

1. Can you briefly introduce yourself?

I am an ocean biogeochemist: my research is on understanding how the ocean functions from a biological, physical and chemical perspective. In the last decade, this scientific field has been linked to men's activities from a perspective on carbon cycle. I do research on the role and process of carbon cycling, especially the carbon dynamics in the ocean: I focus on the dynamics of the upper part of the ocean, how the flocks from the upper part of the ocean fall down on the seabed.

On the other hand interests I have is in the way we modify purposely the marine biogeochemical balances in order to extract more carbon from the atmosphere: thus ocean iron fertilization, and all the issues linked to it, make a significant part of my work.

2. Can you briefly explain how the sediment traps work?

This is an item we use to collect carbon that settles on seabed. It is an upward facing cone attached to a rope that preserves the material received where the carbon falls down. We use one of these item typically during two weeks and then we replace it with another cone.

3. Do we know more about OIF side effects since 2008?

I would be delighted to tell you that we have moved forward in a major way since that paper. Unfortunately, largely because of the nervousness of some organizations, research has been tremendously slowed.

It is a great disappointment to me because my fundamental belief is that we have to make decisions, and for that we need to make evidences, which means doing research: modeling, experimentation in the sea and in the lab.

4. Nothing more about the time scale of OIF effects?

The overall research has been slowed. The only kind of progress we got is purely informative, qualitative (and not quantitative) : in certain parts of the Southern Atlantic where material falls, the thesis saying that particles falling at 1000 m depth will be sequestered there during thousands of years is probably not true. It would mean that materials need to settle deeper. This means that our 2008 paper took the right direction.

5. What is the wide range of properties in the upper part of the water column you exactly measure? I quote it from the abstract of the 2008 paper.

The most important is two chemical variables: carbon and iron marine concentrations. These two variables are used to measure how much carbon has fallen into the trap and how much carbon is associated with iron, given the fact some iron will be recirculating back to the upper part of the water column to feed once again phytoplankton close to the surface. So we collect the materials from the traps and bring it for analysis to the lab.

-6. Can high concentration of iron induce negative impacts on other biochemical balances? And if so, could you give us some examples?

There is a possibility that there will be some negative effects. There is no questions about this. We need to do research to see how likely this is and if this likelihood is acceptable. The most important negative effect is that as a result of fertilization we generate gases such as nitrous oxide, a powerful greenhouse gases (GHGs). So although one reduces the amount of carbon dioxide in the atmosphere, one generates other GHGs. So the effect of this is that you don't reduce the amount of warming at all.

Another side effect is that you generate toxins substances as well – anyway they are naturally produced by some species - but here we artificially enhance the process via local high concentration of life. What could happen is that OIF can increase the release of amount of toxins. We have to be aware of this. We should reduce the probability that this will happen. And if it does happen, we must be ready to respond this question: do we mind?

7. Within the National Ocean Centre, what locality do you study especially?

My particular work is focused on the East Atlantic Porcupine (off the Western coasts of Ireland, NDLR). But NOC carries out operations everywhere, included Arctic, Antarctic...

8. Do you use modeling to make correlations between data collected for many different parts of the planet?

I am an experimentalist. I do experiments in the lab and observations at the sea. I am a great enthusiast in doing modeling. Because you cannot make direct observations over every square meter of the ocean: you have to have computation models which fill those gaps. Up to now we have been learning the way the system works, fundamental principles. If we make measurements in the number of representative media combined with models, you can then draw conclusions and have acceptable view of the global pattern.

-9. GHG emissions are increasing. Do you believe mankind will go toward geoengineering solutions to mitigate global warming?

Until we have appropriate information on which to make judgements, I don't think one can respond to this simple question. There will be for certain difficult decisions in the future, which will be based on the balance of the probability of different types of damages to our environment. For instance we know that atmospheric carbon concentration increases, and there is a strong indication that the current human political system is unable to reduce that increase. We don't seem to be capable as a species to curb that increase because the energy now is too cheap. We are unable as a species to prevent it. That's a fact.

You have to make conclusions after the modeling you have on what is the likely effect of this increase in atmospheric CO₂. It is clearly going to increase in many ways: sea and air temperature, decrease of the oceanic pH, the melting of ice etc... All this is certain.

What is not certain is how it will influence for example food production, distribution of monsoon rains; those are fields whose uncertainties is much more difficult to determine.

The same goes for geoengineering: possible side effects will have to be balanced against possible positive effects. And you probably know the 2 main fields of geoengineering: solar radiation management, and atmospheric CO₂ reduction – the one I have been more concerned with but also the most expansive.

-10. Could OIF & Geoengineering be integrated to a global climate mitigation policy framework?

There is no question in my mind about that [geoengineering and OIF] should be added to a global perspective. One cannot conceive of a sensible way of doing this which doesn't involve a large number of nations , with the UN managing this. The Haida experiment is not the way to be doing this. We need to be doing this in an open concerted coordinated manner. If it is done in a large scale it will affect the whole of the human population and all of the biosphere on the planet in the same way that the extreme use of fossil fuel is affecting the planet. Some will say this is a kind of geoengineering, using fossil fuels is affecting our whole planet.

11. To what extent do you believe that civil societies can participate to the decision making on OIF and geoengineering in general? For example I didn't know anything about OIF before entering into the International Energy Master at the Paris School of

International Affairs. It is very easy to tell people to do things (release iron to the sea for example), and a few can influence everything, the effects can be for everybody.

I think that the first point is that nobody questions the sites where the CO₂ emissions are going to increase at the moment. Look at the astonishing increase in CO₂ emissions in China. Do we ask China to justify that? The West has already experienced their Industrial Revolution; it would have been too easy to dictate other nations not to follow this path. No government can restrict another government to build power stations.

Now, when it comes to geoengineering and OIF: I think we are in a better situation to regulate it, because there have been concerns about pollution and waste. I think particularly of the set of laws against pollution such as the London Convention Protocol (The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, NDLR), which has been modified to allow a specific framework for scientific experiments on the ocean.

I am quite optimistic on the OIF space; to my mind this can be done in a way that takes agreement of a large number of nations who have signed up to this convention.

But it does not mean that every single nation has got equal weight in my view. And it has been one of the infortunes as we can see in the Convention of Biological Biodiversity constituted with statements that have not been very well thought out. And these statements are the result of pressures from very small groups that exercise enormous influence on what should be global problems. I think this is not the way we can make rational decision on this very difficult space.

12. You mention experimentation but to what extent can we have good result from small scale experimentation on OIF? Some people on this issue say large scale experiments are equivalent to geoengineering operations. What about small scale? Is it sufficient to produce viable data?

I don't think that we need larger experiments than we are doing nowadays. But it does not mean that we actually do geoengineering. The order of magnitude of the effects of the current experiments is too low to influence the global average atmospheric CO₂ rate. So we are far from doing real geoengineering operations.

In fact, NGOs want to generate fears about this particular point. It doesn't mean that we don't need to be aware of the side effects: I have personally always talked about this.

13. The next UN Climate Change Conference will be held in Paris in 2015. Do you believe we will have a new protocol which is going to be more environmental-friendly? I am

thinking of this point: a lot of people talk about the GHG emissions coming from China, without mentioning the fact that many Western factories operate there. Do you see an important change in this next summit concerning the regulation of the industrial offshoring to Asia?

I would have loved to say yes, but it won't be the case. I agree on the carbon leakage from the West to China. It added to the fact that we cannot criticize the Chinese CO₂ emissions. The other point is that China is intending to mitigate those emissions by fixing small stacks to scrubbers in power generators to recover CO₂, but in Europe this is not case!

14. Will geoengineering be an important part of the next UNCC in Paris?

I hope it will be. It will become more and more common. We must answer these questions: what is the potential for geoengineering ? What kind of research is needed to be carried out to make sensible conclusions?

15. In conclusion can you tell us what you think?

I think that OIF is unlikely solve the problem alone. It will not. We have never said that. But it can contribute in a major way. We must carry out appropriate, regular, official and open research with the best experts if we want to extract a maximum of data. We should avoid operations such as what happened in Canada (2012 Haida experiment, NDLR).