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Workshop Report

Perspectives on Climate Engineering from Pacific Small Island States

IASS POTSDAM

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Open Discussion Workshop about Climate Engineering: Perspectives from Pacific Small Island States
21st – 23rd August 2013, Suva, Fiji.

The views expressed in this document are those of the authors and the participants of the workshop.

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Content

EXECUTIVE SUMMARY

From the 21st to the 23rd of August 2013, the first "Open Discussion Workshop about Climate Engineering: Perspectives from Pacific Small Island States" took place in Suva, Fiji. It was organized jointly by the Pacific Centre for Environment and Sustainable Development (PaCE-SD) at the University of the South Pacific and the Institute for Advanced Sustainability Studies (IASS) in Germany.

With over 30 participants, the workshop gathered representatives from Pacific Island Countries and Territories (Cook Islands, Fiji, Kiribati, Nauru, Solomon Islands, Tokelau, Tonga and Vanuatu), international and regional organizations, and local NGOs. Its objective was an open exchange of information, perspectives and ideas on the topic of "climate engineering"; it was not intended, explicitly or implicitly, as a promotion of any specific form of climate engineering, nor the application of climate engineering in general.

The workshop organizers brought up the following points about climate engineering:

Given the slow progress of global efforts to mitigate climate change, the topic of climate engineering is increasingly emerging in global policy and science agendas. Climate engineering, also known as geoengineering, denotes a set of technologies that propose to moderate the effects of climate change by intervening in the climate system. They are commonly divided into two non-exhaustive suites:

- Carbon Dioxide Removal (CDR) methods attempt to absorb and store carbon from the atmosphere, either by technological means, or by enhancing the carbon uptake and storage through natural ecosystems.
- Solar Radiation Management (SRM, also known as Sunlight Reflection Methods) aims to reduce temperatures by reflecting sunlight back into space, by various methods such as increasing the reflectivity of the earth's surfaces, deploying a layer of reflective particles in the atmosphere, or making clouds more reflective.

Due to still incomplete knowledge about climatic processes and their complex interactions with both terrestrial and marine ecosystems, the results of computer simulation models on the impacts of climate engineering on global and regional climates still bear large uncertainties.

Once initiated, the cessation of SRM would be particularly difficult: As it does not remove greenhouse gases, it can only mask warming. Once SRM is terminated, temperatures would rapidly increase if greenhouse gas concentrations have not been reduced in the meantime. The subsequent warming would be much quicker than the current ongoing climate change, bearing great challenges for ecosystems and society.

Concerns have been raised that the mere possibility of climate engineering could hinder efforts of mitigation and adaptation, as it might create a false sense of security. The "slippery slope effect" from research to deployment once technologies become available was discussed, and the meeting suggested that highlighting the uncertainties and risks when discussing climate engineering could help to reduce the likelihood of these unintended behaviours from occurring.

Group Picture by Sarika Chand (PaCE-SD)

Group picture after the Opening Ceremony. In the front row (from left to right): Prof. Elisabeth Holland (Director PaCE-SD), Prof. John Bythell (USP Pro-Vice Chancellor Research and International), Esala Nayasi (Director Political and Treaties/Climate Change Unit, Fijian Ministry of Foreign Affairs), Dr. Mark Lawrence (Scientific Director IASS), Achim Maas (IASS), Katharina Beyerl (IASS)

Furthermore, questions of procedural and distributive justice, governance and national and international legislation persist. There is no global consensus on the definition of climate engineering, and existing mechanisms such as the UNFCCC and CBD do not adequately address the issue.

During the workshop discussions the participants agreed that:

1. Intense international mitigation efforts must be the first priority, as it is clearly the safest option;
2. more research, awareness and transparent debate about climate engineering is needed;
3. climate engineering technologies should not be implemented until they can be scientifically proven to be a sufficiently safe option for all potentially affected; and should only be used as a last-resort option to complement mitigation efforts but not substitute them;
4. regulatory and enforceable governance structures are needed before any significant field testing and implementation of climate engineering technologies;
5. it would be advantageous for the Pacific region to discuss and develop a common stance on climate engineering to ensure the region has input into the international debate and potential decisions about climate engineering.

Background and Introduction

This report documents the key outcomes and discussion of the first "Open Discussion Workshop on Climate Engineering: Perspectives from Pacific Small Island States", held in Suva, Fiji, 21st – 23rd August 2013. The workshop was a joint initiative by the Pacific Centre for Environment and Sustainable Development (PaCE-SD) of the University of the South Pacific, and the Institute for Advanced Sustainability Studies (IASS) in Potsdam, Germany. Representatives from twelve Pacific Island Countries and Territories (Cook Islands, Fiji, Kiribati, Marshall Islands, Nauru, Niue, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu and Vanuatu), international and regional organizations, and local NGOs were invited to the workshop, and more than 30 people participated.

The workshop was set against the background of continuously rising greenhouse gas emissions (GHG) over the past decades. In 2009 the AOSIS pointed out in its Declaration on Climate Change[1] the need for mitigation activities that provide for the long-term stabilization of atmospheric greenhouse gas concentrations at well below 350ppm CO_2-equivalent levels and global average surface temperature increases to be limited to well below 1.5 °C above pre-industrial levels. Several countries from the Pacific and elsewhere have embarked on ambitious emission cutting programs. **As long as the global overall trend is not reversed, it is unlikely that global warming will be limited to 1.5 °C increase in the mean surface temperature.** Concurrently, ocean acidification is continuing, and the first impacts of climate change are already recognizable. Due to their unique geographical features, Pacific and other small island states will suffer earlier and more disproportionately from the environmental and societal impacts of climate change. Yet, should global mean temperature increase by 3–4°C or more over the coming decades, even larger, more affluent states will have difficulties coping with the challenges.

Thus, the **concept of climate engineering** (**also called geo-engineering**) **has gained prominence over the past decade.** Its basic idea is to reverse the concept of mitigation: instead of minimizing humanity's impact on the Earth, it seeks to actively intervene into the climate system to prevent the impacts of climate change. The various proposed techniques are commonly divided into two approaches. The first aims at removing GHG and particular carbon dioxide from the atmosphere in order to complement mitigation and perhaps ultimately reach 'negative emissions' (i.e. more GHG taken out of the atmosphere than humanity is emitting). This approach is often called Carbon Dioxide Removal (CDR). The second proposes to reflect more sunlight back into space and thus limit global warming or even cooling the planet. This approach is often called Solar Radiation Management (SRM). Naturally, the latter does not address ocean acidification.

There is currently no internationally coordinated program on climate engineering (**CE**) **research**, but also no intent or preparation for any sort of deployment – no technique is even remotely in a state where deployment could be seriously considered. But the academic, political, and even economic interests are increasing rapidly. Indeed, commercially motivated field experiments with regard to ocean fertilization to enhance carbon uptake by algae have

[1] *See e.g. AOSIS Declaration on climate change from 2009: http://sustainabledevelopment.un.org/content/documents/1566AOSISSummitDeclarationSept21FINAL.pdf (retrieved 30 March 2014).*

already been conducted. Furthermore, companies are acquiring venture capital to develop technological means for removing carbon from the atmosphere. However, a variety of side effects that would be associated with various climate engineering techniques are already clearly identifiable, such as impacts on ocean ecosystems. A multitude of scientific conferences and workshops on managing solar radiation have already been conducted, and every month several new studies and publications are coming out. There have also been significant developments in international law and policy-making on climate engineering. Notably, in October 2013, those countries party to the London Protocol, an international treaty which regulates the dumping of wastes and other matter at sea, adopted an amendment to regulate ocean fertilization and potentially other kinds of marine geoengineering activities in the future. Thus, even though no single technology has been scientifically proven to be safe and feasible, climate engineering has moved from the realm of science fiction to concrete political, academic and economic considerations.

Climate engineering thus warrants attention from Pacific island and other states for two reasons. First, given the possible severity of climate impacts, a sober and serious consideration is needed regarding the potentials, limits and risks of climate engineering. Second – and perhaps more importantly – to be informed and able to make sound decisions should the Pacific island states be approached by governments, business people, activists, or others (including scientists in search of research platforms) with regard to the topic.

The Open Discussion Workshop was therefore designed to inform Pacific stakeholders about the current state of the scientific, political and ethical debate on climate engineering and to provide a platform for discussion and exchange of views between science and policy communities as well as among the Pacific island countries. The workshop itself was therefore not intended to develop any specific outcome or position, but rather to offer an opportunity for open debate and discussion. It explicitly did not aim at creating a consensus or a unified position for the entire Pacific region, but instead at paving the way for communicating and harmonizing viewpoints and perspectives.

This report summarizes its main outcomes and issues discussed. It is structured along the main thematic lines of the workshop:

1. The history of climate engineering.
2. The current state of the scientific debate.
3. Status quo on international politics and regulation.
4. Ethical considerations and decision-making.
5. Perspectives and conclusions from the Pacific.

The sections are the summary of the presentations and the subsequent working group discussions. Participants at the workshop gave a wide range of perspectives and it is impossible to do justice to them in this short summary; however, it is hoped that this report covers the main points of the discussion.

Annexed to this report are the agenda, list of participants, as well as speeches and other materials.

1. History of Climate Engineering

The workshop opened with a presentation by **Mark Lawrence, Scientific Director at the IASS**, on the history of climate engineering. While the idea of rain dances or religious sacrifices to change the weather can be traced back thousands of years in virtually all religions and cultures, serious contemporary scientific discussions on climate engineering only started in the mid-20th century. Indeed, a **committee established by the US government in the 1960s** discussed the possibilities to intervene into the Earth system to counteract adverse environmental change. In parallel, during the Cold War, the superpowers researched how the weather could be controlled for military purposes. Its attempted application during the Vietnam War in the 1960–70s also led to the creation of the ENMOD convention in 1976, which outlaws the application of environmental modification techniques for hostile purposes.

Though climate engineering has long been a small part of the scientific debate on addressing climate change, and several field experiments of ocean iron fertilization have already been conducted, until recently climate engineering was hardly discussed or researched in mainstream climate science. This changed in **2006**, when Nobel Prize laureate **Paul Crutzen** published a seminal article on injecting aerosols in the atmosphere to possibly counteract global warming. Although the paper itself was born out of frustration with the slow pace of climate negotiations, it initially received strong criticism. Nevertheless, the interest in the topic dramatically increased afterwards. In **2009**, the UK Royal Society published its report on "Geoengineering the Climate", the first in a series of reports sponsored by various governmental agencies in Europe and North America[2], while the number of research projects, programs and publications further proliferated. Finally, **the Intergovernmental Panel on Climate Change (IPCC) will substantially review the scientific debate on CE** in the current, 5th assessment report in all three main working groups.

Aside from official reports by inter-/governmental organizations, many new projects on CE have been launched. Perhaps the largest active program so far is the Priority Program on Climate Engineering funded by the German Research Foundation, with an amount of 5 million Euros over the years 2013-2016. The Priority Program focuses on risks and uncertainties, and no field experiments are being conducted. In addition, several projects in the area of a million Euros are funded by various European governments and many more, smaller activities are currently being undertaken. A collection of climate engineering projects which was compiled subsequent to the "Open Discussion Workshop on Climate Engineering: Perspectives from Pacific Island Countries" can be found in Annex 5 of this report.

[2] See Annex 5 for selected publications by national and international organizations.

2. The Scientific Debate on Climate Engineering

As mentioned in the session on the history of climate engineering, actual research has been ongoing for decades, but only recently gained much broader attention. Generally, climate engineering is divided into two main categories: first, carbon-dioxide removal (CDR) which aims at removing GHGs, especially CO_2, from the atmosphere; second, solar radiation management (SRM), which aims at reflecting sunlight and thus cooling the Earth. Each of these categories includes a host of different approaches and technologies. Several comprehensive assessment reports of excellent scientific quality detailing these approaches have already been written and references to them can be found in the Annex 6 of this report.

In his presentation, Mark Lawrence detailed in particular those technologies most commonly discussed and which are representative for their respective category:

- **Ocean iron fertilization** (**OIF**), a CDR technique: Many areas of the world oceans, particularly the Southern Ocean, are very limited in the growth of phytoplankton (algae), despite having sufficient macro-nutrients; the limitation is due to missing micro-nutrients, especially soluble iron. Thus the idea of OIF is to fertilize these regions with iron and spur the growth of algae. The rationale behind this is that the algae would take up more carbon from the atmosphere for photosynthesis, and once they die or are eaten their remains would sink to the ocean floor and thus sequester the carbon. However, the maximum theoretical capacity for carbon uptake is limited and in all estimates well below current global emissions. Also, a number of unintentional side effects may emerge, two of which are particularly important. First, it is unclear how marine ecosystems and thereby food chains would react to massive algae fertilization, and how this would affect fisheries even in distant regions. Second, algae produce other climate-relevant gases, and the biological degradation of algae by bacteria can produce nitrous oxide (also known as laughing gas), which is a powerful GHG (approximately 300x more powerful than CO_2), which could negate any carbon removal effect. Finally, it is questionable, whether the theory will work. Of 13 scientific field experiments to date, carbon was only successfully sequestered in one case. In the other 12 field experiments, for a varying number of reasons, sequestration was either unsuccessful or not possible to document. The Pacific region is judged to be generally less suitable for OIF than the Southern Ocean.

- **Direct air capture** (**DAC**), a CDR technique: Trees naturally take up CO_2 from the atmosphere, and it has been suggested that technological means which could duplicate this capacity could be deployed. Named "direct air capture", its approach is to scrub CO_2 from the atmosphere using amines and other catalysts. Research is intensifying currently, and a number of companies have been set up pursuing this technology in particular. Currently, however, it is economically unfeasible due to very high costs – in the area of several hundred US dollars per ton of CO_2 removed – and also highly energy intensive. Though it is possible that these costs will drop significantly over the coming years as technology progresses, more challenges remain: First, removing gigatons of CO_2 from the atmosphere will require a very large infrastructure, and the question remains where to store the CO_2 safely for an indefinite time. Second, the catalysts used to scrub CO_2 out of the atmosphere may be harmful for human health and the environment.

- **Stratospheric aerosol injection** (**SAI**), a SRM technique: Volcanoes commonly emit large amounts of aerosol particles during eruptions; in some cases, these can be injected high into the atmosphere and cool the entire planet, such as the case of Mount Pinatubo in 1991, which was large enough to cool the Earth by approx. 0.5 °C over the next year. They serve therefore as a template for SAI, which is currently among the most commonly discussed techniques. The idea is to inject sunlight-reflecting aerosol particles, such as sulphates, into the stratosphere. It has been estimated, that reflecting 1% of sunlight back into space may cool the Earth's global average temperature by 1 °C. The amount of aerosols needed would be limited: While humanity emits billions of tons of CO_2 into the atmosphere, a few million tons of aerosols per year may be sufficient to offset global warming. However, without mitigation, GHGs would continue to accumulate in the atmosphere, with two particular consequences. First, ocean acidification would continue unabated. Second, as SAI would reflect sunlight, it would only mask warming. Should SAI cease for any reason and GHG concentrations still remain very high, the Earth would rapidly warm and ecosystems would be threatened as they would need to adapt much faster than would be the case for unmitigated climate change. Furthermore, the Earth would not be cooled uniformly: While global average temperature could be controlled, under the scenario of returning the global mean temperature back to pre-industrial levels, equatorial regions would be cooler than before, while the polar regions would still be warmer. Also, rainfall patterns would change around the globe, with a significant reduction in some regions, particular in the northern hemisphere mid-latitudes and around the equator. These possible impacts are currently being researched further, but indicate that the perhaps limited direct operational costs will be complemented by significant, currently non-quantifiable additional costs. Unequal impacts also raise the question of how benefits and burdens would be distributed.

- **Cloud Brightening**, an SRM technique: Another proposed idea is to increase the brightness of clouds by injecting sea salt aerosols into the boundary layer below the clouds. This could be done, for example, by automated ships. Similar to SAI, cloud brightening would have inhomogeneous impacts with regard to cooling and precipitation patterns, and thus would pose similar challenges. Cloud Brightening could only be deployed in regions where the conditions are right, limiting its application and the degree of cooling that could be achieved. The potential effectiveness of cloud brightening is more uncertain than that of SAI, as key underlying processes are not well-represented in current global climate models. However, its effectiveness is more limited compared to SAI.

Generally, CDR techniques are more cost-intensive than SRM, and their effects would manifest more slowly, at the same time-scales as conventional mitigation. SRM techniques have lower operational costs, and may show quick results in a couple of years. But the risks and uncertainties are far greater than in the case of CDR, as it is essentially a redistribution of climate risks.

A key challenge thereby is also the extreme difficulty of field experiments, especially for SRM: Given the complexity of the climate system, the results of a small-scale field test cannot accurately be scaled up to the global level, while modelling studies are imperfect and with high uncertainties. Thus, to truly understand what the impacts of CE would be and whether it would have the intended impacts, it would require a global-scale field experiment– which would be essentially indistinguishable from actual deployment. This severely limits the ability to actually identify usable and safe methods prior to deployment.

During the discussions of the working group sessions of day 1, the following issues were raised in particular:

Note: The working group sessions were structured along guiding questions which are attached to the workshop program in Annex 1 of this report.

After the opening lectures, but before starting the working groups, all participants were asked to shortly explain their expectations for the workshop. For most of the participants, climate engineering was a new topic and their expectation from the workshop was to learn about technologies, impacts on weather, ecosystems and biodiversity in the region; social impacts of CE; the ethical and moral debate; and also about CE as a disincentive for mitigation. Furthermore, partici-

pants expressed interest in learning if CE should be mainstreamed as a policy issue and how to translate the information to a broader audience. Especially important to the participants was gathering information about the international political debate, learning if CE could affect mitigation efforts and climate negotiations at the UNFCCC, and developing ideas for a Pacific position and potential draft policies.

The afternoon working group sessions, after Mark Lawrence's presentations, started with the discussion about potential consequences of climate change and climate engineering in general. Based on a survey conducted at the beginning of the workshop, many of the participants considered the following aspects of climate change as most harmful: ocean acidification; floods and droughts including long term impacts on sustainable development; sea level rise; coral reef dying; harms to agriculture and fisheries; and impact on biodiversity. The participants stated that there is still a lot to learn about climate change, so adding climate engineering to that would make it even more complicated.

For potential consequences of climate engineering, the participants mentioned human ignorance, insufficient mitigation and the possible failure to honour the commitments of the Kyoto Protocol as most harmful. It was considered that climate engineering might possibly be implemented by countries listed in Annex 1 of the Kyoto Protocol, and thereby might be used as a substitute for mitigation. Participants saw this possibility as particularly worrisome, since those countries in particular should focus on mitigation first. Furthermore, it was questioned by whom climate engineering would be governed, as well as what would need to be done if climate engineering, especially Solar Radiation Management, failed and temperatures immediately rose.

However, when asked which role climate engineering could play in the future, participants stated that climate engineering could perhaps complement mitigation efforts. Yet in the search for solutions, it would be important to address ocean acidification as well, so climate engineering by SRM alone would not be an option. The discussion about the possible future role of CE also included the following points:

- The idea of climate engineering as an emergency solution in a case of crisis was discussed. Furthermore, localized applications to address extreme weather events were brought up as a possible activity.
- Moreover, it was favourably mentioned that research in climate engineering could help to better understand climate systems and contribute to the existing body of knowledge.
- In addition, the general financial ability was discussed especially in the context for PICTs.
- Furthermore the need for transparency was highlighted as well as keeping in mind the sustainability, or lack thereof, of climate engineering projects.
- It was also questioned for what reasons field research in climate engineering would be undertaken since it would be very risky and it would be important to push mitigation instead; generally, field experiments were considered premature.

Regarding the question of what kind research on CE – if any – should be done, most participants were in favour of modelling studies in order to study the effects on ecosystems. At the same time, social science research would be important, looking especially at ethics, social justice and public perceptions.

Furthermore, it was pointed out that governance and regulation for research and any potential deployment are needed at the international as well as local levels based on the precautionary principle, in order to ensure that potential side effects would be considered to avoid harm to people and environment. Governance was discussed for international waters, outer space, as well as at the Convention for Biological Diversity (CBD) and the UNFCCC. Therefore, a holistic view on climate engineering, including effectiveness, feasibility, scalability, sustainability, affordability, detection, governance and uncertainty, was strongly recommended.

At the end of the first day, it was clearly stated that mitigation is and should be the first priority option, whereas climate engineering should at maximum only play a supplementary or complementary role. It was emphasized by the participants that all avenues of mitigation should be exhausted first.

3. Ethics of Decision-Making: Should We Consider Climate Engineering at all?

As a technological response to environmental change, climate engineering is unique due to its aim to affect the entire planet and thereby all living beings. Some commentators have therefore compared climate engineering with "playing God". Taken as a whole CE does raise a number of profound ethical questions, as **Katharina Beyerl** pointed out in her presentation[3]:

- How should **decision-making on climate engineering** and research on it be organized? To what extent could or should different communities be able to participate in the decision-making process? Furthermore, as interventions may need to be conducted for decades and centuries to come to prevent the impacts of the termination effect (see effects of cessation of SRM described above), how could future generations be involved in decision-making, or how do we weigh their needs against ours?

- Does the mere discussion on climate engineering create a false sense of security leading to what some have named "**moral hazard**" – the risk that mitigation efforts lessen because stakeholders might think an untested technology may be capable to prevent the worst impacts of climate change?

- Could the discussion about risks and uncertainties of climate engineering also encourage people to do more to mitigate climate change? If policy-makers and the public get a true sense of how desperately something needs to be done, might they become motivated to reduce emissions?

- Does the research itself create a **slippery slope** towards eventual deployment? Research itself needs resources, including time and money. Could this create momentum to implement CE technologies despite its risks and uncertainties, or prior to the establishment of decision-making procedures and regulations? Could vested interests overwhelm the caution the technology demands?

- Since the Earth system is very complex, all models are always an approximation. Only **large-scale field studies** which effectively amount to the full deployment of climate engineering could prove the effectiveness and safety of climate engineering technologies. What limits should be placed on the field testing of climate engineering? When would our understanding of the Earth system be sufficient to justify large-scale deployment or field testing? What could be principles to govern research and potential deployment?

- Several questions regarding **procedural justice** were pointed out in the presentation:

  How can it be ensured that climate engineering would only be researched and carried out with the **broad and well-informed consent** of stakeholders involved, and how to ensure informed decision-making processes?

  How can we balance **diverging interests, which cross not only geographical and generational lines, but those of species as well**? Which political entity (or entities) should be responsible for including all required stakeholder input? How can agreements that are acceptable to all parties be reached?

[3] *Based on Preston, C. J. (2013): Ethics and geoengineering: Reviewing the moral issues raised by solar radiation management and carbon dioxide removal. Wiley Interdisciplinary Reviews: Climate Change no. 4 (1):23-37.*

Who would set the **targets** (certain temperature, ppm of CO_2 in the atmosphere, others?) which should be reached by climate engineering? Would potential ppm targets for CO_2 in the atmosphere ever be achieved if climate engineering became the favoured strategy for counteracting climate change (although storage capacity for CDR is limited), thereby altering political calculus?

How might **socio-political uncertainties** be dealt with? The effectiveness and safety of climate engineering would depend on a stable institutional framework over a period of many decades. From today's point of view, one important question is if such social and political boundary conditions can be predicted or expected.

Could conditions of an **extreme planetary emergency** – if such a state could be adequately defined and recognized in time to react effectively – maybe lead to the point that **procedural justice might end up being loosened**?

- Concerning **distributive justice**, the main questions discussed were:

Who gets what in a geo-engineered world? How can we ensure that diverse interests and concerns are considered or protected? And how might the benefits and burdens of climate engineering be distributed fairly? Could the deployment of climate engineering increase existing socioeconomic inequalities? How can we also ensure distributive justice for future generations who might bear the risks and consequences of what we decide today?

At the same time it is difficult to discuss how to ensure distributive justice, considering that there is a lot of **uncertainty** about effects of climate change in general, as well as for changes in society. Determining the need for compensation for potential uneven burdens arising through consequences of climate engineering would be difficult because precise regional effects of climate engineering would not be fully predictable. So it would be nearly impossible to determine if "natural" weather conditions, anthropogenic climate change, or climate engineering would have led to certain weather events.

Could market-based incentives steer the benefits of climate engineering away from those who most need them toward those most able to pay? How can we avoid the control of CE by companies that act purely on the basis of **commercial interests?** Furthermore, in order for the investments in a capital-intensive CE technology to amortize, the technology must be deployed for as long as possible, and this would require that CO_2 emissions would not be reduced too drastically.

- Could climate engineering technologies **be misused and thereby also generate conflicts** or even trigger wars in the future?

- How to deal with the fact that climate is a constantly changing metastable system and that any climate engineering would demand complex long term interventions which at the same time could not be prognosticated due to the possibility of **human error**? Is the climate problem at all the type of problem that can be "technologically fixed"? Or should the focus be more on social and behavioural change in terms of a large scale transformation?

- Are there any **religious or cultural reasons** which would speak against the use of climate engineering?

Many of these issues remain yet to be addressed.

During the discussions of working group session II/I, the following issues were raised additionally:

Regarding the question if humans have the right to intentionally modify the climate system the participants' answers were mixed. On the one hand it was said that we humans are already doing it although we do not have the right to do so. On the other hand it was stated that since we already have altered the climate system unintentionally it might be our responsibility now to fix the climate system. One further point was that we should stop activities that change the climate, yet there is the question how to achieve this.

Asked about the role of religion[4] in context of the previous question, the participants said that religion would play a major role in terms of decision making, since religion is a moral compass and guidance for living in balance with nature – especially indigenous reverence of nature and humanity was mentioned here. The idea of stewardship was emphasized, which is common across all religions for the betterment of creation. Dominion, understood as control, was thereby often taken out of context. Furthermore, it was stated that according to the Bible, responsible leadership and humility should be guiding principles. Therefore, it was said that there is a need to consider a stewardship and servant's viewpoint. This could also contribute to reduce the prevailing plundering mentality, to resolve the greed and emotion of plunder. Religions should therefore convey the messages and remind humans they are stewards and not owners of the planet.

Concerning how to address the different interests of all people and the environment for future generations, the participants agreed that there should be more research on the different interests of the people especially in relation to environment. This could be done by involving scientists of different disciplines to carry out multidisciplinary research which can serve the interest of the people as well as the environment for future generations. Furthermore, awareness, consultations, education and training are needed, as well as forums for interaction on international, regional and national level. It was suggested that there is a need for a body to evaluate countries' positions (on current challenges) or maybe even create a new UN body. It would be necessary to ensure free principle and informed consent, fairness, open dialogue and consensus with focus on the common good.

Regarding the question if climate engineering would reduce or increase social disparities, one working group said that it depends firstly on the project proposed and its scale and context; secondly on the definition of social disparity; and thirdly on one's own view. Other groups stated that climate engineering will probably increase social disparities as people owning the technology will use it to benefit them. If it was implemented selfishly it could increase social disparity; if it was implemented altruistically it could reduce social disparity. Therefore, it would be necessary for Pacific Small Island Countries to form a unified voice and voting in assemblies like the UN. Additionally, good governance structures are important, as well as transparent international agreements that allow transfer of technology. Furthermore, there would be the need for strong moral responsibility and ethics. At the same time, to answer this question further, sound research would be requisite.

[4] *Note: Christian faith plays an important role in Pacific Island Communities.*

4. Status Quo of International Law

With regard to international law, **no single treaty currently covers all aspects of climate engineering**. Instead, several treaties contain rules and principles that would be applicable to individual technologies.

There have been extensive discussions by legal scholars on the applicability of various agreements, and the topic of climate engineering has also been addressed by different treaty bodies. Amongst the most relevant treaties are currently:

1. **United Nations Framework Convention on Climate Change, 1992** (**UNFCCC**)**.** The UNFCCC has near universal membership, with 195 Parties. As the UNFCCC addresses climate change and its adverse effects directly, it thus is highly relevant to climate engineering. Some argue that CDR is implicitly covered by the treaty by the provisions on carbon sinks. It is contested whether SRM falls within the scope of the convention. However, adaptation – which is now an essential part of the UNFCCC – was originally also not part of the UNFCCC process. A similar argument was made with respect to adaptation that is now being made regarding CE: that talking about adaptation may reduce the incentives for countries to mitigate. Some scholars have therefore suggested that it would be a possibility to negotiate a new protocol or annex to the UNFCCC to regulate SRM. However, as yet, no state part has proposed including CE on the current negotiation agenda which is intended to be concluded by 2015. Given that just over two years are left for the negotiations and that the UNFCCC requires consensus, it is unlikely that a critical mass of states would push for any agreement on CE prior to 2015 under the climate change regime.

2. **Convention on Biological Diversity, 1992** (**CBD**)**.** In response to ocean fertilization experiments in the mid-2000s, States Parties to the CBD conference of parties discussed the issue in 2008, 2010 and 2012. In 2010, adopted non-binding Decision X/33 on climate engineering. Although some refer to it as providing a de facto moratorium on deployment, upon closer inspection, the decision only calls upon states to not conduct CE activities until the impacts of CE on ecosystems are better understood scientifically. The decision also expressly allows small-scale field experiments which are conducted in a controlled environment. However, the meaning of the term "small" remains undefined, and thus is subject to wide interpretation. Although the CBD was the first nearly universal instrument to address climate engineering, and thus can be taken as an important signal by the international community on this matter, it does not provide for effective regulation on climate engineering. Moreover, CBD decisions are not binding and the USA, where much CE research is taking place, is one of the few countries which are not party to the CBD.

3. **Convention on the Prevention of Marine Pollution by Dumping Wastes and Other Matters, 1972** (**London Convention, LC**) **and its 1996 Protocol** (**London Protocol, LP**)**.** After several scientific experiments and commercial field tests of ocean iron fertilization in the mid-2000s, the contracting parties to the LC/LP began developing a mechanism to address ocean fertilization and later expanded their work to the possible regulation of other marine techniques. In October 2013, countries adopted an amendment to the LP to establish a legally-binding mechanism to regulate ocean fertilization and possibly other marine geoengineering activities in the future.

4. **Convention on the Prohibition of Military and Other Hostile Use of Environmental Modification Techniques, 1976** (**ENMOD**). Although the term climate engineering is not explicitly mentioned in the text of the convention, it prohibits the use of environmental modification techniques for hostile purposes. The use of such techniques for peaceful purposes, however, is not prohibited. The ENMOD convention is considered a dormant treaty, with the last conference of parties being held in the early 1990s. The ENMOD convention is also not universal, having just over 70 parties.

In sum, there exist a number of gaps in international law with regard to the effective regulation of CE, particularly for SRM. It is also argued that states show little appetite for negotiating new treaties and conventions. This makes it more likely that legal gaps could be closed by the progressive development of existing regimes, through the adoption of amendments, annexes, protocols etc.

Several rules of **customary international law** are also relevant to CE. This includes the duty of non-intervention into the affairs of other states, as well as the No Harm principle. Some scholars have therefore started work on developing guiding principles or codes of conduct, but this is only in the early stages.

During the discussions of working group session II/II, the following issues were raised in particular:

Regarding the questions of whether climate engineering should be further regulated, and if so how and in which forum, the participants agreed that there definitely should be further regulation, most of all for deployment. However, they also said that there should be an authorization process in place for research activities. Therefore, further discussions at the international, regional and national levels would be necessary. But most of all, it would be necessary for the countries to know more specifics about climate engineering. Various international bodies were suggested as appropriate fora for addressing climate engineering (e.g., a joint committee of CBD & UNFCCC; possibly merge CBD, UNFCCC & UNCCD). Suggestions were also made for CE governance at the regional level (e.g. Secretariat of the Pacific Regional Environment Programme SPREP, Pacific Islands Development Forum PIDF etc.) and for regulation at the national level.

When asked what the role of Pacific island states should have in climate engineering regulation, the participants agreed that they should be active in discussions, negotiations, and research. They saw a need for Pacific Island nations to develop policies, rules and other measures on research, planning, and implementation of climate engineering, and to make informed decisions based on research findings. Furthermore, it was suggested that consultations with the Pacific island states should be mandatory, regardless of whether an individual country is a party or member to any treaty instrument that would make decisions on climate engineering.

According to the participants, the principles to govern research should be based on the AOSIS 6 Principles, i.e., be transparent, controllable, public, accountable, clean, safe, secure, and environmentally friendly. These principles should be enforced under the national law of the host country, and in cases where activities are conducted in areas beyond national jurisdiction, some participants suggested that the international court of justice should be in charge.

5. Country Perspectives from Around the World

Principally, there are a number of incentives for climate engineering, particularly for SRM, due to its relatively limited operational costs, possibilities to have quick and substantial effects and the potential for a small group or even single state could implement it. Yet, at the same time, there are a number of disincentives: The uncertain downstream costs and the likely inequitably distributed benefits and harms could rally multilateral opposition against unilateral implementation. In addition, based purely on model studies, countries can hardly be certain that the intended impacts will all be realized. Thus, the simple availability of technology does not automatically lead to countries implementing it, as the possible costs and risks may still be simply too high.

Consequently, climate engineering is a mixed bag and though research is ongoing in many countries in the world and particular in Europe and North America, no country has yet taken a final position on climate engineering, as **Achim Maas** pointed out in his presentation. He focused thereby particular on the following countries and organisations:

- **Germany**, was among the drivers for developing regulation for marine-based CE under the LC/LP. Several governmental agencies have issued reports on the issue and the Office for Technology Assessment of the Federal Parliament is looking into the issue as well. Although there is no official, finalized governmental position to climate engineering as a whole, in general a sceptical position prevails. Together with the UK, Germany has the largest and most active research community in Europe.

- The **UK**, similar to Germany, is a driver in developing regulation for CE. The science and technology committee of the parliament has issued a report and the Department for Energy and Climate Change has issued a statement that it is premature to consider climate engineering as a viable option to combat climate change. Generally, the perspectives taken so far by UK officials have been sceptical, but less critical than those within Germany.

- Several other European countries, particular **Norway, Sweden, Finland, the Netherlands and France** are working on assessment reports or are funding research in the area. The supra-national **European Union** itself has not taken any position, but also funds research.

- The House of Representatives of the **USA** jointly with the House of Commons of the UK worked on the topic and issued a joint report. In addition, the National Academy of Sciences and the National Intelligence Community are jointly funding a study, which will be published by late 2014. However, even though there are many research groups in the USA and individual politicians have spoken in favour and against CE, the government has yet to take an official position.

- In several other **G20 nations**, such as **Brazil, Canada, China, Japan, India, Russia** and **South Africa** there have been debates in the media, often with a rather sceptical and critical tone. Research projects are also ongoing in Canada and Japan.

- In **Australia** and **New Zealand**, there are no research programs, but individual academics have commented and published on the issue and Australia has contributed to the development of regulation under the LC/LP.

Though it could be argued that the CBD and its conferences of parties (see above) have provided an avenue for global discussions, the debate has been limited so far. A critical question, which may change the viewpoints of the states is, whether there will be a new agreement finalized in the 2015 climate negotiations and how substantial it will be.

During the discussions of working group session II/III, the following issues were raised in particular:

Asked about the perspectives on SRM and CDR, participants said that there should be emphasis on CDR through natural mechanisms and research in perfecting other CRD techniques, whereas they were more sceptical about SRM since it would not contribute to the mitigation of GHGs. In general, climate engineering should be a last resort only. There should be research to determine short, mid and long term impacts on the environment and society, and it would be better to know about impacts- although this should not imply that CE deployment is desirable.

Regarding the potential development of the international debate, the participants supposed that industrialized nations would probably keep pushing for climate engineering. Since climate engineering is being discussed in the IPCC AR5, there were concerns that mitigation projects and initiatives might be hindered. Future government policies would possibly address issues related to climate engineering, and developed countries might thereby probably control the debate. However, the role of Pacific Island states in the international debate about climate engineering could be to push moral and ethical obligations to remind Annex 1 countries of their mitigation commitments, with the AOSIS ensuring the exercise of conscience and an ethical debate. Yet, it would first of all be essential to have full awareness about climate engineering in the Pacific island states. As climate change is a most sensitive issue in the region it is expected that people of the Pacific could possibly raise the issue of climate engineering at the international level because they are the most vulnerable to climate change. Hence PICs should have a major role in the debate about climate engineering.

Still, mitigation should come first and any climate engineering research or implementation should come with strong mitigation commitments. Regarding climate engineering research PICTs could provide local information on climate data (biological, social, economic, and physical).

6. Perspectives Developed During the Workshop

Climate engineering is for most organizations and individuals still a new topic. This is amplified by the fact that most technologies and approaches are still largely hypothetical, even though some field experiments have already been conducted and more are planned. Nevertheless, during the open discussion workshop in Suva, there was widespread agreement among the participants on a number of issues:

- First of all, throughout all workshop discussions it was clearly emphasized that mitigation is and should be first priority as it is so far the clearly safest option to tackle climate change. Several times the concern was expressed that climate engineering could be promoted as a substitute for mitigation efforts by the countries of Kyoto Protocol Annex 1. Therefore, it was highlighted that climate engineering should at maximum complement mitigation efforts but not substitute them. The participants were well aware of corresponding uncertainties of climate engineering and the complexity of the climate system, which is by far not fully understood and for that reason also hardly controllable. It was discussed that the failure of climate engineering might lead to irreversible or even catastrophic changes, possibly causing more damage than intended good. Therefore, the participants expressed the need for further research but also awareness raising, education and dialogue at international, regional and national levels.

- Regarding research, the participants mentioned that there should be further natural science research in terms of modelling studies to examine risks, uncertainties and implications for various ecosystems, but also multidisciplinary research focusing on interests of people to ensure the basis for procedural and distributive justice. Furthermore, it was stated that it would be premature to conduct field experiments. It was pointed out that any decision made regarding the use of CE should be done based on facts, and more information could also support climate change research in general. However, funding for climate engineering research should be mainly public funding by bodies like the UN and national governments, and some also noted that research funding should not be privatized. Furthermore, the question of financial resources to maintain the technologies was raised.

- All participants urged that there must be further regulation for climate engineering – for research as well as for any form of potential deployment. According to the participants, principles to govern research should be based on the "AOSIS 6 principles" and be transparent, controllable, public, accountable, clean, safe, secure, and environmentally friendly. These principles should be enforced under the national law of the host country, and in case activities would be conducted in areas beyond national jurisdiction, the international court of justice should be in charge. Regulation would be necessary at international, regional and national levels, as well as good governance and transparent international agreements. Additionally, decisions on further regulation of climate engineering demand transparent interaction, awareness and informed debate among all parties. Furthermore, it was emphasized that every party should be consulted before any decision on climate engineering. It was stated that climate engineering technologies should not be applied unless a science based global, transparent and effective framework is in place.

- Although the participants expressed their concern that climate engineering could be potentially promoted by industrialized countries, they also stressed the potential role of Pacific island countries in the debate to highlight moral and ethical obligations. Therefore,

the AOSIS could contribute to ensure conscience on a moral and ethical debate. However, the ethical debate could also be enriched by the idea of stewardship and humans as servants which could be derived from religion as a moral compass and guidance for living in balance with nature.

In general, it was pointed out that a holistic view on climate engineering would be essential to grasp and deal with the topic of climate engineering. This view would need to include effectiveness, feasibility, scalability, sustainability, affordability, detection, governance, and uncertainty. The Pacific island countries would try to do their best to ensure an informed debate, or as one participant put it: "Although having limited resources and being small – Pacific Island Countries have big hearts".

Conclusions and Way Forward

The open discussion workshop on climate engineering discussing perspectives from Pacific small island states aimed to provide a first introduction to and platform for sharing perspectives on CE. Science is rapidly moving forward and many projects are now being conducted in several countries. Negotiations on regulating CE have already commenced, but many gaps remain. Many fundamental questions, such as what roles CE could take - if any - in averting dramatic impacts of climate change and its ethical implications, remain unresolved. Given the increasing interest in many countries, and with rising emissions decreasing hope for limiting global warming to 1.5°C compared to preindustrial times, climate engineering is unlikely to disappear any time soon from the agenda and may under certain circumstances complement mitigation and adaptation. But consideration of this option remains premature, as no technology is even remotely advanced and secure enough to be deployed, and with the possible risks involved, emission reduction measures remain the safer option.

Thus, despite the newness of the topic, participants agreed during the workshop to the following core messages:

1. Intense international mitigation efforts must be the first priority, as it is clearly the safest option;
2. more research, awareness and transparent debate about climate engineering is needed;
3. climate engineering technologies should not be implemented until they can be scientifically proven to be a sufficiently safe option for all potentially affected; and should only be used as a last-resort option to complement mitigation efforts but not substitute them;
4. regulatory and enforceable governance structures are needed before any significant field testing and implementation of climate engineering technologies;
5. it would be advantageous for the Pacific region to discuss and develop a common stance on climate engineering to ensure the region has input into the international debate and potential decisions about climate engineering.

Furthermore, it was discussed during the workshop to take up the issue further and discuss climate engineering in additional Pacific forums.

Annex 1: Workshop Program

First Open Discussion Workshop about Climate Engineering: Perspectives of Pacific Small Island States
21 – 23 August, 2013
Venue: Holiday Inn, Suva and USP Laucala Campus Suva, Fiji

Wednesday, 21 August at Holiday Inn

8:30 – 9:00
Arrival and Registration

9:00 – 10:00
Welcome and Opening Ceremony
Mistress of Ceremony
Professor Elisabeth Holland,
Director PaCE-SD

Official Welcome
Professor John Bythell, USP Pro-Vice Chancellor
Research and International

Overview of the Workshop
Dr. Mark Lawrence, Scientific Director, Institute
for Advanced Sustainability Studies

Chief Guest and Keynote Address
Esala Nayasi, Director Political and Treaties /
Climate Change Unit, Fiji Ministry of Foreign Affairs

Vote of Thanks
Professor Elisabeth Holland

10:00 – 10:15
Morning Tea

10:15 – 11:15
Introduction to the Workshop Schedule
Introduction of Participants and Expectations
Katharina Beyerl, Sarika Chand, Jone Tuiipelehaki,
Viliamu Iese, Dr. Helene Jacot des Combes
Dr. Mark Lawrence, Achim Maas

11:15 – 12:00
Presentation: Introduction Climate Engineering
Definition & Short History
Why is it important to talk about
Climate Engineering now?
Dr. Mark Lawrence

12:00 – 12:30
Collecting Questions and First Impressions of the Topic

12:30 – 13:30
Lunch

13:30 – 14:15
Presentation: Methods of Climate Engineering
Natural Science Risks and Uncertainties
Dr. Mark Lawrence

14:15 – 15:00
Working Groups Session I/I

15:00 – 15:30
Afternoon Tea

15:30 – 16:30
Working Groups Session I/II

16:30 – 17:30
Plenary session to present and discuss first results of the working groups

End of Day 1

Thursday, 22 August at Holiday Inn

8:30 – 9:00
Arrival

9:00 – 9:30
Recap and Collection of Open Questions
Viliamu Iese

9:30 – 10:00
Presentation: Ethical, Philosophical and Cultural Questions
Katharina Beyerl

10:00 – 11:00
Working Groups Session II/I

11:00 – 11:30
Morning Tea

11:30 – 12:00
Presentation: International Political Debate and Current Status
Achim Maas

12:00 – 13:00
Working Groups Session II/II

13:00 – 14:00
Lunch

14:00 – 14:30
Presentation: Current Legal Situation and Governance
Achim Maas

14:30 – 15:30
Working Groups Session II/III

15:30 – 16:00
Afternoon Tea

16:00 – 18:00
Plenary session to present and discuss results of the working groups

19:00
Evening Reception at Holiday Inn

End of day 2

Friday, 23 August at USP, Laucala Campus, ICT Centre

9:00 – 10:30
Public Lecture at USP ICT Multi-Purpose Theatre: Engineering the Climate? An Introduction to the Ideas, Impacts, Uncertainties and Risks
Dr. Mark Lawrence

10:30 – 11:00
Morning Tea

11:00 – 13:00
Closing Discussion
Open Questions?
Expectations met?
Need for further capacity building?
Closing Remarks
Facilitators: Prof. Elisabeth Holland, Dr. Mark Lawrence, Katharina Beyerl

13:00 – 14:00
Lunch

14:00
End of Workshop

Annex 2: Guiding Questions for the Working Groups

WG Session I/I
1. What aspects of climate change and climate engineering do you (or those you represent) consider most harmful?
2. What role do you think CE could play in the future?

WG Session I/II
1. Will CE become an excuse to avoid mitigation? If so, how can this be avoided?
2. Would climate engineering cause more problems and hazards than what we already face? Or what we will be facing in the future under projected conditions of climate change?
3. Do you think there should be further CE research? If yes, what kind of research? (Are there appropriate or inappropriate sources of funding for CE research?)

WG Session II/I
1. Do we have the right to intentionally modify the climate system? What is the role of religion in determining this?
2. How do we address the different interests of all people, and the environment for future generations?
3. Would climate engineering reduce or increase social disparities? How and why? And do you have ideas how to deal with that?

WG Session II/II
1. What is your perspective on SRM and CDR? And has it changed during the workshop?
2. Given the variety of views you just heard, how do you think will the international debate evolve?
3. How do you see the role of the Pacific island states in the international debate about climate engineering?

WG Session II/III
1. Should Climate Engineering be further regulated? If yes, how and at which forum should this continue?
2. What should be the role of the Pacific island states in CE regulation?
3. What should be principles to govern research and how and by whom could these be enforced?

Annex 3: List of Participants

1	Achim Maas	Germany	IASS Potsdam, Cluster Coordinator
2	Alisi Pulini	Fiji	Team Leader Climate Change Unit
3	Ana Tiraa	Cook Islands	Director, Climate Change Division, Office of the Prime Minister
4	Antoine De Ramon N'Yeurt	Fiji	Lecturer at PaCE-SD
5	Apolosa Robaigau	Fiji	WWF
6	Ashmita Ali	Fiji	Research Assistant, PaCE-SD
7	Atelaite Lupe Matoto	Tonga	Ministry of Environment and Climate Change, Assistant Director, Head of Technical and Sustainability Division
8	Creiden Fritz	Nauru	Director, Department of Commerce, Industry and Environment, Republic of Nauru
9	Diana Salili	Fiji	PaCE-SD Student
10	Elisabeth Holland	Fiji / US	Director, PaCE-SD
11	Esala Nayasi	Fiji	Director Political and Treaties Division / Climate Change Unit, Ministry of Foreign Affairs
12	Florence Iautu	Vanuatu	Communications Officer
13	Helene Jacot des Combes	Fiji	Lecturer at PaCE-SD
14	Isoa Korovulavula	Fiji	USAID Project
15	Jason	Fiji	US Embassy
16	Jeremy Cole	Fiji	USAID Project
17	Jese Tawake	Fiji	PaCE-SD Student
18	John Tagiilima	Fiji	SOPAC/SPC
19	Jone Tuiipelehaki	Fiji	PaCE-SD Communications Consultant
20	Josua Turaganivalu	Fiji	UNDP
21	Jovilisi V Suveinakama	Tokelau	General Manager, Office of the Council for the Ongoing Government of Tokelau
22	Judith Giblin	Fiji	PaCE-SD Student
23	Katharina Beyerl	Germany	IASS Potsdam, Project Scientist
24	Kevin Petrini	Fiji	UNDP
25	Linda Vaike	Fiji	PaCE-SD Student
26	Manasa Katonivualiku	Fiji	Climate Change Unit
27	Marii Marae	Kiribati	Environment Inspector
28	Mark Borg	Fiji	IUCN
29	Mark Lawrence	Germany /US	IASS Potsdam, Scientific Director
30	Morgan Wairiu	Fiji / Solomon Islands	Adjunct Fellow PaCE-SD Live and Learn
31	Penehuro Lefale	NZ /Samoa	NZ Met
32	Peter Emberson	Fiji	Pacific Conference of Churches, Animator Climate Change & Resettlement
33	Philip Wiles	Samoa	SPREP
34	Rediet Wubeshet	Fiji	UNDP
35	Sandeep Singh	Fiji	US Embassy
36	Sarika Chand	Fiji	PaCE-SD Communications consultant
37	Siosiua 'Utoikamanu	Fiji	PICPA Pacific Islands Centre for Public Administration
38	Surendra Prasad	Fiji	Associate Professor of Chemistry
39	Susan Vocea	Fiji	SOPAC/SPC
40	Trevor Palusi	Fiji	PaCE-SD Student
41	Trevor Veo	Solomon Islands	Chief Civil Engineer
42	Viliamu Iese	Fiji / Samoa / Tuvalu	Research Fellow at PaCE-SD
43	Vitalynne Dovarua Shankar	Fiji	PaCE-SD Student

Annex 4: Speech by Chief Guest and Keynote Address Esala Nayasi, Director Political and Treaties/Climate Change Unit, Fiji Ministry of Foreign Affairs

Bula vinaka and a warm welcome to all our esteemed delegates from the twelve Pacific Island Countries to this important meeting which I understand is the first ever open discussion on this new phenomenon- climate engineering for Fiji and the Pacific.

The significance that beholds the hosting of this meeting on climate change engineering is not only timely but also an eye- opener, especially at a time when a substantial number of countries in the world today have maneuvered their resources towards this new concept, in the hope that things will turn out right for the broad concept of climate change.

Please allow me to thank the organizers PACE-SD and the Institute for Advanced Sustainability Studies (IASS), Potsdam, Germany for this opportunity in facilitating this forum to exchange views and discuss the science, politics and ethics, as well as the uncertainties and risks of climate engineering – a set of diverse technologies proposed to combat climate change by intervening into the climate system.

With this emerging topic of climate engineering, we cannot overemphasize the importance of the inclusive and participatory approach that we should embrace if we are to effectively address and implement the concept. I would also like, at this juncture, elaborate on how Fiji has progressed it's initiatives to address climate change and I hope that in the process, will shed some light on how climate change engineering can fit into the picture.

I cannot agree more to the fact that Climate change constitutes one of the greatest barriers to sustainable development. It puts Fiji's biodiversity and ecosystems, particularly marine, coastal and infrastructure at risk. In 2012, the Government of Fiji launched its National Climate Change Policy. The absence of a climate change policy has made attempts at coordination slow to establish, which constrained Fiji's efforts to address climate change systematically at the national level. This policy sets a platform for dialogue and collaboration among Government agencies and organizations through organized planning and implementation of national programmes.

Recently the Ministry of Foreign Affairs' Climate Change Unit, in collaboration with all its stakeholders, conducted a mapping and profiling exercise to locate vulnerable communities in Fiji. The main purpose is to locate vulnerable communities with Climate Change projects on the ground, map CC projects and project types, identify the areas where there have not been any Vulnerability and Adaptation (V&A) assessments done to determine the distribution of CC projects in Fiji. The vulnerable communities are identified by partners that have conducted their own V&A assessments using their respective V&A tools.

The Climate Change Unit is also undertaking consultations on its draft Coordination and Finance Guidelines. These two documents have been developed to address the issue of coordination and also to provide clear instructions on the current financial process for Climate Change Projects that are implemented in Fiji. As you may all know, Fiji hosted the 3-day inaugural meeting of the Pacific Islands Development Forum. For the first time in the Pacific, a forum has been established with a view to bringing together representatives from Pacific Island Governments and territories, civil society, private sector and our development partners with the focus on 'sustainable development'.

The meeting was very successful as it came up with new innovative ways and strategies to effectively address sustainable development in the Pacific.

Our Prime Minister's address at this the forum emphasized the need for us to think outside of the box and find ways where we can do things differently in a more effective manner and for us to be 'people' centered.

Just last week, the 2nd National Climate Change Summit was held in Narewa Village in Nadi. This is the first climate change meeting of such magnitude to be held in a village. The 2013 Summit brought together practitioners, experts, community members and policy makers and provided a platform for an inclusive and participatory dialogue, consultations, discussions and information sharing.

More importantly, it provided an opportunity for partners, stakeholders and community representatives to share their experiences and map out a comprehensive plan of action to effectively address climate change through clear, time-bound and detailed implementation strategies. The inclusive approach that we have adopted so far throughout this process has set the right tone for this process.

An outcome from the Summit highlighted that women are not just "helpless victims" of climate change. They hold significant knowledge and skills and successful adaptation and mitigation and hold community knowledge. The leadership of women is critical to manage the impacts of climate change and increase resilience.

Furthermore, the role of Faith Based Organisations to spread the message about climate change and ecosystem based management approaches needs to be recognised and current engagements with the FBO's needs to be strengthened.

The Pacific including Fiji should also recognise the bountiful resources that it has. While climate change and environmental degradation from poor development practices have been prevalent in the past few years, we also need to recognise the availability of natural resources that have managed to withstand such pressures. Rather than dwelling on the resources that have been lost, we must take measures to protect the different biodiversity areas that are still in abundance – Our terrestrial and marine based resources.

As our honorable Prime Minister had alluded to in his opening speech at the National Climate Change Summit 2013 and I quote, "we long ago came to the conclusion that individually, we cannot hope to achieve change. Only by using our collective strength and influence can we persuade our communities of the absolute imperative for an immediate response."

We look forward to learn more about climate change engineering in this workshop and I wish you all a successful deliberation over the next 3 days.

On that note Ladies and Gentlemen, I have the honour to officially declareopen the first ever open discussion on climate engineering for Fiji and the Pacific. Thank you, Dhanyavaad and vinaka vakalevu.

Annex 5: Draft Communiqué of the "Open Discussion Workshop about Climate Engineering: Perspectives from Pacific Small Island States", 21st – 23rd August 2013, Suva, Fiji.

From the 21st to the 23rd of August 2013, the first "Open Discussion Workshop about Climate Engineering: Perspectives from Pacific Small Island States" took place in Suva, Fiji. It was organized jointly by the Pacific Centre for Environment and Sustainable Development (PaCE-SD) at the University of the South Pacific and the Institute for Advanced Sustainability Studies (IASS) in Germany.

With over 30 participants, the workshop gathered representatives from Pacific Island Countries and Territories (Cook Islands, Fiji, Kiribati, Nauru, Solomon Islands, Tokelau, Tonga and Vanuatu), international and regional organizations, and local NGOs. Its objective was to exchange perspectives on the topic of "climate engineering"; it was not intended, explicitly or implicitly, as a promotion of any specific form of climate engineering, nor the application of climate engineering in general.

The workshop organizers brought out the following points about climate engineering:

Given the slow progress of global efforts to mitigate climate change, the topic of climate engineering is increasingly emerging in global policy and science agendas. Climate engineering, sometimes also named geo-engineering, denotes a set of technologies proposed to combat climate change by intervening onto the climate system. They are commonly divided into two non-exhaustive suites:

- Carbon Dioxide Removal (CDR) methods attempt to absorb and store carbon from the atmosphere, either by technological means, or by enhancing the carbon uptake and storage through natural ecosystems.
- Solar Radiation Management (SRM, also known as Sunlight Reflection Methods) aims to reduce temperatures by reflecting sunlight back into space, by various methods such as increasing the reflectivity of the earth's surfaces, deploying a layer of reflective particles in the atmosphere, or making clouds more reflective.

Due to our still incomplete knowledge about climatic processes and their complex interactions with both terrestrial and marine ecosystems, the results of computer simulation models on the impacts of climate engineering on global and regional climates still bear large uncertainties.

Once initiated, the cessation of SRM would be particularly difficult: As it does not remove greenhouse gases, it can only mask warming. Once SRM is terminated, temperatures would rapidly increase, if greenhouse gas concentrations have not been reduced in the meantime. The subsequent warming would be much quicker than the current ongoing climate change, bearing great challenges for ecosystems and society.

Concerns were raised that the mere possibility of climate engineering could hinder efforts of mitigation and adaptation, as it will likely create a false sense of security. The "slippery slope effect" from research to deployment once technologies become available was discussed, and the meeting suggested that highlighting the uncertainties and risks when discussing climate engineering can help to reduce the likelihood of these unintended behaviours from occurring.

Furthermore, questions of procedural and distributive justice, governance and national and international legislation persist. Climate Engineering has not been defined in an international arena, and existing mechanisms such as the UNFCCC and CBD do not adequately address the issue.

During the workshop discussions the participants agreed that:

1. Intense international mitigation efforts must be the first priority, as it is clearly the safest option;
2. more research, awareness and transparent debate about climate engineering is needed;
3. climate engineering technologies should not be implemented until they can be scientifically proven to be a sufficiently safe option for all potentially affected; and should only be used as a last-resort option to complement mitigation efforts but not substitute them;
4. regulatory and enforceable governance structures are needed before any significant field testing and implementation of climate engineering technologies;
5. it would be advantageous for the Pacific region to discuss and develop a common stance on climate engineering to ensure the region has input into the international debate and potential decisions about climate engineering.

Annex 6: List of Assessment Reports on Climate Engineering

- Rickels, W.; Klepper, G.; Dovern, J.; Betz, G.; Brachatzek, N.; Cacean, S.; Güssow, K.; Heintzenberg, J.; Hiller, S.; Hoose, C.; Leisner, T.; Oschlies, A.; Platt, U.; Proelß, A.; Renn, O.; Schäfer, S.; Zürn M. (2011): Large-Scale Intentional Interventions into the Climate System? Assessing the Climate Engineering Debate. Scoping report conducted on behalf of the German Federal Ministry of Education and Research (BMBF), Kiel Earth Institute, Kiel.
http://www.kiel-earth-institute.de/scoping-report-climate-engineering.html

- German Federal Environment Agency – Umweltbundesamt - UBA (2011): Geo-Engineering: effective climate protection or megalomania?, Umweltbundesamt, Dessau.
https://www.umweltbundesamt.de/sites/default/files/medien/publikation/long/4177.pdf

- Royal-Society (2009): Geoengineering the climate: science, governance and uncertainty. Royal Society, London.
http://royalsociety.org/uploadedFiles/Royal_Society_Content/policy/publications/2009/8693.pdf

- House of Commons Science and Technology Committee. The Regulation of Geoengineering. London: The Stationary Office; 2010.
http://www.publications.parliament.uk/pa/cm200910/cmselect/cmsctech/221/221.pdf

- (U.S.) Government Accountability Office (GAO) (2011): Climate Engineering. Technical Status, Future Directions and Potential Responses. Washington: GAO.
http://www.wilsoncenter.org/sites/default/files/GAO_Report.pdf

- Chairman Bart Gordon, Committee on Science and Technology, U.S. House of Representatives (2010), "Engineering the Climate: Research Needs and Strategies for International Coordination Report", 111th Congress 2nd Session: October 2010.
http://www.gpo.gov/fdsys/pkg/CHRG-111hhrg62619/pdf/CHRG-111hhrg62619.pdf

- IPCC, 2012: Meeting Report of the Intergovernmental Panel on Climate Change Expert Meeting on Geoengineering [O. Edenhofer, R. Pichs-Madruga, Y. Sokona, C. Field, V. Barros, T.F. Stocker, Q. Dahe, J. Minx, K. Mach, G.-K. Plattner, S. Schlömer, G. Hansen, M. Mastrandrea (eds.)]. IPCC Working Group III Technical Support Unit, Potsdam Institute for Climate Impact Research, Potsdam, Germany, pp. 99.
http://www.ipcc-wg3.de/publications/supporting-material-1/EM-GeoE-Meeting-Report-final.pdf

Annex 7: Non-exhaustive Collection of Climate Engineering Activities, Reports and Projects

Broadly International:

- Report of the IPCC expert meeting on climate engineering in 2011, link: http://www.ipcc-wg3.de/meetings/expert-meetings-and-workshops/em-geo-engineering

- Solar Radiation Management Governance Initiative (SRMGI), an initiative by the UKs Royal Society, the US-based NGO Environmental Defence Fund and the Third World Academy of Sciences (TWAS), link: http://www.srmgi.org

- The Geoengineering Model Intercomparison Project (GeoMIP) is a group of climate modelers around the world researching via computer simulations climate engineering. Link: http://climate.envsci.rutgers.edu/GeoMIP/publications.html

Europe:

- "European Transdisciplinary Assessment of Climate Engineering", or EuTRACE, which is funded by the EUs research framework program from 2012-2014. Focuses on developing an assessment report on climate engineering from a European perspective, has 14 partners from five (UK, Norway, Germany, France, Austria) countries and a volume of 1 million Euro. Link: http://www.eutrace.org

- "Implications and Risks of Engineering Solar Radiation to limit Climate Change" (IMPLICC): An EU funded research project modeling solar radiation management and its possible impact on precipitation and warming (Mark Lawrence was a contributor and several slides were shown during the workshop showing its results). Link: http://implicc.zmaw.de

- The priority program (SPP) on climate engineering of the German National Research Foundation. The program is divided in two phases, each phase lasting approx. 3 years (the first one from 2013-2016) and each funded with approx. 5 million Euro. A total of seven, basic-science oriented projects are funded under the program, the list is available here http://www.spp-climate-engineering.de

- Assessment of international law and possibilities for regulating climate engineering, running 2012-2013, implemented by the Ecologic Institute in Berlin (Germany) and funded by the German Federal Environmental Agency. Link: http://www.ecologic.eu/de/4633

- Assessment of the impacts of climate engineering on the atmosphere and particular ozone, running 2012-2014, implemented by the IASS and the Max-Planck-Institute for Meteorology in Hamburg (Germany), funded by the German Federal Environmental Agency. Link: http://www.iass-potsdam.de/research-clusters/sustainable-interactions-atmosphere/climate-engineering/investigation-and

- Study by the Office for Technology Assessment of the German Federal Parliament, to be published early 2014, link (in German): http://www.tab-beim-bundestag.de/de/untersuchungen/u9900.html

- The Strategic Planning Office of the German Federal Armed Forces investigated climate engineering, the short version of the final report is available here (in German): http://www.planungsamt.bundeswehr.de/resource/resource/MzEzNTM4MmUzMzMyMmUzMTM1MzMyZTM2MzIzMDMwMzAzMDMwMzAzMDY4NzE2NjMwMzk3YTc5NjYyMDIwMjAyMDIw/Future%20Topic%20Geoengineering.pdf

- There are several research groups in Germany examining CE, most with only one or a few researchers; an exception is the research group "Microcosm on Interdisciplinary Research Climate Engineering" at the IASS, which includes currently 14 individuals and is working on a variety of topics, including (1) regional impacts of climate engineering, (2) impacts of climate engineering on biodiversity and ecosystems, (3) governance of research on climate engineering, (4) regulation of marine-based climate engineering, (5) developing a registry for research on climate engineering, (6) environmental and health impacts of air capture, (7) ethics of climate engineering, and particular the challenges it poses, (8) role of models and narratives in presenting climate engineering, (9) dialogues with societal stakeholders. Link: http://www.iass-potsdam.de/research-clusters/sustainable-interactions-atmosphere-siwa/climate-engineering/interdisciplinary

- "Climate Geoengineering Governance", or CGG, which is funded by the UKs National Environmental Research Council (NERC). Focuses on governance of climate engineering, six partners from the UK, led by the University of Oxford. Link: http://geoengineering-governance-research.org

- "Integrated Assessment of Geoengineering Proposals" (IAGP) is a British project that aims at integrating physical, engineering and social sciences to construct a framework for assessing effectiveness and side effects of geoengineering proposals. Link: http://www.iagp.ac.uk

- The "Stratospheric Particle Injection for CE" (SPICE) is British project, which included besides other activities an intended field experiment on SRM, which was for various reasons was cancelled. Link: http://www2.eng.cam.ac.uk/~hemh/SPICE/SPICE.htm

- Cambridge Conservation Initiative project on impacts of climate engineering on ecosystems: http://www.conservation.cam.ac.uk/collaboration/reviewing-potential-impacts-geoengineering-ecosystems-and-biodiversity

- The Oxford Geoengineering Programme (OGP) seeks to engage with society about the issues associated with geoengineering and conduct research into some of the proposed techniques: http://www.geoengineering.ox.ac.uk

- G360, an assessment project by the University of Exeter: http://www.exeter.ac.uk/g360

- The "COOL" research project is a multi-institute project in Finland on various climate engineering techniques. http://www.aka.fi/Tiedostot/Tiedostot/FICCA/FICCA%2016.04.2013/cool_puoliv%C3%A4li.pdf

- The Swedish LUCE project just started and focuses more on the social science side of things including perception, link: http://www.cspr.se/forskning/luce?l=en&sc=true

- Study by the Rathenau Institute in the Netherlands on climate engineering in general, to be published in late 2013 or early 2014, link: http://www.rathenau.nl/en/themes/theme/project/geo-engineering.html

USA:

- Massachusetts Institute of Technology 2013 program, which focuses on how to get atmospheric concentration of CO_2 back down to 350 parts per million (current concentration is above 400). Link: http://igutek.scripts.mit.edu/terrascope/index.php?page=index

- Assessment report funded by the National Academies of Sciences of the USA and the National Intelligence Community, results to be published in Fall 2014, link: http://www8.nationalacademies.org/cp/projectview.aspx?key=49540

- The "Fund for Innovative Climate and Energy Research" (FICER) has a size of 5 million US Dollars and is sponsored privately by Bill Gates (i.e. he as person, not the Bill & Melinda Gates foundation nor Microsoft). FICER focuses particular on issues more related to carbon dioxide removal, link: http://dge.stanford.edu/labs/caldeiralab/FICER.html

Canada:

- The Canadian CIGI has a project on process mechanisms on governing climate engineering, link: http://www.cigionline.org/activity/function-and-form-of-geoengineering-research-registry

Japan:

- Japanese Environment ministries statement to fund research on various climate change related aspects, including geoengineering (in Japanese): http://www.env.go.jp/policy/kenkyu/suishin/koubo/pdf/2012s-10_needs.pdf

Abbreviations and Acronyms

AOSIS: Alliance of Small Island States

CBD: Convention on Biological Diversity

CDR: Carbon Dioxide Removal

CC: Climate Change

CE: Climate Engineering

CO_2: Carbon Dioxide

DAC: Direct Air Capture

ENMOD: Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques

GHGs: Greenhouse Gases

IASS: Institute for Advanced Sustainability Studies

IPCC: Intergovernmental Panel on Climate Change

IPCC AR5: Intergovernmental Panel on Climate Change Fifth Assessment Report

LC: London Convention

LP: London Protocol

NGOs: Nongovernmental Organizations

OIF: Ocean Iron Fertilization

PaCE-SD: Pacific Centre for Environment and Sustainable Development

PICTs: Pacific Island Countries and Territories

PIDF: Pacific Islands Development Forum

SAI: Stratospheric aerosol injection

SPREP: Secretariat of the Pacific Regional Environmental Programme

SRM: Solar Radiation Management / Sunlight Reflection Methods

UN: United Nations

UNFCCC: United Nations Framework Convention on Climate Change

US: short for United States of America (USA)

USP: The University of the South Pacific

V&A: Vulnerability and Adaptation

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