Interview with Dan Whaley - Climos
By Camila Rodríguez and Maximilien Kitutu-Mbombo
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1. You are now a member of the ISIS (In-Situ Iron Studies Consortium), a center for research and for advising on role of iron in regulating the ocean's capacity to remove atmospheric carbon dioxide. What has been the role of the consortium in policy debates? seems that your are an amateur oceanographer. We imagine that this passion explains your implication on OIF.

A few precisions: I am not part of the ISIS consortium, I helped provide some of the early motivations and contributed to its formation but it is comprised solely of practising scientists and their organisations so I'm friendly with them but not part of the group. My mum is an oceanographer. Her name is Margaret Leinen. She's the director of the Scripps Oceanographic Institute. I definitely couldn't answer that question without including her. She was chief scientist at Climos, our company that I started. The back-story is that over the years she and I talked many times about climate, the situation, the date, the trend. And when she came towards the end of her tenure at her position we talked about putting together group that could explore this thesis, this iron hypothesis to potentially launch or fund more cruises at larger scale to help answer some of the uncertainties that still remain about OIF and the impacts of that as a technique. We talked for a while and decided to put the effort together.

2. With a background in commercial entrepreneurship you have been very active in OIF research and development, founding two organizations dedicated to it. Why did you decide to focus on this area?

Back in 2005 when we had the inspirations to put this together, there were mechanisms being explored and deployed by the framework commission for Climate Change. The financial incentives had been laid out in the form of carbon reductions and carbon offsets as a way to motivate large emitters to reduce their emissions and fund projects outside Annex I countries to reduce carbon emissions in the developing world and elsewhere. I am coming from the business background. From this perspective, you want to provide a mechanism to finance something you want to do, and form grants to existing scientific funding. It seemed like there was a pretext for a financial framework and an economic framework to help fund large scale carbon reductions. There was definitely gap in knowledge, we needed to get more data, do larger projects at that time. Our thought was that perhaps the gap was small enough that you can fund research through venture mechanisms. That was the approach we took.

3. You were a founding member of an OIF commercial enterprise, Climos. In your experience, how are science and commercial interests interwoven ocean fertilization? What was the specific role of Climos?

Initially our objective was to finance a cruise at scale, at least one and then more, to get data and to develop the methodology to understand within boundaries the carbon reduction that are taking place and to explore the methodologies that would be needed under the regulated and voluntary carbon markets. For a variety of reasons, including the downturn in the carbon market, the failure of energy policy here in the United States in 2008-2009, the failure of the Copenhagen negotiations and the increase concern from regulators like the London COnvention and the IMO we turned most of our efforts to regulatory focus and trying to create the freedom to operate for folks that wanted to do cruises and initially operate for commercial ventures and later the freedom to operate for scientific projects. As time wore on, that really became the incentive to start the ISIS group because it was obvious that only cruises with a pure scientific focus were going to have any chance of moving forward: those cruises needed to be run exclusively by scientists and for scientific purposes using funding not destined for commercial enterprises.

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4. You were a founding member of an OIF commercial enterprise, Climos. In your experience, how are science and commercial interests interwoven ocean fertilization? What was the specific role of Climos? To you, how have these contradictions between the commercial objectives affected the scientific or the general debate?

Without a doubt the commercial angle was a central focus and a central objection, coming from the fact that geoengineering itself was generally objected to by many folks. The commercial angle certainly didn't help. I'm not quite sure exactly if I understand why that happened. When you look at other things, we have no problem using commercial vehicles to fund wild forestries and many of the other carbon reductions are funded under CDM are commercial in nature. It was really this notion of geoengineering at scale and some of the things that were done early on that put the wrong light and led to a high level of scrutiny. I dont want to be negative here so I want to believe it was the circumstances.

5. A lot of the controversy has been influenced by environmentalists that question the ethical implications of meddling with the environment. Some, like Clive Hamilton mention moral corruption and moral hazard and even talk of humans playing God. How do you respond to these accusations?

The reason why we got into this phase was an understanding of the scale of the problem we are looking at. I think people who object even to doing research into this, misunderstand a few things. First they misunderstand the scale of the things we are looking at. Geoengineering hasn't been done yet, climate negotiations have failed, and not because of geoengineering. We are staring at 400 ppm (atmospheric carbon dioxide concentration) and heading much higher. We are already starting to see phenomenal impacts. You could argue whether x y z weather event is caused by climate change, by global warming, due to atmospheric carbon.

The IPCC report says that it is 95% certain that atmospheric carbon we are emitting is having effects. The carbon we are introducing now is going to be here for a long time, hundreds of year, at increasingly worse impacts. So carbon reduction that has taken place the last 15 years, I don't think that they understand what we are looking at. I think people don't think that these strategies work, that there's a sense of meddling with mother nature, a "we created the problem, how could we possibly fixt it", mankind is morally corrupt idea, that these kinds of tools in the wrong hands are going to result in outcomes beyond our control. I really think people are wrong for a couple of different reasons: if we don't do the research to understand this strategies, whether there is any opportunity to provide some alleviation of the impacts of climate change while we aggressively pursue the reductions that we are pursuing, then we are going to get to an increasingly worse situation without knowing what our options are.

Secondly, people are talking about the "geoengineering green finger" going off and single handedly taking off some project outside the bounds of global regulatory environment. I think that is highly improbable. Any successful action will need to be done over 50 or a 100 years, and nobody is going to go rogue for 50 years. You might get someone who puts some aerosols in the atmosphere for a year in a very small area which essentially would have zero impact in any measurable way. And the people are going to shut them down in this increasingly over-connected global society.

Another point is that the primary leading forms of solar radiation managements and carbon reduction are environmental analogs, processes that are happen already in naturally. For instance we mimic the effects of large volcanic eruptions by introducing sulphur dioxide (SO2) in the atmosphere. Every 12 to 20 years you have a major volcanic eruption, we will have another one and those will inject way more SO2 in the atmosphere than any small set of trials to try to understand whether we can first of all engineer any kind of approach actually to deliver that magnitude into the atmosphere and secondly begin to understand how

one would use that technique to achieve a kind of impact or whether it is even possible to achieve that using these kind of strategies. I think the people misunderstand how big these natural examples techniques are and the fact that they are already happening. The dust storm that blew off the land masses that bring iron to the ocean which stimulate natural phytoplankton blooms on a yearly basis are huge. These dusts that blow off off China provide most of iron supply to most of the western pacific ocean. The fact that somebody might go and do a big patch experiment, 100km by 100km, to try and measure the effects while millions of tons of iron are being blown into the ocean every year means that people need to put these things in context. When you say you are going to go on land and plant 100km2 of trees to understand what the impact of growing trees is on the biosphere, people wouldn't object, they understand planting trees. But somehow doing something in the ocean, because it is not a place where we normally act and these aren't things that we normally do, provokes a very different kind of response. I think it's a little irrational but I don't argue with the fact that it makes sense.

6. What are in your opinion the ethical implications of OIF development in the future?

I have spent a fair amount of time looking at these questions, it's interesting territory. Let's look at something that is unethical: some banker gaming the savings for personal game or organisational gain at the expense of economies around the world like we've seen. That's pretty unethical in my belief.

Somebody whose goal, and all of the people who I know and work with, including Russ George at Planktos even though some of the things he did were unfortunate, I think everybody involved here is trying to explore potential solutions that ultimately will have beneficial impacts, even if it is commercially structured and they are plenty of people who engage in business, planting trees for instance, that are trying to do things that are right. Certainly that's the point of view that I was coming from: let's try to find a way to do something that might be of benefit. I don't think that's unethical. If we were doing this and lying about our intentions or somehow have some under-handed thing going, that would be unethical.

Other people point to these moral quandaries like if these guys pursue geoengineering then people who don't want society to take action against climate change will point to geoengineering options as things why we just don't have to take emissions reductions actions at all. Those are simply irrational. First of all, the whole concept of there being a market to fund these strategies, specially on the carbon side, means that there have to be an overall cap or target that these strategies would play a part in.

On the solar side as they are not carbon related I can see how it would lead to not worrying of achieving any kind of reductions. But I think that is wrong too because taking these kinds of interventions on the solar side would mean that people fundamentally appreciated the impacts and the threats of climate change which I would say on the balance, globally, and particularly because of the inaction of the US and China who are at poles position in terms of making any meaningful change, that people don't get climate change yet. So taking some sort of rational approach to engaging in research into this and really understanding the potential of it would also mean that we are in parallel taking other actions on a rational basis.

So I don't see there being some sort of slippery slope or a moral trade off here. To my mind most of the moral arguments are merely excuses that bolster this kind of 'hands off mother earth' attitude but aren't from a rational understanding of how actually this would play out.

7. Ocean Iron Fertilization is one of the three areas of geo-engineering that focuses on greenhouse gas removal and sequestration. Can you explain to us how this technique came about and how it pretends to mitigate climate change?

There is a variety of different technique that you would use in combination to try to measure what the impacts, the benefits. The first thing is that you need observations and you need models. You need to directly observe what is happening and a model of what you think is going to happen, a way to take your observations and have a follow off effect on the circulation of the ocean and where that carbon is going over time. That is something you can really only do with ocean models and supercomputer models. If you focus on the observations you want to understand what the typical model for the part of the ocean that you are going into is: what the seasonal productivity is, what the baseline productivity in that part of the ocean is because phytoplankton bloom naturally. And you want to find a place where you think that the additional contribution you are making is additional to the natural baseline of phytoplankton productivity.

In the project area you deploy sensors, a variety of sediments traps both inside of the patch and outside of the patch. You want to measure what would have happened if you had not been there during the experiment. You also would measure parameters such as the DIC (dissolved inorganic carbon). You would look at, the evolution in the surface of water bloom rate.

You might use some bottom traps actually at the bottom of the ocean to see if how much of the phytoplankton is actually making it to depth. We were also looking at using robotic gliders that have propellers or wings that can move in the water. You can put sensors in the gliders to measure oxygen, pH, and other things to try to understand what are the impacts of what it is happening in the water. You can pull water back and look at the phytoplankton that is actually growing in the water columns. Certain kinds of phytoplankton have more silica, sink deeper, taking the carbon away to the bottom of the ocean for longer. So
me phytoplankton really never make it to the bottom of the ocean, they get eaten by predators so that the carbon is pretty much recycled near the surface.

You'd probably also be looking at satellite pictures to get a false color image of the bloom and the spectrum so that you can see from space approximately what the bloom looks like and do some field analysis that way.
You put all these variables together and come up with using couple of different techniques of what you think is an approximation of the amount of carbon, of phytoplankton biomass that was drone additionally to what the baseline was and from there and the life of the bloom, 6 to 8 weeks, how much of that carbon was actually removed from the active layer into deeper waters and what the profile of that carbon export was to deep water. You can feed that into your models to try to understand how much carbon was removed, to what depth.

We never did a project at Climos so we didn't have any results. Climos has been shut since 2010.

8. High concentration of iron favor plankton growth , and thus provide more food supply for the whole marine fauna. Do you think that iron fertilization can be used in aquaculture or in the fishing industry to boost output for economical needs?

Fisheries already do aquaculture and already use nutrients to stimulate phytoplankton growth and fish. I am not an expert on that field. With respect to iron, I haven't heard of anyone using iron for aquaculture. It is more for macronutrient fertilization. Iron is used not because it is in itself the most important nutrient, it is really nitrates, phosphates and sulfates that are much more important in terms of forming the bulk of nutrients that phytoplankton need. It's just that iron inside see water it's the thing that is most rare and in smallest proportion with other nutrients, this gives it this unique leverage in terms of concentration. In places where nutrients exist in surface water in abundance but phytoplankton is not growing in proportion to the amount of nutrients, sometimes that's a result of lack of iron. Those are the places in the ocean

where iron fertilization might be helpful. The places where you would want to do aquaculture tend to be close to shore and iron sufficient as you get iron from river run offs and so forth. There are iron deficient areas close to shore, so you might do aquaculture using iron, and people may be using iron but I am not aware of that.

9. You talked about planting a forest and comparing it to deploying OIF. While we are pretty clear on the side effects of planting trees, it is not the same for OIF. How should the side effects can be taken into account for OIF?

There are various major, potential side effects that we focused on when we worked in Climos. I will explain some of them here.

One thing is that we know that harmful algae blooms that are close to shore happen for different reasons and have different impacts damaging to marine life in the area. A lot of times you will get some nutrient run off from agriculture that contains a lot of nitrates. That would set off a bloom, standing or occasional, in very shallow water where a lot of phytoplankton grow very quickly. Then they die as they have a short lifetime. They sink to the bottom, remineralise which consumes oxygen. You then get a lack of oxygen and fish that need oxygen suffocate. That's a form of harmful algae blooms that are very common in shallow areas.

A concern for increased phytoplankton bloom in the deep ocean, which is where you would usually do ocean fertilization as you need the carbon to sink to bottom of the ocean in order to remove carbon for a long period of time. Our concern is that if you increase phytoplankton would that also lead to oxygen depletion to a sufficient degree that you would have a negative impact on whatever organisms are living there. Because it's deeper you are remineliriising over much greater depth, so you are spreading the impact over a larger area. The question is if in the particular place where the organisms grow, that's to say at the surface, are you having a considerable impact? This is one of the reasons why you want to do research on what the impact of this would be. If it is only a reduction in 2% in dissolved oxygen then there might not be much of an impact. You have to be a biologist to know whether or not that was actually the case. These are all research questions.

Another impact is that some phytoplankton produce sudonichea, a negative substance that can be poisonous. Are organisms where sudonichea grows already adapted to it or not. If you do a project you would want to measure what are the phytoplankton that are growing, in what concentrations, what are the negative substances being produced and what is their impact on the surrounding marine life.

The other question is if you are growing phytoplankton in a particular part of the ocean and taking nutrients as phytoplankton use nutrients, if that water is then going to another part of the ocean where it would have supported other type of marine life. What would be the impact of changing the place where nutrient consumption is being used. You might get more gish where you grew the phytoplankton but then less fish someplace else. What are the impacts of doing that?

Another objection is on the moral side, the idea of meddling with mother earth in a way that is simply not appropriate for humans to do. There you might say we have already done quite a bit and we have set in motion a series of events that are going to create potentially negative conditions on the planet for natural life. You could argue the other side that if there is something that we could do to lessen the impact of what we are pretty certain is coming, that we actually have a moral imperative to figure out whether or not we should take action to alleviate the impacts that we are creating. Simply arguing that we are not capable of acting in a way because we are flawed and we created these problems in the first place I think it's lazy thinking.

That's a range of objections that people have to OIF.

10. Do you feel there is still a place for OIF in research, mitigation and future development?

To me, if I substitute the word OIF for "I am doing research to understand the biogeochemistry in the ocean, ocean biology, better", for sure. I do think the ocean, 90-some percentage, I don't remember exactly, but if you look at where carbon on the planet is, the dissolved, mobile carbon, most of the carbon is in the bottom of the ocean. The reason is, for millions of years of phytoplankton blooms, the surface drove the carbon through the biological pump into depth. The reason why it is not un land is because the organic matter falls on surface it basically it returns straight to the atmosphere so the deep ocean serves as a trap that traps carbon both in sediment and creates a till where the carbon cycle of the ocean tends to put stuff into the bottom of the ocean. If you look at the excess carbon we put into the atmosphere, most of that carbon will end up in the bottom of the ocean, and the stuff that ends up being at the bottom of the ocean will end up there as a result of the biological pump. There is some dissolution into surface water but on the balance, but on the balance I would say most of it is going to the bottom of the ocean, I am not a scientist.

So, should we look at strategies that can accelerate that process by increasing the overall productivity at the surface of the ocean in a way that the impacts are acceptable to the natural world? From my point of view, as humans, we are the ones who, for better or worse, are entrusted with the planet right now, because we are the ones that have had the negative impact. Either Mother earth is going to scrub the surface of the planet from us and return to what she was or we are going to straighten ourselves out and figure out a way to live sustainably on the surface at scale.

Turning to the question, trying to understand whether there is a role to play for some, if we could reduce the excess carbon from the atmosphere, it's tenure from a couple of 100 years to 50, by increasing productivity, for an extended period of time, and better in our estimation, for us and for our earth, I think we should pursue it. And if we don't do the research to understand whether or not that's an option then we can't make that decision. So, I am in favor of research, there is a potential role for this. I think there is a lot of crisis on the horizon and we have to make hard decisions, one of them will be looking at these strategies to understand their utility.

11. When you talk about living sustainably, for you would strategies like OIF be in the short term while we adapt or would it be a part of continuously living sustainable?

Depends on your time prize. 10 000 from now all the carbon we put in the atmosphere now, assuming we are living sustainably at that point, would have been taken out.So There won't be a need unless we decide to regulate our climate in some particular temperature that we favour. The OIF as a strategy for climate mitigation is something that should be used between now and the period of time that you would stop because you would have taken the majority of the carbon out. It would be a part of that short to medium term strategy until we begin to start living sustainably.

12. Would you have anything to add?

To me the experience of being involved and looking at geoengineering and at iron fertilization was much more of an exploration of how we think of ourselves as humans and in relation to our environment. It brings out different sensibilities in people. There are some people that took a very polarized point of view and were unwilling to discuss the philosophical underpinnings of why they held certain points of view. But the net is that we live in a planet with lots of people and we all have to figure out a way to get along with

each other at the same time that we figure out a way to live sustainably in terms energy, resources and space. I think geoengineering is a phenomenal interesting lens through which to look at the nature of who we are. To me it was really part of a study of men more than it was a study of nature.

11. What would you recommend to people who are learning about OIF?

There is only really one answer for me and that is talk to the scientists. Read the papers that came out of these projects. Watch some of the interviews with some of the key scientists. Regardless of the point of view that you have on whether or not these kinds of projects should happen there are a group of people that have a phenomenal wealth of knowledge and understanding of their field, and extraordinary amount of humility of what they know and what they don't know and the questions that they are still trying to ask. They are wonderful people and I think it is very important to sit down and talk to them.

12. Scientists yes, but can we fully and always trust what they say? Is science controversial? Do scientists hold all of the truth? Who do you believe in?

The people you should believe are the people who continue to ask questions. I stop listening when people think they have all of the answers. The people who continue to question are the people who continue to learn. I would vote for the people who are learning seven days a week.