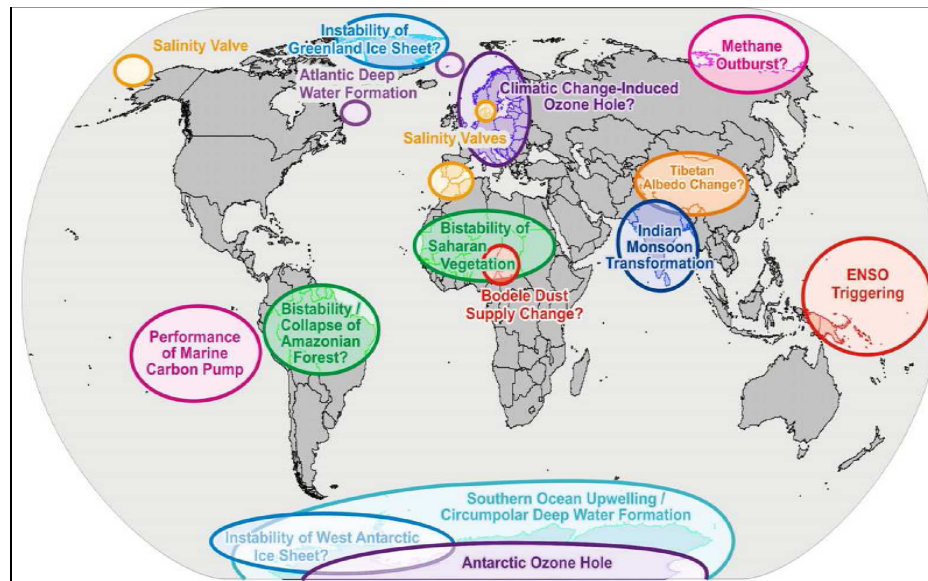


Climate change impact and Cyprus physical infrastructure

-BEACH INSTALLATIONS-

Background and Significance for Sustainability Science

At this point, there appears to be general agreement both in the public domain and scientific world that global climatic change has been taking place, particularly over the last few decades in terms of variables such as global average temperature and sea level rise. More so, it is no longer doubted that this change and rates of change all have roots in human activities. The effect of global climatic change on other variables such as sea-level-rise is becoming more certain, the global sea level appears to be rising, and is likely to accelerate because of climate change (IPCC, 2007). However, the magnitude of the future global mean change is expected to highly vary, across local and regional levels.



These changes, irrespective of their magnitude, will affect the more sensitive systems and areas of the planet earlier and more intensively. As a sensitive system, beach installations and infrastructure along the coasts of Cyprus poses a great concern with consequences that need to be treated in an anticipatory manner.

Several reports, including that of IPCC on global climate change estimates that some small islands such as Cyprus “could suffer land loss and experience increased beach erosion, inundation, and flooding from a sea-level rise of between 50 cm and 1 m”. It’s been generally noted also, that the “largest concentrations of settlements on small islands occur no further than 1-2 km from the coast, and sometimes much less” as is the case in almost all important Cypriot towns, except Nicosia. On the Island of Cyprus, critical and sensitive infrastructure tends to be located in or near coastal areas; this infrastructure will be highly vulnerable to the effects of projected sea-level rise, especially during extreme events. Similarly, significant infrastructural damage could result from any increase in the frequency or intensity of extreme events such as floods, tropical storms, and storm surges.

Moreover in Cyprus, because most of the populations tend to congregate in the few urban centers along the coast where most of the infrastructure and services are located, damage to important infrastructure (e.g., desalinization facilities, electricity plants and high voltage power lines, roads, bridges, seawalls, hotels and tourist sites) would be disruptive to several types of economic, social, and cultural activities, more importantly as tourism forms a substantial part of the Island's GDP. Because "we've designed and built our infrastructure for the climate we've had, not the one we're going to have. E.g. water systems for the temperature and precipitations patterns of the past centuries and those patterns are now changing. We've built our coastal cities along the existing shorelines, not anticipating sea level to rise few meters this century. Because of the rate of change, the changes would be detrimental" (US climate report, 2009) to places like Cyprus. At the same time, tourism, the mainstay of Cyprus economy, may become less attractive through a degraded environment and damaged infrastructure.



<http://icons.bookings.net/images/hotel/org/418/418908.jpg>

"The costs of protecting the shoreline and other infrastructure will vary, depending on the kind of protection needed, the length of area to be protected, design specifications to be adopted, and the availability of construction materials. There is concern, however, that the overall costs of infrastructure protection will be beyond the financial means of many island nations. Vulnerability studies conducted for selected small islands suggest that the costs of coastal protection ("hard" options) would be a significant proportion of GNP (see IPCC 1996, WG II). In Malta and Cyprus, it is estimated that approximately US\$550 million and US\$190 million (please note that this estimate was 15 years ago), respectively, would be needed to provide adequate shore protection works against a 20-30 cm rise in relative sea level. Although these estimated costs might not be excessive in the context of large economies, they represent considerable financial resources that these small island states would have to reallocate".

Global Climate Change project

Climate change is likely to result in rising sea levels, more intense storms and cyclones, reduced water availability and precipitations, and more heat waves. The likely impacts on human settlements in Cyprus include increased costs of managing the already-scarce water resources, increased energy demand, more damage to infrastructure and housing, increased insurance risk, more vector-borne and food-borne diseases, and increased stress on stormwater management systems. Current urban trends may be increasing the vulnerability of settlements to climate change.

The overall situation calls for swift action to initiate into motion of strategies for adaptation. This should involve experts from various fields and sectors, and should include the government agencies, business, academia, and non-profit organizations.

The impacts of climate change on settlements and infrastructure are likely to be widespread and complex. Settlements are complex systems that are affected by a number of internal and external pressures and the impacts of climate change on settlements and their infrastructure should be considered in the context of this complexity. Vulnerability to climate change will vary considerably from settlement to settlement and within settlements. The type, size and structure, location, socio-economic characteristics and institutional arrangements are key factors that affect vulnerability and adaptive capacity of a settlement.

In the case of Cyprus, the key sectors/infrastructures likely to be affected include energy and water supply (see link for locations of major water treatment plants: [http://www.cyprus.gov.cy/moa/wdd/Wdd.nsf/booklets_en/DAEF71F997D25DF9C2256E85004B1583/\\$file/pages%201-23%20\(2.41MB\).pdf](http://www.cyprus.gov.cy/moa/wdd/Wdd.nsf/booklets_en/DAEF71F997D25DF9C2256E85004B1583/$file/pages%201-23%20(2.41MB).pdf)). Major water plants such located at Limassol, Dhekelia, Khirokitia, and Tersephanou are located within less than a kilometer from the shorelines. Any slight increase in sea surface water level, flooding, or storm surge can easily disrupt water supply in an already-acute water shortage problem face by Cyprus.

Health infrastructure and services; Power plants (Dekelia Power Station, Moni Power Station, Vasilikos Power Station); road/transport, Coastal defenses systems (in Limassol, Larnaca, and Paphos); building (hotels and recreational centers especially in Larnaca, Limassol, Ayia Napa, Kokkinochoria areas, Protars etc); Ports and Harbours (Limassol, Larnaca, and about 20 other small ports); financial services (banks), hospitality industry/services (restaurants), and tourism are the major areas of concern with respect to beach installations versus climate change impacts in Cyprus. In addition, coastal infrastructure, such as drainage, waste disposal, electricity, water supply, roads may also have to be moved back from eroding coastal areas.

Adaptation options and measures

Synthesized from IPCC (Intergovernmental Panel on Climate Change), the general climate change effects include:

Sea level rise

- Increased coastal erosion
- Increased inundation of coastal wetlands and lowlands
- Increased risk of flooding and storm damage
- Increased salinisation of surface and ground waters
- Increased risk to coastal housing and infrastructure.
- Infrastructure and economic activity affected

Increases in sea surface temperature

- Increased coral bleaching
- Species migration
- Increased algal blooms
- Impact on tourism

Altered frequency of extreme weather events

- Increased waves and surges
- Altered cyclone zones
- Further damage to coastal infrastructure and natural ecosystems

Altered rainfall and runoff patterns (local increases/decreases)

- Altered river sediment supply
- Altered lowland flood risk
- Water quality/nutrient impacts
- Implications for erosion and flooding

Sectors that have installations on/along beaches and coastal cities of Cyprus and are impacted include:

Energy supply and use

- Warming will be accompanied by decreases in demand for heating energy and increases in demand for cooling energy. The latter will result in significant increases in electricity use and peak demand in most regions.
- Energy production is likely to be constrained by rising temperatures and limited water supplies in many regions.
- Energy production and delivery systems are exposed to sea-level rise and extreme weather events in most parts of the island.

Water Resources

- Climate change has already altered, and will continue to alter, the water cycle, affecting where, when, and how much water is available for all uses. For the past few years, water supply has been rationed across the island.
- Floods and droughts are likely to become more common and more intense as regional and seasonal precipitation patterns change, and rainfall becomes more concentrated into heavy events (with longer, hotter dry periods in between).
- Groundwater quantity which supplies most part of the farming and rural communities will be affected by a changing climate.
- Climate change will place additional burdens on already stressed water systems.
- The past century is no longer a reasonable guide to the future for water management.

Transportation

- Sea-level rise and storm surge will increase the risk of major coastal impacts, including both temporary and permanent flooding of airports, harbors, and roads.
- Flooding from increasingly intense downpours will increase the risk of disruptions and delays in air, sea, and road transportation.
- The increase in extreme heat will limit some transportation operations and cause pavement and road damage. Increased intensity of strong hurricanes would lead to more evacuations, infrastructure damage and failure, and transportation interruptions.

The government of Cyprus and all aforementioned sectors and stake-holders should engage in policy framework to set standards and regulations that integrate climate change considerations into design; land-use policies; building codes; and insurance. Adaptation strategy could involve relocation; seawalls and storm surge barriers; dune reinforcement; land acquisition and creation of marshlands/wetlands as buffer against sea level rise and flooding; protection of existing natural

Global Climate Change project

barriers. Tourism attractions to and revenues from the beaches need to be diversified. For the transport sector, there need to be considerations for realignment/relocation; design standards and planning for roads, other infrastructure to cope with warming and drainage. In the energy sector, strengthening of overhead transmission and distribution infrastructure as well as relocation of those already close to the shorelines are paramount.

Reference:

Since I did not find anything going on in my subject area in Cyprus, most of the things and ideas I put forward are synthesized from IPCC (Intergovernmental Panel on Climate Change), 1993 -2007 reports.

Should be involved:

Nicos Nicolaides: Minister of communications and works

www.mcw.gov.cy/mcw/mcw.nsf/dmlcv_en/dmlcv_en?OpenDocument

Antonis Paschalides: Minister of Commerce, Industry and Tourism

www.mcit.gov.cy/mcit/mcit.nsf/dmlcv_en/dmlcv_en?OpenDocument

Charilaos G. Stavrakis: Minister of Finance:

www.mof.gov.cy/mof/mof.nsf/DMLcv_en/DMLcv_en?OpenDocument

Ministry of Agriculture, Department of water works:

[http://www.cyprus.gov.cy/moa/wdd/Wdd.nsf/booklets_en/DAEF71F997D25DF9C2256E85004B1583/\\$file/pages%201-23%20\(2.41MB\).pdf](http://www.cyprus.gov.cy/moa/wdd/Wdd.nsf/booklets_en/DAEF71F997D25DF9C2256E85004B1583/$file/pages%201-23%20(2.41MB).pdf)