

Harry Ridgewell: How has Hawaii been affected by rising sea levels in the last 10 years?

Dr Charles Fletcher: I'll just shut my door. The last 10 years. In the last 10 years, Hawaii's a little bit unique because we are an island state, small island state, and we live in a dynamic geologically and oceanographically dynamic environment because we have the island building and island erosion process. We have ocean currents, ocean waves all year round. Our coastlines are constantly being eroded.

Dr Charles Fletcher: I think Chip probably mentioned to you that globally, sea level has risen something on the order of 8 inches. I don't know what that would be in centimetres exactly, over the past century. The rate of sea level rise is accelerating. It's increasing. I can talk in millimetres on the sea level rise. It was something like 1.5 centimetres per ... I need to know it. Per decade, what is it? Oh my God. It's too early for me.

Dr Charles Fletcher: It's millimetres I think per year. So that rate, it went up to 3 millimetres and now it's gone up even higher. The curve, the sea level rise curve is bending upwards as we speak. We are seeing the effects of that locally. We're having, experiencing more intense erosion events. We're experiencing more frequent flooding events. Last year, we had in the months of April, May, June and July of 2017, we experienced the highest recorded tides ever in the Honolulu area.

Dr Charles Fletcher: There was a significant amount of inundation, passive inundation at various locations around the state. We think that although it's very complex, oceanographic and climatological things happening, there is an element of long term sea level rise that's beginning to affect us. However, it seems to me and from talking to the scientists here that we're still sort of not suffering to the extent that other places are.

Dr Charles Fletcher: As Chip probably mentioned to you, sea level rise is relative. It doesn't rise at the same rates in one place, in one place as in another. The East Coast of the United States is experiencing significant sea level rise problems as we speak. It has to do with the jet stream, possibly some land subsidence. You live in England?

Harry Ridgewell: Yeah. Near London.

Dr Charles Fletcher: I don't know what the situation is in England, but the further north you go into Canada and probably northern Europe, probably sea level might be going down actually because the continent is rebounding from the last glacial period. But for the most part, in the south, things are submerging. The issue is we're not having, we're not having like horrendous sea level rise events in the Hawaiian Islands but we know they're coming. We're seeing the initial signals now. I'm feeling or being told by people ... I've done a lot of research myself and I believe that these rates of sea level rise, they will continue to increase and we're going to start seeing some serious effects in the next few decades.

Harry Ridgewell: How will future sea level rise affect Hawaii?

Dr Charles Fletcher: It's hard to ... You have these global projections, and the global projections on sea level rise is a bit of a moving target. There was this IPCC report, the inter-governmental panel on climate change. They write a report every five years called the

assessment report. They call it AR assessment report. It's a huge ... You know who they are. They're a huge group of scientist, thousands of scientists and they all agree on publishing this report, kind of a consensus based report.

Dr Charles Fletcher: They said in 2014 that we could expect anywhere from 1.5 to 3.2 feet of sea level rise by then end of the century. Because they are, they look at this sort of conservatively to get consensus, there's a feeling that their projections are conservative, because they didn't maybe consider the impact of the ice sheets melting and the loss of ice on the continents, which is a reality and which is happening more rapidly than people anticipated.

Dr Charles Fletcher: Now we're seeing the new studies, recent studies by NOAA and NASA who are basically indicating that we can expect minimally three feet of sea level rise by 2100 and it's physically plausible that we could get as much as six to eight feet of sea level rise by the end of the century, if there's no change in human behaviour. Because we all know that when you emit carbon, emit greenhouse gas emissions, there's sort of, there's a lag effect right?

Dr Charles Fletcher: Let me give you an example. You look back to the '70s, '60s and '70s and '80s perhaps. We were busy emitting greenhouse gases. Those gases are now one of the four things forcing global warming. Several decades later, we're seeing the effect of the emissions warming our planet, warming our oceans. Everything we're emitting today, which is more than we were emitting back then. We're emitting huge amounts of carbon, is going to manifest itself in the few decades.

Dr Charles Fletcher: We're just kind of stuck now in this cycle that don't seem to be able to break out of, where you can't significantly affect or reduce our emissions and they're cumulative. The CO₂ chemical elements stay in the system for a long time. So you just keep adding more and more carbon. It just continues to force the warming process.

Dr Charles Fletcher: That's melting the ice sheets. It's warming the ocean and when the ocean warms, it expands. All these things taking into consideration now. They're telling us that the projections are low from IPCC and that we probably can expect higher rates of sea level rise, which is hard to believe right? You look out at the ocean and you're like, "Man the ocean is ginormous. You can't, how can you melt a little ice and warm the ocean and have it rise so much? It doesn't make sense." I even have trouble getting my head around that.

Dr Charles Fletcher: I'm not going to sit here and doubt 97.5% of scientists in the world who tell me that that's what's going to happen. You just really have to sort of defer to them on that.

Harry Ridgewell: What is the ... Sorry.

Dr Charles Fletcher: For instance, we're telling people now, because we have a pretty aggressive climate programme here in Hawaii, trying to do adaptation and mitigation. Mitigation means trying to reduce our greenhouse gas emissions and we're telling people that basically the only way we could theoretically keep global warming to two degrees centigrade is if we basically stopped burning oil now. That's impossible. That's not going to happen.

Dr Charles Fletcher: In fact, last year, emissions increased over the previous year, so that's ... If we emitted a trillion cubic tonnes of carbon last year, then we're going to emit another trillion cubic tonnes of carbon this year, and we're going to emit another trillion cubic tonnes of carbon next year. It's not a pretty picture.

Harry Ridgewell: What is Hawaii doing to mitigate the effects of rising sea levels?

Dr Charles Fletcher: Well, we have a ... You know the, our administration, this is a little bit political but our administration in Washington has been sceptical of the issues surrounding climate science and climate change. I'm sure you're well aware of that. However, we have 17 US states that are part of a United States climate alliance. Hawaii's one of the partners in the climate alliance. What we're doing is we're all working together to accelerate our transformation from a fossil fuel based economy, from a carbon based economy to a green economy, to an economy that is based on alternative energy sources.

Dr Charles Fletcher: We're trying to accelerate our switch from burning oil and coal and even natural gas to wind farms, solar energy, hydroelectric power and other types of things. We're also trying to force the changes necessary in people's behaviour in terms of driving carbon emitting vehicles. We're trying to move toward electric vehicles as quickly as possible and to develop the infrastructure obviously to support that kind of thing.

Dr Charles Fletcher: We need to get everybody sort of on board to help us move towards that goal. It's a little bit complicated obviously. If we work as an alliance, we can share information and support each other at a sub-national level. We represent this group of 17 states represents something like the ninth largest economy in the world. So, despite what's happening in DC, I guess we feel that we can still have an impact on this issue.

Dr Charles Fletcher: Yeah, that's a really positive thing. The other thing we're doing locally is we're developing adaptation plans. We just published a sea level rise vulnerability and adaptation report which illustrates where in the Hawaiian Islands we're going to see sea level rise effects over the next century, so that we can begin to incorporate that into our plans and policies. Try to reduce the impact of sea level rise on us in the next generation. Not going to stop it. We're not going to slow it down, but we can try to get out of the way, which would possibly save us resources and money in the long term.

Harry Ridgewell: Are you frustrated by the lack of agreed international targets to combat global warming and Trump for announcing that he's going to pull out of the Paris Agreement.

Dr Charles Fletcher: Frustrated. You know, that's an interesting ... Well I'm not frustrated. I'm not frustrated at Trump. You know what's happening there. They understand what's happening, right? They're not really stupid. They just realise that all their eggs are in the fossil fuel bucket. So they, that's where they get their wealth from. They're going to sort of exploit that, right, long as they possibly can. They're true blue capitalists. This is America. We're a capitalist country, and so despite what [inaudible 00:16:03] says.

Dr Charles Fletcher: I'm frustrated a little bit at the world in the sense that people talk about, people talk about change. They talk about wanting to help and wanting to do things differently, but I don't know that people really understand. I don't think it's in their DNA yet and

they haven't really gotten the memo really. The memo is that we sort of have to consider a change in lifestyle if we're really going to try to sort of get on top of this thing, meaning that we have to do things differently. We can't continue using petroleum and coal.

Dr Charles Fletcher: That means maybe we have to curtail some of the things that we enjoy like frequent travel on aeroplanes . Driving single occupancy vehicles. You think about getting people together to do like modal transport and mass transit, people may have to stay put more often, rather than travel around the globe, flying in aeroplanes . People need to think about consuming differently. There's a lot of things. When I go online, I order a new pair of motorcycle gloves, someone's got to put that on a plane to get to me, right? I've just caused additional carbon emissions.

Dr Charles Fletcher: Even though we know that everything we're doing that is causing, is adding to greenhouse gas emissions and forcing global warming, causing sea level rise, we still continue to do it, while at the same time, talking about not doing it. That's frustrating, you know what I'm saying? That's what's frustrating.

Harry Ridgewell: What do you think the international community should do then, if they want to show that they're taking the problem seriously?

Dr Charles Fletcher: Find a way to get tough in a democratic system, and I don't know how to do that. I mean, you're from, you're in England. You guys have had your own share of problems with the austerity measures and all that kind of stuff. I have no idea what's happening with that. I don't know what that means, how you feel about that, but we need global austerity measures. It's got to be done diplomatically. It's got to be done democratically.

Dr Charles Fletcher: We have to somehow do things in a way that doesn't result in only the wealthy benefiting from it and having a disproportionate impact on lesser advantaged people. This is a big issue. I mean, because there's a real chance that if we try to get tough on these issues that rich people, they'll just continue to do what they do because they can afford it. They can afford to pay the carbon tax, right? Whatever it is. Make it expensive to own a vehicle, maybe a registration fee or increase the price of gasoline. People with a lot of money, they'll just continue to pay it but other people that don't have those kind of resources won't be able to pay it.

Dr Charles Fletcher: Nobody wants any sort of authoritarian type situation to arise from this, and I think we have to be careful that, watch for something like that and hopefully that doesn't happen. People have to be able to get together and help cooperate right? They have consensus and agree that everybody's got to work together to solve this problem. But that means that people have to make sacrifices man. Human beings are so, so, so stubborn man. I don't want to make a sacrifice. I don't want to pay any more for this. I want my cake and I want to eat it too. We have a real problem with this. How do you ... I don't know. I can talk about it. I don't have an answer.

Harry Ridgewell: How hopeful are you that global sea level rise will be tackled before it creates millions of climate refugees?

Dr Charles Fletcher: How hopeful am I? Zero. I don't have any hope that we're going to ... Well, because we've already basically, we've already locked in, we're already locked into a situation where we've done something that now cannot be reversed or stopped. We're going to suffer some significant social economic consequences from what's coming in the form of higher sea level, and of course, another big problem is going to be rising global temperatures.

Dr Charles Fletcher: Areas that are already very warm are going to become nearly uninhabitable. You're going to have refugees moving away from the coasts. You're going to have refugees from sort of fringe sort of desert fringe areas or sub-Saharan areas or the middle latitude areas. They might have to leave because it's just not possible to live in a perpetually hot environment. You want to add air conditioning. That just drives, forces more global warming because you're probably using fossil fuel to power it.

Dr Charles Fletcher: My attitude is we're going to have to think about how to navigate the turmoil that's probably surely sort of going to be coming upon us in the future. At the same time, trying to keep our smarts and our wits about us and making some adjustments in how we do things, sliding or shifting into alternative energy or renewable energy type of economy but it's going to be difficult because there's going to be a lot of problems that are going to basically ... You know how it happens. You want to do something for the future, right? You want to do something that is warm and fuzzy but unfortunately you're fighting a war somewhere. You're dealing with climate refugees.

Dr Charles Fletcher: It becomes very complex. You get into chaotic situation. We're going to have to figure out a way to navigate those types of situations, if we want to come out of this thing with sort of any type of civilization left. It, because when we haven't changed our behaviour, we've chosen not to heed the warnings, and we're going to continue emitting and it's going to increase for a number of years, the greenhouse gas emissions. There's going to be a massive, massive blow back from that.

Dr Charles Fletcher: Again there's the alternative view. There's the alternative view that hey you know what man? It's a crazy world. We've dealt with hardship in the past. Everybody has, if you look at history. We'll somehow manage this one, but in the meantime, I'm comfortable and I just kind of want to continue being comfortable as long as I can be comfortable until somebody stops me. Crazy huh?

Harry Ridgewell: Do you think the countries which are responsible for a larger percentage of greenhouse gas emissions and have a higher standard of living should have to take a large share of future climate refugees and if so, how many or how much?

Dr Charles Fletcher: I have no idea about the quotas or allocating space for climate refugees. I certainly think that in a perfect world, right, in a world of, where we have ethics and we believe in equality, it seems that the industrialised countries, northern industrialised countries who are emitting carbon, they need to think about helping the people that are being most impacted.

Dr Charles Fletcher: The irony of it of course is that, right, the people that, the industrialised countries, the northern countries, are the biggest emitters of carbon, but the people

that emit probably 15 times less carbon per capita, right? Africa, some of the Pacific Islands, parts of South America, they're the ones that are going to suffer the greatest effects from it, in a number of ways. Direct environmental effects and of course the social-economic effects of increased poverty.

Dr Charles Fletcher: The Pacific Islands, they emit virtually nothing comparatively to the industrialised world, but guess what? Their countries are going to be gone. Yeah, I think, I don't think I want to get stuck on that issue because you know how it is when you get stuck on those types of social-ethnic issues. Things tend to get really sketchy. I really want to just try to just solve the problem and get on with it, but certainly you can't ignore the fact that that's what's happening.

Harry Ridgewell: How do you feel about the fact that many bills coming out of the sea level rise report weren't passed and did you expect them to?

Dr Charles Fletcher: I didn't really expect much from this last legislative session to be honest with you. It's very typical of the legislative process that a lot goes in, a lot of garbage goes in and at the end of it, maybe something comes out. Maybe it doesn't. We got one sea level rise measure passed, and then there was sort of a, sort of an aspirational, a couple aspirational measures passed regarding carbon neutrality.

Dr Charles Fletcher: We're going to double down this session. We have a very, pretty high level, pretty high level sort of group or organisation in place right now, where we're going to suss out some new legislation from next year. We're going to attack the transportation issue aggressively here and try to get some momentum going.

Dr Charles Fletcher: We're not a big emitter in Hawaii, but we feel like everybody needs to do their part because maybe we can set an example perhaps of how things could be done. It wasn't like, it wasn't really shocking. It wasn't like a watershed of bills coming down this last session.

Harry Ridgewell: Do you think that the international community should compensate countries which are more affected by the effects of rising sea level than others?

Dr Charles Fletcher: I think they ought to think about it. I think they ought to like study it. Meditate on it. I don't think I really, I don't think I'm really in a place to say whether or not they should or not, but I certainly think it's something that should be discussed.

Harry Ridgewell: How are Hawaii's water supplies being affected at the moment by rising sea levels and how are they predicted to be affected in the future?

Dr Charles Fletcher: Water supplies?

Harry Ridgewell: Yeah.

Dr Charles Fletcher: We don't really have, we don't really have a problem with water because much of our potable water is drawn from these aquifers or these dike systems which really, the source of the water is our mountains or hills. We call them mountains. Those dikes are pretty high. They're not really affected by ... We don't have typical sort of groundwater

aquifers that you find in the continents and stuff. We don't really have, we don't really rely on those, the low aquifers for our water. We're not really looking at any serious potable water shortages at this point.

Dr Charles Fletcher: It's all based on precipitation for us. We don't really know at this point whether or not climate change ... We don't really know for sure how our precipitation is going to change with respect to the recharge of our aquifers, our dike systems. That's something we're sort of studying.

Harry Ridgewell: Finally, what effect will sea level rise have on natural disasters like cyclones and tsunamis that affect Hawaii?

Dr Charles Fletcher: Yeah, it could be bad. I mean, we had these high tides last year where a lot of areas were experiencing the sunny day flooding. That means it's not raining and yet you're experiencing flooding in areas because the groundwater's pushing in or the ocean's sort of creeping in.

Dr Charles Fletcher: If you were to get like a hurricane, at one of these higher tide events, that would be devastating. Because, especially if there was a lot of rain because you can't drain when, you can't drain your lowland areas when it's flooded from the ocean. Yeah, it could be pretty bad, but in general, higher water levels or higher oceans, the wave energy then can penetrate much further into your land mass because the reef doesn't, it doesn't break on, the waves don't break on the reef. There's less friction, so the energy's transferred onto the land. It could be bad.

Dr Charles Fletcher: Of course, generally when we get storms and hurricanes, a lot of it's in terms of, and when we get large waves from that, you really have to look at the tides because if it's a low tide, then maybe the impact won't be so bad, but if it's higher tide, the impact will be more severe. Of course, we could have two feet of sea level rise, and yet if the storm hit us at a very low tide, maybe it wouldn't be so bad. It's really difficult to say exactly what the effect is going to be because there's too many ... There's so many factors.

Harry Ridgewell: Okay.

Dr Charles Fletcher: You could get more storms because of global warming, the ocean warming and the storm track could shift towards us. That could be a problem.