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Implications of Climate Change in the ROPME Region: An Overview

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PREFACE

The closely-related issues of greenhouse gas emissions, global warming and climate change have recently come to the top of the international environmental agenda. In particular, concerns over the problems expected to be associated with the potential impacts of climate change have grown over the past decade and captured the attention of the scientific community, the politicians, decision makers, as well as the private and public sectors. These problems may prove to be among the major environmental problems facing the marine environment and adjacent coastal areas in the near future. Therefore, and in line with UNEP Governing Council decision 14/20 on "Global Climate Change", the Oceans and Coastal Areas Programme Activity Centre (OCA/PAC) of the United Nations Environment Programme (UNEP) launched and supported a number of activities designed to assess the potential impact of climate change and to assist the Governments concerned in identification and implementation of suitable response measures which may mitigate the negative consequences of the impact.

Since 1987 to date, Task Teams on Implications of Climate Change were established for eleven regions covered by the UNEP Regional Seas programme (Mediterranean, Wider Caribbean, South Pacific, East Asian Seas, South Asian Seas, South-East Pacific, Eastern Africa, West and Central Africa, the Kuwait Action Plan Region, the Red Sea and Gulf of Aden and the Black Sea. UNEP also established two Global Task Teams on the Expected Impacts of Climate Change on Coral Reefs and Mangroves in cooperation with the Intergovernmental Oceanographic Commission (IOC) and UNESCO respectively. Some of the Regional Task Teams enjoy the support of the Intergovernmental Oceanographic Commission (IOC) of UNESCO and other relevant international, regional and non-governmental organizations.

The initial objective of the Task Teams was to prepare regional overviews and site-specific case studies on the possible impact of predicted climate change on the ecological systems, as well as on the socio-economic activities and structures of their respective regions based on the climate change models/scenarios developed by the Intergovernmental Panel on Climate Change (IPCC) and widely accepted by the international scientific community.

The overviews and case studies were expected to:

- examine the possible effects of the sea-level rise on the coastal ecosystems (deltas, estuaries, wetlands, coastal plains, coral reefs, mangroves, lagoons, etc.);
- examine the possible effects of temperature elevations on the terrestrial and aquatic ecosystems, including the possible effects on economically important species;
- examine the possible effects of climatic, physiographic and ecological changes on the socio-economic structures and activities; and
- determine areas or systems which appear to be most vulnerable to the above effects.

The regional overviews were intended to cover the marine environment and adjacent coastal areas influenced by, or influencing, the marine environment. They are to be presented to intergovernmental meetings convened in the framework of the relevant Regional Seas Action Plans, in order to draw the countries' attention to the problems associated with expected climate change and to prompt their involvement in development of policy options and response measures suitable for their region.

Following the completion of the regional overviews, and based on their findings, site-specific case studies are developed by the Task Teams and are planned to be presented and discussed at national seminars. The results of these case studies and the discussions at the national seminars should provide expert advice to the national authorities concerned in defining specific policy options and suitable response measures.

The Task Team on the Implications of Climate Change in the ROPME Region was established, and met in its first meeting at the Regional Organization for the Protection of the Marine Environment (ROPME)

in Kuwait, 20 -22 May 1990, and in its second meeting at UNEP's regional Office for West Asia (ROWA) in Bahrain, 1-4 September 1991. The meetings were attended by experts from the region invited by UNEP in their personal capacities, taking into account the need for expertise relevant to the work of the Task Team and for a balanced geographical representation. It was also attended by representatives of the Intergovernmental Oceanographic Commission (IOC) of UNESCO and the Regional Organization for the Protection of the Marine Environment (ROPME). Each member of the Task Team was assigned a specific subject to address in detail, and the present overview is largely based on the contributions by the individual members of the Task Team.

The Task Team members who contributed to the present overview are: Prof. El-Sayed M. Hassan (Coordinator), Dr. Mohammed Abo-Auf, Dr. Sulaiman Almatar, Dr. Saad Al-Numairy, Dr. Dhafer A. Alumran, Dr. Mohammed B. Amin, Mr. Mohammed A. Borhan, Dr. Paul N. Munton, Mr. Walter Vreeland, Dr. Badria Al-Awadi (ROPME), Dr. Amin H. Meshal (IOC/UNESCO), and Dr. Makram A. Gerges (UNEP). The following members also participated in the work of the Task Team during the two meetings in Kuwait and Bahrain: Dr. Mohamoud Y. Abdulraheem, Dr. Mokhles Abou-Seida, Dr. Bahgat B. Habashi, Dr. Hassan Mohammadi, Dr. Fouad Kanbour (UNEP-ROWA) and Ms. Mariam Alkhalifa (ROPME).

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EXECUTIVE SUMMARY

The ROPME Sea Area can be divided into three distinct areas, each with its own characteristic response to climate change. These areas are: SA-I, the northern part of the Arabian Sea bounded to the north by the south coast of the Sultanate of Oman, the mouth of the Gulf of Oman and the southern coast of the Islamic Republic of Iran; SA-II, the Gulf of Oman, an arm of the Indian ocean open to it by a wide deep mouth, and connected to SA-III by the narrow and shallow Strait of Hormuz; and SA-III named in the literature as the Persian Gulf or the Arabian Gulf.

SA-I is the prime representative worldwide of the monsoonal weather system, which produces strong summertime upwelling which results in rich fisheries that disappear in the winter. SA-II shows transition between the monsoonal system and the desert belt climate of SA-III. The prominent feature of SA-III is its shallowness which results in important consequences: a) the annual range of water temperature is the greatest for any water body freely connected to the world ocean. This restricts the ecosystems that can survive such a range and stresses members of these systems, b) it also enhances the effect of sea level rise on the tidal pattern. More than anywhere else on the globe, this will manifest itself in SA-III.

The area, being the greatest oil producing area in the world, experienced a boom which started in the early seventies and continues to varying degrees in different ROPME Member States. Industry is expanding, population is increasingly urbanised in great coastal cities, influx of expatriates is continuing, infrastructures and services are being established and they grow rapidly. The environment and the existing ecosystems are stressed. The newness of the development offers the opportunity of including measures for protection against anticipated likely climate changes, but this opportunity is not fully utilised. This is partly due to the uncertainties about the magnitude of the changes and partly due to the long time scale in which these changes are expected to occur. It is clear from the information available however that certain coastal areas are more vulnerable than others. Foremost among these is the City of Kuwait.

SA-III exhibits two characteristics worth noting for their relevance to the sea level rise: because the region is the major oil and gas extraction area in the world, resulting land subsidence can produce an apparent sea level rise of the same order of magnitude as that postulated from expected climate change. Thus, observed sea level rise could be at twice the rate of the global one. Also because of the shallowness of the area, the change of tidal pattern resulting from the change of depth will be more dramatic and observable than anywhere else in the world.

For the specific interest of the ROPME Member States and as a general contribution in the international effort of studying and facing the challenge of climate change it is recommended that:

(a) A high quality dense tide recording network be established and connected to a land subsidence recording network.

(b) A regional central data collecting and data processing centre be identified within the region and adequately supported.

(c) An active participation in international relevant programs such as TOGA and GOOS by ROPME Member States be maintained.

(d) The Non-Governmental Organizations (NGOs) concerned with environmental issues, with their proverbial tendency for speedy action, should be encouraged to take an active part in environmental matters, particularly where public awareness is involved.

1. INTRODUCTION

1.1 THE GLOBAL SETTING

In spite of the existence of many different climatic types on earth, and in spite of the great year to year variability of the climate elements at any one place, the global means of climatic elements are nearly constant to a remarkable degree, and dramatic effects on earth are associated with small changes in these global means. The earth's mean temperature during the last ice age is estimated to be a mere 4.5°C below today's mean. At that time, however, ice sheets advanced equatorwards for hundreds of kilometres and covered vast areas in Eurasia and the Americas with drastic consequences to the biota on land and in the ocean and a huge drop in the sea level. Smaller variations in the means of climatic elements occur at different times with commensurate results. Prediction of climatic trends is, therefore, an important element in long term planning, but it is fraught with uncertainties due to the inadequacy of data and the complexity of relationships between causes and effects.

Climate results from the interaction between the incoming radiation and the "local" conditions on earth. For the purpose of this work, the incoming radiation will be considered as constant, and changes in the climate will, therefore, result from changes in conditions on earth.

1.2 BASIC INFORMATION

For all practical purposes, solar radiation constitutes the sole source of energy responsible for the earth's climate. The sun emits quantitative and qualitative radiation whose spectrum is consistent with a black body whose surface temperature is around 6000°K. A small cone of this radiation with an apex of 35" reaches the outer atmosphere directed towards the earth. This radiation is called the short wave radiation and its spectrum spans wave lengths from the ultra violet radiation (UV) through the visible light to the infrared radiation (IR). In the mean, spacewise and timewise, outgoing radiation from earth has to equal the incoming radiation. Otherwise the difference will produce changes in the earth's temperature or manifest itself in other ways.

Observations indicate that this is not the case. At any particular point of time, however, or at any particular place the balance can be violated resulting in temporary or local changes in temperature, evaporation, local importation or exportation of energy, growth of plants, desertification or other phenomena. Part of the outgoing radiation is reflection of the incoming radiation from clouds and the earth's surface and other elements of the atmosphere. The reflected radiation is of the same wavelength as the incoming radiation but the back radiation has a spectrum that depends on the temperature of the radiating surface. Back radiation from earth is totally in the IR part of the spectrum and is called the long wave radiation. While the atmosphere is almost totally transparent to the solar radiation it is much more opaque to the pure IR back radiation emanating from the earth (The ozone absorbs parts of the UV while water vapour, CO_2 and