SEA LEVEL RISE, CONSEQUENCES AND POLICIES

PIER VELLINGA
Ministry of Housing, Physical Planning and Environment, P.O. Box 450, 2260 MB Leidschendam, The Netherlands (formerly Delft Hydraulics, The Netherlands).

and

STEPHEN P. LEATHERMAN
Laboratory for Coastal Research, University of Maryland, 1113 Lefrak, College Park, MD 20742, U.S.A.

Abstract. Accelerated sea-level rise and the effects on coastal areas represent one of the most important impacts of global climate warming as a large part of the world's population and food production is situated along low-lying coasts. Coastal nations of the world should now be planning for one-half to a meter rise in sea level during the next century. While the actual extent of sea rise realized may be larger or perhaps smaller, this amount establishes a reasonable baseline for coastal zone planning activities. With respect to actual measures, priority should be given to projects that are beneficial to presently existing problems in coastal areas.

The lowlands along the world's seas will be the areas most vulnerable to impact. They include the deltaic, barrier island, atoll, and marshy coastlines. Increased storm-induced flooding represents the major danger in developing countries because of loss of life. In western countries, beach erosion will be a primary concern, requiring substantial expenditure of public funds to maintain existing recreational beaches. Marshlands will probably be left to their own destiny, which signals a marked decline in most places.

The responses to accelerated sea-level rise must be based on more than a simple cost-benefit ratio; a host of important considerations cannot be expressed in simple dollar terms. Each area must be considered on a site-specific basis as there is considerable geographic variation in the environmental (e.g., hydrologic, geologic) and cultural (e.g., population, human development) factors. The problem is further compounded by the time lag of several decades that exists between public recognition of the problem and actual construction and full operation of major coastal protective devices. It may be necessary to retreat from the eroding shore in some areas, while fortifying and even reclaiming land in others. Clearly a global response is required in that international research and cooperative efforts represent the only reasonable approach.

Introduction

As a result of industrial production, energy consumption and land use change, the concentration of a number of gases in the atmosphere (CO₂, CH₄, N₂O, CFC's) is rapidly increasing. As a result the average global temperature is likely to rise. The projection made at the Villach (1987) conference and published by UNEP and WMO (Jaeger, 1988) for temperature rise is shown in Figure 1. The upper curve reflects a scenario of accelerated emissions of greenhouse gases and a relatively
high climate sensitivity. The middle curve represents a scenario of continued present trend emissions and a moderate climate sensitivity. The lower curve is based on a scenario of radically curtailed emissions and a low climate sensitivity.

In Figure 2, three scenarios of sea level change are displayed. While it is theoretically possible that sea levels will drop, this is extremely unlikely. Since sea level position is largely a temperature-dependent variable, it is anticipated that the historical rate of global sea level rise will be accelerated by greenhouse-induced warming (NRC, 1987).

Eustatic sea level rise is only one component that contributes to the level of the sea relative to the land. Coastal engineers and coastal zone planners should be aware of regional and local differences in the rise in sea level relative to the coast. Important processes that may locally be of the same order of magnitude, illustrated in Figure 3 are:

(a) long-term geological effects,
(b) subsidence (compaction, drainage, minerals/water extraction),
(c) short-term sea level fluctuations.