Modeling Sea Level Rise in Caribbean SIDS: The Need for Tide Gauge Data

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Presentation Outline:

- Sea Level Rise Projections (Potential Threat)
- ICURA Project (Multidisciplinary Methodology)
- Sea Level Rise Model (Methodology and Results)
- Implications of the Lack of Tide Gauge Data

SEA LEVEL RISE PROJECTIONS

SO MANY GLOBAL PROJECTIONS!

Organization	Projection Stated
Climate Research Unit 2000	0.060m rise by 2100
University of Melbourne, School of Earth Sciences	0.030m-0.300m by 2040 and 0.090m-.880m by 2100
Environmental Protection Agency	0.700m by 2080
Centre for Sponsored Ocean Research, Division of the National Oceanic and Atmospheric Administration	0.040m-1.029m by 2095
Australian Academy of Science	0.090m-0.880m by 2100
National Centre for Atmospheric Research	1.9-2.6 ºC means 0.180m-0.200m rise 2.2-3.5 ºC means 0.190m-0.300m rise
American Geological Institute	6m or more over the next 140 years due to melting of ice sheet

Academic Individuals	Projection Stated	Ambiguity Involved
(Raper and Braithwaite 2006)	0.046m and 0.051m by 2100	Applied a melt and geometric model to estimate melt contributions from mountain glaciers & icecaps of Greenland and Antarctica.
(Graversen, et al. 2011)	0.170m by 2100	Associated uncertainties include climate-model projection, greenhouse-gas discharges (present and future aspects), ice sheet model and its boundary fields.
(Church and White 2006)	0.280 to 0.340m by 2100	Extended global mean sea level from 1870-2004, using 20th century rate of sea level rise of 1.7mm yr^{-1} and an acceleration of sea level rise from 1990 to 2100 of 0.013mm yr^{-1}
(Rahmstorf 2007)	0.500 to 1.400m by 2100	It was projected that the rate of SRL is related to warming. Calculations for SLR and temperature throughout the 20th century were found to be 3.4mmyr^{-1}ºC^{-1}, and is applied to IPCC circumstances of forthcoming warming.
(Horton, et al. 2008)	0.100m by 2100	Using (Rahmstorf 2007) model, it was applied to Coupled Global Climate Models previously used for IPCC 4th Assessment Report. Results are dependent on the Coupled Global Climate Model and emissions of greenhouse gases.
(Vermeera and Rahmstorf 2009)	0.750m to 1.900 m by 2100	Proposed a connection between sea level deviations and global mean temperature. Verified on a global model of sea level & temperature for 1880-2000 and then applied to IPCC future global temperature scenarios.
(Jevrejeva, et al. 2008)	0.340 m by 2090	Remodelled sea level from 1700-2000 using tidal data and showed sea level rose by 28cm for 1700-2000 period. They then projected for the 21st century using the results from observed data.
(Dyurgerov and Meier 2005)	0.650m ± 0.160 m	Better estimation of ice sheets with upgraded data, however this projection does not include Greenland and the Antarctic. Calculated volume of this ice was found to be 260km ± 65km X10^{3} km^{3}.

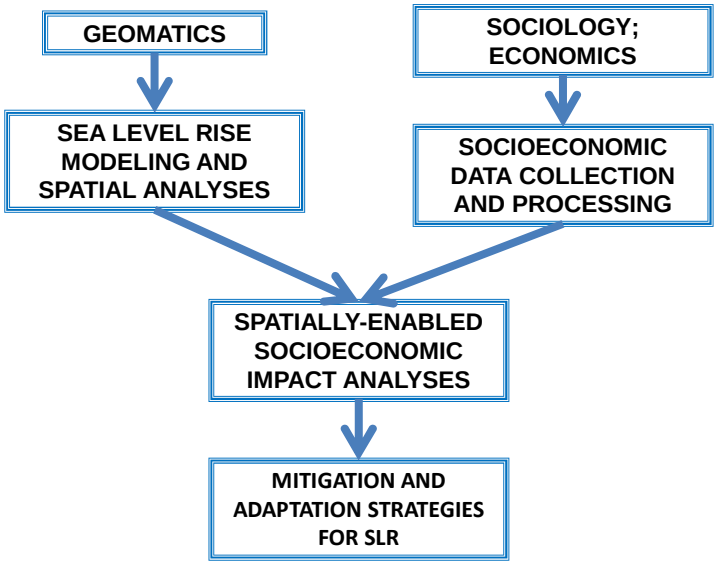
SEA LEVEL RISE PROJECTIONS

IPCC Category	Projection Stated
1	0.4m – 1.4m 2000 - 2015
2	0.5m – 1.7m 2000 - 2020
3	0.6m – 1.9m 2010 - 2030
4	0.6m – 2.4m 2010 - 2060
5	0.8m – 2.9m 2050 - 2080
6	1.0m – 3.7m 2060 - 2090

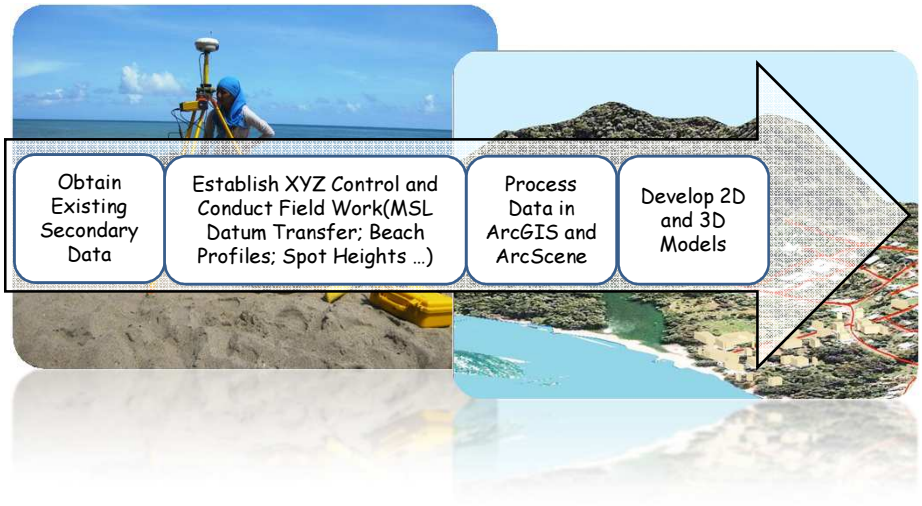
THE ICURA PROJECT ONLY ASKS "IF THE PROJECTIONS ARE TRUE, WHAT WOULD BE THE SPATIAL AND SOCIOECONOMIC IMPACT ON CARIBBEAN COASTAL COMMUNITIES?"

ICURA MULTIDISCIPLINARY METHODOLOGY:

SPATIALLY-ENABLED SOCIOECONOMIC IMPACT ANALYSES



SEA LEVEL RISE MODEL: GEOMATICS METHODOLOGY

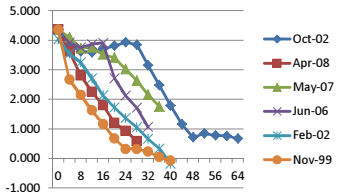


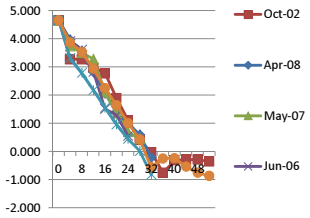
SEA LEVEL RISE MODEL: DATA

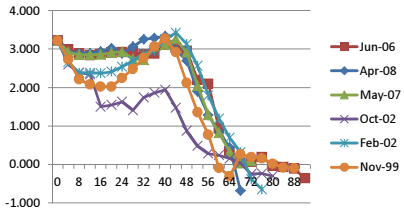
Collected Data	Purpose
Ground Control Points	To establish a reference control within the community, since existing controls were destroyed
Contour data	To get an accurate model of sea level rise and for the generation of 3D model
Topographic Data	To show what would be affected by the rise in sea level (Buildings, Property Boundaries, Roads, River etc.)
Arial Photograph (2007 with Colour)	To provide realistic visualization
Spot heights along the beach	To get a detailed contour shape of the beach
Mean Sea Level	To establish a vertical reference control within the community

SEA LEVEL RISE MODEL: RESULTS

TEMPORAL BEACH PROFILES FOR BEACH DYNAMICS

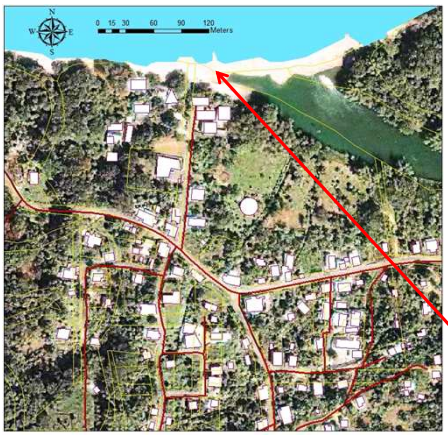






SEA LEVEL RISE MODEL RESULTS:

VISUALIZATION



Simulated MSL at Grande Riviere Beach

SEA LEVEL RISE MODEL RESULTS:
VISUALIZATION

Simulated 0.4m above MSL at Grande Riviere Beach

SEA LEVEL RISE MODEL RESULTS:
VISUALIZATION

Simulated 0.6m above MSL at Grande Riviere Beach

SEA LEVEL RISE MODEL RESULTS: VISUALIZATION

Simulated 0.8m above MSL at Grande Riviere Beach

SEA LEVEL RISE MODEL RESULTS: IMPACTS

GRANDE RIVIERE

- Even at 0.4m above MSL there appears to be impact upon turtle nesting sites
- Secondary impact upon Grande Riviere's socioeconomic wellbeing – community depends upon related tourism
- Support for mitigation/adaptation strategies

SEA LEVEL RISE MODEL RESULTS:
VISUALIZATION

MSL at Bequia, St. Vincent and the Grenadines

SEA LEVEL RISE MODEL RESULTS:
VISUALIZATION

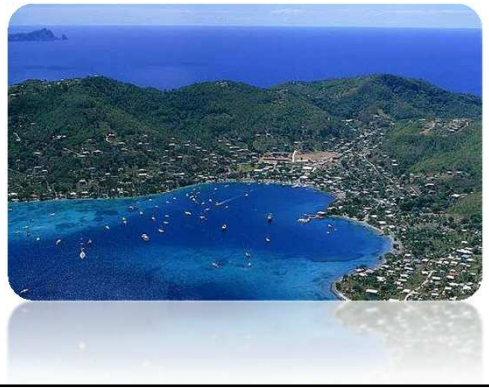
Projected 1.4m above MSL at Bequia, St. Vincent and the Grenadines

SEA LEVEL RISE MODEL RESULTS: IMPACTS

BEQUIA

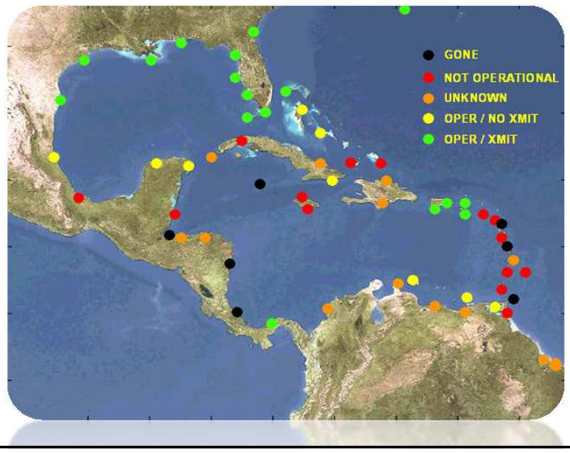
•Threat to tourism, the "life blood" of the island

•Support for mitigation/adaptation strategies



SEA LEVEL RISE MODEL RESULTS: PROBLEM

- ACCURACY OF THE MODELS DEPEND UPON ACCURACY OF ESTIMATED MEAN SEA LEVELS.
- SEVERE LACK OF DEPENDABLE LONG-TERM TIDE GAUGE DATA IN THE CARIBBEAN.
- NOT SURE HOW TO SOLVE THE PROBLEM EXCEPT TO USE SHORT-TERM DATA.
- HIGHLIGHTS THE IMPORTANCE OF HYDROGRAPHY



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