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Environment Manipulation: Force Multiplier in a Maritime Operation

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January 26, 2013; Somewhere off the Sir Creek: *An important naval operation is called for during the early morning hours to support a team of the Army's elite Special Forces (SF) deployed inland as part of a force committed to breaking up a concentration of terrorists with ties to an international organisation. The weather forecast predicts clear skies. As the operation commences just after sunrise heavy fog descends on the sea coast. The SF team moves in as per the previously decided H-hour expecting fire support from sea. The laser designator to direct the missile from the ship fails to acquire the target. The fire support however, continues without accurate spotting due to reduced visibility. Radio communications between the SF team and the naval ship become unreliable. By the time news of the SF advance and their new positions are relayed to the naval commander, the SF team has taken significant casualties. Some terrorists escape although the operation is declared a success. However, the conduct of such joint operations in the future is now endangered. Subsequent analysis released by the navy's meteorological department suggests that an early morning temperature inversion was the cause of the fog build-up and the strong atmospheric gradient resulted in poor radio communications.*

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August 15, 2013; Somewhere off the Coast of Andaman and Nicobar Islands: *A ship suspected of carrying contraband arms has been tracked and is heading for the harbour of a hostile naval base. A Marine Commando team is to be dispatched by a high-speed boat to intercept, board, and take control of the vessel. The team leader checks with the Met officer and ascertains that the wave heights are averaging 3 feet from the southeast. He estimates the intercept can be made a few miles before the ship enters hostile waters if the boat averages 10 knots. The moment the mission is launched at 2300 hours, a tornado develops and the wave height reaches 6 feet. As the boat picks up speed, the violent shocks of the craft engaging the 6-foot seas directly on the bow become unbearable to the team and the boat crew. The boat had to slow to 5 knots and finally the intercept is missed.*

Sunshine is delicious, rain is refreshing, wind braces us up, snow is exhilarating; there is really no such thing as bad weather, only different kinds of good weather.
John Ruskin[1]

Introduction

"All is fair in love and war" is an idiom which has been practised by mankind since the day Adam took a bite of the forbidden fruit or raised his hand in attack/defence. He has since then endeavoured hard to gain an upper hand in any conflict he has entered into. Towards the same end he has also designed and developed various weapons to inflict damage/harm to his enemies. Weapon development has progressed from early wood or stone clubs through revolutions in metal working (swords, maces etc.) and gun powder (guns and cannons), electronics and finally giving mankind technology in the field of nuclear chemical and biological weaponry.

War is presupposed and predetermined by many psychological theories, as being innate to human nature and arms may be construed to include anything used to gain a strategic, material or mental advantage over an adversary on land, sea or air, including outer space and virtual space. The race for achieving superiority in the arms race has led to a development of high-yield weapons of mass destruction. The use of these by the two opposing sides could effectively result in the complete and irrevocable annihilation of both the attackers and defender leading to a war that has no victory nor any armistice but only effective reciprocal destruction.

With most nations undergoing revolution in military affairs, new generations of technology intensive weapon platforms are available with ever improving hardware and software parameters. However, every technological development has certain limitations most of which are related to the weather conditions, e.g. degradation of capabilities of certain sensors is caused by fluctuations in ambient temperature, smoke, fog, rain, etc., and High Frequency (HF) radio wave communication and certain navigational aids like Global Positioning System (GPS) get affected due to changes in the atmospheric conditions. Hence, it is in the interest of our forces to leverage weather conditions to deny the usage of battle equipment by the enemy and also by improving such conditions for use of the equipment by friendly forces. This is where the phenomena of ''environment manipulation'' or ''environment modification'' or ''weather modification'' assume importance towards launching any maritime operation.

Further, with high-yield weapons now used primarily for deterrence, with bans on the use of biological and chemical agents in force and a non-possibility for conventional weapons to be used at large scales, a need exists to develop additional techniques of warfare which could deliver a silent and covert blow to the enemy. ''Environmental warfare'' has been defined by Professor Michel Chossudovsky, Professor of Economics (Emeritus) at the University of Ottawa, as ''the intentional modification of a system of the natural ecology such as climate and weather, earth systems such as ionosphere, magnetosphere and tectonic plate system to cause intentional physical, economic and psycho-social destruction to an intended target, geophysical or population location as part of strategic or tactical war''.[2] The same has, however, more *tactical* rather than *strategic* dimensions.

Instances exist in the historical past when weather phenomena have shown an instantaneous and unprecedented change. This had generally been attributed to the nature's fury, which may not be entirely true. Modification of the environment by scientific techniques could be used to trigger earthquakes, cloud bursts, drought and other excessive forms of precipitations. These artificially triggered environmental phenomena could have a far reaching effect on the outcome of any military operation. It therefore becomes very important for a nation to study and acquire techniques to modify the environment to permit its use by its defence forces and also adopt methods to prevent its usage by hostile states, with a view to increase own combat effectiveness.

Influence of the Environment on Maritime Operations

In 1993 the US National Research Council released *Coastal Oceanography and Littoral Warfare* which highlighted a number of factors that affect maritime operations. It broke these factors down into the following categories: atmosphere, biologic, oceanographic, bathymetric and topographic, acoustic, geophysical/magnetic, and anthropogenic. Various environmental factors of importance include the following:[3]

(a) Atmosphere
  i) weather (clouds, fog, precipitation, wind speed and direction, air temperature);
  ii) ambient light, marine boundary layer properties (temperature, humidity, refractivity).
(b) Biologic:
  i) ambient noise;
  ii) optical scattering;
  iii) bioluminescence.
(c) Oceanographic:
  i) tides;
  ii) internal waves (currents: surface and subsurface);
  iii) water conductivity, temperature, depth, and salinity;
  iv) sea state;
  v) wave height and direction;
  vi) surf conditions;
  vii) optical properties (vertical and horizontal);
  viii) turbidity,
(d) Bathymetric and topographic:
  i) bottom and beach slope;
  ii) beach and bottom composition.
(e) Acoustic:
  i) scattering;
  ii) ambient noise.
(f) Geophysical/magnetic:
  i) bottom roughness and type;

ii) sediment properties, bottom strength and stability;
iii) ambient magnetic and electrical background.

(g) Anthropogenic:
i) pollution;
ii) noise.

The oceans are essentially a three dimensional battle space in which naval forces operate, viz. on, below and above the sea surface. They must also be able to use outer space and the electronic medium. Naval power thus finds its expression through surface ships, submarines and aircraft.[4] Any operation conducted by a naval force is a well-orchestrated functional unison amongst the three components with every aspect of synergy amongst gunfire, communication, missiles, electronic warfare, etc. in place. Naval forces operate in varied, dynamic, and often extreme environments. Thus, accurate and detailed information of the operating areas is of vital importance for mission planning and operations. Personnel and platforms involved in naval surface warfare, aviation strike warfare, SF warfare, amphibious operations, submarine and anti-submarine warfare, and counter-mine warfare operations have certain minimum environmental thresholds. It is when the environmental conditions fall below these thresholds that the combat efficiency gets degraded.

Although most of the advanced weaponry, machine or hardware is designed for an ''all weather'' role, they require an ideal environment to function best to its designed capability and capacity. So, the timing and nature of strike operations from the sea must also be in synchronisation with weather conditions.[5] It goes to say that all the elements of the environment certainly have an influence over the performance of these systems. However, it is more important to know when, and to what degree, these elements act as constraints on specific systems or operations. Though all elements have some or the other effect on naval warfare, only commonly known, observed, or derived weather and environmental elements have been discussed in this article. Some aspects of the ibid influence have been covered in the subsequent paragraphs.[6]

Precipitation

It includes the phenomena of rain, fog, mist, snow and sleet. Rain and snow deteriorate the optical visibility to a large extent and also have a detrimental effect on

other means of night imaging systems like image intensifiers and thermal imagers. Heavy rain increases the ambient noise which affects the capability of SONAR systems. Rain also effects the communication, be it line of sight or through the use of satellites. Some important navigation systems which rely on GPS could also get degraded with rain, fog or snow. Heavy precipitation effects the landing and taking off operations of aircraft / helicopters for land as well as ships. It also effects the propagation of laser beams and degrades the accuracy of optical sensor-based instruments. The accuracy of fire control radars too gets affected in the presence of heavy precipitation.

i. *Clouds*: low overcast clouds decrease the effectiveness of aerial illumination devices. Night vision using image intensifiers do not work effectively in an overcast environment due to lack of natural light from moon and stars.
ii. *Air pressure and density*: it influences the in-flight ballistics of any projectile thereby affect its trajectory and increasing the Circular Error Probability (CEP).
iii. *Wind*: it has a great influence on the in-flight ballistics and therefore, the trajectory of any projectile fired from a ship, submarine or an aircraft. Carrier operations require a minimum of wind across the deck for safe take-offs and landings. Additionally, accurate forecasting of deck-level wind speed and direction is essential for vectoring the carrier, especially in geographic regions where manoeuvrability is constrained.
iv. *Humidity*: it brings in fatigue and severely affects the working efficiency of the troops. It also affects the storage conditions of sensitive instruments and armaments like missiles.
v. *Refractive index*: any change in the refractive index affects radar- and laser-based instruments. Anomalous radar propagation is caused by humidity-dependent refractive index effects. Radar range is highly variable, sometimes reaching over the horizon, due to refractive ''ducting''. Phenomena such as electromagnetic ducting may allow communication signals to carry too far, allowing detection by opposing forces, or can disrupt signals sufficiently to pose tactical problems.
vi. *Illumination*: night operation would require a particular degree of natural illumination on a particular place at a precise timing. The phase of moon on a clear sky dictates the same.

vii. *Ambient temperature*: high ambient temperature affects the operating parameters of all machinery components, sustained rate of fire of automatic weapons, gun droop, etc. It also has a detrimental effect on the morale of troops as they have to operate in hot conditions. Water consumption also increases posing problem on logistics especially in a submarine. Low temperature affects ballistics, and if extreme could also cause the freezing of instruments.

viii. *Sea surface temperature*: the sea surface temperature affects the earth's atmosphere directly above it and plays a role in generation of tropical cyclones, sea fog, sea breeze and also snow in some cases.[7]

ix. *Salinity*: temperature and salinity variations may impart stratification to the water column with associated influences on the acoustic properties of the water column and the performance of acoustic sensors. Temperature and salinity variations may also result in density fronts in the water column that affect acoustic sensor performance. The mixing of water with different salinities may induce flocculation of very fine-grained sediments, resulting in settling as loose aggregates on the seafloor as mud or fluid mud deposits. Suspended sediments may become trapped on these fronts, resulting in turbid horizons in the water column.

x. *Sea surface state and surf conditions*: as surface motion imparts a Doppler shift to a signal, SONAR performance is affected by the sea surface. Surface roughness also impacts the performance of wake detection systems and also increases the ambient noise. The formation of bubbles on the sea surface effects acoustic propagation at sea-surface levels. The sea state also affects the operational preparedness of any port and the parameters for infiltration/insertion by Special Forces in a stealth operation. The wave height needs to be ascertained for the landing of troops during amphibious operations.

xi. *Seafloor state*: seafloor bathymetry is dynamic and can vary on very short timescales. The seafloor may display extreme roughness and clutter density, effecting standard acoustic methods of detection. Mines may be concealed by irregular seafloor relief or by acoustic shadows created by seafloor relief elements in rocky areas of shallow water zones. Unconsolidated sediments and vigorous physical processes (e.g. wind waves, wave-generated currents, and tidal currents) redistribute sediments through erosion or deposition sufficient

to significantly alter bathymetry. The poor quality of acoustic and optical imagery over seafloor with extreme bottom roughness makes mine detection very difficult or impossible.

xii. *Thunderstorm and lightning*: they have a detrimental effect on some sensitive electronic components of weapon and communication systems.

xiii. *Radiation and electric charge*: apart from various health issues of the fighting troops they affect radio waves and satellite signals.

xiv. *Tides and currents*: ambient noise levels go up when the tidal waves break within the ocean. The height of the tides affect infiltration and exfiltration routes by naval Special Forces carrying out operation on hostile ships or ports. Interpretation of data for SONAR analysis also depends on the sea currents. Currents (e.g. river currents, wave-generated currents, wind-generated currents, and tidal currents) are very important parameters for mine warfare activities.

xv. *Ionosphere*: any change in the ionosphere conditions lead to fluctuations in the high frequency (HF) wave propagation which thereby effects radio communication.

Manipulation of the Environment

Environment manipulation is the act of intentionally manipulating, modifying or altering the natural conditions. The term ''environmental modification techniques'' refers to any technique for changing – through the deliberate manipulation of natural processes – the dynamics, composition or structure of the earth, including its biota, lithosphere, hydrosphere and atmosphere, or of outer space.[8] To resort to such a modification, technologically, a solid understanding of the variables that affect weather is required. Ability to model the dynamics of their relationships, map the possible results of their interactions, measure their actual real-time values, and influence their values has to be developed to achieve a particular desired outcome.

Today, weather modification is the alteration of weather phenomena over a limited area for a limited period of time. Within the next three decades, the concept of weather modification could possibly expand to include the ability to shape weather patterns by influencing their determining factors. Recent and future advances in

computational capability, modelling techniques, and atmospheric information tracking could produce a highly accurate and reliable weather prediction capability, validated against real-world weather.

In the broadest sense, weather modification can be divided into two major categories: suppression and intensification. In extreme cases, it might involve the creation of completely new weather patterns, attenuation or control of severe storms, or even alteration of global climate on a far-reaching and/or long-lasting scale.

The History of Environment Manipulation

Magical and religious practices to control the weather are attested in a variety of cultures. In ancient India it is said that *yajna* or *vedic* rituals of chanting *mantras* and offerings were performed by *rishis* to bring sudden bursts of rain fall in rain starved regions. Some American Indians like some Europeans had rituals which they believed could induce rain. Scandinavian witches allegedly claimed to sell the wind in bags or magically confined into wooden staves; they sold the bags to seamen who could release them when becalmed.

Storms also greatly influenced the fate of the Spanish Armada in 1588. Weather affected the naval campaign early, for shortly after the Spanish fleet departed Lisbon in May 1588, a storm scattered the Armada; it took a month to reassemble the ships and to recondition them.

Diverting the Huang He River

In July 1937, Japan moved troops into China and began seizing power in the northern territories, beginning the Second Sino-Japanese War. The Huang He (Yellow River) called ''China's Sorrow'' flows east out of the Chinese highlands across a plateau of loess, or fine sediment, just northwest of Kaifeng. The enormous annual sediment load of the Huang He (providing the characteristic yellow colour of the Yellow River) has complicated human efforts to control the river's course through levees. General Chiang Kai-shek ordered the breaking of these levees to divert the river south into an older channel, and cut off the Japanese rail route to Zhengzhou. In both number of deaths and geographic scale, this event is considered the largest act of environmental warfare in modern history.[9]

Project Storm Fury

Was an ambitious experimental program of research on hurricane modification carried out between 1962 and 1983. The proposed modification technique involved artificial stimulation of convection outside the eyewall through seeding with silver iodide. The invigorated convection, it was argued, would compete with the original eyewall, lead to reformation of the eyewall at larger radius, and thus, through partial conservation of angular momentum, produce a decrease in the strongest winds.[10]

Operation Popeye

From March 1967 until July 1972, the US military cloud-seeded silver iodide to extend the monsoon season over North Vietnam, specifically the Ho Chi Minh Trail. The operation resulted in the targeted areas seeing an extension of the monsoon period by an average of 30 to 45 days.[11]

Area Denial Mission in Vietnam

Between 1965 and 1975, the US military sprayed millions of tons of Agent Orange on the jungles of Vietnam in airborne ''area denial missions'' – intended to deny cover to the Vietcong and North Vietnamese Army. The strategy worked: large areas of Quang Tri Province along the 38th Parallel and a swath of land in the ''iron triangle'' of Tay Ninh Province west of Saigon were stripped of all vegetation.

Operation Neptune

During World War II, weather forecasts played a decisive role in the scheduling of the amphibious landing in Normandy. The invasion was initially scheduled for June 5, but an unfavourable weather report anticipated thoroughly nasty seas and gales of up to 45 miles an hour. A break in the weather on the next day enabled the Allies to land. An unanticipated benefit of the bad weather was that it helped the Allies achieve almost complete surprise.[12]

In Britain, it has been alleged that before the devastating Lynmouth floods in Devon in 1952, the Royal Air Force (RAF) had been conducting secret rain-making tests. Aircraft showered clouds with silver iodide, on which water droplets formed, became heavy and eventually fell to the ground as rain. In the next 12 hours nine inches of rain fell, 250 times the normal amount for August, and 35 people were killed.

Persian Gulf War

On January 21, 1991, a few days after the Coalition Forces launched an air campaign against Iraq, the Iraqi military forces in Kuwait opened valves at the Sea Island oil terminal near Kuwait City and released large quantities of crude oil into the Gulf, an act of environmental warfare. The oil moved southward and began to accumulate on the north coast of Saudi Arabia. This probably altered the conditions of the sea environment affecting any naval warfare designs of the coalition forces.

Environment Manipulation in the Present Day

The manipulation or modification, of the environment is done artificially with two types of aim: peaceful and military. Modification for peaceful gains is basically for economic growth and humanitarian upliftment whereas it could also be a means to further the military agenda of a particular nation.

Purposeful augmentation of precipitation, reduction of hail damage, dispersion of fog and other types of cloud and storm modifications by cloud seeding are developing technologies which are still striving to achieve a sound scientific foundation and need to be adapted to enormously varied natural conditions. Operational programmes in fog dispersion, rain and snow enhancement and hail suppression are taking place in many countries around the world. The primary aim of these projects is to improve the economy in a particular branch of activity (for example, increase in water supply for agriculture or power generation) or to reduce the risks that may be associated with dangerous events (frosts, fogs, hail, lightning, thunderstorms, etc.), or other similar practical results in response to a recognised need for a peaceful purpose.[13]

Claims of weather modification are dismissed by sceptics as wild conspiracy theories and the stuff of James Bond movies but there is growing evidence that the boundaries between science fiction and fact are becoming increasingly blurred. To prevent disruption by rain in the 2008 Olympics the Chinese had decided to manipulate clouds over the Bird's Nest stadium.[14] There are also unconfirmed reports that the US government had manipulated the path of the recent hurricane "Sandy" which struck the east coast of America.[15]

Geo-engineering is defined as "intentional large scale manipulation of the global environment", e.g. by altering climate with the primary intention of reducing

undesired climate change caused by human influences. Geo-engineering schemes seek to mitigate the effect of fossil fuel combustion on the climate without abating fossil fuel use; for example by placing shields in space to reduce the sunlight incident on the earth.[16]

Geo-engineering is the element that is missing from all ecological and social movement discussions about climate change. After withdrawing US support from the Kyoto Protocol, a meeting in September 2001 in the White House organised by the US President's Climate Change Technology Program discussed proposals on "Response Options to Rapid or Severe Climate Change". The proposals included underground storage of carbon dioxide, wind scrubbers to filter carbon dioxide from the air, "fertilisation" of oceans with iron to encourage growth of plankton, petrification of carbon dioxide and deflection of sunlight from the earth through the use of a giant space mirror "spanning 600,000 square miles". Retired Lawrence Livermore physicist Michael MacCracken, a former senior scientist at the US Global Change Research Program who helped organise the meeting said:[17] "We already are inadvertently changing the climate, so why not advertently try to counterbalance it?"

The Tsunami Bomb

For those still doubting the development of devastating secret weapons, an intriguing article in New Zealand's leading newspaper, *The New Zealand Herald* of September 25, 1999, reveals:[18]

> *"Top-secret wartime experiments were conducted off the coast of Auckland to perfect a tidal wave bomb, declassified files reveal. United States defence chiefs said that if the project had been completed before the end of the war, it could have played a role as effective as that of the atom bomb. Details of the tsunami bomb, known as Project Seal, are contained in 53-year-old documents released by the Ministry of Foreign Affairs and Trade."*

In January 2011, several newspapers and magazines, including the UK's *Sunday Times* and *Arabian Business*, reported that scientists backed by the government of Abu Dhabi, the capital of the United Arab Emirates, had created over 50 artificial rainstorms between July and August 2010 near Al Ain, a city which lies close to the country's border with Oman and is the second-largest city in the Abu Dhabi Emirate.

The artificial rainstorms were said to have sometimes caused hail, gales and thunderstorms, baffling local residents.[19]

An unconfirmed report by the Russian Northern Fleets suggested that the devastating Haiti earthquake during 2010 was caused by a US Navy ''earthquake weapons'' test, which was intended to be used against Iran. Although Russia has accused the United States of holding such a type of weapon, a Georgia Green Party leader claimed that Moscow, allegedly possessing similar weapons, caused an earthquake on Georgian territory several years ago.[20]

The High Frequency Active Auroral Research Program (HAARP) is a joint project of the US Air Force and Navy, based in Alaska. The HAARP system is designed to manipulate the ionosphere, a layer which begins about 30 miles above the earth. The transmitter or HAARP device on the ground is a phased array antenna system – a large field of antennas designed to work together in focusing radio-frequency energy for manipulating the ionosphere.

The device will have an effective-radiated-power of 1 billion watts when completed in the first phase of the project. It could be used for earth penetrating tomography (looking through layers of the earth to locate underground facilities or minerals), communications with submarines, to manipulate communication of others, over-the-horizon radar, energy transfers from one part of the world to another, creating artificial plasma (energy) layers or patches in the ionosphere, to alter weather and may also be used as an anti-satellite weapon.[21]

Though denied by HAARP officials, some respected researchers allege that secret electromagnetic warfare capabilities of HAARP are designed to forward the US military's stated goal of achieving full-spectrum dominance by the year 2020. Concerned HAARP researchers like Dr Michel Chossudovsky of the University of Ottawa and Alaska's Dr Nick Begich (son of a US congressman) present evidence suggesting that these disturbances can even cause tsunamis and earthquakes.[22]

Efforts are already under way to create more comprehensive weather models primarily to improve forecasts, but researchers are also trying to influence the results of these models by adding small amounts of energy at just the right time and space. These programmes are extremely limited at the moment and are not yet validated, but there is great potential to improve them in the future. If the military has been secretly developing technology to manipulate environment for the past many years, one really wonders what kind of advanced deadly technology could be available in the future.

The Future of Environment Manipulation

Achieving a highly accurate and reasonably precise weather modification capability in the future will require overcoming some challenging but not insurmountable technological and legal hurdles. A research paper[23] prepared by a group of US Air Force officers published in August 1996 brings out that although the United States already had a limited number of weather-modification technologies available, technology advancements in five major areas were necessary for an integrated weather modification capability. This included advanced non-linear modelling techniques, computational capability, information gathering and transmission, a global sensor array, and weather intervention techniques. According to the paper, the US military was expected to be able to influence the weather on a mesoscale (<200 sq km) or microscale (immediate local area) to achieve operational capabilities by the year 2025. They planned to implement this technology by using highly trained weather force specialists; access ports to a global weather network, where worldwide weather observations and forecasts are obtained near-real-time from civilian and military sources; a dense, highly accurate local area weather sensing and communication system; an advanced computer local area weather-modification modelling and prediction capability within the area of responsibility; proven weather-modification intervention technologies; and a feedback capability.

Needless to say, capability to modify the environment offers a naval commander tools to shape the battlespace in the way he desires. It provides opportunities to impact operations across the entire spectrum of conflict and is pertinent to all possible maritime operations. The environment could be suitably manipulated to work as a force multiplier and increase the combat potential of a naval force. It could also be used to disallow the adversary in its effective use of his maritime forces by degrading his weather dependant capability.

Enhance Capability of Own Naval Forces

(a) Precipitation:
  i) avoidance:
    - increase visibility (day and night);
    - reduction in ambient noise;

- increase affectivity of communication equipment;
- improve output results of navigation systems;
- ease aircraft landings and take offs;
- reduce errors in laser-based instruments.

ii) enhancement:
- increase concealment of activities.

(b) Clouds:
i) generation:
- increase concealment of activities.

ii) removal:
- increase capability of sighting systems.

(c) Wind: suppression:
i) achieve accuracy in the in-flight ballistics of any projectile.
ii) safer take-offs and landings in sea.

(d) Humidity: suppression:
i) reduce fatigue of troops.
ii) improves storage and working conditions of sensitive instruments and armaments.

(e) Refractive index: modification:
i) detect far-of enemy radio and radar signals.
ii) prevent detection of own radio and radar signals.
iii) increase range of self-communication and radar waves.

(f) Ambient temperature: increase in extreme cold and decrease in extreme heat:
i) improve performance of instruments.
ii) provide comfortable working environment to fighting troops.
iii) achieve predictive ballistics of armament.

(g) Sea surface temperature: modification:
i) generation/modification of tropical cyclones, sea fog, sea breeze, snow to suit own advantage.

(h) Salinity: modification:
i) improve performance of acoustic sensors.
ii) provide concealment due to flocculation.

(i) Sea surface state and surf conditions:
  i) calming down:
    • improve performance of SONAR.
    • improve wake detection.
    • ease of movement in stealth operations.
    • ease landing in amphibious operations.
  ii) roughing:
    • deny use of own ports and harbours.

(j) Sea floor state: disruption:
  i) prevent detection of embedded mines.

(k) Thunderstorm and lightening: suppression:
  i) improve sensitivity of certain instruments.

(l) Radiation and electric charge: modification:
  i) improvement of communication and satellite signals.
  ii) provide healthy environment to troops.

(m) Tides and currents: modification:
  i) reduce ambient noise.
  ii) improve movement in stealth operations.
  iii) improve efficacy of mines.

(n) Ionosphere: modification:
  i) reduce dead zone in own HF communication.
  ii) effective HF communication at all times.
  iii) improve communication reliability.

Degrade Enemy's Naval Potential

(a) Precipitation:
  i) avoidance:
    • prevent concealment of enemy's activities.
    • induce drought like situation.
  ii) enhancement:
    • cause flooding in enemy's hinterland.
    • decrease visibility (day and night).
    • increase ambient noise.

- degrade efficiency of communication equipment.
- disrupt navigation systems.
- disrupt aircraft landings and take offs from sea and shore.
- induce errors in laser-based instruments.

(b) Clouds:
  i) generation:
    - degrade capability of sighting systems.
  ii) removal:
    - exposure of concealed hardware.

(c) Wind: creation:
  i) disrupt in-flight ballistics.

(d) Humidity: creation:
  i) induce fatigue in enemy troops.
  ii) degrade storage and working conditions of sensitive instruments and armaments.

(e) Refractive index: modification:
  i) make radio and radar signals detectable at a longer range.
  ii) prevent detection of own radio and radar signals.

(f) Ambient temperature: decrease in extreme cold and increase in extreme heat:
  i) degrade performance of instruments.
  ii) provide uncomfortable working environment to troops.
  iii) negative effect on ballistics of armament.

(g) Sea surface temperature: modification:
  i) generation/modification of tropical cyclones, sea fog, sea breeze, snow to cause disruption to enemy's capability

(h) Salinity: modification:
  i) degrade performance of acoustic sensors.

(i) Sea surface state and surf conditions:
  i) calming down:
    - improve self mobility to enemy's ports and harbours.
  ii) roughing:
    - degrade performance of SONAR.
    - disturb wake detection.

- increase difficulty to move in stealth operations.
- landing in amphibious operations made difficult.

(j) Seafloor state: improve:
  i) allow detection of embedded mines.

(k) Thunderstorm and lightening: creation:
  i) degrade sensitivity of certain instruments.

(l) Radiation and electric charge: modification:
  i) disrupt communication and satellite signals.
  ii) provide unhealthy environment to troops.

(m) Tides and currents: modification:
  i) increase ambient noise.
  ii) disrupt movement in stealth operations.
  iii) degrade efficacy of mines.

(n) Ionosphere: modification:
  i) increase dead zone in HF communication.
  ii) induce unreliability in HF communication.

Technology Involved

Weather modification generally involves two distinct activities. In the first activity, science research seeks to prove concepts and in so-doing make the effectiveness of their application certain to within given limits and with a given degree of confidence. In the second activity, operational programmes seek to apply different modification methods to produce a desired outcome (more rain, less hail, fog cleared, etc.) based on their assessment of the best approaches to follow consistent with the current state of knowledge. Techniques which can be reportedly used to modify or manipulate certain elements of the environment have been discussed in the subsequent paragraphs.

Precipitation

To change the amount or type of precipitation that falls from clouds, cloud seeding (also called chemtrails) is resorted to, by dispersing substances (like silver iodide) into the air that serve as cloud condensation or ice nuclei, which alter the microphysical processes within the cloud. The usual intent is to increase precipitation (rain or

snow), but hail and fog suppression also could be practiced. Cloud seeding only works to the extent that there is already water vapour present in the air. It is used in a variety of drought-prone countries, including the United States, the People's Republic of China, India, and Russia. In the People's Republic of China there is a perceived dependency upon it in dry regions. In mountainous areas of the United States such as the Rocky Mountains and Sierra Nevada, cloud seeding has been employed since the 1950s.

Hurricanes/Tornados

Although the artificial creation of hurricanes/tornados has reportedly not been achieved to date, various methods have been proposed to reduce its harmful effects. Moshe Alamaro of the Massachusetts Institute of Technology proposed using barges with upward-pointing jet engines to trigger smaller storms to disrupt the progress of an incoming hurricane. Aircrafts could drop soot into the near-freezing cloud at the top of a hurricane, causing it to warm up and so reduce wind speeds.[24] Alexandre Chorin of the University of California, Berkeley, proposed dropping large amounts of environmentally friendly oils on the sea surface to prevent droplet formation.[25]

Earthquakes

Triggering of earthquakes may be achieved by a detailed study of the tectonic plate layout and moving them using nuclear energy. As per some scientists, generation of artificial earthquakes is possible using phase differentiation.[26]

Tsunami

According to some scientists and geologists, the earth's brittle tectonic plates can be made to move against each other at a faster rate with the use of pulsating electromagnetic flux generated artificially by extra-terrestrial or terrestrial human technologies.[27] The artificial pulsating electromagnetic flux can be generated by either the position of a set of neutron stars or black holes far away in the middle of galaxy or by artificial generation of the pulsating electromagnetic waves. The earthquake and resulting tsunami in Sumatra could have been caused by this method.

Ocean Currents

Although not much is known on the generation or artificial modification of the ocean currents, manipulation of the sea's coastline alignment, bottom topography, salinity and temperature could cause some changes in the direction, velocity and extent of the already flowing ocean currents.

Lightning

An important parameter for military operations and resource protection, but some offensive military benefit could be obtained by increasing the potential and intensity of lightning. It could be achieved by stimulating the triggering mechanism that initiates the lightning bolt. Possible mechanisms could be developed to modify the electro-potential characteristics over certain targets, to induce lightning strikes on the desired targets as the storm passes over their location.

Thunderstorms

The technologies might involve techniques that would increase latent heat release in the atmosphere, provide additional water vapour for cloud cell development, and provide additional surface and lower atmospheric heating to increase atmospheric instability. The focus of the weather-modification effort would be to provide additional ''conditions'' that would make the atmosphere unstable enough to generate cloud and eventually storm cell development.

Organisation for handling Environment Manipulation

The navy should be able to influence the environment on a meso scale (<200 km^2) or micro scale (immediate local area) to achieve operational capabilities as required in any maritime operation. The capability would be the synergistic result of a system consisting of (1) highly trained weather specialists (2) access to existing weather networks, where worldwide weather observations and forecasts are available in near-real-time from civilian and defence sources; (3) a highly reliable and accurate local area weather sensing and communication system; (4) an advanced local area weather-modification modelling and prediction capability within the area of responsibility; (5) proven weather-modification intervention technologies; and (6) a feedback capability.

Synergy between civilian and defence weather experts is very essential, involving a high-speed communication network filled with near-real-time weather observations taken from a more accurate observation network resulting from highly improved ground, air, maritime, and space sensors. Advanced software and hardware capabilities which can rapidly ingest trillions of environmental data points, merge them into usable data bases, process the data through the weather prediction models, and disseminate the weather information in near-real-time.

In order to work on the field of ''environment manipulation'', technologically, a solid understanding of the variables that affect weather needs to be looked in to. Ability to model the dynamics of their relationships, map the possible results of their interactions, measure their actual real-time values, and influence their values to achieve a desired outcome should be possible. All this is possible by an in-depth knowledge of naval oceanography and meteorology sciences best understood by the related department of respective navies of nations.

To obtain a total synergy in obtaining data on environment conditions in the area of interest or influence a tri-service organisation involving Army, Navy and Air Force should be set up with all-time access to weather data from all other national and international agencies. The requirement of information on weather conditions at a place, by any element of the defence forces should be addressed to by this organisation. The aspect of environment manipulation, activation or suppression, required by any battle force over the battle area should also be handled by this organisation.

Conclusion

The Asian continent is volatile and is a real threat to peace, as seen by the West and other developing nations. The continued involvement of some nations in abetting terrorism and being the epicentre of terrorism, the threat of war between nations remains. In such a context the conventional edge will hence be the decisive factor and therefore, the role of conventional warfare will assume significant importance. China is aspiring to become a superpower and is likely to play a very mature role in the geo strategic scenario not only in Asia but the world over. In the context of nations the role of conventional warfare is likely to grow as the logic of Strategic Arms Limitation dawns on them. Therefore, the use of conventional naval warfare dependant on

environmental manipulation as a force multiplier as a non-nuclear deterrence could assume much significance in any maritime operation.

The lessons of history indicate a real weather-modification capability will eventually exist despite the risk. The potential benefits and power are extremely lucrative and alluring for those who have the resources to develop it. History also teaches that we cannot afford to be without a weather-modification capability once the technology is developed and used by others. Even if we have no intention of using it, others will. To call upon the atomic weapon analogy again, we need to be able to deter or counter their capability with our own. Therefore, the weather and intelligence communities must keep abreast of the actions of others.

Weather modification is a force multiplier with tremendous power that could be exploited across the full spectrum of war-fighting environments. From enhancing friendly operations or disrupting those of the enemy via small-scale tailoring of natural weather patterns to complete dominance of global communications and counter-space control, weather modification offers the war fighter a wide range of possible options to defeat or coerce an adversary.

A high-risk, high-reward endeavour, weather modification offers a dilemma not unlike the splitting of the atom. While some segments of society will always be reluctant to examine controversial issues such as weather-modification, the tremendous military capabilities that could result from this field can only be ignored at our own peril.

January 26, 2034; Off the Sir Creek: *An important naval operation is launched during the early morning hours to support a team of the Army's elite Special Forces (SF) deployed inland as part of a force committed to breaking up a concentration of terrorists with ties to an international organisation. The weather forecast predicts clear skies. As the operation commences just after sunrise heavy fog descends on the sea coast. Support in terms of suppression of the fog is requested. The naval ship commander orders the firing of a salvo of rockets with special warheads over the affected area. The fog dissipates and the SF team moves in at the previously decided H-hour expecting fire support from sea. The laser designator acquires the target and directs a missile from the ship on to the target. With the ship guns blazing, accurate fire support continues and softens the target before the SF team moves in for the final kill. Radio communications between the SF team and the naval ship*

relays the success. The SF team has taken many terrorists captive. The operation is declared a success.

August 15, 2034; Off the East Coast of Andaman and Nicobar Islands: *A ship suspected of carrying contraband arms has been tracked and is heading for the harbour of a hostile naval base. A marine commando team is to be dispatched by a high-speed boat to intercept, board, and take control of the vessel. The team leader checks with the Met officer and ascertains that the wave heights are averaging 3 feet from the southeast. He estimates the intercept can be made a few miles before the ship enters hostile waters if the boat averages 45 knots. The moment the mission is launched at 2300 hours, a tornado develops and the wave height reaches 6 feet. A request for temporary suppression of the tornado is radioed. An Air Force sortie flies over the affected area and releases its precious cargo. The tornado subsides and the boat intercepts the ship at the designated time and place. The marine commandos have achieved yet another success.*

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