the carbon emissions. It's like comparing the whole of Wales with Anglesey, perhaps you'd expect Wales to have a higher carbon emission than Anglesey, just because there's more people in Wales and Anglesey. To get a good idea of what's happening, we need to look at the per capita rates and that is per person and that this is the data, the United States and Canada much higher than China. And up until about 4 or 5 years ago, the average UK person had a higher carbon footprint than the average Chinese person. I think it gets a lot of bad press because most of the world now is starting to decarbonise, you can see the these graphs are coming down, whereas China is still going up. But that's not going to last for too long and I just read last month actually about China's carbon emissions where we saw a flattening off. Installed wind capacity, this is wind turbines and the amount of installed capacity there is in different countries and China is by far leading the world in that, also solar power there even bigger leaders in that, and hydropower, world leaders in that and grid scale battery storage, and what China is doing while it's burning fossil fuels, is using that energy to create a carb and a low carbon energy system. It's also building the, the grid, the national grid to transport all its electricity from where it's produced to where it's needed.

So really forward thinking and my guess is that they're going to beat us all to, to carbon neutrality.

**Humans and ecosystems will adapt.**

Well, this is some research that was done a number of years ago now. And what these researchers did was look at different temperature ranges and whenever there was a cold snap, like a really bad winter and the average temperature sort of plummeted, it looked at death rates among people, that was above the average death rate in that country, and it did the same for heat events as well. So, whenever there was a really hot summer, it looked at death rates, mainly of elderly people above the average and we can see that the human body is not really equipped for, for heat. With cold, we can kind of go indoors and cover ourselves in blankets and put the heating on, but with heat, you can't really get away from it. So, we're not really adapted for extreme heat. If we could click on Europe, what these researchers did was they had a look at extreme weather events all over the world and this is just the data for Europe and it was 160 extreme weather events that they looked at, and these were heatwaves, rain and flooding, cold snow and ice impact storms, droughts, compounded and wildfires and things like that. And what they found out was, well, that heat was more severe or likely to happen in most cases. So these hot spells are more severe, more likely 116 out of 160. With rain and flooding, there's some there as well, some in blue, was less severe or likely. And 17 had no influence altogether. This is an interesting one with cold snow and ice, basically the majority here, was less severe or less likely, so, storms and cold snow and ice. So that's a kind of the positive, the only positive we can take from there. But all the rest storms, droughts, and so on and wildfires that are going to become more extreme, are more severe, more likely to happen or they have done in the past and this will just ramp up with a warming climate. One of the things about melting ice is if the ice is on the land, then when it melts, the water goes into the sea, if the ice is on the ocean and it melts, it doesn't alter things too much. In the Antarctic, there's a huge area of ice that's up to four kilometres thick and if that ever melts, this is what's going to happen to our coastline, because there's enough for 80m sea level rise. And this is quite sobering, could we stop it there, please? So, this might take thousands of years to happen. The latest prediction is probably about a metre sea level rise by the end of the century, so this isn't going to happen any time soon and the human race will survive, but it will make things very difficult for the people who would have to deal with this if we let it happen. So things to think about is, food production, that a lot of these areas are used to sort of grow food or graze cattle and so on. Also floods that during these events but doesn't happen too slowly. What tends to happen is that there'll be a big storm and the sea comes over the sea defences and it's only really got to travel maybe an inch or two above the sea defences, but because it's got the whole ocean behind it, whatever is behind it is just floods. And the frequency of these events, might sort of be on average once every thousand years, but as the, um, sea level rises, it won't go through every 500 years, and then every hundred years and then every 50 years or 20 years and when it gets to every three years, really, we've got a new coastline. Living space and migration, we've seen the effects of relatively small numbers of migrants entering our country and maybe the social unrest that that might cause. This would be on a whole new sort of level. Energy production, most of the power stations are fossil fuel power stations and nuclear are around the coast, they use the cooling water, really, if it ever gets hot enough to do this, we'd have to live in an air conditioned bubble. If anyone's experienced 40 degree heat, in Egypt last year it reached 50 degrees and really, you just can't function in that. And extreme weather events will get worse. So, the United States insurance, sort of payouts are quite concerned about climate change. And what they did was track billion dollars disaster events from 1980 to 2023 and we can see there's a definite pattern of the droughts, the wildfires, the flooding, winter storms, freeze counts, severe storm count and tropical cyclone count. So, this is having a financial impact as well and this is just the finances of it, really, these are people's lives that get affected and I think that it's only when people's lives start to get affected that they realise that something's going on, and perhaps some it shouldn't be done about it.

Thank you. So the era of procrastination, of half measures, of soothing and baffling expedients of delays is coming to its close and in its place, we are entering a period of consequences.

So technically we can fix climate change, and it seems quite simple, really. If you can imagine the carbon dioxide in the atmosphere here, like carbon dioxide in a bathtub, and really, it's 430 parts per million at the moment and really what we need to do is empty the bathtub, so it's gets back to pre-industrial levels, which was about 280 parts per million. And the way to do that is, first of all, to stop putting emissions into it and we know how to do that as engineers, and also once we've done that, we can start removing what we've already put up there and the technologies being developed to do that. And that's quite expensive at the moment and there's lots of problems around this, in other words who's going to pay for these net removals, and the transition to net zero is not straightforward. Well, climate change is a financial and political problem. We know how to fix it technically, it's just the finance and the political system that needs to change before we can go all out to try and fix it. And this misinformation that I've been talking about today does play a role in that.

This is a famous photograph, pale blue dot or Earth Rise and everything that we kind of do in our lives and our children's lives and everybody that comes after us are going to rely on this for all the food that we eat or the water that we drink, and that the climate that we have. And really, we should look after it.

Okay. Does anyone have any questions?