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# Search and Rescue in the Arctic

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# Abstract

The melting of Arctic sea ice leads to an increase in maritime traffic in the region. Growing maritime activity also increases the risk of emergency situations at sea. In order to enhance safety and security the Arctic Council in May 2011 adopted a legally binding “agreement on cooperation in aeronautical and maritime search and rescue in the Arctic”. The challenges for search and rescue operations are manifold: the sheer size of the region, the harsh environment, a capability gap and the lack of sufficient support infrastructure. The aim of this paper is to analyze the status quo of search and rescue cooperation in the Arctic and to make preliminary conclusions about how to close existing capability gaps.

# 1. Introduction

The last decades have seen a dramatic decline of Arctic sea ice. Within the last five years the Arctic[1] has witnessed two record minimum sea ice extents. In 2007 4.28 million square kilometres were covered by ice and in 2012 the ice sheet shrunk to 4.10 million square kilometres.[2] Based on a large number of climatic models and experts assessments a further sea ice decrease could lead to an ice-free Arctic ocean during summer months already within the next decade at the earliest.[3] This results in greater marine access and longer seasons of navigation.[4] Greater marine access, in combination with high global commodity prices and growing global energy demand, might lead to more exploration and exploitation of natural resources (oil, gas, minerals), that are then shipped to European and Asian markets. Longer seasons of navigation further increase the strategic value and use of both the Northern Sea Route (NSR) and the Northwest Passage (NWP) as shipping and transit passages between the Atlantic and the Pacific. Greater marine access and longer seasons of navigation also have led already to a significant increase of tourist voyages into Arctic waters.

Economic opportunities aside growing maritime traffic increases the risk of emergency situations (e.g. ship accidents) arising at sea. Due to the vast size of the region, the harsh climatic conditions and the lack of adequate support infrastructure and associated capabilities such an emergency scenario at sea is particular challenging.[5] Against this background the Arctic Council (AC) in 2011 adopted its first legally binding agreement on the creation of an Arctic wide aeronautical and maritime search and rescue (SAR) system.

The aim of this paper is to analyze the key challenges for search and rescue (SAR) operations at sea and to give, on a basis of publicly accessible documents and interviews with experts and SAR officials, a preliminary overview of the existing SAR system in the Arctic. In a first step an overview of the main areas of maritime economic activities will be given. Subsequently the key challenges of growing maritime economic activities will be discussed. This will be followed by an in-depth analysis of the existing search and rescue system which encompasses the legal, operational and cooperation frameworks related to SAR as well as existing capabilities of the AC member states. Against the background of current and potential future maritime activities and on the basis of

[1] In this paper, the Arctic region is defined as the Northern hemisphere region located north of the Arctic circle, i.e. the circle of latitude where sunlight is uniquely present or absent for 24 continuous hours on the summer and winter solstices, respectively. The Arctic Circle spans the globe at 66.65º (66º34º) north latitude.

[2] U.S. National Snow & Ice Data Center, 2012, http://nsidc.org/arcticseaicenews/2012/08/arctic-sea-ice-breaks-2007-record-extent/ (06.12.2012); J. J. Corbett/D. A. Lack/J. J. Winebrake/S. Harder/J. A. Silberman/M. Gold, 2010, Arctic Shipping Emissions Inventories and Future Scenarios, *Atmospheric Chemistry and Physics*, 10, pp. 9689-9704.

[3] Andreas Maurer/Stefan Steinicke/Arno Engel/Stefanie Mnich/Lisa Oberländer, 2012, *The EU as an Arctic Actor? Interests and Governance Challenges*, SWP, Berlin, 23-25 May 2012, Conference Report.

[4] Arctic Council: *Arctic Marine Shipping Assessment 2009 Report*. 2009, p. 4; G. P. Peters/T. B. Nilssen/L. Lindholt/M. S. Eide/S. Glomsrød/L. I. Eide/J. S. Fuglestvedt, 2011, Future Emissions from Shipping and Petroleum Activities in the Arctic, *Atmospheric Chemistry and Physics*, 11, pp. 5305-5320.

[5] For details about the potential emergency scenarios see: Snyder, John M., *Arctic Marine Tourism. Its History, Prospects and Management*, Colorado, 30 Sept. 2008, (http://arcticportal.org/uploads/Ic/xH/IcxHWm1ZUDJTcLBgqJTv3w/5-4-Arctic-Marine-Tourism-Its-History-Prospects-an.pdf), 18; Coastal Response Research Center at the University of New Hampshire, 2009, Opening the Arctic Seas. Envisioning Disasters and Framing Solutions, http://www.crrc.unh.edu/workshops/arctic_spill_summit/arctic_summit_report_final.pdf.

observed challenges for SAR activities the paper identifies capability gaps. Finally several options on how to close these gaps will be discussed.

## 2. Maritime Economic Activities and its Implications for Safety and Security at Sea

Increasing maritime traffic in the Arctic is first and foremost the result of growing drilling, shipping and tourism activities. According to the U.S. Geological Survey about 25% of global unproven oil and gas resources are expected to lie in the region.[6] Already in 2002 the Arctic share of global petroleum production was 16.2%.[7] As global energy demand is expected to grow by one-third until 2035 Arctic energy resources could become a critical supply base. [8] The Arctic is also home to a number of raw material deposits of global scale. Transport by sea of these energy resources and raw materials to global markets often is the only option. Most prominently is the recent increase of transport of these resources along the NSR. From 2010 to 2011 cargo transport along the NSR, has increased from four vessels to 34. The total amount of cargo grew from 111,000 to 820,000 tons.[9] 2012 has set a new transit record along the NSR. Until October already 35 ships with a total of 1.022,577 tons of cargo travelled along the NSR.[10] In November at the end of the shipping season 46 vessels had taken the NSR.[11] Against the background of soaring sea ice decrease a further rise of these numbers seems plausible. And though current international transit traffic between Western Europe and Asia along the NSR is tiny, compared to traditional transit passages like the Suez or Panama Canals, the shipping of raw material exports from Russian ports along the NSR to Western Europe, as well as to China has multiplied since 2000.[12] Transport, transit and cabotage will grow to about 4,0000 tons in the year 2015.[13] Thus in coming years and decades the NSR might become a regular shipping route between Asia and Europe, especially since the Panama and the Suez Canals are approaching their carrying capacity[14] and the trade volume between the European Union and Asian-ASEM countries (Asia-Europe Meeting) grew again after the financial crisis in 2008/2009 and in 2011 even exceeded the volume from 2008.[15]

[6] U.S. Geological Survey, 2008, 90 Billion Barrels of Oil and 1,670 Trillion Cubic Feet of Natural Gas Assessed in the Arctic, http://www.usgs.gov/newsroom/article.asp?ID=1980#.UMC6nEEvPDY (06.12.2012).

[7] Lars Lindholt, *Arctic Natural Resources in a Global Perspective*, http://www.ssb.no/english/subjects/00/00/30/sa_economy_north/sa84_en/kap3.pdf (06.12.2012), p. 27.

[8] International Energy Agency, 2012, *World Energy Outlook 2012. Executive Summary*, http://www.iea.org/publications/freepublications/publication/English.pdf (06.12.2012), p. 1; Ed Crooks/Guy Chazan, 2012, Drills, Chills and Spills, *Financial Times*, http://www.ft.com/intl/cms/s/0/7a4d24fc-f5c0-11e1-a6bb-00144feabdc0.html#axzz2EHvhyuxv (06.12.2012).

[9] Trude Pettersen, 2012: Record Number of Bulk Carriers through Northern Sea Route, *Barents Observer*, 14.06.2012, http://barentsobserver.com/en/business/record-number-bulk-carriers-through-northern-sea-route (06.12.2012).

[10] Trude Pettersen, 2012, Cargo Record on Northern Sea Route, *Barents Observer*, http://barentsobserver.com/en/business/cargo-record-northern-sea-route-15-10 (06.12.2012).

[11] Barents Observer, 2012, 46 Vessels through Northern Sea Route, *Barents Observer*, http://www.barentsobserver.com/en/arctic/2012/11/46-vessels-through-northern-sea-route-23-11 (06.12.2012).

[12] Margaret Blunden, 2012, "Geopolitics and the Northern Sea Route", *International Affairs* 88: 1 (2012), p. 115.

[13] Kimmo Juurmaa, 2011, *Some Developments after AMSA*, Presentation at the Royal United Services Institute, London, DeltaMarin.

[14] Margaret Blunden, 2012, "Geopolitics and the Northern Sea Route", *International Affairs* 88: 1 (2012), p. 119.

[15] European Commission Directorate General for Trade, 2012, *Asian ASEM Countries EU Bilateral Trade and Trade with the World*, http://trade.ec.europa.eu/doclib/docs/2006/september/tradoc_113472.pdf, (06.12.2012).

Tourism is another economic growth factor in the Arctic. In the last decades the cruise ship industry has become the key factor of growing mass tourism.[16] Cruise ship traffic has increased exponentially in recent years. In 2004 1.2 million passengers travelled to Arctic destinations aboard cruise ships and by 2007 the number had already more than doubled.[17] The number of cruise ships operating in Canadian waters doubled from 11 to 22 in 2006. In 2007 Norway alone received 1.13 million cruise ship passengers. From 2006 to 2007 the number of cruise ship passengers in Alaska grew by 9.2%. The total number of passengers was already twice as large as the state's total population. The most dramatic growth rates are found in Iceland and Greenland. Since 1990 tourism in Iceland has grown annually by at least 9%. The cruise ship sector represents the fastest growing segment of tourism in Iceland. Greenland has an annual growth rate of cruise ship passengers of about 30%. In 2006 about 22,000 passengers visited Greenland. By numbers this represents nearly half of Greenland's total population.[18] From 2002 to 2008 the number of nights spent at Greenlandic hotels rose from 179,349 to 236,913.[19]

Economic opportunities aside growing maritime traffic also increases the risk of emergency situations at sea. These scenarios can range from ship groundings or a ship trapped in ice to a drill ship incident or ship collisions.[20] Maritime emergency scenarios are particularly challenging in the Arctic for several reasons.

1. The vast size of the region:

   The Arctic encompasses 14 Mio. square kilometres.[21] Most parts of the region are sparsely populated. The majority of its inhabitants live in the southern part of the region but not in the north.

2. The harsh climatic conditions:

   In winter average temperatures fall down to -34ºC.[22] This could have negative implications for aircraft and helicopter operations. The icing of ships makes them more top-heavy, further enhancing the risk of a skew position of a ship or the failure of some ship functions.[23] The drifting of icebergs is another major risk as it could split the hull, leading in a worst-case scenario to the abandonment of the ship. Finally, for long time periods the region is in relative darkness further complicating navigation in Arctic waters.

[16] John M. Snyder, 2008, *Arctic Marine Tourism. Its History, Prospects and Management*, http://arcticportal.org/uploads/5b/91/5b91YD6bR11S7jsDBI7J-g/5-4-Arctic-Marine-Tourism-Its-History-Prospects-an.pdf, (06.12.2012), p. 8.
[17] John M. Snyder, 2008, *Arctic Marine Tourism. Its History, Prospects and Management*, http://arcticportal.org/uploads/5b/91/5b91YD6bR11S7jsDBI7J-g/5-4-Arctic-Marine-Tourism-Its-History-Prospects-an.pdf, (06.12.2012), p. 9.
[18] John M. Snyder, 2008, *Arctic Marine Tourism. Its History, Prospects and Management*, http://arcticportal.org/uploads/5b/91/5b91YD6bR11S7jsDBI7J-g/5-4-Arctic-Marine-Tourism-Its-History-Prospects-an.pdf, (06.12.2012), pp. 9-11.
[19] Charles Emmerson, 2012, *Arctic Opening. Opportunity and Risk in the High North*, Lloyds and Chatham House, http://www.lloyds.com/News-and-Insight/Risk-Insight/Reports/Arctic-Report-2012 (06.12.2012), p. 31.
[20] For a detailed **overview of** different maritime emergency scenarios see: Coastal Response Research Center at the University of New Hampshire, 2009, *Opening the Arctic Seas. Envisioning Disasters and Framing Solutions*, http://www.crrc.unh.edu/workshops/arctic_spill_summit/arctic_summit_report_final.pdf.
[21] Central Intelligence Agency, 2011, *Oceans. Arctic Ocean*, https://www.cia.gov/library/publications/the-world-factbook/geos/xq.html (06.12.2012).
[22] NASA, 2006, *Arctic Ice Meltdown Continues with Significantly Reduced Winter Ice Cover*, http://www.nasa.gov/centers/goddard/news/topstory/2006/seaice_meltdown.html.
[23] Charles Emmerson, 2012, *Arctic Opening. Opportunity and Risk in the High North*, Lloyds and Chatham House, http://www.lloyds.com/News-and-Insight/Risk-Insight/Reports/Arctic-Report-2012, (06.12.2012), p. 37.

3. The lack of sufficient support infrastructure:

   As a consequence of small populations in the northern parts also adequate infrastructure (ports, landing strips, hospitals, etc.) that would match up with the increased economic activities, is lacking.

All these factors could negatively affect SAR operations.

# 3. The Current State of Search and Rescue in the Arctic

Even though the Arctic Council's SAR agreement has only been signed in 2011 the region has been before subject to a wide range of legal and operational frameworks aimed at ensuring safety at sea. However the significant increase of maritime traffic in recent years is straining the coastal states' SAR capabilities significantly. Therefore the coastal states are cooperating in a wide range of questions regarding SAR in the Arctic. This cooperative approach challenges the conventional wisdom of inevitable (military) confrontations in the region.

## 3.1 Legal Frameworks

In general SAR operations are planned and organized on the basis of different international agreements. These include the 1979 *International Convention on Maritime Search and Rescue* (SAR Convention)[24], the 1982 *United Nations Convention on the Law of the Sea* (UNCLOS III)[25], the 1994 *Convention on International Civil Aviation* (Chicago Convention)[26] and the *International Aeronautical and Maritime Search and Rescue Manual* (IAMSAR Manual).[27] In 2002 the International Maritime Organization (IMO) approved the *Guidelines for Ships operating in Arctic Ice-Covered Waters* [28] as a specification beyond the more general existing requirements of the *International Convention for the Safety of Life at Sea*[29] (SOLAS Convention) that was approved in its first version in 1914 in response to the Titanic disaster.[30]

[24] International Maritime Organization, 2011, *International Convention on Maritime Search and Rescue (SAR),* http://www.imo.org/about/conventions/listofconventions/pages/international-convention-on-maritime-search-and-rescue-%28sar%29.aspx (06.12.2012).

[25] United Nations, 2011, *United Nations Convention on the Law of the Sea*, http://www.un.org/Depts/los/convention_agreements/convention_overview_convention.htm (06.12.2012).

[26] International Civil Aviation Organization, *Convention on International Civil Aviation*, http://www.icao.int/publications/pages/doc7300.aspx (07.12.2012).

[27] International Maritime Organization, 2011, *International Aeronautical and Maritime Search and Rescue Manual*, http://www.imo.org/OurWork/Safety/RadioCommunicationsAndSearchAndRescue/SearchAndRescue/Pages/IAMSARManual.aspx (06.12.2012).

[28] International Maritime Organization, *Guidelines for Ships operating in Arctic Ice-Covered Waters*, London, 2002, http://www.gc.noaa.gov/documents/gcil_1056-MEPC-Circ399.pdf (06.12.2012).

[29] International Maritime Organization, 2011, International Convention of the Law of the Sea (SOLAS), http://www.imo.org/about/conventions/listofconventions/pages/international-convention-for-the-safety-of-life-at-sea-%28solas%29,-1974.aspx (06.12.2012); http://www.shmsa.gov.cn/UserFiles/File/e%20SOLAS%20consolidated%20edition2004.pdf (06.12.2012).

[30] International Maritime Organization, *International Convention on Maritime Search and Rescue*, http://www.imo.org/About/Conventions/ListOfConventions/Pages/International-Convention-on-Maritime-Search-and-Rescue-%28SAR%29.aspx (07.12.2012); United Nations Division for Ocean Affairs and the Law of the Sea, *United Nations Convention on the Law of the Sea*, http://www.un.org/Depts/los/convention_agreements/texts/unclos/UNCLOS-TOC.htm (07.12.2012); International Maritime Organization, 2011, *IAMSAR Manual*, http://www.imo.org/OurWork/Safety/RadioCommunicationsAndSearchAndRescue/SearchAndRescue/Pages/IAMSARManual.aspx (07.12.2012); Internation-

All these frameworks also apply to maritime activities in the Arctic.

## 3.2 Operational Frameworks

A number of operational frameworks related to Maritime Domain Awareness[31] and SAR are applicable to the region. These include ship tracking systems, navigational and meteorological warning systems and SAR distress alert detection and information distribution systems.

With regard to ship tracking three major systems exist: AMVER, AIS and LRIT.

1. Since 1958 already the U.S. Coast Guard operates the Automated Mutual-Assistance Vessel Rescue System (AMVER). Any commercial vessel over 1,000 gross tons as well as vessels like private yachts or research vessels can enrol in this computer-based voluntary global ship reporting system. This database is then used by SAR authorities to assist in emergency situations at sea.[32] Today, more than 20,000 ships from hundreds of nations participate; more than 4,000 are on AMVER plot every day.[33]
2. In 2000 the International Maritime Organization (IMO) adopted the Automatic Identification System (AIS) as a global standard system to exchange navigational ship data in order to enhance maritime safety and security.[34]
3. Further on in 2006 the Maritime Safety Committee of the IMO established an amendment of the so called Safety of Life at Sea Convention (SOLAS). Ships greater than 300 gross tons and cruise liners operating in international waters are required to frequently transmit information about their identity, location and date and time of position in a distance up to 1,000 nautical miles (1852 km) off the coast via satellite based Long Range Identification and Tracking (LRIT).[35] This information will be send to data collection centres that can provide this information to SOLAS contracting governments and SAR organisations. In Europe, information will be received and processed by the European Maritime Safety Agency (EMSA)[36].

Navigational and meteorological warnings are broadcasted by the World-Wide Navigational Warning Service (WWNWS). In 2008 the IMO agreed that a common broad-

al Maritime Organization, 2002, *Guidelines for Ships operating in Arctic Ice-Covered Waters*, http://www.gc.noaa.gov/documents/gcil_1056-MEPC-Circ399.pdf (07.12.2012).
International Maritime Organization, 2011, *International Convention for the Safety of Life at Sea (SOLAS),* http://www.imo.org/about/conventions/listofconventions/pages/international-convention-for-the-safety-of-life-at-sea-%28solas%29,-1974.aspx (07.12.2012).

[31] Maritime Domain Awareness (MDA) is the effective understanding of anything associated with the maritime domain that could affect the security, safety, economy, or environment of the United States (see: Department of Defense, 2011, *Report to Congress on Arctic Operations and the Northwest Passage*, http://www.defense.gov/pubs/pdfs/Tab_A_Arctic_Report_Public.pdf, p. 14 (07.12.2012)).

[32] The Automated Mutual Assistance Vessel Rescue System, *Saving Lives at Sea Since 1958*, http://www.amver.com/facts/FactSheet.pdf (07.12.2012).

[33] For further details see: United States Coast Guard, 2012, *Welcome to AMVER*, http://www.amver.com (07.12.2012).

[34] International Maritime Organization, 2011, *AIS Transponders*, http://www.imo.org/ourwork/safety/navigation/pages/ais.aspx (07.12.2012).

[35] International Maritime Organization, 2011, *Long-Range Identification and Tracking (LRIT),* http://www.imo.org/OurWork/Safety/Navigation/Pages/LRIT.aspx (07.12.2012).

[36] European Maritime Safety Agency, 2012, *Vessel Tracking Globally (LRIT),* http://emsa.europa.eu/operations/lrit.html (07.12.2012).

cast system for maritime safety information within the WWNWS is also required for the Arctic region. This extended system was declared “fully operational” in 2011.[37] Five new Navigational Warning Areas (NAVAREAS) and Meteorological Areas (METAREAS) were created in the Arctic under the responsibility of Canada, Norway and the Russian Federation.[38] Their geographical limit lays at 90°N.[39] The WWNWS broadcasts all relevant information within a specified area to all ships that are equipped with receivers.

Most important for the reporting of vessels in distress is the Global Maritime Distress and Safety System (GMDSS). Since February 1999 ships with more than 300 gross tons and all passenger ships have to be equipped with communication, warning and alert systems within the Global Maritime Distress and Safety System (GMDSS). In the Arctic, ships have to be equipped with the most extensive set of devices that covers traditional radio communications by Very High Frequency (VHF), High Frequency (HF) and Medium Frequency (MF)[40] and Inmarsat satellite communications.[41]

A key part of GMDSS is the COSPAS-SARSAT satellite programme, established by Canada, France the former USSR and the United States.[42] In case of maritime emergencies, the position of the accident can be send to satellites via Emergency Position-Indicating Radio Beacons (EPIRB’s) that are mandatory ship equipment under the SOLAS convention.[43] The information will then be forwarded from satellites to respective ground control stations. So far the distress alerts can be detected globally up to about 70-75º north (with a five degree elevation angle).[44] Still, as previous ice covered areas become accessible for maritime traffic, the danger of incidents above 75-80º north is growing. Further challenging swift SAR responses is the yet small number of satellites available (only six) that have to pass over a beacon to detect and locate it, before they can send the signal to ground stations.[45] This presents another challenge for swift SAR responses.

[37] International Maritime Organization, 2011, *Expansion of World-Wide Navigational Warning System into Arctic Waters marked by IMO, WMO and IHO Chiefs*, http://www.imo.org/MediaCentre/PressBriefings/Pages/11-arctic.aspx (07.12.2012).

[38] Canada is responsible for NAVAREA/METAREA XVII and XVIII, Norway for Area XIX and the Russian Federation for Areas XX and XXI (see: International Maritime Organization, 2011, *Expansion of World-Wide Navigational Warning System into Arctic Waters marked by IMO, WMO and IHO Chiefs*, http://www.imo.org/MediaCentre/PressBriefings/Pages/11-arctic.aspx (07.12.2012).

[39] For details about the limits of the areas see: *Establishment of Arctic Maritime Safety Information Services. 5 new Arctic NAVAREAs/METAREAs*, http://weather.gmdss.org/General_Arctic_Announcement_final-advance_notice.pdf (07.12.2012) and mapped: International Hydrographic Organization, *Navigation Warnings on the Web*, http://www.iho.int/mtg_docs/com_wg/CPRNW/CPRNW_Misc/RNW_on_the_web.htm (07.12.2012).

[40] The range of radio communication depends on the used radio frequency. As higher the frequency, as lower the range. While VHF only covers line-of-sight communications, HF could be used to communicate worldwide. In general, radio communications are influenced by meteorological conditions that could cause unexpected ranges or disturbances. Radio communication could be received and relayed by aircraft or satellites.

[41] Canadian Coast Guard, 2008, *Global Maritime Distress and Safety System*, http://www.ccg-gcc.gc.ca/eng/CCG/SAR_Gmdss (07.12.2012); for information about Inmarsat see: Inmarsat, 2012, *About Us*, http://www.inmarsat.com/corporate/about-us/index.htm (07.12.2012).

[42] Cospas Sarsat, *International Cospas-Sarsat Programme*, http://www.cospas-sarsat.org/en/about-us/about-the-programme-g/international-cospas-sarsat-programme (07.12.2012).

[43] Cospas Sarsat, 2012, *About Beacons*, http://www.cospas-sarsat.org/en/system/detailed-system-description/beacons (07.12.2012); The Global Maritime Distress and Safety System, *Operational Requirements*, http://www.gmdss.com.au/requirements.html (07.12.2012).

[44] E-mail interview, COSPAS-SARSAT, 05.09.2012.

[45] E-mail interview, Joint Rescue Coordination Centre North Norway, 06.09.2012.

As demonstrated, a diverse set of tools is also applicable to the Arctic maritime environment. Yet with regard to satellite coverage serious gaps exist.

## 3.3 Cooperation Frameworks

During the Cold War the militarization of the Arctic prevented any form of regional SAR cooperation. It was Gorbachev's Murmansk Initiative in 1987 that paved the way for a more cooperative approach in Arctic affairs. A diminishing military presence after the end of the Cold War paved the way for more international cooperation.[46] In 1993 Russia, the USA and Canada held the first Arctic Search and Rescue Exercise (SAREX) in Siberia, aiming at improving SAR procedures between the three countries.[47] In 1996 NATO, under the Partnership for Peace Programme (PfP), sponsored a SAREX exercise in which military units from Russia, Canada and the United States trained common SAR procedures and the delivery of humanitarian assistance. The exercise was organized by the Russian Ministry of Defense.[48] Since then several national and multilateral SAR exercises have been held, like the annual Russian-Norwegian "Barents Exercise" or the biennial exercise "Northern Eagle", organized by Norway, Russia and the United States.[49] But it was only in 2011 that all Arctic coastal states agreed on the creation of a region-wide SAR system.

On 12 May 2011 the so called "Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic" was signed in Nuuk (Greenland) by the member states of the AC.[50] This agreement is the first legally binding agreement negotiated under the auspices of the Arctic Council.

Eight territories, each one under national command, were designed and their respective aeronautical and maritime rescue coordination centers (RCCs) as well as the responsible authorities and agencies were defined.[51] Within their area of responsibility the AC member states have to bear the costs for providing the necessary SAR capabilities and infrastructure.[52] As laid down in the SOLAS Convention, also within the Arctic SAR agreement, "*the delimitation of search and Rescue regions is not related to and shall not prejudice the delimitation of any boundary between states or their sovereignty,*

[46] Lassi Heininen, 2010, *Globalization and Security in the Circumpolar North*, in: Lassi Heininen/Chris Southcott (eds.), 2010, *Globalization and the Circumpolar North*, University of Alaska Press, Fairbanks, p. 221.
[47] Lt Steve Neta, 2005, *Canada, Russia, United States gear up for Arctic SAREX '05*, http://www.frontline-canada.com/Defence/pdfs/05_5_Neta.pdf (07.12.2012).
[48] North Atlantic Treaty Organization, 1996, *PfP Exercise Arctic Sarex 96 Khabarovsk, (Far Eastern Region of Russia) 16th to 20th September 1996*, http://www.nato.int/cps/en/SID-12935998-F01678D3/natolive/news_24865.htm?mode=pressrelease (07.12.2012).
[49] Arctic Council, 2012, *EPPR Workshop Observing an Oil-Spill Response Exercise in Kirkenes*, http://www.arctic-council.org/index.php/en/about/general-news-archive/142-wg-news/498-eppr-workshop-observing-an-oil-spill-response-exercise-in-kirkenes (07.12.2012); Trude Pettersen, 2012, *Exercise „Northern Eagle" has Started*, Barents Observer, http://barentsobserver.com/en/security/exercise-northern-eagle-has-started-20-08 (07.12.2012).
[50] Arctic Council, *Search and Rescue in the Arctic*, http://www.arctic-council.org/index.php/en/oceans/search-and-rescue/157-sar-agreement (07.12.2012).
[51] Arctic Council, 2011, *Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic*, http://www.arctic-council.org/index.php/en/about/documents/category/20-main-documents-from-nuuk (07.12.2012), pp. 10-18; For an overview of the eight SAR areas see: Appendix I.
[52] Arctic Council, 2011, *Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic*, http://www.arctic-council.org/index.php/en/about/documents/category/20-main-documents-from-nuuk (07.12.2012), p. 6.

*sovereign rights or jurisdiction*."[53] This is important to avoid any territorial conflict with regard to SAR cooperation. Interestingly the document also states the possibility to include non-Arctic states in the conduct of SAR operations.[54] This might open the door for greater international (e.g. EU) engagement. Following the SAR agreement Canada in October 2011 was host nation of the first Arctic SAR table top exercise. A second exercise took place from 10.-14.09.2012 in Greenland. Officials declared that because of limited national SAR resources and the vast size of the region international cooperation is necessary.[55] Also they urged their governments to address issues like the only limited radar coverage in the Arctic. [56]

# 4. Stocktaking of Existing Arctic Coastal States' Search and Rescue Capabilities

Preliminary findings indicate that all states face the same challenges. The northern regions of the respective territories are sparsely populated. This often results in a lack of assets and an insufficient infrastructure to cope with certain emergency scenarios. In consequence capability gaps could arise or do already exist.

## 4.1 Canada

According to Prime Minister Steven Harper, „*Canada's landscape is one of the most challenging in the world in which to conduct search-and-rescue operations*".[57] Main challenges for SAR operations include the vast size of the Canadian Arctic territories, the lack of sufficient infrastructure, capability gaps and high operating costs.

*Infrastructure*

Canada has one of the largest SAR-areas to cover. Yet only two stations are earmarked for SAR operations: Joint Rescue Coordination Centre (JRCC) Trenton (Ontario) and Canadian Forces Station (CFS) Alert on Ellesmere Island. JRCC Trenton, located in the southern part of Canada, is responsible for SAR missions in an area of more than 10.000 square kilometers.[58] CFS Alert on Ellesmere Island, Nunavut, is located only 817 km

[53] Arctic Council, 2011, *Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic*, http://www.arctic-council.org/index.php/en/about/documents/category/20-main-documents-from-nuuk (07.12.2012), p. 3.
[54] Arctic Council, 2011, *Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic*, http://www.arctic-council.org/index.php/en/about/documents/category/20-main-documents-from-nuuk (07.12.2012), p. 8.
[55] Foreign Affairs and International Trade Canada, 2011, *Arctic Council Search and Rescue Table Top Exercise*, http://www.international.gc.ca/polar-polaire/northstrat_searchandrescue-stratnord_searchandrescue.aspx?view=d (07.12.2012); Forsvaret Grønlands Kommando, 2012, *SAREX Greenland Sea 2012*, http://forsvaret.dk/GLK/exercise/SEA/Pages/default.aspx (07.12.2012).
[56] Foreign Affairs and International Trade Canada, 27.09.2012, Arctic Council Search and Rescue Table Top Exercise, http://www.international.gc.ca/polar-polaire/northstrat_searchandrescue-stratnord_searchandrescue.aspx?view=d (07.12.2012).
[57] Ron Wallace, 2012, *Emerging Canadian Priorities and Capabilities for Arctic Search and Rescue*, http://www.cdfai.org/PDF/Emerging%20Canadian%20Priorities%20and%20Capabilities%20for%20Arctic%20Search%20and%20Rescue.pdf (07.12.2012), p. 2.
[58] National Defence and the Canadian Forces, 2012, *Trenton Search and Rescue Region*, http://www.cjoc.forces.gc.ca/cont/search-recherche/trenton-eng.asp (07.12.2012).

from the geographic North Pole, where a unit of 8 Wing Trenton (Ontario) is stationed.[59]

With its main population centers in the south, Canadian SAR agencies (Canadian Coast Guard and Canadian Forces) seem to partly lack the necessary support infrastructure (roads, airbases, ports, supply and medical facilities) and capabilities in its Arctic territories to execute the tasks assigned to in the SAR agreement of the Arctic Council.[60] Also the existing infrastructure often is not designed for SAR operations. The recently acquired C-17 transport aircraft[61] can only use a limited number of northern airfields as many of them today are too short or do not have the adequate surface on them for landing such large aircrafts.[62] According to experts "*Canada has only limited infrastructure 'north of sixty' to deal with any type of major air disaster or environmental emergency, such as an oil spill. Currently, any attempt to mount even a small scale operation would be difficult.*"[63] Another emergency scenario would be a cruise ship incident. In recent years the Canadian Arctic witnessed a strong increase of cruise ship voyages. From 2005 to 2006 the number of cruise ships increased from 11 to 22 ships.[64] Questions remain whether the existing SAR structure could cope effectively and swiftly with such a scenario, involving a large number of casualties. Canada for example is the only Arctic coastal state without a substantial port in the Arctic.[65] Therefore Nunavut Premier Eva Aariak has pledged for "*strategic investments in Nunavut's air and marine infrastructure that will enable Canada to implement its Arctic Council accord on search and rescue*".[66]

Huge investments would be necessary to upgrade the existing infrastructure. In addition the ability to supply forces in northern Canada will come at a very high price. According to Canadian experts annual operating costs could run between 843 million and 1 billion $.[67] It remains to be seen whether these investments are financially achievable.

[59] Royal Canadian Air Force, 2010, Canadian Forces Station Alert. On Top of the World, http://www.rcaf-arc.forces.gc.ca/8w-8e/alert/index-eng.asp (07.12.2012); Royal Canadian Air Force, 2010, Canadian Forces Station Alert, http://www.rcaf-arc.forces.gc.ca/8w-8e/alert/page-eng.asp?id=1103 (07.12.2012.

[60] Tony Balasevicius, 2011, Towards a Canadian Forces Arctic Operating Concept, *Canadian Military Journal* 11: 2, p. 22

[61] Siemon T. Wezeman, 2012, *Military Capabilities in the Arctic*, SIPRI Background Paper, http://books.sipri.org/product_info?c_product_id=442 (07.12.2012), p. 3.

[62] Rob Huebert, 2010, The Newly Emerging Arctic Security Environment, Canadian Defence & Foreign Affairs Institute , http://www.cdfai.org/PDF/The%20Newly%20Emerging%20Arctic%20Security%20Environment.pdf (07.12.2012), p. 8.

[63] Tony Balasevicius, 2011, Towards a Canadian Forces Arctic Operating Concept, *Canadian Military Journal* 11: 2, p. 26.

[64] E.J. Stewart/S.E.L. Howell/D. Raper/J. Yackel/A. Tivy, 2007, Sea Ice in Canada's Arctic. Implications for Cruise Tourism, *Arctic* 60: 4.

[65] *Canada as an Arctic Power. Preparing for the Canadian Chairmanship of the Arctic Council (2013-2015),* Presented by the Munk-Gordon Arctic Security Program, Munk School of Global Affairs, May 2012, http://gordonfoundation.ca/sites/default/files/images/CanadaasanArticPower.pdf (07.12.2012), p. 12.

[66] *Canada as an Arctic Power. Preparing for the Canadian Chairmanship of the Arctic Council (2013-2015),* Presented by the Munk-Gordon Arctic Security Program, Munk School of Global Affairs, May 2012, http://gordonfoundation.ca/sites/default/files/images/CanadaasanArticPower.pdf (07.12.2012), p. 13.

[67] Ron Wallace, 2012, *Emerging Canadian Priorities and Capabilities for Arctic Search and Rescue*, http://www.cdfai.org/PDF/Emerging%20Canadian%20Priorities%20and%20Capabilities%20for%20Arctic%20Search%20and%20Rescue.pdf (07.12.2012), p. 3.

*Capabilities*

As Canada's most substantial SAR facilities are located thousands of kilometers away in the south, also most SAR capabilities like helicopters, ships or aircraft are not stationed in the Arctic. This is a handicap for Canadian SAR agencies to react swift and effectively to an emergency situation. Most SAR air capabilities are stationed at JRCC Trenton. These include CC-117 Globemaster III and CC-130 Hercules transport aircraft and the CH-146 Griffon helicopter from the 424 Transport and Rescue Squadron out of 8 Wing Trenton, Ontario.[68] As noted by experts "*vital rotary-wing CF-SAR aircraft in Canada's North are absent. Typically, a CH-149 Cormorant[69] would require approximately four hours to transit, in good weather, the 1850 km route that extends from Gander (Newfoundland and Labrador) to Iqaluit (Nunavut)*".[70]

Aimed at enhancing Canada's ability to act the government plans to replace 17 older C-130 and other aircraft with new C-130J search and rescue aircraft.[71] Due to their ability for "Short Take-Off and Landing" (STOL) these aircraft can better use short and rough airfields.[72] Further the government aims to procure up to 24 new helicopters within the timeframe 2012-2017 in order to renew its existing fleet of helicopters.[73] Yet as long as these assets remain stationed far away in the south, Canadian SAR agencies might not be able to react fast enough.

As Canada lacks substantial port facilities in the Arctic, none of the Coast Guard's 25 vessels listed in the central and Arctic region (most of them SAR lifeboats with a gross tonnage of 30 tons and a medium length of 15 metres) are stationed in or close to the Arctic Sea. The six largest ships (length of at least 50 metres) are stationed in Dartmouth, close to Halifax.[74] A transport of these ships into the Arctic region, to Resolute Bay for example would result in a serious loss of time. Also the nearest base of the Canadian Navy is at Halifax, Nova Scotia.[75]

[68] National Defence and the Canadian Forces, 2012, *Trenton Search and Rescue Region*, http://www.cjoc.forces.gc.ca/cont/search-recherche/trenton-eng.asp (07.12.2012); for more information about the Griffon helicopter see: Royal Canadian Air Force, 2010, *CH-146 Griffon*, http://www.rcaf-arc.forces.gc.ca/v2/equip/ch146/index-eng.asp (07.12.2012).
[69] The CH-149 Cormorant has exceptional long-range capability—it can fly for over 1000 km without refuelling. With its ample cargo space and rear-ramp access, the helicopter can carry up to 12 stretchers or a load of 5000 kg (see: Royal Canadian Airforce, CH-149 Cormorant, http://www.rcaf-arc.forces.gc.ca/v2/equip/ch149/index-eng.asp (07.12.2012)).
[70] Ron Wallace, 2012, *Emerging Canadian Priorities and Capabilities for Arctic Search and Rescue*, http://www.cdfai.org/PDF/Emerging%20Canadian%20Priorities%20and%20Capabilities%20for%20Arctic%20Search%20and%20Rescue.pdf (07.12.2012), p. 4.
[71] Siemon T. Wezeman, 2012, Military Capabilities in the Arctic, SIPRI Background Paper, http://books.sipri.org/product_info?c_product_id=442 (07.12.2012), p. 3.
[72] Rob Huebert, 2010, The Newly Emerging Arctic Security Environment, Canadian Defence & Foreign Affairs Institute, http://www.cdfai.org/PDF/The%20Newly%20Emerging%20Arctic%20Security%20Environment.pdf (07.12.2012), p. 8.
[73] Fisheries and Oceans Canada, Harper Government launches Process to Modernize Coast Guard Helicopter Fleet, http://www.dfo-mpo.gc.ca/media/npress-communique/2012/hq-ac30-eng.htm.
[74] Canadian Coast Guard, Coast Guard Fleet, http://www.ccg-gcc.gc.ca/Fleet/Search.
[75] Siemon T. Wezeman, 2012, Military Capabilities in the Arctic, SIPRI Background Paper, http://books.sipri.org/product_info?c_product_id=442 (07.12.2012), p. 5.

Still the Canadian Coast Guard has two heavy icebreakers and four medium icebreakers and will get a new Polar-class icebreaker in 2017.[76] These icebreakers can become critical assets in SAR operations.

*Maritime Domain Awareness*

Canada's Radarsat-2 satellite system provides coverage of the Canadian Arctic. It covers sea-ice thickness and ice movement, monitors maritime activities and generates high-resolution maps.[77] According to the Canadian government, "*this satellite will help us vigorously protect our Arctic sovereignty as international interest in the region increases…RADARSAT-2 will also provide improved surveillance and monitoring capabilities that will provide critical data for the active management of natural resources and monitoring of the environment. In the event of a disaster, RADARSAT-2 will be an indispensable tool to provide rescue and humanitarian aid to those most in need*."[78]

While Radarsat-2 is of strategic importance for Canada's ability to monitor its Arctic region, a possible delay of a replacement of old satellites might limit this ability significantly in coming years.[79]

In order to enhance the effectiveness of SAR at sea the Coast Guard uses the services of the EU's Global Monitoring for Environment and Security (GMES) program. These services include the detection of icebergs and ships, weather forecasts or ice distribution information.[80]

Finally, the Canadian Forces plan to procure unmanned aerial vehicles (UAV's) for maritime and Arctic patrol.[81] However due to the high latitudes involved and a lack of sufficient around the clock satellite coverage the control of UAV's so far remains problematic. The extreme weather conditions are further decreasing the operational readiness of UAV's.[82]

*Conclusion*

Canada acknowledges the need to upgrade its SAR infrastructure (bases, landing strips, satellites, communication systems) and to acquire new capabilities like aircraft, ships and helicopters. The key question remains whether all plans to upgrade Canada's foot-

[76] Canadian Coast Guard, Coast Guard Fleet, http://www.ccg-gcc.gc.ca/Fleet/Search; Canadian Coast Guard, 2012, *The CCGS John G. Diefenbaker National Icebreaker Project*, http://www.ccg-gcc.gc.ca/e0010762 (07.12.2012).
[77] Canadian Space Agency, 2007, *Radarsat-2. Applications*, http://www.asc-csa.gc.ca/eng/satellites/radarsat2/applications.asp (07.12.2012).
[78] SpaceRef, 2007, *Radarsat-2. Safeguarding Canada's Sovereignty in the Arctic*, http://www.spaceref.com/news/viewpr.html?pid=23897 (07.12.2012).
[79] Elizabeth Howell, 2012, *Satellite Delay Prompts Canadian Defense Concerns*, http://www.space.com/18523-canada-satellite-delays-military-concerns.html /07.12.2012); David Pugliese, 2012, *DND warns Clock Ticking on Surveillance Satellite*, http://www.ottawacitizen.com/technology/warns+clock+ticking+surveillance+satellite/7406084/story.html (07.12.2012).
[80] Global Monitoring for Environment and Security, *Canadian Coast Guard Use GMES Services to Enhance the Effectiveness of Search and Rescue at Sea*, http://www.gmes-dolphin.eu/sites/gmes-dolphin.eu/files/CanadianCoast Guard_WindowOnGMES_2.pdf, p. 1.
[81] Siemon T. Wezeman, 2012, Military Capabilities in the Arctic, SIPRI Background Paper, http://books.sipri.org/product_info?c_product_id=442 (07.12.2012), p. 3.
[82] Rob Huebert, 2010, The Newly Emerging Arctic Security Environment, Canadian Defence & Foreign Affairs Institute , http://www.cdfai.org/PDF/The%20Newly%20Emerging%20Arctic%20Security%20Environment.pdf (07.12.2012), p. 8.

print in the Arctic can be financed. In times of financial austerity some large-scale projects (e.g. satellites and communication systems) might be launched only on a multilateral basis.

## 4.2 Denmark (Greenland)

Denmark's SAR responsibility is linked to Greenland and to the Faroe Islands.[83] Greenland encompasses 2.186,000 square kilometres.[84] However, only 57,000 people live in Greenland. About 85% of the population are located along the west coast.[85] The vast size of the area and the small number of permanently stationed SAR capabilities are particularly challenging. At the same time drilling activities in the western and southern parts of Greenland and a significant increase of cruise ship tourism along the western coastline pose a serious challenge to the responsible SAR agencies.

*Infrastructure and Capabilities*

As Greenland encompasses only a small population SAR support infrastructure and capabilities are on short supply. Established in October 2012 Joint Arctic Command (JACMD) is responsible for SAR in and around Greenland.[86] Altogether JACMD operates six stations in Greenland: the headquarters in Nuuk, a liaison element at Thule air base, and smaller units at Kangerlussuaq, Station Nord (manned by five people), Daneborg and Mestersvig (manned by two people).[87] Station Nord and Mestersvig serve as Forward Operating Bases (FOB's) and fuel depots.[88] Maritime Rescue Coordination Center (MRCC) Nuuk is responsible for SAR at sea. As part of JACMD[89] it is manned and operated by the Danish military. As MRCC Nuuk does not possess any capabilities it has to rely on Danish assets operating around Greenland. In summer Denmark stations one Arctic patrol frigate with an on-board helicopter, two Arctic patrol vessels (Knud Rasmussen[90]) and a cutter off the coast of Greenland. Another Arctic patrol frigate, stationed at the Faroe Islands could be deployed to Greenlandic waters, too. In winter the Danish presence is reduced to one ship.[91] Air Rescue Coordination Centre (ARCC) Kangerlussuaq is responsible for SAR operations related to aircraft incidents and one helicopter (Sikorsky S-61) is on permanent stand-by. A second helicopter (Bell-

[83] The Danish Maritime Authority, Danish Transport Authority and the Ministry of Fisheries – Faroe Islands are the responsible SAR agencies (see: Arctic Council, 2011, *Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic*, http://www.arctic-council.org/index.php/en/about/documents/category/20-main-documents-from-nuuk (07.12.2012), p.17).

[84] Rear Admiral Henrik Kudsk, Greenland Command, http://www.arcticparl.org/files/080812HenrikKudsk1.pdf, p. 4.

[85] Rear Admiral Henrik Kudsk, 2012, *Greenland Command*, http://www.arcticparl.org/files/080812HenrikKudsk1.pdf (07.12.2012), p. 5.

[86] Danish Ministry of Defence, 2012, *Joint Arctic Command*, https://www2.forsvaret.dk/viden_om2/Pages/AKOENG.aspx (07.12.2012).

[87] Danish Ministry of Defence, 2012, *Joint Arctic Command*, https://www2.forsvaret.dk/viden_om2/Pages/AKOENG.aspx (07.12.2012); E-mail interview Danish Ministry of Defence, 26.11.2012; Danish Ministry of Defence, 2012, *Tasks in the Arctic and the Northern Atlantic*, http://www.fmn.dk/eng/allabout/Pages/TasksintheArcticandtheNorthernAtlantic.aspx (07.12.2012).

[88] E-mail interview, Danish Ministry of Defence, 26.11.2012.

[89] Danish Ministry of Defence, 2012, *Joint Arctic Command*, https://www2.forsvaret.dk/viden_om2/Pages/AKOENG.aspx (07.12.2012).

[90] For details see: http://forsvaret.dk/SOK/eng/About/Ships/Pages/07Inspektionsfartoejer.aspx (07.12.2012). These ships stay at all times in the region and only return to Denmark for dockyard-periods.

[91] E-mail interview, Danish Ministry of Defence, 26.11.2012.

212) is “earmarked” for SAR operations. These two helicopters are the only SAR capabilities available in Greenland.[92] Periodically Danish Air Force aircraft (Bombardier CL-604 and C-130 Hercules) are stationed at Kangerlussuaq.[93] Finally the Greenland Police is the responsible agency for SAR on land and small-scale incidents in the fjords. It operates four small patrol boats. These can also assist for other SAR operations.[94]

*Potential Scenario: Grounding of a Cruise Ship*

In recent years cruise ship tourism along Greenland has been growing dramatically. The number of cruise ship passengers visiting Greenland is increasing by about 30% annually and 157 port calls in Greenland have been made in 2006. This corresponds to a total of 22,051 passengers which represents nearly half of Greenland’s population.[95]

A particular challenging scenario would be a cruise ship grounding off the coast of Greenland. Such an incident seems possible. Otherwise this would not have been the scenario of the first live Arctic Search and Rescue Exercise (SAREX) among the eight Arctic coastal states.[96] Most concerning is increased maritime traffic (natural resource exploration, scientific expeditions, smaller cruise-ship tourism) along the north-eastern coast of Greenland as these waters are un-surveyed and the almost total lack of population at the coast.[97] But even in case an accident at sea would happen off the more populated west coast, a full-scale cruise ship evacuation (up to 4,000 passengers) would be quite a challenge.[98]

In case a cruise ship has to be abandoned several factors would seriously challenge any SAR effort:

- Most of the cruise ship passengers are between the ages of 50 and 80 some of the passengers would only have limited mobility. This would complicate any rescue effort.
- With the on-scene weather and water temperatures, passengers would have an average functional time[99] of 4.3 hours. Within this functional time there is a 67% chance of survival.[100]
- Probably, local people, in this case only speaking Greenlandic, would be the first responders to arrive on scene. This would complicate communications between castaways and rescuers.[101]

[92] E-mail interview, Danish Ministry of Defence, 26.11.2012.
[93] E-mail interview, Danish Ministry of Defence, 26.11.2012.
[94] E-mail interview, Danish Ministry of Defence, 26.11.2012.
[95] John M. Snyder, 2008, *Arctic Marine Tourism. Its History, Prospects and Management*, http://arcticportal.org/uploads/5b/91/5b91YD6bR11S7jsDBI7J-g/5-4-Arctic-Marine-Tourism-Its-History-Prospects-an.pdf, (07.12.2012) p. 10.
[96] Arctic Council, 2012, *First Live Arctic Search and Rescue Exercise - SAREX 2012*, http://www.arctic-council.org/index.php/en/oceans/search-and-rescue/620-first-arctic-search-and-rescue-exercise-sarex-2012 (07.12.2012).
[97] E-mail interview, Danish Ministry of Defence, 26.11.2012.
[98] E-mail interview, Danish Ministry of Defence, 26.11.2012.
[99] *„functional time represents the time at which a person becomes incapacitated due to cold.“* (see: Coastal Response Research Center at the University of New Hampshire, 2009, *Opening the Arctic Seas. Envisioning Disasters and Framing Solutions*, http://www.crrc.unh.edu/workshops/arctic_spill_summit/arctic_summit_report_final.pdf, (07.12.2012), p. 7.
[100] Coastal Response Research Center at the University of New Hampshire, 2009, *Opening the Arctic Seas. Envisioning Disasters and Framing Solutions*, http://www.crrc.unh.edu/workshops/arctic_spill_summit/arctic_summit_report_final.pdf, (07.12.2012), p. 7.
[101] Coastal Response Research Center at the University of New Hampshire, 2009, *Opening the Arctic Seas. Envisioning Dis-*

As indicated SAR capabilities in Greenland are small in numbers. In case of a full scale evacuation of a cruise ship local resources would be overwhelmed with this task. Therefore international assistance would be required. Still the long distances in the region would hinder a swift on-scene arrival of additional SAR capabilities. It is expected that a first Danish vessel could arrive within 12 hours and a second one within 24 hours.[102] However the large number of passengers could only be embarked by a second cruise ship. The arrival of an additional cruise ship is expected to take up to 24 hours (in case cruise ships sail alone and not in pairs as advised by SAR officials).[103] In case of mass injuries a large number of saved passengers would have to be medicated immediately. However infrastructure in Greenland (hotels, hospitals, etc.) is not designed for such a large-scale event. Thus most of the injured people would have to be transported to the nearest hospital in Reykjavik (Iceland), 500 kilometres away.[104] Therefore additional tactical (helicopter) and strategic (aircraft) airlift capabilities stationed in Greenland are key in order to increase the Greenlandic SAR ability to respond.[105]

Especially in Greenland, the private sector interested in the exploitation of natural resources might have to take over some sort of co-responsibility. A prominent example for this public-private partnership is Cairn Energy that has invested in meteorological monitoring equipment, boats and helicopters that could be used for SAR operations.[106]

### *Maritime Domain Awareness*

With regard to communications coverage Danish officials acknowledge the existence of certain gaps in the far north, as geostationary satellites cannot be reached.[107] Thus one option could be the establishment of EU radar and satellite stations in Greenland. One possible location could be Thule airbase. In its Arctic strategy the Danish government already elaborated the idea of creating at Thule airbase such a hub for closer cooperation.[108]

### *Conclusion*

Greenland is a prime example of the challenges SAR agencies face in the Arctic. The vast size of the region and the lack of sufficient infrastructure and capabilities are quite challenging. Increasing maritime activities off the coast (cruise ship tourism and resource exploitation) enhance the danger of emergencies at sea. Closer regional and in-

*asters and Framing Solutions*, http://www.crrc.unh.edu/workshops/arctic_spill_summit/arctic_summit_report_final.pdf, (07.12.2012) pp. 8-9.

[102] Coastal Response Research Center at the University of New Hampshire, 2009, *Opening the Arctic Seas. Envisioning Disasters and Framing Solutions*, http://www.crrc.unh.edu/workshops/arctic_spill_summit/arctic_summit_report_final.pdf, (07.12.2012) p. 8.

[103] Coastal Response Research Center at the University of New Hampshire, 2009, *Opening the Arctic Seas. Envisioning Disasters and Framing Solutions*, http://www.crrc.unh.edu/workshops/arctic_spill_summit/arctic_summit_report_final.pdf, (07.12.2012), p. 8.

[104] Arctic Council, 2012, *First Live Arctic Search and Rescue Exercise - SAREX 2012*, http://www.arctic-council.org/index.php/en/oceans/search-and-rescue/620-first-arctic-search-and-rescue-exercise-sarex-2012 (07.12.2012).

[105] E-mail interview, Danish Ministry of Defence, 26.11.2012.

[106] Cairn Energy, 2012, *Contingency Planing*, http://www.cairnenergy.com/index.asp?pageid=82 (07.12.2012).

[107] E-mail interview, Danish Ministry of Defence, 26.11.2012.

[108] Danish Ministry of Foreign Affairs, 2011, Kingdom of Denmark Strategy for the Arctic 2011-2020, http://um.dk/en/~/media/UM/English-site/Documents/Politics-and-diplomacy/Arktis_Rapport_UK_210x270_Final_Web.ashx (07.12.2012), p. 54.

ternational cooperation could be an option to support SAR activities in and around Greenland. Thule airbase could be a potential location of a newly created regional centre for security coordination.[109]

## 4.3 Finland

Finland assigned the Finish Boarder Guard (Rajavartiolaitos) as responsible SAR agency. However, Finland has no access to the Arctic Ocean, and therefore takes over the SAR responsibility on the mainland. All naval SAR assets are stationed in the Baltic Sea. But the air assets, like helicopters and aircraft could be delivered to the north to SAR operations.

In case of a major incident in the Arctic, Finland's armed forces are capable to support SAR operations with transport aircrafts and helicopters. However the transport of these capabilities into the region would take some time.

## 4.4 Iceland

The Icelandic Coast Guard (ICG) is the responsible SAR agency in and around Iceland. Its area of responsibility covers around 1.8 million square kilometres.[110] According to the ICG Iceland is located in the centre of newly open Arctic waterways implying a number of considerable challenges.[111] Due to the consequences of the meltdown of the Icelandic financial system SAR-procurement projects had to be postponed. As in the case of Greenland the vast size of the area and the relatively small number of existing capabilities make SAR operations particularly challenging.

*Infrastructure and Capabilities*

All ICG operations are coordinated at the Joint Rescue Coordination Centre (JRCC) in Reykjavik.[112] The ICG also operates four radar sites that enhance Maritime Domain Awareness (MDA). The sites are located close to Bolungarvíkurkaupstaður (north-west), Þórshöfn (north-east), Hornafjörður (south-east) and Keflavik (south-west), a former US Naval Air Station, that has been closed by the U.S. Navy in 2006 and then been taken over first by the Icelandic Defence Agency and then by the ICG.[113]

The ICG currently operates four offshore patrol and rescue vessels, three Super Puma helicopters and one Dash-8 Maritime Patrol Aircraft (MPA).[114] Two of three helicopters are permanently on stand-by, while the third is in maintenance (also only two crews are

[109] Heather A. Conley/Terry Toland/Jamie Kraut/Andreas Østhagen, 2012, *A New Security Architecture for the Arctic. An American Perspective*, Center For Strategic & International Studies, http://csis.org/files/publication/120117_Conley_ArcticSecurity_Web.pdf (07.12.2012), p. 39.

[110] Icelandic Coast Guard, *Search and Rescue in the Icelandic Search and Rescue Region (SRR),* http://www.lhg.is/english/search_and_rescue/jrcc/ (07.12.2012).

[111] Icelandic Coast Guard, *Icelandic Coast Guard*, http://www.lhg.is/english (07.12.2012).

[112] Icelandic Coast Guard, *Search and Rescue in the Icelandic Search and Rescue Region (SRR),* http://www.lhg.is/english/search_and_rescue/jrcc/ (07.12.2012); Rear Admiral Georg Kr. Lárusson, 2012, *The Icelandic Coast Guard and Search and Rescue in and Around Iceland*, Presentation at Arctic Futures Symposium 2012, http://www.polarfoundation.org/uploads/documents_files/afs_2012_larusson.pdf (07.12.2012), p. 8.

[113] E-mail interview, Icelandic Coast Guard, 26.11.2012.

[114] E-mail interview, Icelandic Coast Guard, 24.10.2012.

on duty).[115] The helicopters have a maximum range of 500 nautical miles (NM) (2x250 nautical miles for return-flight) which equals five hours of endurance. In two hours the helicopter can make it out to 250 nautical miles. It further can stay 30 minutes on scene before it has to head back. This leads the helicopter with a time window of another 30 minutes. The endurance can be extended by along the coastline pre-positioned fuel tanks in strategic locations. This means that the operating radius of 250 NM is not exclusively limited to the JRCC in Reykjavik where the helicopters are stationed.[116] The ICG operates on special fuel depot at Þórshöfn (north-east corner) and uses eight additional fuel depots in Rif (west-coast), Bíldudalur and Ísafjörður (north-west), Sauðárkrókur and Akureyri (north), Egilsstaðir (east), Hornafjörður (south-east) and Vestmannaeyjar (south). The ICG also has a mobile fuel tank that can be transported to the respective area of operations (AEO). Finally the four offshore patrol and rescue vessels have additional helicopter fuel stored onboard. They are also equipped with a helicopter inflight refuelling system (HIFIR).[117]

*Key Challenges*

Iceland is strategically located at the entrance and exit to the Arctic Ocean. The city of Vopnafjörður has a deep-water port that could transform into a transshipment hub.[118] An increase of maritime traffic will come with a growing risk of accidents at sea, too. The biggest risk so far however remains the sinking of a cruise ship. Since 2000 the total number of cruise ship passengers visiting Iceland and its surrounding waters has increased annually by 9.3%: from 27,000 in 2000 to 66,000 in 2011.[119]

*Maritime Domain Awareness*

According to ICG officials, satellite coverage and communication systems within the ICG's area of responsibility (up to 73º north) are sufficient. However in adjacent areas further north a lack of satellite coverage already poses challenges to SAR agencies.[120]

*Conclusion*

Key challenges for the ICG are the vast size of the area of responsibility and the limited availability of capabilities. In 2007 the ICG elaborated a concept for the procurement of future capabilities needed to fulfil their role in the area of interest, but meanwhile an economic recession occurred and forced the ICG to postpone some of these plans. Thus the budget restrain is seen as the biggest challenge for the ICG with regard to SAR activities.[121] According to the ICG major incidents within its area of responsibility would require SAR cooperation of at least two Arctic coastal states. Therefore the ICG also

[115] E-mail interview, Icelandic Coast Guard, 24.10.2012.
[116] E-mail interview, Icelandic Coast Guard, 25.04.2012; E-mail interview, Icelandic Coast Guard, 24.10.2012.
[117] E-mail interview, Icelandic Coast Guard, 20.04.2012.
[118] Malte Humpert/Andreas Raspotnik, 11.10.2012, *The Future of Arctic Shipping*, http://www.thearcticinstitute.org/2012/10/the-future-of-arctic-shipping.html (07.12.2012).
[119] Oddný Þóra Óladóttir, 2012, *Tourism in Iceland in Figures*, http://www.ferdamalastofa.is/upload/files/Tourism_in_Iceland_in_figures_May_%202012.pdf (07.12.2012), p. 3.
[120] E-mail interview, Icelandic Coast Guard, 06.12.2012.
[121] E-mail interview, Icelandic Coast Guard, 23.11.2012.

has institutionalized cooperation agreements the Danish Navy, the Norwegian military authorities and the U.S. Coast Guard.[122]

## 4.5 Norway

Norwegian SAR services are under administrative coordination of the Ministry of Justice and Public Security. Its SAR area of responsibility covers two million square kilometers.[123] As Norwegian energy exploitation is moving further north and tourism in the northern parts of Norway increases the danger of accidents at sea is growing, too. Norway seems to possess a robust SAR system. In contrast to other Arctic coastal states is has increases SAR-related funding in recent years. With regard to satellite coverage and communication systems Norway cooperates closely with the EU.

*Infrastructure*

Norway is divided into two SAR regions, one in the north and one in the south divided north of 65 degrees latitude. The Joint Rescue Coordination Center (JRCC) North in Bodø is responsible for SAR operations in the Arctic. JRCC North operates a network of seven Rescue Sub-Centres (RSC) along the Norwegian coastline.[124]

*Capabilities*

JRCC North has five SAR helicopters under its command. Two Sea King helicopters are stationed in air stations Bodø and Barnak in permanent alert status (15 minutes readiness).[125] The helicopters have an operating radius of 230 nautical miles, can evacuate up to 19 people and remain airborne for over six hours. But the estimated operating radius depends heavily on the task. Due to the required on-station-time to rescue up to 19 castaways, the operational radius is limited to only 53 nautical miles[126]. This describes an important limitation.

Three Super Puma All Weather SAR (AWSAR) helicopters are stationed at Spitsbergen (approximately 15 minutes readiness/one hour outside working hours), in Hammerfest (leased when needed/15 minutes readiness/one hour when no ferry flights) and on Heidrun (leased when needed/15 minutes readiness).[127] In addition the Norwegian Royal Air Force (RNoAF) operates five helicopters, one Maritime Patrol Aircraft (MPA) and one transport aircraft that could be used in a secondary SAR role. The MPA is stationed at Andøya airbase (Nordland county) and the transport aircraft at Gardermoen airbase. In addition two ambulance helicopters in Tromsø and at Brønnøysund and six ambulance fixed-wing aircrafts (Alta, Kirkenes, Tromsø, Bodø

[122] E-mail interview, Icelandic Coast Guard, 20.04.2012.

[123] Canadian Coast Guard, 2010, North Atlantic Coast Guard Forum – Norway, http://www.ccg-gcc.gc.ca/e0008262 (07.12.2012).

[124] Merete Jeppesen, 2012, *Norwegian SAR Service SAR Assets in North-Norway*, Presentation at EPPR Meeting Kirkenes, February 5th 2012.

[125] E-mail interview, Joint Rescue Coordination Centre North Norway, 18.09.2012.

[126] E-mail interview, Joint Rescue Coordination Centre North Norway, 18.09.2012; former Norwegian State Secretary Terje Moland Pedersen, 2010, *The Future Helicopter Search and Rescue Service*, http://www.regjeringen.no/en/dep/jd/whats-new/Speeches-and-articles-/politisk_ledelse/statssekretaer-moland-pedersen/2010/The-future-helicopter-search-and-rescue-service.html?id=620429 (07.12.2012).

[127] E-mail interview, Joint Rescue Coordination Centre North Norway, 18.09.2012.

and Brønnøysund) are earmarked for SAR operations.[128] Three Bell helicopters and one Sea Lynx helicopter are stationed at Bardufoss airbase.[129] In order to enhance the operating radius of rescue helicopters there are several fuel depots in and around Spitsbergen.[130]

The Coast Guard operates seven vessels in the North[131]: one icebreaker (KV Svalbard), one Ulstein UT 512 class vessel (NoCG Harstad), two Nornen class vessels (NoCG Heimdahl, NoCG Farm) and three Barentshav class vessels (NoCG Barentshav, NoCG Bergen, NoCG Sortland).[132]

In strong contrast to other Arctic coastal states, Norway has increased the Coast Guard's operating budget in recent years. This has enabled the modernization of existing capabilities and the acquisition of new ones.[133]

### *Maritime Domain Awareness*

According to the Norwegian government the increasing maritime traffic poses considerable challenges. Therefore improved monitoring systems are necessary.[134] As current maritime monitoring systems have clear limitations, former Norwegian prime minister Thorvald Stoltenberg pledged for the establishment of a monitoring and early warning system called Barents Watch.[135] The establishment of such an integrated maritime monitoring and early warning system is now underway.[136] In order to get a more complete surface picture of maritime activities in the Arctic the Norwegian government is investing strongly in the build-up of additional satellite capabilities. This includes as well closer cooperation with the EU. In its budget plans 2013 the government allocates amongst others NOK 22 million to the Global Monitoring for the Environment and Security (GMES) programme and an increase of NOK 70 million for the Galileo programme.[137]

### *Conclusion*

Norway seems to be better prepared for increases SAR responsibilities than other Arctic coastal states. Closer cooperation with the EU in questions of MDA could manifest its strong position.

[128] E-mail interview, Joint Rescue Coordination Centre North Norway, 18.09.2012.
[129] E-mail interview, Joint Rescue Coordination Centre North Norway, 18.09.2012.
[130] E-mail interview, Joint Rescue Coordination Centre North Norway, 18.09.2012.
[131] E-mail interview, Joint Rescue Coordination Centre North Norway, 18.09.2012.
[132] E-mail interview, Joint Rescue Coordination Centre North Norway, 18.09.2012.
[133] Norwegian Ministry of Foreign Affairs, 2009, *New Building Blocks in the North. The next Step in the Government's High North Strategy*, http://www.regjeringen.no/en/dep/ud/documents/Reports-programmes-of-action-and-plans/Action-plans-and-programmes/2009/north_blocks.html?id=548803 (07.12.2012), p. 38.
[134] Norwegian Ministry of Foreign Affairs, 2009, *New Building Blocks in the North. The next Step in the Government's High North Strategy*, http://www.regjeringen.no/en/dep/ud/documents/Reports-programmes-of-action-and-plans/Action-plans-and-programmes/2009/north_blocks.html?id=548803 (07.12.2012), p. 13.
[135] Thorvald Stoltenberg, 2009, *Nordic Cooperation on Foreign and Security Policy*, http://www.regjeringen.no/upload/UD/Vedlegg/nordicreport.pdf (07.12.2012), pp. 12-14.
[136] Barents Watch, 2012, *A Source of comprehensive Information on Coastal and Sea Areas*, http://www.barentswatch.no/Documents/barentswatch_english.pdf (07.12.2012).
[137] Norwegian Ministry of Foreign Affairs, 2012, *Close to NOK 2 Billion to High North Activities in 2013*, http://www.regjeringen.no/en/dep/ud/press/news/2012/high_north_2013.html?id=701231 (07.12.2012).

## 4.6 Russian Federation

Maritime traffic in the Russian part of the Arctic is expected to increase significantly in coming years.[138] Key drivers of this development are increased shipping along the NSR and growing offshore exploitation activities. The increase of maritime traffic comes with a growing risk of emergencies at sea. Based on preliminary conclusions[139] Russia seems well positioned with regard to infrastructure developments and ice-breaker capability.

*Infrastructure*

Within the Russian Federation, the Federal Air Transport Agency and the Federal Agency for Marine and River Transport are responsible for SAR operations.[140] It operates two Maritime Rescue Coordination Centres (MRCC) in two distinct areas of responsibility, divided along 125º east. In the western part of the Arctic the MRCC is located in the ports of Murmansk and Arkhangelsk. In the eastern part the MRCC is located in the ports of Vladivostok and Petropavlovsk-Kamchatsky.[141]

Besides of the already existing infrastructure, Russia announced the construction of 10 new rescue centres along its Arctic coastline until 2015. The centres will be located in Dudinka, Chukotka, Anadyr, Murmansk, Arkhangelsk, Naryan-Mar, Vorkuta, Nadym and Tiksi.[142] A total of 980 persons will be working at the centres".[143] Russia plans to invest nearly 23,4 million Euro in development of these emergency centres. The centres would significantly increase Russia's SAR infrastructure. However the announced completion of the first new centre in Dudinka, scheduled to open in August 2012, has not been accomplished yet.

*Capabilities*

Maybe the most important feature of Russia's SAR capabilities is its ice breaker fleet. Russia operates 34 vessels, including eight nuclear-powered heavy icebreakers and two conventionally powered heavy icebreakers, all of which are capable of independent Arctic operations all year long.[144]

[138] Captain Lawson W. Brigham, 2011, *Russia Opens its Maritime Arctic*, http://www.usni.org/magazines/proceedings/2011-05/russia-opens-its-maritime-arctic (07.12.2012).
[139] In comparison to other Arctic coastal states official Russian documents and statements are only sparsely available.
[140] Arctic Council, 2011, *Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic*, http://www.arctic-council.org/index.php/en/about/documents/category/20-main-documents-from-nuuk (07.12.2012), p. 17.
[141] E-mail interview, Centre for High North Logistics, 27.09.2012.
[142] Trude Pettersen, 2012, First Arctic Rescue Centre to Open in August, http://barentsobserver.com/en/topics/first-arctic-rescue-center-open-august (07.12.2012).
[143] Andrey Vokuev, 2012, http://barentsobserver.com/en/arctic/arctic-rescue-center-under-construction-naryan-mar-15-08 (07.12.2012).
[144] Department of Defense, 2011, Report to Congress on Arctic Operations and the Northwest Passage, http://www.defense.gov/pubs/pdfs/Tab_A_Arctic_Report_Public.pdf (07.12.2012), p. 27.

*Maritime Domain Awareness*

In order to ensure stable communications along the NSR, Russia is in the process to establish a satellite network that provides navigational aid and communication between vessels, aircraft and ground stations in the Russian part of the Arctic.[145] Compared to the U.S. Global Positioning System (GPS) the Russian system GLONASS enables better coverage in the Arctic.

*Conclusion*

Traffic will increase significantly along the NSR and in some parts of the Russian Arctic due to energy and mineral resource exploitation in these areas. Based on existing information a clear picture of Russia's ability to handle this increased traffic is not available. The country's ice breaker fleet is a huge advantage in any possible SAR scenario. On the other side the announced completion of the first new planned emergency centres has not been achieved so far. Therefore questions remain, whether the existing plans are financially achievable.

## 4.7 Sweden

The Swedish Maritime Administration (Sjöfartsverket) is the responsible SAR agency and its JRCC is located in Gothenburg.[146] Currently Sweden has no specific SAR capabilities in the Arctic but is capable to transport temporarily SAR equipment like icebreakers or helicopters into the region. It is not planned to build up permanent capabilities in the Arctic region. The designated Swedish SAR region relevant to the AC agreement is outside the Arctic waters. Therefore Sweden has no necessity to build up these capabilities.

With regard to satellite coverage and communication systems the Kiruna satellite ground station will play an important role in the EU's Galileo satellite programme that will cover the entire Arctic region.[147]

## 4.8 United States of America

The state of Alaska forms the U.S. part of the Arctic. The U.S. Coast Guard is the responsible agency for SAR missions in the Arctic keeping watch over an area of more than 950,000 square miles off the coast of Alaska.[148]

The Coast Guard faces numerous challenges with regard to SAR operations. While it is responsible for a vast area it lacks key capabilities (ships, icebreakers, aircraft or heli-

[145] Trude Pettersen, 2012, *Russia Launched Communications Satellite for the Arctic*, http://barentsobserver.com/en/security/russia-launched-communications-satellite-arctic-15-11 (07.12.2012), Grace Xingxin Gao/Liang Heng/Todd Walter/Per Enge, 2011, Breaking the Ice. Navigation in the Arctic, http://www.insidegnss.com/node/2748 (07.12.2012).
[146] Arctic Council, 2011, *Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic*, http://www.arctic-council.org/index.php/en/about/documents/category/20-main-documents-from-nuuk (07.12.2012), p. 18.
[147] European Space Agency, 2010, Europe Opens an Arctic Eye on Galileo, http://www.esa.int/esaCP/SEMMNFRRJHG_index_0.html (07.12.2012).
[148] Mickey McCarter, 2012, *Coast Guard Relies on Partnership to Extend Light Arctic Presence*, http://www.hstoday.us/focused-topics/public-safety/single-article-page/coast-guard-relies-on-partnerships-to-extend-light-arctic-presence.html (07.12.2012).

copters). Also most of its SAR support infrastructure is located in the south of Alaska. In case of an emergency scenario this means long transport times of capabilities from south to the north. Finally the work of the Coast Guard and other related agencies is hindered by the unavailability of sufficient satellite and communications data. Whilst additional funding for the Coast Guard seems necessary it is unrealistic in the current climate of fiscal austerity. Nevertheless the Coast Guard intends to upgrade its Arctic presence. In recent years it started to build Forward Operating Bases (FOB) temporarily during summer. This innovative approach could lead as an example for other countries as well.

*Infrastructure*

The Rescue Coordination Centre (RCC) Juneau in Alaska is responsible for the 17th Coast Guard District that covers the northern Pacific Region, the Bering Sea and the Arctic Ocean.[149] Altogether Alaska is home to nine Coast Guard stations (Anchorage, Dutch Harbor, Juneau, Ketchikan, Kodiak, Sitka, St. Paul and Valdez).[150] But only two stations are located in the Arctic. This also means only a limited availability of capabilities in the region. The basic SAR coverage includes two air stations located in Kodiak and Sitka. Air Station Kodiak, about 463 kilometer (or 250 nautical miles) southwest of Anchorage (Alaska)[151], maintains an HC-130H patrol aircraft[152] and an MH-60T helicopter[153]. Both assets are on permanent stand-by. Air station Sitka maintains another MH-60T helicopter, also available on a 24/7 basis.[154]

As U.S. officials are aware of existing limitations of its SAR coverage in the Arctic first steps have been taken to close existing gaps. Amongst others the U.S. Coast Guard in recent years established Forward Operating Bases (FOB's) during summer months in remote locations in order to upgrade its Arctic presence. Since 2008 the Coast Guard established temporary FOB's in Nome, Prudhoe Bay, Cordova and Barrow.[155] During the Coast Guard's operation "Arctic Shield" in summer 2012 two additional MH-60T helicopters have been transferred to Barrow (Alaska)[156], the northernmost city of the USA. Still the lack of adequate infrastructure in the region complicates the deployment of these assets.[157]

[149] U.S. Coast Guard, 2012, *U.S. Coast Guard Rescue Coordination Centres (RCCs)*, http://www.uscg.mil/hq/cg5/cg534/RCC_numbers.asp (07.12.2012).
[150] Alaska Dispatch, 2012, *Murkowski Touts US's Arctic Needs in Kodiak Hearing*, http://www.alaskadispatch.com/article/murkowski-touts-uss-arctic-needs-kodiak-hearing.
[151] U.S. Coast Guard, 2008, *Air Station Kodiak*, http://www.uscg.mil/d17/airstakodiak/ (07.12.2012).
[152] For technical data see: http://www.uscg.mil/hq/cg7/cg711/c130h.asp (07.12.2012).
[153] For technical data see: http://www.uscg.mil/acquisition/mrr/features.asp (07.12.2012).
[154] E-mail interview, U.S. Coast Guard, 02.07.2012.
[155] U.S. Coast Guard, 2008, Report to Congress. U.S. Coast Guard Polar Operations, p. 15.
[156] Kirk Johnson, 2012, *For Coast Guard Patrol North of Alaska, Much to Learn in a Remote New Place*, http://www.nytimes.com/2012/07/22/us/coast-guard-strengthens-presence-north-of-alaska.html (07.12.2012).
[157] In Barrow the only hangar available for the two MH60T helicopters was not built robust enough and sunk several feet into the permafrost (see: Kirk Johnson, 2012, *For Coast Guard Patrol North of Alaska, Much to Learn in a Remote New Place*, http://www.nytimes.com/2012/07/22/us/coast-guard-strengthens-presence-north-of-alaska.html (07.12.2012).

*Capabilities*

Besides of the above mentioned capabilities, all other ships, helicopters and aircraft are located in the southern part of Alaska. In case of an emergency scenario the long transfer time of these capabilities into the Arctic would hinder swift emergency responses. Altogether the U.S. Coast Guard operates 12 cutters in the 17th Coast Guard district.[158] However all of them are stationed south of the Arctic Circle in the Gulf of Alaska.

In addition each Coast Guard sector (Juneau and Anchorage) has a 110 foot patrol boat in a two hour response status. Finally, the District keeps a 225 foot buoy tender in a six or 12 hours response status and maintains one large high endurance or medium endurance cutter on patrol year round in the Bering Sea with an MH-65D short range helicopter aboard.[159]

According to U.S. Coast Guard officials, it could take eight to ten hours for helicopter coverage to arrive in the area depending on the weather conditions and the time needed to provide additional crews to operate the aircraft once in the area. Fixed wing support may take over four hours to arrive in the area, also depending upon weather conditions. The transport of ships into the region would also take time. From Kodiak, the largest U.S. Coast Guard base in the Arctic, to Barrow (distance about 1.500 miles), it would take approximately three to seven days, depending on weather conditions and the size of the ship/cutter.[160]

Another problem for aircraft and helicopters is the limited availability of fueling points in the region. This decreases the flight range significantly. Point Barrow, the northernmost point of Alaska is about 950 miles or eight helicopter flight hours away from Kodiak.[161] This is beyond the range of any land-based Coast Guard helicopter.[162] Even further complicating SAR activities from Point Barrow is its remote location and the lack of support infrastructure. The closest fueling point to Barrow is Dutch Harbour, which is approximately 1,000 nautical miles away.[163] On scene helicopters and aircraft might only be able to operate for a few hours before they have to return for replenishment.[164] This could complicate SAR efforts.

Existing capabilities also face some serious shortages with regard to its operational use. The MH-60 is the most commonly used helicopter of the U.S. Coast Guard and stationed in all air stations and FOB's in the Arctic. However its operational use is limited by the fact that it operates almost exclusively from shore facilities. In theory it can also operate from a Coast Guard icebreaker.[165] However the lack of a sufficient number of icebreakers means that for most of the year the U.S. Coast Guard has no icebreaker available in the Arctic. Thus the MH-60 is forced to operate from shore facilities. Regarding the lack of sufficient fueling stations in the Arctic region might reduce its operating distance significantly. The last factors influencing the operational readiness of the

158 United States Coast Guard, *District Units. Units Located in the 17th District*, http://uscg.mil/d17/units.asp (07.12.2012).

159 E-mail interview, U.S. Coast Guard, 02.07.2012.

160 E-mail interview, U.S. Coast Guard, 02.07.2012; Alaska Dispatch, 31.07.2012, *Murkowski Touts US's Arctic Needs in Kodiak Hearing*, http://www.alaskadispatch.com/article/murkowski-touts-uss-arctic-needs-kodiak-hearing (07.12.2012).

161 E-mail interview, U.S. Coast Guard, 02.07.2012.

162 U.S. Coast Guard 2008, *Report to Congress. U.S. Coast Guard Polar Operations*, p. 5.

163 U.S. Coast Guard 2008, *Report to Congress. U.S. Coast Guard Polar Operations*, p. 11.

164 U.S. Coast Guard 2008, *Report to Congress. U.S. Coast Guard Polar Operations*, p. 11.

165 U.S. Coast Guard 2008, *Report to Congress. U.S. Coast Guard Polar Operations*, p. 14.

MH-60 are the cold and icing weather conditions. The helicopter has anti-ice and de-icing systems, which allow operations in light-ice conditions down to -40ºC. However between October and April, Arctic lows below -40ºC have been recorded.[166] This further limits the utilizability of helicopters for SAR missions.

As indicated a MH-65D short range helicopter is aboard a cutter that operates yearound in the Bering Sea.[167] Its ability to land aboard a cutter is an advantage in comparison to the MH-60. However turbulent sea conditions might prohibit a safe start and landing.[168] A further obstacle for use of the MH-65D is its inability to operate in conditions of -25º C.

The U.S. Coast Guard also operates the HC-130 Hercules, a fixed-wing multi-mission aircraft that can be used for transport or surveillance tasks. However the aircraft is not designed to operate in Polar Regions throughout the entire year. In this case major modifications like landing gear skis or fuel with a lower freezing point would be required.[169] The deployment of the HC-130 into the Arctic region is further limited by the lack of sufficient support infrastructure. Thus extended deployment of fixed-wing capabilities cannot be done by the U.S. Coast Guard.[170] For a sustained presence in the Arctic it would need the support of the Canadian Coast Guard.[171]

Finally the Coast Guard also faces an icebreaker gap. The U.S. Coast Guard Pacific Area Command currently operates two heavy and one medium icebreaker.[172] According to the USCG however the number of icebreakers is not sufficient to fulfill its operational mandate. At least three heavy and three medium icebreakers would be needed.[173] However sufficient funding for these plans is not available.[174]

*Maritime Domain Awareness*

With a lack of sufficient infrastructure and assets in the region communications and surveillance capabilities will become even more important. According to the Department of Defense (DoD) the existing communications infrastructure is insufficient. Due to magnetic and solar phenomena that degrade High-Frequency (HF) radio signals, communications in latitudes above 70º north are extremely limited. In addition Global Positioning System (GPS) performance is degraded due to poor satellite geometry,

[166] U.S. Coast Guard 2008, *Report to Congress. U.S. Coast Guard Polar Operations*, p. 14.
[167] E-mail interview, U.S. Coast Guard, 02.07.2012.
[168] U.S. Coast Guard, 2008, *Report to Congress. U.S. Coast Guard Polar Operations*, p. 13.
[169] U.S. Coast Guard, 2008, *Report to Congress. U.S. Coast Guard Polar Operations*, p. 14
[170] U.S. Coast Guard, 2008, *Report to Congress. U.S. Coast Guard Polar Operations*, p. 14
[171] Heather A. Conley /Terry Toland/Jamie Kraut/Andreas Østhagen, 2012, *A New Security Architecture for the Arctic. An American Perspective*, Center For Strategic & International Studies, http://csis.org/files/publication/120117_Conley_ArcticSecurity_Web.pdf (07.12.2012), p. 23
[172] U.S. Coast Guard, Pacific Area Coast Guard Cutters, http://www.uscg.mil/pacarea/areacutters.asp (07.12.2012); Department of Defense, 2011, Report to Congress on Arctic Operations and the Northwest Passage, http://www.defense.gov/pubs/pdfs/Tab_A_Arctic_Report_Public.pdf (07.12.2012), p. 26
[173] ABS Consulting, 2010, *United States Coast Guard High Latitude Region Mission Analysis Capstone Summary*, http://assets.fiercemarkets.com/public/sites/govit/hlssummarycapstone.pdf (07.12.2012), p. 12
[174] Ronald O'Rourke, 2012, *Coast Guard Polar Icebreaker Modernization. Background and Issues for Congress*, http://www.fas.org/sgp/crs/weapons/RL34391.pdf (07.12.2012); U.S. Coast Guard, 2008, *Report to Congress. U.S. Coast Guard Polar Operations*, p. 11

ionospheric effects, and multipath interference. This could negatively affect missions that require precision navigation, as in the case of search and rescue".[175]

In conclusion the USCG states: "*there is insufficient satellite and radar data, as well as a lack of Automatic Identification System receivers, vessel monitoring system coverage and communications equipment to support intelligence, surveillance and reconnaissance systems and processes…With the expected growth in human activity in the Arctic region, the Coast Guard lacks a comprehensive intelligence and MDA capability*."[176]

## 5. How Prepared are Arctic Council Member States to Proceed with Search and Rescue in the Arctic?

As elaborated above legal and operational frameworks seem to be sufficient. The 2011 signed agreement on aeraonautical and maritime SAR cooperation is an important step forward for closer and more effective SAR cooperation.

However serious capability gaps do exist. The existing primary search and rescue capabilities are in their majority designed and organized for littoral or coastal sea operations. Most of the rescue vessels are too small or weak to operate in the harsh conditions far away of the coastline. Many states are forced to use military ships to operate on the high sea. The problem with them is, that these ships do not operate in a primary search and rescue role in pre-defined stand-by areas far away from their homeports to guarantee a fast support. Moreover, also many warships are not constructed for operations under ice conditions Ships and helicopters can travel long distances in relatively short time. However in a large scale evacuation scenario additional ships would need to be transferred into the region to embark people.

Also additional infrastructure investments are necessary to enable the SAR agencies to access even remote locations. Recent U.S. plans of establishing FOB's are a step in the right direction.

Serious gaps still exist with regard to satellites and communications. With a thin strained human presence in the Arctic permanent satellite coverage is of utmost importance in order to get a full picture of activities in the area of operations. And in order to coordinate any SAR effort reliable communications channels do have to exist. As the Norwegian case study has shown this problem has been identified and plans exist to cope with this challenge. However the high costs related to the design and build-up of additional satellite and communication infrastructure are a serious hurdle that has to be overcome by Arctic coastal states. As elaborated in the case studies of the U.S., Canada or Russia for example financial constraints seem to block any attempts to overcome these gaps.

[175] Department of Defense, 2011, Report to Congress on Arctic Operations and the Northwest Passage, http://www.defense.gov/pubs/pdfs/Tab_A_Arctic_Report_Public.pdf (07.12.2012), p. 16
[176] Department of Defense, 2011, Report to Congress on Arctic Operations and the Northwest Passage, http://www.defense.gov/pubs/pdfs/Tab_A_Arctic_Report_Public.pdf (07.12.2012), p. 15

# 6. Closer Cooperation: The Road Ahead

Due to budget constraints and the vast size of the region that has to be covered sufficiently officials from all Arctic coastal states acknowledge the need for closer cooperation. With regard to capabilities and the build-up of infrastructure closer cooperation between the Arctic Council member states seems to be the most appropriate solution. Another option to close existing gaps would be a closer cooperation between the public and the private sector. As the case studies of Greenland and Russia have shown. The private sector has essential assets at its command.

However with regard to communication systems and satellite coverage international cooperation with a stronger EU engagement could add real value to existing systems and capabilities.

*Cooperation between Arctic Council Member States*

With regard to closer cooperation between AC member states two key steps can be identified:

1. Identification of FOB's and Supply Contingency Planning:
   The coastal states could identify potentially forward operational bases (FOB) that are already equipped with adequate support infrastructure like airports and ports[177]. In a second step a planning process could be initiated to pre-plan the possible distribution of rescue helicopters, personal and equipment like mobile hospitals, via strategic airlift towards the FOB in case of an incident. This type of planning would avoid the permanent provision of still not existing or rare SAR capabilities in the region and would give the rescue procedure more flexibility. Designated units would be in a rotating stand-by modus.
2. Identification of Permanent SAR Stations:
   A second option could be the identification of strategically optimal locations (far away from the coastline) where the AC member states could rotationally station some units that could be alerted in case of emergency. These larger SAR stations could be operated under uni-, bi-, or multilateral command. Thule airbase could be one possible location for such a SAR station.

*A potential EU Role in Communication Systems and Satellite Coverage*

With its two flagship satellite programmes Galileo and GMES the EU could help to close existing gaps in satellite coverage and communication systems.

As indicated above a small-scale human presence in the Arctic calls for close monitoring and sufficient communication capabilities that enable an almost complete coverage of the maritime domain. Yet the Arctic Marine Shipping Assessment in 2009 highlighted that "*remote surveillance and detection technologies (i.e. satellite communica-*

[177] Probably the construction of new airfields that are fitted for military transport aircraft that could land on a harsher ground than civil airliners could also be an option. These airfields only have to be permanently manned with personnel that will ensure the permanent usability.

*tions, GPS availability, weather stations)...are limited in the Arctic due to a lack of coverage and the availability of real-time weather information.*"[178]

Huge financial investments are necessary to build these capabilities. However SAR-related funding in many Arctic coastal states is not expected to increase sufficiently. Therefore closer international cooperation might be an option to establish the necessary satellite and communication systems in the Arctic. One potential cooperation partner is the European Union (EU). With regard to the build up of additional communications and satellite infrastructure, the EU has some unique services to offer that could help to close critical gaps with regard to SAR operations. Via membership in the European Space Agency (ESA) Arctic Council member states like Norway or Sweden (also an EU member state) already possess some of the land-based infrastructure of Galileo. The stations in Tromsø, Svalbard and Kiruna are of critical importance, as polar-related data from satellites is more accessible from these stations.[179] Via its associated ESA membership Canada offers ESA to use some of its Arctic located stations, too.

Its two flagship satellite programmes Galileo and GMES offer essential services that could be of high value for SAR agencies operating in the Arctic.

Galileo is a global navigation satellite system that provides a global positioning service.[180] Full operational capability (FOC) is expected at the earliest in 2019.[181] With regard to SAR Galileo offers three particular services: accurate positioning and navigation as well as SAR messaging.[182]

The only fully operational global positioning and navigation system existing today is the U.S. GPS system. However Galileo offers a greater accuracy of positioning than GPS, going down to a meter or less.[183] In addition, and in contrast to GPS, Galileo will also cover the entire Arctic region on a permanent basis.[184] And finally Galileo is a civilian system. Thus there is no danger of a sudden switch-off of the system.[185] Taken together Galileo could enhance significantly accurate positioning and navigation. Both services are essential for all maritime activities, especially in the Arctic with its dark environment that offers not many other navigation and positioning tools.[186]

178 Arctic Council, 2009, *Arctic Marine Shipping Assessment*, http://pame.is/images/stories/AMSA_2009_Report/AMSA_2009_Report_2nd_print.pdf (07.12.2012), p. 174.

179 Kongsberg Satellite Services, 2011, *Galileo Takes its Place on Top of the World*, http://www.ksat.no/node/86 (07.12.2012); Kongsberg Satellite Services, 2012, *KSAT is Building a new Antenna for the ESA Sentinel Program*, http://www.ksat.no/node/484 (07.12.2012); European Space Agency, 2010, *Europe Opens an Arctic Eye on Galileo*, http://www.esa.int/esaCP/SEMMNFRRJHG_index_0.html (07.12.2012).

180 European Space Agency, 2012, *Fact Sheet. What is Galileo*, http://download.esa.int/docs/Galileo_IOV_Launch/Galileo_factsheet_2012.pdf (07.12.2012).

181 European Commission, 2011, *Bericht der Kommission an das Europäische Parlament und den Rat. Halbzeitüberprüfung der europäischen Satellitenavigationsprogramme*, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0005:FIN:DE:PDF (07.12.2012), p. 20.

182 E-mail interview, European Space Agency, 26.11.2012; European Commission/High Representative of the European Union for Foreign Affairs and Security Policy, 2012, *Joint Staff Working Document. Space and the Arctic*, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=SWD:2012:0183:FIN:EN:PDF (07.12.2012), pp. 6-7.

183 BBC, 2008, *Q&A. Europe's Galileo Project*, http://news.bbc.co.uk/2/hi/science/nature/4555276.stm (07.12.2012).

184 E-mail interview European Space Agency, 26.11.2012.

185 BBC, 2008: *Q&A. Europe's Galileo Project*, http://news.bbc.co.uk/2/hi/science/nature/4555276.stm (07.12.2012).

186 European Commission/High Representative of the European Union for Foreign Affairs and Security Policy, 2012, *Joint Staff Working Document. Space and the Arctic*, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=SWD:2012:0183:FIN:EN:PDF (07.12.2012), p. 6.

Galileo will also directly support the SAR system Cospas Sarsat. Each Galileo satellite will be equipped with a radio beacon that can locate distress calls that have been sent from ships or aircraft to the Cospas Sarsat system. As Galileo covers the entire Arctic region it might enable SAR agencies to react faster to incidents. Also Galileo satellites will send a reply message to those in distress, informing that the signal has been picked up and that help is on the way. This is a novum for the Cospas Sarsat system.[187]

The Global Monitoring for Environment and Security (GMES) system is the second flagship programme of the EU that could add real value in the Arctic. Three services are of particular relevance to SAR activities: ship/iceberg detection, weather forecasts and rapid mapping capabilities.

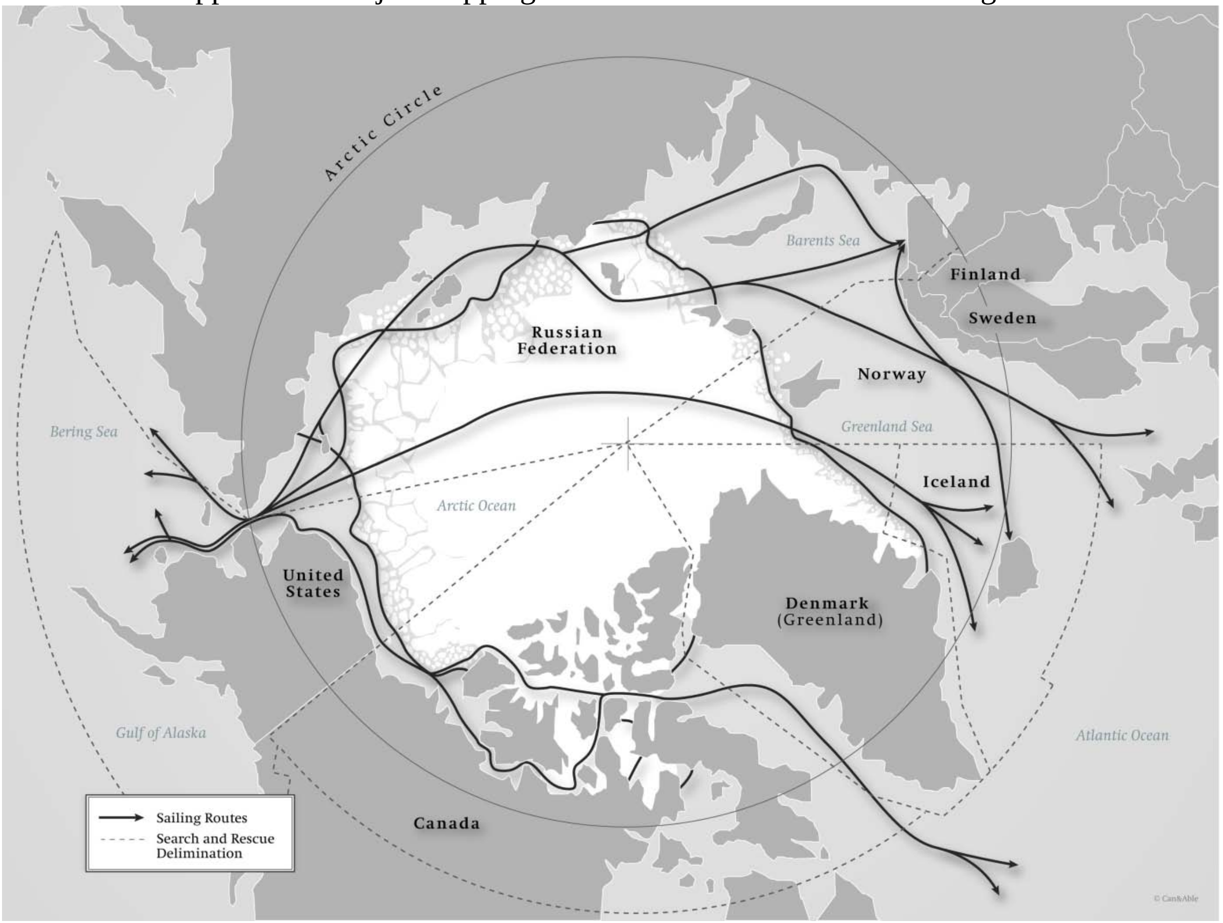
One of the main challenges for maritime activities is the drifting of icebergs that could slash a ship. Heavy fog in parts of the Arctic could lead to near zero visibility.[188] These natural challenges call for better iceberg and ship detection systems. This will be offered by GMES.

In case of an emergency situation happening an accurate situation picture has to be available. A key function of GMES will be the ability to generate high resolution maps on short-notice.[189] Weather patterns often change very quickly in the Arctic. Real-time information of weather forecasts could enhance significantly the safety and security of ships operating in the Arctic.

The build up of SAR infrastructure and the acquisition of capabilities is the primary task of the AC member states. Due to financial constraints closer regional cooperation seems necessary. Yet, even closer coordinated SAR activities will be challenged by the vast size of the region and the harsh weather conditions. Better satellite coverage and better communication systems could compensate some of these challenges. The EU's satellite flagship programmes Galileo and GMES could offer valuable services to Arctic SAR agencies.

[187] European Space Agency, 2012, *Galileo to Spearhead Extension of Worldwide Search and Rescue Service*, http://www.esa.int/esaNA/SEMC9L7YBZG_index_0.html (07.12.2012).
[188] Coastal Response Research Center at the University of New Hampshire, 2009, *Opening the Arctic Seas. Envisioning Disasters and Framing Solutions*, http://www.crrc.unh.edu/workshops/arctic_spill_summit/arctic_summit_report_final.pdf (07.12.2012), p. 21.
[189] E-mail interview, European Space Agency, 26.11.2012.

Appendix I: Major Shipping Routes and Search and Rescue Regions




This map is based on two distinctive maps of the Arctic Portal, that can be used under a creative commons attribution-noncommercial 3.0 licence. For more information about the Arctic Portal's maps: (http://portal.inter-map.com/#mapID=49&groupID=297&z=1.0&up=-309532.0&left=2001105.4 and http://arcticportal.org/images/stories/Illustrative_Map_for_Arctic_SAR_Agreement.jpg For more information about the Arctic Portal: http://arcticportal.org/.

# Abbreviations

| | |
|---|---|
| AC | Arctic Council |
| AEO | Area of Operation |
| AIS | Automatic Identification System |
| AMSA | Arctic Maritime Shipping Assessment |
| AMVER | Automated Mutual-Assistance Vessel Rescue System |
| AOR | Area of Responsibility |
| ARCC | Air Rescue Coordination Center |
| ASEM | Asia-Europe Meeting |
| AWSAR | All Weather SAR |
| CFS | Canadian Forces Station |
| COSPAS-SARSAT | COSPAS: Russian for "Cosmicheskaya Sistema Poiska Avariynyh Sudov" which translates to "Space System for the Search of Vessels in Distress"<br>SARSAT: Search And Rescue Satellite-Aided Tracking |
| DoD | Department of Defense |
| EMSA | European Maritime Safety Agency |
| EPIRB | Emergency Position-Indicating Radio Beacon |
| ESA | European Space Agency |
| EU | European Union |
| FOB | Forward Operating Base |
| FOC | Full Operational Capability |
| GLONASS | Russian for "Globalnaya Navigatsionnaya Sputnikovaya Sistema" which translates to "Global Navigation Satellite System" |
| GMDSS | Global Maritime Distress and Safety System |
| GMES | Global Monitoring for Environment and Security |
| GPS | Global Positioning System |
| HF | High Frequency |
| HIFIR | Helicopter Inflight Refuelling System |
| IAMSAR Manual | International Aeronautical and Maritime Search and Rescue Manual |
| ICG | Icelandic Coast Guard |
| IMO | International Maritime Organization |
| JACMD | Joint Arctic Command Denmark |
| JRCC | Joint Rescue Coordination Centre (Canada) |
| MDA | Maritime Domain Awareness |
| METAREAS | Meteorological Areas |
| MF | Medium Frequency |
| MPA | Maritime Patrol Aircraft |
| MRCC | Maritime Rescue Coordination Center |
| NATO | North Atlantic Treaty Organisation |
| NAVAREAS | Navigational Warning Areas |
| NM | Nautical Miles |
| NoCG | Norwegian Coast Guard |
| NoCGV | Norwegian Coast Guard Vessel |
| NSR | Northern Sea Route |

| | |
|---|---|
| NWP | Northwest Passage |
| PfP | Partnership for Peace Programme |
| RCC | Rescue Coordination Center |
| RSC | Rescue Sub-Centre |
| SAR | Search and Rescue |
| SAR Convention | International Convention on Maritime Search and Rescue |
| SAREX | Search and Rescue Exercise |
| SOLAS Convention | International Convention for the Safety of Life at Sea |
| STOL | Short Take-Off and Landing |
| UNCLOS | United Nations Convention on the Law of the Sea |
| UAV | Unmanned Aerial Vehicle |
| USCG | U.S. Coast Guard |
| VHF | Very High Frequency |
| WWNWS | World-Wide Navigational Warning Service |