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Domains of Climate Ethics[1]

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Abstract: Climate ethics (CE) has become an emerging field in applied ethics. CE is not just a sub-discipline of environmental ethics but has its own moral and ethical profile. Meanwhile, CE is not just about mitigation and future generations but has enlarged onto adaptation, climate engineering, allocating burdens, and distributive justice. This article summarizes recent developments in CE and proposes a coherent set of yardsticks for orientation within the different topics of CE.

Keywords: Climate ethics, mitigation, adaptation, climate engineering.

1. Introduction

Literature on climate change is abundant. Beside the scientific, economical, technological, and political literature there is also an increase in ethical analysis of the many moral problems which are embedded in climate change. The term 'climate ethics' (CE) is taken as title for such analyses.[2] The aim of this article is to present a systematic overview of CE. It seems reasonable to distinguish different domains (topics) of CE.[3] A comprehensive CE will be established if well-substantiated positions in each domain can be conjoined coherently. The article gives an outline of the main building blocks of such theory. At its core, CE refers to a triangular structure of how to reduce the negative impacts of climate change by a) *mitigation* (reduction of greenhouse gas emissions), b) *adaptation*, and c) *climate engineering*. Some sections of the article refer to this structure (sections 4, 7, 8) but the overall article also refers to the ethical profile of climate change (section 2), a reflection on climate economics (section 3), distribution schemes for remaining emission entitlements (section 5), responsibility for historical emissions (section 6), and a comparison between two competing concepts in CE ('Contraction and Convergence' and 'Greenhouse Development Rights', section 9). The article supposes some familiarity with the basics of climate science and, in section 3, with mainstream economics.

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[1] Thanks to Christian Baatz who has critically commented to an earlier version of the article. Thanks to Margarita Berg for linguistic improvements.

[2] Authors who have contributed to the emergence of CE are, among others, Henry Shue, John Broome, Steve Gardiner, Aubrey Meyer, Donald Brown, Edward Page, Michael Northcott, Simon Caney, Marco Grasso, and Christoph Lumer.

[3] The idea to distinguish different domains is taken from GRASSO (2007).

2. The ethical profile of climate change

There is a beneficial natural greenhouse effect and there is natural climate variability. On large time scales the global climate is permanently changing. On a very short time scale of ≈200 years, humans contribute to the natural greenhouse effect by releasing CO_2 and other so-called greenhouse gases (GHG) (as methane) into the atmosphere. Anthropogenic release is performed by burning fossil fuels (oil, coal, gas) and by land-use change (deforestation, livestock grazing). Due to human release, atmospheric concentration of GHG is now ≈390 ppmv CO_2 and roughly ≈430 ppmv CO_2-eq.[4]

The basic physical mechanism of greenhouse-effect is beyond doubt. There are many remaining uncertainties in the details of climate change[5] but the 'big picture' of a warming world partly due to anthropogenic emissions has been scientifically established.[6] Recent scientific attention focuses on 'tipping points' and feed-back mechanisms in the global climate system. All in all, scientific understanding of the global climate system has increased and the models are more trustworthy than 20 years ago.[7]

Anthropogenic climate change is not repugnant in itself. Imagine a world with low CO_2-concentrations that would only allow for an Inuit-like human life in a species-poor borealis-type world. If human cultures and biodiversity could flourish if this 'cold' world could be warmed by means of release of some GHG, most people would not oppose such a strategy. Climate change is a moral problem because of its negative impacts on human systems (and on biodiversity) in the short, middle, and long run. Not all impacts must be seen as negative. Melting of glaciers and retreat of Arctic sea-ice is not bad in itself because mountain forests may grow and new shipping routes may become viable. Such melting is critical if negative impacts outweigh positive ones (sea-level rise versus shipping routes). Negative impacts are those that count as evils according to our axiological common sense. In human life we are facing evils that either are naturally induced (natural disasters) or result from the behaviour of other persons. Climate change manifests itself in events that look like natural disasters but may be anthropogenic. However, hardly any single event except sea

[4] GHG concentrations can be defined in terms of CO_2only or in terms of all GHG which are calculated in CO_2equivalents (CO_2-eq). In the following, I adopt the CO_2-equivalents numbers.

[5] Ocean as carbon sinks, albedo change, cloud cover, precipitation patterns, thermohaline circulation, stability of cryosphere, 'tipping points' etc.

[6] Minor mistakes of IPPC which have attracted the media are painful according to IPCC's review standards but do not shatter this overall picture.

[7] So-called 'climate skepticism' still presumes to adopt the scientific virtue of being skeptical but, as climate science proceeds, this presumption has become misleading.

level rise can be attributed to human emissions with certainty.[8] Although only weather events are directly observable, the increase in risks of climate change can be measured and liability for such increase can be assessed.[9] What can be predicted with some confidence is a modification in probability, frequency, and intensity of events that cause evils for humans. Such disasters are, for instance, floods, droughts, heat waves, forest fires, landslides, spread of diseases, hurricanes, hard rain, decline in local harvests, desertification, increased water stress in (semi)arid regions, conflicts over scarce resources, political instability, and the like. Biologists warn that the combination of climate change and highly intensified land-use system increases the risk of ≈25–30 % on all species of going extinct.[10] This may reduce resilience of many ecosystems against disturbances and shocks. The loss of diversity, resilience, and ecosystem services must be also perceived as evil. Other impacts may be indirectly linked causally with climate change, as large-scale land acquisitions by multinational entrepreneurs that aim at improved food security for wealthier nations.

The impacts of climate change will fall upon specific people by chance but there are some 'patterns of likeliness'. If a person will live at the coastline of Bangladesh or in Mali it is more likely that she will be affected by flood or droughts than a person in the hills of, say, France or Germany. All models indicate that poor people in the global South will have to face most evils. Risks are imposed upon them. Those people might be unaware or ignorant about the nature of the problem they are affected by. Since these people don't contribute much to climate change, they are, by intuition, victimized by the polluters. People who will be affected are not just members of future generations. Since climate change already has begun, people affected are a) contemporary adults, especially in poor strata of Southern countries, b) contemporary children whose life overall prospects are affected for worse, and c) members of future generations.

Climate change is a paradigm case for intergenerational responsibility since, once induced, it will continue for centuries (melting of ice shields in Greenland and Antarctica). The ethical literature on responsibility towards posterity can be applied to the case of climate change. Derek Parfit's 'future individual paradox' does not refute the widespread conviction that there is some moral responsibility against members of future generations.[11] Such responsibility implies, minimally, that it is mandatory to bequeath overall environmental conditions that are not inimical to a decent life for all humans. Such decency can be conceived according to the capability-approach of Martha Nussbaum and Amartya Sen. This implies the *prima facie* obligation not to change the global climate by *GHG emission*s in a way that dignity, decency, and safety

[8] Nobody can claim with confidence that hurricane 'Katrina', the forest fires in Russia or the great flood in Pakistan in 2010 were in part caused by climate change.

[9] ALLEN (2003).

[10] PARMESAN,YOHE (2003).

[11] OTT, K. (2004) .The famous future-individual paradox was outlined in PARFIT (1983).

of human life is impaired or threatened. This highly unspecific formulation must be specified as CE proceeds through its different domains.

*GHG emission*s are collective actions that are not directed against single rights of single persons but create negative external effects on the environmental conditions under which people live. Any single emission is too marginal to be blamed on moral grounds directly (going by airplane, heating with coal in winter, using electricity). Moreover, emitters and affected persons do not encounter each other in a face-to-face-situation but remain anonymous to each other. Due to the inertia and global nature of climate systems, evil impacts occur at different locations.

The moral profile of climate change can be conceived as negative external effects in conjunction with market failure (economics):

– Increase in pain, suffering, sorrow which affects the overall welfare function for worse (welfare based ethics).
– Imposing risks on other people without informed prior consent given by them (ethics of risk). [12]
– Impairing rights of contemporary and future persons (right based morality).
– Unfair victimization of other people (ethics of justice).

Right-based morality, ethics of risk, and ethics of justice are close allies. Under these approaches it seems plausible to conceive climate change as a case of *victimization*.[13] Victimization is a kind of injury against other people. The facets of such victimization are as manifold as the types of evils that are associated with climate change. If one adopts the principle that it is more important to avoid evils than to bring about benefits the attitude against victimization can even be taken by utilitarianism, especially negative utilitarianism. For both Kantian and utilitarian ethicists it seems hard to accept increases in the standard of life of wealthy persons that impose severe risks on poor people.[14] Utilitarian ethicists such as Broome[15] and welfare-ethicists such as Lumer[16] come to results on mitigation policies that differ significantly from those of economists who calculate the economic optimal (efficient) climate policy (section 3). This indicates that neoclassical economics is not just applied utilitarian welfare ethics but a completely different approach.

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[12] Imposing risks upon other people directly affects the situation of these people for worse. According to my intuitions, it is morally repugnant to expose other persons to dangers without prior informed consent given by them. See REHMANN-SUTTER (1998).

[13] The moral case against victimization can be substantiated with a discourse-ethical framework by combining right-based morality, ethics of justice, and a more protective ethics of risk. See OTT et al. (2004).

[14] SHUE (1992).

[15] BROOME (1992). Broome's book relies on the best data available at that time but is still worth reading for its utilitarian rigor.

[16] LUMER (2002).

3. Ethical Suppositions in Climate Economics

Economists do not wish to avoid climate change at any cost. If energy input by fossil fuels increases production of commodities but has *GHG emission*s as unwelcome side-effect, and if the consumption of commodities fulfils preferences while the side-effects create negative external effects, the *GHG emission*s should be curbed to the extent only to which these external effects outweigh the utilities being created by consumption.[17] Standard economic approaches even rely on the idea of maximizing net present value. The paradigm calculation is William Nordhaus's 'classical' DICE-model.[18] Richard Tol continues this efficiency approach (EA) in his many publications in which he downplays the moral problems of climate change.[19] However, the application of EA to global, unique, and long-term problems such as climate change has raised skepticism even among economists.[20]

Meanwhile, it is widely accepted that EA is not neutral with respect to ethics. First of all, it must be understood clearly that in all models costs are opportunity costs, not payments.[21] Furthermore, there are many ethical assumptions in EA-models. Such assumptions are

– the rate of discount,
– the curving of the damage function,
– aggregation of impacts in a single welfare function,
– the marginal value of future consumption units,
– the assumed value of a statistical life,
– technological innovation as either exogenous or endogenous to climate change,
– monetary value of environmental change ad loss of biodiversity,
– shift in transaction costs, control costs, and search costs.

Economic calculations are highly sensitive to these assumptions. It makes a difference whether the damage function is shaped in a linear fashion or whether it allows for non-linearity of damages. A linear damage-function models climate change as rather smooth and without unpleasant surprises. Modelling the monetary value of a

[17] See SCHRÖDER et al. (2002), 417 with further references.
[18] NORDHAUS (1994). LOMBORG uncritically relied on Nordhaus' calculations in his (2001).
[19] TOL (2008).
[20] Gernot Klepper, Ulrich Hampicke, Peter Michaelis, Ottmar Edenhofer, to name but a few.
[21] Most costs are decreases or delays in growth rates of GDP. Given the magnitude of global GDP, even small declines in growth rates amount to huge costs in $-numbers.

statistical life may downplay the death of poor humans. The many cultural amenities of a stable natural environment are also downplayed in most economic models. The costs of strong mitigation increase if technological innovation in carbon-free energy supply systems is modelled as exogenous. Costs decrease if innovations are modelled as endogenous (which is more likely).

The so-called *Stern-Report*[22] provides results on mitigation policies different from EA. One important modification is a discount rate close to zero (0.1 % p. a.). Due to a low rate of discount, future evils are represented in the net present value to almost full extent. Setting the discount rate close to zero might be a reasonable choice from the moral point of view, as ethical reflections on discounting indicate[23], but it is not based on purely economic grounds. Both Nordhaus and Tol criticise the *Stern-Report* for using such a low rate of discount. Tol even questions the economic credibility of the *Stern-Report* in polemical terms.

The debate on the ethical assumptions within EA motivates many (prudent) economists to adopt an alternative approach.[24] This alternative is called *Standard Price Approach* (SPA). This approach starts from a standard set by some legitimate authority (democratic politics, fair negotiation, discourse based). The primary task of economics is to calculate how this standard can be reached by minimizing costs. In SPA, the role of economics is less a master of rational choice than a servant to political objectives.[25]

SPA does not answer the question how to determine such standard with respect to atmospheric greenhouse gas concentrations. One can either rely on factual political decisions or on fair procedures of how objectives might be substantiated. There is no global political authority entitled to determine global objectives of climate change policies. Game theory indicates that factual outcomes of climate negotiations will not provide a proper standard. Thus, CE might contribute to how such standard might be substantiated. The neutrality of ethics in regard to particular interests implies that ethics is in an 'objectively' better position to determine such a standard than the perspective of rational self-interested agents (representatives of states) within strategic bargaining processes.

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22 STERN (2007).

23 Cf. the contributions in HAMPICKE, OTT (2003).

24 The problems of EA increase if not only mitigation but adaptation and climate-engineering are addressed. If EA can't calculate the efficient solution for mitigation policies only it can't calculate *a fortiori* the efficient solution in the triangular affair in between mitigation, adaptation, and modes of climate-engineering. To determine the 'efficient' solution of mitigation, adaptation, and climate-engineering in a global welfare function over a century is, at best, an utopian ideal and, at worst, a misleading, dangerous, and chimerical myth.

25 At least with respect to environmental problems SPA has several advantages over EA since it is hard to see how the 'efficient' pollution of air, rivers, and marine systems or the 'efficient' number of species on planet Earth might be calculated.

4. Stabilization level of atmospheric greenhouse gas concentration

Art. 2 of the *United Nations Framework Convention on Climate Change* (UNFCCC) defines the ultimate objective of this convention and of all related protocols to stabilize atmospheric greenhouse gas concentration at a level that prevents a dangerous anthropogenic interference with the climate system.[26] Very often, a 'tolerable window' approach has been specified with reference to a modest increase in global mean temperature (GMT). Very popular is the so called '2°-target' proposed by the WBGU (Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen).[27] This target claims that GMT should not increase more than 2°C compared to pre-industrial GMT. It has been argued that the overall sum of evils and risks associated with a higher increase in GMT might become too high. Some scientists, as James Hansen, argue that a 2°C-increase in GMT is still too risky since the ice shields of Greenland and Antarctica might melt down slowly but steadily (over centuries) at such a GMT. Thus, the 2°C-target is ambitious from a political perspective, but from a strictly risk-averse position, it might be too risky, still.

Some years ago, a study on behalf of the Environmental Protection Agency[28] outlined an ethical argument in favour of very low GHG stabilization levels. The study compared CE approaches that argue from within different ethical theories. Almost all approaches except ethical contractarianism came to the conclusion that there is a moral commitment to curb global GHG emissions in order to reach as low as possible GHG stabilization levels. This agreement encompassed variants of utilitarianism, welfare-based consequentialism, deontological approaches, Rawlsian approaches, Aristotelian prudential approaches, physiocentric approaches, and, of course, Hans Jonas' ethics of responsibility.[29] Thus, one can argue with some confidence that despite all controversies, most current ethical theories demand stabilization of GHG at the lowest feasible level. This is, indeed, a remarkable convergence of different theories that should not be ignored by politicians. Clearly, the clause 'as low as possible' must be interpreted and specified.

Moreover, the problem remains how atmospheric GHG levels are associated with GMT. The crucial variable is *climate sensitivity*.[30] Recently, the IPCC has given a best guess on climate sensitivity at roughly 3°C. If this 'best guess' is adopted, one

[26] This objective has three normative constraints which I must leave aside here.
[27] WBGU (2009).
[28] OTT et al. (2004).
[29] If one takes a closer look on the recent literature from religion-based ethics this convergence broadens.
[30] Climate sensitivity is defined as increase in GMT at a CO_2-level of 560 ppmv (twice than preindustrial CO_2).

can assess the probabilities with which a 2°C-target might be reached. If one wishes to reach the 2°C-target with certainty emissions must be curbed very rigorously. There is more leeway if one regards as sufficient a 50% probability of reaching the 2°C-target.[31]

In any case, taking the 2°C-target seriously requires that GHG concentrations remain far below 560 CO_2-eq. Given all the carbon on planet Earth, especially coal resources, given economic growth, and given roughly 9.2 billion humans in 2050, it will be very difficult to reduce GHG emissions in the required order of magnitude. All in all, I propose to adopt a prudent and cautious, but not completely unrealistic stabilization level of 450 ppmv CO_2-eq. Given current GHG concentrations (430 ppmv CO_2-eq) and an increase of 1.5–1.9 CO_2 ppmv each year this target would mean that the net intake of GHG into the atmosphere must be stopped within two decades. Global emissions must peak in 2025 and continuously decline afterwards as steeply as possible. This target requires deep cuts in emissions in the North but, meanwhile, it requires cuts in countries like China, too.[32] There might be some overshot above this limit, but it is better to face overshot *as such* than to adapt objectives to emission realities step by step.

5. Distribution schemes for remaining emission entitlements

Any stabilization target raises the problem of how to distribute the remaining sink capacities (or carbon budget) fairly. There are many schemes of how the carbon budget under the given target structure should be distributed.[33] Since emission entitlements are only one good among many it might be tempting to embed the problem at stake into a more comprehensive theory of distributive justice. But as such a theory will be essentially contested it seems more viable to isolate emission entitle-

[31] BETZ (2009) claims that IPCC's methodology of modal verificationism by which climate sensitivity is determined should be replaced by modal falsificationism. If so, there will be more reasons for concern and precaution.

[32] Thus, the current global situation comes close to a dilemma. The atmospheric 'sink' has been already filled up with GHG close to its tolerable limits, while 50% of human population is living in severe poverty, and, at least according to conventional economic wisdom, growth of GDP is seen as the only feasible escape route from such poverty. Under high emission trajectories ('business as usual'-scenarios, see NAKICENOVIC et al. (2000)). GHG-concentrations will peak at 700-800 ppmv CO_2-eq (or even more) in the year 2100. This might affect global tipping points and planet Earth might flip into a 'Venerian' regime to which future generations must adapt.

[33] Grandfathering, basic needs, Rawlsian difference principles, proportionality, per-capita schemes.

ments as one specific good the distribution of which is to be determined irrespectively of how other goods are distributed in a globalized world. Thus, I leave aside all problems of background distribution.

If one assumes, first, that the atmosphere has the status of a *global common pool good*, and if one, second, adopts the Rawlsian intuition on justice that all goods should be distributed equally unless an unequal distribution benefits all, egalitarian schemes deserve special attention. Recently, I have argued in favour of an egalitarian per-capita-approach in more detail.[34] The argument claims that it is fair to shift the burden of proof to those who favour unequal distribution schemes for global common pool goods. Reasons in favour of unequal distribution might be that some people deserve more entitlements from a moral point of view or that unequal schemes are beneficial to all consumers in the global village. There are only few articles that defend this position.[35] Another reason is special needs.

The most plausible claim with respect to special needs might be the claim for heating in winter in the North which might be seen as more basic than the 'luxury need' for cooling in the tropical zones. As a matter of fact, income levels can explain the differences in emission profiles better than natural factors.[36] If so, heating needs can be addressed by technological innovations and social policies in rich Northern countries and should not open the Pandora's box of a global debate on special needs. In such debate, there will be claims for special needs in many countries, as special needs to visit friends and relatives in large countries with high mobility (as in the US). There might be claims on special needs for personal PC's in an information society. Is there a special need to cool mega-towers in the Arabic emirates once they have been built? An egalitarian scheme is well-advised not to address special needs.

An egalitarian scheme under the target-structure given in the previous section would mean that each person is given a carbon budget of roughly 1.8–2.0 tons of CO_2 a year.[37] If the global carbon budget is allocated to national states according to their populations this implies emission reductions of 80% (Germany) or even 90% (US). There are different proposals of how to deal with such budgets. The budget might be auctioned or distributed directly to individuals. In most proposals, the budgets can be traded freely on carbon markets. If properly implemented, such an egalitarian scheme has the welcome effect that persons with low emissions (India, Africa) will be benefited because they can sell their entitlements. Egalitarian schemes

[34] OTT (2010a).

[35] The most inspiring criticism of egalitarianism is to be found in CANEY (2009). Caney's idea is to embed *GHG emission*s in a holistic scheme of goods, capacities, and sources of anthropogenic forcing. This holistic approach adds complexity to an already complex matter.

[36] NEUMAYER (2002).

[37] This approach should be based on a benchmark to avoid incentives for pro-natalistic population policies. It is highly doubtful whether restrictive population policies, as in China, can be regarded as 'early action' in mitigation policies.

can be seen as income generators to Southern countries. In any case, the political integrity of such schemes must be secured against misuse.

6. Responsibility for historical emissions?

Northern countries started to emit GHG in the course of industrialization. Mainly these countries filled up the common atmospheric sink until the 1960ies. Now, Southern countries claim that the polluter-pays-principle must be applied and that there is a huge *historical debt* of the North against the South. Meanwhile, the problem of past emission is haunting political negotiations. At first glance, historical responsibility seems obvious but at a second glance it isn't. Causal responsibility does not imply moral responsibility. In the remote past, almost all persons were ignorant about the causal relation between GHG emissions and climate change, which was established only for decades. We can't blame our ancestors for burning coal and drilling oil. Historical emissions are harmful, but not wrongful.

If historical responsibility is agreed upon, the devil is in the details: Should there be a benchmark after which responsibility cannot be denied or is there full responsibility for all past emissions? Should historical changes in land use also be taken into account? What about emissions of states that do not exist anymore? How can past emissions be measured? If there is a historical debt for past emissions why not add more historical debts for colonialism and for slave trade? Citizens of Northern countries are, on the one hand, beneficiaries of the past creation of wealth that was accompanied by GHG emissions.[38] On the other hand, the historical sources of present wealth are manifold.[39]

In CE, we should better not be haunted by history. At least, we should refrain from trying to calculate exactly how large or small the historical responsibility really is. All things considered, the legacy of the past should be a reason for citizens of the North to recognize themselves as being beneficiaries of past emissions, to agree that past emissions turn out to be harmful, to agree to some duty to compensate victims and, finally, to adopt the attitude to assist countries in the South in the fields of technology transfer and adaptation. Such attitude to assist might be seen as a practical plea for excuse. Thus, readiness to invest a fraction of the wealth of the North

[38] Arguments in favour of the beneficiary account are given by GOSSERIES (2004) and CANEY (2006).

[39] This overall bequest package was produced by former generations via producing, inventing, investing, saving, and other activities and it was consumed away and, in part, destroyed in wars. How much of the overall wealth in the North is linked to former GHG emissions?

into technology transfer and adaptation funding in the South (next section) is not a noble or supererogatory attitude, but mandatory.[40]

7. Adaptation opportunities

Humans are practical beings with large capacities for problem solving. They are settlers on a global scale who can cope with a great variety of environmental conditions. These capacities can be used for adaptation.[41] Adaptation strategies may include buildings like dikes, behavioural patterns like *siesta*, protective strategies against forest fires, improved water supply systems in arid regions, different crops in agriculture, and the like.[42] Adaptation has a broad spectrum across different dimensions of societal life. There are adaptation aspects in agriculture, forestry, freshwater supply, urban planning, transport, medicine, education, disaster management, investment decisions, gender issues, and the like. Adaptation can be seen as a process that should be left to rational private agency or as a politically induced strategy of planned collective action in which the state plays an active role. The latter position is supposed here. Private adaptation might be additional to adaptation as performed by good governance. The practice of adaptation must combine moral initiative with political prudence.

Rich countries can utilize scientific knowledge, financial capital, political administration, and infrastructures in order to implement adaptation strategies on their own.[43] Given only modest climate change and proper adaptation strategies, the prospects for the temperate zones are not completely bleak. The situation is different in Southern countries were many institutional preconditions for effective adaptation are lacking.[44]

With respect to adaptation schemes, there is currently much talk on 'empowerment', 'mainstreaming', 'capacity building', 'endogenous adaptation', 'attention to

[40] Some 'cheap credits' to the South to finance adaptation are clearly insufficient.

[41] The concept of adaptation must be secured against biological definitions of adaptation of organisms to a hostile environment. If not, adaptation to climate change might be seen as an instance of survival of the fittest.

[42] A conceptual framework on adaptation strategies is given by SMIT et al (2000).

[43] Germany has already adopted a national adaptation plan.

[44] It should be asked whether such assistance should be additional to ordinary development aid (ODA) as most NGO's suppose. This problem is not addressed here since such debate relies on assumption of how good or bad the 100 billion $ ODA are spent each year. It remains doubtful whether strict emission reduction (80–90% compared to a 1990 benchmark), doubling of ODA (0.7% GDP), and additional burdens for adaptation funding gradually become somewhat overdemanding even to rich societies that have to deal with many other problems than just climate change.

secondary impacts', 'reducing vulnerability', 'income generation by adaptation', and the like. Even concerns are raised that adaptation measures may put an additional burden on the poor. Some case studies indicate the importance of social cohesion and solidarity for successful adaptation.[45] The emergent adaptation discourse suggests that there can be no such thing as a global master plan of how to adapt. Adaptation is literally 'concrete' because internal and external resources, cultural lifestyles, and patterns of environmental practices must be rearranged within adaptation strategies. Details are beyond the competencies of ethicists.

It is very likely that there will be adaptation funding for Southern countries under the UNFCCC regime. How much payments will come from Northern countries is to be negotiated. Some calculations indicate that even 100 billion $ per year wouldn't be sufficient. This $-number does not entail costs for provision and resettlement of climate refugees.[46] It is very likely that there will be never enough money in the fund. Since adaptation funding is done under the condition of scarcity of resources applications for such funding must be governed and controlled by fixed criteria. Under real-world-conditions one should not expect that all applications for adaptation funding are honest ones. Adaptation funding, as any funding, might be seen a nice opportunity to grab money. There is a peculiar ethical dialectics with assistance and aid: One the one hand, it relies on moral attitudes, while one the other it easily falls prey to strategic behaviour if done without sobriety and prudence.

By intuition, the most vulnerable and marginalized groups should be the first beneficiaries of adaptation funding. Marco Grasso proposes the following vulnerability-based decision rule for spending: The lower the overall level of human security, the more adaptation funds are due.[47] It can't be denied that vulnerability and human security are important criteria for funding priorities. But if these criteria remain unbalanced by other criteria a perverse consequence may result. Imagine countries of the South must compete for money against each other under a vulnerability criterion. If so, they must present themselves as being more vulnerable than others. If so, there is an incentive to present oneself as poor, helpless, ignorant, devoid of capabilities and initiative, and so on. If such outcome is to be avoided the criterion of vulnerability should not be the only one.

Many poor people do not live in misery but use their indigenous knowledge to reproduce a decent livelihood. Why not allocate the lion's share of adaptation spending to communities that have sustained a non-miserable livelihood for generations and might continue to do so even under climate change impacts? To give some resilience and shelter to the most vulnerable groups, including climate refugees, then, must be financed by a fraction of adaptation funding in conjunction with existing facilities for emergency aid.

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[45] An overview of recent literature is given by HEYD (2011). A macroeconomic analysis is given in RINGEL, RÜBBELKE (2010).

[46] See overview in BIERMANN, BOAS (2008).

[47] GRASSO (2007), 243.

Most experts would agree that adaptation must be something else than an intensification of emergency aid. Adaptation funding should reward and stimulate activities by which adaptation is linked to other objectives of sustainable development. Adaptation funding should pay special attention to the conservation and restoration of natural capital.[48] All around the world, there are many such activities as community based forestry in Nepal, water harvesting in the Sahel, reconstruction of traditional water storage systems in Iran, revitalizing the fertility of degraded soils by charcoal, terracing hills against landslides, bringing back moisture into the landscape, increasing local species composition by organic agriculture, and the like. Thus, global adaptation spending might support and stimulate such activities. Activities that combine local adaptation, biodiversity conservation, ecosystem restoration, and carbon storage should be highly welcomed.[49] Adaptation funding should give priority to such, say, 'eco-carbon' activities.

8. Climate engineering

In his last publications, Edward Teller proposes solar radiation management as a technical measure against climate change.[50] According to Teller, a doubling of CO_2-concentrations could be compensated by a decrease of roughly 2–3 % of solar radiation reaching the surface of planet Earth. Solar Radiation Management (SRM) is one type of climate engineering, defined as deliberate human interference with the global carbon cycle or composition of the atmosphere. Carbon Dioxide Removal (CDR) is another type of climate engineering. CDR has much overlap with 'eco-carbon' adaptation strategies and is often close to nature conservation and restoration. Large-scale afforestation, restoring mires and peatlands, carbon sequestration in soils and the like are subtypes of CDR.[51] The effects of CDR are promising but rather slow.

The profile of SRM is different. Ignoring the SRM-option of placing some thousand reflexive discs in outer space on economic grounds (costs of some trillion $), attention falls upon one specific SRM-option: *continuous release of large amounts of sulphate aerosols into the stratosphere*. This option seems attractive to many scientifically credible scholars especially in the US[52] SRM has already become a tempting 'superpower'-option. The more popular message is often quite simple: If there is a quick, cost-efficient, effective technological solution (SRM) to the problem of climate

[48] See OTT, DÖRING (2008).

[49] Sustainability science could assist and assess such 'eco-carbon' activities in participatory case studies.

[50] TELLER et al. (2002).

[51] CCS-technologies for coal burning facilities might also subsumed under CDR.

[52] BLACKSTONE, LONG (2009), KEITH et al. (2010); many think tanks that supported climate skepticism some years ago quickly shifted toward SRM-enthusiasm.

change by which a decline in economic growth and a change in consumerist lifestyle can be avoided, the US should not hesitate to go for such solution.[53] In case of emergency, even unilateral action by technological advanced national states might be the *ultima ratio*.

At the moment, Gregor Betz and I are mapping arguments *pro* and *con* of SRM[54] with respect to theoretical research on SRM, small-scale experiments, large field test, and full deployment. The contra-side of this map of arguments is quite crowded. There are arguments using the concept of *hubris* used by Hans Jonas: Engineering planet Earth might be an instance of such hubris. Another argument places high value on the blue colour of the sky which would not be blue any more under a sulphate-based SRM regime. According to my intuitions, there is more about the blue sky than just an aesthetic preference for deep blue over milky grey. The blue sky (and the bright stars at night) might be regarded as an intangible good of the human lifeworld. Of course, arguments against hubris and the claim that the blue sky, ultimately, 'is' intangible will be clearly contested in contemporary ethics because of their metaphysical smell. But we should not too quickly discard hubris- and lifeworld-arguments simply because they do not fit our contemporary schemes of secular ethics. Perhaps, options as SRM may deepen our reflections about which patterns of arguments may enrich or impoverish our moral discourse.[55]

With respect to the political economy of SRM, it might be argued that SRM should be seen as a protective measure in favour of outdated US industries with their high-emission profiles against the global diffusion of smart 'green' industries with comparatively low *GHG emission*s. SRM fits frightening well within the profile of the most questionable variant of capitalism and its military-industrial complex. Launching SRM as an economic-political project will discourage investments in carbon-poor economics. Sulphates will damage solar energy systems. Given the current 'hype' on SRM in the US, arguments stemming out of traditions of political economy and critics of ideology deserve some credit. Because such arguments are full of premises, I only mention them here, hoping for further elaboration.[56] Moreover, there are risk-based ethical concerns against sulphate-based SRM. Once fully deployed, SRM can't be easily stopped if it is not combined with stringent mitigation. SRM, however, once tested in large field tests and fully deployed may realize itself as *a replacement* of mitigation efforts. If so, reversibility of SRM must be seen critically. There would be a future world with unmitigated high GHG concentrations in the

[53] Sometimes it is added that the problem of global cooperation in mitigation GHG can be easily turned into a technological joint effort problem.

[54] OTT (2010b). A more comprehensive map of arguments is forthcoming as research documentation: BETZ, CACEAN (2011).

[55] Ethics is not free from the dialectics of enlightenment and some tendencies in analytical (meta-)ethics may impoverish or even blind our moral sensibilities. Thus, I would not like to give more credit to such arguments.

[56] Such studies may, as welcomed side-effect, even revitalize critical theory.

lower atmosphere and a sulphate-based shield against solar radiation in the upper atmosphere. Both kinds of human interferences with the atmosphere must be kept in some balance over a long period of time.[57] If so, SRM must not fail with respect to its side effects. If SRM would fail, future persons might be trapped in a dilemmatic situation. One lemma would be stopping SRM. If so, there would be sudden and rapid climate change (some °C in few decades). The second dilemma would be to continue SRM. It seems highly repugnant to impose such risk upon future persons without necessity. One should consider in advance how such dilemmatic situation might be avoided. The old criterion of reversibility[58] requires a robust and viable exit-strategy for SRM. Without such a strategy, SRM should be rejected. It has often been said that SRM should be *supplementary* to mitigation, adaptation and CDR. In reality, however, SRM, once tested in large field tests and fully deployed may come as *a replacement* of mitigation efforts.

Kommentar [JL1]: Oft wird der Ausdruck „horns of a dilemma" benutzt – ist das an dieser Stelle eventuell gemeint?

All arguments considered, CDR should be researched and tested in the field, while SRM might be researched on theoretically by experiments and modelling. There should be a ban on large field test for, at least, next 20 or, better, 30 years. Meanwhile, the risks and threats of SRM can become a useful 'stick behind the door' that might motivate national states to co-operate on a proper global mitigation and adaptation regime. SRM will be on the agenda again if the prediction that all global climate policies are bound to fail should turn out to be true.

9. Contraction and Convergence versus Greenhouse Development Rights

It would be deplorable if members of the political camp that supports most principles, objectives, and strategies outlined in the previous sections of this article might split into supporters of two competing ethical concepts, *Contraction and Convergence* (C&C)[59] and *Greenhouse Development Rights* (GDR)[60]. The GDR concept has found support by many NGO's and some churches. It supposes a global emergency situation and combines strict mitigation with mandatory assistance to adaptation in the

[57] A world with both rising CO_2 concentrations and geoengineered climate stabilization is comparable to an unstable equilibrium held in balance by two opposing forces that grow as a function of time". MATTHEWS, CALDEIRA (2007).

[58] BIRNBACHER (1988), 208–217.

[59] The core idea is presented in MEYER (1999). For further development see the homepage of Meyer's *Global Commons Institute*.

[60] BAER et al. (2008). See also the homepage of www.ecoequity.org. The position adopted here is clearly a variant of C&C which is augmented by some ideas on adaptation beyond the vulnerability criterion, some hopes for GDR, and strict *caveats* against SRM.

global South and, moreover, with a benchmark in monetary income below which persons have no obligation to curb their GHG emissions or care for climate change.[61] A human right to develop is seen as a right to create monetary income. The income baseline is, in principle, open for negotiation. Proponents of GDR have set it at 7500 US-$ a year given in purchase power parity.

If one agrees with the results as given in this and the previous section the concept of *Contraction and Convergence* as proposed by Meyer[62] has been adopted. Meanwhile, this concept has found resonance in climate policies. It must be specified with reference to a time-frame because a sudden introduction would be shock-like for industrialized economics. A gradual convergence from now to 2050 seems both feasible and fair. Such a scheme puts a mitigation burden even on countries like China. The heaviest burden clearly falls on states whose economics have been based on cheap energy, as the US.

While C&C allocates resources, GDR allocates burdens. Under the criteria of responsibility and capability, the burdens of single states are calculated. As result, the burden of states as Germany, the USA, and other wealthy industrialized states becomes greater than 100% emission reduction. Even if these states reduced all GHG emissions to zero there remains a financial burden to assist Southern countries to adapt. On the other side, economics which do not convert GHG emissions into income efficiently will be benefited under a GDR regime. The burden of both mitigation and adaptation is placed upon roughly 1 billion people out of a global population which increases up to 7 billion people in 2011.

To me, the attractiveness of GDR has faded at a closer look. [63] In terms of political feasibility, C&C has clear advantages because some high-rank politicians, like Angela Merkel, have verbally agreed upon the C&C idea. For Northern countries, the economic impacts of C&C are severe but viable under a prudent long-term transition management while the distribution effects of GDR might be beyond control. The North clearly is not bankrupt after the financial crisis of 2009 but the effects of a GDR regime on employment, on domestic social security systems, and on taxation schemes have not been assessed yet. Even from an ethical perspective GDR must be seen with a critical lens because it combines an emergency ethics that allows for uncommon measures with a highly conventional approach to development as being defined in terms of monetary income. GDR seems to place the right to create monetary income at the centre of the system of human rights. If so, there are reasons to claim that a C&C-concept that must be enlarged to the domain of adaptation and might adopt some important points from GDR is, all things considered, the 'better' concept.

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[61] The charming idea that rich persons in poor countries should contribute to mitigation and adaptation efforts is not at the heart of the GDR-concept.

[62] See footnote 62.

[63] KRAUS, OTT (2009).

10. Conclusion

It is mandatory for CE to provide some reasonable ethical orientation for the time being. Without common moral ground, climate negotiations will fall prey to the predicament of becoming a mere muddling through governed by strategic and tactical cleverness of the thousands of stakeholders and negotiators gathering each year at the COP/MOP conferences. Thus, let's summarize some preliminary results of our 'topical' reasoning:[64]

- Ethical profiling: impacts seen as evils, objection against imposing risks and victimization, intergenerational responsibility.
- Standard-Price-Approach in climate economics, discarding 'efficiency' approaches.
- Ultimate stabilization objective at '2°C ↔ 450 ppmv CO_2-eq'.
- Long-term egalitarian distribution at 1.8-2 tons/person/year in conjunction with emission trading.
- Mandatory attitude for Northern countries to assist adaptation strategies in the global South in conjunction with sustainability-'eco-carbon'-criteria for funding.
- Research on CDR options, ban (or moratorium) on SRM.
- Betterness relation: C&C over GDR.

The triangular affair between mitigation-, adaptation-, and climate-engineering-strategies should not be seen as a portfolio. Within this triangular affair, mitigation deserves priority because mitigation is a precondition for adaptation and CDR being successfully performed.

Mitigation on a global scale is by no means utopian any more. Despite still rising GHG emissions that added 1.9 ppmv CO_2 to the atmosphere in the year 2010 substantial change is in the making. Public awareness has increased worldwide. Renewable energies already are going to be established all over the world. Diffusion of existing carbon-poor technologies can be accelerated by political strategies and economic incentives.[65] GHG emissions have been decoupled from GDP growth in advanced industrial societies.[66] There is scientific knowledge, there is plenty of capital for carbon-low investments, there are established technologies waiting for being

[64] Unnecessary to say that these claims are open for further ethical dispute, moral discourse, and political debate.

[65] JÄNICKE (2010).

[66] The German Environmental Advisory Board has outlined scenarios under which Germany could, with modest costs, reach a safe supply system for electricity that runs without nuclear power plants and without conventional coal in the 2030ies. See SACHVERSTÄNDIGENRAT FÜR UMWELTFRAGEN (SRU) (2011).

mainstreamed, there is global civil society being aware. Interesting enough, the major achievements of modern societies (science, technology, capital, public reasoning) are available for problem-solving. If the course of action proposed here will be agreed upon and become a safely paved and reliable pathway, the speed of taking steps may be increased up to running.

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