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E. DOUKAKIS

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## **Towards a national adaptation strategy in view of climate changes**

**E. DOUKAKIS**

National Technical University of Athens,  
School of Rural and Surveying Engineering  
University Campus, 9 Iroon Polytechniou, 157 80 Athens, Greece

e-mail: edouk@central.ntua.gr

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### **Abstract**

*The continuously increasing emissions of CO<sub>2</sub> and Methane result in the enhanced greenhouse effect. The IPCC assessments for the 21<sup>st</sup> century refer to a 3° C increase in temperature and 50 cm rise in sea level on average. It is therefore understood that every nation must create a National Adaptation Strategy to face the impacts of the forthcoming climate changes. For Greece, an adaptation plan should include:*

- The vulnerability index of the coastal regions according to the national development plan.*
- The determination of the procedures towards adaptation in view of climate changes.*
- The determination of the national criteria to face extreme phenomena due to anthropogenic climate changes.*
- The technical and legal action plans.*
- The responsibility of the various public sectors to overcome gaps or overlaps in the actions to mitigate the impact and*
- The general national adaptation principles.*

*The presentation analyses all the above concepts and proposes specific guidelines to formulate a Greek National Adaptation Strategy to mitigate the impacts of anthropogenic climate changes.*

**Keywords:** Climate change; Shoreline impacts; Mitigation strategy.

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### **Introduction**

Since 1980, a scientific consensus has emerged that humanity is gradually setting in motion a global warming by a mechanism commonly known as the greenhouse effect. If current trends continue, our planet is likely to warm 3-5° C in this century, as much as it has warmed since the last ice age. Such a warming would raise the sea level a meter or more and

threaten water supplies, forests, low-lying areas, wetlands, human health, agriculture etc. In response, the U.N. General Assembly established in 1988 the Intergovernmental Panel on Climate Change (IPCC) to develop a plan for decreasing worldwide emissions. However, climatologists have generally concluded that it is too late to prevent a one or two degree of global warming (INTERGOVERNMENTAL PANEL ON

CLIMATE CHANGE, 2001). The need to respond today depends on the likelihood of global warming, the magnitude of the impacts and the potential for anticipatory measures to reduce adverse impacts of sea level rise, without imposing substantial costs if the changes do not occur. This is the real meaning of anticipatory measure, despite the fact that some people assume that it would be unwise to prepare for global warming until its eventuality and consequences are finally established. This is the 'wait and see' philosophy (?) that is by far excluded in the present work.

As the world warms, global sea level rises as oceans expand and glaciers melt. Around much of the Mediterranean basin, sea level could rise by as much as 1 m by the year 2100 (BROCHIER, F. 2001). As a consequence, low-lying coastal areas would be lost through flooding (inundation) and enhanced erosion, while rivers and coastal aquifers would become more saline. It is well-known that one of the worst affected areas will be Thessaloniki where local subsidence means that sea levels could rise by at least one and a half times as much as elsewhere in Greece.

Future climate change could critically undermine efforts for sustainable development in the Mediterranean region through impacts on the environment and social and economic prosperity. Undoubtedly, the coastal zone is an important natural environmental interface often subject to a diverse set of threats. It is an attractive location of human development, which has resulted in its continued degradation over the last few decades. Concern over the issues affecting the coastal zone has led to the development of a number of approaches to assess the vulnerability or sensitivity of coastlines not only to anthropogenic impacts, but also to impacts of a hydrodynamic and climatological nature. The potential risk to human life and property along the coastal zone encompasses the need for natural hazard mitigation. Ultimately, one vital question arises: should nations, coastal managers and people begin to prepare for the consequences

of the greenhouse effect? The answer is a straight 'yes', and the justification comes from the fact that in case climate changes will eventually unfold to a lesser extent, we will have spent a minimal amount for preparation and on the contrary, we will be well prepared.

## Materials and Methods

The milestone of a national mitigation policy is the recognition that policy formulation requires clear identification of critical threats posed by global climate change, in context of each country's national circumstances. Although an entire region is at risk (e.g. Mediterranean) from impacts of global climate change and sea level rise, the level of exposure varies from place to place. Tectonic movements can amplify the vulnerability of a country, low elevation coastal areas, degree of exposure to strong winds etc. Consequently, each country should "customize" its policy according to a method that is responsive to local needs. Needless to say, the national mitigation policy regarding climate change and sea level rise must be consistent with the national development goals and priorities.

Sea level rise has been referred to as the ultimate planning challenge. While sea level changes have played a historic role in shaping Greece's coastal environment, understanding how to address the potential for significant change is a difficult task. This challenge is further complicated by the broad spectrum of coastal issues and interests involved, as well as the inherent uncertainty associated with projecting sea level rise. Despite these challenges, coastal managers around the world have realized the need to begin advance planning for sea level rise. Consequently, vast research has been published on the impacts of sea level rise in the coastal environment, as well as the socio-political aspects of sea level rise response. For this worldwide research the following conclusions can be made:

- a. Governments have the primary responsibility for developing strategies to

mitigate adverse impacts associated with sea level rise.

- b. On-going research should focus not only on the 'possible' but also on the 'likely' impacts.
- c. Meaningful preparations can take place now, despite scientific uncertainty, by building upon current research, utilizing adaptive planning frameworks and assessing a range of sea level rise scenarios.

It is evident that each country must configure its own coastal zone management policy to meet the following goals:

- Protect the public interest, safety and welfare in natural hazard areas
- Preserve and protect coastal resources
- Protect and promote the economic and social stability of coastal communities in a sustainable manner
- Promote intergovernmental coordination and public participation and
- Promote appropriate methods of use of coastal areas.

Concerning the last goal, everyone knows that a huge number of private coastal properties in Greece are situated inside the delineated public seashore intentionally or unintentionally.

It is already obvious that one of the very important early steps in the formulation of the national mitigation strategy is to undertake a vulnerability assessment. This is 'the' critical step in the development of a National Mitigation Strategy. The assessment process helps mitigation planners and coastal managers define the hazards threatening their jurisdictions, show how the coastal communities are vulnerable to those hazards and how often such hazardous events could occur. This type of information can enable the government to better understand how it can develop programs to save lives, protect property and enhance the future economic stability of its communities. The vulnerability assessment process encompasses three basic components, namely, the hazard identification, the vulnerability assessment and the risk analysis. The responsible ministry or

organization, through a methodical step-by-step approach that begins with assigning responsibility for the upcoming work, can most effectively conduct these three components. Planners can then identify the hazards threatening the country and assess the vulnerability of the local communities to the impacts of those hazards. The vulnerability assessment process concludes with determining the actual risk to people and property that these hazards represent. After completing these steps, the government can use the results of the vulnerability assessment to formulate its national mitigation strategy.

As soon as the hazards have been identified and their mode of impacting people and property characterized, the actual vulnerability assessment of the local communities can begin. That includes the mapping of the geographic areas impacted by each hazard in order to compare them to the population, property, facilities and environmental resources existing within them. Computerized mapping makes this process easier and a Geographic Information System (GIS) is ideal for it. Using GIS, hazard area maps could be developed including flood prone areas, flood plains, storm surges zones, aircraft landing zones, areas subject to wildfires etc.

The final step in the vulnerability assessment process is to use the gathered information and conducted analyses as a basis to estimate the risk to which the local communities are exposed to each hazard. A judgement regarding the risk of a specific type of event will be an important tool for the coastal managers to use later in prioritizing mitigation initiatives as they are developed from the vulnerability assessment results. There are many ways to define risk, but for preparing mitigation strategies, risks can be considered as a comparison of the consequences of an incident with the probability that such an incident could occur.

The fundamental starting point for any vulnerability assessment study is the acquisition of basic data on a number of important

parameters that characterize the study area e.g. coastal topography and geomorphology, relative sea level changes, erosion/accretion patterns, trends in sediment supply, hydrological/meteorological/oceanographic characteristics and ecosystem characteristics. As for the socio-economic impacts of the study area, data on demographic developments, land use, infrastructure/economic/cultural assets and trends in resource use and economic development are vital.

Completing the vulnerability assessment analysis, a large number of vulnerable sites, infrastructure, facilities, ecosystems etc. would warrant further assessment. Therefore, further detailed study should focus on the spots with the highest priority. That means, that for the many facilities, systems and neighborhoods that may be vulnerable to disaster impacts, a portion will be threatened by more types of hazards than others. The focusing vulnerability assessment can be concentrated on the coastal areas selected through ranking or prioritizing the types of vulnerabilities that need to be addressed in the local mitigation strategy. These vulnerabilities may be at most concern for specific facilities, systems or neighborhoods or may be influenced by the community's plans and policies that control future developments. The ranking or prioritization of the concerned vulnerabilities can be carried out through 'low, moderate or high' vulnerability or via scaling from 1 to 5 (or any other). Regardless of the ranking method used, four general factors influential to vulnerability should be considered:

- a. The importance of the plan, facility, system etc.
- b. The future vulnerability of all types of hazards
- c. The number of people and infrastructure being influenced by the hazards and
- d. The severity, type and scope of direct and indirect impacts that could result.

Any combination of the above factors or criteria can be appropriate to national circumstances.

## Results

There are numerous publications assessing the impacts of climate change in the Mediterranean. All agree that under the diversity of the climate, the social and geomorphologic characteristics, the impacts of climate change will be firstly felt in the Mediterranean region (INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, 2001). Vulnerability studies on some erosion prone coastal areas in Greece proved that the impacts would be severe in the coming decades (DOUKAKIS, E., 2003). It is worth noting, that during the last 50 years, Greece lost 60% of its wetlands (MARAGOU, P. & MANTZIOU, D., 2000). Thus, the 16.000 Km of the Greek coastline ask for an immediate study according to a national mitigation strategy, which is absent at present. This strategy should be inherently composed of:

- A central, flexible and autonomous organization or authority that will solely and interactively plan the national research concerning the impacts of climate change. A clear legislation covering its spectrum of activities and authorities is considered crucial. The organization will design, attribute, validate and propose the type of research, the research institutes, the conclusions and the measures respectively
- Ending all public expenditures in support of private coastal development
- Replacing economic incentives for private development in high risk areas with incentives to relocate and build in other areas
- Encouraging research in new technologies for managing coastal areas without disturbing natural processes
- Acquiring undeveloped areas to preserve recreational beaches important to the public
- Stabilizing the retreating shorelines to defend private property. This requires private coastal development to pay its full cost

- Ending national funding for roads and other public works serving high risk areas
- Establishing barriers that protect natural beaches and primary dunes and prohibiting permanent structures in threatened (or high risk) areas
- Educating the public about the climate changes, sea level rise and, generally, natural phenomena and the economic consequences of beach management in an effort to mitigate the impacts
- Prohibiting insurance companies to cover the risk of private owners who build in a high risk coastal area
- Adopting zoning and land use controls that encourage development in safe areas
- Removing structures that become a threat to public safety or exist on the surf zone
- Establishing a national fund to buy up private property that should not built on
- Establishing legislation which permits building development rights, inland of the erosion prone beaches
- Setting time limits on the residential use of certain beach fronts, knowing of the long term erosion rates
- Prohibiting and regulating beach stabilization projects
- Discouraging high risk development in coastal areas threatened by enhanced erosion and directing it towards safe areas
- Recording each change of ownership with the descriptions concerning specific risks of hazard zones and
- Not allowing tax deductions or interest paid on loans for properties in the high risk areas.

## Discussion

As coastlines in Greece come under increasing pressure from tourism and other forms of development, there is an urgent need for a national mitigation strategy, environmentally acceptable, to face both the short term and long term future effects and impacts of coastline problems. A base level of

data must be collected rapidly while providing the maximum amount of information with a high degree of accuracy. A nationwide vulnerability assessment allows easy representation of the hazardous areas and assists the government, the responsible scientists and coastal managers to develop a comprehensive national coastal zone management plan. The technical, economic, legal and scientific tools are available worldwide to protect erosion prone coastal areas, help property owners and assure the public that our valuable beaches will be available and preserved. Coastal adaptation requires not only data and information on coastal dynamics and characteristics but also patterns of human behavior and a deep understanding of the potential consequences of climate change. It is also essential that there is a general awareness amongst the public, coastal planners and managers of these consequences but first of all the responsible politicians must abandon the philosophy of 'wait and see'. The most influential people in the Greek community should be aware of the climate changes which have begun in order to address the problems to the public.

It is in our hands to turn retreat to a victory.

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