Term paper on environmental studies: rising sea levels

Environment, Environmental Study

Introduction

This term paper explores the issue of rising sea levels, the likely causes, and the effects the rise is having now and may have in the future on our planet. Specifically, the effects discussed include on the land, the world's freshwater resources, the animal and plant life, and the human race. The paper also considers current and potential longer-term solutions needed to deal with the problem and its effects. Finally, the paper provides recommendations for dealing with rising sea levels, in order to minimize the effects discussed.

Identification of the Problems

Although there are differences of opinion regarding the primary cause(s) of the present increasing trend for rising sea levels, most agree that global sea levels are indeed rising, and that the rate of rise appears to have been accelerating in recent years. According to the Climate Institute, the rising sea levels occurring since the middle of the 19th century have been primarily caused by " human-induced climate change." Over the course of the 20th century, the total rise in the sea level was between 15 and 20 cm, (approximating to between 1. 5 and 2 mm annually). However, that annual rate was greater towards the end of the century. Furthermore, satellite measurements taken during the last ten years show the rate averaging at circa 3. 1 mm per annum – a significant increase on that averaged 20th century rate. Predictions for this (21st) century suggest a higher rate of increase, although there is some uncertainty about the likely contributions from the three principal processes which cause the rise, i. e. " thermal expansion [of the seawater], the melting of glaciers and ice caps, and the

loss of ice from the Greenland and West Antarctic ice sheets” (“ Oceans & Sea Level Rise” 2010).

There are several reasons why the continuing and probably accelerating rising sea levels should concern us. Even the oceanic environment is adversely affected by the processes causing the rising sea levels. Ocean acidification is caused by the increased amounts of carbon emissions, which cause more CO2 to be absorbed by the oceans. Whereas the pH value of the world’s oceans has been fairly stable at around 8. 17 for millions of years, increased acidity in the future could have a substantially negative impact on the marine environment and on the ecosystems it supports. Melting of ice sheets and glaciers coupled with increased air temperatures could also affect the global ocean currents including a process called the thermohaline circulation. Changes in that process could have adverse effects on marine life, and have a knock-on and disruptive effect on weather patterns (“ Oceans & Sea Level Rise” 2010).

Potential effects: land loss. One of the most obvious effects of rising sea levels is the threat of inundation of low-lying land areas, especially coastal regions and islands. Almost a quarter of the global population lives on or near the coast, and in those areas the population density is approximately three times the world average. The effect of rising sea levels on many coastal regions and islands may, at the very least, seriously affect tourism revenues if beaches disappear. Ultimately – if the expected rise in sea level continues – whole communities will be flooded and become uninhabitable, affecting not only the human populations but wildlife habitats, too. Extracted from a 2012 report on the impact of sea level rise (SLR) on wildlife refuges,

Figures 1 and 2 in the Appendix to this paper provide a dramatic illustration of the effect of a projected 70 cm SLR in a specific study area: the Blackwater National Wildlife Refuge in Maryland. The second Figure shows that almost two thirds of the original wetlands area will be lost by 2075 (Liu & Delach 2012 pp. 7 & 8).

Having commented on the obvious adverse effects on tourism when existing beaches are inundated and disappear, it is worth noting that where there is no existing development behind the beach, and if the land contours are relatively flat with dunes along the coast, new beaches may form. As the sea levels rise, sediments will be pushed shoreward, creating new beaches (Huggett 2003 p. 308).

Potential effects on wildlife species. A report in USA Today states that – according to the San Francisco-based Center for Biological Diversity – " Hundreds of species of animals in the U. S. are threatened by sea-level rise due to climate change." The species most threatened include the loggerhead sea turtles, which could lose the beaches where they return each year to lay eggs, and the key deer which could lose their Southern Florida habitat due to inundation (Rice 2013).

Potential effects on birds. As sea levels rise in the future, environmental experts warn that millions of shore birds could disappear. Because up to 40 percent of their traditional feeding sites could be submerged, it is possible that their populations could decline by as much as 70 percent. Millions of migrating birds stop for rest and to feed at coastal wetland areas on their long annual migration journeys to and from breeding grounds (Coe 2013).

The Liu & Delach report referenced earlier covers the potential effects on the

great white heron and its Florida habitat. Because much of the Florida Keys is less than five feet above the present sea level, the report projects that if the sea level in that area rises by one meter, the species will lose more than 40 percent of its present habitat area (Liu & Delach 2012 p. 17).

Potential effects on plants. The rising sea levels adversely affect plant species in coastal regions. Unlike animals, which have the opportunity to move habitats where alternatives are available, plants cannot react so quickly, especially those species having low dispersal capability. They face further difficulties due to ongoing climate change, threatening some species with extinction (Berlin et al. 2012 p. 6).

The effect on plants of rising sea levels is already evident in southern Florida's Everglades. Inland from the salt water mangrove swamps, freshwater loving plant varieties – fed by a southerly flow from Lake Okeechobee – are retreating northwards as the mangroves expand into greater areas of salt water (Guma-Diaz & Gallagher 2013).

Potential effects on freshwater supplies. Rising sea levels will affect coastal groundwater resources, impacting the human populations and the ecosystems in those areas. An increase in the mean sea level " will raise the fresh water table in many coastal regions" and can also cause contamination of groundwater by seawater in coastal aquifers. Pumping from those aquifers can increase the likelihood of seawater intruding into the aquifer, effectively reducing the amount of fresh water that can be extracted. In terms of properties, the rise in water table can cause flooding of basements and failure of septic tank systems (" Coastal Groundwater Systems" 2013).

Interestingly, the ever-increasing demands for fresh water by an expanding

world population are contributing to those rising sea levels. Massive volumes of water are being extracted from aquifers deep below the surface to satisfy those demands. Eventually, that water is returned to the oceans, but faster than those ancient underground reservoirs can be replenished through rainfall. According to Professor Nicholls at Southampton University, " even if we stabilise the climate, we might still get sea level rise due to how we use water." To put it into perspective, the scale of pumping out of the groundwater is circa five times greater than the combined melting of Earth's two major ice caps (Greenland and Antarctica) (Carrington 2012).

Solutions

Mitigating climate change. Historically, efforts have focused on reducing carbon emissions, because scientists have concluded that increased emissions, primarily due to man's extensive use of fossil fuels, are the cause of climate change, which is the primary driver of the rising sea levels. Unfortunately, not all nations are as yet making sufficient efforts to reduce emissions. That situation needs to change, and soon. Environmental experts fear that if early and effective action is not taken, the accelerating climate change and its adverse consequences could become irreversible.

Various international initiatives have promoted action to combat climate change, but more needs to be done. In 1972, a UN organized conference in Stockholm, Sweden founded the UN Environment Programme (UNEP) which involved 114 of the UN's 132 member nations. Then, in 1992, a treaty called the United Nations Framework Convention on Climate Change (UNFCCC) was signed by 195 nations. Subsequently, in 1997, a legally binding accord called

the Kyoto protocol agreed firm targets for limiting greenhouse gas emissions to combat climate change (“ Supporting international action on climate change” 2013).

Sadly, not every country participated in that accord. Of the world’s developed nations, the US was the most notable nation refusing to ratify the Kyoto protocol. However, the test of its success (or failure) is whether it has brought about any reduction in global emissions. Unfortunately, its success has been limited at best; to a large extent because countries that have not signed up to the Kyoto protocol have greatly increased their emissions – notably China and some other developing nations. Figure 3 in the Appendix shows the detail. Overall, there has been no nett reduction in CO2 emissions. The Kyoto protocol was the first significant step in the attempt to reach global agreement in reducing emissions. What matters now is whether that will be followed by further and timely concerted action to prevent irreversible climate change (Clark 2012).

Details of attempts to combat climate change include introduction of alternative energy sources such as wind and solar power – in order to minimize the use of fossil fuels. With that same objective, standards of home energy efficiency have been increased, reducing domestic energy requirements. Furthermore, people are guided by government and consumer organizations to implement energy-saving measures. All these ideas are helpful, but it is changes in government energy policies backed up by legislation that will be needed to make a real difference.

Preventing land loss. Whilst some developed countries may have the resources to construct coastal defenses to protect low-lying areas, many

smaller islands will inevitably have to be abandoned. Two of the islands of Kiribati in the Pacific Ocean have already been submerged, and other islands such as the Maldives are under imminent threat. Further into the future, major cities like Bangkok, London, Mumbai, New York and Shanghai could find themselves below sea level, with major economic and social consequences. Although the more affluent nations may be able to afford the construction of mile upon mile of ever higher sea defenses, there will come a point where it becomes impractical. Taking the US as an example of the scale of the problem, this country has over 12, 000 miles of coastline and almost 20, 000 miles of wetlands on its coasts. Studies have estimated that to protect against the projected 21st century rise in sea level would cost between $156 and $236 billion, even if large areas of land were to be abandoned (“ Sea level rise” 2012).

Recommendations

International agreement (supported by all the world’s countries) will be needed to implement policies to reverse the trend of increasing emissions that are causing climate change. And that concerted and united action – including measures such as large scale reforestation – must happen soon, before climate change cannot be reversed.

Conclusions

Climate change has for too many years been allowed to happen due to lack of the necessary “ green” policies which will curb increasing CO2 emissions. If emissions are reduced and climate change is halted, the accelerating rise

of sea levels can also be halted, if not reversed. Mankind has a bleak future if that does not happen in the very near future.

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Appendix

Figure 1: Blackwater National Wildlife Refuge: 2000

(Source: Liu & Delach. 2012, Figure 3)

Figure 1: Blackwater National Wildlife Refuge: 2075 (69. 8 cm SLR)

(Source: Liu & Delach. 2012, Figure 4)

Figure 3: Changes in CO2 Emissions 1990 to 2011

(Source: Clark Nov. 2012)