On Connecting Climate Change with Security and Armed Conflict

Investigating knowledge from the scientific community

MALIN MOBJÖRK, MIKAEL ERIKSSON, HENRIK CARLSEN

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Sammanfattning

Syftet med denna rapport är att beskriva och sammanfatta vad vetenskaps-samhället har att säga om samband mellan klimatförändringar, säkerhet och konflikter. En central del i detta utgörs av att diskutera vilka slags säkerhetsbegrepp som används i denna kontext. Mera övergripande syftar studien till att analysera vilken betydelse klimatförändringarna får för svensk försvars- och säkerhetspolitik samt för det svenska krishanteringssystemet. Tre frågeställningar har varit vägledande för arbetet:

1. Vilka säkerhetsbegrepp används i anslutning till diskussioner om klimat-förändringar?
2. Vilka konsekvenser förväntas klimatförändringar få för säkerhetsrelaterade frågor?
3. Vilka konfliktrisker identifieras i forskningslitteraturen?

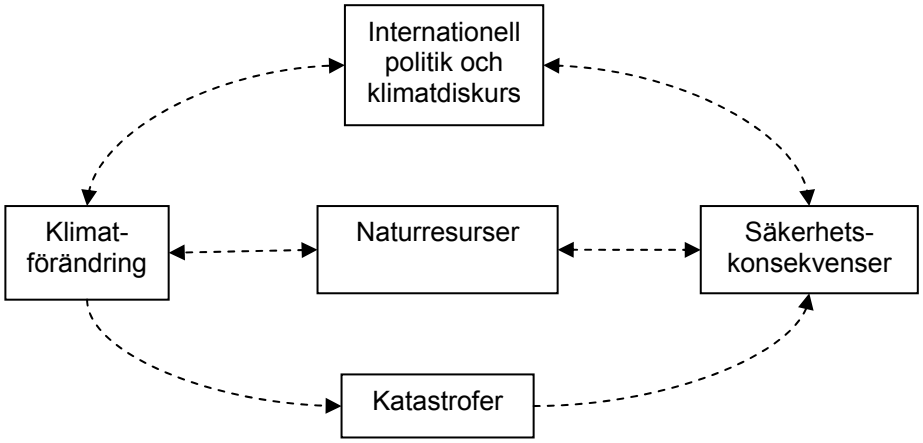
För att besvara dessa frågor har studien primärt inventerat vad som kan betecknas som vetenskaplig litteratur. Denna avgränsning är gjord för att bidra till en faktabaserad analys av vilken kunskap som finns om samband mellan klimatförändringar och säkerhet.

I litteratur om klimatförändringar och väpnad konflikt används i hög utsträckning statscentrerade perspektiv, medan diskurser om klimatförändringar och sårbarhet primärt är individbaserat, s.k. individbaserad säkerhet (eng. 'human security'). Ofta är dessa kopplingar outtalade. Den mest centrala skillnaden mellan den individbaserade ansatsen och det mera klassiska och statscentrerade säkerhets-perspektivet utgörs av en vidgning i fråga om *vilka* det är som kan drabbas av säkerhetshot. Att staten kan ansättas för säkerhetshot från fler faktorer än andra nationers angrepp är idag vedertaget varpå det finns omfattande säkerhets-politiska analyser av olika slags hot, exempelvis energisäkerhet, ekonomisk säkerhet och miljösäkerhet. Klimatförändring och dess konsekvenser anges ofta utgöra ytterligare en i raden av dessa slags nya hot och kan riktas mot stat såväl som individ.

När det gäller vilka konsekvenser klimatförändringarna förväntas få på säkerhetsrelaterade frågor görs det primärt genom historiska analyser av samband mellan klimat- och naturresursförändringar och konflikter. De forskare som blickar framåt tar primärt utgångspunkt i IPCCs uppskattningar av klimatförändringarna (särskilt IPCCs fjärde utvärderingsrapport från 2007). Även denna studie tar utgångspunkt i IPCC, men inkluderar också en uppdatering av de vetenskapliga rönen för tre områden vilka bedöms vara centrala för säkerhet i vid mening nämligen färskvattenresurser, livsmedelsproduktion och hälsa. Dessa områden står därefter centralt i en regional analys som fokuserar på Europa, Afrika, Asien, Ryssland och Arktis. Genomgången visar att förändringarna är mer omfattande än vad som uppskattades i IPCCs fjärde utvärderingsrapport; detta gäller särskilt uppvärmning av oceanerna, havsnivåhöjning och avsmältning av Arktis istäcke sommartid. Därutöver visar faktiska mätningar på att koldioxidutsläppen är högre än vad som har antagits i IPCCs scenarier. Detta ligger till grund för att vi även behandlar extremscenarier.

Eftersom analyser av de säkerhetsrelaterade implikationerna från klimatförändringarna primärt utgår från IPCCs scenarier kan föreliggande studie inte analysera vilka konsekvenser mer extrema klimatscenarier kan få. Det vi däremot har observerat är att de bedömningar som görs tar utgångspunkt i den dynamik som präglar konflikter i stort och att klimatförändringarna förväntas spä på redan existerande konfliktrisker. Klimatförändringar i sig kopplas således inte till konfliktutlösning, men klimatförändringarnas effekter anses försvåra möjligheten till att säkerhetsställa grundläggande villkor, såsom mat och vatten, vilka i sig kan utgöra en grogrund för konflikt. Studien visar också att klimatdebatten primärt tar utgångspunkt i naturresursforskning, vilket innebär att klimatförändringarnas effekter inte analyseras i sin helhet.

För att åskådliggöra sambandet mellan klimatförändringar och säkerhet har vi tagit fram en konceptuell figur (figur A). Utgångspunkten är tre vägar som sammanlänkar klimatförändringar med säkerhet och konflikter. Den första går via traditionell internationell politik och nuvarande klimatdiskurs vilket bland annat handlar om maktbalans mellan nationer, men också vilka föreställningar om säkerhetshot som finns i fråga om klimatförändringarna. Den andra fokuserar på förändrande naturresurser och hur dessa kan länkas till säkerhet. Den tredje riktar uppmärksamhet mot katastrofer som följer på klimatförändringarna.



Figur A: Konceptuell figur över möjliga samband mellan klimatförändring och säkerhetskonsekvenser.

I rapporten identifieras även centrala variabler för att analysera klimatförändringarnas säkerhetsmässiga konsekvenser, de utgörs av: förändringarnas hastighet och omfattning; att klimatförändringarna leder till både minskade och ökade naturresurstillgångar; ökad frekvens och intensitet av oväder; samt havsnivåhöjning. Därutöver behöver man ta i beaktande om förändringen sker gradvis eller plötsligt, eller om händelsen är permanent eller temporär. I befintlig vetenskaplig litteratur om samband mellan klimatförändringar och säkerhet är dessa variabler mestadels åsidosatta. Eftersom hittillsvarande studier också primärt utgår från IPCCs scenarier finns ytterligare en begränsning i fråga om vilka klimatscenarier som beaktas. Mot bakgrund av den pessimistiska bild som framträder i fråga om omfattningen på klimatförändringarna pekar studien på betydelsen av att också analysera konsekvenserna från extrema klimatscenarier. Dessutom behöver man väga in andra förändringsprocesser med betydelse för samhällens förmåga att kunna tillgodose grundläggande behov, men också samhällens kapacitet att möta utmaningar av olika slag.

Avslutningsvis i rapporten identifieras ett antal framtida forskningsområden. De är:

- Diskursanalytiska studier om klimatförändringar, dess säkerhetskonsekvenser och dess betydelse för internationell försvars- och säkerhetspolitik.
- Detaljerade regionala analyser (för exempelvis befolkningstäta områden eller områden med knappa naturresurser)
- Säkerhetskonsekvenser till följd av extrema väderhändelser.

- Klimatförändringar och dess samverkan med andra globala förändrings-processer (t.ex. miljöförstöring och samhällsförändringar).
- Extrema klimatförändringar och ’tipping points’.
- What-if scenarios.

Nyckelord: klimatförändringar, säkerhet, säkerhetisering, väpnad konflikt, klimatsäkerhet, klimatpolitik, individbaserad säkerhet, klimatvetenskap, IPCC.

Summary

The overall aim of this report is to describe and summarise the ongoing scientific debate on the connection between climate change, security and armed conflicts. A pivotal component of this involves identifying how the international community defines 'security', and perhaps more importantly how various concepts are used within this context. The report also aims to provide an analysis of the security implications of climate change for Swedish defence and security policy, as well as for the Swedish civilian and military crisis management system. Three general questions are treated in this study:

1. What security concepts are used in relation to discussions on climate change?
2. What consequences are expected from climate change on security-related issues?
3. What types of armed conflicts risks are identified in the literature on climate change?

To answer these questions, the investigation primarily focuses on the scientific literature (mostly peer-reviewed material). This limit was set in order to promote fact-based analysis of prevailing scientific knowledge on the connection between climate change and security. On some occasions, we have also included major and widely cited policy documents.

In essence, this report shows that research on climate change and armed conflicts to a great extent uses a state-based concept of security, while discourses on climate change and vulnerability generally tend to adopt a human security approach. The main difference between these two approaches concerns a widened conception of *who* is exposed to the security threats. It is now generally accepted that there are a number of threats that can intimidate a state's security apart from military threats. Accordingly, security analyses are conducted on a variety of threats, for instance energy security, economic security and environmental security. Hence, climate change and its consequences should be

treated as an *additional* threat that can be directed towards the state as well as the individual.

As noted in this report, a limitation of the great bulk of studies investigating the implications of climate change on security is that they mainly emerge from historical analyses. Moreover, a number of these historically based studies are derived on the basis of the interlinkages between altered natural resources, climate change and conflicts. Thus, they have limited value in predicting what is to come in the future for security (as a result of climate change) and the parameters used are not sufficient.

When future projections are made, these are primarily drawn from the IPCC's estimation of climate change (particularly from the fourth assessment report from 2007). The present investigation is also based around the IPCC data, but it includes an update of the scientific knowledge for those areas that are considered essential for security matters (broadly defined), namely freshwater resources, food production and health. These topics are the focal point in a regional analysis focusing on Europe, Africa, Asia, Russia and the Arctic.

The brief regional discussion shows that the changes are greater than expected in the fourth assessment report from IPCC. This particularly concerns warming of the oceans, sea level rise and the reduction in Arctic sea ice in the summer. Moreover, actual measures show that the greenhouse gas emissions are higher than expected in the scenarios from IPCC. This is the foundation for acknowledging extreme climate scenarios here.

Since analyses of the security implications of climate change are primarily based on the IPCC scenarios, this investigation was unable to analyse the security implications of extreme climate scenarios in detail. However, the assessments made acknowledge the dynamics that characterise conflicts in general and that climate change is expected to aggravate already existing conflicts risks. Hence, climate change is in itself not linked to the conflict outbreak, but the effects resulting from climate change are regarded as deteriorating the possibility of securing basic needs such as food and water, which in itself can constitute a conflict risk. We also acknowledge that the starting point for the climate debate is primarily research on natural resources; this means that the analysis of the effects of climate change not is comprehensive.

In order to visualise the connection between climate change and security, we set up a conceptual framework (Figure B). The starting point is three pathways linking climate change with security and armed conflicts. The first path emerges from international politics and climate discourse, which concerns e.g. power relations between nations, but also notions of the security threats following climate change. The second path focuses on altered natural resources and how these are linked to security. The third path focuses on disasters following climate change.

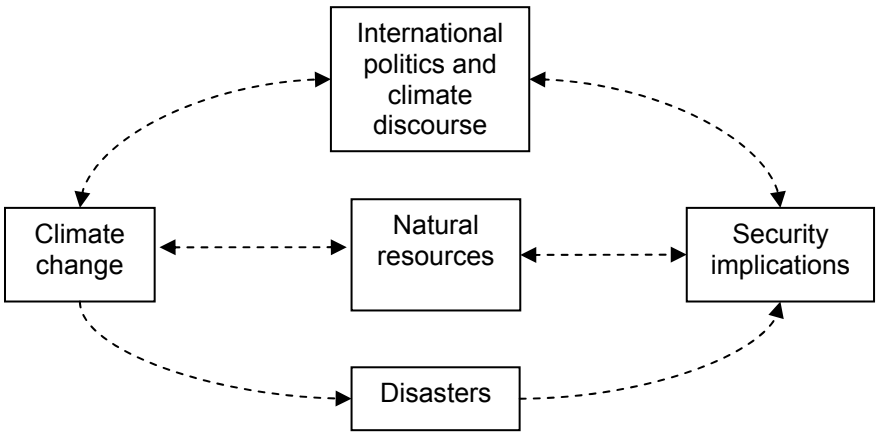


Figure B: Conceptual framework linking climate change to security implications.

The report identifies critical variables for analysing the security implications of climate change. They comprise: the speed and magnitude of the change; the ways that climate change can lead both to increases and decreases in natural resources; the increase in the frequency and intensity of extreme weather events; and sea level rise. Moreover, there is a need to determine whether the changes are occurring gradually or abruptly and whether the climate events are permanent or temporary. These variables are mostly disregarded in current research on the connection between climate change and security. Since research to date has primarily emerged from the IPCC scenarios, this is an additional limitation regarding the climate scenarios. In light of the pessimistic picture that appears regarding the magnitude of climate change, this investigation argues the importance of also analysing the implications of extreme climate scenarios. Moreover, it is critical to take into consideration other global transformation processes of importance for society's capacity to provide basic needs, but also regarding society's capacity to meet challenges of different kinds.

The report concludes by identifying the following six major areas for further research:

- Discourse analysis of climate change, its security implications and its importance for international relations.
- Detailed regional analysis (of e.g. densely populated areas or areas already under pressure from resource scarcity).
- Security implications of extreme weather events.
- Climate change and its interconnection with other global transformations (e.g. environmental degradation and social transformations).
- Extreme climate change and 'tipping points'.

- What-if scenarios.

Keywords: climate change, security, securitisation, armed conflict, climate security, climate policy, human security, climate science, IPCC.

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Foreword

This report is a product of the Swedish Defence Research Agency (FOI). FOI conducts a variety of studies in the field of security policy, strategy and defence. During 2010, FOI received a special assignment to analyse the security implications of climate change and the importance of climate change for the Swedish defence and security policy, as well as the consequences for the Swedish civilian and military crisis management system. It received financial support from the Swedish Ministry of Defence.

As the security implications of climate change have been high on the political agenda in recent years, as well as a subject of much scholarly attention, this study aims to review current scholarly debates on the subject. This is the first report coming from this project.

The approach taken in this study was that of an explorative nature. More specifically, this was done by investigating scientific literature dealing with the connection between climate change and security, the impacts and vulnerabilities from climate change, and the possible interlinkages with armed conflicts. Hence, the analysis stretched over several areas of knowledge and spanned a number of problems and present core issues. Overall, this study serves as an introduction to the subject area of 'security implications of climate change', but can also be used as a foundation for analysing its implications on Swedish defence and security policy, as well as the crisis management system.

In addition to this scoping study, two other studies are underway. One of these is investigating the response to climate change by the policy community, while the other is analysing the methodology behind four hot spots maps of future conflict areas. These studies will be published separately during autumn 2010. Together, these three investigations provide a foundation for a fourth and more synthesised analysis of possible security implications of climate change. That analysis will be finished by the end of 2010 and will be published separately.

In preparing this report we received input from a number of people. We obtained valuable comments at a seminar held by the Swedish Defence Research Agency (FOI) and at a seminar at the Centre for Climate Science and Policy Research (CSPR) at Linköping University. We would also like to express our gratitude to Maria Bergstrand, Patrik Klingberg and Eric Sjöberg, who belong to the working group for this project. We are also grateful to our three commentators, Halvard Buhaug at the Peace Research Institute Oslo (PRIO), Norway, Johannes Stripple at Lund University, Sweden, and Mike Winnerstig, FOI, Sweden. In addition, we are grateful to Heidi Askenlöv, FOI, for assisting with layout. Any errors in the text are the responsibility of the authors.

1 Introduction

Climate change is one of the most prominent challenges contemporary society ever has met. The establishment of the International Panel on Climate Change (IPCC) marks this challenge. In its response, IPCC has hitherto delivered four synthesis reports on the scientific findings on climate change and its impacts for humanity. Despite these efforts, there is a prominent and fundamental uncertainty in relation to what the change is all about and what is at stake. In this sense, climate change is a fundamental issue about knowledge, not least with regard to the potential impact and consequences, but also an issue of how to interlink social science and natural science. One area in which this uncertainty exists is inside the climate change and security nexus.

In this report, an attempt is made to summarise research findings on climate change and security in such a way that it becomes less complex for decision-makers and analysts in this area, but also to provide a clearer picture of what the research community currently has to say with regard to this nexus. Of course, such an investigation cannot be complete, nor is this the first attempt to make this kind of synthesis. On the contrary, there are a number of reports that have previously contributed fruitful analyses of the security concerns from climate change.[1] Nonetheless, we consider our report to be different with regard to two aspects.

To begin with, our starting point is to focus mainly on scientific literature on climate change and thus to exclude policy reports. Policy literature is only referred to in order to show how actors have responded to the issue of climate change, not in the clarifications of the implications that may follow. Moreover the discussion in this study takes into consideration security implications with respect to the state and the security of the individual following climate change.

Relying upon scientific literature is not an easy task, as there is no comprehensive view of what science is. We focused on peer-reviewed articles, but since there are different publication cultures in different areas/disciplines, we also relied upon books. Furthermore, we used recently presented conference papers. Although they have not undergone scientific scrutiny, we found it important to include recent claims and arguments from the scholarly community. Reports from research institutes were the most difficult to relate to, and we only used them to a minor extent. Nevertheless, despite the difficulties in adhering to what can be considered 'scientific', we adopted this approach as we consider that there are a lot of propositions within the area of climate change and its security implications that are based on various interests. These interests are of course also important for how the issue is dealt with, but we consider it fruitful to contribute with an investigation based on the scientific findings. Saying this, we do not

[1] See e.g. Haldén 2007; Mabey 2008; Schubert et al. 2008; Mazo 2010.

regard the scientific community as being free from interests, ideologies or values either, but it does not have a particular political agenda, which makes it different from policy.

The guiding questions for this investigation were: How is the climate change and security nexus framed? What security implications are typically brought forward in relation to climate change? Which notions of security are held in these considerations? Which impacts from climate change are viewed as particularly relevant concerning the security implications? How will these impacts affect different regions in the world? Can climate change be interlinked with armed conflict?

In the attempt to answers these questions it is necessary to recognise the security concept with respect to climate change, but also to acknowledge the process of how climate change has entered the security agenda. The interface between science and policy is also considered important, not least since climate change is a highly politicised field. These areas are focused on in Chapter 2 in this report. In Chapter 3, impacts from climate change are the focal point. Here particular attention is paid to effects on sectors and systems on one hand, and regions on the other. The starting point is the fourth assessment report of IPCC, but we updated the scientific findings in areas considered particularly important from a security perspective, namely on freshwater resources, food production and health. These areas guide the descriptions of climate change implications on regions of the world. We conclude the chapter by acknowledging the possibility of extreme climate change. In Chapter 4 we elaborate on the interlinkages between climate change and armed conflicts. We probe into knowledge about factors known to be important in triggering conflicts and discuss whether climate change can be added to this list. The analysis behind this discussion is mainly based upon empirical investigations on the connection between natural resource constraints and armed conflicts. In Chapter 5 we discuss the core aspects identified concerning the security implications of climate change and the connection between climate change and conflict. We conclude by presenting a conceptual framework that can be fruitful in distinguishing between different roads linking climate change to security and discuss important variables for analysing the security consequences from climate change. Finally, we present areas of importance for further research.

2 Connecting 'security' to 'climate change'

In the policy community, climate change is often described as a 'threat multiplier',[2] i.e. a factor exacerbating already existing problems such as water scarcity or food insecurity by making them more difficult to deal with than would be the situation without climate change. However, there is also increasing agreement that non-climate factors such as level of poverty, governance, presence of mechanisms for conflict management, regional diplomacy, etc. will largely determine whether and how climate change moves from being a conventional development challenge to a security threat.[3] Accordingly, one must ask to what extent climate changes poses security concerns, but also what kind of security concerns that are raised: i.e. when, how and for whom?

In order to shed further light on the connection between climate change and security we begin by acknowledging that the security concept in its classical sense commonly concerns the state and military threats towards the state's territory. Thereafter we turn to the criticism of this approach, highlighting both the process of a broadened security concept including other kinds of issues adequate in a security analysis and a widened approach regarding whose security is the focal point. The attention we put on the shifting character of the security concept, i.e. from a narrow to a broader security perspective, is not meant to result in a platform to be used in subsequent parts of the study. Instead, it is intended to highlight that quite different implications will follow depending on which conceptual understanding of security one assumes when discussing climate change. This is seldom done in the literature discussing climate change and security. This study not only illustrates this trend in thinking of security, but also attempts to demonstrate how climate change has been entering the security agenda, i.e. by a process of securitisation. This process and its relevance for climate change are the focal points in Section 2. We conclude the chapter by reflecting on the kinds of science upon which climate change research is grounded, as well as the interface between science and policy in the climate change discourse.

2.1 Security as a multifaceted concept

The focus of this section is on describing the state-centric perspective of security and the emergence of a widened human security concept. We describe this shift

[2] This notion occurred first in the report CNA 2007 (p. 44) and has thereafter been adopted by many others, see for instance: Brown and Crawford 2009 (IISD); UN 2009 Report of the Secretary-General; EU Commission Report no 7249/08.

[3] Barnett and Adger 2007; Brown, Hammil and McLeman 2007.

in the context of how to understand social implications of climate change. The aim is to make clear the obvious, namely that different understandings of security will also reflect the kind of impacts and responses that follow from climate change. In much of the policy literature, security implications following climate change are treated uncritically, assuming that certain types of effects and responses will be generated as a natural given. The shifting character of security suggests that the social impacts of climate change will differ depending on the security framework that is applied.

2.1.1 The state-centric perspective on security

Scholarly thinking on security is intimately related to the idea of the State, as defined by both the order established by the Peace of Westphalia of 1648 (i.e. as based on nation state sovereignty, territoriality and exclusion of external actors) and by the notion of the *Weberian State* (defined by population, territory, a vested and legitimate monopoly of violence and recognised by external actors). In this tradition, security is primarily linked to the physical protection of the state. Here, the national security of the state is normally preoccupied with the state's survival in the international anarchical arena. Moreover, this arena is typically characterised by the absence of authority, a condition that inevitably causes constant competition over resources for the state's survival.[4] Such competition encourages a condition also plagued by interstate conflict.[5] Security in this classical sense is much tied to European and 'Western' identity, especially with its references to ancient Greek wars, but is also manifested in more recent history such as World War I and II.

Following from this underlying notion, states are under a structural condition of insecurity; whereby security and survival become essential goals for the state to pursue. This in turn requires constant access to resources so as to maintain maximum protection. Consequently, states, for security reasons, tend to arm themselves to prevent other states from dominating them or to prevent other states from depriving them of their chances of maximising their share of resources. Thus, the absence of armed conflicts is often considered a product of temporary security arrangements (alliances) which some states have strategically formed to preserve security. In this regard, geopolitics and *realpolitik* have become a particular dominant aspect of conventional state security as concerns over physical protection, geographical location and natural resources needed for the survival of the state are considered particularly important.[6]

This idea of a structurally conditioned state insecurity is questioned in the liberal perspective in security studies (of which there can be many). The liberal

[4] Waltz 1959; Waltz 1979.
[5] Mearsheimer 2001.
[6] For an introduction to Realism and its many variants see Donnelly 2000.

perspective also recognises that competition over resources and armed conflict may follow from the anarchical situation of the global arena, but argues that this competition does not necessarily hold true for democracies.[7] On the contrary, the liberal perspective tends to claim that the expansion of the global arena in the 21st century shows that states become intertwined through complex beneficial security interdependences, not least by trade and political interaction. Security from this point of view is thus not only understood as a way to ensure survival of the state (in a self-centred sense), but also to preserve certain liberal, moral and democratic attributes of the state.[8] Hence, only by *building* liberal and democratic state structures around the world can security be achieved.[9]

Other scholars aligned with this perspective, such as global institutionalists, suggest that states can gain by cooperating as this helps to ensure security. The idea of UN is such an example. Furthermore, according to liberal institutionalists such as Keohane, security is not always on the top of the agenda. States are preoccupied with absolute gains rather than relative gains. This would also explain the formation of bodies such as the EU and the UN.[10] Yet, within this liberal security framework, security is closely intertwined with the units of the state, such as military, trade and ideology, as well as with the political governance systems. Aspects such as the climate and the environment only become instrumental factors in this sense, rather than primary concerns per se. However, the assumptions underlying this kind of perspective on security form part of a long-standing debate in the field of international relations and are by no means the subject of consensus, nor is it our aim to argue that one perspective of international security is more convincing than the other.

2.1.2 Towards a broadened security concept

Besides the general criticism from the liberal perspective on the over-reliance on the state-centred approach to security, other types of criticisms have been raised by different world system theories (particularly popular in the 1960s and 1970s) and not least in the Nordic Peace Research tradition. For instance, from a world system theory perspective (which has various nuances) an essential notion is that there are a number of immanent forces and structural features of the international system that lead global actors in the centre to exploit other states and entities at the periphery. Armed conflicts and state insecurity are thus triggered either by states dominating other states with strategically important resources, or comprise

[7] The democratic peace theory takes root in Immanuel Kant's 1795. On the democratic peace, see for instance Cederman 2001; Gartzke 2007; Gleditsch 1992.
[8] See for instance Doyle 1983.
[9] Newman, Paris and Richmond (eds.) 2009.
[10] For introductory pieces, see Simmons and Martin 2002; Keohane 1984; Keohane 1986; Keohane 1989.

reactions by the dominated state against its dominator.[11] Even though according to world system theories, the international system may appear rather stable, it is nonetheless fundamentally unstable since it rests on patterns of exploitation. These conditions cause insecurity but could be somewhat overcome by ideological alliance formations.

In more classical peace research literature, however, it is not so much the international system per se that inherently causes fear and global insecurity, but mechanisms to regulate it peacefully. In this view, the international arena is characterised by interdependence and, for the most part, also by cooperation. Agency (i.e. actors), as opposed to structure (e.g. structural social conditions), has an important role to play in this context in order to transcend any insecurity that may exist. The way to do this is to move from features of structural negative peace (absence of war), to positive peace (well-being following cooperation at different levels in the international system from the individual to the state).[12] An approach like this then broadens the scope of security analysis as it incorporates societies, groups and individuals that are often lost in traditional perspectives on security. Hence, security becomes a wider concept and responses towards insecurity call for broader types of responses going beyond military solutions.

Ever since the 1980s and 1990s, the security concept has been widely debated and examined in the scholarly literature.[13] Increasing reactions and criticisms were raised against the predominant Realist perspectives (of which there are many different schools, e.g. classical, neo- and offensive Realism) that dominated Cold War thinking.[14] Among the many perspectives and approaches on alternative security notions formed to nuance traditional security thinking, the so-called *Copenhagen School* has been particularly influential.[15] This school redefined security by analysing it from particular sectors rather than as a general condition of the global arena. This opened the way for various sectors such as societal, environmental, political and economic. Each of these sectors of security is considered as determined by the security actors and the referent objects; the former being those actors that declare an issue – the referent object – as being existentially threatened. As such, the Copenhagen School highlights the process of how a policy issue could transform itself into a security issue for which the speech act, for example, becomes critical.[16] Accordingly, the Copenhagen School includes a 'constructivist' element on security, acknowledging that words, norms

[11] Wallerstein 1974.

[12] Positive and negative peace was an idea advanced by the renowned scholar Johan Galtung.

[13] For example, in 1991 *Security Studies* (the Journal) was established as a scholarly forum for research on security.

[14] Of course are there many different schools within this perspective, e.g. classical, neo and offensive Realism, see e.g. Williams 2005.

[15] Buzan, Weaver and de Wilde 1998.

[16] This means that through the simple fact that of an actoring speak about an issue from a security point of view, it can become a security issue. See e.g. Emmers 2010.

and ideas matter when creating ideas and understandings of security.[17] This element introduces a new approach to the understanding of traditional security, rather than a new alternative security paradigm.

Taking a social constructivist approach to security involves questioning conventional assumptions on how to think of features such as rationality, modernity, causality, structure and agency.[18] Security in this approach is typically investigated by analysing assumptions of underlying norms, power structures, interests, ideas, knowledge production and as well as through the deconstruction of established narratives on security. Whereas the state and the international order were previously seen as the main determinants of security, this line of reasoning places more emphasis on security as a feature of ideas and ordering following social interaction. Although social constructivism is more of an ontological approach, rather than a security school in itself, it questions the traditional view on security. Rather than hard security per se (e.g. arms, troops), security is considered to be more interlinked with ideational power (e.g. the role of language, texts and speeches used by actors). It is thus crucial that what is perceived as a security threat ought to be considered a security threat.[19] This view also broadens the way one could think of security in connection to climate change.

In sum, the security concept has developed alongside inclusion of a widened area of objects regarded adequate for security analysis (e.g. new sectors such as environmental sectors, poverty, crimes), but also a deeper level, since new subjects of security are considered (e.g. by incorporating additional actors traditionally left outside, such as individuals, class, etc.). Rather than relying on traditional hard security, it also brings soft security issues into the analysis. Next we pay further attention to a recent conceptual shift in security portrayed by the human security approach. This change is critical with respect to the overall question about how security can be related to the impacts of climate change, as it both widens (by including new threats) and deepens (by including new subjects) the security agenda.

2.1.3 From state security to human security

Security has historically been closely associated with state, regime and territorial security, but increasing attention is now being devoted to other units of analysis. Such broader understandings of security also capture challenges and threats other

[17] The Copenhagen School is of course not the only approach adopting a constructivist approach. There are obviously many other different schools working in parallel to the Copenhagen School (e.g. the English School, with a quite different perspective on security).

[18] See e.g. Kratochwil 1989; Ruggie 1998; Wendt 1999; Weldes 1996.

[19] See e.g. Pettenger (ed.) 2007; Stripple 2002; Demerritt 2001. Discussion on this matter is also presented in Hulme 2009.

than those the state can meet.[20] This is particularly evident when it comes to analysing the societal impact from climate change, which includes a transformation from (and in addition to) a state-based security approach to a human security approach, which can be understood as a shift from hard to soft security.[21]

The starting point of the 'Human Security' concept is attributed to the programme launched by the United Nations Development Program (UNDP) in 1994.[22] In the Human Development Report, two main aspects of human security can be noted: first safety from 'chronic threats such as hunger, diseases and repressions', and second, 'protection from sudden and harmful disruptions in the patterns of daily life'.[23] The character of the first of these two aspects is a probable reason for the tendency to focus on the world's poor within much literature on human security. As Matthew et al. have underscored, human security emphasises 'the faces of the world's poor, in rural and urban areas, struggling to earn a living'.[24] MacDonald defines it as 'protecting and empowering the world's most vulnerable people'.[25] Nevertheless human security is also characterised by its universal concern, that its components are interdependent, and that it is easier to ensure through early prevention rather than late intervention.[26] It is thus obviously a concept applicable for all people, regardless of where they live. Hence, a number of Western and industrialised countries have taken the human security concept into their foreign policy realm.[27] Whereas some actors have adopted human security as an official policy, there are actors that have not officially done so but still act with this broader view of security regarding their daily foreign and security policies. The question is how we should view the human security concept and the importance of understanding the security implications of climate change.

Literature on human security to date makes particular reference to seven main categories of threat to human security: economic security, food security, health security, environmental security, personal security, community security, and political security.[28] Considering that loss of human security can be either a slow, silent process or an abrupt emergency, it is evident that human security is an adequate concept when it comes to understanding the impacts from climate change. However, the concept is also questioned. The criticism concerns its

[20] Another stream of argument has been from the basis that the state itself has been a major source of security threats to its people, see Dalby 2009, p. 39.
[21] This said, hard security will continue to exist in parallel to soft security notions.
[22] UNDP 1994. See analysis in e.g. Floyd 2008; Dalby 2009.
[23] UNDP 1994, p. 23.
[24] Dabelko 2010.
[25] McDonald 2010, p. 54.
[26] Dalby 2009, pp. 41-42.
[27] Human Security Center 2005; Kostopoulos 2006, foreword.
[28] UNDP 1994, p. 22-23. See also Floyd 2008; Dalby 2009; McDonald 2010.

broad and diffuse character, which can be used as justifying interventions from other countries with the rather vague statement that a nation cannot guarantee the human security of its inhabitants. As such, it can be used as a way of sidestepping the international laws on the relationship between countries.[29] This criticism concerns how the concept can be used in international relations, while it can encompass so many different meanings, and thus obstruct the international relation analyses. On the other hand, the concept is fruitful since it is based on the fundamental idea that people, regardless of where they live, ought to have access to some fundamental rights. Hence, the concept alters the reference object from state to individual. As such, it ought to be taken into consideration as a complement to the state-based security concept.

The concept of human security includes issues that affect the daily lives of individuals and communities around the world.[30] This approach is fundamental in the edited book by Matthew et al., who suggest that individual and human well-being should be placed at centre stage, revealing the insufficiency of a state-based approach to security.[31] The authors emphasise:

> '…the connection among the individual, the state, and the globe must be tackled together as environmental change not only impacts people's lives and options but also puts pressure on emerging political systems in many fragile states and conflict-prone parts of the world. The links between natural resources and poverty lead us to examine larger questions of human vulnerability, the dynamics of conflict and cooperation, and, ultimately, equity and justice'.[32]

An intriguing question in this context is why the concept of human security is important and in what way it could help us understand climate change.

Barnett and Adger note that in recent years there have been a number of attempts and investigations to understand the relationship between climate change and human security and that these have focused on the local dynamics that limit access by individuals and groups to the environmental, financial and social resources necessary to respond to climate variability and change.[33] Their conclusion of this research discourse is that marginalised people are particularly vulnerable to environmental change, all of which helps substantiate the argument that climate change poses significant risks to human security. Evidently the possible security implication of climate change is that it widens the traditional focus of state security to many other entities that could be affected, such as the

[29] Weber 2009; De Larrinaga and Doucet 2008.
[30] McDonald 2010, p. 54.
[31] Matthew et al. 2010.
[32] Dabelko 2010, p. viiii.
[33] Barnett and Adger 2007, p. 639-655.

individual or the community. It also broadens the various risks that can challenge the object, acknowledging a much wider array of risks than military aggression.

However, it is pivotal to recognise that a state-centred perspective of security can also deal with a broader range of risks (such as a reduced supply of energy resources or a recession triggered by intentional or inadvertent changes in the global market). Hence, widening security in this way does not necessarily change the referent *object* that ought to be secured, i.e. the nation-state, although it could.[34] The human security approach widens this discourse both concerning what counts as security threats and with respect to the reference object. Accordingly, the question 'whose security?' is utterly important, while a wider approach to issues that ought to be regarded as security issues does not necessarily alter the power means dealing with those issues. In this context it is worth noting that the human security approach may adopt an objectivistic attitude to security, letting the analyst decide what counts as security threats. However it can also emerge from a constructivist approach, letting perceived notions of what threatens security be the focal point; this matter needs also to be taken into account.[35]

Considering climate change as a security issue may, with a state-centred perspective, lead to a concentration of power for the state, and not enhanced security for its population.[36] With a human security perspective, on the other hand, the means of dealing with security issues must emerge from a people-centred perspective.[37] Hence, human security can be considered as a decentralisation of security away from the state, but can still be applicable to the same issues (threats) that could threaten the nation-state. Moreover, the question of 'whose security?' opens the way for recognising inequalities between people and that some people's security can occur at the expense of others.[38] Acknowledging the importance of asking the question 'whose security?' undermines a hegemonic discourse of security as 'national security' and leads to considerations of alternative meanings of security, as well as alternative strategies for achieving security.

[34] Barnett et al. 2010, p. 6.
[35] Stripple 2002.
[36] For discussions of this matter, see e.g. Floyd 2008; Dalby 2009.
[37] Barnett et al. 2010, p. 5. (with references to Ullman 1983, Westing 1976, Stewart & Fitzgerald 2000).
[38] Barnett et al. 2010, p. 7; Floyd 2008 (with references to Rosenau 1990, Booth 1991).

2.1.4 Human security and vulnerability

Obviously, human security is a broad concept and there are different interpretations of how it could be applicable depending on the perspective taken.[39] Within this broad approach, the perspective from international relations is merged with development studies approaches to human security.[40] Accordingly, the concept is inherently plural and withdraws from *what individuals themselves regard* as their paramount concerns, becoming a variable condition where people and communities have the capacity to manage stresses to their needs, rights and values.[41] Vulnerability can be described as a function of exposure and sensitivity of a system (e.g. a community) to hazardous conditions and the capacity, ability or residence to cope, adapt or recover from the effects of those conditions.[42] Hence, as stressed by Brklacich et al., human security and vulnerability are intimately interlinked and they define human security as 'the capacity to overcome *vulnerability* and to respond positively to environmental change'.[43]

Vulnerability is a fundamental characteristic of all human societies and people's vulnerability to climate change is dependent on the extent to which people are reliant on natural resources and ecosystems services, the degree of support communities receive from the state, their access to economic opportunities, and the effectiveness of the decision-making processes.[44] Typically one distinguishes between vulnerability, sensitivity and exposure, but it is vital to recognise that these are dynamic as well as place- and system-specific. Accordingly, external stresses, e.g. extreme weather events or food crises, ought to be understood as *exposing* rather than causing vulnerability.[45]

Hence, the key factor that inhibits people and groups from achieving security is the capacity of individuals and communities to cope with and, if necessary adapt to, changes (from local to global changes), and these processes are essential for understanding human vulnerability.[46] The greater the coping and adaptive capacity, the more likely the individual or society will be to move toward a more secure state.[47] However as Barnett and Adger stress, even though the focus on human security is people-orientated, the processes that undermine or strengthen

[39] The spectrum covers the area from issues that threaten a person's physical safety (e.g. as held by the *Human Security Report Project*) or those who consider all things necessary for meaningful participation in community life (e.g. Thomas 2001).
[40] Floyd 2008, p. 57-58; Barnett et al. 2010, p. 8. The book edited by Dodds and Pippard 2005 *Human & Environmental Security: An Agenda for Change* is an example of this.
[41] Barnett et al. 2010, p 18.
[42] Smit and Wandel 2006.
[43] Brklacich, Chazan and Bohle 2010, p. 37.
[44] Barnett and Adger 2007.
[45] Brklacich et al. 2010 (with references to Adger 1999; Mustafa 1998). See also Smit and Wandel 2006.
[46] Brklacich et al. 2010, pp. 37-38.
[47] Smit and Wandel 2006.

human security are often external to the location of the community where individuals reside. This means that the contextual factors affect the vulnerability of individuals, and hence the same physical effect can affect the vulnerability of individuals and communities differently.[48] Societies that are able to respond to changes quickly are considered to have high 'adaptability'.[49] Accordingly, research on vulnerability towards climate change and adaptive capacity is also fruitful for the security implications of climate change.

In sum, given this shift with respect to the concept of security from a state-based perspective to a human security perspective, there are evidently implications for how empirical investigations should be conducted, and for the applicability of older investigations. Emphasising people's notions of security and issues of power, interests and narratives changes the methodological approaches adequate for dealing with security issues. Therefore, the social constructivist approach can be considered a complement to the more quantitative analysis of armed conflicts, since it acknowledges the implicit assumptions made. A re-interpretation of conventional threats using different analytical frameworks such as the constructivist or human security framework could thus encompass new types of risks that not only concern states, but also consider other categories of violence such as non-state violence (posed by terrorist groups and criminal networks), inter-communal violence (posed by ethnic communities), one-sided violence (posed by states towards civilians), and insecurities for individuals, besides a conventional state-based view on conflict definition (involving at least one state as part of the conflict).

2.2 Climate change enters the security agenda

Climate change has obviously become an issue with security implications. This is particularly true in a broad notion of security. Acknowledging the human security approach requires inclusion of the 'securitisation' process, i.e. a process that broadens the framework for issues that can be considered security issues. As Dalby stresses, 'securitisation' is the mode of analysis that can be described as 'the active process of invoking security and setting in motion policies and actions on the basis of presenting matters as threatening'.[50] Thus, securitisation triggers a debate on the underlying risk assessment. Trombetta stresses that all sectors reflect a distinct set of values, priorities and practices, and points out that security is connoted with urgency, emergency and survival.[51] How this shapes the policy is hence a matter to recognise.

[48] Barnett and Adger 2007; Smit and Wandel 2006.
[49] Smit and Wandel 2006 (with reference to Denevan 1993).
[50] Dalby 2009, p. 47.
[51] Trombetta 2009.

Pivotal for being considered as a securitised issue within the Copenhagen School, and hence a matter for security policy, is that the issue has become the referent object for security, i.e. that the issue is regarded as threatening the object of security.[52] In this section we consider whether climate change can be regarded as a securitised issue. However, since securitisation is not necessarily a good way of approaching an issue, we begin by recognising some general thoughts about the implications on securitisation, with the focus on the notion of environmental security, since it is a more well-researched area than climate security. After this, we turn to the process of securitising climate change. We conclude by distinguishing main reasons for this securitisation process.

2.2.1 Securitisation and the environment

Environmental security officially became established in the publication *Our Common Future* in 1987, but has a much longer history going back at least to the 1970s.[53] In particular, the UN conference on Human Environment in 1972 is recognised as an important milestone. Environmental security can be considered as intrinsically linked with the modern environmental movement. Accordingly, environmental security has become related to the vision of sustainable development and elaborates on the environment, development and security nexus.[54]

A strength with sustainable development was the juxtaposition between different areas where environmental degradation was related to poverty, and consequently economic development was considered the best strategy for dealing with protecting the environment and reducing poverty. Accordingly, sustainable development became an attractive concept (for the policy community) as it bridged the conflict between economic development and environmental protection; a conflict that has characterised the modern environmental debate.[55] The security gap was added in the aftermath of the Cold War, when environmental security became a vital position in much policy discourse. As Barnett argues, environmental security shares two basic characteristics with the threat of global nuclear warfare: 'both are global in reach and the effects of both could be highly devastating'.[56]

Framing a concern as a security issue leads to it becoming a focus for state actions, implying that (political) actions are mobilised as well as (economic) resources. Nevertheless, as the debate on environmental security shows,

[52] Stripple 2002: Emmers 2010.
[53] WECD Our Common Future 1988.
[54] See e.g. WECD Our common Future 1988; Dodds and Pippard (eds.) 2005; Dalby 2009.
[55] See e.g. Hayward 1994; Hajer 1996; Dryzek 1997; Dryzek 2000; Ekins 2000; Keil 2007; Rommetveit, Funtowicz and Strand 2010.
[56] Barnett 2003, p. 8.

understanding an issue in security terms does not necessary imply that the political actions mobilised are adequate for the threats or their causes.[57] As Dalby argues, environmental degradation as a threat predominately reinforces an interpretation that it is external in its causes, rather than an inbuilt consequence in modern society, implying that many environmental problems are ineffectively dealt with.[58] Hence, securitising an issue does not necessarily mean that the issue will be dealt with successfully (it particularly calls for urgency and priority); if the adequate means are lacking (regardless of reason), firm action will not succeed. This is evidently a lesson that needs to be taken into consideration when it comes to climate security. However, does it matter which security concept is applied with respect to the process of securitisation?

Deudney has criticised environment degradation being interpreted in security terms. He argues that this can be counterproductive and stresses that 'environmentalism is a threat to the conceptual hegemony of state-centred national security discourses and institutions'.[59] The security approach here draws upon a state-based security concept. With this approach, threats are viewed from traditionally security concerns, which are, or at least have been, characterised by violent and direct intentional acts. These acts are particularly performed by national states, which imply that it is the conventional means used in the nation that causes insecurity for people.[60] Environmental threats, on the other hand, tend to be diffuse, indirect and international, originating both inside and outside the state concerned.[61] However, if security is instead linked with humanity in line with the human security concept, another interpretation emerges. Crucial in human security is that threats are often unintended consequences of social, economic and environmental changes (rather than deliberate threatening actions by foreign states). With this notion, environmental degradation is not an external threat against communities (or societies) but inherent in society and ought to be managed as such. Moreover, such an approach does more easily recognise the different (and unequal) consequences environmental degradation has for individuals and communities.[62]

The perception of security is pivotal and forms the foundation regarding whether we can interpret global nuclear warfare and environmental degradation as similar, as done by Barnett, or present a strong argument for not viewing these issues as related, as done by Deudney. Consequently, in all discussions of

[57] Dalby 2009, p. 47.
[58] Dalby 2009, p. 47. For insightful knowledge about the relationship modern society and environment see e.g. Beck 1992; Lash, Szerszynski and Wynne (eds.) 1996; Fischer and Hajer (eds.) 1999.
[59] Deudney 1999, p. 214.
[60] See e.g. discussions in Tagesson 2008; Dalby 2009.
[61] Dalby 2009, p. 50; Deudney 1999.
[62] Stripple emphasises that impacts are neither randomly nor evenly distributed (2002). This matter is well explored in the scholar field 'environmental justice', see e.g. Harvey 1996; Agyeman 2005.

security we need to recognise the notion of security held, but also the issue of what it is that ought to be secured.

To conclude, the question 'whose security?' is essential, but we also need to recognise the means suggested for dealing with a particular security matter; external means for inherent problems will (in the long run) inevitably fail. With regard to securitisation, the human security approach has major strengths as it emphasises the importance of recognising whose security is at stake and permits the existence of contradictory conceptions simultaneously held on a particular matter in a given setting. The notion of environment as 'global in reach' must accordingly be pinned down; environmental degradation is far from a unified change, as there are major differences both within and between countries. This is also true for climate change.

2.2.2 The securitisation of climate change

Security analysts and academics have warned for some time now that climate change may raise tensions and trigger conflicts.[63] One hypothesis for this is that proponents of the environmental movement are, at least in some circles, being successful in connecting security to high politics and national security. In so doing, environmentalists have required governments to take extraordinary responses to deal with environmental degradation. Measures demanded have been significant in terms of magnitude and urgency.[64] However, this alarmist perspective of climate change is far too simple. As mentioned above, it could be more fruitful to understand what conditions this perspective of climate change impact on security rests upon and how it comes about. For instance, securitisation is a possible strategy of achieving legitimacy for a certain issue and a way to mobilise actions. Concerns for the implications of climate change can hence be regarded as an object for a securitisation process that includes not only governments, but also international and regional organisations, NGOs, academics and practitioners, bringing the climate change and security nexus to the table. In this section we examine this development, exploring possible reasons that can explain why climate change has come to enter the security field, but also investigating notions held by some policy actors with respect to climate security.

The securitisation of an issue can take place at different stages in the formation process and it is particularly during the problem framing phase that the issue can be interpreted differently. For instance climate change can be framed as a problem for a region, or the global society. It can be seen as a symmetric tragedy of the commons or asymmetric externalities, a stand-alone problem or an

[63] See e.g. Barnett 2003; Brown, Hamill and McLeman 2007; Nordås and Gleditsch 2007; Barnett and Adger 2007; Lee 2009.
[64] Barnett 2007, p. 199.

ecosystem one.[65] Depending on how it is framed, different solutions or management strategies appears fruitful and one must recognise that various actors can have diverging interests and may seek to interpret a threat or a problem in a certain way so it can support their particular policy. To give an example, a global approach towards a climate change policy that does not recognise regional differences can be an argument behind politics emphasising the need for a global reduction in Greenhouse Gas Emissions (GHG), regardless of those making the reduction, which ignores the responsibility of heavy emitters. This can be contrasted to a policy focusing on equality in a historical perspective, which emphasises the responsibility of heavy emitters to take a lead in reducing GHG. These two positions have been vital in the negotiations on a binding climate agreement. Moreover, one needs to recognise that framing an issue such as climate change in security terms can act as an instrument to obtain public acceptance for driving the issue, but acceptance could also be undermined if it becomes evident that the issue lacks security implications (or if inadequate policy means are chosen for addressing the issue). In legitimising issues in general, scientific evidence has played, and continues to play, a crucial role. Environmental issues, including climate change, are one such area that heavily relies upon science.

Although the process of securitisation is diffuse and the consequences of such a process are contested, there are examples of situations that signify particular moments when the issue of climate change and security has been brought to the agenda by policy-makers. With respect to climate security, a number of reports and events are worth considering in gaining an understanding of how security has been brought into the discourse on climate change. Below we introduce some of these, the actors in focus being the UN, EU and USA.

2.2.3 Policy actors responding to climate change and its security consequences

At the request of the UK, the Security Council of the United Nations held its first debate on the climate change and security nexus in 2007.[66] This was followed by a report in September 2009 on the possible security implications of climate change.[67] In this report climate change is considered a threat multiplier and the security perspective is human security. Much emphasis is placed on connecting the threat posed by climate change to ongoing processes within the UN, such as the Millennium Summit, as well as identifying channels that can act as threat

[65] Mitchell 2002/2006, p. 504.
[66] UN 2007 Security Council SC/9000 Meeting 5663. In the UK concept paper, six security risks were identified: border disputes, migration, energy supplies, resource shortages, societal stress and humanitarian crises.
[67] UN 2009 Report of the Secretary-General.

minimisers. These channels cover issues of securing basic human rights (to life, health, food, water and housing), reducing poverty and desperation, strengthening the adaptation capacity, minimising the risk from loss of statelessness and territorial disputes following sea level rise, and developing cooperation on shared natural resources.[68] However, the connection between climate change and security has a longer history in other UN bodies, not least within UNEP, which concentrates upon the history of environmental degradation and conflicts, but has also explored the implications of climate change for human development.[69] The conflict in Darfur is the case particularly used to show the interlinkages between climate change and conflicts.[70]

In the EU, the starting point is the European Security Strategy presented in 2003. Within this strategy climate change is implicitly assumed as aggravating the scarcity of water in particular and thus reinforcing competition for natural resources.[71] However, in 2007 the issue travelled higher up on the political agenda. A number of reports, beginning with the *Joint Paper* produced by the High Representative Javier Solana and the European Commission in 2008, have been presented including recommendations for how to deal with the (international) security implications of climate change.[72] Climate change is considered to be 'best viewed as a threat multiplier which exacerbates existing trends, tensions and instability'.[73] The recommendations referred to concern enhanced cooperation between EU and UN, as well as between EU and other regional partners, in order to strengthen development cooperation and institutional capacity to work on the issues of climate change and international security. Enhancing the capacity for early warning systems as well as building and implementing a successful international agreement on climate change to promote global climate security are also of major concern.[74]

Within the EU there is a steering group on the theme 'climate change and international security' that has been running since 2008. As noted in the paper 'Climate Change & The Military: The State of the Debate' particularly active countries are the UK, Germany, Denmark and Sweden.[75] Within these countries a number of reports have been produced by various organisations, such as the

[68] UN 2009 Report of the Secretary-General, § 14-18.
[69] UNEP 2004; UNEP 2009; Human Development Report 2007/2008; UNISDR 2009.
[70] UNEP 2007. Darfur is also discussed in Mazo 2010; Hulme 2009; Tagesson 2008. The debate is far from uniform.
[71] EU 2003 European Security Strategy, p. 3.
[72] EU 2008 The Commission and the Secretary-General, no. 7249/08. The subsequent reports are: EU 2008 Secretary General/High Representative no. 16994/08; EU 2009 Secreteriat/Cion/Presidency no. 16645/09. EU 2009 2985th Foreign Affairs Council meeting; EU 2009 PMG Recommendations on Climate Change and International Security.
[73] EU 2008 The Commission and the High Representative no. 7249/08, p. 3.
[74] EU 2009 Secreteriat/Cion/Presidency no. 16645/09.
[75] IES 2009, p. 10.

Swedish Defence Research Agency (FOI), the Royal United Service Institute (RUSI), the International Institute of Strategic Study (IISS) and the German Advisory Council on Global Change (WBGU).[76] Besides these, there are a number of other organisations within Europe that have shown an interest in climate security issues in various ways, such as International Alert, Adelphi Consult, International Institute for Sustainable Development and Institute for Environmental Security.[77] Note that many of these organisations and research institutes are funded by government bodies to various degrees.

Turning to the American context, there are a number of government bodies, research institutes and think tanks acknowledging the intricate link between climate change and security. A Pentagon report from 2003 mentioned climate change and the authors stressed that 'severe environmental problems are likely to escalate the degree of global conflict' and that 'conflicts over land and water use are likely to become more severe – and more violent'.[78] The *2010 Quadrennial US Defense Review* recognises that climate change will play a significant role in the future security environment and calls for changes in future military planning in operating environment, missions and facilities.[79] These reports are in line with President Barack Obama's recent remarks that there is little scientific dispute that climate change and environmental impact will fuel conflicts for decades to come unless its challenges are met.[80]

It is within the American context that the concept 'threat multiplier' has been suggested as describing the security concerns held in relation to climate change. The concept first appeared in a report from the American Center for Naval Analyses (CNA) in 2007, in which climate change was described as 'a threat multiplier for instability in some of the most volatile regions of the world'.[81] This report also points out that the projected climate change poses 'a serious threat to America's national security', that it 'will add to tensions even in stable regions of the world', and that 'climate change, national security, and energy dependence are a related set of global challenges'.[82] Similar comments are made by both the Center on Strategic and International Studies (CSIS) and the Center for a New American Security (CNAS), which emphasise that 'the cascading consequences of unchecked climate change are to include a range of security problems that will have dire global consequences'.[83] In addition, the report *Global Trends 2015*

[76] Haldén 2008; Mabey 2008; Mazo 2010; Schubert et al. 2008.
[77] See e.g. Smith and Vivekananda 2007; Maas and Tänzler 2009; Brown and Crawford 2009; IES 2009.
[78] Schwartz and Randall 2003, p. 14-15.
[79] Quadrennial Defence Review Report 2010.
[80] Obama 2009.
[81] CNA Corporation 2007, p. 44.
[82] CNA Corporation 2007, p. 44-45.
[83] Campbell et al. 2007, p. 10.

stated that 'global warming will challenge the international community'.[84] These reports laid the foundation for the American Council of Foreign Relations to commission a report on Climate Change and National Security, which was finalised in 2007. The focus was on the connections between climate change and national security from an American point of view and the report suggests specific recommendations to address the security consequences of climate change for the United States.[85] These recommendations are on an aggregated and general level and consist of supporting research on climate vulnerability, developing mitigation policy as diplomacy (the United States has since adopted a domestic regime to control carbon emissions), and developing policies that address problems in multiple domains.

To conclude, two things must be considered regarding these initiatives, firstly the question of what security approach is held and secondly how to interpret these initiatives in a broader framework of a securitisation process. Regarding the first issue, it is apparent that the security implications of climate change with the UN and EU context are framed in terms of human security. Furthermore, these initiatives heavily stress the need to identify the threat minimisers which can reduce the security concerns from climate change. Within the American context, on the other hand, much more emphasis is placed on the state-based approach to security. Regarding the second issue, one can see that there is an ongoing debate on the security implications of climate change. However, this does not necessarily imply that climate change ought to be considered a securitised issue in line with the Copenhagen School of securitisation. Settling this matter is to a certain degree a matter of definition. From a pragmatic point of view one can acknowledge that a number of actors stress security implications of climate change. Thus climate change is obviously considered to have security implications, but that does not in itself make it a securitised issue according to the Copenhagen School definition.[86] As these actors adopt various approaches towards, for instance, the security approach and hence may propose various policy means for dealing with these issues, this can be brought into analysis with the goal of gaining a better understanding of the agendas that are shaping the policy of climate change. It is apparent that the security concept is open for redefinition, where the human security approach has growth forth. Nevertheless the practice of security is embedded in international political structures.[87] This lies behind the call for a new diplomacy for this kind of issue.[88]

[84] NIC 2000 'Global Trends 2015', quoted in Campbell et al. 2007, p. 17.
[85] Busby 2007.
[86] For analysis of this, see e.g. Stripple 2002; Detraz and Betsill 2009; Trombetta 2009; Scott 2009.
[87] Stripple 2002.
[88] Kjellen 2009, passim.

2.2.4 Possible reasons behind the securitisation processes

When examining the securitisation process, an important aspect is the underlying reasons for why and how climate change and security travelled this path in the first place. Five aspects seem particularly relevant: First, linking the environment with a government's national security interests will promptly trigger bureaucratic reflexes that move climate change up the ladder of government attention. Second, connecting climate change with security has increasingly come to be attached to public economic aspects and therefore concerns a large segment of the public.[89] Third, the commercial aspects of the climate change and security nexus also attract interests and economic operators, thus becoming an important driver and argument in the debate and the securitisation process.[90] Fourth, the actual collapse of various ecological systems and the possible link to climate change and the potential human aspects of this inevitably prompt reactions. Last but not least, direct lobbying actions by local, regional and international NGOs that link climate change with security push the issue further into the securitisation process. In sum, these aspects could be considered drivers for the increasing linkage of climate change with security. Similarly to early problem framing, the process involves a dynamic political struggle between various networks of power/knowledge in which policy-makers and stakeholders interpret and frame knowledge in light of specific interests.[91]

The aspects above do not complete the picture; there are many more forces that may move the discussion on climate change into the field of security. These may be of a rational or 'random' character. Although one commonly expects securitisation to be actor- or interest-driven, it could also be socially driven. For instance, the act of engaging in a question may itself contribute to the institutionalisation of a discourse. Moreover, the very fact of states and policy advocates engaging and intervening in an agenda on e.g. climate change may also position groups and actors politically. For example, the very act of negotiating the reports of the panel and their findings becomes a political process with security implications. This analytical viewpoint needs to be viewed in light of the frequent claim that there is actually a link between climate change, environmental change and social conflict in the first place.

Thus there is a complex interplay of processes that shapes the notion of what climate change is all about, but also the security implications of climate change. We consider this process as having intrinsic security implications. Accordingly, discursive analysis of climate change and its security implications is a matter of acknowledging the issue, whereas the problem framing phase, power relations and notions of security and threats to security are pivotal aspects. Moreover, the

[89] Stern 2007.
[90] For discussion, see Giddens 2009.
[91] Mitchell 2002, p. 504.

securitisation process means that these power relations occur both in science and in the policy community. Thus it is important to consider some basic propositions concerning climate science, as well as the science-policy relationship with regard to climate change.

2.3 Climate science and the science-policy nexus

As the securitisation debate reveals, policies are shaped by a web of notions, expectations, interests, ideologies and knowledge. As argued, a purely rational understanding of policies is in itself inadequate, as there are so many other things that shape the policy formation process. A strong argument for legitimising a policy is scientific knowledge, but what characterises scientific knowledge? As sociologists and historians have shown, science is also shaped by ideologies, interests and values; consequently the notion of a complete value-free science is inadequate and the idea that 'science speaks truth to power' is obsolete.[92]

Understanding science as a cultural, social and historical process allows an understanding of its context dependence, which is a notion that has become successful in the contemporary discussions on knowledge production.[93] Nevertheless the policy community is in need of scientific knowledge and policies are reinforced if they are legitimised by value-free statements/ knowledge, and the legitimacy of the science community is grounded in the belief that it is objective and free from values. So, even though 'we' know that science is not universal, objective and value-free, politicians and scientists have reasons for pursuing this rhetoric. It is essential to understand that science is also shaped by historical circumstances and includes inherently cultural values, while in addition scientists themselves have values, interests and notions about the world.[94]

Although it is difficult to probe deeply into this area of arguments withheld and interpretations made, it is important to reflect upon two issues of substantial

[92] This notion has been influential in the conventional understanding of the relationship between science and policy and builds upon a notion that science can inform policy and make it more rational, see e.g. Jasanoff and Wynne 1998, pp. 7-10; Bäckstrand 2000, pp. 56-59.

[93] Context-dependence is vital in e.g. the Mode 2-concept suggested by Gibbons et al. 1994; Nowotny et al. 2001. The concept also shapes the ideas in the Triple Helix approach, in the concept 'post-normal science' and in the concept 'situated knowledge', see Leydesdorff and Etzkowitz 1998; Funtowicz and Ravetz 1993; Haraway 1991.

[94] One can use the famous work of Kuhn in exploring this. A (scientific) paradigm is unified around a number of unwritten play rules which form the research. This web of approaches, agreements and techniques consists of symbolic generalisations (about nature), metaphysical notions (about life), values (criteria of what characterises science and a good scientific theory), and examples (models or ideals of a successful scientific contribution), see Kuhn 1992/1962, passim.

importance in obtaining a better understanding of science and policy circumscribing the nexus of climate change and security. The first concerns the need to consider what climate science is characterised by, with respect to what can be considered more or less certain or uncertain, but also regarding its interdisciplinary and cross-sectoral character. The second area concerns the relationship between science and policy, with emphasis on the role of the IPCC, which is the cornerstone in shaping the notions of scientific knowledge about climate change.

2.3.1 Climate science as a complex area

As Hulme argues, it is a fundamental expectation of classical empirical science that it should be able to resolve competing claims to truth: 'seeking out evidence, testing that evidence and distinguishing between fact and error'.[95] In this context science is described as explanatory, i.e. the role of science is to explain, for instance, how the climate system works. Regardless of whether this goal can be achieved, there are other expectations of science that Hulme exemplifies by predicting future events. The ability to predict the outcome of experiments is in many cases regarded as *the* criterion for whether there exists an understanding of the underlying system dynamics. For climate science, these predictions are crucial and concern the average and statistics of the weather, i.e. the average weather over a certain period of time.

It is vital to understand that climate modelling is not an isolated natural science like, for example, physics or chemistry. The predictions of future climate produced by various climate models are conditioned on the development of future society. Here, the IPCC Special Report on Emissions Scenarios (SRES) is of immense importance in that it determines the levels of GHG used as input to the climate models.[96] SRES comprises four groups of scenarios for the future and these are structured depending on different levels of GHG emissions, obviously reflecting notions, ideas and ideologies about the future. As scenarios can be viewed as a possible way of grasping the future and being able to structure the uncertainties concerning the future, this approach is vital.[97] Nevertheless, the SRES are restricted regarding the range of possible futures as the assumption is made that energy efficiency will increase and that economic growth will continue (even though on different scales). The role of the SRES in climate science clearly shows the interlinkages between natural sciences and society and that all societal activities also interact with and affect the physical processes, but also how policy processes affect scientific investigations by setting the framework for what scientific knowledge to include.

[95] Hulme 2009, p. 73.
[96] Nakićenović, Alcamo, Davis, et al. 2000.
[97] Hulme 2009 p. 83; Berkhout et al. 2010.

In this context it is relevant to refer to the concept of post-normal science. This concept, which was proposed by Funtowicz and Ravetz in 1993, denominates a new type of science which is contrasted with the traditional notion of a problem-solving strategy.[98] Post-normal science is considered the case when it comes to highly complex areas, where 'we face radical uncertainty', where control and predictability is no longer a possibility and the expertise role is altered.[99] Hence, it regards the reductionist, analytical world view, which divides systems into smaller elements that can be studied in detail (and in isolation), as replaced by a systemic (holistic) approach. What follows is an approach that recognises the complexity and openness that characterise both social and natural systems; this approach must accordingly take into consideration that all investigations are made from a perspective and that this shapes the investigation (including the outcome). Consequently, the phase of problem identification is critical since it affects how the problem is framed and the very basic notion of what kind of problem we are facing. This is a matter for researchers as well as policy-makers and is pivotal in the sense that their values, interests and world views take part in this problem formulation process. Thus democratisation is required, with a wider array of actors involved in the knowledge production process (and not only researchers).[100]

Post-normal science has been criticised for relying upon the notion that it is only adequate for some kind of research problems and that after fruitful research, these problems can be transformed into a 'normal' research process.[101] Despite this, the concept is useful in shaping an understanding of what characterises scientific activities surrounding many problems modern society is facing. Global environmental change and climate change are problems that correspond to the descriptions of what characterises post-normal science. Moreover, what is crucial within these areas is the cross-disciplinary[102] character they have, but also that they address a multitude of sectors in society, i.e. they both address a variety of disciplines and sectors and thus need to overcome the boundaries between them.

Another area of importance with respect to post-normal science concerns its recognition of 'systems uncertainties' and of the fact that (political) decisions cannot wait until the uncertainties are resolved. This is crucial with respect to

[98] Funtowizc and Ravetz 1993.
[99] Funtowizc and Ravetz 1993.
[100] Post-normal science has thus become pivotal in the Mode 2-concept of knowledge production, which stresses the adequacy of including a wider area in the knowledge production processes, but is also essential in descriptions of transdisciplinarity, which is an approach including a joint process of actors from both within and outside academia. See e.g. Nowotny 2001, Rommetveit et al. 2010.
[101] See e.g. Jasanoff and Wynne 1998, p. 12.
[102] Cross-disciplinary is a general concept denominating any kind of scientific approach including boundaries crossing between disciplines (the three most common subgroups are multidisciplinarity, interdisciplinarity and transdisciplinarity), see Mobjörk 2010.

climate change. Many of these uncertainties are inherent and cannot be resolved, but a distinction can be made between different modes of uncertainties. With respect to climate change and climate science, Hulme has distinguished three kinds of uncertainties. The first concerns 'an incomplete understanding of how the physical climate systems works', which he exemplifies with the effects of atmospheric aerosols on clouds, arguing that these uncertainties in principle can be reduced over time.[103] A second uncertainty emerges from 'the innate unpredictability of large, complex and chaotic systems such as the global atmosphere and ocean', where at best we can estimate some probability of a particular future climate outcome.[104] Third, he points out uncertainties originating from the fact that human beings are part of the future that is being predicted; these uncertainties can neither be resolved nor estimated. Hulme suggests that the best we can do in order to address this matter is to work with a range of broad-scale scenarios and an array of possible futures.[105]

Considering these aspects of uncertainties in relation to the model of the relationship between science and decision-making, which is founded on the belief that science can dissolve uncertainties and inform politics (and make it more rational), the situation can be perceived as anomalous. Hulme argues 'the assumption seems to be that certainty is an attainable state of knowledge, despite the evidence that for most of human history we have accepted that *lack* of certainty is our natural lot.[106] Hence, uncertainty is something inherent in (scientific) knowledge.

2.3.2 IPCC: the interface between science and the policy community

To respond to the complexity of climate science, the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) established the Intergovernmental Panel on Climate Change, IPCC, in 1988. The mandate of IPCC is to evaluate the risk of climate change caused by human activity and to compile and synthesise research relevant to the implementation of the UN Framework Convention on Climate Change (UNFCCC), an international treaty that acknowledges the possibility of harmful climate change. Since its establishment, the IPCC has published four Assessment Reports which cover human-induced climate change, the impacts of climate change and options for adaptation and mitigation. Importantly, the IPCC does not carry out research on its own, but assesses available information about climate change, particularly from peer-reviewed and published scientific literature. Thus

[103] Hulme 2009, p. 83.
[104] Hulme 2009, p. 83.
[105] Hulme 2009, p. 83.
[106] Hulme 2009, p. 84.

researchers from all around the world contribute to the process. Based on a comprehensive review of the scientific literature, the IPCC also presents a summary for policy-makers. The work of IPCC is hence the most comprehensive analysis there is on climate change and its effects on the biosphere and on human society. Its work is not free from criticism and has a number of weaknesses that need to be acknowledged.

A first criticism concerns the mission of IPCC, which is to estimate the magnitude of the human impacts on global warming (and not on reviewing whether global warming exists). It is impossible to estimate the effects this goal has had on the review process (as well as the research conducted), but it definitely affects the legitimacy of IPCC if (and when) publications show counter-arguments for the man-made contribution to global warming. Related to this criticism is how the IPCC works to reach *consensus* about climate change. The word consensus can mean different things to different people. One thing that makes climate change science a special (natural) science is the lack of verifications of hypothesis; there is simple no laboratory for climate scientists to test ideas and settle disputes. Instead, climate scientist must discuss and debate to reach consensus about the current status of the best knowledge available. This does not mean that the IPCC must reach consensus about all parts of the work, and differing views of a scientific or socio-economic nature must be represented in the document concerned.[107]

A second criticism concerns the summary reports, which are those reports particularly communicated outside the scientific community. These summary reports are the result of a negotiation process between governments, and when compared against the substantial underlying reports, factual differences have been identified.

A third criticism concerns the SRES scenarios, which have received considerable attention both in the research community and in the public arena.[108] The objective and descriptive character of the SRES scenarios is a key to the approach of IPCC. Although it is stated that no scenario work can be totally value free, it is the intention of SRES to keep the approach as objective as possible. This is the foundation for acknowledging the assumptions made concerning for instance the relationship between economic growth and energy efficiency, but also the future emissions of greenhouse gases. Both these assumptions reflect values and, considering the estimations made regarding these issues, they are also questionable in terms of what has been measured. Accordingly, the SRES has been criticised for being too conservative and there are claims that it should widen the range of possible future societies when

[107] Principles Governing IPCC Work, Approved at the Fourteenth Session (Vienna, 1-3 October 1998) on 1 October 1998, amended at the 21st Session (Vienna, 3 and 6-7 November 2003) and at the 25th Session (Mauritius, 26-28 April 2006).

[108] See e.g. See e.g. the Economist 2003; Reilly, Stone, Forester et al. 2001.

estimating future emissions of greenhouse gases.[109] IPCC has acknowledged that the scenarios are open to various interpretations and that a particular development described in one scenario may be viewed positively by some people and negatively by others. As argued by Schenk and Lensink, the scenario logic particularly reflects the world view of Western European parties.[110]

In early autumn 2010, the independent review panel evaluating the scientific foundation on which the IPCC is based presented its findings.[111] In its conclusions, the review panel suggested that a number of flaws in the climate panel structure had contributed to the scientific arguments in the debate having been questioned. Although much of the scientific data applied has been cleared, the entire debate on the validity of science in the climate change area fundamentally influences the overall credibility of the climate change agenda. The work of IPCC evidently portrays the intricate interplay between science and policy. Its mission as well as its assumptions are shaped by the policy community, which not ought to be considered unified regarding this matter. The review panel's emphasis on the importance of transparency in the IPCC process is thus rather self-evident and is considered crucial for gaining credibility in the work. The role of science as a factor itself is also a major aspect brought forward in this project. As has been emphasised, the role of sciences, i.e. the kind of theories, methodologies and approaches that are being applied, effectively contributes to shaping the climate change agenda in specific directions. This matter concerns not least the possible connections between climate change and security. Science can speak for itself, but it can often be presented in such a way that some arguments take precedence over other. What is important to recognise in this regard is that science plays different roles and that there are many different stories to be told.

[109] Carlsen 2009.
[110] Schenk and Lensink 2007.
[111] Committee to Review the IPCC 2010.

3 Impacts of climate change

In Chapter 2 we addressed the changes that have occurred concerning the concept of security and particularly emphasised the establishment of the concept of human security. As noted, human security adopts an individual approach, without denying security concerns for the state. The object of security – individuals, communities, regions, nations, etc. – is thus one parameter to consider in security discussions. Another area of change within the security literature and in the policy community is the threats that exist to actually maintaining security. In this regard new areas of concern have emerged in security discussions, for instance economic security, environmental security, health security, water security and food security. In recent years, yet another area has entered the discussion: climate security. Here, the concern is the possible security implications of climate change. In this chapter, the focus is on the direct physical impacts that can be expected from climate change and that are of relevance for security.

In order to describe the effects of climate change on the biosphere and human society, the results of working group II's[112] contribution to the fourth IPCC Assessment Report (AR4) are a good starting point.[113] That report summarises the peer-reviewed literature on impacts, adaptation and vulnerability at the time of writing. Many of the findings in the substantial synthesis have been backed up by more evidence since 2007, while we also include scientific findings made since the AR4.

Given the discussion in the previous chapter, it should be underlined that the selection and interpretation of impacts from climate change is contingent on the definition of security one adopts. The notion of 'security impacts' highlights the importance of being explicit when considering impacts from climate change in the present context. In for example Schubert et al., the impacts studied are selected on the basis of 'having particular potential for triggering conflicts'.[114] The selection made here is mostly in line with a people-centred perspective on security, i.e. human security.[115] Nevertheless, the approach is on a highly aggregated level which cannot address the regional and local variability that exists. More profound and context-specific analyses are hence needed.

[112] The Working Group II (WGII) of the IPCC assesses the scientific, technical, environmental, economic and social aspects of the vulnerability (sensitivity and adaptability) to climate change. It furthermore assesses negative and positive consequences for ecological systems, socio-economic sectors and human health, with an emphasis on regional, sectoral and cross-sectoral issues.

[113] IPCC 2007.

[114] Schubert et al. 2008, p. 64.

[115] A state-centred perspective would, on the other hand, emphasise e.g. natural resources such as oil, gas, minerals, etc. This is not to say, however, that these impacts could not have an effect given a human security perspective.

Below we consider impacts on security with regard to three areas likely to be affected by climate change: a freshwater resource, food production and human health, the last obviously being dependent on the other two. This is then followed by a review of the impacts, with special emphasis on these three thematic areas, in various geographical regions mainly chosen with regard to the impacts from climate change and their geographical location in relation to Sweden. Since some observed effects of climate change have been more severe than estimated in AR4,[116] we consider it important to discuss more extreme climate scenarios. The last section puts the emphasis on that area.

3.1 The science of climate change since AR4

The fourth IPCC Assessment Report (AR4) summarised the state of the art of climate change research up to 2007. Over the following years, a number of new results have emerged that update these findings. In this section we look briefly into the major findings made.[117]

The first finding concerns the very basic driver of current climate change, i.e. anthropogenic contributions to the greenhouse effect. The observed growth rate of atmospheric carbon dioxide since 2000 has been shown to be greater than for the most fossil-fuel intensive of all the SRES.[118] Two socio-economic forces − increase in population and in per capita income − have been identified as the main driving forces behind this strong growth rate. This increase in GHG levels could have the potential to be very important for the security issues under consideration in this report, since impacts associated with the higher IPCC climate projections need to be considered seriously.

With regard to the climate itself, many key climate indicators show a more dramatic trend than that previously reported by IPCC. It has been experimentally verified that the ocean has warmed significantly in recent years, with some reports indicating a warming of 50 percent greater than the IPCC estimate. Perhaps the most talked-about recent trend is sea level rise. AR4 reported levels up to 59 cm by 2100. Observations that the rate of sea level rise has increased substantially during the past decade and is now at, or near, the upper limit of the IPCC projections have led to concerns that IPCC projections are underestimated Recent research suggests that we could expect a sea level rise of 0.5 to 1.6 metres by 2100.[119] Another important development since AR4 is the rapid reduction in

[116] See e.g. 'Synthesis Report" from the Conference 'Climate Change: Global Risks, Challenges & Decisions', Copenhagen 10-12 March 2009.
[117] For a summary report of the new climate science in Swedish see Rummukainen and Källén 2009.
[118] Raupach et al. 2007.
[119] Ramhstorf 2007; Jevrejeva, Moore and Grinsted 2010.

Arctic sea ice in the summer.[120] This is important, since less ice will lead to more absorption of heat into the earth.

As a final point in this section, it is important to underline the speed at which the climate is currently changing. Global temperature increase until 2100 at the upper range of current IPCC projections implies an increase of 5 to 6ºC over approximately 100 years. This is in the same range as the difference between the last ice age and today's climate. Hence, we cannot rule out the possibility that in the coming 100 years we will experience a temperature shift of the same magnitude as a previous shift that took between 10 000 and 20 000 years. This aspect – the speed of global warming – together with the increase in extreme weather events and increasing variability is perhaps the most important feature of global environmental change to keep in mind, especially in relation to human civilisation.

3.2 Impacts on systems and sectors

The cornerstone in the impacts on systems and sectors lies in what can be described as ecosystem services. Fundamentally this concerns the dependency of humans on a basic supply of water, food and shelter, but also concerns economic prosperity and the long-term function of ecosystems, damage to which would further decrease the possibility of securing basic needs of water and food.

In the following, we concentrate on sectors of importance for the link between climate change and security. The sectors are freshwater resources, food production and human health. It should be underlined that the review here does not include impacts from so-called extreme events, for example storms, droughts, flood and heat waves. In recent decades, the number of heat waves has increased.[121] There is also evidence that the number of severe hurricanes per year has increased over the past few decades.[122] A number of studies report an increased risk of more intense and more frequent extreme events as a result of a warmer climate, for example in the case of heat waves.[123] Extreme events will also add to the impacts described below. It most cases extreme events will worsen the situation further, one example being a recent study showing that heat extremes will have implications on food production.[124] However, it is more difficult to produce accurate projections over future extreme events compared with projections over the future development of mean values. Therefore this review only includes impacts that result from changes in mean values.

[120] Richter-Menge et al. 2008.
[121] Trenberth et al. 2007. p. 308.
[122] Meehl et al. 2007, p. 783.
[123] E.g. Meehl and Tebaldi, 2004; Schär et al. 2004 and Clark et al. 2006.
[124] Battisti and Naylor 2009.

An important aspect in impact studies is the gap between the speed of climate change on the one hand and societal change on the other. Climate change is a relatively slow process and as a result the major impacts will influence a different society compared with what we see today. Social, economic, political and a number of other factors will have an influence on the vulnerability and adaptation capacity of society. Indeed, the definition of climate change impacts adopted by the IPCC states: 'difference … between socio-economic conditions projected to exist without climate change and those projected with climate change'.[125] Perhaps a little paradoxically, most impact studies are performed with future climate conditions imposed on today's society. One obvious change of importance for security is demographic change and although this is acknowledged in the environmental security literature, it is seldom taken into consideration in more focused impact studies. Another aspect is the development of adaptation measures, for example new technologies for increased food production productivity. Therefore, the review below of the current scientific literature does not include other global change trends of major importance for security.

The sectors identified here are also discussed in the next section, where we consider geographical regions of particular interest for this report.

3.2.1 Freshwater resources

The relationship between climate change and freshwater is of primary concern to human society, since freshwater-related issues are critical in determining key societal vulnerabilities. The rate at which freshwater is renewable is determined by the speed at which water circulates in the global hydrological cycle, which is linked to changes in atmospheric temperature and radiation balance. The most important climate change parameters for the hydrological cycle are changes in precipitation, evaporation and snowmelt. The importance of the link between climate change and freshwater resources can be seen from the fact that IPCC has devoted one of its six technical papers to this issue.[126]

It is important to underline that the impact of climate change on freshwater resources will not be entirely negative, as the changes are not going to be similar for all regional areas across the globe. However, by the 2050s, the area of land subject to increasing water stress due to climate change is projected to be more than double that with decreasing water stress. IPCC states that: 'Globally, the negative impacts of future climate change on freshwater systems are expected to

[125] Carter et al. 2004.

[126] Bates et al. 2008. Note, that like all IPCC Technical Papers, the report on Climate Change and Water is based on the material of previously approved/accepted/adopted IPCC reports and underwent a simultaneous expert and Government review, followed by a final Government review.

outweigh the benefits'.[127] We thus need to acknowledge the major differences concerning the impacts in relation to various regions, and indeed the difference in itself might cause security problems. In any case, it has been argued that even with appropriate adaptation measures, the impacts on freshwater resources in many parts of the world will be severe with only a 1ºC-1.5ºC rise in temperature.[128]

A particular problem connected to access to freshwater is the rapid growth of so-called mega-cities, i.e. cities with more than 10 million people. Lack of clean water in many of the new mega-cities, the residents of which are often poor, is already a serious concern. As both the number of mega-cities and their size are expected to increase very rapidly in the coming decades, this – in combination with climate change – will exacerbate the problem.[129] However, it is most important to recognise that urbanisation also has positive effects, while the phenomenon is an utterly complex area to investigate.

Apart from the issue of the availability of freshwater, effects on water quality are important in connection with climate change. Water quality is expected to be affected due to increased water temperature and changes in floods and droughts, as well as other forms of pollution. Furthermore, the areas with salinised groundwater are projected to be extended as a result of sea level rise.[130]

Projecting the impacts of climate change on freshwater resources is particularly challenging. One reason for the difficulty is that the availability of freshwater resources is linked to potential abrupt change ('tipping points'), e.g. the Asian monsoon changing to a substantially drier state or the eventual loss of water storage capacity in Himalayan glaciers. This would lead to severe stress of freshwater availability in the Indo-Ganges plain.[131]

Finally, climate change will affect the functioning of existing water infra-structure. These effects are of course dependent on the technology available, as well as the geographical location. This highlights the importance of the socio-technological system in terms of climate change and its effects on society.

3.2.2 Food production

There is a direct link between freshwater resources and food production. Today, agriculture consumes about 70 percent of the freshwater co-opted for human use. Therefore changes in freshwater quantity and quality are expected to affect the

[127] Bates et al. 2008, p. 3.
[128] Steffen 2009. Note that this report is produced for general information only and does not represent a statement of the policy of the Commonwealth of Australia.
[129] UN Habitat 'The State of African Cities' 2008 has acknowledged this issue.
[130] Bates et al. 2008, p. 70.
[131] Barnett et al. 2005.

availability of food, as well as the stability of food production. It has been argued that this will lead to decreased food security and increased vulnerability of rural farmers, especially poor farmers in the arid and semi-arid tropics and Asian and African mega-deltas.[132]

In a recent study by Lobell et al. similar conclusions were reached.[133] However their study was much more detailed in that they investigated climate risks in a 20-year perspective for crops in 12 food-insecure regions in order to identify adaptation priorities. The 12 regions were identified based on two criteria. First, each region comprised groups of countries with broadly similar diets and food production systems. Second, the regions included the majority of the world's undernourished people. In terms of the number of people, regions in Asia and Africa totally dominate the picture. Although the results are associated with relatively severe uncertainties – with regard to climate projections as well as crop models – their quantitative analysis revealed many cases where 'food security' (as they call it) is threatened in a 20-year perspective. In Southern Africa for example, without appropriate adaptation measures the study indicates that there will be a drastic reduction in production of maize (almost -30 percent) and wheat (approx. -15 percent).

To date, most studies on climate change impacts on food production have focused on the agricultural sector. This ignores the large contribution of protein stemming from marine fisheries. A recent study projecting changes in global catch potential for more than 1000 species of fish and invertebrates by 2055 found that climate change may lead to large-scale redistribution of global catch potential.[134] In general, high-latitude regions will see an increased potential while the tropics will experience a drop in catch potential. The nations that will see the highest increase in catch potential include Norway, Denmark (Greenland), Russia and the United States (Alaska). Among the countries with the biggest decrease in catch potential the study mentions Chile, China, Indonesia and regions in the United States except Alaska and Hawaii. The study quotes quite dramatic figures for 50 years from now. For example, the decrease in the tropics is estimated at 40 percent, while the increase in catch potential in high-latitude regions could be as much as 30 to 70 percent.

3.2.3 Human health

Climate change has already had a significant impact on human health. According to IPCC estimates, in the year 2000, 'climate change is estimated to have caused

[132] Bates et al. 2008, section 4.2.3.
[133] Lobell et al. 2008.
[134] Cheung et al. 2010.

the loss of over 150 000 lives and 5 500 000 DALYs[135] (0.3 percent of deaths and 0.4 percent of DALYs, respectively)'.[136] The main areas of importance for health effects are infectious diseases (e.g. malaria), heat- and cold-related mortality and the effects of air quality, especially in urban environments. Other more indirect causes include health impacts from floods, storms, fires and drought. It is also predicted that climate change will bring some health benefits, e.g. lower cold-related mortality.

One of the major concerns is the future development of malaria. Modelling the impacts of climate change on malaria is a complicated task, partly due to the fact that the spread of malaria also depends on a large number of factors unrelated to climate change. In any case, most studies show an impact of climate change on malaria outside Africa, although there are exceptions, e.g. a study showing some increased risk of local malaria transmission in the UK.[137] Within Africa, however, models indicate changes in malaria due to climate change. The projections suggest that the geographical distribution will change, with expansions in some regions while other regions will experience a contraction.[138] Another important aspect is that some regions will experience longer seasons of transmission.

Health impacts from climate change will affect the world's population very differently. In general, risks to human health will mostly hit developing countries. In effect, the countries with the least resources to cope with these risks will also be the countries hardest hit. On an aggregated level, the groups hardest hit will be the urban poor, the elderly and children.

3.3 Impacts on regions

In the following, the emphasis is on climate change implications on various regions around the world. A general consideration is that climate change will not occur symmetrically and that already vulnerable regions will be more severely affected. This section reviews current knowledge regarding impacts on regions of importance for the connection between climate change and security. Note that our focus is large-scale and that local variation only are included to a minor extent. The regions covered meet at least one of two criteria: 1) the region is projected to be particularly hard hit by the impacts of climate change and/or 2) the region lies in the neighbourhood of Sweden. These criteria led to the selection of Europe, Africa, Asia, Russia and the Arctic.

[135] DALYs – Disability Adjusted Life Years, i.e. the sum of years of potential life lost due to premature mortality and the years of productive life lost due to disability.
[136] Confalonieri et al. 2007, p. 407.
[137] Confalonieri et al. 2007, p. 408. See also Kuhn et al. 2002.
[138] Ebi and Gamle 2005.

3.3.1 Europe

The impacts of climate change will vary across the European continent. In terms of rising temperatures, northern and southern parts of Europe will experience the highest temperature increases. It has been projected that the future summer climate will experience a pronounced increase in year-to-year variability and thus a higher incidence of heat waves and droughts.[139] These developments are predicted to take place especially in the Mediterranean and in much of Eastern Europe.

Given the object of this report – i.e. to study the connection between climate change and security – it could perhaps be argued that impacts on Europe should not be included in the study. We believe, however, that there is one sector worth highlighting in this regard, namely agriculture. We do not consider that climate change impacts on this sector would lead to conflicts within Europe, but given the immense importance of this sector within the EU system, it is difficult to rule out the possibility that the impacts of climate change on agriculture could lead to increased tension between member states.

In southern Europe the economy is dependent to a relatively large extent on climate-sensitive sectors such as tourism and agriculture. Climate change is a real concern for the development of agriculture within Europe. Although some aspects of climate change (e.g. longer growing season and warmer temperature) may bring benefits, the negative impacts, including reduced water availability and more frequent extreme weather, are projected to dominate the picture.

In a comprehensive study on climate change impacts in Europe conducted by the Joint Research Centre of the European Commission, agriculture was one of the focus areas.[140] The study concluded that most European regions would experience yield improvements, particularly in northern Europe, while southern Europe is projected to experience yield losses. The study acknowledges the high uncertainties pertaining to the projections, but cited simulated yield changes ranging from +2.8 to +70 percent for certain northern regions and decreases ranging from -1.9 to -22.4 percent for southern regions. This huge difference between northern and southern parts of Europe is the single most important message with regard to future EU policies within this sector.

3.3.2 Africa

Africa is obviously not a homogeneous continent. However, climate change is likely to be a major threat to sustainable growth and development in Africa and it is often argued that Africa is the continent that is most vulnerable to the impacts

[139] Schär et al. 2004.
[140] Ciscar et al. 2009.

from climate change. Clearly, certain parts of Africa are more vulnerable to climate change fluctuations and extreme weather phenomena (densely populated areas, less developed regions, areas with already existing desertification processes, etc.). In general, there are fewer projections for the future climate in Africa compared with many other regions, but available projections point to a degree of warming by the end of the century of 3 to 4 °C, somewhat above the average global rise in temperature.[141] However, there are estimates of more extreme temperature increases in specific parts of Africa. For example, Ruosteenoja et al. report up to 9°C for North Africa (Mediterranean coast) in June to August and up to 7°C for southern Africa in September to November.[142]

The IPCC review of the scientific literature on potential impacts has identified changing rainfall patterns affecting agriculture and reducing food security, worsening freshwater availability, decreasing fish resources in large lakes, shifting vector-borne diseases and rising sea level affecting low-lying coastal areas with large populations as the main longer-term impacts.[143]

The vast majority of Africa's agriculture is rain-fed, which means that agricultural production, including access to food, is projected to be severely compromised by climate variability and change. Furthermore, the areas suitable for agriculture are expected to decrease. Desertification is already a problem today in some African countries, and climate change could exacerbate this problem, especially in northern fringes of the Sahara.[144] Another aspect is that rising water temperatures could negatively affect the prospects for fishing in large lakes. Global sea level rise will affect Africa at many spots. Today, over 25 percent of the African population lives within 100 kilometres of the coast and this number is expected to increase further in the future. One such area that could be severely affected by sea level rise is the Nile Delta, of immense importance to the whole Egyptian economy.

Due to climate change, freshwater resources are a particularly acute problem in future Africa. There are estimates that in only 10 years time, between 75 and 250 million people will be exposed to a decrease in freshwater resources.[145] This problem is even more acute in North Africa (Algeria, Egypt, Libya, Morocco, Sudan, Tunisia, Western Sahara), with already high freshwater use and very high population growth rates.

[141] Christensen et al. 2007.
[142] Ruosteenoja et al. 2003.
[143] Boko et al. 2007, p. 435.
[144] Millenium Ecosystem Assessment 2006.
[145] Arnell 2004.

3.3.3 Asia[146]

Asia, a region with growing political and economic powers such as India and China, is vital to consider when studying the connection between climate change and security. In general the region is characterised by rapid economic development as well as social and military tensions. As a result, the region is increasingly attracting the attention of global powers outside Asia.

Asia will experience a substantial increase in surface temperature during the 21st century. South-east Asia will experience the least rapid warming, while Central, West and North Asia will see larger increases in surface temperature.[147] Annual precipitation will also increase during this century. The occurrence of extreme weather, e.g. heat waves and intense precipitation, is projected to increase.[148] Sea level rise is a major concern in Asia as the region includes many small island states, as well as low-lying states like Bangladesh. A further concern is the fact that many important economic regions are located in coastal areas, for example in China. Given the high population density and the fact that huge areas are low lying, even a modest rise in sea level will have a huge impact on many people in Asia.[149]

The rapid economic development in many Asian countries has helped to amplify environmental problems. The impacts of climate change could further increase the stress on the environment. Salinisation, erosion, desertification and loss of arable land as a result of industrialisation are already serious environmental problems today in many regions.

In many respects Asia is considered vulnerable to climate change. In its fourth assessment report IPCC stated that 'Multiple stresses in Asia will be compounded further due to climate change'.[150] The worries include all sectors covered above, i.e. freshwater resources, food production and human health. A special concern is the large number of poor people that are urbanised. This group is especially vulnerable to several effects of climate change. Concerning human health, climate change will in most cases make things worse in Asia. Just one example is that future excess mortality due to heat waves is expected to be very high in India and China.[151] Other concerns include spread of vector-borne diseases and health problems in connection with air pollution, which could be amplified by climate change. Food production is also threatened by climate change, as is freshwater availability. The latter problem is related to the issue of

[146] This section excludes the parts of Russia that belong to Asia.
[147] Cruz et al. 2007, p. 478.
[148] Cruz et al. 2007, p. 479.
[149] Cruz et al. 2007, p. 485.
[150] Cruz et al. 2007, p. 471.
[151] Takahashi et al. 2007. It should be noted that this study, like many other studies on the subject, does not include adaptation and demographic change.

melting glaciers, which could have an impact on freshwater resources for hundreds of millions of people in the Hindu-Kush region (Afghanistan and Pakistan) and in China.[152]

3.3.4 Russia

In general, the increase in temperature is projected to be larger in Russia than the global average. Since the temperature rise is larger in winter, the snow cover will be reduced in almost all areas of Russia. One consequence is expected to be more frequent and intensive flooding. Indeed, already today there are a number of clear signs of ongoing climate change in Russia regions. Due to the large size of the country, climate change impacts will differ greatly between different regions; most places will experience negative impacts but in some place the impacts could be favourable. However, it is important to underline that impacts in Russia – the world's largest country and rich both in natural resources and biodiversity – will in many cases have global consequences.

The most talked about impact of climate change in Russia is probably the decreased thickness and areal extent of permafrost.[153] Areas with permafrost amount to more than 60 percent of the total land area. The decrease in permafrost will have huge impacts on infrastructure and buildings and calls for new methods for these in the affected regions.[154] Already today, conditions for transportation using *zimnik* roads, roads on frozen ground, have become worse due to warming in Siberia and Far East districts. One particular worry in Russia is the status of the huge pipeline systems and what will happen when conditions change. Enormous economic resources are linked to a functioning Russian pipeline system.

Food production is an example of how climate change will have diverse impacts in different Russian regions. In general, increased temperatures will permit substantial expansion of the area suitable for food production in the Russian Federation. At the same time, there are worries that climate change will negatively affect food production in eastern Russia. It has been argued that climate change could hamper attempts to increase productivity to meet growing demands.[155] As noted above (Section 3.2.2), conditions for fisheries will be changed due to climate change and this could be expected to further increase the strategic value of the northern Russian regions.

[152] Barnett et al. 2005.
[153] Frauenfeld et al. 2004.
[154] Mazhitova et al. 2004.
[155] Izrael and Sirotenko 2003.

3.3.5 Arctic

The Arctic is a region of special interest for the climate change and security nexus for at least two reasons. First, the Arctic region responds faster than the global average to global environmental change. This is partly due to the region's special physical conditions, including extreme climate and sensitive ecosystems. Second, the impacts of climate change in the Arctic highlight a number of issues related to security.

Many climate change effects will be amplified in the Arctic compared with global averages. For example, it is a well established empirical fact that the Arctic is warming much faster than the global average,[156] although the underlying reasons for this effect are not very well understood. The surface temperature is rising faster over the Arctic than the global average. Compared with the mid-1960s the temperature rise north of 60º was 1.9-2.0 ºC,[157] while the global temperature increase was only about 0.6-0.7 ºC. Another key change is ice sheet shrinking. This was underlined in the fourth IPCC assessment report, but newer research indicates that its estimates were too conservative.[158] Although predictions tend to differ about the rates at which ice sheets are shrinking, there are estimates that the pack ice in the Arctic could disappear in 20 years' time.[159]

The rather dramatic climate change that the Arctic will experience could be followed by equally dramatic impacts. The first and perhaps most obvious impact is that climate change is threatening the biodiversity of the Arctic. This includes, for example, the spread of new insects, shifting vegetation and changes in wetlands.

Food production is a general concern for the Arctic with regard to climate change. Food production and northern livelihoods tend to be tightly linked to climate and local ecosystems. There have been studies that claim that these systems are under pressure.[160] On the other hand, as has been noted above, the changing climate is projected to increase the catch potential for fisheries. This must be put into the context of the loss of biodiversity, which could force the system out of equilibrium, with unknown consequences.

Finally, there are two major developments of significant strategic importance in the Arctic. The shrinking ice cover could open up an Arctic commercial navigation channel. This would mean a much shorter distance from Asia to ports in Europe, which would of course be financially beneficial. At the same time this would also mean that systems such as environmental monitoring, navigational

[156] Kennedy et al. 2007.
[157] Richter-Menge et al. 2008.
[158] Stroeve et al. 2007.
[159] Serreze et al. 2007.
[160] White et al. 2007.

systems and rescue services of a standard not present today must be developed. The second development of strategic importance is the potential for extracting natural resources in the Arctic. It is generally believed that the Arctic region is one of the largest reserves of oil and gas in the world. These resources could lead to increased tension between the five coastal states Canada, Denmark (Greenland), Norway, Russia and the United States.

3.4 Extreme climate change

The analysis of impacts so far in this chapter deals with what could be called *likely* or *very likely* climate change. However, when dealing with the intersection of climate change and security, it is important not to omit the more extreme climate change scenarios, i.e. improbable but extreme outcomes, from the analysis. Perhaps a little surprisingly, most of the work on the security implications of climate change uses the trends described in IPCC reports and therefore cannot comprise the more extreme – and perhaps more unlikely – climate change scenarios. We believe that these extreme scenarios must also be acknowledged, not least from the view of a defence approach which includes the responsibility for crisis management and thus has an interest in being prepared for the unlikely and the unknown. This is reinforced by the fact that the predictions in IPCC seem to be rather low in comparison to what has been measured during recent years.

Climate change is associated with deep structural uncertainty. In Section 2.3.1 Hulme's typology of uncertainties was discussed. First, there are the uncertainties pertaining to climate science itself. In the latest IPCC assessment report, the 'likely range' of projected global average surface warming until 2100 (relative to 1980-1999) was between 1.1 and 6.4 ºC. For sea level rise the range given was 0.18 to 0.59 metres above the average 1980-1999 level. Of course, these estimates only include *known* mechanisms, which further underline the uncertainties associated with climate science. In the case of sea level rise, it is explicitly noted that the indicated range excludes future rapid dynamic changes in ice flow. There are many other geophysical processes of potential importance for climate change that are under discussion. The vast volumes of GHG sequestered in Arctic permafrost are one example of a potential multiplier that has captured much attention recently.[161]

Hulme also defines one type of uncertainties originating from the fact that human beings are part of the system.[162] The atmospheric level of GHG is the primary example of this. What we do know is that the current level of CO_2 is 385 ppm, which is the highest level in at least 800 000 years. Data also suggest that

[161] Shakhova et al. 2010.
[162] Hulme 2009. p. 83.

anthropogenic activities are the main cause of these high levels and that there is no analogue to the current rate of change in GHG in past geological records. Since the earth has not experienced anything like this before, knowledge of the consequences is very limited. Furthermore, the uncertainty regarding future mitigations of GHG is very great, especially after COP-15 in Copenhagen.[163] That meeting resulted in the 'Copenhagen accord', which is a framework for capturing the national climate commitments already on record. Critics have argued that even if the commitments are implemented this could lead to GHG levels that would imply global warming of nearly 4 °C by the end of the century. Overall, climate change is characterised by deep structural uncertainty, but as we shall see, this is not an argument for disregarding the more extreme outcomes.

This section takes a closer look at two different types of extreme climate change: 'fat-tailed climate sensitivity' and 'abrupt climate change'. Climate sensitivity is introduced as a measure of the range of response from different climate models. A non-technical definition of climate sensitivity is that it is the long-term equilibrium warming response to a doubling in atmospheric CO_2.[164] It is important to recognise that climate sensitivity is not a projection; it only measures, for a given climate model, the global average surface temperature that would follow from a doubling of CO_2 concentration. The fourth IPCC assessment report states that the climate sensitivity is likely to be in the range 2 to 4.5 °C, see Figure 1. Interestingly it also states that: 'Studies that take all the important known uncertainties in observed historical trends into account cannot rule out the possibility that the climate sensitivity exceeds 4.5°C, although such high values are consistently found to be less likely than values of around 2.0°C to 3.5°C'.[165]

[163] COP – The Conference of the Parties is the highest decision-making authority of the UN United Nations Framework Convention on Climate Change.
[164] For a technical definition see Meehl et al. 2007, p. 762.
[165] Meehl et al. 2007, p. 798.

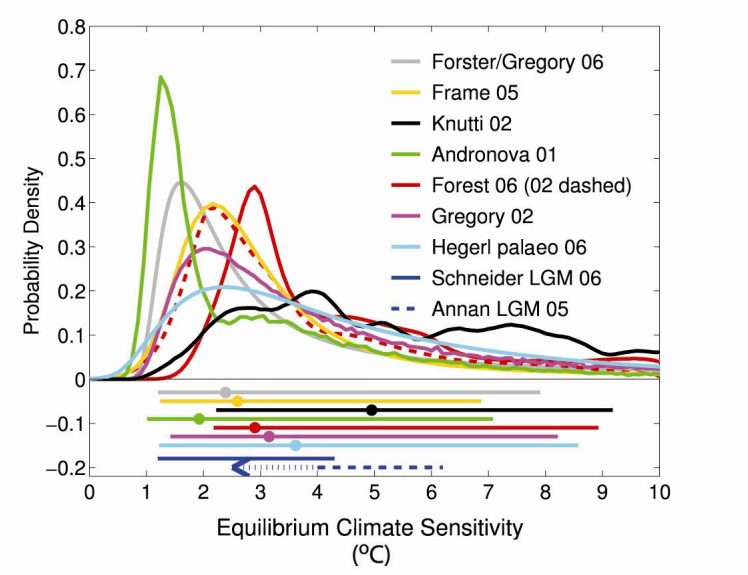

Figure 1: Equilibrium climate sensitivity, i.e. the long-term equilibrium warming response to a doubling in atmospheric CO_2, for nine climate models. For each climate model, the corresponding graph shows the probability density as a function of climate sensitivity.[166]

The IPCC reports, and indeed most others as well, focus on the impacts that follow from predictions based on climate sensitivity in the range called *likely*, i.e. between 2 and 4.5 °C. An exception is the economist Martin Weitzman who – from an economic perspective (cost-benefit analysis) – argues that we should not ignore what he calls the 'fat-tailed logic'.[167] In essence, what Weitzman means by fat-tailed logic is that the probability distribution for climate sensitivity does not go to zero quickly enough for higher temperatures, indicating that the probability of extreme temperature responses is not negligible. For example he estimates that the probability of a temperature response (given a doubling in CO_2 concentrations) of more than 7 °C is roughly 5 percent and – even more worrisome – that the probability of a temperature response of more than 10 °C is roughly 1 percent.

Weitzman does not stop there. Instead, he argues forcefully that we could in fact have significant supplementary components that should be added to the climate sensitivity as of today. Since current models – which give climate sensitivity in the range 2 to 4.5 °C – do not include mechanisms such as long-term reinforcing feedback processes that could further increase warming (e.g. decreased sea ice

[166] Figure adopted from Hegerl et al. 2007, p. 720.
[167] Weitzman 2009.

cover and change in land-use), even higher climate sensitivity could be expected. Weitzman introduces a 'generalised climate sensitivity' that includes heat-induced feedback from e.g. release of natural sequestered GHG and other sources. With this generalised measure he concludes that the probability of global warming of more than 10 °C with a doubling of atmospheric CO_2 is roughly 5 percent, i.e. fivefold higher than the previous estimate derived from the IPCC report.[168] The point is not to put forward exact estimates on the upper boundary of climate sensitivity, but rather to argue that any such estimate must – by the inherent logic of the subject matter, i.e. climate change – be imprecise and that this lack of precision must be taken seriously. As has been shown by Roe and Baker, we are bound to live with the uncertainty associated with climate sensitivity.[169] They show that the probability of a large temperature increase is relatively insensitive to decreases in uncertainties associated with the underlying climate processes. In other words, we cannot expect to decrease the uncertainty when new information and knowledge about the climate system are produced.

The next class of extreme climate change is *abrupt* climate change. This is an important area of research in climate change projections and IPCC has adopted the following working definition: 'an abrupt climate change occurs when the climate system is forced to cross some threshold, triggering a transition to a new state at a rate determined by the climate system itself and faster than the cause'.[170] Implicit in the definition is that once a critical threshold has been passed, the resulting changes are generally difficult to bring under control again. It is important to note that the climate system is only *one* possible anthropogenic environmental change where the risk of abrupt change is present. In a recent paper, Rockström et al. proposed an approach to global sustainability in which they defined nine so-called 'planetary boundaries' within which humanity can operate safely.[171] Transgressing one or more of these boundaries may be deleterious due to the risk of crossing thresholds that can trigger abrupt changes. One of the planetary boundaries is climate change.[172] Clearly, such boundaries are socially constructed and not determined by natural sciences.

Two factors are particular relevant in the present context. The first is 'new state', which is illustrated in Figure 2. A gradual change in some determining quantity (red) of a system can cause a variety of structurally different responses (blue). At the bottom, a new stable state is achieved, which is structurally similar but not

[168] Meehl et al. 2007, p. 799.
[169] Roe and Baker 2007.
[170] Meehl et al. 2007, p. 775. These kinds of transitions are often called tipping points and sometime regime shifts.
[171] Rockström et al. 2009.
[172] The other planetary boundaries are 1) rate of biodiversity loss (terrestrial and marine), 2) interference with the nitrogen and phosphorus cycles, 3) stratospheric ozone depletion, 4) ocean acidification, 5) global freshwater use, 6) change in land use, 7) chemical pollution and 7) and atmospheric aerosol loading.

necessarily close to the original state. If the system contains more than one stable state, transitions to structurally different states are possible (two top lines).

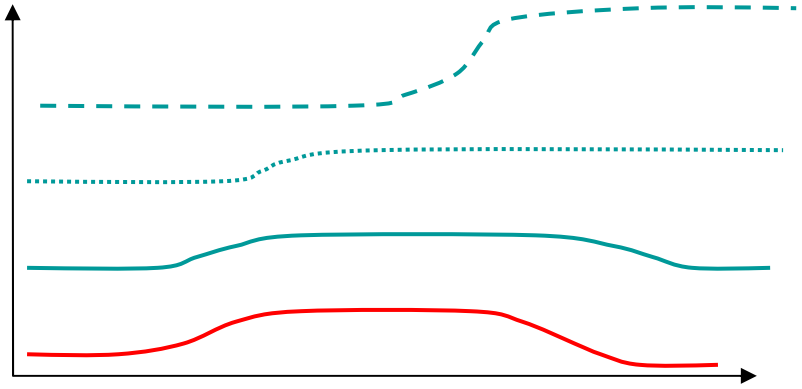

Figure 2: Transitions between different states due to external forcing.[173]

The next important aspect is related to the word 'abrupt'. For societal implications of transitions in the climate system, the timescale under which the transition takes place is of vital importance. If the transition is very fast (uppermost blue line in Figure 2), ecosystems and societies have more difficulties in adapting compared with a slow and gradual change. Transitions between different states might not only be caused by external forcing; systems can also change states due to gradual internal changes that decrease the system's ability to resist disruption and change. The latter is related to the concept of ecological resilience.[174] It is the combination of external forcing (e.g. climate change) and internal stability (e.g. societal resilience) that ultimately determines the impacts of abrupt climate change on insecurity.

In an attempt to study policy-relevant critical transitions under anthropogenic forcing, Lenton et al. introduced the term 'tipping element'.[175] Their definition is broader since they wanted to include for example non-climatic variables and cases where there may be no abrupt change, but where a slight change in one parameter may have a qualitative impact on the future. Given four criteria,[176] they identified nine policy relevant tipping elements, see Table 1.

[173] The figure is constructed with inspiration from Figure 1 in Box 10.1 in Meehl et al. 2007, p. 775.
[174] Holling 1986.
[175] Lenton et al. 2008.
[176] For details see Lenton et al. 2008.

Table 1: Policy relevant potential future tipping elements in the climate system. Global warming is interpreted as the global mean temperature change above the average during the period 1980-1999. In the fourth column R = rapid, S = slow and G = gradual.[177]

Element	*Feature*	*Global warming (ºC)*	*Transition Timescale (yrs)*	*Key impacts*
Arctic summer sea ice	Areal extent (-)	+0,5-2	~ 10 (R)	Amplified warming, ecosystem change
Greenland ice sheet	Ice volume (-)	+1-2	> 300 (S)	Sea level +2-7m
West Antarctic ice sheet	Ice volume (-)	+3-5	> 300 (S)	Sea level +5 m
Atlantic thermohaline circulation	Overturning (-)	+3-5	~ 100 (G)	Regional cooling, sea level
El Niño-Southern oscillation	Amplitude (-)	+3-6	~ 100 (G)	Drought in South East Asia
Indian summer monsoon	Rainfall (-)	N/A	~ 1 (R)	Drought, decreased carrying capacity
Sahara/Sahel and West African monsoon	Vegetation fraction (+)	+3-5	~ 10 (R)	Increased carrying capacity
Amazon rainforest	Tree fraction (-)	+3-4	~ 50 (G)	Biodiversity loss, decreased rainfall
Boreal forest	Tree fraction (-)	+3-5	~ 50 (G)	Biome switch

The analysis suggests that a number of tipping elements could reach their critical threshold within this century. The Arctic sea ice and the Greenland ice sheet are identified as the most alarming threats because of the low values of global warming for tipping these elements. Note that a tipping element is not necessarily a change with negative consequences. The Sahara/Sahel and West African Monsoon can for instance lead to increased carrying capacity. A critical aspect is the uncertainties that circumscribe these alterations.

Nevertheless, for these kinds of dynamic behaviour – typically including non-linearity – it is notably difficult to predict whether and when a critical transition could be expected. This is yet another uncertainty associated with climate change. However, there have recently been some attempts to identify generic properties of dynamic systems near critical points. One promising candidate is

[177] The table is reproduced from Lenton et al., 2008.

that researchers have found general characteristics of a wide range of dynamic systems approaching a critical threshold.[178] This research is still in its infancy, but any progress would be important for the ability to monitor the climate system in order to cope with potential dangerous critical transitions with ramifications for society and security.

[178] Scheffer et al. 2009.

4 Climate change and armed conflict

In Chapter 3 we focused on the physical effects of climate change and recognised the severe implications it may have on human societies. Interpreting the magnitude of these implications of climate change on society is mainly a matter for the scholarly community, but policy-makers must take the necessary decisions. However, the policy community is likely to rely on what the science community has to say about climate change and its security implications. Hence, science on armed conflict (e.g. wars, civil wars, etc.) and its impact becomes a crucial source for policy-makers. In this context it is fruitful to identify factors that seem to be particularly important for the nexus of climate change and armed conflicts.[179]

In this chapter we address the potential links between climate change and armed conflict more specifically. The point of departure is to analyse the *interconnection* between climate change and armed conflicts. We begin with some general understandings on the relationship between climate change and armed conflicts. This section is followed by empirical studies investigating this connection. It is important to bear in mind during this section that the concept of armed conflict is dependent on the definition used and that different authors may apply different definitions. The guiding questions for this chapter are: What implications does climate change have for armed conflicts in general? Under what circumstances can climate change trigger conflicts? What knowledge can be drawn from empirical investigations on the interlinkages between climate change and armed conflicts?

Before going into further discussions on climate change and armed conflict, it is worth noting that the analysis is based on three premises. The first premise concerns the matter that climate change is an ongoing process where it is complicated to determine whether a particular event is grounded in climate change or an event that is merely extraordinary. Therefore, there are no empirical investigations pin-pointing a causal relationship between armed conflicts and climate change. This leads us to the second premise. The empirical and scholarly knowledge that exists today is mainly drawn from experiences of scarce natural resources and the potential linkages to armed conflict. If climate change leads to increasing scarcity of, for instance, freshwater resources and food production this knowledge is adequate, but it is not possible to link this directly to an increased likelihood of armed conflict. An element that cannot be disregarded, however, is that climate change is expected to lead to an increase in disasters following extreme weather events and territorial change. Research linking these matters to

[179] Although much of the literature on causes of war are sensitive to definitions of armed conflicts (wars between states, civil wars, inter-communal violence etc.), we have here consciously to restrict ourselves to a specific definition. The aim is to keep the analysis on a more general level.

conflicts is hence also vital to consider. Although we only briefly touch on this issue in the present study, it is worth greater attention. The third premise is that climate change differs with respect to the magnitude of the changes, as well as the speed that alters the conditions. The importance of this for conflict dynamics is unknown.

4.1 Causes of armed conflict

Causes of armed conflict is a well studied field in international relations.[180] There are probably as many theories and understandings as to what causes war as there are scholars investigating the matter. Armed conflicts obviously differ and so do their underlying causes. For instance, while intergovernmental armed conflict usually leads to war in a more conventional sense (i.e. by state-based armies and paramilitary units), civil wars are by definition fought between one state and a non-government party, or between two non state-based parties.[181] Typically, there are different motivations for armed conflict in these types of conflicts. Motivations also changes over time, which give way to different forms of armed conflicts.

Following the end of the Cold War, inter-state wars have more or less tended to disappear, at least in large-scale form (with the notable exception of the initial phase of the current wars in Afghanistan and Iraq). However, internal wars have come to replace classical inter-state types of armed conflict. Yet, it is worth noting that the post-WW2 period, including the period following the end of the Cold War, is marked by a steady decline in internal armed conflict.[182] Unlike war between states, internal wars such as civil wars often arise around goals of self-determination, ethnic identity problems, greed and grievance, and opportunity.[183]

The literature examining causes of post-Cold War armed conflicts is immense. Despite the early notion of new wars, as proclaimed by scholars such as Mary-Ann Kaldor, there is still no consensus on whether armed conflicts today are really that different from other conflicts fought in history.[184] Theories explaining causes of armed conflicts give different answers depending on the unit of analysis being investigated or the level of abstraction being applied. Thus,

[180] A sample of introductory works includes Barash and Webel 2002; Berdal and Malone 2000; Deutsch and Coleman 2000; Crocker, Hampson, Aall 2001; Brecher 1993; Buzan 1991; Gurr 2000; Holsti 1991; Mitchell 1981; van Evera 1999; Kalyvas 2001; Waltz 2001; Wallensteen 2002.
[181] Wallensteen 2002.
[182] At least if keeping persistant definitions according to the Uppsala Conflict Data Program. For trends and analysis, see Gleditsch 2002.
[183] Berdal and Malone 2000; Collier 2003.
[184] Kaldor 2006. For a re-interpretation of this thesis on new vs. old wars, see e.g. Melander, Öberg and Hall 2009.

economic, political, behavioural, sociological, demographic, ethnic and cultural theories give different answers to causes of war. Motivating factors can be either structural or agent-based, or a combination of both. They can be triggered by reason or by chance. Moreover, interests and capabilities, frustration, perception and expectation, power balances and absence of security help explain armed conflicts. Another aspect is that the causes of war may be quite different from the actual framing of war, e.g. religious war, ethnic war, climate war, etc.

Given the many different methods, theories and approaches being applied to understand and explain occurrences of armed conflict (e.g. wars, civil wars, etc.), there is no single analytical framework that can be used in explaining the dynamics behind it. Not surprisingly, one needs to combine various approaches and consider different perspectives depending on what one wants to emphasise when investigating causes of armed conflict. This is particularly important when thinking of armed conflict and climate change nexus.

However, before adopting any theories or methodologies one needs to pay careful attention to defining the type of questions that will help understand why parties take up arms and why incompatibilities lead to the use of force. In this regard, Richmond suggests that there are objective questions to be posed, suggesting universal answers to peace and war, as well as subjective questions that require negotiated as well as multiple answers.[185] Objective questions include: what is conflict, what are the roots of conflicts, how efficient are the methods to achieve peace, when does conflict necessitate external intervention, and how can one create peace equating with justice, democracy, human rights, and marketisation? Subjective questions include: what are the multiple roots of conflict, who defines them and for what objective, but also what are the discourses or concepts of war and peace, and what are the inherent political, social and economic interests in the construction of war and peace?

Over the years, a number of scholars have taken different approaches to identify factors commonly contributing to the occurrence of armed conflicts and war in general. Conflict theories in this regard typically include different entry points to this overall question: violence/aggression; biological/genetics; psychological; societal explanations/group level theories; nationalism/ethnic causes; socio-economic explanations; norms/constructs/discourses/grand-narratives; state explanations; and the international system.[186] Clearly, these factors (what some would characterise as independent variables) could be nuanced or criticised for being too narrow and too abstract. Yet, they indicate the broad spectrum of factors one needs to reflect upon in order to understand causes of armed conflict.

[185] These questions are based on a similar set of questions brought forward in Richmond 2005.
[186] For an introductory reading on causes of war classics, see for example: Wright 1964; von Clausewitz. 1984; Morgenthau 1967; Gurr 1970; Howard 1984; Tzu 2009.

Since this study is primarily concerned with causes of armed conflict and climate change, our scope of interest is limited to the question of strong and weak states that in the literature is commonly said to being an important determinant in this regard. Here the literature typically suggests that weak nations are in general vulnerable to negative changes, regardless of whether these are political, economic or ecological, and thus are more inclined to be involved in armed conflicts than 'strong states'. But what characterises a weak state? That question can be answered by considering the characteristics of strong states.

There seems to be a consensus that strong states have the following characteristics:[187] *Effective administration*, which means that the state can maintain the institutions that are essential for the rule of law and establish and enforce legal and social norms and public order. Thus the state is able to mediate in impending conflicts before they turn violent, and is capable of managing environmental degradation and change. *Provision of basic public services*, such as infrastructure, health and education, so the state can safeguard fundamental socio-economic welfare. *Control of the legitimate use of force*, which includes the state having a monopoly on using force, internally as well as externally. Weak (or fragile) states, on the other hand, lack these features and are hence considered to be characterised by lacking coherent central government, lawlessness and, since livelihoods are undermined, large-scale emigration.[188] States having these features are considered vulnerable to change, including climate change.

The phenomenon of weak states is particularly widespread in sub-Saharan Africa where a substantial number of states are considered to be at acute risk of state failure. It is also well-established in the literature that the capacity of these states to adapt to change is limited, regardless of what kind of change it is. This also provides an interest on the role of weak states and climate change. However, the concept of weak states has been criticised for downplaying the regional context of states, which can be essential in the eruption of armed conflicts.[189] Hence, the concept of 'pivotal states' has been suggested.[190] A pivotal state is one whose impact in a region is of vital importance for the stability of the whole region.

The perspective of the pivotal state widens the scope from considering weak states in the first place to a broader view where states are positioned in their regional context in order to promote regional stability. The focus should then be on the pivotal state as well as the weak states themselves in strengthening the security in a region. In this respect the understanding of security becomes important. An emphasis on pivotal states predominately reflects a state-based

[187] Schubert et al. 2007, p. 42
[188] Lee 2009, p. 91 (with reference to Esty et al. 1998).
[189] It has also been criticised for being to judgemental, ignoring many other features, which may contradict this notion of weak states.
[190] Haldén 2007, p. 152.

approach to security, whereas individuals in weak states are disregarded as long as they do not affect the security of the states in the region. Within a human security approach that would be impossible, since the security of the individual is the focal point.

Weak states are one essential factor in conflict-prone areas, but other factors such as poverty, large influx of migrants and dependence on natural resources should also be taken into consideration.[191] However, none of these factors explains *why* individuals and groups who are (or who may become) insecure are more likely to join armed groups and engage in violent acts (i.e. which links back to the idea of human security).[192] In this context it is important to draw attention to the conclusion by Welzer in his book *Climate Wars*. Here, interest lies in what motivates people to kill each other and how peoples' perceptions about the world can change so that they become inclined to use violence. He found that the fundamental characteristic seems to be the alteration of people's moral perspectives, values and identifications.

Thinking of these aspects in relation to what characterises climate change Welzer recognizes that the cause and effect behind climate change are disconnected in time and space. This diminishes the political responsibility since there is an inbuilt lack of responsibility for actions.[193] Climate change is also regarded as amplifying the global asymmetries between different nations,[194] which may isolate various actors (or group of actors) from each other. These characteristics may undermine people's notions about society's capability for addressing the challenges, as well as their confidence in the action taken. Through the concept 'shifting baselines', used in psychological research on people's notions of nature, Welzer points out that changing conditions are not considered in absolute terms, but in relative terms. Hence, he underscores that there is no stability in people's values and norms for what is considered a normal and civilised behaviour; a radicalisation of any change (climate change or others) can lead to radical changes in values. The notion of threats, moreover, reinforces the identity of 'we' and defines 'others'. This polarisation has been critical in rapid social processes of change historically.[195]

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[191] Barnett and Adger 2007.
[192] Barnett and Adger 2007.
[193] Welzer 2008. p. 164. See also Beck 1995; Hayward 1994.
[194] This has been recognised during the debate in the Security Council 2007, see e.g. Brown, Hammil and McLeman 2007; Welzer 2008 p. 85. It was also acknowledged during the negotiations in Copenhagen in December 2009.
[195] Welzer 2008, p. 192. This discussion is grounded in the moral philosophy of Levinas, which has pointed towards the essential notion of 'the other' in moral behaviour and responsibility, see Levinas 1988; Bauman 1995.

4.2 Conflict dynamics and climate change

As climate change is an ongoing process, much of the current research analysing the linkages between climate change and armed conflicts emerges from investigations on natural resources and security implications. What we can learn from these is that environmental change has impacts on human insecurity, but also that there are numerous vehicles contributing to social uncertainty and armed conflicts.[196] Hence, environmental change does not undermine human security in isolation. Therefore one needs to consider a broader range of social factors such as poverty; the relationship of local communities with the state (degree of support or discrimination); economic opportunities for local communities; the effectiveness of decision-making processes; and the social cohesion within vulnerable groups.[197] Consequently, environmental change is understood as a feature that can exacerbate factors that are important in generating armed conflict as it can cause human insecurity, but does not in itself cause conflicts.

It can therefore be assumed that many factors leading to the occurrence of armed conflict are grounded in structural patterns in society.[198] This matter is also pertinent when it comes to the security implications of climate change. Lee, a scholar interested in this topic, identified three primary roads to conflict: 'sustained trends', i.e. conflicts that originate from long-term periods of climate change; 'intervening variables', i.e. other factors that contribute and shape the conflicts, and 'conflict triggers', i.e. factors that provoke conflict.[199] Hence, it is essential to recognise the kinds of conditions that seem pivotal and the security implications climate change may have.

In this context the analysis by Barnett and Adger, which seeks to explain the link between climate change and conflict, can be fruitful. They propose three principles explaining the connection:[200]

1. Climate change may undermine human security by reducing the access to, and quality of, natural resources that are important to sustain livelihoods.
2. The kinds of human security that climate change may undermine can increase the risk of violent conflicts.
3. Climate change may undermine the capacity of states to act in ways that promote human security.

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[196] van Ireland et al. 1996; Swart 1996; Homer-Dixon and Blitt 1998; Swain and Krampe 2009; Sachs 2005; Barnett and Adger 2007; Brown, Hamill and McLeman 2007; Trombetta 2008; Detraz and Betsil 2009; Lee 2009.
[197] Barnett and Adger 2010, p. 121.
[198] Lee 2009, p. 3. See also Brown, Hammil and McLeman 2007; Barnett and Adger 2007.
[199] Lee 2009, p. 3-4.
[200] Barnett and Adger 2007.

Hence, they argue that both direct effects on livelihoods and indirect effects on the state's function increase the risk of armed conflicts arising from climate change. It is worth recognising here that climate change may decrease *the ability of the state* to create opportunities for individuals, as well as decreasing *the capacity of government* to adapt and respond to climate change. Both these paths enhance the level of insecurity, which – in turn – amplifies the risk of conflicts. But what kind of approach to security is taken in this analysis?

Welzer, in line with Barnett and Adger, found that the impacts of climate change first of all jeopardise the ability of human beings to survive through negative effects on freshwater resources, reduced food production, increased health risks and limitations with respect to livelihoods through a decrease in productive land. Consequently, these types of problems can undermine human security and increase the risk of armed conflict.[201] A question regarding the character of these conflicts is whether they predominately concern the intrastate or interstate level. In the greed and grievance literature, resource scarcity and resource abundance are commonly cited as conflict triggers. In particular, albeit not only, resource scarcities trigger intrastate conflicts, while resource abundance alters the relationship between states, and thus may exacerbate interstate conflicts.[202] This understanding is for instance applied by Lee, but he adds a third mechanism that interlinks climate change and conflict, namely the issue of sovereignty.[203] Lee divides these mechanisms into three sub-categories, scarcity, abundance and issues of sovereignty:[204]

Scarcity: (i) Physical scarcities related to the availability of finite resources; (ii) geopolitical scarcity involving the distribution of resources between countries, both finite and renewable; (iii) socio-economic scarcity concerning the distribution differences within countries; and (iv) environmental scarcity concerning the availability of renewable resources.

Abundance: Abundance concerns in particular access to resources that humans hitherto have lacked or where resource extraction has previously not been economically viable. This particularly concerns the oil and gas fields in the Arctic, but also the energy and mineral resources in Antarctica.

Issues of sovereignty: Melting glaciers and ice caps as well as sea level rise are altering territorial borders and challenging international laws on how to regulate e.g. the Northwest Passage in Canada.

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[201] Barnett and Adger 2007; Welzer 2008 p. 82-90.
[202] See for instance Nordås and Gleditsch 2007; Wolf 2007; Barnett 2003; Welzer 2008 p. 86 (with references to Libiszewski 1999; Bouldner 2001; Blatter and Ingram 2001; Wolf and Shira 2003; Dabelko and Carius 2004, etc).
[203] Lee 2009, p. 5.
[204] Lee 2009, p. 6-7.

The divisions made here are only examples of factors triggering intrastate armed conflicts.[205] Clearly there are many more. Yet, based on these mechanisms and structural dimensions, Lee suggested that climate change will create two global 'tensions belts'. The first is characterised by intensification and expansion of an existing area of climate change and conflict, for example the 'equatorial tension belt' (Lee's concept). The second is a new tension belt that will arise, (roughly) located around the polar circles.[206] These two tension belts, which mainly differ in terms of whether land gradually loses resource assets or increases access to resources, form the basis of the first attribute Lee applies when analysing the predicted consequences of climate change. The other attributes concern the conflict type (between or within states); the form of climate change (temperature increase, precipitation patterns); and finally the resiliency of conflicts (episodic or gradual and continuous).[207] Furthermore, Lee points out two forms of connections between climate change and conflicts, both visible on a regional level: first, in regions which already have a high inclination for conflicts, climate change will readily increase this inclination. Second, in regions where climate change will be most severe, new types of conflict may occur in regions lacking a history of conflict or change character.[208]

It is possible to find support for the first proposition, as conflict-prone areas are to great extent correlated to areas with a history of conflict.[209] However, the second proposition is more speculative, as there is little data and experience available. In this context one can perhaps mention the changes between nations and national interests in the polar regions, not least with respect to the High North Arctic. This distinction may cause a possible difference between conflicts depending on the region in focus; conflicts exacerbated by diminished access to natural resources seem particularly to be a matter of internal conflicts within a nation, while conflicts (e.g. trade conflicts, military conflicts, etc.) in for instance the polar regions concern the relationship between nations. Thus we have one way of recognising different development pathways that shows how climate change can bring security concerns for both nations and individuals.[210]

The framework proposed by Lee is useful, as he underscores different paths to conflicts and recognises a number of features adequate for analysing conflict dynamics. The strength lies in his emphasis on both loss of, and access to, resources. A weakness is that this particularly occurs through gradual changes. Sudden changes related to climate, for instance through extreme weather events,

[205] Collier and Hoeffler 2000.
[206] Lee 2009, p. 7.
[207] Lee 2009, p. 60-61.
[208] Lee 2009, p. 66.
[209] Barnett and Adger 2010, p. 131 (with references to Collier 2000); Nel and Righarts 2008; Hegre et al. 2009.
[210] Barnett 2003.

are mentioned, but not further discussed. This is perhaps because most research to date concerns natural resources, while the conflict dynamics in relation to natural disasters are disregarded (but not neglected).[211] This bias also arises in investigations made on climate change and armed conflict. A more significant problem with this framework, however, is that it places more emphasis on structure rather than agency and as such leaves out possible elements such as interests and motives as explanatory factors. Nevertheless, these investigations illustrate the complexity behind armed conflicts and exemplify how different mechanisms behind conflicts are interconnected.

4.3 Empirical investigations of climate change and armed conflicts

This section examines empirical investigations into the resource scarcity, climate change and armed conflicts nexus. The research in this area is mainly dominated by two different but common methodological approaches: (1) Large-scale statistical analysis of the relationship between environmental change and armed conflicts, and (2) case studies on the interlinkages between environmental change and conflict. These two approaches are fruitful in different ways, as well as having their drawbacks. The statistical analysis is heavily dependent on the definitions used and cannot take into consideration the whole area of complexity. The case studies can address this complexity, but cannot in isolation be generalised to other cases. In the following section we use insights from both these research approaches.

There are three common areas in the literature that make the connection between environment and armed conflicts, namely water and conflict, environment/ migration and conflict, and scarce natural resources and conflict.[212] These areas are obviously adequate for describing the known consequences of climate change, e.g. degradation of arable land and increasing freshwater scarcity, which may lead to population displacement due to undermined livelihood. However, as noted above, climate change also affects other areas such as issues of sovereignty due to e.g. sea level rise, and an increase in natural disasters caused by extreme weather events. As a consequence, deeper investigations on a wider area of consequences following climate change are needed. This also concerns the discursive approach mentioned earlier, which hitherto seems to be downplayed.

[211] Researchers have put emphasis on natural disasters of various kinds and have shown that there are linkages between these and conflict, see e.g. Nel and Righarts 2008; Brancati 2007.
[212] See e.g. Raleigh and Urdal 2007.

4.3.1 Water and armed conflict

Water is important for human society and lack of clean water poses a risk to human health.[213] This is also why many armed conflicts have water as one of the main incompatibilities.[214] One frequent claim in the literature is that climate change will increase the likelihood of water conflicts. The most common reason given for this is that water is a vital resource for survival and that it is scarce in some geographical regions. For example, access to water is a major problem in many African countries and in many places the problem concerns both quantity and quality. The challenge in climate change studies is to predict the shift in precipitation pattern and the rise in temperature which will lead to additional pressures on water availability and accessibility. Some scholars have therefore argued that there is a potential risk of water wars,[215] while others have used large-scale statistical analysis to show a correlation between shared river basins and an increased risk of conflict between neighbouring countries.[216]

Although it may seem logical in many situations to link water scarcity to causes of armed conflicts, there are countless studies showing the opposite, namely that water tensions often end up in negotiations and settlements.[217] For example, Wolf et al. showed that cooperation over water is twice as likely as conflicts between countries sharing the same water (between 1945 and 1999).[218] Such positive results are in line with Barnett's contention that the risk of water wars is overstated and that wars are more likely to be the result of strategic rationality than resource scarcity.[219]

Nevertheless, as Wolf shows in a study of transboundary water resources, shared waters do lead to tensions, threats and even some localised violence, but not to regular warfare.[220] Here, the viewpoint of Raleigh and Urdal is interesting, as they claim that there are different paths to conflict depending on whether the water dispute is on an international or domestic level. They also point out that there may be some empirical links between reduced freshwater resources and increased likelihood of conflict on the community level (not direct links), but not

[213] Bindoff et al. 2007, p. 389.
[214] There are many different conflicts relating to water. It is not our intention here to enter into specific types. Yet it is worth noting that water could be fought about following upstream/downstream disputes, transnational rivers, dam construction, riots and protests following poor water quality, poor water access, changing flows, impacts of water levels, etc. Mostly these conflicts are integrated with many other complex issues. However, what is of main concern here is the connection to climate change, which in itself is not that clear.
[215] Klare 2001; Wolf 2007 (who exemplifies with Starr 1991).
[216] Gleditsch et al. 2006; Wolf 2007.
[217] Barnaby 2009 (with reference to Allan 2000); Jägerskog 2003; Yoffe, Wolf and Giardano 2003; van der Molen and Hildering 2005.
[218] Wolf et al. 2005 (with reference to Wolf et al. 2003).
[219] Barnett 2000, p. 276.
[220] Wolf 2007.

to the same extent as on an intrastate level.[221] Accordingly, interlinkages can be identified, but of different characters depending on the case. Moreover one needs to bear in mind that a web of factors lies behind the escalation of tensions and conflicts. This notion goes in line with the common conception held concerning the relationship between environmental (and climate) change and armed conflict and could explain the contradictory statements made (the proponents using different scientific approaches in their analysis as well as in their definitions of what e.g. is regarded as being a war).

A problem with making claims on the potential of water-induced conflict is that there is too little sub-national information and too few systematic comparisons over different regions to make any general claims. What are needed therefore are more in-depth studies of particular countries that can incorporate the complexity behind conflict-triggering mechanisms and elaborate on different approaches to security. An example here is the recent investigation on climate change and consequences for Africa made by Thiesen, Holtermann and Buhaug, which comprised a rigorous empirical evaluation of the assumption commonly made that drought and water shortages increase the risk of civil war. Their findings suggest that armed conflict seldom erupts into bloodshed following abrupt local water shortages, nor did they find a direct relationship between drought and onset of local civil war. African civil wars, they argue, break out in peripheral and politically marginalised areas of a country.[222] In fact, they note that ethno-political exclusion is robustly related to a higher risk of civil war 'The primary causes of civil war are political, not environmental'.[223]

A study with similar conclusions – also testing the common assumption that links droughts to outbreaks of armed conflict – focuses on scarcity and organised violence in Kenya. Theisen studied sub-national data for the period 1989-2004 and found that that 'climatic factors' influence the risk of conflict, but do not occur in isolation. His analysis shows that years following wetter years are more violent than drier ones; that heating may increase the risk of conflict; and that more densely populated areas run a higher risk of conflict (although this is restricted to election years).[224] This investigation hence reveals the numerous factors involved in conflicts and suggests that other mechanisms such as poverty and population density have a stronger effect on conflict risk than climate change per se.[225] Drought has also been considered in connection with other social and

[221] Raleigh and Urdal 2007.
[222] Theisen, Holtermann and Buhaug 2010.
[223] Theisen, Holtermann and Buhaug 2010.
[224] Theisen 2010. Another attempt for such a project is made by Miguel, Satyanath and Sergenti 2004.
[225] Theisen 2010.

economic factors influencing conflicts among rural populations in West African Sahel.[226]

However, water scarcity is not the only area of concern in relation to climate change. There are also areas/regions where water disputes arise as a result of too much water, leading to new security landscapes. In Asia this is the case in e.g. Bangladesh and the Pacific (concerning the disappearance of Tavlu following the rise in sea level). Another geographical area where water is an important variable in the climate change-security nexus is the Arctic region.[227] Recent changes following the melting of the polar ice cap have raised a number of long-term security implications (following temperature increase, sea level rise, change in ocean currents, permafrost thaw and coastal erosion, etc.). As noted by Åtland, such changes may increase the risk of conflicts between interest groups and sectors, conflicts over access to petroleum and maritime resources, conflicts over access to shipping lanes, and possible military conflicts over geostrategic interests.[228]

4.3.2 Migration and armed conflict

Another common claim in the literature linking climate change to armed conflict is that migration may become an increasing source of future conflicts. However, research suggests that this topic needs to be approached carefully as there are many different forms of migration, i.e. for economic reasons, political reasons, social and cultural etc. Some migration is voluntary, while forceful displacement occurs in other cases. The sharpest distinction is obviously between voluntary migrants and refugees. Different categories could have different security consequences (for states, nations and groups).[229] What we are primarily concerned with is migration following climate change. To date, little data exists on this.

For example, the report 'Climate Change and Security in Africa' by Brown and Crawford states that climate change will cause population movements due to unreliable food and water supplies, undermining livelihood, sea level rise and flooding and the increase of destructive storms.[230] UNHCR has estimated that approximately 51 million people were displaced worldwide by 2007, of whom 26 million were displaced due to armed conflict and 25 million due to natural disasters.[231] Around 30 percent of these refugees and internally displaced people

[226] Nyong and Fiki 2005. For agriculture: see Brown and Crawford 2008.
[227] See e.g. Granholm (ed.) 2008; Maas et al 2010 (with references to Ullbäck Selvig 2009 and Paskal 2010).
[228] Åtland 2010.
[229] Raleigh, Jordan & Salehyan 2008.
[230] Brown and Crawford 2009 (with reference to Brown 2008).
[231] Brown and Crawford 2009 (with reference to UNHCR 2008 State of the World Population).

are housed by African countries.[232] The vulnerability to climate change, which is considered a particular threat for Africa, relates to already drought-prone areas and to coastal cities.[233] Displacement is hence an issue of major concern, but the question is whether and how it is linked to armed conflict.

Brown and Crawford clearly reject the notion that migration itself leads to conflict, but cite the claim by Schubert et al. that migration can increase the likelihood of conflict in transit and target regions.[234] Several investigations also show that a great influx of migrants into new areas has been a significant factor in many environmental conflicts.[235] What is generally recognised is that the most important factor behind the potential for migration to cause armed conflict is the political and institutional response to migrants. As Welzer emphasises, there is no scientific evidence that armed conflicts follow large migration flows, but climate change-induced migration must be considered a potential cause of violence when the demand on resources becomes greater than the resource availability.[236] Another consideration is that many articles on this matter use very little empirical data on the potential linkages, but there are a few exceptions.

Recently, Reuveny treated the question of climate change-induced migration and armed conflict in depth.[237] In general, he suggests that people facing environmental problems can stay in place and do nothing, stay in place and mitigate the problems or leave the affected area. Leaving can be done either slowly – as is most common – or quickly following rapid changes. It is assumed that when migrants move rapidly conflicts can occur in host countries. However, the outbreak of armed conflict seems to be most determined by the adaptation capacity of the host community (e.g. host country), i.e. the capability to receive migrants. Typically, developed countries are more likely to mitigate problems through technological innovation and institutional redesign, while less developed countries are less likely to succeed in mitigating such problems as they often lack capacities or expertise.[238] Thus, features contributing to a conflict situation include competition and the existing economic and general resource base of the host community; existing ethnic tension; a sense of distrust between migrants and host community; and pressure on socioeconomic fault lines such as competition over jobs or farm land.

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[232] Brown and Crawford 2009 (with reference to Garcia 2008).
[233] Brown 2008.
[234] Brown & Crawford 2009, p. 19 (with references to Schubert et al. 2007)
[235] Barnett and Adger 2007 (with references to Peluso and Harwell 2001; Baechler 1999: Klötzli 1994).
[236] Welzer 2008. p. 85.
[237] Reuveny 2007. Note that Reveney uses the concept 'violent conflict', while we have chosen 'armed conflict'. In order to be consistent, we adhere to the latter expression.
[238] Reuveny 2007.

Without claiming that conflicts take place as a consequence of migration, there are a number of situations where migration following changes in environmental contexts has led to armed conflict. In Reuveny's investigation consisting of 38 cases where environmental migrations had taken place, 19 cases ended up in armed conflict. The reasons for migration varied between the cases and were tied to land degradation, droughts, deforestation, water scarcity, flooding, storms and famine. Therefore, both rapid and slow changes were included. Fourteen of the 19 cases included intrastate migration, which Reuveny interpreted as 'conflict is less likely when migrants and residents are of the same ethnicity and religion, as is often the case for internal migration'.[239] He furthermore emphasised that in almost all conflict cases the receiving area was underdeveloped and dependent on the environment for livelihood; as such, the conflicts did not come about in isolation. Similarly, Nordås and Gleditsch pointed out that:

> 'the starting-point for most of these is that climate change results in a reduction of essential resources for livelihood, such as food or water, which can have one of two consequences: those affected by the increasing scarcity may start fighting over the remaining resources. Alternatively, people may be forced to leave the area, adding to the number of international refugees or internally displaced persons. … when migrants encroach on the territory of other people who may also be resource-constrained, the potential for violence rises'.[240]

To summarise, climate change is recognised as a condition pushing for larger movements of people. These movements can have the potential for triggering conflicts, but the major factor behind the outcome is related to the community where the displaced people reside. If the host community for the immigrants is weak, with existing alienation, social problems and scarce resources, the likelihood of conflict increases.[241] Furthermore, people hardly ever migrate for environmental reasons alone, and a frequently suggested alternative reason concerns economics and the potential for improving their living conditions.[242]

4.3.3 Natural resources and armed conflict

In recent years increasing attention has been paid to the role played by natural resources in causing armed conflict. For instance, the UN Peace Building Commission of 2008 recognised the interplay between conflict, environment and

[239] Reuveny 2007, p. 668.
[240] Nordås and Gleditsch 2007, p. 631.
[241] Reveney 2007; Welzer 2008, p. 85-86.
[242] Barnett 2003, p. 11.

natural resources.[243] However, such linkages operate differently in different conflicts and are hard to predict, especially with respect to climate change. This debate on natural resources has also followed the greed or grievance debate on the causes of civil war, at least to some extent. Essential in this debate is a view that natural resources encompass two different kinds of reserves; on one hand resources such as minerals, oil and gas, and on the other timber, water, fisheries, land, etc. Both of these types of resources can trigger conflicts and both a profusion of natural resources and insufficiencies can drive armed conflicts.[244] Hence, one needs to consider both access and scarcity in the analysis of the relationship between natural resources and armed conflicts, as well as the fact that the interlinkages follow several (parallel) streams of relationships and dependencies. As recognised earlier, it is not possible to identify a simple chain of cause and effect.

However, some linkages have been identified. In an article in *International Affairs* Brown, Hamill and McLeman point out four major pathways between climate change and scarcities and describe how these may trigger tensions and conflicts. First, unstable weather patterns swinging between extremes, together with changes in rainfall and temperature, have the capacity to reshape the productive landscape of entire regions and thus exacerbate food, water and energy scarcities.[245] Second, climate change can cause unregulated population movements, most of which will be internal, but the side-effects will be felt beyond national boundaries. Third, extreme weather conditions may lead to more serious natural disasters, stretching resources and the coping capacity of developing countries. Fourth, extreme weather events and climate-related disasters can trigger short-term disease spikes and give rise to longer-term health implications as certain infectious diseases become more widespread.[246]

Nevertheless, it must be recognised that research on conflicts is to certain extent theoretically driven,[247] and that quantitative studies of resource scarcity and armed conflict have primarily focused on state-level factors.[248] More in-depth studies are thus required. However, as in the case of water scarcity, researchers claim that environmental pressures are more likely to cause internal rather than international violence, but also that shared resources may be a vehicle for

[243] UNEP 2009. This insight lies as a foundation for recommending reinforced action for integrating environment and natural resource issues into peace-building interventions and conflict prevention.
[244] See e.g. Barnett 2007; Vinci 2006; de Soysa 2001; Berdal and Malon 2000.
[245] Brown, Hamilll and McLeman 2007.
[246] Brown, Hamilll and McLeman 2007, p. 1147.
[247] Barnett 2003 (with references to Baechler 1999). Two schools dominate the field, neomalthusians emphasise that rising population puts pressure on the planet and will lead to resource strains and conflicts, and the other school claims that natural resources (particular oils, minerals etc.) are fuelling economic failure, corruption and conflict, for an overview see Binningsbo et al. 2007.
[248] Raleigh and Urdal 2007.

increased cooperation.[249] The potential role of the state is considered fundamental in how the cause and effects chain develops, with the functional capacity and social cohesion of the state being critical.[250] Despite the scattered view in the literature on natural resources and their relationship to armed conflicts, it is important to consider this issue further alongside the effects of climate change. As climate change alters the conditions for food production, marine resources and freshwater, basic necessities may become more difficult to obtain and this has interconnections to insecurity and to conflicts. Moreover, as stressed above, this is particularly the case for already weak states, i.e. states that have diminished capabilities (technical, economic, social) to meet challenges.

One resource scarcity considered is food. Food insecurity is not only a matter of availability of food; it is a function of poverty, poor governance and inequity within and between countries. There are approximately 1.1 billion under-nourished people in the world, 200 million of whom live in Africa. In general, agriculture in that region is highly dependent on rainfall and the droughts in southern Africa in recent years have led to serious food shortages. As drylands and areas under water stress are predicted to increase as a consequence of climate change, this will probably reinforce the situation, but, as already acknowledged, the causal contribution of climate change to food insecurity is not fully understood.

For instance, Schubert et al. argue that drops in food production could trigger regional food crises and further undermine the economic performance of weak and unstable states. This is an issue at the state level, where economic prosperity of a country is correlated to agriculture, but also at the individual level, if food prices increase.[251] This is the foundation for concluding that inequalities will increase. References are made to Kaplan, who has shown that violent outbreaks as a consequence of hunger are greater in countries with major inequalities.[252] However, armed conflict as a consequence of declining food production is determined by a complex range of social, economic and demographic factors: how they interact and shape conflicts is not known. Usually, the natural resource problem is closely intertwined with socioeconomic indicators, not least to poverty. Buhaug et al. tested the assertion that climate change is likely to most severely affect those countries and people that are the most vulnerable, i.e. the 58 bottom billion countries (less equally developed countries).[253] Their test of this assertion on African countries provided little support for the general claim and

[249] Raleigh and Urdal 2007 (with references to Baechler 1999; Homer-Dixon 1999; Kahl 2006; Wolf, Kramer, Carius and Dabelko 2005).
[250] Raleigh and Urdal 2007 (with references to Kahl 2006).
[251] Schubert et al. 2007, p. 93-99
[252] Kapland riot 1725, French Historical Studies.
[253] Buhaug, Falch and Gleditsch 2010.

since the study only focused on African countries little could be said on a more global scale.

To conclude, on one hand some studies show a correlation between resource scarcity and armed conflicts while others show no such correlation, but when this correlation appears it can never be considered in isolation. Hence, many different factors interact and resource scarcities alone can never explain the path to conflict. The remaining question concerns why people organise themselves and turn to violence.

4.4 The climate change and armed conflict nexus

This chapter has examined possible interlinkages between climate change and armed conflicts. Next we summarise these findings. A starting point is the assumptions made at the outset of Chapter 4, namely that: (1) Climate change is an ongoing process and a single event cannot be attributed to a changing climate or to a merely extraordinary event naturally occurring, (2) the knowledge available centres particularly on natural resources and the connection to armed conflicts, and (3) climate change and the security nexus is a rather recent and poorly understood phenomenon (mostly due to lack of knowledge grounded in empirical investigations of this nexus). The necessity for such assumptions highlights the need for deeper investigations, as also noted by many others.[254]

The analysis shows that it is not possible to identify a causal relationship between environmental change, and hence also climate change, and armed conflict. This failure lies not so much in the factor 'environmental change' as in the approach used; it seems that there is no single factor that can explain why armed conflicts occur. Instead, a web of interlinked mechanisms makes up the complex pattern characterising a conflict. For example, a study by Buhaug et al. pointed out at least four social effects of climate change as intermediary catalysts of organised violence: (1) reduced state income following increased resource scarcity; (2) increased resource competition in heterogeneous societies; (3) increased scarcity of renewable resources in a subsistence economy leading to loss of livelihood; and (4) deteriorating environmental conditions that may force people to migrate in large numbers.[255] Labelled differently, one could talk of political instability, social fragmentation, poverty, inequality and economic instability, migration and inappropriate response.[256] This notion coincides with the proposition by Barnett and Adger that whether an event develops into a conflict situation is mainly related to the (local) community's response to this

[254] See e.g. Welzer 2008; Barnett and Adger 2007.
[255] Buhaug, Gleditsch and Theisen 2010, p. 81.
[256] Buhaug, Gleditsch and Theisen 2010, p. 83-89.

particular event.[257] How does this view respond to experiences of conflict mechanisms such as water or resource scarcity?

Resource scarcities are widely considered to be an exacerbating factor behind the escalation of conflicts, but this view is not uniformly held and some have used large-scale statistical analysis to question its veracity.[258] However, in order to interpret these objections one needs to consider the scientific approach used and the limitations behind different scientific approaches. Many of the statistical analyses of armed conflicts use data from sources such as the well-known Uppsala Conflict Data Program (UCDP). A limitation with such conflict databases is the narrow, but strict, definition of what constitutes an armed conflict.[259] The definition applied when citing armed conflict events is utterly important because the definition shapes the results of studies based on such data. While the UCDP has hitherto focused on interstate conflicts, since 2002 the Uppsala group has also collected additional data using different definitions of conflict, some of which better correspond to the human security approach discussed earlier in this report. This point towards the possibility of conducting more refined analysis of the data set when trying to interpret climate change.[260]

A subsequent problem is how to define a process such as climate change; most statistical analysis to date having focused on average temperature or average precipitation patterns (thus being historical). This must be taken into consideration with respect to what characterises climate change. First, climate change is an ongoing process and we cannot easily see its effects. Second, climate change is characterised by increased volatility in how temperature and precipitation will fluctuate. A third limitation concerns the meaning of correlation. Even though a correlation can be found, it is not necessarily

[257] Barnett and Adger 2010. In a review of research on resource scarcity and armed conflict Theisen noted the immense importance of the quality of institutions, Theisen 2008 (with references to Baechler 1999 and Kahl 2006).

[258] For criticism towards the interconnection between climate change and conflicts, see e.g. Salehyan 2008; Buhaug, Gleditsch and Theisen 2010, pp. 83-89; Brown, Hamill and McLeman 2007, pp. 1146-47. Note that there are some large-scale statistical investigations that point towards correlations between climate change and conflicts, see e.g. Burke et al. 2009; Zhang et al. 2007,. These have also been criticised, see e.g. Buhaug 2010 (criticising Burke et al.).

[259] The formal definition is: An armed conflict is a contested incompatibility that concerns government and/or territory where the use of armed force between two parties, of which at least one is the government of a state, results in at least 25 battle-related deaths in one calendar year.

[260] Within this project we commissioned Florian Krampe at Uppsala University to extract data from the UCDP linking climate change to conflict data using both data on state-based conflicts and interstate conflicts. The tentative analysis could not show any evident connection to climate change, but for interstate conflicts some environmental change is found to be interlinked. Yet, how and whether climate change has played a role in these environmental changes is still not known and requires additional research and data collection. As such, the analysis evidently points towards the utterly intricate matter of how to operate climate change so that it can be transformed into a number of factors that can be used as a foundation in available data sets on conflicts. We note that this process is far from finalised.

explanatory, nor does it include the societal processes leading to the conflict outbreak. As climate change is an ongoing process the possibility of finding correlations is most difficult due to the time span and its interwoven character with other kinds of large-scale transformations.

In order to explain the reason behind an armed conflict, there is a need for contextual knowledge on the causes of that armed conflict and particularly analysis of when and why different groups decide to resort to violence and how to prevent these developments.[261] However, conclusions drawn from such investigations cannot easily be generalised into other local settings. To give an example, investigations on water scarcity have shown that scarcity situations can lead to negotiations and even peace agreements between war-prone countries. However, the agreement itself does not solve the water scarcity situation and one must therefore recognise how the water scarcity has been managed. As illuminated in an essay by Barnaby, this has often been solved through 'virtual water'[262], which presupposes the possibility of importing water (in e.g. food, as food production is circumscribed by the water scarcity) and this in turn means that the community (or country) has the capability for such imports. This raises the responding capacity of a state, an example of which concerns the water scarcity in the Mediterranean; the physical conditions are rather equal in southern Europe and northern Africa, but the adaptation capacity is different. Accordingly, the poor countries in northern Africa will face much more severe consequences due to climate change than wealthier nations in southern Europe. What also needs to be acknowledged is that the magnitude of climate change can be severe without it necessarily leading to armed conflict. As Wolf has stressed with respect to shared water, it does not lead to war, but it leads to tensions, threats and to some localised violence.[263] Herein the security approach adopted becomes crucial; from a human security approach all these matters are important, but from a state-based approach they only become important when they challenge the security of the state itself.

To conclude, the relationship between climate change and conflicts builds on a logical sequence: climate change amplifies insecurity and as insecurity increases the risk of conflicts, climate change has security implications. However, the implications will be context-specific and the local ability to meet the challenges is critical for the effects arising, not the physical effects per se. Climate will also have different impacts at different points in time, thus leading to both short-term and long-terms security concerns. The speed at which changes occur is also important, as society in general has difficulties in responding to fast alterations. Therefore climate change will affect both developing and developed countries, but in different ways. When climate change alters society and affects norms and

[261] Trombetta 2009.
[262] A concept suggested by Allen, see Barnaby 2009.
[263] Wolf 2007.

values, this will have a bearing on the conditions in which people use violence or accept their country using violence against others.

Considering that the empirical sources of the climate change and conflicts nexus particularly derive from scarce natural resources, there is a need to acknowledge other physical changes following climate change, as well as the discursive alterations. Firstly, climate change can also lead to increased resource availability, particularly in countries in the High North. This alteration could thus bring changes in the relationship between countries having an interest in the area, as well as widening inequalities between countries. Secondly, climate change is expected to increase the frequency and intensity of extreme weather events, which includes an increase in disasters. Disasters have also been linked to conflicts, but as with changes in natural resources the linkages are not straightforward.[264] Thirdly, climate change will lead to territorial changes, which follow from sea level rise as well as melting glaciers and ice-caps in polar regions. All in all, these processes portray different kinds of linkages between climate change and security and conflicts, as well as illuminating that the consequences will affect both individuals and states.

[264] Reveney 2007; Nel and Righards 2008; Brancati 2007; Lee 2009.

5 Conclusions and the path ahead

This report reviews the current scientific knowledge on the security implications following climate change. As climate change is a rather recent phenomenon, much of the current research relies on experiences gained within the area of global environmental change and particularly scarce natural resources. The report analyses this issue and tries to move the thinking forward. This final chapter presents the main findings concerning the connection between climate change and security; the security concept held with respect to climate change; the impacts from climate change and its long-term effects on society; and the interlinkages between climate change and conflicts. Following this summary, we present a conceptual framework that identifies three major pathways between climate change and security; international politics and climate discourse, resources for livelihood and disasters. The concluding section contains some reflections made during this investigation and identifies areas in need of further attention.

5.1 Climate change, security and conflicts

The security concept used with respect to climate change is broad and stretches from insecurity for individuals to the state (Section 2.1.1-2.1.3). The human security approach has become vital in the analysis of climate change, since it adopts a human-centred perspective with respect to the issues with security implications and their management. Human security is sometimes contrasted with a state-based concept of security, but in fact the pivotal point in the human security concept is a widened approach to security that includes all kinds of issues, as well as objects relevant in a security context but taken from the perspectives of individuals. Thus, state security is included when the state is considered important for securing the security of individuals, but is not a necessary object to secure in itself. It is vital to adopt both approaches to security, i.e. the state-based approach and the human security approach, as they bring different conceptions on security to the debate. To date, the state-based approach has mainly been adopted in quantitative analysis of climate change and armed conflicts, while the human security approach mainly influences case studies. However, as the human security approach is adopted to a certain degree in case studies on the effects arising from changes in natural resources, it has influenced the research on the security implications of climate change. A possible reason for this is that the human security approach is context-dependent and acknowledges that what is framed as a security issue can vary over historical and cultural settings, but also between actors within one particular historical and cultural setting. Moreover, it takes into consideration the security threats perceived by people (communities and societies). Finally, the human security approach underscores that the management strategies used for dealing with any

kind of security threat must emerge from the consequences for the people affected.

Climate change is clearly regarded as being related to security issues in the research community, while climate change is also on the policy agenda in the context of security. Hence, it can be described as being within a process of securitisation, even though it is not yet considered to be securitised (Section 2.2.2-2.2.3). An essential feature of this process is that various actors have different agendas, and that these can be more or less deliberative. We identified a number of reasons for this trend for securitisation (Section 2.2.4), among which receiving greater attention and increased economic assets seem to be important. In addition, we underscored the significance of the problem framing phase, which is a process that involves a dynamic political struggle between various networks of power/knowledge in which policy-makers and stakeholders interpret and frame knowledge in light of specific interests. However, these aspects do not complete the picture; there are many more forces that may move the discussion on climate change into the field of security. Hence, there is a complex interplay of processes that shapes the notion of what climate change is all about and the security implications of climate change. This in itself has security implications. Accordingly, the problem framing phase, power relations and notions of security and threats to security are pivotal aspects in discursive analysis of climate change and its security implications.

Besides the discursive aspects of climate change, we considered the physical changes emanating from climate change. The major findings presented in Chapter 3 are that actual GHG emissions are higher than predicted by IPCC and that the energy intensity is increasing and not decreasing as is assumed in the emissions scenarios. Therefore the climate scenario projections may be too moderate and the physical consequences of climate change are likely to be greater than expected. Hence, there is a need to analyse the consequences of more extreme scenarios based on higher GHG emissions, higher energy intensity and greater climate sensitivity. The investigation also showed a need to analyse tipping elements (or tipping points), which trigger abrupt climate change, and the resilience – of ecosystems and society – to these. In this regard it is critical to recognise other large-scale transformations, such as environmental degradation and societal transformations (e.g. urbanisation and demographic change). The security implications of these matters are uncertain.

Regarding the security threats from climate change, following its physical impacts on regions and systems, this report places particular focus upon decreases in natural resources and their connection to security and conflicts. However, other aspects are also recognised, for instance that climate change is expected to lead to increased resources, as well as an increase in extreme weather events, and that issues of sovereignty may alter due to sea level rise and melting glaciers and ice-caps. These areas deserve much greater attention. As climate

change is a very complex issue and is intertwined with all kinds of physical and social processes, we perceive a great need for theorising upon what climate change is about and for more context-specific analyses that take into consideration the local context and its unique features, including the capability for adaptation to climate change. The context is essential both with respect to the impacts resulting from (the physical) changes brought about by climate change and with respect to the potential of climate change to trigger conflicts. Hence, it is critical to take into consideration all kinds of processes of change, as climate change cannot be dealt with in isolation.

5.2 A conceptual framework linking climate change to security implications

Climate change can lead to security concerns in different ways. In order to illuminate the different pathways a conceptual framework linking climate change to security was developed, see Figure 3.

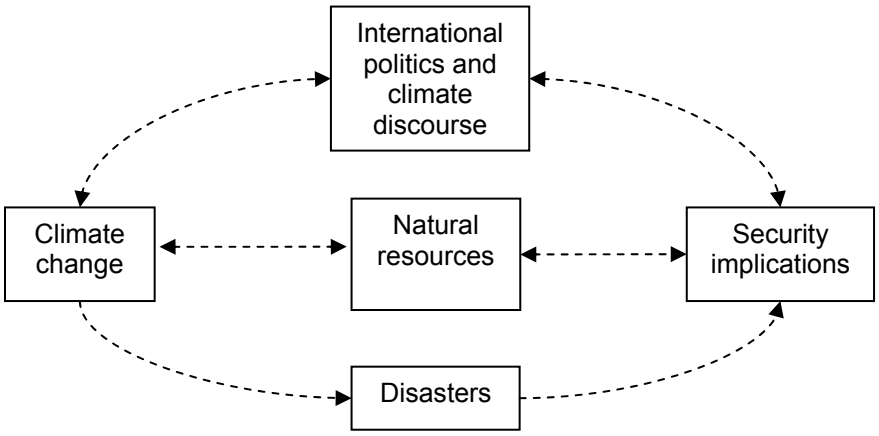

Figure 3: Conceptual framework linking climate change to security implications.

The first path – international politics and climate discourse – concerns notions and expectations of climate change, which can have security implications. However it also concerns how territorial changes due to climate change can alter the relationship between nations, which can also have security implications. As notions on a problem matter, the definitions and perceptions of a problems are crucial and shape how different actors act in the international community. Hence, climate change plays a part in international relations and has impacts on power relationships, which in turn have security implications. Note that the politics held also have effects on climate change (not least through the measures taken on GHG emissions). However, since climate change, through e.g. sea level rise, can

also have direct impacts on territories, this matter also plays a part in the policies adopted by the policy community, which can yield security implications depending on the actions taken. Since the connection between climate change, international politics and climate discourse, and security is two-way, the arrows in the conceptual framework point in both directions.

The second path – natural resources – concerns altered access to natural resources. This path tends to be most frequently used to link climate change to security. Note that altered natural resources can mean increased access to resources, as well as increased resource scarcity, and there is a global asymmetry regarding where these two changes mainly occur. The polar regions are areas where access to resources is likely to increase, while the equatorial belt will mainly experience decreased resources. Both increased and decreased resources can cause tensions between and within countries and thus become one factor among others aggravating the risk of conflicts. The interconnection between climate change, resources and security is two-way, and accordingly the arrows point in both directions.

The third path – disasters – relates to extreme weather events (storms and flooding), as well as disasters following sea level rise, and concerns the security implications of these. This area has received little attention to date, but investigations on disasters have shown linkages between natural disasters and security concerns (not only negative effects, but also positive effects). However, how this knowledge is applicable to disasters following climate change is uncertain.

While Figure 3 portrays the three main pathways linking climate change to security, it does not show the speed at which the changes take place, e.g. the rate of climate change, or whether the changes occur abrupt or gradually, which can be exemplified by extreme weather events on one hand and decreased natural resources on the other. These matters are important to acknowledge, as well as whether the phenomenon is permanent or temporary.

Climate changes are constantly occurring, but the climate change measured today is happening at a speed not previously seen. This matter is important since history shows that fast changes are more difficult to respond to than slow and/or gradual processes. Thus we have two dimensions of speed, one concerning climate change per se, i.e. that we have an issue of climate change and it is much faster than previous changes, the other concerning the effects from climate change, which can occur gradually or abruptly (e.g. altered natural resources or extreme weather events). These two time-scales of changes are important to address with respect to society's capability to anticipate and adapt to these changes.

Another dimension that needs to be addressed with respect to the security implications of climate change as well as society's capability to adapt to these

changes concerns the magnitude of the change and whether the climate event is permanent or temporary. Through sea level rise, permanent and fundamental alterations can occur (for instance loss of land), but these changes can be foreseen. Extreme weather events, on the other hand, are of an abrupt character, but the effects are mostly temporary (but can of course be devastating during that time). A society can increase its capacity to respond to these events and thus become less vulnerable to them. However, each single event will be abrupt and the frequency of these events could also have impacts on society's capability to respond.

To conclude, the implications of climate change are very complex and the framework above aims to conceptualise main roads connecting climate change to security. What is not visualised to date in the conceptual framework is the internal dynamics of climate change or the dynamics within each of these roads. In order to analyse the security implications of climate change these dynamic features must be taken into consideration. However, in doing this it is important to consider the variability of climate change and recognise that the same change – physical or social – can have different implications depending on the context. Therefore, context-specific analysis is critical, as is developing a better framework conceptualising the implications of climate change and how societies can meet these and other interlinked changes.

5.3 Reflections and further research

It is evident from the investigation in this report that much research concerning the interlinkages between climate change and armed conflicts draws upon studies of scarce natural resources and the consequences of such scarcity for security. This is problematic from two perspectives. First, climate change is not only predicted to have negative effects on natural resources, but also positive effects. Second, climate change will also have security implications through altered international relations and from disasters following extreme weather events. Furthermore, one needs to consider whether the change occurs abruptly or gradually and whether the climate events are temporary or permanent. These matters need to be taken into account when investigating the (security) implications of climate change. However, knowledge of these different alterations together with the pathways linking climate change to security is at present rather weak.

In analysing the pathways linking climate change to security it is crucial to acknowledge that there is not a causal relationship between the two. This is grounded in methodology and concerns the relationships between a particular event and its implications for society. To give an example, a conflict outbreak is always apparent in a particular moment, but the reason behind the conflict might not be apparent in that moment. Hence, it is difficult, or even impossible, to link

a conflict to a single cause. Research on this matter is clear; no causal relationship has been found between climate change and armed conflict. Instead, there are a number of interrelated factors such as poverty and weak states, but also natural resources and disasters. The critical factor is the response to change, which means that an event can have different consequences depending on the response by the community. Countries characterised as 'weak states' are regarded as being particularly vulnerable to climate change (consider for example the notion of conflict triggers). Case studies are needed on various kinds of implications of climate change, as well as meta-studies of such case studies, in order to provide knowledge on how to relate the implications of climate change to the outbreak of armed conflict in more detail.

Another area that needs further attention is the scientific projections used in the analysis of the security implications of climate change. As noted earlier, most research relies on the projections taken from the IPCC and particularly the middle-range scenarios of the effects of climate change. Since scientific findings on the actual emissions of GHG emissions imply that we are close to the upper range of the levels stipulated by the IPCC emissions scenarios, we consider it important to address 'extreme climate scenarios' and their possible impacts on society, security and conflicts. The tipping elements should also be considered in this analysis. One aspect to consider would be key impacts and related potential threat mechanisms, for example via mapping the tipping elements onto a map of conflict regions, particularly those tipping elements that are occurring relatively fast.

Extreme climate change scenarios and tipping elements affect all three paths linking climate change to security, i.e. international politics and climate discourse, livelihood resources and disasters. However, we as human beings have no experiences of tipping elements and one fundamental characteristic of these is that we do not know where the new equilibrium exists. A crucial consideration with respect to tipping elements is co-existing global transformations and how these interact with each other. From a defence agency point of view, extreme climate scenarios and tipping elements should be of particular interest considering the mandate such agencies have for recognising the unlikely but devastating. Such work must consider society's capability of responding to altered conditions, which includes adaptation capacity.

This report on climate change and its security implications clearly illustrates the importance of combining various perspectives. There is a need for data on different levels of analysis, levels of abstraction and subjects of attention, i.e. for interdisciplinary and even transdisciplinary investigations that link different scientific approaches and consider the local context and local actors, as well as the interplay (dependencies and power relations) between various actors from local to national and international level. In order to determine whether climate change is linked to conflicts, more attention must be paid to rules, norms and

orders that shape violence. Case studies are of immense importance in order to comprehend the local context, the variability of climate change in that context and the capability of the local community to respond to this change and to any other transformations occurring. Looking at climate impact, basic social needs, poverty, traditional conflict-solving mechanisms, ecological variances, etc. could provide indicators of the potential linkages between the natural and social system that make up what we generally consider to be 'climate conflicts'.

In such work, it is essential to be analytical in approach and critical of the sources used. The security implications of climate change have recently been placed high up on the political agenda and 'climate security' can be considered the latest issue travelling on the road of securitisation. Based on experiences from other securitised areas, such as environmental security, which is intimately linked to climate security, it is crucial to analyse the related discourses. This includes the different ideas/goals various actors have in pursuing an issue as a security issue, but also how the linkages between climate change and conflicts are investigated. In our review of the literature we noticed how ideological this field is and how the agendas, motives and interests of different actors are largely disregarded in the analysis. We also observed that many analysts in both the policy community and the science community appear to seek support for preconceived notions/interpretations. The security implications of climate change deserve – and demand – a treatment that is critical in its approach to the sources used.

We conclude this report suggesting a number of areas we have identified as being in need of further attention:

Discourse analysis of climate change, its security implications and its importance for international relations

Discursive analysis of the interconnection between climate change and security is pivotal in obtaining knowledge of how different actors interpret the issue and thus provides a better framework for understanding the actors' policies in this and related issues. The interconnections to other policy areas are of great importance, for instance energy, environment, migration and aid are co-dependent areas. An additional area in this context is a better conceptual framework describing the security implications of climate change. This must be grounded in more in-depth analysis of different kinds of approaches to conflict (for instance addressing the issue of climate change in altering how conflicts appear rather than in causing further conflicts), as well as different conceptions to security (and how these affect the analysis made).

Detailed regional analysis

There is a great need for context-specific analysis that can address the complexity of climate change (the physical changes including climate variability), as well as the interconnections with other transformations in society (see further below). Regions of great concerns are for instance densely populated

areas (e.g. eastern coast of China, catchment basin of the Himalayas and the Mediterranean), areas already under pressure from conflicts over natural resources (e.g. the Hindu-Kush region, the Sahel and the eastern Horn of Africa), and areas where the projections from climate change effects are high (e.g. the Arctic, Siberia, Australia).

Security implications of extreme weather events

Greater knowledge is needed of the security implications of extreme weather events. This analysis can take information from research on natural disasters and their interconnections to security and conflicts, but needs to be elaborated and focused on the implications of extreme weather events and sea level rise. The volatility and variability of climate change are important features to address. The implications of extreme weather events can also be focal points in regional analysis, for instance concerning flooding in densely populated areas and in areas where a greater number of storms is expected, and can be adopted in thematic studies highlighting e.g. great industrial regions and node-points for infrastructure.

Climate change and its interconnection with other global transformations

As the consequences of climate change are highly dependent on the social setting and as climate change is one of many global transformations, better knowledge is needed on the complex interplay between different transformation processes. Transformations of great concerns are e.g. environmental degradation (such as deforestation, water scarcity, land-use), social transformations (such as demographic changes, urbanisation, migration), and biological transformations (e.g. insects, bacteria etc. that affect food production, human health situations). A pivotal consideration in conducting these investigations is that they can encompass the local variability; address the speed with which the different transformations occur; determine society's ability to adapt to the altered conditions; and adopt different approaches to what is considered a conflict.

Extreme climate change and 'tipping points'

Extreme climate change is evidently an area that needs greater attention and concerns acquiring better knowledge of the implications of a wider spectrum of scenarios with respect to emissions of GHG, mitigation policy and economic development. Furthermore the implications of extreme climate change need to be estimated, both in general and with respect to its security consequences. Regions of particular interest are those where tipping points can occur at relatively high speed, i.e. the Arctic, Indian summer, Sahel/West African monsoon, Amazon rainforest, boreal forests. Another potentially fruitful approach could be to map tipping points onto a map of conflicts and use that as a starting point for deeper regional analysis.

What if-scenarios

In order to increase the capability of policy response, we suggest predictive exercises on the future security implications of climate change. It is important

that these exercises include researchers and policy-makers from a broad area of sectors. The exercises are important as catalysts for thinking about the future and being able to improve contemporary policy processes for meeting the future. Furthermore, the exercises increase the mutual understanding of the problem matter and increase the knowledge of how different actors of relevance approach the security implications of climate change.

Abbreviations

AR4, the fourth IPCC Assessment Report

CFSP, Common Security Foreign Policy

CNA, Center for Naval Analyses

CNAS, Center for New American Security

CSIS, Center on Strategic and International Studies

EU, European Union

FOI, Swedish Defence Research Agency

GHG, Green House Gas

IES, Institute for Environmental Security

IISD, International Institute for Sustainable Development

IISS, International Institute of Strategic Study

IPCC, International Panel on Climate Change

IR, International Relations

RUSI, Royal United Service Institute

SIDA, Swedish International Development Cooperation Agency

SRES, the IPCC Special Reports on Emissions Scenarios

UK, United Kingdom

UN, United Nations

UNDP, United Nations Development Program

UNEP, United Nation Environmental Program

UNFCCC, United Nation Framework Convention on Climate Change

UN-HABITAT, United Nations Human Settlements Programme

UNISDR, United Nations International Strategy for Disaster Reduction Secretariat

WBGU, German Advisory Council on Global Change

WECD, World Commission on Environment and Development

WMO, World Meteorological Organization

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