Climate Change Impacts - The Gozitan Case-Study

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Introduction

The global warming debate, at strategic, administrative and technical levels would seem to spell doom and gloom with varying approaches being posited on the utility of prediction methodologies and implementation strategies, a scenario which the Maltese Islands have not been left out of. This situation has now gone beyond mere debates on whether climate change is a reality or not, as both political and scientific arenas have agreed to review the situation and come up with viable strategies for studies. The Intergovernmental Panel on Climate Change (IPCC) report published its review of the impacts of climate change whilst more recent conferences are debating issues to tackle the repercussions as well as operands to tackle the change.

The Debate

There are various facets to the debate, from journalistic interpretations that verge on the sensational to hard-science analysis which result in a spectrum of prediction scenarios. However, there is consensus that change is and will continue to happen. These include a temperature increase of 1.2^{0}C by 2100, reduced ability of oceans and rainforests to absorb emissions, collapsing ice sheets, high levels of atmospheric water vapour, discharge of ice from major ice sheets and a measurable sea-level rise. Whilst all these have hit the headlines, none other than the last seems to have reached myth status. This is due to the fact that most cities are either located on the coast or on riverbanks, rendering them highly vulnerable to even small increases in sea-level rise.

Such figures vary from IPCC statements that sea level rise will reach 50cm to extreme figures of 13m published in the EEA's State of the Environment Report (EAA, 2005). Each is based on scientific studies with their own scenarios using a multitude of complex models. It is not easy to understand the situation considering the vast gaps between such figures. Whilst a 50cm rise can be handled through technology and natural protection mitigation measures, a 13m rise requires the migration of populations from low grounds to higher areas as well as having an impact on the economic fabric of a country.

Malta has been at the fore-front in addressing this issue through its commitment within the framework

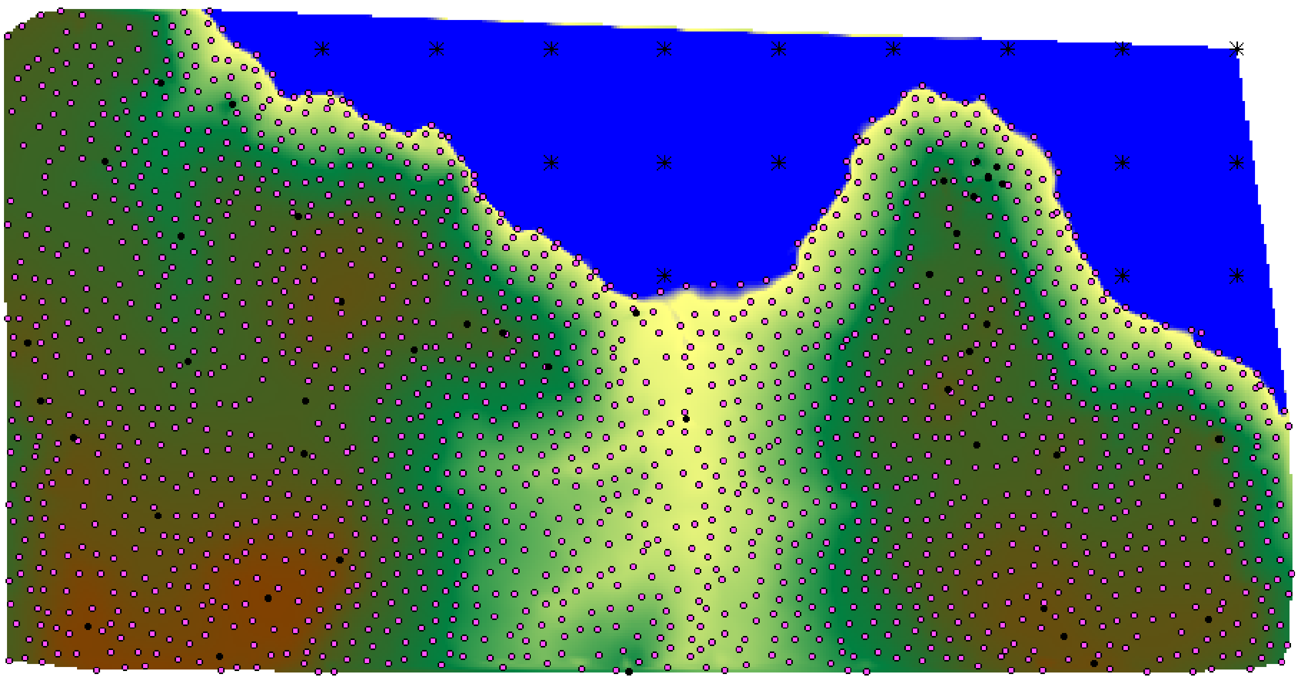


Figure 1: Current Ramla l-Ħamra topography.

of the EU Expert Group on Integrated Coastal Zone Management. These include the sustainability indicators as developed by the Working Group on Indicators and Data (WG-ID) to help assess the status of the European coasts in accordance with the EU ICZM Recommendation (2002/413/EC).

It is to be noted that as in any scientific study, there are limiting factors associated with lack of reliable data or absence of a long time series data. To be able to predict climate change impacts, one requires data that has been systematically collected over a long period of time, and in some instances this is missing. One parameter is the length of dynamic coastline where geomorphological data can enable a better understanding of the rate of coastal erosion along our coast. The more vulnerable a coastline is to erosion, the more the impact from potential sea level rise.

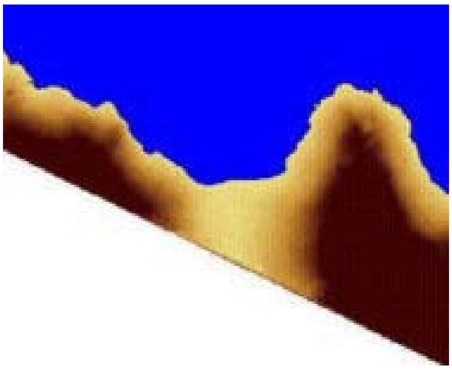
The Ramla l-Ħamra Case Study

If we apply such predictions to the Gozitan scenario using only topography as a parameter, the different sea-level rise increments will result in drastic changes as depicted in Figures 1 to 4.

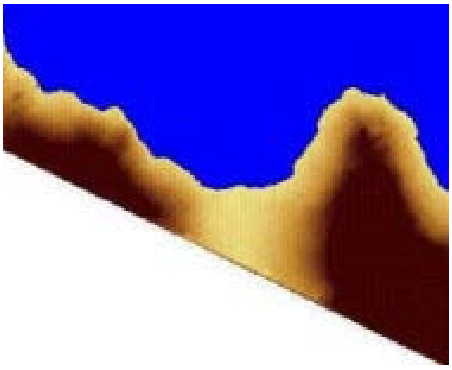
Figure 1 depicts the current Ramla l-Ħamra topography, which image shows the height points as delineated by the Land survey Unit and Mapping Unit at MEPA. Rendering the points into a 3D model serves to identify the topography which is discernable from the different colour outputs where beige signifies very low lying (near to 0m – current sea-level) with increasing grades from green to brown the higher the topographical increment.

Most of the activities of this bay lie along the low-lying coast, mainly utilised for agriculture, as well as leisure and recreation. However it is not a doom and gloom situation and caution is called for when interpreting available information. Figures 2a-e show a number of scenarios relating to the vulnerability of our coastal areas to sea-level rise.

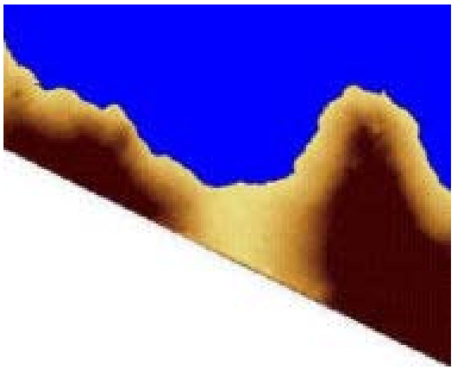
A review of Figure 2 immediately leads to an observation that there is a drastic change in Ramla l-Ħamra's formation as the sea-level gradually rises from its present position to a mid-way approach of 6m. Different measurements were taken in order to understand what the resultant predicted changes would result in. These measurements are 0m, 1m, 6m and 13m. Whilst there are small discernable differences between the current 0m and 1m, mainly that the sandy beach will experience a coastline loss, the 2m rise shows a clear incursion over the sand and in the valley outfall. The 6m image shows a drastic change in the topography and the definite reshaping



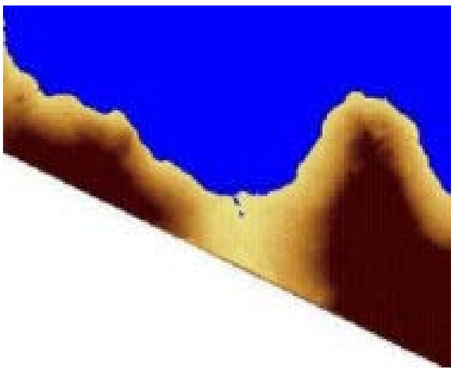
(a) Current Sea-Level 0m



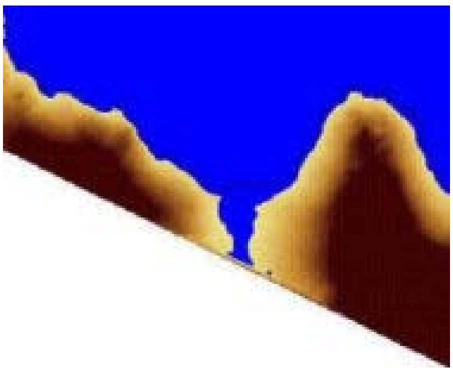
(b) Sea-Level Change 0.5m



(c) Sea-Level Change 1m



(d) Sea-Level Change 2m



(e) Sea-Level Change 6m

Figure 2: Predicted Ramla l-Ħamra topography

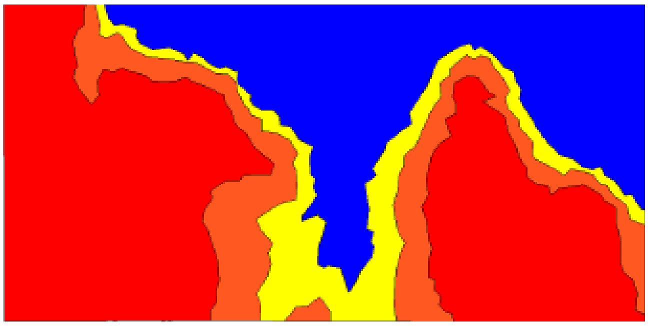


Figure 3: Predicted Ramla l-Ħamra topography at 6m: polygonal analysis

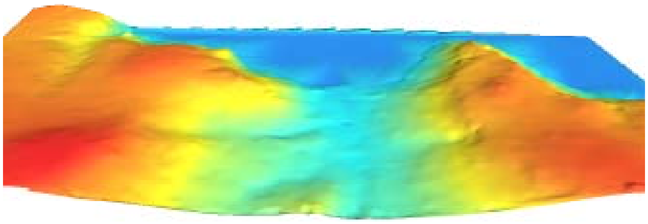


Figure 4: Ramla l-Ħamra topography at 13m: 3D Predicted Model analysis

of the landscape with the resultant repercussions.

This includes the elimination of all the leisure and recreation together with agricultural activities as well as biodiversity loss.

The process employed to deliver this output required access to basic statistical and highly-specific spatial tools as well as height measurements of the Ramla Bay's landform. Once this data was provided it was plotted into a spatial mapinfo format and analysed using different methodologies: point-entity analysis (each point was divided into several different categories marked by the assigned colours), TIN rendering interpolation analysis and 3D interpolation. These processes of thematic and spatial mapping lead to the identification of the area or points which could potentially possibly be submerged by the sea-level rise. The outputs in Figure 3 show one such potential as based on a 6m rise, where each layered polygon was colour coded in order to symbolise the specific height category (blue being the new sea-level).

The final analysis based on the EEA 13m sea-level rise is depicted in Figure 4, which shows a 3D render of the Ramla l-Ħamra area which indicates a total realignment of the area: a redefined landscape, a new coast and a deep underwater valley extended well into the landmass.

Conclusion

Studies such as the one conducted for Dwejra need to be reviewed in conjunction with other parameters such as the frequency and scale of marine storms, and the extent of erosion. Knowledge about these factors can further shed light on the identification of coastal areas at risk from climate change.

Such specialist research on the impact of sea-level rise can help us to better predict its economic, social and environmental repercussions, particularly with regard to potentially vulnerable locations.

References

Formosa, S., Borg, M., Conchin, S., and Rizzo, M. (2007) "Sea-Level Rise: A time to Review, Explain," *The Sunday Times of Malta*, (May 2007)

DEDUCE, (2007) *Climate Change and Coastal Areas*, Spain: Printing House WL

European Environment Agency, (2005) *The European Environment - State and Outlook 2005*, Copenhagen: EEA and OPOCE

IPCC, (2007) *Climate Change 2007: Impacts, Adaptation and Vulnerability,* Geneva: IPAC

Lange, E. (2001) "The limits of Realism: Perceptions of Virtual Landscapes," *Landscape and Urban Planning*, Vol. 54, (4): 163-182. Switzerland: Elsevier

Longley, P.A., Batty, M. *(eds)* (2003) *Advanced Spatial Analysis – The CASA book of GIS*, Redlands, California: ESRI Press

Pullar, D.V., Tidey, M.E. (2000) "Coupling 3D Visualisation to Qualitative Assessment of Built Environment Designs," *Landscape and Urban Planning*, Vol. 55, (1): 29-40. Switzerland: Elsevier

Ranzinger, M., Gleixner, G. (1997) "GIS Datasets for 3D Urban Planning," *Computers, Environment and Urban Systems,* Vol. 21, (2): 159-173. Switzerland: Elsevier

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