Contemporary Expeditionary Warfare for Scientists and Engineers

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1. Introduction

Expeditionary forces from many countries have deployed to mitigate the effects of natural disasters and human conflicts. Humanitarian Assistance/Disaster Response Operations have been planned and executed to mitigate the effects of catastrophic tropical cyclones, flooding, wild fires, and tsunami. Expeditionary forces have also provided rapid response to man-made disruptions such as mass casualties by terrorists, vessel hijackings by pirates, murders by drug cartels, and nuclear accidents. The conduct of successful expeditionary operations is therefore crucial to restoring order so that governments can perform their civil functions. This type of crisis response requires expeditionary forces to be self-sustaining and able to make data-driven decisions in austere and chaotic environments.

Most expeditionary operations involve a maritime component owing to the fact that the ocean comprises 70 percent of our globe and major population centers tend to be located near major seaports or littoral regions where land and ocean meet. Sea control and maneuver from the sea are key components for expeditionary forces. While sea control is a prerequisite for amphibious operations, so is understanding the environment. Maneuver is impacted by a variety of environmental conditions, which may contribute to mishaps from mechanical failures to navigation errors. Some of the most important natural phenomena impacting expeditionary operations are wind, depths, waves, currents, and tides. All of these factors work together to determine the size of wind waves and these waves once generated will eventually reach the beach and break as surf.

2. Environmental Factors

The coastal environment can affect all aspects of expeditionary operation, including initial covert intelligence gathering, mine clearing, landing operations, and protection and support of the subsequent military operations, both seaward and landward [1]. Critical environmental data for mission planning should be representative for the operating areas. Environmental phenomena may be measured remotely by overhead sensors, *in situ* with buoys or bottom-mounted instruments, or forecasted using numerically models such as Surface Waves Nearshore (SWAN) or DELFT3D. Important parameters are usually described as statistics that reveal the extreme conditions as well as the long- and short-term variations in an operating area.

Combat swimmers to landing craft or connectors are especially susceptible to the force of large waves and wave-induced longshore currents. Waves also impact the laying and clearing of mines. The launching and recovery of boats is especially dangerous in rough seas. Ride quality and seakeeping are impacted by waves. The installation of coastal structures is also sea state limited. Information on surf zone characteristics is critical to selecting landing locations for surf zone breaching.

During World War II (1939-1945) many landing-craft and amphibious-vehicle casualties were due to enemy action, but many were also related to problems with waves and currents causing capsizing, swamping, broaching, grounding and, when the ramps were down, filling with water and sand. Launching, beaching, retracting, and recovery are critical phases for landing craft operations. Weather factors can cause a craft to broach, thrown broadside to the surf and beach (see Fig. 1). Errors in reconnaissance such as collecting littoral intelligence at high tide and then navigating through an estuarine entrance at low water, contributed to capsizing of 9 of 17 rubber raiding craft in heavy surf during Exercise Valient Usher 1989. For regions without a port, today's Joint Logistics Over the Shore (JLOTS) operations require specialized sea state limited equipment, including the Army's floating causeway Trident Pier. Wave erosion can erode sand ramps that must be rebuilt in order to use the pier to offload rolling stock across the surf zone onto a beach. Without frequent and accurate weather forecasts, JLOTS operations cannot be conducted in a safe and efficient manner.

Figure 1. LCU-1619 broached while offloading tanks on San Clemente Island, CA. Surf lifted and pounded the hull on a large rock during the rising tide. (1964 picture courtesy of NavSource Naval History).

3. Future

Meteorological and oceanographic information is needed to characterize the environment to gain an operational advantage and ensure the safety of operational forces. Military planning for expeditionary operations should be based on data from historical archives, remote sensors, *in situ* instruments, and models. This data should be fused together aboard command and control ships.

4. References

[1] Joint Publication 3-59, Meteorological and Oceanographic Operations, 7 December 2012.