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Changement climatique, transition énergétique, recherche

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Il y urgence. Les résultats de la recherche scientifique, concernant le changement climatique, nous disent que ce dernier pourrait s'emballer. Cependant, ces résultats scientifiques ne disent pas à quel moment l'emballement s'enclencherait, ni même si cet emballement est déjà enclenché. La science ne permet pas de répondre à cette interrogation, tout comme elle ne permet pas de construire des scénarios portant sur le devenir du climat d'ici à la fin du XXIe siècle. En effet, aujourd'hui des aspects majeurs du changement climatique sont encore très peu compris par la science. Il en va ainsi du risque de déstabilisation des hydrates de méthanes stockés sous le permafrost ou au fond des océans, déstabilisation déjà amorcée dans le permafrost du Nord de la planète. Il en va aussi ainsi des interactions du changement climatique avec la vie sous-marine, et plus largement des interactions entre toutes les composantes du système Terre, toutes perturbées par l'activité humaine. Que l'emballement climatique soit déjà enclenché ou non, il est urgent que l'humanité lance une mobilisation générale et solidaire pour limiter autant que faire se peut les effets dramatiques du changement climatique. Changement dont certaines populations, notamment dans de pays à faibles revenus, sont déjà victimes. (Ce paragraphe est développé ci-après, page 2 à 5, dans l'article «Emergency of Climate change: Scientific Knowledge, IPCC Scenarios and Representations of Climate Change»)

Le changement climatique nécessite une transition énergétique très rapide. Disposons nous pour cela des connaissances scientifiques, des technologies et des techniques suffisantes. Ma réponse est à la fois oui et non. Oui, si nous étions dans un monde idéal où, en un temps très bref, les comportements, la production économique et la consommation pouvaient changer radicalement ; dans un monde où il n'y aurait pas de rapports de forces sociaux, de dominations, d'avidités… Mais ce monde idéal, nous savons que ni en 2015, ni dans une, deux ou trois décennies, il ne pourra devenir réalité, même si des transformations positives sont un objectif à poursuivre et à atteindre. Dans notre monde, nous ne disposons pas à ce jour des connaissances scientifiques, ni des technologies et des techniques suffisantes pour répondre à l'urgence climatique et plus largement à l'urgence environnementale (d'autant que les énergies dites renouvelables actuelles peuvent être consommatrices de matière rares et être génératrices de déchets), d'une part, et d'autre part pour aller vers la satisfaction des droits sociaux fondamentaux. Atteindre l'ensemble de ces objectifs exige que l'humanité développe de façon conséquente des connaissances scientifiques, des technologies et des techniques. Non pas des connaissances scientifiques, des technologies et des techniques au service des entreprises multinationales, de leur pouvoir de domination et de leur capacité de destruction de l'environnement, des sociétés et des hommes ; mais, au contraire, au service des femmes, des hommes et de l'environnement. Ce qui nécessite, partout dans le monde, une profonde transformation du mode de gestion de la recherche et de ses orientations. Sont de plus nécessaires des moyens financiers et humains à la hauteur des enjeux et de l'urgence. Selon le Programme des Nations unies pour l'environnement (PNUE), en 2014 l'humanité a consacré moins de 12 milliards de dollars[1] pour la recherche dans le domaine des énergies dites renouvelables ; en d'autres termes, quand l'humanité dépense 10 000 dollars, elle en destine seulement deux à la recherche dans les énergies renouvelables. Au regard de l'importance de l'enjeu, cette dépense est dérisoire.

Toutefois, la technologie et la technique ne constituent qu'un seule des deux faces de la réponse à la question climatique, environnementale et sociale. L'autre face est une transformation du système et une mobilisation générale et solidaire de l'humanité. La recherche est indispensable à chacun de ces faces, y compris la seconde : des recherches actions/participatives sont indispensables au lancement et à l'accompagnement de la transformation du système et de la mobilisation générale et solidaire. Quant à la FMTS, ne lui revient-il pas, plus qu'à toute autre organisation internationale, de mettre en évidence cette importance de la recherche et sa nécessaire transformation afin qu'elle soit au service de l'humanité ? De toute l'humanité ?

1 http://www.unep.org/newscentre/default.aspx?DocumentID=26788&ArticleID=34875&l=fr

Seminar For a Democratic European Energy Model

Emergency of Climate Change
Scientific Knowledge, IPCC Scenarios and Representations of Climate Change

Marc Delepouve (Transform! Akademia WG Energy. Research team, Scité : Lille University), Brussels, April 2015.

One of the main goals of the energy transition is the mitigation of climate change, which could become a dramatic question. Therefore, it is very important to have an accurate and relevant representation of climate change for taking decisions concerning the energy transition.

I will first present a representation of climate change, based on scientific results and on the limits of these results. I will then present a second perception of climate change, based on scenarios from the Intergovernmental Panel on Climate Change (IPCC). Finally, I will propose a political conclusion.

I. Representation of climate change based on scientific results

Scientific findings concerning the future of climate change, provide us with four major lessons :
The first one is **"Current climate system change is very bound with Earth system change. Strong interactions link together the changes of all the components of Earth system : oceans, life, climate..."**

The second one is **" Climate change is so complex and so complicated that today climate change is widely out of scientific knowledge scope."**

The third one is **" Today, what we cannot quantify is much more important than what we can quantify"**

The fourth and last one is **"Thanks to scientific findings, Human kind is aware of the speedy climate change and of the threat of climate change to Earth system and Human kind."**

These lessons are illustrated by, for example, clouds, methane stocks in grounds and life.

Concerning clouds

The cloud system has two effects on climate. One of them is the greenhouse effect; it is a heating effect ; the other is the mirror effect; it is a cooling effect. The balance between these two effects could change with global warming, to heating or to cooling. According to scientific results, the future evolution of this balance should likely be heating, but today it is absolutely impossible to elaborate a quantified scenario of the future evolution of this balance.

On this issue, the full fifth IPCC assessment report (2014) says :
"The quantification of cloud and convective effects in models, and of aerosol and cloud interactions, continues to be a challenge. Climate models are incorporating (some) relevant processes, but confidence in the representation of these processes remains weak. (Today) model estimates of aerosol-cloud interactions and their radiative effects will carry large uncertainties."[2]
"T*he sign of the net radiative feedback due to all cloud types is likely positive. Uncertainty in the sign and magnitude of the cloud feedback is due primarily to continuing uncertainty in the impact of warming on low clouds.*"[3]

Concerning methane stocks in ocean floor

Scientific findings provide us with some information. Methane (CH 4) stocks should release some methane gas in oceans and in atmosphere, caused by temperature increasing, but we do not know when this will happen or the magnitude of it. This is not a secondary issue, because methane stocks in ocean ground are over-sized, gigantic. According to a communication published in 2006 by the Geological and Geological

2 Full WG1 AR5 Report, page 572. http://www.climatechange2013.org/images/report/WG1AR5_ALL_FINAL.pdf
3 Full WG1 AR5 Report, page 574.

Engineering department of Laval University, methane of seabed, in the form of methane hydrate, contains around twice the carbon quantity of all known fossil fuel reserves in the world. Moreover, a methane molecule is 65 times more greenhouse powerful than a molecule of CO2. Therefore, releasing a small part of the seabed methane could induce an important increase of greenhouse gases in the atmosphere, which then could induce a temperature increase, which in turn could induce methane releasing again, and so on.

In 2006, the Geological and Geological Engineering department of Laval University wrote[4] : « *A massive destabilization of methane hydrates caused for example by an increase of 1 or 2° C of the temperature of the oceans, which is entirely consistent with current climate models, may produce a catastrophic increase in atmospheric greenhouse gas.*"

Yet, this scientific warning must be nuanced, due to the substitution of a part of methane by CO2 during its way from sea ground to atmosphere.

On this issue, the 5th IPCC assessment report said[5]: "T*he likelihood of the future release of CH 4 from marine Carbon in response to sea floor warming is poorly understood. In the event of a significant release of CH 4 from hydrates in the sea floor by the end of the 21st century, it is likely that subsequent emissions to the atmosphere would be in the form of CO 2, due to CH 4 oxidation in the water column."* And: " *CH 4 release from marine hydrates and sub-sea permafrost may also occur but uncertainty is sufficient to prevent plotting emission rates"*

The International Arctic Research Center (IARC)[6] from Fairbanks University, in Alaska, published a study in the scientific publication *Science*, in 2010, showing that leakage of methane stored under the 2 million km^2 of the Arctic were already switched and said that it "*might have in the future a dramatic effect on global warming*". Here is an excerpt of a resume of this study published by EurekAlert, website of the American Association for the Advancement of Science (AAS): "*Releasing of methane from the Arctic is faster than expected. The amounts of methane emerging from Arctic Ocean's submarine permafrost in atmosphere are an important and overlooked source of methane, and researchers say that similar but more widespread emissions could in future have a dramatic effect on global warming. (...) After more than 5,000 measures in East Siberian Sea, the researchers report that 80 % of the deeper water and more than 50 % of those close to the surface are supersaturated with methane from underlying permafrost. The sea-floor permafrost contains large amounts of carbon and experts fear that its release as methane leads to a warming of the atmosphere, creating a positive feedback loop with an even larger gas release.*"

L'Institut Français de Recherche pour l'Exploitation de la MER (Ifremer)) wrote in 2012[7] :

"*Releasing large quantities of methane, the destabilization of gas hydrates found in marine sediments could play a fundamental role in global climate change. It has indeed been noted that all periods of global warming over the last 60 000 years have been marked by high levels of atmospheric methane. But the mechanism "start warming - thermal destabilization of hydrates - methane release" has the effect of accelerating the warming.*"

Concerning methane releasing from the continental permafrost

On this methane issue, the 5th IPCC assessment report states[8]: "*There is high confidence that reductions in permafrost extent due to warming will cause thawing of some currently frozen carbon. However, there is low confidence on the magnitude of carbon losses through CO 2 and CH 4 emissions to the atmosphere*"

In the CNRS Journal, January 2015, excerpts of *Permafrost, the climate trap* : "*Permafrost represents 25% of the land in the Northern Hemisphere. This is the largest terrestrial carbon reservoir in the world, ahead of fossil fuel such as oil, gas and coal, "1700 billion tons of carbon from plant" explains Florent Dominé. This is two times more carbon than in the atmosphere!". "Florent Dominé evokes a temperature increase of 5 ° to 8 ° C by 2100, when the worst case scenario of the Intergovernmental Panel on Climate Change (IPCC) 2 is now at 4 ° C*". *"All we know today is that we are facing a formidable positive feedback loop, says the researcher. More the air temperature increases, more the permafrost melts, and more greenhouse gases in the atmosphere increases, resulting in a further increase in the temperature of the air,*

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4 « Les hydrates de méthane : une réserve énergétique énorme, mais une bombe écologique en puissance », February 2 2006. Published on the website: http://www2.ggl.ulaval.ca/personnel/bourque/s3/hydrates.methane.htm

5 Full WG1 AR5 Report, page 468-469

6 Natalia Shakhova, Igor Semiletov, Anatoly Salyuk, Vladimir Yusupovn, Denis Kosmach from Russian Sciences Academy (Vladivostok), eand Ôrjan Gustafsson from Stockholm University. Authors are members of a research team from International Arctic Research Center (IARC) of Fairbanks University (Alaska), directed by the both first mentioned.

7 http://wwz.ifremer.fr/grands_fonds/Les-enjeux/Les-applications/Ressources-energetiques/Les-hydrates-de-gaz

8 Full WG1 AR5 Report, page 468

and so on ... ". "The thermokarst ponds, these true bioreactors are at the heart of the frozen carbon releasing process. When permafrost thaws, floor pieces break off and fall into the water, bringing nutrients and carbon to the bacteria and plankton present in the pond, which degrade to CO2 (in the water layers close to the surface), and to methane (in bottom of the pond which is deprived of oxygen) "

This case illustrates the complex interactions and loops between climate change, release of methane and life. More widely, increasing temperature, acidification of ocean water, release of methane, decreasing oxygen rate of some ocean waters and change of life in oceans, all these are submitted to interactions in a complex and very complicated change process that is far from fully covered by scientific knowledge.

Also, in its 5th assessment report, IPCC noted[9]: *" Between the mid-1980s and the mid-2000s the atmospheric growth of CH 4 declined to nearly zero. More recently since 2006, atmospheric CH 4 is observed to increase again ; however, it is unclear if this is a short-term fluctuation or a new regime for the CH 4 cycle*". Farther it said[10]: "*Of the natural sources of CH 4 , emissions from thawing permafrost and CH 4 hydrates in the northern circumpolar region will become potentially important in the 21st century because they could increase dramatically due to the rapid climate warming of the Arctic and the large carbon pools stored there*". *" Supersaturation of dissolved CH 4 at the bottom and surface waters in the East Siberian Arctic Shelf indicate some CH 4 activity across the region, but it is not possible to say whether this source has always been present or is a consequence of recent Arctic changes. The ebullition of CH 4 from decomposing, thawing lake sediments in north Siberia is another demonstration of the activity of this region and of its potential importance in the future*."

The story of missing heat

From 50 millions years BC to one million years BC, Earth surface atmosphere had cooled by approximately 15 ° C. Specifically, the temperature had constantly fluctuated in cycles with a cycle's average temperature that had lowered by approximately 15 ° C. Since the nineteenth century, a new and reverse trend has occurred with an exponential temperature increasing. But, during the last 16 years, the increase was much weaker than during the two previous decades. This question was the subject of an article of the scientific publication *Nature*, in January 2015. Here are excerpts from this article : "*Sixteen years into the mysterious 'global-warming', scientists are piecing together an explanation*". *"...average atmospheric temperatures have risen little since 1998, in seeming defiance of projections of climate models and the ever-increasing emissions of greenhouse gases. Climate scientists know that heat must still be building up somewhere in the climate system, but they have struggled to explain where it is going, if not into the atmosphere. Some have begun to wonder whether there is something amiss in their models". "Now, as the global-warming hiatus enters its sixteenth year, scientists are at last making headway in the case of the missing heat."the oceans serve as giant sponges for heat".* Also, this article remarked that : *" none of the climate simulations carried out for the IPCC produced this particular hiatus at this particular time*".

Until the end of 2014, science knowledge undervalued the heat sponge function of oceans, therefore they also undervalued the amount of heat that is absorbed by oceans. IPCC models and the Fifth IPCC Assessment Report, launched in 2014, did the same.

Several questions arise. Where is this heat going exactly inside oceans? What is happening and what will happen to the warm ocean currents? Will they warm some methane stocks of the sea ground, causing their release ? Will they accelerate life changing in the oceans, with a speedy development of methanogenic bacteria? Each of these major questions is open and no answer can be quantified.

The four previous cases illustrate four lessons, as I said at the beginning of my topic:
- The current change of climate system is very bound with change of the Earth system. Strong interactions link together all the change of all the components of Earth system: oceans, life, climate, etc.
- Climate change is so complex and so complicated that today it is widely out of scope of scientific knowledge.
- Today, what we cannot quantify is much more important than what we can quantify.
- The last but not the least. Thanks to scientific findings, Humankind is aware of the speedy climate change and of the threat of this development to Earth system and Human kind. And, according to scientific findings, Humankind has to launch a general and solidarity-based mobilisation without further delay, to avoid or limit as much as possible the risk of huge and dramatic climate runaway.

9 Full WG1 AR5 Report, page 475
10 Full WG1 AR5 Report, page 508

II. Representation of climate change based on IPPC scenarios

Since its beginning, IPCC has published 5 Assessment Reports. The last and 5th one in 2014, the 4th one in 2007. Each IPCC Assessment Report contains a full report and a summary for policy makers. Since its second edition (1995), the IPCC Assessment Report has included some scenarios of the climate change until 2100. The interpretation of these scenarios by media and politicians have a huge impact on the public representation of climate change, on the public debate and on the reaction of humans facing climate change.

According to the interpretation by media and politicians of scenarios from the 4th IPCC Assessment Report, a good target should be a reduction by 50% of emission of greenhouse gas by 2050 compared to the beginning of the 21st century. It was the famous factor 2. A magical figure, very useful for political communication.

According to the interpretation by media and politicians of scenarios from the 5th IPCC Assessment Report, a good target should be between "*40 to 70% global anthropogenic GHG emissions reductions by 2050 compared to 2010*". We can observe that this target seems to be less magical than factor 2, it seems even to be scientific. It's like a Confidence interval. But it is not a Confidence interval.

In this two IPCC Assessment Reports, the target is delayed to 2050, in 35 years. Moreover, according to this target, in this time humankind could continue to release some quantities of greenhouse gas in the atmosphere, less important than now, but huge in any case.

The 5th IPCC Assessment Report contains 4 scenarios. Each one is based on the results of several climate models, between 25 and 42 models by scenario. In the full 5th IPCC Assessment Report, it is stated: "*Results (*presented by each scenario*) are a statistical summary. They do not account for model biases and model dependencies, and the percentiles do not correspond to assessed uncertainty. The statistical spread across models cannot be interpreted as uncertainty ranges". " In summary, there does not exist at present a single agreed on and robust formal methodology to deliver uncertainty quantification estimates of future changes in all climate variables. As a consequence, statements using the calibrated uncertainty language are a result of the expert judgement of the authors". " (…) in general it remains an open research question to find significant connections that justify some form of weighting across the ensemble of models and produce aggregated future projections that are significantly different from straightforward one model–one vote ensemble results. Therefore, most of the analyses performed make use of all available models in the ensembles, with equal weight given to each of them*". Moreover, the full 5th IPCC Assessment Report recognizes that several major and threatening questions are not accounted for by IPCC models or by each IPCC models, and when questions are accounted for, it is sometimes with a low level of confidence and based on the judgement of some scientists but not on scientific results. Also, as we saw, the interactions between the components of earth system are so complex and complicated that today some future and major climate evolutions cannot be forecasted. However, the IPCC summary for policy makers does not expose any of this cautions.

Conclusion

IPCC is an Intergovernmental panel and the word *Intergovernmental* is meaningful. IPCC Reports are both scientific and political. If you read the full IPCC Assessment Reports, you can get a representation of climate change based on the scientific results and on the limits of these results. But nobody reads the full report, except a few people. If you only read the IPCC summary for policy-makers, you will get a false representation of climate change based on a lot of figures and on scenarios until 2100 resulted of the quantification of the unquantifiable. This false representation hides that the whole of humankind must launch a general and solidarity-based mobilisation.

Science results are sounding the alarm: the climate system is threatened by a speedy and major runaway effect. Humankind has to launch a general and solidarity-based mobilisation without further delay, to avoid or limit as much as possible the risk of huge and dramatic climate runaway effect. The Earth system is the country of humankind. The Earth system and its climate are under attack, by humankind itself. The richest and powerful people and their transnational corporations are the first guilty. But the richest and powerful populations are the less threatened. The richest and powerful people do not want a general and solidarity-based mobilisation of humankind, because such a mobilisation would attack the system of production, consumption, general competition, and so on ; the system on which their wealth and their power are founded. Could we suppose it is the cause of the mistaken representation of climate change based on IPCC scenarios,

disseminated by media and most of the politicians?

Climate change representation is actually a very political issue. Using its own representation of climate change, based on scientific results and its limits (for example on the full IPCC Assessment Report), but not based on IPCC scenarios, is a major issue for the political left, for social movements and for environment NGOs. It is a democratic necessity.