



# 5th Global Conference on Oceans, Coasts and Islands



## Draft Policy Brief on Ensuring Survival: Oceans, Climate, and Security



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**Draft Policy Brief on  
Ensuring Survival: Oceans, Climate and  
Security**

**Prepared by Janot Mendler de Suarez, Biliana Cicin-Sain,  
Kateryna Wowk, Rolph Payet, Ove Hoegh-Guldberg\***

*\*Policy Briefs on each of the three major themes of the Global Oceans Conference 2010—Climate and Oceans, Marine Biodiversity, and Integrated Governance—have been prepared to elicit discussion and debate at the Global Oceans Conference.*

*Any opinions expressed in the Policy Briefs are solely the opinions of the contributing authors and do not reflect institutional positions on the part of the Global Oceans Forum nor of any of the Conference sponsoring organizations.*

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# Draft Policy Brief on Ensuring Survival: Oceans, Climate and Security

Janot Mendler de Suarez, Biliana Cicin-Sain, Kateryna Wowk,  
Rolph Payet, Ove Hoegh-Guldberg

## Introduction

The global oceans play a vital role in sustaining life on Earth by generating half of the world's oxygen, as the largest active carbon sink absorbing a significant portion of anthropogenic carbon dioxide (CO<sub>2</sub>), regulating climate and temperature, and providing economic resources and environmental services to billions of people around the globe. The oceans of our planet serve as an intricate and generous life-support system for the entire biosphere.

Ocean circulation, in constant interaction with the earth's atmosphere, regulates global climate and temperature – and through multiple feedback loops related to ocean warming, is also a principal driver of climate variability and long-term climate change. Climate change is already affecting the ability of coastal and marine ecosystems to provide food security, sustainable livelihoods, protection from natural hazards, cultural identity, and recreation to coastal populations, especially among the most vulnerable communities in tropical areas. There is now global recognition of the importance of forests and terrestrial ecosystems in addressing climate change. An emerging understanding, through ecosystem-based management, of the complex and intimate relationship between climate change and the oceans offers new hope for mitigating the negative impacts of global warming, and for building ecosystem and community resilience to the climate-related hazards that cannot be averted. Ecosystem-based ocean and coastal management also generates co-benefits ranging from food security and health to livelihoods and new technologies that contribute to progress in equitable and environmentally sustainable development towards a low-carbon future.

Recent observations indicate that impacts of our changing global climate on oceans and coasts –

especially in the Arctic—now far exceed the findings of the 2007 report of the Intergovernmental Panel on Climate Change (IPCC). Moreover, we know that increasingly ocean acidification (a consequence of rising atmospheric CO<sub>2</sub>) is impacting on coral reefs, marine invertebrates and as a consequence changing the structure and nature of ocean ecosystems.

The oceans offer an important key to averting some of the potentially far-reaching, devastating and long-lasting humanitarian and environmental consequences of climate change. With good governance and ecosystem-based management, the world's oceans and coastal regions can play a vital role in transitioning to a low-carbon economy through improved food security, sustainable livelihoods, as well as natural protection from threats to human health, hazards and extreme weather events. *Out of all the biological carbon captured in the world, over half is captured by marine living organisms, and hence the term “blue carbon.”* In a 2009 report produced by three United Nations agencies, leading scientists found that carbon emissions equal to half the annual emissions of the global transport sector are being captured and stored by marine ecosystems such as mangroves, salt marshes and seagrass meadows. A combination of reducing deforestation on land, allied to restoring the coverage and health of these coastal ecosystems could deliver up to 25 percent of the emissions reductions needed to avoid ‘dangerous’ climate change. But the report warns that instead of maintaining and enhancing these natural carbon sinks, humanity is damaging and degrading them at an accelerating rate. It estimates that up to seven percent of these ‘blue carbon sinks’ are being lost annually or seven times the rate of loss of 50 years ago (UNEP 2009).

“Oceans” and “coasts” must be integrated into the UNFCCC negotiating text in order to appropriately address both the critical role of oceans in the global climate system, and the potential for adaptive management of coastal and marine ecosystems to make significant contributions to both mitigation and adaptation. Ecosystem-based approaches generate multiple co-benefits, from absorbing greenhouse gas emissions to building resilience to the significant and differential impacts that coastal and island communities are facing due to global climate change. While the international community must redouble its efforts to adopt major emissions reduction commitments, at the same time, there is a need to focus on the scientifically supported facts about natural solutions through ecosystem-based approaches that contribute to climate adaptation and mitigation, to human health and well-being, and to food security.

This policy brief provides an overview of the latest facts and concerns on the synergy between oceans and climate, highlights climate change impacts on ocean ecosystems and coastal and island communities, and presents key recommendations for a comprehensive framework to better integrate vital ocean and coastal concerns and contributions into climate change policy and action.

## **1. The Oceans Have a Vital Role in Combating Climate Change**

The oceans are the blue lungs of the planet – breathing in CO<sub>2</sub> and exhaling oxygen. The oceans have also absorbed over 80 percent of the heat added to the climate system (IPCC 2007), and act as the largest active carbon sink on earth. Ocean absorption of CO<sub>2</sub> reduces the rate at which it accumulates in the atmosphere, and thus slows the rate of global warming (Denman 2007). Over the last 250 years, oceans have been responsible for absorbing nearly half of the increased CO<sub>2</sub> emissions produced by burning fossil fuels (Laffoley 2010) as well as a significant portion of increased greenhouse gas emissions due to land-use change (Sabine et al. 2004). A combination of cyclical processes enables the ocean to absorb more carbon than it emits. Three of the ocean’s key functions drive this absorption: first is the

“solubility pump,” whereby CO<sub>2</sub> dissolves in sea water in direct proportion to its concentration in the atmosphere – the more CO<sub>2</sub> in the atmosphere, the more will dissolve in the ocean; second is water temperature – CO<sub>2</sub> dissolves more easily in colder water so greater absorption occurs in polar regions; third is mixing of CO<sub>2</sub> to deeper levels by ocean currents. Convergence of carbon-enriched currents at the poles feed into the so called ocean ‘conveyor belt,’ a global current which cycles carbon into ocean depths with a very slow (about 1500 years) turnover back to the surface. The ‘biological pump’ begins with carbon captured through photosynthesis in surface water micro-organisms, which make up 80-90 percent of the biomass in the ocean. These tiny plants and animals feed carbon into the food chain, where it is passed along to larger invertebrates, fish, and mammals. When sea plants and animals die and part of their organic matter sinks to the ocean floor, it is transformed into dissolved forms of carbon. The seabed is the largest reservoir of sequestered carbon on the planet. However the efficiency of the ocean’s ability to capture carbon relies on the structure and ‘health’ of the upper layer marine ecosystem (Williams 2009).

Increasing oceanic concentrations of CO<sub>2</sub> influence the physiology, development and survival of marine organisms, and the basic functioning and critical life support services that ocean ecosystems provide will be different under future acidified ocean conditions (UNEP 2010). Increased atmospheric CO<sub>2</sub> has already increased the acidity of the ocean by 30 percent, making the ocean more acidic than it has been in the last 650,000 years, and affecting marine life, such as corals, microscopic plants and animals. Increased ocean acidity is likely to not only affect the ‘biological pump’ and ocean food webs, but is also likely to influence the global carbon cycle leading to an increase in global warming (Williams 2009).

### ***Ocean Acidification: Facts, Impacts and Action***

Ocean acidification is happening now—at a rate and to a level not experienced by marine organisms for about 20 million years (Turley et al. 2006;

Blackford and Gilbert 2007, Pelejero et al. 2010). Mass extinctions have been linked to previous ocean acidification events and such events require tens of thousands of years for the ocean to recover. Levels of CO<sub>2</sub> produced by humans have decreased the pH (i.e. increased the acidity) of the surface ocean by 0.1 units lower than pre-industrial levels, and are predicted to further decrease surface ocean pH by roughly 0.4 units by 2100 (IPCC 2001). Decreases in calcification and biological function due to ocean acidification are capable of reducing the fitness of commercially valuable sea life by directly damaging their shells or by compromising early development and survival (Kurihara et al. 2007, Kurihara et al. 2009, Gazeau et al. 2007). Many ecosystems such as coral reefs are now well outside the conditions under which they have operated for millions of years (Hoegh-Guldberg et al. 2007, Pelejero et al. 2010). Even if atmospheric CO<sub>2</sub> is stabilized at 450 parts per million (ppm), it is estimated that only about eight percent of existing tropical and subtropical coral reefs will be surrounded by waters favorable to shell construction. At 550 ppm, coral reefs may dissolve globally (IAP 2009).

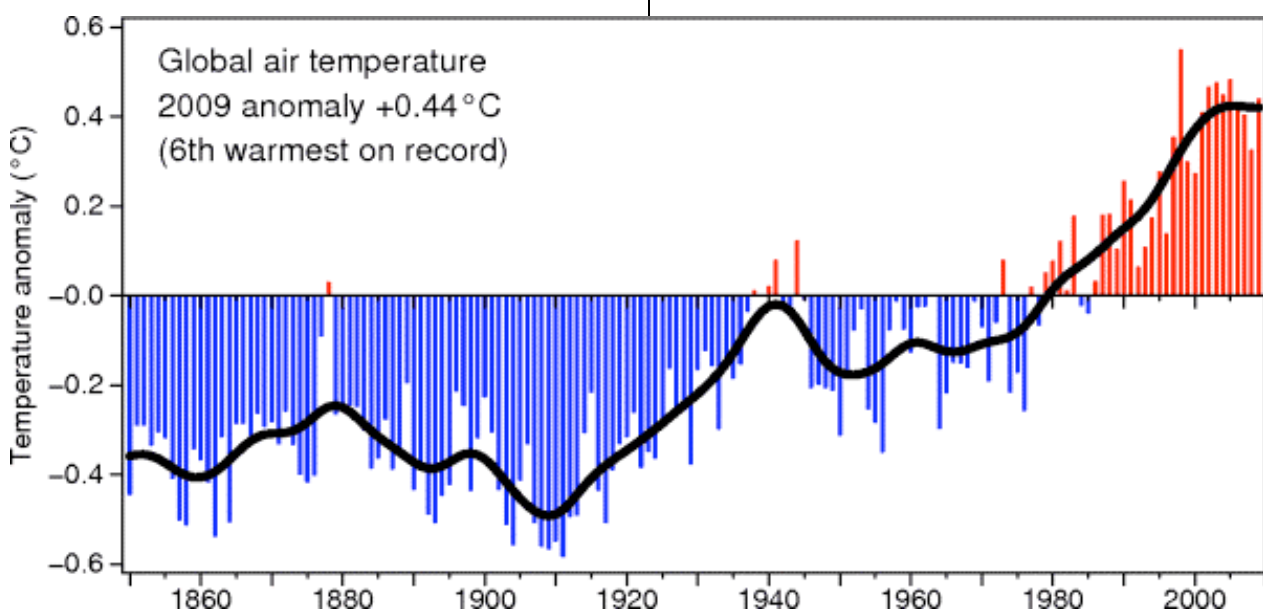
Climate change is adversely impacting marine and coastal ecosystems and biodiversity. Further, acidification of the oceans can impact food security both directly and indirectly through impacts on marine ecosystems and food webs, and also threatens the ocean's ability to continue providing important ecosystem services to billions of people

around the world (Worm et al. 2006). The bottom line is that no effective means of reversing ocean acidification currently exists at a scale sufficient to protect marine biodiversity and food webs. There are no short-term solutions to ocean acidification. Substantial perturbations to ocean ecosystems can only be avoided by urgent and rapid reductions in global greenhouse gas emissions and the recognition and integration of this critical issue into the global climate change debate (UNEP 2010).

### ***Ocean Warming: Impacts and Implications***

The world's weather is driven by ocean-atmosphere interactions. A steady rise in global temperature over the last century, computed as a combination of both land and sea temperatures, is effectively injecting more energy into global weather systems.

This time series shows the combined global land and marine surface temperature record from 1850 to 2009, which is the sixth warmest year on record, exceeded by 1998, 2005, 2003, 2002, and 2004. This global temperature record, compiled jointly by the Climatic Research Unit and the UK Met. Office Hadley Centre, is being continually updated and improved, including new and more thorough assessment of errors, recognizing that these differ on annual and decadal timescales. Increased concentrations of greenhouse gases in the atmosphere due to human activities are the



most likely underlying cause of warming in the 20<sup>th</sup> century (Brohan et al 2006).

Ocean temperature changes are similar to trends in the atmosphere, but differ because of changes in ocean circulation. The large global jump in the temperature record that began in the late 1970s can be explained by increasing heat content in the oceans (Levitus et al. 2000). Water vapor is actually the most significant atmospheric greenhouse gas, absorbing much more heat than carbon dioxide, and driving a positive feedback mechanism that amplifies global warming driven by fossil fuel emissions. As the earth warms, evaporating sea water increases tropical humidity and winds, causing a rise in tropical heat, moisture, cloud, wind, and energy circulation (Flohn and Kappala, 1989; Flohn et al. 1990).

Global warming also complicates the acidification-induced changes to ocean biological, physical and chemical processes. Warmer water impacts the distribution and abundance of marine life, and reductions in biological productivity in the ocean are now commonplace and expected to increase. A warmer and more acidic ocean will absorb CO<sub>2</sub> at a slower rate and that the effect of water temperatures on currents will alter the convergence and subduction of CO<sub>2</sub>. Between 1981 and 2004, the Southern Ocean absorbed less CO<sub>2</sub> than expected under the known increased atmospheric concentrations (Williams 2009). Overall, the impact of greenhouse gas emissions will grow considerably as the ability of the ocean to absorb CO<sub>2</sub> dwindles. This has serious implications for the sensitivity of global temperature to carbon dioxide emissions in particular.

### ***Sea Level Rise: Facts, Impacts, and Action***

The degree of sea level rise under different scenarios remains one of the most discussed findings of the 2007 IPCC report. However, although there is still uncertainty on the rate of sea level rise and its eventual effects on land, especially in low-lying coral atolls, evidence for sea level rise is clearly established in the scientific literature.

The potential impacts of sea level rise include increased frequency and severity of flooding in low-lying areas, erosion of beaches and other coastal habitats, and damage to infrastructure and the environment, with significant impacts on biodiversity and ecosystem function.

Increases in global temperature result in changes in sea-level mainly through thermal expansion of the warming ocean water, the addition of new water from melting glaciers and polar ice, and additional water from land surface runoff. All three are accelerated by global warming. Over the past 100 years the world has warmed by about 0.5°C (Brohan et al. 2006) and the rate of sea level rise has increased from roughly 1.5mm/year to about 3.3 after 1990, primarily due to increased rates of warming in the southern and tropical oceans (Merrifield 2009). Due to increasing atmospheric concentrations of anthropogenic carbon dioxide and other greenhouse gases, the prospect for the future is an even warmer world.

Recent studies conclude that a mean sea-level rise of 0.5m-0.8m over 1990 levels by 2100 is likely and that a rise of more than one meter in that time is possible (Rahmstorf 2007, Pfeffer et al. 2008, Richardson et al. 2009). The recent Copenhagen consensus considered compelling evidence that sea level rise will be at least 1 m by 2100, with the possibility of even higher levels of sea level rise highly likely (Alison et al. 2009).

Addressing the question, “Sea Level Rise: Not If but When, and How Much?”, the 2007 UN World Population report underscored the alarming prospects of climate change impacts on sea level rise in light of potential consequences for coastal urban areas. Combined with extreme weather events, sea level rise threatens to flood large parts of coastal areas, introduce salt water into fresh water supplies and aquifers, and modify coastal ecosystems. These threats to vital ecological services and natural resources, upon which coastal populations depend, will inevitably provoke large-scale migration (UNFPA 2007).

Over half of the world’s population living within 100 kilometers of the coast is also living less than 100 meters above sea level (Small et al. 2000).

Small island and coastal developing countries are differentially impacted by sea level rise, and cannot afford to wait for emissions reductions to become more acceptable to the industrialized countries. Aggressive mitigation targets and timetables are urgently needed, along with technical and financial adaptation assistance for the most vulnerable countries and peoples.

## **2. Coastal and Island Populations are on the Front-line of Climate Change**

*The climate-change debate needs to be reframed, putting people at the centre. Unless climate policies take people into account, they will fail to mitigate climate change or to shield vulnerable populations from the potentially disastrous impacts.*

Central theme of the 2009 State of World Population report (UNFPA 2009)

Climate change and its varied impacts threaten thousands of islands and 183 coastal nations (McGranahan et al. 2007), some of the world's most significant biodiversity, and compound existing pressures on marine fisheries and ecosystems. Coastal and inland communities with ocean-based livelihoods are at risk from sea level rise, the migration of important marine species including global fish stocks, and ocean acidification.

Humankind is in the process of annihilating coastal and ocean ecosystems. At the root of the problem are burgeoning human numbers and their ever-growing needs. Population distribution is increasingly concentrating in coastal cities and towns. For over a decade, the overwhelming bulk of humanity has been concentrating along or near coasts on just 10 percent of the earth's land surface. By 1998, over half the population of the planet – over 3 billion people – were already living and working in a coastal strip just 200 kilometers wide (120 miles), while a full two-thirds, 4 billion, were found within 400 kilometers of a coast (Hinrichson 1998).

Today coastal cities large and small are growing 20 percent faster than any other cities in the world – with 10-15 percent higher densities than other

cities. At present, 15 of the world's 20 megacities lie along the coast (UN Habitat 2008). At the same time, uncontrolled coastal development and increasing uses of the ocean are threatening sensitive and important ecosystems and marine resources, while exposing growing numbers of people to coastal hazards that are exacerbated by climate variability and change. The next few decades will also see an unprecedented scale of urban growth in the developing world, which will be particularly notable in Africa and Asia – where the urban population will double between 2000 and 2030 – at which point the towns and cities of the developing world will make up 81 percent of urban humanity. In view of climate change and the considerable urban concentrations at or near sea level, proactive policies for sustainability are crucial (UNFPA 2007).

The world has seen a doubling of coastal population over the last 20 years, resulting in 60 percent of the world's population now living in the coastal zone exposed to natural hazards from both land and sea (Wolanski 2010). Coastal settlements in lower-income countries are more vulnerable and lower-income groups living on flood plains are most vulnerable of all. Despite lower urbanization levels, Africa and Asia have much larger proportions of their urban populations in coastal zones than North America or Europe. The 10 countries with the largest number of people living in these vulnerable, low-elevation zones, include in descending order: China, India, Bangladesh, Vietnam, Indonesia, Japan, Egypt, the United States, Thailand and the Philippines. While most of the countries with large populations in the coastal zone are large countries with heavily populated deltas, developing countries on average have a higher proportion of people *and* a larger percentage of urban dwellers living in the lowest-lying of coastal areas, while the 44 small island states represent a disproportionate number of the countries with a significant share of their population in this most vulnerable segment of the coastal zone (McGranahan et al 2007).

Often the most exposed and flood-prone areas of coastal cities are the most populated and where the

poorest inhabitants are concentrated. With the widespread loss of land in the coastal zone as a result of sea level rise, there will be massive displacement of people and loss of culturally, ethnically, and industrially significant areas (Kelman 2008). A recent report produced by the UNU Institute for Environment and Human Security (UNU-EHS) concluded that “if both population and emissions continue to grow at high rates, the number of people flooded per year will reach 21 million by 2030, 55 million by 2050 and 370 million by 2100” (UNU-EHS 2009). In the Asia-Pacific region alone, by the year 2100 about 150 million people could be forced to leave their homes due to climate change (Nicholls 1995). These direct effects of climate change on people could cause regional or international conflicts over needs as fundamental as drinking water and space.

Coastal populations, especially when concentrated in large urban areas within rich ecological zones, can be a burden on coastal ecosystems, many of which are already under stress. Protecting coastal residents from risks related to climate change requires urgent mitigation of greenhouse gas emissions, modification of the prevailing forms of coastal development, and a reversal of current coastal migration trends. These measures require concerted vision, commitment and a long lead time (UNFPA 2009). Without urgent intervention now, coastal peoples worldwide, and especially the small island states, will suffer severe and unfairly disproportional impacts from ocean warming, sea level rise, extreme weather events and ocean acidification.

### ***Small Island Developing States: A Matter of Security and Survival***

*The adverse impact of Climate Change and Sea-level Rise are critical security issues for the global community in this new millennium, and more so, for low-lying island states like Kiribati. The issue must take centre stage along with other international security issues. We urge the international community to agree on a unified global response to better protect the environment, in the same way that the international community is being encouraged to respond to terrorism and*

*other threats to global security. Our inability as a global community to agree on a unified stand on Climate Change and Sea-Level Rise is most disappointing and we deplore the notion that economic growth must take precedence over environmental issues. Our very existence as a state is at stake if this thinking prevails.*

– Address to the United Nations, President Anote Tong of Kiribati, 2004

Sea level rise can lead to the disappearance of beaches and low-lying islands (IPCC 2007). Many Small Island Developing States (SIDS) would be unable to adapt effectively to climate change impacts associated with a global 2–3°C mean temperature increase, given the potential impacts on their economies, infrastructure and overall human well-being (IPCC 2007). In Kiribati, a 50 cm rise in sea level and a reduction in rainfall of 25 percent would reduce the freshwater lens (floating freshwater store) by 65 percent (World Bank 2000). With a 50 cm increase in sea level, over one-third of the beaches in the Caribbean would be lost (UNDP 2007).

Water resources are likely to be increasingly stressed in the future. In 2080, flood risk is expected to be in the order of 200 times greater than at present for Pacific atoll countries (Nicholls et al. 1999). For many SIDS, life-sustaining ecosystems such as coral reefs are highly climate-sensitive and can suffer severe damage from exposure to sea temperatures as low as 1°C above the seasonal maximum (Nurse and Moore 2007). Extreme events such as hurricanes and floods cause damage in excess of 20 percent of GDP in many SIDS (Payet 2008). In 1993, 30 percent of the forested area on the Santa Cruz Islands was lost during one cyclone event (Nurse et al. 2001). Hurricane Ivan’s impact on Grenada in 2004 caused losses in the agricultural sector equivalent to 10 percent of GDP (OECS 2004).

In Maldives, a 1m rise in sea level amounts to the complete disappearance of the nation. The President has said that he intended to create a "sovereign wealth fund" to purchase a new land in case global warming causes the country to disappear into the sea (Telegraph 2008). The

President of Kiribati says his country's decision in 2009 to establish the world's largest marine protected area in the Phoenix Islands was a gift to humanity. Meanwhile rising sea levels caused by climate change claim more of the island nation's land and threaten the I-Kiribati way of life.

Kiribati's elevation is no more than 2 m above sea level. Its fresh water comes from aquifers. Saltwater intrusion into the aquifers is expected to make the islands uninhabitable before rising water overtakes settlements. "We will lose our homes. The islands will lose their ability to sustain life," said Kiribati President Tong, who is working with other countries to plan for the gradual evacuation of his nation of 110,360 people. President Tong has struck deals with Australia and New Zealand to train a small number of I-Kiribati to perform jobs those countries have trouble filling. He is also trying to find other options for Kiribati's citizens as he pursues his goal of relocating 1,000 I-Kiribati a year for the next 20 years. "We want to move our people with as much dignity as possible. For us it is not a matter of economics, it is a matter of survival." (Tong 2004)

### ***Extreme Weather Events: Facts, Impacts and Action***

The most recent report of the IPCC concludes that it is very likely that an increase in ocean temperatures will result in increased frequency and intensity of extreme weather events, such as hurricanes and heat waves (IPCC 2007). Scientific research has concluded that human influences on climate are indeed increasing the likelihood of certain types of extreme events (Gutowski 2008). The rising variability in the occurrence and magnitude of hurricane, cyclone, erosion and storm surge events due to climate change are putting coastal areas at greater risk.

Over the past 50 years, great weather disasters have caused some 800,000 fatalities and over a trillion dollars in economic loss – and in the present decade the damage wreaked by such disasters has reached record levels (ECA 2009). Warm ocean waters fuel cyclones (hurricanes). Cyclone Nargis, which struck Myanmar in 2008, caused upwards of 150,000 deaths. In the United

States, Hurricane Katrina killed hundreds and sickened thousands, created one million displaced persons, and sent ripples throughout the global economy, exposing the vulnerabilities of all nations to climate extremes. While no one event is conclusive evidence of climate change, the relentless pace of severe weather – prolonged droughts, intense heat waves, violent windstorms, more wildfires and more frequent "100-year" floods – is indicative of a changing climate. Although the association among greater weather volatility, natural cycles and climate change is debated, the rise in mega-catastrophes and prolonged widespread heat waves are, at the very least, a harbinger of what can be expected in a changing and unstable climate (Epstein and Mills, 2005).

Sea level rise and an increase in the frequency and intensity of extreme events can lead to severe impacts on infrastructure, such as closure of roads, airports and bridges, and damage to port facilities. Extreme temperature and flooding caused by climate change can result in heat stress, increased vector- and water-borne diseases, and infectious diseases and respiratory illnesses (WHO 2005).

Katrina was one of the most devastating hurricanes in the history of the United States, producing catastrophic damage estimated at \$75 billion in the New Orleans area and along the Mississippi coast – and is the costliest U. S. hurricane on record (NOAA 2005). While Hurricane Katrina and its destructive aftermath in 2005 were unprecedented, Hurricanes Dennis, Rita, and Wilma were also powerful hurricanes affecting the Gulf of Mexico that year. A USGS study of these storms highlighted the importance of restoring resilience to the Gulf of Mexico coast, and the need to integrate science that supports restoration of natural landscapes with intelligent coastal planning (USGS 2005).

The insurance sector is like the proverbial canary in the mine pointing out the most severe hazard areas and in recognizing the link between a changing climate and increasing losses, as well as threats to the health of insurers' investments. Managing and transferring risks are the first

responses of the insurance industry, and rising insurance premiums and exclusions are already indicators of climate change. Insurance companies are also changing – some are seizing business opportunities for products aimed specifically at reducing climate-related risks. Corporations and institutional investors have begun to consider public policies needed to encourage investments in clean energy on a scale commensurate with the heightened climate and energy crises (Epstein and Mills 2005, Appiott et al. 2009).

The unparalleled protective function of coastal ecosystems, from coral reefs and seagrass beds to mangrove forests and estuaries, is deserving of special attention and special protection policies, in light of the documented protection that mangrove areas in particular have provided in recent extreme weather events. FAO cites lessons from the 2004 Indian Ocean tsunami, earlier efforts to conserve and rehabilitate the mangroves of the Ayeyarwady Delta, and cyclone Sidr that struck southern Bangladesh in November 2007, where the Sunderbans forests played a crucial role in the mitigation of the deadly effects of the cyclone (FAO 2008).

Discouraging further expansion of settlements close to the coast and maintaining healthy mangroves and other coastal forests are important measures to protect coastal assets and populations. Reestablishment of the damaged infrastructure and communication facilities is urgently required and measures should be put in place to facilitate sound coastal area planning to maintain the resilience of coastal areas and reduce the vulnerability of coastal communities and ecosystems. Coastal planning to avoid development in vulnerable areas and maintenance of coastal vegetation as buffers are important measures, but will not be enough to protect against all such storms (FAO 2008).

While recognizing that all ecosystems and species are important, some marine ecosystems are critical and the designation of protected areas and reserves are an important element in a comprehensive approach to mitigation, through the management of natural coastal carbon sinks, and adaptation, through protecting key elements of ecosystem

function. Marine Protected Areas (MPAs) have demonstrated significant effects in more biomass, more animals, larger animals, more species, more robust dynamics and greater resilience within their borders. MPAs and networks of MPAs have an important role in addressing the increased uncertainty regarding the responses of organisms and changes to ecosystems resulting from the effects of climate change in the marine environment (Smith et al. 2009). In light of climate change, MPAs can help to maintain and restore ecological resilience and capacity to provide ecological goods and services (Mumby et al. 2010, Babcock et al. 2010). Protection of the world's coasts and oceans needs to increase in scale, levels, representation and rate to meet present goals, in order to address global marine biodiversity loss, climate change, ocean acidification, human health and food security challenges (Laffoley 2010).

Restoring mangroves and creating new mangroves are “soft” technologies using local knowledge, tailored to local conditions. Empirical evidence exists for scientifically designating areas to afford protection from different types of natural hazards. For example, typhoon winds would require 100-300 m of mangroves, or 1-2 km of coastal forests. Typhoon waves need 500-1000 m of mangroves to protect small coastal dykes, but will fail if the coast is naturally eroding. Storm surge protection is afforded by 200 m of coastal forest. While mangroves can weaken currents, they will not change much the storm surge height; however, mangroves will speed up draining out the flooded area after a surge. Such buffer areas cannot provide complete protection and incorporation of a ‘sacrificial zone’ is advisable. The specifics of management plans depend on the severity of the natural hazards, the bathymetry, the climate, the local land use and vegetation, and the available options to survive extreme events, as part of a regional plan to reduce the risk of loss of life, property and infrastructure to an acceptable level (Wolanski 2010).

Investment in protection and restoration of healthy coastal ecosystems is a strategy with significant co-benefits that requires urgent policy support world-

wide. Coastal buffer zones, and mangrove areas in particular, offer multiple benefits beyond dissipating the impact of cyclones and storms; in addition to filtering nutrients, trapping sediments and providing protection from erosion, these critical ecosystems harbor valuable and productive biodiversity and serve as fisheries breeding grounds and refugia, with the potential to also provide resilience in sustaining the food security and livelihoods of millions of coastal people in the face of climate extremes and change. Regional early warning and early action disaster prevention and response systems, including effective regional communication and networked coastal transport infrastructure, must also be implemented as necessary measures to protect lives in the future from the increasing frequency and intensity of extreme weather events due to a changing climate.

### **3. Emerging Scientific Information Indicates Climate Change Impacts Will Be More Extensive and More Disastrous Than Forecast by the Last IPCC Report**

In its most recent report in 2007, the IPCC estimated that sea level would rise by between 18 and 59 cm this century, but this estimate is very conservative. The IPCC looked at individual contributions to sea level rise from thermal expansion of the oceans and glacier melt. We now know there is more to sea level rise than that. A recent paper published in *Geophysical Research Letters* used a statistical model using 300 years of global sea level data to look at the cumulative effects of both natural and manmade changes on sea level rise. Because the model faithfully reproduces past sea level, the researchers are confident in estimates of future sea level rise between 0.6 and 1.6 m by the end of this century. During the 20th century sea level rose by 18 cm, and 25 percent of this rise attributable to natural factors. However, sea level rise in the 21<sup>st</sup> century will be 95 percent driven by anthropogenic greenhouse gases, with natural factors responsible for only five percent of the rise.

### ***Melting of Ice in Both Arctic and Antarctic Polar Regions Impacts the Rest of the World***

Impacts on polar regions, including rising air temperatures, melting sea ice, warming of the surface ocean, snow cover decline, warming permafrost, accelerating glacial retreat, and in the Arctic, melting of the Greenland Ice Sheet, will have significant global consequences. Among others, these include impacts on Northern Hemisphere weather and climate, changes to the global ocean circulation system, global sea level rise, and changes to the capacity of these regions to act as a carbon sink – Arctic marine systems currently provide a substantial carbon sink, but the continuation of this service depends critically on Arctic climate change impacts. Along with a decreased sink capacity, warming and changes in surface hydrology will cause a greater release of carbon (Martin 2009). Complicating these issues is the potential release of carbon to the atmosphere from Arctic shallow seafloor permafrost, which, if released, will further exacerbate global warming.

Conditions are also warming at the southern pole. From 1996 to 2006 there was a 75 percent increase in ice loss in Antarctica (NASA 2008). This holds large implications for coastal and island populations around the globe. Further, ice coverage at the poles is crucial not only for ice-dependant species but for important global processes as well. For example, winter sea ice acts as a “lid” that prevents CO<sub>2</sub> from returning to the atmosphere, and the formation of sea-ice produces brines that promote the sinking of CO<sub>2</sub>-laden surface water (MCCPI 2009).

Observed polar temperature changes can be directly attributed to human activities and not solely explained by internal climate variability or natural climate drivers (Gillett et al. 2008). Major ice sheets and glaciers are melting as a result of rising temperatures, thereby contributing significantly to sea level rise. Abrupt changes such as disintegration of the West Antarctic Ice Sheet could occur with atmospheric CO<sub>2</sub> concentrations of between 450 ppm to 550 ppm and a 2°C temperature increase. Such an occurrence would

cause global sea levels to rise by between 4-6 m (IPCC 2001). Ice sheet melt will be the primary contributor to future sea level rise, and reduced sea ice will amplify warming, which in turn will be amplified over land. Glaciers have been retreating worldwide for at least the last century, and the rate of retreat has increased in the past decade (Lemke 2007). The total volume of glaciers on Earth is declining sharply, which also has implications for water supply in certain areas.

### ***Effects of Ocean Warming on Coral Reefs Which Support Livelihoods for 500 Million People***

Life-sustaining ecosystems such as coral reefs are highly sensitive to climate and can suffer severe damage from exposure to rising ocean temperatures; already 20 percent of the world's coral reefs are estimated to be damaged due to ocean warming (Nurse and Moore 2007). If current trends in greenhouse gas emissions continue, many of the remaining reefs will be lost to coral bleaching over the next 20 to 40 years (Wilkinson 2008). Even the most optimistic future atmospheric CO<sub>2</sub> concentrations (e.g. 450 ppm) could be high enough to cause carbonate coral reef ecosystems to no longer be sustainable (Hoegh-Guldberg et al. 2007, Hoegh-Guldberg et al. 2009), large areas of polar waters to become corrosive to shells of some key marine species (McNeil and Matear 2008), and marine ecosystems to look nearly unrecognizable (Orr et al. 2009).

It is important to note that levels of atmospheric carbon dioxide of 450 ppm are considered by many to be unsustainable. New scientific analysis suggests that we must head towards long-term levels of atmospheric carbon dioxide of no more than 350 ppm. This growing body of information is based on evidence that many ecosystems such as coral reefs will be fundamentally changed (Veron et al. 2009), as well as strong paleological evidence that suggests the complete breakdown of the landlocked ice sheets of Greenland and the Western Antarctic (Naish et al. 2009). This all points to the conclusion that emission levels must approach zero over the next few decades (Meinshausen et al. 2009).

Since the 1980s, corals have undergone unprecedented high temperature mass bleaching and mortality. Locations, intensity, and severity of bleaching are predictable using a sea surface temperature (SST) "HotSpot" method. Current observations using the 'Hotspot Method' indicate large patches of warm waters around the Seychelles with on the ground confirmation of coral bleaching in many areas. The recurrence of coral bleaching since the devastating coral bleaching event in 1998, is further evidence that the planet is warming and delayed action will only reduce coastal security in many parts of the world.

Patterns over the last two decades suggest that ocean circulation is being systematically altered by world-wide changes in winds, ocean currents, and upwelling. The data suggest that: 1) intensities of all warm currents are increasing; 2) intensities of all cold currents are decreasing; 3) coastal upwelling is being reduced at all major sites; 4) open-ocean upwelling is increasing in the interiors of all ocean basins; 5) wind driven upwelling is increasing all around Antarctica; and 6) flow from the Pacific to the Indian Ocean through Indonesia is increasing. Because of their magnitude, these changes will have much greater effects on regional climatic extremes and ecosystem alterations than mean global warming rates. The most rapidly warming areas are potential sites of regional coral reef ecosystem collapse. Corals may survive in areas where warming is slowest due to increased upwelling. However they will persist in marginal coral communities, not constructional coral reefs, due to increased competition from algae and filter feeders. These changes have strong implications for future patterns of global warming, ocean-atmosphere CO<sub>2</sub> fluxes, marine biodiversity, fisheries catches, and primary productivity. Pelagic fisheries are expected to be displaced from intense coastal upwelling zones to less productive open-ocean upwelling areas, with important economic consequences. The trends indicated by measured temperature records suggest that negative effects on coral reef ecosystems will be much more imminent than predicted by current models of climate change (Goreau et al 2006).

## ***Impacts on Biodiversity and Fish Stocks***

Global warming will likely result in species migrations, further exacerbating the impacts of dangerous invasive species that cause disease and broad scale environmental destruction. As these species move into other ecosystems, they can cause serious harm (Mooney and Cleland 2001) even before direct impacts of climate change are observable (Lotze et al. 2006). In addition, changes in fish stocks have begun to be observed, with uncertain implications for coastal countries with significant investment in fisheries. For example, failure of some seasonally migrating species to return to the Benguela current where sea temperatures have risen about 1°C over the last decade can result in the inability of South African and Namibian fish-processing facilities to operate at economically viable levels.

Climate change will have far-reaching effects on these key resources and the people that depend upon them, including impacts on ecosystems, societies and economies. The ability of people to access fish supplies will become an increasingly important issue for sustainable development. According to a report of an expert workshop convened by the FAO, “some 42 million people work directly in the sector, with the great majority in developing countries. Adding those who work in processing, marketing, and distribution and supply industries, the sector supports several hundred million livelihoods. Aquatic foods have high nutritional quality, contributing 20 percent or more of average per capita animal protein intake for more than 2.8 billion people, mostly from developing countries” (FAO 2009). The demands on fisheries resources are only expected to grow, yet climate change impacts may impact this key food resource for billions of people and some 500 million people that directly or indirectly rely on the industry (FAO 2008b).

A recent report produced by the Global Partnership Climate, Fisheries and Aquaculture (PaCFA) summarizes some key messages that need to be addressed, including that aquatic ecosystems are critical to both food security and economic prosperity, and the billions of people that benefit

from fisheries and food products. PaCFA notes the urgent need to better understand the risks to aquatic and coastal systems, and address the changes that are occurring and are expected to occur (PaCFA 2009).

## ***Will the Ocean ‘Conveyor Belt’ Collapse?***

Thermohaline circulation is one of the ocean’s global cycling mechanisms that transports carbon to the deep ocean. Sinking occurs in the North Atlantic Ocean (and not in the North Pacific) because the Atlantic is much more saline and hence, denser. More evaporation in warmer water increases the salinity of sea water. Warm saltier water is brought to the North Atlantic by this circulating current from the tropical and South Atlantic. The impact of currents such as the Gulfstream on warming the European climate is highly significant and the impacts of a slowdown or switch off of this current would be extremely serious. To some extent this ‘conveyor belt’ appears to be self-sustaining, and if some event occurs to break this self-sustaining chain of processes, there is the potential for the circulation to break down rapidly (i.e. over several decades) and to remain in a reduced-circulation state for several centuries. While there is evidence of periodic slowing, the majority of climate scientists believe that a critical change in this global ocean circulation is unlikely to occur during this century. The question cannot yet be answered with certainty, yet due to the potentially serious impact on our climate of a collapse, it must be regarded as a low-risk, high-impact event that cannot be ignored (Osborn and Kleinen 2008).

## **4. Crafting a Comprehensive Policy and Action Agenda for Oceans and Climate**

This policy brief has highlighted the critical role of the oceans and coastal ecosystems in effectively addressing climate change. It is urgent that the international community come together to take decisive action to protect the central role of the oceans on Earth and to manage the climate change risks to coastal and island peoples. A comprehensive and synergistic program of complementary measures is both necessary and achievable.

Within the UNFCCC process, the international ocean community must ensure that national negotiators are armed with the knowledge of the central role of oceans in climate in order to ensure that references to oceans and coasts are fully and appropriately integrated into the UNFCCC negotiating text. Governments should take into account the very serious climate change impacts that will accrue to oceans, coasts, and SIDS by agreeing to the most stringent greenhouse gas reduction targets and timetables. 'Blue Carbon' policy and a funded implementation program should be raised up to at least the level of importance of the 'REDD' (UN Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries). Nations should collectively commit to carrying out adaptation through integrated and ecosystem-based management institutions, and within international climate change policy instruments, create mechanisms to allow the future use of carbon credits for marine and coastal ecosystem carbon capture and effective storage. At the same time, there is an urgent need to develop international governance guidelines to ensure the utmost precaution in research and potential use of ocean-related geo-engineering mitigation measures.

The following actions are recommended for the consideration of national and international decisionmakers:

***Proceed with utmost caution to ensure continued functioning of oceans in sustaining life on Earth by:***

- Adopting the most stringent reductions in greenhouse gas emissions, within a short time frame, to avoid disastrous consequences on oceans and coastal communities around the world. Compelling scientific evidence indicates that if we are to safeguard the essential role of oceans in regulating climate and the productive function of marine ecosystems, emission targets need to be incorporated into policy which target atmospheric carbon dioxide at levels no

higher than 450 ppm, and which eventually bring atmospheric carbon dioxide to below 350 ppm in the longer term.

- Giving special consideration to the positions of SIDS countries and of other coastal nations especially vulnerable to climate change.
- Taking measures to reduce air pollution from ships, which accounts for significant contributions of world greenhouse gas emissions.
- Promoting management and protection of natural carbon sinks in coastal areas as opportunities to protect biodiversity, save and restore global fisheries, change the 'world view' on the economic value of ecosystems and biodiversity, and recognize the deep links between ecosystem degradation and rural poverty.
- Promoting the establishment of global governance frameworks for ocean-related geo-engineering research and potential use.
- Managing natural ecosystems in order to boost their ecological resilience in the face of climate change: Protecting ecosystem components such as biological diversity and ecologically important species have been shown to improve recovery from climate change impacts across many ecosystems.
- Gathering and exchanging information improving public awareness of early warning system capacity related to climate change impacts on marine ecosystems, communities, fisheries and other industries, as well as emergency preparedness, monitoring, and forecasting climate change and ocean variability.
- Continuing at regional and national levels, to exchange lessons learned and best practices, and to enhance assessment of the vulnerability of oceans and coasts to the effects of climate change in order to facilitate the implementation of

adaptation measures.

- Cooperating in furthering marine scientific research and sustained integrated ocean observation systems; promoting education and public awareness; working together for the improved understanding on the role of oceans on climate change and vice-versa, and its effects on marine ecosystems, marine biodiversity and coastal communities, especially in developing countries and small island states.
- Inviting scientific community/institutions to continue developing reliable scientific information on the roles of coastal wetlands, mangrove, algae, sea-grass and coral reef ecosystems in reducing the effects of climate change; sharing of knowledge on available best practices on the dynamic relationship between oceans and climate (MOD 2009).

***Emphasize the positive contribution that oceans can and do play in the mitigation of global warming:***

Marine and coastal ecosystems are regarded as vital global carbon stores, but their role in carbon management has been largely ignored in international climate change discussions (Thompson 2008, Laffoley and Grimsditch 2009).

- Greenhouse gas stabilization targets should reflect recent marine findings and observations (e.g. on ocean acidification) and fully account for the crucial role of the ocean in the global carbon cycle.
- Carbon capture and storage via injection into geological formations in the ocean seabed is a potential mitigation measure to address climate change. This kind of geo-engineering needs to be studied and highly regulated and monitored to ensure safe and effective practice.
- On the other hand, some geo-engineering approaches, such as direct

injection of CO<sub>2</sub> into the water column, should be discouraged due to the potential for irreversible harm to sensitive marine organisms.

- Ocean fertilization could pose serious and unforeseen consequences for the marine environment and should therefore also be discouraged.
- National governments should facilitate the development of ocean-based renewable energy industries, e.g. wind power, currents, tides, and OTEC, through the utilization of marine spatial planning giving appropriate priority to marine renewable energy development, and through consistent and dependable funding for large-scale development and implementation.
- A renewed effort internationally is needed to switch power sources from fossil fuels to non-carbon dioxide emitting sources. Part of this will be to reduce subsidies of fossil fuels and to dramatically increase research and development of renewable energy sources. This may require an international collaboration which has the hallmarks of a “Marshall Plan” for global deployment of renewable energy.
- Blue carbon could be traded and handled in a similar way to green carbon - -such as rainforests--and entered into emission and climate mitigation protocols along with other carbon-binding ecosystems. There is a need to establish baselines and metrics for future environmentally sound ocean carbon capture and sequestration and to establish enhanced coordination and funding mechanisms.

***Deploy adaptation strategies in coastal communities and island nations with sufficient financing:***

- Implement adaptation measures through integrated coastal and ocean management institutions and processes at

local, national, and regional scales (e.g. Large Marine Ecosystems, Regional Seas).

- Governments should encourage ecosystem-based adaptation strategies to preserve, restore and increase the resilience of key coastal and marine ecosystems to provide shoreline protection, food security, maintenance of water quality, income and livelihoods and the full suite of natural resources on which vulnerable communities depend.
- Improve preparedness, resilience and adaptive capacities of communities that depend on marine and coastal resources for their livelihoods and food security.
- Protect coastal populations and infrastructure in the coastal zone following a risk-based approach, through integrated coastal and ocean management institutions, including flexible adaptation plans, and the expansion of a viable insurance market.
- Provide sufficient support for continual capacity development and technology exchange to equip coastal communities to adapt to climate change and to deploy and monitor appropriate mitigation measures using the oceans. The UNFCCC should specifically provide capacity development for adaptation and mitigation in developing nations and SIDS (GOPD 2009)

## **5. Action Agenda: Restoring the Power of Oceans and Coasts for Humanitarian, Environmental, and Climate Security**

*We have to make sure that sensitive marine policies will be included in the new regime so that a humanitarian approach can be made to the climate change challenge, an approach that is comprehensive and holistic.*

--President Susilo Bambang Yudhoyono,  
Opening Address to World Ocean Conference,  
Manado, Indonesia, 2009

## ***What is the cost of humanitarian and environmental security on the frontlines of climate change, in the differentially impacted coastal and island regions?***

Current estimates of adaptation costs in coastal areas and small island states are woefully inadequate, as are the adaptation resources currently available (Hale et al. 2009). There is an urgent need to provide sufficient funding to support adaptation for coastal and island communities that are at the frontline of climate change in 183 coastal countries.

The UNFCCC has estimated that the cost of adapting the coastal zone to the impacts of climate change will be roughly \$11 billion per year. However, this estimate uses lower predictions of sea level rise and does not include potential impacts due to increased storm intensity, so actual costs are likely to be much higher (UNFCCC 2007, IIED 2009). Meanwhile, the Adaptation Fund, established by the Parties to the UNFCCC to finance concrete adaptation projects and programs in developing countries, currently expects its total available resources to be only USD 250-350 million by 2012 (Adaptation Fund 2010).

While the UNFCCC has estimated the overall cost of adaptation up to 2030 will range from \$49-171 billion per year, subsequent estimates place this number as much as three times higher. It seems that some of the metrics used for estimating costs in the industrialized countries can produce artificially low estimates when applied to developing countries. For example, in Africa and Asia, the cost of adaptation infrastructure has been estimated between \$22 and \$371 million in Africa, and in Asia from \$1.9 to \$32.4 billion. Although Africa and Asia have very high levels of vulnerability to climate change with significant coastal populations at risk, these estimates are extremely low since so much of these regions have little or no infrastructure in place to “adapt” and the actual cost is very likely to be much higher (UNFCCC 2007, IIED 2009). Worldwide, the cost of adaptation in developing countries has been estimated to range from \$9-109 billion annually (World Bank 2006, UNDP 2007).

Nevertheless, there are existing and proven processes through which adaptation can be operationalized using ecosystem-based approaches, including through integrated coastal and ocean management institutions and processes at local, national, and regional scales. Adaptation needs to take many forms, using a variety of measures (soft, hard, and floating), and must focus on the need to preserve and restore natural ecosystems that can provide cost-effective protection against climate change threats, and to conserve biodiversity and make ecosystems more resilient to climate change so that they can continue to provide the full suite of natural services (Kullenberg et al. 2009). Further, the protection of coastal populations and, where it exists, infrastructure in the coastal zone should follow a risk-based approach through integrated coastal and ocean management institutions, including flexible adaptation plans, and the expansion of a viable insurance market.

***With over half the people of the world now living in coastal regions, should not at least half the funds made available for adaptation go to coastal and island peoples and countries?***

An international collaborative public and private sector assessment of the economics of climate adaptation reports that if current development trends continue to 2030, representative locations studied stand to lose 1 to 12 percent of GDP as a direct result of current climate patterns, with low-income populations losing an even greater portion of their income, while under a scenario of accelerated climate change, today's climate-related losses could go up to 200 percent within the next 20 years (ECA 2009).

Recognizing the potential of the oceans for mitigation (Snyder et al. 2009) with all of the co-benefits of ecosystem-based adaptation approaches in building ecosystem and community resilience (Lafferty 2003, Mumby et al. 2010, Babcock et al. 2010), the time is now ripe for the establishment of a robust Blue Carbon program to complement the terrestrial 'REDD' mechanism, which can help to channel necessary resources to vulnerable coastal and island regions. The 'Blue REDD' program

would focus on creating financial compensation and other positive incentives for countries willing and able to reduce emissions through the conservation of coastal habitats. This would enable emissions reductions while simultaneously conserving biodiversity and sustaining ecosystem services.

To implement a 'Blue REDD' program, there is a need to operationalize and estimate CO<sub>2</sub> absorption by the oceans under different emissions reduction scenarios (choosing major emissions reduction scenarios relevant to the UNFCCC negotiations), while considering the impacts of CO<sub>2</sub> uptake on ocean acidification and the provision of ecosystem services.

What kinds of processes and steps are needed to take forward the suite of actions recommended for consideration by national and international decisionmakers?

Enhanced coordination mechanisms are fundamental to ensure coherence across sectors, agencies, institutions and civil society from the local community through international levels. Harmonization of policies across sectors and regions is a challenge that can, however, be addressed through support for consultative dialogue processes among diverse actors and stakeholders at multiple levels.

Prospects for new, innovative and sustainable funding mechanisms include valuation of ocean and coastal habitats, biodiversity and ecosystem services. Climate-indexed micro-insurance schemes and other innovative risk transfer mechanisms to distribute the climate-related costs of the most vulnerable are also promising. Partnerships among public, private, environmental and humanitarian sectors are necessary in the development of participative and operational Early Warning and 'early action' systems, and to build resilience and disaster preparedness and response capacity in coastal regions.

We do not yet have sufficient knowledge of the risks associated with using methods for global climate intervention and remediation, their intended and unintended impacts, and their

efficacy in reducing the rate of climatic change to assess whether they should or should not be implemented. Thus, further research is essential. Climate intervention and remediation research and possible implementation should proceed in a timely, safe, ethical and transparent manner, addressing social, humanitarian and environmental issues (Climate Institute 2010).

There is a crucial need to support continual human and institutional capacity building for those charged with enacting and implementing measures to secure the resilience and health of oceans and coastal people and the ecosystems they depend on in the face of climate change. This includes capacitation of decisionmakers in order to better bridge science and policy. Decisionmakers need the power of knowledge both to inform the enactment of coherent ocean and coastal climate and development policy and to mobilize the necessary budgets for decisive action.

There is a real need to move beyond the constraints of fragmented institutional and legal frameworks which are not delivering on global development objectives, reversing environmental degradation or curtailing climate change. The measures proposed in the preceding section can bring coherence to new and more nimble policy frameworks that both reflect the best available knowledge, and are flexible enough to quickly adjust.

We need to do a better job of adapting governance both as new scientific knowledge becomes available, and in taking on board lessons learned while the implementation of policy measures is underway. Information flows between decisionmakers and the people and institutions on the ground responsible for acting on and carrying out policies, should provide feedback to inform adjustments and course corrections that continually improve ocean and coastal management and governance.

Opportunities for consultative dialogue processes such as those facilitated by the Global Forum on Oceans, Coasts and Islands and its partners enable ocean leaders to explore ways to reduce costs, increase benefits and accelerate results through the harmonization of national, regional and

international policies and actions. These dialogue processes are crucial in enabling ocean leaders to chart together a course that can secure our collective future.

The 5<sup>th</sup> Global Ocean Conference in Paris May 3-7, 2010, aims to bring the perspectives of world leaders from all sectors together--including but not limited to governments, international agencies, nongovernmental organizations, industry, science, museums and aquaria--to discuss these urgent policy issues and options, including emission targets, mitigation, adaptation, geo-engineering, capacity development, public education and participation, within and beyond the UNFCCC process. This important opportunity to advance our collective knowledge and commitments is crucial to bring a coherent oceans and climate agenda forward from Paris to the 10th meeting of the Conference of the Parties to the Convention on Biological Diversity (CBD COP-10) in Nagoya, Japan later this year, and to then ensure that integration of oceans and coasts is a hallmark of the UNFCCC 16th Conference of the Parties (COP-16) in Mexico at the end of 2010.

Consensus is sought, on behalf of the close to four billion coastal and island people at increasing risk due to climate variability and change, to mobilize the international community in endorsing concerted action with sufficient financial commitments to protect, restore and fully leverage the natural climate-regulating functions of the global ocean and its coastal zones, in order to secure the twin objectives of mitigating and adapting to climate change. The ocean and coastal peoples of the world have tremendous potential to lead the way in deploying the ecosystem-based approaches that not only form the most cost-effective and risk-reducing basis for equitable and sustainable development towards a low-carbon future, but can also establish productive and resilient foundations for food security, environmental security, health and livelihoods security, security from forced migration and conflict potential--in short for comprehensive humanitarian, environmental and climate security.

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