An Assessment and Model for Dynamic Behaviour and Climate Change Mitigation Action Plan

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Abstract: Behavioral models have been found to play a distinct and important role in climate research. Besides countries suing one another, there are also cases where people in a country have taken legal steps against their own government. Legal action for instance has been taken to try to force the U.S Environmental Protection Agency to regulate greenhouse gas emissions under the Clean Air Act, and against the Export – Import Bank and OPIC for failing to assess environmental impacts (including global warming impacts) under NEPA.

Active climate change is also rarely modeled, with adaptation and mitigation generally represented as responses to economic drivers under static climatic conditions. Furthermore, dynamic behaviors, objectives, or decision-making processes are almost entirely absent, despite their clear relevance to climate change responses.

We investigated a dynamic behaviour and climate change, built a model of the greenhouse gas emissions and looked vividly into the climate change mitigation plan presented schematic illustration of the results generated by the developed model and emphasized the pertinent need to look into crucial and critically urgent litigation measures in climate changes triggered issues.

We suggest that greater attention be paid to the cumulative coverage of models, projecting beyond, mitigation plans and litigation measures in this field, and that improvements in the representation of certain key behaviors be prioritized.

Keywords: *Behavioral Model, Dynamic Behavior, Mitigation Plan, Litigation Measures.*

I. INTRODUCTION

Models of the land system are essential to our understanding of the magnitude and impacts of climate change. These models are required to represent a large number of processes in different sectors, but face particular challenges in describing the individual and social behaviors that underpin climate change mitigation and adaptation. We assess descriptions of these behaviors in existing models, their commonalities and differences, and the uses to which they have been put.

It has been found that behavioral models have a distinct and important role to play in climate research, but that they currently suffer from being strongly sectoral in nature, with agricultural models being the most common and behaviorally rich.

There are also clear convergences, with economic-based decision-making remaining dominant and behaviors such as diffusion, interaction, anticipation, or learning remaining relatively neglected. Active climate change is also rarely modeled, with adaptation and mitigation generally represented as responses to economic drivers under static climatic conditions. Furthermore, dynamic behaviors, objectives, or decision-making processes are almost entirely absent, despite their clear relevance to climate change responses. We conclude that models have been more successful in the identification of important processes than in their implementation and that, while some behavioral processes may remain impossible to model, behavioral models of adaptation and mitigation in land-based sectors have substantial unexplored potential.

We suggest that greater attention be paid to the cumulative coverage of models in this field, and that improvements in the representation of certain key behaviors be prioritized.

II. MODELS & PROJECTIONS

The **uncertainty** in the temperature-**carbon** cycle feedback amplification parameter was derived from the recent model inter-comparison study, C4MIP (Friedlingstein **et al**. 2006). Each of the model **projections** are treated with equal probability and no observational constraints are applied.

For the past two decades, efforts to mitigate emissions of carbon dioxide and other greenhouse gases have centred around the goal of stabilizing atmospheric concentrations of these gases.

Efforts to mitigate carbon emissions, majorly carbon dioxide and other greenhouse gases have been intensely focused around the goal of stabilizing atmospheric concentrations of these gases.

This focus on atmospheric stabilization is historically rooted in the text of Article 2 of the United Nations Framework Convention on Climate Change (UNFCCC), in which is written:

The ultimate objective of this Convention … is to achieve … stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

(UNFCCC (UN Report, 1992),

Towards this goal and aim, a considerable body of literature has evolved to attempt to first quantify what could be considered to be a 'dangerous' level of climate change, and second to determine what levels of greenhouse gas stabilization are consistent with avoiding said climate changes (Schneider, 2005, Smith, 2009, Knutti,2008).

Obviously, there are several inherent difficulties or challenges with this approach, which have posed a considerable and severe challenge to the progress of climate mitigation. Defining 'dangerous' levels of climate change is clearly a subjective exercise, which is difficult to incorporate in a compelling manner into the process of policy decision making.

There has been consistently debated and a recent convergence in policy discussions towards a stated goal of limiting global warming to 2°C above pre-industrial temperatures (UNFCCC, 2009); while there is evidence that 2°C of global warming would avoid a number of important and potentially dangerous climate impacts (see available and extant documents or literatures, for instance (Solomon, 2011) for a review of climate impacts associated with various levels of global temperature change), there is little by way of quantitative evidence that suggests or strongly affirms this represents a 'safe' policy target, and some climate scientists argue that 2°C would result in unacceptably severe impacts (Hansen, 2008,Rockstrom, 2009).

Even given some chosen target and templates for global temperature change, however, it is extremely difficult within the paradigm of greenhouse gas *concentration* stabilization to define or formulate an appropriate policy target for greenhouse gas *emissions*.

The reasons for this are obviously no doubt known and appears in threefold.

First, the relationship between emissions and atmospheric concentrations is quite a complex and complicated one; achieving stabilized concentrations over time would clearly require large emissions reductions, but would also imply continued emissions at a changing level consistent with the level of natural sinks that evolve over time in a manner difficult to quantify (Mathew, 2006, Meehl, 2007). Second, the relationship between greenhouse gas concentrations and temperature change is an elusive quantity that has preoccupied climate scientists for a distant long time and quite worrisome for several decades.

This 'climate sensitivity' has been estimated many times, but remains subject to at least a threefold probable uncertainty range which has not narrowed appreciably in 30 years of research (Meehl,2007). Third, even given some known instantaneous temperature response to increased greenhouse gas concentrations, there is still a considerable lag between the point of atmospheric concentration stabilization and the eventual 'equilibrium' condition for climate change. This lag results from the slow adjustment of the ocean and other slowly responding climate system components to the relatively rapidly increasing atmospheric forcing; consequently, the eventual temperature change associated with a given greenhouse gas stabilization level will not most likely be fully realized or achieved for many centuries (Meehk & Wigley, 2005).

Global greenhouse gas (GHG) emissions have grown since pre-industrial times, with an increase of 70% between 1970 and 2004 facts & schematics:

- Since pre-industrial times, increasing emissions of GHGs due to human activities have led to a marked increase in atmospheric GHG concentrations (*); Working Group I SPM].
- Between 1970 and 2004, global emissions of CO_2, CH_4, N_2O, HFCs, PFCs and SF_6, weighted by their global warming potential (GWP), have increased by 70% (24% between 1990 and 2004), from 28.7 to 49 Gigatonnes of carbon dioxide equivalents ($GtCO_2$-eq) (see **Fig.1 illustrations***). The emissions of these gases have increased at different rates. CO_2emissions have grown between 1970 and 2004 by about 80% (28% between 1990 and 2004) and represented 77% of total anthropogenic GHG emissions in 2004.
- The largest growth in global GHG emissions between 1970 and 2004 has come from the energy supply sector (an increase of 145%). The growth in direct emissions from transport in this period was 120%, industry 65% and land use, land use change, and forestry (LULUCF) 40%. Between 1970 and 1990 direct emissions from agriculture grew by 27% and from buildings by 26%, and the latter remained at approximately at 1990 levels thereafter. However, the buildings sector has a high level of electricity use and hence the total of direct and indirect emissions in this sector is much higher (75%) than direct emissions, Figures 1.
- The effect on global emissions of the decrease in global energy intensity (-33%) during 1970 to 2004 has been smaller than the combined effect of global per capita income growth (77 %) and global population growth (69%); both drivers of increasing energy-related CO_2 emissions (Fig.1*). The long-term trend of a declining carbon intensity of energy supply reversed after 2000. Differences in terms of per capita income, per capita emissions, and energy intensity among countries remain significant. In 2004 UNFCCC Annex I countries held a 20% share in world population, produced 57% of world Gross Domestic Product based on Purchasing Power Parity (GDP_{ppp}), and accounted for 46% of global GHG emissions, illustrations (Fig.1).*
- The emissions of ozone depleting substances (ODS) controlled under the Montreal Protocol, which are also GHGs, have declined significantly since the 1990s. By 2004 the emissions of these gases were about 20% of their 1990 level.
- A range of policies, including those on climate change, energy security, and sustainable development, have been effective in reducing GHG emissions in different sectors and many countries. The scale of such measures, however, has not yet been large enough to counteract the global growth in emissions. *

Projections of future greenhouse gas emissions are highly uncertain (Fisher et al, 2007). In the absence of policies to mitigate climate change, GHG emissions could rise significantly over the 21st century (Rogener et al, 2007).

Any **predictions** of **future** glacio-eustatic sea-level change are subject to large **uncertainties**, including **future** levels of **greenhouse gas emissions**, how such emissions ... gas emissions follow different trajectories, depending on alternative demographic, economic and technological development paths (**Fisher et al**., **2007**).

Numerous assessments have considered how atmospheric GHG concentrations could be stabilized (Fisher et al, 2007). The lower the desired stabilization level, the sooner global GHG emissions must peak and decline (Fisher et al, 2007). GHG concentrations are unlikely to stabilize this century without major policy changes (Rogner et al, 2007).

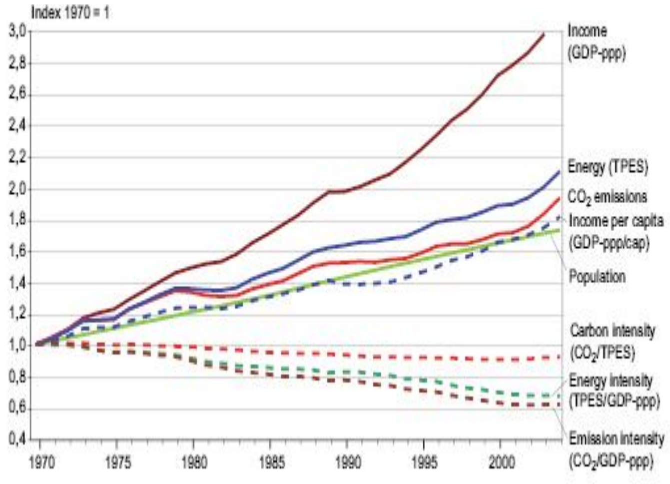

Figure 1: Global Green House Emissions

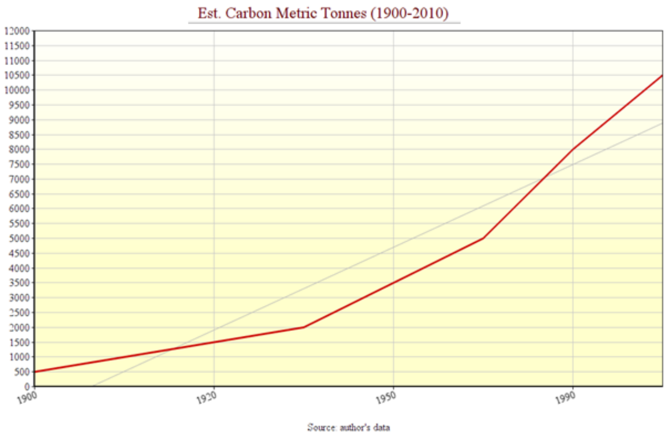

Fig. 2: Estimate from our Model starting 1900 beyond 2000

Climate change mitigation

Climate change mitigation consists of actions to limit the magnitude or rate of long-term climate change (Fisher et al, 2007). Climate change mitigation generally involves reductions in human (anthropogenic) emissions of greenhouse gases: GHGs (IPCC, 2007). Mitigation may also be achieved by increasing the capacity of carbon sinks, e.g., through reforestation (IPCC, 2007) reforestation Mitigation policies can substantially reduce the risks associated with human-induced global warming (IPCC, 2009).

According to the IPCC's 2014 assessment report, IPCC's 2014 assessment report: "Mitigation is a public good; climate change is a case of the 'tragedy of the commons.

Effective climate change mitigation will not be achieved if each agent (individual, institution or country) acts independently in its own selfish interest (See International cooperation and Emissions trading), suggesting the need for collective action. Some adaptation actions, on the other hand, have characteristics of a private good as benefits of actions may accrue more directly to the individuals, regions, or countries that undertake them, at least in the short term. Nevertheless, financing such adaptive activities remains an issue, particularly for poor individuals and countries (IPCC, 2014).

Examples of mitigation include phasing out fossil fuels by switching to low-carbon energy _ sources, such as renewable and nuclear energy, and expanding forests and other "sinks" to remove greater amounts of carbon dioxide from the atmosphere. Energy efficiency may also play a role for example, through improving the (Fisher et al, 2007). Another approach to climate change mitigation is climate engineering (IPCC, 2007).

Kyoto Protocol

The main current international agreement on combating climate change is the Kyoto Protocol, which came into force on 16 February 2005. The Kyoto Protocol is an amendment to the United Nations Framework Convention on Climate Change (UNFCCC). Countries that have ratified this protocol have committed to reduce their emissions of carbon dioxide and five other greenhouse gases, or engage in emissions trading if they maintain or increase emissions of these gases.

One of the issues often discussed in relation to climate change mitigation is the stabilization of greenhouse gas concentrations in the atmosphere. The United Nations Framework Convention on Climate Change (UNFCCC) has the ultimate objective of preventing "dangerous" anthropogenic (i.e., human) interference of the climate system.

As is stated in Article 2 of the Convention, this requires that greenhouse gas (GHG) concentrations are stabilized in the atmosphere at a level where ecosystems can adapt naturally to climate change, food production is not threatened, and economic development can proceed in a sustainable fashion.

Energy consumption by power source

To create lasting climate change mitigation, the replacement of high carbon emission intensity _ power sources, such as conventional fossil fuels – oil, coal and natural gas – with low-carbon power sources is required. Fossil fuels supply humanity with the vast majority of our energy demands, and at a growing rate. In 2012 the IEA noted that coal accounted for half the increased energy use of the prior decade, growing faster than all renewable energy sources. Both hydroelectricity and nuclear power together provide the majority of the generated low-carbon power fraction of global total power consumption.

Litigation measures & Perspectives Next

*It is pertinent and salient we look beyond the model of climatic changes, modelling and representation in this investigation shifting huge attention as well to the litigation measures as crucial also towards pragmatic approaches to resolution of climate changes issues and challenges.

In some countries, those affected by climate change may be able to sue major producers. Attempts at litigation have been initiated by entire peoples such as Palau. and the Inuit, as well as non-governmental organizations such as the Sierra Club. Although proving that particular weather events are due specifically to global warming may never be possible, methodologies have been developed to show the increased risk of such events caused by global warming.

For a legal action for negligence (or similar) to succeed, "Plaintiffs ... must show that, more probably than not, their individual injuries were caused by the risk factor in question, as opposed to any other cause. This has sometimes been translated to a requirement of a relative risk of at least two.

Another route (though with little legal bite) is the World Heritage Convention, it can be shown that climate change is affecting World Heritage Sites like Mount Everest.

Besides countries suing one another, there are also cases where people in a country have taken legal steps against their own government. Legal action for instance has been taken to try to force the U.S Environmental Protection Agency to regulate greenhouse gas emissions under the Clean Air Act, and against the Export – Import Bank and OPIC for failing to assess environmental impacts (including global warming impacts) under NEPA.

In the Netherlands and Belgium, organisations as Urgenda and the vzw Klimaatzaak in Belgium have also sued their governments as they believe their governments aren't meeting the emission reductions they agreed to. Urgenda has all ready won their case against the Dutch government.

According to a 2004 study commissioned by Friends of the Earth, ExxonMobil and its predecessors caused 4.7 to 5.3 percent of the world's man-made carbon dioxide emissions between 1882 and 2002. The group suggested that such studies could form the basis for eventual legal action.

In 2015, Exxon received a subpoena. According to the Washington Post and confirmed by the company, the attorney general of New York, Eric Schneiderman, opened an investigation into the possibility that the company had mislead the public and investors about the risks of climate change.

Many countries, both developing and developed, are aiming to use cleaner technologies (World Bank, 2010, p. 192). Use of these technologies aids mitigation and could result in substantial reductions in CO_2 emissions. Policies include targets for emissions reductions, increased use of renewable energy, and increased energy efficiency.

It is often argued that the results of climate change are more damaging in poor nations, where infrastructures are weak and few social services exist. The Commitment to Development Index is one attempt to analyze rich country policies taken to reduce their disproportionate use of the global commons. Countries do well if their greenhouse gas emissions are falling, if their gas taxes are high, if they do not subsidize the fishing industry, if they have a low fossil fuel rate per capita, and if they control imports of illegally cut tropical timber.

CONCLUSION

Some countries, with favorable geography, geology and weather well suited to an economical exploitation of renewable energy sources, already get most of their electricity from renewable sources, including from geothermal energy in Iceland (100 percent), and Hydroelectric power in Brazil (85 percent), Austria (62 percent), New Zealand (65 percent), and Sweden (54 percent). *

Renewable power generators are spread across many countries, with wind power providing a significant share of electricity in some regional areas: for example, 14 percent in the U.S. state of Iowa, 40 percent in the northern German state of Schleswig-Holstein, and 20 percent in Denmark. Solar water heating makes an important and growing contribution in many countries, most notably in China, which now has 70 percent of the global total (180 GWth).

Worldwide, total installed solar water heating systems meet a portion of the water heating needs of over 70 million households. The use of biomass for heating continues to grow as well. In Sweden, national use of biomass energy has surpassed that of oil. Direct geothermal heating is also growing rapidly.*

Renewable biofuels for transportation, such as ethanol fuel and biodiesel, have contributed to a significant decline in oil consumption in the United States since 2006. The 93 billion liters of biofuels produced worldwide in 2009 displaced the equivalent of an estimated 68 billion liters of gasoline, equal to about 5 percent of world gasoline production. *

Our model based estimate of the Carbon emission has been presented in **Figure 2** from 1900 beyond 2005. The increase seemed worrisome on the rise, however we have to look beyond the modelling, and shift to mitigation measures and plans to mitigation.

We have pointed attentions and emphasis to some extant protocol and regulations towards checks, litigation and mitigation plans.

It is crucial and expediently become necessary to pay attention and tackle this subject matter of climatic change from the behavioral model, psychology perspectives or cognitive behavioral look and synergize with the appropriate legislature and a conscious drive zealously and more pragmatically into a long term sustainability measure.

Conclusively and in final close, the government, policy makers and all concerned agencies, bodies and parties need to unite in a forum to work out collectively and unanimously a drastic measure and action plans towards a long term & future sustainable goal.

Glossary/Appendix

1. The definition of carbon dioxide equivalent (CO_2-eq) is the amount of CO_2 emission that would cause the same convective or radiation forcing as an emitted amount of a well mixed greenhouse gas or a mixture of well mixed greenhouse gases, all multiplied with their respective GWPs to take into account the differing times they remain in the atmosphere [WGI AR4 Glossary].

2. Direct emissions in each sector do not include emissions from the electricity sector for The SRES 2000 GHG emissions assumed here are 39.8 GtCO2-eq, i.e. lower than the emissions reported in the EDGAR database for 2000 (45 GtCO2-eq). This is mostly due to differences in LULUCF emissions.

3. Baseline scenarios do not include additional climate policy above current ones; more recent studies differ with respect to UNFCCC and Kyoto Protocol inclusion.

4. See AR4 WG I report, Chapter 10.2.

Key note(s):

GHG emissions could rise significantly over the 21st century (Rogener et al, 2007).

Mitigation plans & averting side-effects:

Emphasized;

(accessed 14.08.14.)

Zikmund-Fisher et al., 2008

Climate change mitigation is climate engineering (IPCC, 2007).

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