

GEOPOLITICS OF CLIMATE CHANGE: A REVIEW

by

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The paper reviews the geopolitical elements of the emerging discourse on how to control, and cope with climate change. Two complementary approaches may be distinguished: the actor-related approach analyses the positioning of states and interest groups, which develop strategies on coping with climate change; the other approach addresses processes and problem areas (physical, economic, demographic...) emerging in the geographic space as a consequence of, or linked to climate change. With failing mitigation policies and instruments, the urgency of adaptation to climate change is increasing. Assessment of regional consequences of climate change includes the perceptions and motivations of presumed losers or winners. New security implications related to climate change are emerging in the Arctic, South-East Asia, Africa, and the Pacific. Energy supply security is a dominant factor in geopolitical considerations. The geopolitics of climate change is inextricably linked to many other issues of globalization. Significant shift of global power raises the discussion of ethical responsibility. Climate change is evolving as a testing ground for competitiveness and innovation potential of political and economic models in achieving sustainability.

Key words: *geopolitics, climate change, mitigation, adaptation globalization, energy security, global power*

Introduction

Whilst the amount of global warming that corresponds to “dangerous anthropogenic interference” has not been formally enshrined in an international treaty, there is a growing consensus in policy and science that aiming for 2.0 °C warming above the pre-industrial level is a reasonable working figure [1]. Politically, this limit has been accepted by the G8, G20, and by the Cancun summit in 2010, but the policy responses have so far had little impact on the continuing build-up of emissions of greenhouse gases (GHG) that are believed to cause global warming [2]. The Copenhagen Summit negotiations, in December 2009 on climate change mitigation failed to reach a world-wide binding agreement on emission reductions. This outcome has brought into focus a number of issues and differing perspectives that had been more or less avoided so far or screened behind the rhetoric of politicians and activists. The inability of the major world players to address jointly a common challenge of global dimensions, points to the need to understand their differing positions and motivations.

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“Geopolitics, precisely because it is preoccupied with borders, resources, flows, territories, and identities, can provide a pathway for critical analysis and understanding – albeit a controversial one” ([3], p. 3).

In view of the renewed interest for geopolitics in a globalised and changing world, the present paper first gives a brief overview of the usage of the term “geopolitics”. In the subsequent sections, a pragmatic approach to the geopolitics of climate change is introduced, and then elaborated with respect to the major players, processes and problem areas. Since successful mitigation is looking less and less likely, particular emphasis is given to the urgently needed adaptation to climate change. Finally, the role of climate change in a changing world order will be discussed.

Old and new relevance of geopolitics

What exactly is geopolitics? Webster’s Third New International Dictionary of 1968 defines geopolitics as “a study of the influence of such physical factors as geography, economics, and demography upon the politics and especially the foreign policy of a state”. For Meyer’s Lexicon of 1904, the term did not exist yet: no wonder, the term was coined at the beginning of the 20th century by Rudolf Kjellen, a Swedish political scientist inspired by the German geographer Friedrich Ratzel, whose book *Politische Geographie* was published in 1897. Halford Mackinder had a pioneering role in this field in the Anglophone world although he actually never used the term geopolitics himself [4]. Traditionally, geopolitics indicates the links and causal relationships between political power and geographic space [5]. The study of geopolitics involves the analysis of geography, history, and social science with reference to spatial politics and patterns at various scales. The reputation of geopolitics declined after World War II because of its misuse as instrument of imperial ambitions in the first half of the 20th century, in particular the “alleged influence of German geopolitical thinking on Hitler and his associates” ([3], p. 34). However, by the mid-1980s, geopolitical discussions were revived and “primarily shaped by a group of scholars strongly influenced by political realism and a desire to maintain American power in the midst of the so-called second cold war following the collapse of détente” ([3], p. 41). This triggered a counter-current by the critics, in whose view realist-inspired geopolitics over-emphasized conflict and competition at the expense of cooperation and détente.

Within recent decades, the world has been experiencing a transformation from a relatively static, bipolar, East-West confrontation, to a pluriform setting where fundamental, multidimensional changes take place with an unheard of intensity and speed. The changes are many, they concern everybody, and climate change is only one of them. The changes include continuing demographic growth and urbanisation in developing countries; increase of material demands and expectations, by individuals, by groups and by nations; at the same time, consumption of both renewable and non-renewable resources is rapidly increasing, with looming scarcity ahead of food, water, and environmental quality. At the same time sweeping changes are taking place in non-material variables: explosive growth of global interconnectivity, including communication, transparency, and mobility; rapidly changing gender roles, and increasing demands to respect human rights including the rights of minorities. Each of these change patterns generates specific strategic adaptations, fuelled not only by emerging security threats and conflicts of interest, but also by new opportunities for cooperation. Geopolitical architectures are undergoing sweeping changes as well, involving states and other non-state bodies, which far from eroding the significance of borders and territory are contributing to dynamic configurations.

As a growing number of non-Western states are gaining relative geo-economic weight, geopolitics takes centre stage again [6]. The world is experiencing the “irresistible shift of global power to the East”, as suggested by some recent titles [7, 8], in the first place through the rise of two Asian nations that represent nearly half of the global population: China and India. In contrast, the US and the EU are struggling with severe economic weakness. In a geopolitically fragmented world, finding common ground on global challenges and the resolution of regional conflicts will become even more difficult. Geo-economic power has gravitated so far east that whether we should still term China as ‘emerging’ is highly debatable [9]. China is no longer just engine of economic growth; it is catalyst of geopolitical movement: China has replaced the US as the key trade partner of Japan, Thailand, Malaysia, Singapore, Hong Kong, Australia, the Philippines, South Korea, and Indonesia. Smarter states are even starting to position themselves between the US and China: Africa, Central Asia, and Latin America are playing this “Chimerica” game. Not all emerging markets can be braced in the same political bracket: differentiation is needed, not only between China and the rest of the BRIC¹ states, but between the BRIC and other emerging players all riding the Chinese dragon. The West and the US can no longer singularly keep pulling all the geo-economic and geopolitical strings. At the same time, Europe tends to become geopolitically marginalised ([9], p. 18).

So what is the meaning of these developments for coping with climate change? The basic idea of the present paper is that although global warming is caused by global emissions of GHG, which can be mitigated only by joint action, both the consequences of and responses to climate change might be very different from region to region, and from state to state. The relevance of these different responses has been so far either neglected or downplayed. The goal of this paper is to put focus on these different positions in the present phase of changing world order and try to reach some initial understanding of the underlying driving forces.

Climate change mitigation

Emissions reduction of GHG, in response to climate change, cannot be effective if it is not organized globally. Stabilizing the climate warming near 2.0 °C (around 450 ppm of CO₂eq) would require global emissions to decline immediately by about 1.5% a year ([1], p. 10). By 2050 emissions would need to be 50 percent below 1990 levels and be zero or negative by 2100 ([1], p. 10 and fig. 5).

Currently global emission flows are around 40-45 Gt of CO₂eq each year [10], corresponding to average *per capita* emissions of seven tonnes. Reducing aggregate emissions by 50% by 2050 will require *per capita* emissions to be around two tonnes, given that the world population will be around nine billion by 2050. Even if emissions in currently rich countries were to fall to zero, people in currently poor countries will still need to limit emissions to not more than 2-2.5 tonnes, because eight billion of the global population will live in these countries. This basic arithmetic shows that the currently poor countries (including China and India) must be at the centre of any effective global deal. The USA, Canada, and Australia emit around 20 tonnes of CO₂eq *per capita*, Europe and Japan around 10 tonnes, China around 5 tonnes, and India around 2 tonnes, while most of sub-Saharan Africa emits much less than 1 tonne. At current emissions, and assuming the equity principle, the US, Australia, and Canada would need a reduction of 90% by 2050 to achieve emissions

¹ The BRIC group consists of Brazil, Russia, India, and China; South Africa joined in December 2010. BRICS is neither an economic block, nor a political alliance or defence pact. It is an informal group without address or secretariat.

at the global average of 2 tonnes, Europe would need a downsizing of 80%. But note that even China would need an emissions reduction from the present level by 60%! This clearly explains why most countries hesitate to commit themselves to the consequences of a 50% reduction by 2050. Setting long-term targets is the easy part; achieving them will be difficult, and borders on wishful thinking. Since emissions from some sectors like agriculture will be difficult to cut back anyway, and richer countries should make much bigger proportional reductions than poor countries, richer countries will need to have close to zero emissions in power and transport sectors by 2050. Whether such a mitigation effort is feasible – technically, economically, and politically – is a highly controversial issue.

The 1997 Kyoto Protocol² introduced several mechanisms to achieve mitigation, the most important one being the cap-and-trade mechanism. This mechanism allows industrialised countries (Annex 1 countries) to buy emission permits from other parties to help meet domestic emission reduction targets. Despite the enormous effort and controversy in agreeing, ratifying and implementing the first phase of the Kyoto Protocol, so far it has proved at best only partly successful in controlling worldwide emissions of GHG. In the first place, Annex 1 countries cover less than 30% of global emissions, and even so, the goal set, namely 5.2% reduction on the average between 1990 and 2012 must be considered less than modest: globally, this means only about 1.5% reduction over a period of more than 20 years, less than the annual (!) increase during that period! Even more important, no binding caps are imposed on big emitters USA (no ratification) and on China and India, as these are not Annex 1 countries. No real restrictions were imposed on Russia and Ukraine either, as they would not have joined Kyoto otherwise. Other drawbacks include: responsibility on emissions is put only on the producer and not on the consumer; important sectors like aviation and shipping are not covered; and there is no enforcement mechanisms. While the summits in Copenhagen (2009), Cancun (2010), and Durban (2011) did not lead to an agreement on badly needed legally binding national reduction limits, the real climate continues to heat up. Even worse, Canada, otherwise a champion of environmentally sustainable development, decided to leave the Protocol³. But in Durban, the 195 Parties to UNFCCC agreed at least on a roadmap for drawing up a legal framework by 2015 and making it operational by 2020. This new regime will see the burden of emission-cutting shared among all countries, even if rich ones will still be expected to do much more than poorer countries⁴. It seems clear that the outcomes of the international process are driven by national politics, not *vice versa*.

The goal of the present paper is therefore *twofold*: to highlight, on the one hand, the positions of major global players with regard to climate change mitigation (emissions reduction), including their possibly geopolitical motivations; on the other hand, to identify problem areas related to the physical, economic and social consequences of climate change that carry a geopolitical conflict potential. There is a need to understand the various interests that do not want a deal on climate change. The stage is dominated by those with power and those with emissions to negotiate. In this context, the UN climate process is indispensable as it is the only forum where the small and most vulnerable countries can make their voices heard⁵.

² Under the UN Convention on Climate Change (UNFCCC)

³ *Canada to withdraw from Kyoto Protocol*. www.bbc.co.uk/news/world-us-canada-16151310

⁴ *A deal in Durban*. The Economist, December 11, 2011

⁵ *Progressive countries score a Realpolitik victory in Durban while the real climate continues to heat up: a first assessment of the climate conference in Durban by Wolfgang Sterk*. 19 December 2011. Wuppertal Institut für Klima, Umwelt, Energie GmbH (www.wupperinst.org)

The impacts of a changing climate are already being felt, with more droughts, more floods, more strong storms, and more heat waves. Even stabilizing the global warming near 2.0 °C will require substantial adaptation. Since the outcome of the future negotiations regarding a stringent, binding agreement on emission reduction are still uncertain, the world must get ready for a likely global warming going considerably beyond the presumably feasible limit of 2 degrees. By century's end, it might lead to 5 °C or more above preindustrial levels and to a vastly different world from today, with more extreme weather events, most ecosystems stressed and changing, many species doomed to extinction, and whole island nations threatened by inundation ([1], p. 2). Either path will force all countries, big and small, to face the consequences and develop adaptation policies and measures with regard to climatic changes. But the consequences may be very different from country to country. To put it more bluntly: each player will estimate and weigh the economic, political, and social costs (or perceived gains) of the evolving climate change. This brings a major geopolitical issue in the picture: the unequal regional distribution of the consequences of global warming.

Adaptation to climate change: a race with time?

The *mitigation* dimension is concerned with looking at how to limit anthropogenic emissions of GHG. The *adaptation* dimension is concerned with how to deal with the impact of climate change: those already observed, those predicted to happen with a high degree of certainty, and those more uncertain, but also more frightening impacts that may happen.

Predicting changes of climate parameters at the regional and local levels may still lack precision, but the trends are emerging clearly. The projected impacts of climate change per region, as a function of the global mean annual temperature change relative to 1980-1999, are based mainly on various reports by intergovernmental panel on climate change (IPCC) and have been summarized by the World Bank ([1], p. 77). Striking changes, on a gliding scale, include: increase of semi-arid or arid areas in Africa, with corresponding additional people under increased water stress; decrease of crop yield potential in India and China; additional people with increased water stress, as well as increased risk of coastal flooding in Asia; 5 to 20% more availability of water in Northern Europe, but 2 to 30% less in Europe's South, with corresponding changes in wheat yield potential.

The basic message is that much of the climate change impact is in fact "hit" through the land and water system: *if mitigation is about energy, the adaptation is about water* [11]. Globally some 14% of all water use is for domestic use, 70% is for growing food and fibre, 16% for industrial and energy purposes. Each day, a person drinks 2-4 litres but eats food equivalent to 2000–5000 litres. Providing the basic water needs is not a *water* problem, it is a *political* problem. Feeding 9 billion people in 2050 is a water challenge which calls for fundamental, technological, and management changes, and international solidarity, and cooperation. However, the world does not face a "water crisis": it is a "crisis of water governance". In this sense, the so-called "water crisis" and the "climate change crisis" have common features: they are largely created by man, they impact poor nations more, there is a global imbalance in consumption patterns and it impacts efforts to eradicate poverty and improve health conditions. Earth climate change will result in a 10-40% increase in precipitation in higher latitudes, and a 10-30% decrease in mid-latitudes and the dry tropics. If wetter climate is uncomfortable to many Westerners, water scarcity is catastrophic to millions of poor people in the developing countries, such as parts of Africa where increased water stress may lead to a decrease in agricultural production of up to 50%. Increasing climate variability is already resulting in some places in higher frequency and severity of both floods

and droughts. Negative effects combine and accumulate in coastal zones, affected by both the changed river flow regimes, and sea level rise. More than a third of the world population lives less than 100 km from the coast, and more than one billion people live in the major coastal cities, with hot spots in the mega-deltas of Africa and Asia. Ensuring water availability and quality will be the main pressure on societies and the environment under climate change [11].

The vulnerability is a combination of the impact and the capacity to adapt. Countries of the North are generally less vulnerable than those of the South, even where impacts are potentially serious. The Netherlands, with large parts of the country under sea level, depend on major coastal engineering structures such as dykes and sluices for their safety, and sea level rise is a serious threat to address. However the Dutch have the knowledge, the institutions, the technology and the financial resources to cope with that. Another low lying country, Bangladesh, were it to be affected by a combination of sea level rise, increased floods and decreased water flows from the upper Ganges-Brahmaputra River Basin, does not have the capacity to address these changes.

Water is central to many different sectors that directly depend on water being available and of high quality. Thus, water management, as essential part of governance, can limit or enhance adaptation of water-related sectors. But it is the quality of governance which determines in the first place the resilience *vis-à-vis* natural and man-made disasters, both in terms of prevention, preparedness for and response to catastrophic developments. This became evident in three recent examples: the Katrina disaster in the US in 2005; the unprecedented catastrophic forest fires in Russia, and the floods in Pakistan, both in the summer of 2010. In all three cases, the measure of disaster was for a major part caused by mismanagement⁶. They can be used to show how poor regulations, planning, and emergency response, and even corruption, can aggravate crises that will almost certainly increase as a result of climate change, but that cannot be attributed to climate change alone.

Any adaptation policy needs to consider climate change as one of many pressures on water resources. Ensuring that data and information are readily available is crucial for making climate projections and identifying vulnerable groups and regions. Current and future vulnerability assessments are needed for effective adaptation ([13], p. 70-75). The vulnerability of a system includes both an *external* dimension – exposure to climate change and variability, and an *internal* dimension – its sensitivity to these factors and its adaptive capacity. A highly vulnerable system is one that is very sensitive to modest changes in climate. An adaption strategy consequently aims at reducing the vulnerability, which includes increasing the adaptive capacity. Vulnerability has, apart from physical aspects, also geographical, social, economic, environmental, and psychological ones. To capture the essence of this definition of vulnerability, a composite index approach has been proposed ([13], p. 72-73), as used in the construction of the human development index (HDI). Incorporating indicators which represent the diverse dimensions of risks resulted in a method of assessment known as the climate vulnerability index (CVI). The method is based on global impact factors, the major ones being: geospatial, resource quantification, accessibility and property rights, capacity of people and institutions, utilisation, and ecological integrity maintenance. The global distribution of CVI, as given in fig. 3 of [13], roughly suggests *high* vulnerability in Saharan and Sub-Saharan countries; *medium high to medium* vulnerability in the rest of Africa, in West, South and Southeast Asia, most of Latin America and Australia; and *medium low to low* vulnerability in most of North America, Europe and Russia.

⁶ For a more detailed discussion, see Bošnjaković ([12], footnotes on p. 15)

Effective adaptation to climate change requires a cross-sectoral approach including at the trans-boundary level, in order to prevent possible conflicts between different sectors and riparian states, and to consider trade-offs and synergies between adaptation and mitigation measures. Adaptation may be costly, but it is much more cost-effective to start it now, because costs will be much higher once the effects of climate change are irreversible. The need for adaptation may be seen as an opportunity for stimulating alternative and innovative approaches. A crucial shift would be from a supply-side approach to a more sustainable, “demand-side” approach to water resource management, focusing on conserving water and using it more efficiently.

The need for adaptation inevitably raises the key question of financing. This is particularly difficult for poor countries, which lack the resources to prepare for and respond to these changes. Under the unlikely assumption that global emissions will be reduced by half until 2050, UN Development Programme (UNDP) estimated that *additional annual* costs for developing countries amount to US\$ 86 billion by 2015 [14]. The World Bank ([1], p. 263) estimates the annual climate funding required for a 2 °C trajectory to US\$ 28–100 billion for adaptation and US\$ 139-175 billion for mitigation. These numbers are far beyond the present official development assistance (ODA) commitments ([1], p. 56). Beyond 2015, the appropriate level of development assistance should account for the likely additional costs from climate change if mitigation fails. Making funding available through the adaptation fund and the least developed countries fund is of great urgency, but it is important that financial assistance for climate adaptation be integrated into development spending more generally. Countries with good governance and successful diversified economies are less vulnerable to shocks of all kinds, including those related to climate impacts.

Notably, the Durban summit agreed on the broad design of a global Green Climate Fund, which is supposed to funnel some of the \$100 billion that rich countries have promised to make available to poor ones by 2020, to help them cut emissions and adapt to climate change. There was no agreement – and little discussion – on the important question of where the money will be found⁷.

Geopolitics: players and their motivations

In the present chapter, the positions of only a few most important governmental players will be addressed: the EU, USA, Russia, China, and India. Several important developed countries like Australia, Canada, and Japan, as well as many developing countries, ranging from the least developed ones to powerful emerging economies such as Brazil, Indonesia, and Nigeria, have not been separately addressed. A more complete treatment would require having a look not only at more states, but also at other acting subjects like multi-national enterprises, intergovernmental, and nongovernmental public advocacy organisations. Still, the author believes that the selected players give a representative picture of the main geopolitical issues at stake.

European Union

The EU climate change policy⁸ with its 20-20-20 targets is one of the most ambitious in the world. EU leaders agreed in 2007 on climate and energy targets to be met by 2020: a reduction in EU GHG emissions of more than 20% below 1990 levels; 20% of energy

⁷ *A deal in Durban*. The Economist, December 11, 2011

⁸ European Commission Climate Action, http://ec.europa.eu/clima/policies/adaptation/index_en.htm

consumption to come from renewable resources; a 20% reduction in primary energy use compared with projected levels by improving energy efficiency. These targets resulted in a 'climate and energy package', adopted as binding legislation in 2009. The main elements are: the "Emissions Trading System" (ETS) as the key tool to cut emissions cost-effectively to 21% below the 2005 level in 2020; the "Effort Sharing Decision", stipulating that the emissions from sectors not covered by ETS (transport, housing, agriculture, waste), should be reduced by 10% from 2005 to 2020; national targets for *renewable energy*, which should result in an average doubling of the renewables share from 9.6% in 2006 to 20% in 2020; and a legal framework to promote the development and safe use of *carbon capture and storage* (CCS). ETS covers 40% of its GHG emissions. At the same time, it is "work in progress": airlines should join the scheme in 2012, and an extension to other industries, like petrochemicals, ammonia, and aluminum, should follow in 2013. ETS showed that trading in GHG emissions is possible, but selling the concept has been less successful: a hoped for OECD-wide carbon market still far away. Its internal weaknesses include over-allocation⁹, carbon price volatility¹⁰, and carbon leakage¹¹. ETS has been an open door for crime: Europol estimated 90% of the market volume of emissions traded in some countries could be result of tax fraud, costing governments more than 5 billion €¹². Most significantly, EU ETS on its own is globally irrelevant: it covers about 2 Gt emissions, *i. e.* less than 5% of the overall global GHG emissions: reducing them by 20% means a global emissions reduction by 1% only!

Most European politicians agree that achieving emission cuts of 80-95% below 1990 levels by 2050 requires a process of *decarbonising* the economy, however they are deeply split on the roles of nuclear energy and "clean coal": whereas France sticks to nuclear as an important option, Germany wants to opt it out completely. National policies on renewables and low-carbon technologies look like a mishmash of support mechanisms, from feed-in tariffs to traded permits for renewables, and widely varying levels of market penetration, *e. g.* for photovoltaics. The most important single reason for not coping effectively with climate change is the much too low price for fossil energy. But there are other important factors limiting a short and medium-term introduction of renewables. *Missing interconnections* prevent greater penetration of solar and wind in the power sector: costly grid development is needed. The variable power generation from solar and wind is at present still being backed up with fossil fuel: possible solutions require both development and installation of huge storage capacities and smart grids. In densely populated parts of Europe, space for solar, wind, biofuels is limited due to *competition with other needs* (*e. g.* for agriculture, biodiversity, recreation), and because of public resistance¹³. This may reinforce the tendency to outsource unsustainable effects by switching to the harvesting of solar and wind energy abroad (*e. g.* to North Africa). Given the importance it attaches to historical responsibility and development aid, the EU could serve as a bridge between developed and developing countries. The EU could exercise leadership by pursuing a global level pricing of carbon. One route would be to pursue scaled-up post-2012 mechanisms that allow for the establishment of a global carbon price; another route would be to impose an import tax on the content of CO₂ of all goods

⁹ Over-allocation: generous national allocations of allowances exceeded actual emissions

¹⁰ Carbon price volatility: a peak price of €30 per tonne CO₂ in April 2006 was followed by collapse to €0.01 in September 2007, a recovery in 2008, and another low in 2009 due to recession

¹¹ Carbon leakage: increase in GHG emissions in one country as result of emissions reduction by a second country with strict climate policy

¹² Tax fraud loses EU carbon trading billions: Europol. EU Business, 10 December 2009. See also: *Steuerbetrug weitet sich aus*, Neue Zürcher Zeitung, 8 March 2011, p. 9

¹³ "Öko-Strom im Gegenwind", Neue Zürcher Zeitung am Sonntag, 10 April 2011, p. 17

imported into the EU from countries that do not have their cap-and-trade system or equivalent measures. A key effect of such a tariff is that it would *always* lower global emissions [15]. However, such a tariff is likely to face fierce resistance from countries whose economies depend on exports of gas and oil, like Russia, and on goods, China and India.

USA

The failure of President Obama's administration to enact climate change legislation in 2009 demonstrated that there is no short term prospect for adoption of binding emission targets by the USA. It was apparent in Durban that the US negotiators, envoys of a Democratic President, showed little enthusiasm for almost any part of the international process. And a Republican President would most likely block international climate negotiations. The overwhelming majority of EU citizens consider climate change as a serious problem and call for more action against global warming. In contrast, more than one third of Americans say that climate change is not an issue and only a minor percentage think that it is the consequence of human activity, international polls reveal¹⁴. US society is addicted to automotive mobility and oil consumption, not the least because of the spatial distribution of human settlements. Oil and gas production subsidies have been estimated to be between 15 and 35 billion US\$ per year. The ongoing revolution of production technologies for unconventional gas from shales lowers the gas price and decouples it from the rising oil price¹⁵. Many US coal power plants (still 48%) are being replaced by gas-fired plants (now 18%)¹⁶. The role of nuclear power plants (now 20%) is likely to diminish. In spite of the current addiction to automotive mobility and oil, and the world-wide strategic and military engagements often related to oil, the US potential for future innovation should not be underestimated. Climate-friendly innovation may not be driven sufficiently at the federal level, but bottom-up initiatives, at private, city and state levels¹⁷, in particular California, display an impressive pace ([16]; see also [1], p. 215). Some analysts estimate that very soon US and China will dominate the hotly disputed solar production market¹⁸. Solar World Industries America Inc., along with six other solar manufacturers, have filed cases with the US Department of Commerce and International Trade Commission accusing Chinese solar cell and module manufacturers of illegal dumping in the US market¹⁹. In a recent speech, President Obama announced his intention²⁰ to reduce oil imports, and to produce, by 2035, 80% of electric power from "clean" sources (according to him not only renewables²¹, but also nuclear and clean gas).

Russia

Russia has various reasons to believe it will be a geopolitical winner of climate change. Russia had no problems to comply with Kyoto Protocol due to the base line year

¹⁴ EU, *US citizens split over climate change*. EurActive, 03 December 2009

¹⁵ Gabriela Weiss: *Neue Fördertechnologien senken den Gaspreis*, Neue Zürcher Zeitung am Sonntag, 13 March 2011, p. 30. See also: *Prices drop amid glut in natural gas*, The Wall Street Journal, January 13-15, 2012, p. 10

¹⁶ *Gute Aussichten für Erdgas in den USA*, Neue Zürcher Zeitung 24 March 2011, p. 37

¹⁷ For green federalism in the US: see [1], p. 136

¹⁸ *An Interview with Sam Wilkinson of IMS Research on Changing PV Market Dynamic*. The Solarserver, 23 March 2011.

¹⁹ Kari Williamson: *US solar firms accuse China of dumping solar modules in the US*. Renewable Energy Focus, 24 October 2011. www.renewableenergyfocus.com

²⁰ Christoph Eisenring: *Obama will Erdölimporte senken*, Neue Zürcher Zeitung 31 March 2011, p. 27.

²¹ At present, American wind output still meets only about 2% of the nation's overall demand for electricity. Der Standard-New York Times, 28 February 2011, p. 4.

1990 that was followed by a collapse of its obsolete industry. Moreover, Russia expects that climate change may increase its agricultural yields and expand its ability to enhance and modernise its agricultural food production and exports²². Climate warming may also increase considerably its ability to explore and exploit fossil energy resources in Siberia and in the Arctic Ocean. Russia, already heavily dependent on its exports of oil and gas, has not hesitated to use these resources at the same time as a strategic weapon in the power play with its neighbours²³, as long as there was a shortage of gas in the world markets. Russia, whose élite is heavily dependent on, and personally involved in, the main fossil-fuel industries, clearly has no interest in stopping earning money from supplying its energy-hungry neighbours with gas and oil. At the same time, Russia increasingly thinks of itself as also an Asian nation, as shown when newly-inaugurated president Medvedev chose Kazakhstan and China as his first official visits to, during which he stated: "Russian-Chinese co-operation has today emerged as a key factor in international security, without which it is impossible for the international community to take major decisions"²⁴. Vladimir Putin, the Russian prime minister, is pursuing a project to build a "Eurasian economic union" by 2013²⁵. However, there are few signs that such a union will pursue vigorous climate change policies.

China

In its meteoric rise as an economic super-power, China is working toward creating a major geo-economic shift that will help it secure a supply of various strategic essentials, including energy, food and diverse industrial raw materials. Sustained economic growth of around or more than 10% during decades has been one of the root causes for China's growing contribution to world emissions of GHG. China's elite is heavily reliant on fast gross domestic product (GDP) growth based on energy-intensive industries to retain power. Several counteracting factors may slow down this trend ([2], p. 32-33). *First*, a much lower growth could be caused by a shrinking world demand, or erosion of China's competitive advantages, such as cheap land and cheap labour. A *second* possibility is that an oil-price shock may disproportionately affect an energy-intensive China. China's strategic options in responding to higher oil prices include a scramble for resources (notably in Africa and Central Asia), and further exploitation of coal reserves. A *third* possibility is a political implosion as part of a revolt against the communist party oligarchy and authoritarian state power. This scenario remains unlikely as long as the attraction of high consumption keeps the wider population calm. Helm ([2], p. 33) concludes that none of these possibilities is likely to sufficiently derail China's economy in such a way as to offset projected emissions growth – at least in the medium term until 2030.

However, one important risk remains: environmental degradation – not only through future climate change, but acutely due to water pollution and scarcity – may lead to a collapse of economic growth, massive health hazards and ensuing popular unrest. Indeed, a report by UNDP [17] concluded that if the negative impacts of climate change and environmental degradation are not adequately addressed in China, there is a danger that three decades of

²² But the 2010 fires have destroyed a huge amount of agricultural land and revealed serious structural weaknesses of agricultural management. See: Johannes Voswinkel: *Verbranntes Land–Russlands Aufstieg zur Agrarweltmacht ist in Gefahr*, Die Zeit, 12 August 2010, pp. 34-35

²³ Russian gas and oil politics was used to exert political pressure in various ways on its neighbours or near neighbours including Latvia, Lithuania, Poland, Czech Republic, Belarus, Ukraine, Georgia and Turkmenistan

²⁴ "Medvedev says Russia-China force to be reckoned with". Agence France-Press, May 24, 2008

²⁵ Neil Buckley: *Putin gains traction for his Eurasian grand union*. Financial Times, August 17, 2011, p. 4

social and economic achievements may be reversed. Most energy-consuming assets needed between now and 2020 have yet to be built. As urbanisation rate grows, the country will need to introduce and enforce strict standards of energy efficiency in the residential sector. It will also need to vigorously develop public mass transportation to prevent a massive increase in energy demand and carbon emissions from the transport sector. The low carbon model may bring temporary risks such as job losses, higher prices and fiscal revenue shortfalls. Advantages might include long lasting green job opportunities, greater competitiveness in new technology, technological innovation, improved standing in the world, and reduced harm to human health along with the protection of vital ecosystems. The UNDP China report calls for setting the stage for the introduction of a cap and trade system, based on a national carbon intensity target, and an enhanced system of monitoring and enforcement.

Can climate-change policies facilitate a benign decarbonisation of the Chinese, Indian, and other rapidly developing economies over the next two decades? The central challenge of future negotiations is to achieve a significant and rapid *reduction* in emissions against a sharply *rising* trend. China has been praised for adopting green growth strategy²⁶. Renewables constituted already 9% of the total primary energy mix in 2009²⁷, and are planned to reach 15% by 2020. China just increased its 2015 target for solar power by 50%. China's CO₂ intensity (CO₂ emission per unit GDP) is being reduced annually by impressive 3% ([18], p. 113), but this should be seen in the perspective of its even larger average 8% to 10% annual growth of GDP during the last 30 years. This means that unless there will be a significant slowing down of economic growth²⁸ there still remains an annual growth of CO₂ emissions of 5%-7%, an awe-inspiring number. These huge emissions are mainly caused by burning of coal: China produces 43% of global coal consumption, most of it for domestic use. Each week two new 500 MW coal power plants are being built [19], to cope with the still ongoing electricity demand growth of 4.5%.

Developing countries: who is responsible for paying mitigation and adaptation?

Lack of trust between developing and developed countries in the international climate change negotiations used to be common knowledge. The unequal distribution of past and present emissions, between developing and developed countries, has been at the core of the dispute. But despite the still low energy consumption and emissions per capita, developing countries will dominate much of the future growth in total energy consumption and CO₂ emissions ([1], p. 194).

The concept of dichotomy between developed and developing countries under the Kyoto Protocol has become unrealistic, divisive, anachronistic and ineffective, given that the so-called developing countries given a free pass under Kyoto, including South Korea and Saudi Arabia as well as China and India, are now responsible for 58% of global emissions. Moreover, the rapidly developing economies like China, oil-rich Gulf monarchies, or the poorest African countries are neither in the same league, nor do they necessarily share identical interests. BRIC countries are united in their desire to end the economic dominance of the West. At the same time they are divided by political concepts and by rivalries, such as that

²⁶ Mukul Sanwal: 'Taking the lead' to reduce GHG emissions: the transformative impact of the rise of China. IISD Reporting Services, MEA Bulletin no. 112, 25 March 2011, p. 1 and 4

²⁷ Xie Zhenhua: Strengthening international cooperation to address climate change. Guest Article #45. Climate-L.org, IISD 2010

²⁸ According to the recently adopted Five Years' Plan, the growth should be slowed down to 7% per year. *China verordnet sich langsameres Wachstum*. Neue Zürcher Zeitung 15 March 2011, p. 25

between India and China [20]. Some of the geographic groupings of developing countries articulate common concerns and develop joint positions, especially if they are menaced by the same climate-linked risks like the hurricanes in the Caribbean. However, there are intrinsic divisions within these groups because of varying vulnerabilities with respect to climate change. Interventions of outside powers that wish to increase their influence in a specific region such as Africa or in the Pacific, may add to tensions. According to Muller²⁹, funding of adaptation, in the poorest and most vulnerable countries, is not a matter of charity but may be seen as a matter of *restitution*, of making good for costs imposed from outside. As such, recipients believe they have a right to be involved in deciding how the payments are carried out. In general Western donors impose conditionalities concerning good governance, respect for human rights, democracy, independent justice. China does not impose this type of conditionality, its primary goal is to win the trust of developing countries and gain access to their resources. China's position is that negotiating parties should adhere to the *principle of common but differentiated responsibilities* so as to achieve equitable development globally³⁰. A 2010 workshop³¹ concluded – possibly prematurely – that conditionalities and distrust related to assistance from developed countries are strengthening the trend towards closer links between Africa and China. In fact, the summit in Durban witnessed a *renversement des alliances*: it was the EU which appeared on the scene united and determined, and succeeded to forge common position with the majority of the least developed countries, as well as two important emerging economies, Brazil and South Africa. Their strong support for the EU's proposals made it much harder for the Indians and Chinese to decry them as a developed-world plot against the poor and helpless³².

India and China: partners or rivals in climate matters?

In spite of their economic rise on the world economic stage, China and India are both still considered to be developing countries – mainly due to the continually very low standard of living of their rural populations. According to Promode Kant, the Director of India's Institute of Green Economy³³, during the two years before the Copenhagen summit there were many arguments why China and India should stick together on the whole approach to tackling climate change. Where does India really stand in relation to China? China has overtaken the US as the largest emitter of GHG recently³⁴ while India is the fifth largest. But India's emissions are just about 1.5 tons per capita compared to a stable 20 tons in the US while China's are roughly 5 tons rising rapidly. Both have large reserves of coal to meet the demand for another 50 years and both are competing around the world to access secure oil supplies over a long time horizon. The similarities of large aggregate emissions, large populations, and endless demand for energy have persuaded some to put much faith in a common China-India strategy in climate change negotiations. But similarities appear far fewer than the mismatch. In slowing down the growth of emissions, China is relying on its evident demographic success in curbing its population growth drastically without parallel

²⁹ Müller, B.: *No trust without respect*; Oxford Energy and Environment Comment, March 2010

³⁰ Xie Zhenhua: *Strengthening international cooperation to address climate change*. Guest Article #45. Climate-L.org, IISD 2010

³¹ Foundation for International Law and Development (FIELD): *Workshop on international decision making following Copenhagen–Summary Report*. London, 24–25 March 2010

³² *A deal in Durban*. The Economist, December 11, 2011

³³ Kant, P.: *Will the Sino-Indian Climate Alliance Hold?* Institute of Green Economy, 3 June 2010. www.igrec.in

³⁴ In 2010, China hit two more records: it displaced Japan as the second economic power in the world, and became number one in energy consumption

outside the developed world. China is adding 2 nuclear reactors per year and staying in the forefront of R&D in nuclear technology and nuclear sciences. China has been expanding its forest cover relentlessly for the past several decades, at a phenomenal 4.1 million ha or 2.2% per year, with a carbon sequestration rate of 800 Mt of CO₂ per year. China is undertaking remarkable efforts in developing carbon capture and storage. In contrast, India has no population growth reduction programme. In removing carbon from the atmosphere, India is not in the same league: the annual sequestration is 38 Mt, with an annual increment of only 0.6%. On top of these sharp differences³⁵, the central cause for divergence in the Chinese and Indian approaches lies in what these two countries really want and fear from climate negotiations. China's one great fear is the very real possibility of imposition of carbon tax linked to production linked emissions and on emissions in shipping of both the raw material and of finished products. For a country that sources a large part of its raw material from across the world to manufacture for consumers everywhere this would be disastrous. China's negotiation strategies should thus essentially focus on preventing developed countries from forming carbon barriers around their economies. India's dependence on exports is much lower and its exports are also less energy-intensive, so carbon tax is not only less worrisome, it might actually make India's exports more competitive by creating a level playing field. For India a low-carbon path is currently impossible on account of deterrent costs unless it is backed by massive financial support and very liberal technology transfer. Both China and the US seemed to use the climate negotiations in their pursuit of dominance in the world, with the West wanting to preserve its status and China seeking to overthrow them³⁶. In view of this constellation, it is not surprising that the Durban roadmap for a new treaty was achieved only against strong objections not only from the USA, but also from the biggest developing-country polluters, India and China.

Geopolitics: processes and problem areas

In view of the specific positioning of the major players, selected problem areas will be addressed in the present paper to illustrate the mutual influence of geopolitical interests and climate change. Some of these examples arise as a consequence of climate change (warming of the Arctic, dwindling water from the mountains, endangered island states), some of them are important contributors to global warming (cheap fossil energy sources, increased demand for agricultural and forest products), whereas others may fail to live up to the expectations of being instruments of climate change mitigation (nuclear power, biofuels). However different, all these examples have in common that they possess clear geopolitical features.

Arctic: new opportunities, new risks, new conflicts

The planetary warming will not have a uniform effect over the entire globe. The Arctic is now experiencing some of the most rapid and severe climate changes on earth [22]. Monthly December ice extent for 1979 to 2011 shows a decline of 3.5% per decade³⁷. The decrease in ice cover allows Arctic Ocean waves and storm surges to batter the shore harder and longer, eating away at the fragile coastline. This structural instability is made even worse

³⁵ Kant did not mention that there has been continuing rivalry and tensions between the two countries in the past, including several military clashes because of China's claims on territories in Kashmir

³⁶ According to [21], contemporary China, in its process of modernization, cannot escape its history of several thousands of years. Key reminiscences are the deeply traumatic humiliations imposed on China by Western powers during the 19th century

³⁷ National Snow & Ice Data Center, January 28, 2012. <http://nsidc.org/arcticseaicenews/>

by thawing of the permafrost. An even more serious problem is that the permafrost thaw is starting to release CO₂ and methane that has been frozen in the ground for millennia. Around 550 Gt of carbon is thought to be frozen in northern Siberia's permafrost – if released, it would equal around two-thirds the amount that is already in the atmosphere [23]. Meanwhile, the changes in the Arctic are increasingly being seen as an opportunity for resource extraction by oil and gas industries. Russians, Canadians, and Danes have launched scientific expeditions to determine the extent of the continental shelf. Out of the eight members of the Arctic Council, the five riparian states have claimed stewardship [24] over the Arctic Ocean, based on the UN Convention on the Law of the Sea.

As long as there is no Arctic Convention, each Arctic state is pursuing its own strategy [25]. As the oceans open up, potentially one of the industries with the most gain in the long term is global shipping ([26], pp. 79-84). The melting Arctic sea ice opens up a whole new transportation route, the Northwest Passage through the islands of the Canadian Arctic. The London-Tokyo route alone would be thousands of miles shorter than travelling via either the Panama or Suez Canals. This means huge savings for the companies and a big strategic advantage for those with access³⁸. Shipping is big business – it constitutes about 5% of world trade. The real cost of shipping has dropped by around 80% in 25 years due to containerization, bigger ships, and computer-assisted resource allocation ([26], p. 81). The annual increase of traffic on shipping trade lanes shows how Asia is a key supplier to North America and Europe. However, Asia is not just exporting. In 2008, Chinese parent companies controlled the third highest percentage of the world fleet (11.8%), after Greece (17.4%), and Japan (15.1%) [27]. China is creating a major geo-economic shift that will help it secure a supply of various strategic essentials, including food. If shipping starts going through the Northwest Passage, much of it will pass through the 53-mile-wide Bering Strait, which will become of prime geopolitical importance. The thawing of the Russian route could significantly affect political alliances ([26], pp. 82-84).

Oil, gas and climate politics

All the improvements in energy and carbon intensity have not been enough to offset rising energy demand ([1], p. 193). One reason for that is the small amount of world public funding for energy related R&D in comparison with huge world subsidies to energy ([1], p. 293), and in particular to petroleum products. In real markets the rate of consumption of fossil energy is the result of both demand and supply. Sinn [28] has stressed the overriding importance of the supply side in the functioning of the world fossil energy resource markets. The proprietors of these (non-renewable) resources have to decide which strategies to choose in finding an optimum between short-term and long-term revenues. The proprietors of gas and oil reserves are not willing to have their strategies being dictated by policies aimed at reducing consumption of their products. In contrast to the situation about 40 years ago, when big oil companies controlled the supply market, between 77% and 90% of known oil reserves are now under the control of state funds³⁹. There is a growing rivalry between the state oil funds and the international multi-nationals, whereby the latter concentrate even more on the comparative advantages of technical know-how such as deep off-shore exploration and

³⁸ According to the Xinhua News Agency, Russia has decided to give green light to a Norwegian gas tanker to pass the Northeast Passage in the Arctic Ocean to Japan, as the Norwegian Ship-owners Association said on January 7, 2012, <http://english.cri.cn/>

³⁹ Karin Kneissl: *Offshore-Bohrungen im Zwielicht*. Neue Zürcher Zeitung, 10 June 2010, p.31; Peter Rásonyi: *BP nach „Deepwater Horizon“*. Neue Zürcher Zeitung, 26 June 2010, p. 45

drilling, as is the case with BP in the Caribbean. With some exceptions, *e. g.* the Norwegian Statoil, the large majority of state oil and gas funds are controlled by authoritarian regimes that are rarely interested in environmental and climate change issues, and more in power politics that will preserve the dominance of ruling élites⁴⁰. A point in case is a clear division of perceived interest in the international climate change negotiations observable between OPEC member states of the Gulf and other states [29]. Despite clear indications regarding future negative impacts of climate change in the region, Arab states of the Middle East still do not perceive climate change as a threatening factor to their economic development and stability.

All the Middle East Arab states may be divided into two categories: the oil exporting monarchies⁴¹, with an average GDP *per capita* ranging from 24 000 to 86 000 US\$, and the resource scarce/unstable countries⁴² with GDP *per capita* from 2 400 to 13 000 US\$. Ironically, all Arab countries in the Middle East, including the wealthy monarchies of the Gulf with the world's highest per capita CO₂ emissions, are classified in the UNFCCC as developing countries, and, therefore, have not faced binding emissions caps so far. The OPEC members' focus on the stability and continuity of oil export revenues continues to override any concern over their vulnerability to climate change itself. The resource-poorer states, with the lowest GDP and CO₂ emissions will most likely be those that suffer the most as climate change advances. The stability of the oil exporting monarchies in the coming decades will mainly depend on the continuance of international demand for oil and their capability to diversify their economies away from oil revenue dependence. Their international climate policy positions have so far been guided greatly by the self-preserving interests of the élites who seek to maintain the *status quo* of power in both domestic and international energy politics. These states' interests in the international climate regime often run parallel to those of oil companies. In contrast, the resource-poorer Arab states have not had a similar vested interest in the climate change negotiations nor the financial means to build up a strong and competent core of negotiators. They have often given support to positions advanced by the OPEC member states, frequently formulated by representatives from the oil sector. The OPEC member states, led by Saudi-Arabia, have been carrying out a long-term strategy of obstructionism since the early 1990s: their skilful negotiating strategy is a mixture of rhetoric, financial demands, and incentives and, in some cases, intimidation ([29], p. 7). Several obstacles continue to hinder regional cooperation to combat climate change in the Middle East as a whole: Israel's and Iran's and their Arab neighbours' difficult, even volatile, relations and a mutual distrust among the Arab states. Whereas the Gulf Cooperation Council is currently the best example of regional multilateral cooperation that includes a common market and plans for a common currency, all-inclusive regional cooperation in the area of climate change is not on the horizon as long as the current geopolitical configurations prevail.

Competition for land space: forests, food, (bio-)fuels

"Who controls the territory" is a classic geopolitical issue. It is now back in full strength, not only because of the changing world order, but also in relation to climate change

⁴⁰ Sinn [28] (p. 382-389) argues that 75% of world oil reserves are located in Venezuela, Kazakhstan, Russia, the Middle East, Libya and Nigeria—countries and regions with predominantly unstable political circumstances and correspondingly unsafe property rights of the ruling clans that control the resources. When the rulers fear to be overthrown, they will be tempted to sell the oil and to cash at an accelerated rate

⁴¹ Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates, forming the Gulf Cooperation Council

⁴² Egypt, Jordan, Lebanon, occupied Palestinian territories, Syria, Yemen and Iraq

and energy security. The question is: how should the limited land space be used, and who decides. The main competing modes of land exploitation addressed here are: forest ecosystems and various ways of their use; food production; growing biomass for bio-fuels; and space requirements for renewables.

Terrestrial ecosystems store more than twice the carbon⁴³ in the atmosphere and remove about 3 GtC per year through net growth [31]. Land-use changes over the past 100 years – mainly clearance for croplands, pasture and timber – have therefore played a significant role in altering soil carbon stores and fluxes. Emission from global land-use change probably amount to 5-8 Gt CO₂eq per year, implying that up to 20% of current emissions are from this category, primarily *deforestation* in Brazil and Indonesia. Tropical deforestation alone now accounts for about 16% of global emissions, and is the fastest rising source of emissions [32].

Deforestation occurs because the value of the logged timber, coupled with the value of converting the forest to agriculture (for commodities such as soy and palm oil), is greater than the value of the standing forests. Stern [33] estimated that emissions from deforestation could be roughly halved for around US\$5 per tonne of CO₂, at a total of US\$15 billion per annum. Strategies based on protection and management of forest ecosystems – avoided deforestation, afforestation, reforestation, sustainable forest management – could do much to enhance the natural drawdown⁴⁴. However, such strategies are increasingly facing serious land-use conflicts due to the rapidly growing demand for food-producing agricultural land. The world-wide *agricultural surface* – actually 1.5 billion ha – has to cope with a growing population (adding 200.000 per day to feed), fighting the basic hunger of 850 million, and satisfying increasing meat consumption, in particular the huge Chinese population. Indeed, about three quarters of the loss of forests are due to their conversion into agricultural land⁴⁵. States with limited water and food resources started even buying or leasing land in developing countries to assure their food security. China has reportedly secured 2.8 million ha in Congo, 100.000 ha in Zimbabwe, and South Korea 690.000 ha in Sudan⁴⁶.

To make matters more acute, the projected or existing production of *biofuels*⁴⁷ is generating an additional pressure on the forests, whereby the effects of bio-fuels on climate change mitigation, based on life-cycle analyses, are not always positive. A specific problem arises when forest clearing by fire precedes the growing of bio-fuel feedstock, as is the case in Brazil, Indonesia, and Malaysia. In such cases it takes a very long time, roughly between 17 years (for sugar cane ethanol) and 400 years (for biodiesel from palm oil), to balance the CO₂ emissions due to forest fires ([28], p. 232). The potential consequences for global geopolitics

⁴³ Tropical and sub-tropical forests store the largest amount of carbon (550 Gt C); the boreal forests hold the second largest stock of carbon, mostly stored in the soil and waste. Draining of peat lands, certain forestry practices and inappropriate fire management cause significant losses of stored carbon [30]

⁴⁴ The UN programme to reduce GHG emissions from deforestation and forest degradation (REDD) received a large boost recently when a conference on climate and forests in Oslo concluded with Australia, France, Germany, Japan, Norway, UK and the US agreeing to finance REDD with a combined four billion US\$. See: Global Issues, Friday, June 4, 2010, www.globalissues.org. But the implementation of the scheme will be challenging. Property rights need to be strengthened, as do democratic institutions which are needed to protect the poor and to resolve and arbitrate between competing usage claims. Large payments for avoided deforestation could become counterproductive in the countries buying permits if the funds are not directed towards achieving clear development goals

⁴⁵ *Das Schicksal der tropischen Regenwälder*, Neue Zürcher Zeitung, 21 July 2010, p. 48

⁴⁶ "Die Zeit", 11 February 2010, p. 21

⁴⁷ All biofuels are in some way derived from biomass. First generation biofuels include bioalcohols, green diesel, biodiesel, vegetable oil, bioethers, biogas, syngas and solid biofuels. Most second generation biofuels are still in development, whereby cellulosic ethanol production poses difficult technical problems to solve. Algae biofuel, still in an early phase of development, is an example of third generation biofuels. Wikipedia, article Biofuel. <http://en.wikipedia.org/wiki/Biofuel>

of massive introduction of first generation bio-fuels are considerable. The demand for bio-fuel feedstock will increase prices of maize, sugarcane, cassava, and indirectly have an effect on prices of livestock that depend on, say, maize [34]. Shifts in crop production and the changes in world price of agricultural commodities due to the expansion of the bio-fuel market are expected to have global impacts on consumers: food price volatility has the largest impact on the extremely poor, those who spend 55-75% of their income on food. The "tortilla crisis" in Mexico City in January 2007 that exploded after the doubling of the price of maize in 2005-2006, allowed a glimpse in the type of popular riots that may be expected if the maize is more profitably used for bio-ethanol production. Sinn ([28], pp. 237-246) correlates the extreme rise of oil prices in 2008 with famine-related riots in 37 countries in the same year. His explanation as an economist is that oil and food are linked, but not in a symmetric way: foodstuff may be used to produce fuel, but fuel cannot be converted into food.

Power generation by renewables, always requiring land surface, may lead to geopolitical implications. One example is the DESERTEC concept to harvest the huge potential for solar and wind energy in the desert areas of the Middle East and North Africa (MENA), and import solar electricity to Europe where the potential is limited and unevenly distributed⁴⁸. The DESERTEC Foundation launched an industrial initiative supported by several top companies and banks. The technologies chosen to be used need not be developed: they include concentrating solar thermal power (CSP) because of its ability to supply power on demand for 24 hours per day; and high voltage direct current (HVDC) for transmission of electricity over vast distances [35] whereby loss of power during transmission can be limited to only about 3% per 1000 km. The planned SuperSmart Grid⁴⁹ could have important implications for participating countries. The overarching goal is providing clean, cost efficient electricity for EU and MENA as soon as possible and based on economic co-operation between the countries in the region. It would speed up the process of cutting European emissions of CO₂ and increase the security of European energy supplies. For people in the MENA region, this would mean better economic prospects through plentiful supply of clean electricity, an improved infrastructure and potential for the desalination of sea water. But the project has to confront high political, financial and security challenges and risks. Its roadmap is extremely ambitious, both in terms of financing (400 billion €), and the timetable (100 GW of exportable solar power in 2050); overcoming deficits of governance and technology in North Africa will require time; and there are incalculable safety and security risks in one of the still most unstable regions of the world, which is considered as a retreat area for some of the most militant Islamic movements. The project would also create a future geopolitical dependence of the EU on that region. The DESERTEC concept might be of considerable future value both for the EU and the North African countries, but the EU has first to sort out its energy policy and to define more strongly its security policy in the MENA region.

Nuclear power: problem or solution?

The tsunami of March 2011 has shattered Japan in its fundamentals. But it was the nuclear disaster in Fukushima, triggered by the tsunami, which sent reverberations around the world, in particular in Europe. The importance of seismic activity for the siting of nuclear reactors has received renewed urgency. Most countries announced re-examination of safety

⁴⁸ <http://www.desertec.org>

⁴⁹ Policy Roadmap to 2050—a 100% renewable electricity supply for Europe and North Africa possible. Posted by Antonella Battaglini, 29 March 2010, www.supersmartgrid.net/

standards and stress tests for their existing nuclear power plants. Germany announced immediate temporary closure of seven nuclear power plant, three additional countries (Italy, Switzerland, and Venezuela) chose to opt out of nuclear power. But very few countries outside Europe announced closure of existing reactors or outright opting out. At the time of the Fukushima disaster, 27 nuclear reactors were under construction in China, 11 in Russia, 5 in South Korea, and 6 in India. None of these countries decided to stop the projects. China, Japan, Korea, India are not going to give up the nuclear option, neither are the USA or Brazil. Similarly, the majority of European nuclear power countries (Belgium, Czech Republic, Finland, Hungary, the Netherlands, Poland, Romania, Russia, Spain, Slovakia, and Sweden) did not opt out of nuclear⁵⁰. Of course the public opinion – mainly in high-income countries that invite or at least tolerate public criticism – has become strongly sensitized with regard to the nuclear option. The reductions of nuclear capacities announced in some countries will not lead to immediate bottlenecks in electricity supply, but are likely to result in higher prices⁵¹ – by how much is a hotly discussed question. Moreover, accelerated adaptation of energy strategies towards increased contributions of renewable is taking place all over the world.

What are the implications of Fukushima for climate change policies? In Europe, there is a general tendency to replace closed electrical power capacities by gas-fired plants. Also wind power could contribute, as its costs are approaching the market price. However, wind power, because of its variability is presently still dependent on the base load that is provided by gas-fired plants. Thus in the short and the medium term, diminishing nuclear power in Europe means in the first place a boost for gas, and thus more CO₂ emissions and more import dependence – mainly from Russia. In the longer term, as many people hope, renewables might be able to close the gap caused by a nuclear opt-out. But a different type of nuclear renaissance could also be imagined: development of smaller, modular reactors with inherently high safety. Such reactors might result from a different economic thinking in the future. At present, the price of nuclear power generation does not include the full external costs – insurance against highly improbable but extremely costly residual risks⁵². Inclusion of such costs might put more pressure on research and development of small-size, inherently safe nuclear reactors.

Dwindling water from the mountains

A large percentage of the world population derives water from watersheds. The potential for water scarcity is most pronounced for the nations surrounding the Himalayas. This massive range encompasses about 15,000 glaciers⁵³, and is one of the largest storehouses of fresh waters outside the Polar Regions⁵⁴. The Himalayan watershed rivers link close to half the world's increasingly water-starved populations, and each country is dependent on flow from the upstream – more often than not a potential for upstream-downstream trans-boundary conflicts⁵⁵. The Himalayan water supply is facing the twin threats of glacial melt ([36], p. 20) and changing precipitation patterns. Whereas the immediate impact of glacial melt is localized

⁵⁰ Rolf Hartl: *Die Kernenergie ist angezählt, aber nicht k.o.*, Neue Zürcher Zeitung, December 29, 2011, p. 23

⁵¹ Urs Meister: *Das Desaster in Japan trifft den europäischen Strommarkt*, NZZ March 19, 2011, p. 31

⁵² Marco Metzler: *Pandoras Atomkraftwerke*, Neue Zürcher Zeitung 25 March 2011, p. 39

⁵³ <http://en.wikipedia.org/wiki/Himalayas>

⁵⁴ The Himalaya watershed provides water directly to Afghanistan, Bangladesh, Bhutan, China, India, Nepal and Pakistan (and indirectly to numerous other countries), and is the source of the world's three largest water systems.

⁵⁵ One of the relatively minor rivers, the Mekong, starts in the Tibetan Plateau and then flows over a length of more than 4000 km through 6 countries – China, Myanmar, Laos, Cambodia, Thailand, and Vietnam – before ending in the South China Sea

flooding, the more serious and increasing threat is water scarcity. Already now 22% of Indians face “absolute water scarcity” [37], and water scarcity has caught the attention of the Chinese government as one of the key environmental factors. China is ahead of many of its neighbours in its determination to secure water supplies in any way it can. Approximately 18% of China is desert, mainly concentrated in the north. Paskal ([26], p. 143) speculates that control over the Himalayan watershed may have been a factor in the Tibet takeover, and a desire for access to the water from Siberia’s rivers may be one of the components of Sino-Russian relations. The government is concerned⁵⁶: the results are engineering plans of staggering proportions, such as a \$ 63 billion canal, to be built during 50 years, which would bring water from the south to the north ([26], p.144). But even if such a mega-project would alleviate the serious water deficit and imbalance, it would not solve problems related to water quality caused by forced industrial growth: the toxic pollution of surface waters is not only a serious health problem⁵⁷ but it also adds to the problem of water scarcity. Solutions would require enormous investments and institutional reforms. The strictest pollution regulations and their implementation could only be imaginable within a transparent political and judicial system.

Devastating floods

In one fundamental respect, almost all scientists agree: sea levels are already rising and will continue to rise [38]. Whereas there are several contributing factors (thermal expansion of water, thawing of permafrost, melting of mountain glaciers), the oft-repeated long-term nightmare scenario for sea level rise is the collapse of one of the great ice sheets covering huge sections of the Earth’s land area: Antarctic and Greenland. Even apart from the effects of sea rise, storm surges and cyclones are predicted to increase, perhaps not in numbers but in intensity, resulting in devastating floods. In Bangladesh, in the Bay of Bengal, it can take an inundation of more than 50% of the country for a flood to be considered “heavy” [39]. There are already Bangladeshi refugee camps along the tense Indian border and forecast changes could swell these numbers by millions. Large numbers of poor and desperate refugees form formidable security problems, especially in the likely case of spillover into a neighbouring state. At most obvious risk of being lost, are atoll type islands, like the ones that make up the country of Tuvalu in the Pacific, and the Maldives in the Indian Ocean. Many atolls are only a few feet above sea level, having a natural protective barrier in the form of coral reefs. Coral reefs are under pressure all around the world, mainly because they can survive only within a rather narrow temperature range. However, speculations that 60% of the world’s coral reefs could be lost in the next 10 to 30 years, as mentioned by Paskal ([26], p. 194) are not yet convincing. Even so, small islands have characteristics which make them especially vulnerable to the effects of climate change, sea-level rise and extreme events. Their water resources are likely to be seriously compromised [40]. If Tuvalu and other countries have to be abandoned because they become uninhabitable, it could have profound repercussions for the global balance of power. The question would be: if Tuvalu and other states physically disappear, do they cease to exist as a legal country? Do they lose their seat at

⁵⁶ Chinese President Hu Jintao is himself a hydraulic engineer

⁵⁷ Under pressure from Beijing government ministries, the World Bank has cut by roughly one third a report on the widespread cost of pollution in China, according to the Financial Times. The report had concluded that some 750,000 people die prematurely each year in China due to extremely poor air and water quality, asserting that China’s rural poor were “at a substantially higher risk from surface water pollution than the non-poor”. <http://www.worldwatch.org/node/5192>

the UN? Does their territory become international waters? Or do vast swaths of ocean end up being administered by a population that does not live there? These are legal questions with complex and far-reaching geopolitical implications ([26], p.218).

As a whole, the Pacific region is of great geostrategic importance, functioning as a buffer zone between the Americas and Asia. The Pacific is a vast store of essential and strategic commodities. Kiribati alone is nearly 5000 km from east to west and 2000 km from north to south, with an exclusive economic zone of about 3 million sq km. Control over the Pacific means access to fisheries, sea-lanes, underwater resources, geostrategic advantage, and political leverage. Several states have a vital interest in the Pacific, including Australia, New Zealand, Japan, and Russia. But the most critical players are China and the US. The Pacific is a key component of China's global positioning. From China's point of view, this zone is a potentially vulnerable vast backdoor, with a string of "steppingstone" islands leading from the Americas right up to the China mainland⁵⁸. Whereas the US assumes that the Pacific will be a secure area, China, in its quest for regional if not global dominance, is making military purchases of submarines, ships and weapon systems that back up its navy's doctrine of "offshore active defence" [41], with the Navy's primary focus on preparing for operations within the "first and second island chains".

The fourteen small Pacific countries, with a combined population of approximately 8 million, have a disproportionately large voting influence in the UN and other international organizations. Achieving as much political influence as possible with the Pacific mini-states is a key for a geostrategic advantage for any of the big players in the Pacific theatre. On the other hand, the South Pacific island states are perfectly aware of their situation and vulnerability, in particular with respect to climate change. The 2010 summit of the states represented in the Pacific Islands Forum (PIF) was dominated by water and climate issues, as the Prime Minister of Vanuatu described climate change as a great danger for the existence of the population in the South Pacific⁵⁹.

Getting prepared for climate refugees?

The IPCC [38] and the Stern report [42] warn that the effects of climate change – including rising sea levels, heavier floods, more frequent and severe storms, drought and desertification – will cause large-scale population movements. Figures range from 50 million to 1 billion; a frequently cited number is 200 million climate change migrants by 2050 [43]. While the term "climate change migration" implies that a direct or even mono-causal line can be drawn between climate change and displacement, it has become evident that the assumption that climate variability leads to migration in a linear way is not supported by empirical investigation [44]. In attempting to determine the relationship between climate change and migration perhaps the most difficult variable to account for is human adaptive capacity or "resilience" [45]. Population, poverty and governance are key variables [46]. Non-climatic drivers can be as important as the strength of the climate itself. However, regardless of the above considerations, there is a consensus in literature that climate change will lead to

⁵⁸ China's navy has been playing an active role for a long time in the boundary conflicts and claims in the front door South China Sea. The central issues—who controls the maritime lanes, and the still unexplored underwater resources around thousands of small islands, including the Paracel and Spratly islands—led to a collision of interests between China and other riparian countries, in particular Vietnam, Malaysia, the Philippines and Taiwan. Peter A. Fischer: *Muskelspiele im Südchinesischen Meer*. Neue Zürcher Zeitung, 31 Juli 2010, p. 6. Bernhard Bartsch: *China lässt die Muskeln spielen. Aggressive Machtdemonstration im Südchinesischen Meer beunruhigt die Nachbarstaaten*. Neue Zürcher Zeitung am Sonntag, 29 August 2010, p. 6

⁵⁹ René Vautravers: *Klimawandel dominiert Südpazifik-Forum*, Neue Zürcher Zeitung, 9. August 2010, p. 5

major forced displacements over time. Piguet [47] argues that forced displacement will result principally from rising sea levels, but will only progressively manifest itself over the coming centuries, with the exception of the flooding of certain islands. However, there is considerable controversy among migration researchers as to whether it is possible to predict the magnitude of displacement due to drought and desertification. There is a broad consensus that current protection at international law does not adequately provide for a number of categories of persons likely to be displaced by climate change. The Refugee Convention [48] relies upon a restrictive definition of a refugee as someone with a well-founded fear of being persecuted for reasons of race, religion and nationality, membership of a particular social group or political opinion. In view of the situation in the South Pacific, it is unsurprising that it was a group of Australian lawyers that elaborated a proposal of a convention for persons displaced by climate change [49].

Climate change in an evolving world order

Very few will be willing to qualify the commitment of the Durban summit as an unequivocal success: after all, its main result is a meagre agreement (1) to continue to work towards identifying a global goal for substantially reducing global emissions by 2050; (2) to continue to work towards identifying a time frame for the global peaking of GHG emissions based on equitable access to sustainable development; and (3) that consideration of a global goal for substantially reducing global emissions by 2050 and the time frame for global peaking of GHG emissions cannot be undertaken in the abstract and will necessarily involve matters related to the context for such considerations⁶⁰. But behind the diplomatic language one can discern a new realism and new geopolitical constellations.

First, there is no mention of a 2 °C limit – the global goal is to substantially reduce global emissions by 2050, including the identification of a time frame for reversing the presently irresistible increase of GHG emissions. Lord Nicholas Stern noted that the world is heading towards a 3 °C increase in global average temperature, and warned that this situation "will bring temperatures not seen for three million years, with unforeseeable consequences."⁶¹

Second, the compromise admits implicitly how arduous the way to cope with climate change will be: not in the abstract, but by ensuring equitable access to sustainable development. It is a concession to the dashing economies of China and India, but also a side blow at the same time, warning them that they should not orient themselves on the example of the West.

Third, the compromise was only made possible by the pressure of a new coalition consisting of Europe, Brazil, South Africa, the AOSIS⁶² negotiation group and a large group of African states – a surprising geopolitical development, which may or may not hold in the future.

The World Economic Forum (WEF), one of the most influential meeting places of world leaders, has been publishing its Global Risks series since seven years. In its most recent edition, Global Risks 2012 [50], fifty risks, defined as product of impact and likelihood of a certain development, have been quantified and compared in five main categories: economic,

⁶⁰ FCCC/AWGLCA/2011/L.4. <http://unfccc.int/resource/docs/2011/awglca14/eng/crp39.pdf>

⁶¹ *Davos Forum Debates Adaptation to Climate Risk*. Climate Change Policy & Practice, 26 January 2012. <http://climate-1.iisd.org/news/davos-forum-debates-adaptation-to-climate-risk/>

⁶² AOSIS (Alliance of Small Island States established in 1990) is an intergovernmental organisation of 42 low-lying coastal and small Island countries, the main purpose of which is to consolidate the voices of Small Island Developing States to address global warming

environmental, geopolitical, societal, and technological. In contrast to the 2011 report, the main environmental risks (rising GHG emissions, failure of climate change adaptation) are seen in 2012 only as second in comparison to the main socio-economic risks (chronic fiscal imbalances, severe income disparity, water supply and food shortage crises). The report emphasizes the singular effect of a particular constellation of global risks rather than focusing on a single existential risk. Several distinct constellations of risks present a very serious threat to prosperity and security. Two of those are relevant for the understanding of geopolitical aspects of climate change.

First, the interplay of *fiscal, demographic and societal risks* could result in a world where a large youth population contends with chronic, high levels of unemployment, while the largest population of retirees in history becomes dependent upon already heavily indebted governments. Both an income gap as well as a skills gap, threaten social and political stability. This could precipitate a downward spiral of the global economy fuelled by protectionism, nationalism and populism.

Second, as the world grows increasingly complex and interdependent, the constellation of *risks arising from emerging technologies, financial interdependence, resource depletion and climate change* exposes the weak and brittle nature of existing safeguards – the policies, norms, regulations or institutions which serve as a protective system. Our safeguards may no longer be fit to manage vital resources and ensure orderly markets and public safety. The interdependence and complexity inherent in globalization require engaging a wider group of stakeholders to establish more adaptable safeguards which could improve effective and timely responses to emerging risks.

The foregoing risk assessments have implications for the ways how to cope with climate change, with opinions often divided, as was shown during the discussions at the most recent Davos WEF meeting⁶³. Christiana Figueres, UNFCCC Executive Secretary, warned that the private sector "is not immune" to the effects of climate change, calling on governments and the private sector to work together. She urged businesses to "step up" and climate-proof their operations, adding that the technologies developed for that purpose should be put on the market for wider dissemination and use. Kenneth A. Hersh, Founder and Chief Executive Officer, NGP Energy Capital Management, USA, noted that large-scale deployment of clean energy technologies is likely to take another 50 years, during which time big polluters like China will continue to raise their emissions unapologetically. Therefore, he reasoned, there is a need to "look at the right way to allocate sources", which he said should focus on adaptation.

The findings of Global Risks 2012 have geopolitical implications with regard to climate change. A downward spiral of the global economy, accompanied by protectionism, nationalism and populism would most likely amplify the focus on – presumable or perceived – national interests, defined in narrow economic terms, as opposed to global threats. One consequence would be a weakening of supranational institutions such as the UN or the EU. Ultimately, there might arise an increased probability of using force in solving trans-boundary conflicts – including those related to water and environmental degradation.

In a world of growing risks and corresponding tensions, the ability to cope with environmental degradation might be considered, not only in our time, as an additional, and possibly critical, measure of comparative power. Resilience to do that successfully depends,

⁶³ *Davos Forum Debates Adaptation to Climate Risk*. Climate Change Policy & Practice, 26 January 2012. <http://climate-1.iisd.org/news/davos-forum-debates-adaptation-to-climate-risk/>

among other factors on good governance and geographic advantages. Good governance, a measure of collective ingenuity, is largely function of the political system and favoured by higher degrees of participation, whereas geography is a key factor with regard to existing but changing regional resources (climate, water, space, soil, renewable potential, minerals, fossil energy resources ...)⁶⁴. There is evidence that effective governance goes hand in hand with good environmental performance ([1], fig. 8.6).

Where is the quest for power leading to in a globalised world of growing population, increasing inequality, rising consumption, deteriorating environment and tougher competition? A debt-ridden US will stagger on, Europe may falter, new powers will rise on Beijing's commodity back. No common rule book will be found, and no cohesive blocs formed either way ([9], p. 11). Dodds ([3], pp. 113-114), reiterates "the fundamental importance of territory and geographical relationships within global geopolitics ... State territories remain terrifically important in defining national identities and it would be complete exaggeration to claim that globalization has eroded this connection". In an address to the Congress of Deputies of Spain at the Superior Centre of National Defence Studies in Madrid, Spain, UNFCCC Executive Secretary Christiana Figueres noted that the link between security concerns and climate change has gained importance over the past few years⁶⁵.

Conclusions

The findings and recommendations of IPCC regarding climate change due to the anthropogenic increase of GHG in the atmosphere have proved remarkably robust. Keeping the global temperature increase below 2.0 °C has proved to be an illusion as it can only be reached by halving global carbon emissions until 2050. Since the beginning of an international response to climate change the world order has been undergoing a thorough change. With the rise of emerging economies, in particular China, the division of the world under the Kyoto Protocol in two blocks – developed and developing countries – has become outdated. Global carbon emissions continue to grow. With no emission restrictions imposed on the USA, China, and India, the emissions reductions by the EU do not carry weight, in particular due to the shift of carbon-intensive production to emerging economies. The grim outlook threatening the most vulnerable countries – least developed countries, coastal areas and many island states – stresses the urgent need for adaptation to climate change consequences.

If mitigation is about energy, adaptation is about water, requiring adequate responses to water "volatility": droughts and floods are predicted to increase in frequency and gravity. But the "water crisis" is in reality a "crisis of water governance": good governance, including the quality of water management, determines in the first place resilience with respect to natural and man-made disasters.

The sweeping changes taking place in an increasingly globalised and interconnected world demonstrate that climate change is only one of the numerous challenges, including financial interdependence, supply of energy, water, food and natural resources, and all of them under the pressure of population trends. As the world experiences a shift of global power to the East, the geopolitical implications *of* climate change, or *for* climate change, are becoming of prime interest. They find their expression both in the positions of the major

⁶⁴ A discussion of how to achieve a sustainable future in the European region is addressed in [51]

⁶⁵ "UNFCCC Executive Secretary Discusses Security and Climate Change", 15 February 2011, IISD Reporting Services.
<http://climate-l.iisd.org/news/unfccc-executive-secretary-discusses-security-and-climate-change/>

players with regard to climate change, and in the related problem areas. The major players: US, Russia, China, India, and to some extent the EU, are not yet ready to cope effectively with the implications of climate change. Electorate bodies in the democracies are not prepared to pay for the costs of mitigation, whereas authoritarian élites of emerging economies continue to force economic growth in order to avoid popular unrest. Climate change is given lower priority than conserving or increasing political and economic dominance. Some countries like Russia and Canada may even expect advantages from the thawing of permafrost and an Arctic Ocean free of ice. Oil and gas exporting countries are not particularly keen to see an effective mitigation policy that would diminish demand for their products.

With a growing population, there is increasing competition between various options of land use: for timber, biofuel or food production, as well as space for wind or solar power. The geopolitical implications of climate change become particularly visible in the case of dwindling water from the mountains that may increase trans-boundary disputes, and of devastating floods that might make coastal regions or island states inhabitable, forcing desperate refugees to look for space and livelihood elsewhere.

Controlling the use of space and resources, both on land and at sea, has always been a central variable of geopolitics. The US has subordinated its climate-change policy to conserving its dominant role in the world, which is perceived to depend on continuing reliance on oil and gas consumption. China's climate-change policy has been made conditional on the ongoing economic growth which is the basis for achieving its long-term goals. States with great power appearances and an exceptional hunger for fossil energy, such as the US, China, and Russia, are also investing heavily in military assets. China's policies have so far demonstrated much pragmatism and restraint in handling power – but also ruthlessness where access to vital resources is concerned. The EU, still the largest economic space in the world, sees its future role in promoting democracy and stability, with controlling climate as a central element of long-term strategy. To have a less than marginal effect on global warming, only sweeping changes, such as the introduction of a world-wide carbon tax, and massive investment in R&D and commercialization of low carbon technologies might turn the tide. An appropriate EU climate change package would need to assure a long-term carbon price, and a level-playing field for all low-carbon technologies. The EU needs to do much more to adapt to the consequences of global warming, and to explore how to make the best out of it. It is questionable whether EU, with its real power diminishing, and dependent as it is on energy imports, with an ageing population and possessing only limited military assets, will be able to influence climate change policies in the rest of the world.

Achieving a sustainable future – reconciling population growth, food security, a healthy environment, respect for democratic principles and human rights – sometimes looks as incompatible as the squaring of the circle. But sacrificing the principles of democracy certainly would not help, as only good governance – a scarce good based on such principles – can guarantee resilience of societies with regard to the consequences of climate change, now and in the future.

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