Quantification and Magnitude of Losses and Damages Resulting from the Impacts of Climate Change:

MODELLING THE TRANSFORMATIONAL IMPACTS AND COSTS OF SEA LEVEL RISE IN THE CARIBBEAN

Prepared by The CARIBSAVE Partnership for UNDP Barbados and the OECS for CARICOM Member States

FULL DOCUMENT









Quantification and Magnitude of Losses and Damages Resulting from the Impacts of Climate Change: Modelling the Transformational Impacts and Costs of Sea Level Rise in the Caribbean

Copyright © United Nations Development Programme (UNDP), 2010

The United Nations Development Programme (UNDP) is the UN's global development network, advocating for change and connecting countries to knowledge, experience and resources to help people build a better life.

This publication or parts of it may be reproduced for educational or non-profit purposes without special permission from the United Nations Development Programme, provided acknowledgement of the source is made, (see citation below).

The views expressed in this publication are those of the authors and do not necessarily represent those of the United Nations, including UNDP, or its Member States.

We would like to acknowledge the assistance and work of the University of the West Indies, the Caribbean Community Climate Change Centre and the Institute of Meteorology of the Republic of Cuba (INSMET) in providing climate modelling data for the Caribbean, and to thank them for their work. We also express our gratitude to Rachael Blomfield and Paula Taylor-Nobbs for their tireless work on the collation, proof reading and administrative assistance in this study.

This publication is to be cited as follows:

Simpson, M.C.^{1,2}, Scott, D.^{2,3}, Harrison, M⁴., Sim, R.³, Silver, N.⁵, O'Keeffe, E.⁶, Harrison, S.⁴, Taylor, M.⁷, Lizcano, G.¹, Rutty, M.³, Stager, H.^{2,3}, Oldham, J.³, Wilson, M.⁷, New, M.¹, Clarke, J.², Day, O.J.², Fields, N.², Georges, J.², Waithe, R.², McSharry, P.¹ (2010) Quantification and Magnitude of Losses and Damages Resulting from the Impacts of Climate Change: Modelling the Transformational Impacts and Costs of Sea Level Rise in the Caribbean (Full Document). United Nations Development Programme (UNDP), Barbados, West Indies.

- 1 University of Oxford, United Kingdom
- 2 The CARIBSAVE Partnership, West Indies
- 3 University of Waterloo, Canada
- 4 Climate Change Risk Management (CCRM)
- 5 Callund Consulting Limited
- 6 University College London, UK
- 7 University of the West Indies

FULL DOCUMENT

Please Note: A DVD was distributed at the Cancun COP16 November/ December 2010 with the 'Key Points and Summary for Policy Makers' document of this report. The DVD contains copies of the following:

1. Quantification and Magnitude of Losses and Damages Resulting from the Impacts of Climate Change: Modelling the Transformational Impacts and Costs of Sea Level Rise in the Caribbean - KEY POINTS AND SUMMARY FOR POLICY MAKERS

2. Quantification and Magnitude of Losses and Damages Resulting from the Impacts of Climate Change: Modelling the Transformational Impacts and Costs of Sea Level Rise in the Caribbean - SUMMARY DOCUMENT

3. 'Partnerships for Resilience: Climate Change and Caribbean Tourism' A short film (18 minutes) commissioned by the British Foreign and Commonwealth Office and the UK Department for International Development; Highlights adaptation measures being taken by governments, private sector and communities across the Caribbean.

Copies of these documents, the Full Document and the short film can be obtained via free download at www.caribsave.org

Contents

Contents	3
List of Tables	5
List of Figures	6
Authors List	9
1. Introduction	10
2. Climate Change Projections for the Caribbean Region under $+2^{\circ}C$ and $+2.5^{\circ}C$ Global Warming Scenarios	13
2.1 Interpretation of Projections from Climate Models	13
2.1.1 Use of 14 Models	14
2.1.2 Emissions Scenarios	15
2.1.3 Climate Sensitivity and Timing of Changes	16
2.1.4 Global and Regional Projections	20
2.2 Caribbean Region Scenario Results	20
2.2.1 Temperature	20
2.2.2 Sea Surface Temperatures	33
2.2.3 Rainfall	34
2.2.4 Wind Speeds	44
2.3 Interpretation of the Climate Modelling Results	49
3. Sea Level Rise Projections	54
3.1 Historic Sea Level Rise Trends	54
3.2 Future Sea Level Rise Projections	55
4. Implications of Sea Level Rise and Storm Surge for CARICOM Member States	62
4.1 Remote Sensing and GIS Methodology for Sea Level Rise Impact Mapping	63
4.1.1 ASTER Digital Elevation Model Construction	65
4.1.2 GIS Analysis and Mappi	67
4.2 Impacts of Sea Level Rise and Storm Surge Activity	71
4.2.1 Impacts of 1m and 2m Sea Level Rise Scenarios on CARICOM Countries	74
4.2.2 Impacts of 1m Sea Level Rise Combined with 1 in 100 Year Storm Surge Event	80
4.2.3 Impacts of Erosion Associated with 1m and 2m Sea Level Rise Scenarios	85
4.2.4 Sea Level Rise Adaptation Case Study: Structural Protection of CARICOM Cities	87
5. Actuarial Analysis of the Costs of Losses and Damages Associated with Sea Level Rise	91
5.1 Methodology for Economic Analysis	92

5.2 Economic Impacts of SLR for CARICOM	101
5.3 Summary of Economic Impact by Country Type	108
5.3.1 Small islands and Cays	108
5.3.2 Volcanic islands	109
5.3.3 Large coastal plains	112
5.3.4 Varied coastlines	115
6. Conclusion and Summary for Policy Makers	119
7. Recommendations	125
7.1 Improving the Information Base for Informed Decisions	125
7.2 Adaptation Actions and Policies	129
8. Key Points for Policy Makers	132
8.1 Climate Change Observed Trends and Projections for the 21st Century	132
8.2 Sea Level Rise – Observed Trends and Projections for 21st Century	133
8.3 Impacts of Sea Level Rise and Storm Surge in CARICOM Member States	134
8.4 Actuarial Analysis: Costs of Losses and Damages	137

List of Tables

Table 1: Details of the models used, scenarios under which each model was run, and years that average	
global temperature increase thresholds of 1.5°C, 2.0°C and 2.5°C were passed	18
Table 2: Summary of global sea level rise projections for 21st Century	61
Table 3: Geospatial data sources utilised in the SLR vulnerability assessment	64
Table 4: ASTER mosaic country groupings	65
Table 5: Summary of geophysical characteristics of CARICOM countries	72
Table 6: Impacts of a 1m sea level rise in CARICOM nations	77
Table 7: Impacts of a 2m sea level rise in CARICOM nations	78
Table 8: Additional notes on a 1 in 100 year storm surge	81
Table 9: Impacts of 1 in 100 year storm surge for CARICOM nations under a 1m sea level rise scenario	83
Table 10: Impacts of beach erosion associated with 1m or 2m sea level rise in CARICOM nations	86
Table 11: Coastal protection cost estimates for CARICOM cities	89
Table 12: Economic indicators of impacts by sector in CARICOM nations	95
Table 13: High and Mid range sea level rise scenarios used in the cost estimation	95
Table 14: Annual changes in GDP and population for the A2 and B1 scenarios	96
Table 15: Annual and capital costs of sea level rise in CARICOM countries	101
Table 16: Annual and capital costs mid range sea level rise scenario 2050	104
Table 17: Annual and capital costs high range sea level rise scenario 2050	105
Table 18: Annual and capital costs mid range sea level rise scenario 2080	106
Table 19: Annual and capital costs high range sea level rise scenario 2080	107
Table 20: Tourism: Economic indicators and resort count and inundation under 1m and 2m sea level rise	
and erosion due to 1m sea level rise	139
Table 21: Annual and capital costs of sea level rise in CARICOM countries	141

List of Figures

Figure 1: Annual and seasonal air temperature changes over land under scenario A1B according to the ensemble mean	21
Figure 2: Minimum annual and seasonal air temperature changes under scenario A1B according to the ensemble mean	23
Figure 3: Maximum annual and seasonal air temperature changes under scenario A1B according to the ensemble mean	24
Figure 4: Distribution of maximum air temperature under scenario A1B in Belize according to the Max Planck Institute ECHAM5 model	27
Figure 5: Distribution of minimum air temperature under scenario A1B in Belize according to the Max Planck Institute ECHAM5 model	28
Figure 6: Distribution of maximum air temperature under scenario A1B in The Bahamas according to the Max Planck Institute ECHAM5 model	29
Figure 7: Distribution of maximum air temperature under scenario A1B in Jamaica according to the Max Planck Institute ECHAM5 model	30
Figure 8: Distribution of maximum air temperature under scenario A1B in Dominica according to the Max Planck Institute ECHAM5 model	31
Figure 9: Distribution of maximum air temperature under scenario A1B in Guyana according to the Max Planck Institute ECHAM5 model	32
Figure 10: Annual and seasonal sea surface temperature changes under scenario A1B according to the ensemble mean	34
Figure 11: Annual and seasonal rainfall changes under scenario A1B according to the ensemble mean	35
Figure 12: Maximum annual and seasonal rainfall changes under scenario A1B according to the ensemble mean	37
Figure 13: Minimum annual and seasonal rainfall changes under scenario A1B according to the ensemble mean	38
Figure 14: Annual and seasonal rainfall changes under scenario A2 according to the ensemble mean	39
Figure 15: Daily rainfall distributions (mm/day) for Jamaica from the GISS ER model	41
Figure 16: Daily rainfall distributions (mm/day) for Jamaica from the GFDL CM2.0 model	42
Figure 17: Daily rainfall distributions (mm/day) for Jamaica for the IPSL CM4 model	43

Figure 18: Daily wind speed distributions for Jamaica from the GISS ER model	46
Figure 19: Daily wind speed distributions for Jamaica from the CSIRO Mk3.0 model	47
Figure 20: Daily wind speed distributions for Jamaica from the MRI CGCM2.3.2a model	48
Figure 21: Comparison of SRTM DEM and ASTER GDEM Data with Google maps image for reference	66
Figure 22: Example of criteria used to reclassify GDEM mosaics to binary sea level rise scenarios	67
Figure 23: Vulnerability of tourism resorts in Nassau and Paradise Island, The Bahamas to sea level rise	79
Figure 24: Vulnerability of Belize City to combined sea level rise and storm surge	84
Figure 25: Vulnerability of tourism resorts in Nassau and Paradise Island, The Bahamas to sea level rise induced coastal erosion	87
Figure 26: Extent of coastal protection works required for Belize City, Belize	90
Figure 27: Methodological framework of economic analysis	94
Figure 28: Summary of annual costs (US \$ million) on CARICOM countries	103
Figure 29: Summary of capital costs (US \$ million) on CARICOM countries	103
Figure 30: Annual costs of sea level rise to the Bahamas as % of GDP	108
Figure 31: Capital costs of sea level rise to the Bahamas as % of GDP	108
Figure 32: Annual costs of sea level rise to St. Kitts and Nevis as % of GDP	111
Figure 33: Annual costs of sea level rise to St. Lucia as % of GDP	111
Figure 34: Annual costs of sea level rise to St. Vincent and the Grenadines as % of GDP	111
Figure 35: Annual costs of sea level rise to Grenada as % of GDP	111
Figure 36: Capital costs of sea level rise to St. Kitts and Nevis as % of GDP	111
Figure 37: Capital costs of sea level rise to St. Lucia as % of GDP	111
Figure 38: Capital costs of sea level rise to St. Vincent and the Grenadines as % of GDP	112
Figure 39: Capital costs of sea level rise to Grenada as % of GDP	112
Figure 40: Annual costs of sea level rise to Dominica as % of GDP	112

Full Document

Figure 41: Annual costs of sea level rise to Montserrat as % of GDP	112
Figure 42: Capital costs of sea level rise to Dominica as % of GDP	112
Figure 43: Capital costs of sea level rise to Montserrat as % of GDP	112
Figure 44: Annual costs of sea level rise in Belize due to SLR as % of GDP	114
Figure 45: Annual costs to Guyana from sea level rise as % of GDP	114
Figure 46: Annual costs of sea level rise to Suriname as % of GDP	114
Figure 47: Capital costs of sea level rise in Belize due to SLR as % of GDP	114
Figure 48: Capital costs to Guyana from sea level rise as % of GDP	114
Figure 49: Capital costs of sea level rise to Suriname as % of GDP	114
Figure 50: Annual GDP loss costs of sea level rise for Antigua and Barbuda as % of GDP	117
Figure 51: Annual costs due to sea level rise in Barbados as % of GDP	117
Figure 52: Annual costs to Haiti from sea level rise as % of GDP	117
Figure 53: Annual costs of sea level rise to Jamaica as % of GDP	117
Figure 54: Capital costs of sea level rise at intervening periods for Antigua and Barbuda	117
Figure 55: Capital costs due to sea level rise in Barbados as % of GDP	117
Figure 56: Capital costs of sea level rise to Haiti as % of GDP	118
Figure 57: Capital costs of sea level rise to Jamaica as % GDP	118

预览已结束, 完整报告链接和二维码如下:



https://www.yunbaogao.cn/report/index/report?reportId=5_9971