

## THE IMPACT OF CLIMATE CHANGE ON MILITARY ACTIVITIES

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**Abstract:** *Climate change and its consequences have become a major public concern and policy issue in many countries. In some countries this also includes national security actors, particularly the armed forces, in the big countries, such as USA, UK, China and Russia.*

*A changing climate will have real impacts on our military and the way it executes its mission. The military could be called upon more often to support civil authorities, and provide humanitarian assistance and disaster relief in the face of more frequent and more intense natural disasters. Our coastal installations are vulnerable to rising sea levels and increased flooding, while droughts, wildfires, and more extreme temperatures could threaten many of our training activities. Our supply chains could be impacted, and we will need to ensure our critical equipment works under more extreme weather conditions.*

*These impacts increase the frequency, scale, and complexity of future defence missions, requiring higher costs of military base maintenance and impacting the effectiveness of troops and equipment in conflict.*

**Keywords:** *humanitarian, disaster, military, civilian authorities*

### 1. Why do Militaries Care about Climate Change?

Climate change presents risks to three elements of military effectiveness: readiness, operations and strategy.

**Readiness:** Readiness refers to the ability of a military to carry out operations in a timely manner. Climate change will directly impact military readiness, impacting installations and operations in a number of ways that include the availability of quality land and ranges, reductions in water supply, greater flood and fire hazards, and weather risks to the electricity supply. Installations near the coastlines are threatened by coastal erosion and sea level rise, damaging infrastructure and reducing the land available for operations. Intensified heat waves will present challenges to outdoor training and personnel efficiency. Climate change may also affect DOD military supplies, affecting where they are purchased and the method of transport and storage.

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Strained access to staple resources, damaged infrastructure, and mass migration represent challenges to ensuring the stability of regions abroad, creating environments ripe for terrorist activity.

Most of the countries already recognize the threat of climate change on their military installations, and warn that more resources and monitoring systems are needed to boost preparedness.

(EXAMPLE)

In 1992, Hurricane Andrew nearly wiped out Homestead Air Force Base in Florida and Hurricane Katrina caused USD 950 million of damage to Kessler Air Force Base in Mississippi. Both of these bases were rebuilt, but at the cost of millions of dollars.

(EXAMPLES) Unusual rains and flooding caused USD 64 million in damages to 160 facilities at an Army installation in the USA Southwest. And record-breaking rainfall and flash flooding overwhelmed the Department of Energy's Pantex plant, which is responsible for assembling and disassembling nuclear weapons.

**Operations:** Climate change affects military operations, whether they are war-fighting operations or humanitarian missions. For example, climate change can place significant burdens on the supply chains and logistical capacity of armed forces engaged in "theatre." Extreme drought or flooding in areas where militaries are engaged in war fighting, for example, can compromise water supply lines, and thus threaten military personnel directly. Extreme drying can also increase the likelihood of non-state actors using the seizure water of resources as leverage against populations and adversaries. An increase in the frequency and intensity of natural disasters may also put strains on the capacity of armed forces to deliver humanitarian assistance and disaster relief.

**Strategy:** Climate change can impact military strategy through increasing the possibility of destabilizing conditions in strategically-significant regions of the world. In the Arctic, a melting ice cap, coupled with increasing tensions between Russia and other Arctic nations, could increase the likelihood of conflict. In the Middle East and North Africa, climate change effects on water security may increase the probability of instability in the future. In Central Asia, increases in glacial melt and flooding, coupled with existing security dynamics (such as terrorism and nuclear materials proliferation), can create a volatile mix. In the broader Asia-Pacific region, rainfall variability will interact with a growing urban and coastal population, as well as an increasing demand for energy, to present enormous challenges to security in this increasingly important part of the world. Migrating fish stocks in the South China Sea may create pressures on the fishing industry to move into contested water, leading to increased tensions between China, its neighbours and the United States. These risks

can increase the likelihood of militaries being called on to resolve conflicts, or provide post-conflict assistance. All of these dynamics will put stresses and strains on military strategies.

## **2. New Role for the Military**

The Fourth Assessment Report (AR4) of the United Nations International Panel on Climate Change (IPCC) of November 2007 says that the surface warming cannot be stopped and in the best case the average temperature in 2090 to 2099 will be 1.1 to 6.4 degrees higher than between 1980 and 1999. About 20 – 30% of all types of animals and plants could disappear if the worldwide average of temperature increases by more than 1.5 to 2.5 degrees Celsius.

The sea level will rise up by 18 – 59 centimetres, which means a threat of flooding for millions of people by 2080.

Climate change is seriously and disproportionately affecting the lives and livelihoods of people in developing countries, increasing vulnerability to poverty and social deprivation. Its impact is magnified by the limited human, institutional and financial resources.

More frequent and more severe droughts, heat waves, rising sea levels, more destructive tropical cyclones and changes in precipitation patterns are expected to have wide-ranging consequences for human health, food production and food security, access to drinking water and human habitat, particularly in coastal areas. The world's poorest areas of Sub-Saharan Africa, Asian river deltas, tropical areas of Latin America and some low-lying island nations face the greatest risk, both due to increased exposure to hazards and to underlying vulnerability and limited coping capacities.

In 2006, drought posed a threat to more than ten million people in Kenya and Ethiopia alone. In 2007, the destruction of farmland displaced over 20 million people in Bangladesh, India, Nepal and Pakistan. Tens of thousands of people in nine West African countries in the Sahel region lost their homes or livelihoods during unprecedented flooding in September 2007. There is a growing consensus among the scientific community that the increase in the severity and frequency of these extreme events is a direct result of global warming and changing climate.

Rising global temperatures will increase resource scarcity, particularly regarding water and arable land for food production. This is likely to lead to greater migratory movements, which in turn could combine with existing factors of tension to increasingly causing conflicts, both within and between countries. Demand for essential resources has already exacerbated underlying social, political and economic tensions, contributing to violent conflicts in places such as Darfur, Chad, Somalia or the Central African Republic.

Environmental migration is the source of a new category of refugees or internally displaced persons (IDPs) leaving lands at risk, either voluntarily or because of government coercion. Rising sea levels that damage coastal regions through flooding

and erosion, desertification and shrinking freshwater could create millions of environmental refugees according to some forecasts. The Institute for Environment and Human Security at the United Nations University forecasts up to 50 million environmental refugees by the end of the decade.

As we have already seen, the effects of climate change are well known and we soon will find out that an increase of problems regarding security and disasters - especially conflicts of migration and "resource wars" - will take place. For instance Africa, due to a 2-5°C temperature increase as the XXI century unfolds, will experience increased desertification, water stress and disease. In the unstable Middle East, in future there will be water stress, soil erosion and accelerated loss of arable land. The Indian government intends to build an eight feet high barbed wire fence for the length of its 2,500-mile frontier with Bangladesh. Delhi's intention is to prevent migration from Bangladesh as rising sea levels brought about by „catastrophic climate change“ are forecast to inundate the low-lying country.

Thus, on the one hand we have massive potential dislocation that rising sea levels could bring to delta regions in Bangladesh, China, Egypt and Nigeria, on the other hand a drying out of continental interiors will lead to migration and tension too.

Therefore, if the consequences of climate change increase as shown before, we will have new and more acute humanitarian crises that can lead to regional instability, especially more conflicts not only between nations and states, but also inside states and regions between the different tribes as you can see already in one of the worst affected areas - the Sahel, where tensions among competing nomads, subsistence farmers and other communities are increasing.

The military will probably have to deploy more peacekeeping forces or delegate authority to regional organizations such as the African Union (AU) e.g. in the Darfur conflict. This means that Peace Support Operations are needed for stabilization in the world and in special regions – but we will not only have Peace Keeping and Peace Enforcement but as a challenge to the consequences of climate change, we also will have to fulfil more and more Humanitarian Operations. The military will have to focus more on the Petersberg Tasks<sup>3</sup> and on an increase of involvement in huge disaster relief operations.

While military forces have roles in disaster relief, the broader impact of serious climate change will require multinational, multi-agency cooperation on a scale heretofore unimaginable and could provide no-fault ground for global cooperation.

**But it also means that there is a new role for military:** New types of forces – dealing more with Civil Military Coordination (CIMIC), specialized training espe-

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<sup>3</sup> The Petersberg tasks cover a great range of possible military missions, ranging from the most simple to the most robust military intervention. They are formulated as:

- Humanitarian and rescue tasks
- Peacekeeping tasks
- Tasks of combat forces in crisis management, including peacemaking.

cially for disaster management operations, liaison and cooperation in international humanitarian operations like during the Tsunami in 2005 in SE-Asia, where more than 30,000 troops were operating for the affected people in the region. This was the first powerful sign of the Military and Civil Defence Assets (MCDA) project, showing that only military can provide special equipment and troops for the people on short term. But we should still keep in mind: Military is always the last resort and should not take over the civilian tasks.

The new challenge for the military is clear: more humanitarian operations need more specialized training at all levels and for all ranks. To reach this high degree of interoperability, it is necessary to know about the different systems and their training opportunities.

### **3. Primary Geography and Climate Concerns Impacting on NATO by 2035**

Based on the analysis, the primary geography and climate concerns impacting on NATO by 2035, as related to urbanization, are likely to include the following issues:

**Urban overstretch, decay and fragility.** Massive growth of urban populations, principally in lesser-developed countries and regions that lack the governmental, financial and infrastructure capacity to deal with the pace and scale of that growth, will prompt overstretch the inability of city and national governments to cope with urbanization in some cities. In some cases this may result in out-of-control slum growth, in others (perhaps established cities that are economically or demographically declining) it may manifest as urban decay and feral urban spaces. Resilience the adaptive capacity to deal with urban fragility will be an increasingly important concern for NATO analysts and planners by the 2030s.

**Internal secession and the rise of urban non-state armed actors.** Citizens at the top of the socio-economic and political ladder will increasingly opt out of city governance and infrastructure, establishing privatized, “gated community” enclaves, avoiding interaction with the mass population, and thus attempting “urban internal secession”. At the bottom of the ladder, marginalized and excluded populations often in slums on the urban fringe-will be excluded from or unable to access government systems, and community-based, private groups will emerge to meet the population’s needs. Poor and affluent communities alike will employ armed groups (private military corporations, private security, community-based police forces, and militias, gangs) to protect these enclaves. In some cases criminals will gain control of areas against the population’s will, and may establish alliances with business and political leaders, including government officials and local military or police commanders. As a consequence, for NATO in 2035, non-state armed groups and hybrid operators in urban enclaves will emerge as potentially powerful adversaries (or allies) in operations to secure, stabilize or provide humanitarian assistance in such cities.

**Littoral urban vulnerability.** There is a tendency for urban populations to cluster in littoral areas including coastlines, low-elevation coastal zones, and broader littoral (coastal, swamp, riverine or estuarine) environments. Even leaving aside any climate change, this tendency will place increasing numbers of people, as well as a vastly increased value of commercial property and national economic assets, at risk from coastal weather events. Floods, storm surges, tsunamis and localized inundations are already the most common and widespread natural disasters, and as more and more people crowd into dense urban settlements in littoral zones by the 2030s, the vulnerability of cities to such events as well as efforts to mitigate them will become an increasingly important concern for NATO.

**Climate-induced migration and conflict.** Assuming a degree of climate change commensurate with the conservative estimates discussed earlier, by the 2030s there is likely to be increasing concern among NATO governments about climate-induced migration, whether internal (as rural populations move to cities to avoid rural environmental problems such as drought and desertification or international (as populations move into, or among, NATO countries). Potential for unrest and conflict including both irregular and state-on-state warfare arising from climate-induced migration is hard to quantify, but by 2035 more will be known about this phenomenon, which is likely to remain a key concern for the alliance.

**Vulnerability of cities to climate change.** On more aggressive climate projections, changes in average temperature, modified rainfall, and an increased number and severity of extreme weather events and natural disasters will be detectable by the 2030s, prompting sustained concern from governments worldwide including NATO countries. Rising risk from pandemic and epidemic disease, and critical resource shortages including water, food and energy are likely to mean that climate change vulnerabilities in large and medium-sized cities remain key concerns for the Alliance in 2035. Some richer countries (including several in NATO) are already engaged in significant mitigation and adaptation efforts, and may suffer comparatively little disruption from climate change. Other countries may come late to the problem, prompting them indulge in panicked or ill-considered catch-up efforts (from the 2020s onward) that may damage or disrupt key cities, while the majority of rapidly urbanizing countries in the Global South simply lack the resources to effectively adapt.

#### **4. Impact of Geography and Climate on NATO by 2035**

Impact of geography and climate can identify the following specific capability implications for NATO:

**Cluttered battlespace.** The presence of vastly larger numbers of people, vehicles, aircraft (including UAVs) and offshore vessels and installations in urban spaces by 2035 will contribute to a densely cluttered battlespace, both in the physical/spatial sense and in terms of the electromagnetic spectrum. This will complicate targeting and hamper mobility for a NATO force attempting to identify and prosecute targets, move through cluttered sea and airspace, and operate in or around dense urban envi-



ronments. Capabilities to understand, analyze, and plan for operations in these environments will be critical.

**Disaggregated battlespace.** Urbanized environments create disaggregated battlespaces that break up a larger force into small units, while fragmenting combat action into numerous small, fleeting, close-range engagements. Improvements in weapons and communications technology by 2035 (analyzed elsewhere) will enable adversaries to exploit this disaggregated battlespace to soak up large numbers of troops and dissipate the effects of NATO combat power.

**Edgeless cities.** As discussed above, the emergence of city clusters (in which the edges of existing cities merge and the space between them fills with slums, light industry or post-industrial wasteland) and urban infill (in which open spaces within existing cities are filled in by new settlement) by 2035 will mean that some urbanized spaces will lack open areas or edges that enable maneuver by a NATO force using current operational doctrine. For example, clear beach landing sites, beach exits, areas for airmobile and air landed forces may be extremely difficult to identify in edgeless cities.

**Sea/Air Points of entry.** Because of the changing nature of the environment, and the encroachment of urban environments into previously open space, the seizure of air and sea points of entry for NATO forces operating in urban space will become extremely important, posing operational and tactical risk for mission achievement if such points of entry cannot be seized, held, defended and operated for extended periods of time. Ports, airfields, terminal facilities and dockyards will become increasingly important strategic objectives, due to the fact that they will be some of the few remaining areas of open and accessible space across large urban areas, and because of their critical importance to the functioning of cities.

**Urban mapping.** A related capability implication will be the need for NATO to enable rapid, crowd-sourced, self-synchronized mapping capabilities for urban spaces, to include fluid (rapidly-changing), modular, and informal settlements. These capabilities would focus less on mapping the locations of particular buildings and infrastructure (which is already relatively straightforward) and more on identifying the purpose, ownership, and social-political-economic orientation of key locations in urban areas where the force might seek to operate.

**Urban protected mobility.** Capabilities will be needed to allow NATO forces to maneuver in a cluttered, constricted urban environment while achieving sufficient firepower, protection and mobility to enable adequate force protection. The narrow streets/alleys and constricted mobility corridors of informal urban settlements will require smaller, narrower, lighter platforms, which will need 360-degree protection against blast, fragmentation and penetration. These platforms may employ active sensors and active defense systems, but such systems must take into account the collateral risk to dismounted forces and civil population in the environment. This applies both to ground and air mobility platforms, and (in the case of littoral urbanized environments) may apply also to maritime and riverine platforms.

**Subterranean/Subsurface Warfare.** NATO forces in 2035 will require the capability to undertake subterranean warfare in sewers, tunnel systems and under buildings, as well as underwater beneath the surface of canals, waterways and harbours. These capabilities will include significantly enhanced doctrine, education, training and simulation, as well as breathing apparatus, sensors, motion and heat detectors, weapon systems capable of being operated safely in confined spaces, and systems for logistic support, casualty evacuation and unmanned surveillance and reconnaissance. Indeed, given the importance of the subsurface domain in urban operations, this may need to be a separate integrated development effort in its own right.

**Water Scarcity.** As noted earlier, climate projections for the 2030s suggest drought. Like sea-level rise, water stress is extremely likely to occur, even independently of climate change, simply due to rapid population growth and urbanization, so that water shortage is a virtual certainty for major cities in 2035, even in the most benign future climate scenario. For example, an integrated assessment published by the Massachusetts Institute of Technology in 2014 suggests that “for many developing nations water-demand increases due to population growth and economic activity have a much stronger effect on water stress than climate change. By 2050, economic growth and population change alone can lead to an additional 1.8 billion people living in regions with at least moderate water stress. Of this additional 1.8 billion people, 80% are found in developing countries. Uncertain regional climate change can play a secondary role to either exacerbate or dampen the increase in water stress due to socio-economic growth. The strongest climate impacts on relative changes in water stress are seen over many areas in Africa, but strong impacts also occur over Europe, Southeast Asia and North America. The combined effects of socioeconomic growth and uncertain climate change lead to a 1.0 to 1.3 billion increase of the world’s 2050 projected population living in regions with overly exploited water conditions where total potential water requirements will consistently exceed surface-water supply.”

Even Europe, where drought is likely to be milder, water stress is expected by 2030 for Mediterranean littoral countries, and urbanized and industrialized areas in northwest Europe

**Food shortages.** Climate and geographical factors associated with urbanization suggest significant likelihood of food scarcity in the 2035 timeframe. This derives from several interrelated factors:

- Nutritional transition in urbanizing countries. Countries that are rapidly urbanizing tend to go through what is known as a “nutritional transition”. The World Health Organization projects that, by 2030, per capita calorie consumption will have risen by roughly 3.6 percent from current consumption (as of 2015), while specific regions will see much greater rise in demand for food per capita as a result of urbanization, with demand rising by 7.1 percent in Sub-Saharan Africa and 6.9 percent in South Asia between now and 2030, for example. Note that these are *per capita* requirements when the multiplying effect of very significant population growth in these areas (discussed



earlier) is factored in, these data suggest major food production challenges for these regions in the next 15 years.

- Food scarcity and violence. Several studies have shown that food density maps can be used to predict the emergence of security hotspots in urban environments, suggesting a strong correlation (and perhaps causative link) between food scarcity and violence within cities. In addition, a comprehensive study by the World Food Programme in 2011 concluded that “food insecurity especially when caused by a rise in food price is a threat and impact multiplier for violent conflict. It might not be a direct cause and rarely the only cause, but combined with other factors, for example in the political or economic spheres, it could be the factor that determines whether and when violent conflicts will erupt. Changes in food security, rather than levels of food insecurity, are probably most influential.” This in turn suggests that adaptive capacity, the ability for cities to regulate and ensure a reliable supply of food to key populations is a key component of urban fragility in this respect.

**Energy Scarcity.** A final factor, related to production and distribution of both food and water (since both these require significant energy use) is energy scarcity in the future urban environment. As the Chief Scientific Adviser to the British Government, Professor Sir John Beddington, argued in 2009, the world faces a “perfect storm” in the 2030s as global demand for food, energy and water peak, and as urbanization and industrialization increase demand for these commodities even as population also grows very significantly Beddington (2009). Electricity demand is forecast to grow by 30 percent by 2035 as a result of this combination of factors, while demand for oil, coal and gas will increase significantly in the same timeframe. The same distribution, production and supply line vulnerabilities, noted above for food supply, will affect urban populations reliant on energy supply and will form part of an increased pattern of urban fragility by 2035, while some projections suggest that global demand for energy will double by 2050 [Mike Hightower and Suzanne A. Pierce (2008) “The energy challenge” in *Nature* Vol. 452, pp. 285-286 (20 March 2008)]

## 5. Resilience

Many adaptations to climate change that involve the military can result in significant co-benefits, such as alleviating poverty and enhancing development, especially in developing countries. Various adaptation interventions promote well-being and security through the diversification of income-generating activities, adaptive migration in agricultural and fishing communities, insurance systems and education of women.

**Flood preparedness.** The benefits of protecting against increased coastal flooding and land loss due to submergence and erosion at the global scale are greater than the social and economic costs of inaction. Without adaptation, hundreds of millions of people will be affected by coastal flooding and will be displaced due to land loss by 2100. The majority are in East, Southeast and South Asia. However, some low-lying

developing countries (e.g. Bangladesh, Vietnam) and small island states are expected to face unavoidable land loss and annual flooding damage.

**Relocating military installations and bases.** Numerous naval bases located in coastal areas may need to be relocated further inland if the coast is not protected. Some may require relocation even with coastal protection.

**Preparing for population displacement.** Some migration flows are caused by changes in resource availability and ecosystem services. Major extreme weather events have in the past led to significant population displacement, and the likely increase in extreme events will amplify the challenges and risks of such displacement. Climate change effects of this type present chronic and episodic challenges to state capacity and to the fundamental welfare of populations at a scale that raises questions of state stability. The military has the ability to provide infrastructure immediately, bringing medical supplies, lift capability, and communications to devastated regions.

**Adapting weapons.** Climate change “will also impact the design of current and future weapons systems to account for extreme weather. It is anticipating more health risks from exposing troops to greater heat, having to deal with dustier training grounds and field environments, and needing to cope with phenomena like erosion and flooding lapping at its facilities.

**Preparing for water insecurity.** Climate change is projected to reduce both the quantity and quality of freshwater resources in many regions of the world. Groundwater resources will be reduced in many regions. Adaptation measures can include water resource management projects, additional water treatment systems, and water conservation. Many of these methods are expensive and take significant amounts of time to implement. This may limit their application in poorer countries.

**Increasing resilience.** Strategies and actions with an emphasis on disaster risk reduction can be pursued that increase climate resilience while at the same time helping to improve human livelihoods, social and economic well-being and responsible environmental management.

## 6. Mitigation potential

The global military complex is an energy-intensive industry and in many nations, defense forces are the largest single consumer of fossil fuels. Given the significance of its impact on climate conditions, the defence sector may come under significant pressure to reduce its GHG emissions – especially if governments enact policies to curb climate change in line with the globally agreed 2°C target. However, reducing fuel consumption may benefit operations; particularly for deployed forces, where moving large quantities of fuel is costly and dangerous.

**More efficient vehicles.** Internal combustion engines and jet turbines are becoming increasingly efficient. Expectations are for 40–70% improvements in the fuel efficiency of light-duty vehicles by 2035 compared to present. New aircraft typically offer a 20–30% improvement in fuel efficiency over existing models, driven by im-

proved engine performance, weight reductions, and design. Further gains of 40–50% between 2030 and 2050 are possible, compared with 2005 levels.

**Alternative fuels.** It may be possible to replace kerosene with biofuels, which offers direct GHG emission reductions of +30%. Shifting to electric or hydrogen-fuelled vehicles promises to dramatically reduce emissions.

**Operational improvements.** Aviation carbon dioxide (CO<sub>2</sub>) emissions can be reduced through more efficient planning of operations, including routes, altitudes and speeds. Unintended consequences of some efforts to mitigate emissions and adapt to climate change can increase insecurity and the risk of armed conflict. Where these efforts change the distribution of or access to resources, they have the potential to cause or aggravate conflict. For example, biofuel production can lead to disputes over land, food price spikes and rioting. Offering payments for Reduced Emissions from Deforestation and Forest Degradation (REDD) projects may trigger conflict over land and property rights. And some forms of low-carbon power, such as hydropower, have led to conflict over forced resettlement.

## Summary

Climate change is a fact and the effects are well known.

Nobody can say that it does not exist. A lot of small pieces put together in a puzzle show us now how dramatic it already is. And it does not only have an impact on civilians, it also has an impact on the military. However, this means that we maybe have to change our planning and training according to consequences of climate change. Militaries are concerned about climate change because it is their job to address all credible threats to their respective nation's security. These threats come in forms both direct and indirect, including direct threats to military installations from sea level rise and extreme droughts, and indirect threats through the exacerbation of instability in critical regions.

Problems in connection with security and disasters will increase – especially “resource wars”. There will be a new role for the military - if climate change increases, more Peace Support Operations will be necessary (Peacekeeping, Peace Enforcement), but also more Humanitarian Operations, especially disaster management operations, and more tasks focused on the Petersberg Tasks.

New types of forces are needed – dealing with CIMIC, specialized training especially for disaster management operations, liaison, etc.

And last but not least – There is also a need for a new definition of security, especially in our military strategic concepts, and maybe additional military tasks – the impact of climate change must be included in planning.

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