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**Abstract**

**Coastal Erosion Along Godavari Delta, India - a Fallout of Global Warming (?)**

**B.HEMA MALINI\*, V.V.L.N.SARMA and K.NAGESWARA RAO**

Dept. of Geography, Andhra University, Visakhapatnam, India

[\\*bhmalini@hotmail.com](mailto:bhmalini@hotmail.com)

The delta shoreline of the Godavari, the largest river system in the Peninsular India is facing erosion. The remote sensing based multi-date imagery and maps reveal that the 160 km long delta coastline is retreating during the past 25 years. About 1024 ha of land was eroded between 1976 and 1992; about 487 ha more was lost between 1992 and 1997 and a further 136 ha was lost between 1997 and 1999. Such a large-scale erosion even at the distributary mouths in the Godavari Delta which is hitherto known as a major depositional zones on the eastern seaboard of India, cannot be attributed to any reduction in the sediment load as not even a single dam was built across the river during the recent decades. Weather disturbances in the region are on the increase as indicated by the occurrence of synoptic features at an average number of 16.02 per year during the last two decades as against the 20<sup>th</sup> century average of 10.29 along the east coast of India. The pronounced coastal erosion, widening of distributary mouths and landward rollover of spits and barrier islands is considered to be a result of increased cyclonic activity and sea level rise, which could be due to the Global warming.

*Key words: coastal erosion, remote sensing, cyclones, sea levels, global warming*

**Mailing Address of Corresponding Author:**

Title and Name	Dr. B.Hema Malini
Department	Department of Geography
University or other organization	Andhra University
City, State, ZIP CODE	Visakhapatnam 530 003
Country	INDIA

## Assessment of Impacts of Sea Level Rise on Coastal Lagoons

Y. HIRAI

Department of Geography, Senshu University

[hirai@isc.senshu-u.ac.jp](mailto:hirai@isc.senshu-u.ac.jp)

Sea level is estimated to rise 14 cm to 80 cm by the end of the next century by “global warming”. And it is predicted that such sea-level rise will have great impacts not only on physical and biological systems, but also on the traditional land and water use pattern of local community in the coastal zone. As the coastal lagoons are connected to the sea and made of soft sediments, and many people are living in low-lying coastal or lacustrine area, relevant assessment of the impacts of sea-level rise is especially important. So in this study some impacts assessments of sea-level rise were carried out mainly from a viewpoint of geomorphological classification in the coastal area of south Thailand and middle Vietnam. According to the characteristics of both natural and socioeconomic systems in each classified unit, such serious impacts as severe coastal erosion, increase in salinity of the lake, severe floods and long-term inundation will be estimated.

*Key words: sea level rise, coastal lagoon, impact assessment, coastal erosion, geomorphological classification*

**Artificial Structures and the Coast of Japan**K. KOIKE<sup>1</sup> AND H. WALKER<sup>2\*</sup><sup>1</sup>Department of Geography, Komazawa University<sup>2</sup>Department of Geography, Louisiana State University

kazkoike@komazawa-u.ac.jp

Japan, which has a coastline that is about equally divided between that of the four major islands (ca. 19,000 km) and of the nearly 4000 smaller islands (ca. 15,500 km), is frequently subjected to extreme tectonic, meteorologic and oceanographic events. Japan's population has concentrated along the one-sixth of the coast that is non-cliffy. Throughout Japanese history reclamation, the desire to protect the shore from erosion and subsidence and the need to reduce loss of property and life have led to a variety of coastal structures including seawalls, groins and breakwaters (both attached and detached). These structures have taken many forms, are of a variety of sizes, and composed of numerous materials. Especially advanced in Japan is the research that has been done on construction of armor blocks such as tetrapods, hexalegs, akmons and the like. At the turn of the millennium, more than 55% of the coastline of the four large islands was bordered by artificial structures. In addition to changing the form of the coastline, these structures have also modified the processes that would be operative under normal conditions.

*Key words: armor units, coastal erosion, coastal structures, shoreline processes*

## Mailing Address of Corresponding Author:

Title and name	Professor Koike, Kazuyuki
Department	Geography
University	Komazawa University
Address	1-23-1 Komazawa , Satagaya-ku Tokyo – 154-8525, JAPAN

**Holocene Geomorphic Development of Barriers and Beach  
Ridges along the Coasts in Japan**

A. MATSUBARA

Department of Geography, Faculty of Economics, Keio University  
[matubara@hc.cc.keio.ac.jp](mailto:matubara@hc.cc.keio.ac.jp)

Most coastal lowlands in Japan are characterized by presence of barriers or beach ridges. The geomorphic development of typical coastal lowlands with barriers or beach ridges in Japan is clarified. Especially, the processes of enclosure of bays by barriers are reconstructed based on the analysis of fossil foraminiferal assemblages in bore hole cores. Coastal barriers began to form in the stage of sea-level rise during early to middle Holocene, without reference to present landforms of coastal lowlands. Variability in the development of coastal barriers occurred in both the initial and final periods of enclosure of bays by barriers. This variability was affected by the basal landforms of barriers, sediment supply and crustal movements. These factors also influence present landforms of coastal lowlands. The final periods of barrier and beach ridge formation correspond to the stable or lowered stages in the Holocene relative sea-level changes.

*Key words: Holocene, Japanese coast, barriers, beach ridges, foraminifera*

**Mid- and Late-Holocene Coastal Change in Rarotonga, Cook Islands**H. MORIWAKI<sup>1</sup>\*, M. CHIKAMORI<sup>2</sup>, M. OKUNO<sup>3</sup> and T. NAKAMURA<sup>4</sup><sup>1</sup> Faculty of Law, Economics and Humanities, Kagoshima University<sup>2</sup> Faculty of Literature, Keio University<sup>3</sup> Faculty of Science, Fukuoka University<sup>4</sup> Nagoya University Center for Chronological Research

\*morih@leh.kagoshima-u.ac.jp

oluvsi7c

Rarotonga situated in the southern Cook Islands, is an early Quaternary volcanic island, which centres a dissected caldera with a central volcano. We present here a model for mid- and late-Holocene changes in sea level and shorelines for Rarotonga based on micro-landforms and surface deposits in the coastal plain, using air-photographs, level-equipment, power shovel, hand-borer and radiocarbon dates.

The results are as follows. A rapid early Holocene sea-level rise attained near-present levels c. 6000 <sup>14</sup>C BP. A gradual rise occurred until c. 4000 <sup>14</sup>C BP, when +1.5 m maximum height was attained. Sea level was essentially stable 4000 to 1000 <sup>14</sup>C BP. Since c. 1000 <sup>14</sup>C BP sea level has fallen to the present-day level. This curve is similar to other curves in Polynesia. Post-glacial hydro-isostatic movements seem to be responsible for the shape of this curve. Shoreline changes have been greatly dominated by the sea-level change. Marine transgression attained most inland points c. 5000 - 6000 <sup>14</sup>C BP when sea level ceased rising rapidly and reached near-present sea levels. The coastal plain began to emerge c. 4400 <sup>14</sup>C BP, which matches the culmination of sea-level rise.

*Keywords: Rarotonga, coastal plain, shoreline, sea level, Holocene*

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**The (W)hole Story: Broadening Biogeomorphology Research.**

LARISSA A. NAYLOR\*<sup>1</sup> and HEATHER A VILES<sup>1</sup>

School of Geography and the Environment, University of Oxford,  
Mansfield Road, Oxford OX1 3TB, UK.

Email: [larissa.motiuk@geog.ox.ac.uk](mailto:larissa.motiuk@geog.ox.ac.uk)

This paper presents the findings of a three-year investigation of biogeomorphic processes on a limestone shore platform in South Wales, UK. It involved a detailed study of the biological contributions to shore platform development from the lower to upper eulittoral zones. It involved repeat monitoring of two ecological communities, the establishment of exposure block trials and an in-depth assessment of the bioconstructive and bioprotective role of *Sabellaria alveolata* (Linné). In the mid-upper eulittoral zone, experimental exposure blocks emplaced in rock pools revealed bioerosion by cyanobacteria and heavy grazing activity after 20 months. The results of each research component were combined and a conceptual model was developed, in an effort to determine the collective contribution of two ecological communities on shore platform processes. Thus, it provides a broader understanding of the role of organisms in shore platform processes and expands the theoretical basis of biogeomorphology by attempting to quantify the interrelated processes of bioconstruction and bioprotection. *Keywords: coastal processes, scale linkages, bioerosion, bioconstruction and bioprotection.*

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**Diachronic studies of shorelines changes by analogue processing of aerial photos**

**A. OZER<sup>1\*</sup>, T. BOUMEAZA<sup>2</sup>, A. CHARLIER<sup>1</sup>, Y. CORNET<sup>1</sup>, D. GOBERT<sup>1</sup>,  
PHAN TRONG TRINH<sup>3</sup> and S. RISACK<sup>1</sup>.**

<sup>1</sup> Géomorphologie et Télédétection, University of Liege, Belgium.

<sup>2</sup> Institut de Géographie, University of Mohameddia, Morocco.

<sup>3</sup> Institut de Géologie, Centre National de recherches scientifiques, Hanoi, Vietnam.

\*aozer@ulg.ac.be

To better understand the changes of the beaches, the analogue and digital processing of aerial photos was applied. Four examples are presented: [A] In Corsica, for over 40 years, the open-cast asbestos mine of Canari discharged vast quantities of debris into the sea. The sedimentary material was immediately transported by the littoral drift causing noticeable changes to the coastline and the creation of a new beach measuring 1350 meters in length and 300 meters in width. [B] In Morocco, the retreat of the Moulouya delta (more than 200 meters in 30 years) was observed as a consequence of the building of a dam which stopped the sediments drift near the sea. [C] In Vietnam, between 1953 and 1994, a beach retreat of more than 400 metres is noted on Din Vhu Island. [D] On the Belgian coast, a long-term shoreline evolution analysis was made possible thanks to the 1918's aerial photos taken during World War I. This diachronic study shows a continuous erosion during the last 80 years where there is a housing site pressure. In conclusion, the use of series of multi-date aerial photos can help scientists and land planners for a better understanding of the long-term coastal evolution.

*Key words: beach erosion, aerial photos, Mediterranean, Vietnam, Belgium.*

## Spatial and Temporal Pattern of Sea-cliff Retreat, Chengkung, Eastern Taiwan

Su-Min SHEN<sup>1</sup> and Jonathan FRENCH<sup>2</sup>

<sup>1</sup> Department of Geography, National Taiwan Normal University

<sup>2</sup> CERU, Department of Geography, University College London  
t24005@cc.ntnu.edu.tw

Huatung coast, eastern Taiwan, is tectonically-active, swash-aligned and sediment-poor. Widespread sea-cliff retreat and beach narrowing has been reported but not previously investigated in detail. This paper quantifies the rate and pattern of historical shoreline/cliff-line change, with special reference to the Chengkung region, which has suffered the most serious erosion over recent decades. A comprehensive investigation of all available topographical maps, aerial photographs and cadastrals, has been conducted, including, for the first time, the earliest set of aerial photographs taken in 1948/51. Detailed measurements within the Chengkung littoral cell reveal a highly variable cliff retreat, both spatially and temporally. Significant sea-cliff recession is largely restricted to three consecutive sub-cells in the northern part of the cell. The spatial average retreat rate is  $1.1 \pm 0.3 \text{ m yr}^{-1}$  (maximum  $3.2 \pm 0.3 \text{ m yr}^{-1}$ ) for these three sub-cells between 1951 and 1990. The Huatung coast differs from apparently similar sea-cliff erosion systems elsewhere, in that it is characterised by multiple terraces which vary greatly in their spatial extent and continuity. This is mainly a result of the high Holocene uplift rate and strong lithological contrasts, which combine to produce a complicated pattern of sea-cliff retreat.

**Keywords:** sea-cliff retreat, shoreline change, aerial photographs, eastern Taiwan



### Modeling Shore Platform Evolution in the Quaternary

A. S. TRENHAILE

Department of Earth Sciences, University of Windsor, Ontario, Canada N9B 3P4

Tren@uwindsor.ca

A mathematical model was used to simulate the development of wave-cut shore platforms with changing Quaternary sea level. The model incorporated deep water wave height and period spectra, breaker height and depth, breaker type, the width and bottom roughness of the surf zone, the gradient of the submarine slope, rock resistance, the tidal duration factor, and the amount and persistence of the cliff-foot debris. Sea level was made to fluctuate in twenty-six glacial-interglacial cycles from 2 million to 0.9 million years ago, and nine, of approximately twice the amplitude and wavelength, in the last 900,000 years. Although platform width increased and gradient decreased during interglacial stages, the morphology of each platform at the end of each interglacial was the same as its morphology at the end of previous interglacial stages; this equilibrium condition was dynamic in some model runs and static in others. Although some simulated intertidal platforms were entirely contemporary, most were, at least in part, inherited from previous interglacial stages, in some cases from the beginning of the middle Pleistocene. Platform gradient increased with tidal range and rock resistance, and platform width increased with tidal range and decreased with rock resistance; neither gradient nor width had any consistent relationship with wave height or cliff-foot debris.

*Key words: Quaternary, sea level, shore platforms, model*

**Relation between Postglacial Morphologic Change and Tidal Current Field in  
Osaka Bay, Central Japan**

K. Uehara<sup>1</sup> and T. Fujiwara<sup>2</sup>

<sup>1</sup> Research Institute for Applied Mechanics, Kyushu University

<sup>2</sup> Laboratory of Fisheries and Environmental Oceanography, Kyoto University  
\*uehara@riam.kyushu-u.ac.jp

A numerical experiment was carried out to investigate the sensibility of the tidal current field in the Osaka Bay, to its basin geometry change caused by the Holocene sea-level rise of about 80m. It was found that the opening of Tomogashima (about 13,000 years ago) and Akashi (about 8,000 years ago) straits played a key role in establishing the prominent east-west difference of the tidal current field observed today—much energetic in the western side compared to the eastern region. Such difference in the current strength was responsible for the development of an erosive sea-bottom structure in the west and a thick mud layer in the east. The model result indicated that the sedimentation of the mud layer was initiated from the southeastern region, which might correspond to the acoustic profile analysis made by Onodera and Oshima (1983). In addition, deepening of the sea-bottom near the straits caused by strong tidal currents acted to enhance the tidal current in the region between the straits. These results may suggest the existence of the strong interaction between the tidal current field and the postglacial basin development in the Osaka Bay.

*Keywords: tidal current, numerical model, sea-level rise, Holocene, Osaka Bay*

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