



Admiral Jonathan Greenert

I appreciate the invitation to this event, and I am glad to be here. I want to thank The Johns Hopkins University Applied Physics Laboratory for hosting this event. I think you have put together a terrific agenda. The mix in the audience is very good, too. You have both military and civilian personnel as well as students and scientists. As I see it, you have the DoD, interagency, Hatfields, McCoys, cats, and dogs. So it ought to come together just right.

Admiral Jonathan W. Greenert is a native of Butler, Pennsylvania. He graduated from the U.S. Naval Academy in 1975 and completed studies in nuclear power for service as a submarine officer. His career as a submariner includes assignments aboard USS Flying Fish (SSN-673), USS Tautog (SSN-639), Submarine NR-1, and USS Michigan (SSBN-727, Gold Crew), culminating in command of USS Honolulu (SSN-718) from March 1991 to July 1993. Subsequent fleet command assignments include Commander, Submarine Squadron 11; Commander, U.S. Naval Forces Marianas; Commander, U.S. Seventh Fleet (August 2004 to September 2006); and Commander, U.S. Fleet Forces Command (September 2007 to July 2009). Admiral Greenert has served in various fleet support and financial management positions, including Deputy Chief of Naval Operations for integration of capabilities and resources (N8); Deputy Commander, U.S. Pacific Fleet; Chief of Staff, U.S. Seventh Fleet; Head, Navy Programming Branch; and Director, Operations Division Navy Comptroller. He is currently Vice Chief of Naval Operations. He is a recipient of various personal and campaign awards, including the Distinguished Service Medal (five awards), the Defense Superior Service Medal, and the Legion of Merit (four awards). In 1992, he was awarded the Vice Admiral James Bond Stockdale Award for Inspirational Leadership. He considers those awards earned throughout his career associated with unit performance to be most satisfying and representative of naval service.

The Navy's *Cooperative Strategy for 21st Century Seapower*—our maritime strategy, if you will—lays out a key theme that is very enduring, and that theme is creating partnerships. [1] It is applicable to all aspects of our maritime operations today, and it applies as well to the focus for this symposium. When we ultimately decide how our nation is going to adapt to climate and energy challenges, whatever approach we use is going to have to be an interagency approach as well as an international approach.

So, in kicking off this symposium today, I want to provide a couple of points for your consideration, and I will do that by asking a series of questions. What are we learning now about climate change and how does the Navy integrate that into our programmatic behavior? How are we going to build programs so that we prepare ourselves and prepare our people to deal with climate change? What are we doing now, and what will we be doing about energy in the future? As I will explain shortly, I think that when we act on this is probably as important, if not more important, than how we act or what we do.

Let me start by reporting that the Navy just completed the Navy Ice Exercise, or ICEX. For those of us who spend time on ships and submarines, that is quite an event. It has been on my “bucket list” for a long time. I am running out of air speed and altitude, as they say, and I have never been on an ICEX. So I was really planning to go last weekend, but I just could not make it.

An ICEX, if you are not familiar with the term, is a long-standing biannual exercise in which we typically take two submarines up into the Arctic do some testing. I cannot get into detail regarding the specific nature of those tests, but you can probably imagine what we do and why we do it. I can tell you that we hook the subs up with some equipment, go out to an ice camp, and show people around to see what the Arctic is like. In the process, we learn a lot about the Arctic and how it is changing and how we might operate there in the years ahead.

This year we deployed the USS *New Hampshire*, one of our new, cutting-edge *Virginia*-class submarines, and the USS *Connecticut*, which is a *Sea Wolf*-class submarine but still very

cutting edge. Given the unique nature of the Arctic and the difficulty of operating there, we had to put special equipment on the submarines. We could not just send submarines up as they are and be able to do the things that we wanted to do. We needed upward-looking sonar, for example, and a video camera to help us find ice sheets on the surface and ice keels under the surface.

Despite all of our preparation, we were once again reminded of the remoteness, the starkness, and the ruggedness of the Arctic. We had a casualty in the oxygen generator on one of the submarines; our submarines use hydrolysis to produce oxygen from water. During the exercise, an oxygen generator on one of the submarines failed. Because oxygen is essential, the crew had to resort to using the backup system—sodium chlorate candles. These candles are meant to be used only for short periods of time, and if they are not properly ignited, they can produce dust that is very irritating to one's nasal passages. When that happens in an area that is not covered by ice, the submarine can just come up, raise the snorkel mast, and bring fresh air in and all will be well. It was not an option in this case. Fortunately, things worked out well, but it was a reminder that the unexpected can happen.

So, when operating in the Arctic, it is helpful to remember that things are different—it is rugged, it is remote. The submarine crews also had to deal with a lot of condensation. To some extent that is to be expected—you go up in the cold water and you have metal, cold water, and difference in temperature, so you generate condensation. With the wide array of electrical and electronic equipment on our submarines, the crews had to be very cognizant of exactly where condensation was occurring.

During the exercise, a sailor on one of our submarines got appendicitis and had to be evacuated. However, because the submarine was in the Arctic, it could not just surface and call for a helicopter rescue. So they had to deal with that, and it worked out reasonably well. And they had an air conditioner fail during one of the surface operations. Air conditioner, Arctic—what is the big deal? Well, some things do get warm on the submarine, even in those reaches.

The point here is the Arctic is harsh. It is remote, and it is an unforgiving environment; we learn that lesson again and again with each operation. We invariably discover—or rediscover to be precise—that some of the very basic issues that our crews have to deal with on a day-to-day basis turn out to be of great importance.

Whenever we do an ICEX, we like to bring VIPs up there—congressmen, people in the administration. So, this year, the Under Secretary of the Navy and the Under Secretary of the Army went up. Before leaving, though, the Under Secretary of the Army told us that he needed to be back on Monday, because he had to testify on the Hill on Tuesday. But guess what? The weather changed. I think he got in last night and is testifying this afternoon. I hope things work out. But again, here is another reminder that our standard approach of thinking that we can just move around like this and that, and we'll just schedule things heel to toe, may not work out quite as slick when we are in the Arctic. The weather, the ocean conditions, and the ice conditions can change dramatically and necessitate equally dramatic changes in plans.

We also had to have a different communication plan, given the uniqueness of the Arctic. The bandwidths do not operate the same, the weapons do not operate the same, and the sensors do not operate the same. All of these have to be taken into account. And, as I mentioned before, there is little infrastructure in the Arctic to support operations, so supply becomes an issue. Search and rescue becomes an issue, as does medevac should one be required. In the case of the ICEX, we had been planning it for months, perhaps even a year, so we were able to anticipate a lot of things. Will we be able to respond like that when we are trying to conduct typical operations up there?

So, it can be kind of difficult when we want to go see Mother Nature. But I think what we are talking about in climate change is Mother Nature coming to us. I am not actually talking about the Arctic coming down to us, but I am talking about the need perhaps to operate much more in the Arctic. Mother Nature is going to start changing things. How do we prepare ourselves for that unavoidable change?

We can be certain that within this century climate change is going to cause us to deal with maritime security in a profoundly different way. We are going to have to anticipate, we are going to have to plan how we go about doing this, and we have to act in a deliberate manner. I will mention why in just a minute.

When we went to the Middle East some decades ago, we were using a lot of equipment that was built originally for use in the Cold War. It was meant to be used in the European theater, where the climate is completely different. The Middle East was dusty and hot. We found that we had to modify many of the systems that we were using. In laying out the requirements for those modifications, we employed what are Joint Urgent Operational Needs Statements, or JUONS. And we went from JUONS to JUONS to JUONS—I need this, and I need it now because I am operating over here. Because we were not sure how long this was going to go on, we asserted that we needed joint solutions and that we needed them urgently. We did not, however, try to fundamentally change the way we approach our programs.

So, we kind of muddled through how we built our equipment to deal with operating in a different climate. I submit to you that we cannot do this when we are dealing with climate change. If we are going to the Arctic or another area as the climates change, we cannot just go from JUONS to JUONS. We cannot muddle our way through. We need to think about this in a deliberate manner.

So what kind of activities does the Navy have underway today that will help us understand exactly what we need to do? I think many of you have studied what is likely to happen with climate change. Arctic routes will be open maybe by the 2030s. We will have creeping sea-level rise and enhanced storm surges, threats to our coastal installations. Increased weather extremes could lead to geopolitical instability. We need to think about these possibilities and budget accordingly.

Today, our fleets budget for hurricanes and they budget for typhoons. They do not budget for tsunamis, but they might start giving that some thought. When I was Atlantic Fleet Commander, we would budget about \$30 million a year for damage that resulted

from hurricanes. It was not really a very thoughtful thing; we looked at our wake and saw how things worked in the past, and we put that amount of money in the budget. We never really thought about how you prepare for one hurricane or for several hurricanes in succession. After Katrina and a few more years of having one hurricane after the other, we finally learned the hard lesson that we had to try to prepare for such events.

The same goes for extended periods of cold weather, for California wildfires, and other things of that nature. Just planning for what climate could bring to you is something that needs to be thought out. The effects of water shortages from droughts, water excess from floods, or other events should cause us to think about how we are going to disperse our forces globally. We have now come to the point in the Western Pacific where during typhoon season, it is sensible to send amphibious ships toward Southeast Asia to do humanitarian assistance operations. We have to plan our maintenance accordingly and disperse the fleet so that it is able to respond to such events. Rather than continuing to muddle through, we have to become more thoughtful as we look ahead.

Water shortages, perhaps, will lead to population movement, with the inevitable social, political, economic, and cultural impacts. Such changes seem certain to amplify the stresses that already exist. It could accelerate what we might call the point of conflict. In other words, people's tempers are getting shorter, and we need to take a look at that and understand that the kind of timing that we thought we had in the past for some smoldering issues may not be available in the future. We probably need to consider this and plan our humanitarian assistance and disaster relief strategy accordingly.

The Chief of Naval Operations (CNO) established Task Force Climate Change in May 2009 because he wanted to take a lead angle on this. He wanted the Navy to look out ahead toward climate change. So, he asked the Task Force to start thinking about this and then come back and tell him what they thought he needed to do. That Task Force held its first Arctic game at the Naval War College in 2009. In September 2011, we will do it again.

The Task Force conducted an Arctic shipping game in December 2010. They have also sponsored international exchanges, conferences, and interagency partnerships. The Navy, the Air Force, and the National Oceanic and Atmospheric Administration (NOAA) have had an interagency partnership going for some time. The Task Force put together a very nice Arctic Roadmap that was issued in November 2009 and a Climate Change Roadmap that came out in May 2010. [2] [3] That same month, they released their Arctic strategic objectives publication, which describes our partnerships in joint surveying and research, search and rescue, and maritime domain awareness. [4]

In addition to those studies, we have done some tangible things. During Operation Nanook in 2010, we operated with the Canadians and the Danes off Greenland. We took the USS *Porter* with a dive and salvage unit and one of our P-3 aircraft, and we went up and operated with a ship from the Canadian naval forces. The environment was certainly challenging. There was a lot of fog. And this was not the regular fog that we in the Navy are used to. When we see fog, we try to avoid it, or we go through it. In this case, we had to operate consistently in the cold, freezing fog.

How do you operate when your crewmen look like the Michelin Man all the time? How do you become effective doing that? Do we need to develop better outfits so that our crews can more easily carry out their assigned tasks? Given that we were in the ocean, you would think that there is plenty of water to be had. But we found that our water-producing units were not very effective in the Arctic. Our ships use a lot of water—so we found that we had to look at how we produce water.

When we go to the Arctic, our communications plans effectively have to be rewritten. In planning for the recent ICEX, we found that the angles, the best operating frequencies, and how we employed our antennae had to be redone. We also get some tangible, albeit anecdotal, output when we do these exercises. The Norwegians, who have come with us several times, have proposed that we link up our command centers so that it is less of a helter-skelter operation when we want to talk about maritime

domain awareness. We have a similar initiative with the Danes in that regard.

The Naval Research Laboratory is currently investing about \$6 million a year to observe and predict high-latitude climate changes. We are also conducting what we call a capabilities-based assessment to determine which platforms and systems we might need to invest in so that we will have the capabilities we need in the Arctic. We intend to finish that assessment later this summer so that when we go to our Fiscal Year 2014 Program Objective Memorandum (POM), we will be able to deal with specific programs and not just have an unstructured discussion.

Our intent is to integrate the lessons learned from the full spectrum of wargames, studies, exercises, and anecdotal evidence into our current programs and processes so that ultimately climate change is not being regarded as a crisis but as one of a series of future challenges. Just as we are dealing with warfare challenges and major changes in strategy, we propose to deal with climate change in a similar way.

Our guiding principle should be to invest diligently and to avoid surprise. We want to invest at the right time so that we do not have to make fundamental or dramatic changes or turn things upside down. We do not want to have to go from JUONS to JUONS to JUONS as we deal with climate change.

Now let us look at how we deal with the impacts of climate change programmatically. How do we integrate these considerations into something tangible for a program? We do that by trying to understand the threats that are out there, the severity of those threats, and the rate at which those threats are changing. We collaborate with our allies and our partners to determine the threat that we want to overcome or that we want to counter. We assess the performance that is needed for the threat. We do scenarios, we do wargames, and we model, and from those we try to identify the specific capabilities that we need to try to attain and the limitations associated with those capabilities.

We embed that in the POM process starting with our research, development, test, and evaluation (RDT&E) budget. As part of the

process of providing new capabilities to our forces, we like to do what we call an “evolution.” Basically, it is an exercise where we deploy the capability with the fleet as soon as possible. We call it “getting it wet.” One way to do it—and it has been an effective way—is to embed the desired attributes for important new capabilities in the Key Performance Parameters of all of our programs—ships, aircraft, submarines, you name it. If there is something that has to do uniquely with climate that we need to have on our platforms or system in the future, it becomes a Key Performance Parameter or a Key System Attribute.

We try to test our proposed solutions as early as possible and use our combatant commanders and our fleet feedback process to see how well it did and whether we need to evolve the capability in some way. Then we adjust the doctrine and the way that the fleet operates with the new capability. We call that our Joint Capabilities Integration and Development System, or JCIDS. JCIDS is a very deliberate bureaucratic process, but it is the process we live in. To some extent, you can try to work around it or skirt it by going from JUONS to JUONS. But to get to the end state that we want, we need to integrate what we want for climate change into the JCIDS process.

Now I would submit to you that we can approach the climate adaptation problem in a couple of ways. One, we can put the attributes that are needed because of climate change into all of our programs, or two, we can define programs that are strictly attributable to climate change—Arctic programs, programs to respond to water change, programs to respond to increased sea level, whatever it is—and have a bundle of programs to deal with climate change.

However we decide to do this, we first need to think this through. I have not determined if it is one or the other. I think that we first need to define what we need. Once we know what we need and why we need it, we will have a clearer picture of what we need to do. There is precedence for this as I mentioned before. When we started operating in the Arabian Gulf and in the Middle East decades ago, we found logistics issues that we had to put into our programs, and we had unique logistics solutions that provided capability to operate in a very hot, dry, and dusty environment.

When we first went to the Middle East, we found that our heat exchangers were fouling because the warmer water tended to generate more biological matter that gummed up our equipment. We had heat stress, both in our equipment and in our people. The fine, talcum-like dust would get sucked into the turbine engines on our F/A-18 Hornets and on our helicopters and wear them out early.

So, we have been down this road before. We had some successes in adapting. Some programs did it smartly, some did not. We did not approach it directly and deliberately like this conference and other sessions like this have the opportunity to do. Here is my list of some of the things we need to consider. How many of our future platforms will need to be ice strengthened? How do we establish reliable communications with our partners in these remote sites? How will sea-level rise affect when we should invest in a shore installation that needs to be protected from weather? Is the current afloat medical capacity sufficient for our future needs in remote areas, be it the Arctic or otherwise? What mix of assets is best suited to deploy together in the future? The ships that we normally operate together now may not be the right mix of ships that we need in the future. What new tactics, techniques, and procedures or doctrine do we need to adopt for working with nongovernment and international organizations? How and when do we modify our fleet response training plan?

The fleet response training plan is the deliberate approach that we use to prepare our ships to operate for their 6- or 7-month deployment. So how do we integrate the climate changes that we are going to see into where our units are going to operate? How do we train and prepare them to do that, both from the maintenance perspective and from the training of the crew itself? Should we adjust our global posture, our rotational forces, our prepositioned forces accordingly based on the new zones of instability that could result from climate change?

THE NAVY AND ENERGY

Let me now shift to the energy side and talk about what we are doing now and what we may be doing shortly. I think our energy strategy is much more mature than our climate change strategy.

Basically, our energy approach has been worked by Rear Admiral Philip Cullom in a very straightforward manner and one that is understandable, and it has some good synergy going.

Put simplistically, the Navy has decided that we need to be efficient with the energy that we have and that we need to find alternative fuels and sources of energy. Our programs have pretty good momentum under Task Force Energy, which was established a few years ago. Our approach is part technical and part operational. On the technical side, we are looking at system efficiencies and alternative energy. The *Makin Island*, which is one of our newest big-deck amphibious ships, and our future *Arleigh Burke*-class destroyers, our DDG-51 class, will have hybrid electric drives that are much more efficient.

Some of the other technical options that we are examining are low-drag hulls and propeller coatings, improved engineering plant controls, and the ability to have a hybrid fuel or an alternative fuel that we can just drop in using a 50/50 blend of alternative fuels. We have successfully demonstrated the usability of those fuels in jet engines, helicopter engines, and small boat engines. We are testing them now in our marine turbines and diesels. We are also looking at alternative energy sources like wind, solar, and geothermal as options for our shore installations. We have a series of pilots, and in some cases, flat-out programs, that we are using to get ourselves off the national electric power grid, and we have pretty good goals for the future.

Operationally, we are ratcheting down our flying and steaming hours pretty hard to make sure that we are only flying when necessary, only steaming when necessary, and using optimum routes and best speeds. We are trying to use our fuel judiciously. Our expeditionary forces are preparing to use hybrid energy storage modules. The Secretary of the Navy and the Marine Corps are working together to reduce the huge logistics tail required by our expeditionary forces when they deploy.

We are metering our piers, our plants, and our buildings to alter the behavior and change our input lineup so that it is more standardized and much more energy efficient. What we ultimately

want to do is use this opportunity to enhance our combat capability. Every \$10 increase in the cost of a barrel of oil costs the Navy about \$300 million a year. If we can reduce the amount that we spend on fuel, the savings can be invested in the combat power that we will need in the future. Improving fuel efficiency will also help our range, it will increase our endurance, and it will loosen the logistics tether that we have been stuck on for so long.

In closing, I think we have a pretty good plan with regard to energy; the question is: can we sustain it? Can we stay the course, follow through, and get to where we need to go?

With regard to climate change, I think the question is: how do we integrate what we are going to need to do as a result of climate change with our overall program? We have put a series of programs out there. Are we going to need to change the attributes of any of those programs to accommodate climate change?

We need to determine when and how we start programming for these changes. There is a lot of activity going on today—a lot of good activity. We are going to have to bring that into a deliberate approach so that we can say, "here is the approach to deal with the climate change that we expect in the future and this is when we need to get started." We need to do that judiciously and efficiently and not just go from JUONS to JUONS.

REFERENCES

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2. Department of the Navy, *Navy Arctic Roadmap*, 10 Nov 2009, http://www.navy.mil/navydata/documents/USN_artic_roadmap.pdf.
3. Department of the Navy, *Navy Climate Change Roadmap*, 21 May 2010, <http://www.navy.mil/navydata/documents/CCR.pdf>.
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Q&A SESSION WITH ADMIRAL GREENERT

Q: *Will you get the money for the things that you need?*

ADMIRAL JONATHAN GREENERT: I would tell you that Secretary Ray Mabus is totally committed to this. He has said that he wants to build ships, to increase use of unmanned systems, and to have alternative energy and an energy policy. He has said very clearly that we need to move out on energy. And he has stayed the course on those three. We often have a tendency when we deal with new things to say that we would like to shave a little bit off. But, he says, “not on our life.” We are going to hold the line on this. So, our Secretary is very much behind it.

I can also tell you that we have great support from the Secretary of Defense and on the Hill. We had some savings from military construction last year because of the economy. We had budgeted funds for a new auditorium, but when it was built, the cost turned out to be less than expected. The Secretary told us that he would like to keep those savings. The usual answer in such situations is something akin to “ha, ha, ha.” When we asked what he intended to do with the money, he said energy initiatives. And so we said okay. So, it is starting to get some pretty good traction. And I think what Secretary Mabus has said is that tough economic times are exactly the exactly the time to stay the course on something that we believe in. We have great support from our Secretary so far through the process.

Q: *I am from Coast Guard Research and Development. In the Coast Guard we are having a discussion right now about whether or not to have an Arctic variant of a new class of ship. Is there a similar kind of a discussion going on in the Navy?*

ADMIRAL JONATHAN GREENERT: As of now, there is no discussion going on within the Navy about building a new icebreaker. Part of that is because we want to see who is going to blink. I can tell you,

though, that we understand that we will not be able to operate successfully in marginal ice without making some changes. We have to evaluate the strength of our hulls today and, as we start building new ships, determine what strength we are going to need in our future hulls, including those on submarines. So, we are discussing how much structural integrity will be needed. But as for a ship constructed specifically for the Arctic, I am unaware of any discussion at this point. We are kind of hoping the Coast Guard will take the lead on that.

Q: *What is the state of the Navy's understanding regarding the topography of the Arctic and the need for charting and mapping of that region?*

REAR ADMIRAL DAVID TITLEY: About 5% of the Arctic has been charted to modern standards using GPS and sonar. We are working with the U.S. Coast Guard cutter *Healy*, which I once thought was an icebreaker but is apparently now an oceanographic survey ship. There is a lot to be done. This ultimately will come back to the Combatant Commanders. As the Vice Chief said, these requirements must be examined in a deliberate fashion. When directed to do so, we will start working those requirements.

ADMIRAL JONATHAN GREENERT: To that answer I will add that we will invest in the things that we need. Activities like our ICEX will continue to help us understand what those needs are. But I am pretty confident we will invest in the need to make sure that we produce the revisions and the upgrades to things like our global positioning systems and our other navigation systems.

Q: *I am curious how the fact that only 5% of the Arctic is charted played out in the most recent Arctic ICEX. My understanding from the Naval Studies Board report was that lack of data was a problem for some antisubmarine warfare operations. Was that an issue in the most recent exercise? [1]*

ADMIRAL JONATHAN GREENERT: Our subs take a fix and then use inertial navigation to get them through. They do not use the bottom topography nearly as much today. They can, but it is not necessary. Now that is great as long as all your inertial navigation systems are

working well and you can go up and get a fix every now and again. But if you are under the ice for long periods of time, and you have inertial issues, then you have to rely on bottom-type navigation. That is where charts become a key factor. So, we are going to have to take a hard look at the range of capabilities that will be needed to ensure sustained and continued operations.

Q: *Much of our shoreside infrastructure has lifetimes that could be as long as 40 years, and up to 60 years with upgrades. Some of the piers that are still being used at Naval Station Norfolk are 75 years old. How are you addressing sea-level rise, given those lifetimes?*

ADMIRAL JONATHAN GREENERT: To me it is not just sea-level rise. I think the degree of tidal changes and changes in currents are likely to prove just as important. Something that used to be a tidal swing of a few meters is now all of a sudden 10 meters. But it will not be universal. In some places you have pretty good tidal swing and in other places you do not. So, we need to think about how dramatic the changes will be and how they might be affected by inclement weather. Erosion is likely to be another important piece of the equation. In some areas it starts to get significant, and if you do not build for that, you find that you are in there bulldozing out and changing entire waterfronts to keep the erosion down. And then you have to start dredging.

Thanks for your time today. I think that the subject you are dealing with here is both very real and very exciting. Fortunately, we have some time to do this deliberately, and so I urge you to help those of us who work at the headquarters not do this in a knee-jerk manner but to start ramping up in a manner that makes sense and that will allow us to adapt our future systems and operations appropriately.

REFERENCE

1. Naval Studies Board, *National Security Implications of Climate Change on U.S. Naval Forces*, National Academies Press, 2011.