Appendix 1

Background information on climate change

1 The scientific sources and how climate change works

In this appendix more detailed information on the origins of the problem of CC and the effects and consequences for the chosen countries of Brazil and China shall be delivered.

This thesis analyzes the determinations of CP blockade in Brazil and China and is therefore to be described as a social science analysis in a wider and as an international politics analysis in a more narrow sense. Nevertheless, are the analyzed political processes growing out of a phenomenon that is meteorological in nature (namely CC itself). The provision of more detailed information on this meteorological phenomenon than integrated in the actual thesis-text seems very beneficial, as an in-depth understanding of the political processes that are blocking CP can better be achieved, if the scientific causes, developments and consequences of CC are properly understood. Further would be many remarks regarding the operation mode, development, consequences and costs of CC possibly not be understood without the following explanations. As the issue of CC is filling several thousand pages in the latest IPCC report, it becomes apparent that a selection of information has to be conducted. Therefore, only the most basic, but inevitable background information shall be delivered. For this purpose the latest report of the IPCC and the Stern review shall build the basic sources that are completed with information from other sources. Due to the importance and the size of the issue of CC there are vast amounts of scientific sources that could be chosen; in the following arguments for the choice of the IPCC and the Stern Review as sources shall be delivered.

The Intergovernmental Panel on Climate Change (IPCC) is an organization that is connected with the UN and that is not carrying out research on CC itself but is collecting the results in the field and delivers a well balanced assessment of the results of these reports.

The IPCC has very recently come under strong criticism as in the newest reports of 2007 some mistakes could be detected.[1] Nevertheless appears the IPCC to be a very reliable source on the CC issue, this out of the very fact that it is containing the results of a large number of peer-reviewed studies on CC, and that its assessment is renewed every four to five years. A strong indicator for the fair balance of the IPCC assessment is the fact that it receives criticism for being too pessimistic on climate development as well as being too optimistic.[2] E.g. Toulmin describes the

[1] E.g. was it claimed that the Himalayan glaciers could be melted on ground of CC until 2035, whereas the actual estimation sees this scenario to be reality only in 2350.
[2] Toulmin 2009 p.4-5;Giddens 2009 p.24-25

IPCC as “the best foundation for understanding what is happening to the world’s climate”.[3] The IPCC is therefore used by a large number of scholars in the research field.

Another source that is delivering basic natural science assumptions for this thesis is the so-called Stern Review that was composed by the British economist Nicholas Stern, the former chief economist of the World Bank, in 2006 by order of the British government. This Review shall foremost deliver data on the economic costs and consequences of CC. Stern is categorized as a 'well-respected, established economist' by most scholars, e.g. by Ackerman,[4] and therefore his report is seen as a competent source. Nevertheless was Stern put under severe criticism for his report, first for exaggerating the costs and damages of CC by one (and probably the more conservative) fraction; this stance was e.g. taken by Tol/Yohe.[5] Second, he further received criticism for proposing the possible solution of emissions trading, this time the criticism being verbalized from a different (more alternative) direction, a criticism that is e.g. coming from Vandana Shiva, an Indian environmental activist.[6] The criticism from both conservatives and 'greens' shows that Stern is with his report standing somewhere in the middle, building a sound compromise. As Ackerman claims: “the Stern Review [...] rests on much sounder ground than the economists who have attacked it.”[7] It is probably therefore, that just as well as the IPCC reports the Stern Review is used by a large majority of scientists in the field of climate (politics) research, and shall therefore also be seen as a reliable source in this thesis.

A common misunderstanding shall be done away with: the habit of relating individual weather phenomena with CC. It should be noted, that weather is not climate, but the taken mean of weather measured and calculated over decades. This means that ‘climate’ is a statistical term which is not physically sensible, making up for the distorting influence of our selective perceptions.[8] In example is a warm year no proof for CC, but the measurement of 11 of the 12 warmest years in only 12 years time (1995-2006) is a strong indication for a warming atmosphere.[9]

Next shall be explained how CC is working physically. The effect standing behind CC is called ‘the greenhouse effect’. At the beginning of this effect stands the solar radiation that is passing through the atmosphere and warming the surface of the planet; next is this radiation reflected into the space as infrared radiation. At this step the GHG’s (CO^2, CH4 and N^2O) come into play: most of the mentioned infrared radiation is ‘escaping’ the earth’s atmosphere into the space, but some is held back by the mentioned gases through absorption, causing a ‘warming jam’ and thus warming the atmosphere of the earth. If now the concentration of GHG’s in the atmosphere

[3]Toulmin 2009 p.4
[4]Ackerman 2009 p.33
[5]Tol/Yohe 2006 p.236
[6]Shiva 2008 p.19
[7]Ackerman 2009 p.33
[8]Plöger 2007 p.3-4
[9]IPCC 2007 I p.5;Toulmin 2009 p.17-18

increases (through land use change or higher emissions), the density of the atmosphere increases as well and less of the infrared radiation will reach the space, thus will the atmosphere of the earth become warmer. A warming effect has with that taken place.[10] The latter as a warmer atmosphere will lead to warmer oceans, and these will together lead to higher average surface temperatures, changes in rainfall, melting of ice sheets and glaciers and a rising sea level, thus having drastic impacts on physical, biological and human systems; in other words causing the CC![11]

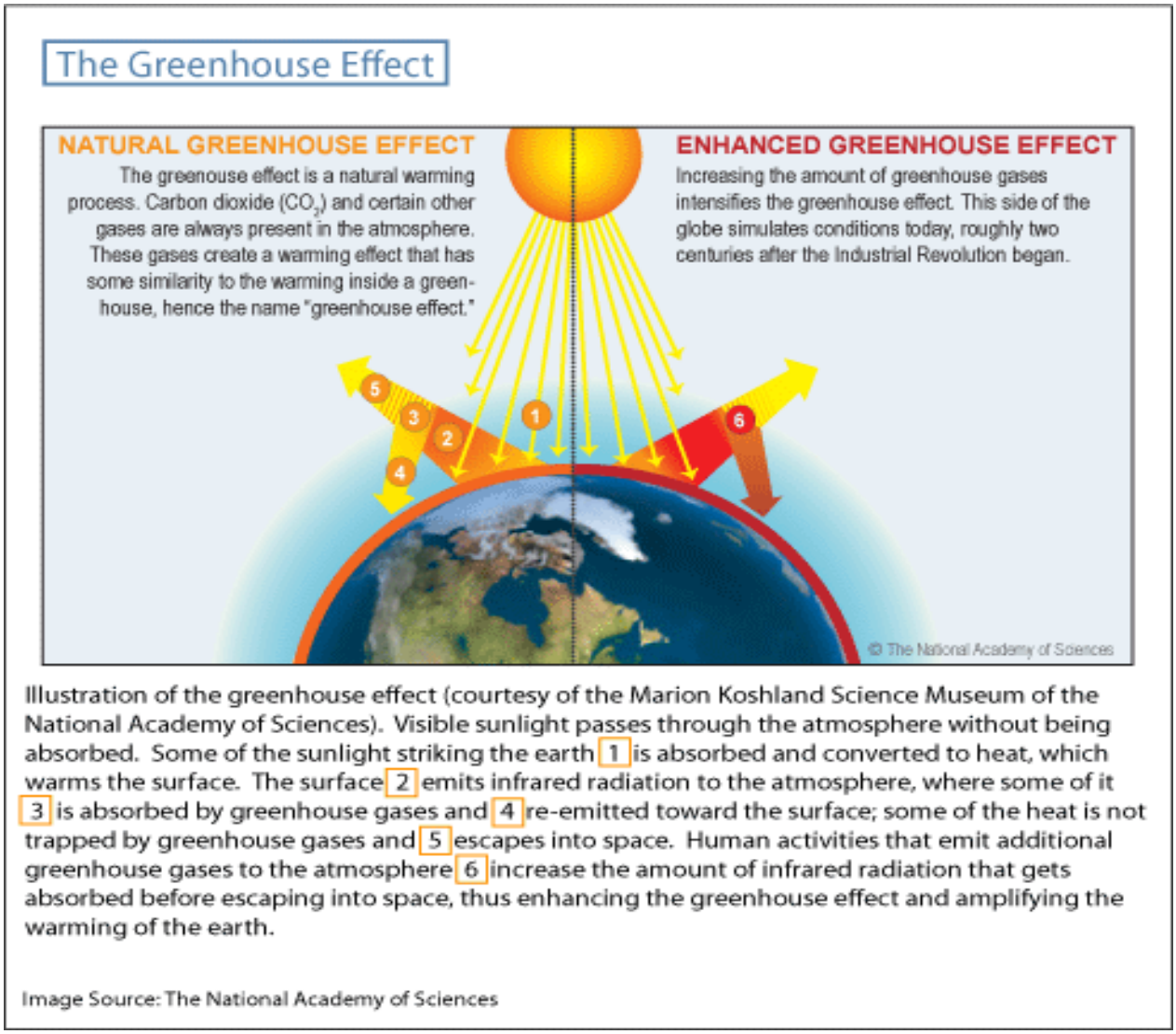


Illustration of the greenhouse effect (courtesy of the Marion Koshland Science Museum of the National Academy of Sciences). Visible sunlight passes through the atmosphere without being absorbed. Some of the sunlight striking the earth 1 is absorbed and converted to heat, which warms the surface. The surface 2 emits infrared radiation to the atmosphere, where some of it 3 is absorbed by greenhouse gases and 4 re-emitted toward the surface; some of the heat is not trapped by greenhouse gases and 5 escapes into space. Human activities that emit additional greenhouse gases to the atmosphere 6 increase the amount of infrared radiation that gets absorbed before escaping into space, thus enhancing the greenhouse effect and amplifying the warming of the earth.

Image Source: The National Academy of Sciences

[10] Stern 2006 p.4
[11] Stern 2006 p.8;Rahmstorf 2007 p.7-8

In regard to the cutting of the rainforest which is translated into CO^2 emissions by most scientist, and which plays a decisive role in the climate records of Brazil, it is to say that deforestation contributes as explained in the following: trees and plants in general have the ability to absorb CO^2 out of the atmosphere and subsequently storage this $C0^2$. Alone the trees of Amazonia are reported to store up to 140 billion tons of $C0^2$. When now a massive amount of trees is cut down, the amount of $C0^2$ in the atmosphere will increase due to the prevented absorption and the release of the stored $C0^2$, in effect will worsen. The amount of $C0^2$ that is set free due to deforestation is estimated to lie at around 400 million tons and tropical deforestation is responsible for 20% of global climate emissions, more than all transportation means combined.[12]

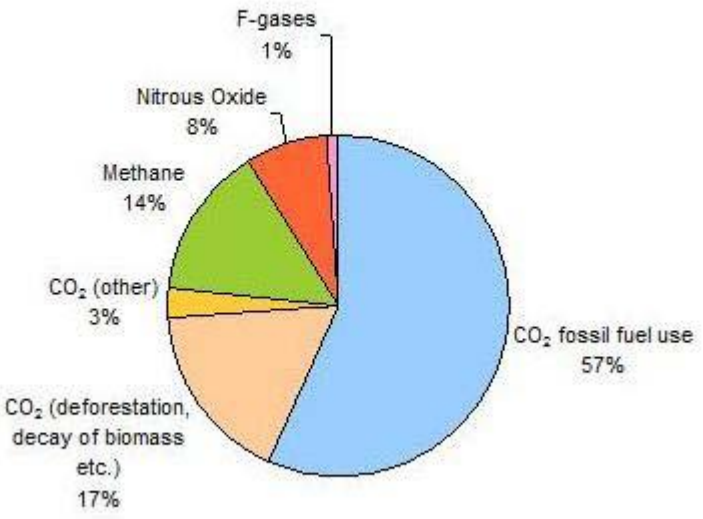
Furthermore is it to realize, that CC has feedback consequences that further increase the speed of the whole phenomenon. In example reduces warming the ability of absorbing CO^2 emissions, both of land mass and oceans, e.g. are soils and plants decreasing their absorbing resources with warming.[13] Another example of this kind is the unfreezing of the permafrost areas in the Northern hemisphere (mostly Russia): the permafrost soils could start to thaw und release large amounts of CH4, thus speeding up CC processes. Scientific models mentioned in the Stern Review suggest that up to 90% of the upper layer of the existing permafrost soils could be thawed in the year 2100, thus releasing a drastic additional amount of CO^2 and CH4 to the atmosphere. Such feedback phenomena could lead to another 1-2 C° of warming until the end of the 21st century.[14] Observations in Siberia show that thawing of permafrost in the region has already drastically increased, thaw lakes increased their size by 10-15% and their emission by up to 60% since the 1970s.[15] With warming the risk for sudden changes in the climate patterns of the earth rises, e.g. is it thinkable that warming could disrupt ocean and atmospheric circulations, resulting in immediate shift of the weather patterns of whole regions.[16]

[12]Simon 2008 p.1-2;Greenpeace 2009 II p.2
[13]Stern 2006 p.2+8+11;IPCC 2007 I p.13
[14]Stern 2006 p.2+8+11;IPCC 2007 I p.15
[15]Stern 2006 p.11
[16]Stern 2006 p.2

2 Newest data for the world, Brazil and China

The concentration of CO^2, the most important anthropogenic GHG in the atmosphere has increased from around 280ppm (parts per million) in the year 1750 to 379ppm in 2005 and is currently increasing by 2ppm each year. The concentration of overall GHG's, adding CH4 (methane) and N^2O (nitrous oxide), lies at around 430ppm of CO^2 equivalent.[17] A CO^2 concentration of 550ppm could be reached in the year 2035 if no substantial action is taken. The intensity of the increase of CO^2 concentration is revealed when compared to the increase in pre-industrialization time: Prior to 1750 the concentration rose by only 20ppm in 8000 years. And whereas the natural concentration never exceeded a range of 180 to 300 ppm in 650,000 years, the concentration of CO^2 lay as mentioned at 379 ppm in 2005. The same is valid for the second important GHG, CH4: The concentration of CH4 lay at 1774ppb in 2005, the natural range of the last 650.000 years being 320-790ppb.[18]

Global Anthropogenic GHG Emissions by Gas (2004)



Source: IPCC Assessment Report 4 (2007), Summary of Policymakers: Figure SPM 3

A difference is found in the growth rates of the emissions: whereas the growth rate of CO^2 emission has increased in the years from 1995 on (1.9ppm per year, whereas it was lying at 1.4ppm for the years from 1960), the growth of CH4 emission is seeing decline since the beginning of the 1990s. The concentration of a further climate destroying gas, N^2O, has increased from

[17] CO^2 and other GHG's measured in CO^2 concentration
[18] IPCC 2007 I p.2-5;Stern 2006 p.3-4;Toulmin 2009 p.17-18;Giddens 2009 p.18;Shiva 2008 p.10

270ppb in pre-industrial times to 319ppb in 2005, with a rather constant growth rate.[19] The additional emissions (compared to pre-human times) are in case of CO^2 caused by land-use change and to an even bigger extend by the use of fossil fuels, in case of methane agricultural and fossil fuel use are to be made responsible for the increase in emissions. The additional emissions of N^2O stems mainly from increased agricultural activity as well.[20]

According to the newest data of the IPCC, the average temperature has on ground of the increased concentration of the mentioned gases already increased by 0.74 C° in the last 100 years.[21] A significant warming with an anthropogenic cause over the last 50 years could be detected for all continents except Antarctica, Asia seeing the fastest warming with an increase in average temperature of slightly more than one degree Celsius (South America seeing an increase of almost 0.5C° during this period).[22]

According to the non-profit NGO World Research Institute (WRI) have the CO^2 emissions of China increased by more than 400% between 1970 and 2000.[23] Since 2000 the emissions have doubled again,[24] which made China the biggest GHG emitter in the world.[25] China will see a grave warming as well, the projections even speak of a warming that will lie very well over global average. In example is the mean warming of the Tibet region between the periods 1980-1999 and 2080-2099 estimated with 3.8C°, the warming of the Eastern part of the country is estimated to lie at around 3.3C°.[26]

The total CO^2 emissions of Brazil have increased by more than 50% since 1990, the per capita increase was very similar to that.[27] The peer reviewed projections of warming included in the fourth assessment of the IPCC for the Amazonas region (covering the whole of Northern South America and 90% of Brazil) have a median of 3.3C° (for the same periods of time as in the case of China) with half of the models projecting a warming between 2.6C° and 3.7C°. With that the warming in this region would lie around 30% over global average.[28]

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[19]IPCC 2007 I p.2-5;Stern 2006 p.3-4
[20]IPCC 2007 I p.2-5
[21]IPCC 2007 I p.5;Stern 2006 p.5
[22]IPCC 2007 I p.10-11
[23]WRI 2003 I
[24]Olivier/Peters 2010 p.6
[25]Pittock 2009 p.289
[26]IPCC 2007 I p.879-883
[27]WRI 2003 II
[28]IPCC 2007 I p.894

3 Future predictions and scenarios

After having constituted the development of the past a projection of the future development shall be delivered; this is logically an even harder task (especially in such an extremely complicated field of research), which explains why the used sources are rather cautious in the strength of their claims when it comes to such projections. Estimating CC is complicated because it means estimating future emissions; the sources that are used here try to solve this problem by establishing certain scenarios of pollution. If the emission growth would continue with actual speed, the concentration of CO^2 in the atmosphere would reach almost 550ppm already in 2035, leading to a warming of around 2-5C°.[29] To avoid such a concentration and warming, big emission cuts in both developed and developing countries would have to be carried out: e.g. to limit emission growth to 500ppm until 2050, the developed countries would have to cut emissions by 60% on a 1990 basis, whereas the developing countries would have to cut emissions by 35% on 1990 levels.[30] It becomes clear that the claim that the world's average temperature rise in the coming century will lie between 2 and 6C° could be reached already at the middle of the century and the estimate in the introduction is therefore very conservative. Even an increase of only 2-3C° would lead to an average temperature that was not to be found on the earth since the middle Pliocene around 3 million years ago. The IPCC sees an increase between 2C° and 4.5C° as most probable, 3C° being the 'best estimate'. An increase of less than 1.5C° is seen as highly unlikely. An even higher increase of more than 4.5C° cannot be excluded, but such a scenario is according to the IPCC hard to project on ground of insufficient observation models.[31] Even if emissions would be held constant at the level of the year 2000 the average temperature could still rise on ground of the slower reaction of the oceans.[32] It is to say that the scenarios from the IPCC are to be considered as conservative, as they do not include the above mentioned feedback effects and other possible worsening effects such as population growth or changes in ice sheet flow in their estimate about CC,[33] and as the IPCC also integrates CC skeptic voices in its peer review.

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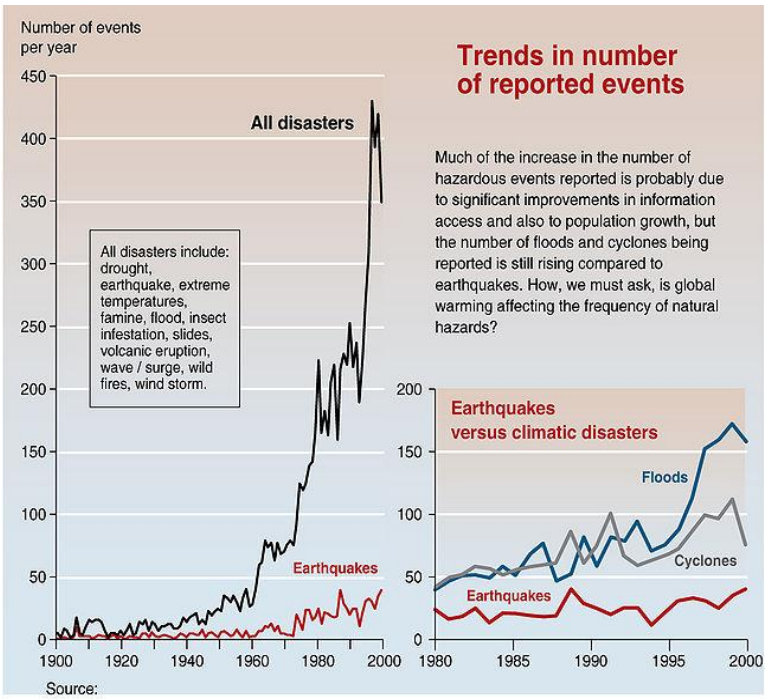
[29]Stern 2006 p. 169
[30]Stern 2006 p. 459
[31]IPCC 2007 I p.12
[32]IPCC 2007 I p.12
[33]Stern 2006 p.12;IPCC 2007 I p.14

4 Impacts on nature and mankind

As already mentioned has CC a grave effect on nature: the sea level is rising, glaciers melting, polar caps melting, patterns of rainfall change, floods, droughts, heat waves and storms increase and furthermore feedback effects of CC such as thawing of permafrost, change of ice sheet flow and a decrease of the absorption abilities of oceans and plants possibly evolve their effect.[34]

Almost all of the mentioned consequences of CC on nature have direct influences on mankind that will lead to higher death tolls, e.g. is it obvious that more people will be casualties of floods or other weather extremes. But also indirect effects that lead to grave consequences for mankind are to be found. So will crop yields decline in many regions if warming exceeds 3C° and the infection rate of malaria will increase by 40-80 million people a year with warming of 2-4C°, leading to a strong increase of casualties due to malaria and malnutrition.[35] Heat waves will increase the number of people dying on ground of CC as well.[36] Further are massive migration movements away from those areas that are hit the hardest by CC thinkable, as well as conflicts arising on ground of problems caused by CC, e.g. water shortages.[37] People living in coastal areas will be in a more risky position due to the sea level rise and the increased weather extremes, this is especially valid for people living in those coastal regions that are already densely populated, suffering under floods and without resources to adapt to the new challenge (especially the big deltas in Asia and Africa).[38]



[34] IPCC 2007 I p.5-7,13-16;Stern 2006 p.56-57
[35] Stern 2006 p.55-57;IPCC 2007 II p.11-12,16
[36] IPCC 2007 II p.18
[37] Welzer 2008 p.26-27;Barnett 2007 p.1364; Santarius 2007 p.20
[38] IPCC 2007 II p.12,16;Santarius 2007 p.19;Stern 2006 p.57

5 Costs of damages and counteractive measures

The named negative consequences of CC will also cause serious economic costs for nations around the world, including China and Brazil. In general is it estimated by the IPCC that for an increase of 2-3 C° in average onwards all world regions will see net losses due to CC.[39] Nevertheless underlines the IPCC that it is extremely hard to estimate only a half-way precise range of future costs of CC due to the high uncertainty and complexity surrounding the phenomenon (e.g. found the IPCC the social costs of carbon estimated from 10$ per ton of carbon to 350$ per ton in a per review survey). The IPCC is rather content with stating that the scientific evidence on CC "indicates that the net damage costs of CC are likely to be significant and to increase over time", and that "globally aggregated figures underestimate the damage costs because they cannot include many non-quantifiable impacts."[40] The Stern Review is more courageous in putting a number on the costs of CC and estimates that the phenomenon could amount to cost 20% of the global economic output given that global warming exceeds 3C°, this by adding costs of amplifying feedback effects and adding costs of non-market impacts (e.g. health or environment costs) to the 5% of market costs that were taken as basis.[41] A decline that would bring the danger of another serious economic recession.[42] In China would e.g. the imminent flooding of the Changjiang and Zhujiang deltas be costly in an economic sense, as e.g. Shanghai is the economic 'boom-region' in China.[43] The rising sea level and possible storms and floods could destroy the infrastructure and the industrial facilities of the booming east-coast; such catastrophes would diminish the development chances of the country and thus would bring the political stability of the country under pressure.[44]

Also Brazil could come under economic pressure if CC would stay untackled. First would the economically important region around Rio de Janeiro come in danger of being severely damaged if storms and flooding increased. Further, will the risk of flooding increase in the economically important South-Eastern region, due to intensified precipitation.[45]

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[39] IPCC 2007 II p.17
[40] IPCC 2007 II p.17
[41] Stern 2006 p.143-144
[42] Kemfert 2007 p.15;Gurria 2006 p.48-49
[43] IPCC 2007 II p.493
[44] Bauer/Richerzhagen 2007 p.22
[45] IPCC 2007 II p.583