Remote sensing and GIS for multi-hazard risk assessments in the coastal zone: recent applications and challenges in the Pacific

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The First Pacific Regional Workshop on Multi-Hazard Risk Assessment and Early Warning Systems by Using Space and GIS Applications
Nadi, Fiji, 13 – 15 September 2016
Outline

1. Overview of The Pacific Community (SPC)
2. Lifuka Island, Tonga
3. Kiritimati Island, Kiribati
The Pacific Community (SPC)

Sustainable Pacific development through science, knowledge and innovation

26 Member Countries and Territories

600 staff

14 Sectors

USD 100 million annual budget
SPC’s Geoscience Division - the region’s principal provider of applied research and technical services, in work areas such as

• Ocean and Coastal Geoscience,
• Disaster Risk Reduction,
• Climate Change,
• Water and Sanitation,
• Natural Resource Economics,
• Geothermal Energy,
• Geological Resources and Surveys,
• Geoinformatics,
• Remote Sensing
• etc.
Major Coastal Hazards

- Erosion
  - Sediment supply & demand/loss
  - Beach mining

- Inundation
  - Sea level rise
  - Storm surge
  - Wave setup & runup

- Subsidence
  - Tectonic movement
  - Tilting
Lifuka Island, Tonga

- 500 households
- 3000 people
Coastal erosion, Lifuka hospital

September 2011  June 2012

DEVELOPING AN EVIDENCE-BASED STRATEGY FOR ADAPTING TO SEA-LEVEL RISE, LIFUKA
Historical Imagery of Lifuka

Images

1968 aerial
1990 aerial
2004 QB2 image
2008 QB2 image
2011 digital orthophoto

44 years

DEVELOPING AN EVIDENCE-BASED STRATEGY FOR ADAPTING TO SEA-LEVEL RISE, LIFUKA
Digitised Shoreline Dataset

Legend
Historical shorelines
- 24/08/1968 Aerial photograph
- 22/05/1990 Aerial photograph
- 24/04/2004 Quickbird satellite image
- 20/06/2008 Quickbird satellite image
- 10/06/2011 Digital Orthophoto

Hospital
Annual erosion rates for Lifuka

Analysis using DSAS
Chronic erosion
Natural variability

Annual erosion rate (m/year)

Transect number

Hihifo
Pangai
Holopeka
Koulo

Hospital
Wharf

DEVELOPING AN EVIDENCE-BASED STRATEGY FOR ADAPTING TO SEA-LEVEL RISE, LIFUKA
Final Coastal Hazard Map

**Coastal Setback Zone**
Long term erosion zone also subject to coastal inundation and damaging waves

**Coastal High Hazard Area**
subject to coastal inundation and damaging waves

**Coastal Hazard Area**
subject to coastal inundation and wave action

Contours show depth of flooding including wave effects in metres above ground level
Tongan language version of the coastal hazard map

Community engagement component
Coastal Impact due to strong 2015/16 El Nino, Kiritimati Atoll, Kiribati
El Nino Impact, Kiritimati

Sea level anomalies – January 2016
Mean level of the sea in the Line Islands of Kiritimati: + 0.30m

Source: Ocean Portal, Climate and Ocean Support Program in the Pacific (COSPPac)
El Nino Coastal Impact, Kiritimati

Inundation Event-January 2016

- Wave: Hurricane Pali – 1500 km West of Kiritimati
- Storm Tide:
  - Spring Tide
  - El Nino – High MLOS
Unmanned Aerial System (UAS) / drone survey

Staff from Ministry of Environment Lands and Agricultural Development (MELAD) and former Line and Phoenix Minister launching the UAS.
El Nino Coastal Impact, Kiritimati

Topography collected in March 2015

Topography collected in May 2016
Coastal Impact driven by 2016 El Nino at Koil, Kiritimati
PacSAFE produces realistic natural hazard impact scenarios for better planning, preparedness and response activities for Pacific Countries using hazard and exposure geographic data, and is based on InaSafe and QGIS.

Impact on buildings in London from a 100 year water level event occurring in 2090.
Final Remarks

1. Coastal development needs to be informed by science-based multi-hazard risk assessments
2. Major coastal hazards of erosion and inundation can be assessed via remote sensing techniques
3. Other hazards such as wind, ground shaking and subsidence must also be included
4. Information must be made available to decision makers and planners via Portals and GIS system: E.g. Ocean Portal and PacSAFE
5. Decision making needs to be enabled by appropriate policy and legislation