SEA LEVEL RISE: IMPACT OF GLOBAL CLIMATE CHANGE

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Abstract

The study of sea level rise is an interdisciplinary endeavor as it adapts to a warming climate. Sea Level Rise (SLR) in response to the present and future warming of the earth's surface is probably the most contentious issue being debated at present. Although the past two decades have revolutionized our understanding of sea level rise and its causes, major scientific challenges must be met before useful predictions could be made. The rate of SLR has accelerated considerably in relation to the pre-industrial era. Over the twentieth century, global sea level increased at an average rate of about two mm per year, which is substantially larger than the rate of the previous millennia. Nevertheless, accurate prediction of future sea level rise requires continued observations as well as significant advances in modeling of the coupled ice-ocean-land-atmosphere climate. A major effort is needed to sustain data recording from satellite altimeters, time-variable gravity missions and from autonomous ocean observing systems. In addition, an interdisciplinary research effort is required to address major problems, including improvement of the historical records of sea level rise and ocean warming, the separation of other geophysical processes from sea level rise signals, and a more complete understanding of interactions between the ocean and ice sheets throughout the globe.

Key words- Climate Change, Global Warming, SLR, SAS, Iceberg

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Introduction:

Since immemorial, sea level has risen so slowly that it seems constant. So, people had the opportunity of extensively develop the shorelines of the world. Multistoried buildings, industries, vacation sports, farmland, etc. have been developed in the coastal regions throughout the globe. This balance is upset now by the rise in sea level through global warming. Sea level rise by one meter or more is expected in the mid of this century. Due to global warming, melting of mountain glaciers and polar sliding of ice resulting sea level rise. This may cause severe damage to low-lying areas, drown coastal marshes and swamps of rivers, bays and aquifers throughout the world.

Causes:

There are several causes of sea level rise; prominent among them depends upon the shape and size of the ocean basins, amount of water in the ocean and average density of sea water. Environmental scientists like Hays and Pitman analyzed fossil records and concluded that over the last one hundred million years changes in mid ocean ridge systems have caused sea level to rise and fall by over three hundred meters. On the other hand Clark et. al have accounted for sea level change of less than one millimeter per century.

Several researchers have attempted to explain the source of current trends in sea level rise. Barnett and Gornitz, Labedeff and Hansen, estimate that thermal expansion of the upper layers of the oceans resulting from the observed global warming of 0.4 degree celcius isotherm had migrated one hundred meters downward, and concluded that the resulting expansion of ocean water could be responsible for some or the entire observed rise in relative sea level. Meier estimates that the retreat of alpine glaciers and small ice caps could be responsible for a current contribution to a sea level of between 0.2 and 0.72 mm per year.

Effects

A rise in sea level of one or two meter would permanently inundate wetlands and low lands, accelerate costal erosion, exacerbate costal flooding, threaten coastal structures, and increase the salinity of estuaries and aquifers.

a. Submergence of Coastal Wetlands

The most direct impact of a rise in sea level is the inundation of areas that had been just above the water level before the sea rose. Coastal Wetlands are generally found at elevations below the highest tide of the year and above mean sea level. Estimating past sea level rise has been the analysis of marsh peats commonly. Thus the impacts of sea level rise on wet lands are fairly well understood.

b. Inundation

Although coastal wetlands are found at the lowest elevations, inundation of lowland could also be important in some areas, particularly if sea level rose at least by one meter.

c. Costal Erosion

Sea level rise can also result in the loss of land above sea level through erosion. Processes other than sea level rise also contribute to the erosion process including storms, structures currents and along shore transport. For example, water levels along the great lakes can fluctuate over one meter in a decade.

d. Flooding and storm damage

A rise in sea level could increase flooding and storm damages in coastal areas for three reasons: erosion caused by sea level rise would increase the vulnerability of communities, higher water levels would provide storm surges with a higher base to build upon, and higher water levels would decrease natural and artificial drainage.

e. Increased salinity in Estuaries and Aquifers

Although most researchers and general public have focused on the increase flooding and shoreline retreat associate with a rise in sea level, the inland penetration of salt water could be important in some areas. Besides as a rise in sea level increases the salinity of an estuary represents the outcome that (1) the tendency for the ocean salt water to completely mix with the estuarine water , and (2) the tendency of fresh water flowing into the estuary to dilute the saline water and push it back toward the ocean. During the rainy season, therefore, low salinity level prevails. A rise in sea level has an impact similar to decreasing the freshwater inflow. By

widening and deepening the estuary, sea level rise increases the ability of salt water to penetrate upstream.

Sea level rise and its impact on South Asia

It has become increasingly clear that man has acquired the power and capability to alter the ecology of the planet adversely. Researchers in the past few decades have clearly demonstrated that urgent attention is needed to reverse this trend. The influence of the oceans which cover nearly 71 per cent of the earth's surface is of much importance for regulating the climate of this planet. The last decade has witnessed sudden increase in man's awareness of the oceanic environment, and the progressive deterioration of our seas due to human activity.

Human dimension and Sea level rise

Global climate change directly and indirectly affect human activities such as social, economic and political set- up. Due to global climate change sea level is rising which directly affects the life of human beings, especially those who live in coastal areas. Their economics are very much dependent on sea and any changes in the sea will naturally bring about changes in their life styles.

There is an interaction between social conditions and the impacts of sea level rise. On the one hand, particularly if coastal defense is impossible, there could be a large social impact in the form of the abandoning coastal areas and the migration of population through sea. On the other hand, seventy per cent of the human population lives within 60 km. of the sea and the percentage is increasing.

Some nations are particularly vulnerable. Eight to ten million people live within one meter of high tide in each of the unprotected river deltas of Bangladesh, Egypt and Vietnam. Even in nations that are not vulnerable to sea level rise, some areas could be seriously threatened. Examples include Sydney, Shanghai, coastal Louisiana and other areas economically dependent on fisheries or sensitive to change in estuaries habitats.

Morphologic Processes and human interference

Deltas belong to the most rapidly changing parts of the crust of the earth from a geological point of view. The land areas of the deltas are built up by sediments from the river

and from the sea. A rapid rise of the sea level within a certain period will upset the present dynamic equilibrium. In deltas where the distribution of the upland discharge over the tributaries has not been stabilized by hydraulic works, a river branch may be cut off from the supply of sediments. The part of the delta which was supplied with sediments by that branch will be exposed to erosion in the case of a rapid rise of the sea level.

Impacts

a) Flood Protection

High sea levels are caused by astronomical spring tides. But, a rise of the sea level will affect cyclones, typhoons and hurricanes in different ways. The propagation of the astronomical tides in shallow coastal waters will be modified increasing the tidal range. The set-up will decrease but this effect will be small. The wave up rush may substantially increase the depths in front of sea dikes are small or where tidal foreland exists. The result is that the sea dikes will have to be raised to a greater height than the rise of the sea level to maintain the same degree of safety.

b) Surface and ground water

In all estuaries where a fresh water river debauches into a basin with saline water the heavier saline water will penetrate into the estuary and more in an upstream direction in spite of the flow of fresh water in the opposite direction. Depending on various factors, in the first place the tidal range in the basin, the estuary will show a distinct interface between the fresh water near the surface and the saline water near the bottom or a situation will occur when there is a partial or complete mixing. The saline intrusion renders the water unsuitable for various purposes and is a maximum when the river flow is minimum during dry periods when the need for fresh water is high.

c) Water management systems

i. Non embanked areas

It is seen that lowland rice is often grown in many deltas in the humid tropical zones where storm surges occur. In these places there is no protection against river floods. There are only low coastal embankments to protect the coastal strip from flooding with saline water during

high astronomical spring tides. Local rice varieties are grown which are adapted to the depth of flooding caused by river. Near the coastal strips the depths of flooding are small and relatively high yields are obtained.

ii. Embanked areas

Depending on the land elevation, pump lift drainage can be applied where rice or dry food crops could be cultivated. In the coastal zone of many deltas all over the world tidal drainages is applied on a large scale when the land is not too low.

iii. Irrigation

The sea level rise will increase the salt water intrusion threatening the intake points of irrigation water along the river. New canals will have to convey the irrigation water from the new locations of these intakes to the downstream areas. And when the stops are small booster pumping stations in the canals will be necessary. A benefit of the sea level rise will be the increase in head for the flow of irrigation water from the river to the land.

iv. Urban areas and harbors

Pocket dikes are necessary if there is rapid rise of sea level in low lying coastal areas. This is an operation which is already underway in a number of large cities mainly as a consequence of man-induced land subsidence.

Coastal storage reservoirs

In a number of coastal areas in France, India, Japan, the Netherlands and Bangladesh estuarine reservoirs have been framed by damming by tidal embayment or estuaries. Excess water from the rivers is discharged into the sea through sluices and the enclosed basins have been keen transformed into reservoirs with fresh water by the inflow of river water.

Thus a gentle coherence is needed and to understand the human response, they can be put into three categories.

1. Retreat, i.e., abandon vulnerable areas and resettle inhabitants.
2. Accommodation- adjusts to sea level rise.

3. Protection for vulnerable areas particularly those with high population, density, economic value or precious natural resources.

Conclusion-

Sea level rise is a problem, whose impact will be seen in nearly all the regions, especially coastal regions all over the world. It is a slow phenomenon, and its impact is gradual. It needs long term and precise observations to understand and predict the likely changes that may occur along the coasts of the continents and islands. These impacts of SLR are global in nature but they undergo annual, regional and local variations. They are influenced by the coastal morphology and rainfall, particularly in the countries situated in the monsoon belt on Asia. South Asian Region or SAS is said to be the most vulnerable one. A vulnerability which is caused by factors like low lying coastal areas. Rapid deforestation, overgrowing rate of population, developing and poor economics, and an uneducated population. These factors create all the more space for degradation of the coastal areas. Special programmes thus have been started in the South Asian Region. These programmes would not just help combat the rise in the sea level, but have also taken steps for prevention of the rise.

The developing countries of South Asia need a special treatment while talking of their prospects in the wake of the rising sea level and the climate change. Their economies need to be developed and only then can they dream of standing on par with the developed world of the North. As for a sustainable development this is an issue, which naturally must take priority with any nation and so the South Asian nations are no exception, but trying to force their growth to meet the conveniences of the North is quite an unreasonable requirement of the developed world. South Asia cannot be denied its right to grow nor to choose its own pathways to growth. No should that right be constrained by new conditions of trade or financial aid imposed in the name of environment, because who would know the meaning of the impact of the rise in sea level, better than South Asia?

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