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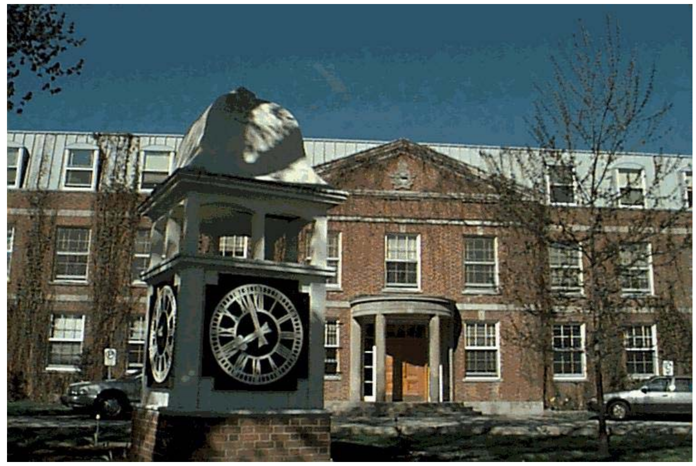

DIRECTING THE DART TOWARDS CLIMATE CHANGE

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ABSTRACT

The Canadian Armed Forces' (CAF) Disaster Assistance Response Team (DART) is a capability that the Government of Canada (GoC) may choose to contribute as part of a response to a major natural disaster. The DART fits into a CAF and GoC operating framework for disaster assistance (DA) that is comprehensive and considers the humanitarian guidelines of the international community. Despite the risk of militarizing a disaster response situation and the fiscal concerns associated with deploying military assets, overall the DART's contribution to six DA missions between 1996 and 2014 can be considered both appropriate and effective. Climate change is now a scientifically-proven and politically-charged issue because the consequences are being felt worldwide as population vulnerability increases and as extreme weather events become more frequent. Statistics show that occurrences of climate-related disasters over the past 20 years have increased steadily, especially those disasters caused by floods and windstorms. Likewise for the future, the risk of climatic disasters is expected to rise and so the CAF should be prepared for an increased requirement to conduct DA operations.

This paper argues that the future role of the DART should include a special attention to the impacts of climate change. First, the scientific evidence behind climate change, its causes, and the resulting impacts will be discussed. Second, the nature of disaster management and DA at the international and domestic levels will be examined in order to understand the context and the effectiveness of the DART's role. While the CAF's Regional Task Forces have historically fulfilled all domestic DA requirements, the DART has been, and is expected to continue to be, the first choice for the conduct of expeditionary DA operations as part of CONPLAN RENAISSANCE and the Humanitarian Operations Task Force (HOTF) concept. Finally this paper provides a 20-year outlook concerning climate change impacts, climatic disaster occurrence, and CAF DA requirements. In accordance with these projections, the DART's efforts should be directed towards the impacts of climate change which can be supported at the operational level of the CAF. The ability to predict disaster events, partner with civilians, and project the appropriate force package is recommended in order to optimize the DART's ability to fulfil future requirements.

CHAPTER 1

INTRODCUTION

The impacts of climate change are being felt throughout the world with extreme weather events on the rise. Many regions of the world are facing warmer temperatures, more severe storms, and an increase in precipitation. Global warming has been attributed to these shifts in the climate and has also increased disaster risks. Throughout the past decade there has been a greater awareness of the climate change issue which has prompted policy makers across a variety of sectors to try and determine how people and societies can adapt to the disaster risks posed by climate change.[1] Those who are involved in disaster management activities should be particularly aware of climate change impacts. When a major natural disaster occurs, the Canadian Armed Forces (CAF) is capable of assisting civil authorities in disaster response efforts as part of the their overall mandate to contribute to peace and security as well as uphold Canadian values and interests. The CAF's Disaster Assistance Response Team (DART) is part of the Government of Canada's (GoC) response "to meet international and domestic requests for help and underscores Canada's resolve to support disaster victims anywhere in the word."[2] Therefore, the impact that climate change will to have on the DART role should be examined in order to ensure that this important disaster response capability remains relevant and responsive to future requirements.

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[1] Madeleen Helmer and Dorothea Hilhorst, "Natural Disasters and Climate Change," *Disasters* 30, no. 1 (2006),1.

[2] Department of National Defence, *B-GJ-005-307/FP-040 Humanitarian Operations and Disaster Relief Operations*, Vol. B-GJ-005-307/FP-040 (Ottawa: DND Canada, 2005), 4-1.

TERMINOLOGY

Involvement in disaster response activities can be described a variety of ways. The CAF doctrine manual for "Humanitarian Operations and Disaster Relief Operations" differentiates terminology depending on where the operation is conducted. In Canada, CAF activities involving humanitarian assistance are called disaster relief operations (DRO) while in an international setting they are termed humanitarian operations (HO).[3] Both DRO and HO imply the provision of humanitarian assistance (HA), which the North Atlantic Treaty Organization (NATO) defines as the use of available military resources to assist or complement the efforts of civilian actors and humanitarian organizations in fulfilling the primary purpose of saving lives and alleviate human suffering.[4] HA is broad in scope because human suffering can result from a variety causes and HA can occur in both permissive and non-permissive operating environments. The term HO encompasses the circumstance for which HA is provided. This generally implies an expeditionary context as defined in CAF doctrine:

> [HO is] …an international military operation conducted where the prime task is purely to assist agencies of the humanitarian enterprise in the delivery of humanitarian assistance… Normally these missions are launched in response to Rapid Onset Disasters and are conducted in a permissive environment. They may be conducted in other environments but the parameters for [CAF] involvement will be jointly defined between [DFATD] and DND.[5]

The ReliefWeb definition indicates that an HO can result from the lack of available support to help a population in crisis:

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[3] *Ibid*.,i.

[4] North Atlantic Treaty Organization, *NATO Glossary of Terms and Definitions*, (n.p.: NATO Standardization Agency,2008), 130.

[5] Department of National Defence, *B-GJ-005-307/FP-040 Humanitarian Operations and Disaster Relief Operations*, Vol. B-GJ-005-307/FP-040 (Ottawa: DND, 2005), 1-4.

> [An HO is] …conducted to relieve human suffering, especially in circumstances where responsible authorities in the area are unable or unwilling to provide adequate service support to civilian populations.[6]

Therefore, the conduct of an HO is not purely limited to disaster response operations and is considered broad in scope. For the purpose of this research paper, it is necessary to accurately describe the operating environment associated with the CAF's response to natural disasters, for both domestic and expeditionary contexts. Using the term DRO would limit the scope to operating in Canada, while using HO would refer to international operations that may be caused not only by natural disasters but a variety of other circumstances and may include non-permissive environments. When considering the term Disaster Response, it is often used to describe a phase in disaster management. Accordingly Disaster Response can be defined as the "sum of decisions and actions taken during and after disaster, including immediate relief, rehabilitation, and reconstruction."[7] To this end, an accurate description of the CAF's disaster response activities can be made by simply using the first two words of the DART acronym: "Disaster Assistance".

Therefore the term Disaster Assistance (DA) will be used throughout the rest of this paper, which the author defines as the following: the activities involved in the response to a domestic or international disaster through the provision of assistance in order to save lives and minimized human suffering.

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[6] ReliefWeb,*Glossary of Humanitarian Terms* (Geneva: World Health Organization, 2008), 32.
[7] *Ibid.*,22.

OUTLINE

This research paper makes the connection between the impacts of climate change and the role of the DART. It will argue that the future role of the DART should include a focus on responding to disasters caused by climate change. In the discussion that follows, the first part will describe the correlation between climate change and an increase in natural disasters. The foundations of a changing climate have been well-defined by the Intergovernmental Panel on Climate Change (IPCC) that consists of a large network of scientists from around the world and has been able to assemble an extensive amount of research. Accordingly, the Fifth IPCC Assessment Report (AR5) has been used extensively to identify the causes and impacts of climate change. The discussion will also highlight the emerging risks associated with climate change and the prevalence climatic disasters. The second part aims to contextualize the role of the DART with respect to the both the international community and the CAF. The appropriateness and effectiveness of the DART capability will be discussed in relation to expeditionary DA operations. The Stockholm International Peace Research Institute's (SIPRI) report on the "Effectiveness of Foreign Military Assets in Natural Disaster Response" and the United Nation's "Oslo Guidelines" serve as important references that outline humanitarian principles that should guide military participation in DA activities. How the DART fits into the CAF's DA framework will be defined through a detailed analysis of information of previous domestic and expeditionary DA operation. Although the focus of the DART is on expeditionary operations, the potential for the DART to deploy domestically will be explored especially since Canada is not immune to the rising risk of climatic disasters.

The third portion of the paper makes projections concerning climate change and the frequency of DA operations. Climate projections for Canada and the world were compiled using reports published by Natural Resources of Canada (NRCAN) as well as the IPCC that were based on historical data and established climatological models. The future rates of natural disasters and DA requirements were more challenging to determine given the variability and subjectivity of contributing factors. However predictions were made by the author by applying 10-year historical trends forward to 10 and 20 year timeframes. By combining these projections, the consequences of climate change indicate that the CAF will increasingly be called upon to respond to climatic disasters, especially outside of Canada. This outlook shapes how the role of the DART should adapt into the future, and be directed towards climate change.

CHAPTER 2

CLIMATE CHANGE AND NATURAL DISASTERS

This chapter will explore the evidence that reveals an increase in natural disaster frequency due to climate change. When examining the issue, it is necessary to consider the scientific proof of global warming and its effect on the global climate system. The Inter-governmental Panel on Climate Change (IPCC) is an authoritative body of scientists from around the world that was established in 1988. Since 1990, the IPCC has published five climate change assessment reports based on long-term data collected from various sources that provides credible and internationally recognized evidence of climate change and its impacts. The IPCC has provided a foundation for understanding the root causes of climate change as well predicting the short and long term impacts. The IPCC defines climate change as an identified change in the state of the climate that persists for an extended period, which may be caused by natural internal processes, external forces, or by persistent anthropogenic changes in the composition of the atmosphere or in land use.[8] Furthermore, IPCC assessments reveal that changes in the global climate have caused more frequent and severe extreme weather events that can increase the risk of natural disasters. The figure below is the author's view of how global warming can evolve into natural disasters. It also highlights the importance of population vulnerability when evaluating disaster risk. As extreme weather events occur more often, the effect on communities and infrastructures may compound to increase vulnerability. Therefore as disaster risk increases, the DART should be prepared to face this future challenge.

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[8] ReliefWeb,*Glossary of Humanitarian Terms* (Geneva: World Health Organization, 2008), 16.

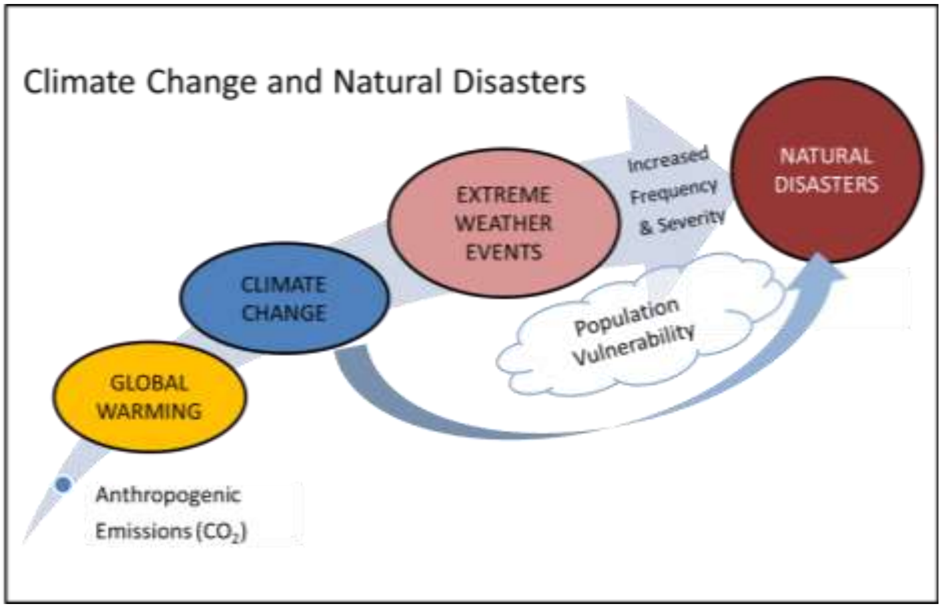

Figure 2.1 - The Climate Change Evolution
Source: Author.

THE SCIENCE BEHIND CLIMATE CHANGE

It is widely accepted that an increase in atmospheric greenhouse gases, and the associated increase in the earth's temperature, has led to the climate change reality that the world faces today. This section will address the interrelationship that exists between anthropogenic greenhouse gas emissions, global warming and the associated effects on the global climate. Through the identification of the cause and effects of climate change, the relationship to natural disaster occurrence can be better understood. In acknowledgement of climate change issue, the IPCC was established in 1988 to provide regular assessments concerning the scientific basis of global warming and climate change, its impacts and future risks, and options for adaptation and mitigation.[9] Subsequently, the United Nations Framework Convention on Climate Change (UNFCCC) was created in 1992 and has played an important role in bringing climate change to

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[9] Intergovernmental Panel on Climate Change ,"IPCC Factsheet", last accessed 30 April 2015. http://www.ipcc.ch/news_and_events/docs/factsheets/FS_what_ipcc.pdf

the forefront of international politics.[10] The science of climate change has clearly identified the human contribution to global warming and the major impact this has had and will continue to have on the global climate. This is aptly summarized by the following statement from IPCC:

> Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and dice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased.[11]

Global Warming

Changes in the global climate, although a natural phenomenon, have been accelerated by human activities, especially the emission of greenhouse gases which has intensified the greenhouse effect.[12] With global warming identified as a chief cause of climate change, it is worth reviewing the latest scientific evidence concerning this topic. The UN's World Meteorological Organization (WMO) recently declared 2014 as the hottest year on-record.[13] Similar findings were reported by two separate analyses from the United States' NASA and NOAA. In 2014 the average temperature of the earth in 2014 was 14.59 degrees Celsius (°C) which is 0.69°C above the 20th century average of 13.9°C, breaking the previous records of 2005 and 2010.[14] This trend is consistent with an observed long-term warming of the planet, with the ten warmest years on-record having all occurred since 1998.[15] Global warming has been

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[10] The IPCC is comprised of 195 member countries and the UNFCCC has been ratified by 196 states. Consequently these entities have been responsible for raising extensive awareness about the issue of climate change among world leaders.

[11] Intergovernmental Panel on Climate Change, *Summary for Policy Makers In Climate Change 2013 The Physical Science Basis* (UK: Cambridge University Press, 2013), 4.

[12] Geoff O'Brien et al." Climate Change and Disaster Management." *Disasters* 30, no.1(2006), 65.

[13] Damian Carrington, "14 of the 15 Hottest Years on Record have Occurred since 2000, UN Says," *The Guardian*, 2 February 2015.

[14] National Oceanic and Atmospheric Administration, "National Climate Data Center Global Analysis 2014," last accessed 9 February 2015. http://www.ncdc.noaa.gov/sotc/global/

[15] National Aeronautics and Space Administration, "NASA, NOAA Find 2014 Warmest Year in Modern Record," last accessed 3 February 2015. http://www.nasa.gov/press/2015/january/nasa-determines-2014-warmest-year-in-modern-record/

accelerated because of an increase in carbon dioxide and other emissions into the earth's atmosphere. Excess carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases have all contributed to an exaggeration of the natural warming effect of the earth's atmosphere. The production of these gases from human activities, known as anthropogenic greenhouse gas (GHG) emissions, is a proven driver of global warming as emphasized in IPCC's AR5 as follows:

> Human influence has been detected in warming of the atmosphere and the ocean, in changes in the global water cycle, in reductions in snow and ice, in global mean sea level rise, and in changes in some climate extremes. This evidence for human influence has grown since AR4. It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century.[16]

Although the planet's hydrological system is capable of absorbing about half of these anthropogenic emissions, the remaining gases linger in the atmosphere for many years, resulting in profound and enduring effects. Despite the heightened global awareness of the dangers of anthropogenic GHG, the IPCC has actually reported a steady increase in emissions over the past forty years, from 27 Gigatons in 1970 up to 49 Gigatons reported in 2010.[17] Between 1970 and 2000 there was an average increase of 1.3% annually and between 2000 and 2010 this rose to 2.2% annually.[18]

[16] Intergovernmental Panel on Climate Change, *Climate Change 2014: Synthesis Report* (Geneva: IPCC, 2014), 47.
[17] *Ibid.*, 46.
[18] *Ibid.*, 45.

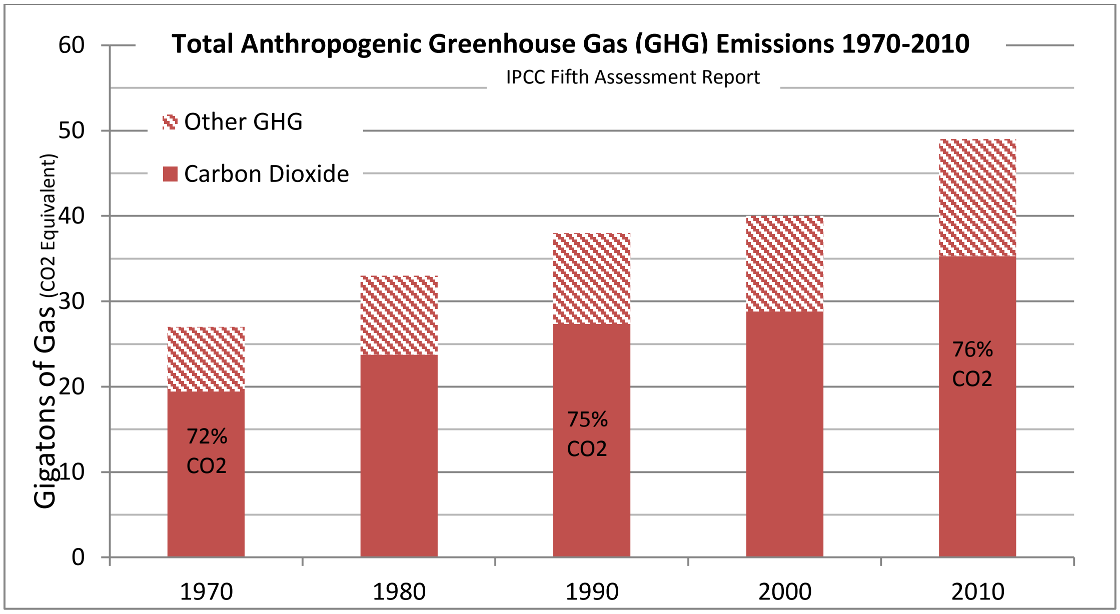

Figure 2.2 - Summary of Greenhouse Gas Emissions from Human Activities
Source: Author compilation of IPCC data.[19]

This anthropogenic GHG emission trend is depicted in the figure above and highlights the relative amount of CO_2 which is largely a result of fossil fuel combustion. Increasing amounts of atmospheric GHG correlate directly to rising temperatures, both on the earth's surface, and within the oceans. The 2014 global average ocean temperature was a record high, at 0.57°C above the 20th century average of 16.1°C, and the global average land surface temperature was 1.00°C above the 20th century average of 8.5°C.[20] The IPCC has determined a rise in the mean rate of global warming over the long term since the year 1880, whereby the combined average land and ocean surface temperature has increased by 0.85°C, with each of the last three decades becoming successively warmer.[21]

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[19] See Appendix 1 (1-A. Greenhouse Gas (GHG) Emissions Breakdown).

[20] National Aeronautics and Space Administration, "NASA, NOAA Find 2014 Warmest Year in Modern Record," last accessed 3 February 2015. http://www.nasa.gov/press/2015/january/nasa-determines-2014-warmest-year-in-modern-record/

The Impact of Global Warming on the Oceans

Increases in both GHG and average global temperatures have affected the delicate balance between the earth's atmosphere and its oceans. With global sea temperatures reaching record highs in 2014, the WMO highlighted anthropogenic GHG emissions as one of the main causes since "93% of the heat trapped in the atmosphere caused by GHG emissions from fossil fuels and other human activities, ends up in the oceans."[22] GHG and temperature uptake by the oceans has also affected the levels of salinity and acidity, which impact marine ecosystems and the hydrological cycles. Likewise, the IPCC reported that over the past century oceans have become more saline and regions of low salinity have become fresher.[23] In Canada long-term changes in salinity levels and an increase in acidity have been observed in all three of its oceans. As a result, the climate change reality is revealed through the changing nature of the earth's oceans, which will be explored below by considering rising sea levels and the melting of the Arctic.

Rising Mean Sea Levels

It is well documented that global sea levels have been rising since the year 1900 and modern technology has enabled the collection of increasingly more precise data to be recorded. During the 20th century, the earth's mean sea level rose between 15 and 20 centimetres at a rate between 1.5 to 2 millimetres per year.[24] The attribution of rising sea levels remains controversial because of the breadth of factors, such as thermal expansion, geological movements, salinity

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[21] Intergovernmental Panel on Climate Change, *Summary for Policy Makers In Climate Change 2013 The Physical Science Basis* (UK: Cambridge University Press, 2013), 5.

[22] Damian Carrington, "14 of the 15 Hottest Years on Record have Occurred since 2000, UN Says," *The Guardian*, 2 February 2015.

[23] Intergovernmental Panel on Climate Change, *Summary for Policy Makers In Climate Change 2013 The Physical Science Basis* (UK: Cambridge University Press, 2013), 8.

[24] The Climate Institute, "Oceans and Sea Level Rise," last accessed 8 February 2015. http://www.climate.org/topics/sea-level/#sealevelrise

levels, and regional ocean cycles. This debate extends to whether or not human-induced global warming is the main cause of rising sea levels. However, data shows that since the introduction of anthropogenic GHG emissions global mean sea levels have risen at an increasingly faster rate. Since 1993, sea level has been rising at a rate of around 3 millimetres per year (mm/yr), which is projected to increase to 4 mm/yr through the 21st Century.[25]

Debate about such projections arises out of uncertainties about the interrelationships between regional variations, melting ice, and thermal expansion. For example in Canada, a relative sea level rise of over 3 mm/year has been observed on the Atlantic coastlines and the Beaufort Sea coast, however sea levels have fallen at a rate of 10 mm/year around Hudson Bay where the land is rising rapidly due to post-glacial rebound. The availability of satellite altimetry data with nearly global is expected to improve scientist’s overall understanding of sea level rise and the ability to make projections. Using a combination of satellite and coastal tide gauge measurements over the long-term, the IPCC estimates that there will be a steady increase in global mean sea level rise that will affect 95% of the ocean area by the end of the 21st Century.[26] Therefore coastal populations, systems, and infrastructure must be prepared to adapt to this increased exposure to water hazards.

Reduction of Arctic Sea Ice

The Arctic region reveals dramatic evidence of the impacts of global warming. The relative warming of the Northern Hemisphere has been more dramatic than in other parts of the world. Since the 1980s permafrost temperatures have increased and Arctic sea ice end-of-

[25] Intergovernmental Panel on Climate Change, "Is Sea Level Rising?" last accessed 8 February 2015. http://www.ipcc.ch/publications_and_data/ar4/wg1/en/faq-5-1.html

[26] *Ibid*.

summer extent has decreased at a rate of 13% per decade.[27] In Eastern Canada, declines in winter sea ice extent have been observed in the regions of Newfoundland-Labrador and the Gulf of St. Lawrence.[28] The loss of Arctic sea ice was most remarkable in August 2012, when the US National Snow and Ice Data Center (NSDIC) reported the Northern Hemisphere ice extent to be more than 38% below average and ranked as the smallest August sea ice extent in the 1979-2012 period of record.[29] The recent US Navy assessments of the Artic show a very progressive reduction in sea ice and estimates that by 2030 the Northwest Passage will experience up to 5 weeks of open water conditions.[30] Subsequently, both the GoC and the US Government are paying particular attention to the conditions of the Northwest Passage. With the impact of global warming so prevalent in the Arctic, the strategic importance of the region has prompted a greater awareness of climate change issues. Sea ice reduction is making the Arctic increasingly accessible with the opening of new transportation route and therefore introduces new complexities for the future.

Global Warming the Global Climate

With added heat in the global climate system, a more active hydrological cycle and shifting weather patterns has brought about more extreme weather events. This interrelationship was confirmed in the IPCC AR5:

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[27] Fiona Warren and Donald Lemmen, *Synthesis:Canada in a Changing Climate - Sector Perspectives on Impacts and Adaptation* (Ottawa, ON: Government of Canada,2012). 7.

[28] *Ibid.*,7.

[29] National Climatic Data Center, "Global Snow & Ice: August 2012," last accessed 9 February 2015. http://www.ncdc.noaa.gov/sotc/global-snow/2012/8

[30]United States,*US Navy Arctic Roadmap for 2014 to 2030* (Washington: USN, 2014), 11.

> Changes in many extreme weather and climate events have been observed since about 1950. Some of these changes have been linked to human influences, including a decrease in cold temperature extremes, an increase in warm temperature extremes, an increase in extreme high sea levels and an increase in the number of heavy precipitation events in a number of regions.[31]

Following the announcement that 2014 was the hottest year on-record, the secretary-general of the UN World Meteorological Organization (WMO) acknowledged that "rising levels of greenhouse gases in the atmosphere and increasing heat content of the oceans are committing us to a warmer future".[32] As the future gets warmer so will the frequency and severity of a variety of weather hazards that are outlined in the following sections.

Heat waves and Drought

The IPCC has also reported an increase in the frequency, intensity and duration of heat waves, especially in Europe, Asia, and Australia.[33] Recent examples include the 2003 European heat wave which was attributed to almost 35,000 deaths and caused economic losses of over 13 billion USD.[34] Warmer global surface temperatures will likely cause variations in precipitation patterns as the hydrological cycle speeds up. Many areas are likely to experience increased precipitation and increased risk of flooding, while areas located far from storm tracks are likely to experience less precipitation and increased risk of drought.[35] For example since the 1950s, some regions of the world have experienced longer and more intense droughts, particularly in

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[31] Intergovernmental Panel on Climate Change, *Climate Change 2014: Synthesis Report* (Geneva: IPCC, 2014), 7.

[32] Damian Carrington, "14 of the 15 Hottest Years on Record have Occurred since 2000, UN Says," *The Guardian*, 2 February 2015.

[33] Intergovernmental Panel on Climate Change, *Summary for Policy Makers In Climate Change 2013 The Physical Science Basis* (UK: Cambridge University Press, 2013), 5.

[34] Maarten van Aalst, "The Impacts of Climate Change on the Risk of Natural Disasters," *Disasters* 30, no. 1 (2006), 10.

[35] Environmental Protection Agency, "Climate Change Indicators in the United States: Drought," last accessed 10 February 2015. http://epa.gov/climatechange/science/indicators/weather-climate/drought.html

southern Europe and West Africa. Extreme and prolonged dryness negatively affects agriculture, water supplies, energy production, and many other aspects of society. Low reservoir levels, reduced stream flow, and low groundwater levels all lead to vegetation dry-out and increase the risk of wildfires.[36] Therefore, both extreme precipitation events and droughts and be attributed to rising global temperatures.

Heavy Precipitation

As the hydrological cycle is affected by warmer temperatures, global precipitation patterns are affected. The IPCC reported an increase in the frequency and intensity of heavy precipitation events in North America and Europe.[37] IPCC assessments of precipitation data collected since 1901 show that there has been an overall increase in precipitation over the mid-latitude land areas of the Northern Hemisphere.[38] For example, Canada has experienced a steady increase in average annual precipitation with more frequent heavy precipitation events and in several regions there has been a shift in precipitation type, with decreasing snowfall and increasing rainfall.[39] While climate change is influencing weather in many parts of the world, the extent and nature of changes in precipitation patterns remains uncertain due to regional variations.[40]

Cyclones

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[36] *Ibid.*
[37] IPCC, *Climate Change 2014…,* 53.
[38] *Ibid.*

[39] Fiona Warren and Donald Lemmen, *Synthesis:Canada in a Changing Climate - Sector Perspectives on Impacts and Adaptation* (Ottawa, ON: Government of Canada,2012), 7-9.
[40] Maarten van Aalst, "The Impacts of Climate Change on the Risk of Natural Disasters," *Disasters* 30, no. 1 (2006), 12.

Cyclones represent a category of intense rotating windstorms that comprises hurricanes, typhoons, and monsoons. Cyclone activity is influenced by many factors and is subject to regional and annual variability as well as the El Nino effect. However there has been a direct relationship between the amount of global warming and an increase in the frequency and intensity of wind storm activity. IPCC assessments also point to a change in the coverage area and length of season, especially for monsoons. The Accumulated Cyclone Energy (ACE) index derived from Atlantic cyclone data collected since the 1800s has become a standard indicator based on wind measurements that encompasses frequency, strength, and duration of tropical cyclones.[41] The total annual ACE indices have risen noticeably over the past 20 years and six of the ten most active years have occurred since the mid-1990s.[42] This was exemplified by Atlantic hurricane seasons experienced in 2004 and 2005 which were particularly intense. For example, Hurricane Katrina caused extensive damages along the United States Gulf Coast causing a major disaster that required a military assistance and included a response from the CAF.

CLIMATE CHANGE AND NATURAL DISASTER FREQUENCY

Having established the nature of a changing climate, this section will argue that an increased exposure to weather hazards will increase the risk of natural disasters. Disasters occur when natural and man-made systems cannot cope with the effects of natural hazards. Thus, the vulnerability of populations and infrastructure are important factors contributing to disaster risk. This has led to an increased requirement for governments and international organizations to develop strategies that promote adaptation and resilience to climate change. However, the

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[41] Environmental Protection Agency, "Climate Change Indicators in the United States: Tropical Cyclone Activity," last accessed 10 February 2015. http://epa.gov/climatechange/science/indicators/weather-climate/cyclones.html

[42] *Ibid*.

residual risk inherent with a more variable and extreme global climate implies natural disasters will continue to occur. The trends associate with natural disaster occurrence can be identified from global statistics published by the Centre for Research on the Epidemiology of Disasters (CRED) and the International Federation of the Red Cross (IFRC).[43] By considering the Canadian and global perspectives of these trends, the CAF's DA requirements can be identified. First of all key terms and concepts will be defined in order to frame the discussion on natural disasters and to establish terminology that will be applied throughout the remainder of the paper.

Definition of Disaster

CAF doctrine defines a disaster as "a serious disruption of the functioning of a society, causing widespread human, material, or environmental losses which exceed the ability of the affected society to cope."[44] The IPCC characterizes a disaster by the requirement for an immediate emergency response in order to satisfy critical human needs and may include a requirement for external support.[45] Defining a disaster event by the requirement for a response effort is relevant to this research paper as it relates to the role of the DART. CRED definition for disasters relate to specific criteria that have to be met in order for an event to be entered into the International Disaster Database (EM-DAT). A qualifying disaster event must satisfy at least one

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[43] IFRC and CRED statistics for the annual number of climatic were compiled by the author and included at Appendix 1 (1-B. Global Natural Disasters 1996-2013).

[44] Department of National Defence, *B-GJ-005-307/FP-040 Humanitarian Operations and Disaster Relief Operations*, (2005), 1-2.

[45] A. Lavell et al., "Climate Change: New Dimensions in Disaster Risk, Exposure, Vulnerability, and Resilience." in *IPCC Special Report: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*, eds. Susanne Moser and Kuniyoshi Takeuchi (Cambridge, UK: Cambridge University Press, 2012), 31.

of the following criteria: 10 or more people reported killed; 100 or more people reported affected; declaration of a state of emergency; and/or a call for international assistance.[46]

Types of Natural Disasters

Natural disasters are characterized by the threat posed by natural phenomena that occur in proximity to people and infrastructure. The CAF defines two categories of natural disasters, geological and climatic. Only climatic disasters will be addressed here since they directly relate to the effects climate change. Indirect effects of climate change will be covered briefly in the next section concerning complexity, since climate change may indirectly exacerbate the consequences other types of disasters, when the affected population had become vulnerable as a result of extreme weather events. Therefore the scope of this research paper will include three sub-groups of climatic disasters, as defined by CRED: meteorological, hydrological, and climatological. These subgroups are defined and classified in Table 2.1 below.

Table 2.1 - Classification of Climatic Natural Disasters

Disaster Subgroup	Definition	Main types of disaster events
Meteorological	Events caused by short-lived atmospheric processes (in the spectrum from minutes to days)	Storm, cyclones
Hydrological	Events caused by deviations in the normal water cycle and/or overflow of bodies of water.	Flood, landslides (wet)
Climatological	Events caused by long-lived processes (in the spectrum of seasonal and climate variability).	Extreme temperatures, drought, wildfire

Source. Author compilation from CRED.[47]

Vulnerability, Adaptation and Resilience

[46] Debarati Guha-Sapir et al., *Annual Disaster Statistical Review 2013*,(Brussels: Centre for Research on the Epidemiology of Disasters (CRED), 2014), 7.

[47] *Ibid*., 7, Table 1.

The following concepts influence the degree of risk associated with natural disasters. Vulnerability can be defined as the extent to which a community, structure, service or location is likely to be damaged or adversely affected by a hazard.[48] Adaptation refers to processes of adjustment by both human and natural systems in order to moderate harm or exploit beneficial opportunities from climate change effects.[49] Effective adaptation to climate change requires an understanding of the various ways in which processes can be implemented to reduce disaster risk. For over a decade, resilience is a term that has been widely employed in the field of disaster risk management. The UN Office of Disaster Risk Reduction (UNISDR) defines resilience as the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner.[50] The concepts of vulnerability, adaptation, and resilience are relevant when determining the tipping point between effective response to a natural hazard and the onset of a natural disaster.

Disaster Risk

The risk of natural disasters associated with climate change is a function of the probability of exposure to an extreme or severe weather event and the likelihood that the exposed system will be adversely affected. In general terms, disaster risk can be defined as the likelihood over a specified time period, that a community or society will experience widespread and adverse human, material, economic, or environmental effects when exposed to hazardous

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[48] DND, *Humanitarian Operations…*,1-2

[49] A. Lavell et al., "Climate Change: New Dimensions in Disaster Risk, Exposure, Vulnerability, and Resilience." in *IPCC Special Report: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*, eds. Susanne Moser and Kuniyoshi Takeuchi (Cambridge, UK: Cambridge University Press, 2012), 36.

[50] United Nations Office for Disaster Risk Reduction, "UNISDR Terminology Page," UNISDR, http://www.unisdr.org/we/inform/terminology (accessed February/11, 2015).

events.[51] More specifically, those risks associated with climate change are defined by the IPCC as follows:

> Risks from climate change impacts arise from the interaction between hazard (triggered by an event or trend related to climate change), vulnerability (susceptibility to harm) and exposure (people, assets, or ecosystems at risk).[52]

Accordingly, vulnerability and exposure are key determinants of disaster risk and help explain why non-extreme events and chronic hazards can lead to a disaster, while some extreme events do not. Risk can be offset by implementation of measures that promote resilience and preparedness. The WHO defines disaster preparedness as the "organization, education, and training of populations and institutions to facilitate effective control, early warning, and response in the event of a disaster."[53] Furthermore, disaster risk can be reduced through adaptation measures such as physical improvements to infrastructure as well as warning and response systems.[54]

System Vulnerability

It is evident that climate change can affect both natural and human systems and compound the extent to which these systems are adversely impacted by extreme weather events. Accordingly, less developed countries that are burdened with slow-onset disasters, such as heat-waves and drought, become less resilient in their capacity to deal with rapid-onset disasters such

[51] Lavell et al., *Climate Change: New Dimensions in Disaster Risk, Exposure, Vulnerability, and Resilience.*, 32.

[52] IPCC, *Climate Change 2014*…, 36.

[53] World Health Organization, Glossary of Humanitarian Terms, Relief Web (2008), 22.

[54] Disaster Risk Reduction (DRR) cross-cuts a variety of government sectors (public safety, natural resources, defense, and transport) from the federal down to the municipal level. Internationally, the UNFCCC and the UNIDR have encouraged many countries to adopt DRR as part of their strategies to cope with climate change impacts. Despite the emergence of plans and policies to reduce disaster risks, the implementation of practices and processes is expected to take time and requires significant capacity building, especially in less developed countries.

as storms or floods. The increase in the occurrence of disasters is impacting disproportionately on the poor, especially where disaster risk mitigation measures have not been put in place.[55] In addition to the economic factor, proximity to the ocean is another aspect that influences vulnerability. Rising mean sea levels, increases in ocean surface temperature, and melting Arctic ice mean that populations and infrastructure in coastal and littoral zones are at a higher risk of experiencing a climatic disaster due to more frequent exposure to wind and water hazards. Population vulnerability in proximity to the oceans is an issue faced by Arctic communities. As rising waters and temperatures change the nature of Arctic ecosystems, the natural resources and way of life that Aboriginal communities rely-on may be threatened. This has the potential to make northern populations increasingly vulnerable to changing hydrological conditions and extreme weather events. With this in mind, the Canada First Defence Strategy (CFDS) recognizes the Arctic region "as an area that will bring new challenges for sovereignty and security", which brings an increased potential for military support.[56]

The IPCC estimates with very high confidence that climate change will increase risks for people, assets, economies and ecosystems.[57] This highlights the need for disaster preparedness in areas exposed to natural hazards associated with climate change. In urban environments, infrastructures and services should be ready to cope with extreme weather, especially floods and storms. When rural areas experience heat waves and droughts, this will have an effect on food security, agriculture income, and the location of food production areas around the world.[58] Likewise, a drought that occurs in a key area for food production will impact all the populations

[55] Geoff O'Brien et al.,"Climate Change and Disaster Management." *Disasters* 30, no.1(2006), 65.

[56] Government of Canada, *Canada First Defence Strategy* (Ottawa, ON: Department of National Defence, 2008), 6.

[57] IPCC, *Climate Change 2014*…,54.

[58] *Ibid*.

that rely on that food source. Therefore, system vulnerability also implies that the effects of natural disasters can extend beyond the affected region. With the potential for more people to be affected by natural disasters the overall need to provide humanitarian assistance may become greater.

GLOBAL NATURAL DISASTER STATISTICS

The evaluation of data extracted from the CRED EM-DAT provides a perspective of the location, types, and frequency of natural disasters. According to CRED reports, the regional distribution of disaster damages has remained constant between 2003 and 2012. Given this consistency, the 2013 annual disaster statistics can be used to provide an indication of areas of the world that persistently experience natural disasters. This information is useful for the identification of regions of the world that may result in future DART deployments. 2013 statistics show that Asia has been the continent most affected by disasters in terms of the number of occurrence as well as the number of people affected and killed. This is reflected in Table 2.2 below which summarizes the top 10 countries most impacted by climatic disasters.

Table 2.2- Top 10 Countries Most Affected by Natural Disasters in 2013

Rank	Number of Climatic Disasters		Number of affected people (disaster victims) in millions		Number of deaths (disaster mortality)	
1	China	34	China	27.47	Philippines	7750
2	USA	28	Philippines	25.67	India	7119
3	Philippines	13	India	16.72	China	1395
4	Indonesia	12	Vietnam	4.13	United Kingdom *	772
5	India	11	Thailand	3.52	Pakistan	730
6	Vietnam	10	Zimbabwe	2.21	Japan	400
7	Japan	9	Israel	2	Mexico	223
8	Brazil	6	Pakistan	1.7	United States	212
9	Afghanistan	5	Bangladesh	1.53	Cambodia	200

10	Bolivia	5	Cambodia	1.5	Vietnam	200
Totals		133		86.45		19001

Source: Author compilation from CRED.[59]

A large majority of the countries listed in the table above are from Asia and reflects the fact that Asia experienced 70% of total number of climatic disasters in 2013 and attributed 90% of global disaster victims. In particular, China experienced the largest number of climatic disasters and disaster victims in part due to China's large land mass and populations relative to the rest of the world. Furthermore India and the Philippines had the greatest disaster mortality rate due to the exposure to cyclones and included the major international disaster caused by Typhoon Haiyan in late 2013. Asia's tendency to experience natural disasters can be attributed to its greater exposure to weather hazards, the relative concentration of less-developed countries, and the fact that Asia's four and a half billion people represents a large percentage (61%) of the world's total population.[60]

The type and frequency of climatic disasters that occur globally were determined using information from the IFRC World Disasters Report that is published annually and compiles natural disasters data from CRED. The 2014 IFRC report stated that floods and storms have consistently been the two most frequent causes of natural disasters.[61] Using the available data from IFRC, the number of climatic disaster events were analyzed over a selected timeframe in order identify trends.[62] Figure 2.3 below represents the breakdown of climatic disasters which shows that floods account for almost 50% of global climatic disasters and wind storms just over

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59 Debarati Guha-Sapir et al., *Annual Disaster Statistical Review 2013*,(Brussels: Centre for Research on the Epidemiology of Disasters (CRED), 2014. 15-17.

60 World Population Statistics, "World Population 2014," last accessed 13 February 2015. http://www.worldpopulationstatistics.com/population-of-asia-2014/

61 International Federation of Red Cross and Red Crescent Societies (IFRC), *World Disasters Report: Focus on Culture and Risk* (Lyon, France: Imprimerie Chirat, 2014), 220.

62 See Appendix 1.

30%. Furthermore, Figure 2.4 illustrates how the types of climatic disasters have occurred over time. During the selected time period (1996 to 2013), the rate of floods and windstorms increased steadily, while the rate of wild fires, droughts, and extreme temperatures has been relatively stable.

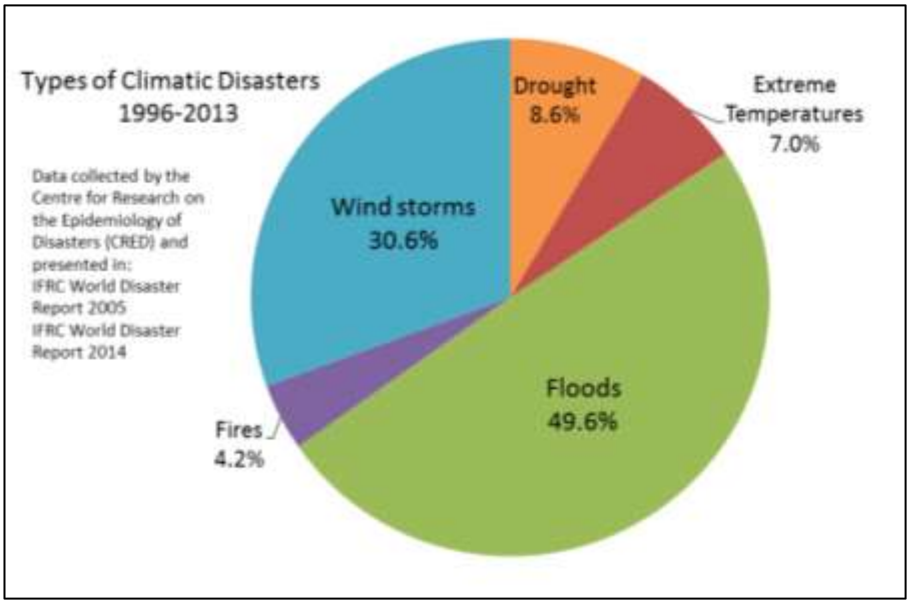

Figure 2.3 - Global Disaster Occurrence by Type
Source: Author.[63]

[63] Author calculations based on CRED data. See Appendix 1 (1-C Types of Disasters Globally).

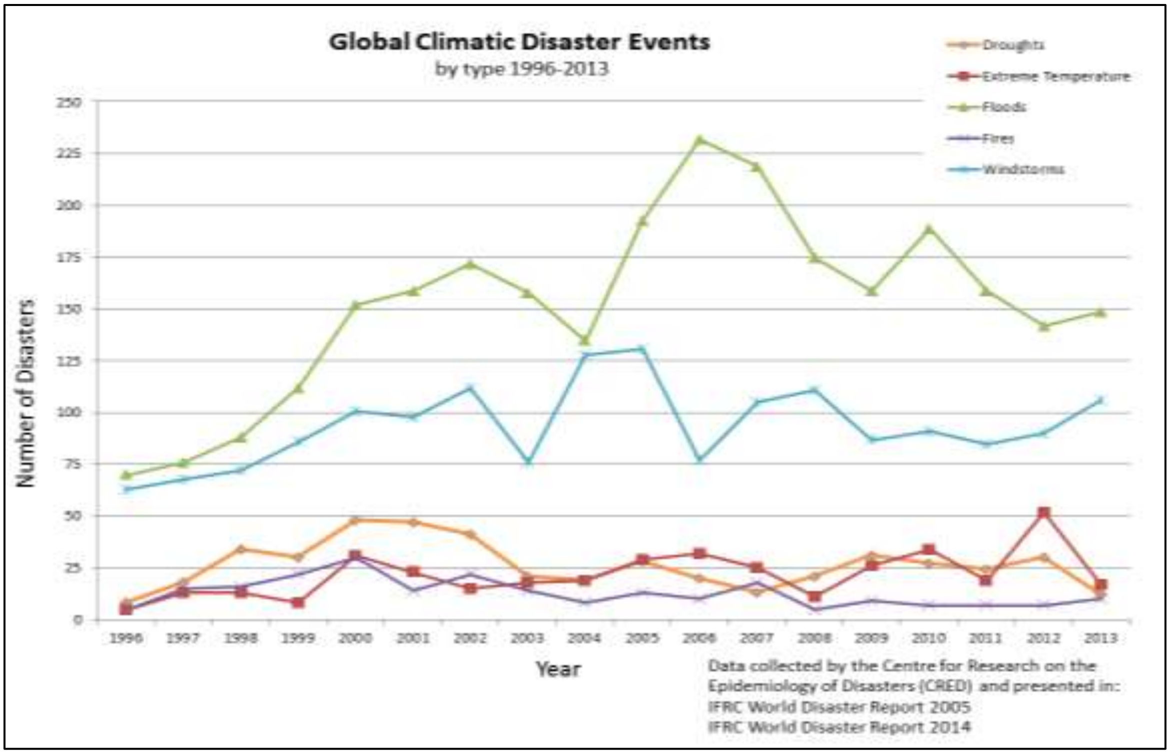

Figure 2.4 - Climatic Disaster Trends
Source: Author.[64]

In summary, global warming and GHG emissions from human activities are the main drivers of climate change. Increasing global temperatures, rising sea levels, and extreme weather events are all compelling signs of a changing climate. The extent of climate change around the world places stress on human and man-made systems and subsequently reduces resilience. Accordingly, system vulnerability is associated with an increased risk of disasters occurrence and may also mean that impacts of a disaster are felt beyond the affected area. Recent natural disaster statistics clearly show a trend in the overall increase of floods and storms, with Asia being the most affected continent. Therefore, the evidence presented in this chapter provides the foundation for the discussion that follows concerning the implications for the CAF's DA requirements and the impact on the DART role.

[64] Author representation of CRED data. See Appendix 1 (1-B).

CHAPTER 3

THE CONTEXT OF THE DART ROLE

Having established that the occurrence of climatic disasters has increased due to climate change, this chapter will consider the implications for disaster response. As the requirement to respond to disasters becomes even greater with climate change, the demand for civilian humanitarian resources will increase along with the potential for military involvement. Therefore the overall effectiveness of the military in the provision of DA will be discussed in order to provide a global context for the role of the DART. In addition the role of the DART within the CAF mandate will also be described. Through the analysis of domestic and expeditionary DA operations conducted by the CAF since the DART's inception in 1996, the nature and the frequency of disaster response requirements can be identified. By understanding how the DART fits into international and CAF frameworks for DA, this will provide a foundation for recommendations concerning the future role of the DART in light of the impacts of climate change.

THE MILITARY AND DISASTER MANAGEMENT

For major natural disasters where civilian resources become overwhelmed, military assets may be deployed to augment civilian capabilities in order to mitigate immediate impacts and help stabilize the situation. This section emphasizes the effectiveness of military assets in DA especially when their efforts are synchronized with civilian actors and when humanitarian principles are taken into account. By extension this applies to the CAF and especially the DART when conducting expeditionary DA operations. In order to frame the argument, it is worthwhile to consider disaster management as whole in order to understand where and how military contributions can contribute. Disaster management is characterized by four interdependent phases: Mitigation, Preparedness, Response, and Recovery.[65] Figure 3.1 illustrates the four phases of disaster management and offers a perspective of where military capabilities can contribute. Because the disaster management cycle is led by civil authorities, military involvement occurs only when specific requests for assistance are made or through pre-arranged agreements that call for specific capabilities.

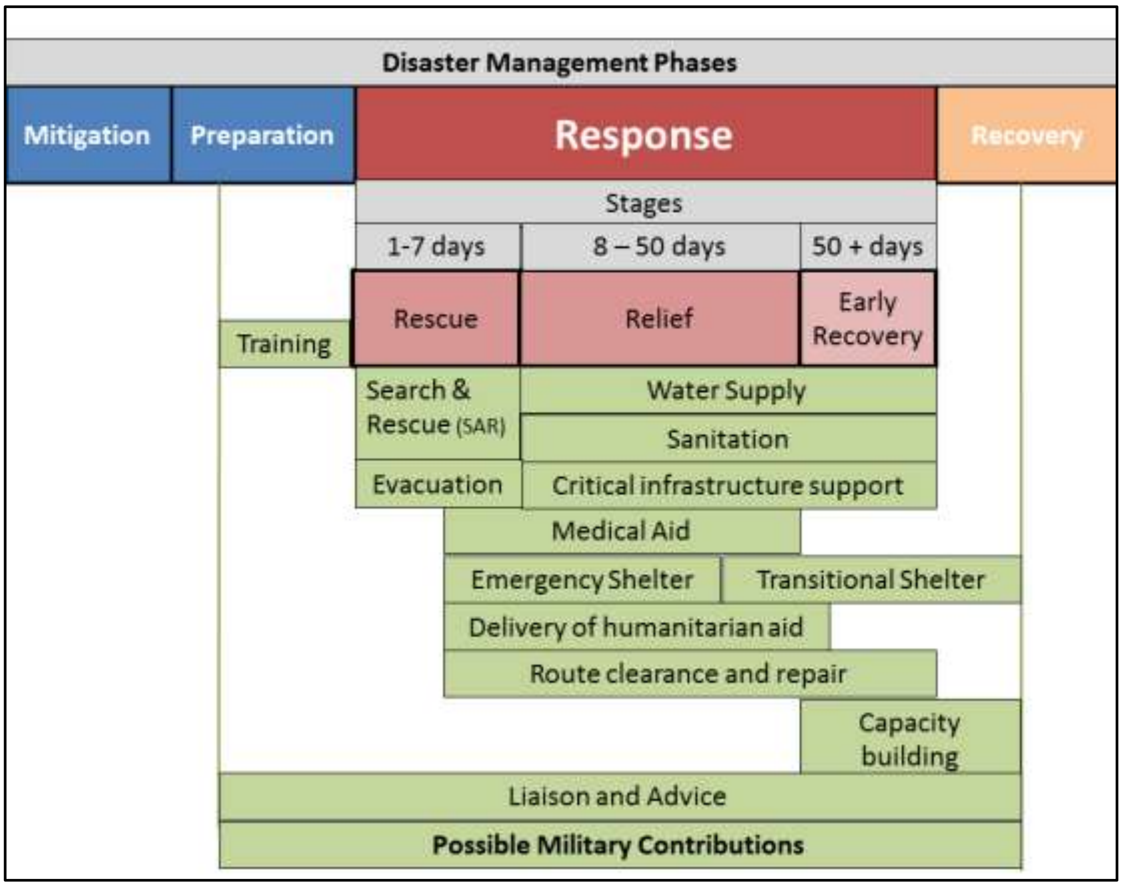

Figure 3.1 - Possible Military Roles in Disaster Management
Source: Author.

[65] Damon Coppola, *Introduction to International Disaster Management*, 2nd ed. (Boston: Butterworth-Heinemann, 2011), 305.

Even though there is scope for military involvement in each phase, the military typically provides the greatest amount of assistance during the Response phase. The mandate of the DART is therefore focused on this phase. Even if this may appear to limit the scope of the DART's contribution, the following description by the IFRC signifies the breadth and importance of the Response phase:

> The primary aims of disaster response are rescue from immediate danger and stabilization of the physical and emotional condition of survivors. These go hand in hand with the recovery of the dead and the restoration of essential services such as water and power. How long this takes varies according to the scale, type and context of the disaster… and is composed of a search and rescue phase in the immediate aftermath of a disaster followed by a medium-term phase devoted to stabilizing the survivors' physical and emotional condition.[66]

Response refers to what is done immediately prior, during, and following a disaster event, with the primary aim to save lives, reduce injuries, and decrease damage to infrastructure.[67] The Response phase is the most complex of the four phases of disaster management because of the time-constraints associated with emergencies and the requirement to coordinate the wide range activities.

This phase can be further divided into three stages: Rescue, Relief, and Early Recovery [68] which are depicted in Figure 3.1 above. These stages are not distinct in terms of time and space and they may have to be carried out concurrently depending on the nature of the disaster. Activities within these stages begin as soon as a disaster event is imminent and lasts until the emergency situation is declared to be over.[69] Public Safety Canada identifies emergency public communications, search and rescue, emergency medical assistance, and evacuation as critical

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[66] International Federation of Red Cross and Red Crescent Societies, "Responding to Disasters," last accessed 6 March 2015. http://www.ifrc.org/en/what-we-do/disaster-management/responding/

[67] Jeffrey Bumgarner, *Emergency Management* (Santa Barbara: ABC-CLIO, 2008), 28.

[68] Department of National Defence, *CONPLAN RENAISSANCE*, (Ottawa: CJOC, 2014), 2.

[69] Damon Coppola, *Introduction to International Disaster Management*, 2nd ed. (Boston: Butterworth-Heinemann, 2011), 305.

response activities.[70] The military can make important contributions to each of these functions. Military aircraft can be especially useful for the evacuation of people from disaster zones and for the transport of supplies and aid workers. In addition, military engineers can conduct water supply and sanitation operations, as well as support the restoration of critical infrastructures such as road networks and utilities. Other engineering contributions can include the construction of basic shelters and the provision of sanitation for displaced populations.

Prior to the onset of disasters the military can enhance preparedness through embedded liaison officers within civilian organizations. Civil-military collaboration can also enhance disaster management training and improve working relationships in order to enhance the ability to synchronize efforts when a disaster strikes. The importance of civil-military integration during training and needs assessment was reinforced by the Stockholm International Peace Research Institute's (SIPRI) in their report on the effectiveness of the military in natural disaster response.[71] After the Response phase, military personnel and resources can contribute to capacity building in order to support the full transition into the Recovery phase. CAF involvement in DA operations has been almost exclusively in a response role and relatively short in duration so as to not continue into the Recovery phase. As it will be discussed further, military involvement is disaster relief efforts must be moderated with humanitarian principles and should not take the place of civilian resources. In accordance with these guidelines, military assets should be used as a last resort in order to avoid creating a dependency and to maintain the autonomy of civilian and humanitarian organizations.

The US Military and Disaster Management

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[70] Public Safety Canada, *An Emergency Framework for Canada*, 2nd ed., 2011), 4.

[71] Sharon Wiharta et al., *The Effectiveness of Foreign Military Assets in Natural Disaster Response* (Stockholm: SIPRI, 2008), xiii and xiv.

The US Department of Defense (DoD) also focuses its DA efforts on the Response phase, through the deployment of military personnel domestically and internationally when called upon. In the 2014 Quadrennial Defense Review, DoD identified climate change as a critical issue. As climate change impacts North America and the world, US military forces have been used increasingly more to respond to climatic disasters. Because of its size and worldwide disposition, the US military has a significant capacity to respond to major international disasters. Unsurprisingly, the US was assessed by SIPRI to be the greatest contributor of military forces to natural disaster relief efforts, deploying 15 times between 2003 and 2006.[72] For domestic disasters, the US National Guard[73] are mandated and structured to respond to both federal and state requests for assistance.[74]

It is worth noting however that the DoD also plays a significant in the areas of mitigation and prevention. The DoD has launched several initiatives in response climate change as part of a wider government action plan. For example, the US Navy Climate Change Task Force was created in 2009 and this organization has been responsible for publishing the US Navy Arctic Roadmap as well as supporting the development of an entire fleet of ships powered by biofuel in order to reduce GHG emissions.[75] In the US Army, the Corps of Engineers (US ACE) has developed a Climate Change Adaptation Plan to implement measures to protect DoD from the adverse effects of climate change and to enhance the US military humanitarian and disaster

[72] *Ibid.*, x.

[73] Each state maintains its own National Guard force. A State Governor can activate Army and Air National Guards as well as the US Coast Guard resources in times of emergency or disaster. The Army National Guard is the largest organization with over 350,000 personnel and can integrate with national military elements as well as with the Department of Homeland Security's Federal Emergency Management Agency (FEMA).

[74] Jeffrey Bumgarner, *Emergency Management* (Santa Barbara: ABC-CLIO, 2008), 57.

[75] Climate Council. "Is Climate Change a Security Threat? The Pentagon Thinks So," last accessed 13 February 2015. https://www.climatecouncil.org.au/climatesecurity

assistance capabilities.[76] Furthermore, US ACE[77] has been involved in flood-prevention and environmental protection which will continue to be relevant as climate change implies rising sea levels and heavy precipitation events. This DoD engineering resource can also be used in the long-term Recovery phase to support the restoration of infrastructure following a disaster. In summary, US DoD capabilities provide a high-degree of depth and flexibility to contribute throughout the disaster management cycle.[78] Although Canada clearly does not have the same degree of military, the aforementioned examples from the US provide a perspective for what may be within the realm of the possible for CAF involvement in disaster management.

The DART and Disaster Response

The CAF's main contributions to disaster management are focused on the Response Phase. In the domestic context, Regional Joint Task Forces (RJTF) located across Canada have the mandate to respond to requests for assistance from provincial or territorial governments. RJTF resources are generally able to fulfil the requirements and so DART capabilities are typically not deployed within Canada. In the expeditionary context, the DART is designed to conduct DA following a major international disaster that calls for a GoC response. In accordance with CAF doctrine, DART is designed to offer the following capabilities during the Response Phase:

a. Primary medical care, in order to treat up to 300 people per day;
b. Production of potable water, over 100,000L per day;

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[76] United States Army, "The US Army Corps of Engineers Releases Robust Climate Change Adaptation, Strategic, Sustainability Plans," last accessed 13 February 2015. http://www.usace.army.mil/Media/NewsArchive/StoryArticleView/tabid/232/Article/547550/the-us-army-corps-of-engineers-releases-robust-climate-change-adaptation-strate.aspx.

[77] USACE serves as the federal engineering agency and is responsible for overseeing and managing public works projects that include flood control and environmental protection. USACE first became involved in disaster mitigation projects in 1936 through the Flood Control Act which authorized USACE to construct flood control infrastructure throughout the country.

[78] Federal Emergency Management Agency, "The Disaster Process & Disaster Aid Programs," Department of Homeland Security, last accessed 10 March 2015. https://www.fema.gov/disaster-process-disaster-aid-programs

c. Specialised engineering detachments such as urban search and rescue (USAR), heavy equipment and tradesmen;
d. Tactical aviation in the form of CH-146 Griffon helicopters
e. Command and control structure to facilitate communications and coordination between DART HQ and civilian partners (host nation, UN OCHA, GoC partners, international and non-governmental organizations).[79]

In addition to the declared core functions, strategic airlift is also a critical capability which is not part of the DART structure but is provided by the Royal Canadian Air Force (RCAF) in direct support. Military aircraft such as the C-17 Globemaster and the C-130 Hercules enable the deployment of the DART and delivery of humanitarian supplies. These aircraft can also be used to perform other DA activities such as aid the evacuation of disaster victims or the transport of humanitarian personnel and aid within a disaster zone. The organization chart at Figure 3.2 depicts the current structure and capabilities of the DART.

[79] DND, *Humanitarian Operations…,* 4-1.

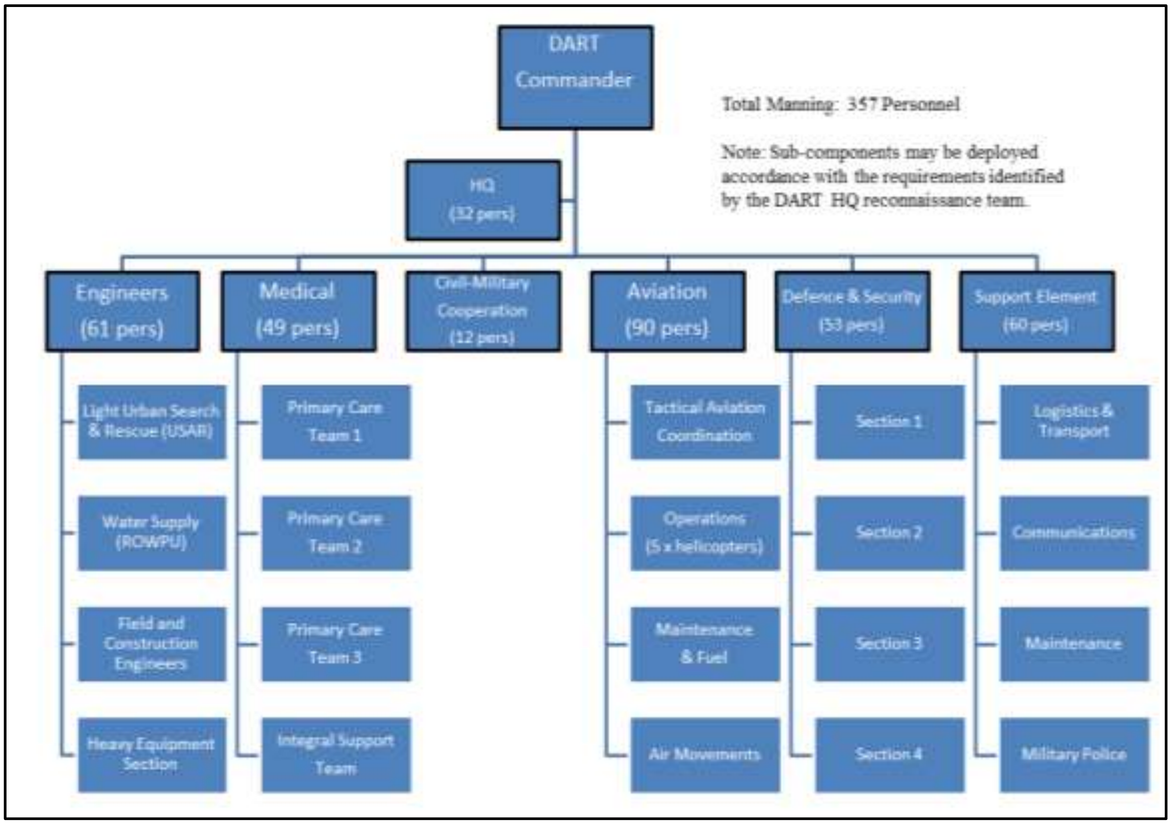

Figure 3.2 - DART Organization Chart
Source: Appendix 2.

Pre-Deployment

Before committing DART capabilities, the reconnaissance component known as the Humanitarian Assistance Reconnaissance Team (HART) typically deploys within 12 hours of a disaster to assess the requirements.[80] The efforts of the HART are integrated into the GoC's Interdepartmental Strategic Support Team (ISST) that is led by the Department of Foreign Affairs, Trade, and Development (DFATD). It is during this critical needs assessment stage that the appropriate DART capabilities are selected to deploy based on gaps in civilian resources and humanitarian needs.

[80] The HART is available at 12 hours' notice to move, while the remainder of the DART is at a readiness of 48 hours' notice to move.

Rescue Stage

The military offers the advantages of being able to project unique capabilities into a disaster zone with relative speed and can therefore play a meaningful role especially in the early stages of the Response phase. Immediate lifesaving activities conducted by the DART may include urban search and rescue (USAR), medical aid, evacuation, and the provision of emergency shelter. Emergency lifesaving by military personnel in a disaster zone should be carried out under the appropriate mandate and when the capacity of civilian first responders is overwhelmed. Nevertheless, given a timely deployment to the disaster zone, DART capabilities can significantly contribute to life saving activities.

Relief Stage

In the Relief stage, the DART can provide purified water, shelter, and sanitation. These capabilities are carried out by CAF military engineers that operate specialized equipment and perform basic construction tasks. One of the DART’s critical pieces of equipment is the reverse osmosis purification unit (ROWPU) which can provide a very high output of potable water and has proved to be a valuable asset in meeting humanitarian needs during every DART deployment. Another key engineering task during is restoring critical infrastructure. Route repair and opening through the removal of debris may be performed by the DART. In additional DART technicians can support civilian efforts to restore key utilities such as power. Ongoing medical assistance by the DART’s primary care teams continues throughout this stage as well. Furthermore DART helicopters can support the transport of personnel and supplies within a disaster zone in support of relief efforts.

Early Recovery Stage

During the Early Recovery stage the DART can help set the conditions for the redeployment of military assets and full civilian control of the situation. Early recovery is characterized by the development of local capacity which includes supporting local agencies and NGOs towards implementing long-term development activities. This stage consists of the completion of engineering activities that enhance mobility (route repair) and survivability (water supply, shelter, and sanitation). The DART's medical assistance and support to NGO's will focus on capacity building so that civilian actors can deal with the ongoing secondary impacts of a disaster. Examples of activities that the DART can perform to facilitate this transition is preparing sites for future use by NGOs and local civil authorities. This may also include the DART handing over its camp location for use by the host nation or incoming humanitarian actors.

GUIDELINES FOR MILITARY INVOLVEMENT

Having established how the military, and specifically the DART, can be involved in the response to a disaster, guidelines for such contributions will now be presented. If the increased frequency of climatic disasters means a greater requirement for military support, it is important to consider the various factors that guide the deployment and employment of military assets. As a foundation, humanitarian principles should be rigorously applied during the needs assessment process and throughout the conduct of DA missions. Building on these principles, governmental guidelines and policies then weigh into the application of military resources for DA. Therefore the employment of the DART is guided in many ways; external to the CAF by the GoC and the internationally community and international to the CAF through established plans and procedures.

Humanitarian Guidelines

When responding to a disaster, the provision of HA is almost always a necessity and therefore the humanitarian principles established by the United Nations (UN) apply. As per the 1991 UN General Assembly Resolution 46/182, HA is to be provided in accordance with the principles of humanity, neutrality and impartiality:

> Humanity: Human suffering must be addressed wherever it is found, with particular attention to the most vulnerable in the population, such as children, women and the elderly. The dignity and rights of all victims must be respected and protected.
>
> Neutrality: Humanitarian assistance must be provided without engaging in hostilities or taking sides in controversies of a political, religious or ideological nature.
>
> Impartiality: Humanitarian assistance must be provided without discriminating as to ethnic origin, gender, nationality, political opinions, race or religion. Relief of the suffering must be guided solely by needs and priority must be given to the most urgent cases of distress.[81]

Oslo Guidelines

Humanitarian principles forms the basis for the Oslo Guidelines, which were first established by the UN Office for the Coordination of Humanitarian Affairs (OCHA) in Norway in 1994 and later updated in 2007.[82] These guidelines serve to influence how foreign military assets are used in response to an international disaster, and are relevant to CAF and the DART whenever conducting DA operations. Oslo Guidelines maintain that military assets should not been seen to take-over control of the situation, nor fully assume the roles that other government agencies and NGOs are equipped to fulfil. The principle of last resort states that military

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[81] ReliefWeb, *Glossary of Humanitarian Terms* (Geneva: World Health Organization, 2008), 33.
[82] Office for the Coordination of Humanitarian Affairs, *Oslo Guidelines* (Geneva: UN, 2008).

contribution should be "be unique in capability and availability".[83] In accordance with the guidelines, military assets should only be employed when there is no comparable civilian alternative, when there is a need to complement existing relief mechanisms, and in order to meet a critical humanitarian need.[84] Therefore when needs assessments are conducted by the HART in conjunction with the ISST, Oslo Guidelines can help inform decision makers concerning which DART elements to deploy. In addition to adherence to the core values of humanity, neutrality, impartiality, the respect for state sovereignty should be upheld whenever foreign assistance is provided to an affected nation.[85] Respect for state sovereignty is fulfilled by the DART because every DART deployment stems from GoC authorization in accordance with a clear request for assistance by an affected nation.

Types of Humanitarian Assistance

Oslo Guidelines also categorize three main types of HA activities (Direct, Indirect, and Infrastructure Support) in order help identify the most appropriate form of military contributions. Direct assistance is the provision of materials and services directly to the affected population without a civilian interface. This type of HA should only be conducted by military assets based on the humanitarian need and when civilian capacity is insufficient. Limiting the amount of direct assistance by the military is further articulated in OCHA's Civil-Military Guidelines for Complex Emergencies: "The large-scale involvement of military personnel in the direct delivery of humanitarian assistance should be avoided".[86] However there are situations, especially in the

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[83] *Ibid.*, 8.
[84] *Ibid.*
[85] *Ibid.*, 12.

[86] United Nations Office for the Coordination of Humanitarian Affairs, *Civil-Military Guidelines and References for Complex Emergencies* (New York: United Nations, 2008), 151.

early periods of the response phase, where the provision of medical aid and potable water directly to disaster victims by military personnel is necessary in order to save lives and alleviate human suffering. Following the immediate lifesaving stage, during the stabilisation stage military contributions should focus on Indirect assistance which is at least one step removed from the affected population and includes activities such as transporting relief supplies and personnel.[87] Infrastructure support provided during the stabilisation stage can include road repair and power generation that are not necessarily for the sole benefit of the affected population but facilitate transition to the Recovery phase.[88] The SIPRI study on the effectiveness of military contributions identified Indirect assistance as the most common type of HA. As Table 3.1 indicates, air transport, medical assistance and subject matter expertise were the most common military contributions to natural disaster response between 1997 and 2006, which were most often realized as Indirect assistance.

Table 3.1 – Most Common Military Contributions to Disaster Response

Capability	**Type of HA**
Air Transport	Indirect: delivery of relief supplies, transport to relief personnel Direct: search and rescue, evacuation
Medical Assistance	Indirect: medical supplies Direct: field hospitals, mobile medical teams, hospital ships
Expertise	Indirect and Direct: Needs assessment, civil-military liaison, coordination of logistics, communications.

Source: Author summary from SIPRI report.[89]

The DART capabilities outlined previously demonstrate that it is possible to contribute to each of the three types of HA. By considering the UN humanitarian principles and Oslo Guidelines the DART can appropriately and effectively carry out their mission. The Oslo guidelines are intended to be consulted by governments when making a decision to deploy

[87] Office for the Coordination of Humanitarian Affairs, *Oslo Guidelines* (Geneva: UN, 2008), 7.
[88] *Ibid.*
[89] Sharon Wiharta et al., *The Effectiveness of Foreign Military Assets in Natural Disaster Response* (Stockholm: SIPRI, 2008), 15-17.

military assets in response to a major international disaster as part of a broader humanitarian assistance package. However, the SIPRI report on the effectiveness of the military in natural disaster response reveals that the application of these guidelines has been uneven at the national level and the "last resort" principle has been interpreted and applied very differently.[90] However when the DART and other CAF assets are deployed on DA missions, planning and decision making processes of the GoC and the CAF are intended to take into account humanitarian guidelines.

Government of Canada Guidelines

When the GoC evaluates and plans for the response to a major international disaster, humanitarian principles are supposed to remain primordial even though Canada's national interests in the socio-political realm may be factored in. DFATD coordinates the Canadian government's response to disasters in accordance with the stated Canadian values of "freedom, democracy, human rights, and rule of law".[91] DFATD aims to provide assistance that conforms not only to the UN principles of Humanity, Neutrality and Impartiality, but also Independence. According to DFATD, "Independence" refers to assistance that is "autonomous from political, economic, or military objectives."[92] When considering CAF involvement in DA a comprehensive evaluation is supported through the GoC's "Guidelines on Humanitarian Action and Civil-Military Coordination". These guidelines are designed so that CAF involvement is appropriately targeted and moderated by humanitarian approaches, stating that "to the greatest

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[90] Sharon Wiharta et al., *The Effectiveness of Foreign Military Assets in Natural Disaster Response* (Stockholm: SIPRI, 2008), xi.

[91] Department of Foreign Affairs Trade and Development, "START: How we Respond to Conflict and Crisis," last accessed 10 March 2015. http://www.international.gc.ca/START-GTSR/how-comment.aspx?lang=eng

[92] Department of Foreign Affairs Trade and Development, "Responding to Humanitarian Crisis," last accessed 29 March 2015. http://www.international.gc.ca/development-developpement/humanitarian_response-situations_crises/iha-ahi.aspx?lang=eng

extent possible, CF operations should be conducted with a view to respecting the humanitarian operating environment".[93] Accordingly, these guidelines describe Indirect Assistance and Infrastructure Support as military activities that present a lowest risk to the humanitarian operating environment.[94]

Immediacy of response is emphasised as a key criteria especially when considering the provision of CAF resources. Strategic airlift and relief supplies are able to deploy quickly and can quell concerns over the fiscal expenses associated with military resources. However, in order to fulfil unique DA requirements, specialized military equipment and personnel may not arrive in theatre as quickly. Nevertheless, specialized DART capabilities are postured to deploy within 48 hours' notice which does provide a certain degree of responsiveness. GoC guidelines also call for close coordination with host nation authorities and with OCHA from the very beginning of a DA mission and throughout the execution. By emphasizing civil-military coordination, the appropriateness of CAF contributions and the ability to synchronize with response efforts can be realized. In conclusion, DFATD has acknowledged humanitarian principles as part of its comprehensive approach for the coordination of a GoC response to international disasters. By extension, the employment of the DART is likely to be properly guided and appropriate to the recognized humanitarian need.

CAF Guidelines

The CAF mandate for the conduct of DA operations is based on the Canada First Defence Strategy (CFDS). Two of the six core missions relate to the requirement to respond to disasters both at home at abroad: Mission 4 "Support civilian authorities during a crisis in Canada such as

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[93] Government of Canada, "Government of Canada Guidelines on Humanitarian Action and Civil-Military Cooperation", last accessed 20 April 2015. http://www.asean.org/archive/arf/13ARF/5thISM-DR/annex16.pdf

[94] *Ibid.*, 4.

a natural disaster"; and Mission 6 "Deploy forces in response to crises elsewhere in the world for shorter periods".[95] In recognition of these requirements, plans and procedures have been established to guide the contribution of CAF capabilities in support of DA missions. The existing CAF plans for the conduct of DA operations reflect the comprehensive and whole of government approach that is deemed necessary for success.

Domestic DA

First of all, the conduct of DA operations within Canada is based on the contingency plan developed by the Canadian Joint Operations Command (CJOC) known as CONPLAN LENTUS which was published in July 2014. CONPLAN LENTUS is the designated plan to support Canadian civil authorities in the event of a disaster relief operation.[96] For domestic DA operations, the CAF remains responsive to the civil authorities who have jurisdiction in the affected area. DA within Canada requires the authority of the government which is realized through the request for assistance (RFA) process. CJOC's Standing Operations Order for Domestic Operations (SOODO) provides further direction on RFA procedures which emphasizes the legal framework for CAF contributions. Appropriateness of CAF involvement is also influenced by CAF doctrine for domestic operations which states that DA will "normally be limited to provision of essential resources and unique military capabilities, and such support will terminate as soon as the situation becomes manageable by the civil authorities who are responsible."[97] Therefore, even though Oslo Guidelines focus on international military

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[95] Government of Canada, *Canada First Defence Strategy* (Ottawa: DND, 2008), 10.

[96] Department of National Defence, *Standing Operations Order for Domestic Operations* (Ottawa: DND, 2014), 13.

[97] Department of National Defence, *B-GJ-005-302/FP-001 Canadian Forces Joint Publication 3-2 Domestic Operations* (Ottawa: DND, 2011), 5-3.

involvement, these guidelines are reflected in the CAF's concept for the provision of DA here in Canada.

In Canada, the six Regional Joint Task Forces (RJTFs) are structured to provide DA within their respective areas of responsibility. High-readiness response units are established within each RJTF which may be augmented by other Regular and Reserve force elements depending on the crises. In addition, there is a ready duty ship and helicopter assigned at each coast that can assist in disaster response if required. Finally, the CAF SAR capability is coordinated through three regional response centres based in Halifax, Trenton and Victoria. It should be noted that the DART has never been activated in response to a domestic disaster. Although the DART is able to deploy within Canada it is optimized for international disaster response.[98] In addition, disaster response capabilities similar to the DART reside within an RJTF, therefore minimizing the domestic requirement for the DART. Nevertheless, given the potential for more frequent and complex natural disaster due to climate change, the DART should be prepared to augment RJTFs if their resources become overwhelmed.

Expeditionary DA

The conduct of expeditionary DA operations is also based on a CJOC contingency plan. CONPLAN RENAISSANCE was promulgated in November 2014 and provides direction for a CAF response to a major international natural disaster. The intent outlined in the CONPLAN is to deploy a "Humanitarian Operations Task Force" (HOTF) as part of a coordinated GoC response.[99] Further details of the concept of operation for CONPLAN RENAISSANCE are included at Appendix 2. The HOTF construct is based on DART capabilities and is designed to

[98] *Ibid.*,5-5.

[99] Department of National Defence, *CONPLAN RENAISSANCE*, (Ottawa: CJOC, 2014), 4-5.

be scalable subject to the demands of the operating environment. In the earliest stages of an expeditionary DA, the CONPLAN calls for the HART to play a pivotal role in the needs assessment process and to integrate with DFATD's ISST and with humanitarian actors such as OCHA. Lessons identified from previous DA operations have been concerned with the speed of deployment and the applicability of DART capabilities. In response, today's CONPLAN RENAISSANCE calls for the timely activation of strategic airlift to ensure that DART, and by extension HOTF capabilities are deployed as rapidly as possible. Furthermore, the modular structure of the HOTF facilitates the ability to only deploy capabilities deemed necessary by the ISST and HART.[100] Modularity also enables the HOTF to be adaptable to the disaster situation and responsive to humanitarian requirements.

CONPLAN RENAISSANCE makes direct reference to the Oslo Guidelines by emphasizing humanity, neutrality, and impartiality in order to ensure that DA is appropriately targeted.[101] As outlined in the CONPLAN, the DART is the preferred choice to make-up the HOTF and thus maintains its status of being a strategic, high-readiness capability. If the extent and severity of a disaster requires a response that is beyond the core DART capabilities, additional CAF resources may be deployed. The CONPLAN stipulates a several "be-prepared-to" tasks for the Royal Canadian Navy (RCN), Canadian Army (CA), and RCAF in order to augment the DART or form a larger HOTF structure as necessary. Therefore, the DART should be prepared to operate as a HOTF and integrate joint capabilities from across the CAF.

In summary, the plans and procedures that have been established for the conduct of DA both in Canada and internationally reflect a comprehensive approach and the ability for the CAF

[100] See Appendix 2.

[101] Department of National Defence, *B-GJ-005-302/FP-001 Canadian Forces Joint Publication 3-2 Domestic Operations* (Ottawa: DND, 2011), 2.

to deliver a task-tailored response. The CAF DA operating framework as defined by contingency plans LENTUS and RENAISSANCE demonstrates that the CAF anticipates an enduring requirement to respond to disasters especially as climatic disasters become more prevalent due to climate change. Within the framework, the DART role is almost exclusively focused on expeditionary requirements as outlined in CONPLAN RENAISSANCE. Despite the fact that the DART has never deployed within Canada, the potential to contribute to domestic operations is not entirely negated and the DART should remain responsive if RJTF resources are unable to meet future domestic requirements.

HISTORICAL ANALYSIS

This section will analyze previous DA deployments conducted by the CAF in order to examine the nature of the requirements and to confirm the expeditionary focus of the DART. The 1996 to 2014 timeframe was chosen for the analysis. This 19-year time period was selected because 1996 marks the year that the DART was formed and thus can be used to determine how DA was conducted with the advent of this capability. Data was only collected for those DA operations caused by natural disasters and were grouped into five categories: floods, fires, hurricanes/wind storms, snow/ice storms, and earthquakes. Although earthquakes are not considered to be related to climate change, they were included in order to compare their relative frequency to the occurrence of climatic disasters. The tabulation of data also included the types of military capabilities and number of personnel deployed in order to understand how CAF resources including the DART, have been employed. Finally the location and duration of each DA operation was recorded in order to identify regional trends concerning disaster risk. All of the data tables and calculations supporting the analysis are included at Appendix 3.

Domestic DA Operations

Between 1996 and 2014, the CAF conducted a total 15 domestic DA operations in response natural disasters in accordance with RFAs from civil authorities. This equates to a rate of one deployment every 15 months. Table 3.2 below summarizes the CAF's historical domestic DA requirements by date, location, and disaster type. The most common type of disaster that the CAF has responded to in Canada has been floods, which accounted for more than half of all DA operations that occurred.

Table 3.2 - Summary of CAF Domestic Disaster Assistance Deployments

	Operation	Year	Location	Disaster Type	Number of Personnel	Duration (days)	Contributing Environment(s)
1	N/A	1996	Southern BC	Extreme Ice/Snow	N/A	N/A	Army
2	N/A	1996	Saguenay QC	Flood	450	N/A	Army, RCAF
3	ASSISTANCE	1997	Southern MB	Flood	8,700	45	RCN, Army, RCAF
4	RECUPERATION	1998	Southern ON, Southern QC	Extreme Ice/Snow	15,784	22	Army, RCAF
5	PREAMBLE	1999	Toronto ON	Extreme Ice/Snow	400	N/A	Army
6	N/A	2003	Halifax NS	Hurricane	600	N/A	RCN, Army
7	PEREGRINE	2003	Kelowna BC	Forest Fires	2,200	45	Army, RCAF
8	LAMA	2010	Eastern NFLD	Hurricane	1,200	17	RCN, Army, RCAF
9	FORGE	2011	Northwestern ON	Forest Fires	100	16	RCAF
10	LUSTRE	2011	Southern MB	Flood	1,800	18	Army, RCAF
11	LOTUS	2011	Southern QC	Flood	844	43	RCN, Army, RCAF
12	LYRE	2011	Southern MB	Flood	375	N/A	Army
13	LENTUS	2013	Southern AB	Flood	2,300	7	Army, RCAF
14	LENTUS 14-01	2014	Northern ON	Flood	100	8	RCAF
15	LENTUS 14-05	2014	Manitoba	Flood	600	7	Army, RCAF

Source: Appendix 3, Section 3-A.

Besides floods, snow and ice storms accounted for 20% of DA deployments followed by wind storms and wild fires at 13% respectively (see Figure 3.3 on the following page). Although earthquakes were considered during the data collection, they have yet to trigger a CAF response despite the prevailing risk along British Columbia's west coast. However, a response to a major earthquake is included as part of CONPLAN LENTUS. In terms of regional trends, the CAF deployed most often to Western Canada with Manitoba experiencing several disasters due to flooding along the Red River. Therefore, climatic natural disasters are the dominant type affecting Canada and the CAF should continue to prepare for DA requirements related to flooding and severe storms.

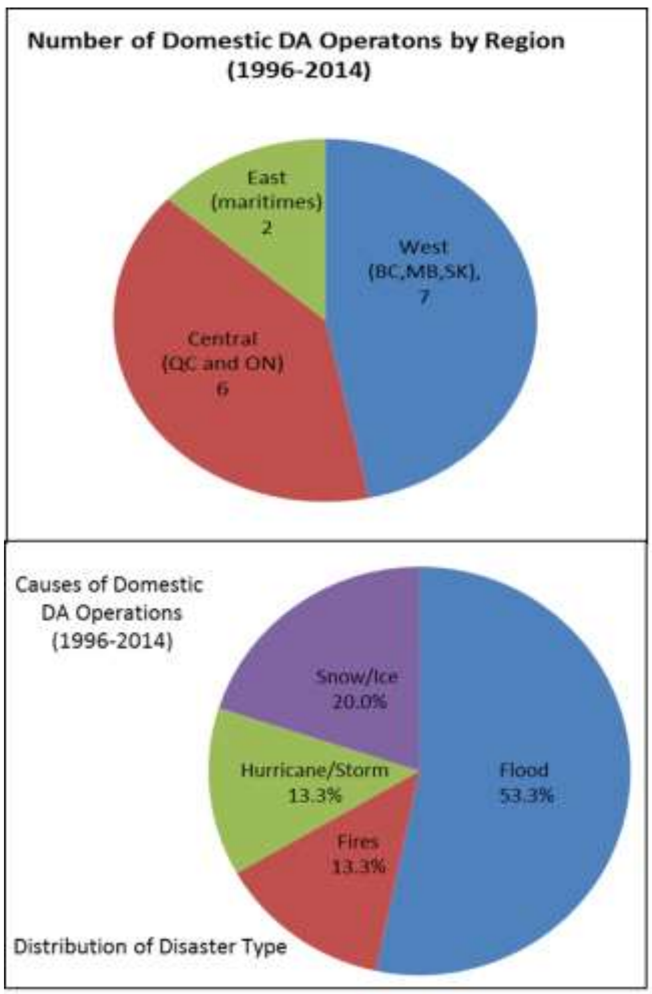

Figure 3.3 - Locations and Causes of Domestic DA Operations
Source: Appendix 3, Section 3-A.

The analysis has shown that the CAF has provided a mix of air transport, engineering support, and human resources when responding to disasters in Canada. Further analysis of the CAF capabilities employed reveals the demand for a Joint force structure, which is highlighted in the last column in Table 3.2. The deployment of forces from two or more components was required 66% of the time. For a handful of DA missions where the RFA was very specific, only capabilities from a single environment were deployed. However, the joint force structure is the prevailing tendency when conducting DA missions. [102]

The existence of the required capabilities within the RJTFs has precluded a requirement for the DART to deploy within Canada. In addition, two of the core DART functions, medical care and water supply, are usually not required domestically because of the resilience and capacity of existing civilian infrastructures. Concerning water supply, this capability has been deployed on a domestic DA mission on only one occasion. During Op LAMA in Newfoundland following a severe hurricane in 2010, a water supply detachment was deployed. Although the DART was not activated, the personnel operating the ROWPU were from the engineer unit that normally force generates for DART operations (4 Engineer Support Regiment located in Gagetown, New Brunswick). Therefore, as long as there are no domestic requests for medical support and water supply, the likelihood of the DART to deploy domestically will remain slim. Moreover, since the DART is a strategic asset that is not easily reconstituted it is expected that this resource will be reserved for international deployments.

Expeditionary DA Operations

Between 1996 and 2014, a total of eight expeditionary DA operations in response natural disasters were conducted by the CAF. On six occasions the DART was deployed. The relatively small number of deployments at first appears to undermine the requirement. Nevertheless, the

[102] See Appendix 3-A, Contributions by Environmental Service.

SIPRI study revealed that between 1997 and 2006 Canada was on-par with the number of Japanese and British military deployment in response to international natural disasters.[103] Further, six of the eight deployments have occurred since 2005 which points to an increasing demand over the past 10 years (see Table 3.3).

Table 3.3 - Summary of CAF Expeditionary Disaster Assistance Deployments

	Operation	Year	Location	Disaster Type	Number of Personnel	Duration (days)	Contributing Environment(s)	DART Contribution
1	CENTRAL	1998	La Cieba, Honduras	Storm, Hurricane	270	48	Army, RCAF	Yes
2	TORRENT	1999	Serdivan, Turkey	Earthquake	200	31	Army, RCAF	Yes
3	STRUCTURE	2005	Ampara, Sri Lanka	Earthquake	200	47	Army, RCAF	Yes
4	UNISON	2005	Gulf Coast, USA	Storm, Hurricane	900	16	RCN, RCAF	No
5	PLATEAU	2005	Pakistan	Earthquake	200	51	Army, RCAF	Yes
6	HORATIO	2008	Haiti	Hurricane	219	13	RCN, RCAF	HQ Only
7	HESTIA	2010	Leogane and Jacmel, Haiti	Earthquake	2,050	78	RCN, Army, RCAF	Yes
8	RENAISSANCE	2013	Iloilo, Phillipines	Storm, Typhoon	319	32	Army, RCAF	Yes

Source: Appendix 3, Section 3-B.

The capabilities deployed were focused on the four principle DART roles of medical aid, water supply, engineering, and command and control. CAF contributions were made during the Response phase and occurred over a relatively short timeframe with each deployment lasting an average of 45 days.[104] CAF air assets were employed in every operation to support the deployment into theatre and for the purpose of transporting humanitarian resources and supplies. This trend is consistent with the SIPRI assessment that air transport is the most needed military resource when responding to a major natural disaster. The types of assistance provided included a combination of Direct and Indirect assistance as well as Infrastructure support. The main thrust of direct assistance was through medical aid and water supply. It should be noted that water

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[103] Sharon Wiharta et al., *The Effectiveness of Military Assets…,* x.

[104] Appendix 3, Section 3-B.

supply may constitute Indirect assistance whenever ROWPU water is distributed to disaster victims through NGOs. Other forms of Indirect assistance included air transport and human resources (expertise, command and control), while engineering tasks constituted Infrastructure support.

A breakdown of the type and location of expeditionary DA operations is illustrated in Figure 3.4 below. The regional distribution of expeditionary DA operations shows an even split between the hemispheres. The expected increase in the severity of cyclones in the Asia-Pacific region may generate an increased requirement for this part of the world. Four of the eight operations conducted were related to major earthquakes and the other half were related to climatic disasters such as hurricanes, typhoons, and floods.

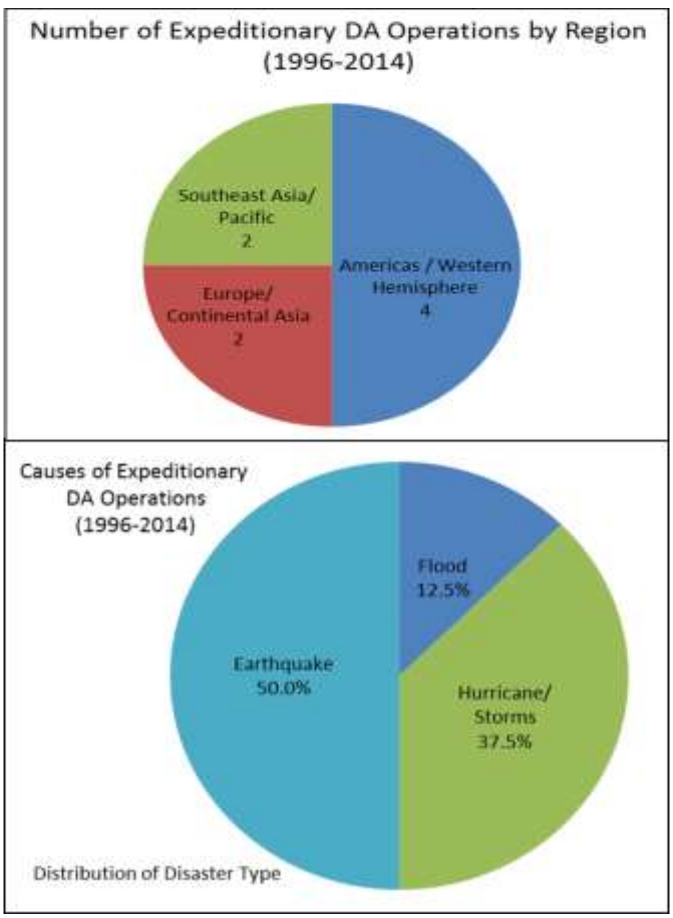

Figure 3.4 - Locations and Causes of Expeditionary DA Operations
Source: Appendix 3, Section 3-B.

Finally, there has been an enduring demand for a Joint force structure when conducting expeditionary DA which is indicative of the range of required capabilities. The joint force concept is reflected in HOTF structure outlined in CONPLAN RENAISSANCE. As Figure 3.5 illustrates, every international deployment has involved contributions from two or more Environments. Op HESTIA in 2010 proved to be an exceptional case where a contribution was made by the every Environment in addition to the full complement from the DART. RCN ships positioned off of the north and south coasts of Haiti proved highly complementary to DA activities through the provision of supplies, maritime aviation, potable water, and man power. The successful application of maritime resources in Haiti may lead to more opportunities for contribution as part of a HOTF. Furthermore, the analysis showed that the CAF has demonstrated prudence in the commitment of its resources. For example, during Op UNISON and Op HORATIO the DART was not required and only specific CAF capabilities were deployed.

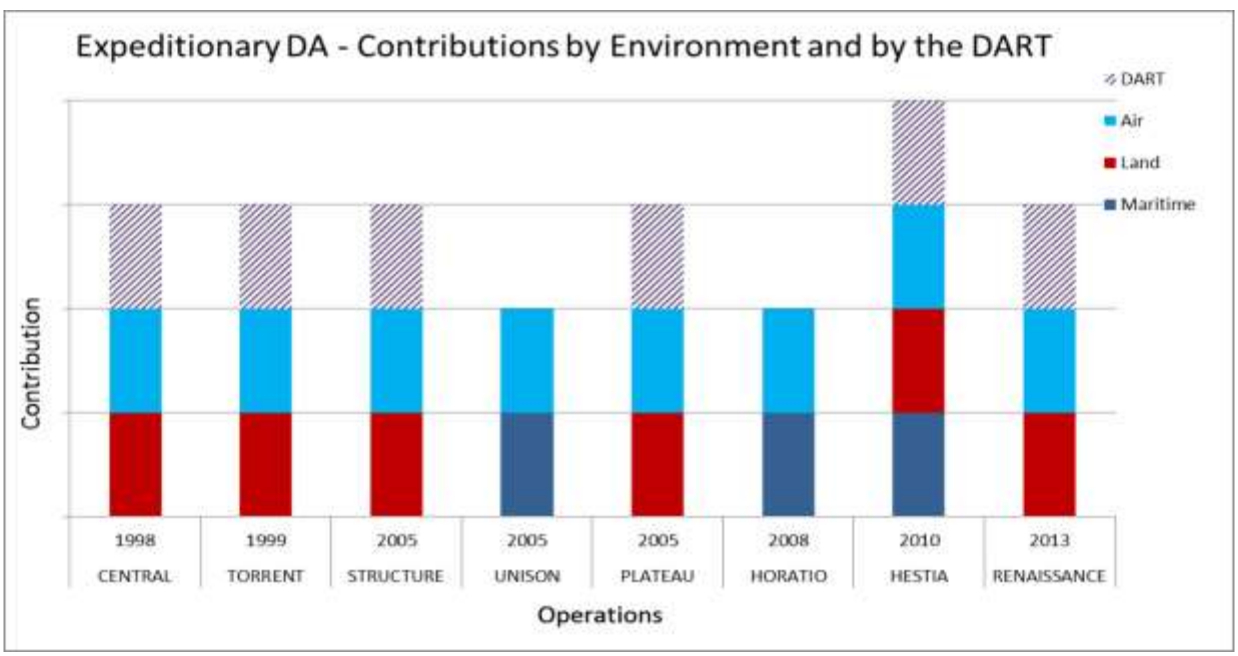

Figure 3.5 – Joint Contributions to Expeditionary DA
Source: Appendix 3, Section 3-B.

Comparing Domestic and Expeditionary Requirements

Finally, when comparing domestic and expeditionary requirements for DA over the 19-year time period the frequency of deployment has not been consistent year to year. Figure 3.6 below shows the spread of deployments with 2005 and 2011 proving to be outstanding years for CAF involvement in DA operations. There were three major international disasters that occurred in 2005: the impacts of the Pacific Ocean tsunami, the hurricanes that affected the US Gulf Coast, and the devastating earthquake in Pakistan. Meanwhile, in 2011 Canada experienced record setting precipitation that resulted in three major flood relief operations. In the same year, wild fires in Northern Ontario led to the CAF providing air assets to evacuate over 3600 residents. Therefore, as the global climate becomes more variable and extreme weather events occur more often these spikes in DA requirements may continue to happen.

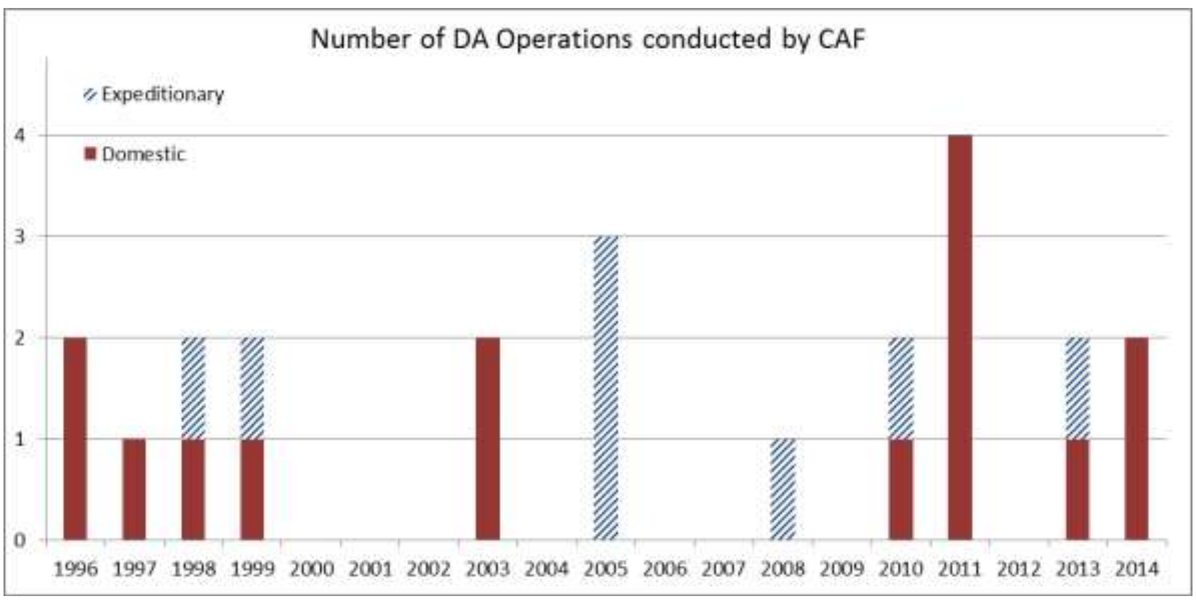

Figure 3.6 – Timeline of CAF Disaster Assistance Operations
Source: Appendix 3, Section 3-C.

This historical analysis has revealed some key differences between the nature of DA missions that are conducted in Canada and abroad. In Canada, the steady rate of DA operations

(1 deployment every 15 months)[105] demonstrates the CAF's enduring commitment to support Canadian civil authorities in accordance with the CFDS. Internationally, the past 10 years have been characterized by an increasing requirement for DA. Since 2005 the rate of expeditionary operations has been 1 deployment every 20 months.[106] Because RJTF resources have been able to fulfil all domestic DA requirements to-date and there has not yet been a requirement for DART involvement. In contrast, the requirement for the DART to deploy internationally has been made clear having contributed to 75% of expeditionary operations. In terms of geographic locations, the DART should be postured to continue to deploy within the Americas as well as in Asia. In Canada, the enduring flood risk along the Red River and the exposure of Canada's coastlines to severe weather indicate Manitoba and the Maritimes as locations of interest for the future. Climate change trends have shown an increase in wind storms and heavy precipitation, which correlates to the types of climatic disasters that the CAF has responded to in the past. In Canada all DA requirements were attributed to weather-related hazards with floods being the most prevalent type of disaster. Internationally, half of the DA deployments were a result of earthquakes, while the remaining deployments were related to extreme weather events. A changing global climate and an expected increase in floods and storms may mean a change in this equal split in the future. Therefore the both the DART and the RJTFs should expect to conduct DA in the face climatic disasters into the future.

THE VALUE OF MILITARY INVOLVEMENT

This section will address the overall effectiveness of military assets in natural disaster response, in order to set the foundation for a discussion that will follow on the relevance of the

[105] See Appendix 3-D, Deployment Rate Comparison.
[106] *Ibid.*

DART. There are six interconnected aspects that define the effectiveness of foreign military contributions to disaster response: timeliness, appropriateness, efficiency, absorptive capacity, coordination, and costs.[107] These were identified by SIPRI in their 2008 report *The Effectiveness of Foreign Military Assets in Natural Disaster Response,* which was commissioned by the UN OCHA. The six factors are summarized in Table 3.6 below. This may offer a tool for both political and military decision makers when considering the commitment of military resources and when reviewing lessons identified from DA operations.

Table 3.6 - Military Effectiveness in Disaster Response

Factor	**Effective Military Contribution**
Timeliness	Assets and support arrive within days.
Appropriateness	Capabilities meet the needs of the response and is suitable for the local social-political culture. Assets are withdrawn once they are no longer required.
Efficiency	Assigned tasks are efficiently carried out and assets complement the larger relief effort.
Absorptive Capacity	Affected nation's disaster management structure is able to accept and use the military capabilities. Assets are self-sufficient and do not compete with affected population or humanitarian actors for resources.
Coordination	Military personnel coordinate activities and foster collaboration with all stakeholders.
Costs	Funds spent on military assets do not compete with humanitarian aid budgets.

Source: Author's summary from SIPRI.[108]

In addition to SIPRI, OCHA also acknowledges that military resources can offer advantages in terms of speed, specialisation, and efficiency especially in the early stages of disaster response.[109] Military forces bring an "instantaneous infrastructure" to a disaster location because of their ability to repair structures, provide communication and health services, and distribute

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[107] Sharon Wiharta et al., *The Effectiveness of Foreign Military Assets…, xii.*
[108] *Ibid., xii-xiii and 32-42.*

[109] United Nations Office for the Coordination of Humanitarian Affairs, *Oslo Guidelines*, (Geneva: United Nations, 2008b), 8.

aid, among other roles.[110] This is especially valid considering the applicability of military aircraft, engineering assets, and medical personnel. In addition to the provision of these specialized capabilities, military forces have the capacity to generate a large volume of manpower for less-specialized tasks. Likewise, the use of foreign military assets in disaster relief has been significant over the past 20 years. The US Asia Pacific Centre has linked the overall increase disaster response requirements (including military contributions) to the impacts of climate change:

> Most of this rise in recorded large-scale natural disasters has been due to the increasing frequency of hydro meteorological hazards such as floods and windstorms… in recent years many more actors, particularly non-governmental organizations but also foreign militaries, have started participating in international disaster relief.[111]

As suggested from the various sources cited here, military forces will continue to play a role into the future. Therefore CAF disaster response assets such as the DART should expect an enduring requirement to operate alongside other military forces as part of the larger international response effort following major disasters.

The DIME Approach

The involvement of military assets for the provision of DA offers several advantages when considering the military as one of the instruments of national power. National power can be grouped into four areas and is commonly referred to as DIME: diplomatic, informational, military, and economic. First of all, the military are able to bring physical capabilities such as aircraft, equipment, and supplies with relative speed in order to meet humanitarian needs. Secondly, military forces provide personnel who are trained to operate in adverse conditions and

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[110] Asia Pacific Centre, "Report from the Conference on the Evolving Roles of the Military in the Asia-Pacific", last accessed 10 March 2015. http://www.apcss.org/Publications/Report_Evolving_Roles.html

[111] *Ibid., ix.*

who have the organizational and leadership skills to support the coordination of relief efforts with other actors. Thirdly, the commitment of military forces can be used as part of a nation's ability to exercise its influence and power in world politics. The demonstration of humanitarian support to another nation can be considered a form of soft power, which can be optimized if one or more instruments of national power are used together.[112] American political scientist Joseph Nye describes soft power as "the ability to obtain preferred outcomes through attraction".[113] In the context of offering assistance to another nation following a disaster, a country may seize the opportunity to make its national values and humanitarian interests seem attractive on the world political stage. Further, having a positive impact in another state may be part of a wider plan to seek desirable political outcomes in the long term. Therefore, the use of the military in DA as a soft power tools as part of a comprehensive DIME approach can not only meet essential humanitarian needs in a time of crisis but also support wider national interests.

The employment of military resources in a humanitarian role can be complementary to the other DIME instruments by bringing to bear capabilities that enhance diplomatic, information, and economic interests. Accordingly, employment of the military in this fashion facilitates the whole of government methodology that can optimize results. The use of foreign military forces for humanitarian purposes over the past two decades has increased the understanding within military culture that outside of combat operations, success can only be achieved if military efforts are well coordinated and synchronized with those of international military partners, other government departments, humanitarian actors, and the local population.[114] This culture is not new for the CAF, and by extension the DART, because of a

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[112] Joseph Nye, "Get Smart," *Foreign Affairs* 88, no. 4 (2009), 161.
[113] *Ibid*., 161.

significant amount of experience over the past 20 years operating in a joint, interagency, multi-national, and public (JIMP) environment. The requirement to integrate in to a JIMP and whole of government environment is expected to endure for the DART. Besides the political outcomes associated with DIME a comprehensive approach to DA should continue to respect humanitarian principles as a first priority. A study by the Canadian Foreign Policy Journal following Op HESTIA in 2010 revealed an overwhelming consensus that the objective of the whole of government approach is to "uphold the humanitarian ideals of responding based on the needs on the ground and assisting those affected."[115]

Disadvantages: the cost and risks of militarization

The arguments against military involvement in DA include an overemphasis on command-and-control, top-down management structures, and a mismatch between civilian and military cultures.[116] Furthermore, military resources have been shown to be very costly in terms of assigning a dollar value to their contributions. The relative cost of different means of providing disaster relief is a difficult but important issue, and so the relationship between cost and performance of military assets needs to be considered.[117] The 2008 SIPRI report outlines the following concerns over the expense of military forces as well as the potential negative impact a military presence may have on civilian and humanitarian actors:

> There is disagreement among governments and humanitarian actors about how much weight is given to the unique and timely characteristics of military assets when balancing them against issue such as cost burdens, the risk of militarising the relief effort and how

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[114] David Etkin et al., "The Military and Disaster Management: A Canadian Perspective on the Issue", last accessed 12 March 2015. http://www.crhnet.ca/canadian-disaster-management-textbook-chapter-5b

[115] Aaida Mamuji, "Canadian military involvement in humanitarian assistance: progress and prudence in natural disaster response,"*Canadian Foreign Policy Journal*, Vol 18, No.2 (2012), 213.

[116] David Etkin et al., "The Military and Disaster Management: A Canadian Perspective on the Issue", last accessed 12 March 2015. http://www.crhnet.ca/canadian-disaster-management-textbook-chapter-5b, 26.

[117] *Ibid.,* 43.

> the presence of foreign troops affects civilian humanitarian workers' safety and freedom to operate.[118]

A Canadian example of these concerns is the investment that the GoC put into its military response Operation HESTIA in Haiti following the 2010 earthquake. During this mission over 2,000 CAF personnel were deployed over a period of 78 days.[119] The entire cost of CAF resources committed to the disaster response totaled almost 184 million Canadian dollars and represented approximately 46% of the overall cost of the GoC relief effort.[120]

This created a debate whether financial resources could have been more effectively used to meet the immediate needs of the affection nation. Both the ROWPU and the enhanced medical capability ("Role 2 Hospital") that deployed on Op HESTIA were seen to be resource intensive and were criticized for taking too long to become operational.[121] The CAF's Role 2 Hospital was established 17 days after the earthquake and ended up treating a majority of conditions that were unrelated to the disaster. While medical care meets humanitarian needs and makes a positive impact, this situation raises the question whether alternative solutions for medical assistance may have been more appropriate, such as through an NGO such as the Canadian Red Cross. A final point on the topic of costs should address the fact that the procurement and maintenance costs associated with military resources are already absorbed by the department of defence, independent of whether or not the asset is in use or not. The idea that deploying military assets is much more expensive that deploying civilian assets should be regarded with caution:

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[118] Sharon Wiharta et al., *The Effectiveness of Foreign Military Assets…* , xi.

[119] See Appendix 3-B, CAF Expeditionary Disaster Assistance Deployments.

[120] Aaida Mamuji, "Canadian military involvement in humanitarian assistance: progress and prudence in natural disaster response,"*Canadian Foreign Policy Journal*, Vol 18, No.2 (2012), 216.

[121] *Ibid*.

> The additional cost to the contributing country of deploying military assets for humanitarian relief operations may be competitive with the cost of procuring and deploying equivalent civilian assets.[122]

A final consideration relates to the potential for military resources to overrun civilian actors and create dependencies. The perception that the military has a strong desire to become involved in longer-term development work following disaster response is tempered by the reality that donor nations withdraw their military assets when no longer required. Respondents to the 2008 SIPRI study articulated a preference for withdrawing military resources "as soon as their mandated tasks have been completed and when their presence no longer adds value."[123] However, if military assets are removed too quickly an effective transition to an exclusively civilian involvement in the Recovery phase may be endangered. Some countries that have been the victim of natural disasters often come to rely on military capabilities and once military assets are withdrawn, it can be difficult to sustain the emergency response over the medium and long-term.[124] Subsequently, it is important that the termination plans of military forces conducting disaster response mission are well are comprehensive and facilitate transition to civilian agencies.

RELEVANCE OF THE DART

This section will highlight the praise and criticism concerning the DART in order to provide a balanced view of its relevance and effectiveness during previous DA operations. The advantage of military involvement in DA stems from the ability to offer unique capabilities and to operate in challenging environments characterized by chaos and uncertainty. This applies to

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[122] Sharon Wiharta et al., *The Effectiveness of Foreign Military Assets…*, 44.

[123] *Ibid.*, 37.

[124] Mark Phillips, "The Role of the Military in International Disaster Relief Activities," last accessed 20 April 2015. http://www.nids.go.jp/english/event/symposium/pdf/2011/e_03.pdf

the DART which is structured to offer critical capabilities often considered unique to the situation (medical support, water supply, engineering, and expertise). In addition, the DART is comprised of trained personnel who are prepared for adverse operating environments. Despite the apparent utility of the DART, the established humanitarian guidelines and operating frameworks are in place to help ensure that the actual employment of the DART and other CAF DA resources are appropriate to the situation. This reality is effectively summarized in the statement below extracted from CAF doctrine:

> Military forces have an ability to quickly task-organise to perform such operations and have unique capabilities that can complement the overall relief effort. Employing military capabilities may not be the most efficient or cost effective means of response, but in certain situations they may be the only actor capable of bringing a particular capability to bear rapidly.[125]

In the sections that follow, the measures of effectiveness identified by the SIPRI report will be applied to the DART in order to highlight the advantages and disadvantages associated with this resource.

Timeliness and Appropriateness

The structure of the DART and the primary capabilities it offers are generally appropriate for most DA scenarios, however the response time has been a persistent point of concern. The updated DART organization and modular structure makes it possible for only required capabilities to be deployed based on the needs assessment by the ISST. An article by the Canadian American Strategic Review (CASR) following the devastating 2010 earthquake in Haiti, offered a positive evaluation of the actual DART capabilities, yet this view was tempered by concerns over timeliness:

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[125] DND, *Humanitarian Operations…*, 2-9.

> The DART is certainly successful at what it does - medical assistance, water purification, the basic infrastructure engineering – once on the ground… but invariably civilian disaster response teams are on-scene before military assistance arrives.[126]

The delay of the DART's establishment in Haiti was not entirely a function of shortcomings in aviation assets or CAF logistics. The acquisition of the C-17 Globemaster aircraft has contributed to improved response times for the DART and the processes for DART activation are well-established. Due to the very large scale of the disaster and an outpouring of humanitarian assistance globally, the capacity of the Port-au-Prince airport was quickly overwhelmed. Even through the HART arrived within 24 hours to conduct reconnaissance activities, the actual allocation of the DART area of operations was delayed due to the GoC decision to commit additional CAF resources as part of a larger joint task force. Finally, the extent of the infrastructure damages and the presence of after-shock earthquakes inhibited freedom of movement and thus caused delays in the provision of assistance. The response time of the DART can be improved if the GoC assessment of the situation leads to a timely decision. For example, in comparison to Haiti the 2013 deployment to the Philippines following the typhoon was accelerated because the Prime Minister decided to send the DART before an official request came from the affected nation's government. This political risk was accepted in order to effect a timely projection of disaster relief and was offset by the influence of the Filipino diaspora in Canada and the anticipation of the request from the Philippine government. Therefore, the DART has been able to exhibit timeliness and appropriateness, especially when political decisions are made as early as possible and when the needs assessment assures that only required capabilities are deployed.

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[126] Diane De Mille, "Haitian Earthquake & Canada's Disaster Assistance Response Team DART's Label Misleads Us about the True Strenths of this Military Unit," last accessed 29 March 2015. http://www.casr.ca/ft-dart-haiti-demille-1.htm

Efficiency and Value for Money

Efficiency refers to whether the military assets are employed effectively within the larger relief effort and if the tasks assigned to military forces are effectively carried out. The DART's efficiency can be measured by the unique capability-set. For example, the ROWPU water purification unit is a robust and efficient piece of equipment. It offers unmatched production rates of up to 105,000 litres per day and the ability to treat almost all types of water sources. CASR describes the value of the ROWPU as follows:

> No civilian agency has the ability to match the Canadian Forces' containerized Reverse Osmosis Purification Units. Lives will be saved almost as soon as the ROWPU is operational.[127]

However, depending on the operating environment it takes time for the ROWPU to become fully operational, as experienced during Op HESTIA and Op RENAISSANCE. The logistical challenges associated with the provision of ancillary resources (filters, spare parts, chemicals) and an inconsistency in operator experience challenged the effectiveness of the DART's water supply capability. This was expressed in the 2014 Auditor General's report following the deployment to the Philippines:

> … the CAF experienced water production issues such as difficulty in ensuring acceptable water quality due to limited experience of the operators and insufficient chemicals, testing equipment, and other supplies… National Defence should examine how to improve the use, reliability, and operations of CAF water capabilities used in humanitarian operations.[128]

The CAF acknowledged these identified technical and operator challenges associated with ROWPU through a working group that was convened in 2014 that made improvements to training and standard operating procedures. Even if DART capabilities are able to meet unique

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[127] *Ibid.*
[128] Government of Canada, *2014 Report of the Auditor General*, (Ottawa: GoC, 2014), 22.

requirements that integrate well into the overall disaster relief effort, the value for money of the DART has been a topic of debate. Table 3.7 below summarizes the incremental costs associated with previous DART deployments.

Table 3.7 - Incremental costs to DND associated with DART Deployments

Disaster	**Year**	**Cost (Canadian Dollars)**
Typhoon in the Philippines	2013	$29.2 million
Earthquake in Haiti	2010	$52.3 million
Earthquake in Pakistan	2005	$9.6 million
Tsunami in Sri Lanka	2005	$10 million

Source: Author's summary from the CBC.[129]

It is important to note that there are inherent costs associated with the maintenance of DART resources at a status of high-readiness, that are absorbed by DND and are not associated with GoC humanitarian aid budgets. This can be viewed as a positive aspect whereby fewer funds are required to activate the capability and the additional cost to the GoC would only be associated with the actual deployment of DART. On the other hand, why should DND expend funds on a resource that is only deployed at an average rate of once every 3 years? The actual value of projecting the DART capability is difficult to measure purely in relation to the price tag. The value can be seen in the context of a comprehensive DIME approach, where the deployment of military assets can be a visible and clear sign of national commitment to a crisis. However, higher costs associated with the robustness and reliability of military resources need to be weighed against the critical humanitarian needs and risks associated with using non-military assets that may not be as dependable or may be delayed in their arrival. The SIPRI report offers some insight into the political and diplomatic considerations that come into play when assessing

[129] Everson, K, "Canada's 2013 DART mission to the Philippines cost $29M", CBC, 15 July 2014.

the cost of disaster response operations. Media coverage and public opinion can place significant pressure on governments to respond to a major international disaster, and countries may be inclined to should the more tangible costs of offering military resources to offset the risk of inaction. In conclusion, the cost-benefit analysis of the application of military assets for disaster relief is not straightforward and governments should continue to exercise caution when determining the extent of military involvement.

Absorptive capacity and Coordination

Finally, the overall effectiveness of the DART can be measured by the ability of the capabilities to fit into the disaster management system and the ability to coordinate activities with other stakeholders. The DART is structured so that it is the self-supporting in order to minimize the strain on local resources. Furthermore, the DART headquarters is designed and trained to link into civilian coordination centres that include the UN OCHA. Civil-military cooperation is an important function within the DART and needs to be sustained and resourced appropriately into the future. Following Op RENAISSANCE in the Philippines, the Auditor general report found that the co-location of the DART HQ with DFTAD, OCHA, local authorities, and NGOs was very effective for the coordination of activities and information sharing.[130] However, the distribution of purified water from the ROWPU was limited because local resources were not always available to pick-up the water. This resulted in only 73% of the water being distributed.[131] Therefore effective coordination with civilian actors, especially with OCHA, and correctly evaluating the absorptive capacity of the affected region must be applied in order to maximize the DART's effectiveness.

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[130] Government of Canada, *2014 Report of the Auditor General*, (Ottawa: GoC, 2014), 21.
[131] *Ibid.*, 22.

Closing the Case for the Effectiveness of the DART

As described in the preceding sections, a multi-faceted approach is necessary in order to evaluate whether military resources are effective contributors to disaster response. Beyond the six measures of effectiveness identified by the SIPRI report (timeliness, appropriateness, efficiency, absorptive capacity, coordination, and costs) there are political aspects to be considered that are less tangible and difficult to quantify. The influence that the DART can have as one of the DIME instruments can be measured over the longer term and in relationship to the effects of other instruments. CAF participation in DA using the DART can have a positive and lasting effect on Canada's relationship with an affected nation especially when deployed as part of a comprehensive approach. The ability of the DART to represent Canadian interests abroad is something that cannot be achieved by simply directing GoC to an NGO. Furthermore, there may be instances where an affected nation makes an appeal for foreign military assets to be part of the international relief effort and therefore the DART enable the GoC to respond to such requests. Returning again to findings of the 2014 Auditor General's report, it was concluded that the DART met the aim of the mission despite some shortcomings related to technical challenges and resource allocation.

> National Defence's humanitarian operation as part of the Government of Canada's response to Typhoon Haiyan "was undertaken in a manner consistent with the Canadian Armed Forces' stated objective for humanitarian operations: to help fill a gap in assistance until the affected country or aid organizations can provide assistance.[132]

[132] *Ibid.,* 23.

SUMMARY

The aim of this chapter was to understand the role of the military within disaster management and to provide context for the DART's mandate. Guiding principles and frameworks for DA have been identified along with a better understanding of the nature previous DA operations conducted by the CAF. The impacts of climate change have been linked to the tendency of the CAF's DA requirements to be caused by floods and storms, and it is expected that climatic disaster risks will continue to influence how the CAF contributes to DA both in Canada and abroad. Finally, despite some shortcomings, the overall effectiveness of the DART has been confirmed through the acknowledgement of the many advantages that this resource can bring when responding to disasters.

CHAPTER 4

PROJECTIONS FOR CLIMATE CHANGE AND THE DART

In recognition of the impacts of climate change and the likelihood that natural disasters will become a more frequent occurrence, the CAF must be prepared for an increased requirement to conduct DA operations. If climate change is going to affect the business of disaster response for the CAF, what does this mean for the DART? This chapter will determine the nature of the future requirements based on projections of climate change, disaster events, and CAF DA deployments. This will be followed by recommendations on how to direct the DART's efforts towards climatic disasters. Although Canada is not immune to disasters caused by extreme weather events, the requirement for the DART domestically will likely continue to be minimal. Disaster risk reduction strategies and civilian disaster management capacity throughout Canada is relatively well developed and Regional JTF resources are expected to continue to meet DA requirements when called upon. Therefore this chapter will focus on future requirements for the CAF to provide DA outside of Canada as a result of major international disasters that are caused by a changing climate. The projected demand for expeditionary DA has been determined by the author based on deployment trends observed during the past 10 years and from climate predictions made by governmental and international organizations. In accordance with this ongoing requirement fueled by climate change, the DART will continue to be the CAF's most viable resource to meet this demand.

CLIMATE PROJECTIONS

Global statistics presented by CRED revealed an increasing rate in weather-related disasters during the past 10 years.[133] The discussion in Chapter 2 concluded that the frequency of disasters caused by extreme temperature, floods, and windstorms increased significantly over the past decade. When estimating the future impacts of climate change it is necessary to take into account many variables, making precise predictions difficult to determine. General projections made by IPCC in 2014 are generalized for both the short and long term timeframes. Climate change projections made by the IPCC take into account information about various climate divers including future GHG emissions scenarios developed by the international scientific community, known as Representative Concentration Pathways (RCP).[134] For the purpose of the discussion that follows, the details of the RCP scenarios will not be explained but are mentioned here because of the influence they have when making climate predictions. The continued emission of anthropogenic GHG has led to the view that climate change is advancing more rapidly than estimated earlier.[135] Observed GHG emissions trends reflect the “RCP 8.5” scenario which accounts for very high GHG levels into the future. Therefore, the highest RCP emission scenario was taken into consideration by the author when selecting IPCC data concerning climate projections.

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[133] See Appendix 1- B and1-C.

[134] “Representative Concentration Pathways” (RCPs) are used for making projections based on these factors describe four different 21st century pathways of greenhouse gas emissions and atmospheric concentrations, air pollutant emissions and land-use. The RCPs include a stringent mitigation scenario (RCP2.6), two intermediate scenarios (RCP4.5 and RCP6.0), and one scenario with very high greenhouse gas emissions (RCP8.5).(IPCC, 2014, page 8)

[135] James Bruce, *Climate Change Information for Adaptation: Climate trends and projected values for Canada 2010 to 2050* (Canada: Institute for Catastrophic Loss Reduction, 2011), 1.

The international scientific community has been able to make some general projections concerning the global climate through to the end of the 21st century. The IPCC has indicated a growing confidence that certain types of phenomena will increase in frequency and intensity on a global scale due to climate change. Temperature, precipitation, wind storms, and sea level are all expected to experience change. The projections for these key climate factors were compiled by the author from information published by IPCC and Natural Resources of Canada (NRCAN) and are summarized within Appendix 1. Table 4.1 below provides a short summary of the mid-term climate projections and illustrates relative consistency between global projections and those made for Canada.

Table 4.1 - Climate Change Projections

Phenomenon	**Global Climate**	**Canadian Climate**
	Early 21st Century Projections 2016-2035 (IPCC)	**Projections to Middle of 21st Century (NRCAN)**
Temperature	More frequent and intense hot days and nights, global mean surface temperature to rise by up to 2.6 °C.	Increase in the length, frequency and/or intensity of warm spells. A 1-in-20 year extreme hot day is projected to become a 1-in-5 year event over most of Canada by 2050.
Precipitation	Likely increase in frequency and intensity over many land areas	More frequent heavy precipitation events with rare extremes projected to be twice as frequent by 2050.
Wind storms	Monsoon systems will increase in area, intensity, and seasonal duration.	A general increase in storm frequency and/or intensity due to warmer climate.
High Sea level	Likely increase in frequency and magnitude of extreme sea levels, global mean sea level to rise by up to 0.38m.	Canadian coastline sea-level rise will be enhanced where the land is subsiding.

Source. Appendix 1, Sections 1-E and 1-F.

Besides taking into account RCP emission scenarios, regional variations also introduce a degree of complexity when predicting the future climate. While rates of change vary by region and by weather phenomena, the directions of change are consistent with global warming and climate models indicate that many of the observed trends will continue over the coming decades and beyond.[136]

PROJECTING DISASTER ASSISTANCE REQUIREMENTS

As established in Chapter 1, risk of natural disaster occurrence is a function of a system's ability to cope with exposure to natural hazards. The resilience of human systems to extreme weather conditions can be considered a very important factor when linking disaster risk to climate change. The IPCC estimates with medium confidence that climate change will increase the displacement of people exposed to extreme weather events, particularly in developing countries with low income.[137] By amplifying population vulnerability in less developed countries, the risk of major natural disasters related to climate change is expected to increase. There has been no formal assessment concerning the rate at which certain climatic disasters are expected to increase throughout the 21st century. However, CRED statistics for natural disaster occurrence globally may be used to identify trends that can be projected into the future. Similarly, historical data of CAF DA deployments can be assessed to identify tendencies that identify operational requirements for the future. For the purpose of this paper, the author has made projections by simply applying the trends observed over the past 10 years (2005-2014) into the future 10 and 20-year timeframes. Similar to the analysis in Chapter 2, the 1996-2014

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[136] Fiona Warren and Donald Lemmen, *Synthesis: Canada in a Changing Climate…*, 2.
[137] IPCC, *Climate Change 2014*…, 16.

timeframe was considered in order to emphasize the relevance to the DART. 10-year historical trends for both global climatic disasters and CAF deployments were determined by evaluating the percentage of change between the average annual occurrences for 2005-2014 in comparison with the average for 1996-2004.[138]

Future Disasters Worldwide

First of all, global statistics for natural disasters were assessed. The available data covering the past 10 years points to a steady increase in climatic disasters, especially those caused by extreme temperatures, floods, and storms. CRED statistics extracted from the IFRC World Disasters Report 2014 reveal that between 2005 and 2013 the number of disasters caused by extreme weather events has increased by 23%.[139] CRED reported that a total of 294 climatic disasters occurred in 2013. When the observed 10- year increase of 23% is applied to the next decade, it is expected that the annual number of climatic disasters will increase to 411.[140] Disasters caused by floods and storms are expected to rise significantly, at respective rates of 42% and 19% per decade.[141] The observed annual rates and the projections through to 2035 are depicted in Figure 4.1 below. Therefore, the requirement for the CAF to conduct expeditionary DA is expected to increase and will likely be caused by floods and wind storms.

[138] For 10-year rates of global disasters see Appendix 1-D. For 10-year rates for CAF deployments see Appendix 3-D.

[139] See Appendix 1-D.

[140] See Appendix 1-E.

[141] See Appendix 1-D.

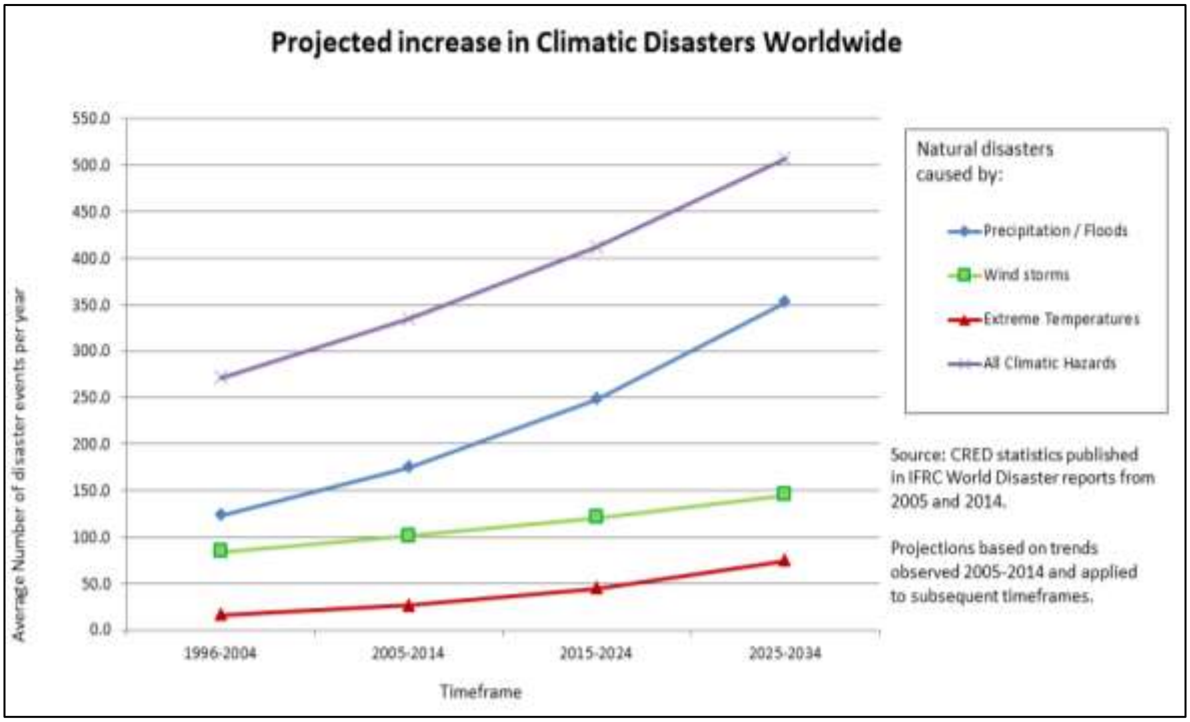

Figure 4.1 - Global Climatic Disaster Trends
Source: Appendix 1, Section 1-D.

Future Requirements for Disaster Assistance

Given the occurrence of past disaster response operations and the impacts of climate change, it is expected that the CAF will continue to be called upon to respond to domestic and international natural disasters. The CAF must continue to be prepared to conduct HADR operations, with the DART considered to be the first choice for international operations but also be prepared to augment RJTF resources for major domestic disasters. CAF statistics for DA deployments were further analyzed to identify trends concerning the frequency and the nature of requirements. The analysis in the previous chapter revealed that over the 19 year timeframe (1996 to 2014), the CAF conducted fifteen domestic DA missions and eight expeditionary missions. Although the demand for domestic DA has been historically greater, when the timeframe is analyzed further important trends concerning the frequency of each type of deployment can be observed. The CAF's domestic DA requirement has remained relatively stable at an average of one deployment every 15 to 17 months. When isolating the 2005-2014 time period, the trend actually shows a 6% reduction in the rate of annual domestic DA deployments.[142] In contrast the CAF has experienced a marked increase in frequency in expeditionary DA operations, with six of the eight deployments occurring since 2005. Considering the overall increase in the number of natural disasters globally and the vulnerability of populations outside of Canada, this rise in expeditionary requirements is not surprising. By projecting the 2005-2014 deployment rates into the next 20 years (to 2034), the rate of expeditionary DA operations is expected to increase significantly while domestic requirements are expected to remain stable. These projections are summarized in Table 4.2 and highlights how the operational tempo of expeditionary DA operations could increase to 4 deployments per year by 2034. Further, Figure 4.2 below illustrates observed historical trends as well as the deployment rates projected for the next 20 years.

Table 4.2 - Rates of Disaster Assistance Operations

	Domestic DA Ops		Expeditionary DA Ops	
Timeframe	Annual Rate (Deployments/year)	Frequency (Time between deployments)	Annual Rate (Deployments/year)	Frequency (Time between deployments)
1996-2004	0.78	15 months	0.22	4.5 years
2005-2014	0.73	17 months	0.60	20 months
2015-2024	0.68	18 months	1.62	7 months
2025-2034	0.64	19 months	4.37	3 months

Source: Appendix 3, Section 3-D.

[142] See Appendix 3.

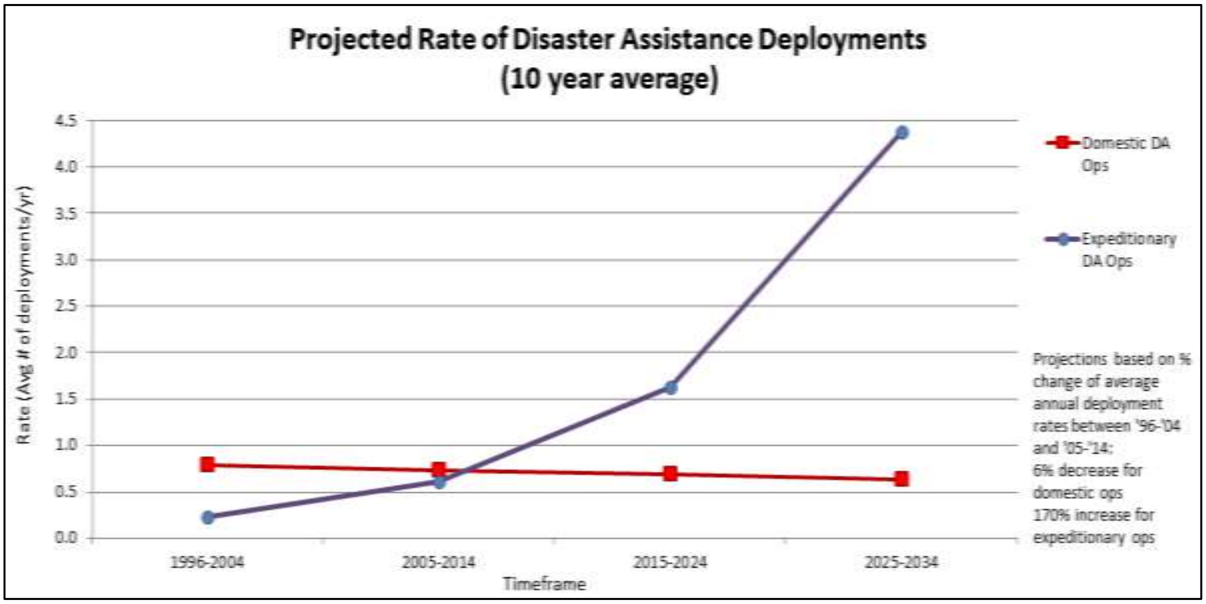

Figure 4.2 - Projected Disaster Assistance Requirements
Source: Appendix 3, Section 3-D.

When applying the 2005-2014 trends to subsequent decades, the requirement for expeditionary DA is shown to increase significantly. In order to assess the significance of these future requirements, the 10-year trend was applied incrementally for the 2015-2024 and 2025-2034 timeframes. From this analysis, key points in time were identified when the operational tempo is expected to increase by one deployment per year. These milestones are highlighted in Figure 4.3 below. In the near future, it is projected that by 2018 the CAF will conduct one expeditionary DA mission per year, and this rate may double by 2026.

Trend Impacts on the DART

Summarizing the analysis above, over the next 20 years the annual number of climatic disaster is projected to nearly double and the tempo of CAF DA deployments internationally is estimated to increase to 4 deployments per year by 2034.

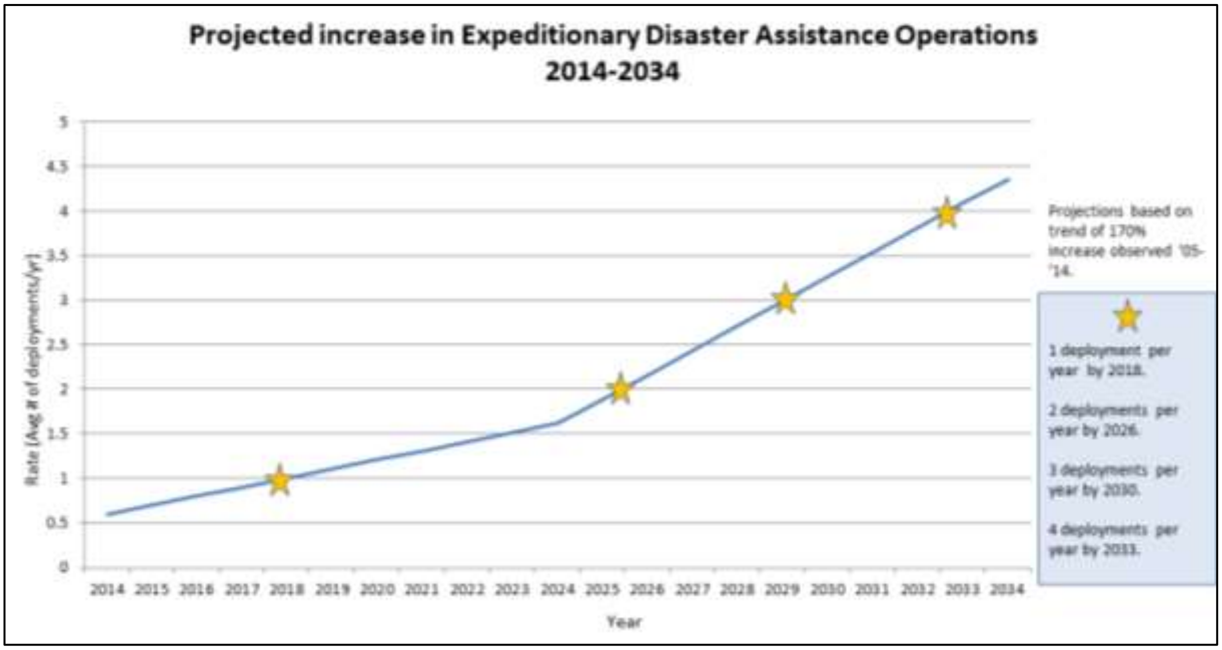

Figure 4.3 - Projected Expeditionary Requirements
Source: Appendix 3, Section 3-D.

These projections should nevertheless be considered with caution as they do not take into account the effect of future disaster risk reduction measures and the variety of factors that weigh into a GoC decision to deploy CAF assets in response to a disaster. The capacity of civilian authorities, humanitarian principles, political interests, and the future readiness of CAF capabilities are all germane as to whether or not the CAF requirement to conduct DA will increase. These factors are subjective and difficult to quantify, and therefore were not factored into the calculations. These estimates were calculated by simply projecting observed rate increases into the future in order to provide and idea for future DA requirements. However, this analysis does generate awareness of the increasing requirement internationally for the CAF and how this may generate an increase in operational tempo for the DART over the next 20 years.

Even though the CAF's domestic DA deployment rate has been relatively consistent, the small decrease observed over the past 10 years may be an indication of the ability for Canadian civil authorities to deal with disasters. When comparing disaster management in Canada with the rest of the world, it is expected that less developed countries will be more likely to require international assistance as the world experiences an increase in extreme weather events that cause disasters. Furthermore, Canada's population can be considered to be more resilient that those in developing countries due to the relatively stable socio-economic environment. The potential for the DART to be deployed domestically in the next 20 years therefore remains low as long as Regional JTF resources are able to continue fulfil the requests for assistance by the provinces and territories. Nevertheless, in accordance with the CAF's domestic operational priorities, the DART should continue to be ready to deploy particular capability sets within Canada if existing CAF resources become overwhelmed. Realistically, the DART's focus on expeditionary requirements must be maintained into the future. The potential for the DART to respond to a major climatic disaster internationally during the next 20 years is expected to increase significantly as indicated by the Figures and Tables above. In order for the CAF to respond to the expected increase in major international disasters resulting from climate change, the DART remains a worthwhile resource now and into the future.

HOW TO DIRECT THE DART TOWARDS CLIMATE CHANGE

This final section will recommend an emphasis on certain operational level activities in order to optimize the DART's ability to respond to climatic disasters internationally. The processes of predicting extreme weather events, partnering with civilians, and projecting the appropriate capabilities will enhance both the responsiveness and effectiveness of the DART in light of climate change. These activities should occur at the operational level as part of CONPLAN RENAISSANCE and therefore requires the involvement of headquarter elements of both CJOC and the DART. Although the decision to activate and deploy the DART resides at the strategic level, important enabling activities occur at the operational level. Therefore prior to the onset of a disaster, CJOC should emphasize predicting extreme weather events that could lead to a disasters and partnering with civilian stakeholders both in Canada and internationally. Once a climatic disaster strikes, civil-military partnerships will continue to be essential as well as the ability of the CAF to project the appropriate resources. When prediction, partnering, and projection are successfully carried out at the operational level, the effectiveness of the DART at the tactical level can be enhanced.

Predicting Climatic Disasters

First of all, predicting DART requirements is enabled at the operational level by CJOC HQ. In order to facilitate the early warning of a DART response to a climatic disaster, metrological forecasting and assessment will be essential. Predicting the time and location of weather hazards that can lead to a disaster is fulfilled through Geospatial Intelligence (GEOINT) and especially by contributions made by meteorological and oceanographic technicians. GEOINT promotes an understanding of the operational environment through combining information derived from images, maps, and weather observations. Therefore CJOC should leverage available GEOINT resources to identify potential climatic disasters as early as possible within the CAF's areas of interest and responsibility. Long term forecasting should aim to identify regions of the world that are susceptible to climatic disasters. As part of this outlook seasonal trends can also help identify the time of year when regions of the world are most vulnerable. Shorter term forecasting can provide warning of the onset of extreme weather events. The potential impacts of a particular weather extreme can then be assessed in consideration of regional factors and the vulnerability of populations and infrastructures. Monitoring the weather and its effects on regions outside of Canada that are of strategic interest will be key to identifying a potential DART deployment. Therefore a DART mandate that includes a focus on climatic disasters requires support from operational level GEOINT residing within CJOC HQ.

Partnership with Civilians

Secondly, establishing partnerships between the CAF and civilian stakeholders in the domains of disaster management and climate change will bring several advantages. Partnerships will enable procedures used by the CAF and the DART capability to be understood by civilian organizations that the CAF expects to collaborate with during an expeditionary DA operation. In addition, it will ensure that the DART HQ's needs assessment process is comprehensive, timely, and synchronized with civilian partners. Further, civil-military partnerships will also facilitate the sharing of best practices and lessons learned that can improve how the DART operates. With the expected increase in operational tempo due to climate change, cooperation between the CAF and civilian agencies will occur more often and will be increasingly linked to mission success.

Because military involvement in DA works best when part of a comprehensive and WoG approach, the CAF should continue to develop relationships with civilian counterparts in organizations such as the GoC's DFATD and the UN's OCHA. SIPRI has reinforced the requirement for civil-military integration not only during the actual delivery of DA, but also beforehand during training and throughout the needs assessment phase.[143] Over the long term and prior to the onset of a disaster, establishing civil-military relationships will contribute to the understanding of how the military can best contribute. This can be achieved by the CAF at the operational level through direct liaison between CJOC and DFTAD in order to communicate contingency plans and operating procedures. The annual DART training plan should include

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[143] Sharon Wiharta et al., *The Effectiveness of Foreign Military Assets…*, xiii - xiv.

involvement with GoC partners as well as international partners and NGOs. Furthermore, personnel assigned to the DART HQ should be afforded the opportunity to interact with representatives from OCHA and from relevant NGOs as part of pre-deployment training events. DART liaison officers should also participate in international fora concerning disaster management and climate change, in order to develop expertise and to exchange best practices with civilian partners.

Upon the detection of a possible climatic disaster, liaison with DFATD can help determine whether a request for assistance is forthcoming and will support timely decision making at the strategic level. This will contribute to the responsiveness of the DART recce team (the HART) and enable the needs assessment process to be integrated as early as possible with civilian counterparts. In accordance with recommendations by SIPRI, military actors should be included in the needs assessment activities as early as possible and military assets should also be used to for important enabling roles.[144] The needs assessment is a whole of government effort lead by DFATD and relies on military contributions from the commanding officer of the DART as well as the HART. Personnel assigned to the HART work closely with civilian actors in the disaster zone and provide advice concerning the DART capabilities that may be required. The needs assessment process can be enhanced if supported by military ISR resources that can help overcome information gaps when attempting to understand the extent and severity of a disaster. Therefore existing CAF Intelligence, Surveillance, Reconnaissance (ISR) assets that can collect up-to-date imagery over the affected area, such as the CP-140 Aurora or the CH-146 Griffon, can make important contributions. This will be especially relevant for disasters resulting from extreme weather events where the size and extent of a disaster zone can be very large. In

[144] *Ibid.*, xiv.

summary, incorporating CAF resources such as the HART and CAF ISR assets with civilian authorities will contribute to a timely and accurate needs assessment and determine the most appropriate role for the DART.

Projecting Appropriate Capabilities

If the future role of the DART is to be responsive to the impacts of climate change, the projection of force has to be timely and versatile. Today's modular and scalable construct of the DART has improved the responsiveness and versatility, and in the future this concept should be sustained. In addition, the expected increase in operational tempo will require the DART to be sustainable through having depth in certain capability areas and by having the ability to reconstitute capabilities following a deployment.

The timely projection of the DART into a disaster zone has improved over the past five years with the advent of the CAF's improved strategic airlift capacity. Strategic platforms such as the C-177 Globemaster and the C-130 Hercules should continue to be activated as early as possible pending approval of a DART deployment. Timeliness can also be improved through arrangements made prior to the onset of a disaster that allow for the pre-positioning of equipment and supplies within regions of the world that are susceptible to climatic disasters. Coordination at the operational level by CJOC HQ staff can facilitate the use of operational support hubs (OSHs) as well as allied military bases for the storage of materiel that supports core DART capabilities. For example, CAF OSHs in Jamaica and Kuwait provide gateways for DA operations that are likely for parts of Central America and Southwest Asia. The use of allied military bases for the staging of equipment, supplies, and personnel can also promote the speed of response, especially for regions of interest beyond the reach of established OSHs. As highlighted in Chapter 1, the

Asia-Pacific region experienced 70% of the world's climate-related disasters in 2013. The DART's ability to respond for this part of the world would be enhanced with the eventual establishment of an OSH in the Pacific region. In the near term, the CAF should consider making agreements with key allies such as US and Australia that have bases in the Asia-Pacific region, in order to support the projection of DART capabilities.

The modular and scalable construct of the DART as part of wider HOTF concept defined by CONPLAN RENAISSANCE has improved the versatility of the DART. The concept will help ensure that the DART's response to future climatic disasters is appropriate to the identified needs. The core medical and engineering capability groups can be scaled to deploy in smaller sub-sets according to priorities identified by the HART and the needs assessment process. This operating concept should continue into the future and DART capability development in the areas of medical and engineering should take into account emerging technologies and improved equipment. Further, by evaluating the damages associated with climatic disasters this will help identify new requirements for training, equipment, or skills that may lead to adjusting the capability set of the DART.

As part of CONPLAN RENAISSANCE, the aviation capability in the form of CH-146 Griffon helicopters was recently added to the core DART capability set. This is a very useful resource to access remote areas and deliver aid when ground transportation is hindered by damage and debris caused by extreme weather. This is consistent with the enduring requirement for military air assets as identified by both the SIPRI report and from the historical analysis of previous CAF deployments. The role of airborne ISR platforms was mentioned earlier to support civilian partnerships in the needs assessment phase. However, CAF ISR assets are also versatile during the execution phase of DA operations. Up-to-date imagery contributes to situational awareness through ongoing monitoring of the extent of the damages as well as monitoring the progress of DA activities. For example in the case of large scale flooding, the collection of near real-time imagery by fixed wing patrol aircraft (such as the CP-140 Aurora) is highly beneficial throughout the response phase in order to assess the changing extent of flood waters and to synchronize relief operations. Although commercial satellite imagery is becoming increasingly more precise and affordable, airborne collection platforms are highly adaptable to the coverage area and the imagery data can be rapidly processed. A future consideration is the application of unmanned aerial vehicles (UAVs) and drone technology as part of the ISR capability. Therefore, the use of ISR assets has the potential to be a key enabler for the DART and to serve as a unique military capability that can complement civilian resources. Additionally, ISR represents an appropriate form of military contribution because since it is considered indirect assistance and does not impact the activities of humanitarian actors on the ground.

SUMMARY

This chapter has offered a perspective on the future of climate change and how this relates to an increase in demand for the DART. While the IPCC and other organizations have projected changing climate patterns with reasonable confidence, precise changes in natural disaster risks are more challenging to predict. In general, natural disasters throughout the world are expected to continue to increase over the next 20 years, especially those caused by heavy precipitation and wind storms. By applying historical trends for CAF deployments, the next 20 years will likely generate a significantly greater requirement to conduct expeditionary DA deployments. By 2026 the rate may reach three deployments per year. Trend analysis revealed a consistent rate for domestic DA requirements and it is unlikely that the DART will deploy domestically into the future. Therefore, the directing the DART towards climate change implies an emphasis on expeditionary operations. This also means that the DART should be supported at the operational level through intelligence, civil-military liaison, and prioritizing the needs assessment process. The ability to predict climatic disasters, partner with civilian stakeholders, and project appropriate capability packages will enhance the DART's ability to focus on responding to climatic disasters. These processes will enable the DART to continue to be a viable strategic resource for the CAF response to future disasters, especially those related to climate change. In conclusion, as the rate of climatic disasters increases over the next 20 years, this means that the CAF will increasingly be called upon to respond which has important implications for the future role of the DART.

CHAPTER 5

CONCLUSION

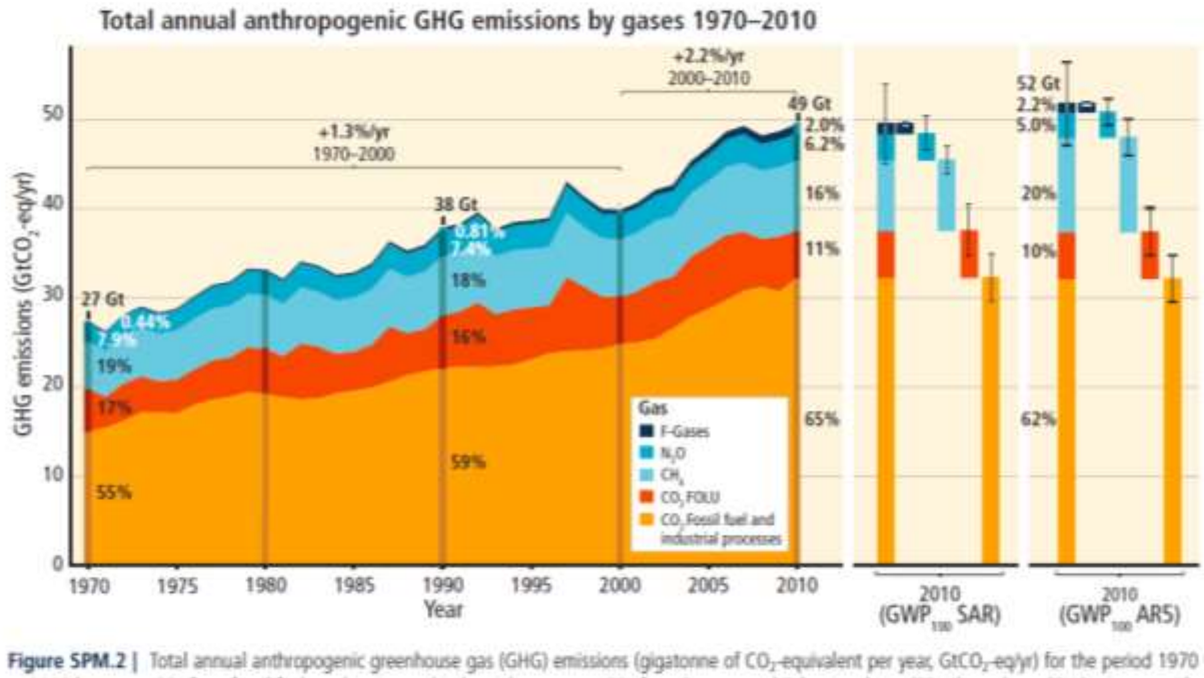
This paper has argued that the future role of the DART should include a special attention to the impacts of climate change. First of all it was necessary to identify the scientific evidence behind climate change, its causes, and the resulting impacts. The consequences of climate change include an increase in the frequency and severity of extreme weather which creates a greater risk for climatic disasters to occur. This increasing disaster risk therefore poses a greater requirement for disaster response activities by both civilian and military actors, which includes the DART. Secondly it was important to appreciate the nature of disaster management and disaster assistance at the international and domestic levels in order to understand the context of the DART's role. Humanitarian guidelines for the use of military assets in response to natural disasters have been established in order to influence how capabilities such as the DART can be most appropriately used. CAF contributions to DA missions since 1996 have indicated the enduring domestic requirement and a rapidly increasing expeditionary requirement. The overall effectiveness of the DART was also confirmed by taking into consideration specific strengths and shortcomings, as well as relating the advantages and disadvantages military involvement in DA. While the CAF's RJTFs have been able to fulfil all the domestic DA requirements, the DART has been, and is expected to continue to be, the first choice for the conduct of expeditionary DA operations as part of CONPLAN RENAISSANCE and the HOTF concept. However the regional variability and severity of extreme weather events worldwide due to climate change does not preclude Canada from experiencing a large scale climatic disaster in the future, which may warrant a domestic contribution from the DART if RJTF resources cannot meet the need.

Finally, using available IPCC estimates concerning the future of climate change and analyzing trends concerning disasters and DA requirements, several projections were made. Over the next 20 years the annual number of climatic disaster is projected to nearly double and the tempo of CAF DA deployments internationally is estimated to increase to 4 deployments per year by 2034. The most prevalent types of climatic disasters expected throughout the rest of the 21^{st} century are those caused by floods and wind storms. In addition, global temperatures and rising sea levels are expected to rise more rapidly than previously observed which will introduce further risks for disasters. As the frequency and severity of natural disasters increases, the CAF should be prepared for an increase in requirement to respond, both in Canada and internationally. In order for the DART to fulfil future requirements related to climate change it is recommended that this be facilitated at the operational level. Support from CJOC HQ for the early prediction of climatic disasters and emphasizing a network of liaison efforts to further establish partnerships with civilians would enhance the responsiveness of the DART. In addition, by supporting the needs assessment process through the integration of military expertise, intelligence, and aviation this would enhance the appropriateness of the DART's projection of capabilities. In conclusion, this outlook has provided a perspective on the future role of the DART and how the DART should be directed towards climate change.

Appendix 1

CLIMATE AND DISASTER STATISTICS

1-A. Greenhouse Gas (GHG) Emissions Breakdown



Source: Intergovernmental Panel on Climate Change, *Climate Change 2014: Synthesis Report: Fifth Assessment Report* (Geneva: IPCC, 2014), 5.

Total Anthropogenic Greenhouse Gas Emissions 1970-2010				
Year	Greenhouse Gas (Gigaton CO2 Equivalent)	% of Contribution from CO2	CO2 (Gton)	Other GHG (Gton)
1970	27	72	19.4	7.6
1980	33	73	23.8	9.2
1990	38	75	27.4	10.6
2000	40	75	28.8	11.2
2010	49	76	35.3	13.7

Source: Author’s extraction from IPCC Figure SPM.2.

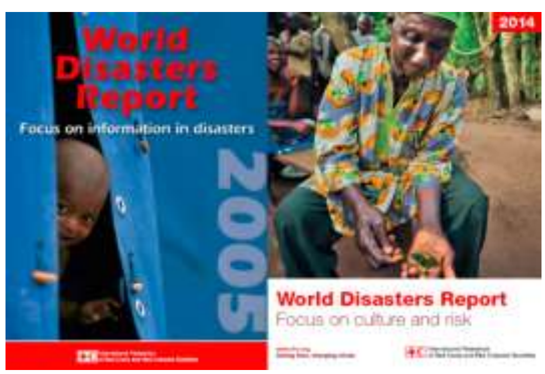
Appendix 1

1-B. Global Natural Disasters 1996-2013

	1	2	3	4	5	6	7	8	9	10	11
Type	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Droughts/food insecurity	8	18	34	30	48	47	41	21	19	28	20
Extreme temperatures	5	13	13	8	31	23	15	18	19	29	32
Floods	70	76	88	112	152	159	172	158	135	193	232
Forest/scrub fires	5	15	16	22	30	14	22	14	8	13	10
Windstorms	63	68	72	86	101	98	112	76	128	131	77
Total Events	151	190	223	258	362	341	362	287	309	394	371

	12	13	14	15	16	17	18	
Type	2007	2008	2009	2010	2011	2012	2013	Totals
Droughts/food insecurity	13	21	31	27	24	30	12	472
Extreme temperatures	25	11	26	34	19	52	17	390
Floods	219	175	159	189	159	142	149	2739
Forest/scrub fires	18	5	9	7	7	7	10	232
Windstorms	105	111	87	91	85	90	106	1687
Total Events	380	323	312	348	294	321	294	5520

Source: compiled from IFRC reports, 2005 and 2014.[145]



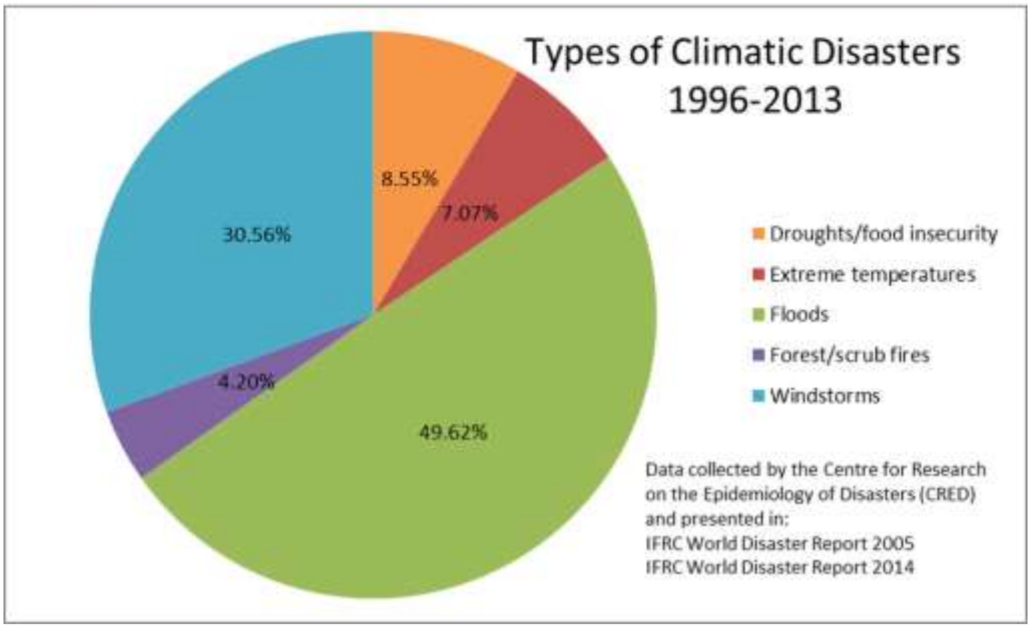
[145] International Federation of Red Cross and Red Crescent Societies. *World Disasters Report: Focus on Information on Disasters.* Geneva: IFRC, 2005. Annex 1, Table 5.
International Federation of Red Cross and Red Crescent Societies. *World Disasters Report: Focus on Culture and Risk*. Lyon, France: Imprimerie Chirat, 2014. Annex 1, Table 5.

Author's Note: IFRC reports compile information from the EM-DAT database published by the Centre for the Research and Epidemiology of Disasters (CRED).

Appendix 1

1-C. Types of Climatic Disasters (Globally) 1996-2013

	Total	Climatic %	Average Number of Events
Droughts/food insecurity	472	8.55%	26.2
Extreme temperatures	390	7.07%	21.7
Floods	2739	49.62%	152.2
Forest/scrub fires	232	4.20%	12.9
Windstorms	1687	30.56%	93.7



Source: compiled from IFRC reports, 2005 and 2014.[146]

[146] *Ibid.*

Appendix 1

1-D. Climatic Disaster Projections (Globally) 1996-2013

Totals	Average Number of Events (18-year)	First 8 year Avg 96-04	Second 9 year avg 05-13	Change to Overall Average	1st and 2nd timeframe change	
472	26.2	30.9	22.5	-14.2%	-27.1%	Droughts/food insecurity
390	21.7	15.8	26.4	21.8%	67.6%	Extreme temperatures
2739	152.2	123.4	175.2	15.1%	42.0%	Floods
232	12.9	17.3	9.4	-27.1%	-45.5%	Forest/scrub fires
1687	93.7	84.5	101.1	7.9%	19.6%	Windstorms
5520	306.7	271.8	334.6	9.1%	23.1%	TOTAL

	Global annual average for number of disasters caused by:			
	All Climatic Disasters	Precipitati on/ Floods	Wind and storms	Extreme temperatures
1996-2004	271.8	123.4	84.5	15.8
2005-2014	334.6	175.2	101.1	26.4
2015-2024	411.9	248.8	120.9	44.2
2025-2034	507.0	353.3	144.6	74.2

Source: compiled from IFRC reports, 2005 and 2014.[147]

[147] *Ibid.*

Appendix 1

1-E. 21st Century Outlook for Climate Change (Global)

Phenomenon	**Projection**	
	Early 21st Century (2016-2035)	**Late 21st Century (2081-2100)**
Temperature		
Global Mean Surface Temperature increase under RCP 8.5.*	1.4 to 2.6 °C *	2.6 to 4.8°C *
Warmer and more frequent hot days and nights over land areas.	Likely	Virtually Certain
Precipitation and other hydrological indicators		
Increase in frequency, intensity, and amount of heavy precipitation.	Likely over many land areas.	Very Likely to be more intense and more frequent in mid-latitude and wet tropical regions.
Increase in intensity and duration of drought.	Likely (Low confidence)	Very likely (medium confidence)
Tropical wind storm activity	* Globally, it is likely that the area encompassed by monsoon systems will increase over the 21st century and monsoon precipitation is likely to intensify due to the increase in atmospheric moisture. Monsoon onset dates are likely to become earlier and retreat dates will likely be delayed, resulting in lengthening of the monsoon season in many regions. ** There is high confidence that the El Niño-Southern Oscillation (ENSO) will remain the dominant mode of variability in the tropical Pacific, with global effects throughout the 21st century. Due to the increase in moisture availability, ENSO-related precipitation variability on regional scales will likely intensify.	
Oceanographic		
Global mean sea level rise under RCP 8.5. *	0.22-0.38m *	0.45-0.82m *
Increase in frequency and magnitude of extreme sea levels.	Likely	Very likely
Extent of sea level rise	***Sea level rise will not be uniform. By the end of the 21st century, it is very likely that sea level will rise in more than about 95% of the ocean area.	

Source: Author summary from IPCC 2014 *Summary for Policy Makers* Table SPM.1, page 7.
(* Table SPM.2, page 23, ** Page 23, *** Page 26.)

Appendix 1

1-F. 21st Century Outlook for Climate Change (Canada)

Phenomenon	Projection
Temperature	
Seasonal temperature	Warming will be greatest in winter, and in this season, the largest increases in air temperature are projected for northern Canada. In summer, the largest increases are projected for southern Canada and the central interior. The magnitude of projected warming varies substantially with the emission scenario.
Extremes in daily temperature	Increases in the frequency and magnitude of unusually warm days and nights and decreases for unusually cold days and nights are projected to occur throughout the 21st century
Long duration hot events	The length, frequency and/or intensity of warm spells, including heat waves, are projected to increase over most land areas.
Rare hot extremes	Rare hot extremes are currently projected to become more frequent. For example, a one-in-20-year extreme hot day is projected to become about a one-in-5 year event over most of Canada by mid-century
Precipitation and other hydrological indicators	
Seasonal precipitation	Increases in precipitation are projected for the majority of the country and for all seasons, with the exception of parts of southern Canada where a decline in precipitation in summer and fall is suggested
Heavy precipitation	More frequent heavy precipitation events are projected, with an associated increased risk of flooding
Rare precipitation events	Rare extreme precipitation events are currently projected to become about twice as frequent by mid-century over most of Canada
Stream flow	Increases in winter stream flow for many regions in southern Canada.
Storm activity	Storms will increase in frequency and/or intensity in a warmer climate.[148]
Oceanographic	
Relative sea level change	Patterns of change along Canadian coastlines will continue to be influenced by land uplift and subsidence as well as by changes in the oceans. Sea-level rise will be enhanced where the land is subsiding.
Arctic summer sea ice	A nearly ice-free summer is considered a strong possibility for the Arctic Ocean by the middle of the century

Source: Author Summary from Fiona Warren and Donald Lemmen, *Synthesis Report: Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation* (Ottawa: NRCAN, 2012). Table 2.

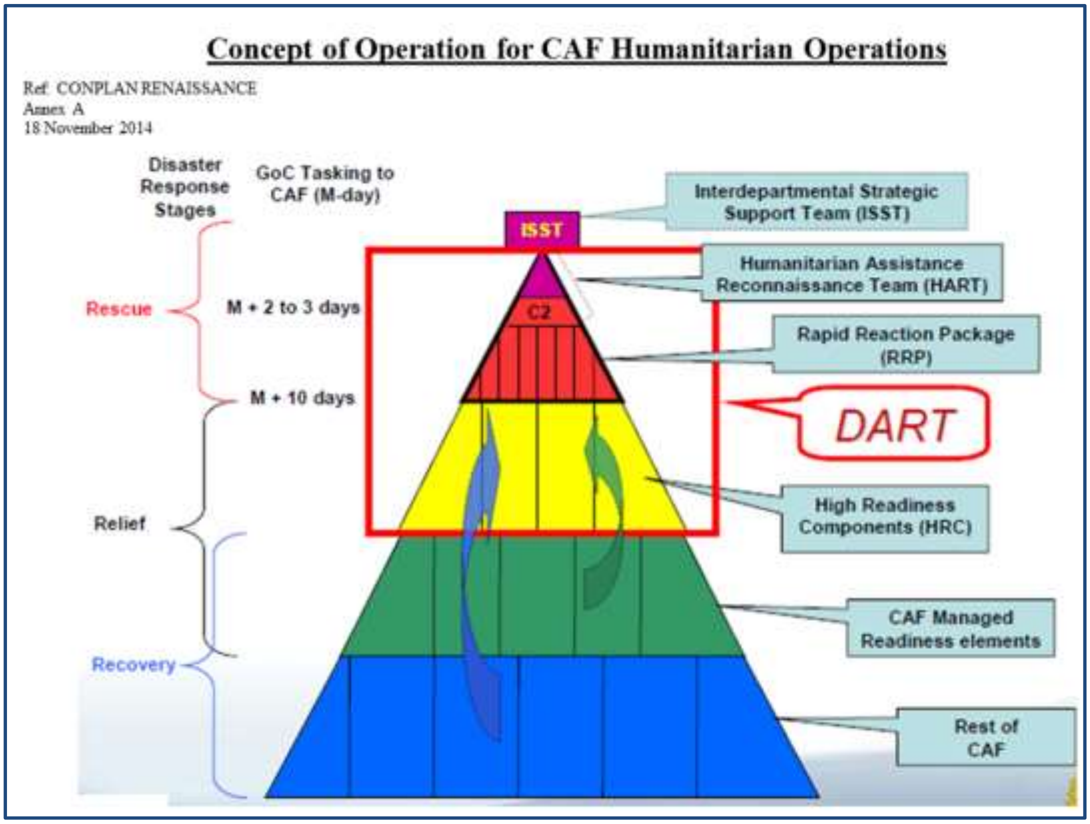
Author's Note: The above examples of projected changes in the climate system for Canada were derived from ensembles of global climate models driven by the IPCC special report on emission scenarios (SRES). In general, the magnitude of the stated changes will increase under higher emission scenarios.

Appendix 2

CONPLAN RENAISSANCE CONCEPT OF OPERATIONS

[148] Table 2 in the NRCAN report does not provide projections for wind storms. The following statement made on page 11 has been applied here: "Studies have suggested that droughts, especially in the southern Prairies, heavy precipitation events, with associated increased risk of flooding, forest fires, storms and hot days and warm nights would increase in frequency and/or intensity in a warmer climate."

The following information has been extracted directly from the CAF's Canadian Joint Operations Command (CJOC) contingency plan RENAISSANCE which represents an operating framework for CAF involvement in disaster assistance (DA) activities outside of Canada. The concept of operation described below demonstrates how the CAF response to international natural disasters is incorporated into a whole of government response in coordination with DFATD. It also provides further detail to the reader concerning how the DART fits into this framework as part of a wider Humanitarian Operation Task Force (HOTF).



Source: Department of National Defence, *CJOC CONPLAN 20855/14 RENAISSANCE* (Ottawa: CJOC, 2014), Annex A.

Appendix 2

CONPLAN RENAISSANCE CONCEPT OF OPERATIONS

Explanation of Concepts[149]

Interdepartmental Strategic Support Team. The ISST is a small DFAIT-led team that conducts the strategic analysis to assess the magnitude of the disaster and assist the diplomatic head of mission in making recommendations. The ISST has representatives from DFATD and DND. As required, the CAF will contribute to the ISST and dispatch the HART to support further GoC decision-making and preparing the ground to receive other capabilities as required.

Humanitarian Assistance Reconnaissance Team. The HART is a small team (between 7 and 15 persons depending on the situation) which will deploy with the ISST or shortly thereafter. The role of the HART is to assist the ISST in performing its needs assessment, evaluate the suitability of deploying CAF elements, make recommendations on the composition of a potential HOTF and prepare the ground for its deployment.

Rapid Reaction Package. The RRP consists of capabilities recommended by the ISST/HART. The elements included on the RRP will deploy with the capability of operating in austere conditions and be sufficient for 7 days. The RRP should not be considered just the initial flights, but rather the initial set of effects and enablers deployed. Should the GoC decide to continue or expand the CAF engagement, then identified high readiness components will be dispatched to augment existing capabilities or deploy new capabilities to meet emerging needs.

High readiness components. The HRC contribution is the balance of the DART and could include RRP elements that did not deploy initially. This can deploy until the complete DART is in theatre or the GoC determines that other resources/organizations can fill the need being provided by the CAF. At all times, continuous assessment of needs and force balance (Deliver Effects and Sustain the Force) will be maintained. Not all elements must deploy if the need is not identified. Finally, the CAF mandate can include the activation of any other CAF resource that fills an identified need and contributes to GoC recovery activities. These elements can be a reaction to an emerging requirement or to meet an identified, longer-term need should this be decided by the GoC.

Managed Readiness Elements. This includes CAF assets already on a stated notice to move through the CAF managed readiness system or on a be prepared to task within this CONPLAN. Their use would be subject to further coordination with other potential force employers and the strategic assessment. These might include, as an example, the standby ships and planes, or immediate reaction unit (IRU) elements. Based on the situation and need, these capabilities can be deployed at any time to meet identified needs and fill gaps.

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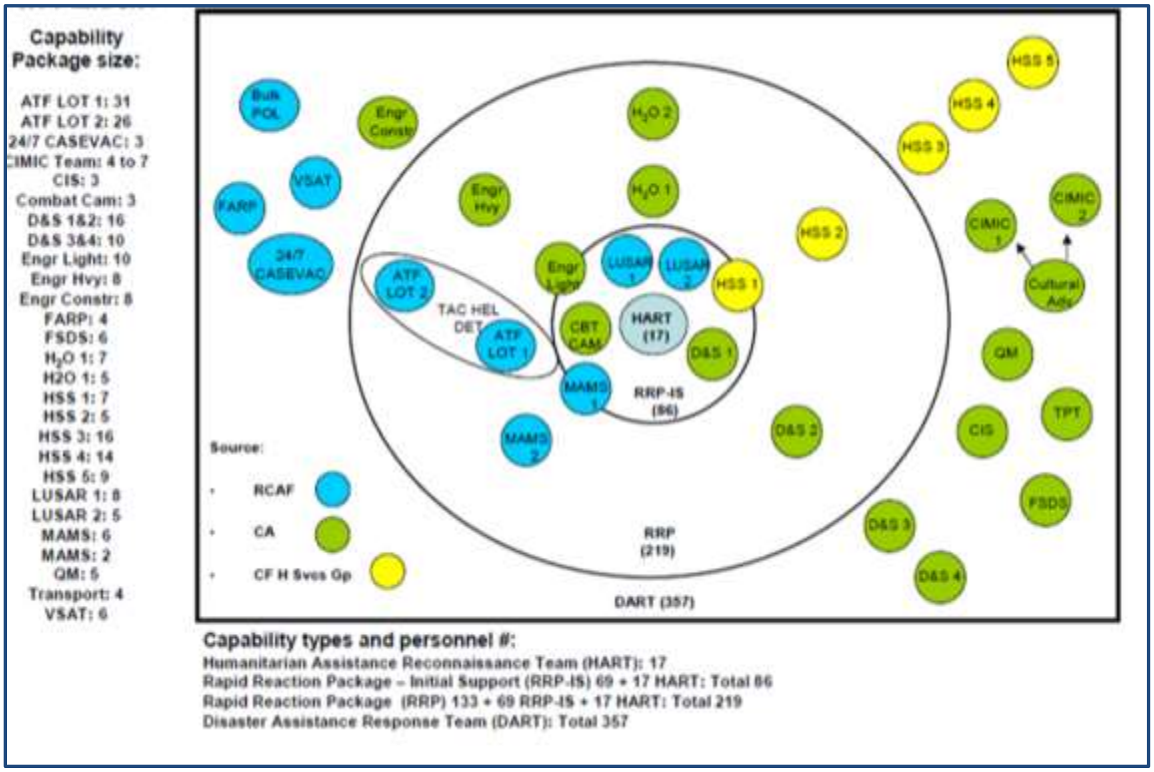
[149] Department of National Defense, *CJOC CONPLAN 20855/14 RENAISSANCE* (Ottawa: CJOC, 2014), Annex A.

Appendix 2

CONPLAN RENAISSANCE CONCEPT OF OPERATIONS

Modularity Construct of the HOTF [150]



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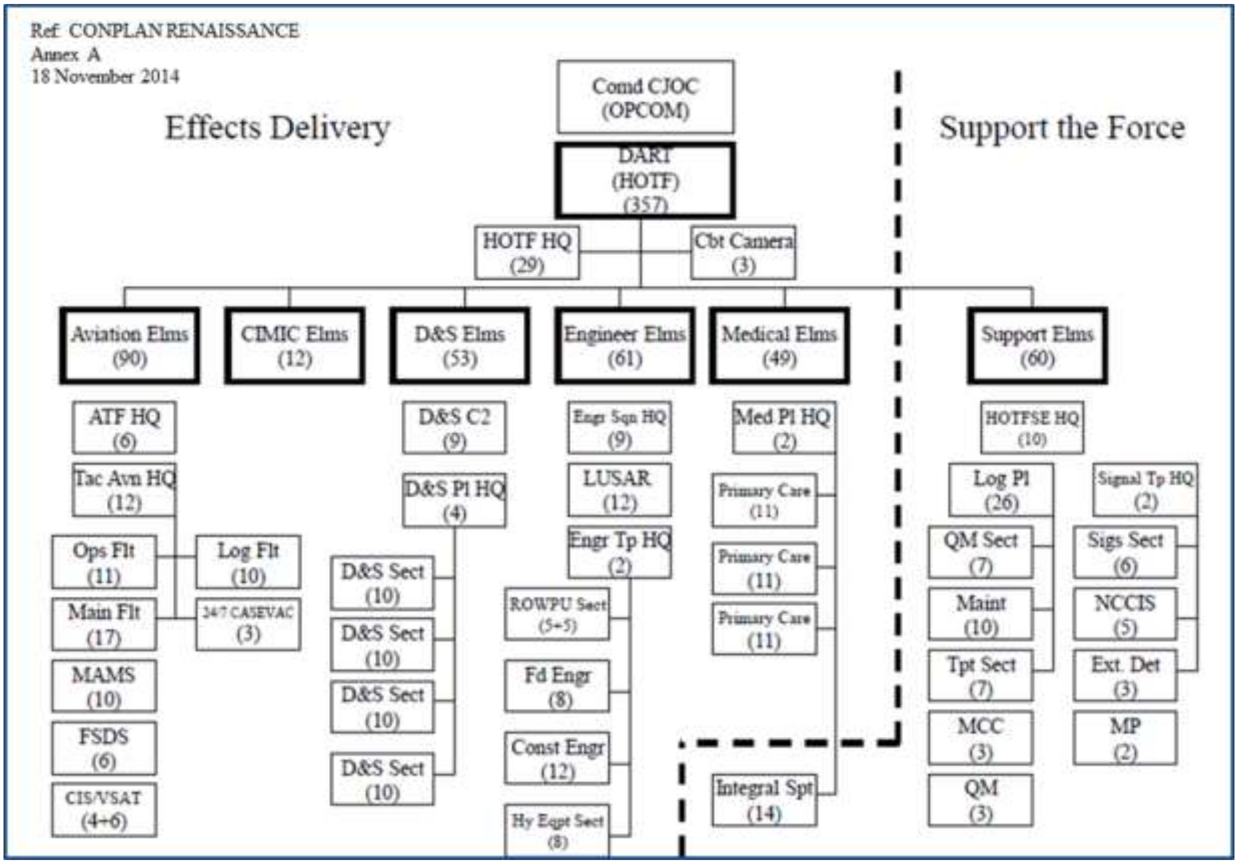
[150] *Ibid.*

Appendix 2

CONPLAN RENAISSANCE CONCEPT OF OPERATIONS

DART Organization Chart[151]



[151] *Ibid.*, Annex B.

Appendix 3

ANALYSIS OF CAF DISASTER ASSISTANCE OPERATIONS

3-A. Domestic Disaster Assistance 1996-2014

	Op Name	Year	Location	Type of Event	CAF Personnel (#)	Duration (days)	Medical Patients	Water Produced	Engineering (construction, route opening, clean-up)	Air Mobility (Evacuation)	Aid Distribution
1	BC SNOW	1996	Southern BC	Extreme Ice/Snow	N/A	N/A	No	No	Ground evacuation	No	No
2	SAGUENAY	1996	Saguenay QC	Flood	450	N/A	No	No	Debris removal	Yes	Yes
3	ASSISTANCE	1997	Southern MB	Flood	8,700	45	No	No	Critical Infrastructure Protection (CIP), Dike repair and monitoring, mobility over water.	SAR, Med evac	N/A
4	RECUPERATION	1998	Southern ON, Southern QC	Extreme Ice/Snow	15,784	22	No	No	Debris removal, assistance to utility crews.	Yes	Food, Fuel, and Water
5	PREAMBLE	1999	Toronto ON	Extreme Ice/Snow	400	N/A	No	No	Snow removal, ground evacuation	No	No
6	HALIFAX	2003	Halifax NS	Hurricane	600	N/A	No	No	Debris removal, assistance to utility crews.	No	N/A
7	PEREGRINE	2003	Kelowna BC	Forest Fires	2,200	45	No	No	Manpower for fire fighting	Surveillance	No
8	LAMA	2010	Eastern NFLD	Hurricane	1,200	17	No	Yes, but no data available	Road clearance and repair, 3x temporary bridges, route recce, ROWPU, Assistance to utility crews Water purification (ROWPU) Medical evacuation Assistance to utility crews	Yes, including medical evacuation	Food, Fuel, and Water
9	FORGE	2011	Northwestern ON	Forest Fires	100	16	No	No	N/A	3614 evacuees	N/A
10	LUSTRE	2011	Southern MB	Flood	1,800	18	No	No	CIP, Dike repair and monitoring, mobility over water.	Yes	Sandbags
11	LOTUS	2011	Southern QC	Flood	844	43	No	No	CIP, Dike repair and monitoring, mobility over water, divers, route recce.	Air recce	Sandbags and bottled water
12	LYRE	2011	Southern MB	Flood	375	N/A	No	No	CIP	N/A	Sandbags
13	LENTUS	2013	Southern AB	Flood	2,300	7	No	No	CIP, Route Recce, Mobility over water.	Yes	Sandbags
14	LENTUS	2014	Northern ON	Flood	100	8	No	No	No	985 evacuees	No
15	LENTUS 14-05	2014	Manitoba	Flood	600	7	No	No	CIP, Route Recce, Mobility over water, culvert repair.	Yes, Surveillance and Recce	Sandbags

List of Sources:

(1) OP LENTUS http://www.forces.gc.ca/en/operations-canada-north-america/op-lentus.page
(2) Victoria 96 http://www.cbc.ca/archives/categories/environment/extreme-weather/extreme-weather-general/bc-digs-out-from-the-blizzard-of-96.html
(3) Ice Storm 98 http://www.thecanadianencyclopedia.ca/en/article/ice-storm-1998/
(4) Ice Strorm 98, 25 MP Pl http://www.oocities.org/pentagon/2931/ftx_pu.htm
(5) Swissair 98 http://en.wikipedia.org/wiki/Swissair_Flight_111
(6) Toronto 99 http://www.cbc.ca/archives/categories/environment/extreme-weather/extreme-weather-general/toronto-calls-in-troops-to-fight-massive-snowstorm.html
(7) CANOPY 05 http://www.cbc.ca/news2/background/aboriginals/kashechewan.html , http://www.wawataynews.ca/archive/all/2005/11/18/Canadian-forces-fly-to-the-aid-of-Kashechewan_11287 http://en.wikipedia.org/wiki/OP_Canopy
(8) Manitoba 14 http://www.army-armee.forces.gc.ca/en/news-publications/western-news-details-secondary-menu.page?doc=operation-lentus-14-05/hxbj1ef8
(9) CF Dental Support http://www.cda-adc.ca/en/about/forces/history/
(10) LAMA http://www.forces.gc.ca/en/news/article.page?doc=the-canadian-forces-complete-relief-operation-in-newfoundland-and-labrador/hnps1uf1
(11) NANOOK 11 http://www.forces.gc.ca/en/news/article.page?doc=whole-of-government-operation-nanook-11-concludes/hnps1vaa
(12) LUSTRE http://www.forces.gc.ca/en/news/article.page?doc=the-canadian-forces-complete-flood-mitigation-operation-in-manitoba/hnps1vac
(13) LOTUS http://www.forces.gc.ca/en/news/article.page?doc=operation-lotus-1-11/hnps1vdc
(14) Conplan Lentus article http://www.forces.gc.ca/en/news/article.page?doc=the-force-of-last-resort-how-the-caf-respond-to-natural-disasters-across-canada/hwriv2eb

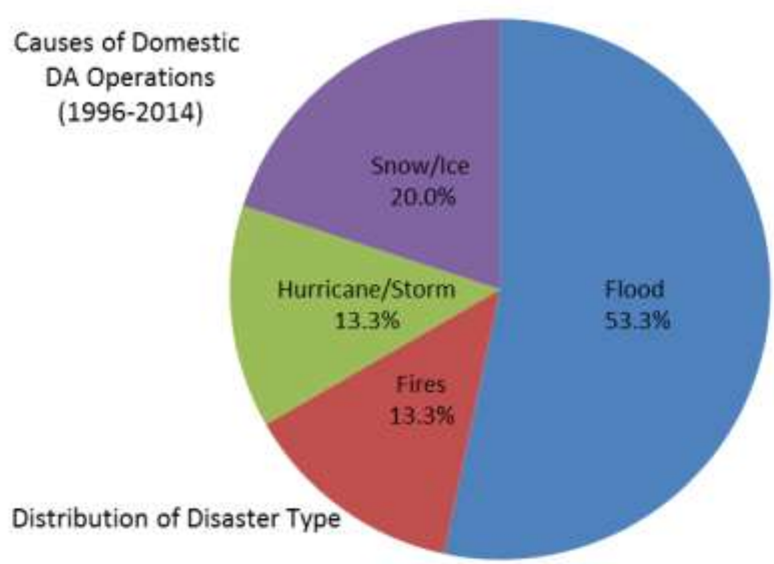
Appendix 3

ANALYSIS OF CAF DISASTER ASSISTANCE OPERATIONS

3-A. Domestic Disaster Assistance 1996-2014

Type Analysis

	Op Name	Year	Location	Type of Event*			Frequency	Percentage
1	PYRAMID	1996	Southern BC	Extreme Ice/Snow	3	Flood	8	53.3%
2	N/A	1996	Saguenay QC	Flood	1	Fires	2	13.3%
3	ASSISTANCE	1997	Southern MB	Flood	1	Hurricane/Storm	2	13.3%
4	RECUPERATION	1998	Southern ON, Southern QC	Extreme Ice/Snow	4	Snow/Ice	3	20.0%
5	PREAMBLE	1999	Toronto ON	Extreme Ice/Snow	4	Earthquake 0%	0	0.0%
6	N/A	2003	Halifax NS	Hurricane	3			
7	PEREGRINE	2003	Kelowna BC	Forest Fires	2			
8	LAMA	2010	Eastern NFLD	Hurricane	3			
9	FORGE	2011	Northwestern ON	Forest Fires	2			
10	LUSTRE	2011	Southern MB	Flood	1			
11	LOTUS	2011	Southern QC	Flood	1			
12	LYRE	2011	Southern MB	Flood	1			
13	LENTUS 13	2013	Southern AB	Flood	1			
14	LENTUS 14	2014	Northern ON	Flood	1			
15	LENTUS 14-05	2014	Manitoba	Flood	1			
				Total	* Types:			
				Avg	1-Flood, 2-Fire, 3-Hurricane/Storm, 4-Snow/Ice, 5-Earthquake			



Appendix 3

3-A. Domestic Disaster Assistance 1996-2014

Location Analysis

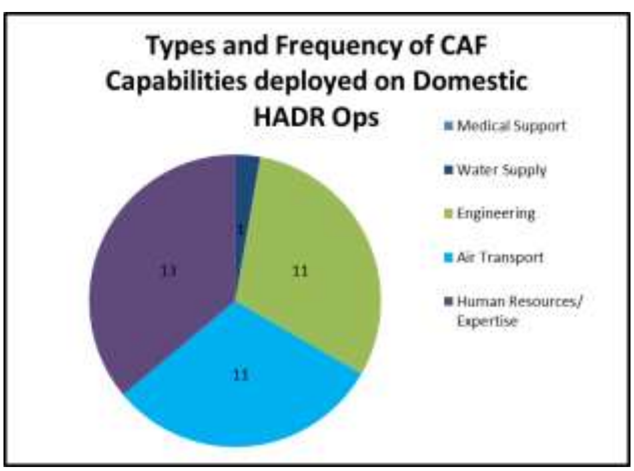
	Op Name	Year	Location	Type	West (BC to Manitoba &	Central (QC and ON)	East (maritimes)
1	BC SNOW	1996	Southern BC	Extreme Ice/Snow	1		
2	SAGUENAY	1996	Saguenay QC	Flood		1	
3	ASSISTANCE	1997	Southern MB	Flood	1		
4	RECUPERATION	1998	Southern ON, Southern QC	Extreme Ice/Snow		1	
5	PREAMBLE	1999	Toronto ON	Extreme Ice/Snow		1	
6	HALIFAX	2003	Halifax NS	Hurricane			1
7	PEREGRINE	2003	Kelowna BC	Forest Fires	1		
8	LAMA	2010	Eastern NFLD	Hurricane			1
9	FORGE	2011	Northwestern ON	Forest Fires		1	
10	LUSTRE	2011	Southern MB	Flood	1		
11	LOTUS	2011	Southern QC	Flood		1	
12	LYRE	2011	Southern MB	Flood	1		
13	LENTUS	2013	Southern AB	Flood	1		
14	LENTUS	2014	Northern ON	Flood		1	
15	LENTUS 14-05	2014	Manitoba	Flood	1		
				Total	7	6	2
				% Floods	71.43%	50%	0%
				% Hurricane/Extreme	14.29%	0.33%	100%
					West (BC to Manitoba &	Central (QC and ON)	East (maritimes)

Appendix 3

3-A. Domestic Disaster Assistance 1996-2014

Capability Analysis

				Direct	Dir/Indirect	Infra	Dir/Indirect	Indirect
	Op Name	Year	Location	Medical Support	Water Supply	Engineering	Air Transport	Human Resources/ Expertise
1	BC SNOW STORM	1996	Southern BC	0	0	0	0	1
2	SAGUENAY FLOOD	1996	Saguenay QC	0	0	1	1	1
3	ASSISTANCE	1997	Southern MB	0	0	1	1	1
4	RECUPERATION	1998	Southern ON, Southern QC	0	0	1	1	1
5	PREAMBLE	1999	Toronto ON	0	0	1	0	1
6	HALIFAX HURRICANE	2003	Halifax NS	0	0	1	0	1
7	PEREGRINE	2003	Kelowna BC	0	0	0	1	1
8	LAMA	2010	Eastern NFLD	0	1	1	1	1
9	FORGE	2011	Northwestern ON	0	0	0	1	0
10	LUSTRE	2011	Southern MB	0	0	1	1	1
11	LOTUS	2011	Southern QC	0	0	1	1	1
12	LYRE	2011	Southern MB	0	0	1	0	1
13	LENTUS 13	2013	Southern AB	0	0	1	1	1
14	LENTUS 14	2014	Northern ON	0	0	0	1	0
15	LENTUS 14-05	2014	Manitoba	0	0	1	1	1
				0	1	11	11	13
				0.0%	6.7%	73.3%	73.3%	86.7%
				% = instances of employent out of 15 operations conducted between 1996 -2014				

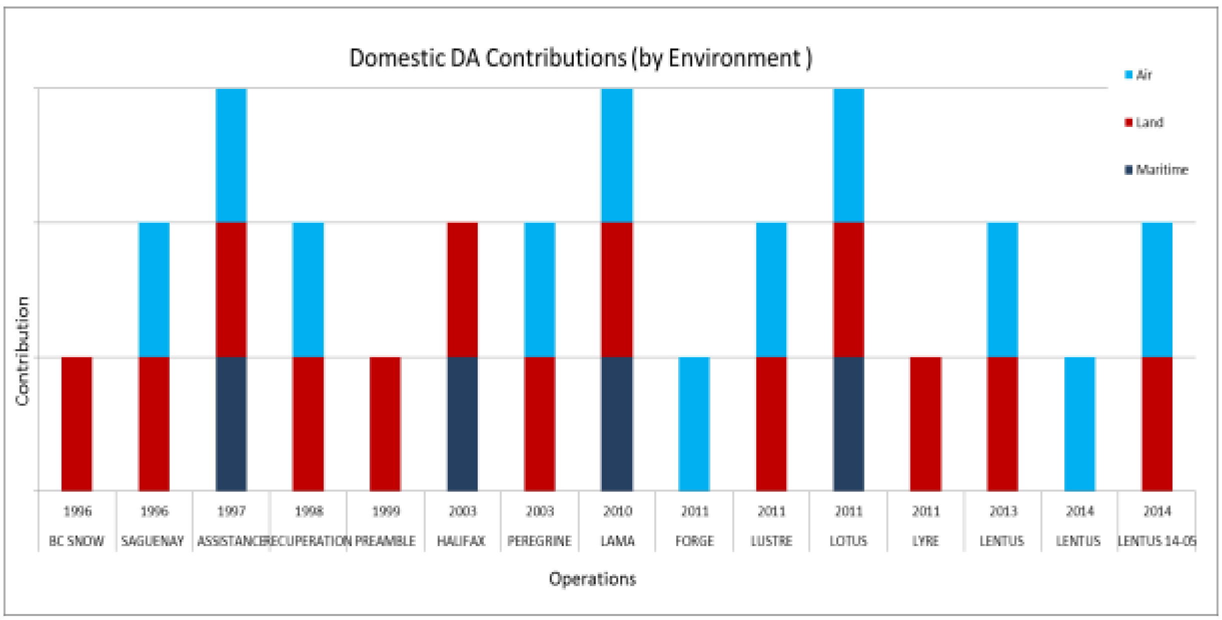


Appendix 3

3-A. Domestic Disaster Assistance 1996-2014

Contributions by Environmental Service

Op Name	Year	Location	Navy	Army	Airforce	DART
BC SNOW	1996	Southern BC	0	1	0	0
SAGUENAY	1996	Saguenay QC	0	1	1	0
ASSISTANCE	1997	Southern MB	1	1	1	0
RECUPERATION	1998	Southern ON, Southern QC	0	1	1	0
PREAMBLE	1999	Toronto ON	0	1	0	0
HALIFAX	2003	Halifax NS	1	1	0	0
PEREGRINE	2003	Kelowna BC	0	1	1	0
LAMA	2010	Eastern NFLD	1	1	1	0
FORGE	2011	Northwestern ON	0	0	1	0
LUSTRE	2011	Southern MB	0	1	1	0
LOTUS	2011	Southern QC	1	1	1	0
LYRE	2011	Southern MB	0	1	0	0
LENTUS	2013	Southern AB	0	1	1	0
LENTUS	2014	Northern ON	0	0	1	0
LENTUS 14-05	2014	Manitoba	0	1	1	0



Appendix 3

ANALYSIS OF CAF DISASTER ASSISTANCE OPERATIONS

3-B. Expeditionary Disaster Assistance 1996-2014

	Op Name	Year	Location	Type of Event	CAF Personnel (#)	Duration (days)	Medical Patients (#)	Water Produced (litres)	Engineering (construction, route opening, clean-up)	Air Mobility (Evacuation, airlift)	Aid Distribution (kg)
1	CENTRAL	1998	La Cieba, Honduras	Storm, Hurricane	270	48	7,500	254,219	Small scale engr support	Yes	114000
2	TORRENT	1999	Serdivan, Turkey	Earthquake	200	31	5,000	2,500,000	Shelter and Sanitation	Yes	N/A
3	STRUCTURE	2005	Ampara, Sri Lanka	Earthquake	200	47	7,620	3,500,000	Transport over water	Yes	N/A
4	UNISON	2005	Gulf Coast, USA	Storm, Hurricane	900	16	0	0	Vertical reconstruction, Divers	SAR	Yes
5	PLATEAU	2005	Pakistan	Earthquake	200	51	11,782	3,811,535	N/A	Yes	500000
6	HORATIO	2008	Haiti	Hurricane	219	13	0	0	N/A	Yes	450000
7	HESTIA	2010	Leogane and Jacmel, Haiti	Earthquake	2,050	78	15,000	2,900,000	Debris removal, Shelter and Sanitation, vertical construction, route clearance.	Yes	Yes
8	RENAISSANCE	2013	Iloilo, Phillipines	Storm, Typhoon	319	32	6,520	500,000	Road clearance	Yes	136200
				Total	4,358	316	53,422	13,465,754			
				Avg	623	45	7,632	1,923,679			
				DART Avg		50	8,904	2,244,292			

List of sources:

References:

(1) CAF webpage accessed 16 Jan 15. http://www.forces.gc.ca/en/operations-abroad-recurring/dart.page

(2) Op HESTIA, End Tour Report, dated 21 March 2010.

(3) Typhoon Haiyan, general info accessed 20 Jan 15. http://en.wikipedia.org/wiki/Typhoon_Haiyan

(4) Op TORRENT, CAF webpage accessed 20 Jan 15. http://www.forces.gc.ca/en/operations-abroad-past/op-torrent.page

(5) Op UNISON, CAF webpages accessed 20 Jan 15. http://web.archive.org/web/20070812232933/http://www.forces.gc.ca/site/Operations/unison/news_e.asp , http://web.archive.org/web/20070214055302/http://www.forces.gc.ca/site/newsroom/view_news_e.asp?id=1739 "The Canadian Forces has always been ready to assist when required to do so by the federal and provincial governments."

(6) http://www.cmp-cpm.forces.gc.ca/dhh-dhp/od-bdo/di-ri-eng.asp?IntlOpId=214&CdnOpId=255

(7) Directorate of History and Heritage, operations Database http://www.cmp-cpm.forces.gc.ca/dhh-dhp/od-bdo/index-eng.asp

(8) Thomas Weiss, Military Civilian Interactions: Humanitarian Crises and the Responsibility to Protect, 2nd Edition, page 107.

(9) OP HORATIO http://www.forces.gc.ca/en/operations-abroad-past/op-horatio.page , http://www.forces.gc.ca/en/news/article.page?doc=hmcs-st-john-s-heading-home-upon-completion-of-wfp-humanitarian-operation-in-haiti/hnps1tv5

Appendix 3

3-B. Expeditionary Disaster Assistance 1996-2014

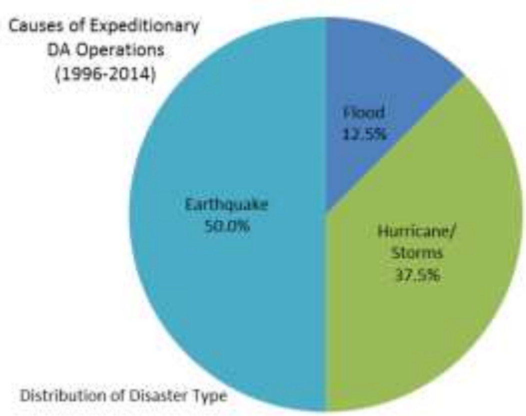
Type and Location Analysis

	Op Name	Year	Location	Type of Event *
1	CENTRAL	1998	La Cieba, Honduras	Flooding due to Hurricane
2	TORRENT	1999	Serdivan, Turkey	Earthquake
3	STRUCTURE	2005	Ampara, Sri Lanka	Earthquake
4	UNISON	2005	Gulf Coast, USA	Storm, Hurricane
5	PLATEAU	2005	Pakistan	Earthquake
6	HORATIO	2008	Haiti	Hurricane
7	HESTIA	2010	Leogane and Jacmel, Haiti	Earthquake
8	RENAISSANCE	2013	Iloilo, Phillipines	Storm, Typhoon
				Total
				Avg
				DART Avg

		Frequency	Percentage
1	Flood	1	12.5%
2	Fires 0%	0	0.0%
3	Hurricane/Storm	3	37.5%
4	Snow/Ice 0%	0	0.0%
5	Earthquake	4	50.0%

* Types: 1-Flood, 2-Fire, 3-Hurricane/Storm, 4-Snow/Ice, 5-Earthquake

DART Only		Frequency	Percentage
1	Flood	1	16.7%
2	Fires 0%	0	0.0%
3	Hurricane/Storm	1	16.7%
4	Snow/Ice 0%	0	0.0%
5	Earthquake	4	66.7%



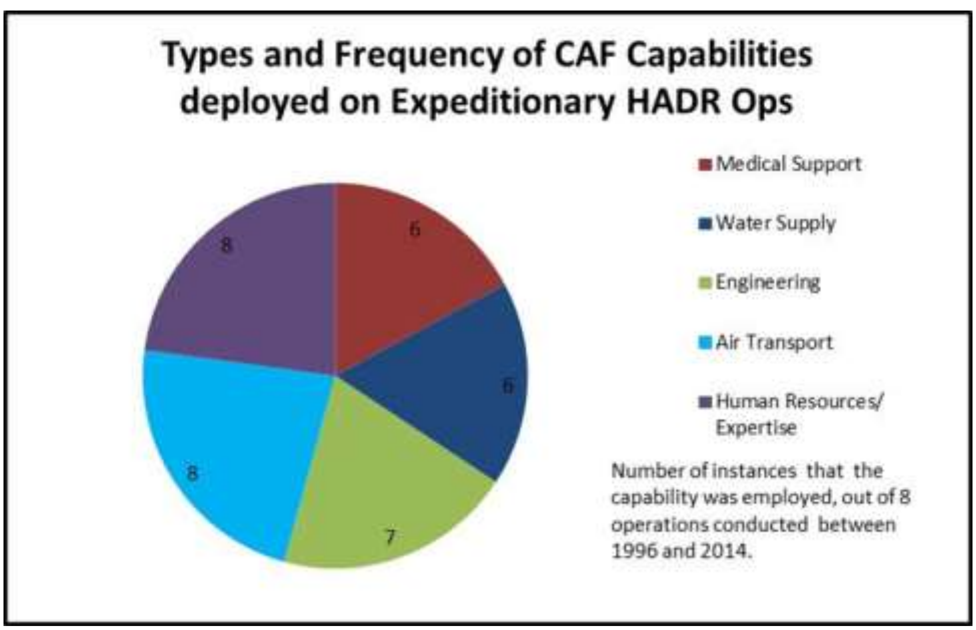
	Op Name	Year	Location	Type	Americas / Western Hemisphere	Europe/ Continental Asia	Southeast Asia/ Pacific	DART
1	CENTRAL	1998	La Cieba, Honduras	Storm Flood	1	0	0	Yes
2	TORRENT	1999	Serdivan, Turkey	Earthquake	0	1	0	Yes
3	STRUCTURE	2005	Ampara, Sri Lanka	Earthquake	0	0	1	Yes
4	UNISON	2005	Gulf Coast, USA	Storm, Hurricane	1	0	0	No
5	PLATEAU	2005	Pakistan	Earthquake	0	1	0	Yes
6	HORATIO	2008	Haiti	Hurricane	1	0	0	No
7	HESTIA	2010	Leogane and Jacmel, Haiti	Earthquake	1	0	0	Yes
8	RENAISSANCE	2013	Iloilo, Phillipines	Storm, Typhoon	0	0	1	Yes
				Total	4	2	2	
				Percentage	50%	25%	25%	
				DART Percentage	33.3%	33.3%	33.3%	

Appendix 3

3-B. Expeditionary Disaster Assistance 1996-2014

Capability Analysis

				Direct	Dir/Indirect	Infra	Indirect	Indirect
	Op Name	Year	Location	Medical Support	Water Supply	Engineering	Air Transport	Human Resources/ Expertise
1	CENTRAL	1998	La Cieba, Honduras	1	1	1	1	1
2	TORRENT	1999	Serdivan, Turkey	1	1	1	1	1
3	STRUCTURE	2005	Ampara, Sri Lanka	1	1	1	1	1
4	UNISON	2005	Gulf Coast, USA	0	0	1	1	1
5	PLATEAU	2005	Pakistan	1	1	1	1	1
6	HORATIO	2008	Haiti	0	0	0	1	1
7	HESTIA	2010	Leogane and Jacmel, Haiti	1	1	1	1	1
8	RENAISSANCE	2013	Iloilo, Phillipines	1	1	1	1	1
				6	6	7	8	8
				75%	75%	88%	100%	100%
				% - Instances of employent out of 8 operations conducted 1996 - 2014.				

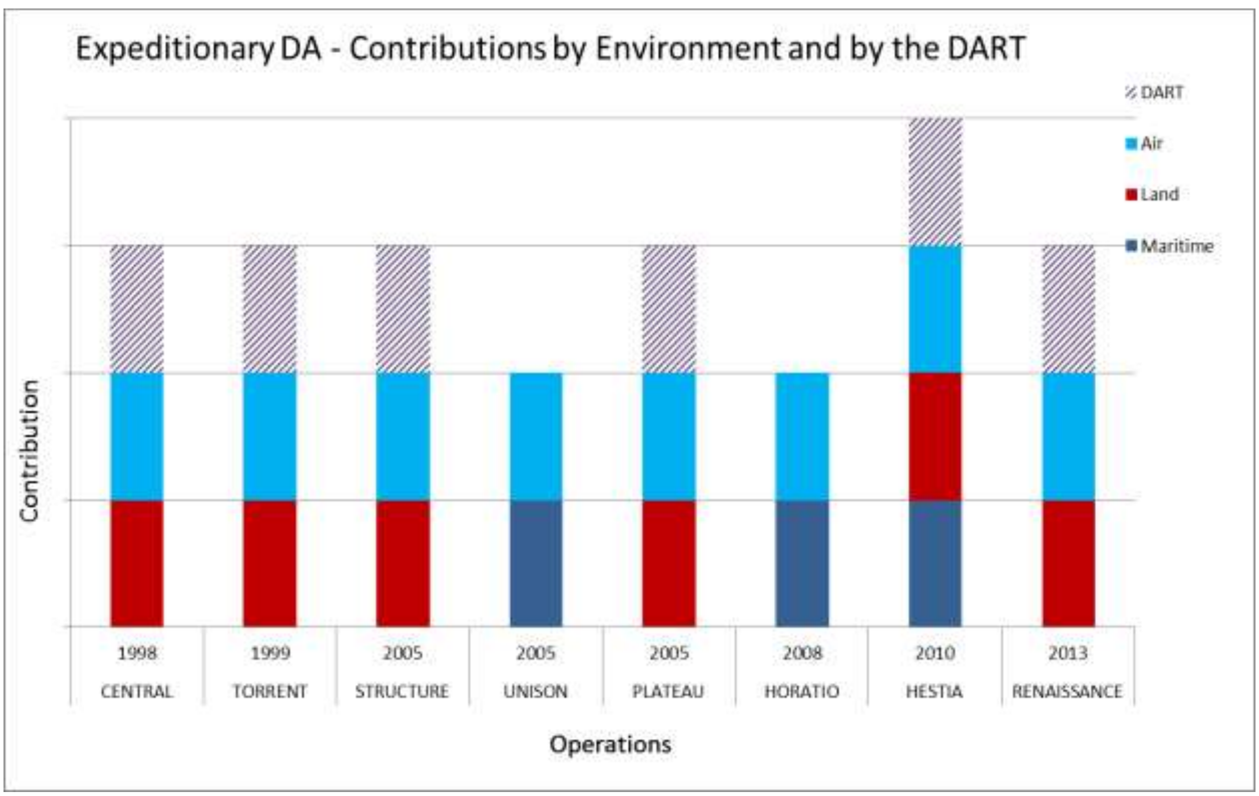


Appendix 3

3-B. Expeditionary Disaster Assistance 1996-2014

Contributions by Environment

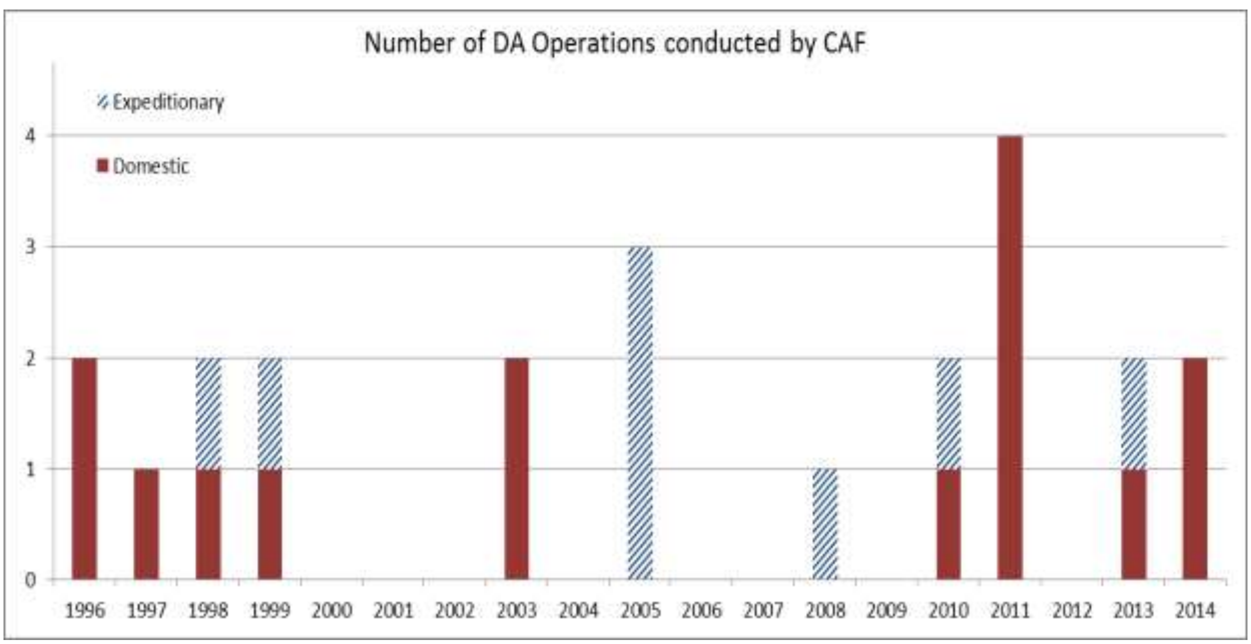
		Navy	Army	Airforce	DART
CENTRAL	1998	0	1	1	1
TORRENT	1999	0	1	1	1
STRUCTURE	2005	0	1	1	1
UNISON	2005	1	0	1	0
PLATEAU	2005	0	1	1	1
HORATIO	2008	1	0	1	0
HESTIA	2010	1	1	1	1
RENAISSANCE	2013	0	1	1	1
		3	6	8	6
	Annual Rate	0.16	0.32	0.42	0.32
	Frequency	6	3	2	3



Appendix 3

3-C. Comparison between Domestic and Expeditionary Requirements

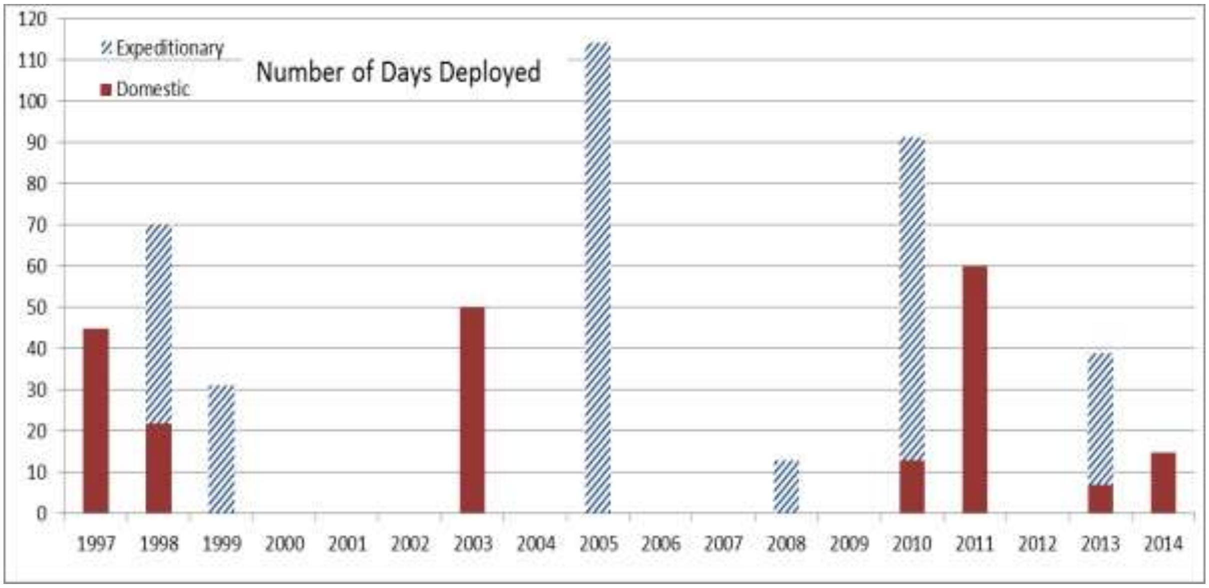
Year		DOM	EXPED		CAF Pers Deployed (total)	DOM	EXPED		Days Deployed (total)	DOM	EXPED	
1	1996	2	0		500	500	0		N/A			1996
2	1997	1	0		8700	8700	0		45	45	0	1997
3	1998	1	1		16054	15784	270		70	22	48	1998
4	1999	1	1		200	0	200		31	0	31	1999
5	2000	0	0		0	0	0		0	0	0	2000
6	2001	0	0		0	0	0		0	0	0	2001
7	2002	0	0		0	0	0		0	0	0	2002
8	2003	2	0		2800	2800	0		50	50	0	2003
9	2004	0	0		0	0	0		0	0	0	2004
10	2005	0	3		1300	0	1300		114	0	114	2005
11	2006	0	0		0	0	0		0	0	0	2006
12	2007	0	0		0	0	0		0	0	0	2007
13	2008	0	1		219	0	219		13	0	13	2008
14	2009	0	0		0	0	0		0	0	0	2009
15	2010	1	1		3250	1200	2050		91	13	78	2010
16	2011	4	0		3119	3119	0		60	60	0	2011
17	2012	0	0		0	0	0		0	0	0	2012
18	2013	1	1		2619	2300	319		39	7	32	2013
19	2014	2	0		700	700	0		15	15	0	2014
TOTALS	23 Ops	15	8		39461	35103	4358		528	212	316	

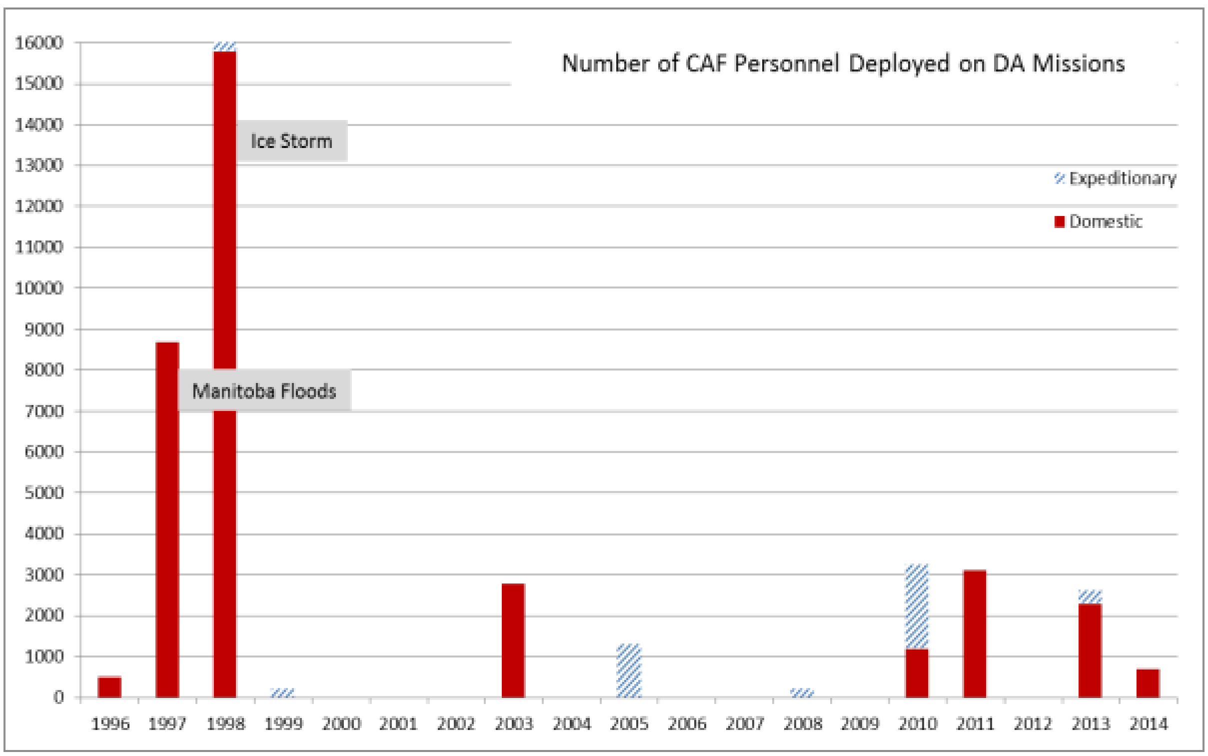


Appendix 3

ANALYSIS OF CAF DISASTER ASSISTANCE OPERATIONS

3-C. Comparison between Domestic and Expeditionary Requirements





Appendix 3

ANALYSIS OF CAF DISASTER ASSISTANCE OPERATIONS

3-D. Projections for CAF DA Operations

Calculations

OPS CONDUCTED			
	Year	Domestic DA	Expeditionary DA
1	1996	2	0
2	1997	1	0
3	1998	1	1
4	1999	1	1
5	2000	0	0
6	2001	0	0
7	2002	0	0
8	2003	2	0
9	2004	0	0
10	2005	0	3
11	2006	0	0
12	2007	0	0
13	2008	0	1
14	2009	0	0
15	2010	1	1
16	2011	4	0
17	2012	0	0
18	2013	1	1
19	2014	2	0
	23 Ops	15	8

RATE ANALYSIS		
	DOMESTIC	**EXPEDITIONARY**
19 Year Avg rate (# per yr)	0.79	0.42
Frequency*	1.27	2.38
	15 months	29 months
9 year (96-04) rate (# per year)	0.78	0.22
Frequency*	1.29	4.50
10 year (05-14) rate (# per year)	0.73	0.60
Frequency*	1.38	1.67
% Change between the 10-yr and 9-yr rates **	-6%	170%

** Frequency is the the amount of time between deployments*
ie. 1 deployment occurs every "x" number of years.
***Change = (10yr rate/9 yr rate)-1*

Projecting the % Change for the next 20 years ***		
	DOMESTIC	**EXPEDITIONARY**
2015-2024 Rate (# per year)	0.68	1.62
Frequency*	1.47	**0.62**
2025-2034 Rate (# per year)	0.64	4.37
Frequency*	1.57	**0.23**

**** Projections = previous 10 yr rate * (1+ % change)*

10-yr Average: Number of DA Missions Per Year		
Timeframe	Domestic	Expeditionary
1996-2004	0.78	0.22
2005-2014	0.73	0.60
2015-2024	0.68	1.62
2025-2034	0.64	4.37

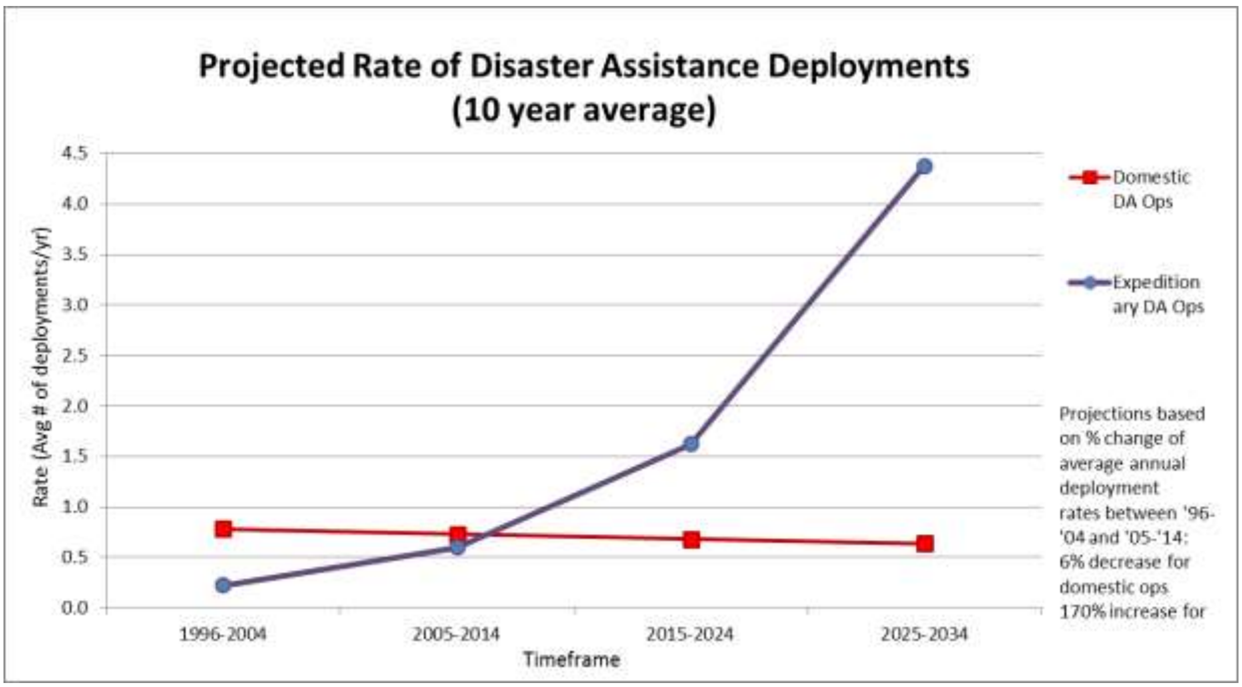
Author's note: 10 and 20-year projections were based on compounding the % change in rates observed '15-'14 (-6% for domestic operations and +170% for expeditionary operations).

Appendix 3

3-D. Projections for CAF DA Operations

Deployment Rate Comparison

Summary Table							
		Domestic DA Ops			Expeditionary DA Ops		
	Timeframe	Total Number of Deployments	Annual Rate (Deployments/ year)	Frequency (Time between deployments)	Total Number of Deployments	Annual Rate (Deployments/ year)	Frequency (Time between deployments)
Observed	1996-2004 (9 years)	7	0.78	15 months	2	0.22	4.5 years
	2005-2014	8	0.73	17 months	6	0.60	20 months
Projected	2015-2024	7	0.68	18 months	11	1.62	7 months
	2025-2034	6	0.64	19 months	31	4.37	3 months
		Frequency (Yea	Partial Years	Months	FrequencyYear	Partial years	Months
		1.282	0.282	15	4.500	0.500	54
		1.375	0.375	17	1.667	0.667	20
		1.470	0.470	18	0.617	0.617	7
		1.573	0.573	19	0.229	0.229	3

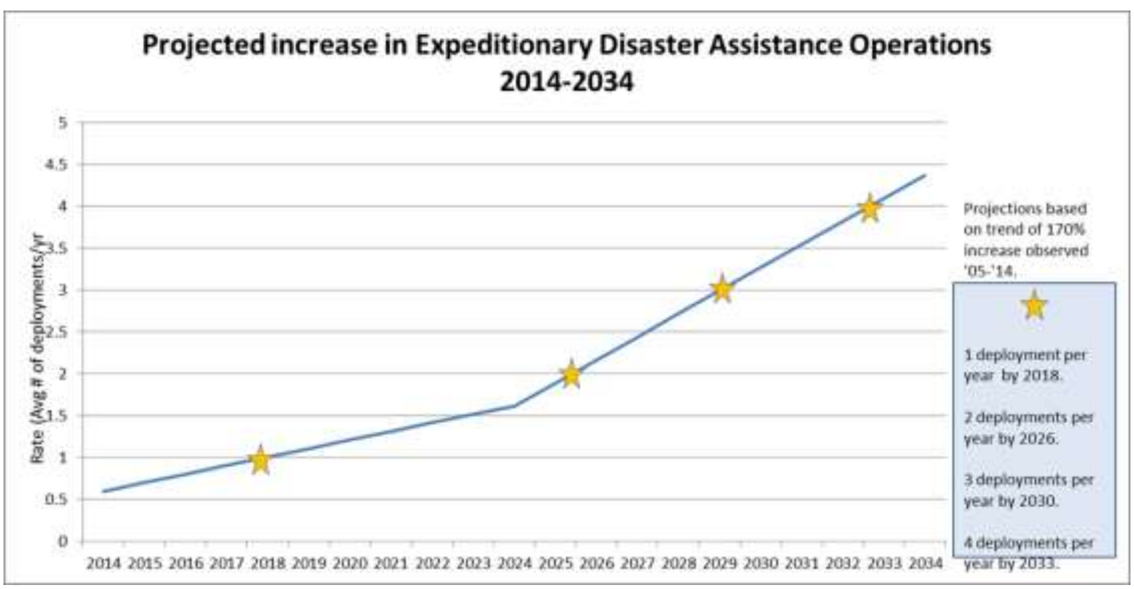


Appendix 3

3-D. Projections for CAF DA Operations

Expeditionary Outlook to 2034

Expeditionary Operations Future Estimate			
Year	Annual Rate Projection		
2014	0.6	Annual Increment 2014-2024	
2015	0.702	(1.62-0.6)/11	Total Events
2016	0.804	0.102	11.61
2017	0.906		
2018	1.008	*1 per year rate to be reached by 2018*	
2019	1.11		
2020	1.212		
2021	1.314		
2022	1.416		
2023	1.518	Annual Increment 2024-2034	
2024	1.62	(4.37-1.62)/10	Total Events
2025	1.895	0.275	31.325
2026	2.17	*2 per year rate to be reached by 2026*	
2027	2.445		
2028	2.72		
2029	2.995		
2030	3.27	*3 per year rate to be reached by 2030*	
2031	3.545		
2032	3.82		
2033	4.095	*4 per year rate to be reached by 2033*	
2034	4.37		



BIBLIOGRAPHY

Asia Pacific Centre. "Report from the Conference on the Evolving Roles of the Military in the Asia-Pacific." Last accessed 10 March 2015. http://www.apcss.org/Publications/Report_Evolving_Roles.html.

Bumgarner, Jeffrey. *Emergency Management*. Contemporary World Issues.Santa Barbara: ABC-CLIO, 2008.

Bruce, James P., *Climate Change Information for Adaptation: Climate trends and projected values for Canada 2010 to 2050,* Canada: Institute for Catastrophic Loss Reduction, (2011), 56 pages. http://www.iclr.org/images/Bruce_climate_change_info_march_2011.pdf

Carrington, Damian. "14 of the 15 Hottest Years on Record have Occurred since 2000, UN Says." *The Guardian*, 2 February 2015.

Carrington, Damian. "Climate Change Poses Grave Threat to Security, Says UK Envoy." *The Guardian*, 30 June 2013.

Climate Council. "Is Climate Change a Security Threat? The Pentagon Thinks so." Last accessed 13 February 2015. https://www.climatecouncil.org.au/climatesecurity.

Coppola, Damon. *Introduction to International Disaster Management*. 2nd ed. Boston: Butterworth-Heinemann, 2011.

De Mille, Diane. "Haitian Earthquake & Canada's Disaster Assistance Response Team DART's Label Misleads Us about the True Strenths of this Military Unit," Canadian American Strategic Review. Last accessed 10 March 2015. http://www.casr.ca/ft-dart-haiti-demille-1.htm.

Department of Foreign Affairs Trade and Development. "Responding to Humanitarian Crisis", accessed 29 March 2015, http://www.international.gc.ca/development-developpement/humanitarian_response-situations_crises/iha-ahi.aspx?lang=eng.

Department of National Defence. *B-GJ-005-302/FP-001 Canadian Forces Joint Publication 3-2 Domestic Operation*. Ottawa: DND, 2011.

Department of National Defence. *B-GJ-005-307/FP-040 Humanitarian Operations and Disaster Relief Operations*. Ottawa: DND, 2005.

Department of National Defence. *CONPLAN 20855/14 RENAISSANCE*. Ottawa: Canadian Joint Operations Command, 2014.

Department of National Defence. *Standing Operations Order for Domestic Operations (SOODO).* Ottawa: Canadian Joint Operations Command, 2014

Department of National Defence. “Departmental Performance Report 2013-14.” Last accessed 1April 2015. http://www.forces.gc.ca/en/about-reports-pubs-departmental-performance/2014-section-iii-departmental-sustainable-development-strategy.page.

Environmental Protection Agency. “Climate Change Indicators in the United States: Tropical Cyclone Activity.” Last accessed 10 February 2015. http://epa.gov/climatechange/science/indicators/weather-climate/cyclones.html

Environmental Protection Agency. "Climate Change Indicators in the United States: Drought." Last accessed 10 February 2015. http://epa.gov/climatechange/science/indicators/weather-climate/drought.html.

Etkin, David, Kenneth McBey, and Cliff Trollope. "The Military and Disaster Management: A Canadian Perspective on the Issue." In *Canadian Disaster Management Textbook*, 1-27: Canadian Risks and Hazards Network, 2011. http://www.crhnet.ca/canadian-disaster-management-textbook-chapter-5b.

Everson, K.“Canada’s 2013 DART mission to the Philippines cost $29M.” *CBC*, 15 July 2014.

Federal Emergency Management Agency. "The Disaster Process & Disaster Aid Programs." Department of Homeland Security, Last accessed 10 March 2015. https://www.fema.gov/disaster-process-disaster-aid-programs.

Goldenberg, Suzanne. "Climate Change a Threat to Security, Food and Humankind - IPCC Report." *The Guardian,* 31 March 2014.

Goldenberg, Suzanne. "US Senate Refuses to Accept Humanity's Role in Global Climate Change, again." *The Guardian,* 22 January 2015.

Government of Canada. *Federal Emergency Response Plan*. Ottawa: Public Safety Canada, 2011.

Government of Canada. *Canada First Defence Strategy*. Ottawa: DND, 2008.

Government of Canada. *Canada's Northern Strategy: Our North, our Heritage, our Future*. Ottawa: Minister of Indian Affairs and Northern Development, 2009.

Government of Canada. “Government of Canada Guidelines on Humanitarian Action and Civil-Military Cooperation.” Last accessed 20 April 2015. http://www.asean.org/archive/arf/13ARF/5thISM-DR/annex16.pdf

Guha-Sapir, Debarati, Philippe Hoyois, and Regina Below. *Annual Disaster Statistical Review 2013*. Brussels: Centre for Research on the Epidemiology of Disasters (CRED), 2014. http://www.cred.be/sites/default/files/ADSR_2013.pdf

Helmer, Madeleen and Dorothea Hilhorst. "Natural Disasters and Climate Change." *Disasters* 30, no. 1 (2006): 1-4.

Intergovernmental Panel on Climate Change (IPCC). *Climate Change 2014: Synthesis Report*. Geneva: IPCC, 2014. http://www.ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_FINAL_full.pdf

Intergovernmental Panel on Climate Change (IPCC). *Summary for Policymakers: Climate Change 2013 The Physical Science Basis*. United Kingdom: Cambridge University Press, 2013.

Intergovernmental Panel on Climate Change. “IPCC Factsheet: What is the IPCC 2013.” Last accessed 30 April 2015. http://www.ipcc.ch/news_and_events/docs/factsheets/FS_what_ipcc.pdf

Intergovernmental Panel on Climate Change. "Is Sea Level Rising?" Last accessed 8 February 2015. http://www.ipcc.ch/publications_and_data/ar4/wg1/en/faq-5-1.html.

International Federation of Red Cross and Red Crescent Societies. *World Disasters Report: Focus on Information on Disasters.* Geneva: IFRC, 2005.

International Federation of Red Cross and Red Crescent Societies. *World Disasters Report: Focus on Culture and Risk*. France: Imprimerie Chirat, 2014.

International Federation of Red Cross and Red Crescent Societies. "Responding to Disasters." , Last accessed 6 March 2015. http://www.ifrc.org/en/what-we-do/disaster-management/responding/.

Lavell, A., C. Oppenheimer, J. Diop, R. Hess, J. Lempert, R. Li, R. Muir-Wood, and S. Myeong. "Climate Change: New Dimensions in Disaster Risk, Exposure, Vulnerability, and Resilience." In *IPCC Special Report: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*, edited by Moser, Susanne and Kuniyoshi Takeuchi, 25-64. United Kingdon: Cambridge University Press, 2012.

Mamuji, Aaida. "Canadian Miltiary Involvement in Humanitarian Assistance: Progress and Prudence in Natural Disaster Response." *Canadian Foreign Policy Journal* 18, no. 2 (June 2012, 2012): 208-224.

Mark Phillips."The Role of the Military in International Disaster Relief Activities." Last accessed 29 April 2015. http://www.nids.go.jp/english/event/symposium/pdf/2011/e_03.pdf

North Atlantic Treaty Organization, *NATO Glossary of Terms and Definitions*, NATO Standardization Agency (2008), 465 pages, http://fas.org/irp/doddir/other/nato2008.pdf.

National Aeronautics and Space Administration. "NASA, NOAA Find 2014 Warmest Year in Modern Record." Last accessed 3 February 2015.

http://www.nasa.gov/press/2015/january/nasa-determines-2014-warmest-year-in-modern-record/.

National Climatic Data Center. "Global Snow & Ice : August 2012." Last accessed 9 February 2015. http://www.ncdc.noaa.gov/sotc/global-snow/2012/8.

National Oceanic and Atmospheric Administration. "National Climate Data Center Global Analysis - Annual 2014." Last accessed 9 February 2015. http://www.ncdc.noaa.gov/sotc/global/.

Nye, Joseph. "Get Smart." *Foreign Affairs* 88, no. 4 (2009): 160-163.

O'Brien, Geoff, Phil O'Keefe, Joanne Rose, and Ben Wisner. "Climate Change and Disaster Management." *Disasters* 30, no. 1 (2006): 65-80.

Office of the Auditor General of Canada. *Responding to the Onset of International Humanitarian Crises*. Ottawa: Government of Canada, 2014. www.oag-bvg.gc.ca.

ReliefWeb. *Glossary of Humanitarian Terms.*Geneva: World Health Organization, 2008.

The Center for Climate and Security. "The Center for Climate & Security Exploring the Security Risks of Climate Change." Last accessed 10 February 2015. http://climateandsecurity.org/.

The Climate Institute. "Oceans and Sea Level Rise." Last accessed 8 February 2015. http://www.climate.org/topics/sea-level/#sealevelrise.

Thompson, Wiley. "Success in Kashmir: A Positive Trend in Civil-Military Integration during Humanitarian Assistance Operations." *Disasters* 34, no. 1 (2010): 1-15.

United Nations Office for the Coordination of Humanitarian Affairs. *Civil-Military Guidelines and References for Complex Emergencies*. New York: United Nations, 2008.

United Nations Office for the Coordination of Humanitarian Affairs. *Oslo Guidelines*. Geneva: United Nations, 2008.

United Nations Office for Disaster Risk Reduction. "UNISDR Terminology Page." Last accessed 11 February 2015. http://www.unisdr.org/we/inform/terminology.

United States. “DoD Releases Climate Change Adaptation Roadmap.” Last accessed 2 April 2015. http://www.defense.gov/Releases/Release.aspx?ReleaseID=16976.

United States. *Quadrennial Defense Review Report*. Washington: Secretary of Defense, 2014.

United States. *U.S. Navy Arctic Roadmap for 2014 to 2030*. Washington: US Navy, 2014.

United States Army. "Army National Guard." Last accessed 10 March 2015. http://www.army.mil/news/nationalguard/.

United States Army. "The US Army Corps of Engineers Releases Robust Climate Change Adaptation, Strategic, Sustainability Plans" Last accessed 13 February 2015. http://www.usace.army.mil/Media/NewsArchive/StoryArticleView/tabid/232/Article/547550/the-us-army-corps-of-engineers-releases-robust-climate-change-adaptation-strate.aspx.

United States Navy, "Energy, Environment, and Climate Change – Great Green Fleet." Last accessed 2 April 2015, http://greenfleet.dodlive.mil/energy/great-green-fleet/.

van Aalst, Maarten. "The Impacts of Climate Change on the Risk of Natural Disasters." *Disasters* 30, no. 1 (2006): 5-18.

Warren, Fiona and Donald Lemmen. *Synthesis:Canada in a Changing Climate - Sector Perspectives on Impacts and Adaptation*. Ottawa: Natural Resources of Canada (NRCAN), 2012.

Wiharta, Sharon, Hassan Ahmad, J-Y Haine, Josefina Lofgren, and Tim Randall. *The Effectiveness of Foreign Military Assets in Natural Disaster Response*. Sweden: Stockholm International Peace Research Institute (SIPRI), 2008.

World Population Statistics. "World Population 2014." Last accessed 13 February 2015. http://www.worldpopulationstatistics.com/population-of-asia-2014/.

Worley, Robert. "Instruments of Power." Last accessed 30 November 30 2014. www.drworley.org/Pubs/Orchestrating/3b-Instruments.doc.

Zinni, Anthony, Ronald Keys, and Frank Bowman. "US Military Refuses to be 'Too Late' on Climate Change." *The Sydney Morning Herald*, 29 October 2014.